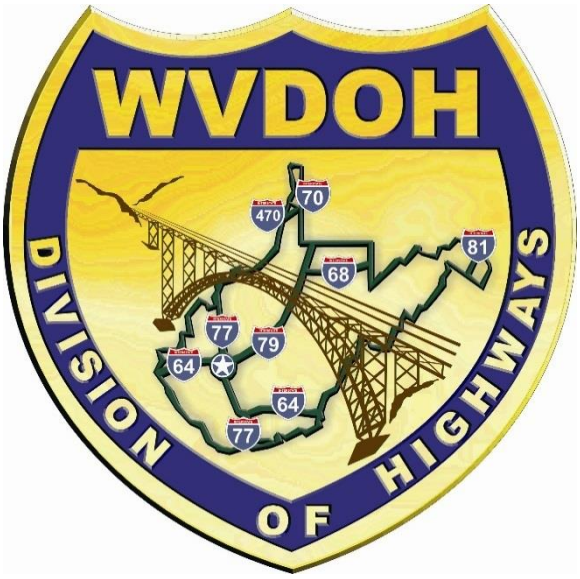
WEST VIRGINIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS



2021 SUPPLEMENTAL SPECIFICATIONS

To accompany the 2017 Edition of the
Standard Specifications Roads and Bridges

Electronic copies of this book can be obtained via the Internet at
http://transportation.wv.gov/highways/contractadmin/specifications/

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NOTE: Areas with a vertical line on the left side of the page, as shown here, represent new specification changes included in 2021 Supplemental Specifications.

DIVISION 100
GENERAL PROVISIONS

SECTION 101
DEFINITION OF TERMS

101.2-DEFINITIONS:

ADD THE FOLLOWING AS A NEW DEFINITION:

Completion. Contractor completes all specified work satisfactorily and executes and delivers all required documents, certificates, and proofs of compliance.

DELETE SUBSTANTIAL COMPLETION AND REPLACE WITH THE FOLLOWING:

Substantial Completion or Substantially Complete-The work on the Contract will be considered substantially complete when all Items of Work are complete, as determined by the Engineer; with the exception of permanent roadway striping.

SECTION 102
BIDDING REQUIREMENTS AND CONDITIONS

102.3-ISSUANCE OF PROPOSAL FORMS:

DELETE THE CONTENTS OF SUBSECTION 102.3 AND REPLACE WITH THE FOLLOWING:

Proposal forms, will be issued to Prequalified Contractors only or to their authorized representatives, or to Contractors who have filed on a Division standard form an application for prequalification 15 calendar days prior to the date set for receiving bids on projects on which the applicant desires to bid.

The Division may at its discretion issue to a Contractor a Proposal requiring prequalification in excess of the amount allotted the Contractor provided it considers that this Contractor is particularly fitted by reason of their experience or equipment, or both, to perform work of this type involved in an amount exceeding their prequalification limits and further provided that the prospective bidder furnish the Division with a letter from a reputable Surety advising of their willingness to furnish bond to the Contractor for the project. No letter from a reputable Surety will be accepted after 4:00 PM Eastern Time of Friday before project letting. Lettings must be submitted to DOHContractProcure@wv.gov. The Surety letter should include the following information: call number, project name, project number, and letting date for each project the Contractor requests to exceed their prequalification limits on. Failure to submit this information by the specified time may result in a Contractor's proposal(s) being irregular.

When more than one project is advertised, Proposals will be issued on as many projects as the Contractor requests, providing the Contractor is qualified as above for each individual project,

but no contracts will be awarded exceeding the permissible limit of the Contractor's prequalification rating except as otherwise provided in 103.1.

102.7-IRREGULAR PROPOSALS:

DELETE THE CONTENTS OF SUBSECTION 102.7 AND REPLACE WITH THE FOLLOWING:

Proposals may be considered irregular and rejected for any of the following reasons:

i. When the Proposal is on a form other than that furnished by the Division or if the form is altered. Use of a Division approved computer generated Schedule of Items shall not be considered an alteration of form or format within the meaning of these Specifications.

ii. When there are unauthorized additions, conditional or alternate bids, or irregularities of any kind which may tend to make the Proposal incomplete, indefinite, or ambiguous as to its meaning. Also, when Division approved computer generated Schedule of Items show any alteration of format, additions or amendments not called for, errors or omissions in units of measure, or erasures.

iii. When the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a Contract pursuant to an award. This does not exclude a bid limiting the maximum gross amount of awards acceptable to any one bidder at any one bid letting, providing that any selection of awards will be made by the Division.

iv. Failure to sign or properly execute the Proposal.

v. Failure to indicate a proposed goal in Section C, Item 3 of the Notice contained in the Proposal, when a Division determined goal is indicated in paragraph 5 of the Special Provision for Disadvantaged Business Enterprise Utilization.

vi. Failure to properly acknowledge receipt of amendment(s) in accordance with Section J of the notice contained in the proposal.

vii. Failure to show the West Virginia Contractor’s License Number when required in Section H of the notice contained in the proposal.

viii. When exceeding prequalification limits, Contractor’s failure to submit a letter from a reputable Surety by 4:00 PM Eastern Time of Friday before project letting, advising of the Surety’s willingness to furnish a bond in an amount exceeding the Contractor’s prequalification limits.

ix. The proposal is mathematically and materially unbalanced. A mathematically unbalanced bid contains lump sum or unit price items that do not include reasonable labor, equipment, and material costs plus a reasonable proportionate share of the Bidder’s overhead costs, other indirect costs and anticipated profit. A Materially Unbalanced Bid is when the Division determines that an award to the Bidder submitting a Mathematically Unbalanced Bid will not result in the lowest ultimate cost to the Division.

102.16-PRE-CONSTRUCTION DATA:

DELETE THE CONTENTS OF SUBSECTION 102.16 AND REPLACE WITH THE FOLLOWING:

Prospective bidders may review additional information not included in the contract proposal including, but not limited to, old plans, old shop drawings, geotechnical information, environmental documents, permit applications, permits, asbestos reports, hazardous materials reports, and other documents or data. If provided, the additional documents will be posted as an Exhibit for the project and can be found on the WVDOH Bid Express website. All additional documents are to be considered as part of the proposal documents, unless the additional documents specifically states that it is for informational purposes only. Documents marked "for informational purposes only" are not to be considered contract documents, and potential bidders rely upon information contained therein at their own risk.

Any requests for additional information or other pre-construction data should be presented to the Division through the Division's Bid Express website.

SECTION 103
AWARD AND EXECUTION OF CONTRACT

103.6-INSURANCE REQUIREMENTS:

103.6.1-Contractor's General Liability Insurance:

DELETE THE TABLE AND REPLACE WITH THE FOLLOWING:

General Aggregate	$2,000,000
Products/Completed Operations Aggregate	$2,000,000
Personal & Advertising Injury	$1,000,000
Each Occurrence *	$1,000,000
Damages to Rented Premises	$300,000
Medical Expense Limit	$5,000

* Each Occurrence limit shall be $2,000,000 when performing any operations that are subject to 107.8 – Railway-Highway Provisions.

103.6.5-Countersignature of West Virginia Agent:

DELETE ENTIRE SUBSECTION 103.6.5.

SECTION 105
CONTROL OF WORK

105.4-COORDINATION OF PLANS, SPECIFICATIONS, SUPPLEMENTAL SPECIFICATIONS, AND SPECIAL PROVISIONS:

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

These Specifications, the Supplemental Specifications, the Plans, Special Provisions, and all Supplementary Documents are essential parts of the Contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of discrepancy, calculated dimensions will govern over scaled dimensions; Supplemental Specifications will govern over Specifications; Plans will govern over Specifications and Supplemental Specifications; Special Provisions will govern over Specifications, Supplemental Specifications and Plans. When the plans provide that new work is to connect with existing structures, the Contractor must verify all dimensions with the Engineer before proceeding with the work.

The Contractor shall take no advantage of any apparent error or omission in the Plans or Specifications. In the event the Contractor discovers such an error or omission, the Contractor shall immediately notify the Engineer. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the Plans and Specifications.

105.6-COOPERATION WITH UTILITIES:

ADD THE FOLLOWING SUBSECTION:

105.6.1-Division Owned Utilities: It will be the Contractor's responsibility to locate WVDOH owned utilities (electrical service lines, conduit, signal, etc.) within the project limits. This work shall be incidental to the project.

Division owned utilities or components that are cut, damaged, or destroyed by any work performed as part of the project shall be replaced by the Contractor at no additional cost to the Division.

Lighting, traffic signal, overhead sign plans, etc. if available, may be obtained by contacting Traffic Engineering Division at 304-558-3063.

105.16-ACCEPTANCE:

105.16.2-Final Acceptance:

DELETE THE CONTENTS OF SUBSECTION 105.16.2 AND REPLACE WITH THE FOLLOWING:

After the Contractor completes all specified work satisfactorily and executes and delivers all required documents, certificates, and proofs of compliance, the Contractor shall provide written notice of completion to the Engineer. If the Engineer agrees the Project is substantially complete they will notify the Contractor and will conduct a final inspection within 30 calendar days.

If the Engineer determines that all construction and other contractual requirements provided for and contemplated by the Contract are satisfactorily completed, that inspection will constitute the final inspection.

If the Engineer determines any work, in whole in part, is unsatisfactory, the Engineer will give the Contractor a punch list for correction in writing, within 15 calendar days after inspection. The Contractor shall immediately comply with and execute such instructions. The Contractor shall supply to the Engineer all material certifications, all documents necessary for project finalization, and agree to final quantities within 90 calendar days of punch list notice.

If the Contractor fails to give notice of disagreement to the Engineer about any issue within 90 calendar days of punch list notice, including the reason for dispute and justification, the final payment will be based on the Engineer's list of final quantities. If the Contractor fails to provide material certification, the Division may deduct cost of material from the project. The Contractor shall complete all remaining punch list work within 135 calendar days of punch list notice. If the Engineer determines that the punch list is incomplete, the Division may withhold all payments on any and all Contracts. Upon timely correction of the work, another inspection will be made which will constitute the final inspection provided the Engineer determines that the work has been satisfactorily completed.

The Engineer will make the final acceptance and notify the Contractor in writing of acceptance. Final acceptance will be the date the Contract Completion Report is fully executed by the Division.

105.16.2.1-Punch List: The punch list will identify and include, but not be limited to, any item of work that need corrected before Final Acceptance; all necessary material certifications; any unsigned change orders; any applicable certified payrolls; all certification of subcontractor payment; any applicable Proof of Payments needed for B&O tax; and any other item needed for finalization.

SECTION 107
LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

107.8-RAILWAY-HIGHWAY PROVISIONS:

107.8.2-Insurance:

107.8.2.2-Railroad Protective Liability Insurance:

DELETE THE CONTENTS OF SUBSECTION 107.8.2.2 AND REPLACE 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 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.

107.21-PROTECTION OF RIVERS, STREAMS, AND IMPOUNDMENTS:

107.21.1-Erosion and Sedimentation Control:

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

Any details not shown in the plans shall be in accordance with the latest version of the West Virginia Department of Environmental Protection, Erosion and Sediment Control Best Management Practices Manual. In the event that temporary erosion and sediment control

measures are necessary due to the Contractors negligence, carelessness or failure to install permanent controls as part of the work as scheduled, such work shall be performed by the Contractor at their own expense.

107.21.2-Pollution:

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

The Contractor shall exercise every reasonable precaution throughout the life of the Project to prevent pollution of rivers, streams, or impoundments. Pollutions such as chemicals, fuels, lubricants, bitumen, raw sewage, products associated with bridge cleaning and painting, and other harmful wastes shall not be discharged into or alongside of rivers, streams, impoundments, or into natural or man-made channels leading thereto. The quality of the surface waters affected by construction shall meet the requirements of the West Virginia Code, Volume 8A, Chapter 22, Article 11.

SECTION 108
PROSECUTION AND PROGRESS

108.3-PROSECUTION OF THE WORK:

108.3.1-General:

DELETE THE THIRD PARAGRAPH AND REPLACE WITH THE FOLLOWING:

Schedules will be required for all projects where the Contract Bid Amount is greater than $2,000,000. Additionally, any Project that contains an Incentive/Disincentive clause, and all Design Build, Alternative Project Delivery, and Public Private Partnership projects shall require a Schedule.

108.3.2-Detailed Construction Schedule (Schedule):

DELETE THE CONTENTS OF SUBSECTION 108.3.2 AND REPLACE THE FOLLOWING:

The Schedules shall be prepared using scheduling software Primavera Project Manager P6 version 6.0 or higher.

The following criteria shall apply to the development and maintenance of the Schedule:

1. All Resources shall be grouped in a Project Resource Tree. This tree structure shall have one main heading name that begins with the Project's specific 7 digit Contract ID Number followed by an underscore, followed by the Project Name.
2. Individual Resource names shall be shown as a sublevel to the main heading name. The Individual Resource names shall begin with the Project's specific 7 digit Contract ID Number followed by an underscore, followed by the Project Name. Any additional description may follow the underscore.
3. The use of Project Codes is prohibited.

4. The use of Global Activity Codes are prohibited, however, Project Activity Codes may be used. The Project Activity Code names shall begin with the Project's specific seven (7) digit Contract ID Number followed by an underscore. Any additional description may follow the underscore.
5. Global Calendars are prohibited (except as noted below in section 7). However, Project Calendars may be used. The Project Calendar names shall begin with the project's specific seven (7) digit contract number, followed by an underscore. Any additional description may follow the underscore. In addition, the Project Default Calendar shall be assigned as a Project Calendar.
6. The use of Cost Accounts is not required. However, if the Contractor elects to use them, then all Cost Account names shall be grouped in a Project Cost Accounts Tree. This tree structure shall have one main heading name that begins with the project's specific 7 digit Contract ID Number followed by an underscore, followed by the Project Name.
7. Individual cost account names shall be shown as a sublevel to the main heading name. The individual cost account names shall begin with the Project's specific seven (7) digit Contract ID Number, followed by an underscore. Any additional description may follow the underscore.
8. The Contractor Resource Calendar shall be linked to the WVDOT Standard Calendar. The WVDOT Standard Calendar shall be assigned to each resource and shall be allowable as the only calendar for all Schedule Resources. This shall be accomplished by creating a Global Calendar named and formatted exactly as follows:

    WVDOT Standard 5 Day Workweek with holidays.

9. The first activity on the Schedule shall be Project Award which shall be designated as a milestone starting on the actual Contract Award date.
10. The second activity on the Schedule shall be Notice to Proceed which shall be designated as a milestone with a 30-day lag from the Project Award milestone (or with a 7 day lag from Project Award on projects with an Incentive/Disincentive clause).
11. Subsequent to the Notice to Proceed milestone, the logic and duration of remaining activities shall be developed and tied to the Substantial Completion milestone described in Section 108.3.1.
12. Schedule calculation will be computed by Retained Logic method.
13. Only contractual Constraints can be used on activities when preparing the Schedule, otherwise the use of Constraints is prohibited.
14. All Actual Start Dates and Actual Finish Dates shall be reasonably captured in updated schedules.
15. The activity costs described in Section 108.3.4 shall be incorporated into the Schedule via Resource Section. The use of Expenses for costs is prohibited

The Schedule shall be submitted on standard D size sheets (24" x 36"). The critical path shall be distinguished from other paths on the Schedule. All back-up data used to generate the Schedule shall be submitted in digital form on acceptable media that is compatible with the computer system.

The submitted Print Out of the Schedule shall include the following data for each activity in the initial submittal and in all updates and revisions:

1. Activity number, as well as preceding and following activity numbers;
2. Activity description;
3. Duration of activity, in working days;
4. All quantities in accordance with pay items;
5. Dollar value of activity;
6. Remaining duration of activity, in working days;
7. Earliest start date, by calendar date;
8. Earliest finish date, by calendar date;
9. Actual start date, by calendar date;
10. Actual finish date, by calendar date;
11. Latest start date, by calendar date;
12. Latest finish date, by calendar date;
13. Total float for activity;
14. Free float for activity;

108.3.3-Schedule Resource Loading Criteria:

108.3.3.2-Resource Loaded Schedules:

DELETE THE FIRST PARAGRAPH AND REPLACE WITH THE FOLLOWING:

Schedule resource loading will be required for all projects on which the Contract Bid Amount is equal to or exceeding $7,500,000. Additionally, all Design Build Projects, Public Private Partnerships, and Alternative Project Delivery projects will require Schedule resource loading regardless of the Contract Bid Amount.

108.6-DETERMINATION AND EXTENSION OF CONTRACT:

108.6.1-General:

DELETE THE CONTENTS OF THE FIFTH PARAGRAPH AND REPLACE THE FOLLOWING:

The work on the Contract will be considered substantially complete when all Items of Work are complete, as reasonably determined by the Engineer; with the exception of permanent roadway striping. When the Project is considered substantially complete, the Contract time charges shall be discontinued prior to final acceptance being made by the Engineer as prescribed in 105.16.

108.7-COMPLETION DATES:

108.7.1-Failure to Complete on Time and Liquidated Damages:

DELETE THE CONTENTS OF SUBSECTION 108.7.1 AND REPLACE WITH THE FOLLOWING:

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

Therefore, for each calendar day the project is deemed not to be Substantially Complete after the Contract Time specified for completion of the work, subject to such extensions of contract time required or permitted in 108.6, the Division will assess liquidated damages against the Contractor. Daily charges will be deducted for each calendar day, as defined in 101.2, on all contracts, except daily charges will not be deducted between November 30 and April 1. The total amount of daily charges will be deducted from any monies due the Contractor, not as a penalty but as liquidated damages. Unless specified elsewhere in the Contract, the amount of the daily charge will be calculated using Table 108.7.1 on the date of the project letting.

TABLE 108.7.1
Schedule of Liquidated Damages

Original Contract Amount		Daily Charges
For More Than	To and Including	Per Calendar Day
$0	$500,000	$300
$500,000	$2,000,000	$600
$2,000,000	$10,000,000	$1,500
$10,000,000	$25,000,000	$3,000
$25,000,000		$4,000

108.7.2-Interim Completion Date:

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

When an interim completion date has been specified in the Contract documents for the Contractor to complete a specific amount of work, pay item, or structure, and if the Contractor fails to meet the interim date, the Division will assess a per calendar day charge as liquidated damages, as specified in Section 108.7.1, unless otherwise specified elsewhere in the Contract documents, until such amount of work, pay item, or structure has been completed. Extension of interim completion dates will be governed by the provisions of 108.6. The liquidated damages provided for in this subsection are in addition to those provided for elsewhere in this Section.

SECTION 109
MEASUREMENT AND PAYMENT

109.1-MEASUREMENT OF QUANTITIES:

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

All work completed under the Contract will be measured by the Engineer according to United States standard measure.

The method of measurement and computations to be used in determining of quantities of materials furnished and of work performed under the Contract will be those methods generally recognized as conforming to good engineering practice.

Unless otherwise indicated, the requirements prescribed shall govern.

Earthwork will be computed by the average end area method, using the horizontal length measured along the centerline as the distance between sections, applying corrections for curvature where the apparent error exceeds 25 percent of the volume in any one cut. Other acceptable methods may be used.

Unless otherwise specified, longitudinal measurements for area computations will be made horizontally and no deductions will be made for individual fixtures having an area of nine square feet (one square meter) or less. Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the Plans or ordered in writing by the Engineer.

Structures will be measured according to neat lines shown on the Plans or as altered to fit field conditions.

All items which are measured by the linear foot (meter), such as pipe culverts, guardrail, underdrains, etc., will be measured parallel to the base or foundations upon which such structures are placed.

The term "gage" when used in connection with the measurements of plates, will mean the U.S. Standard Gage.

The galvanized sheet thicknesses to be used in the manufacture of metal cribbing, corrugated steel culvert pipe, underdrain pipe, plate pipe, pipe arches, plate pipe arches and plate arches shall be as specified in AASHTO M 36 or AASHTO M 167. The sheet thicknesses to be used in the manufacture of corrugated aluminum alloy culvert pipe, underdrain pipe, plate pipe, pipe arches, plate pipe arches and plate arches shall be as specified in AASHTO M 196 or AASHTO M 219.

The "size number" used in the measurement of wire will be as specified in AASHTO M336.

The term ton will mean the short ton consisting of 2,000 lb. (The term megagram is defined as a mass of 1,000 kg). All materials which are measured or proportioned by weight shall be weighed on approved scales by competent, qualified personnel. Scales for weighing shall be of either the beam type, springless-dial type or digital recorder type. All plant and truck scales and metering devices shall be inspected, approved and sealed in accordance with the requirements of the West Virginia Division of Labor, Bureau of Weights and Measures, or other appropriate agencies of the State or its political subdivisions. Poises shall be designed to be locked in any position to prevent unauthorized changes. When the beam type scales are used, provisions for a "telltale" dial shall be made for indicating to the operator that the required load in the weighing hopper is being approached. A device on the weighing beams shall clearly indicate the critical position.

Truck scales shall be provided by the producer or Contractor, except that truck scales are not required where the material is weighed at properly calibrated automatic batching plant facilities which are equipped with digital print-out equipment or electronic ticket delivery (e-ticket) capabilities. The scales shall be of sufficient size and capacity to weigh the heaviest loaded trucks that are used for delivery of the material. All truck scales shall be mounted on solid foundations which will ensure their remaining plumb and level.

A weigh person shall be provided by the producer. The weigh person shall certify that the weight of the material, as determined either by the truck scales or from the digital print-out of the weights, is correct. To signify the certification of weight the weigh person must either sign their full name on each ticket, or if the ticket printer prints the weigh person’s full name they must at least initial each ticket. In instance where an e-ticket is provided as documentation on the project;

a digital signature of the weigh person on the e-ticket will be considered equivalent as hand-signed/initialed, printed ticket.

Each truck shall be weighed empty prior to each load, except at automatic batch plants approved to operate without truck scales. A digital recorder shall be required on all truck scales. The digital recorder shall produce a 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 recording process. The system shall be interlocked so as to allow recording of results only when the scale has come to rest.

In case of a 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.

If material is shipped by rail, the car weight may be accepted provided the actual weight of material only will be paid for. However, car weights will not be acceptable for material to be passed through mixing plants.

Devices, used to meter or measure component or other materials in a simultaneous manner, shall be located so as to be readily accessible and visible to a single Inspector, unless otherwise directed by the Engineer.

Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured at the point of delivery. Vehicles for this purpose may be of any size or type acceptable to the Engineer, provided that the body is of such shape that the actual contents may be readily and accurately determined. All vehicles shall be loaded to at least their water level capacity, and all loads shall be leveled when the vehicles arrive at the point of delivery.

When approved by the Engineer, material specified to be measured by the cubic yard (meter) may be weighed and these weights converted to cubic yard (meter) for payment purposes. Further, when it is impractical to measure the material by weighing, or in its original position, the material will be measured in its final position and adjusted by a volume change factor. These conversion factors will be determined by the Engineer and shall be agreed to by the Contractor before these methods of measurement are used.

When asphalt material is measured by volume, the measured volume at loading temperature shall be converted to volume at 60° F (15° C) using the temperature correction factors in 705 for asphaltic materials and 706 for tar materials, except that when volume is measured by an approved temperature compensated metering device, no further volume correction for temperature shall be required. When asphalt material is measured by weight, the actual specific gravity, API gravity, or weight per gallon (liter) of the material shall be used to convert the measured weight to volume at 60° F (15° C). The Contractor shall furnish all information necessary as determined solely by the Division to determine the amount of asphalt material actually incorporated into the project.

Net certified scale weights or weights based on certified volumes in the case of rail shipments will be used as a basis of measurement, subject to correction when asphalt material has been lost from the car or the distributor, wasted, or otherwise not incorporated in the work.

When asphalt materials are shipped by truck or transport, net certified weights or volume, subject to correction for loss or foaming may be used for computing quantities.

Cement will be measured by the cement in hundredweight (cwt) (hundredweight = 100 lb.) (kilogram). For the purpose of determining the total amount used in the mixture, one bag of cement

shall be considered as weighing 0.94 cwt (42.64 kg), and one barrel of cement shall be considered as weighing 3.76 cwt (175.55 kg).

Timber will be measured by the thousand feet board measure (mfbm) (cubic meters) actually incorporated in the structure, unless otherwise noted on the plans. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term "lump sum" when used as an item of payment will mean complete payment for the work described in the Contract.

When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gage, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

109.8-ACCEPTANCE AND FINAL PAYMENT:

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

When the project has been accepted, as provided in 105.16, the Engineer will prepare the final estimate of the quantities of the various classes of work performed. Before the final payment is made, the Contractor shall execute the Statement of Acceptance on the back of the final estimate.

After the Contractor executes such final estimate or if the Contractor fails or declines to execute the final estimate within 30 calendar days after receipt, the Division will consider the estimate approved and accepted and Contractor will be paid the entire sum found to be due after deducting all previous payments and all amounts to be retained or deducted under the provisions of the Contract.

If the Contactor disputes the final estimate, written notice must be provided to the Engineer within 30 calendar days after receipt, indicating the reason for disagreement and all documents, calculations, data or information supporting Contractor's position. Failure to provide timely notice and supporting information to the Engineer will constitute a waiver of Contractor's right to dispute the final estimate. Upon written request from the Contractor received within 30 days of his receipt of the final estimate, the time for review and execution of the final estimate may be modified by mutual agreement of the Contactor and Engineer.

Should the Contractor desire to reserve the right to file a claim with the State Court of Claims for any sum or compensation not included in the final estimate, growing out of the Contract, then a Reservation of Right stipulating the nature, each item and the amount claimed shall be added at the end of the acceptance statement. This claim must be filed with the State Court of Claims within 60 calendar days of execution of the final estimate. If any monies owed the Division are not paid within 60 calendar days of the execution of the final estimate, the Division shall have the right to revoke the Contractor's Prequalification until the monies are paid.

All prior partial estimates and payments will be subject to correction in the final estimate and payment.

109.10-PRICE ADJUSTMENT OF ASPHALT BINDER:

DELETE THE CONTENTS OF SUBSECTION 109.10 AND REPLACE WITH THE FOLLOWING:

Because of the uncertainty in estimating the cost of petroleum products that will be used during the life of this contract, adjustment in compensation for certain contract items is provided for as follows:

The contract items listed in Table 109.10.1, will be adjusted in accordance with the Division's indices for asphalt binder. The bidding index (Ib) for asphalt binder will be equal to the placement index as listed on the Contract Administrations website for Fuel and Asphalt adjustments for the Wednesday prior to the first day of the month, with the effective date of the index being the first day of the month. If the Wednesday prior to the first day of the month falls on a holiday or the price is otherwise not published for that date, the index will be based on the next earliest date as reported. The placement index (Ip) will be the price in effect on the first of the month in which the specific adjustable material was actually placed. Both the bidding index (Ib) and the placement index (Ip) will be based on the average of the posted prices of PG64S-22 (PG 64-22) asphalt binder per ton/megagram as reported from the following sources on the Wednesday prior to the first day of each calendar month:

Marathon Petroleum Company, LLC, Catlettsburg, Kentucky
Marathon Petroleum Company, LLC, Floreffe, Pennsylvania
Asphalt Materials, Inc., Marietta, Ohio
Associated Asphalt, Baltimore, Maryland
Associated Asphalt, Martinsburg, West Virginia

If one of the sources listed above changes ownership and/or name the posted price for that terminal will continue in use as though the ownership and/or name change had not occurred.

If one of the sources used for determining either the bidding index or the placement index goes out of business, any future index will be based on the average of the remaining sources. Thus, the bidding index (Ib) could be based on the average of five sources and the placement index (Ip) on the average of four sources or vice-versa. If a source that goes out of business reopens at a later date, the placement index would once again be based on the average of five sources as indicated above.

The posted price for each source will be compared to the average of all sources. If the difference between the average and the individual price is greater than 25 % of the average, that individual source will be excluded from the calculation of the average price (Ib) or (Ip) and a new average will be calculated using the remaining sources.

