

# 20220601 - June's Specifications Committee Meeting

## June Specifications Committee Meeting Agenda

### Meeting Date

Wednesday, June 1, 2022 @ 9:00am

Google Meet video conference. E-mail distribution message includes instruction.

### Approved Permanent Specification changes from last Committee meeting (4/6/22)

- **Section 703.1.1-General Requirements** The revision is to assure the aggregates provided by any source are not contaminated or mixed with any undeclared materials.
- **Section 108.7.1-Failure to Complete on Time and Liquidated Damages** The revision updates Table 108.7.1-Schedule of Liquidated Damages.
- **Section 605.2-Materials, 605.4-Method of Measurement, & 605.6-Pay Items** The revision clarifies materials for perforated slot inlets and adds items for Modified Inlet and Modified Manhole.
- **Sections 601.12-Water Temperature and 679.3-Water Temperature** Two specification changes related to controlling water temperature of concrete curing
- Six specification changes related to AASHTO name change T23 to R100.
  - a. **501.4-Test Methods**
  - b. **511.3.6.1-Testing**
  - c. **601.4.1-Sampling and Testing Methods**
  - d. **603.6.4-Sampling and Test Methods**
  - e. **620.5.5.1.2-Compression Testing**
  - f. **679.2.2-Specialized Concrete Mix Design and Testing**

### Approved Project Specific Special Provisions (SP) from last Committee meeting (4/6/22)

- **SP613-Spray Applied Pipe Liner**

### Items removed from Committee Agenda

- **SP622-Cantilever Mailbox**

### Old Business-Provisions discussed at last Committee meeting

SECTION	TITLE	DESCRIPTION
410	<b>Section 410-Asphalt Base and Wearing Courses, Percent within Limit (PWL)</b>	<b>9th time to Committee.</b> Proposed specification change to Section 410. This specification incorporates suggestions is from Industry (these changes are redline copy showing the proposed changes).
	Champion: Industry and WVDOH	The bonus structure has been removed from specifications; these changes are redline copy with yellow highlights.

		<p>The provision has been updated per comments at the last meeting.</p> <p><b>Approval is expected in June.</b></p>
636	<p><b>636.20-Temporary Traffic Signals or Temporary Lighting, 636.23.16-Temporary Traffic Signal , 636.23.23-Temporary Lighting and 636.25-Pay Items</b></p>	<p><b>5th time to Committee. Discussed in October, December, February, &amp; April.</b> Specification changes to Section 636-Maintaining Traffic. The update clarify the temporary traffic signal requirements.</p> <p>No update to the specification; it is redline copy showing the proposed changes.</p>
710	<p><b>710.8-Service, Lighting, and Class D Traffic Signal Poles</b></p>	<p><b>2nd time to Committee. Discussed in April.</b> Two specification changes in Division 700 related to Type D Traffic Signal Poles:</p>
715	<p><b>715.42.9.3-Wood Pole Signal Support (Type D)</b></p> <p>T. Whitmore</p>	<p>1. Section 710, Subsection 710.8-Service, Lighting, and Class D Traffic Signal Poles 2. Section 715, Subsection 715.42.9.3-Wood Pole Signal Support (Type D)</p> <p><b>Approval is expected in June.</b></p>
102	<p><b>102.5.3-Bidding Requirements</b></p> <p>S. Danberry</p>	<p><b>2nd time to Committee. Discussed in April.</b> Specification change to Section 102-Bidding Requirements and Conditions. The revision revised the 102.5.3 subsection title and clarifies the Categorizes of Work requirements.</p> <p>No update to the specification; it is redline copy showing the revisions.</p> <p><b>Approval is expected in June.</b></p>
106	<p><b>106.1-Source of Supply and Quality Requirements</b></p>	<p><b>2nd time to Committee. Discussed in April.</b> Three specification changes updating references to Section 103 so that they are in line with the revision to Section 103 in 2022 Supplemental.</p>
107	<p><b>107.8.2.1-Contractor's Public Liability Insurance and Protective Public Liability Insurance &amp; 107.8.2.2-Railroad Protective Liability Insurance</b></p>	<p>1. Section 106, Subsection 106.1-Source of Supply and Quality Requirements 2. Section 107, Subsection 107.8.2.1-Contractor's Public Liability Insurance and Protective Public Liability Insurance &amp; 107.8.2.2-Railroad Protective Liability Insurance 3. Section 109, Subsection 109.4.5-Contract Bond &amp; 109.4.6-Insurance</p>
109	<p><b>109.4.5-Contract Bond &amp; 109.4.6-Insurance</b></p>	<p>No update to the specifications; they are redline copy showing the revisions.</p>

	S. Danberry	<b>Approval is expected in June.</b>
<b>508</b>	<b>508.9-Smoothness</b>	<b>2nd time to Committee. Discussed in April.</b> Two specification changes removing bonus structure from Section 508 and Section 720. <ol style="list-style-type: none"> <li>1. Section 508, Subsection 508.9-Smoothness</li> <li>2. Section 720-Smoothness Testing</li> </ol>
<b>720</b>	<b>Section 720-Smoothness Testing</b>	
	B. Whelan	The specification are redline copy showing the revisions; Section 720 has been revised.
<b>601</b>	<b>601.5.2.3-Scales</b>	<b>2nd time to Committee. Discussed in April.</b> Specification change to Section 601. The revision adds reference to MP.  No update to the specification; it is redline copy showing the revisions to the current specification.  <b>Approval is expected in June.</b>
	A Thaxton	
<b>636</b>	<b>636.2-Materials, 636.6.2-Shadow Vehicle, 636.9-Traffic Control Devices, 636.12-Temporary Impact Attenuating Devices, &amp; 636.23.6-Traffic Control Devices</b>	<b>2nd time to Committee. Discussed in April.</b> Three specification changes updating NCHRP-350 reference dates, funding source sign, and better organize 636.9. <ol style="list-style-type: none"> <li>1. Section 636, Subsection 636.2-Materials, 636.6.2-Shadow Vehicle, 636.9-Traffic Control Devices, 636.12-Temporary Impact Attenuating Devices, &amp; 636.23.6-Traffic Control Devices</li> <li>2. Section 104, Subsection 104.13-Funding Source Identification Signs</li> <li>3. Section 715, Subsection 715.9.3-Channelizing Devices, 715.9.3.4-Barricades, 715.9.3.5-Surface Mounted Flexible Tubular Markers, 715.9.6-Portable Sign Stands</li> </ol>
<b>104</b>	<b>104.13-Funding Source Identification Signs</b>	
<b>715</b>	<b>715.9.3-Channelizing Devices, 715.9.3.4-Barricades, 715.9.3.5-Surface Mounted Flexible Tubular Markers, 715.9.6-Portable Sign Stands</b>	
	T. Whitmore	No update to 636 or 104. 715 has been updated per comments. The specification are redline copy showing the revisions.



<b>704</b>	<b>704.4-Dump Rock Gutter</b>  D. Matics	<b>2nd time to Committee. Discussed in April.</b> Specification change to Section 704-Stone and Crush Aggregates. The revision clarifies the type of rock for dump rock gutter.  The specification has been updated; it is redline copy showing the revisions.
<b>709</b>	<b>709.1-Steel Bars for Concrete Reinforcement</b>  G. Hanna	<b>2nd time to Committee. Discussed in April.</b> Specification change to Section 709-Metals. The revision updates plain and deformed bar reinforcement and adds subsections for galvanized and epoxy coated reinforcement.  The specification has been updated; it is redline copy showing the revisions.
<b>715</b>	<b>715.14.2-Approval of Bearing Pads without Shims</b>  D. Simmons	<b>2nd time to Committee. Discussed in April.</b> Specification change to 715.14-Elastomeric Bearing Pads. The revision adds subsection for approval of bearing pads without shims.  Specification updated per comments at the last meeting; it is redline copy showing the revisions.  <b>Approval is expected in June.</b>
<b>221</b>	<b>SP221-Rockfall Mitigation</b>  T. Priddy	<b>2nd time to Committee. Discussed in April.</b> Project Specific Special Provision (SP) for the following rockfall mitigation items: Rock Slope Scaling; Pinned Wire Mesh; Slope Drape; Rockfall Attenuator Barrier; Attenuator Barrier Drape; and Rockfall Barrier.  The SP has been updated per comments at the last meeting.

### New Business - New Provisions for Spec Committee

SECTION	TITLE	DESCRIPTION
<b>601</b>	<b>SP601-Surface Resistivity</b>  A. Thaxton	<b>Update to previously approved SP. 1st time to Committee.</b> Project Specific Special Provision (SP) for surface resistivity.  The SP is redline copy showing the revisions.
<b>401</b>	<b>401.13.2-Blank</b>  S. Boggs	<b>1st time to Committee.</b> Proposed specification change to Section 401; the subsection references Table 401.7.2 & these were removed previously, so the entire subsection can be removed  The specification is redline copy showing the revisions.

403	<p><b>Section 403-Crack Sealing in Asphalt Pavement</b></p> <p>S. Boggs</p>	<p><b>1st time to Committee.</b> Proposed specification change adding Crack Sealing of Asphalt Pavement to the spec book. This item has traditionally been utilized via SP 403.</p> <p>The specification is redline copy showing the revisions to current SP.</p>
601	<p><b>SP601-FRP</b></p> <p>D. Estep, GPI</p>	<p><b>1st time to Committee.</b> Project Specific Special Provision (SP) for FRP.</p>
602	<p><b>Section 602-Reinforcing Steel</b></p> <p>S. Boggs</p>	<p><b>1st time to Committee.</b> Proposed specification change to Section 602-Reinforcing Steel; the updates the material requirements and adds galvanized steel requirements.</p> <p>The specification is redline copy showing the revisions.</p>
625	<p><b>Section 625-Rock Socketed Drilled Shaft</b></p> <p>S. Boggs</p>	<p><b>1st time to Committee.</b> Proposed specification change to Section 625-Rock Socketed Drilled Shaft; Division's contact information updated and clarify testing on Alternative Project Delivery.</p> <p>The specification is redline copy showing the revisions.</p>
628	<p><b>SP628-Exploratory Drilling and Sampling</b></p> <p>D. Ahmed</p>	<p><b>1st time to Committee.</b> Project Specific Special Provision (SP) for exploratory drilling and sampling.</p>
642	<p><b>642.1-General, 642.5.1-General, 642.7-Method of Measurement, &amp; 642.9-Pay Items</b></p> <p>S. Boggs</p>	<p><b>1st time to Committee.</b> Proposed specification change to Section 642-Temporary Pollution Control; remove sediment dam/pond verbiage and using WVDEP sediment basin in section and clarify method of measurement.</p>
642	<p><b>642.7.1-Temporary Pollution Control, Unit Value Method &amp; 642.9-Pay Item</b></p> <p>S. Boggs</p>	<p><b>1st time to Committee.</b> Proposed specification change to Section 642-Temporary Pollution Control; adding unit value method to the section.</p> <p>The specification is redline copy showing the revisions.</p>
663	<p><b>663.8-Pay Items</b></p> <p>S. Boggs</p>	<p><b>1st time to Committee.</b> Proposed specification change to Section 663-Pavement Markings; revising pay item description, so that it matches with TEM-3 'Lane Reduction Arrow, Type V'.</p> <p>The specification is redline copy showing the revisions.</p>

708	<b>708.3-Joint and Crack Sealant, Hot-Poured for Concrete and Asphalt Pavements</b>  S. Boggs	<b>1st time to Committee.</b> Update subsection title to include ‘crack’ repair.  The specification is redline copy showing the revisions.
711	<b>711.5.3-Approval, 711.6.1.1-General, 711.22.1-General, 711.22.4-Top Coat, &amp; 711.23-Sample Submission and Approval</b>  K. Hoover Trent	<b>1st time to Committee.</b> Proposed specification change to Section 711-Paints, Coating, Oil, and Inks. Update clarifies NTPEP testing & adds subsection on Sample Submission and Approval.  The specification is redline copy showing the revisions.

### Comments

Comments are requested on these Specifications Changes and Project Specific Special Provisions. Please share your comments by **May 27, 2022**, they help in the decision making process.

Please Send Comments to: [DOHSpecifications@wv.gov](mailto:DOHSpecifications@wv.gov)

### Deadline for new items & updates to these provision for next meeting is **May 6, 2022**.

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, **August 3, 2022 at 9:00 a.m.**

Meeting will be held virtually via Google Meet video conference. E-mail distribution message includes instruction.

### 2017 Standard Specification Roads and Bridges & 2022 Supplemental Specifications

Electronic Copy (pdf): The 2017 Standard Specifications Roads & Bridges & 2022 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: We are out of hard copies of the 2017 Standard Specifications Roads and Bridges. Hard copies of the 2022 Supplemental Specifications are available thru Technical Support Division. An order form for the book is on Specifications Website. A link to the page is here: <http://transportation.wv.gov/highways/contractadmin/specifications>

### 2022 Specifications Committee

The Specification Committee typically meet every other month; on the first Wednesday. 2022 meetings will be held in February (2/2), April (4/6), June (6/1), August (8/3), October (10/5), and December (12/7).

*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>

## **Materials Procedures**

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

For questions regarding the Standard Specifications Road and Bridges, Supplemental Specifications, Project Specific Provisions, or the Specifications Committee please email [DOHSpecifications@wv.gov](mailto: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 Specifications & Project Specific Provisions as they progress thru Specifications Committee. This procedure would facilitate a means of tracking changes from meeting to meeting; as the agenda & 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 should be setup & submitted in the following format:

1. Specification Changes – Show 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 which indicates removal or addition of text. You can redline a Microsoft Word document by using the built-in “Track Changes” feature or you can manually reline 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 the next meeting.
- SP's in committee may be used in advertised project. Hope to work to address comments & finish approving at subsequent meeting.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

SUPPLEMENTAL SPECIFICATION

FOR

SECTION 410  
ASPHALT BASE AND WEARING COURSES,  
PERCENT WITH LIMITS (PWL)

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

**410.1-DESCRIPTION:**

**410.1.1-General:** The Contractor shall note that this Section is to be used for Square Yard Paving operations; however, the proposal and / or plans may contain 401 and 402 items to be paid and measured by the Ton (TN). In instances where those items occur, they shall be constructed and measured in accordance with the applicable sections of the West Virginia Division of Highways Standard Specifications Roads and Bridges, current edition, and the Supplemental Specifications current when the contract is let.

Additionally, the following Materials Procedures (MP's) for Square Yard Paving ~~may can~~ be ~~obtained by contacting found on~~ the Materials Control, Soils and Testing (MCS&T) Division website: <https://transportation.wv.gov/highways/mcst/Pages/WVDOH-Materials-Procedures.aspx>.

- a. MP 401.02.31 QC & Acceptance
- b. MP 401.07.20 Sampling Loose Asphalt Pavement Mixtures
- c. MP 401.07.21 Sampling Compacted Asphalt
- d. MP 401.07.22 Thickness of Asphalt Concrete Using Cores
- e. MP 401.07.23 Bond Strength
- f. MP 401.07.24 Pavement Macrotexture
- g. MP 401.07.25 Evaluation of Asphalt Pavements
- h. MP 401.13.50 Determination of PWL

**410.1.2-PWL Paving Description:** This work shall consist of constructing one or more courses of asphalt, mixed mechanically in a plant, composed of aggregate and asphalt material designed in accordance with either the Marshall or Superpave Design System as specified in the contract documents, on a prepared foundation in accordance with these specifications and in ~~reasonable~~ reasonably close conformity with the lines, grades, weights or thicknesses, and cross sections shown on the Plans or established by the Engineer.

The unit of measurement for asphalt will be by the ton-~~(megagram)~~, square yard-~~(square meter)~~, or cubic yard-~~(cubic meter)~~.

The work will be accepted in accordance with these Specifications and the applicable requirements of Sections 105, 106, and 109.

#### 410.2-MATERIALS:

The materials shall conform to the following requirements:

MATERIAL	SUBSECTION
Coarse Aggregate	703.1 thru 703.3 <sup>Note 1 &amp; Note 2</sup> (See MP 401.02.28 for exceptions and additions required for Superpave Items.)
Fine Aggregate	702.3 (See MP 401.02.28 for additions required for Superpave Items)
Mineral Filler	702.4
Performance Graded Binders	705.5

Note 1 The total shale, coal and other lightweight deleterious material and friable particles shall not exceed 3%.

Note 2 When slag is specified in the contract, the coarse aggregate shall be slag which meets the requirements of 703.3, except as amended in this subsection.

**410.2.1-Performance Graded Binder Grade:** The standard grade for Performance Graded (PG) binders shall be PG 64S-22, any deviation will be noted in the contract documents. PG 64H-22 shall be used on projects specified with over 20 million ESALs over the design life. PG 64S-22 binder may be used in asphalt placed below the top two lifts in any pavement section, scratch course and patching-and-leveling are not identified as lifts.

### CONSTRUCTION METHODS

#### 410.3-GENERAL:

Construction methods to be used in performing the work shall be submitted to the Engineer for review prior to the start of work. This review may require modification of the proposed methods to provide the desired end product. All equipment, tools, machinery, and plant shall be maintained in a satisfactory working condition.

#### 410.4-COMPOSITION OF MIXTURES:

**410.4.1-General:** The aggregate for use in the designated mixture shall consist of a mixture of aggregate (coarse, fine, reclaimed asphalt pavement (RAP) if desired, or mixture thereof) and mineral filler if required. It shall be the responsibility of the Contractor to determine the percentage of RAP to be used in the mix. The amount and grade of virgin PG Binder to be used in the RAP designs shall be determined in accordance with Materials Procedure (MP) 401.02.24 and MP 401.02.28.

**410.4.2-Job Mix Formula:** Job Mix Formula (JMF) is the specification for a single mix produced at a single plant. This mix may be specific to a single project or be used on multiple projects if the basic design criteria (design compaction level and PG Binder grade) are the same.

The Contractor shall submit a proposed JMF for each combination of aggregate and asphalt material for each asphalt mixture to be produced. Depending on the design type, the JMF gradations shall be within the tolerances set forth in either Table 410.4.2A or Table 410.4.2B. Marshall mix designs shall be developed in accordance with MP 401.02.22. Superpave mix designs shall be developed in accordance with MP 401.02.28.

Each proposed JMF must be documented on the Division Form T400 or T400SP and the entire JMF package shall be forwarded for review to the District Materials Engineer/Supervisor. After the District reviews the T400/T400SP and JMF package shall then be transmitted to the Materials Control, Soils and Testing Division for final review. If the JMF requires revision, it will be returned to the designer through the District. The T400/T400SP Form shall contain the following information:

- i. Identification of the source and type of materials used in the design.
- ii. The aggregate blend percentages and the percentage for each sieve fraction of aggregate considered the desirable target for that fraction.
- iii. The percentage of virgin asphalt binder to be blended with RAP and the total asphalt binder representing the optimum asphalt content for the JMF submitted, which is to be considered the desirable target percentage.
- iv. The temperature of the completed mixture at the plant which shall be within  $\pm 25^{\circ}$  F ( $\pm 14^{\circ}$  C) of the median mix temperature established by the temperature-viscosity chart or as recommended by the asphalt supplier.
- v. The ratio (calculated to the nearest one-tenth percent) of the Fines to Asphalt (FA). For Marshall mixes the ratio is defined as the percentage of aggregate passing the No. 200 (75  $\mu$ m) sieve, divided by the percentage of asphalt content calculated at the percentage optimum asphalt content of the design. For Superpave mixes the ratio is defined as the percentage of aggregate passing the 75  $\mu$ m (No. 200) sieve, divided by the percentage of effective asphalt content calculated at the percentage optimum asphalt content of the design.

**TABLE 410.4.2A**  
**Design Aggregate Gradation Requirements for Marshall Mix Designs**

Type of Mix	Base-I	Base-II (Patch & Level)	Wearing IV	Wearing-I (Scratch-I)	Wearing-III (Scratch-III)
	Nominal Maximum Size				
Sieve Size	1 ½ in (37.5 mm)	¾ in (19 mm)	¾ in (19 mm)	3/8 in (9.5 mm)	No. 4 (4.75 mm)
2 in (50 mm)	100	–	–	–	–
1 ½ in (37.5 mm)	90-100	–	–	–	–
1 in (25 mm)	90 max	100	100	–	–
¾ in (19 mm)	–	90-100	90-100	–	–
½ in (12.5 mm)	–	90 max	90 max	100	–
3/8 in (9.5 mm)	–	–	–	85-100	100
No. 4 (4.75 mm)	–	–	47 min	80 max	90-100
No. 8 (2.36 mm)	15-36	20-50	20-50	30-55	90 max
No. 16 (1.18 mm)	–	–	–	–	40-65
No. 30 (600 $\mu$ m)	–	–	–	–	–
No. 50 (300 $\mu$ m)	–	–	–	–	–
No. 200 (75 $\mu$ m)	1-6	2-8	2-8	2-9	3-11

**TABLE 410.4.2B**  
**Design Aggregate Gradation Requirements for Superpave Mix Designs**

Type of Mix	37.5	25	19 <sup>Note 1</sup> (Patch & Level)	12.5	9.5 (Scratch)	4.75 (Scratch)
Sieve Size	Nominal Maximum Size					
	37.5 mm (1 ½ inch)	25 mm (1 inch)	19 mm (¾ inch)	12.5 mm (½ inch)	9.5 mm (⅜ inch)	4.75 (No. 4)
50 mm (2")	100	–	–	–	–	–
37.5 mm (1½")	90-100	100	–	–	–	–
25 mm (1")	90 max	90-100	100	–	–	–
19 mm (¾")	–	90 max	90-100	100	–	–
12.5 mm (½")	–	–	90 max	90-100	100	100
9.5 mm (⅜")	–	–	–	90 max	90-100	95-100
4.75 mm (No.4)	–	–	–	–	90 max	90-100
2.36 mm (No.8)	15-41	19-45	23- 49	28-58	32-67	
1.18 mm (No.16)	–	–	–	–	–	30-60
600 µm (No.30)	–	–	–	–	–	–
300 µm (No. 50)	–	–	–	–	–	–
75 µm (No.200)	0-6	1-7	2-8	2-10	2-10	6-12

Note 1 When a 19 mm mix is specified for use as a heavy-duty surface mix, it shall be designed as a fine graded mix with the additional requirement of a minimum of 47% passing the 4.75 mm (No.4) screen.

If it becomes necessary to change aggregate sources, a new mix design shall be developed and submitted for approval. When using neat (unmodified) PG Binders, the binder grade must always remain the same for each design, however the binder source may be changed without requiring a new mix design given that the replacement binder is provided from an approved source. If a source change results in the use of an additive enhanced modified binder of the same grade, a new mix design will be required.

If a modified binder source is changed or if the modification process is changed, a new mix design shall be developed and submitted for approval. A source change to a new location with the original manufacturer/supplier and the original modification process will not require a new mix design.

At no time shall different grades of PG Binders be mixed together in the same storage tank. When it is necessary to switch to a new binder grade the tank shall be drawn down as far as possible, normally to the top of heating coils, before refilling with the new binder. The new binder shall be circulated thoroughly before restarting production.

**410.4.2.1-Warm Mix Asphalt:** When the Contractor chooses to use an approved asphalt design to be produced as warm-mix asphalt (WMA) using the water injection system, the temperature of the completed mixture at the plant may be lowered to an established range that has previously been determined through trial production. The allowable temperature range specified on the approved T400 mix design form shall be adjusted accordingly when producing WMA. In addition, all references to the minimum compaction temperatures in Sections 410.10.3 and 410.10.4 of this specification, may be

waived if it can be established that additional density can be obtained at lower temperatures without damaging the pavement. All testing requirements established for Hot Mix Asphalt mix designs and quality assurance/quality control testing shall also apply to WMA.

#### 410.5-TESTING:

##### 410.5.1-Test Methods:

MP 700.00.06	Aggregate Sampling Procedures
AASHTO T168	Sampling Hot-Mix Asphalt
AASHTO T11	Materials Finer than No. 200 (75 µm) Sieve in Mineral Aggregates by Washing
AASHTO T27	Sieve Analysis of Fine and Coarse Aggregates
AASHTO T30	Mechanical Analysis of Extracted Aggregate
AASHTO T164	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
AASHTO T308	Asphalt Content of HMA by the Ignition Method (Test Method A)
AASHTO T245	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D5581	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (For Base-I Marshall designs only)
AASHTO T166	Bulk Specific Gravity of Compacted Bituminous Mixtures
AASHTO T209	Maximum Specific Gravity of Bituminous Paving Mixtures
AASHTO T312	Determining the Density of HMA Specimens by Means of the Superpave Gyrotory Compactor
AASHTO T331	Bulk Specific Gravity and Density of Compacted HMA Using Automatic Vacuum Sealing Method
ASTM D7227	Rapid Drying of Compacted Asphalt Specimens Using Vacuum Drying Apparatus
MP 401.02.31	Quality Control and Acceptance of Asphaltic Mixtures
MP 401.07.20	Sampling Loose Asphaltic Mixtures in the Field
MP 401.07.21	Sampling Compacted Asphaltic Mixtures in the Field
MP 401.07.22	Measuring Thickness of Asphalt Pavement using Drilled Cores
MP 401.07.23	Measuring Bond Strength of Cored Specimens
MP 401.07.24	Measuring Asphaltic Pavement Macrottexture
MP 401.07.25	Evaluation of Pavement with Substandard Properties
MP 401.13.50	Determination of Percent Within Limits

#### 410.6-CONTRACTORS QUALITY CONTROL:

**410.6.1-Quality Control Testing:** Quality control of the asphalt pavement is the responsibility of the Contractor. The Contractor shall maintain equipment and qualified personnel including at least one certified Asphalt Plant Technician at each plant. The technician shall be in charge of all plant quality control activities such as mix proportioning and adjustment and all sampling and testing activities necessary to maintain the various properties of asphalt within the limits of the specification.

The Contractor shall maintain necessary equipment and qualified personnel including at least one certified Asphalt Field and Compaction Technician at each project during paving operations. Additionally, a certified Asphalt Field and Compaction Technician with certification to perform nuclear density testing of asphalt pavements shall perform all testing

necessary to assure compaction of the asphalt meets specification requirements. ~~Compaction Technicians may serve as Asphalt Field and Compaction Technicians for asphalt compaction testing until December 31, 2017.~~

**410.6.2-Job Mix Formula Field Verification:** For each JMF, a mix design field verification shall be conducted during the first days of plant production. For Marshall and Superpave designs, the verification shall be in accordance with the guidelines established in MP 401.02.31. The field verification is for the purpose of demonstrating that the JMF can be produced within the specified tolerances set forth in the MP 401.02.31. If the mix cannot be produce within these requirements, a new mix design will be required.

**410.6.3-Quality Control Testing Requirements:** After the JMF design field verification has been successfully completed, sampling frequency and test requirements for quality control shall be as set forth in MP 401.02.31 for Marshall and Superpave designs. If the Division determines that a mix cannot be consistently produced within the tolerance limits of the specified design properties, approval of the mix may be revoked and the contractor will be required to provide a new mix design.

#### **410.7-ACCEPTANCE TESTING:**

**410.7.1-Acceptance Testing of Asphalt:** For Interstates and divided NHS Highways, material from the paving of the traveled lanes and shoulders will be accepted in the field on a lot-by-lot basis. Lots will be established cumulatively and will be specific for each JMF. Each lot consists of five equal sublots (n=5). A completed subplot will have cores obtained for Pavement Density, and Bond Strength and a Loose Mixture sample for gradation and asphalt content. Samples for mat density and bond strength shall also be used to measure lift thickness prior to any preparation for density or bond strength. All field samples shall be obtained from locations determined as per MP 401.07.20 and MP 401.07.21.

A normal lot size is 2,500 tons with five, 500-ton sublots (n=5), unless operational conditions or project size dictate otherwise. If operational conditions or project size dictate, readjustment of the lot will be made as specified in Table 410.7.1. When lots are adjusted, all sublots shall be of equal size. Breakdowns or stoppages of short periods due to such causes as weather or equipment failure will not be considered as reason to adjust the lot size. The original lot will be continued when work resumes after stoppages of less than 5 days. If a lot is terminated due to a stoppage of 5 days or more, adjust the lot size and number of sublots as specified in Table 410.7.1.

For two lane and non-divided NHS Routes, refer to Section 410.13.7.1.

**TABLE 410.7.1**

<b>Re-adjustment of Lot Size and Associated Number of Sublots Remaining Quantity Following Last Full Lot</b>	<b>Action</b>
Less than 500 tons without a combination of one mixture acceptance sample and one density core	Quantity combined with the previous lot, (n=5)
Less than 500 tons with a combination of one mixture acceptance sample and one density core	One new subplot defined and quantity combined with the previous lot, (n=6)
500 tons to less than 1,000 tons without a combination of two mixture acceptance samples and two density cores	One new subplot defined and quantity combined with the previous lot, (n=6)
500 tons to less than 1,000 tons with a combination of two mixture acceptance samples and two density cores	Two new sublots defined and quantity combined with the previous lot, (n=7)
1,000 tons to less than 1,500 tons without a combination of three mixture acceptance samples and three density cores	Two new sublots defined and quantity combined with the previous lot, (n=7)
1,000 tons to less than 1,500 tons with a combination of three mixture acceptance samples and three density cores	New lot defined, (n=3)
1,500 tons to less than 2,000 tons without a combination of four mixture acceptance samples and four density cores	New lot defined, (n=3)
1,500 tons to less than 2,000 tons with a combination of four mixture acceptance samples and four density cores	New lot defined, (n=4)
2,000 tons to less than 2,500 tons without a combination of five mixture acceptance samples and five density cores	New lot defined, (n=4)
2,000 tons to less than 2,500 tons with a combination of five mixture acceptance samples and five density cores	New lot defined, (n=5)

Immediately after each sample is taken, it shall be identified by labeling or otherwise with the following information:

1. Contract ID
2. State Project Number
3. Sample Type (density, bond, loose, etc.)
4. Pavement Course (surface, base)
5. Lot Number
6. Sublot Number
7. Date
8. Sampled By



A sample labeling standard is shown in MP 401.07.20 Sampling of Loose Asphaltic Pavement Mixtures and MP 401.07.21. Upon fully identifying, marking, or labeling, and securing, samples shall be transported to the District Materials Laboratory for testing unless otherwise indicated in the proposal.

**410.7.1.1-Mixture Acceptance Samples.** The Inspector will select sample locations in each subplot according to MP 401.07.20 Sampling of Loose Asphaltic Pavement Mixtures. The Inspector or in the presence of the Inspector, one loose mixture sample shall be obtained for each subplot. This sample is to be taken directly from the uncompacted mixture and immediately processed in accordance with the MP.

**410.7.1.2-Compaction:** Compaction testing for mat density shall be performed for all traveled lanes, ramps and shoulders. Work will be evaluated based on an Upper Specification Limit (USL) of ~~97.0-98.0~~ and a Lower Specification Limit (LSL) of 91.5 for all mats within travel lanes. Acceptance of mat density shall be in accordance with 410.13.3.

Maximum density values that are supplied by the asphalt producer shall be verified by the District Materials staff by determining the theoretical maximum specific gravity in accordance with AASHTO T209 Theoretical Maximum Specific Gravity (Gmm). This verification of Gmm shall be conducted once per lot for all mixes, or one in each five reported values from the asphalt producer. This Gmm value must be within 0.024 of the asphalt producer's daily average. Any deviation of greater shall warrant special evaluation. Joint density testing is required. The joint density shall be evaluated based on a Lower Specification Limit (LSL) of 89% of a maximum density established by averaging the maximum densities for the paved mats adjacent to the constructed longitudinal joint. The joint density requirement shall only apply to the surface lift of the pavement structure. Lots for joint density shall also be established cumulatively and laid out as per the applicable provisions within MP 401.07.21.

A normal lot size for evaluation of joint density is 10,000 linear feet of constructed joint with five, 2000 foot long sublots, unless operational conditions or project size dictate otherwise. Lots for joint density determined to be 4000 feet in length or less shall be incorporated into the previous full lot. If the length is 2000 feet or less, then one sample shall be taken, and the lot be evaluated with six equal subplotssamples (n=6). If the length is greater than 2000 feet, then ~~and~~ two samples shall be taken, and the lot be evaluated with seven ~~samples-equal sublots~~ (n=7). Lots for joint density that are greater than 4000 feet in length shall have samples taken representative of each 2000-foot long subplot or portion thereof.

Acceptance for joint density shall be as per 410.13.4.

Patching-and-leveling and scratch courses shall not be included in determining the total new pavement thickness to be tested for compaction. When asphalt is placed in areas that require a non-uniform thickness or is tapered to a thin edge, the method of acceptance testing shall be determined by the Engineer. Acceptance testing is not required on areas in which a full-size roller is restricted from compacting the mat properly. These areas shall be compacted to the satisfaction of the Engineer.

**410.7.1.3-Shoulders and Ramps:** As per MP 401.07.21, shoulders and ramp areas that are constructed simultaneously with the mainline are not included in the sampling plan. However, these simultaneously constructed shoulder and ramp areas shall be included in the lot of the adjacent mainline for the purposes of penalty ~~and bonus~~ calculations for compaction and mixture properties.

Shoulders that are constructed independently of the mainline shall be tested as per MP 401.07.21. However, compaction penalty calculations for these independently constructed shoulders shall not apply.

**410.7.1.4-Thickness:** Thickness testing shall be performed on all traveled lanes, ramps and independently constructed shoulders.

Cores obtained for mat density and bond strength will both be measured for thickness as per MP 410.07.22 Measurement for Thickness of Asphalt Pavement Using Drilled Cores, prior to those subsequent analyses. The core measurements which represent the thickness of the sampling units shall be analyzed to determine the average value of the pavement thickness. Pavement Thickness (T) shall include all of the pavement layers as specified excluding any patch and level course and scratch courses. This value will be used to determine the degree of compliance with the provisions and to develop certain factors to be used in the derivation of equitable deductions as set forth in Section 410.13.5, in the event the provisions of this Specification are not met.

**410.7.1.5-Bond Strength:** Bond Strength Testing shall be conducted to ensure the creation of a monolithic layered pavement; this is typically achieved by the application of a tack coat between pavement layers. Any tack coats applied by the Contractor shall be applied in accordance with Section 408.

Bond Testing shall be performed on all surface layers beginning with the existing pavement layer and then all intermediate pavement layers called for in the proposal and plans, this testing shall be performed on all traveled lanes and shoulders. Bond Testing is not required for pavement layers placed on top of a granular type layer (aggregate base, rubblized concrete, macadam, etc.).

If an asphalt pavement layer is to be placed atop a concrete surface, Bond Strength testing is not required however, a tack coat shall be applied in accordance with Section 408 to ensure complete coverage of the surface and to the satisfaction of the Engineer.