Sources chosen for the index are required to report their posting to the Division no later than the Wednesday prior to the first day the month. Failure to report in a timely manner may impact source approval.

The portion of the contract unit price which reflects the cost of the specified material will be adjusted for the change in accordance with the following formula:

$$\mathbf{Pa = Q*AC*(Ip - Ib)}$$

Where:

Pa	=	Price Adjustment
Ip	=	Price Index at time of placement
Ib	=	Price Index for Bidding

AC = Asphalt Content (see Table 109.10.1)
Q = ”As Constructed” Quantity

The price index for determining price adjustments for all work performed after the contract completion date, as revised by approved time extensions, will be determined as follows: The price index (Ip) shall be for the month in which the contract completion date (as extended) falls, or the price index for the month in which the work was performed, whichever is less.

TABLE 109.10.1-Table of Materials to be Adjusted for Price of Asphalt at the Time of Placement (English & Metric)

Item Number	Asphalt Content (%)	Item Number	Asphalt Content (%)	Item Number	Asphalt Content (%)
311006-001	3.2%	401003-002	5.0%	402001-038	7.6%
401001-020	3.9%	401003-003	5.0%	402001-039	7.6%
401001-021	3.9%	401003-011	5.0%	402001-040	6.0%
401001-022	3.9%	401003-012	5.0%	402001-041	6.0%
401001-023	5.0%	401007-020	5.7%	402001-045	5.5%
401001-024	5.0%	401007-021	5.7%	402001-046	5.5%
401001-025	5.0%	401007-022	5.7%	402001-050	5.0%
401001-040	5.0%	401007-030	7.6%	402001-051	5.0%
401001-041	5.0%	401007-031	7.6%	410001-010	3.9%
401001-042	4.5%	401007-032	7.6%	410001-020	5.0%
401001-043	4.5%	401007-040	6.0%	410001-030	5.0%
401001-050	4.1%	401007-041	6.0%	410001-040	4.5%
401001-051	4.1%	401007-050	7.6%	410001-050	4.1%
401002-020	5.7%	401007-051	7.6%	410002-010	5.7%
401002-021	5.7%	402001-020	6.2%	410002-020	7.6%
401002-022	5.7%	402001-021	6.2%	410002-030	4.9%
401002-023	7.6%	402001-022	6.2%	410007-010	6.2%
401002-024	7.6%	402001-023	7.6%	410007-020	7.6%
401002-025	7.6%	402001-024	7.6%	410007-030	4.9%
401002-035	4.9%	402001-025	7.6%	410007-040	7.6%
401002-036	4.9%	402001-026	4.9%	410007-050	6.0%
401002-037	4.9%	402001-027	4.9%	410007-060	5.5%
401003-001	5.0%	402001-028	4.9%	410007-070	5.0%

The bidding Indexes (Ib) and the placement indexes (Ip) may be found posted on Contract Administrations website for Fuel and Asphalt Prices at the following link:
http://www.transportation.wv.gov/highways/contractadmin/Lettings/Pages/FuelandAsphaltPrices.aspx

The bidding index (Ib) for asphalt binder will be listed on the Contract Administrations website for Fuel and Asphalt adjustments for the Wednesday prior to the first day of the month, with the effective date of the index being the first day of the month for which the contract is let.

Any dispute concerning the bidding index shall be resolved during the first voucher estimate review.

109.20-LOAD LIMIT VIOLATIONS AND WEIGH TICKETS:

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

The Allowable Gross Weight for any vehicle being used to haul materials on publicly maintained highways under the terms of this contract shall be as follows.

Title 23 Code of Federal Regulations, Section 658.17, establishes maximum allowable gross weight on the Interstate System. The maximum allowable gross weight on WV and US Routes will be as established in Chapter 17C, Articles 17 and 17A of the Official Code of West Virginia, as amended. The Public Service Commission, Weight Enforcement Section is responsible for the enforcement of these provisions.

A weigh ticket shall be required with each load of material from a commercial source which would normally have truck scales. This includes, but is not limited to, all asphalt paving materials and all aggregates regardless of the contract pay unit. The weigh ticket shall include gross, tare, and net weights, time and date of loading, Item Number or Description of Materials, Contract Number or Project Number, number of axles on haul unit, license number of haul unit, and signature of the weigher certifying that all information on the ticket is correct. If the weigher's name is printed by the computer on the ticket, then it only needs to be initialed by the weigher.

The Department will accept electronic ticket delivery (e-ticket) as documentation on projects provided that the standard information currently provided on the paper ticket is included on the e-ticket. The e-ticketing system must provide WVDOH field personnel the ability to access tickets from a smartphone, tablet, or laptop and to make notes associated with each ticket if needed. The service must also provide a daily summary report. A digital signature of the weigh person on an e-ticket or daily summary report shall be considered the equivalent as a hand-signed/initialed, printed ticket.

For material from a commercial source or a batch plant, which would not normally have truck scales, a weigh ticket documenting the tare weight, number of axles on the haul unit, license number of haul unit, date weighed, location of scales, and signature of the weigher certifying that all information on the ticket is correct, may be supplied for each haul unit as an alternate to the ticket required in the previous paragraph. The tare weight ticket shall be supplied for each contract on a yearly basis and when modifications are made to the vehicle or combination of vehicles. The weight of the material delivered shall be calculated and furnished by the vendor/supplier shipping the material to the project site or DOH facility. This includes, but is not limited to, concrete, structural steel, piling, reinforcing steel and all prepackaged material of known weight, such as cement, grout, fertilizer, lime, abrasives, etc.

If the haul unit is a combination of vehicles, the license number shall be supplied for each component. The tare weight shall be for the complete haul unit.

All weighing shall be done on scales approved and sealed by the West Virginia Division of Labor, Bureau of Weights and Measures. If the scales are moved or upon the request of the Engineer, the scales shall be reapproved and sealed. The Engineer shall be notified of any scale malfunctions. The Division of Highways may, at its option, accept inspection and sealing by out of state agencies when the material is being loaded outside West Virginia.

Any material, covered by this provision, which is delivered without the proper weigh ticket shall not be accepted by the Division of Highways.

Nothing in this provision relieves any party from compliance with the State Law on load limits or any fines which may be assessed for violation of said law.

DIVISION 200
EARTHWORK

SECTION 203
DISMANTLING STRUCTURES

203.1-DESCRIPTION:

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

This work shall consist of dismantling such structure or structures specifically designated on the Plans for removal, match marking, handling and storage if called for, or disposal if required.

The Contractor is responsible for determining the current condition of the structure (s) and shall use methods and procedures for dismantling the structures in a safe and efficient manner.

Bridge inspection reports are available for informational purposes and may be viewed at the following location:

West Virginia Division of Highways
1900 Kanawha Boulevard East
Building 5, Room A-350,
Operations Division
Charleston, West Virginia 25305

The work shall also include the preparation of a demolition/dismantling plan by the contractor. The plan shall be prepared and sealed by a Professional Engineer registered in the State of West Virginia, experienced in structural analysis of bridges.

The plan shall include a complete structural analysis for all phases of the demolition/dismantling with due regard to the existing condition of the structure at the time the work is performed. Additionally, the analysis shall show that the structure meets the design criteria of the latest edition, including all Interims, of the *AASHTO Standard Specifications for Highway Bridges*, or the *AASHTO LRFD Bridge Design Specifications* during all phases of demolition/dismantling. The design loads shall match those applied to the structure by the contractor's "means and methods" of demolition/dismantling.

The demolition/dismantling plan shall be provided to the Division's Project Supervisor at least seven calendar days prior to the beginning of any demolition/dismantling work. Receipt of the demolition/dismantling plan does not constitute review or approval or relieve the Contractor of his/her responsibility to satisfactorily demolish/dismantle the structure specified.

SECTION 204
MOBILIZATION

204.5-BASIS OF PAYMENT:

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE THE FOLLOWING:

Partial payments will be made as the work progresses in accordance with the following schedule.

i. 2.5% of the original contract amount or 50% of the amount bid for mobilization, whichever is less, will be released to the Contractor as the first estimate payable, not less than 15 days after the start of work at the project site.

ii. 2.5% of the original contract amount or the remaining 50% of the amount bid for mobilization, whichever is less, shall be released with the estimate payable 30 days after the first estimate.

When the project is deemed substantially complete, any remaining amount bid for mobilization will be released for payment.

Nothing herein shall be construed to limit or preclude partial payments otherwise provided for by the contract.

No deduction will be made, nor will any increase be made, in the lump sum mobilization item amount regardless of decreases or increases in the final total contract amount or for any other cause.

SECTION 207
EXCAVATION AND EMBANKMENT

207.2-MATERIALS:

207.2.2-Sampling and Testing:

207.2.2.2-Gradation:

DELETE CONTENTS OF SUBSECTION 207.2.2.2 AND REPLACE WITH THE FOLLOWING:

The material shall be sampled and tested in accordance with 207.2.2. Acceptance for gradation shall be based on test results of consecutive random samples from a lot. A sublot is the quantity of material represented by a single gradation test as defined in MP 700.00.06. A lot shall be considered the quantity of material represented by an average test value, not to exceed five sublots. In the case where only one sample is needed for the total plan quantity, this sublot shall be considered the lot.

The average shall start on the second sample result. The average is continued for the third through fifth sample result, averaging all previous sample results. Thereafter, only the last consecutive five sample results will be averaged (i.e., second test value through sixth test value, third test value through seventh test value, and so forth) as defined in MP 300.00.51.

When the average test values of a lot and the test value of the last sublot, or when the last three consecutive individual test values of a lot fall outside the limits specified in 716.1 and 716.1.1.2, the lot of material represented will be considered nonconforming to the extent that the last of its sublots is nonconforming. When this occurs, the last sublot shall have its price adjusted in accordance with 207.2.2.3.

207.6-DISPOSAL OF MATERIAL:

207.6.3-Waste:

207.6.3.1-Waste Within WVDOH Right-Of-Way Limits:

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

Upon receipt of the Contractor's complete waste site submission, the Engineer shall follow the guidelines as set forth in the latest edition of the WVDEP Erosion and Sediment Control Best Management Practices Manual for review and acceptance by the Division. The Contractor may be required to revise the site plan prior to acceptance by the Division. The Contractor's waste site plan must be approved as per section 105.2.1.2 and the West Virginia Department of Environmental Protection before any waste material can be placed in the site.

207.9-SUBGRADE:

ADD THE FOLLOWING PARAGRAPH AFTER PARAGRAPH TWO:

Reclaimed asphalt pavement (RAP) may be used for subgrade. The top size of gradation shall not exceed 3 inches (75 mm) and shall be placed in accordance with Sections 207 and 716.2. Approval for gradation shall be by visual inspection by the Engineer.

SECTION 211
BORROW EXCAVATION

211.3-GENERAL:

211.3.1-Borrow within WVDOH R/W Limits:

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

Upon receipt of the Contractor's complete borrow site submission, the Engineer shall follow the guidelines as set forth in the latest edition of the WVDEP Erosion and Sediment Control Best Management Practices Manual for review and acceptance by the Division. The Contractor may be required to revise the site plan prior to acceptance by the Division. The Contractor's borrow site plan must be approved as per section 105.2.1.2 and the West Virginia Department of Environmental Protection before any borrow material may be obtained from the site.

211.3.3-Impervious Core:

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

The impervious core shall have minimum dimensions as set forth in WVDEP Erosion and Sediment Control Best Management Practices Manual, latest edition.

SECTION 212
STRUCTURE, ROCK AND WET EXCAVATION

212.2-MATERIALS:

212.2.2-Acceptance Testing:

212.2.5.2-Gradation:

DELETE CONTENTS OF SUBSECTION 212.2.5.2 AND REPLACE WITH THE FOLLOWING:

The material shall be sampled and tested in accordance with 212.2.3. Acceptance for gradation shall be based on test results of consecutive random samples from a lot. A sublot is the quantity of material represented by a single gradation test as defined in MP 700.00.06. A lot shall be considered the quantity of material represented by an average test value, not to exceed five sublots. In the case where only one sample is needed for the total plan quantity, this sublot shall be considered the lot.

The average shall start on the second sample result. The average is continued for the third through fifth sample result, averaging all previous sample results. Thereafter, only the last consecutive five sample results will be averaged (i.e., second test value through sixth test value, third test value through seventh test value, and so forth) as defined in MP 300.00.51.

When the average test values of a lot and the test value of the last sublot, or when the last three consecutive individual test values of a lot fall outside the limits specified in 212.2, the lot of material represented will be considered nonconforming to the extent that the last of its sublots is nonconforming. When this occurs, the last sublot shall have its price adjusted in accordance with 212.2.5.3.

SECTION 219
CONTROLLED LOW-STRENGTH MATERIAL

219.4-CONSTRUCTION MEHTODS:

219.4.1-Proportioning:

ADD THE FOLLOWING PARAGRAPH AFTER THE FOURTH PARAGRAPH OF THE SUBSECTION:

A pH test, in accordance with ASTM G51, shall be performed on at least one sample during the mix design testing, and the results shall meet the requirements of Section 219.3.

219.4.2-Testing:

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

Material shall be sampled in accordance with ASTM D5971. Flow tests shall be conducted in accordance with ASTM D6103. Compressive strength tests shall be conducted in accordance with ASTM D4832.

219.5-PAY ITEM:

DELETE THE CONTENTS AND SUBSECTION TITLE OF 219.5 AND REPLACE THE FOLLOWING:

219.5-METHOD OF MEASURMENT:

The quantity of CLSM will be determined by the volume noted on printed batch tickets with subtraction of rejected and wasted material.

In situations where a foaming agent is used in the CLSM, the volume of CLSM will be determined after the foaming agent has been added. The volume of a batch of CLSM will be determined after a Unit Weight Test (conducted in accordance with AASHTO T121) has been performed on a representative sample of that batch of CLSM after the addition of the foaming agent. The total volume of that batch of CLSM will be calculated by dividing the sum of the batch weights noted on printed batch tickets by the Unit Weight determined by the Unit Weight Test conducted on that batch. The net volume used for payment will be determined by subtracting the rejected and wasted material from the total volume.

The Contractor and the Engineer shall agree in advance on a method to determine the volume of waste.

219.6-PAY ITEM:

ITEM	DESCRIPTION	UNIT
219001-*	Controlled Low Strength Material, Type “type”	Cubic Yard (Meter)

* Sequence number

DIVISION 300
BASES

SECTION 307
CRUSHED AGGREGATE BASE COURSE

307.2-MATERIALS:

307.2.4-Acceptance Procedure:

307.2.4.1-Acceptance Plan:

307.2.4.1.2-Gradation:

DELETE CONTENTS OF SUBSECTION 307.2.4.1.2 AND REPLACE WITH THE FOLLOWING:

The material shall be sampled and tested in accordance with Section 307.2.3. Acceptance for gradation shall be based on test results of consecutive random samples from a lot. A sublot is the quantity of material represented by a single gradation test as defined in MP 700.00.06. A lot shall be considered the quantity of material represented by an average test value, not to exceed five sublots. In the case where only one sample is needed for the total plan quantity, the sublot shall be considered the lot.

The average shall start on the second sample result. The average is continued for the third through fifth sample result, averaging all previous sample results. Thereafter, only the last consecutive five sample results will be averaged, i.e., second test value through sixth test value, third test value through seventh test value, and so forth as defined in MP 300.00.51.

When the test value of a lot and the test value of the last sublot, or when the last three consecutive individual test values of a lot fall outside the gradation limits of Table 704.6.2A, the lot of material represented will be considered nonconforming to the extent that the last of its sublots are nonconforming. When this occurs, the last sublot shall have its price adjusted in accordance with Table 307.9.1.

SECTION 311
OPEN GRADED FREE DRAINING BASE COURSE

311.5-TESTING:

311.5.1-Quality Control Testing:

DELETE THE CONTENTS OF SUBSECTION 311.5.1 AND REPLACE WITH THE FOLLOWING:

Quality control is the responsibility of the Contractor as specified in 106.1. The contractor shall design a quality control plan detailing the methods by which the quality program will be conducted. The Contractor shall conduct one test daily to determine mix properties in accordance with 311.4. Frequency will be one test per day. Acceptance for gradation will be in accordance with section 703.4. If gravel is used for the coarse aggregate a crushed particle

analysis, in accordance with Section 311.2 will be conducted before placement and every 10,000-ton (9000-mg) thereafter. Unless otherwise specified compaction testing shall be waived.

DIVISION 400
ASPHALT PAYMENTS

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

401.2-MATERIALS:

DELETE THE TABLE AND REPLACE THE FOLLOWING:

MATERIAL	SUBSECTION
Coarse Aggregate	703.1 thru 703.3 Note 1 & Note 2 (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.

ADD THE FOLLOWING SUBSECTION:

401.2.1–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.

401.5-TESTING:

401.5.1-Test Methods:

DELETE ENTIRE SUBSECTION 401.5.1 AND REPLACE WITH THE FOLLOWING:

401.5.1-Procedures:

AASHTO R 47	Reducing Samples of HMA To Testing Size (Quartering Method)
AASHTO R 68	Preparation of Asphalt Mixtures by Means of The Marshall Apparatus

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 T166	Bulk Specific Gravity of Compacted Bituminous Mixtures
AASHTO T168	Sampling Hot-Mix Asphalt
AASHTO T209	Maximum Specific Gravity of Bituminous Paving Mixtures
AASHTO T245	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
AASHTO T308	Asphalt Content of HMA By the Ignition Method (Test Method A)
AASHTO T312	Determining the Density of HMA Specimens by Means of The Superpave Gyratory Compactor
AASHTO T355	Standard Method of Test for In-Place Density of Asphalt Mixtures by Nuclear Methods
ASTM D5581	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (For Base-I Marshall Designs)
MP 700.00.06	Aggregate Sampling Procedures

401.6-CONTRACTORS QUALITY CONTROL:

ADD THE FOLLOWING SUBSECTION:

401.6.4-Compaction: Projects shall be tested for compaction in accordance with the Lot-by-Lot test method described in Section 401.6.4.2 if the project limits meet all four of the following requirements:

1. Measured roadway width greater than 16 feet
2. Total design overlay thickness of pavement greater than or equal to 1.5 inches.
3. Total average daily traffic(ADT) greater than 500.
4. Total projects length greater than or equal to 0.5miles, excluding skip paving.

If a project does not meet the above criteria, testing for compaction shall be in accordance with the Rollerpass test method described in Section 401.6.4.2.

In addition, areas of Trench Paving, Pavement Widening, and Pavement Repairs shall be tested in accordance with the Rollerpass test method or to the satisfaction of the Engineer.

When asphalt is placed in areas that require a non-uniform thickness and tapers to a thin edge including patch and level and scratch, acceptance testing of the material is not required. Compaction shall be accomplished with a minimum of eight (8) roller passes prior to reaching the temperature specified in section 401.10.4. A pass shall be defined as the entire roller traversing a spot on the pavement. Compaction shall be performed by a three-wheel (steel) roller or pneumatic-tire roller.

Acceptance testing is not required on areas which are too narrow to be compacted with the roller use for the mainline paving, as defined in the contractor's QC plan; such areas shall be compacted to the satisfaction of the Engineer.

401.6.4.1-Density Testing: All Gauge standardization procedures, calibration procedures and all Density testing conducted shall be in accordance with AASHTO T 355 - *Standard Method of Test for In-Place Density of Asphalt Mixtures by Nuclear Methods.* Testing shall be conducted in the backscatter position and follow the AASHTO Procedure with the exception that no gauge rotation will be required. All gauge tests shall be conducted with the source end of the gauge in the direction of paving. The Gauges used for both QC and QA, shall also have a gauge comparison tested as prescribed in section 401.6.4.1.1.

401.6.4.1.1-Gauge Comparison: For purposes of an accurate comparison, nuclear gauges used for QC and QA shall be compared using the following procedure.

1. The gauge used for the Contractor's quality control testing should be compared with the gauge used for the Division's verification testing.
2. Standardize both gauges according to AASHTO T 355.
3. Place the aluminum plate provided by the Division on the standard block used for verification testing. Place the standard block on material weighing a minimum of 110lb/ft3 (1762 kg/m3). The block must not be near metal or other objects during testing and must not be moved. Keep the gauges separated a minimum of 30 feet (9.1 meters) during testing.
4. Take five (5) one-minute wet density readings with each gauge in the backscatter position. The gauges are to be oriented on the block the same as for standardization.
5. Record the wet density readings exactly as shown on the gauge. The range of the five readings shall not exceed 1.5 lb/ft^3 (24 kg/m^3). If the readings exceed this range, perform a new set of five readings. A gauge should not be used if the repeatability of the gauge is not within this range.
6. Average the five readings for each gauge. The gauges are considered similar if the averages of the readings are within 3 lb/ft^3 (48 kg/m^3).
7. The density readings for verification testing will not be adjusted to compensate for any differences in readings between gauges.

401.6.4.1.2-Thin Lift Correction: A Thin Lift Correction shall be performed on the existing pavement layer, in the state at which it will be paved. Density readings for the Correction shall be taken prior to paving. The correction shall be calculated as described in the operations manual of the testing device. The Thin Lift Correction shall be established as described below:

a. Lot-By-Lot: Ten randomly located tests within the initial 1500 feet. The average of the ten tests shall be used as the underlying density in the correction equation. These values shall be recorded on the thin lift correction testing form. A new thin lift correction shall be completed if the existing pavement changes, e.g. milled, unmilled, scratch, concrete.
b. Rollerpass: Five randomly located tests within the initial area of paving for the day or wherever a new Rollerpass is to be established. These five tests shall be conducted within a 400-foot section, the average shall be used as the underlying density in the correction equation. These values shall be recorded on the thin lift correction testing form. This section shall begin 100 feet beyond the transverse joint, or immediately when a new Rollerpass is to be conducted.

401.6.4.2-Lot-by-Lot Testing: Density of the traveled lanes, shoulders, and Longitudinal Joint 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 shall consist of five equal sublots. Sublots shall be tested with randomly located nuclear density tests, tests shall utilize the Thin Lift Correction as described in 401.6.4.1.2. A normal lot size shall not exceed 1500 linear feet of paving with five, 300 linear foot sublots, unless operational conditions or project size dictates otherwise. 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. Relative density shall be calculated based on the Maximum Specific gravity from the Division approved JMF or the Maximum Specific Gravity established under section 401.6.2, Job Mix Formula Verification, whichever is more recently established.

401.6.4.2.1-Mat Density: Compaction testing for the mat density shall be performed for all traveled lanes and shoulders and will be evaluated based on an Upper Specification Limit(USL) of 97.0% relative density and a Lower Specification Limit(LSL) of 92.0% relative density. The average mat density of the Lot shall be calculated as the average of the sublot results. Acceptance of Mat Density shall be in accordance with Section 401.13.3.

401.6.4.2.2-Joint Density: Longitudinal Joint Density testing shall be performed on all constructed joints between traveled lanes. A Longitudinal Joints constructed between a travel lane and a shoulder will not require testing. Joint density testing is not required until both lanes of the joint are constructed. The first lane constructed shall be referred to as the cold side and the second lane shall be referred to as the hot side. Joint density testing shall be conducted on the hot side, with the gauge positioned four inches from the constructed joint.

Longitudinal Joint Density testing shall be accepted in the field on a lot by lot basis as described in Section 401.6.4.1. Compaction testing for the Joint density will be evaluated based on an Upper Specification Limit(USL) of 97.0% relative density and a Lower Specification Limit(LSL) of 90.0% relative density. The average Joint density of the Lot shall be calculated as the average of the sublot results. Acceptance of Joint density shall be in accordance with Section 401.13.3.

401.6.4.3-Roller Pass Testing: A Rollerpass Control Section shall be completed on a daily basis, when roadway conditions change where they would affect the compaction effort, or when the Engineer determines the current rollerpass is unsatisfactory. The Rollerpass shall be established prior to the mat reaching the temperature specified in section 401.10.4 and shall be conducted in the following manor:

1. The Control Rollerpass section shall be conducted within the first 100 feet beyond the initial transverse construction joint, or immediately when a new Rollerpass is to be conducted. Follow section 401.6.4.1.2 to establish a Thin Lift correction factor.
2. Apply four passes (a pass shall be defined as the entire roller traversing a spot on the pavement) to the roadway, then conduct two randomly located nuclear density testing within the section; record the results, the average, and the mat temperature at each test location.

3. Apply an additional two passes and repeat the nuclear density testing in the same locations; record the results, the average, and the mat temperature at each test location.
4. Repeat step 3 until one of the following conditions occur: less than 5 kg/m^3 increase occurs between the average of two sets of readings, the density of the material exceeds 97.0% Gmm, or one test location "breaks over" (i.e. shows a decrease in density) after exceeding 92.0% Gmm.
5. Compute the Percent of Gmm using the thin lift correction.

Once the control section is completed, the Thin Lift corrected density shall be equal to or greater than 92.0% Gmm. If the thin lift corrected density does not meet 92%, repeat the procedure above immediately. If after two the density still does not meet 92% Gmm, contractor shall apply the number of passes associated with the highest percent density, minimum of 8 passes, unless the Engineer determines more appropriate means.

If the thin lift corrected density meet 92% Gmm conduct a proving section in the proceeding 200 feet. Within the proving section, apply the established number of passes and conduct ten randomly located nuclear density tests. The average of these ten tests shall be within ±34.0 kg/m^3 of the average wet density determined in the Rollerpass control section. If this is not achieved a new test section shall be conducted.

All data shall be submitted the Engineer on associated Rollerpass forms.

401.7-ACCEPTANCE TESTING:

DELETE SUBSECTION 401.7 TITLE AND REPLACE WITH THE FOLLOWING:

401.7-VERIFICATION TESTING:

401.7.2-Surface Tolerance:

DELETE THE CONTENTS AND REPLACE THE FOLLOWING:

Final smoothness testing of all new Asphalt surfaces shall be in accordance with Section 720.

When compaction is completed on the course, it shall present a uniform surface, true line and grade, conforming to the cross section shown on the Plans. When tested with a straightedge of approximately 10 feet (3 meters) in length and a template of the specified dimensions, the finished base course shall not show a deviation greater than ¼ inch (6 mm) and the finished wearing course shall not show a deviation from the required surface greater than 3/16 inch (5 mm).

The Contractor shall provide the straightedge and template for checking the surfaces and an employee to use them under the direction of the Engineer. Any irregularity of the surface exceeding the limits specified shall be corrected. Depressions which develop after the initial rolling shall be corrected by loosening the mixture and adding new material. High places shall be corrected by removing excess material.

Areas of completed courses found to be defective shall be removed and replaced with approved mixtures laid in accordance with these specifications, and no additional compensation will be allowed for materials used or work involved in replacing defective areas.

401.7.3-Compaction:

DELETE THE ENTIRE CONTENTS OF SUBSECTION 401.7.3 AND REPLACE WITH THE FOLLOWING:

401.7.3-Lot by Lot Compaction: Verification testing of mat and joint density is the responsibility of the Division. The division will conduct density verification testing in accordance with section 401.6.4.1. Verification activities will be accomplished by conducting testing completely independent of the quality control activities. Tests will be taken at a frequency approximately equal to two lots per eight for both mat and joint density, with a minimum of two lot evaluation for each Mat and Joint per project. If a Joint density lot is to be tested, it will be tested with the corresponding Mat lot.

401.7.3.1-Evaluation for Similarity: The ten (10) verification tests taken by the Division will be statistically evaluated, using an F-test and T-test at a 95% confidence level, for statistical similarity to the Contractors ten (10) quality control tests. If the evaluation indicates that the Division's test results are statistically similar to the Contractor's test results, then the test results represented by this evaluation will be considered acceptable, therefore shall be used in the price adjustment in accordance with section 401.13.3. If the evaluation proves statistically not similar an investigation will be conducted to determine the cause and extent of nonsimilarity. The intent of the investigation is to define and correct any testing deficiencies that may cause a misrepresentation of the tested material. In addition, if the evaluation is statistically not similar, the Division may test additional lots and use the verification testing results for the basis of payment.

401.10-PAVING OPERATIONS:

401.10.3-Spreading and Finishing:

DELETE THE CONTENTS OF SUBSECTION 401.10.3 AND REPLACE THE FOLLOWING.

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 mixes produced with neat (non-modified) asphalts (which may include PG64H-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 within the master temperature range of 250° and 338° F (121° and 170° C) unless otherwise specified by the asphalt supplier. The mix temperature shall be monitored by inserting a dial type 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° F (6° C) of the weather restrictions of Table 401.8, the mix temperature may be increased up to a maximum of 338° F (170° 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, which will be referenced on the JMF.

ADD THE FOLLOWING SUBSECTION:

401.10.6-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.

401.12-METHOD OF MEASUREMENT:

ADD THE FOLLOWING TO THE END OF THE SECTION:

No additional measurement is necessary nor will addition compensation be allowed for the placement of Safety Edge.

401.13-BASIS OF PAYMENT:

401.13.3:

DELETE THE CONTENTS OF SUBSECTION 401.13.3 AND REPLACE WITH THE FOLLOWING:

A Lot of asphalt pavement shall have its price be adjusted in accordance with Table 401.13.3A using Formula-1. If a Lot of asphalt pavement is associated with a Longitudinal joint Lot its price shall be adjusted in accordance with Table 401.13.3A and Table 401.13.3B using Formula-2. The longitudinal joint density determined in accordance with Section 401.6.4 shall represent the Lot on which the joint density testing was performed. Any price adjustment for joint density shall be applied to that Lot only.

Use Formula-1 on the first lane paved before a longitudinal joint is constructed. Use Formula-2 when both mat and joint density testing is required on a project.

FORMULA-1: Lots requiring only mat density testing:

Lot Price Adjustment (Mat only) = (unit price) X (Lot quantity) X (mat density price adjustment % from Table 401.13.3A)

FORMULA-2: Lots requiring both mat and joint density testing:

Lot Price Adjustment (Mat + Joint) = (unit price) X (Lot quantity) X [(mat density price adjustment % from Table 401.13.3A) + (joint density price adjustment % from Table 401.13.3B)]

TABLE 401.13.3A

Adjustment of Contract Price for Pavement Mat Density	
Percent of Density	Percent of Contract Price to be Paid
Greater than 97 %	Note 1
95% to 97%	102
92% to 94%	100
91% to 88%	= 100 – 4*(92% - Percent density)
Less than 88%	= 84 – 10*(88% - Percent density) Note 2

Note 1: Mat 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.

Note 2: When the density is less than 92%, 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.

TABLE 401.13.3B Note 7

Adjustment of Contract Price for Pavement Joint Density	
Percent of Joint Density	Percent Adjustment
Greater than 97 %	Note-3
94 % to 97 %	+2.0%
92% to 93%	+1.0
90% to 91% Note 4	0%
89 % Note 5	-1.0%
88 % Note 5	-3.0%
Less than 88 %	Note 5 and 6

Note 3: Density greater than 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.

Note 4: If the longitudinal joint density is determined to be less than 92% on 25% or more of the total project LOTs, then the Contractor shall be required to seal the joint a minimum of 3" on each side of the joint with a heated PG 64S-22 binder (or approved equivalent) on the entire project at no additional cost to the Division.

Note 5: Any longitudinal joint densities determined to be below 90% the Contractor shall be required to seal the joint a minimum of 3" on each side of the joint on the entire project with a heated PG 64S-22 binder (or approved equivalent) at no additional cost to the Division

Note 6: Density values less than the minimum specified 90% will be more susceptible to accelerated deterioration of both the joint and the surrounding pavement. For Joint densities less than 88%, the percent of adjustment will be decreased by an additional 6% per percentage of joint density less than 88%, unless a Special evaluation performed by the Division determines a more appropriate action.

Note 7: This table shall be enforced, effective with contracts awarded after January 1, 2020.

SECTION 405
SURFACE TREATMENTS

DELETE THE ENTIRE CONTENTS AND REPLACE THE FOLLOWING:

SECTION 405
CHIP SEALS

405.1-DESCRIPTION:

This work shall consist of the construction of a wearing course, composed of asphalt emulsion immediately followed by a single layer of aggregate, in one or more applications, followed by a fog seal. The type of Chip Seal will be indicated on the Plans.

The contractor shall notify the Engineer a minimum of two weeks prior to starting any Chip Seal operation. In addition, the contractor shall submit proposed sources of all materials.

405.2-MATERIALS:

405.2.1-Aggregate: The aggregate shall be from a WVDOT approved source and shall conform to the requirements of the Standard Specifications Section 703.1-4. It is expected that the aggregate will be washed to reduce dust content. The aggregates shall be crushed with a minimum of 80% two face fracture. Aggregates shall meet the following gradations when specified in section 405.12:

Table 405.2.1
Design Aggregate Gradation Requirements for Chip Seal

Sieve Size	Type A	Type B	Type C
	Nominal Maximum Size		
	1/2 in (12.5 mm)	3/8 in (9.5 mm)	No. 4 (4.75)
1 in (25 mm)	–	–	–
3/4 in (19 mm)	100	–	–
1/2 in (12.5 mm)	90-100	100	–
3/8 in (9.5 mm)	5-30	90-100	100
No. 4 (4.75 mm)	0-10	5-30	90-100
No. 8 (2.36 mm)	–	0-10	5-30
No. 16 (1.18mm)	0-2	–	0-10
No. 30 (600 µm)	–	0-2	–
No 50 (300 µm)	–	–	0-2
No. 200 (75 µm)	0-2	0-2	0-2

405.2.2-Asphalt Emulsion: The asphalt emulsion for Chip Seals and the emulsion for the fog seal shall be from a WVDOT approved source and shall meet the requirements of AASHTO M316, Table 1. Other asphalt emulsions may be used with testing and approval prior to construction. Testing shall be done a minimum of two weeks prior to the projected start date and follow the process outlined in Materials Procedure 401.02.25 Certification of Asphalt and Tar Shipping Terminals.

405.3-WEATHER RESTRICTIONS:

Chip Seal shall be constructed only when the condition of the existing surface is satisfactory to the Engineer, when the temperature of the existing pavement is 50° F (10° C) or above, and when other weather conditions are satisfactory for construction. The temperature may be waived but only when approved by the Engineer. No Chip Seal shall be performed between October 1 and May 1.

Chip Seal operations shall be suspended immediately when rain begins or when the Engineer determines that a rain event is imminent.

405.4-EQUIPMENT:

Equipment shall include equipment for emulsion distribution, aggregate spreading, compaction, and sweeping before and after application. Equipment shall also include scrapers, hand brooms, shovels, and other items as may be necessary to thoroughly clean the existing surface.

405.4.1-Emulsion Distributor: The distributor shall be so designed, equipped, maintained and operated that asphalt material may be applied uniformly on variable widths up to 16 ft. (4.6 m) at readily determined and controlled rates from 0.05 to 2.0 gal. per sq. yd. (0.22 to 9.3 liters sq. m) with uniform pressure and with an allowable variation from any specified rate not to exceed 0.02 gal. per sq. yd. (0.09 liter sq. m).

The distributor shall also have a cab-metering system that will automatically adjust the flow of the asphalt material as the speed of the truck changes and allow the operator to adjust the rate of application from the cab of the truck.

Distributor equipment shall include a tachometer, pressure gages, and a thermometer for measuring temperatures of tank contents.

Distributors shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically. A manifold connection shall be provided and hand spraying equipment shall be available to cover areas and patches inaccessible to the distributor.

Verification of distributor truck calibration within the past 12 months shall be available on the project site, preferably located within the cab of the truck.

405.4.2-Aggregate Spreader: The aggregate spreader shall be self-propelled with front discharge capable of adjusting to evenly and accurately distribute at the required placement rates. Aggregate spreader calibration according to ASTM D5624 shall be performed prior to starting work. Recalibrate after any maintenance, repairs, or modifications that could affect spread rate.

405.4.3-Compaction Equipment: A minimum of two self-propelled pneumatic tire rollers shall be used, at a minimum of 12 tons each. Roller tires shall have a minimum pressure of 60 psi.

405.4.4-Sweepers: Power sweepers, pickup sweepers, or rotary brooms shall be used for surface preparation as well as removing any loose aggregate after compaction. Steel bristles shall not be used on the Chip Seal after compaction.

405.5-PREPARING AND REPAIRING EXISTING SURFACE:

No chip seal shall be applied until breaks, holes, depressions, and other irregularities in the existing surface have been repaired and cured sufficiently to permit the asphalt material to be placed in a uniform application. Patching and leveling material shall be plant mixed. Hand patching will be permitted where necessary. Remove all existing thermoplastic markings and raised pavement markers. Protect any drains or other utility covers. Apply a light fog seal to asphalt patched surfaces less than 2 months old, using an asphalt emulsion that is compatible with the emulsion being used for the chip seal.

405.6-CLEANING AND SWEEPING:

Immediately prior to construction, the existing surface shall be swept and thoroughly cleaned to remove all mud, dirt, dust, vegetation, and other caked or loose foreign material. Cleaning shall be done to a minimum width of one foot on each side beyond the width of the surface to be placed excluding the shoulder. Materials collected in the cleaning operation shall be removed and disposed of as directed.

405.7-APPLICATION OF ASPHALT MATERIAL:

After the existing surface has been cleaned, and is in a dry condition, the asphalt material shall be applied by means of a pressure distributor. The spray bar shall be raised to a sufficient height so as to uniformly and completely coat the entire surface. The rate of application of asphalt material shall be in accordance with section 405.12, or as modified by the plans. Application temperatures of the asphalt material shall be within the range specified in Subsection 705 for the particular material being used, or as documented by the manufacturer.

Except when required to maintain traffic, Chip Seal operations shall be done upon the full width of the section.

After application, asphalt material shall completely and uniformly cover the underlying pavement and be free of streaks, voids, and puddles.

405.8-APPLICATION OF AGGREGATE:

Immediately following each application of asphalt material, aggregate at the rate or rates called for in 405.12 shall be spread with the spreader in such a manner that the entire area being treated is uniformly covered. No traffic, construction or otherwise, shall be allowed on the asphalt material before placing aggregate. Additional aggregate shall be spread if necessary, and hand spreading shall be done to cover areas inaccessible to the spreading equipment. The aggregate shall be dried or moistened as required in order to obtain a near Surface Saturated Dry condition.

If the process must stop during that application any asphalt material that has been applied to the surface shall be covered with aggregate to prevent breaking of the emulsion prior to embedment of the aggregate.

405.9-ROLLING AND SWEEPING:

Immediately following spreading of the aggregate, the entire surface of the aggregate shall be rolled until the aggregate is keyed into the asphalt material. Any area that ravels shall be repaired and rerolled. Rolling shall be parallel to the centerline and shall begin at the edges of the treatment and progress toward the center, each trip uniformly overlapping the preceding trip. There shall be at least three passes made with a pneumatic tire roller.

Rolling shall cease before the aggregate is crushed to any appreciable extent. Rollers shall be the type and weight specified in 405.4.3. To ensure aggregate embedment before the emulsion has set, the minimum number of rollers shall be two (2). More rollers may be used to obtain compaction to the satisfaction of the Engineer.

The roller speed shall not exceed 10 miles per hour to prevent aggregate pick up and ensure embedment. Water, to prevent adhesion of the asphalt material to the roller wheels, shall not be used in excessive amounts. The use of fuel oil, paraffin oil, and kerosene on rollers or other equipment, for the purpose of preventing material from picking up or sticking, is prohibited.

After the emulsion has cured, sweeping can commence. The status of being cured shall be determined by the ability to sweep all loose aggregate from the surface without removing any aggregate adhered to the asphalt emulsion.

405.10-JOINTS:

The longitudinal construction joints between adjacent lanes shall be kept clean of material foreign to the surface being treated. The joints shall be constructed without overlaps or gaps between the materials.

The beginning of the project and all transverse joints shall be covered with paper to prevent overlapping of the seal and provided a uniform joint. Following its use, the paper shall be removed and disposed of satisfactorily.

405.11-PROTECTION OF PAVEMENT AND TRAFFIC CONTROL:

The Contractor shall be responsible for the protection of the surface against damage by their equipment and personnel. Traffic shall not be permitted on any part of the work under construction until sweeping has been completed. The applicable provisions of 636 shall apply for regulating traffic.

405.12-SEQUENCE OF OPERATIONS AND QUANTITIES OF MATERIALS:

The quantities and kinds of materials to be used and the sequence of applications and operations for the various treatments shall be as follows. Maximum quantities of asphalt emulsion may be used only when the old surface is open or porous. Sweep each layer when applying multiple layers. The rates of aggregate and asphalt emulsion may be adjusted by the Engineer. The contractor may suggest different application rates to the Engineer for consideration by submitting a project specific Chip Seal design based on McLeod or Modified Kearby Design Methods.

Table 405.12.1

Type	Layer	Asphalt Emulsion (gal/SY)	Aggregate (lb/SY)	Gradation Type
Light	First	0.15 to 0.25	8 to 10	C
Single	First	0.25 to 0.40	15 to 25	B
Double	First	0.25 to 0.40	25 to 35	B
	Second	0.25 to 0.35	10 to 20	C
Triple	First	0.30 to 0.50	25 to 45	A
	Second	0.30 to 0.50	25 to 35	B
	Third	0.25 to 0.35	10 to 20	C

405.13-FOG SEAL:

Unless otherwise specified, a fog seal shall be applied on the final surface according to Section 407. This shall be done no less than 3 but no more than 7 calendar days after the application of the Chip Seal. The surface must be dry before application, and the surface shall be swept to remove loose material. An asphalt emulsion shall be applied uniformly at a rate of 0.09 ± 0.03 gallons per square yard to the surface. Any raveled areas, flushed areas, or other defects in the chip seal shall be repaired prior to the application of the fog seal.

405.14-TESTING AND ACCEPTANCE:

405.14.1-Quality Control Testing: Quality Control Testing: Quality Control is the responsibility of the Contractor, as specified in 106.1. The Contractor shall design and submit a quality control plan in accordance with applicable section of MP 307.00.50 detailing the methods by which the quality control program will be conducted.

405.14.2-Acceptance Testing: Acceptance sampling and testing is the responsibility of the Division. Acceptance for aggregate will be based on the uniformity of the aggregate and the dust content. Samples shall be taken from the conveyor belt on the chip spreader in accordance with MP 700.00.06 or from the roadway in accordance with ASTM D5624. Samples may be split with the contractor. Sampling frequency shall be one sample for every lane mile per layer. This sample shall be the lot. Fractions of a mile less than 0.5 will be included in the previous lot, and fractions of a mile greater than 0.5 will be a separate lot.

405.14.2.1-Acceptance of Aggregate Uniformity: The more uniform the material, the better performance potential of the chip seal. Uniformity of the aggregate will be measured by the Coefficient of Uniformity, C_u, as defined in ASTM D2487. Adjustments per lot will be as follows.

TABLE 405.14.2.1

Adjustment of Contract Item Price for Aggregate Uniformity	
Cu	**Percent Adjustment**
<1.7	1% incentive per 0.1 below
1.7 – 3.0	No Adjustment
3.1 – 4.0	2% disincentive per 0.1 above
>4.1	*Special evaluation to consider remove and replace

405.14.2.2-Acceptance of Aggregate Dust Content: Dust content will be determined by AASHTO T11. Adjustments per lot will be as follows.

TABLE 405.14.2.2

Adjustment of Contract Item Price for Dust Content	
% Dust	**Percent Adjustment**
0 – 1.0	2% incentive
1.1 – 2.0	No Adjustment
2.1 – 3.0	2% disincentive
3.1 – 3.5	5% disincentive
3.6 – 4.0	8% disincentive
4.1 – 4.5	12% disincentive
>4.5	*Special evaluation to consider remove and replace

405.15-METHOD OF MEASUREMENT:

The quantity of "Asphalt Emulsion Material" shall be the number of gallons (liters) incorporated into the completed work, which volume will be measured as described in 109.1.

The quantity for "Chip Seal, Aggregate Type" shall be paid for by the Square Yard (Square Meter). The quantity will be determined by the Plan Quantity as provided for in the proposal unless otherwise directed by the Engineer.

405.16-BASIS OF PAYMENT:

The quantities, determined as provided above, will be paid for at the contract unit prices and shall be full compensation for the furnishing, hauling, and placing of all materials, all cleaning and sweeping, compaction and for all other materials, labor, tools, equipment, supplies, and incidentals necessary to complete the work.

405.17-PAY ITEMS:

ITEM	DESCRIPTION	UNIT
405007-*	Chip Seal Aggregate, Type **	Square Yards (Square Meters)
405010-*	Asphalt Emulsion Material	Gallon (Liter)

* Sequence number

** Type of Aggregate Gradation from Section 405.2.1, either A, B, or C. Each aggregate gradation will have its own pay item. For example, a Double Chip Seal would have two pay items; one for Type B and one for Type C gradations.

ADD THE FOLLOWING SECTION:

SECTION 407
FOG SEAL

407.1-DESCRIPTION:

This work shall consist of preparing and fog sealing an existing roadway surface with asphalt material in accordance with these Specifications and in reasonably close conformity with the lines shown on the Plans or established by the Engineer.

407.2-MATERIALS:

Materials shall be from an approved source and conform to the requirements of the following Subsections:

MATERIALS	SUBSECTION	TYPE
Asphalt Emulsion	705.4	SS-1 or SS-1h
Cationic Emulsified Asphalt	705.11	CSS-1 or CSS-1h
Non-Tracking Asphalt Material	705.13	NTSS-1HM or similar*

*Refer to MP 401.02.25 for a list of Certified Bituminous Materials

407.2.1-Quality Control: Quality control is the responsibility of the Contractor as specified in 106.1.

Quality control shall consist of calibrating the distributor to the proper application rate, verifying the volume and temperature measuring devices, and when performed, assuring and documenting that the proper dilution rate is maintained.

407.2.1.1-Acceptance Testing: Approval of asphalt emulsions used for fog seal material will be handled by the Materials Control, Soils and Testing (MCS&T) Division. MCS&T maintains a list of all approved asphalt emulsion sources and grades. The local District Materials Section can provide a copy of the latest list. The list is also posted on the MCS&T web page under the heading Approved Source/Product Listing. The use of

non-approved material without prior testing by MCS&T may result in nonpayment of the item.

CONSTRUCTION METHODS

407.3-WEATHER RESTRICTION:

Fog seal shall be applied only when the weather and existing surface are satisfactory to the Engineer and when the temperature of the surface is 50°F (10°C) or above. When the surface temperature is less than 60°F (16°C), care must be exercised to assure that the fog seal sets prior to resuming traffic.

407.4-EQUIPMENT:

Equipment for Surface Preparation may include a power broom and power blower, and a broom drag. Equipment may also include scrapers, hand brooms, shovels, and other equipment as may be necessary to thoroughly clean the base or surface.

Equipment for distribution of asphalt material shall include equipment for heating asphalt material, and a self-powered asphalt material pressure distributor. Equipment for heating asphalt material to the required temperature shall consist of a retort coil so designed that steam will not be introduced into the material and shall not degrade the emulsion. The distributor shall be so designed, equipped, maintained and operated that asphalt material at even heat may be applied uniformly on variable widths of surface up to 15 ft. (4.6 m) at readily determined and controlled rates from 0.05 to 0.15 gal/sy (0.2 to 0.7 liters/m^2) with uniform pressure and with an allowable variation from any specified rate not to exceed 0.02 gal/sy (0.09 liter/m^2). The distributor shall also have a cab-metering system that will automatically adjust the flow of the asphalt material as the speed of the truck changes and allow the operator to adjust the rate of application from the cab of the truck.

Distributor equipment shall include a tachometer, pressure gages, and accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically. A manifold connection shall be provided and hand-spraying equipment shall be available to cover areas and patches inaccessible to the distributor.

407.5-PREPARING AND REPAIRING EXISTING SURFACES:

No fog seal shall be applied until breaks, holes, depressions, and other irregularities in the existing surface have been repaired and cured sufficiently to permit the fog seal to be placed in a uniform application.

407.6-CLEANING AND SWEEPING:

Immediately before application, the existing surface shall be swept and thoroughly cleaned by the use of tools or machinery as may be required to remove all loose aggregate, mud, dirt, dust, and other caked or loose material foreign to the type of surface to be placed. Cleaning shall be done to a minimum width of one foot on each side beyond the width of the surface to be treated including the shoulder.

407.7-APPLICATION OF ASPHALT MATERIAL:

Except when required to maintain traffic, the work shall be done on the full width of the section. Joints shall overlap by 2 to 6 inches.

After the surface has been cleaned, when called for, and is in a dry condition, the asphalt material shall be applied by means of a distributor. The spray bar shall be raised to a sufficient height so as to uniformly and completely coat the entire surface. The rate of application of asphalt material shall be as recommended in 407.10, or as determined by the Engineer. Application temperatures of the asphalt material shall be within the range specified in Subsection 705 for the particular material being used. Anionic asphalt emulsion grades SS-1 and SS-1h, and cationic emulsion grades CSS-1 and CSS-1h, may be diluted at a 1:1 ratio by addition of water to the emulsion. Dilution shall occur by the manufacturer at the terminal.

The surfaces of sidewalks, curbs, other structures, and trees adjacent to the area being treated shall be protected in such a manner as to prevent being spattered or marred. Material used for such protection shall be removed and disposed of in an appropriate manner. The distributor shall not be cleaned or discharged within the right-of-way, into borrow pits, or so as to pollute or block water courses.

407.8-APPLICATION OF COVER AGGREGATE:

Any fog seal material applied in excess of the requirements shall be removed or covered with a blotter course of dry sand or stone chips as directed by the Engineer.

407.9-PROTECTION OF THE PAVEMENT AND TRAFFIC CONTROL:

The Contractor shall be responsible for the protection of the surface against damage by their equipment and personnel. Traffic shall not be permitted on any part of the work under construction until the treatment has cured sufficiently to prevent raveling or picking up under traffic. The applicable provisions of 636 shall apply for regulating traffic.

407.10-QUANTITIES OF MATERIALS:

The application rates referenced in Table 407.10 shall be used as guide to assure the proper amount of asphalt is distributed over the pavement surface under various pavement conditions. The undiluted application rate refers to the unmodified emulsion that meets all standard specifications of the specified grade. When an SS or CSS grade emulsion is diluted with water at the allowable 1:1 ratio, the residual asphalt content is defined as the amount of asphalt remaining on the pavement surface after all water has evaporated from the emulsion.

Unless otherwise specified on the Plans, the recommended application rates for undiluted and diluted asphalt fog seal shall be as specified in Table 407.10. These rates are provided for guidance and may be adjusted as directed by the Engineer based on field conditions.

TABLE 407.10

Surface to be Sealed	Application Rate (gal/sy) / (L/m^2) (Note 2)	
	Undiluted	Diluted (1:1)
Oxidized HMA	0.06 – 0.08 / (0.27 – 0.36)	0.12 – 0.15 / (0.54 – 0.68)
Chip Seals	See Specification 405	

Note 2: Application rates are for slow setting emulsions grades (SS and CSS) that contain approximately 60% asphalt material. Non-Tracking Emulsions may contain different asphalt contents. Refer to manufacturer's recommendations for application rates.

407.11-METHOD OF MEASUREMENT:

No materials shall be removed from the Project for any purpose until the operation has been completed and the quantities of materials incorporated into the operations have been determined, except when authorized by the Engineer.

The quantity of "Asphalt Material" for fog seal shall be the number of gallons (liters), prior to dilution, incorporated into the completed work. Any applicable dilution rates, shall be supplied to the Engineer by the Contractor on the material delivery ticket.

Dry sand or stone chips used as a blotter course due to excessive use of fog seal shall be considered incidental to the work.

407.12-BASIS OF PAYMENT:

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

407.13-PAY ITEM:

ITEM	DESCRIPTION	UNIT
407001-*	Non-Tracking Fog Seal	Gallon (Liter)
407002-*	Fog Seal	Gallon (Liter)

*Sequence number

SECTION 408
TACK COAT

408.2-MATERIALS:

DELETE THE TABLE AND REPLACE WITH THE FOLLOWING:

MATERIALS	SUBSECTION	TYPE
Asphalt Emulsion	705.4	SS or RS Grades
Cationic Emulsified Asphalt	705.11	CSS or CRS Grades
Non-Tracking Asphalt Material	705.13	NTSS-1HM or similar*

* Refer to MP 401.02.25 for a list of Certified Bituminous Materials.

408.14-PAY ITEM:

ADD THE FOLLOWING ITEM TO THE TABLE:

ITEM	DESCRIPTION	UNIT
408001-*	Non-Tracking Asphalt Material	Gallon (Liter)

*Sequence number

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

410.2-MATERIALS:

DELETE THE TABLE AND REPLACE THE FOLLOWING.

MATERIAL	SUBSECTION
Coarse Aggregate	703.1 thru 703.3 Note 1 & Note 2 (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.

ADD THE FOLLOWING 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.

410.7-ACCEPTANCE TESTING:

410.7.1-Acceptance Testing of Asphalt:

410.7.1.5-Bond Strength:

DELETE THE CONTENTS OF THE SUBSECTION 410.7.1.5 AND REPLACE WITH THE FOLLOWING:

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.

410.10-PAVING OPERATIONS:

410.10.1-Spreading and Finishing:

DELETE SUBSECTION 410.10.1 AND REPLACE WITH THE FOLLOWING:

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 ±45°F (±25°C) with a maximum mixing temperature of 338°F (170°C). Additional allowances will be made for water injection processes with a minimum mixing temperature of 220°F (105°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° F (6° C) of the weather restrictions of Table 410.8, the mix temperature may be increased up to a maximum of 338° F (170° 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 ± 25° F (14° C).

ADD THE FOLLOWING SUBSECTION:

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.

410.12-METHOD OF MEASUREMENT:

ADD THE FOLLOWING TO THE END OF THE SUBSECTION:

No additional measurement is necessary nor will addition compensation be allowed for the placement of Safety Edge.

410.13-BAISIS OF PAYMENT:

410.13.6-Bond Strength:

DELETE THE CONTENTS OF THE SUBSECTIONS 410.13.6, 410.13.6.1, AND 410.13.6.2, AND REPLACE WITH THE FOLLOWING:

410.13.6-Bond Strength Adjustment: Bond Strength PWL calculations shall be in accordance with 410.13.50, 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 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.

Positive adjustment calculated as follows:

$$\$T = \frac{PWL - 90}{10} \text{ X } 2{,}000$$

Negative adjustment calculated as follows:

$$\$T = \frac{70 - PWL}{70} \text{ X } 40{,}000$$

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.

410.13.7-Lot Payment Calculations:
410.13.7.4-Bond Strength Adjustment:

DELETE THE CONTENTS OF SUBSECTION 410.13.7.4 AND REPLACE WITH THE FOLLOWING:

If it is determined that a Bond Strength Adjustment is warranted by the formulas in Section 410.13.6 shall be used to calculate the adjustment. This adjustment shall be applied to the overall payment for the lot.

SECTION 412
WINTER GRADE ASPHALT PATCHING MIXTURE

DELETE THE ENTIRE SECTION.

ADD THE FOLLOWING SECTION:

SECTION 420
SINGLE / MULTIPLE COURSE MICRO SURFACING

420.1-DESCRIPTION:

This section covers the materials, equipment, construction and application procedures for placing Micro Surfacing material for filling ruts and for surfacing existing paved surfaces. The Micro Surfacing is a mixture of a latex-modified asphalt emulsion, crushed mineral aggregate screenings, mineral filler, water and other additives for control of set time in the field. All ingredients are to be properly proportioned, mixed and spread on the paved surface in accordance with this Specification and as directed by Engineer.