Core bond strength shall exceed a minimum of 100 psi when tested in accordance to MP 410.07.23 Guide to Determining Interface Bond Shear Strength.

**410.7.2-Surface Tolerance:** Shall be in accordance with Section 720 on the finished mat.

**410.7.3-Pattern Segregation:** Pattern segregation is continuous or repeated areas of non-uniform distribution of coarse and fine aggregate particles in the finished mat. The Division will address pattern segregation as follows:

**410.7.3.1-Evaluating Pattern Segregation:** If the Engineer observes pattern segregation that may result in defective pavement, then:

- i. The Inspector will notify the Contractor of the observed pattern segregation.
- ii. The Contractor may continue to work at their own risk while they immediately

and continually adjust the operation to eliminate the pattern segregation from future work.

- iii. As a minimum and in the presence of the Engineer and the Contractor's Representative, Division personnel shall determine the average depth of pavement surface macrotexture according to MP 401.07.24 in areas with the pattern segregation and in areas with non-segregated pavement. The pattern segregation is unacceptable if the difference in average pavement texture depth between the non- segregated and segregated areas exceeds the following:
  - a. For 9.5 mm or Wearing I mixes – 0.012 inch ~~(0.305 mm)~~
  - b. For 12.5 mm mixes – 0.016 inch ~~(0.406 mm)~~
- iv. The Engineer will determine if the pavement is defective as specified in Section 410.7.3.3.

**410.7.3.2-Test Section:** If the macrotexture tests identify unacceptable pattern segregation, then:

- i. Immediately suspend placing the asphalt course. Evaluate the cause of pattern segregation according to the Paving Operation QC Plan. Provide proposed corrective actions to the Engineer and do not resume placing the asphalt course until after the Engineer reviews the proposed corrective actions and authorizes paving to continue.
- ii. Determine if the pattern segregation resulted in defective pavement as specified in Section 410.7.3.3.
- iii. After the Engineer allows paving to resume, place a test section not to exceed 200 tons. If the corrective actions do not eliminate observed pattern segregation, the Department will suspend paving, even if it is before the Contractor places the entire test section. Propose additional corrective actions and construct another test section. Resume normal paving operations after constructing an entire test section without pattern segregation as determined by the Engineer.

**410.7.3.3-Defective Pavement:** At locations selected by the Engineer and with the Engineer present, drill three 6-inch diameter cores from the area of pattern segregation and three cores from the pavement representing a non-segregated area. Do not compress, bend, or distort samples during cutting and handling and immediately provide the cores to the Inspector. The Inspector will transport cores to the producer's laboratory. With the Engineer present, test the cores at the plant for density, asphalt content, and gradation. Additional cores and/or additional testing as per MP 401.07.24 Measuring Pavement Macrotexture Depth can be used to further evaluate the pavement.

An area of pattern segregation contains defective pavement if:

- a. the summation of absolute deviations from any two sieves is 20% or more from the JMF;
- b. the core density is defective, the mixture is defective in asphalt content;
- c. or the mixture is defective for percent passing the 75  $\mu$ m (No. 200) sieve.

The core density is defective, or the cores are defective for asphalt content or gradation of the 75  $\mu$ m (No. 200) sieve if the PWL is less than 55 as determined in accordance with MP 401.13.50 and based on three samples (n=3). Remove and replace the full width of the

affected lane and a minimum of 5 feet beyond each end of the area with unacceptable pattern segregation. Construct replacement pavement conforming to the appropriate surface tolerances.

**410.7.4-Flushing:** Provide a mix that will not flush. Flushing is continuous or repeated areas of excessive asphalt on the pavement surface. The Division may recognize flushing until the Division approves the project through final inspection. The Division will address flushing as follows:

**410.7.4.1-Evaluating Flushing:** When the Engineer observes flushing, then:

- i. The Engineer will immediately notify the Contractor of the observed flushing.
- ii. The Contractor may continue work at its own risk while it immediately and continually adjusts the operation to eliminate flushing from future work.
- iii. In the presence of the Engineer, determine the average depth of pavement surface macrotexture according to MP 401.07.24 in areas of suspected flushing. If the average texture depth is less than or equal to 0.006 inches (~~0.152 mm~~), then the pavement will be considered to be flushed and is defective.

**410.7.4.2-Test Section:** If the macrotexture tests identify flushing, then:

- i. Immediately suspend placing the paving course. Evaluate the cause of flushing according to the Paving Operation QC Plan and as directed. Provide proposed corrective actions to the Engineer and do not resume placing the paving course until after the Engineer reviews the proposed corrective actions and authorizes paving to continue.
- ii. Remove and replace the defective wearing course at no cost to the Division for the full width of the affected lane and a minimum of 5 feet beyond each end of the area of defective wearing course. Construct replacement wearing course conforming to the appropriate surface tolerances.
- iii. After the Engineer allows paving to resume, place a test section not to exceed 200 ~~TN~~ tons. If the corrective actions do not eliminate observed flushing, the Division will suspend paving even if it is before the Contractor places the entire test section. Propose additional corrective actions and construct another test section. Resume normal paving operations after constructing an entire test section without flushing as determined by the Engineer.

#### **410.8-BLANK**

#### **410.9-EQUIPMENT:**

**410.9.1-Plants:** All plants shall meet the general requirements set forth in AASHTO M156 unless it can be demonstrated to the satisfaction of the Engineer that a consistent quality mix can be produced with modifications to any of these requirements.

All plants in West Virginia producing asphalt for the Division shall provide documented evidence of compliance with current requirements of the West Virginia Air Pollution Control Commission.

All plants which are not in West Virginia but producing asphalt for the West Virginia Division of Highways shall provide documented evidence of compliance with current

requirements of the laws and regulations of the State in which they are producing, applicable to air pollution.

**410.9.2-Dust Collector:** An efficient dust collecting system shall be provided to prevent the loss of fine material. The material collected may be returned to the mixture at a uniform rate or discarded.

**410.9.3-Truck Scales:** Truck scales shall be provided at each Plant, except that truck scales are not required at properly calibrated automatic batching plant facilities which are equipped with digital printout equipment, and which load the trucks directly from the mixer or the weigh hopper in a surge or storage silo.

A person designated as a weigher shall be provided by the producer. The weigher shall certify that the weight of the asphalt, as determined either by the truck scales or from the digital printout of the batch weights, is correct.

Each truck shall be weighed empty prior to each load, except at automatic batch plants approved to operate without truck scales.

All truck scales shall be mounted on solid foundations which will insure them remaining plumb and level.

Approval and sealing of scales shall be conducted at the frequency determined by the West Virginia Division of Labor, Bureau of Weights and Measures, and when the plant is moved, or upon the request of the Engineer. The Engineer shall be notified of any scale malfunctions when material is being furnished to Division of Highways projects. The Division may, at its option, accept inspection and sealing by out-of-state agencies when the mixing plant is located outside West Virginia.

A digital recorder shall be required on all truck scales. The digital recorder shall produce a printed record of the gross, tare and net weights, and the time, date, truck identification, and project number. Provision shall be made for constant zero compensation and further provision shall be made so that the scales may not be manually manipulated during the printing process. The system shall be interlocked so as to allow printing only when the scale has come to rest. In case of breakdown of the automatic equipment, the Engineer may permit manual operation for a reasonable time, normally not to exceed 48 hours, while the equipment is being repaired.

The scales shall be of sufficient size and capacity to weigh the loaded trucks that are used for delivery of asphalt from the plant.

**410.9.4-Test Weights:** As part of its standard equipment, each plant which proportions aggregate by weight shall provide a minimum of ten 50-pound ~~(22.68 kg)~~ test weights for the purpose of verifying the continued accuracy of its weighing equipment.

Plants which proportion asphalt material by weight shall furnish, in addition to the above, one five pound ~~(2.268 kg)~~ test weight.

**410.9.5-Surge and Storage Silos:** During the normal daily operation of the plant, asphalt may be stored in a surge or storage silo for a maximum of ~~12-6~~ hours, provided the silo has received prior evaluation and acceptance through the District plant inspection. The resulting temperature of the material at time of placement and compaction shall be sufficient to comply with 410.10.1, ~~3~~ and 410.10.4

~~Longer silo storage times, up to 24 hours, may be permitted for dense graded asphalt if the storage silo is insulated and/or heated to assure that the proper mix temperature is maintained. The gates at the bottom of the storage silo shall be adequately heated and sealed when the asphalt is held for the extended period of time. When asphalt is stored for the extended time period, it shall not be used until the temperature has been checked and the asphalt has been visually inspected for hardening of the mix and stripping of the asphalt from the aggregate. Approval of the extended storage time may be revoked if it is determined through inspection and/or testing that the extended storage is having a detrimental effect on the asphalt.~~

**410.9.6-Inspection of Equipment and Plant Operations:** The Engineer shall have access to the plant to assure the adequacy of the equipment in use, to inspect the conditions and operation of the plant, to verify weights, to verify the proportion and character of materials, and to determine if specified temperatures are being maintained in the preparation of the mixture.

**410.9.7-Trucks for Transporting Mixture:** The use of diesel fuel, kerosene, or similar solvent-based products which can dissolve the asphalt film from the aggregate particles will not be permitted for use as a release agent. Any commercial release agent which is certified as harmless to the mix may be used; however, the Division reserves the right to restrict any release agent that is shown to cause problems during placement of the mix. All excess release agent shall be removed from the truck bed prior to loading the asphalt.

All truck beds shall be insulated with approved material. No trucks shall be used which cause segregation of the materials, which show large oil leaks, or which cause undue delays in delivery of material. All trucks shall be provided with a waterproof cover and a hole in the body for the purpose of conveniently checking the temperature of the load. Covers shall be suspended slightly above the mixture, shall extend over the sides of the truck, and shall be securely fastened to eliminate air infiltration and to prevent water from coming in contact with the mixture.

**410.9.8-Laboratory:** A testing facility or laboratory, as described below, shall be provided within reasonable proximity of the asphalt plant. Plant operations must be visible from within the laboratory.

The laboratory shall be of sufficient size to hold all laboratory test equipment and supplies with adequate floor space to allow the technicians to test samples in an efficient manner. The laboratory shall be furnished and maintained with adequate ventilation, heat, light, water, sink and drainage, electrical or gas outlets, or both, work table, shelves, and supply cabinets.

The laboratory shall be supplied with the equipment and materials listed below and these shall be maintained to meet the applicable requirements of AASHTO or ASTM:

- i. Hot plate, gas or electric.
- ii. Large ovens (as needed for heating and drying samples), gas or electric.
- iii. Unit weight container, ½ cubic foot ~~(0.014 cubic meter)~~. Required for slag only.
- iv. Balances of sufficient capacity and accuracy for conducting specified tests and plant calibration.

- v. Thermometers: dial type, liquid-in-glass, and digital as required for conducting standard test procedures and monitoring mix temperatures. Digital thermometers shall be equipped with an appropriate sturdy probe that can be pushed into a sample of hot asphalt to check the temperature of the mix.
- vi. Ro-Tap Sieve shaker or equivalent, with 8 and/or 12 inch ~~(200 and/or 300 mm)~~ diameter screens.
- vii. Sample splitters for fine and coarse aggregates.
- viii. Miscellaneous items (including sample splitting trowels, scoops, square point shovel, aggregate sample pans, heat resistant gloves, measuring rules, brushes, flashlight, timing devices, and glassware as needed).
- ix. Expendable supplies necessary for performance of tests.
- x. Equipment for determining the maximum specific gravity of asphalt mixtures as specified in AASHTO T209.
- xi. Non-contact infrared thermometer accurate to  $\pm 2^{\circ}\text{F}$  ~~( $\pm 1^{\circ}\text{C}$ )~~.
- xii. Equipment for determining the bulk specific gravity of asphalt mixtures using saturated surface dry specimens complying with AASHTO T166.
- xiii. Marshall equipment necessary to comply with AASHTO T245 and ASTM D5581, including a calibrated automatic testing apparatus having recording capabilities and compaction hammers. (Marshall designs only)
- xiv. Asphalt content ignition oven with built-in scale and printer meeting the requirements of AASHTO T308, Test Method A.
- xv. Calibrated Gyratory compactor meeting requirement of AASHTO T312 with computer (including software for data acquisition and test calculations) and printer. Compactor must be calibrated to the internal angle in accordance with AASHTO TP71 with annual verification (Superpave designs only).

**410.9.9-Asphalt Paving Equipment:** Asphalt paving equipment shall be self-contained and of sufficient size, power, and stability to receive, distribute and strike-off the asphalt mixture at rates and widths commensurate with the typical sections and other details shown on the plans. The paver shall be provided with an activated screed or strike-off assembly equipped to be heated. Approval of the paver by the Engineer will be based on the demonstrated capability of the equipment to place the mixture to the required cross-section, profile, and alignment in an acceptable, finished condition ready for compaction.

The paver shall be equipped with means of preventing the segregation of the coarse aggregate particles when moving the mixture from the paver hopper to the paver augers. It shall also be capable of pushing a sufficient amount of the mixture under the auger gearbox to prevent streaking or tearing of the mat. Some paver models may require the installation of a manufacturer retrofit kit or equipment modification to accomplish this.

Specialized equipment or hand methods approved by the Engineer may be employed to spread the asphalt mixture where the use of standard full-scale paver is impractical due to the size or irregularity of the area to be paved.

Pavers shall be equipped with mechanical or automatic grade and slope controls. The use of automatic grade and slope controls with a traveling straight edge shall be required only when specified on the Plans or in the Proposal. Both the grade and slope controls shall be in working order at all times. In the event of failure of the automatic controls, the Contractor will be permitted to finish the day's work using manual controls but will not be allowed to resume work the following day until the grade and slope controls are in proper working order.

**410.9.10-Compaction Equipment:** Compaction may be performed by self-propelled steel-wheeled, pneumatic-tired and/or vibratory rollers. Hand-held rollers or vibrating plates may be used in small inaccessible areas if approved by the Engineer. Prior to use on any project, the roller shall be inspected to see that it is in good mechanical condition. The total weight, weight per inch of width (steel-wheeled), and average ground contact pressure (pneumatic-tired) shall be documented.

#### **410.10-PAVING OPERATIONS:**

**410.10.1-Spreading and Finishing:** Before spreading any material, the contact surfaces of curbs, gutters, manholes, and of adjacent Portland cement concrete pavement edges shall be painted or sealed with asphalt material. Exact edge of pavement, except on concrete, shall be established by a string or chalk line for a distance of not less than 500 feet ahead of the spreading operation. For projects where the existing pavement was milled prior to the placement of new asphalt, the edge of pavement shall be the edge of milled section.

For mixes produced with neat (non-modified) asphalts (which may include PG 64H- 22, PG 64S-22, PG 58H-28, and PG 58S-28) the temperature of the mixture at the time of placement shall be within the temperature requirements of the JMF. The JMF temperature range shall be the liquid asphalt supplier's specified mixing temperature  $\pm 45^{\circ}\text{F}$  ~~( $\pm 25^{\circ}\text{C}$ )~~ with a maximum mixing temperature of  $338^{\circ}\text{F}$  ~~( $170^{\circ}\text{C}$ )~~. Additional allowances will be made for water injection processes with a minimum mixing temperature of  $220^{\circ}\text{F}$  ~~( $105^{\circ}\text{C}$ )~~.

The mix temperature shall be monitored by inserting a thermometer into the mix through the hole in the truck bed.

The temperature of the completed mix, when measured at the plant, shall be within the tolerance as established by the JMF. The first load which demonstrates temperatures outside of that range shall be accepted, provided that the temperature is still within the master temperature range. No additional loads of material shall be run out until necessary steps are taken to reestablish the temperature of the mix within the plant tolerance. When measured at the project site, the temperature of the mix shall be within the tolerance established by the JMF. The first truck load of material which demonstrates temperatures outside of that range or any trucks in transit at that time shall be accepted provided temperatures are within the master temperature range. Any truckload of material which exceeds the master temperature range may be rejected by the Engineer. However, the plant shall immediately be notified that no additional loads of material are to be dispatched until necessary action is taken to reestablish temperature within JMF specification limits.

When the surface temperature falls to within  $10^{\circ}\text{F}$  ~~( $6^{\circ}\text{C}$ )~~ of the weather restrictions of Table 410.8, the mix temperature may be increased up to a maximum of  $338^{\circ}\text{F}$  ~~( $170^{\circ}\text{C}$ )~~ unless otherwise specified by the asphalt supplier. The temperature of each truckload of material shall be monitored for compliance. Any truckload of material which exceeds this maximum temperature may be rejected by the Engineer.

Mixes produced with asphalts that contain modifiers for high or low temperature performance enhancement shall meet the temperature requirements recommended by the asphalt supplier, as determined using the mid-point of the mixing temperature range shown on the asphalt temperature-viscosity charts and allowing for  $\pm 25^{\circ}\text{F}$  ~~( $14^{\circ}\text{C}$ )~~.



**410.10.2-Safety Edge:** When the total specified lift thickness of pavement is 1.5 inches or greater, asphalt safety edge shall be constructed on the outside pavement edge. The device utilized shall be a model listed on Division Approved Product Listing.

The resulting finished surface of the safety edge shall be sufficiently consolidated so as to show no segregation or raveling of the aggregate and shall have the same surface profile and texture of the compacted mat surface.

Safety edge is not to be used through intersections, against curb or barrier, or when directed by the Engineer. The paving operation shall allow for automatic and/or manual transitions at cross roads, driveways, and intersections. The Engineer may allow short sections of handwork for transitions at driveways, intersections, interchanges, and bridges.

#### **410.11-PROTECTION OF PAVEMENT AND TRAFFIC CONTROL:**

The Contractor shall be responsible for the protection of asphalt surfaces from damage by their equipment and personnel. When the construction of asphalt surfaces is undertaken on projects under public traffic and the road surface is 16 feet wide or greater and the ADT is 400 or greater, the Contractor shall place no passing signs, Interim pavement markings, and Temporary pavement markings to delineate the edge line, centerline, and/or lane line of the roadway as required herein and in the project plans. The provision of Section 336: Maintaining Traffic shall apply.

Interim markings are described as markings applied to freshly resurfaced roadways between lifts and after placement of the final lift prior to opening the portion of the roadway being resurfaced to traffic. These markings are intended to provide the minimum amount of delineation required for safe navigation of the roadway and are to be succeeded by Temporary markings within a three (3) to fourteen (14) day period, based on the type of roadway and ADT, as specified herein. Interim and Temporary markings shall conform to the requirements of Section 663: Pavement Markings.

#### **410.12-METHOD OF MEASUREMENT:**

Asphalt will be measured by the Square Yard (SY). The quantity will be determined by the Plan Quantity as provided for in the proposal unless otherwise directed by the Engineer.

Any patching or leveling mixture placed on a subbase or base course constructed in the same Contract with the asphalt items shall be at the expense of the Contractor. No additional compensation will be allowed for the material or any work incidental to its placement unless otherwise approved by the Engineer. No additional measurement is necessary nor will additional compensation be allowed for the placement of Safety Edge.

#### **410.13-BASIS OF PAYMENT:**

The quantities determine as provided above, will be paid for at the contract unit price for the items listed below, which prices and payment shall be full compensation for furnishing all the materials and doing all the work herein prescribed in a workmanlike and acceptable manner, including all labor, tools, equipment, field laboratory, supplies, tack coat, and incidentals necessary to complete the work and provide the performance criteria specified.

There will be no additional compensation for Interim Pavement Markings.

**410.13.1-**When a Lot of asphalt material is found not in compliance with the tolerance requirements for asphalt content and gradation as shown in MP 401.02.31, it shall be subject

to a price adjustment in accordance with the criteria for Determination of Percent Within Limits established in MP 401.13.50 and pay factors in Table 410.13.3.1.

**410.13.2-Blank**

**410.13.3**–For Interstates and divided NHS Highways, the unit price for each Lot of asphalt pavement Mat shall be adjusted as follows in Table 410.13.3.1 in accordance with MP 401.13.50. For two-lane and non-divided NHS Routes, the pay factor for asphalt content and percent passing the 75 µm (No. 200) sieve shall be determined by Table 410.13.3.1. However, the mat density pay factor shall be determined by Table 410.13.7.2.

**TABLE 410.13.3.1**

Percentage of Material Within Specification Limits (PWL)	Lot Pay Factor (Percent of Contract Unit Price)
<del>96-100</del> <sup>Note 1</sup>	<del>102</del> <sup>Note 1</sup>
90- <del>95-100</del>	100
75-89	[(0.5)PWL]+55
55-74 <sup>Note 2 1</sup>	[(1.4)PWL]-12

~~Note 1 Payment of 102% for mat density shall be subject to additional requirement of the average compaction for the lot being evaluated to be a minimum of 93% density.~~

Note ~~2~~ 1 Material with a PWL less than 55 is considered defective and will be considered for removal and replacement of the lot. If only one lot characteristic has a percent within limits less than 55, the Engineer, may allow the Contractor to leave the defective lot in place. The decision to remove and replace the subject lot shall include evaluation of all lot characteristics for pay and surface characteristics as per guidelines set forth in MP 401.07.25. If the material is left in place, the Department will pay for the defective lot at a value not to exceed 50% of the contract unit price of asphalt per square yard. (~~i.e.~~, Contract unit price = \$10 sy → \$5 sy max)

**410.13.3.1-Price Adjustment:** The Division will compute the percent of the contract unit price paid as follows:

$$\text{Lot Payment} = \text{CP} (2\text{PD} + \text{PB} + \text{PA}) / 400$$

Where:

CP = Contract unit price per lot (unit price times lot quantity)

PD = Payment Factor Percentage for mat density

PB = Payment Factor Percentage for asphalt content.

PA = Payment Factor Percentage for percent passing the 75 µm (No. 200) sieve

Shoulders and ramps shall be included in penalty calculations for mixture and compaction unless they are constructed independently, where the density requirements shall be waived. When compaction requirements are waived, PD will be minimum of 100.

**410.13.4-Joint Density Adjustments:** For Interstates and divided NHS Highways, joint Density PWL calculations shall be in accordance with MP 401.13.50. Joint Density bonus adjustments will be calculated for joint lots with a PWL greater than or equal to 80. Joint Density negative adjustments will be calculated for joint ~~lot~~ lots with a PWL less than or equal

to 60. Price adjustments shall be calculated using the formulas below. There will be no adjustment for joint lots who's PWL ~~falls between 60 and 80 is greater than 60.~~

~~Bonus adjustment calculated as follows:~~

$$\text{\$T} = \frac{\text{PWL} - 80}{20} \times 4,000$$

Negative adjustment calculated as follows:

$$\text{\$T} = \frac{60 - \text{PWL}}{60} \times 12,500$$

Adjustments calculated for lots less than or greater than 10,000 feet in length shall be prorated directly proportional to the amount of length less than or greater than 10,000 feet.

For two-lane and non-divided NHS Routes, refer to Section 410.13.7.3.

**410.13.5-Thickness Adjustments:** No payment will be made for pavement areas deficient in thickness by more than 35% T.

Pavement which is deficient in thickness by more than 50% T is considered to be inadequate to perform satisfactorily and shall be removed and replaced at no added cost to the Division.

The balance of the item, the portion of the item not treated in the manner set forth above, will be treated in the manner set forth in 410.13.5.1 below.

**410.13.5.1-Price Adjustments for Thickness** - When all individual measurements meet or exceed the specified thickness, there will be no adjustment for payment. If any individual values or when the average value of the pavement thickness per lot is less than the specified total thickness, the quantity of pavement represented by this average thickness will be paid by a direct calculation as defined as follows:

$$\text{Price Adjustment \%} = \left( \frac{t}{T} \right) \times 100$$

Where:

T = Total Plan Thickness

t = avg. lot thickness + 0.04 in.

This value is then applied to the unit price for the asphalt place in the lot, this adjustment shall remain separate from the PWL adjustments for AC, Gradation, Density, etc.

**410.13.6-Bond Strength Adjustment:** For Interstates and divided NHS Routes, bond Strength PWL calculations shall be in accordance with ~~410.13.50~~ MP 401.13.50, Guide to Statistical Analysis of Material Using Quality Level Analysis-Percent within Limits. However, for the purpose of relieving large standard deviations from abnormally strong samples, any sample with a strength exceeding 150 psi will be evaluated as 150 psi instead of the actual strength. The actual strength ~~should~~ shall still be recorded as such on the reporting form.

~~Bond Strength positive adjustments will be calculated for lots with PWL greater than or equal to 90.~~ Bond Strength Negative adjustment will be calculated for lots with PWL less than or equal to 70. There is no adjustment for bond Strength lots who's PWL ~~falls between 70 and 90 is greater than 70.~~

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Positive adjustment calculated as follows:

$$\$T = \frac{PWL - 90}{20} \times 2,000$$

Negative adjustment calculated as follows:

$$\$T = \frac{70 - PWL}{70} \times 40,000 - 25,000$$

Adjustments calculate for lots less than or greater than the standard 2,500 tons shall be prorated directly proportional to the amount of tonnage less than or greater than 2,500 tons. This shall be calculated on the theoretical tonnage for the lot, not the actual tonnage used.

For two-lane and non-divided NHS Routes, refer to Section 410.13.7.4.

**410.13.7 – Two-Lane and Non-divided NHS Route Exceptions:** Due to the wide range of variability on the roadway, the following exceptions for lot/sublot layout and analysis of existing condition dependent test results shall apply:

**410.13.7.1-Acceptance Testing of Asphalt:** A lot shall consist of three (3) to seven (7) equal sublots. A normal sublot size is 500 tons unless operational conditions and sublot size dictate otherwise. Determine the number of sublots on the project by converting the square yardage of the travel lanes and simultaneously paved shoulders to tonnage. Divide the tonnage by 500 and round to the nearest whole number (n). Use that number (n) in Table 410.13.7.1 to determine the number of lots to be used for acceptance.

**TABLE 410.13.7.1**

<b><u>Number of Sublots (n)</u></b>	<b><u>Number of Lots</u></b>
<u>3 to 7</u>	<u>1 Lot with (n) even sublots</u>
<u>8</u>	<u>2 Lots with 4 even sublots each</u>
<u>9</u>	<u>2 Lots - Lot 1, 5 Sublots / Lot 2, 4 Sublots</u>
<u>10</u>	<u>2 Lots with 5 even sublots each</u>
<u>11</u>	<u>2 Lots - Lot 1, 6 Sublots / Lot 2, 5 Sublots</u>
<u>12</u>	<u>2 Lots with 6 even sublots each</u>
<u>13</u>	<u>2 Lots - Lot 1, 7 Sublots / Lot 2, 6 Sublots</u>
<u>14</u>	<u>3 Lots - Lot 1, 5 Sublots / Lot 2, 5 Sublots / Lot 3, 4 Sublots</u>
<u>15</u>	<u>3 Lots with 5 even Sublots each</u>

Turn lanes, intersections, and independently constructed shoulders shall not be subject to price adjustments, positive or negative, if the combined square yardage converts to less than 500 tons. If the square yardage converts to over 500 tons, then one additional sublot for asphalt content, percent passing the 75 µm (No. 200) sieve, and bond strength shall be added to the last lot constructed. Compaction shall be monitored, documented, and submitted to the Engineer by a certified Asphalt Field and Compaction Technician to assure that it meets specification requirements.

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**410.13.7.2 -Basis of Payment:** The payment factor for density shall be adjusted as follows in Table 410.13.7.2. This payment factor (PD) will then be used in the Lot Payment calculation formula in Section 410.13.3.1.

**TABLE 410.13.7.2**

<b>Payment Factors for Pavement Mat Density</b>	
<b>Average Lot Percent Density</b>	<b>Payment Factor (PD)</b>
Greater than 98 %	Note 1
94.00% to 98.00%	102
93.00% to 93.99%	101
91.50% to 92.99% 98.00%	100
88.00% to 91.49%	= 100 – 4*(91.50% - Percent density)
Less than 88%	= 84 – 10*(88% - Percent density) <sup>Note 2</sup>

**Note 1** High mat density is only a problem if it leads to asphalt flushing on the surface of the mat or rutting due to an unstable mix. The Division will make a special evaluation of the material and determine the appropriate action.

**Note 2** When the density decreases, the mat will be more susceptible to accelerated deterioration and a decrease in the expected service life of the pavement. For mat densities less than 88%, the percent of Contract Bid Price will be decreased by an additional 10% per percentage of mat density less than 88%, unless a Special evaluation performed by the Division determines a more appropriate action.

**410.13.7.3-Joint Density Adjustments:** The adjustment for joint density shall be determined by Table 410.13.7.3. This adjustment is per linear foot and will be multiplied by the total number of linear feet in the lot to determine the total lot adjustment. This is calculated per lot and applied per Section 410.13.8.3.

**TABLE 410.13.7.3**

<b>Pay Adjustment for Pavement Joint Density per Linear Foot</b>	
<b>Average Lot Percent Density</b>	<b>Price Adjustment (\$ / LF)</b>
Greater than 97 %	Note 3
94.00% to 97.00%	0.40
91.50% to 93.99%	= [0.40 – {0.12*(94.00 – Percent Density)}]
89.00 % to 97.00%	0
88.00% to 88.99%	-0.20
Less than 88%	= [{0.50*(Percent Density – 88.00)} – 0.20]

**Note 3** Joint density slightly above 97% is normally only a problem if it leads to asphalt flushing on the surface of the mat or rutting due to an unstable mix. The Division will make a special evaluation of the material and determine the appropriate action.

**410.13.7.4-Bond Strength Adjustments:** The adjustment for bond strength shall be determined by Table 410.13.7.4. This is calculated per lot and applied per Section 410.13.8.4. This shall be calculated on the theoretical tonnage for the lot, not the actual tonnage used.

<b>TABLE 410.13.7.4</b>	
<b>Pay Adjustment for Bond Strength per 2500 Ton Lot</b>	
<b>Average Lot Bond Strength (PSI)</b>	<b>Price Adjustment (\$ / Lot)</b>
Greater than 150.00	5,000
100.00 to 149.99	= [5,000 – 100*(150.00 – PSI)]
100.00 and Greater	0
75.00 to 99.99	= [{"1,000*(PSI - 75.00)} – 25,000]
Less than 75.00	- 25,000

**410.13.78-Lot Payment Calculations:** The pay factors that are calculated with in the specification are to be applied in the following way:

**410.13.78.1-PWL Factors:** The calculated total PWL for a given lot is applied to the bid unit price for the asphalt mixture in the lot. Once the unit price has been adjusted the quantities can be calculated to arrive at the payment for the lot.

**410.13.78.2-Thickness Adjustment:** There is no adjustment for thickness greater than the thickness that is specified in the plans. If there is a Price Adjustment (Section 410.13.5) for thickness this factor (percentage) is applied to the contract bid unit price times the quantity in the lot to arrive at a dollar amount penalty. This penalty is applied to the overall payment for the lot.

**410.13.78.3-Joint Density Adjustment:** If it is determined in Section 410.13.4 of this specification that a Joint Density Adjustment is warranted the dollar amount determined in the formulas of Section 410.13.4 or Table 410.13.7.3 shall be applied to the overall payment for the lot.

**410.13.78.4-Bond Strength Adjustment:** If it is determined that a Bond Strength Adjustment is warranted ~~by~~ the formulas in Section 410.13.6 or Table 410.13.7.4 shall be used to calculate the adjustment. This adjustment shall be applied to the overall payment for the lot.

#### 410.14-PAY ITEMS:

ITEM	DESCRIPTION	UNIT
410001-*	“design method” Asphalt Base Course, Type “mix type”	Square Yard ( <del>Meter</del> )
410002-*	“design method” Asphalt Wear Course, Type “mix type”	Square Yard ( <del>Meter</del> )
410007-*	“design method” Asphalt Skid Pavement, Type “mix type”	Square Yard ( <del>Meter</del> )

- \* Sequence number  
 “design method” shall be either Marshall or Superpave  
 “mix type” from Table 401.4.2A or 401.4.2B

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

SUPPLEMENTAL SPECIFICATION

FOR

SECTION 636  
MAINTAINING TRAFFIC

**636.20-TEMPORARY TRAFFIC SIGNAL(S) OR TEMPORARY LIGHTING:**

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

**636.20-TEMPORARY TRAFFIC SIGNALS OR TEMPORARY LIGHTING:**

**636.20.1-Temporary Traffic Signals:** Temporary traffic signal work may involve temporary modifications to existing permanent traffic signals or the installation of temporary signals. Temporary signal installations may entail the installation of traffic signals and associated equipment using wood pole supports, or the use of portable temporary traffic signal trailers. Individual signals or trailers at specific project Plan designated locations shall be interconnected and programmed to operate in a coordinated manner as a system. Temporary traffic signal work shall consist of furnishing, installing, maintaining, adjusting, and subsequent removal of various types of traffic signal components and equipment as necessary due to the maintenance of traffic plan. It shall include, but not be limited to, temporary traffic signals and traffic signal interconnections to be installed, and temporary modification to permanent traffic signals in accordance with Section 660 and Subsection 715.42 of the Specifications. As a minimum, ~~the~~ temporary traffic signals shall be equipped with ~~a~~-three-dial fixed time controllers. When ~~the~~ temporary traffic signals are no longer needed, they will become the property of the Contractor. Existing permanent signals shall be modified as detailed in the plans to match the traffic pattern for each phase of construction work and shall be returned to their original condition at the completion of the project.

Wood pole temporary traffic signal installations shall be in conformance with Standard Details Book Volume II sheet TES-23, Section 715.42.9.3, and Section 710.8.

**636.20.2-Temporary Lighting:** Temporary lighting shall consist of furnishing, installing, maintaining, and subsequent removal of various types of lighting systems as necessary due to the maintenance of traffic plan. It shall include but not be limited to lighting to be installed in accordance with Section 662 of the Specifications. When the temporary lighting is no longer needed, it will become the property of the Contractor.

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**636.23-METHOD OF MEASUREMENT:**

**636.23.16-BLANK**

DELETE SUBSECTION 636.23.16 AND REPLACE WITH THE FOLLOWING:

**636.23.16-Temporary Traffic Signal:** "Temporary Traffic Signal" shall include the furnishing, and installation, of complete and operational temporary traffic control signals. It shall also include adjusting and/or furnishing equipment and/or components for existing traffic signals to address different phases of construction work. Payment shall include interconnection, maintaining, relocating, resetting, and removal of all equipment and material necessary to adequately meet the requirements of the Traffic Control Plan and shall be measured as complete units and paid by the month, or fraction thereof, or Lump Sum as appropriate.