420.2-MATERIALS:

Furnish a Micro Surfacing mixture consisting of a properly designed and proportioned blend of polymerized asphalt emulsion, fine aggregate, Portland cement, water and other additives. All materials must be from a WVDOT approved source. Use materials meeting the following:

420.2.1-Mineral Filler: Portland cement, hydrated lime, limestone dust, fly ash, or other approved filler meeting the requirements of ASTM D 242 shall be used if required by the mix design.

420.2.2-Fine Aggregates, 2FA and 3FA: The fine aggregate used shall be suitable for the particular application and shall be a crushed stone such as granite, slag, limestone, chat, or other high-quality aggregate, or combination thereof and shall meet the requirements of the Division of Highways and grading requirements as stated. In addition, aggregates used for surface courses on projects with an ADT greater than 3000 shall be from an approved source identified as having polish-resistant aggregates and considered potential skid-resistant aggregate sources.

Tests		Requirements
Sand Equivalent Value of Soils and Fine Aggregate	AASHTO T176	65 minimum
Soundness of Aggregates by Use of Sodium Sulfate	MP703.00.22	15%max. w/NA2SO4

Material	Percent Passing							
	3/8 in	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
2FA[(a)]	100	85-100	50-80	40-65	25-45	13-25		5-15
3FA[(a)]	100	70-90	45-70	28-50	19-34	12-25	7-18	5-15

[(a)] Gradation represents the final blended product.

420.2.3-Asphalt Emulsion-CSS-1hM or CQS-1hM: Polymer Modified Asphalt Emulsion shall be a quick-set, CSS-1hM or CQS-1hM emulsion in accordance with AASHTO M 316 with the following exceptions: the emulsion shall have a minimum 60% residue by distillation; the distillation procedure shall be conducted at 175°C with a 20 minute hold period; and the cement-mixing test shall be waived. The polymer material shall be processed into the asphalt cement or milled into the asphalt emulsion. Post adding to the asphalt emulsion is not permitted. The minimum polymer solids content will be 3.0% based on the residual of the emulsion.

420.2.4-Water: Water shall be potable and free of harmful salts and contaminants.

420.2.5-Additives: Chemical additives may be used to accelerate or retard the break/set of the Micro Surfacing mixture if required by the mix design.

420.3-MIXTURE REQUIREMENTS:

420.3.1-Mix Design: Submit to the Engineer, at least fourteen calendar days before the start of production, a complete mix design prepared and certified by an experienced laboratory. Provide a job mix formula (JMF) to the Engineer at the pre-paving meeting showing individual proportions of each material, that when combined, will meet the following mix design criteria. A new mix design is required for any change in aggregate or asphalt emulsion source.

Micro Surfacing Mix Design Criteria

ISSA TB-139 Wet Cohesion*	
30 minutes minimum (set time)	12 kg-cm min
60 minutes minimum (traffic)	20 kg-cm min or near spin
ISSA TB-114 Wet Stripping	90% min
ISSA TB-100 Wet Track Abrasion Loss	
One Hour Soak	50 g/ft2 max
Six Day Soak	75 g/ft2 max
ISSA TB-144 Saturated Abrasion Compatibility	3 g loss, max

ISSA TB-113	
Mix Time at 77 °F*	Controllable to 120 sec, min
Mix Time at 104 °F*	Controllable to 35 sec, min

* Check the ISSA TB-139 (set time) and ISSA TB-113 (mix time) tests at the highest temperature expected during construction. For ISSA TB-113 test at 104°F, preheat all ingredients and containers.

The JMF must be within the following limits:

Asphalt Binder Content (Residual)	7.0%-8.5%, dry weight, 2FA aggregate 6.5%-8.0%, dry weight, 3FA aggregate
Mineral Filler	0.25%-3.0%, dry weight, of aggregate

420.3.2-Mix Design Format: Provide the following information in the final mix design:

a. Sources of each material
b. Aggregate
    1. Type
    2. Gradation
    3. Sand equivalence
c. Field Simulation Tests
    1. Wet stripping test
    2. Wet track abrasion loss
    3. Saturated abrasion compatibility
    4. Trial mix time at 77 °F and 100 °F
d. Interpretation of results and the determination of a JMF
    1. Mineral filler (minimum & maximum), percent
    2. Water, including aggregate moisture (minimum & maximum), percent
    3. Quantitative effects of moisture content on the unit weight of the aggregate
    4. Mix set additive (if required), percent
    5. Modified emulsion, percent
    6. Residual content of modified emulsion
    7. Residual, percent
e. Mix designer's signature and date

420.4-CONSTRUCTION:

420.4.1-Equipment: Provide safe, environmentally acceptable equipment that can produce a specification product.

420.4.1.1-Mixing Machine: Provide one or more self propelled, front feed, continuous loading mixing machines equipped and operated as follows:

a. A positive connection conveyer belt aggregate delivery system and an interconnected positive displacement, water-jacketed gear pump to accurately proportion aggregate and asphalt emulsion.
b. Continuous flow, twin shaft, multi-blade type pugmill a minimum of 50 inches long.
c. Blade sizes and side clearances that meet the equipment manufacturer's recommendation.

d. Mineral filler feed located to ensure that the proper quantity of mineral filler drops on the aggregate before discharging into the pugmill.
e. Asphalt emulsion introduced within the first one-third of the mixer length to ensure proper mixing of all materials before they exit from the pugmill.
f. Computerized material monitoring system with integrated material control devices that are readily accessible and positioned so the amount of each material used can be determined at any time. The mixer shall be equipped with a back-up electronic materials counter that is capable of recording running count totals for each material being monitored. The mixer shall be equipped with a radar ground measuring device. Each material control device shall be calibrated prior to each mix application and as often thereafter as deemed necessary by the Engineer. The computer system shall have the capability to record, display and print the following information:
    1. Individual sensor counts for emulsion, aggregate, cement, water and additive
    2. Aggregate, emulsion, and cement output in lbs.(kgs) per minute
    3. Ground travel distance. The mixer shall be equipped with a Radar Ground metering device
    4. Spread rate in lbs./s.y.(kgs/m2)
    5. Percentages of emulsion, cement, water and additive
    6. Cumulative totals of aggregate, emulsion, cement, water and additive
    7. Scale factor for all materials
g. Equipped with a water pressure system and nozzle type spray bar to provide water spray ahead of and outside the spreader box when required. Apply water to dampen the surface without resulting in free flowing water ahead of the spreader box.
h. Opposite side driving stations on the front to optimize longitudinal alignment during placement. Remote forward speed control at the back mixing platform so that the back operator can control forward speed and level of mixture in the spreader box.

Use a sufficient number of transports to assure a continuous operation during mix production and application. Use transport units with belt type aggregate delivery systems, emulsion and water storage tanks of adequate size to proportionally mix aggregate delivered by each transport.

Unless otherwise noted in the plans or as approved by the Engineer, truck-mounted batch type machines will only be allowed on small projects (15,000 square yards or less).

Provide a minimum of two units at all times. Schedule these truck-mounted machines so that mixture production is never delayed more than 15 minutes. Stop production anytime there is noncompliance with this requirement.

Calibrate the mixing machines before use. Maintain documentation of calibration of each material metering device at various settings. Supply all materials and equipment, including scales and containers, necessary for calibration. Recalibrate after all changes in aggregate or asphalt emulsion sources.

420.4.1.2-Spreader Box: Attached to the machine shall be hydraulically adjustable (adjustable while applying mixture) type spreader box with a positive screed adjustment for yield control and a positive adjustment for the joint matcher.

Equipped with paddles or augers mounted on adjustable shafts to continually agitate and distribute the mixture to prevent stagnation, excessive build-up, or lumps. Equip spreader boxes with front and rear flexible seals to maintain direct contact with the road. Use a secondary strike off attached to the spreader box to provide a finished smooth surface texture on the final pass or surface pass. Use a drag that produces a uniform finish.

420.4.1.3-Rut Box: Use a steel V configuration screed rut box specifically designed and commercially manufactured to fill ruts to perform all Micro Surface, rut-filling applications. Ensure a mixture spread width of 5 to 6 feet and use a secondary strike off to control crown on the rut box. The rutbox must be equipped with a third strike off that may be used to control texture.

420.4.1.4-Miscellaneous Equipment: Provide hand squeegees, shovels and other equipment as necessary to perform the work. Provide cleaning equipment such as power brooms, air compressors, water flushing equipment, and hand brooms for surface preparation.

420.4.1.5-Lights on Equipment: Equip power brooms, distributors and truck mount spreaders with at least one approved, flashing, rotating or oscillating amber light that is visible in all directions. Equip continuous spreader units with one such light on each side.

420.4.2-Application: Micro Surfacing mixtures shall be applied in a manner to fill ruts, minor cracks and leave a uniform surface with straight longitudinal joints, transverse joints and edges.

When performing multiple course Micro Surfacing, the total application rate shall be a minimum of 30 pounds per square yard by weight of dry aggregate with the final surface course not less than 16 pounds per square yard by weight of dry aggregate.

a. Restored Cross-Section: The construction of the leveling course of Micro Surface, Multiple Course will restore the cross section of the driving lane within 1/4 inch as measured transversely across the pavement with a 7-foot straight edge. The preceding will not apply to any pavement segment that is designed with a quarter crown cross slope or any area of the segment within 6 inches of the edge line, lane line, or centerline.
b. Rutfilling: Rutfilling is required when the rut depth is ½ inch or greater and the pay item is Micro Surface. Rutfilling shall use a Micro Surfacing mix with fine aggregate 3FA applied with an approved rut box for each designated wheel track. A clean overlap and straight edges shall be required between wheel tracks. Each pass of rutfilling shall be limited to a maximum depth of 1 inch. For each 1 inch of applied mix, an additional 1/8 inch crown is required for traffic consolidation. All rutfilling material should cure under traffic for at least twenty four (24) hours before additional material is placed.

Micro Surface, Single Course: A single course shall be applied full lane width in one course to the entire pavement surface including the shoulder if indicated in the contract documents at a minimum of 20 pounds per square yard by weight of dry aggregate.

420.4.3-Temporary Pavement Marking: Shall be in accordance with Section 636.

420.4.4-Pre-paving Meeting: Hold an on-site pre-paving meeting with the Engineer before beginning work to review and discuss the following.

1. Detailed work schedule
2. Traffic control plan
3. Calibration of equipment
4. Mix design previously submitted to the Engineer
5. Equipment inspection, including transport units

420.4.5-Test strip: Test Strip(s) to demonstrate the mixing of materials and placement procedures of each mixing machine to be used on the project. Test strip shall be performed at the beginning of the first day production and on the roadway to be treated. The completed test strip (minimum 500 feet length) shall be reviewed to detect and correct any variances in surface texture, material ratio(s) and finished surface appearance. Additionally, the test strip will be used to establish the target job application rate.

420.4.6-Surface Preparation: Remove all plastic pavement markings using an abrasion method. Remove markings just before the surfacing operation. Work and payment for removal of pavement markings shall follow Section 636.7 of the Specifications.

Micro Surfacing shall not be placed on top of patches, crack seal, Base Repairs, Edge Repairs, or any other asphalt pavement repairs for at least 14 calendar days. Work and payment for these items shall follow their appropriate sections.

Thoroughly clean the existing surface of all loose materials, vegetation, dirt, dust, mud and other objectionable materials at the time of placing the mixture. Remove animal remains and thoroughly wash the surface before placing the mixture.

The project plans will dictate whether to remove or temporarily cover existing RPMs prior to placement of micro surfacing; payment for removal or covering shall be incidental. When removal is required, the Contractor shall remove RPMs with minimal damage to the pavement surface. Payment for new RPMs shall be in accordance with 663.

Protect drainage structures, monument boxes, water shut-offs, etc., during application of tack coat and mixture.

Apply tack coat according to section 408, except for the following. Mix tack coat with one part emulsion to three parts water. Use the same emulsion as used in the production mixture. Apply the tack coat uniformly, at an application rate of 0.05-0.12 gallons per square yard and without excessive run off. Allow the tack coat to cure before placement of mixture.

Establish 1,000-foot intervals for the entire project, before placing the mixture. Clearly identify and maintain these intervals until project completion.

420.4.7-Surface Quality: Provide a finished surface free from excessive scratch marks, tears, rippling, and other surface irregularities. Do not leave ripples greater than 1⁄8 inch measured by a 10-foot straight edge. Do not leave tear marks greater than 1⁄2 inch wide and 4 inches long, or other marks greater than 1 inch wide and 1 inch long. If the finished surface exceeds the described tolerance, stop work immediately and determine appropriate correct action. Review corrective action with the Engineer before resuming production.

Place longitudinal construction joints and lane edges to coincide with the proposed painted lane lines. Construct longitudinal joints with less than 3 inches overlap on adjacent passes and no more than 3⁄8 inch overlap thickness as measured with a 10-foot straight edge. Place

successive passes to prevent ponding of water on the up-slope side of the overlap. Construct neat and uniform transverse joints with less than a 1⁄8 inch difference in elevation across the joint as measured with a 10-foot straight edge. Provide neat and uniform lane edges with no more than 2 inches of horizontal variance in 100 feet. If defective joints or edges are placed, stop work and take corrective action and reviewed by the Engineer.

420.4.8-Traffic Control: Do not allow traffic on the mixture until it has cured sufficiently to prevent pickup by vehicle tires. The new surface must be able to carry normal traffic without damage within one hour of application. Protect the new surface from damage at intersections and driveways. Repair all damage to the mixture caused by traffic. All costs associated with this repair work will be borne by the Contractor. Otherwise Traffic Control will be in accordance with Section 636, and the *Manual on Temporary Traffic Control for Streets and Highways, 2006 Edition*, or as directed by the Engineer.

420.4.9-Weather and Seasonal Limitations:

1. Place the mixture when the air and pavement temperatures are at least 45 °F.
2. Do not place mixture in rain or inclement weather or when temperatures are forecast to be below 32 °F within 24 hours of completion of the work.

420.4.10-Quality Control: Produce a mixture that will meet the JMF and the quality control tolerances. Notify the Engineer immediately if the quality control test results exceed any of the tolerances and stop mixture production. Identify the cause of the excess deviation and determine the corrective action necessary to bring the mixture into compliance. Secure the Engineer's approval before resuming work.

Micro Surfacing Quality Control Tolerances

Aggregate Gradation Tolerances (±) from JMF							
Sieve Size	# 4	# 8	# 16	# 30	# 50	# 100	# 200
Tolerance	5.0%	5.0%	5.0%	5.0%	4.0%	3.0%	2.0%
General Quality Control Tolerances (±)							
Asphalt Cement Content Single Test	0.5 % from JMF						
Asphalt Cement Content Daily Average	0.2 % from JMF						
Application Rate:	2 lb/sq yd (as determined by 1000 ft yield checks)						
Sand Equivalent Test (AASHTO T176)	7% from JMF						

Verify and document quality control with the following minimum measures:

1. **Fine Aggregate:** Sample from the project stockpile and test for gradation at one test per 500 tons of aggregate or one test per day of mixture production, whichever is greater.
2. **Sand Equivalent Test (AASHTO T176):** Perform a minimum of one test for each project aggregate stockpile.
3. **Asphalt Content:** At least three times per day, on a random basis, calculate the percent asphalt content of the mixture using the equipment counter readings.
4. **Application Rate:** At least three times per day, on a random basis, calculate the yield of the course being placed using the equipment counter readings.

5. **Documentation:** Complete a daily report that includes the following information. Complete a separate daily report for each truck mounted machine:
    a. Control section, job number, route, Engineer
    b. Date, air temperature
    c. Control settings, calibration values
    d. Unit weight of emulsion (lbs/gal), percent residue in emulsion
    e. Beginning and ending intervals
    f. Counter readings (beginning, ending, and total)
    g. Length, width, total area (sq yd), weight of aggregate, gallons of emulsion
    h. Percent of each material including asphalt cement
    i. Application rate, (lbs/sq yd), combined application rate, (lbs/sq yd)
    j. JMF (percent Portland cement, percent emulsion, gradations, percent
    k. asphalt cement)
    l. Contractor's authorized signature
    m. Calibration forms
    n. QC aggregate gradations
    o. Aggregate certification
    p. Asphalt emulsion bill of lading
    q. QC sand equivalent test results

For Quality Assurance purposes, samples for gradation will be taken from aggregate stockpiles designated by the Contractor for use. The frequency of sampling and testing will be established by the Engineer based upon the Division's current acceptance program and local conditions encountered.

420.5-MEASUREMENT AND PAYMENT:

Payment for Micro Surface, Multiple Course includes all materials, equipment, labor for preparing the surface, placing the micro surfacing mixture and complying with all requirements. The placement includes application of a rut-filling and/or leveling course and a surface course for full width coverage as specified in the contract documents.

Payment for Micro Surface, Single Course, includes all materials, equipment, labor for preparing the surface, placing the Micro Surfacing mixture and complying with all requirements. The placement includes application of a single course of mixture for full width coverage as specified in the contract documents.

The completed work as measured will be paid for at the contract unit price for the Items detailed in Section 420.6.

Materials placed in stockpiles or on the road not meeting the required tolerances may be accepted at a reduced price if it is not considered detrimental to the life of the treatment by the Engineer in accordance with ISSA A-143, Section 3. The following price adjustment schedule will be used when appropriate and applied accordingly to representative material:

(i.) One percent reduction in the bid price per square yard for each one-tenth percent the asphalt content is out of tolerance.

(ii.) One-quarter percent price adjustment in the bid price per square yard for each one percent that the aggregate gradation is out of the job mix range.

(iii.) One and a half percent reduction in the bid price per square yard for application rate dropping below the established rate by more than 2 lb/sq yd. If the application rate

drops below the established rate by more than 3 lb/sq yd, the material will not be accepted and measures will need to be taken by the contractor to correct for such deficiency

Price adjustments under 1, 2, and 3 above shall apply concurrently; however, price adjustment will not apply in the event the material is rejected. The disposition of rejected material will be subject to the approval of the Engineer

420.6-PAY ITEMS:

ITEM	DESCRIPTION	UNIT
420001-*	Micro Surface Multiple Course	Square Yard (Meter)
420002-*	Micro Surface Single Course	Square Yard (Meter)
420003-*	Micro Surface Rut Fill	Ton (TN)

*Sequence number

DIVISION 500
RIGID PAVEMENT

SECTION 501
PORTLAND CEMENT CONCRETE PAVEMENT

501.1-DESCRIPTION:

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

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

501.2–MATERIALS:

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

MATERIAL	SUBSECTION
Supplementary Cementitious Materials (SCMs)	707.4

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

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

501.3–PROPORTIONING:

DELETE TABLES 501.3.1 AND REPLACE WITH THE FOLLOWING:

TABLE 501.3.1 {US CUSTOMARY}

Minimum 28-Day Design Strength	Minimum Cement Factor	Maximum Water Content	Standard Size of Coarse Aggregate	Target Entrained Air
Pounds per square inch	lbs./c.y.	lb. of water / lb. of cement	Number	Percent
3,000 Compressive or 500 Flexural*	564**	0.44	357, 467 57 or 67	7.0

TABLE 501.3.1 {METRIC}

Minimum 28-Day Design Strength	Minimum Cement Factor	Maximum Water Content	Standard Size of Coarse Aggregate	Target Entrained Air
Mpa	kg/c.m.	L of water / kg of cement	Number	Percent
20.7 Compressive or 3.5 Flexural*	335**	0.44	357, 467 57 or 67	7.0

* Flexural strength when tested by the third point method.

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

MATERIAL	QUANTITY
Fly Ash	20%
Slag Cement	50%
Silica Fume	8%

501.5-EQUIPMENT AND TOOLS:

501.5.2-Batching Plant Equipment:

501.5.2.3-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 MP700.00.30. The Contractor shall have on hand not less than ten 50 pound (22.68 kg) test weights for frequent testing of all scales.

501.5.3-Mixers and Hauling Equipment:

501.5.3.4-Nonagitator Trucks:

DELETE THE CONTENTS OF SUBSECTION 501.5.3.4 AND REPLACE WITH THE FOLLOWING:

Bodies of nonagitating hauling equipment for concrete shall be smooth, mortar tight, metal containers and shall be capable of discharging the concrete at a satisfactorily controlled rate without segregation. The concrete shall be discharged from the bottom of the container. If discharge of concrete is accomplished by tilting the body, the surface of the load shall be retarded by a suitable baffle. Covers shall be provided when needed for protection.

501.7-HANDLING, MEASURING, AND BATCHING MATERIALS:

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

When cement or SCMs are being added in bag form, under no circumstances shall the packaging material be allowed to enter into the mix.

501.9-PLACING CONCRETE:

ADD THE FOLLOWING SUBSECTION:

501.9.1-Safety Edge: Concrete safety edge shall be constructed on the outside pavement edge using a wedge shape meeting the requirements of the plan details.

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.

501.12-FINAL STRIKE-OFF, CONSOLIDATION AND FINISHING:

501.12.7-Final Finish:

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

Use a burlap drag or other method approved by the Engineer, which spans the entire width of pavement being placed, as soon as all excess moisture has disappeared and while the concrete is still plastic enough to make a granular surface possible. Drag the burlap longitudinally along the pavement surface after finishing to enhance the pavement texture. Clean or replace the drag material as necessary to prevent it from getting plugged with grout. Measures should be taken to produce a surface of uniform appearance that is free from deep striations.

Following the dragging operation, the surface of the mainline pavement, acceleration and deceleration lanes, ramps, and all travelled ways shall be given a final tined groove finish. This grooved finish shall be a longitudinally tined texture parallel to the pavement centerline. A 3 ± 1/2 inch wide strip of pavement surface shall be protected from tining for the length of and centered about the longitudinal joint(s). The longitudinal tining shall extend to within 6 inches of the outside edge of the pavement.

The equipment used for longitudinal tining shall have automated horizontal and vertical controls to ensure straight, uniform depth tined grooves. It shall be mounted on a device which is driven by tracks (wheel-driven equipment will not be permitted) and shall be controlled by the same grade alignment method as the concrete paver. The tool used for tining shall have a single row of tines and shall produce a groove that is 1/8 in. wide (3 mm) and 1/8 to 1/4 in. (3-6 mm) deep. The grooves shall be spaced uniformly apart at a center to center distance of 3/4 in. (20 mm). Tining shall be performed when the concrete surface is of such plasticity as to prevent excessive raveling (concrete too dry) or to prevent mortar from flowing back into the grooves (concrete too wet). All tining shall be accomplished with a single pass of the tool. Tines should be cleaned and replaced as necessary.

Transverse tining shall be permitted in areas requiring hand finishing and consolidation, including shoulders, as required in Section 501.12.4.

501.13-SURFACE TOLERANCE:

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE THE FOLLOWING.

The smoothness of the riding surface will be determined using the procedures outlined in Section 720. When corrective action is needed, the diamond grinding operations shall be in accordance with section 508.

501.22-METHOD OF MEASUREMENT:

ADD THE FOLLOWING TO THE END OF THE SUBSECTION:

No additional measurement is necessary nor will addition compensation be allowed for the placement of Safety Edge.

501.23-BASIS OF PAYMENT:

501.23.1.1-General:

501.23.1.1:

DELETE THE CONTENTS OF SUBSECTION 501.23.1.1 AND REPLACE WITH THE FOLLOWING:

The measurements which represent the thickness of the sampling units shall be analyzed to determine the average value of the pavement thickness. This value will be used to determine the degree of compliance with the provisions set forth in 501.19 and to develop certain factors to be used in the derivation of equitable deductions as set forth in 501.23.1.2 and 501.23.1.3, in the event the provisions of this Specification are not met.

No payment will be made for pavement areas that are 0.922T or less in thickness, the area being defined in the manner set forth in 501.19.2. Any area of pavement which is deficient in thickness by more than 0.7 inches (18 mm) and is considered by the Engineer to be inadequate to perform satisfactorily 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 501.23.1.2 or 501.23.1.3.

SECTION 504
BITUMINOUS UNDERSEAL FOR CONCRETE PAVEMENT

DELETE THE ENTIRE SECTION

SECTION 506
CONCRETE PAVEMENT REPAIR

DELETE THE ENTIRE CONTENTS AND REPLACE THE FOLLOWING:

506.1-DESCRIPTION:

This work consists of the removal and replacement of deteriorated concrete pavement and patches, and replacing subbase material where required, at locations as shown on plans or as specified by the Engineer.

The following is a description of each patch type:

i. Jointed Concrete Pavement Patch, Type I:
Patching shall consist of full depth, full lane width concrete pavement repairs equal to or greater than 4 feet (1.2 meters) in length. Type I patches shall constructed in accordance with the Concrete Repair Details in the plans.

ii. Jointed Concrete Pavement Patch, Type II:
Patching shall consist of partial depth concrete pavement repairs that extend a minimum of 2 inches (50mm) and no deeper than one-half the slab thickness at cracks or no more than one-third the slab thickness at doweled joints. Type II patches shall be constructed in accordance with the Concrete Repair Details in the plans.

iii. Jointed Concrete Pavement Patch, Type III:
Patching shall consist of a repair along the edge of a transverse crack or joint that extends from the bottom of a partial depth repair (Type II) to potentially the full depth of the slab, and isolated within 12” of either the longitudinal joint or pavement edge. Type III patches shall be constructed in accordance with the Concrete Repair Details in the plans.

506.2-MATERIALS:

Materials shall meet the requirements of section 501 or 601, and as follows:

MATERIAL	SECTION OR SUBSECTION
Accelerating Admixtures	707.13
Curing Materials	707.6-707.10
Epoxy-Coated Dowel Bars	709.15
Joint Sealer	708.3, 708.4
Portland Cement Concrete	501 or 601
Subbase	307
Tie Bars and Hook Bolts	709.1

A non-shrink cementitious grout meeting the requirements of ASTM C1107 or an approved epoxy adhesive meeting the requirements of AASHTO M 235, Type IV, Grade 3, Class B or C shall be used to firmly anchor dowel bars in 30 minutes. This material shall be approved by the Engineer for the intended application.

Cement meeting the requirements of ASTM C150, Type III may be used in the concrete mixes for concrete pavement repair.

506.3-PROPORTIONING:

Portland cement concrete for patching concrete pavement shall meet the requirements of Section 501, or Class B or Modified Class B as specified in Section 601, except that it shall be shown by compressive strength tests, in the approved mix design, that the concrete mix shall attain 2,000 psi (13.8 Mpa) prior to the time at which the pavement will be opened to traffic. Also, the maximum water-cement ratio (w/c) shall be 0.44, and an AASHTO number 8 coarse aggregate shall be required in Type II repairs with a depth of 3 inches (75 mm) or less.

Type III repairs may be placed simultaneously with Type II repairs. When constructed in this manner, the same concrete mix shall be used in both repair types.

Prior to the start of work, the Contractor shall submit the mix proportions and recent compressive strength test data for the specified age at which the concrete is to be opened to traffic.

506.4-TESTING:

All testing shall be in accordance with section 501. The Contractor shall fabricate a minimum of nine compressive strength cylinders for each 24-hour period of operation. Six of these nine field cured cylinders shall be field cured in a temperature and moisture condition as close as possible to that of the concrete in the repair area. When the concrete in the repair area must attain the compressive strength, required to open it to traffic in less than 8 hours, the cylinders which represent that concrete shall be cured in a curing device which automatically maintains the curing temperature and duplicates the temperature of the in-place concrete that the cylinders represent. When the average strength of three of these cylinders, representing the concrete placed, indicate that the concrete has attained the required strength for opening to traffic, that concrete may be put into service. These cylinders shall represent concrete produced from the batch from which they were fabricated and, if applicable, concrete from previous batches also. These cylinders will not represent any concrete which was placed after the time that they were fabricated. Three of the nine cylinders shall receive standard curing and shall be tested at 28 days to verify that the required strength at that age has been achieved.

In lieu of six field cured cylinders required above, the Contractor may use the Maturity Method for the Estimation of concrete strength, as outlined in MP 601.04.21 for determining when the pavement may be opened to traffic.

506.5-EQUIPMENT AND TOOLS:

Equipment and tools shall be in accordance with section 501 unless noted otherwise. Saw cutting equipment shall be capable of sawing neat vertical faces along the patch boundaries. The use of a carbide-toothed wheel saw shall not be permitted for sawing the patch boundaries. A carbide-tipped wheel saw may be used for additional saw cuts provided that a minimum 3-inch (75 mm) clearance from the sawed boundary is maintained.

Gang drills shall be used to drill multiple dowel bar holes simultaneously for Type I repairs.

The drilling equipment shall firmly hold the drill bits in a horizontal position at the correct height and prevent them from wandering. The drilling equipment shall maintain holes with consistent diameters. Drilling equipment which damages existing concrete or causes the holes to exceed the specified diameter due to movement, bouncing, wobbling, etc. shall not be used. Drilling operations shall be stopped if the drilling equipment is deemed to be inadequate by the Engineer, and drilling operations shall not be resumed until adequate drilling equipment is used.

506.6-CONSTRUCTION METHODS:

506.6.1-Removal of Existing Pavement: Designated defective pavement shall be removed full depth, and undisturbed portions of the existing pavement adjacent to the area to be patched shall be left with straight vertical sides.

The existing pavement to be removed shall be sawed full depth along the transverse and longitudinal boundaries, including the lane and shoulder/lane joints as shown on the plans or as directed by the Engineer. Additional saw cuts inside the patch boundaries will be permitted to facilitate the concrete removal operation.

Concrete sawn full depth to be removed shall be lifted out by means of chains, lift-pins, or other approved devices. The breaking of concrete in-place shall not be permitted. During the removal operations, utmost care shall be exercised to minimize disturbance and damage to the base material, and the adjacent pavement and shoulder.

506.6.2-Conditioning Existing Subbase: Prior to placing concrete in the repair area, any subbase material that is disturbed below the desired level of cleanout shall be removed and the patch area compacted to the satisfaction of the Engineer. Unsuitable subbase material, concrete, reinforcing steel, and any other debris shall become property of the Contractor and shall be legally disposed. The Contractor shall replace the removed subbase material with concrete integral to pavement replacement. If more than an additional 1 inch (25 mm) of concrete is needed to replace subbase or subgrade material, then the additional volume of concrete, required to fill the excavated area up to the elevation of the bottom of the existing pavement, shall be paid for by the cubic yard (meter) as a separate pay item.

506.6.3-Placing Concrete: Unless behind permanent closures or unless otherwise approved by the Engineer, all excavated areas shall be patched the same day that they are excavated. The excavated area shall be thoroughly cleaned of loose material and debris and moistened prior to the placement of concrete.

Existing pavements shall not be removed if such removal will result in concrete being placed when the ambient air temperature is below 32° F, unless approved by the Engineer. Concrete for partial depth repairs shall not be placed when the ambient temperature is below 40° F. The concrete temperature at the time of placement shall not be less than 70° F and not more than 95° F, unless approved by the Engineer.

Concrete shall be deposited in the excavated area, and the free fall shall not be more than 3 feet (1 m). If the concrete does not fall into its final position in the patch, it shall be moved by means of shovels; raking is prohibited. The concrete shall be worked with tampers, spades, or other tools to completely fill the patch area. Maximum effort will be used to ensure that the area beneath the existing concrete pavement is completely filled. Internal vibration shall be used.

Following the placing of the concrete, the surface will be struck off to a finished grade and

floated to a smooth finish. Finishing of the plastic concrete shall conform to the requirements of Section 501.12 of the Specifications, except that the final concrete surface shall be textured similar to that of the adjoining pavement.

506.6.4-Straightedge Checking and Surface Correction: During finishing operations, deviations in adjacent lanes which are also to be repaired shall not be transferred to the new construction. The Contractor shall furnish and use straightedges to check the surface tolerance. For patches 10 feet (3 m) or more in length, a 10 foot (3 m) straightedge shall be used. Shorter straightedges shall be used for patches less than 10 feet (3 m) in length.

The minimum length straightedge shall be 6 feet (1.8 m). Section 501.12.6 shall govern except that the shorter straightedges shall be used for shorter patches.

506.6.5-Curing: Immediately after straight edging and texturing, the concrete shall be cured in accordance with Section 501.14. Where early opening to traffic is required, insulation mats or blankets may be used over the repairs during curing in order to accelerate strength gain.

506.6.6-Sealing Joints: When patching two lanes simultaneously, the longitudinal joint shall be reestablished by sawing. Joint sealing shall be done in accordance with Section 510.

506.6.7-Repair of Adjacent Shoulders: Within 24 hours after completion of a patch area, any adjacent shoulders damaged during pavement repair operations shall be reconstructed in accordance with the requirements of the applicable section of the specifications to match the finished shoulder grade and to the satisfaction of the Engineer. In the event traffic is to be permitted on the patch area prior to reconstruction of the shoulder, the Contractor shall first make such temporary repair to the shoulder as is necessary to avoid any hazardous condition.

506.6.8-Specific Construction Methods: Construction methods specific to each repair type are noted in the following sections.

506.6.8.1-Type I Repairs: Where the existing joint dowel assembly is to be removed, the existing concrete shall be sawcut full depth and removed a minimum of 1 foot (300 mm) on either side of existing transverse joints. Minimum length of removal shall be 4 feet (1.2 m) in accordance with that shown in the WVDOH Concrete Repair Details. Multiple repairs shall be combined to make one large patch if the edges of adjacent repairs, in the same lane, are less than 10 ft (3 m) apart.

Oversawing into the adjacent slabs or shoulder shall be kept to the minimum amount necessary to ensure that full depth cuts in the corners have been achieved. All oversawing shall be cleaned and filled with an approved joint sealing material meeting the requirements of Section 708.3.

Any areas damaged during concrete sawing and removal operations shall be repaired to the satisfaction of the Engineer by extending the patch boundary or repairing spalls at the Contractor's expense. Spalls greater than ¼ inch (6 mm) wide and 2 inches (50 mm) long and more than ½ inch (13 mm) deep below the pavement surface shall be repaired using an approved epoxy mortar. The patch boundary shall be extended by re-sawing the limits of the patch beyond the spalled area when spalls greater than 1 inch (25 mm) wide

and 12 inches (300 mm) long and more than ½ inch (13 mm) deep below the pavement surface are created by the pavement removal operation.

A bond breaking material, approved by the Engineer, shall be placed at the longitudinal joint for Type I patches as shown in WVDOH Concrete Repair Details. Acceptable bond-breaking materials include white pigmented curing compound, roofing felt, and tar paper.

Where dowels are required, holes slightly larger than the diameter of the dowels shall be drilled 9 inches (225 mm) into the face of the existing slab starting 6 - 12 inches (150 – 300 mm) from either edge and then on 12-inch (300 mm) centers. Hole diameters shall be 1⁄16 in. (1.6 mm) larger than the dowel bar diameter when using epoxy material to anchor the dowels, and hole diameters shall be 0.20 to 0.25 in. (5 to 6 mm) larger than the dowel bar diameter using when cementitious grout to anchor the dowels. The number of dowels per joint shall be as shown in the WVDOH Concrete Repair Details. The holes shall be located at a depth as shown in the WVDOH Concrete Repair Details. The dowels shall be carefully aligned (within ¼ inch (6 mm) over a 1-foot (300 mm) length) with the direction of the pavement and parallel to the plane of the surface. The drilled holes shall be thoroughly cleaned with compressed air to remove all dust, dirt, loose material and moisture. An approved quick setting, non-shrinking cementitious grout or epoxy adhesive shall be used to anchor the dowels in the holes. Before installing dowels, place the anchoring material (cementitious grout or epoxy adhesive) in the back of each hole. This ensures that the anchoring material flows out around each bar, fully encasing it. Do not coat one end of the bar with anchoring material and then insert the bar into the hole – the air pressure inside the hole will force the anchoring material back out of the hole, leaving a void around the bar. Dipping of the dowels into the anchoring material (cementitious or epoxy), prior to insertion into the holes, is not permitted. The holes shall be filled from the back to the front with the anchoring material prior to insertion of the dowel. The anchoring material shall be put into the hole in sufficient quantity so that when the bar is inserted, the anchoring material completely fills the annular space around the dowel. Rotate the dowel bar one full revolution while inserting it into the hole. The holes shall be completely filled with the anchoring material around the dowels so as to minimize vertical movement of the dowels and ensure that the dowels are permanently fastened to the existing concrete. A grout retention ring shall be used around all dowels, as shown in the WVDOH Concrete Repair Details. The end of the bar that extends into the repair area should have a bond breaker applied to it to prevent bonding with the patch material. This bond breaker may be applied at the manufacturer or field applied.

After installation, the vertical and horizontal skewness of the dowels shall be checked. If more than 3 dowels per joint are misaligned by more than 3/16-inch (5 mm) over a 9-inch (230 mm) length, the repair boundary shall be re-sawed 1 foot (300 mm) back from the existing repair boundary, and dowels shall be re-installed. Type I patches less than 6 feet in length shall require 2-#4 rebar placed transversely as noted in the Standard Detail. This work shall be done at the Contractor's expense.

The surface edges of all patches shall be tooled, formed and/or sawed, and cleaned to result in a properly dimensioned reservoir for sealant. All transverse and longitudinal joints at pavement repair locations shall be sealed in accordance with manufacturer's recommendations unless otherwise approved by the Engineer.

506.6.8.2-Type II Repairs: Full lane-width partial depth repairs at transverse joints and cracks and at longitudinal joints 12 feet or more in length shall be a minimum of 18 inches (450 mm) wide, with the vertical face of the repair being no less than 6 inches (150 mm) from the crack or the joint. Partial depth repairs shall be sawed a minimum depth of 2 inches (50 mm) around the perimeter of the patch area to provide a vertical face at the edges unless removal is to be performed with milling operations. Acceptable milling operations shall provide neat vertical faces and be approved by the Engineer. Concrete within the patching area shall be broken out with a pneumatic hammer not heavier than a 35-pound class or by other methods approved by the Engineer. Edge spalls greater than ¼ inch (6 mm) wide and 2 inches (50 mm) long and more than ½ inch (50 mm) deep below the pavement surface shall be repaired using an approved epoxy mortar. The patch boundary shall be extended by re-sawing the limits of the patch beyond the spalled area when spalls greater than 1 inch (25 mm) wide and 12 inches (300 mm) long and more than ½ inch (13 mm) deep below the pavement surface are created by the pavement removal operation.

The area of failure shall be removed by equipment that will not damage the adjacent sound pavement. The exposed faces of the concrete shall be free of loose particles, oil, dust, and other contaminants before placement of patch material. Immediately prior to placement of the concrete patch, all exposed concrete faces within the patched area shall be cleaned by sandblasting, then airblasting, then coated with an approved epoxy bonding compound per the manufacturer's recommendations. All residues shall be removed just prior to placement of the concrete bonding agent. The fresh concrete shall be placed in the repair area while the epoxy bonding compound is still tacky. If the epoxy bonding compound is no longer tacky immediately prior to placement of the fresh concrete, then all surface contaminants shall be removed, and another coat of epoxy bonding compound shall be reapplied.

Any crack or joint within the limits of, or adjacent to, the partial depth repair shall be re-established by forming with an acceptable material in order to follow the crack or joint alignment. The method and material used to re-establish the crack or joint shall be approved by the Engineer. However, at joint repairs, sawcutting through the full-depth of the repair area may be used to fully re-establish the joint being repaired. Additionally, the Contractor shall saw and seal existing joints and cracks, involving partial depth repairs, in accordance with Section 510.

506.6.8.3-Type III Repairs: "Turned Down Edge" repairs at transverse joints and cracks shall extend no more than 12 inches (300 mm) into the slab from the edge of pavement whether at the outside or along an interior longitudinal joint. Concrete within the patching area shall be broken out with a pneumatic hammer not heavier than a 35-pound class or by other methods approved by the Engineer. The area of failure shall be removed by equipment that will not damage the adjacent sound pavement.

Number 4 tie bars, 10 inches (250 mm) in length, shall be inserted into the exposed vertical faces within the repair area. One bar shall be placed per one-foot (300 mm) of exposed face, or fraction thereof, on each side of the transverse crack or joint. The bar(s) shall be inserted at mid-depth of the slab, allowing for five inches (125 mm) of length to extend into the area to be repaired. The hole(s) for placement of the tie bar(s) into the exposed vertical face of the slab shall be slightly larger than the diameter of the bar and

shall be drilled at an angle in order to allow for drill clearance. Hole diameters shall be 1⁄16 in. (1.6 mm) larger than the bar diameter when using epoxy material to anchor the bars, and hole diameters shall be 0.20 to 0.25 in. (5 to 6 mm) larger than the bar diameter using when cementitious grout to anchor the bars. Additionally, a minimum clearance of one inch shall be maintained around the hole for placement of concrete. The drilled holes shall be thoroughly cleaned with compressed air to remove all dust, dirt, loose material and moisture. An approved quick setting, non-shrinking cementitious grout or epoxy adhesive shall be used to anchor the bars in the holes. Before installing bars, place the anchoring material (cementitious grout or epoxy adhesive) in the back of each hole (see Figure 506.6.8.1). This ensures that the anchoring material flows out around each bar, fully encasing it. Do not coat one end of the bar with anchoring material and then insert the bar into the hole – the air pressure inside the hole will force the anchoring material back out of the hole, leaving a void around the bar. Dipping of the bars into the anchoring material (cementitious or epoxy), prior to insertion into the hole is not permitted. The holes shall be filled from the back to the front with epoxy or grout prior to insertion of the bar. The anchoring material shall be put into the hole in sufficient quantity so that when the bar is inserted, the anchoring material completely fills the annular space around the bar. Rotate the bar one full revolution while inserting it into the hole. The holes shall be completely filled with the anchoring material around the bars so as to minimize vertical movement of the bars and ensure that the bars are permanently fastened to the existing concrete. The bar should be bent prior to insertion into the grouted hole such that the exposed portion of the bar within the area being repaired shall be parallel with the pavement surface. No bars shall be placed in a manner that would interfere with free movement of the joint or crack being repaired and re-established.

The exposed faces of the concrete shall be free of loose particles, oil, dust, and other contaminants before placement of patch material. Immediately prior to placement of the concrete patch, all exposed concrete faces within the patched area shall be cleaned by sandblasting, then airblasting, then coated with an approved epoxy bonding compound per the manufacturer's recommendations. All residues shall be removed just prior to placement of the concrete bonding agent. The fresh concrete shall be placed in the repair area while the epoxy bonding compound is still tacky. If the epoxy bonding compound is no longer tacky immediately prior to placement of the fresh concrete, then all surface contaminants shall be removed, and another coat of epoxy bonding compound shall be reapplied.

Any crack or joint within the limits of, or adjacent to, the repair shall be re-established by forming with an acceptable material in order to follow the crack or joint alignment. However, at joint repairs, sawcutting through the full-depth of the repair area may be used to fully re-establish the joint being repaired. The method and material used to re-establish the crack or joint shall be approved by the Engineer. Additionally, the Contractor shall saw and seal existing joints and cracks, involving partial depth repairs, in accordance with Section 510.

506.7-RIDE ACCEPTANCE:

As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 10 foot (3 m) straightedge. The straightedge shall be placed in successive positions parallel to the road centerline, matching existing wheel paths. Areas showing deviations (either high or low)

of more than ¼ inch (6 mm) in 10 feet (3 m) shall be marked and corrected down with approved grinding equipment to an elevation where the surface deviations will not be more than ¼ inch in 10 feet (3 m). All joint sealing operations shall be performed after any grinding operations.

In the event that the deviation cannot be corrected to ¼ inch (6 mm) or less (either high or low) in 10 feet (3 m), the areas shall be removed and replaced at the discretion of the Engineer and at the Contractor's expense. All areas or sections so removed shall not be less than 6 feet (1.8 m) in length or less than full width of the traffic lane involved. Any remaining portion of the slab adjacent to the joints that is less than 6 feet (1.8 m) in length shall also be removed and replaced. Where concrete repairs are made that are to be overlayed, the smoothness criteria is waived for the concrete repair.

506.8-METHOD OF MEASUREMENT:

The quantity of concrete pavement repair to be paid for will be the number of square yards (meters) complete in place and accepted for all Type I and Type II repairs.

Additional concrete required to fill the excavated area up to the elevation of the bottom of the existing pavement for Type I repairs, as outlined in Section 506.6.2, shall be paid for by the cubic yard (meter).

For Type III repairs, each location complete in place and accepted will be paid for.

506.9-BASIS OF PAYMENT:

The quantity of concrete pavement repair, determined as provided above, will be paid for at the contract unit price and shall constitute full compensation for the furnishing, hauling, and placing of all materials, saw cutting pavement to the required depth, the removal and disposal of old concrete, preparing of sublayer, furnishing and installing steel dowels, furnishing and installing reinforcing steel as specified, furnishing, placing, finishing, and curing the concrete, cleaning and sealing joints, patch area protection, and for all other materials, labor, tools, equipment, and incidentals necessary to complete the item.

506.10-PAY ITEMS:

ITEM	DESCRIPTION	UNIT
506001-003	Concrete Pavement Repair, Type I, "thickness"	Square Yard (Meter)
506001-004	Concrete Pavement Repair, Type II	Square Yard (Meter)
506001-005	Concrete Pavement Repair, Type III	Each
506003-*	Additional Concrete for Type I Repair	Cubic Yard

* Sequence number
"thickness" shall be in inches

DIVISION 600
INCIDENTAL CONSTRUCTION

SECTION 601
STRUCTURAL CONCRETE

601.2–MATERIALS:

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

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

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

MATERIAL	SECTION OR SUBSECTION
Supplementary Cementitious Materials (SCM)***	707.4

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

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

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

601.3–PROPORTIONING:

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

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

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

601.3.1-Mix Design Requirements:

DELETE TABLE 601.3.1A AND REPLACE WITH THE FOLLOWING:

TABLE 601.3.1A {US CUSTOMARY}

Class of concrete	Design 28 Day Compressive Strength	Target Cement Factor	Maximum Water Content	Standard Size of Coarse Aggregate***	Entrained Air
	Pounds per Square inch	lbs./c.y. *	lb. of water / lb. of cement **	Number	Percent
A	3500	682	0.51	7, 78, or 8	7.5
K	4000	658	0.44	57, 67	7.0
B	3000	564	0.49	57, 67	7.0
C	2500	494	0.58	57, 67	6.0
D	2000	400	0.62	57, 67	5.5
H	4000	See Table 601.3.1C	0.40	57,67	6.5
DC	4500	705	0.44	7, 78, 8	6.0

TABLE 601.3.1A {METRIC}

Class of concrete	Design 28 Day Compressive Strength	Target Cement Factor	Maximum Water Content	Standard Size of Coarse Aggregate***	Entrained Air
	Mpa	Kg per cu. m. *	L/Kg of cement **	Number	Percent
A	24	404	0.51	7, 78, or 8	7.5
K	28	390	0.44	57, 67	7.0
B	21	335	0.49	57, 67	7.0
C	17	295	0.58	57, 67	6.0
D	14	235	0.62	57, 67	5.5
H	28	See Table 601.3.1C	0.40	57,67	6.5
DC	31	418	0.44	7, 78, or 8	6.0

* An equal mass of a SCM may be substituted for Portland cement up to the maximum amount in Table 601.3.1B. Only one SCM is permitted in a mix design, except for Class H concrete. The target cement factor of Class H concrete shall consist of Option 1 or Option 2 from Table 601.3.1C. The Contractor may choose either option.

** When using a SCM, masses of these materials shall be considered as cement for purposes of establishing maximum water content.

*** A number 67 coarse aggregate may be used in Class DC concrete, provided the Engineer approves the use of that size aggregate for the specific project on which it is to be used. That approval will depend on the minimum spacing of the reinforcing steel in the drilled caisson.

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

TABLE 601.3.1B

Material	Class of Concrete	Quantity
Fly Ash	All Classes Except H	20%
Slag Cement	All Classes Except H	50%
Silica Fume	All Classes Except H	8%

TABLE 601.3.1C

Option	Cement	Fly Ash	Slag Cement	Silica Fume
1	470 lbs. (213 kg)	132 lbs. (60 kg)		30 lbs. (13.6 kg)
2	423 lbs. (192 kg)		195 lbs. (88 kg)	30 lbs. (13.6 kg)

ADD THE FOLLOWING SUBSECTION:

601.3.1.1-Mix Design Using Potentially Reactive Aggregate: Alkali-Silica Reaction (ASR) is a reaction between the alkali hydroxide in concrete pore solution and reactive forms of silica in the aggregate. The reaction forms a gel that swells when moisture is present and may cause deleterious expansion within the concrete.

The Division will sample aggregate according to MP 700.00.06 and test fine aggregate and coarse aggregate in accordance with AASHTO T 303 to determine the reactivity class of aggregate. The reactivity class for each aggregate source will be listed on the MCS&T web page under Division Approved Source/Product Listing (APL) for aggregate. If the reactivity class of an aggregate Source is not listed on the APL, the Division will test fine and coarse aggregate from the Source, in accordance with AASHTO T 303, to determine the reactivity class of the aggregate prior to its use on any WVDOH project. If one or both of the aggregates (coarse or fine) used in a concrete mix are reactive (R1, R2 or R3), preventive measures are required as specified in section 601.3.1.1.1.4. The Division will test Aggregate Sources on a 3-year cycle in accordance with AASHTO T 303.

Aggregate Suppliers may have their fine aggregate and coarse aggregate tested in accordance with ASTM C1293 at a Division approved lab (an AASHTO accredited Lab, accredited for ASTM C1293) at the Aggregate Supplier's expense. The sampling and shipping of all aggregate shall be witnessed by a representative of the Division. Aggregate Suppliers may also submit results of ASTM C1293 tests which were performed by another State DOT lab. The results of ASTM C1293 testing and the resulting determination of the reactivity class of aggregate shall supersede the reactivity class of aggregate, as determined by the Division, when tested in accordance with AASHTO T 303. ASTM C1293 test will be considered valid for 5 years from the date of testing.

This requirement applies to all permanent concrete structures on WVDOH projects.

601.3.1.1.1-Selecting Preventive Measures For ASR: The level of prevention shall be determined by considering the classes of concrete, precast concrete member, prestressed concrete member, the degree of aggregate reactivity and the level of alkalis from the Portland cement. The different levels of prevention are shown in Table 601.3.1.1.1.3.

601.3.1.1.1.1-Aggregate Reactivity: The degree of ASR reactivity of an aggregate will be determined as outlined in 601.3.1.1. Aggregate-reactivity classes are given in Table 601.3.1.1.1.1 If the coarse and fine aggregates in a mix design are of different reactivity classes, the level of prevention shall be selected for the most reactive aggregate type in the mix.

TABLE 601.3.1.1.1.1

Classification of Aggregate Reactivity

Aggregate-Reactivity Class	Description of Aggregate Reactivity	14-Day Expansion when tested in accordance with AASHTO T 303, %	1-Year Expansion when tested in accordance with ASTM C1293
R0	Non-Reactive	≤0.10	≤0.04
R1	Moderately Reactive	>0.10 to ≤0.30	>0.04 to ≤0.12
R2	Highly Reactive	>0.30 to ≤0.45	>0.12 to ≤0.24
R3	Very Highly Reactive	>0.45	>0.24

601.3.1.1.1.2-Level of ASR Risk: Determine the level of ASR risk occurring in a structure by considering the aggregate reactivity class in Table 601.3.1.1.1.2.

TABLE 601.3.1.1.1.2

Aggregate-Reactivity Class	R0	R1	R2	R3
Level of ASR Risk	Risk Level 0	Risk Level 1	Risk Level 2	Risk Level 3

601.3.1.1.1.3-Level of Prevention: The level of prevention required is determined from Table 601.3.1.1.1.3 by considering the risk of ASR from Table 601.3.1.1.1.2 in different classes of concrete, precast concrete member and prestressed concrete member (Section 603).

TABLE 601.3.1.1.1.3

Determining the Level of Prevention

Level of ASR Risk	Classes of Concrete		Precast Concrete Member	Prestressed Concrete Member
	D	A, B, C, K, H, DC		
Risk Level 0	V	V		V
Risk Level 1	W	X		Y
Risk Level 2	X	Y		Z
Risk Level 3	Y	Z		See footnote**

** It is not permitted to construct prestressed concrete members (Section 603) with Aggregate Reactivity Class of R3. Measures must be taken to reduce the level of risk in these circumstances by selecting the aggregates only from the Reactivity Classes of R0, R1, or R2.

601.3.1.1.1.4-Requirements for Various Prevention Levels: These requirements shall apply to all classes of concrete except Class H. The prevention levels for Class H concrete is specified in section 601.3.1.1.1.5.

601.3.1.1.1.4.1-Prevention Level V: No special measures need to be taken for prevention level V.

601.3.1.1.1.4.2-Preventions Level W, X and Y: If it is determined that prevention level W, X, or Y is required, there are two options for prevention as follows:

Option 1: Limiting the Alkali Content of the Concrete: Table 601.3.1.1.1.4.2a prescribes maximum permissible concrete alkali contents in a concrete mix. The alkali content of concrete is calculated on the basis of the alkali contributed by the Portland cement alone.

TABLE 601.3.1.1.1.4.2a

Maximum Alkali Contents in Portland Cement Concrete
to Provide Various Levels of Prevention

Prevention Level	Maximum Alkali Content of Concrete (Na_2Oe)	
	kg/m^3	lb/yd^3
V	No limit	No limit
W	3.0	5.0
X	2.4	4.0
Y	1.8	3.0

Note: The alkali content of the concrete is calculated by multiplying the Portland cement content of the concrete by the alkali content of the Portland cement. The alkali content of all approved cement sources is listed on the WVDOH list of Certified Portland Cement Mills. For example, for concrete containing 550 lb/yd^3 of Portland cement, which has an alkali content of 0.82 percent Na_2Oe, the alkali content of the concrete is 550 X 0.82/100 = 4.51 lb/yd^3 Na_2Oe. SCMs also contain alkalis; however, the use of SCM usually increases the amount of alkalis bound by the hydrates and thus reduces the available alkali content in the concrete. Thus, the alkalis present in SCMs do not need to be considered when calculating the alkali content of the concrete. However, the alkali content of the SCM shall not exceed the limits given in Table 601.3.1.1.1.4.2b. The alkali content of all approved SCM source is listed on the WVDOH approved list of SCMs.

Option 2: Using Minimum Supplementary Cementitious Materials (SCM) based on Level of Prevention. Utilize a minimum mass replacement level from Table 601.3.1.1.1.4.2b below.

TABLE 601.3.1.1.1.4.2b

Minimum Replacement Level of SCM (percentage by mass of cementitious material)

Type of SCM	Alkali Content of SCM* (Na_2Oe)	Level W	Level X	Level Y
Fly ash** (Cao ≤18%)	≤3.0	15	20	25****
	>3.0, ≤4.5	20	25****	Not Allowed
Slag Cement	≤1.0	25	35	50
Silica Fume***	≤1.0	1.2 x LBA or 2.0 x KGA	1.5 x LBA or 2.5 x KGA	1.8 x LBA or 3.0 x KGA

* The alkali content of all approved SCM sources is listed on the WVDOH approved list of SCMs (APL). If the alkali content of an SCM source is not listed on the APL, the Division will test the SCM from the source to determine the alkali content prior to its use on any WVDOH project.

** The CaO content of approved fly ash sources is listed on the WVDOH approved list of fly ash (APL). If the CaO content of a fly ash source is not listed on the APL, the Division will test the fly ash from the source to determine the CaO content prior to its use on any WVDOH project.