**636.23.23-Temporary Traffic Signal(s) or Temporary Lighting:**

DELETE SUBSECTION 636.23.16 AND REPLACE WITH THE FOLLOWING:

~~**636.23.23-Temporary Traffic Signal(s) or Temporary Lighting:** "Temporary Traffic Signal(s)" shall include the furnishing, installation, maintaining and subsequent removal of all equipment and material necessary to adequately meet the requirements of the Traffic Control Plan and shall be measured as complete units and paid by the month, or fraction thereof.~~

“Temporary Lighting” shall be on a lump sum basis and shall include the furnishing, installing, maintaining and subsequent removal of all equipment and material necessary to adequately meet the requirements of the Traffic Control Plan.

**636.25-PAY ITEMS:**

DELETE ITEM 636023 “TEMPORARY TRAFFIC SIGNAL” AND REPLACE WITH THE FOLLOWING:

ITEM	DESCRIPTION	UNIT
<u>636023-001</u>	<u>Temporary Traffic Signals, Wood Pole</u> <sup>Note 1</sup>	<u>Lump Sum</u>
<u>636023-002</u>	<u>Temporary Traffic Signals, “location”</u> <sup>Note 1</sup> <u>Portable</u> <sub>Note 2</sub>	Month
<u>636023-003</u>	<u>Temporary Traffic Signals, Modification to Permanent Traffic Signals</u>	<u>Lump Sum</u>

Note 1 Wood pole supported temporary signals are only to be specified for projects with approval from the Traffic Engineering Division.

Note 1: “location” shall be designated as “01”, “02”, etc. for each different physical location as designated on the plans. Each different, physical location will have only one item for each location and shall include all individual temporary traffic signals required at the location regardless of how many signals are required.

Note 2 Units shall be computed as the total combined number of months that each portable temporary traffic signal trailer is operational on the project.



**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 710  
WOOD MATERIALS**

**710.8-SERVICE AND LIGHTING POLES:**

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

**710.8-SERVICE, ~~AND LIGHTING,~~ AND TYPE D TRAFFIC SIGNAL POLES:**

Wood Service or lighting poles shall be ANSI Class 5, or larger, or as called for on the contract plans. Lighting poles shall be southern yellow pine and service poles shall be either southern yellow pine or Douglas fir.

Type D traffic signal poles shall be ANSI O5.1 Class 3 or greater, or as called for on the contract plans. Species shall be either southern yellow pine or Douglas fir. Poles shall not have more than 180 degree twist in grain over the full length and the sweep shall be no more than 4 inches.

The poles shall be pressure-treated) to meet the requirements of American Wood Protection Association (AWPA) Standard U1 UC4C (Commodities Specification D: Poles).

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

SUPPLEMENTAL SPECIFICATION

FOR

SECTION 715  
MISCELLANEOUS MATERIALS

**715.42-TRAFFIC SIGNAL MATERIALS AND EQUIPMENT:**

**715.42.9-Signal Supports:**

**715.42.9.3-Wood Pole Signal Supports (Type D):**

**715.42.9.3.1-General Description:**

DELETE THE FIRST SENTENCE OF THE SECOND PARAGRAPH AND REPLACE WITH THE FOLLOWING:

~~The shaft length and diameter of the poles shall be as described on the Plans.~~ Shaft lengths of the poles shall be as described on the Plans.

ADD THE FOLLOWING PARAGRAPH TO THE END OF THE SUBSECTION:

ANSI O5.1 Class and material requirements for the poles shall be as specified in Section 710.8.1.

DELETE SUBSECTIONS 715.42.9.3.2 AND 715.42.9.3.3

~~—715.42.9.3.2-Material: Poles shall not have more than 180-degree twist in grain over the full length and the sweep shall be no more than 4 inches (100 mm).~~

~~—715.42.9.3.3-Treatments: Poles shall be pressure treated in accordance with Section 710 of the Specifications.~~

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 102**

**BIDDING REQUIREMENTS AND CONDITIONS**

**102.5-PROPOSAL SUBMISSION:**

**102.5.3 Notice to Contractors:**

DELETE SUBSECTION TITLE AND REPLACE WITH THE FOLLOWING:

**102.5.3- Bidding Requirements:**

DELETE BULLET x. AND REPLACE THE FOLLOWING:

- x. Section L: Categories of Work – Bidder must acknowledge that they will perform, with their own organization, work amounting to not less than 30 percent of the total contract cost, as detailed in Section 108.1. All categories of work in the contract for which the bidder is not prequalified to perform must be subcontracted to a contractor who is prequalified in those categories. Failure to meet the prequalification requirement may be basis for termination of the contract and the awarding of said contract to the next responsible bidder or readvertisement and letting of the contract. Any additional costs for said actions shall be the responsibility of the bidder.

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 106**

**CONTROL OF MATERIALS**

**106.1-SOURCE OF SUPPLY AND QUALITY REQUIREMENTS:**

DELETE THE FIRST PARAGRAPH AND REPLACE WITH THE FOLLOWING:

The material used on the work shall meet all quality requirements of the Contract. To expedite the inspection and testing of materials, the Contractor shall notify the Engineer of their proposed sources of materials as required in ~~103.10~~ 103.11. At the option of the Engineer, materials may be approved at the source of supply before delivery is started. If it is found after trial that sources of supply for previously approved materials do not produce specified products, the Contractor shall furnish materials from other sources at no increase in cost to the Division.

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**  
**DIVISION OF HIGHWAYS**  
**SUPPLEMENTAL SPECIFICATION**  
**FOR**  
**SECTION 107**  
**LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC**

**107.8-RAILWAY-HIGHWAY PROVISIONS:**

**107.8.2-Insurance:**

**107.8.2.1-Contractor's Public Liability Insurance and Protective Public Liability Insurance:**

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

Commercial General Liability (CGL) coverage as required by Section ~~103.6.1~~ 103.7.1 shall be written with a \$2,000,000 Each Occurrence Limit. This limit may be single limit of primary coverage or a combination of primary and excess coverage which will meet the \$2,000,000 requirement. A certificate of insurance shall be provided to the Railroad before work begins and said certificate shall provide the Railroad thirty (30) days advance written notice of cancellation or material change in insurance coverage. If any part of the work is sublet, ~~Commercial General Liability-CGL~~ Insurance and evidence thereof in the same amounts as required of the Prime Contractor, shall be provided by or in behalf of the subcontractor to cover his operations on railroad right of way.

**107.8.2.2-Railroad Protective Liability Insurance:**

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

With respect to the operations performed by the Contractor or subcontractors of any tier the Contractor must provide in the name of Railroad. This policy shall be written on the ISO/RIMA Form of Railroad Protective Insurance (ISO Form CG00350690) with Pollution Exclusion Amendment ISO Form CG 28311185 or their equivalents). ~~The policy of insurance specified in this section shall be countersigned by a resident agent of the State of West Virginia in accordance with Section 103.6.5.~~ The original of the policy shall be submitted to and approved by the Railroad before work is commenced on its right of way or within 200 feet of the nearest track or 1000 feet if blasting is required for the construction.

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 109**

**MEASUREMENT AND PAYMENT**

**109.4-FORCE ACCOUNT WORK:**

**109.4.5-Contract Bond:**

DELETE THE FIRST PARAGRAPH AND REPLACE WITH THE FOLLOWING:

The cost of premiums for contract bond required by ~~103.5~~ 103.6 which is extra cost and related to the force account work will be paid to the Contractor.

**109.4.6-Insurance:**

DELETE THE FIRST PARAGRAPH AND REPLACE WITH THE FOLLOWING:

The cost of premiums for Contractor's Public Liability and Property Damage Liability Insurance required by ~~103.6.1~~ 103.7.1 and Contractor's Protective Public Liability and Property Damage Liability Insurance required by ~~103.6.2~~ 103.7.2 which is extra cost and related to the force account work will be paid to the Contractor.

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 508**

**DIAMOND GRINDING**

**508.9-SMOOTHNESS:**

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE THE FOLLOWING.

Smoothness of the riding surface shall be determined by the Engineer using an inertial profiler. ~~Smoothness incentives based on the International Roughness Index (IRI) shall be as follows:~~

**TABLE 508.9-ENGLISH**

Posted Speeds $\leq$ 45 mph		Posted Speeds $>$ 45 mph	
Final IRI (inches/mile)	Incentive (\$ per 0.1 mile section)	Final IRI (inches/mile)	Incentive (\$ per 0.1 mile section)
0.00—70.00	\$450.00	0.00—50.00	\$450.00
70.01—100.00	$-11*(IRI)+1220.00$	50.01—65.00	$-22*(IRI)+1550.00$
100.01—135.00	\$0.00	65.01—80.00	\$0.00

**TABLE 508.9-METRIC**

Posted Speeds $\leq$ 70 km/h		Posted Speeds $>$ 70 km/h	
Final IRI (meters/km)	Incentive (\$ per 0.1 km section)	Final IRI (meters/km)	Incentive (\$ per 0.1 km section)
0.0000—1.1048	\$450.00	0.0000—0.7892	\$450.00
1.1050—1.5784	$-950*(IRI)+1499.56$	0.7893—1.0259	$-1899.54*(IRI)+1949.12$
1.5785—2.1308	\$0.00	1.0261—1.2627	\$0.00

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**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 720**

**SMOOTHNESS TESTING**

**720.5-NATIONAL HIGHWAY SYSTEM (NHS) PAVEMENT PROJECT:**

**720.5.2-Schedule 1 NHS Pavement Projects:**

DELETE TABLE 720.5.2 AND REPLACE THE FOLLOWING.

**TABLE 720.5.2**

**Schedule 1 NHS Pavement Projects**

<b>IRI for each 0.1-mile section (in/mi)</b>	<b>Price Adjustment (\$)</b>
<del>30.0 or Less</del>	+600
<del>30.1 to 60.0</del>	<del>-20(IRI) + 1,200</del>
<del>60.1 to 65.0 or Less</del>	0
65.1 to 95.0	-20(IRI) + 1,300
95.1 or Greater	Corrective Action Required

**720.5.3-Schedule 2 NHS Pavement Projects:**

DELETE TABLE 720.5.3 AND REPLACE THE FOLLOWING.

**TABLE 720.5.3**

**Schedule 2 NHS Pavement Projects**

<b>IRI for each 0.1-mile section (in/mi)</b>	<b>Price Adjustment (\$)</b>
<del>46.0 or Less</del>	+600
<del>46.1 to 76.0</del>	<del>-20(IRI) + 1,520</del>
<del>76.1 to 80.0 or Less</del>	0
80.1 to 120.0	1,200 - 15(IRI)
120.1 or Greater	-600



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**720.5.4-Schedule 3 NHS Pavement Projects:**

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE THE FOLLOWING.

NHS pavement projects with a pavement thickness less than three (3) inches and more than one (1) inch shall be classified as Schedule 3 NHS Pavement Projects. The final price adjustments for Schedule 3 NHS Pavement Projects shall be determined using the calculations shown in Table 720.5.3 720.5.4. ~~Payment for any bonus on a project shall require the average IRI for the entire project to be 67 in/mi or less.~~

**TABLE 720.5.4  
Schedule 3 NHS Pavement Projects**

IRI for each 0.1-mile section (in/mi)	Price Adjustment (\$)
<del>46.0 or Less</del>	<del>+300</del>
<del>46.1 to 76.0</del>	<del>-10 (IRI) + 760</del>
<del>76.1 to 80.0 or Less</del>	0
80.1 to 120.0	1,200 – 15 (IRI)
120.1 or Greater	-600

**720.6-NON-NATIONAL HIGHWAY SYSTEM PAVEMENT PROJECTS:**

**720.6.3-Final Price Adjustments:**

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

~~**720.6.3 Final Price Adjustments:** Final price adjustment incentives shall be calculated using percent improvement. 0.1 mile sections of after project completion data with an IRI of 170 in/mi or greater will be ineligible for final price adjustment and if the average percent improvement for the entire project is less than fifty percent (50%) the project will not be eligible for price adjustments. If the average percent improvement is more than fifty percent the final price adjustments for non-NHS pavement projects shall be determined using the calculations shown in Table 720.6.5.~~

**TABLE 720.6.3  
Non-NHS Pavement Projects**

Percent Improvement (%)	Price Adjustment Incentive (\$ per 0.1-mile Section)
50.1 or Greater	<del>18 (Percent Improvement) — 700</del>
50.0 or Less	0
<del>Where:</del>	

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$$\text{Percent Improvement (\%)} = \frac{\text{Before IRI of Lot} - \text{After IRI of same Lot}}{\text{Before IRI of Lot}} \times 100$$

**720.6.3-Final Price Adjustments:** If the average percent improvement for the entire project is 30.1% or more, no price adjustment will be assessed for the project. If the average percent improvement for the entire project is 30.0% or less, then each 0.1 mile lot that has an IRI of 80.1 or greater, will be penalized based on the following table. Table 720.6.3.

**TABLE 720.6.3**  
**Non-NHS Pavement Projects**

<u>IRI for each 0.1-mile section</u> <u>(in/mi)</u>	<u>Price Adjustment</u> <u>(\$ per 0.1-mile Section)</u>
80.1 – 170.0	320 - 4(IRI)
170.1 or Greater	-360

Where:

$$\text{Percent Improvement (\%)} = \frac{\text{Before IRI of Lot} - \text{After IRI of same Lot}}{\text{Before IRI of Lot}} \times 100$$

**720.7-PROJECT THAT DO NOT FALL UNDER PREVIOUS CHARACTERIZATIONS:**

DELETE THE SUBSECTION TITLE AND REPLACE WITH THE FOLLOWING.

**720.7-PROJECTS THAT DO NOT FALL UNDER PREVIOUS CHARACTERIZATIONS:**

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 601  
STRUCTURAL CONCRETE**

**601.5-EQUIPMENT AND TOOLS:**

**601.5.2-Batching Plant And Equipment:**

**601.5.2.3-Scales:**

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

Scales shall be inspected and sealed as often as the Engineer deems necessary to ensure their continued accuracy and as outlined in MP 700.00.30. The Contractor shall have on hand not less than ten 50 lb. weights for frequent testing of all scales.

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**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 636  
MAINTAINING TRAFFIC**

**636.2-MATERIALS:**

DELETE TRAFFIC CONTROL FROM THE TABLE AND REPLACE WITH THE FOLLOWING:

MATERIAL	SUBSECTION
<del>Traffic Control</del>	<del>715.9</del>
Traffic Control Devices	Division 700 subsections referenced in Section 636.9

**636.6-PILOT TRUCK AND DRIVER OR SHADOW VEHICLE:**

**636.6.2-Shadow Vehicle:**

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

A shadow vehicle shall be furnished by the Contractor and used at the locations called for on the Plans or directed by the Engineer. A Shadow Vehicle shall consist of a commercial host vehicle equipped with a flashing or rotary yellow beacon which can be seen in all directions and a truck mounted attenuator (TMA) or Trailer Truck Mounted Attenuator (TTMA) mounted on the rear. When the shadow vehicle is no longer needed, it shall be relocated behind a positive barrier or off the job site in a safe location.

~~Except as allowed for herein, TMA's and TTMA's utilized shall be listed on the Division Approved Products List (APL) for Impact Attenuators – MASH and shall meet the applicable requirements contained in Section 715.41. TMA's and TTMA's utilized shall be listed on the Division Approved Products List (APL) for Impact Attenuators – MASH and shall meet the applicable requirements contained in Section 715.41.~~

The Contractor shall utilize the TMA or TTMA in accordance with the manufacturer's recommendations, shall be responsible for selecting an appropriate host vehicle configured in accordance with and meeting the manufacturer's recommendations, and shall be responsible for taking into consideration all factors such as expected post-impact roll ahead distance for their specific operation at each differing location. In all cases, the Gross Vehicle Weight

(GVW) of the host vehicle shall be within the range specified on the APL. This range is based on the parameters of the host vehicle weight(s) utilized during the MASH testing of the device.

~~For projects let on or prior to December 31, 2022, TMA's and TTMA's not listed on the Impact Attenuators MASH APL but listed on the Impact Attenuators NCHRP APL and manufactured on or prior to December 31, 2019 may be utilized.~~

Test Level 2 devices listed on ~~either~~ the MASH ~~or NCHRP-APL's~~ may only be utilized on roadways with a normal posted speed limit of forty (40) MPH or less.

### 636.9-TRAFFIC CONTROL DEVICES:

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE WITH THE FOLLOWING: NOTE: SUBSECTION IS NOT REDLINE COPY.

Signing, delineation, and channelization devices for work areas include, but may not be limited to, signs, portable sign stands, barricades, drums, cones, channelizer cones, delineators, and warning lights. Devices shall be installed in accordance with standards detailed in the manual "Manual on Temporary Traffic Control for Streets and Highways" (traffic control manual), latest version, published by the Division, or as shown on the plans. Devices shall be assembled and utilized in a manner that is consistent with the manufacturer's recommendations pertaining to parameters such as size, weight, placement, and material makeup of potential device attachments, location, weight, and material makeup of additional device ballast, etc. Specific device restrictions or requirements noted by the WVDOH on the Approved Products List on which the device is listed shall be followed. In addition to any other requirements contained herein, the following requirements for specific devices shall be met:

Drums	Section 715.9.3.1 and listed on Flexible Plastic Drums MASH APL
Channelizer Cones	Section 715.9.3.2 and listed on Channelizer Cones MASH APL
Cones	Section 715.9.3.3 and meet MASH Test Level 3 requirements <sup>Note 1</sup>
Type I and II Barricades	Section 715.9.3.4 and meet MASH Test Level 3 requirements <sup>Note 2</sup>
Type III Barricades	Section 715.9.3.4 and listed on Type III Barricades MASH APL
Surface Mounted Flexible Tubular Markers	Section 715.9.3.5 and listed on Flexible Plastic Delineators MASH APL
Soil Anchored Flexible Delineator Posts	Section 715.9.3.6 and listed on Flexible Plastic Delineators MASH APL
Guardrail Mounted Delineator Posts	Section 715.9.3.7 and listed on Flexible Plastic Delineators MASH APL
Type B-1 Delineators	Section 715.9.3.8 and listed on Flexible Plastic Delineators MASH APL
Portable Sign Stands	Section 715.9.6 and listed on Portable Sign Stands MASH APL

Portable Sign Stand Signs	Roll-up signs shall be manufactured consistent with those used in the MASH testing of the stand using elastomeric retroreflective sheeting and fiberglass ribs. The signs shall be manufactured using Type ASTM-VI material listed on the Division APL for Retroreflective Sign Sheeting, and matched components recommended by the sheeting manufacturer. Manufacturing methods shall be those recommended by the sheeting manufacturer. Signs shall be designed and fabricated in accordance with fabrication details provided in the Plans or the publication WVDOH Sign Fabrication Manual, as applicable. Rigid signs shall be manufactured in accordance with the requirements contained in Section 636.9.1 below.
Warning Lights	Section 715.9.5

Note 1: MASH Category 1 work zone device. No APL is maintained for this device type. As part of the Contractor's Materials Certification described in Section 636.2.1, the Contractor shall provide a copy of the manufacturer MASH self-certification letter for each make and model to be used on the project.

Note 2: MASH Category 2 work zone devices. No APL is maintained for these device types. As part of the Contractor's Materials Certification described in Section 636.2.1, the Contractor shall provide a copy of a statement from the manufacturer referencing the applicable FHWA MASH acceptance letters, or test reports from FHWA qualifying crash testing laboratories, which demonstrate MASH compliance for each make and model to be used on the project.

**636.9.1-Static Support Mounted Signs:** Unless otherwise specified or allowed for by the Plans or Engineer, static ground mounted sign assemblies which are subject to being impacted shall be installed on u-channel supports listed on the Division APL for U-channel Post. All static ground mounted assemblies shall be considered subject to impact except for specific assemblies agreed upon by the Engineer. The installation of the supports and signs shall be in accordance with the applicable portions of Section 657 and the WVDOH Standard Details Book Volume II, latest version in regard to support depth, use of breakaway devices as required, sign offset, and sign mounting height. Support size and quantity shall be sufficient to support the assembly when subjected to wind loading. Signs shall be attached to the supports in accordance with the Standard Details or shall otherwise be attached to the supports in a manner to remain secure during impacts. For larger assemblies, the maximum number of u-channel or back-to-back u-channel allowed for on the Standard Details may be increased. However, no more than three (3) u-channel or two (2) back-to-back u-channel may be installed within a seven (7) foot width. An approved breakaway device shall be used with u-channel when required on the Standard Details and in all cases with back-to-back u-channel. Breakaway devices shall be those approved by the Division for use with the specific brand of supports used. Provided the supports are driven to the depth specified in the Standard Details, the concrete foundation required for permanent back-to-back u-channel may be omitted if allowed for by the breakaway device manufacturer.

Variations to the requirements specified above such as number of supports within seven (7) feet, use of breakaway devices, and types of supports may be applied with the approval of the Engineer for assemblies, such as those shielded by barriers, agreed upon by the Engineer as not being subject to impacts. Requirements in the Standard Details for sign mounting height above the roadway shall be met.

Unless otherwise called for on the Plans or approved by the Engineer, signs shall be fabricated using 0.080-inch aluminum substrate, sheeting materials listed on the Division APL

for Retroreflective Sign Sheeting, and matched components recommended by the sheeting manufacturer. Aluminum composite material of a lighter weight than 0.080-inch aluminum and approved by the sheeting manufacturer may also be used. Manufacturing methods shall be those recommended by the sheeting manufacturer. All orange signs shall be fabricated using Type ASTM-XI sheeting. The sheeting used for all other signs shall be in accordance with Section 661.2.3. Substrate splicing utilized to fabricate signs from substrates smaller than the intended sign size shall only be allowed along edges of signs greater than five (5) feet in length, shall only be allowed once every five (5) feet, and shall be spliced in a manner to prevent separation during impacts. Signs shall be designed and fabricated in accordance with fabrication details provided in the Plans or the publication WVDOH Sign Fabrication Manual, as applicable.

The following static support mounted supplemental lead-in signs shall be provided and installed on projects meeting the requirements specified herein. The cost of furnishing, erecting, maintaining, and removal of these signs, including supports, shall be included in the units of Item 636011-\* to be paid for each sign as indicated herein. At no time shall these signs be installed closer than 500 ft. from any other work area signing. The Contractor shall install such signs during the initial mobilization phase of the project and shall promptly remove each sign at the completion of the project for which the sign was erected.

**636.9.1.1-Project Funding Source Signs:** Project funding source signs shall be installed if the Total Contact Bid Amount is \$750,000 or greater, or as otherwise noted on the plans. The quantity and locations of the signs shall be as directed by the Engineer. The Contractor shall be paid 180 units of Item 636011-\* for each assembly installed.

These signs shall be fabricated in accordance with fabrication detail D40-1 of the publication WVDOH Sign Fabrication Manual. The funding agencies and the dollar amounts involved will be furnished to the Contractor by the Engineer.

**636.9.1.2-Give 'Em A Brake Signs:** Give 'Em A Brake (GEAB) signs shall be installed if the project is on an Interstate Highway, an APD (Appalachian Highway Corridor), a controlled access highway with posted speed limit of 40 Miles Per Hour (MPH) or greater, or if otherwise noted on the plans. The Contractor shall be paid 300 units of Item 636011-\* for each assembly installed.

The signs shall be installed 500'-1500' after the first lead-in work area sign unless the work zone is greater than one (1) mile, in length, in which case the GEAB sign shall be installed approximately ¼ mile in advance of the active work area. The signs shall be installed in both directions on the right side of the highway.

GEAB signs shall only be installed in active work areas where workers are present and visible to passing motorists. During periods of inactivity in the work area, the GEAB signs shall be covered or removed.

These signs shall be fabricated in accordance with fabrication detail G30-1 of the publication WVDOH Sign Fabrication Manual.

**636.9.1.3-Fines Doubled Signs:** Fines Doubled signs shall be installed if the Total Contact Bid Amount is \$750,000 or greater, and the following criteria are met:

1. Four lane Interstate or expressway roadways with a posted speed limit of 55 MPH or greater

2. Two lane roadways with a posted speed limit of 50 MPH or greater and with an ADT at 3,000 or greater

These signs shall be fabricated in accordance with fabrication detail R20-2 of the publication WVDOH Sign Fabrication Manual. The Contractor shall be paid 300 units of Item 636011-\* for each assembly installed.

These signs shall be installed approximately 500 ft. after the first maintenance of traffic sign installed for each project. The signs shall be installed in both directions on the right side of the highway.

#### **636.12-TEMPORARY IMPACT ATTENUATING DEVICE:**

DELETE THE 2<sup>ND</sup> AND 3<sup>RD</sup> PARAGRAPHS, AND REPLACE WITH THE FOLLOWING:

~~Except as allowed for herein, devices utilized~~ Devices utilized shall be listed in the applicable Class category on the Agency Impact Attenuators – MASH Approved Products List (APL). The type of Impact Attenuator utilized shall be a Test Level 2 or 3, Class 1 or 3 Impact Attenuator as defined in and meeting the requirements of Section 715.41, and as specified in the Plans. If space permits, a Test Level 3 device may be utilized where a Test Level 2 device is specified. Test Level 2 devices shall not be utilized on roadways with normal posted speed limits greater than forty (40) MPH. Only Class 1 devices noted on the APL as being approved for temporary work zone use may be used. All approved Class 3 devices are for temporary or emergency use only. In cases where a Class 3 device is specified, the array shall be properly designed for the obstacle to be shielded and shall be winterized in accordance with the manufacturer recommendations. Class 3 device arrays shall be designed for a minimum of forty-five (45) MPH for Test Level 2 and a minimum of sixty-five (65) MPH for Test Level 3.

~~For projects let on or prior to December 31, 2021, devices not listed on the Impact Attenuators – MASH APL but listed on the Impact Attenuators – NCHRP APL and manufactured on or prior to December 31, 2018, may be utilized. Appropriate Test Level Type II, III, VIII, or IX devices on the NCHRP APL noted as being approved for temporary work zone use may be utilized as a Class 1 device. Type V devices on the NCHRP APL appropriately designed for the specified Test Level may be utilized as a Class 3 device.~~

#### **636.22-WARNING LIGHTS:**

DELETE THIS SUBSECTION AND REPLACE WITH THE FOLLOWING:

#### **636.22-WARNING LIGHTS:**

~~Warning lights shall consist of the furnishing, installation and maintenance of a portable, lens directed, enclosed light. The warning lights shall be in accordance with the requirements of 715.9.5 of the Standard Specifications.~~

#### **636.22-BLANK:**



**636.23-METHOD OF MEASUREMENT:**  
**636.23.6-Traffic Control Devices:**

REPLACE THE TRAFFIC CONTROL DEVICES RATE SCHEDULE TABLE WITH THE FOLLOWING:

<b>TRAFFIC CONTROL DEVICES RATE SCHEDULE</b>		
<b>Device #</b>	<b>Description</b>	<b>Value in Units Each Traffic Control Device</b>
1	Signs on portable mounts and barricades (Total sign area 16 sq. ft. (1.5 sq. meters) or greater)	170
2	Signs on portable mounts and barricades (Total sign area less than 16 sq. ft. (1.5 sq. meters))	80
3	Signs on permanent posts (Total sign area 16 sq. ft. (1.5 sq. meters) or greater)	180
4	Signs on permanent posts (Total sign area less than 16 sq. ft. (1.5 sq. meters))	90
5	Barricades-Type I	35
6	Barricades-Type II	60
7	Barricades-Type III	90
8	Drums	60
9	Cones	5
10	Vertical Panel or Ground Mounted Delineators	10
11	Barrier or Guardrail Mounted Delineators (Bid Incidental to Barrier or Guardrail)	0
12	Channelizer Cones	40
13	Oversize signs	300

- ~~1. Orange sign sheeting to be retroreflective fluorescent orange. WVDOH approved Type ASTM VI material shall be used for roll up signs. WVDOH approved Type ASTM IX or ASTM XI material shall be used for rigid signs on projects advertised prior to April 1, 2019. WVDOH approved Type ASTM XI material shall be used for rigid signs on projects advertised on or after April 1, 2019. All other signs shall be manufactured using WVDOH approved Type ASTM IV material unless fluorescent yellow or fluorescent yellow green material is specified, in which case WVDOH approved Type ASTM XI material shall be used.~~
- ~~2. Drum and Channelizer Cone sheeting to be six (6) inch WVDOH approved Type ASTM IV material.~~
- ~~3. Barricade and cone sheeting shall be WVDOH approved Type ASTM IV material.~~
- ~~4. Only those Drums, Channelizer Cones, Sheetings, Soil Anchored Flexible Delineator Posts, Surface Mounted Tubular Markers, Guardrail Mounted Flexible Delineators, and B-1 Delineators which have been field tested and approved by the Division will be permitted. A list of the approved suppliers and their code numbers may be obtained by contacting:~~

~~West Virginia Division of Highways  
Materials Division  
190 Dry Branch Dr.  
Charleston, WV 25306~~

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

SUPPLEMENTAL SPECIFICATION

FOR

SECTION 104  
SCOPE OF WORK

**104.13-FUNDING SOURCE IDENTIFICATION SIGNS:**

DELETE THE ENTIRE 104.13 SUBSECTION.

~~**104.13-FUNDING SOURCE IDENTIFICATION SIGNS:**~~

~~**104.13.1-General:** Funding Source Identification Signs shall be furnished by the Contractor if the Total Contract Bid Amount of the construction exceeds \$500,000 or otherwise noted on the plans, and shall be erected during mobilization of the project. The cost of furnishing, erecting, maintaining, and removal of these signs shall be incidental to the cost of construction of the project.~~

~~**104.13.2-Location:** Funding Source Identification Signs shall be located as directed by the Engineer. The Contractor shall promptly remove each sign at the completion of the project for which the sign was erected.~~

~~**104.13.3-Sign Content:** The content of each sign and the size of letters and the size of board shall be as required by the Engineer. The funding agencies and the dollar amounts involved will be furnished to the Contractor by the Engineer.~~

~~**104.13.4-Sign Construction:** The materials for Funding Source Identification Signs, such as for the sign panels, their supports, and for the legend and background, are to be of a type and method of fabrication that will be consistent with the conditions and estimated period of use. Signs shall have black letters for the legend on a white background. Reflective sheeting will be permitted, but not required. Mounting, transverse location, height, and similar features for Funding Source Identification Signs shall be consistent with practices used for the installation of other informational signs either on wooden or steel U-channel supports to comply with small sign support safety practices. The sign shall be mounted as directed by the Engineer.~~

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 715  
MISCELLANEOUS MATERIALS**

**715.9-WARNING DEVICES:**

**715.9.3-Channelizing Devices:**

DELETE THE THIRD PARAGRAPH AND REPLACE WITH THE FOLLOWING:

With the exception of Guardrail Mounted Delineator Posts and Type B-1 Delineators, all devices described above shall be crashworthy when assembled, installed, and utilized in accordance with the device manufacturer's instructions. Crashworthy ~~shall be defined as meeting the crash testing performance requirements of National Cooperative Highway Research Program Report 350 (NCHRP-350) Test Levels I, II, and III for projects let on or prior to December 31, 2019, and~~ shall be defined as meeting the crash testing performance requirements of the 2016 edition AASHTO Manual for Assessing Safety Hardware (MASH-2016) at Test Levels I, II, and III ~~for projects let after December 31, 2019. Devices which meet MASH-2016 and that have not been tested to NCHRP-350 may be used on projects with a letting date on or prior to December 31, 2019. Devices used for temporary traffic control applications that are manufactured on or prior to December 31, 2019 which meet NCHRP-350, but do not meet MASH-2016, may be used on projects with a letting date on or prior to December 31, 2022.~~

DELETE THE FIFTH PARAGRAPH WITH REPLACE WITH THE FOLLOWING:

The manufacturer shall be required to demonstrate the crashworthiness of a device as part of the submittal requesting consideration for including the device on the Division APL. Demonstration shall be by means of the manufacturer's ~~NCHRP-350 or~~ MASH-2016 self-certification letter for Drums, Channelizer Cones, Surface Mounted Flexible Tubular Markers, and Soil Anchored Flexible Delineator Posts. ~~Barricades eligible for use based on meeting NCHRP-350 shall be demonstrable to meet NCHRP-350 by means of a FHWA eligibility letter and are not required to be listed on the APL. Barricades required to meet MASH-2016 are required to be listed on the APL and~~ shall be demonstrable to meet MASH-2016 by means specified in official guidance issued by the WVDOH.

DELETE THE SIXTH PARAGRAPH.

~~The Contractor shall be required to demonstrate the crashworthiness of Cones to be utilized upon the Engineer's request. Demonstration shall be by means of the manufacturer's self-certification letter referencing the applicable crash testing standard.~~

#### **715.9.3.4-Barricades:**

DELETE BULLET v. AND REPLACE WITH THE FOLLOWING:

- v. ~~Type III Barricades shall incorporate horizontal skids for stability.~~  
Type III barricades shall be self-supporting and shall remain stable by incorporating a base design, such as horizontal skids or weighted components, in order to provide adequate wind resistance.

#### **715.9.3.5-Surface Mounted Flexible Tubular Markers:**

DELETE BULLET viii. AND REPLACE WITH THE FOLLOWING:

- viii. ~~Bases shall be colored black. In order to be approved for permanent applications, the bases shall be designed to allow mechanical fastening to the roadway using asphalt or concrete anchors. SMFTM's shall utilize bases designed to be mounted to the top surface of the roadway and shall be colored black.~~ Appropriate anchors for the intended substrate shall be supplied by the manufacturer for permanent applications. SMFTM's whose bases are recommended by the manufacturer for installation using only non-mechanical means such as mixed, melted, or preformed adhesive shall be considered for temporary use approval only.

#### **715.9.6-Portable Sign Stands:**

DELETE REQUIREMENTS ii, iii, AND iv AND REPLACE WITH THE FOLLOWING:

- ii. ~~Support legs shall have a retracted position for use on narrow shoulders and with smaller signs and an extended position for use on wider shoulders and with larger signs.~~ Stands shall be self-supporting and shall remain stable by incorporating a base design, such as an x-footprint leg design or weighted components, in order to provide adequate wind resistance.
- iii. ~~With the support legs deployed, the side to side footprint taken up by the stand shall not exceed sixty (60) inches with the legs in the extended position and shall not exceed thirty-six (36) inches with the legs in retracted position. When using thirty-six (36) inch diamond signs and forty-eight (48) inch diamond signs, the side to side footprint taken up by the stand base shall not exceed thirty-six (36) inches and sixty (60) inches, respectively.~~

- iv. ~~When using thirty six (36) inch diamond signs with the legs in the retracted position, and forty eight (48) inch diamond signs with the legs in the extended position, the stand shall remain in place, upright, and oriented correctly in wind gusts created by typical 55 MPH and 70 MPH speed limit traffic, respectively. Additional ballast in accordance with the specifications herein is permissible. The stand's mechanism of wind spilling shall not result in the sign being oriented such that the sign message is illegible to drivers for excessive durations. When using thirty-six (36) inch diamond signs and forty-eight (48) inch diamond signs, the stand shall remain in place, upright, and oriented correctly in wind gusts created by typical 55 MPH and 70 MPH speed limit traffic, respectively. The stand's mechanism of wind spilling shall not result in the sign being oriented such that the sign message is illegible to drivers for excessive durations.~~

DELETE THE SEVENTH PARAGRAPH AND REPLACE WITH THE FOLLOWING:

“Crashworthy” shall be defined as meeting the crash testing performance requirements of the 2016 edition AASHTO Manual for Assessing Safety Hardware (MASH) at Test Levels 1, 2, and 3 ~~for projects let after December 31, 2019. Stands manufactured on or prior to December 31, 2019 that do not meet MASH may be used on projects with a letting date on or prior to December 31, 2022, provided the stands meet the crash testing performance requirements of National Cooperative Highway Research Program Report 350 (NCHRP 350) Test Levels 1, 2, and 3.~~

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

SUPPLEMENTAL SPECIFICATION

FOR

SECTION 658  
OVERHEAD SIGN STRUCTURES

**658.5-ERECTION:**

**658.5.6-Structure Installation:**

**658.5.6.2-Installation Preparation:**

DELETE THE LAST SENTENCE OF THE FIRST PARAGRAPH AND REPLACE WITH THE FOLLOWING:

Galvanized structural connection bolts that have been fully pretensioned shall not be reused. If a new structure is to be placed on existing foundation(s) and connected to existing anchor bolts, all washers and nuts for the connection shall be replaced with new.