*** The minimum level of silica fume (as a percentage by mass of cementitious material) is calculated on the basis of the alkali (Na_2Oe) content of the concrete contributed by the Portland cement and expressed in lb/yd³ (LBA in Table 601.3.1.1.1.4.2b). LBA is calculated by multiplying the cement content of the concrete in lb/yd³ by the alkali content of cement divided by 100. For example, for a concrete containing 500 lb/yd³ of cement with an equivalent alkali content of 0.81 percent of Na_2Oe, the value of LBA = 500 x 0.81/100 = 4.05 lb/yd³. For this concrete, the minimum replacement level of silica fume for Level Y is 1.8 x 4.05 = 7.3 percent. Regardless of the calculated value, the minimum level of silica fume shall not be less than 7 percent when it is only method of prevention. Mix design with silica fume > 8% shall be reviewed and approved by the Engineer.

**** Mix designs with minimum 25% of fly ash shall be reviewed and approved by the Engineer.

Note: The minimum replacement levels in Table 601.3.1.1.1.4.2b are appropriate for use with Portland cements of moderate to high alkali contents (0.71 to 1.00 percent Na_2Oe). Table 601.3.1.1.1.4.2c provides recommendations for adjusting the level of SCM when the equivalent alkali content of the Portland cement is above or below this range. The replacement levels should not be below those given in Table 601.3.1.1.1.4.2b for prevention level W, regardless of the equivalent alkali content of the Portland cement.

TABLE 601.3.1.1.1.4.2c

Adjusting the Minimum Level of SCM Based on the Alkali Content of the Portland Cement

Alkali Content (Na_2Oe)*	Level of SCM
≤0.70	Reduce the minimum amount of SCM required in Table 601.3.1.1.1.4.2b by one prevention level.*
>0.70, ≤1.00	Use the minimum levels of SCM required in Table 601.3.1.1.1.4.2b
>1.00, ≤1.25	Increase the minimum amount of SCM required in 601.3.1.1.1.4.2b by one prevention level.
>1.25	Not permitted to be used in PCC

* The alkali content of all approved cement sources is listed on the WVDOH list of Certified Portland Cement Mills (APL). If the alkali content of a cement source is not listed on the APL, the Division will test the cement from the source to evaluate alkali content prior to its use on any WVDOH project.

** The SCM replacement levels should not be below those required in Table 601.3.1.1.1.4.2b for prevention level W, regardless of the equivalent alkali content of the Portland cement.

601.3.1.1.1.4.3-Prevention Level Z: If it is determined that prevention level Z is required, limit the maximum alkali content of concrete to ≤ 3.0 lb/yd^3 (1.8 kg/m^3) plus use the minimum SCM replacement level shown for level Y in Table 601.3.1.1.1.4.2b.

The mix design for Prevention Level Z shall be reviewed and approved by the Engineer.

601.3.1.1.1.5-Requirements for Various Prevention Levels for Class H Concrete:

601.3.1.1.1.5.1-Prevention Level V: No special measures need to be taken for prevention level V.

601.3.1.1.1.5.2-Prevention Level X: The contractor may choose Option 1 or Option 2 from Table 601.3.1C. The alkali content of cement shall not exceed 1.25%. The alkali level of fly ash shall not exceed 4.5% in option 1. The CaO of the fly ash must be limited to a maximum of 18% in option 1. The alkali level of slag cement shall not exceed 1.00% in option 2. The alkali level of silica fume shall not exceed 1.00% in option 1 and option 2.

601.3.1.1.1.5.3-Prevention Level Y: The contractor may choose Option 1 or Option 2 from Table 601.3.1C if the alkali content of cement does not exceed 1.00%. The alkali level of fly ash shall not exceed 4.5% in option 1. The CaO of the fly ash must be limited to a maximum of 18% in option 1. The alkali level of slag cement shall not exceed 1.00% in option 2. The alkali level of silica fume shall not exceed 1.00% in option 1 and option 2.

601.3.1.1.1.5.4-Prevention Level Z: The contractor may choose Option 1 from Table 601.3.1C if the alkali content of cement does not exceed 1.00% and the alkali level of fly ash does not exceed 3.00%. The contractor may also choose Option 1 from Table 601.3.1C if the alkali content of cement does not exceed 0.85% and the alkali level of fly ash does not exceed 4.5%. The CaO of the fly ash must be limited to a maximum of 18%.

The contractor may choose Option 2 from Table 601.3.1C if the alkali content of cement does not exceed 0.85%. The alkali level of slag cement shall not exceed 1.00%. The alkali level of silica fume shall not exceed 1.00% in option 1 and option 2.

601.3.1.1.1.6-Evaluation of the effectiveness of SCM to prevent deleterious expansion: The contractor may evaluate the effectiveness of an SCM in the reduction of expansion in accordance with ASTM C1567*, when a reactive aggregate(s) is (are) used in a concrete mix, at a Division approved lab (an AASHTO accredited Lab, accredited for ASTM C1567) at the contractor's expense. The sampling and shipping of all aggregate shall be witnessed by a representative of the Division. ASTM C1567 test will be considered valid for 5 years from the date of testing.

If both of the aggregates (coarse and fine) used in a concrete mix are reactive (R1, R2 or R3), the contractor shall evaluate the effectiveness of SCM for both of the aggregates separately. When the same source material** is proposed for the use both as coarse and as fine aggregate, test only a selection of the reactive fine aggregate or reactive coarse aggregate, unless there is reason to expect that the coarse aggregate has a different composition than the fine aggregate or vice-versa. The combination of cement, SCM and aggregate that expand less than 0.10% at 16 days after casting will be considered as meeting

the "Requirements for Various Prevention Levels (Section 601.3.1.1.1.4)" except for Class H concrete. The evaluation with the higher percentage of SCM replacement shall be selected for the minimum replacement level of SCM for prevention level in a mix design using potentially reactive aggregate.

When more than one mix design, for the same Producer/Supplier, is submitted for evaluation, only one evaluation of the effectiveness of an SCM in the reduction of expansion in accordance with ASTM C1567 testing data, as outlined in paragraphs first through four of this sub-section, will be required for that entire group of mix designs (except Class H) if all of the mix design in that entire group of mix designs have the same combination of cement, SCM and aggregate sources.

The alkali level of fly ash shall not exceed 4.5%. The alkali level of slag cement shall not exceed 1.00%. The alkali level of silica fume shall not exceed 1.00%. Mix designs with minimum 25% of fly ash shall be reviewed and approved by the Engineer. Mix design with silica fume > 8% shall be reviewed and approved by the Engineer.

* Modify the w/c ratio of the mortar used in the ASTM C1567 test to 0.50.

** Same source material applies to same Limestone, Diabase, Quartzite and Basalt source.

601.3.2-Field Tolerances and Adjustments:

601.3.2.1-Consistency:

DELETE FOOTNOTE * OF TABLE 601.3.2 AND REPLACE WITH THE FOLLOWING:

TABLE 601.3.2 CONSISTENCY

* If the consistency exceeds the target value plus one inch (25 mm), the Contractor shall take immediate steps to reduce the slump of succeeding loads by making necessary adjustments in the mixture. The Contractor will be allowed a reasonable time for the trucks already on the road for a central mix or truck mix operation. Failure to comply will be cause for rejection of the concrete. If the consistency exceeds the target value plus 1 ¾ inches (43.75 mm), the concrete will be rejected.

601.3.2.3-Yield:

ADD THE FOLLOWING SENTENCE TO THE END OF THE THIRD PARAGRAPH

The Division shall perform Yield tests randomly throughout the progress of work to verify the accuracy of the Contractor's tests.

601.4-TESTING:

601.4.2-Contractor's Quality Control:

DELETE THE CONTENTS OF SUBSECTION AND REPLACE WITH THE FOLLOWING:

Quality control of the structural concrete is the responsibility of the Contractor as designated in MP 601.03.50. The Contractor shall maintain equipment and qualified

personnel, including at least one certified Portland cement concrete technician who shall direct all field inspection, sampling and testing necessary to determine the magnitude of the various properties of concrete governed by the Specifications and shall maintain these properties within the limits of this Specification. The Contractor's personnel who conducts the field sampling and testing shall be a certified Portland Cement Concrete Inspector. The quality control plan designated in MP 601.03.50 shall be submitted to the Engineer at the preconstruction conference. Work shall not begin until the plan is reviewed for conformance with the contract documents.

A certified Portland cement concrete (PCC) Technician shall be present at the Concrete Supplier during all batching operations and shall directly oversee those batching operations and any subsequent necessary mix adjustments. A certified PCC technician may perform this work from an alternate remote location, provided that the PCC Technician uses District approved concrete QC batching software to directly oversee all batching operations and perform any subsequent necessary mix adjustments. The details of this remote monitoring shall be outlined in the Quality Control Plan for plant operations.

The Contractor shall provide a copy of the quality control test results to the Supplier of the concrete which was tested within 48 hours of the completion of the test.

Any Agency or Laboratory which tests Contractor Quality Control concrete compressive strength specimens, that may be used for acceptance by the Division, shall be evaluated by the Cement and Concrete Reference Laboratory (CCRL) and certified by the Division as meeting the all the requirements of ASTM C1077 pertaining to testing concrete cylinders, as outlined in Section 4.2 of MP 601.03.50.

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 deem necessary to ensure their continued accuracy. The Contractor shall have on hand not less than ten 50 lb. (22.68 kg) weights for frequent testing of all scales.

601.6–HANDLING, MEASURING, AND BATCHING OF MATERIALS:

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

When silica fume densified powder is used, the densified powder shall be weighed using an approved cement scale or standard 25 lb. (11.3 kg) or 50 lb. (22.6 kg) full bags may be substituted. Batching tolerance for the cement plus densified powder shall be 1.0%.

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

These recommendations include procedures to be used when the Ready-Mix Supplier desires to add silica fume, which is supplied in repulpable bags, into the mix. If these recommendations are followed, and the Ready-Mix Supplier can satisfactorily demonstrate to the Engineer, by means of testing and wet-sieving a trial batch (see section 7.3.6 of the Silica Fume User's Manual), that there are no fragments of the packaging material remaining in the mix, then the restriction in section 501.7, concerning the addition of the SCM packaging material, may be waived.

601.7-MIXING:

DELETE THE CONTENTS OF SUBSECTION AND REPLACE WITH THE FOLLOWING:

Concrete may be central-mixed, truck-mixed, or shrink-mixed as defined in AASHTO M 157 and will be designated as ready-mixed concrete. The production of ready-mixed concrete shall meet the applicable requirements of AASHTO M 157, paragraphs ten and eleven, except as otherwise specified.

Concrete for incidental construction items may be made by volumetric batching and continuous mixing as designated in ASTM C 685, except as otherwise specified. Concrete produced by this method will not be permitted in bridge, box culvert, pavement, or retaining wall construction.

When a truck mixer or agitator is used for transporting concrete, the concrete shall be delivered to the site of work and discharge completed within one and one-half hours after the addition of the cement to the aggregates. Each batch of the concrete delivered at the job site shall be accompanied by a batch ticket that contains complete batching information, including the batch weights (or batch volume, in the case of water) of all materials in that batch of concrete. In adverse weather or under other conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85° F (30° C) or above, the time between the introduction of the cement to the aggregates and the discharge shall not exceed one hour. When a truck mixer is used for the complete mixing of the concrete, the mixing operation shall begin within one hour after the cement has been added to the aggregate.

When placing concrete at remote locations, due to excessive haul time to the site of work from the closest approved batch plant, and when discharge of the concrete within the time limits specified in the previous paragraph is not possible, or in other circumstances when approved by the Engineer, a concrete mix that includes a hydration control stabilizing admixture may be used to extend the allowable concrete discharge time. The subject concrete mix containing this admixture must be approved in accordance with section 601.3.1, and the hydration control stabilizing admixture must be approved in accordance with section 707.15. When conditions are such that a hydration control stabilizing admixture is used, the allowable time between the introduction of the cement to the aggregates and discharge of the concrete shall be increased to three hours. The limit of 300 maximum revolutions (pertaining to truck mixers or agitators) specified in AASHTO M 157 may be waived when hydration control stabilizing admixtures are used, provided that no additional water is added prior to discharge of the concrete. A single batch of concrete containing a hydration control stabilizing admixture may not be discharged on more than one project. When a mix, containing a hydration control stabilizing admixture is used, and that mix has been approved for the three-hour discharge time, the reduced discharge time required

when concrete temperatures are 85 °F (30 °C) or above, and specified in the third paragraph of this sub-section, shall not apply, provided that the concrete supplier has adjusted the hydration control stabilizing admixture dosage rate to account for that higher concrete temperature.

The addition of water after completion of initial mixing will not be permitted, except that when concrete is delivered in truck mixers, additional water may be added to adjust to a specified consistency. In this event, a minimum of 20 additional revolutions of the truck mixer drum at mixing speed shall be required before discharge of any concrete; the maximum allowable time between the addition of the cement to the aggregates and the discharge of the batch shall not be exceeded. Concrete that is not within the specified consistency limits at the time of placement shall not be used. When superplasticizer is used to adjust the consistency of a mix at the job site, as outlined in Section 601.3.2.1, water may still be used to adjust the consistency of the mix prior to the job site addition of superplasticizer, but no additional consistency adjustment of that mix with water shall be permitted after the job site addition of superplasticizer. The additional consistency testing required in Section 601.3.2.1 applies each time that superplasticizer is added at the job site. When superplasticizer is used to adjust the consistency of a mix at the batch plant, but not at the job site, as outlined in Section 601.3.2.1, additional consistency adjustment of that mix with water at the job site shall still be permitted.

For all classes of concrete except Class H and concrete for specialized overlays, the total amount of water in a concrete mix, including any water added at the job site, shall not be more than the amount which would cause the water-cement ratio (w/c) of that concrete mix to exceed the w/c which corresponds to the Mix Design Approved Strength, as outlined in Section 5.4 of MP 711.03.23. The maximum water amount shall also be shown in Attachment 4 or 5 of MP 711.03.23 for all approved concrete mix designs. However, under no circumstances shall the w/c in Table 601.3.1A be exceeded.

Shrink-mixed concrete is a ready-mixed concrete which is initially and partially mixed in a central mix plant and lastly mixed to completion in a truck mixer while in transit to or after arrival at the job site. Shrink-mixed concrete will be allowed for use in the work if specified in the Contract.

601.8-FORMS:

601.8.7–Removal of Forms and Construction of Superimposed Elements:

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

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

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

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

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

TABLE 601.8.7

Requirements for Removal of Forms and Construction of Superimposed Elements		
Structural Element	**Removal of Forms**	**Placing Concrete In Superimposed Elements**
	Compressive Strength-psi (Mpa)	**Compressive Strength-psi (Mpa)**
Bridge Decks	2000 (14.0)	3000 (21)
Columns	2000 (14.0)	2000 (14.0)
Walls & Beams	2000 (14.0)	2000 (14.0)
Footings	500 (3.5)	2000 (14.0)
Components Supported By Falsework	3000 (21)	3000 (21)
Parapets	2000 (14.0) (See 601.11)	----------

601.11-FINISHING CONCRETE SURFACES:

601.11.4-Finishing Concrete Bridge Decks:

601.11.4.3-Straightedge Testing of Hardened Bridge Decks:

DELETE THE CONTENTS OF SUBSECTION 601.11.4.3 AND REPLACE THE FOLLOWING:

When finishing has been completed and the concrete has hardened sufficiently, the surface shall be given a further test for trueness with a rolling straightedge or a certified inertial profiler and operator (see Section 720.2.). When using a rolling straight edge, areas showing high spots of more than 1/8 inch (3 mm) shall be marked by the Engineer. When an inertial profiler is used, the data shall be analyzed by using the rolling straight edge simulation on the most recent version of ProVal Software. Areas showing more than 1/8 inch (3mm) on the rolling straight edge simulation will be mapped showing locations. Only when directed by the Engineer, such areas that are higher than 1/8 inch (3 mm) shall be ground with an approved grinding tool, utilizing carborundum stones or industrial diamond wheels; grinding shall be done to an elevation where the area or spot will not show a surface deviation in excess of 1/8 inch (3 mm) when tested with the 10 feet (3.048 meter) rolling straightedge, except that the maximum depth of grinding shall not exceed 1/4 inch (6 mm). The ground areas shall be treated as directed by the Engineer. Where the initial deviation from the straightedge is 1/2 inch (13 mm) or more, the Contractor will be required to remove and replace the complete pour in which the areas not meeting the required tolerance are located.

After grinding, all areas either high or low, not meeting the requirements of 1/8 inch (3 mm) tolerance will be measured and disposition of these areas will be as set forth in 601.15.2

601.12-CURING AND PROTECTING CONCRETE:

601.12.1–Curing Under Normal Conditions:

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

Concrete surfaces shall be kept completely and continuously moist. Curing shall be continued for a period of at least 7 days. This curing period may be reduced if the contractor presents evidence that the in-place concrete has attained 70% of the specified strength for the class of concrete under cure. Under no circumstances, shall the period of cure be less than 3 days. The reduced curing period option is not applicable to Class H or Class K concrete. When placing concrete elements with a minimum dimension greater than 2-feet (0.61 m), the contractor shall not be permitted to add additional cement to the target cement factor in the approved mix design in order to obtain high-early strength and/or reduce curing time. Surfaces may have coverings temporally removed for finishing, but the covering shall be restored as soon as possible.

601.13-PROTECTIVE SURFACE TREATMENT:

601.13.3-Concrete Protective Coating:

DELETE THE ENTIRE SUBSECTION 601.13.3 AND REPLACE WITH THE FOLLOWING:

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

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

601.13.3.2-Concrete Surface Preparation: All concrete surfaces to receive a protective coating shall be prepared in accordance with SSPC-SP 13, Surface Preparation of Concrete, SSPC-The Fundamentals of Cleaning and Coating Concrete, ASTM D4258-Standard Practice for Surface Cleaning Concrete for Coating. All surfaces to receive a protective coating shall be thoroughly cleaned and kept free of oil, form oil, grease, dust,

dirt, mud, curing compound, release agents, loose patching mortar, or any other substances that may prevent bonding.

601.13.3.3-Paint Application Requirements: The following surfaces shall be coated, including all beveled edges.

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

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

601.13.3.3.2-Paint Storage: Paint and thinners shall be stored in a temperature-controlled environment between 40° F (5° C) and 100° F (38° C). At no time will paint be used beyond the manufacturer's shelf life.

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

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

Application requirements and drying times between coats shall be in accordance with the manufacturer's recommendations.

Spray guns must be equipped with the recommended size tip for the paint product being applied and shall be held perpendicular (90 degrees) to, and at, the proper distance from

the receiving surface. Complete protection shall be provided by the contractor against paint spatter, spillage, overspray, wind-blown paint, or similar releases.

Appropriate containment shall be placed around the work area to protect public and private property. Staging must be adequate to provide access to all areas being painted. Violation of these requirements causing excessive paint waste will be justification for the WVDOH Engineer to order the Contractor to cease all work on the project until corrective action has been taken. The method of cleaning and/or replacement shall be submitted to the Engineer in advance for approval.

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

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

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

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

601.13.3.4-Environmental, Worker Protection, And Waste Handling:

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

601.13.3.4.2-"Spent Material": This shall include material generated by surface preparation operations, and shall be disposed of in accordance with Section7 of SSPC SP-13. The Contractor shall, at the Contractor's expense, select a laboratory that will sample and analyze the "spent materials". The laboratory must be certified by the WVDEP, EPA or by another state's DEP-equivalent. Certification will be provided to the Engineer prior to the beginning of work. The waste transporter for both hazardous and non-hazardous waste will be listed on the Contractor's Containment/Disposal Control Plan.

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

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

601.13.3.5-Contractor Responsibilities:

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

601.13.3.6-Inspection Requirements:

601.13.3.6.1-Inspection of Applied Paint: If in the opinion of the Engineer the coating has flaws other than deficiencies in the prescribed dry film thickness, the material shall be repaired or shall be removed and replaced. Defects in the film, including but not limited to runs, sags, mud-cracking, lifting, overspray, and dry spray, shall be corrected until a continuous uniform film has been applied.

Excessive film thickness shall be reduced and insufficient film thickness shall be increased. If the thickness of the finish coat is reduced, a thin coat of the finish shall be reapplied to seal the surface and to blend the area into the surrounding coating. Depending on the defect, total removal and replacement of the effected coating may be required. No unsightly runs or sags shall be visible. All "mud-cracking" and/or "dry overspray" in the paint film shall be removed. Calibration of the thickness gage and dry film thickness measurements shall be in accordance with MP 708.40.00.

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

601.13.3.6.3-Repair Procedures for Field Paint Deficiencies: All field repairs to the coating shall be made in strict accordance with the coating manufacturer's recommendations, except where the requirements listed in this specification are more stringent. Any products used during repairs to the coating deficiencies shall be from the same manufacturer as the coating being repaired. Surfaces that will be inaccessible for coating after erection shall be repaired and/or recoated prior to erection. The Engineer is to review and accept a repair plan before deficient areas are repaired. The requirements specified herein for provisions for inspection, mixing, thinning, temperature and humidity,

and application shall govern the coating of the repaired areas. In order to avoid abrupt changes in paint thickness, the area adjacent to repair areas shall transition from zero paint thickness to full system thickness within not less than 3 inches (75 mm) of the repair area by means of sanding the transition area. The requirements for the dry film thickness of the repair coats are the same as those specified for the paint system.

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

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

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

601.15-BASIS OF PAYMENT:

601.15.2-Price Adjustments:

DELETE THE CONTENTS OF SUBSECTION 601.15.2 AND REPLACE THE FOLLOWING.

The Contractor will be assessed equitable deductions of twenty-five dollars ($25.00) per square foot (two-hundred- seventy dollars ($270.00) per square meter) for areas of bridge decks not meeting the specified 1/8 in (3mm) tolerance and not specified to be removed nor directed to be ground, and for any areas that have been ground but do not meet the specified tolerance. Deviations will be tested with a 10 foot (3.048 meter) rolling straightedge or using certified inertial profiler and operator (See Section 720.2). Inertial profiler data will be analyzed by using the rolling straight edge simulation on ProVal Software.

Concrete not found in compliance with the requirements of 601.4.4 for compressive strength will be paid for at a reduced contract price in accordance with the following formula:

$$\text{Percent Reduction} = \frac{f'_c - X}{0.6f'_c - \sigma}$$

Where:

f'_c = Design Strength, psi (MPa)

X = Observed Strength, psi (MPa)

σ = Standard Deviation

The percent reduction shall be applied to the sublot with the low strength.

SECTION 602
REINFORCING STEEL

602.2-MATERIALS:

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

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.

602.11-PAY ITEMS:

DELETE ITEM 602003 FROM THE TABLE AND REPLACE WITH THE FOLLOWING:

ITEM	DESCRIPTION	UNIT
602003-*	Corrosion Resistant Reinforcing Steel Bar, "type"	Pound (kilogram)

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

SECTION 603
PRESTRESSED CONCRETE MEMBERS

603.2-MATERIALS:

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

Precast/Prestressed Concrete Materials	Sections/Subsections
+Admixtures:	
Supplementary Cementitious Materials (SCMs)**	707.4

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

603.2.1-Inspection and Testing:

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

A representative of the Engineer shall have free entry at all times, while the work on the Contract is being performed, to all parts of the manufacturer's works which concern the manufacture of the materials ordered. The manufacturer shall afford the representative of the

Engineer, without charge, all reasonable facilities to satisfy themselves that the material is being furnished in accordance with these specifications. Inspection and acceptance procedures for prestressed concrete bridge members shall be in accordance with MP 603.10.40.

The Fabricator's QC Personnel, as a minimum, shall be a certified ACI Grade I Concrete Field Testing Technician and/or a WVDOH PCC Inspector. In addition, if Self-Consolidating Concrete (SCC) is used, Fabrication Plant QC Personnel shall be a certified ACI SCC Testing Technician.

ADD THE FOLLOWING SENTENCE AT THE END OF THE SUBSECTION:

Component materials used in the fabrication of precast and prestressed concrete members, and any ship loose materials pertaining to precast and prestressed concrete items, shall be approved in accordance with MP 603.02.10.

603.2.1-Inspection and Testing:

DELETE PARAGRAPH ONE AND REPLACE WITH THE FOLLOWING:

A representative of the Engineer shall have free entry at all times, while the work on the Contract is being performed, to all parts of the manufacturer's works which concern the manufacture of the materials ordered. The manufacturer shall afford the representative of the Engineer, without charge, all reasonable facilities to satisfy themselves that the material is being furnished in accordance with these specifications. Inspection and acceptance procedures for prestressed concrete bridge members shall be in accordance with MP 603.10.40.

603.6-CONCRETE:

603.6.1-General:

603.6.1.1-Class S-P Concrete:

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

Class S-P concrete shall consist of a homogeneous, flowable mixture of cement, fine aggregate, coarse aggregate, chemical admixtures and water. Class S-P concrete may also contain fly ash, slag cement, and silica fume. The mixture proportions shall be such that the Class S-P concrete will resist segregation, bleeding, and the generation of foam during placement, and will need no external compaction or vibration, unless the mix is qualified as outlined in Section 603.6.1.1.1. While the properties of fresh SCC differ significantly from that of conventional fresh concrete, the quality in terms of strength, durability, and performance of the hardened SCC shall be equal to or better than that of a similar specified conventional concrete mix. Establishment of the mixture proportions shall be coordinated with the manufacturer of the admixtures which will be used in the Class S-P concrete.

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

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

603.6.2-Mix Design:

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

Concrete mixtures shall be established initially by methods in accordance with ACI 301, Chapter 4. Class S-P concrete mixtures shall be developed in accordance with MP 711.03.23 and the requirements of this Section, not the ACI methods. Mixes may be designed either by a commercial laboratory or by PCI certified concrete plant personnel. Prior to adoption of a mix design as a plant standard, it shall be field tested by use of the production plant batching and mixing equipment, construction methods, and curing to be used in production of the members.

ADD THE FOLLOWING PARAGRAPH AFTER PARAGRAPH TWO:

Any design mix with an aggregate(s) that has a reactivity class R1, R2, or R3, as shown as in Approved Aggregates Source List, shall be developed in accordance with subsection 601.3.1.1. If an aggregate Source is not listed on the Approved Aggregates Source List, the Division will test the fine and coarse aggregate from the Source, in accordance with AASHTO T 303, to determine the reactivity class of the aggregate prior to its use on any WVDOH project. The Division will inform the Fabricator of the reactivity class of aggregates that they are proposing to use. If a cement Source and/or a SCM Source are not listed on the Approved Source List, the Division will test cement and/or SCM from that Source prior to its use on any WVDOH project.

603.6.2.1-Class S-P Concrete Mix Design Testing:

DELETE THE FIRST PARAGRAPH AND REPLACE WITH THE FOLLOWING:

To ensure repeatability of production, two batches of concrete with the same mix proportions shall be created for mix qualification testing. The results of this testing shall be submitted to the Division for approval at least 45 days prior to the use of the mix in construction. Personnel performing testing on Class S-P concrete shall be certified by ACI as a Self-Consolidating Concrete Testing Technician.

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

603.6.3.1-Proportioning of Class S-P Concrete:

DELETE TABLE 603.6.3.1 AND REPLACE WITH THE FOLLOWING:

TABLE 603.6.3.1

Cementitious Materials	Maximum Percent of Total Cementitious Materials in Class S-P Concrete by Mass
Class F Fly Ash	25
Slag Cement	50
Silica Fume	10
Total of Class F Fly Ash and Silica Fume	35
Total of Slag Cement and Silica Fume	50

NOTE:
Class F Fly Ash shall constitute no more than 25 percent of the total weight of cementitious materials. Silica fume shall constitute no more than 10 percent of the total weight of cementitious materials.

SECTION 604
PIPE CULVERTS

DELETE THE ENTIRE CONTENTS AND REPLACE WITH THE FOLLOWING:

604.1-DESCRIPTION:

This work shall consist of the construction or reconstruction of pipe culverts, in accordance with these Specifications and in reasonably close conformity with the lines, grades, dimensions, and locations shown on the plans or established by the Engineer.