**658.5.6.3-Installation Procedure:**

DELETE THE ENTIRE CONTENTS AND REPLACE THE FOLLOWING:

**658.5.6.3-Installation Procedure:** The following steps shall be followed during the erection procedure:

1. Clean the anchor bolts with a wire brush or equivalent and lubricate the anchor bolts as described herein if this has not already been done.
- 2.3.4. If the structure is to be placed on existing foundation(s) and connected to existing anchor bolts, the Contractor shall verify that it is possible to turn a new properly lubricated nut onto each anchor bolt by hand below the elevation where the leveling nut will be initially placed. If this is not possible, the installation procedure shall be suspended and this issue shall be reported to the Engineer and in turn referred to the Traffic Engineering Division for further direction.
- 2.3. Place and level the foundation leveling nuts with washers on top. Initial placement of the leveling nuts shall be no more than ¼-inch above the top of the foundation.
- 3.4. Bring the support leg(s) into position for placement. Insure anchor bolts and the bolt holes in base plate are properly aligned. No cold working of the anchor

bolts shall be allowed. No cutting or reaming of holes will be allowed without prior approval from the Traffic Engineering Division.

- ~~4.5.~~ Place the support leg(s). The Contractor shall take due care to avoid damaging the anchor bolt threads during this process. If the structure has multiple support legs, one support leg shall be placed and fully tightened into place at a time.
- ~~5.6.~~ With the support leg as plumb as possible, adjust the leveling nuts as needed. The gap between the top of concrete and the bottom of each leveling nut shall not exceed the diameter of the anchor bolt after this process is completed.
- ~~6.7.~~ Place top washers and nuts. Snug tighten the top nuts, followed by the leveling nuts. Each set of nuts shall be snug tightened in a star pattern. Snug tightness is considered to be the tightness which exists due to the full effort of a man using a spud wrench with the appropriate length handle for the bolt being tightened. The handle length used for bolts ¾ inch to 1 ¼ inches in diameter shall be 23 inches. The handle length used for bolts 1 ½ inches to 2 ¼ inches in diameter shall be 36 inches. Fully tighten the anchor bolt top nuts in accordance with Materials Procedure (MP) 658.05.06. The tightening process shall be documented and transmitted to the Traffic Engineering Division in accordance with MP 658.05.06. When the snug tightening portion of MP 658.05.06 is completed, the Contractor shall verify that all nuts and washers were brought into firm contact with the base plate. Beveled washers may be necessary under the leveling or top nut if any face of the base plate has a slope greater than 1:20 and/or any nut could not be brought into firm contact. If it is determined that beveled washers are required, the support leg shall be disassembled from the anchor bolts and the erection procedure shall be restarted using the beveled washers. Beveled washers shall be manufactured of the same material as the base plate and shall be galvanized. Beveled washers shall be square with the length of each side being equal to or greater than the diameter of the normal washers. The minimum thickness of the beveled washers shall be the thickness of the normal washers
- ~~7.~~ Fully tighten the anchor bolts following the procedure described in Section 658.5.6.3.1.
8. Release any load by crane or other erection device. The anchor bolt nuts must be properly tightened before removal of the crane. If problems exist such as the anchor connections are loose after release, then repeat the nut tightening procedure.
9. Lift the structure arms or span into place. The Contractor shall be responsible for determining and selecting appropriate lift points in order to not overstress the structural components or attachments during lifting.
10. Once components that are attached using structural connection bolts are lifted into place and lubrication is applied to the hardware components as required, the bolts shall be snug tightened and then fully tightened immediately. The snug tightening procedure used shall be the same as described for the anchor bolts ~~above under item number 6~~ in MP 658.05.06. The procedure for fully tightening the bolts is described in Section ~~658.5.6.3.2~~ 658.5.6.3.1. Once span structures are lifted into place and proper alignment is verified, they shall be secured to the support legs by installing and tightening the u-bolts immediately.

11. Check structure. If problems exist, such as loose arm connections or showing gaps, the load must be removed from the area in question and steps repeated as necessary. If this requires loosening structural connection bolts that have already been fully tightened, the bolts shall be replaced.
12. If not installed prior to lifting the arms or chords into place (required for box truss spans), all signs to be attached to the structure arms or chords shall be installed immediately after the attachment hardware for the arms or chords are fully tightened.

~~—658.5.6.3.1 Anchor Bolt Tightening: After snug tightening has been accomplished, the following procedure shall be followed for fully tightening anchor bolts:~~

- ~~1. Verify that all nuts and washers were brought into firm contact with the base plate. Beveled washers may be necessary under the leveling or top nut if any face of the base plate has a slope greater than 1:20 and/or any nut could not be brought into firm contact. If it is determined that beveled washers are required, the support leg shall be disassembled from the anchor bolts and the erection procedure shall be restarted as described in Section 658.5.6.3 using the beveled washers. Beveled washers shall be manufactured of the same material as the base plate and shall be galvanized. Beveled washers shall be square with the length of each side being equal to or greater than the diameter of the normal washers. The minimum thickness of the beveled washers shall be the thickness of the normal washers.~~
- ~~2. Before tightening, at each bolt location the reference position of the top nut in the snug tight condition shall be marked with a suitable marking on one flat with a corresponding reference mark on the base plate.~~
- ~~3. Top nuts shall be turned in increments and in a star pattern over at least two full tightening cycles, meaning the rotation applied to each nut during each cycle shall be approximately half the amount described herein. Nut rotation shall be  $\frac{1}{3}$  of a turn for bolts 1  $\frac{1}{2}$  inches in diameter or less and shall be  $\frac{1}{6}$  of a turn for bolts greater than 1  $\frac{1}{2}$  inches in diameter. The amount of torque required to fully tighten each nut shall be recorded for use in steps 4 and 5. After tightening, the nut rotation shall be verified. The wrench used shall be a hydraulic torque wrench with sufficient capacity for the bolts to be tightened, and with the capability of loosening. Prior to tightening any fasteners, the Contractor shall provide the Engineer with a copy of calibration certificates for the hydraulic wrench. Separate calibration certificates are required for each wrench and for the gauge associated with each power pack to be used on the project. The date of the calibrations shall be one year or less prior to the advertising date of the Contract. The certificate provided shall be from a calibration lab that is International Organization for Standardization (ISO) 17025 accredited, with the certificate indicating as such. Both the certificate and wrench or gauge shall display matching serial numbers.~~
- ~~4. The same hydraulic torque wrench and power pack combination which was used to fully tighten the anchor bolts shall be used to verify that a torque at least equal to the torque value given by the following equation is required to additionally tighten the leveling nuts and the top nuts. If the required torque is~~



~~less, this should be interpreted to indicate that the threads have stripped and should be reported to the Traffic Engineering Division.~~

$$T_v = 0.12 (D_b) F_i$$

Where:

~~$T_v$  = verification torque (inch-kips)~~

~~$D_b$  = nominal body diameter of the anchor bolt (inches)~~

~~$F_i$  = 60% of the anchor bolt minimum tensile strength (kips)  
(= 45 ksi for ASTM F1554 Grade 55)~~

Multiply  $T_v$  by 83.3 to calculate  $T_v$  in ft-lbs

- ~~5. After at least 48 hours, the same hydraulic torque wrench and power pack combination which was used to fully tighten the anchor bolts shall be used to verify that a torque at least equal to 1.10  $T_v$  is required to additionally tighten the leveling nuts and the top nuts. If the required torque is less, this should be interpreted to indicate that the threads have stripped and should be reported to the Traffic Engineering Division.~~

~~658.5.6.3.2–658.5.6.3.1-Structural Connection Bolt Tightening:~~ After snug tightening has been accomplished, apply the appropriate rotation to the turning elements in the same sequence as snug tightening. Rotation shall be in accordance with Table 615.5.6.3 B. Full tightening of each bolt shall be accomplished in approximately 10- seconds using a hydraulic torque wrench meeting the requirements specified herein, or impact wrenches of adequate capacity.

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SPECIAL PROVISION**

**FOR**

**STATE PROJECT NUMBER:** \_\_\_\_\_

**FEDERAL PROJECT NUMBER:** \_\_\_\_\_

ADD THE FOLLOWING.

**SECTION 665  
WATER WELL SURVEY**

**665.1-DESCRIPTION:**

This work shall consist of a preconstruction water well survey as designated on the Plans.

**665.2-MATERIALS**

**665.2.1-Water Well Survey:** The water well survey is intended to document preconstruction conditions. The Contractor, or subcontractor, shall be a WVDEP certified monitoring well driller. At a minimum, the representative shall complete the WVDEP Inspector Check-Off List for Monitoring Wells. Any additional remarks relating to the casing, screen and well head are to be noted on the report.

In addition to providing a WVDEP Inspector Check-Off List for Monitoring Wells, the Contractor shall document the water quality of the existing well by collecting water samples and performing chemical and bacterial testing at a WVDEP approved laboratory. The chemical testing shall at a minimum, include sulfates, iron, chlorides, hardness, dissolved solids, conductivity, pH and turbidity. Bacterial testing is to include total coliform. The chemical and bacterial testing shall be conducted at a WVDEP approved laboratory, at no additional cost to the Division.

The Contractor shall provide a copy of the Inspector Check-Off List and testing reports to the Engineer. In addition, the Contractor shall provide copies of all reports to the well owner, if requested, and a copy of the transmittal letter providing these reports to the Engineer.

Unless otherwise noted, The Division will obtain right-of-entry. Contractor shall enter property with the aid of Law Enforcement.

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**665.3METHOD OF MEASUREMENT:**

The water well survey, field and laboratory work will be measured and paid for per each well surveyed and tested.

**665.4-BASIS OF PAYMENT:**

The quantities, determined as provided above, will be paid for at the contract unit price bid for the items listed below, which prices and payment shall be full compensation for furnishing all the materials and doing all the work prescribed in a workmanlike and acceptable manner, including all labor, tools, equipment, supplies and incidentals necessary to complete the work.

**665.5-PAY ITEMS:**

ITEM	DESCRIPTION	UNIT
665004-001	Water Well Survey	Each

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**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 663**

**PAVEMENT MARKINGS AND RUMBLE STRIPS**

**663.2-MATERIALS:**

DELETE THE LAST ITEM IN TABLE AND REPLACE WITH THE FOLLOWING:

MATERIAL	SUBSECTION
White or Yellow Fast-Dry Traffic Paint, Types <u>II and IX</u>	711.41

**663.5-APPLICATION:**

**663.5.2-Temporary and Permanent White or Yellow Traffic Zone Paint:**

DELETE THE FIRST SENTENCE OF PARAGRAPH EIGHT AND REPLACE WITH THE FOLLOWING:

Permanent Traffic Paint shall be Type II or Type IX, White or Yellow Fast-Dry Traffic Paint as ~~described in Materials sections 711.41, unless otherwise~~ specified in the Plans.

**663.5.2.2-Contractor’s Warranty:**

DELETE THE TITLE AND CONTENTS OF THE SUBSECTION AND REPLACE WITH THE FOLLOWING: NOTE: SUBSECTION IS NOT REDLINE COPY.

**663.5.2.2-Performance and Warranty Requirements:**

**663.5.2.2.1-Temporary White or Yellow Traffic Paint:** Temporary white or yellow traffic paint shall perform as and for the duration specified in Section 711.40. The performance of the markings in relation to the performance requirements shall be assessed and determined as specified in Section 711.40. Such markings determined by the Engineer to be in non-compliance with Section 711.40 shall be replaced within twenty (20) Calendar Days.

**663.5.2.2.2-White or Yellow Fast-Dry Traffic Paint, Types II and IX:** Except as specified herein, the Contractor shall warrant white or yellow fast-dry traffic paint, Types II and IX, to perform as and for the duration specified in Section 711.41. The performance of the markings in relation to the performance requirements shall be assessed and determined as specified in Section 711.41.

Type II or Type IX markings placed prior to April 15th, or on or after November 1<sup>st</sup>, shall be required to meet the performance requirements of Section 711.41 at the time of application only.

During the warranty periods, if any markings greater than 1000 feet are found to be deficient for any reason, the Contractor will be given notification stating the locations and the type of deficiency. These notifications will be given at any time within the specified warranty periods for the markings. The Contractor shall completely replace the deficient markings, as directed by the Engineer, within twenty (20) calendar days of the written notification. Retroreflectivity and color may be checked after re-application of the pavement marking to ensure that segment meets the performance requirements of Section 711.41.

If the Contractor does not complete the replacement of all of the deficient pavement markings by the end of the twenty (20) calendar day replacement period, and the Contract has not been finalized, the Contractor shall be subject to liquidated damages as described within Section 108.7 until replacement is completed. These liquidated damages shall not stop during the winter shut-down period. No direct payment shall be made for the replacement of any deficient pavement marking during the warranty period as such work shall be considered as incidental to the work as paid for by the various pavement marking items in the Contract.

**663.5.5-Type V Preformed Intersection Traffic Markings:**

**663.5.5.1-Contractor's Warranty:**

DELETE THE TITLE AND THE FIRST AND SECOND PARAGRAPHS AND REPLACE WITH THE FOLLOWING: NOTE: SUBSECTION IS NOT REDLINE COPY.

**663.5.5.1-Performance and Warranty Requirements:** If the material has been identified by the Division as having failed the skid resistance (when applicable), adherence, road presence, color, and/or retroreflectivity requirements described in Materials Section 715.40.2 before finalization of the Contract, the material shall be corrected by the Contractor in a manner acceptable to the Division and in accordance with the Manufacturer's recommendations at no additional cost to the Division if the failure is determined by the WVDOH to be caused by improper installation or defects in the manufacturer's materials. If the material has been identified as having failed after finalization of the Contract, but less than one (1) year from the date of application, the material shall be corrected by the Contractor in accordance with the requirements above if the failure is determined by the WVDOH to be caused by improper installation.

DELETE THE SECOND SENTENCE OF THE THIRD PARAGRAPH AND REPLACE WITH THE FOLLOWING:

In the event that the Contractor fails to meet this time requirement, and the Contract is not finalized, the Contractor shall be subject to liquidated damages will be charged for each Calendar Day in the amount of \$120 per day as described within Section 108.7 until replacement is completed.

**663.6-METHOD OF MEASUREMENT:**

DELETE THE SECOND SENTENCE OF THE FIRST PARAGRAPH AND REPLACE WITH THE FOLLOWING:

Length mMeasurement shall be based on the actual length footage or mileage of the line placed and shall exclude gaps. The individual lines of centerlines along two-way, two-lane roadways shall be individually measured.

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 711  
PAINTS, COATINGS, OILS, AND INKS**

**711.40-TEMPORARY WHITE OR YELLOW TRAFFIC ZONE PAINT:**

**711.40.1-Color and Retroreflectivity Requirements:**

UNDER “RETROREFLECTIVITY” DELETE THE SECOND SENTENCE OF THE SECOND PARAGRAPH AND REPLACE THE FOLLOWING:

Readings shall be taken with a Delta Light and Optics LTL-X or later Delta model handheld reflectometer.

**711.40.2-MAP-21 Section 1504 Requirements:**

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

**711.40.2-Reflective Element Arsenic and Lead:** Any reflective elements containing glass used in the markings shall contain no more than 200 parts per million of arsenic or lead, as determined in accordance with Environmental Protection Agency testing methods 3052, 6010B, or 6010C.

Prior to application of the markings, the Contractor shall provide certifications of compliance for all glass containing reflective elements to be used. These certifications shall be from each element supplier and shall identify the reflective element products being supplied by product name or number. Each supplier’s certification shall be accompanied by certification from an independent testing laboratory. The lab certification shall certify that a representative sample of the supplier’s products has been tested, and that the products meet the requirements previously specified. The lab certification shall provide clear indication that the products tested include the products specified by the suppliers in their certification letters and shall indicate the dates that the testing was performed. The date of testing for each product shall be one (1) year or less prior to the letting date of the Contract. The representative samples tested are not required to be from the same batch or lot number assigned to the beads used on the project.

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**711.41-WHITE OR YELLOW FAST-DRY TRAFFIC PAINT (TYPE II):**

DELETE THE TITLE AND REPLACE WITH THE FOLLOWING:

**711.41-WHITE OR YELLOW FAST-DRY TRAFFIC PAINT (TYPES II AND IX):**

**711.41.1-General:**

DELETER THE FIRST SENTENCE OF THE FIRST PARAGRAPH AND REPLACE WITH THE FOLLOWING:

Type II and Type IX pavement marking materials shall be capable of providing one year and two years of continuous performance, respectively.

DELETE THE SECOND SENTENCE OF THE SIXTH PARAGRAPH AND REPLACE WITH THE FOLLOWING:

Section 663 specifies that the Contractor shall be required to apply an appropriate Type II or Type IX material at ambient air temperatures as low as thirty-five (35) degrees Fahrenheit.

DELETE THE FIRST SENTENCE OF THE SEVENTH PARAGRAPH AND REPLACE WITH THE FOLLOWING:

The warranty and performance criteria of this specification shall apply to Type II and Type IX markings placed on or after April 15th and prior to November 1st.

**711.41.2-Color and Retroreflectivity Requirements:**

ADD THE FOLLOWING AFTER THE FIRST PARAGRAPH:

In addition to testing with handheld equipment as described herein, markings are also subject to mobile testing by the Division using equipment that has been evaluated and determined to be acceptable for such use by the Division. A 15% tolerance with the stated minimum required retroreflectivity values herein shall be allowed when tested with mobile equipment.

DELETE THE SECOND SENTENCE OF THE THIRD PARAGRAPH IN THE “COLOR SECTION” AND REPLACE WITH THE FOLLOWING:

The colorimeter utilized by the Engineer shall be a make and model determined to be acceptable by the Division. Colorimeters utilized by the Contractor for verification shall be subject to approval by the Division, shall be properly field calibrated at the time of use, and shall have been properly lab calibrated one year or less prior to the date of use. Delta Light and Optics LTL-Y or later Delta models shall be considered approved by the Division.



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DELETE THE “RETROREFLECTIVITY SECTION” AND REPLACE WITH THE FOLLOWING:

**RETROREFLECTIVITY:** Markings installed on or after April 15th and prior to November 1<sup>st</sup> shall be subject to the following minimum retroreflectivity requirements for the duration specified:

<b>Material</b>	<b>White Retroreflectivity</b>	<b>Yellow Retroreflectivity</b>	<b>Duration</b>
Type II	200 mcd/lx/m <sup>2</sup>	150 mcd/lx/m <sup>2</sup>	Through October 31st of the same year as application
Type IX	Need Values	Need Values	Through October 31st of the year following application

<u>Material</u>	<u>White Retroreflectivity</u>	<u>Yellow Retroreflectivity</u>	<u>Duration</u>
Type II	200 mcd/lx/m <sup>2</sup>	150 mcd/lx/m <sup>2</sup>	Through October 31st of the same Calendar Year as application for all Contracts
Type IX	300 mcd/lx/m <sup>2</sup>	225 mcd/lx/m <sup>2</sup>	For seventy-five (75) Calendar Days after placement for all Contracts
Type IX	190 mcd/lx/m <sup>2</sup>	160 mcd/lx/m <sup>2</sup>	Through October 31 <sup>st</sup> of the Calendar Year following the Calendar Year of application for statewide Interstate and expressway restriping Contracts  For one year following application for all other Contracts.

Thirty Meter (30-meter) geometry retroreflectivity measurement equipment shall be used to verify marking retroreflectivity levels. The retroreflectometer utilized by the Engineer shall be a make and model determined to be acceptable by the Division. Retroreflectometers utilized by the Contractor for verification shall be subject to approval by the Division, shall be properly field calibrated at the time of use, and shall have been properly lab calibrated one year or less prior to the date of use. Delta Light and Optics LTL-X or later Delta models shall be considered approved by the Division.

**711.41.3-Sampling and Testing Procedures for Performance Samples:**

DELETE THE FIRST PARAGRAPH AND REPLACE WITH THE FOLLOWING:

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In addition to mobile equipment testing, the Division may utilize the following sampling method using handheld equipment in order to determine the conformance of the markings with the requirements herein:

**711.41.4-MAP-21 Section 1504 Requirements:**

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

**711.41.4-Reflective Element Arsenic and Lead:** Any reflective elements containing glass used in the markings shall contain no more than 200 parts per million of arsenic or lead, as determined in accordance with Environmental Protection Agency testing methods 3052, 6010B, or 6010C.

Prior to application of the markings, the Contractor shall provide certifications of compliance for all glass containing reflective elements to be used. These certifications shall be from each element supplier and shall identify the reflective element products being supplied by product name or number. Each supplier's certification shall be accompanied by certification from an independent testing laboratory. The lab certification shall certify that a representative sample of the supplier's products has been tested, and that the products meet the requirements previously specified. The lab certification shall provide clear indication that the products tested include the products specified by the suppliers in their certification letters and shall indicate the dates that the testing was performed. The date of testing for each product shall be one (1) year or less prior to the letting date of the Contract. The representative samples tested are not required to be from the same batch or lot number assigned to the beads used on the project.

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 715  
MISCELLANEOUS MATERIALS**

**715.40-PAVEMENT MARKING MATERIAL:**

**715.40.2-Preformed Intersection Traffic Markings (Type V Material):**

**715.40.2.2-Adherence, Retroreflectivity, Color, Road Presence, and Skid Resistance Warranty Requirements:**

UNDER “RETROREFLECTIVITY SECTION”, DELETE THE FIRST AND SECOND SENTENCES OF THE SECOND PARAGRAPH AND REPLACE WITH THE FOLLOWING:

Retroreflectivity readings shall be taken with a Delta Light and Optics LTL-X or later Delta model handheld reflectometer.

UNDER THE “COLOR SECTION”, DELETE THE FIRST SENTENCE OF THE SECOND PARAGRAPH AND REPLACE WITH THE FOLLOWING:

The colormeter used shall be a Delta Light and Optics LTL-Y or later Delta model.

**715.40.3-Interim Pavement Markings (Type VIIA Interim Pavement Marking Tape):**

DELETE THE CONTENTS OF THIS SECTION AND REPLACE WITH THE FOLLOWING:

This specification describes an interim pavement marking tape, to be placed immediately after paving operations are completed, and prior to the opening of the roadway to traffic, as described in Section 663.5. The material shall be designed to be inlaid and used in place of centerlines and lane lines until temporary edge lines, centerlines, and lane lines are placed as described in Section 636.8, within the time period specified in Section 663.5.

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**715.40.3.1.1-Requirements:**

UNDER PARAGRAPH “ii. Color” AFTER THE TABLE, DELETE THE SECOND SENTENCE AND REPLACE WITH THE FOLLOWING:

The colormeter used shall be a Delta Light and Optics LTL-Y or later Delta model.

**715.40.4-Temporary Pavement Marking Tape (Types VIIB and VIIC):**

**715.40.4.2-Temporary Pavement Markings (Type VIIB):**

**715.40.4.2.1-Requirements:**

UNDER PARAGRAPH “ii. COLOR” AFTER THE TABLE, DELETE THE PARAGRAPH AND REPLACE WITH THE WITH THE FOLLOWING:

The colormeter used shall be a Delta Light and Optics LTL-Y or later Delta model.

UNDER PARAGRAPH “vii. RETROREFLECTIVITY” DELETE THE SECOND SENTENCE AND REPLACE WITH THE FOLLOWING:

Retroreflectivity readings shall be taken with a Delta Light and Optics LTL-X or later Delta model handheld reflectometer.

**715.40.4.3-Temporary Pavement Markings (Type VIIC):**

**715.40.4.3.1-Requirements:**

UNDER THE PARAGRAPH “ii. COLOR” DELETE THE FIRST SENTENCE OF THE SECOND PARAGRAPH AND REPLACE WITH THE FOLLOWING:

The colormeter used shall be a Delta Light and Optics LTL-Y or later Delta model.

UNDER THE PARAGRAPH “x. RETROREFLECTIVITY” DELETE THE FORTH SENTENCE AND REPLACE WITH THE FOLLOWING:

Retroreflectivity readings shall be taken with a Delta Light and Optics LTL-X or later Delta model handheld reflectometer.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

SUPPLEMENTAL SPECIFICATION

FOR

SECTION 704

STONE AND CRUSHED AGGREGATE

**704.4-DUMPED ROCK GUTTER:**

DELETE THE FIRST PARAGRAPH AND REPLACE WITH THE FOLLOWING:

The material for dumped rock gutter shall be rock that is not classified as shale or shale-like. This rock shall not be combined with containing a combined total of not more than 15 percent of any other suitable material, as determined by visual inspection. Other inorganic material not classified as shale or shale-like may be deemed suitable for use. This material shall be deemed suitable by visual inspection and approved by the Engineer before installation.

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 709**

**METALS**

**709.1-STEEL BARS FOR CONCRETE REINFORCEMENT:**

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

All plain and deformed bar reinforcement, ~~whether deformed or plain,~~ shall meet the requirements of AASHTO M31 ~~or AASHTO MP18 and be NTPEP certified where applicable.~~ The manufacturer shall also be an active member in the National Transportation Product Evaluation Program (NTPEP) as well as conform to the requirements of MP 709.01.55. ~~All reinforcement for use in structures shall be labeled to correspond with marks on the plans before being shipped to the job site.~~

~~When reinforcing steel material is furnished by a supplier who is not certified under provisions of MP 709.01.50, with either epoxy coated or plain bar, the supplier shall at their expense be required to have each heat or lot of material to be furnished to the Division sampled by a Division approved inspection agency in accordance with MP 700.00.01 and shall have the samples tested for compliance with the governing specification by a Division approved laboratory. The test and inspection information shall be furnished in the Division approved computer acceptable format.~~

~~Epoxy coated reinforcing steel shall meet the requirements of ASTM A775, except that Section 12.1 of ASTM A775 shall be deleted and replaced with the following. The Contractor shall repair any damage to epoxy coating of reinforcing steel that occurs during shipment, storage and installation of the steel. The sum of all damage areas in each one foot (300 mm) length of bar shall not exceed two percent of the bar area. The total bar surface area covered by patching material shall not exceed five percent. All field handling and patching requirements shall conform to ASTM D3963.~~

ADD THE FOLLOWING SUBSECTIONS:

**709.1.3-Galvanized Coated Bars for Concrete Reinforcement:** For galvanized coated reinforcing steel, the uncoated material shall conform to Section 709.1, ~~and the~~ The galvanized coating shall ~~meet conform to the requirements of~~ ASTM A767 for the immersion

process or ASTM A1094 for the continuous hot dip galvanizing process, unless otherwise specified in the Contract Documents. All field handling and repair requirements shall conform to ASTM A767 or ASTM A1094 as applicable.

**709.1.4-Epoxy Coated Reinforcing Steel:** Shall meet the requirements of Section 709.1, MP 709.01.51, and ASTM A775, except that Section 12.1 of ASTM A775 shall be deleted and replaced with the following. The Contractor shall repair any damage to epoxy coating of reinforcing steel that occurs during shipment, storage and installation of the steel. The total damaged surface area (prior to repair with patching material), shall not exceed 2 % in any given 1-foot section of coated reinforcement. The total bar surface area covered by patching material shall not exceed 5-% in any given 1-foot section of coated reinforcement. This limit on damaged and repaired area shall not include sheared or cut ends. All field handling and patching requirements shall conform to ASTM D3963.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

SUPPLEMENTAL SPECIFICATION

FOR

SECTION 715  
MISCELLANEOUS MATERIALS

**715.14-ELASTOMERIC BEARING PADS:**

Bearing pads shall meet the requirements of the AASHTO Standard Specifications for Highway Bridges, except for sampling frequency.

**715.14.1-Sampling Frequency for Elastomeric Bearing Pads:** The sampling rate shall be one bearing pad per lot, per nominal dimensional size. (A change in nominal dimensional size is any change in the designed length, width or height of the bearing pad.)

ADD THE FOLLOWING SUBSECTION:

**715.14.2-Approval for Bearing Pads Without Shims:** Beginning January 1, 2024 bearing pads that do not include shims or internal stiffeners will only be accepted using NTPEP test results and a certificate of compliance from NTPEP.

Prior to January 1, 2024 the WVDOH will accept NTPEP test results and a certificate of compliance from NTPEP for approval of bearing pads without shims or internal stiffeners, or a company without NTPEP test results and a certificate of compliance from NTPEP can still submit bearing pads for acceptance testing using 715.14 and 715.14.1 until December 31, 2023.



**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SPECIAL PROVISION**

**FOR**

**STATE PROJECT NUMBER:** \_\_\_\_\_

**FEDERAL PROJECT NUMBER:** \_\_\_\_\_

ADD THE FOLLOWING SECTION:

**SECTION 221  
ROCKFALL MITIGATION**

**221.1-DESCRIPTION:**

This work shall consist of constructing various rockfall mitigation devices in accordance with these Specifications and in reasonably close conformity to the lines, grades, dimensions, and locations shown on the Plans or established by the Engineer.

The types of rockfall mitigation are as follows:

1. Rock Slope Scaling
2. Pinned Wire Mesh
3. Slope Drape
4. Rockfall Attenuator Barrier
5. Attenuator Barrier Drape
6. Rockfall Barrier
7. Localized Rock Bolting

**221.2-MATERIALS:**

The Contractor shall furnish materials that are new and without defects; all defective materials shall be removed from the job site at no additional cost to the Department.

Materials shall be stored to assure their preservation of their quality and work. Stored materials, even though approved before storage, may again be inspected prior to their use in the work.

**221.3-SUBMITTALS:**

The Contractor shall deliver all submittals required by this specification to the Engineer no later than thirty (30) calendar days prior to constructing any rock mitigation device. No rock mitigation device shall be performed prior to the Engineer's review and acceptance of all submittals.

**221.3.1-Qualifications and Experience:** The Contractor shall submit a project reference list verifying the successful completion of at least three (3) rockfall mitigation projects during the last three (3) years, for which the Contractor, or Contractor's key personnel who will be on-site, have installed rockfall mitigation devices like those shown in the plans, similar quantities, and under similar subsurface conditions. These projects shall include the use of high-angle industrial rope or platform access. A brief description of each project with the owner's representatives name and current contact information who can verify the participation in those projects shall be included.

A West Virginia Registered Professional Engineer employed by the Contractor shall supervise the work and have experience in rockfall mitigation devices construction on at least three (3) completed projects over the past three (3) years. The on-site supervisor, technicians, and equipment operators shall have experience in rockfall barriers on at least three (3) projects over the past three (3) years, including projects requiring use of high-angle industrial rope and platform access. The Contractor shall not use consultants or manufacturer's representatives to satisfy the requirements of this section.

**221.3.2-Work Plan:** The Contractor shall submit a work plan including the following information:

- (a) Method of Operation.
- (b) Proposed construction sequence and schedule.
- (c) Type and quantity of equipment and tools to be utilized in the work.
- (d) Number crews required and estimated number of hours for each operation.
- (e) Removal and disposal plan for materials.
- (f) Type of shielding system designed to protect personnel, equipment and adjacent facilities from injury or damage that may be caused by activities. The system shall be designed with sufficient height and structural integrity to withstand the impacts and to prevent loose rock and debris from leaving the roadway and impacting adjacent property.

**221.3.3-Construction Preconstruction Meetings:** The Contractor and Engineer shall meet before beginning any rockfall mitigation item to clarify construction requirements, coordinate schedules and activities, and identify responsibilities of the Contractor and the Subcontractors. The Subcontractor shall attend the meeting if performing any work.

#### **218.4-ROCK SLOPE SCALING:**

This Work shall consist of scaling rock slopes by manual or machine scaling methods requiring high-angle industrial rope access/platform, or by mechanical percussion as specified herein. The work shall be performed at locations specified on the Plans, to the specified degree, and proper disposal of scaled material(s). The work includes removal and disposing of vegetation (including trees and brush) and excavation of soil or weathered rock, when required.

The work shall include removing and disposal of loose and/or potentially unstable rock from the rock slope, rock resting on any soil slope above the rock face, and existing rockfall material in roadway ditches and slope catchment areas by hand and/or hand tools, and mechanical methods such as metal bars or light equipment such as hydraulic splitters used to scrape the slope face.

The work includes removing overhangs of loose and/or potentially unstable rock from the rock slope, rock boulders resting on any soil slope above the rock face and other potentially

dangerous conditions; which may require additional equipment such as air bags or pneumatic jacks in order to removal the material.

Prior to start of any scaling activities, the Contractor and Engineer shall jointly inspect the site to observe and document the pre-construction condition of the site, existing structures and facilities. During construction, the Contractor shall observe the conditions in the vicinity of the rock slope areas daily for signs of ground movement in the vicinity of the scaling operation(s). The Contractor shall immediately notify the Department if signs of movement, such as: new cracks in structures, increased size of old cracks or separation of joints in structures, foundations, streets or paved and unpaved surfaces are observed. If the Department determines that the movements exceed those anticipated for typical rock slope scaling and require corrective actions, the Contractor shall take corrective actions necessary to stop the movement and perform repairs. When due to the Contractor's methods or operations, or failure to follow the specified/approved construction sequence, as determined by the Department, the cost of providing corrective actions shall be borne by the Contractor.

Scaling of loose or potentially unstable rock shall be accomplished by manual or mechanical scaling methods and may include mechanical percussion equipment. The rock slope locations delineated on the Plans shall be thoroughly scaled and trimmed to the satisfaction to assure that the desired rock face is obtained. No loose or potentially unstable rock shall be left on the rock face or the soil slope above the rock face. No vegetation shall be left on the rock face. No overhangs or launching pads shall be left on the rock face. Care shall be taken to minimize damage to the surface of any roadways, utilities, guiderail, drainage structures, signs, or other facilities by equipment or falling rock.