604.2-MATERIALS:

Materials shall conform to the following requirements of Division 700, except as otherwise noted:

MATERIAL	SUBSECTION
Aluminum Structural Plate Box Culvert	713.18
Aluminum Coated Corrugated Steel Pipe and Pipe Arch	713.24
Bitumen Sealant	708.9
Controlled Low Strength Material (CLSM)	219
Concrete End Section for Arch, Elliptical, or Round Concrete Pipe	714.8
Crushed Aggregate	704.6, Class 1 or Class 3
End Section for Corrugated Steel Pipe, Safety Slope, or Pipe Arch	713.20
Concrete Safety Slope End Section for Arch, Elliptical, or Round Pipe	714.8
Fine Aggregate	702.1.2-702.1.5 and 702.6, or 702.2
Granular Material	716.1.1.2

MATERIAL	SUBSECTION
High Density Polyethylene Pipe (HDPE), Profile Wall	714.19
High Density Polyethylene Pipe (HDPE), Steel-Reinforced	714.18
Polypropylene Pipe	714.17
Polyvinyl Chloride (PVC) Pipe	714.22
Precast Reinforced Concrete Box Culverts	714.7
Random Material	716.1.1
Reinforced Concrete Pipe	714.2

When the locations of manufacturing plants allow, the plants may be inspected periodically for compliance with specified manufacturing methods, and material samples may be obtained for laboratory testing for compliance with material quality requirements. This may be the basis for quality acceptance of manufactured lots.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the Engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

All references to "corrugated steel pipe" are considered applicable to the paving classes (paved invert, full paved, etc.) for which the base metal conforms to AASHTO M 218 or AASHTO M 274.

604.2.1-Quality Control Testing: Quality control of the granular material and crushed aggregate is the responsibility of the Contractor as specified in 106.1.

The Contractor shall maintain necessary equipment and qualified personnel to perform all sampling and testing necessary to determine the magnitude of the various properties of the material governed by the Specifications and shall maintain these properties within the limits of the Specifications.

The Contractor shall submit a quality control plan detailing the methods by which the quality control program will be conducted. This plan, prepared in accordance with the guidelines set forth in the appropriate portions of MP 307.00.50 and MP 717.04.21, shall be submitted to the Engineer at the preconstruction conference. The work shall not begin until the plan is reviewed for conformance with the contract documents.

604.2.2-Acceptance Testing: Quality control sampling and testing performed by the Contractor may be used by the Division for Acceptance.

604.2.3-Sampling and Testing: Frequency of sampling and testing shall be in accordance with the contractor's quality control plan. The minimum sampling and testing frequencies for gradation shall be as indicated in Attachment 1 of MP 307.00.50. The material shall be sampled in accordance with MP 700.00.06. The minimum sampling and testing frequency for compaction will be in accordance with MP 717.04.21.

604.2.4-Acceptance Plan:

604.2.4.1-Compaction: Compaction of backfill material shall meet 604.8.

604.2.4.2-Gradation: The material shall be sampled and tested in accordance with Section 604.2.3. Acceptance for gradation shall be based on test results of consecutive

random samples from a lot. A sublot is the quantity of material represented by a single gradation test as defined in MP 700.00.06. A lot shall be considered the quantity of material represented by an average test value, not to exceed five sublots. In the case where only one sample is needed for the total plan quantity, the sublot shall be considered the lot.

The average shall start on the second sample result. The average is continued for the third through fifth sample result, averaging all previous sample results. Thereafter, only the last consecutive five sample results will be averaged, i.e., second test value through sixth test value, third test value through seventh test value, and so forth as defined in MP 300.00.51.

When the test value of a lot and the test value of the last sublot, or when the last three consecutive individual test values of a lot fall outside the gradation limits of Table 704.6.2A the lot of material represented will be considered nonconforming to the extent that the last of its sublots are nonconforming. When this occurs, the last sublot shall have its price adjusted in accordance with Table 604.14.1.

604.2.4.3-Degree of Nonconformance: When a sublot of material is to have its price adjusted, the percentage point difference between the nonconforming test value and the specification limit shall be determined for each sieve size determined to be nonconforming, and this value shall be multiplied by its appropriate multiplication factor as set forth in Table 604.2.4.3

TABLE 604.2.4.3

Nonconforming Sieve Size	Multiplication Factor
1 ½ in. (37.5 mm)	1.0
¾ in. (19 mm)	1.0
No. 4 (4.75 mm)	1.0
No. 40 (425 µm)	1.0
No. 200 (75µm)	2.0

The total measure of nonconformance of an individual sublot is the sum of all nonconformance of an individual sieve sizes of that sublot.

When the total degree of nonconformance has been established and it is 12.0 or less, the material will be for at an adjusted contract price as specified in Table 604.14.1.

When the degree of nonconformance is greater than 12.0, the nonconforming sublot shall be resolved on an individual basis, requiring a special investigation by the Engineer to determine the appropriate course of action to be followed.

CONSTRUCTION METHODS

604.3-GENERAL:

Subject to the provisions prescribed, the flow line of a pipe culvert may be altered from that shown on the plans.

Galvanized steel pipe or bands shall not come in contact with aluminized steel pipe or bands.

The diameter of pipe, as used in this Section, is the largest dimension, horizontal or vertical.

604.4-TRENCH EXCAVATION:

604.4.1-Pipe Culverts 18 Inches (450 mm) Through 96 Inches (2400 mm): In complete or partial fill sections, before trenching is begun, the fill shall be constructed for a minimum distance of six diameters on each side of the pipe and to a height of 2 feet (600 mm) over the top of the pipe or to the surface of the completed embankment if less than 2 feet (600 mm) above the top of the pipe.

The minimum width of the trench, in either cut of fill sections, shall be calculated using the formulas below. The Contractor shall increase these minimums to a width that allows the jointing of the pipe, and adequate placement and compaction of the backfill.

Pipe Culverts of 36 inches (615 mm) diameter or less:

= Outside Diameter + 18 Inches (450mm) on each side of the pipe

Pipe Culverts with diameter greater than 36 inches (615 mm)

= Outside Diameter + 24 Inches (600 mm) on each side of the pipe

604.4.1.1-Pipe Culverts Installed Using Controlled Low Strength Material (Type F Trench): When using a controlled low strength material (CLSM) the width of the trench shall not be less than the values in the table in Standard Detail DR-10; and for trenches in rock , a minimum trench width of Outside Diameter plus 6 inches on each side of the pipe.

604.4.2-Pipe Greater Than 96 Inches (2400 mm): In complete or partial fill sections, before trenching is begun, the fill shall be constructed for a distance of six diameters on each side of the pipe and to a minimum height of 25 percent of the vertical dimension of the pipe.

Installation of the pipe shall be as detailed in the plans, including the type and amount of backfill and bedding.

The Contractor shall submit shop drawings detailing all erection procedures including anticipated movements during backfilling operations. Backfill operations shall also be detailed to show lift thicknesses, sequence of lifts and shape of the culvert during these operations.

The Contractor shall submit a plan of field control for the installation insuring the pipe is erected in accordance with the shop and erection drawings.

604.4.3-Structural Plate Box Culvert: Excavation for the foundations of structural plate box culvert shall be in accordance with 212.3.

604.4.4-Precast Concrete Box Culvert: The minimum width of the trench shall be 18 inches on each side of the box culvert.

604.5-BEDDING:

Unless otherwise noted in the plans, bedding shall conform to the following requirements. Rigid pipe bedding shall be granular material or crushed aggregate with a 3 inch (75 mm) minimum thickness. Flexible pipe bedding shall be crushed aggregate with a 4 inch (100 mm) minimum thickness. The bedding material placed under the middle 1/3 of the pipe diameter shall be loosely placed and uncompacted to allow for cradling of the pipe bottom. Bedding outside of the middle 1/3 shall be compacted.

When rock or unyielding material is present in the trench bottom, 6 inches of granular material shall be installed below the bottom of the pipe or box culvert.

Box culvert bedding shall be fine aggregate with a 4-inch (100 mm) minimum thickness.

604.6-LAYING AND JOINING:

604.6.1-Rigid and Flexible Pipe and Concrete Box Culvert: The pipe/culvert placing, unless the Contractor is otherwise directed, shall begin at the downstream end of the pipe/culvert. The lower segment of the pipe/culvert shall be in contact with the bedding throughout its full length. Bell or groove ends of pipes and outside circumferential laps of corrugated steel pipe shall be placed facing upstream.

Paved or partially lined culverts shall be laid so that the longitudinal centerline of the paved segment coincides with the flow line.

Rigid pipes/culverts may be of either bell and spigot or tongue and groove design, unless one type is specified. The method of joining pipe sections shall be such that the ends are fully entered, and the inner surfaces are reasonably flush and even. Joints for rigid pipes/culverts shall be made with flexible gaskets that conform to ASTM C443 or bitumen sealant combined with an external sealing wrap which conforms to ASTM C877, Type III. All joints shall be installed to form a leak resistant seal.

Flexible pipes shall be joined by bell and spigot joints, and the pipe shall be installed to preserve the alignment, provide a leak resistant joint that conforms to ASTM D3212 performance requirements, and prevent the separation of sections.

Pipe culverts shall be inspected before any backfill is placed. Any pipe found to be out of alignment, unduly settled, or damaged shall be removed and re-laid or replaced.

604.6.2-Structural Plate Box Culvert: Plate box culvert shall be set on footings as shown on the Plans. Beginning at the upstream end, the first side plates shall be set on the base angles. Then the remaining side plates and the top plates shall be bolted into place using only enough bolts to hold them without tightening securely. Drift pins may be used to assist in matching bolt holes. Temporary props may be used to hold plates in place until connections are made. After the plates comprising the first set have been assembled, the next set shall be placed in the same manner, finishing each set of side plates with a top plate before placing in the same manner, finishing each set of side plates with a top plate before placing the next set of side plates. New plates shall be lapped one corrugation on the outside of the preceding plates. When all the plates are in position, the remaining bolts shall be inserted and all nuts firmly tightened. Steel bolts shall be torqued during installation to a minimum of 100 ft-lbs. (135 Newton meters), and a maximum of 300 ft-lbs. (400 Newton meters), Aluminum bolts shall be torqued during installation to a minimum of 100 ft-lbs., (135 Newton meters), and a maximum of 150 ft-lbs. (200 Newton meters). For power driven tools, the hold-on period may vary from 2 to 5 seconds. Bolts shall be of sufficient length to provide for a full nut.

604.7: Blank

604.8-BACKFILLING:

The use of a bulldozer or other bladed equipment in placing backfill is expressly forbidden. Mechanical equipment with various type buckets may be used. All pipe, after being bedded and backfilled, shall be protected by a 4 feet (1200 mm) cover of fill, or more if necessary, before heavy equipment is permitted to cross during the construction of the roadway. The Contractor will be held responsible for any damage to the pipe resulting from movement of equipment over the structure.

604.8.1-Initial Backfill Zone: Rigid Pipe initial backfill material shall be suitable granular material free from particles larger than 1-½ inch (40mm), crushed aggregate, or controlled low strength material. For flexible pipe, the initial backfill material shall be crushed aggregate or controlled low strength material. The initial backfill material shall be placed along the pipe in layers not to exceed 4 inches (100 mm) and compacted to 95% standard proctor; to a minimum of the spring line for rigid pipe and to a minimum height of 6 inches (150 mm) over the top of flexible pipe. Controlled low strength material (CLSM) shall be placed according to Section 219; and any type of CLSM may be used unless otherwise indicated on the Plans or Standard Details. Unless otherwise specified in the plans, CLSM can be used as a substitute for granular material or crushed aggregate at the contractor's option. At the contractor's option, and if permitted by the Engineer, Class B concrete may be used as a substitute for CLSM at no additional cost to the Division.

Care shall be taken to compact the material under the haunches of the pipe, to place the backfill evenly on each side of the pipe to retain its vertical axis, and to avoid displacement. The backfill and compaction efforts shall be advanced simultaneously on both sides of the pipe.

Box culvert initial backfill material shall be suitable granular material free from particle sizes larger than 1-1/2 inch (40 mm) or crushed aggregate. Unless otherwise noted on the plans, it shall be placed to a minimum of 12 inches (300 mm) over the top of box culvert.

604.8.2-Final Backfill Zone: Unless otherwise noted in the plans, the area above initial backfill zone shall be one of the following:

1. Suitable random material with material sized up to 3" (75mm) with no more than 20% retained on the 1-1/2 sieve (40mm),
2. Crushed aggregate, or
3. Controlled low strength material.

This method of backfilling and compacting shall be followed until the top of the trench is reached.

604.8.3-Backfill Testing: The quality control testing and acceptance of CLSM shall be in accordance with Section 219. Class B concrete shall be in accordance with Section 601, except that the job site and A-bar testing are waived.

The quality control testing and acceptance for compaction of the random backfill material shall be in accordance with applicable sections of 207 and 716, granular material according to 716, and crushed aggregate according to 717, with the following exception:

Testing will be conducted on both sides of the pipe and testing within a lot may include tests on both sides of the pipe. For pipe installations in an embankment where existing tests are on file for the adjacent embankment material, the target percentage of dry density for the pipe backfill will be equal to the average of the X values for the tests in the adjacent lots of embankment material or a minimum value of 95, whichever is greater. For embankments where no tests are on file, the target percentage of dry density will be 95. A lot shall have five (5) density tests performed for quality control.

For pipes less than 60 inches (1500 mm) in diameter, a lot will normally consist of the quantity of backfill required for each 75 linear feet (23 m) of pipe installed.

For pipes 60 inches (1500 mm) in diameter and larger, a lot will normally consist of not more than 5 lifts of backfill. For pipe with lifts of backfill placed for the full length of the pipe, a sublot will normally consist of a lift of backfill placed on both sides for the full length of the pipe. For pipes that are backfilled in segments, a sublot will normally consist of a lift of backfill placed on both sides for the length of each segment of pipe backfilled.

Backfill placed outside embankments and roadbed is to be compacted to or better than the average total dry density for the existing soil. An average total dry density will be determined from representative density tests conducted for each existing soil. Quality control testing will normally consist of one test per 100 linear feet (30 m) of pipe installed, and lot evaluations are not required. The moisture tolerance is not applicable.

604.9-FIELD PAVING:

The Contractor may pave with Portland cement concrete or use shotcrete. If practicable, such paving shall be delayed until completion of the fill over the structure. Before the placing of the paving, the surface of the plates shall be cleaned. The Portland cement concrete or shotcrete, mesh reinforcement, fastening of mesh, and paving dimensions shall be as specified and the minimum thickness over the crest of the corrugations shall be 1-½ inches (40 mm).

Concrete used shall have a design 28-day compressive strength of 3,000 psi (21 MPa) (equivalent to Class B in 601.3); concrete may be hand mixed and shall be handled and placed as directed by the Engineer. After initial set has taken place, the paving shall be flooded or kept moist by sprinkling for three days. Liquid membrane-forming compound, conforming to 707.9 may be used for curing at a minimum application rate of one gallon per 150 square feet (0.25 liters per m^2) of concrete surface. Other methods of curing may be used if approved by the Engineer.

Field paving with shotcrete shall conform to the applicable provisions of 623. When paving with shotcrete, the exposed surface shall be brought to a uniform surface by screeding or troweling. After completion of the shotcrete paving, the rebound material shall be cleaned from the culvert above the paved surface. Shotcrete shall be cured by (a) covering with burlap mats and keeping them wet for at least seven days after placing, (b) flooding for a period of at least seven days or, (c) applying liquid membrane curing compound, conforming to 707.9, at a minimum rate of one gallon per 150 per feet (0.25 liters per m^2) of shotcrete surface for each application. Shotcrete cured by membrane forming compound shall receive two applications; the second application shall be made after the first application has set. Other methods of curing may be used if approved by the Engineer.

After the completion of the fill over the pipe, any gaps which develop between the plates and the concrete or shotcrete paving shall be filled by pouring heated asphalt material complying with requirements of 713.3.

Prior to using Portland cement concrete or shotcrete for paving culverts with coatings containing aluminum, the aluminum-concrete contact area shall be coated with commercially-available paint.

604.10-REMOVE AND RELAY PIPE:

When specified, the Contractor shall remove, salvage, clean, safely store, and relay existing culverts. The construction requirements in this Section shall apply equally in the case of remove and relay pipe. The Contractor shall restore or replace, any pipe designated for reuse that incurs damage or destruction through faulty handling or storage. All pipes salvaged for relaying shall be cleaned of all foreign material prior to reinstallation.

604.11-JACKING PIPE:

Jacking or tunneling may be designated on the Plans or may be permitted if written approval is obtained. Culverts to be jacked shall be reinforced concrete pipe. The strength of pipe designated in the Contract will be designated as required for vertical load only. Additional reinforcement or strength of pipe required to withstand jacking pressure shall be determined and furnished by the Contractor without additional cost to the Division. Variation from theoretical alignment and grade at the time of completion of jacking placement shall not exceed 0.2 feet for each 20 feet (10 mm per m) of pipe so placed.

An approach trench shall be constructed on the side from which jacking operations shall take place. The end of the approach trench away from the jacking face shall be cut perpendicular to the axis of the jacking operation to provide bearing surface for the back stop and the jack blocking. The length of the approach trench shall be such that the distance between the jack blocking and the face of the bore shall be equal to 5 feet (1500 mm) plus the length of the individual pipe sections. The jacking face shall be a minimum of 3 feet (1 m) above the top of the pipe; the face shall be cut vertically and shall be shored to prevent raveling and slipping. A sump shall be constructed in one corner of the trench to provide drainage. The back stop shall be constructed of heavy timbers or steel rails capable of withstanding the jacking force.

In the event the site of jacking operations is such that an approach trench cannot be constructed, the jack blocking shall be constructed to carry the reaction of the jack to the ground. This may be accomplished by means of timber, steel, or concrete vertical back stops set into the ground with the tops supported by diagonal members bearing against an embedded anchorage.

Directly opposite the approach trench, an exit trench shall be constructed to line and grade. The exit trench shall be constructed in the same manner as the approach trench except that no back wall is necessary.

Jacks shall be of sufficient capacity to overcome soil resistance to the jacking operation and shall be operated in pairs. As a guide, capacity of jacks for concrete pipe shall be a minimum of 50 tons (45 Mg) each. For large pipe, more than one pair of jacks may be required. Small track jacks may be used to start the pipe.

Pipe guides shall be constructed in the approach trench and may be either timber or steel rail or concrete guides on a cradle. Since the pipe guides will support the pipe as it enters the jacking face, the pipe guides shall be accurately set to line and grade, and excavation for the guides shall be made to grade to avoid occurrence of settlement. Guides shall be spaced, as required.

Reaction of the jack to the pipe shall be transmitted by either a jacking frame or jacking beams constructed of timber or steel. Jacking frames and beams shall be so placed as to exert equal pressure on each side of the pipe. For pipes 36 inches (900 mm) in diameter or smaller, a steel jacking ring may be used in lieu of the jacking frame.

The pressure from the jacking frame or beams may be transmitted to a jacking collar or head on the pipe itself. Jacking collars or heads for concrete pipe shall be constructed to prevent damage to the pipe ends. Jacking collars and jacking frames shall be constructed to allow passage of men and material.

Joints of concrete pipe shall be cushioned and protected from infiltration of fine materials occurring during the jacking operation by insertion of a plywood or OSB of 1/2”-3/4” thickness cushioning material into each pipe joint. After the pipe is in position, the joints shall be pointed from the inside with mortar joint compound. The use of a jacking shield is permitted.

To prevent the pipe from "freezing" and becoming incapable of movement, jacking operations should, if possible, be carried out on a 24-hour basis. Alignment and grade of the pipe

guides shall be checked at least once each shift. To aid in the prevention of "freezing," the pipe shall be lubricated in a manner and with a material meeting the approval of the Engineer.

Excavation for the bore shall be to grade at the bottom and approximately 1 inch (25 mm) greater than the diameter of the pipe at the top and sides. As excavation proceeds, the jacking shall proceed until the effective limit of the jacking is reached, at which time additional blocking shall be added. This process shall be continued until there is room for an additional pipe section. For long runs of pipe, the use of intermediate jacking stations will be allowed as approved by the Engineer.

Pipe cover shall be a minimum of one diameter or 3 feet (900 mm) from top of pipe to bottom of the subgrade of ballast when jacking under a highway.

After the pipe has been jacked into place, the annular area between the pipe wall and the remaining soil shall be pressure grouted to remove any chance of settling. The backfill shall be tightly compacted around both ends of the culvert to prevent erosion. Any departure from the above specifications necessitated due to site conditions shall be approved in writing by the Engineer.

Areas resulting from caving or excavation outside the above limits shall be backfilled with grout, or by a method which will fill the voids. Joints shall be completed as specified for the type of pipe being installed.

604.12-INSPECTION AND ACCEPTANCE:

In addition to the inspection performed by the Division during the initial installation of pipe culverts, a post installation inspection will be conducted before final acceptance. No sooner than 30 days following installation, the Engineer will visually inspect all culverts. Pipes larger than 42 inches in diameter will be manually inspected by inspectors on the project for excessive deflection of flexible pipe, excessive cracking in rigid pipe, and joint issues for all pipes. Inspectors will note and document any defects with locations in their daily work reports.

Any excessive cracks, differential movement, spalls, exposed reinforcement, delamination, slabbing, dents, buckling, holes, damaged coating, obstructions, improperly engaged joints, improper gasket placement, excessive joint gaps, misaligned joints, excessive deflection, or undue horizontal or vertical misalignment will be cause for repair or replacement at no cost to the Division. Efflorescence and rust stains should be evaluated to determine if detrimental or just a cosmetic defect.

604.12.1-Rigid Pipe Criteria: Concrete pipe cracks equal to or less than one hundredth of an inch (0.01) are considered hairline and minor. Cracks greater than one hundredth of an inch (0.01) but less than five hundredths of an inch (0.05), shall be sealed by the method proposed by the manufacturer and approved by the Engineer. Concrete pipe with cracks with width equal to or greater than five hundredths of an inch (0.05) and less than one tenth (0.1) shall be evaluated by the Engineer for repair or replacement. Concrete pipe with cracks one tenth (0.1) inch or greater in width shall be replaced by the Contractor to the satisfaction of the Engineer. Cracking, whether longitudinal or transverse, shall be evaluated as described above.

Spalling is defined as a localized pop-out of concrete along the wall of the pipe/culvert, or at the edges of longitudinal or circumferential cracks. If spall/chips are detected, there are 3 classifications:

a. Spalled areas with no exposed reinforcement, are considered nonstructural and shall be patched with material from approved list and meeting Section 715.4 with R-3 requirements and approved by the Engineer.
b. Spalled area with exposed reinforcement, with a single spall area less than or equal to 150 square inches, the Contractor shall submit repair plan for remediation to the Engineer.
c. Spalled area with exposed reinforcement with a single spall area greater than 150 square inches, the Contractor shall submit a pipe analysis and remediation plan for repair or replacement.

Delamination and Slabbing appears as a separation of the concrete from the reinforcing steel and can be detected by a hollow sound when tapped with a device such as a hammer. If identified, the Contractor shall submit remediation methods for delamination/slabbing in accordance with recommendations of the pipe manufacturer, to the Engineer for approval before proceeding. Where delamination/slabbing is of such magnitude that, in the opinion of the Engineer, the integrity or service life of the pipe or culvert is severely compromised, the section(s) of pipe shall be replaced at the Contractor's expense to the satisfaction of the Engineer.

Maximum allowable joint gaps are dependent on each pipe manufacturer's joint design and equipment. Pipe manufacturers will provide maximum joint gaps based on minimum gasket compression required.

If any soil infiltration is identified at a pipe joint during inspection, a pipe analysis and a remediation plan for repair or replacement shall be submitted to the Engineer for approval.

604.12.2-Flexible Pipe Criteria: Flexible pipe deflection equal to or less than 5 percent of the original diameter will not require remediation. Deflections of 5 percent up to 7.4 percent of the original diameter will be evaluated by the Engineer for repair or replacement; if repaired the final pipe deflection must be equal to or less than 5 percent of the original diameter for acceptance. If flexible pipe is deflected 7.5 percent or more than the original diameter, the pipe shall be replaced by the Contractor to the satisfaction of the Engineer.

Flexible pipe with any crack (interior, exterior, or both) shall be replaced to the satisfaction of the Engineer.

Pipes showing evidence of crushing at the joints will need a repair plan submitted to the Engineer for approval. Replacement at no cost to the Division as an option if necessary. If any soil infiltration is identified at the pipe joint during inspection, a pipe analysis and a remediation plan for repair or replacement shall be submitted to the Engineer for approval.

604.12.3-Testing of Pipe: A post installation camera/video inspection of pipe culverts and laser/mandrel deflection inspection of flexible pipe shall be conducted by the Contractor on all pipe culverts that meet the following requirements:

1. Cumulative total of 200 linear feet (70 m) or more of pipe culverts on project
2. Project located on NHS routes

The Contractor may visually inspect, in the presence of the Engineer, in lieu of camera/video inspection where pipe culverts size, orientation, and location allow for easy visual examination.

When camera/video inspection is required, it shall be conducted by the Contractor in the presence of the Engineer. The Contractor will note and document any defects or flaws with locations in their reports. Equipment used in these inspections must have the following features:

Camera/Video inspection equipment shall be:

1. Configured properly in the pipe both vertically and horizontally, and having the ability to pan and tilt to a 90 degree angle with the axis of the pipe and rotate 360 degrees.
2. Low barrel distortion camera capable to measure cracks as small as 0.01".
3. Color image with a minimum standard resolution of 720x480 pixels.
4. Equipped with sufficient lighting to provide a clear image of the full circumference of the pipe.
5. Capable of recording the station, milepost, distance along the invert of the pipe, or other indicators of location superimposed on the video.
6. Capable of moving through the entire length of the pipe.
7. Software capable of generating a report that shows each fault along with its location from the inspection entrance and a still frame image of the fault.

Laser deflection measure device on flexible pipe up to 48 inches in diameter shall be capable of measuring deflection to an accuracy of 0.5% or better with a repeatability of 0.12% or better.

Mandrel device must have an odd number of legs (9 minimum) having a length not less than the outside diameter of the mandrel. The mandrel shall be pulled by hand with no mechanical assistance. The diameter of the mandrel, whether it is fixed or variable size, must be verified with a proving ring or other method as per the manufacturer's guidelines. The minimum diameter of the installed pipe at any point shall not be less than the diameter, as calculated per equation below:

Minimum Diameter of Installed Pipe = (Actual Pipe Diameter) x (Deflection Percentage)

Where:

Actual Pipe Diameter = Inside pipe diameter of pipe being installed prior to installation
Deflection Percentage = 0.95 for 5% deflection and 0.925 for 7.5% deflection

The Contractor shall provide a digital copy of the camera/video inspection and issue a report in digital format, detailing all issues or deficiencies noted during the inspection, including a remediation plan for each deficiency, no later than 7 calendar days after completion of the inspection.

604.13-METHOD OF MEASUREMENT:

Pipe of the different types and sizes, both new and re-laid, will be measured by the linear foot (m) in place, the measurement being made along the centerline of each pipe installed. Branch connections, tees, wyes, and elbows will be measured along their centerlines and these lengths included in the total lengths of the pipe. Wyes, tees, and other branch connections will be measured along the centerlines to points of intersection. Pipe with sloped or skewed ends will be measured along the invert. The portion of pipe extending through to the inside face of headwalls of all types, manholes, inlets, boxes, or other structures shall be included in the measurement.

End sections will be measured by the number of units installed.

Pipe designated on the Plans to be installed by the jacking method will be measured separately by the linear foot (m) in place and shall be the actual portion jacked, completed in place, and accepted.

604.14-BASIS OF PAYMENT:

The quantities, determined as provided above, will be paid for at the contract unit prices bid for the items listed in 604.15, which prices and payments shall be full compensation for excavation and bedding, except as otherwise provided, backfilling, jacking when called for, furnishing all 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. The unit price bid for end sections shall include excavation and backfill.