Rock slope scaling shall be completed prior to any slope stabilization such as rock bolting, installation of rockfall barriers or rockfall drapes, or other protection systems.

The rock scaling work shall be performed as follows, unless otherwise noted in approved work plan:

1. Begin rock slope scaling at the top of the slope and proceed downward toward the roadway, removing all loose rock blocks as the work progresses.
2. Remove the loose rocks and boulders, large blocks of rock protruding out of the slope and overhangs to create a uniform surface for placement of the wire mesh as directed by the Engineer. Prepare a finished rock slope surface that is suitable for placing the wire mesh system by using hand tools, small pneumatic and hydraulic tools, mechanical methods, chemical methods (non-explosive demolition agent), or other approved methods.
3. Do not excavate material that will disturb the intact rock comprising the toe of slope.
4. Do not remove pieces of rock that will result in undercutting of overlaying material.
5. Repair excessive undercutting or over hanging rock as shown and as directed by the Contractor's rockfall engineer.
6. Remove stumps as directed by the Engineer during scaling.
7. Provide telecommunication inspection equipment to allow the Engineer to adequately analyze the slope conditions. The Engineer will evaluate the final rock face for stability prior to accepting the completed work. Perform scaling only in the presence of the Engineer.
8. Prevent damage to the adjacent roadway and related items and repair or replace any damaged pavement, guiderail, or other roadway appurtenances at the Contractor's expense.

9. Blasting is prohibited.
10. Construction

### **221.5-PINNED WIRE MESH:**

This work is for furnishing and installing pinned wire mesh. The Contractor shall furnish all labor, materials, equipment and incidentals required for completing the work. The Contractor shall select the method and equipment to meet the performance requirements specified herein.

**221.5.1-Materials:** Materials shall meet the following corrosion protection requirements:

Mesh, Ropes, and Hardware. Facing hardware to include high-tensile steel wire mesh facing, hex nuts, spike plates, boundary ropes, wire rope anchors, and compression claws. Galvanize in accordance with manufacturer specifications. Materials shall be powder coated to match US Government Standard Color 595C 26255.

Anchors. Epoxy Coating meeting requirements of AASHTO M284/ASTM A775. Minimum 12 Mils electrostatically applied. Bend test requirements are waived.

High tensile steel wire mesh reinforcement system with a minimum of 150 kN/m tensile strength to be designed by Contractor utilizing steel wire mesh facing, spike plates, boundary ropes, wire rope anchors, compression claws and other facing hardware meeting the following minimum requirements:

1. Spike Plates. Diamond-shaped:
  - Length (minimum): 350 mm (13.77")
  - Width (minimum): 170 mm (6.69")
  - Thickness (minimum): 10 mm (0.39")
2. Boundary Ropes.
  - Heavy Type: Rope, steel wire:
    - Diameter = 12 mm (0.47") minimum
    - Breaking Force: ZR = 84 kN (9.44 tons) minimum
3. Wire Rope Anchors: Galvanized 2-stranded with double steel tube in loop section.
  - Diameter = 19 mm (0.75") minimum
  - Breaking Force: ZR = 235 kN (26.46 tons) minimum
4. Seam Rope for Wire Mesh Overlaps: Galvanized wire.
  - Diameter = 8 mm (0.3125") minimum
  - Breaking Force = 41 kN (4.6 tons) minimum

### **221.5.2-Work Plan - Wire Mesh, Rock Anchor Bolts, and Wire Rope Anchors:**

Installation of the wire mesh, rock anchor bolts and wire rope anchors shall be included on Work Plan, as noted in 221.3.2. Include the following minimum information for the plan:

- (a) General installation procedures including, but not limited to, inspection reports and survey plan.
- (b) Description and purpose of essential equipment to be used including catalog cuts, brochures and other literature describing the equipment to be used for drilling, grouting, handling, and installing wire mesh, rock anchor bolts and wire rope anchors.

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- (c) Procedures and sequences for wire mesh and wire rope anchor installation including any grout mix design.
- (d) Procedures for wire rope anchor stressing and testing procedures detailing lengths, forces and elongation including test reports.

**221.5.3-Installation.** Install mesh at the locations identified on the drawings or as directed by the Engineer. Fasten ends of mesh with wire rope anchors in accordance with the Contractor’s design. Install the Pinned Wire Mesh in vertical strips to the limits as shown on the Contract drawings or as directed by the Engineer. Install all wire mesh in accordance with the slope treatment details and as directed by the Engineer. Install all fasteners, connectors, ropes and associated hardware in accordance with the manufacturer’s recommendations.

Configuration and load testing of wire rope anchors to support the ends of the wire mesh will be in accordance with the Contractor’s design.

Anchor the bottom of the wire mesh to prevent accumulated rockfall from impacting traffic barrier.

**221.5.4-Wire Rope Anchor Testing:** Perform proof testing on a minimum of five (5) percent of wire rope anchors at each cut location as selected by the Contractor and approved by the Engineer.

**221.6-SLOPE DRAPE:**

This work consists of furnishing and constructing a slope drape, consisting of a wire mesh either with or without a cable net, draped over a rock slope to restrain and control falling rocks. The slope drape is suspended from anchors and wire ropes along the crest of a slope.

The Contractor shall select the drilling method and equipment; drilled hole diameters, spacings and depths; and anchor type and grouting procedures to obtain the required results. The Contractor shall furnish all labor, materials, equipment, and incidentals required for completing the work.

**221.6.1-Materials:** Materials shall conform to the following requirements:

Steel components, including anchors and clamps	ASTM A36
Bolts, Nuts, and Washers	ASTM F3125, Grade A325

Furnish wire rope, cable net, if required, and support ropes that are galvanized in conformance with Federal Specification RR-W-410F. For all other steel components that are not manufactured from zinc-coated wire, galvanize according to ASTM B 695, Class 50.

Furnish materials shall be labeled by the manufacturer so that they can be identified on the manufacturer’s working drawings.

Wire Mesh. Furnish a double-twist, 8 × 10 hexagonal type wire mesh that is manufactured from either zinc-coated steel wire conforming to ASTM A641, Class 3 coating, soft temper, or from Zn-5Al-MM-coated steel wire conforming to ASTM A856, Class 3 coating, soft temper. Mesh openings for 8 × 10 type are nominally 3.25 in × 4.5 in (83 mm × 114 mm). Use a wire with a minimum nominal diameter of 0.120 inch (US Steel Wire Gage No. 11, 3.05 mm) and a minimum tensile strength of 60,000 pounds per square inch (414 MPa), as tested according to ASTM A370, to manufacture the mesh. Include the zinc when calculating the tensile area. Furnish locking clips, lacing wire, and fasteners (hog rings) conforming to the above

requirements except the minimum nominal diameter is 0.148 inch (US Steel Wire Gage No. 9, 3.80 mm).

Cable Net. Furnish cable net consisting of individual square cable net panels joined along their edges. Furnish cable net panels composed of woven wire ropes with a maximum opening size of 12 in  $\times$  12 in (305 mm  $\times$  305 mm). Securely fasten wire ropes where they cross using a clip strong enough to resist slipping or breaking when subject to the loads generated by the design conditions.

Use a galvanized wire rope with a minimum diameter of 5/16 inch (7.9 mm) and a minimum breaking strength of 9,000 pounds (40 kN) to manufacture the cable net. Use the same wire rope to lace the cable net panels together.

Top Horizontal Support Wire Rope. The top of the slope drape is secured to a top horizontal support wire rope. For the wire rope used to support wire mesh, furnish a galvanized wire rope with a minimum diameter of 0.5 inch (12.7 mm), and a minimum breaking strength of 25,000 pounds (111 kN). For the wire rope used to support cable net, furnish a galvanized wire rope with a minimum diameter of 0.75 inch (19 mm), and a minimum breaking strength of 50,000 pounds (222 kN). Furnish additional wire rope meeting these requirements to use as tag lines to connect the perimeter rope to the anchors.

Anchors. Furnish either steel bolt or wire rope anchor types. For steel bolt anchors, furnish a 1-inch (25 mm) diameter, galvanized, continuously threaded or deformed steel bar conforming to ASTM A615, Grade 75, with a minimum ultimate strength of 79,000 lbs (351.4 kN). For wire rope anchors, furnish a galvanized 0.75 inch (19 mm) wire rope with a minimum breaking strength of 50,000 pounds (222 kN). Furnish centralizers fabricated from Schedule 40 PVC plastic pipe or tube, steel or other material not detrimental to the anchor. Do not use wood.

For rock anchors furnish grout consisting of a neat cement or sand/cement mixture. Furnish Type I, Type II, Type III, or Type IV cement conforming to ASTM C150 for the grout. Expansive admixtures may be used. Admixtures which control bleed or retard set may be used if approved by the Engineer. Furnish grout with a minimum 3-day compressive strength of 1500 psi (10.5 MPa) and a minimum 28-day compressive strength of 3000 psi (21 MPa) per AASHTO T106/ASTM C109.

If using a steel bolt anchor, furnish a 0.375 inch (9.5 mm) thick, galvanized, 6-inch square or round mild steel bearing plate. The plate must have a rounded edge on the side in contact with mesh wire and/or anchor cable. Furnish a galvanized flat washer and hex nut torqued to 100 ft- lbs. Furnish wire rope clips compatible with the cable sizes shown in the plans, with drop forged carbon steel bases and heavy-duty hexagonal type nuts. Use thimbles and wire rope clips in accordance with the manufacturer's recommendations for size, number, spacing and torque.

**221.6.1-Work Plan, Slope Drape:** Installation of the slope drape shall be included on Work Plan, as noted in 221.3.2. Include the following minimum information for the plan:

1. Complete working drawings and engineering calculations, prepared, signed, sealed and dated by a Professional Engineer registered in the State of West Virginia.
2. Proposed construction sequence and schedule.
3. Proposed anchor drilling methods and equipment, including drill hole diameter and length proposed to achieve the required pullout resistance.
4. One sample of the proposed type of wire mesh and cable net, ground anchor, and hardware (bearing nuts and plates) from the normal stock of the supplier. With the

samples, include certified mill reports indicating tensile yield point and elongation results of the ground anchors, and the tensile and punching tests of the cable net and wire mesh.

5. Submit the grout design and include the following:
  - a. Manufacturer's certified test results of set time, shelf life, and compressive strength.
  - b. Type of Portland cement.
  - c. Aggregate source and gradation.
  - d. Proportions of mix by weight and water-cement ratio.
  - e. Manufacturer, brand name and technical literature for proposed admixtures.
  - f. Results of compressive strength tests performed according to AASHTO T106/ASTM C109 and completed no more than one year before the start of grouting. Use an AASHTO accredited independent testing lab to verify the specified minimum 3 and 28-day grout compressive strengths.
6. Proposed anchor grout placement procedures and equipment.
7. Proposed anchor testing methods and equipment setup.
8. Identification number and certified calibration records for each test jack, pressure gauge and load cell to be used.
9. The manufacturer's recommended maintenance program for the slope drape.

#### **221.6.1-Installation:**

**211.6.1.1-Anchors.** Design the anchor type, dimensions, and spacing to support the loads determined from the slope drape design. Do not exceed a primary anchor spacing of 100 feet and 12 feet for intermediate anchor spacing for slope drape. Determine the anchor length to meet the requirements of the pullout test. Do not use an anchor length less than 10 feet. Ground conditions may require anchors that are longer than the minimum length. Where the lengths of the anchors vary, the Engineer will permit the use of threaded couplers to extend the anchor tendon, or other methods recommended by the manufacturer.

Do not use water during drilling. Provide a uniform hole diameter for the entire length of the hole unless otherwise approved by the Engineer. The minimum hole diameter is shown on the plans. Drill holes within five degrees of the orientations and inclinations shown on the plans. Clean the hole before installing the anchor.

Place at least two centralizers on each anchor to position the tendon within 1 inch of the center of the hole. Place the centralizers within 2 feet of the top and bottom of the hole. Securely attach the centralizers to the anchor tendon.

Test at least five (5) percent of the anchors and at least one (1) anchor of each type of anchor, soil, and rock. The Engineer will select the location of each test anchor. Perform each test in the presence of the Engineer. Each pullout test consists of incrementally loading the anchor assembly to the maximum test load or to failure, whichever occurs first. Failure is defined as when the movement of the anchor continues without an increase in the load or when the anchor has displaced 2 inches. If more than 20 percent of the tested anchors fail, increase the number of tested anchors to 50 percent of the total. Replace all failed anchors and retest them at no additional cost to the Department.

Apply the test load by jacking against a temporary yoke or load frame. No part of the yoke or load frame may bear within 3 feet of the anchor. Measure the applied test load using either a calibrated pressure gage with graduations no greater than 100 psi or a calibrated load cell. Calibrate the pressure gage and the hydraulic jack as a unit and provide

the certified calibration chart. Calibrate against a test machine whose calibration is traceable to the National Institute of Standards and Technology (NIST). Ensure the calibration is done to an accuracy of 2 percent and at least one year before shipment to the project. Measure movement of the anchor using dial gages that have an accuracy of 0.001 inch. Measure movement relative to a fixed reference point that is at least 3 feet from the anchor and yoke or load frame. Record all measurements, including the failure load if failure occurs.

Load each anchor in the following sequence (ADL = allowable design load):

Load	Hold Time
AL (0.05 ADL max.)	Until Stable
0.25 ADL	Until Stable
0.50 ADL	Until Stable
1.00 ADL	Until Stable
1.50 ADL	Until Stable

The alignment load (AL) is the minimum load required to align the testing equipment and should not exceed 5 percent of the ADL. Dial gages should be set to “zero” after the alignment load has been applied.

Unload the anchor after completion of the test.

**211.6.1.2-Slope Drapes.** Install the slope drape according to the manufacturer’s recommendations when they do not conflict with the plans or specifications.

Have a representative from the slope drape manufacturer on site for at least one day at the beginning of the slope drape installation work to train and provide guidance on the installation of the slope drape. Have the slope drape manufacturer inspect the installed drape and submit to the Department a statement declaring that the slope drape was installed according to the manufacturer's requirements and recommendations.

Connect the wire mesh and cable net together before placing the slope drape on the slope. Securely fasten the wire mesh to each cable net panel and to the lacing. Fasten the wire mesh and cable net so they are flush without any gaps that exceed 4 inches. No discontinuities in the wire mesh are allowed. Attach the mesh every 12 inches, horizontally and vertically, using galvanized steel fasteners, approximately 0.148 inch in diameter (US steel wire gauge 9, 0.377 mm), after coating. Use fasteners that have a connection strength equal to or greater than the strength of the mesh.

Connect the cable net panels using 5/16 inch lacing cable (seam rope) through each square of the net. Loop the end of the seam rope back on itself and secure it with two 5/16 inch rope clips. Place the wire mesh between the slope and the cable net. Place the slope drape so it follows the contours of the slope and minimizes gaps and large spaces between the drape and the ground surface. Secure the top of the slope drape to a top horizontal support wire rope. Position the top support rope at least 5 feet above the top of the cut slope. Use top horizontal support ropes that are no longer than 100 feet each. Interior horizontal support ropes are not required.

Connect wire ropes (tag lines) to the end of the anchors and secure the ends of the wire rope with wire rope clips. Install the wire rope clips according to the manufacturer’s recommendations.

**221.7-ROCKFALL ATTENUATOR BARRIER:**



This work shall consist of constructing an attenuator rockfall barrier fence as specified herein, as instructed by the manufacturer, and as shown on the Plans. The Contractor shall furnish all labor, materials and equipment required for completing the work. The Contractor shall select the equipment, installation method for anchor and post foundations, and grouting procedures to meet the performance requirements specified herein, as instructed by the manufacturer, and approved by the Engineer.

This work includes but is not limited to installing attenuator rockfall barrier posts; drilling anchor holes to the specified minimum depth and orientation indicated herein; providing, placing, and grouting the anchors into the drill holes; performing pullout testing; and fastening wire mesh, nets, and rope net. The permanent rockfall protection system that shall be capable of absorbing, arresting, and retaining Maximum Energy Level (MEL) of 2000kJ of kinetic energy to eliminate rockfall bounce and rockfall landing in the traveling roadway.

### **221.7.1-Materials:**

Ring Net. Ring net shall be defined as fabric consisting of interlocking steel rings, each ring with a diameter of no more than 14 inches. Each ring shall connect to the four or six adjoining rings by passing through them; they must be interlocked. Use high tensile strength steel wire with a nominal 0.12-inch (3 mm) diameter with a minimum breaking strength of 198,700 psi. A minimum of 5 strands shall be bundled into each ring. Steel wire used in the fabrications of the ring net shall be galvanized.

Cable Net / Woven Wire Rope Net. Cable/Woven wire rope nets shall have a uniform grid pattern, shall be constructed of galvanized aircraft cable, with a square or diamond weave, and must have no more than a 12-inch opening size. Nominal opening size for cable nets/wire rope nets may be specified on the contract documents as 6, 8, 10, or 12 inches. Connectors used to fasten adjacent panels shall have connection strength equal to or greater than the connection strength of the net.

High Tensile Wire Mesh. High tensile wire mesh shall be of woven construction with a minimum nominal wire diameter of at least 0.15-inch (4-mm). The wire shall have ends formed into a loop and twisted with loops fastened together to prevent unraveling of the mesh. This wire shall have a minimum of 250,000 psi breaking strength. The mesh shall have a minimum longitudinal tensile strength or load capacity of at least 10,000 lbs/ft.

Wire Mesh. When added to a rockfall barrier system, wire mesh shall be securely attached to the cable or ring net fence. Spacing of tie wire or connectors shall be in accordance with manufacturer's recommendations. This mesh shall be flush with no gaps exceeding 4 inches. Tie wires or connectors used to fasten the wire mesh to the cable net of adjacent panels shall have connection strength greater than or equal to the strength of the mesh.

Net Support Posts. Posts shall be fabricated from steel meeting ASTM A36 for pre-formed steel shapes, except as otherwise approved in writing, as part of an approved rockfall barrier system prior to letting of contract. Posts shall be as specified in the certified rockfall barrier equipment list and substitutions are not permitted unless posts for a higher capacity system by the manufacturer are substituted and the manufacturer certifies that the substitution is acceptable. Test results shall be required to prove that the system and posts are capable of resisting design loads as specified in general requirements above. Substitutions of different net support post members after contracts are issued shall not be allowed.

Net Support and Lateral Bracing Ropes. Braking element design shall have been verified through testing and certification of the rockfall barrier to ensure satisfactory performance and

a minimum of required maintenance. Written documentation of testing of braking elements used with support or bracing ropes shall be supplied to the Engineer upon request.

Rock and Soil Anchors. Anchors shall meet the requirements of the Foundation Details and Wire Rope Anchor Details. Anchors in rock and soil shall be installed per manufacturer's recommendations for the Rockfall Attenuator Barrier.

Epoxy and Grout. Epoxy shall be in accordance with manufacturer specifications and that of the Department. Grout shall be a neat-cement or a sand-cement grout consisting of a pumpable mixture capable of reaching a 3-day compressive strength of 1500 psi and 28-day compressive strength of 3500 psi, in accordance with AASHTO T 106. Chemical additives that control bleed, improve flowability, reduce water content, or retard set in the grout are to be used only when approved in writing by the Department. Accelerators shall not be permitted. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations.

Cement. Shall conform to the requirements of Subsection 701.1.

Grout in Footings and Anchors. Grout shall meet the requirements in Subsection 707.

Fine Aggregate. Shall conform to the requirements of Subsection 702.

Corrosion Protection. Rock anchors shall be galvanized in accordance with ASTM A767 or epoxy coated. Epoxy coating applied electro-statically to the anchor shall be 14 mils to 18 mils in thickness. The epoxy coating shall be in accordance with AASHTO M 284. Bend test requirements shall be waived.

Any and all miscellaneous materials associated with the rockfall barrier fence including, but not limited to, wire rope clamps, eyelets, and bolts shall be hot-dipped galvanized.

Miscellaneous Materials. All miscellaneous hardware such as wire rope clips, thimbles, bolts, shackles, etc., shall be supplied by the manufacturer with the rockfall barrier. Shackles shall be used to fasten nets to each other and to the net support ropes, unless specifically not allowed by the manufacturer.

All structural steel components, including anchors and clamps, shall conform to the requirements in ASTM Designation A36. All bolts, nuts, and washers shall conform to the requirements in ASTM Designation A325 and as required to conform to the tested rockfall barrier.

Storage - Store cement to prevent moisture degradation and partial hydration. Do not use cement that has become caked or lumpy. Store aggregates so that segregation and inclusion of foreign materials are prevented. Do not use the bottom six (6) inches of aggregate piles in contact with the ground.

Steel shall be stored on supports to keep the steel from contact with the ground, in a manner that eliminates bending. Damage to the steel as a result of abrasion, cuts, nicks, welds and weld splatter shall be cause for rejection by the Department. Protect steel from dirt, rust and other deleterious substances prior to installation. Heavy corrosion or pitting of steel shall be cause for rejection. Light rust that has not resulted in pitting is acceptable.

Rockfall fence and posts shall be powder coated to match US Government Federal Standard Color 595C 26255, or approved alternate.

### **221.7.2-Installation:**

Excavation - The foundation work for the posts shall be performed in accordance with the typical sections for the fence system details shown on the design drawings and in accordance with the manufacturer's requirements. The distance from centerline to centerline of the posts must be kept as close as possible to that shown on the manufacturer's approved design

drawings and cannot exceed plus or minus 3 inches of the distance except as approved by the Engineer. In addition, do not vary the posts from the indicated pitch, or from vertical, by more than 2 inches from top to bottom of the post. All loose soil or rocks shall be removed from the holes.

Dispose of excess excavated material in a similar manner as other ditch work material on the project.

Support the anchor bars or cables in the center of the drilled holes with centralizers spaced a maximum of 2 ft on center.

Barrier Fence and Foundation Installation - Verify that all materials are marked by the manufacturer in order to identify the materials on the shop drawings.

Install the rockfall protection barrier fence in accordance with the procedures, tolerances, and requirements of the manufacturer, as shown on the plans, as specified in these provisions, and as directed.

Install the foundations and post foundations in accordance with the procedures, tolerances, and requirements of the manufacturer, as shown on the plans, as specified in these provisions, and as directed.

Use of neat cement in post foundations or sand-cement grout in cable anchor foundations shall conform to the requirements of the manufacturer, as specified in these provisions, and as directed. Submit the proposed grout mix design to the Department for review and approval in accordance with the Submittal section. The design mix submittal shall include compressive strength test results verifying that the proposed mix design will have a 3-day minimum compressive strength of 1500 psi and a 28-day minimum compressive strength of 3500 psi.

Previous test results for the proposed grout mix completed within one (1) year of the start of work may be submitted for initial verification of the required compressive strengths for installation of pre-production verification test anchors and initial production anchors. During production, anchor grout shall be tested by the Contractor in accordance with AASHTO T 106/ASTM C109 at a frequency of no less than one (1) test per day that grout is placed. All testing shall be performed in an AMRL-accredited laboratory. Provide grout cube test results to the Department within 24 hours of testing.

Grout the drill hole after installation of the wire rope anchor and foundations. Each drill hole shall be grouted within two (2) hours of completion of drilling, unless otherwise approved by the Department. Cold joints are not allowed in the grout column. Grouting before insertion of the anchor is allowed provided the anchor is immediately inserted through the grout to the specified length without difficulty.

Maintain grout pressures or vibration sufficient to ensure that the drill hole shall be completely filled. Control grout pressures to prevent excessive ground heave or fracturing. Remove the grout and anchor if grouting is suspended for more than thirty (30) minutes or does not satisfy the requirements herein and replace with fresh grout and undamaged anchor at no additional cost.

No drilling or installation of wire rope anchors and foundations shall be permitted in any soil/rock unit until successful pre-production verification testing of anchors is completed in that unit and approved by the Department. Install verification test anchors using the same equipment, methods, anchor and drill hole diameter as planned for the production anchors. Perform pre-production verification tests in accordance with the Verification Testing section prior to installation of production anchors in the specific unit in which the designated verification test anchors are located. The number and location of the verification tests will vary depending on site conditions.

The Contractor shall select drilling equipment and methods suitable for the ground conditions as dictated by the site conditions. The Contractor shall also select drill hole diameter(s) required to develop the specified pullout resistance and to also provide a minimum one (1) inch grout cover around the anchor bars. It is the Contractor's responsibility to determine the final drill hole diameter(s) required to provide the specified pullout resistance. Use of drilling muds such as bentonite slurry to assist in drill cutting removal is not acceptable, but air may be used. With the Department's approval, the Contractor may be allowed to use water or foam flushing upon successful demonstration, at the Contractor's cost, that the installation method still provides adequate anchor pullout resistance. If caving ground is encountered, use cased drilling methods to support the sides of the drill holes. Where hard drilling conditions such as rock, cobbles, boulders or obstructions are encountered, percussion or other suitable drilling equipment capable of drilling and maintaining stable drill holes through such materials may be used.

The Contractor shall immediately suspend or modify drilling operations if ground movement is observed, if the rock slope or anchors are adversely affected or if adjacent structures are damaged from the drilling operation. Immediately stabilize the adverse conditions at no additional cost.

**211.7.3-Proof Testing of Production Anchors:** The Contractor shall perform proof testing on 5% of all production anchors. Rock anchors shall have a minimum pullout strength of 15 tons (or more if required by specific manufacturer fence design) and must be verified by the contractor in the field. The testing shall consist of a pullout test on 5% of all anchors. Testing shall be performed against a temporary yoke or load frame. No part of the yoke or load frame shall bear within 3 feet of the anchor.

Rock anchors shall be considered acceptable when held under maximum load for a minimum of three (3) minutes without movement of more than 0.10 inch. Movement of an anchor shall be cause for rejection of that anchor and any others installed on the same day except that each anchor installed that day may be tested and accepted individually.

If a test anchor does not satisfy the acceptance criteria, the Contractor shall determine the cause. The Department shall evaluate the results of each proof test. Installation methods that do not satisfy the rock anchor testing requirements shall be rejected. The Contractor shall propose alternative methods and install replacement verification test anchors. Contractor modifications may include, but are not limited to, the installation of additional proof test anchors, increasing the drill hole diameter to provide increased capacity, modifying the installation or grouting methods, reducing the production anchor spacing from that shown herein, and installing more production anchors at a reduced capacity or installing longer production anchors. Installation and testing of additional proof test anchors or installation of additional or modified rock anchors as a result of proof test anchor failure(s) shall be at no additional cost to the Department.

Successful proof tested rock anchors meeting the above test acceptance criteria may be incorporated as production anchors.

**211.7.4-Installation Records:** Records documenting the rock anchor and rockfall barrier fence construction shall be maintained by the Contractor's Engineer, unless specified otherwise. The Contractor shall provide the Department with as-built drawings showing as-built rock anchor locations within five (5) calendar days after completion of the anchor curing and/or testing.

**211.7.5-Certificate of Compliance:** The Contractor shall provide the Engineer with a Certificate of Compliance from the manufacturer in accordance with the provisions of the Standard Specifications.

A Certificate of Compliance shall be provided to the Engineer certifying that the materials, additional corrosion protection and rockfall barrier to be furnished conform to the requirements of these special provisions. The Certificate of Compliance shall be supported by a certified copy of the results of tests performed by the manufacturer.

#### **221.8-ATTENUATOR BARRIER DRAPE:**

This work is for furnishing and installing draped wire mesh in conjunction with the Attenuator Barrier. The Contractor shall furnish all labor, materials, equipment and incidentals required for completing the work. The Contractor shall select the method and equipment to meet the performance requirements specified herein.

**221.8.1-Materials:** Attenuator Barrier Drape materials shall conform to the requirements of 211.5.1.

**221.8.2-Work Plan, Attenuator Barrier Drape:** Installation of Attenuator Barrier Drape shall be included on Work Plan, as noted in 211.3.2. The plan shall also include the information in 211.5.2.

**211.8.3-Installation:** Install mesh at the locations identified on the drawings or as directed by the Engineer. Fasten ends of mesh with wire rope anchors in accordance with the Contractor's design. Install the wire mesh in vertical strips to the limits as shown on the Contract drawings or as directed by the Engineer. Install all wire mesh in accordance with the slope treatment details and as directed by the Engineer. Install all fasteners, connectors, ropes and associated hardware in accordance with the manufacturer's recommendations.

Configuration and load testing of wire rope anchors to support the ends of the wire mesh will be in accordance with the Contractor's design.

**211.8.3- Wire Rope Anchor Testing:** Perform proof testing on a minimum of five (5) percent of wire rope anchors at each cut location as selected by the Contractor and approved by the Engineer.

#### **221.9-ROCKFALL BARRIER:**

This work shall consist of constructing a rockfall barrier fence as specified herein, as instructed by the manufacturer, and as shown on the Plans. The Contractor shall furnish all labor, materials and equipment required for completing the work. The Contractor shall select the equipment, installation method for anchor and post foundations, and grouting procedures to meet the performance requirements specified herein, as instructed by the manufacturer, and approved by the Engineer.

This work includes but is not limited to installing rockfall barrier posts; drilling anchor holes to the specified minimum depth and orientation indicated herein; providing, placing, and grouting the anchors into the drill holes; performing pullout testing; and fastening wire mesh, nets, and rope net.

The term “rockfall barrier fence” as used in these specifications is intended as a generic term and refers to a permanent rockfall protection system that shall be capable of absorbing, arresting, and retaining Maximum Energy Level (MEL) of 2000kJ of kinetic energy to eliminate rockfall bounce and rockfall landing in the traveling roadway.

**221.10-LOCALIZED ROCK BOLTING:**

This work shall consist of furnishing and installing rock bolts in accordance with this special provision, AASHTO LRFD Bridge Construction Specifications (4<sup>th</sup> Edition, 2017), and in reasonably close conformity with the dimensions, locations and details shown on the Plans or established by the Engineer.

**221.10.1-Materials:** Materials shall conform to the following requirements:

<b>Material</b>	<b>Subsection</b>
Portland Cement	701.1
Fine Aggregate	702.1
Prestressing Steel	709.2
Structural Steel	709.12

Minimum grout strength at stressing shall be 3,500 psi. Expansion additives in grout will not be allowed. Grout shall not be re-tempered or used after it has begun to set. Proportioning and testing of grout (including requirements for submission to the Department), quality control, and testing of grout (including number, size, and shape of samples) shall conform to the applicable provisions of Subsections 601.3 and 601.4.

All other materials, including sheaths, grease, tubes, centralizers and spacers, shall be of good quality, acceptable to the Engineer. The contractor shall submit Manufacturer’s certificates and catalogs, test reports or other such documents, as required by the Engineer.

**221.10.2-Work Plan, Slope Drape:** Installation of rock bolts shall be included on Work Plan, as noted in 221.3.2. Include the following minimum information for the plan:

1. Complete working drawings and engineering calculations, prepared, signed, sealed and dated by a Professional Engineer.
2. Proposed construction sequence and schedule.
3. Proposed rock bolt drilling methods and equipment, including drill hole diameter and length proposed to achieve the required pullout resistance.
4. Submit the grout design and include the following:
  - a. Manufacturer’s certified test results of set time, shelf life, and compressive strength.
  - b. Type of Portland cement.
  - c. Aggregate source and gradation.
  - d. Proportions of mix by weight and water-cement ratio.
  - e. Manufacturer, brand name and technical literature for proposed admixtures.
  - f. Results of compressive strength tests performed according to AASHTO T106/ASTM C109 and completed no more than one year before the start of grouting. Use an AASHTO accredited independent testing lab to verify the specified minimum 3 and 28-day grout compressive strengths.

5. Proposed rock bolt grout placement procedures and equipment.
6. Proposed rock bolt testing methods and equipment setup.
7. Identification number and certified calibration records for each test jack, pressure gauge and load cell to be used.

### **221.10.3-Installation:**

**211.10.3.1-General.** Prepare a complete design for the rock bolts that conforms to the criteria on the Plans, Specifications, and other documents referenced therein. The design shall be based on the Contractor's experience on similar work and on accepted practice described in AASHTO LRFD Bridge Construction Specifications "Section 6: Ground Anchors". The design shall also include the corrosion protection scheme.

The Contractor is cautioned that the soil and rock information shown on the Plans is based on visual observation from ground level and aerial reconnaissance. The actual conditions and elevations may differ from those shown.

Any design different from that shown on the Plans shall be prepared and sealed by a duly licensed Professional Engineer in the state of West Virginia. The design and working drawings shall be reviewed by the Engineer to confirm that the design meets the design requirements.

The Contractor may use a nominal (ultimate) grout-rock bond stress higher than those recommended in the geotechnical report, provided that a field pullout test is performed by the Contractor to confirm the higher bond stress. The anchor to be pullout tested shall have a minimum bond length of 10 feet. The pullout test shall be done at no cost to the Department. If the Contractor chooses to use a higher bond stress, the Contractor will be responsible for failed performance tests and/or proof tests as a result of using a higher bond stress. The cost of installing and re-testing additional anchors will be the responsibility of the Contractor.

Anchor centerlines shall not deviate from their planned location by more than 3 degrees, nor shall they approach each other closer than 4 feet at their lower ends.

A resistance factor unit bond stress and a set of estimated required bonded lengths and corresponding grouted diameters are specified on the plans. Should the Contractor decide to use a different factored unit bond stress, he shall be responsible for determining the bond length necessary to develop adequate load capacity to satisfy anchor testing acceptance criteria for the design load. Any rock anchor that does not meet the test acceptance criteria shall be replaced at no additional cost to the Department.

The diameter of the drilled hole shall be adequate for grouting inside and outside the polypropylene tube. The hole shall be free of fall-in soil or other debris immediately prior to grouting.

**211.10.3.2-Hole in the Stressing Length:** Casing of portions of many or all holes may be needed to maintain an open clean hole. There will be no additional compensation for such casings: their cost shall be included in the bid prices.

**211.10.3.3-Hole in the Bond Length:** Drilling Logs shall be prepared in a manner approved by the Engineer, and submitted daily. They shall contain the following information:

1. Characteristics of all materials encountered during the drilling process, and their specific locations within the holes

2. Location of special features such as mud seams, open cracks, broken rock, etc.
3. Points where abnormal loss or gain to drill water has occurred
4. Groundwater levels or other items of interest for grouting
5. All significant actions of the bit
6. If any weak material, such as coal, clay, weathered rock or the like is encountered within the required bond length, the hole shall be extended to compensate for the weak material
7. If large voids are encountered, consolidation grouting and re-drilling of the hole will be required. The grout shall be injected at the lowest point of the drill hole and shall proceed such that the hole is filled progressively from the bottom to the top, in order to prevent air voids.

Consolidation grout should have a water/cement ratio of between 0.45 and 0.55. Variations from these ratios shall require an approval from the Engineer prior to the placement. Special measures (such as stiff grout mixes) may be required to prevent or reduce grout loss. A consolidation-grouted hole shall not be re-drilled until the grout has had a minimum of 24 hours to set up.

**211.10.3.4-Grouting:** During grouting, the end of the grout pipe shall be covered by at least 2 feet of wet grout. Grouting shall proceed from the bottom up, to prevent air voids. The grout in the stressing length must not interfere with the stressing operation; tendons in the stressing length must not develop any bond to the surrounding grout. To achieve this, the grout inside the polypropylene tube shall preferably be placed after stressing.

The grout shall be placed over the entire bond length without interruption. The anchor shall then remain undisturbed until the grout has reached a minimum strength of 3,500 psi. The following data shall be recorded and submitted to the Engineer, about the grouting operation, on a daily basis:

1. Type of Mixer
2. Type of cement and water/cement ratio
3. Type of additives (if approved)
4. Grout pressure
5. Test sample strengths (prior to stressing)
6. Volume of grout placed in the bond and in the stressing lengths.

**211.10.3.5-Corrosion Protection of Anchorage:** Following acceptance of the rock bolt by the Engineer, the portion of each bolt extending past the lock-off plate shall be cut off in a manner that will not develop excessive heat. The anchorage shall not be damaged by the cutting operation.

**211.10.3.6-Rock Bolt Tests:** In the following sections, AL denotes the alignment load (0.10P) and P denotes the anchor design load.

**211.10.3.6.1-Performance Test:** A performance test shall be carried out on a minimum of 5% of the rock bolts for each identified areas shown on the plans, and as directed by the Engineer. During the performance test, the contractor shall incrementally load and unload the rock bolt in accordance with the following schedule. The movement of the bolt shall be recorded to the nearest 0.001 inches at each increment, with respect to an independent



(fixed) reference point. The load applied by the jack shall be monitored with a pressure gauge and preferably a load cell.

Each load shall be held for a minimum of one minute with the maximum loading being held for 60 minutes.

All leaks in the jacking system shall be repaired as discovered and the test restarted at the initial reading.

Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5	Cycle 6
AL	AL	AL	AL	AL	AL
0.25P	0.25P	0.25P	0.25P	0.25P	0.25P
	0.50P	0.50P	0.50P	0.50P	0.50P
	0.25P	0.75P	0.75P	0.75P	0.75P
		0.50P	1.00P	1.00P	1.00P
		0.25P	0.75P	1.20P	1.20P
			0.50P	1.00P	1.33P (Max)
			0.25P	0.75P	- hold for creep test
				0.50P	- reduce for lock off load, P
				0.25P	

All anchors undergoing performance tests shall hold the maximum load, i.e. 1.33P, for 10 minutes (or 60 minutes). The jack shall be repumped as necessary in order to maintain a constant load. During this period, the rock bolt movement with respect to a fixed reference point shall be recorded at 0 seconds, 30 seconds, 1 minute, 2,3,4,5,6, and 10 minutes (and 15, 20, 25, 30, 45, and 60 minutes). The dial gauge used for monitoring movement shall be capable of reading the entire movement with resetting. Upon passing the acceptance criteria, the anchor shall be adjusted to lock off load, P.

**211.10.3.6.2-Lift Off Test:** A lift-off test shall be part of the performance test. After transferring the load to the end anchorage, a lift-off reading shall be made. The load determined from the lift-off reading shall be within 5 percent of the desired transfer or lock-off load otherwise the end of the anchorage shall be reset to the design load and another lift-off reading shall be made.

Lift-off tests can be made a minimum of 24 hours, and a maximum of 7 days, after the design load has been locked off in the rock bolt. The results of the test shall be submitted to the Engineer on the day of the test. All tendons which are to be lift tested must have an adequate length of bolt protruding over the anchorage to permit jacking. The jack utilized for lift-off testing shall be calibrated within two weeks of testing and at intervals of approximately 3 months throughout testing. The contractor shall furnish the calibration chart and submit it to the Engineer.

**211.10.3.6.3-Proof Test:** All rock bolts not performance tested shall be proof tested by incrementally loading the anchor in accordance with the following schedule. Load and movement shall be monitored as indicated above.

<b>Load</b>
AL
0.25P
0.50P
0.75P
1.00P
1.20P
1.33P (Max)
- Hold for Creep Test
- Reduce to lock-off load, P

The proof test results shall be compared to the performance test results. Any significant variation from the performance test results may require a performance test on the next anchor. Lift-off tests for proof tested anchors may be required as designated by the Engineer. The contractor shall do all additional tests due to inadequate results of a proof test at no cost to the Department

Upon passing the acceptance criteria, the rock bolt shall be adjusted to lock-off load, P.

**211.10.3.6.4-Acceptance Criteria:** A performance-tested or proof-tested rock bolt with a 10-minute load hold shall be accepted if (1) the rock bolt resists the maximum test load with less than 0.04” of movement between 1 minute and 10 minutes; and (2) the total elastic movement at maximum test load exceeds 80% of the theoretical elastic elongation of the unbonded length; or (3) the total elastic movement at the maximum test load does not exceed the theoretical elastic elongation of the unbonded length plus 50% of the theoretical elongation of the bonded length.

A performance-tested or proof-tested rock bolt with a 60-minute load hold shall be accepted if (1) the rock bolt resists the maximum test load with a creep rate that does not exceed 0.08” in the last log cycle of time; and (2) the total elastic movement at maximum test load exceeds 80% of the theoretical elastic elongation of the unbonded length.

The initial lift-off reading shall be within +5% of the design lock-off load. If the criterion is not met, the tendon load shall be adjusted accordingly and the initial lift-off reading repeated.

If any bolt fails to meet the acceptance criteria, the Contractor shall determine, if possible, the reason for failure. An additional bolt shall be installed in accordance with this specification at a location approved by the Engineer and tested to verify that the capacity of the new anchor meets the 1.33P load. The Department will make no payment for failed bolts. An additional bolt in this area shall be performance tested when a failure occurs, at no cost to the Department.

Records shall be kept of the load and elongation for each increment of loading for each tieback and shall be furnished to the Engineer following the completion of each test.

## **221.11-BLANK**

## **221.12-METHOD OF MEASUREMENT:**

The quantities of work will be measured as follows:

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**211.12.1-Rock Slope Scaling:** Scaling will be measured in square yards. The quantity will be determined by the Plan Quantity as provided in the proposal unless otherwise directed by the Engineer.

**211.12.2-Pinned Wire Mesh:** Pinned Wire Mesh will be measured in square yards. The quantity will be determined by the Plan Quantity as provided in the proposal unless otherwise directed by the Engineer and shall include overlap of wire mesh rolls needed to properly cover the slope face.

**211.12.3-Slope Drape:** Slope Drape will be the number of square yards of surface area of installed. Overlap areas of slope drape, anchors, and anchor tests are incidental to the slope drape and will not be measured separately.

**211.12.4-Rockfall Attenuator Barrier:** The Rockfall Attenuator Barrier will be measured in linear feet, complete in place and accepted. The price for the system shall be full compensation for all material including freight, supervision, engineering, drawings and spare parts; plus labor, equipment, tools, royalties and other incidentals necessary to install a complete system ready to use.

**211.12.5-Attenuator Barrier Drape:** Attenuator Barrier Drape will be the number of square yards of surface area of installed. Overlap areas of slope drape, anchors, and anchor tests are incidental to the slope drape and will not be measured separately.

**211.12.6-Rockfall Barrier:** The Rockfall Barrier will be measured in linear feet, complete in place and accepted. The price for the system shall be full compensation for all material including freight, supervision, engineering, drawings and spare parts; plus labor, equipment, tools, royalties and other incidentals necessary to install a complete system ready to use.

**211.12.7-Localized Rock Bolting:** Localized rock bolting will be measured and paid per rock bolt, complete in place and accepted. The price for the bolting shall include full compensation for all material, supervision, engineering, drawings and spare parts; plus labor, equipment, tools, and performance testing.

**221.13-BASIS OF PAYMENT:**

The quantities, determined as provided above, will be paid for at the contract unit price bid for the items listed below, which prices and payment shall be full compensation for furnishing all the materials and doing all the work prescribed in a workmanlike and acceptable manner, including all labor, tools, equipment, supplies and incidentals necessary to complete the work.

**221.14-PAY ITEMS:**

ITEM	DESCRIPTION	UNIT
221002-001	Scaling	Square Yard
221004-001	Pinned Wire Mesh	Square Yard
221006-001	Slope Drape	Square Yard
221008-001	Rockfall Attenuator Barrier	Linear Foot
221010-001	Attenuator Barrier Drape	Square Yard
221012-001	Rock Fall Barrier, "Height"	Linear Foot

<b>ITEM</b>	<b>DESCRIPTION</b>	<b>UNIT</b>
221014-001	Localized Rock Bolting	Each

“Height” = Barrier Height, in feet

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**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SPECIAL PROVISION**

**FOR**

**STATE PROJECT NUMBER:** \_\_\_\_\_

**FEDERAL PROJECT NUMBER:** \_\_\_\_\_

**SECTION 601  
STRUCTURAL CONCRETE**

**601.3–PROPORTIONING:**

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

Design mixture testing for Class H concrete shall be in accordance with MP 711.03.23 and shall include air content, slump, compressive strength, rapid chloride permeability tests, and surface resistivity testing. For establishment of mixture proportions, rapid chloride permeability tests shall be made on representative samples prepared and tested in accordance with AASHTO T277. The rapid chloride permeability test specimens shall be tested at an age of 90 days (or at any time prior to 90 days), and the results of this test shall not exceed 750 coulombs. Specimens shall be moist cured for 56 days prior to the start of specimen preparation unless specimens are to be tested prior to 56 days, in which case the specimens shall be moist cured until the time of test. The 28-day compressive strength of the test mix that satisfies the 750 coulomb threshold shall be used as the basis for acceptance of Class H concrete per Section 601.4.5. For establishment of mixture proportions, surface resistivity testing shall be performed in accordance with AASHTO T 358. A set of three 4-inch x 8-inch ~~(100 mm x 200 mm)~~ cylinders shall be fabricated and moist cured, as specified in AASHTO R 39, for 28 days prior to testing. Surface resistivity test results shall be for information purposes only, but ideally, the average result of the three cylinders should not be less than ~~61-40~~ k $\Omega$ -cm for 4-inch x 8-inch ~~(100 mm x 200 mm)~~ cylinders. The cost of all test mix requirements for new Class H mix designs shall be considered incidental to the cost of Class H concrete.

For existing Class H mix designs, which have already approved by the Division, surface resistivity testing shall be performed on a laboratory trial batch at a Division Approved Concrete Mix Design Laboratory. The cost of conducting this surface resistivity test shall be paid as a separate Pay Item.

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**601.4-TESTING:**

**601.4.1–Sampling and Testing Methods:**

ADD THE FOLLOWING TO THE TABLE IN SUBSECTION 601.4.1:

Surface Resistivity	AASHTO T 358
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**601.4.5–Tests for Permeability Acceptance of Class H Concrete:**

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

**601.4.5–Tests for Permeability Acceptance and Surface Resistivity of Class H Concrete:**

ADD THE FOLLOWING PARAGRAPH TO THE END OF THE SUBSECTION:

The Contractor shall also be required to fabricate and test three Surface Resistivity test specimens, in accordance with AASHTO T23 and AASHTO T358, every time that a set of compressive strength specimens for Class H concrete is fabricated. These test specimens shall be the same size as the Surface Resistivity test specimens that were tested in the approved mix design, and they shall be tested at an age of 28-days. These test specimens shall be moist cured, in the same manner as the Class H compressive strength specimens, until as close to the time of testing as possible. The average Surface Resistivity test result of these three test specimens shall be used for information purposes only. The 28-day Surface Resistivity result of each of these three specimens, the Project Number for which they were fabricated, and the approved mix design number which was used to batch the concrete shall be forwarded to the following e-mail address: DOHConcreteMixDesign@wv.gov as soon as testing is completed. Average Surface Resistivity results equal to or greater than 29-30 kΩ-cm for 4-inch x 8-inch cylinders (~~100 mm x 200 mm~~) are considered acceptable.

**601.16-PAY ITEMS:**

ADD THE FOLLOWING PAY ITEM:

ITEM	DESCRIPTION	UNIT
601050-005	Surface Resistivity Testing of Existing Class H Concrete Mix Design	Each

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**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 401  
ASPHALT BASE, WEARING, AND  
PATCHING AND LEVELING COURSES**

**401.13-BASIS OF PAYMENT:**

**401.13.2**

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

~~401.13.2-When a Lot of asphalt pavement is represented by a smoothness value larger than that shown in Tables 401.7.2E or 401.7.2M, the unit price of the Lot (surface course only) shall be determined as follows:~~

~~ENGLISH VERSION:~~

~~Reduced Unit Price = Unit Bid Price X [(127.86—As)/100]  
Where A = 0.429 when specified smoothness is 65 in/mi  
Where A = 0.341 when specified smoothness is 81 in/mi  
Where s = Smoothness value measured as per 401.7.2~~

~~METRIC VERSION:~~

~~Reduced Unit Price = Unit Bid Price X [(127—As)/100]  
Where A = 0.0274 when specified smoothness is 1 000mm/km  
Where A = 0.0218 when specified smoothness is 1 250  
mm/km  
Where s = smoothness value measured as per 401.7.2~~

~~When the measured smoothness value exceeds the specified value by 50% or more, the Lot so measured shall be corrected, at the Contractor's expense, to comply with Tables 401.7.2E or Table 401.7.2M.~~

**401.13.2-Blank**

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

ADD THE FOLLOWING SECTION:

**SECTION 403  
CRACK SEALING IN ASPHALT PAVEMENT**

**403.1-DESCRIPTION:**

The work shall consist of the cleaning, crack sealing, and crack filling in asphalt pavement in the manner and subject to the conditions and regulations prescribed.

**403.2-MATERIALS:**

The material shall be hot poured crack sealant and conform to the requirements of Section 708.3 of the Specifications. ~~As well as being~~ The material must be compatible with asphalt pavement recycling.

**403.3-WEATHER RESTRICTIONS:**

The sealant material shall not be applied when the weather is foggy, rainy or when the ambient and pavement temperatures are below 40° F.

**403.4-CONSTRUCTION:**

**403.4.1-Preparation of Material for Use:** Before charging the compound into the melting unit, the unit shall be free from all foreign material. If the type of heater to be used requires that the sealing material, as shipped, be cut into smaller pieces before melting, the cutting method used is subject to the approval by the Engineer.

The heating kettle used for melting sealing materials shall be of the indirect heating or double boiler type, using oil as the heat transfer medium. It shall have a thermostatically controlled heat source, a built-in automatic agitator, and thermometers installed to indicate both the temperature of the melted sealing material and that of the oil bath. Other methods of indirect heating approved by the Engineer may be used. A positive means of controlling the temperature of the heat transfer at all points in the system shall be incorporated in the heater. Sealing material shall be uniformly heated until the pouring temperature recommended by the manufacturer is reached. Should the maximum pouring temperature recommended be exceeded, the material will be rejected. The material shall be poured as soon as possible after the pouring temperature is reached. Only sufficient material for the day's operation shall be heated each day.



**403.4.2-Preparation of Joints and Cracks for Sealing:** The cracks shall be thoroughly cleaned of all loose scale, dirt, dust, vegetation, or other foreign matter prior to placing hot poured crack sealant. This shall be accomplished by use of a hot air lance, and any other tools necessary to complete the work. The use of any tool which results in damage to the pavement is prohibited.

**403.4.3-Equipment for Applying Sealer:** The equipment used shall conform to the manufacturers recommendations and consist of heating units from which material may be discharged into the crack through the use of flexible lines and suitable shoes.

**403.4.4-Placement Requirements:** Any spillage of sealing material on pavements shall be immediately removed. A neat and workmanlike job will be required at all times. At no time shall sealing material be placed in a crack which is either dirty or wet. The crack shall be clean and surface dry at the time of placement. Work will be suspended when cracks are wet or damp and when the atmospheric temperature is below 40 degrees. The standard overband shall be 3" centered over the crack. After the sealant has cooled, settling shall not exceed 3/8" below the surface. Any damage to uncured sealant shall be repaired at the contractor's expense. Cracks wider than 1" and deeper than 3" shouldn't be sealed to avoid improper sealing. If no overlay work is being performed then no more than 25% of the surface area is to be crack sealed, due to danger of diminished skid resistance.

Spalling, adhesive failure, or cohesive failure within 96 hours of installation shall be replaced at no additional cost.

**403.4.5-Equipment, Personnel, and Documentation Requirements:** The Contractor (two (2) days prior to commencement of the project) shall submit to the Engineer a detailed list of all equipment to be used for crack sealing on the project. The Contractor shall also provide certification from the Sealing material manufacturer that the Contractor is qualified to apply the manufacturer's material in conformance with these specifications and the manufacture's recommendations.

The Contractor is responsible for quality control, and shall submit a quality control plan in accordance with these specifications to the Engineer at the Pre-Construction Conference.

**403.5-METHOD OF MEASUREMENT:**

The quantity of work done will be measured in linear feet of "Crack Sealing in Asphalt Pavement" applied and accepted.

**403.6-BASIS OF PAYMENT:**

The quantity of work, as determined above, will be paid for at the contract unit price bid for the item below, which price and payment shall be full compensation for furnishing all materials, and doing all the work prescribed in a workmanlike and acceptable manner, including all the labor, tools, equipment, supplies and incidentals necessary to complete the work.

**403.7-PAY ITEM:**

ITEM	DESCRIPTION	UNIT
403001-001	Crack Sealing in Asphalt Pavement	Linear Foot

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**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 TO THE END OF THE SECTION:

**Fiber Reinforced Polymer (FRP) For Structural Repairs** - This work shall consist of the repair or retrofit of concrete with an externally bonded, high-strength, Fiber Reinforced Polymer (FRP) composite wrap system in accordance with these specifications and in reasonably close conformity with the lines, grades, dimensions, and locations as shown on the Contract Plans or as established by the Engineer.

**601.2-MATERIALS:**

ADD THE FOLLOWING TO THE END OF THE SECTION:

**Fiber Reinforced Polymer (FRP):** All constituent materials of the FRP system (fabric, epoxy resin, primer, etc.) shall be supplied by a single FRP Manufacturer (mixing of materials from different manufacturers is not approved). All materials must be approved by the Department.

Provide a unidirectional, high-strength fiber fabric fully saturated with compatible epoxy resin per the manufacturer’s recommendations. Use epoxy resin and FRP laminae in accordance with the latest edition of ACI 440.8 *Specification for Carbon and Glass Fiber-Reinforced Polymer Materials Made by Wet Layup for External Strengthening of Concrete and Masonry Structures*.

Polyester or vinyl ester resins are not allowed as a substitute for epoxy resin. Fiber may be either Carbon (CFRP) or E-Glass (EGFRP). Input fibers of FRP systems shall meet or exceed the following requirements:

Property	Carbon	E-Glass
Tensile Strength (ASTM D3039)	550 ksi	330 ksi
Tensile Modulus (ASTM D3039)	33,000 ksi	10,500 ksi
Ultimate Elongation (ASTM D3039)	1.50%	4.00%
Minimum dry fabric weight	9 oz/yd <sup>2</sup>	27 oz/yd <sup>2</sup>
Maximum dry fabric weight	18 oz/yd <sup>2</sup>	27 oz/yd <sup>2</sup>

#### 601.4-TESTINGS:

ADD THE FOLLOWING TO THE END OF THE SECTION:

**601.4.6-FRP Approvals:** Working drawings shall be submitted to the Engineer for review and approval a minimum of thirty (30) working days prior to installation. The working drawings shall be signed and sealed by a Professional Engineer registered in the State of West Virginia. Working drawings shall include the type of FRP system, number of layers and orientation of all FRP materials, repair locations, relevant dimensions of the system and the work plan including the necessary preparations of the existing structure. The drawings must be accompanied by the design calculations, the Safety Data Sheet (SDS), and the manufacturer's system data sheet identifying mechanical, physical, and chemical properties of all components of the FRP system, and application guide including installation and maintenance procedures. The installation procedure must clearly identify any environmental and substrate conditions that may affect the application and curing of the FRP system. The design calculations shall provide the additional required structural strength shown in the contract plans and shall be performed in accordance with the latest edition ACI 440.2R *Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures*. The Contractor shall also submit a Quality Control Plan to the Engineer for review prior to securing materials and beginning of installation.

**601.4.7-FRP Quality Control:** Quality control is the responsibility of the Contractor. Quality control and assurance during installation of the FRP system components shall be described in a Quality Control Plan. The Quality Control Plan will include, but not limited to, the following:

1. Evidence that the Contractor has been trained to apply the FRP wrap material and can demonstrate experience in supplying the FRP system on projects similar in size and scope
2. Delivery, handling, and storage requirements for raw materials
3. Time schedule for various steps in the work
4. Procedures to inspect wrap during installation to ensure that it meets the manufacturer's instructions and those in the Contract Documents and these provisions
5. Inspection and quality standards for all completed work
6. Sampling plans
7. Test methods
8. Criteria for acceptance or rejection
9. Repair procedures for any defective work
10. Record keeping standards

11. All safety precautions for all FRP wrap system components, including containment, disposal, and cleanup

Any part of the work that fails to comply with the Contractor's approved Quality Control Plan, the Contract Documents, or these provisions may be rejected by the Engineer, and shall be remedied, or removed and replaced by the Contractor at no additional cost to the Department.

The Contractor shall have present prior to the start of the work and during the installation of the FRP system, a manufacturer's representative, knowledgeable in the methods of installation of the FRP system, for technical expertise and to verify the Contractor's personnel installing the system are knowledgeable and are installing the system's components in accordance with the manufacturer's recommendations. The Contractor shall also arrange to have the manufacturer's representative present during inspection and testing of the material. The manufacturer's representative shall certify that the system was properly installed at the completion of the installation prior to final payment to the Contractor.

Before applying the protective coating, the Contractor shall perform a direct pull-off test in the presence of the Engineer and manufacturer's representative following ASTM D7522 to verify the tensile bond between the FRP wrap system and the concrete substrate. At a minimum, perform three direct pull-off tests or one test per 1,000 square feet of the installed FRP wrap system, whichever is greater. Tension adhesion strengths should exceed 200 psi and exhibit failure of the concrete substrate. Tensile adhesion strengths exceeding 500 psi or exceeding the capacity of the testing apparatus shall also be deemed acceptable. A failure at the bond line with a tensile stress below 200 psi is unacceptable. If one or more of the pull-off tests is found unacceptable, perform two additional tests adjacent to the area where the unacceptable pull-off tests were located. If one of the additional pull-off tests is found unacceptable, the work will be rejected. At the discretion of the Engineer, pull-off tests may be performed at locations of similar substrate near the FRP installation area. The Contractor shall prepare test samples using identical application procedures at the same time that the project FRP is installed. Repair the damaged FRP and concrete at test areas using approved methods after testing is complete.

For structural strengthening applications, quality assurance witness samples shall be made by the Contractor during FRP wrap system installation to permit tensile testing of the cured laminate to verify the material properties. Witness samples are not required for non-structural or low strain applications. Witness samples shall be fabricated using the same fiber, saturating resins, equipment, and methods used in the installation of the FRP system. The sample(s) shall be at least 12"x12" and must be made of one or two plies. One witness sample per lot or batch of composite material or for every 5,000 square feet of material installed shall be provided to verify compliance with the specification requirements. Store witness samples in a dry location on site and allow the panels to cure under the same environmental conditions as the installed FRP system. Five tensile tests will be conducted on the sample(s) in accordance with ASTM D7565 to verify the as-built laminate matches the minimum specifications. Samples will be tested by the Department or an approved, experienced testing laboratory within five (5) business days following the cure period. The FRP wrap system may be considered deficient if the value for tensile force per unit width of two (2) or more of the five (5) valid test results is less than the value for the ultimate tensile strength per unit width as stated on the material data sheet. The FRP wrap system may be considered deficient if the calculated average chord tensile

stiffness per unit width from the five (5) coupons tested is less than 90% of the value for chord tensile stiffness per unit width as stated on the material data sheet. If tested samples do not meet the minimum specifications listed above, the Engineer will make a determination regarding the disposition of the affected element. Such determination may include complete removal and reapplication at no additional cost to the Department.

#### **601.10-PLACING CONCRETE:**

DELETE THE SECTION AND REPLACE WITH THE FOLLOWING:

#### **601.10-FRP CONSTRUCTION REQUIREMENTS:**

Unless otherwise dictated by the FRP manufacturer's instructions, the following installation guidelines shall be followed for the FRP wrap system.

##### **601.10.1-Examination:**

1. Verify dimensions of concrete members to be strengthened with externally bonded FRP reinforcement.
2. Visually assess the member to be strengthened and all surfaces to receive the FRP system for conditions that may affect the installation. Report all areas exhibiting evidence of deterioration or distress to the Engineer prior to initiation of surface preparation of FRP installation.
3. Provide necessary pathways, scaffoldings, or other means of access to the repair areas for personnel (including Owner and Engineer representatives), equipment, and materials.
4. Make a record drawing, sketch, or photo of all obstructions including pipes, conduits, wiring, junction boxes, and other items that affect the installation of the FRP system to enable them to be removed, relocated, and subsequently reinstalled at no additional cost to the Department. The Engineer shall approve any removal or relocation of obstructions.
5. Provide all necessary equipment in clean and operating condition and in sufficient quantities to ensure continuous and uninterrupted FRP installation.

##### **601.10.2-Substrate Repair:**

1. Make all substrate concrete repairs in the area of the FRP wrap system in accordance with the Contract Documents. Repair of deteriorated concrete in these areas will be measured and paid for as indicated in the Contract Documents. Consult with manufacturer to determine the appropriate degree of curing and drying of repairs to which the FRP system will be bonded.
2. Inject all cracks in the surface of the concrete wider than 0.01-inch with epoxy resin under pressure in accordance with the manufacturer's recommendations.

##### **601.10.3-Surface Preparation:**

1. The concrete surface should be prepared to a minimum concrete surface profile (CSP) 3 as defined by the ICRI-surface-profile chips (ICRI 03732, NCHRP Report 609). All

- irregularities, unevenness, and sharp protrusions in the surface profile shall be ground to a smooth surface with less than 1/32-inch deviation or the tolerances recommended by the FRP manufacturer.
2. Round or chamfer all inside and outside corners and sharp edges to where FRP is wrapped to a minimum radius of ½-inch. Grind ridges, form lines, and sharp or roughened edges greater than ¼-inch.
  3. Clean concrete surfaces using methods recommended by the manufacturer to remove all laitance, dust, dirt, oil, curing compound, existing coatings, foreign particles, disintegrated materials, and any other matter that could interfere with the bond between the FRP and the concrete substrate using abrasive or water blasting techniques. If power wash is used, the surface shall be allowed to completely dry before installing the FRP wrap system. Protect the cleaned surface against redeposit of any bond-inhibiting materials.

#### **601.10.4-Installation of FRP System:**

1. Do not apply the FRP system or any of its constituent materials to frozen or wet surfaces. Do not apply FRP materials if rain, snow, or dew point condensation is expected.
2. Ensure ambient and concrete surface temperatures are within the range specified by the manufacturer for FRP installation. Contractor shall provide verification of the temperature and humidity at the application location prior to use.
3. Unless the resin has been specifically formulated for wet applications, do not install the FRP system when environmental conditions support moisture vapor transmission from the concrete substrate. If the resin is formulated for wet applications, ensure moisture levels on concrete substrate and moisture vapor transmission rates comply with manufacturer's recommendations.
4. Commencement of FRP installation will constitute acceptance of substrate conditions by the Contractor.
5. Mix all resin constituent materials in accordance with manufacturer's instructions. Follow manufacturer's instructions regarding mix ratio, temperature range, paddle type, mix duration, etc. Do not dilute any resin constituent materials with any organic solvents or thinners. Discard any mixed resin that exceeds its pot life or shows signs of increased viscosity.
6. If required by the FRP system manufacturer, coat the concrete surface to receive the FRP system with a primer resin. Apply primer at a coverage rate such that it penetrates the pores of the concrete substrate but does not drip or run. Fill and smooth all voids or depressions with diameters larger than ½-inch or depths greater than ⅛-inch with a compatible putty resin. Do not apply the putty until the primer is tack-free, unless approved by the manufacturer. Fillers or other thickening agents may be added to the putty in accordance with the manufacturer's instructions. Do not apply putty to a previously applied primer or putty coat if that coat has fully cured, unless first prepared per the manufacturer's instructions.
7. Follow manufacturer's recommended procedures for impregnating fiber sheets with saturating resin. Apply saturating resin using a medium nap roller or calibrated mechanical saturator. Do not apply saturating resin or impregnated fiber sheet to a previously applied resin coat if that coat has fully cured, unless prepared per the

- manufacturer's instructions. Place fiber sheet onto substrate. Roll fiber sheets in the direction of the fibers to remove any entrapped air between the fiber sheets and concrete surface and to fully impregnate the fiber sheets with saturating resin. Achieve full contact with the concrete substrate during rolling. Do not roll unidirectional fiber sheets in the direction transverse to the fibers to avoid damaging the fibers.
8. Ensure FRP fibers are oriented as noted in the working drawings. Report any deviation in the alignment of fibers of more than  $5^{\circ}$  to the Engineer for acceptance/rejection.
  9. For multi-ply installations, follow the manufacturer's recommended procedures for installing multiple fiber sheet plies and the working drawings for the orientation of the fibers, ply stacking sequence, and length. Limit the number of plies applied in a single day to that which can be supported by the previously applied system without sloughing or sliding. Consult with the manufacturer to determine the maximum number of plies that can be applied in a single day considering temperature and other variables. Do not apply additional fiber sheet plies to previously cured plies unless first prepared per the manufacturer's instructions. Apply an additional coat of saturating resin if required by the manufacturer.
  10. Provide lap splices equal to or exceeding the length recommended by the manufacturer such that the full tensile strength of the fiber sheet is achieved. Stagger lap splices for multiple plies or side-by-side installations.
  11. Apply a final coat of thickened epoxy. Detail all fabric edges, including butt splice, termination points, and jacket edges, with epoxy.
  12. Follow curing procedures in accordance with the manufacturer's recommendations. The FRP wrap system shall be protected from weather, large temperature variations, moisture, sand, dust, and other foreign particles during curing.
  13. Apply protective coating meeting the requirements of 601.10.1 between 24 and 72 hours after final application of epoxy. Use paints that allow vapor transmission at gaps. Remove dust and residue prior to application of paint coats. If after 72 hours the epoxy is cured, the surface must be roughened by sanding or brush blasting.

After at least 24-hours for initial cure of the resin and before protective coatings are applied, the Contractor, in the presence of the Engineer and manufacturer's representative, will perform a visual and acoustic sounding inspection of the FRP surface for any swelling, bubbles, voids, delaminations, external cracks, chips, cuts, loose fibers, external abrasions, blemishes, foreign inclusions, depressible raised areas, or fabric wrinkles. Conduct acoustic tap testing at a frequency of one tap per 0.5 square feet. If any defects are found, they must be repaired according to manufacturer's instructions and the satisfaction of the Engineer or removed and replaced. Defects smaller than 2 square inches in area will require no corrective action, unless they occur next to edges, or the delaminated area exceeds 5% of the total laminate area or there are more than 10 such defects in an area of 10 square feet. Repair defects larger than 2 square inches. Defects will be addressed as follows:

1. **Epoxy Injection of Minor Defects** - Repair small defects between 2 square inches and 25 square inches using low-pressure epoxy injection, as long as the defect is local and does not extend through the complete thickness of the laminate in the case of multi-ply FRP wrap systems. Two small holes may be drilled into the delamination to facilitate injection of the epoxy and escape of entrapped air.

2. **Localized Replacement of Large Defects** - For defects larger than 25 square inches or where deemed necessary by the Engineer, mark the defect and remove the entire thickness of the defect to a minimum of 1-inch beyond the defect limit on all sides. Prepare the concrete substrate and apply the FRP system in accordance with the manufacturer's recommendations. Extend the additional FRP layers a minimum of 6 inches on all sides of the defect repair or greater as recommended by the manufacturer. Do not apply additional fiber sheet plies to previously cured plies unless first prepared per the manufacturer's instructions.

Repairs and filling of voids is required for completion of the work and will be at no additional cost to the Department.

**601.10.1-Coating System Application Notes:** After the final wrap layer is completely cured, apply a flexible, waterproofing, non-vapor barrier protective top coating. The coating may be a polymer-modified Portland cement coating or a polymer-based latex coating compatible with the FRP manufacturer's recommendations to protect FRP from ultraviolet radiation and mild abrasion. Match the color and texture of the protective top coating to adjacent bare concrete or concrete protective coating.

**601.14-METHOD OF MEASUREMENT:**

ADD THE FOLLOWING TO THE END OF THE SECTION:

The measurement for payment for Item 601015-005, FRP Wrap System, 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. No extra measurement or payment will be made for overlap areas or multiple layers.

**601.15-BASIS OF PAYMENT:**

ADD THE FOLLOWING TO THE END OF THE SECTION:

The quantity, determined as provided above, will be paid for at the contract unit price bid for this item, which price and payment shall be full compensation for design and preparation of working drawings and Quality Control Plan, and all labor, tools, materials, equipment, storage, supplies, witness samples, testing, and incidentals necessary to complete the FRP installation as identified in this Special Provision and the Contract Documents. Payment shall include multiple ply wraps and all means of access required to place material (lifts, etc.) and provide inspection access to the Department.

**601.16-PAY ITEMS:**

ADD THE FOLLOWING ITEM TO THE TABLE:

ITEM	DESCRIPTION	UNIT
601015-005	FRP Wrap System	Square Feet (Meter)



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**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 602  
REINFORCING STEEL**

**602.1-DESCRIPTION:**

This work shall consist of furnishing and placing galvanized, epoxy coated, or uncoated reinforcing steel or corrosion resistant reinforcement in accordance with these Specifications and in reasonably close conformity with the Plans.

**602.2-MATERIALS:**

~~Reinforcing steel bars and welded wire reinforcement, epoxy coated or plain shall meet the requirements of 709.1 and 709.4.~~

~~Corrosion resistant reinforcing steel bars shall meet the requirements of 709.1.1 for stainless reinforcement and 709.1.2 for high chromium reinforcement respectively. The degree of corrosion resistance for reinforcement shall be specified in the plans.~~

The materials shall meet the requirements specified in the following Subsections of Division 700:

<u>MATERIAL</u>	<u>SUBSECTION</u>
<u>Corrosion Resistant Reinforcing Steel Bar, Stainless*</u>	<u>709.1.1</u>
<u>Corrosion Resistant Reinforcing Steel Bar, High Chromium*</u>	<u>709.1.2</u>
<u>Epoxy Coated Reinforcing Steel</u>	<u>709.1.4</u>
<u>Galvanized Reinforcing Steel</u>	<u>709.1.3</u>
<u>Reinforcing Steel Bar</u>	<u>709.1</u>
<u>Welded Wire Reinforcement</u>	<u>709.4</u>

\* The degree of corrosion resistance will be specified in the plans.

**CONSTRUCTION METHODS**

**602.3-ORDER LISTS:**

All order lists and bending diagrams shall be furnished by the Contractor. If requested by the Engineer, order lists and bending diagrams shall be submitted for approval. Approval of order

lists and bending diagrams by the Engineer shall in no way relieve the Contractor of responsibility for the correctness of such lists and diagrams.

#### **602.4-PROTECTION OF MATERIALS:**

Steel reinforcement shall be stored above the well-drained surface of the ground upon platforms, skids, or other supports and shall be protected from mechanical injury. Reinforcement shall be free from injurious defects such as cracks and laminations. Any loose scale, loose rust, dirt, paint, grease, oil or other foreign materials present on the reinforcement shall be removed by wire brushing, sand blasting or other approved methods before the placement of concrete.

Reinforcing steel which will be exposed over the winter shall be protected, within one week after the placing of the initial concrete, with a brush coat of neat cement, mixed with water to a consistency of thick paint. This coating shall be removed by lightly tapping with a hammer or other tool not more than one week before the placing of the adjacent pour.

#### **602.5-BENDING OF REINFORCING BARS:**

Unless otherwise permitted, all reinforcing bars shall be cold bent in the shop. Bars partially embedded in concrete shall not be field bent except when shown on the Plans or permitted by the Engineer. Only competent men shall be employed for cutting and bending, and proper appliances shall be provided for the work.

Bending shall be in accordance with the Manual of Standard Practice for Detailing, Reinforced Concrete Structures, ACI 315, latest revision. Rail-steel bars shall not be field bent or straightened.

Unless otherwise specified in the plans, bending of all corrosion-resistant reinforcing bars shall be per requirements of ~~with~~ the latest edition of the AASHTO LRFD Bridge Design Specifications.

#### **602.6-PLACING AND FASTENING:**

**602.6.1-General:** All reinforcing steel shall be accurately placed and, during the placing of concrete, firmly held by supports in the position shown on the Plans. Reinforcing bars shall be securely fastened together. Bars shall be tied at all intersections except where spacing is less than 1 foot (300 mm) in each direction, in which case alternate intersections shall be tied. Distance from the forms shall be maintained by means of stays, blocks, ties, hangers, chairs, or other approved supports. Blocks for holding reinforcement from contact with forms shall be precast mortar blocks of approved shape and dimension; the use of pebbles, broken stone, metal pipe or wooden blocks will not be permitted. Reinforcement in any member will be inspected and approved before any concrete is placed.

The clear distance between the reinforcing steel and the face of the concrete unless otherwise shown in the plans shall be:

Top of deck slab:	2.5"
Bottom of deck slab:	1.0"
Bottom of footings:	3.0"
All other locations:	2.0"

**602.6.2-Epoxy Coated Bars:** Epoxy coated bars shall be placed on plastic coated wire supports. Supports shall be installed in a manner to prevent planes of weakness in the hardened

concrete. The reinforcing steel shall be held in place by use of plastic or plastic coated tie wires especially fabricated for this purpose.

Any visible damage to the epoxy coating of the reinforcing steel that occurs during shipment, storage and installation of the steel shall be repaired. The ~~patching~~ Supplier shall furnish epoxy patching material to the project with the first shipment of epoxy coated steel. The patching material shall be prequalified as required for the coating material and shall be either identified on the container as meeting the requirements of AASHTO M284, Annex A ASTM A775 or shall be accompanied by a Certificate of compliance. ~~Patching/Repair~~ of damaged areas shall be performed ~~in accordance with the patching material manufacturer's recommendations per 709.1.4.~~

In the event it is anticipated that the epoxy bars will be stored on the project site, and/or placed in final position without the concrete cover for a period of 90 days or more, then the bars shall be stored in a temporary shed or covered with plastic to prevent damage to the epoxy coating due to ultra-violet rays or other atmospheric conditions. Any temporary storage means used, shall provide adequate ventilation to the bars to prevent the build-up of moisture on the bar surface.

**602.6.3-Galvanized Coated Bars:** Galvanized coated bars shall be placed on wire bar supports that are hot-dip galvanized, coated with epoxy or another polymer, or on supports made of plastic. Supports shall be installed in a manner to prevent planes of weakness in the hardened concrete. Galvanized reinforcing steel shall be held in place by use of zinc or polymer coated tie wire especially fabricated for this purpose.

Any visible damage to the galvanized coating of the reinforcing steel that occurs during shipment, storage and installation of the steel shall be repaired. If the extent of damaged coating does not exceed 2% of the surface area in any 1-foot length, all damaged coating discernible to a person with normal or corrected vision shall be repaired with a zinc-rich formulation in accordance with ASTM A780. If galvanized reinforcing bars are cut in the field, the bar ends shall be coated with a zinc-rich formulation in accordance with ASTM A780. The reinforcing bar Supplier shall furnish zinc-rich paint meeting the requirements of ASTM A780 to the project with the first shipment of galvanized coated steel. The repair material shall be prequalified and shall be either identified on the container as meeting the requirements of ASTM A780 or shall be accompanied by a Certificate of Compliance. Repair of damaged areas shall be performed in accordance with the repair material manufacturer's recommendations.

In the event it is anticipated that the galvanized bars will be stored on the project site, and/or placed in final position without the concrete cover for a period of 90 days or more, then the bars shall be stored in a clean and dry environment to prevent damage to the galvanized coating due to atmospheric conditions. Any temporary storage means used, shall provide adequate ventilation to the bars to prevent the build-up of moisture on the bar surface.

## **602.7-BAR SPLICES:**

**602.7.1-Lapping:** All reinforcement shall be furnished in full lengths as indicated on the Plans. No splicing of bars, except where shown on the Plans, will be permitted without the written approval of the Engineer. Lapped splices shall be well distributed or located at points

of low tensile stress. The bars shall be rigidly clamped or wired at all splices in a manner approved by the Engineer. Minimum lengths of lap splices unless otherwise noted shall be:

Bar Designation	Min. Lap Splice (Ft)
#4 Bar	1'-9"
#5 Bar	2'-2"
#6 Bar	2'-9"
#7 Bar	3'-9"
#8 Bar	4'-11"
#9 Bar	6'-2"
#10 Bar	7'-10"
#11 Bar	9'-7"

For epoxy coated bars, the minimum lap splice length shall be increased by 50 percent at locations where concrete cover is less than 3 bar diameters and 20 percent at all other locations.

Lapped splices for corrosion-resistant rebar shall be in accordance with the latest edition of the AASHTO LRFD Bridge Design Specifications.

**602.7.2-Welding:** Splicing by welding of reinforcement will be permitted only if detailed on the Plans or if authorized by the Engineer in writing. Welding shall comply with the current specifications of the American Welding Society, D-1.4, and the weld shall develop an ultimate strength equal to or greater than that of the bars connected. Welding of corrosion resistant reinforcement is not permitted.

**602.7.3-Mechanical Splice Connectors:** Mechanical splice connectors shall develop in tension or compression at least 125 percent of the specified yield strength of the bar.

#### **602.8-FABRIC REINFORCEMENT:**

Mesh sheets or uncoated reinforcing steel, except steel mesh, will be measured by the pound (kg), based on Plan lengths and numbers of bars, using the unit weights in Table 602.9. The quantity for payment will be the number of pounds (kg) calculated and placed as shown on the Plans or directed, complete in place and accepted, subject to adjustment as provided for in 104.2 and 109.2.

#### **602.9-METHOD OF MEASUREMENT:**

Galvanized, Epoxy-coated or uncoated reinforcing steel or corrosion resistant reinforcement, except steel mesh, will be measured by the pound (~~kg~~), based on Plan lengths and numbers of bars, using the unit weights in Table 602.9. The quantity for payment will be the number of pounds (~~kg~~) calculated and placed as shown on the Plans or directed, complete in place and accepted, subject to adjustment as provided for in 104.2 and 109.2.

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**TABLE 602.9**

Bar Designation	Weight Per Lin. Ft. in Lb. <del>(Mass kg per meter)</del>	Bar Designation	Weight Per Lin Ft. in Lb. <del>(Mass kg per meter)</del>
# 3 <del>(10)</del>	0.376 <del>(.560)</del>	# 9 <del>(29)</del>	3.400 <del>(5.060)</del>
# 4 <del>(13)</del>	0.668 <del>(.994)</del>	# 10 <del>(32)</del>	4.303 <del>(6.404)</del>
# 5 <del>(16)</del>	1.043 <del>(1.552)</del>	# 11 <del>(36)</del>	5.313 <del>(7.907)</del>
# 6 <del>(19)</del>	1.502 <del>(2.235)</del>	# 14S <del>(43)</del>	7.650 <del>(11.38)</del>
# 7 <del>(22)</del>	2.044 <del>(3.042)</del>	# 18S <del>(57)</del>	13.600 <del>(20.24)</del>
# 8 <del>(25)</del>	2.670 <del>(3.973)</del>		

**602.10-BASIS OF PAYMENT:**

The quantity, determined as provided above, will be paid for at the contract unit price bid for the items listed below, which price and payment shall be full compensation for furnishing, fabricating, transporting, storing and placing galvanized, epoxy coated, or uncoated reinforcing steel; and the furnishing of all other materials and doing all the work described in a workmanlike and acceptable manner, including all labor, tools, equipment, supplies, and incidentals necessary to complete the work.

**602.11-PAY ITEMS:**

ITEM	DESCRIPTION	UNIT
602001-*	Reinforcing Steel Bar	Pound <del>(Kilogram)</del>
602002-*	Epoxy Coated Reinforcing Steel Bar	Pound <del>(Kilogram)</del>
602003-*	Corrosion Resistant Reinforcing Steel Bar, "type"	Pound
<u>602004-*</u>	<u>Galvanized Reinforcing Steel</u>	<u>Pound</u>

\* Sequence number  
 "type" shall either be stainless or high chromium

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 625**

**ROCK SOCKETED DRILLED SHAFT**

**625.1-DESCRIPTION:**

The work of this section includes the furnishing of all materials and the construction of rock socketed drilled shaft foundations consisting of reinforced concrete placed within the drilled excavations. Each rock socketed drilled shaft foundation shall consist of an upper drilled shaft portion in a steel casing and a lower rock socket portion.

**625.2-SUBMITTALS:**

The Contractor shall deliver all submittals required by this specification to the Engineer no later than one month prior to constructing any rock socketed drilled shafts shown in the plans. No rock socketed drilled shafts shall be constructed prior to the Engineer's review and acceptance of all submittals.

**625.2.1-Experience:**

1. A satisfactory record of experience in rock socketed drilled shaft construction is of the utmost importance in obtaining a satisfactory rock socketed drilled shaft installation. The installation of the drilled shaft is required to be performed by a contractor or specialty subcontractor specializing in installing and having experience with rock socketed drilled shafts of similar length, diameter, and subsurface conditions as those shown in the contract documents.
2. The Contractor shall submit data on at least two projects performed during the past ten years, for which the Contractor, or Contractor's key personnel who will be the on-site supervisor, have installed rock socketed drilled shafts of a range of diameters and lengths similar to those shown in the plans, in similar quantities, and under similar subsurface conditions. The list of projects shall contain names and phone numbers of owners' representatives who can verify the participation in those projects.
3. The Engineer shall review and approve the Contractor's (Subcontractor's) qualifications. If in the opinion of the Engineer the Contractor's qualifications are not adequate, the Contractor shall submit to the Engineer a proposed method of obtaining the necessary qualifications.
4. The installation of all components of the drilled shaft including; drilling, reinforcement placement, concrete placement, and required wet hole condition work, casing installation

and removal, slurry placement, and any other work required to complete the rock socketed drilled shaft, shall be performed by the approved contractor or specialty subcontractor.

**625.2.2-Site Inspection:** A signed statement shall be submitted affirming that the Contractor (or the Subcontractor if applicable) has inspected the project site and the available subsurface information including any available soil or rock samples.

**625.2.3-Installation:** The Contractor shall comply with applicable environmental regulations, including but not limited to the protection of river/stream water from degradation due to material excavated from rock socketed drilled shaft locations or due to other harmful erosion, protection of the environment from slurry spillage or discharge if slurry is used, and general environmental protection of the area from all operations related to rock socketed drilled shafts.

The installation shall be in accordance with the Contractor's proposed Safety Plan per Section 625.6.1.7.

The Contractor shall provide a projected schedule of work to the MCS&T Technical Support Division, ~~DOHMCSnTeaission@wv.gov~~ DOHDrilledShafts@wv.gov, thirty (30) days in advance of construction of drilled shafts. This projected schedule will be used by the MCS&T Technical Support Division to schedule preinstallation core hole drilling and drilled shaft inspection.

**625.2.4-As-Built Records:** Within 24 hours of the completed construction of each drilled shaft, the Contractor shall submit a report on the actual location, alignment, elevation, and dimensions of the drilled shaft, and will also submit a completed drilled shaft log.

**625.3:** Blank

**625.4-DIMENSIONAL REQUIREMENTS:**

If the specified dimensional requirements are not met, the Contractor shall submit a corrective plan for any deviation from the drilled shaft location, alignment and elevation tolerances, and reinforcement dimensional requirements to the Engineer for approval. This approval may take up to fourteen (14) calendar days. The corrective plan shall be certified (signed by a Professional Engineer licensed in West Virginia knowledgeable in rock socketed drilled shaft installation). The cost of any corrective action shall be borne by the Contractor.

**625.5-MATERIALS:**

**625.5.1-Concrete:** Concrete for the rock socketed drilled shafts shall be Class DC and shall conform to the requirements of Section 601.

The design 28-day compressive strength shall not be less than 4500 psi unless shown otherwise in the Plans. The Contractor shall prepare a mix design in accordance with MP 711.03.23 to attain this strength. Slump for dry placement shall be 7 inches plus-or-minus 1 inch. Unless otherwise specified in the Plans, the cement shall be Type I.

For placement of concrete by tremie or pumping, the cement factor shall be increased by 94 lbs. from the original design cement factor, the slump shall be 8 inches plus-or-minus 1 inch and shall maintain a slump in excess of 4 inches throughout the concrete placement.

**625.5.2-Reinforcing Steel:** Reinforcing steel for main vertical bars and ties shall conform to Section 709.1, deformed type, grade 60. Reinforcing steel for use as spirals shall conform to Section 709.1, plain type, grade 60.

**625.5.3-Casing:** Metal casing shall be used in the upper drilled shaft portion of the rock socket drilled shaft to prevent caving of the soil material or to exclude ground water. Casing shall be metal, of unit or sectional construction, be strong enough to withstand handling stresses, withstand the pressures of concrete and of the surrounding earth and ground water, and prevent seepage of water. Also, the casing used shall be selected by the Contractor to control dimensions and alignment of excavations within tolerances, to seal the casing into impervious materials, and to execute all other construction operations.

Casing pipe used for permanent applications shall be new material and conform to ASTM A252, Grade 2. Casing pipe, when used for temporary applications only, will initially be required to meet the requirements of permanent pipe but when removed can be transferred to the contractor's stock and reused on subsequent projects.

Any required casing splices shall be welded with no interior splice plates, producing true and straight casing. All welding shall be in accordance with ANSI/AWS D1.1.

Permanent casing is required in all drilled shafts where noted on the plans. All temporary casing shall be removed during placement of concrete unless otherwise noted on the plans. Should the Contractor be unable to remove the temporary casing or if conditions require the temporary casing remain in place, the Contractor shall pressure grout the annular space between the casing and soil. Materials and methods for grouting operation shall be submitted to the Engineer for approval for the grouting operation. There shall be no additional cost to the Division for the grouting operation.

**625.5.4-Crosshole Sonic Logging (CSL) Testing Tubes:** Tubes required for CSL Tests shall be ASTM A53, Grade B, nominal 2-inch diameter. Hydrostatic test requirements are waived. Threaded Couplings shall be used per ASTM A865.

**625.5.5-Thermal Integrity Profiler (TIP) Wires:** Wire, equipment, and testing procedure shall conform to ASTM D7949, Method B.

**625.6-CONSTRUCTION:** The following sequence describes a generalized construction method that is expected to be appropriate for the installation of the rock socketed drilled shafts. Deviations will be permitted with the Engineer's approval.

- a. Contractor shall provide suitable access to the "Preinstallation Core Hole" location at each rock socketed drilled shaft.
- b. Drilling of a "Preinstallation Core Hole" will be performed by the Division\* as specified in 625.7.2.1.
- c. Drilling of cased hole through the soil overburden down to top of competent rock. Seating bottom of casing to minimize entry of ground water.
- d. Drilling of rock socket to the minimum diameter shown in the plans and to an elevation shown on the drawings or otherwise directed by the Engineer.
- e. Determination of wet or dry hole condition, by the Division\*, as specified in 625.7.2.2.
- f. Inspection of drilled hole for plumbness, by the Division\*, as specified in 625.7.2.3.



- g. Cleaning of the drilled hole by the Contactor, particularly the rock socket and the inside face of the casing, as specified in 625.7.2.5.
- h. Inspection of the drilled shaft sidewall and bottom cleanliness, by the Division\* as specified in 625.7.2.4 and 625.7.2.5.
- i. Placement of the pre-assembled cage of reinforcing steel with CSL tubes and/or TIP wires and securing it in place against movement during concreting and during casing withdrawal, as specified in 625.6.2. It also must be secured in such a way that the minimum clear cover over the bars is maintained.
- j. Placement of concrete in either dry or wet conditions. The temporary casing shall be withdrawn carefully and slowly so as not to leave any voids in the concrete and so as not to dislocate any reinforcing steel. Any concrete not meeting this specification's slump requirements will be rejected.
- k. Curing, stripping, and finishing shall be the same as for other structural concrete. Casing may be used as forms.
- l. Inspection of the concrete, by the Division\* as specified in 625.7.2.6.
- m. Corrective measures for any unacceptable drilled shaft, removal of water from the CSL tubes and filling with an approved grout. All core holes, as specified in 625.7.3, must be filled with an approved grout.

\* For Design Build / Alternative Project Delivery projects, the Design Build Team are responsible for the testing, however all notifications to the Division are required.

#### **625.6.1-Excavation:**

**625.6.1.1-Scope:** The Contractor shall perform all excavations required for the drilled shafts and the rock sockets, through whatever materials are encountered, to the dimensions shown in the plans, or required by the site conditions, or directed by the Engineer. The Contractor shall make each drilled shaft excavation available to the Engineer for inspection, providing tools, equipment, and safety measures as hereinafter specified. Based on preinstallation core hole information or on general inspection of the rock socket, the Contractor shall drill the rock socket deeper if directed by the Engineer.

**625.6.1.2-Excavation through Overburden:** Unless otherwise shown in the plans, rock socketed drilled shaft excavations in the overburden shall be vertical bored holes extending from the ground surface down to the surface of competent rock. Temporary or permanent casings shall be required down to the competent rock surface and be seated in rock in a manner that prevents caving and minimizes the entry of ground water. In the event of a groundwater condition, appropriate measures shall be taken subject to the Engineer's approval. Such measures may include pumping from within the excavation, external dewatering, or excavation through a slurry-filled hole until the casing can be seated and sealed.

**625.6.1.3-Excavation in Rock:** Rock sockets shall be excavated to the dimensions and depths shown in the plans, forming a bearing area at the bottom of the socket, flat to within a tolerance of ½ inch per foot. Each socket shall be excavated into continuous rock for the indicated length. Blasting methods will not be permitted.

The top elevation of competent rock must be confirmed as the socket drilling is started. The effective "top elevation" is based on observation of the boundary zone where broken or weathered rock becomes competent rock and is also influenced by the presence of any

shale or coal seams. Based on that elevation, and the information from the preinstallation core hole, the Engineer will determine the final depth of socket and bottom elevation.

Upon completion of each rock socket excavation, the Engineer may (1) accept the socket, or (2) order deeper excavation based upon preinstallation core hole data or general inspection of the socket. The adequacy of each socket will depend on the soundness of its bottom surface and on the soundness of its underlying layers.

Contractor is cautioned not to over-drill the rock sockets. Unauthorized over-drilling will be at the Contractor's expense. In the case where over-drilling would bring the drilled shaft base too close to a coal seam or other weak layer, then drilling must be extended through such weak layer, at the Contractor's expense, to a satisfactory deeper bearing level as determined by the Engineer.

No portion of the rock socket shall be exposed to drilling fluid or groundwater for more than 96 hours. Any portion of the rock socket exposed to drilling fluid or water for more than 96 hours, and any portion of the rock socket which, in the opinion of the Engineer, has deteriorated due to exposure to air or water, shall be reamed with an approved grooving tool to a depth of not less than ¼ inch, or as directed by the Engineer. Reaming of the socket, if necessary, is considered incidental to the cost of drilling the rock socket, and no separate payment will be made for this work.

**625.6.1.4-Providing for Socket Inspection:** Upon completion of the excavation of each rock socket, and upon mechanical cleaning of the socket, the Contractor shall make the socket available to the Engineer for inspection, as specified in 625.7.

**625.6.1.5-Disposal of Materials:** Disposal of excavated materials shall be accomplished under the general provisions of Section 207.6.

**625.6.1.6-River/Stream Area:** Rock socketed drilled shaft construction in the river/stream shall employ whatever special methods the Contractor finds necessary for access and for accomplishing the work. These methods may include cofferdams, temporary causeway, or other suitable measures. The Contractor will be responsible for conforming to all regulatory and environmental requirements related to the river/stream and for obtaining any permits that are required by ~~his~~-their river/stream operations.

**625.6.1.7-Safety Measures:** Safety of all persons is to be considered an objective of the utmost importance on all projects. Therefore, the Contractor shall take whatever measures are necessary to protect ~~his~~-their own personnel, ~~his~~-subcontractors' personnel, the Engineer or other agents of the state, regulatory personnel, and others including the general public. The following list is presented as representative of issues that the Contractor must address. It is not intended as all-inclusive and does not relieve the Contractor of conforming to other regulations, laws, requirements, or other measures reasonably required for safe excavating operations. The Contractor shall develop a safety plan in accordance with these requirements and provide this plan to the Engineer for ~~his~~-their review.

- a. Any required equipment within an excavation shall be operated by air or electricity. The use of gasoline-driven engines or diesel engines within an excavation will not be permitted. All lighting shall be electric, and precautions shall be taken regarding potential short circuits of electric current within ground water.

- b. The Contractor will take precautions to assure that no explosive or noxious gases are present. Fresh air shall be supplied into the excavation and foul air shall be removed whenever any personnel are present in the hole.
- c. A safety harness or chair lift, with separate safety line, protective cage, and two-way radio communication shall be used for any entry into an excavation.
- d. No open excavation shall be left unattended. During non-working hours excavations shall be protected using solid, safe covers that are firmly fastened in place.

**625.6.2-Reinforcing Steel Installation:** Prior to installation of reinforcing steel, the steel cage shall be checked and cleaned of any materials that would tend to prevent bonding. The excavated hole shall also be checked, and any remaining or newly deposited debris shall be removed. Immediately upon the Engineer's approval of the condition of the cage and his acceptance of the socket, and just prior to placement of concrete, the fully assembled cage of reinforcing steel shall be installed into the excavation.

The cage will consist of longitudinal (vertical) bars, spiral or tie bars, cage stiffener bars as required, spacing devices, and any other appurtenances required to maintain alignment, shape, and clearances. Cages shall include steel tubes and TIP wires in shafts where CSL and TIP testing is to occur as outlined in 625.6.2.1. Each cage shall be placed in one unit by lowering into the hole in a manner that will prevent distortion. Concrete spacers or other approved noncorrosive spacing devices shall be used at sufficient intervals (near the bottom and at intervals not exceeding 10 ft along the rock socketed drilled shaft) to ensure concentric spacing for the entire cage length. The minimum number of centering devices at each level shall be three. All steel centering devices with less than 3 inches of concrete cover shall be epoxy coated. The cage shall be supported from the top by use of a ground surface frame or other positive means. Setting the cage on the socket bottom without support will not be permitted. The Contractor may, with the approval of the Engineer, remove the top support after sufficient concrete has been placed to adequately support the cage vertically and prevent distortion or racking of the cage.

The bottom of the reinforcing steel cage shall be a minimum of 3 inches and a maximum of 24 inches from the bottom to the rock socketed drilled shaft excavation. Additional clearance may be approved by the Engineer.

All intersections of rock socketed drilled shaft reinforcing steel shall be tied with cross or "figure 8" ties. The reinforcing steel in the drilled shaft shall be 100% tied and supported so that the reinforcing steel will remain within allowable tolerances for position. Unless otherwise shown in the plans, splicing shall be by mechanical connectors or couplers which develop at least 125% of yield strength of the reinforcing bar. No more than 50% of the longitudinal reinforcing shall be spliced within 60 bar diameters of any lapped splice location or within 2 ft of any mechanical splice or coupler location. Cage stiffener bars shall be used as required to provide a reinforcement cage of sufficient rigidity to prevent racking, permanent deformations, etc. during installation. If the concrete is to be placed by the free-fall method, these bars must first be removed.

In the event that the rock socketed drilled shaft has been excavated below the anticipated tip elevation, the reinforcing cage may be extended at the tip (bottom) end by lap splices, mechanical connectors, or welded splices in conformance with the Standard Specifications. In this instance, splices need not be staggered and 100% of the reinforcing bars may be spliced at a given location. Lap splice lengths shall be as shown in the plans or approved by the Engineer.

Prior to placing the reinforcement cage, the Contractor shall demonstrate to the satisfaction of the Engineer that the fabrication and handling methods to be used will result in a reinforcing cage

placed in the proper position, with the proper clearances, and without permanent bending or racking of the reinforcement cage.

The elevation of the top of the steel cage shall be checked before and after the concrete is placed. If the rebar cage is not maintained within the specified tolerances, corrections shall be made by the Contractor to the satisfaction of the Engineer. No additional drilled shafts shall be constructed until the Contractor has modified ~~his~~-the reinforcement cage support system in a manner satisfactory to the Engineer.

**625.6.2.1-Contractor Preparation for Testing:** To accommodate the CSL and TIP test requirements, the Contractor shall install the appropriate number of tubes and/or TIP wires in each drilled shaft to be tested. The number of tubes and wires per drilled shaft shall be as tabulated below:

**TABLE 625.6.2.1**

<b>Drilled shaft Diameter</b>	<b>Number of CSL Tubes</b>	<b>Number of TIP wires</b>	<b>Tube / Wire Spacing</b>
Less than 42"	3	0	120°
42" to ≤ 60"	4	0	90°
> 60" to ≤ 96"	6	6	60°
Greater than 96"	8	8	45°

The tubes shall be per 625.5.4. Each tube shall have a round, regular internal diameter free of defects or obstructions including defects or obstructions at pipe joints; in order to permit the free, unobstructed passage of 1½ inch diameter source and receiver probes. The tubes shall be watertight and free from corrosion with clean internal and external faces to ensure passage of the probes inside and a good bond with the concrete outside.

Each tube shall be fitted with a watertight shoe on the bottom and a removable cap or plug on the top. The tubes shall be securely attached to the interior of the reinforcing steel cage. The tubes are typically wire-tied to the reinforcing cage every 40 inches, or otherwise secured such that the tubes stay in position during placement of the cage and during placement of concrete. The tubes shall be installed in each shaft in a regular, symmetric pattern such that the tube spacing in degrees will correspond to that shown in the table above.

The tubes shall be as near to parallel as possible. They shall extend from 6 inches above the drilled shaft bottom to at least 40 inches above the drilled shaft top. No tube may be allowed to rest on the bottom of a drilled excavation. If the drilled shaft top is sub-surface, then the tubes shall extend at least 2 feet above the ground surface or above the water surface if the ground surface is below water. Any joints required to achieve full length tubes shall be made watertight. The Contractor shall investigate all CSL tubes, making sure that there are no bends, crimps, obstructions or other impediments to the free passage of the testing probes. A record of the tube lengths, including a note of the projection of the tubes above the top of the shaft shall be made. The Contractor shall provide information on the shaft bottom and top elevations, length and construction dates to the Engineer prior to the CSL tests. Care shall be taken during placement of the reinforcing steel cage so as not to damage the tubes.

After placement of the cage, and before placement of concrete, the tubes shall be filled with clean water and the tube tops shall be capped or sealed to keep debris or other foreign

matter out of the tubes. Care shall be exercised in the removal of caps or plugs so as not to apply excess torque, hammering, or other stresses that could break the bond between the tubes and the concrete.

The TIP wires shall be per 625.5.5.

**625.6.3-Placement of Concrete:** Method of placement shall be determined by measuring the water infiltration rate into the shaft as specified in Section 625.7.2.2. Concrete placement for wet hole shall be placed by tremie. Free fall placement shall be permitted for dry hole condition, except that free fall height shall not exceed 5 feet unless the concrete is placed using a drop chute or centering device. Free fall height is not restricted as long as a drop chute or centering device is used, and the concrete is directed down through the center of the shaft without directly hitting the reinforcing cage or the sides of the hole. Dry hole shall not have more than 3 inches of water in the bottom of hole at start of concrete placement.

Prior to concrete placement, the Contractor shall make all necessary arrangements to ensure the uninterrupted delivery of concrete so that there will not be any cold joints in the drilled shafts. Placement of concrete shall generally conform to the applicable portions of Section 601.10. The rate of placement of concrete, as related to the height of fresh concrete at any time, will be subject to the Engineer's approval. The placement method will be developed by the Contractor, taking account of set time, hydraulic pressures and casing removal.

All costs of replacement of defective drilled shafts shall be the responsibility of the Contractor and shall be at no cost to the Division.

After the concrete level has reached the required top elevation, it shall be forced to overflow in the case of tremie or pump placement, leaving only fresh, uncontaminated concrete. In the case of placement by free fall (dry conditions), the concrete shall be continued high enough to compensate for any settlement due to removal of casing.

The top 10 feet of each rock socketed drilled shaft shall be vibrated except when more than 10 feet is to be exposed above the ground line or the riverbed/streambed, then the entire exposed portion shall be vibrated. The concrete shall not be vibrated until after any temporary casing is removed. Exposed portions of each rock socketed drilled shaft shall be cured in accordance with Section 601.12.

**625.6.4-Removal of Casing:** Removal of the casing from a shaft may occur gradually as concrete is placed. Insofar as possible, casing extraction shall be done at a slow uniform rate by application of a steady vertical upward pull in the direction of the axis of the shaft. To facilitate extraction, tapping on the casing, exertion of temporary downward pressure, slight rotation, or the controlled use of a vibratory hammer will be permitted, but care must be taken to avoid harmful impacts or disturbances to the fresh concrete. Vibration or rodding may not be used to break the casing loose for extraction.

If, during extraction of casing, upward movement of concrete and/or reinforcing steel occurs, the Engineer shall be notified immediately. If the Engineer considers the movement to be minor, then the extraction of the casing may continue. If, however, the movement is deemed significant and indicative of squeezing of the surrounding soil thus resulting in a reduction of the drilled shaft diameter, then the Engineer may order the casing to be left in place, or permit extraction to proceed and order a later non-destructive load test, or may order other procedures as appropriate at no additional cost to the Division.

For the upper portions of rock socketed drilled shafts that will be exposed and visible, the casing may remain in place as a form until the concrete has attained a strength that enables it to stand alone without further deformation. Casing shall then be removed.

## **625.7-INSPECTION OF SOCKETS:**

**625.7.1-Inspection:** The Engineer will inspect the shaft as outlined in 625.7.2.4 and 625.7.2.5.

Time required for inspection will be considered incidental to the work and will not be cause for extra compensation related to a claim or extension of contract time.

### **625.7.2-Division Testing:**

**625.7.2.1-Preinstallation Core Holes:** The Contactor shall provide notice to the ~~MCS&T—Technical Support~~ Division via e-mail (~~DOHMCSnTcaisson@wv.gov~~) (~~DOHDrilledShafts@wv.gov~~)—when each site is ready for drilling. The Division will commence drilling of the preinstallation core hole within 5 working days after notification from Contractor that site has suitable access for drilling.

A preinstallation test boring will be drilled by the Division at each rock socketed drilled shaft location, or as shown on the plans, to determine the character of the material that the rock socketed drilled shaft extends through and the material that is at the base of the shaft in order to ensure the material along and below the tip of the rock socket is capable of carrying the load that will be imposed on it. The preinstallation borings are to be drilled prior to beginning excavation for each representative rock socketed drilled shaft. The Contractor shall provide all work necessary to allow access for the drill rig to the preinstallation test boring location, which at a minimum shall include constructing drill pads and access roads.

Unless otherwise directed, the preinstallation test borings are to be extended a minimum depth of 2 upper drilled shaft diameters but not less than 10 feet below the planned tip elevation of the rock socketed drilled shaft shown on the plans. Standard Penetration Testing (SPT) and sampling shall be performed at 5-foot intervals in the preinstallation borings in accordance with AASHTO T 206. Rock coring will be performed in accordance with ASTM D2113 using a wireline core barrel system and will commence immediately upon obtaining an SPT value of 50 blows per 6-inches or less on bedrock. The recovered core sample size will be approximately 2-inch diameter (NX or NQ size). Additional preinstallation test borings in other locations may be required where directed by the Engineer.

Test boring logs of each preinstallation boring will be prepared by the Division and will be provided to the Contractor within 3 working days of completion of the test boring. The preinstallation test borings logs will describe the type and thickness of all soil and rock layers, and locate the presence of groundwater, open joints, voids, soft rock, or other deleterious material. All recovered soil and rock samples shall be maintained by the Division and stored on site at suitable location, provided by the Contractor, until completion of the project.

Within 10 working days after completion of preinstallation core hole, the Engineer will notify the Contactor of the final tip elevations for each drilled shaft location.

**625.7.2.2-Wet or Dry Hole Determination:** The Division will check the depth of water at the bottom of the drilled shaft. If the depth does not increase by more than 12 inches over a 1-hour period, the hole will be considered dry. Otherwise, the hole will be considered wet.

**625.7.2.3-Plumbness:** Contractor shall provide notice to the ~~MCS&T-Technical Support~~ Division via e-mail ~~(DOHMCSnTeaisson@wv.gov)~~ (DOHDrilledShafts@wv.gov) 5 working days prior to the date each drilled shaft will be ready for inspection.

Plumbness of the rock socketed drilled shaft/rock socket shall be measured by the Division by measuring the geometry of the drilled shaft excavation using SHAPE, Sonicaliper, or other suitable means. For any rock socketed drilled shaft, the maximum permissible deviation from plumb shall be 1.5% measured with respect to the vertical axis at the center of the drilled shaft excavation.

The Contractor shall provide suitable access and means for lowering inspection equipment into the drilled shaft excavation.

For any rock socketed drilled shaft at its top, the maximum deviation of the center shall be 3 inches from its project plan location. The maximum deviation of the finished top of shaft from the plan elevation shall be minus 1 inch or plus 3 inches. An absolute minimum cover of 3 inches to the reinforcing steel is strictly required. In the event of any deviations in the dimensional requirements, the contractor shall not proceed with construction of pier columns or cap until submission and approval of a corrective plan has been granted.

**625.7.2.4-Rock Sock Sidewall Inspection:** Contractor shall provide notice to the ~~MCS&T-Technical Support~~ Division via e-mail ~~(DOHMCSnTeaisson@wv.gov)~~ (DOHDrilledShafts@wv.gov) 5 working days prior to the date each drilled shaft will be ready for inspection.

The Division will inspect the rock socket side walls with a downhole camera or other suitable device. The Engineer shall evaluate the rock quality and construction, as outlined in 625.6.1.3.

**625.7.2.5-Shaft Bottom Cleanliness:** Contractor shall provide notice to the ~~MCS&T-Technical Support~~ Division via e-mail ~~(DOHMCSnTeaisson@wv.gov)~~ (DOHDrilledShafts@wv.gov) 5 working days prior to the date each drilled shaft will be ready for inspection.

The contractor shall clean the rock socket so that a minimum of 75% of the base will have less than ½ inches of sediment at the time of placement of the concrete. Sediment depth at any location shall not exceed 1 ½ inches. The Division shall determine shaft cleanliness by using a mini-SID, SQUID, or other suitable device. The contractor shall use an air-lift to achieve the required bottom cleanliness.

The contractor shall begin concrete placement in the shaft within 3 hours after the shaft bottom cleanliness is approved. If concrete placement in the drilled is not started within 3 hours, the rebar cage shall be removed, and hole shall be re-inspected at no additional time to the Contractor or cost to the Division.

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**625.7.2.6-In-place Concrete Quality Testing:** The Contractor shall furnish and place the Crosshole Sonic Logging (CSL) tubes and thermal integrity profiler (TIP) wires in all drilled shafts. The number of tubes and tip wires to be used shall be as specified in 625.6.2.1. The Division will perform the testing and provide a report of the drilled shaft integrity testing to the Contractor. The CSL tubes shall remain open in the shaft and be grouted by the Contractor after acceptance of that shaft.

**625.7.2.6.1-Crosshole Sonic Logging (CSL):** The nondestructive testing method known as CSL shall be used on any rock socketed drilled shaft which is constructed with the placement of concrete under wet conditions or as required in the plans. The testing shall not be conducted until at least three (3) calendar days after placement of concrete is concluded in the drilled shaft and will be completed within fourteen (14) calendar days after such placement.

The CSL tests shall be conducted in conformance with ASTM D6760 and by a testing company approved by MCS&T Technical Support Division.

The Contractor shall comply with the scheduling and notification requirements for drilled shaft construction outlined in Section 625.2.3 by contacting the following MCS&T Technical Support Division e-mail address: ~~(DOHMCSnTeaisson@wv.gov)~~ (DOHDrilledShafts@wv.gov). This will allow MCS&T Technical Support Division to provide a qualified company to perform testing within the time frames allotted for in this subsection.

**625.7.2.6.1.1-CSL Testing Results:** The CSL test results will be compiled into a drilled shaft integrity testing report for each drilled shaft. The report will summarize and analyze any defect zones indicated on the logs. A copy of each report will be provided to the Contractor.

**625.7.2.6.1.2-Evaluation of CSL Test Results:** The Engineer will review the report and, if the report determines that the drilled shaft is acceptable, will submit to the Contractor in writing within seven (7) calendar days approval to proceed with the work.

The rating of the rock socketed drilled shaft integrity will consider the increases in first arrival time (FAT) and the energy reduction relative to the FAT or energy in a nearby zone of good concrete. The criteria for rating the concrete from the CSL test will be:

<b>TABLE 625.7.2.6.1.2</b>	
<b>Rating</b>	<b>Criteria</b>
Good (G)	FAT increases 0-10% and energy reduction < 6 db
Questionable (Q)	FAT increases 11-20% and energy reduction < 9 db
Poor / Flaw (P/F)	FAT increases 21 to 30% or energy reduction of 9 to 12 db
Poor / Defect (P/D)	FAT increases 31% or more or energy reduction >12 db

Flaw or defect zones as indicated in Table 625.7.2.6.1.2 will be indicated on the logs and listed in a table within the report. The flaw or defect zones and their horizontal and vertical extent will be discussed in the report text. Flaws will be addressed by the Division if they affect more than 50% of the tested tube pairs at the same depth. Defects will be



addressed by the Division if they affect two or more of the tested tube pairs at the same depth. At a minimum, addressing flaws and defects will include Crosshole Tomography (CT). If it is determined that the rating is less than Questionable, based on the results of the CSL and CT testing, the Division will require core drilling and sampling by the Contractor for further evaluation of the flaw or defect at no additional cost to the Division. The diameter, number, depth, and location of cores shall be as directed by the Engineer.

The acceptance of each drilled shaft shall be the decision of the Engineer, based on the results of the drilled shaft integrity testing report and other information on the drilled shaft placement. Rejection of a drilled shaft shall require conclusive evidence that a defect exists in the drilled shaft, which will result in inadequate or unsafe performance under service loads. If the Non-Destructive Testing records are complex or inconclusive, the Engineer will require the Contractor to verify drilled shaft conditions by core drilling. If a flaw or defect is confirmed, the Contractor shall pay for all coring and grouting costs. If no flaw or defect is encountered, compensation for all coring and grouting will be in accordance with 104.3 and 109.4.

**625.7.2.6.1.3-Remedial Action:** In the case that any rock socketed drilled shaft is determined to be unacceptable, the Contractor shall submit a plan for remedial action to the Engineer for approval. The approval or rejection of the remediation plan may take up to fourteen (14) calendar days. If the remediation plan is rejected the Contractor shall revise the plan and submit it for approval and the approval time is restarted. Any modifications to the rock socketed drilled shaft and load transfer mechanisms caused by the remedial action will require calculations and working drawings stamped by a Professional Engineer licensed in the State of West Virginia for all foundation elements affected. All labor and materials required to perform remedial drilled shaft action shall be provided at no cost to the Division and with no extension of the contract time.

**625.7.2.6.2-Thermal Integrity Profiler (TIP):** Perform TIP testing using the embedded thermal wire array, and in accordance with the ASTM D7949 (method b). Thermal integrity profiling is performed to evaluate shaft integrity and location of the reinforcing cage. The number of wires to be used shall be as specified in 625.6.2.1. Thermal wire cables shall be connected to a thermal access port (TAP) immediately following casting.

The Contractor shall provide cooperative assistance and labor as required to assist the Division in inspecting the thermal wires prior to concreting the shaft. Prior to TIP testing, the contractor shall provide shaft installation details to the TIP consultant. Because the method relies on the heat of hydration, tip testing is generally performed between 8 and 48 hours of concrete placement (note the optimum TIP testing time is dependent on shaft size and concrete mix and could range from 4 to 72 hours).

**625.7.2.6.2.1-Criteria to be used for acceptance or rejection of rock socketed drilled shaft using TIP testing:** The rating of the shaft integrity using tip shall consider variations in temperature as measured by the thermal wires. Potential local anomalies may be indicated by locally low temperatures relative to the average temperature at that depth, or average temperatures significantly lower than the average temperatures at other depths. The criteria for rating the concrete from the TIP test shall be:

Satisfactory (s) = 0 to 6% effective radius reduction and cover criteria met  
 Anomaly (a) = effective radius reduction > 6% or cover criteria not met

When a tested shaft is categorized as anomaly (a), slices modeled at the area of question may be provided so that a structural evaluation of the shaft can be performed prior to implementing any corrective measures. Core drilling shall be performed to investigate problem areas found during TIP testing.

**625.7.3-Evaluation by Core Drilling:** A rock socketed drilled shaft that is found to be unacceptable shall be core drilled by the Contractor in accordance with ASTM C42. Cores shall be 4 inch nominal diameter. One or more core holes shall be drilled at the location(s) as determined by the Engineer. An accurate log of the core shall be kept, and the core shall be crated and properly marked showing the drilled shaft depth at each interval of core recovery. The core and one copy of the coring log shall be provided to the Engineer.

The Engineer shall determine if the rock socketed drilled shaft is acceptable. The Engineer will submit to the Contractor in writing within seven (7) calendar days approval to proceed with the work. If the quality of the drilled shaft is determined to be unacceptable, then the Contractor shall proceed in accordance with 625.7.2.6.1.3.

**625.8-METHOD OF MEASUREMENT:**

Rock socketed drilled shafts and Rock Socket foundations will be measured by the linear foot. For payment purposes, the drilled shafts are the portion from the finished top of each rock socketed drilled shaft to the top of competent rock. Rock Socket is the portion from the top of competent rock to the bottom of the drilled shaft rock socket as shown in the plans or as directed by the Engineer. Each measured drilled shaft is to be complete in place, accepted, and ready to function. "Top of drilled shaft" is the top of concrete as shown in the plans. "Top of competent rock" is as tabulated in the drilled shaft schedules in the plans unless a difference of one 1 foot or more is found during drilling.

**625.9-BASIS OF PAYMENT:**

The accepted quantities of rock socketed drilled shaft foundations, measured as provided above, will be paid for at the contract unit price per linear foot; complete in place including excavation, slurry if required, temporary or permanent metal casing, steel reinforcing, concrete, curing, and any required forming and finishing. No additional payment will be made for temporary casing that remains in place and pressure grouting due to the Contractor's inability to stabilize a drilled excavation, for the need to place concrete by tremie or pumping, for the need to use slurry for drilling, or for extra excavation and concrete that may be required due to drilling diameters larger than the minimum diameters specified. No additional payment will be made for methods employed to gain access to rock socketed drilled shaft construction or for means required to provide a dry working environment within the drilled shafts. Tubes for CSL testing, TIP wires, and other responsibilities related to testing and inspection assistance are incidental, with no separate payment being made.

**625.10-PAY ITEMS:**

ITEM	DESCRIPTION	UNIT
625001-*	Drilled shaft "D" Diameter	Linear Foot
625003-*	"D" Rock Socket	Linear Foot

March 14, 2022

\* Sequence number  
D = Diameter of shaft, in inches

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**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SPECIAL PROVISION**

**FOR**

**STATE PROJECT NUMBER:** \_\_\_\_\_

**FEDERAL PROJECT NUMBER:** \_\_\_\_\_

ADD THE FOLLOWING:

**SECTION 628  
EXPLORATORY DRILLING AND SAMPLING**

**628.1-DESCRIPTION:**

This work shall include exploratory drilling at locations designated in the plans, or as directed by the Engineer. The exploratory drilling work shall be performed after the excavation to highway grade is completed.

**628.2-EQUIPMENT:**

All equipment and tools shall be subject to the approval of the Engineer. They shall be modern, in condition of good repair, and capable of doing the work herein described.

**628.3-EXPLORATORY DRILLING:**

**628.3.1-Drilling:**

**628.3.1-Core Borings:** Those borings designated core boring in these specifications shall include investigation of both the soil and rock portions within a specified boring and shall be accomplished as follows:

**628.3.1.1-Soil Portion:** Soil borings shall be made for the purpose of ascertaining the nature and elevation of each stratum of material encountered above rock. Test samples shall be collected as outlined in AASHTO Designation T-206. Unless otherwise specified or directed, sampling will be of the Standard Penetration Test (SPT) method. The soil boring may be advanced by Rotary Drill. If required to maintain an open hole and facilitate sampling, Rotary Drill - Mud Method or Rotary Drill - Cased Boring Method, which are described below, may be used:

- a) Rotary Drill - Mud Method: Any method which demonstrates to the satisfaction of the Engineer successful advancement of the boring maintaining an open hole and permitting the securing of disturbed and undisturbed samples, and SPT blow counts shall be permitted. The method described in Bulletin 35, Waterways Experiment

Station, Corps of Engineers, U.S. Army, Vicksburg, Mississippi, is a satisfactory method.

- b) Rotary Drill - Cased Boring Method: This method shall be considered satisfactory for advancing the boring, maintaining an open hole and securing disturbed and undisturbed samples, and SPT blow counts. The hole shall be advanced by driving steel casing of such inside diameter to accommodate the sampling equipment herein described. The casing shall be driven without the use of wash water, but the soil within the casing may be removed by wash method to the depth at which a sample is to be taken. The contractor shall maintain a clean hole when performing Standard Penetration Testing. This shall be accomplished by augering with a center head assembly inside of the hollow stem auger or other proven method to prevent cuttings from entering the hollow stem auger that will affect the SPT sampling.

**628.3.1.2-Rock Portion:** When rock is encountered within the specified boring depth, core drilling shall be accomplished in accordance with AASHTO T-225 except that only drills with hydraulically or mechanically activated feeds or thrusts will be permitted and only double tube core barrels will be allowed. Only NX size core shall be recovered unless otherwise stated or by approval of the Engineer.

- a) Determination of Top of Rock: Unless otherwise specified by the Engineer, Standard Penetration Testing shall be performed at five (5) foot intervals until a blow count of 25 over six (6) inches of penetration is obtained, and the sample displays rock-like structure. This material is defined as Intermediate Geo Material (IGM) and shall be treated as rock.
- b) Sampling of IGM: Standard Penetration Testing shall be performed on 2.5-foot interval once an IGM is encountered until or a blow count of 50 over six (6) inches is obtained. Once 50 over six (6) inches of penetrations is obtained, the Contractor shall attempt rock coring; provided the rock is suitable to be cored. In any event, rock coring shall commence at 50 over three (3) inches. It is the intent of this specification to obtain samples by core drilling at the earliest opportunity after encountering IGM. Advancing much of a five (5) foot auger for placement of its top near the ground surface is not acceptable. Use of a short auger section will sometimes be required to satisfy this requirement.
- c) Encountering Boulders/Cobbles: Where boulders and/or cobbles are encountered the Contractor may believe that the top of rock has been reached. Once penetrating the encountered boulder/cobble with the appropriate core barrel, the contractor will again encounter unconsolidated material. The Contractor, under these circumstances, shall ream the borehole, or advance the borings by other means acceptable to the Engineer, to continue downward once again utilizing the Standard Penetration Testing method. This method shall be employed until bedrock is encountered at which time rock coring shall commence.

**628.3.2-Water Level Measurements:** The Contractor shall take water level measurements, measured from the ground surface, during the drilling operation at the following intervals:

1. During augering through the overburden soils when there is an indication that a water table has been encountered (i.e. saturated split spoon samples, water coming out of the auger hole with cuttings, water marks on the drill rods or split spoons, etc.) A

water level measurement taken during augering through the overburden soil, and before water is introduced into the drill hole, shall be termed “Immediate” and recorded on the boring logs.

2. At the completion of auger advancement and prior to beginning coring operations. A water level measurement shall be attempted before introducing water into the hole for core drilling. A water level measurement taken at the completion of augering and prior to coring shall be termed “Before Coring” and recorded on the boring logs.
3. Immediately after the completion of drilling and prior to removal of the hollow stem augers from the hole. A water level measurement shall be taken at this time. A water level measurement taken at this time shall be termed “At Completion” and recorded on the boring logs.
4. At some time period after the “At Completion” water level measurement is taken (typically 24 hours). If the Contractor has been instructed to backfill the core hole immediately by the Engineer and cannot leave the core hole open due to safety or environmental reasons, or the core hole caves in, then no measurement will be required at this time. A water level measurement taken at this time, if taken, shall be termed “After ‘X’ Hours” and recorded on the boring logs.

### **628.3.2-Sample Collection & Preparation:**

**628.3.2.1-Sample Types:** The following listed sample types may be required. Each sample shall be clearly and permanently identified by project number, boring number (or station and offset for sample that would otherwise lack reference to its location), sample depth, and date material is sampled. Facilities for temporary storage of samples shall be provided by the Contractor. All samples will be kept from freezing until the Engineer has observed and evaluated the sample. Under no circumstances will samples selected for testing be permitted to freeze.

- a) **Thin Wall Tube Samples:** Thin wall tube samples with a minimum diameter of 3 inches shall be recovered at the locations and depths indicated in the contract documents or as directed by the Engineer. Advancement of the boring to the elevation at which the sample is to be taken will be by the rotary drill – cased boring method as previously described herein. The apparatus, collection, and preparation of the sample shall be in accordance with AASHTO Designation T-207.
- b) **Standard Penetration Test & Split-Barrel Samples:** Standard penetration samples required in the normal advancement of borings Engineer shall be obtained in accordance with AASHTO Designation T-206. Representative samples of material shall be placed immediately in tightly capped glass jars. The jars will be of a size which can be stored in standard core boxes (approximately 2.5 inches by 5 inches). The jar samples shall be properly identified and boxed in core boxes or containers with individual jar compartments.
- c) **Rock Core Samples:** When rock is encountered, a continuous core of rock shall be recovered to the depth specified or directed by the Engineer. When a rock core is to be retained for reasons other than photographing as directed by the Engineer, the contractor shall provide wooden or other durable material boxes to retain the core in the manner described in AASHTO Designation T-225. Rock core from more than one boring shall not be packed in a single box. The boxes shall have approximate inside dimensions of 48 inches by 12 inches by 2.5 inches. All core boxes for structure borings shall be provided for the use of the Engineer for the purpose of

- photographing the cores.
- d) **Bag Samples:** At locations indicated in these specifications or as directed by the Engineer, bag samples will be required. These samples shall be placed in a tightly woven plastic lined cloth bag with identifying sample sheets placed inside the bag and attached to the outside. In addition, for field moisture determination, a small sample bearing the same identification shall be placed in a taped Zip Loc® bag and included inside the bag. The quantity required per bag sample shall be not less than 40 lbs. For samples to be taken in water, the samples are to be obtained utilizing a hand bucket auger or other device approved by the Engineer.

### **628.3.3-Reporting:**

**628.3.3.1-Boring Log:** Within 72 hours after completion of a boring, one copy of the field boring log exactly as recorded by the driller shall be submitted to the office of the Engineer. The driller's log shall contain the following information:

1. **Heading:** The heading of each boring log shall contain the following information:
  - a. Project number and common name, as designated on the location plan.
  - b. Boring number, if applicable, as designated on the location plan.
  - c. Location, referenced to centerline of survey stationing, and offset measured to the nearest foot.
  - d. Method of drilling and sampling employed.
  - e. Diameter of borings.
  - f. Date of start and date of completion of borings.
  - g. Name of driller.
  - h. Ground surface elevation of boring. Elevation of top of water and stream bed in water borings.
  - i. Sheet number and total number of log sheets for each boring.
2. **Sub-Surface Conditions:** The boring log of subsurface conditions encountered and samples secured shall include the following:
  - a. Depth of layer boundaries.
  - b. A description of each layer encountered in the following order: color, material description, minor constituents, grain size, structure, weathering, moisture, and stiffness/hardness as applicable.
  - c. Field number of each sample taken and depth at which taken.
  - d. Depth of water observed in the boring.
  - e. Depth at which obstacles were encountered in advancing the boring; such as boulders, metal, or caving material.
  - f. Number of blows required to drive casing per foot where applicable.
  - g. Depth to which casing was driven or installed.
  - h. Length of drive for soil samples and length of sample recovered.
  - i. Number of blows required to drive sampler when Standard Penetration Test is used and hammer type. (automatic or cathead and rope).
  - j. Length of each run for rock core and footage of core recovered by each run.
  - k. Record of color of drilling fluid and type of cuttings flushed to surface in advancing the boring.
  - l. Interval or depth where drilling fluid returned, or circulation was lost.
  - m. Record of changes occurring in rate of advance of bit when coring rock.
  - n. Thickness of sod cover to nearest 0.1 foot and depth of humus or surface soil

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- zone to nearest 0.1 foot.
- o. Reason for abandoning the boring if specified depth was not reached.
- p. Any unusual conditions encountered in advancing the boring and in sampling.
- q. Rock Quality Designation (RQD) - The RQD percentage is to be recorded for each core run. RQD is defined as the total length of recovered core pieces 4 inches or greater in length expressed as a percentage of the core run. Generally, RQD should be based on consistent 5 foot or 10-foot core runs.
- r. Hardness And (Estimated) Compressive Strength Index of The Rock (HCSI) - The HCSI of the rock will be indicated by a number (0 through 6). The HCSI number will be recorded for each change in bedrock hardness. The determination of this number will be in accordance with the following table:

Hardness and (Estimated) Unconfined Compressive Strength Index (HCSI)

INDEX	HARDNESS	FIELD IDENTIFICATION	TONS/FT <sup>2</sup>	psi
0	Extremely Soft Rock	Indented by Thumb Nail	2.0-7.0	28-100
1	Very Soft Rock	Crumble under firm blows with point of geological pick. Can be peeled by a pocket knife.	7.0-70	100-1,000
2	Soft Rock	Can be peeled by a pocket knife with difficulty. Shallow indentations made by firm blow with point of geological hammer.	70-280	1,000-4,000
3	Mediumhard Rock	Cannot be scraped or peeled with a pocket knife. Specimen can be fractured with single firm blow of hammer end of geological pick.	280-560	4,000-8,000
4	Hard Rock	Specimen requires more than one blow with hammer end of geological pick to fracture it.	560-1120	8,000-16,000
5	Very Hard Rock	Specimen requires many blows of hammer end of geological pick to fracture it.	1120-2240	16,000-32,000
6	Extremely Hard Rock	Specimen can only be chipped with point of geological hammer.	Over 2240	Over 32,000



- s. Additional Description of Material: The material encountered in the boring shall have the following additional descriptions as is appropriate.

AASHTO Designation T-206 Standard Penetration for Granular (Sandy or Gravelly) Soils		
Description	Abbreviation	Blow per Foot
Very Loose	VL	0 – 4
Loose	L	4 – 10
Medium Dense	MD	10 – 30
Dense	D	30 – 50
Very Dense	VD	> 50

AASHTO Designation T-206 Standard Penetration for Cohesive (Clayey) Soils			
Description	Abbreviation	Blow per Foot	Hand Manipulation
Very Soft	VS	0 – 1	Easily penetrated by fist.
Soft	S	2 – 4	Easily penetrated by thumb.
Medium Stiff	MST	4 – 8	Penetrated by thumb with moderate effort.
Stiff	ST	8 – 15	Readily indented by thumb, but no penetration
Very Stiff	VST	15 – 30	Readily indented by thumb nail.
Hard	H	>30	Indented by thumb nail with difficulty.

- t. Color: The color should be described as Brown (Br.), Gray (Gr.), Black (Bl.), etc. If a major color appears to be modified by a secondary color, the modified color shall precede the major color such as Gray Brown (Gr. Br.). Colors may be either light (lt) or dark (dk).

- u. Type Of Material:

Primary Description

- i. Rock: Siltstone, shale, sandstone, limestone, claystone, coal, and conglomerate.
- ii. Soil: Gravel, sandy gravel, gravelly sand, sand, silty sand, clayey sand, sandy silt, clayey silt, silty clay, sandy clay, and clay.

Secondary Description

List other material such as sand, gravel, boulder, and organic materials as follows:

- Trace - 0 - 10%
- Little - 11 - 20%
- Some - 21 - 35%
- and - 36 - 50%

The following soil components and sizes shall be used to in descriptions:

<b>Soil Components and Sizes</b>			
<b>Component</b>	<b>Size</b>		
	<b>Mm</b>	<b>in</b>	<b>US Standard Sieve No.</b>
Boulders	> 305	> 12	
Cobbles	76 - 305	3 – 12	
Coarse Gravel	19 - 76	$\frac{3}{4}$ – 3	
Fine Gravel	4.75 - 19	$\frac{3}{16}$ – $\frac{3}{4}$	
Coarse Sand	2 - 4.75	$\frac{3}{32}$ – $\frac{3}{16}$	10 – 4
Medium Sand	0.425 - 2		40 – 10
Fine Sand	0.0745 - 0.425		200 – 40
Silt	0.002 - 0.074		
Clay	< 0.002		

Visual differentiation between silts and clays shall be made by manipulation as follows:

- a. Silt: When subjected to shaking in the palm of the hand, a part of saturated inorganic silt expels enough water to give a glossy appearance to the surface and when then bent or slightly squeezed between the fingers, the surface of the part will become dull. The part upon working in the hand loses moisture, becomes brittle, breaks easily, and tends to dust.
- b. Clay: Clay, at high water content, is sticky, is plastic over a wide range of water content, and can be rolled into a fine thread without breaking, and upon drying becomes hard and will not dust off.

Rock shall be described in accordance with the following:

- a. In the examination and description of rock, the following terminology and factors shall be considered and employed:
  1. color,
  2. rock type,
  3. grain size,
  4. structure,
  5. bedding,
  6. weathering,
  7. type and number of fractures,
  8. moisture,
  9. hardness,
  10. RQD,
  11. HCSI, and
  12. note other qualifying factors.
- b. Shale shall be further distinguished as clayey shale, limey shale, carbonaceous shale, or sandy shale. The term limey shall be used if the rock is calcareous or contains calcium carbonate. If silica is present, the term sandy shall be used.
- c. The term carbonaceous shall apply to shale containing material of organic

- origin. The term clay shale shall be used where the shale is argillaceous.
- d. Rocks comprised of various degrees or organic content shall be classified as carbonaceous shale, coaly shale, or coal.
  - e. The relative hardness of the rock shall be defined as:
    - extremely soft - 0;
    - very soft - 1;
    - soft - 2;
    - medium hard- 3;
    - hard - 4;
    - very hard - 5; or extremely hard -6.
  - f. The condition of the rock shall be further defined as: weathered, broken, shattered, jointed, cavernous, or as containing slickensides.
  - g. In describing sandstone, the size of the sand grains shall be described as very fine, fine, medium, or coarse. Information concerning type cementation shall be given. Cross bedding shall be noted when occurring.
  - h. In describing a conglomerate, information shall be included concerning the kind and size of pebbles, cobbles, or boulders contained and the type and firmness of cementation.
  - i. Condition:
    - Rock: Weathered, broken, jointed, shattered, cavernous, slickensides,etc.
  - j. Moisture:
    - Dry – no surface moisture
    - Moist – damp to the touch
    - Wet – visible surface moisture

**628.4-METHOD OF MEASUREMENT:**

The quantity of drilling work done will be based upon the length of borings taken below the ground surface, without regard for the type of material encountered in the boring, as indicated by the below ground drill rod lengths, and as determined by the Engineer. All sampling and reporting shall be incidental to and included in the unit bid price of Exploratory Drilling and Sampling.

**628.5-BASIS OF PAYMENT:**

Payment for Exploratory Drilling and Sampling will be made at the contract unit price bid for this item, including mobilization/demobilization, coring, drilling, sampling, reporting, and incidentals necessary to complete the work.

**628.6-PAY ITEMS:**

ITEM	DESCRIPTION	UNIT
628004-001	“Exploratory Drilling and Sampling”	Lineal Foot

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 642**

**TEMPORARY POLLUTION CONTROL**

**642.1-DESCRIPTION:**

DELETE THE FIRST PARAGRAPH AND REPLACE THE FOLLOWING.

This work shall consist of temporary control measures performed during the life of the Contract to control water pollution through use of berms, rock check dam, sediment structures (traps, ~~ponds,~~ or ~~dams basins~~), mulches, fiber mats, seeding slope drains, and other erosion control devices or construction methods, in accordance with these Specifications and in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the Plans or established by the Engineer.

**642.5-SEEDING AND MULCHING:**

**642.5.1-General:**

DELETE THE SECOND PARAGRAPH AND REPLACE THE FOLLOWING.

Seeding or mulching, or both, shall be performed on all cut and fill slopes, including waste sites and borrow pits, during the construction process. All disturbed areas such as diversion ditches, sediment ~~dams basins~~, areas around sediment structures, haul road slopes, cleared and grubbed areas to remain exposed during a period of critical erosion, storage areas, location of batch plants, etc. shall be seeded when and where necessary to eliminate erosion.

**642.7-METHOD OF MEASUREMENT:**

DELETE THE SECOND AND THIRD PARAGRAPH AND REPLACE THE FOLLOWING.

Berms constructed prior to suspension of construction operations and slope drains will be measured in linear feet; sediment traps, ~~ponds, or dams sediment basins,~~ and sediment removal will be measured by the cubic yard; for sediment ~~dams basins~~, risers will be measured by the unit and conduit for principal spillway under the dam will be measured in linear feet and included under Item 642008-\*; seed will be measured by the pound; straw, hay and wood cellulose fiber mulch

will be measured by the ton; ~~wood chips or bark mulch will be measured by the cubic yard;~~ fertilizer and agricultural limestone will be measured by the ton; matting will be measured by the square yard; contour ditching will be measured by the linear foot. Measurements will be made on the surface of the work done when applicable. Anchoring for mulch or other chemical binders will not be measured separately, but their cost shall be included in the unit price bid for mulch. ~~Cereal rye or cereal wheat added to Type D mixture in fall seeding will not be included for payment but its cost shall be included in the unit prices in 642.9.~~

Temporary pipe will be measured by the linear foot complete and in place. If the Contractor elects to utilize a series of small pipes in lieu of one large pipe, measurement for payment will be made only for a length necessary to extend one conduit under the haul road or sediment ~~dam~~ basin.

**642.9-PAY ITEMS:**

DELETE ITEM 642034 “SEDIMENT DAM” AND REPLACE WITH THE FOLLOWING:

ITEM	DESCRIPTION	UNIT
642034-*	Sediment <del>Dam</del> <u>Basin</u>	Cubic Yard

DELETE ITEM 642037 “SEDIMENT POND” FROM THE TABLE:

ITEM	DESCRIPTION	UNIT
<del>642037-*</del>	<del>Sediment Pond</del>	<del>Cubic Yard</del>

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**  
**DIVISION OF HIGHWAYS**  
**SUPPLEMENTAL SPECIFICATION**  
**FOR**  
**SECTION 642**  
**TEMPORARY POLLUTION CONTROL**

**642.7-METHOD OF MEASUREMENT:**

ADD THE FOLLOWING:

**642.7.1-Temporary Pollution Control, Unit’s Value Method:** For “Temporary Pollution Control” for which a number of units are established in the contract, will be measured by each temporary pollution control device used and accepted. The relative value of each temporary pollution control device shall be as shown in Table 642.7.1.

The total units of temporary pollution control shown in the Contract is an estimated amount only and may be adjusted up or down by the Engineer in accordance with the project needs.

**TABLE 642.7.1**

<b>Description</b>	<b>(Item)</b>	<b>Unit</b>	<b>Value per Unit</b>
Temporary Berm	(642001-001)	LF	2
Slope Drain	(642002-001)	LF	21
Seed Mixture, Temporary	(642004-001)	LB	2
Seed Mixture, B	(642004-002)	LB	5
Seed Mixture, D	(642004-003)	LB	12
Seed Mixture, L	(642004-004)	LB	18
Mulch, Straw or Hay	(642005-001)	TN	450
Mulch, Wood Cellulose Fiber	(642005-002)	TN	810
Mulch	(642005-003)	TN	2,500
Fertilizer	(642006-001)	TN	850
Fiber Matting	(642007-001)	SY	2
Temporary Pipe	(642008-001)	LF	73
Contour Ditch	(642009-001)	LF	2
Agricultural Limestone	(642010-001)	TN	68
Silt Fence	(642012-001)	LF	3
Super Silt Fence	(642015-001)	LF	10
Compost Filter Sock, 8 IN	(642016-001)	LF	10
Compost Filter Sock, 12 IN	(642016-002)	LF	5

DRAFT

**TABLE 642.7.1**

<b>Description</b>	<b>(Item)</b>	<b>Unit</b>	<b>Value per Unit</b>
Compost Filter Sock, 18 IN	(642016-003)	LF	8
Compost Filter Sock, 24 IN	(642016-004)	LF	10
Compost Filter Sock, 32 IN	(642016-005)	LF	11
Rock Check Dam	(642031-001)	EA	93
Sediment Trap	(642033-001)	CY	17
Sediment Dam	(642034-001)	CY	17
Riser	(642035-001)	EA	7,050
Skimmer	(642035-002)	EA	1,625
Sediment Removal	(642036-001)	CY	7
Sediment Pond	(642037-001)	CY	6
Inlet Protection	(642040-001)	EA	270
Flocculant Block	(642042-001)	EA	180
Premanufactured Ditch Check	(642043-001)	EA	67
Turbidity Curtain	(642045-002)	FT	100
Dewatering Device	(642050-001)	EA	720
Erosion Control Matting	(642055-001)	SY	2

Note: Units are calculated by multiplying the quantity of temporary pollution control devices installed on project by the rate value.

Example: 175 lbs of Seed Mixture, Temporary X 2 = 350 Units

**642.9-PAY ITEMS:**

ADD THE FOLLOWING ITEM TO THE TABLE:

<b>ITEM</b>	<b>DESCRIPTION</b>	<b>UNIT</b>
642000-001	Temporary Pollution Control	Unit

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 708  
JOINT MATERIALS**

**708.3-JOINT SEALANT, HOT-POURED FOR CONCRETE AND ASPHALT PAVEMENTS:**

DELETE THE HEADING AND REPLACE WITH THE FOLLOWING:

**708.3- JOINT AND CRACK SEALANT, HOT-POURED FOR CONCRETE AND ASPHALT PAVEMENTS:**



**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION**

**DIVISION OF HIGHWAYS**

**SUPPLEMENTAL SPECIFICATION**

**FOR**

**SECTION 711**

**PAINTS, COATING, OILS, AND INKS**

**711.5-CONCRETE PROTECTIVE COATINGS AND STAIN:**

**711.5.3-Approval:**

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

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-materials~~ 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:**

DELETE THE CONTENTS OF SUBSECTION 711.6.1.1 AND REPLACE WITH THE FOLLOWING:

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 ~~will~~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.

## **711.22-ZINC RICH LOW VOC SYSTEM:**

### **711.22.1-General:**

DELETE THE CONTENTS OF SUBSECTION 711.22.1 AND REPLACE WITH THE FOLLOWING:

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.

### **711.22.4-Top Coat:**

DELETE THE CONTENTS OF SUBSECTION 711.22.4 AND REPLACE WITH THE FOLLOWING:

This material shall meet the manufacturer's specification and shall meet the requirements of 711.22.4.1. ~~After system approval, all topecoat 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,  $\Delta E$ , 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.

ADD THE FOLLOWING:

**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 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