When, by the authority of the Engineer, the flow line of a pipe is lowered from that shown on Plans, or due to a lack of a firm foundation, or due to a solid rock foundation, unsatisfactory material is removed and replaced with suitable material, the work of excavation, replacement, and compaction of material will be paid for in accordance with 109.4.

1. For pipe culverts less than 48-inches (1200 mm) diameter, the work of excavation, measured in excess of 1 foot (300 mm) below the original planned pipe elevation, will be paid for under the provisions of 109.4. When suitable material is not available from the project excavation, payment for replacement material below final grade line will be made in accordance with 109.4.
2. For pipe culverts 48-inches (1200 mm) diameter or larger, all additional excavation below the original planned pipe elevation and for a width not in excess of the outside pipe diameter plus 18 inches (450 mm) on each side of the pipe, will be paid for at the unit bid price for Item 207001-* "Unclassified Excavation". When no Item 207001-* is included in the Proposal, payment for excavation, backfill compaction and replacement material will be made in accordance with 109.4. When suitable material is not available from the project excavation, replacement material will be paid for in accordance with 109.4.

604.14.1-Price Adjustment: Crushed aggregate not conforming with the gradation requirements as described in 604.2.4.2 will be paid for at the adjusted contract price base on the degree of nonconformance as specified in Table 604.14.1.

A revised unit price for calculation purposes in 307.9.1 will be established based on the unit bid cost minus the cost of the pipe.

TABLE 604.14.1

Adjustment of Contract Price for Gradation not Within Specifications	
Degree of Nonconformance	Percent of Contract Price to be Reduced
1.0 to 3.0	2
3.1 to 5.0	4
5.1 to 8.0	7
8.1 to 12.0	11
Greater than 12	*

* The Division will make a special evaluation of the material and determine the appropriate action.

604.15-PAY ITEMS:

ITEM	DESCRIPTION	UNIT
604037-*	"size" Reinforced Concrete Pipe, Class **	Linear Foot (Meter)
604039-*	"size" Reinforced Concrete Pipe Arch, Class **	Linear Foot (Meter)
604041-*	"size" Reinforced Concrete Elliptical Pipe, X	Linear Foot (Meter)
604045-*	"size" Polypropylene Pipe	Linear Foot (Meter)
604050-*	"size" High Density Polyethylene Pipe, profile wall	Linear Foot (Meter)
604051-*	"size" High Density Polyethylene Pipe, steel reinforced	Linear Foot (Meter)
604052-*	"size" Polyvinyl Chloride Pipe	Linear Foot (Meter)
604053-*	"size" Relaid Existing Pipe	Linear Foot (Meter)
604054-*	"size" Jacked Pipe, Reinforced Concrete Pipe, Class **	Linear Foot (Meter)
604070-*	"size" Precast Concrete Box Culvert	Linear Foot (Meter)
604071-*	"size" Concrete Safety Slope End Section for Round Pipe	Each
604074-*	"size" Aluminum Structural Plate Box Culvert, YZ	Linear Foot (Meter)
604076-*	"size" Aluminum Coated Corrugated Steel Pipe, YZ	Linear Foot (Meter)
604077-*	"size" Aluminum Coated Corrugated Steel Pipe Arch, YZ	Linear Foot (Meter)
604080-*	"size" Aluminum Coated Corrugated Steel Pipe and Paved Invert	Linear Foot (Meter)
604090-*	"size" Corrugated Steel Pipe End Section	Each
604091-*	"size" Corrugated Steel Pipe Arch End Section	Each
604092-*	"size" Corrugated Steel Pipe Safety Slope End Section	Each

***** Sequence number

****** Class designated by Roman numerals. "special design" may be used for unique circumstance

X = Type of elliptical pipe in accordance with the following table

Y = Base metal thickness in accordance with the following table.

Z = A one digit number designating metal pipe corrugations in accordance with the following table. For Aluminum Box Culverts, haunch and crown plate thicknesses as specified on the Plans

Y	Mil Thickness	
	Steel	Aluminum
A	64 (1.63)	60 (1.52 mm)
B	79 (2.0)	75 (1.90 mm)
C	109 (2.77)	105 (2.67 mm)
D	138 (3.51)	135 (3.43 mm)
E	168 (4.27)	164
F	188 (4.78)	---
G	218 (5.54)	---
H	249 (6.32)	---
J	4 Bolts/Ft (13 Bolts/M) 280 (7.11)	--
K	6 Bolts/Ft (19 Bolts/M) 280 (7.11)	100 (2.54 mm)
L	8 Bolts/Ft (26 Bolts/M) 280 (7.11)	125 (3.18 mm)
M	313 (7.95)	150 (3.81 mm)
N	375 (9.52)	185 (4.41 mm)
P	---	200 (5.08 mm)
Q	---	225 (5.72 mm)
R	---	250 (6.35 mm)

Z	Metal Corrugations	Pipe Class
1	1½"x ¼" (37.5 x 6.25 mm)	---
2	2/3" x ½" (66.8 x 12.5 mm)	---
3	3" x 1" (75 x 25 mm)	---
5	5" x 1" (125 x 25 mm)	---
6	6" x 2" (150 x 50 mm)	---
7	7½" x ¾" x ¾" (190 x 19x 19)	---
I or 1	---	I
II or 2	---	II
III or 3	---	III
IV or 4	---	IV
V or 5	---	V

X	Concrete Pipe
H	Horizontal Elliptical
V	Vertical Elliptical

SECTION 606
UNDERDRAINS

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

606.1-DESCRIPTION:

This work shall consist of constructing underdrains and free draining base trenches using pipe and granular material, blind drains, aggregate filled engineering fabric, prefabricated pavement edge drain and underdrain pipe outlets in accordance with these Specifications and in reasonably close conformity with the lines, grades, dimensions and locations shown on the Plans or established by the Engineer.

When Item 606025-*, "size" Underdrain Pipe, is included as a pay item in the Contract, any of the following pipe types may be furnished for construction of the underdrain: corrugated polyethylene underdrain pipe, or perforated plastic semicircular pipe.

606.1.1-Free Draining Base Trench: This work shall consist of constructing free draining base trenches and Outlet Pipes in accordance with these specifications and in reasonably close

conformity with the lines, grades, dimensions, and locations shown on the plans or established by the Engineer.

606.2-MATERIALS:

The materials shall conform to the following requirements:

MATERIAL	SUBSECTION	TYPE OR GRADATION
Concrete for Miscellaneous Uses	715.12	
Corrugated Polyethylene Underdrain	714.19	
Crushed Aggregate for Free Draining Base Trench [2]	703.1, 703.2, 703.3, 703.4	AASHTO 57, 67, 357, or 467
Gravel for Aggregate Filled Fabric Underdrains [2]	703.2 & 703.4 or 703.2.3	AASHTO #2 thru #57 or Pea Gravel
Gravel for Underdrains [2]	703.2 & 703.4	AASHTO Size # 57, 67, 7 or 78
Crushed Stone for Aggregate Filled Fabric Underdrains [2]	703.1 & 703.4	AASHTO #2 thru #57 inclusive
Crushed Stone for Underdrains [2]	703.1 & 703.4	AASHTO Size # 57, 67, 7 or78
Engineering Fabric for Subsurface Drainage	715.11.4	
Miscellaneous Concrete	715.12	
Outlet Pipe	715.10.1.5	
Perforated Plastic Semicircular Pipe [1]	714.20	
Prefabricated Pavement Edge Drain	715.10.1	
Silica Sand for Underdrains	702.1.2, 702.1.3 & 702.6	

1 Plastic semicircular pipe may be furnished only when six inch (150 mm) diameter is called for on the Plans.

2 Only one size may be used at any one installation.

When the locations of manufacturing plants allow, the plants may be inspected periodically for compliance with specified manufacturing methods, and material samples may be obtained for laboratory testing for compliance with material quality requirements. This may be the basis for acceptance of manufacturing lots as to quality. All materials will be subject to inspection for acceptance as to condition at the latest practicable time the Engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

606.2.1-Quality Control Testing: Quality control is the responsibility of the Contractor as specified in 106.1. The contractor shall develop a quality control plan in accordance with applicable sections of MP 307.00.50 excluding the attachment page.

Samples will be obtained at a minimum frequency of one sample per day of aggregate placement. Aggregate for underdrain shall be evaluated for specification compliance in accordance with MP 606.03.50. Aggregate for aggregate filled underdrain shall be evaluated for specification compliance in accordance with MP 606.03.50 except Section 6.0 through 6.2 are excluded.

606.2.2-Acceptance Testing: Acceptance sampling and testing of aggregates used for underdrain is the responsibility of the Division, Except for furnishing the necessary materials. Quality control sampling and testing performed by the Contractor may be used by the Division for Acceptance.

606.2.3-Free Draining Base Trench Materials: The perforated pipe and outlet pipe as detailed on the plans shall meet the requirements of this Section.

606.3-CONSTRUCTION METHODS:

606.3.1-Pipe Installation:

606.3.1.1-Trenching: Trenches shall be excavated to a width of the outside diameter of the pipe plus 1 ft. (300 mm), to a depth of 4 inches (100 mm) below the flow line, and to the grade required by the Plans or as directed. Trench walls shall be as nearly vertical as practicable.

606.3.1.2-Bedding and Placing Pipe: A minimum 4 inch (100 mm) bedding layer of gravel or crushed stone shall be placed in the bottom of the trench for its full width and length.

Subdrainage pipe of the type and size specified shall be embedded firmly in the bedding material. Upgrade ends of all underdrainage pipe installations shall be closed with suitable plugs to prevent entry of soil materials.

Perforated pipe shall normally be placed with the perforations down. Flexible pipe sections shall be joined with couplings or bands as recommended by the manufacturer. Non-perforated pipe and rigid pipe shall be firmly set and laid with the bell and groove ends upgrade and with open joints, wrapped with suitable material when specified, to permit entry of water.

606.3.1.3-Placing Filter Material: After the pipe installations have been inspected and approved, crushed stone or gravel shall be placed to a height of 6 inches (150 mm) above the top of pipe. The trench shall then be filled with silica sand to a minimum thickness of 12 inches (300 mm) over the top of the filter stone or gravel. In the event damp trench sides indicate the necessity; the Engineer may direct an increase in the thickness of the silica and cover. When the underdrain is used to drain the base or subbase, course, the sand filter shall be carried vertically to the bottom of the base or subbase. Care shall be taken not to displace the pipe or the covering at open joints. When there is a heavy percolation of water into the trench at underdrain level, the Engineer may substitute sand for the crushed stone or gravel bedding, cover and filter.

606.3.1.4-Backfill: Above the sand filter, when underdrains are not used to drain the base or subbase, the trench shall be filled with suitable random material, as shown on the Plans or as directed by the Engineer, in layers not exceeding 4 inches (100 mm) after compaction. The use of bulldozers or other blade equipment in backfilling is expressly prohibited.

The quality control testing and acceptance of suitable soil, soft shale or granular material will be according to applicable sections of 207 and 716, with the following exceptions:

1. A lot normally consist of the quantity of backfill material required to backfill 100 linear ft. (30 m) of the installation, or as directed by the Engineer.
2. For underdrain installations in an embankment, where existing tests are on file for the adjacent embankment material, the target percentage of dry density for the suitable random backfill will be equal to the X value of the tests in the adjacent lot of embankment material or a minimum value of 95, whichever is greater. For embankments where no tests are on file, the target percentage of dry density will be 95.

606.3.1.5-Underdrain Outlets: Trenches for underdrain outlets shall be excavated as for underdrains, except that the depth of the trench shall be limited to the flow line. Pipe shall be laid in the trench with all ends firmly joined by the applicable methods and means. The use of perforated pipe may be omitted or, if used, it shall be laid with perforations up. No filter material shall be used. After inspection and approval of the pipe installation, the trench shall be backfilled with suitable material in layers and compacted as provided for underdrains.

606.3.2-Underdrain Structures:

606.3.2.1-Underdrain Junction Boxes: Underdrain junction boxes shall be constructed to the dimensions and elevations at locations as shown on the Plans or as directed.

606.3.2.2-Slope Walls for Underdrains: Slope walls for underdrains shall be constructed of concrete conforming to the requirements of 715.12 of the Specifications and shall be constructed to the dimensions and elevations at locations as shown on the Plans or as directed.

606.3.2.3-Spring Control: Underdrain spring boxes and underdrain for spring control shall be constructed to the dimensions and elevations at locations as shown on the Plans, or as directed. Any remaining upper portion of the trench shall be filled and compacted as for underdrains.

606.3.3-Aggregate Filled Fabric Underdrain and Blind Drains: Trenches for aggregate filled fabric underdrains and blind drains shall be excavated to the width and depth shown on the plans. The trench shall be prepared to a relative smooth state, free of sharp protrusions, depressions, and debris.

When fabric is used, it shall be placed with the long dimension parallel to and centered with the alignment of the trench. It shall be placed in the trench in reasonable conformance with the shape of the trench and shall be smooth and free of tension, stress, folds, wrinkles or creases. The fabric shall be installed so that any splice joints have a minimum overlap of at least 2 feet (600 mm) in the direction of flow. The overlap of the closure at the top shall be approximately the width of the trench and shall be temporarily used to cover the excavated material on either side of the trench.

The aggregate shall be placed by any method which will result in the trench being completely filled to the line shown. The filling process shall not cause the permeability of fabric to be impeded.

The fabric, when used, shall be overlapped at the top of the aggregate. Any portion of the trench not filled with aggregate shall be backfilled in accordance with 606.3.4.

606.3.4-Prefabricated Pavement Edge Drain: Trenches for prefabricated pavement edge drain shall be excavated to the dimensions and grade shown on the Plans.

The edge drain shall be placed against the pavement side of the trench and held firmly in place while backfill is placed to a compacted height of not more than 6 inches (150 mm). For one-sided drains, the more open side shall be placed toward the pavement. After the first lift is compacted and any tears in the fabric have been satisfactorily repaired, the remainder of the backfill shall be placed and compacted in layers not exceeding 6 inches (150 mm) deep. All compaction shall be accomplished with a vibratory compaction system. The backfill shall be the material excavated from the trench. Unless otherwise approved by the Engineer, the excavation of the trench, the placement of the edge drain, and the placement of the first lift of backfill shall be accomplished in a single continuous operation.

Each segment of edge drain shall be joined to the adjacent segment prior to installation. Splices shall keep the adjoining edge drain in proper alignment and shall not separate during installation.

Four inch (100 mm) diameter non-perforated outlet pipes shall be installed to provide positive drainage at low points of sags, at the low ends of all runs and at intervals not exceeding 500 ft. (150 m) on continuous runs, except edge drains with two separate flow channels shall have a crossover coupling at approximately 250 ft (75 m). The manufacturers' recommended fitting shall be provided for attaching the edge drains to the outlet pipes. A standard underdrain concrete slopewall shall be used at each pipe outlet unless the pipe is connected to a drainage structure. Slopewalls shall be fitted with a galvanized rodent screen.

The outlet pipe trench shall be constructed in accordance with 606.3.1.4 and 606.3.1.5 using as backfill the material excavated from the trench.

606.3.5-Free Draining Base Trench Construction Methods:

606.3.5.1-Trench: The FDB trench shall be excavated to the width and depth as detailed on the plans. Trench walls shall be as nearly vertical as practicable.

606.3.5.2-Bedding and Placing Perforated Pipe: After excavating the trench, Engineering fabric shall be placed in the trench in reasonable conformance with the shape of the trench. The Engineering fabric shall be smooth and free of tension, stress, folds, wrinkles, or creases. The Engineering fabric shall be installed so that any splice joints have a minimum overlap of at least 1 foot (300 mm) any direction. Enough Engineering fabric will be placed in order to properly tie to the mainline placement of Engineering fabric (Item 207034 -*). A 2 inch (50 mm) bedding layer of crushed stone or gravel aggregate shall be placed in the bottom of the trench for its full width and length. The pipe shall then be placed in the trench. The pipe sections shall be joined with couplings or bands as recommended by the manufacturer. After pipe installation, the remainder of the trench will be backfilled with crushed stone or gravel aggregate. (refer to table in section 606.2 for material requirements of aggregate)

606.3.5.3-Outlet Pipe:

606.3.5.3.1-Connection to Perforated Pipe: At locations designated on the plans or as directed by the Engineer, rigid outlet pipe will be connected to the perforated pipe. A

drop connection utilizing a tee or wye or other means as satisfactory to the Engineer will be used for this connection. This operation may be performed concurrently with the placement of the perforated pipe or separately.

606.3.5.3.2-Trenching: The outlet pipe trench shall be excavated to the depth of the flow line of the outlet pipe. Minimum slope of the outlet pipe is to be 3%. Width of the trench will be that width which will allow proper room for pipe placement and backfilling operations.

606.3.5.3.3-Placing and Backfilling Pipe: The outlet pipe shall be placed in the trench with all ends firmly joined by couplings or bands as recommended by the manufacturer. The outlet pipe shall be backfilled with random material in accordance with Subsection 606.3.1.4.

606.3.5.3.4-Pipe End Treatment: The outlet end of all outlet pipes not tied to drainage structures shall be equipped with a slopewall. Outlet pipes shall be tied to inlets or culverts by the use of pipe saddles, grouting Cementing, or other means satisfactory to the Engineer.

606.4-METHOD OF MEASUREMENT:

The quantity of work done will be measured by the linear foot (meter) for pipe, including outlet pipe, for each of the types and sizes as specified, complete in place and accepted. Length will be determined from actual measurements after the pipe is in place. Angles, tees, and wyes, and other branches which may be required will be measured from centerline of main pipe along the centerline of the branch to the end and the length included in the pipe length. Crushed stone, gravel, or silica sand for bedding, filter, and spring control will be measured by the volume; the volume will be the product of the specified trench width and depth, and the length in place, less the volume of the pipe computed on the basis of the outside diameter of the barrel or corrugations. Blind drains will be measured by the volume of granular material. The quantity of work done for "Aggregate Filled Fabric Underdrains" will be measured in linear feet (meters) of trench, complete in place and accepted. The quantity of work done for "Prefabricated Edge Drain" will be measured in linear feet (meters) of edge drain and outlet pipe, complete in place and accepted. Volume will be computed on the basis of the specified trench depth and width, and the length in place. Underdrain junction boxes will be measured by the unit. Slopewalls for underdrains will not be paid for separately, but shall be included in the cost of the underdrain pipe.

606.4.1- Free Draining Base Trench Method of Measurement:

606.4.1.1-FDB Trench: The quantity of work done will be measured by the LF (m) of FDB 606.3.5.1 trench installed, complete, in place, and accepted. The perforated pipe is a component of the FDB trench. Length will be determined from actual measurements once the FDB trench is in place. No deductions will be made for placement of the drop connection required at outlet pipe locations.

606.4.1.2-Outlet Pipe: The quantity of work done will be measured by the LF (m) of rigid pipe complete in place and accepted. Angles, tees, wyes, and other branches which may be required will be included in the length of the outlet pipe. Measurement shall begin at the intersection of the perforated pipe and the rigid pipe. Slopewalls for outlet pipe and

the connection of outlet pipes to drainage structures will not be paid for separately, but shall be included in the cost of the outlet pipe.

606.5-BASIS OF PAYMENT:

The quantities, determined as provided above, will be paid for as provided below, which prices and payments shall be full compensation for furnishing the materials, excavation, placing pipe, filter material, edge drain, outlet pipe, backfill, disposing all surplus material and doing all the work, including all labor, tools, equipment, supplies and incidentals necessary to complete the work. Payment for engineering fabric for Free Drain Base Trench will be as Item 207034-*.

606.6-PAY ITEMS:

ITEM	DESCRIPTION	UNIT
606020-*	Aggregate Filled Fabric Underdrains, "size"	Linear Foot (Meter)
606022-*	Crushed Stone, Gravel, or Silica Sand for Underdrains	Cubic Yard (Meter)
606025-*	"size" Underdrain Pipe	Linear Foot (Meter)
606027-*	Corrugated Polyethylene Underdrainage Pipe	Linear Foot (Meter)
606029-*	Free Draining Base Trench	Linear Foot (Meter)
606030-*	Outlet Pipe, "size"	Linear Foot (Meter)

* Sequence number

SECTION 607
GUARDRAIL

607.1-DESCRIPTION:

DELETE THE CONTENTS OF SUBSECTIONS 607.1 AND REPLACE WITH THE FOLLOWING:

This work shall consist of the construction or reconstruction of guardrail in accordance with these Specifications and in reasonably close conformity with the lines and grades shown on the Plans or established by the Engineer.

The types of guardrail are designated as follows:

Type 1: Galvanized Steel Deep Beam Type Guardrail or Zinc-Aluminum-Magnesium Alloy-Coated Steel Deep Beam Type Guardrail
Type 2: Blank
Type 3: Blank
Type 4: Blank
Type 5: Galvanized Steel Double-Faced Guardrail (Deep Beam Type) or Zinc-Aluminum-Magnesium Alloy-Coated Steel Double-Faced Guardrail (Deep Beam Type)

All installations of Type 1 & 5 Guardrail will be classified according to one of the designations specified. The guardrail class will be indicated in the pay items and on the Plans,

Class I: 6 feet - 3 inches (1 905 mm) post spacing with blocks
Class II: 12 feet - 6 inches (3 810 mm) post spacing with blocks

Class III: 12 feet - 6 inches (3 810 mm) post spacing without blocks.
Class IV: 3 feet - 1½ inches (952 mm) post spacing without blocks.
Class V: 3 feet - 1½ inches (952 mm) post spacing with blocks.

The construction of the guardrail shall include the complete furnishing, assembling and erecting of all component parts and materials at the location shown on the Plans or directed by the Engineer.

A Modified Cut Slope Terminal shall consist of supplying and installing additional length guardrail posts, an additional W-beam guardrail section (bottom beam), and standard guardrail cut slope terminal components

607.2-MATERIALS:

DELETE THE TABLE AND REPLACE WITH THE FOLLOWING:

MATERIAL	SUBSECTION
Concrete for Footers	715.12
Galvanized Steel Deep Beam Type Guardrail Fasteners and Anchor Bolts	712.4
Miscellaneous Concrete	715.12
Offset Blocks	710.3, 710.5 *
Pressure Treated Wood Guardrail Posts	710.3, 710.5
Retroreflective Sheeting for Traffic Control	715.9.2.8
Steel Guardrail Posts	709.45
Zinc-Aluminum-Magnesium Alloy-Coated Steel Deep Beam Type Guardrail	712.5
Zinc Rich Primer (Galvanized Repair)	711.21

* Other material types may be substituted from the division's approved list.

607.4-ERECTING RAIL ELEMENTS:

DELETE THE ENTIRE SUBSECTION 607.4 AND REPLACE WITH THE FOLLOWING:

607.4-ERECTING RAIL ELEMENTS:

607.4.1-General: Rail elements shall be erected in a manner resulting in a smooth, continuous installation.

All bolts, except where otherwise required, such as expansion joint bolts and adjustment bolts, shall be drawn tight. Bolts through expansion joints shall be drawn up as tight as possible without being tight enough to prevent the rail elements from slipping past one another longitudinally. Bolts shall be sufficiently long to extend at least 1/4 inch (6 mm) beyond the nuts. Except where required for adjustment, bolts shall not extend more than 1/2 inch (13 mm) beyond the nuts. Bolts through variable thickness posts shall be cut off a maximum of 1/2 inch (13 mm) beyond the nuts.

All metal guardrail elements shall be fabricated in the shop. Field punching, cutting, and drilling of all guardrail elements other than rail may be permitted after it has been demonstrated that it will not result in damage to the surrounding metal and if approved by the Engineer.

When additional slotted holes are required in W-beam to secure rail to post, slotted hole shall be per Standard Details Volume I. Slotted hole shall be field punched or shop fabricated so that they are free from tears, jagged edges and damage to the surrounding metal. Drilling to create slotted holes is prohibited.

It shall be permissible to join Galvanized and Zinc-Aluminum-Magnesium Alloy-Coated Guard Rail together. Additionally, it shall be permissible to use galvanized fasteners and end terminals with Zinc-Aluminum-Magnesium Alloy-Coated Guard Rail beams.

Galvanized or zinc-aluminum-magnesium alloy-coated surfaces which have been abraded so that the base metal is exposed, any field welded surfaces, threaded portions of all fittings and fasteners, and cut ends of bolts shall be protected with zinc rich primer or by field galvanizing, when approved by the Engineer.

607.4.2-Type 1 Guardrail (Galvanized Steel Deep Beam / Zinc-Aluminum-Magnesium Alloy-Coated Steel Deep Beam): The rail shall be erected so that the bolts at expansion joints will be located near the centers of the slotted holes. The rail elements shall be spliced by lapping in the direction of traffic. The rail elements at each splice shall make contact throughout the area of the splice. Shop-curved rail shall be used on curves with radii less than 150 feet (45 m).

Any surface damage to galvanized beams or zinc-aluminum-magnesium alloy-coated beams shall be repaired with a material meeting the requirements of 711.21.

When called for, guardrail end terminals conforming to the details shown on the Plans shall be constructed.

607.4.3 through 607.4.4: Blank

607.4.5-Type 5 Guardrail (Galvanized Steel, Double-Faced / Zinc-Aluminum-Magnesium Alloy-Coated Steel, Double-Faced): This rail shall be erected in accordance with the requirements of 607.4.2 and as shown on the Plans.

607.5-GUARDRAIL REMOVED AND REBUILT OR STORED:

ADD THE FOLLOWING SENTENCE TO THE END OF THE SECOND PARAPGRAPH:

It shall be permissible to join Galvanized and Zinc-Aluminum-Magnesium Alloy-Coated Guard Rail beams.

607.8-PAY ITEMS:

DELETE ITEM 607027 AND REPLACE ITEM 607046 IN THE TABLE:

ITEM	DESCRIPTION	UNIT
607046-*	7 In Round X 6 Ft (175 Round X 1800 mm) Treated Wood Post Note 1	Each
Note 1: For repair and replacement of existing round treated wood post only.		

SECTION 609
SIDEWALKS

609.1-DESCRIPTION:

DELETE THE CONTENTS OF THE SUBSECTON AND REPLACE THE FOLLOWING.

This work shall consist of the construction of Portland cement concrete sidewalks and curb ramps in accordance with these Specifications and in reasonably close conformity with the lines and grades shown on the Plans or established by the Engineer.

609.2-MATERIALS:

609.2.1-Detectable Warning Surfaces:

DELETE THE CONTENTS OF THE SUBSECTON AND REPLACE THE FOLLOWING.

Detectable warning panels shall have a detectable warning surface meeting Proposed Accessibility Guidelines for Pedestrian Facility in Public Right of Way (PROWAG), latest edition, requirements. The panel dimensions shall not deviate more than 1/16 in (3 mm). The panel colors shall be as shown in the plans or as approved by the Engineer. The panel shall contrast visually with adjacent gutter, street or highway, or curb ramp surface, either light-on-dark or dark-on-light. The panels shall be textured to provide a slip resistant surface.

There shall be two types of warnings surfaces: panels for fresh concrete surfaces while the concrete is still plastic and panels for cured concrete surfaces. Mold-in-place concrete domes, brick pavers, tiles, or iron or steel warning systems shall not be used. Detectable warning panels must be approved and on the WVDOH Approved Products List. The material approval for detectable warning panels will be based on results from WVDOH field evaluation tests or based on actual performance on WVDOH projects. All materials to be used shall be covered by a 5 year manufacturer warranty under normal conditions.

609.2.5-Acceptance Plan:

609.2.5.1-Gradation:

DELETE CONTENTS OF SUBSECTION 609.2.5.1 AND REPLACE WITH THE FOLLOWING:

The material shall be sampled and tested in accordance with Section 609.2.4. Acceptance for gradation shall be based on test results of consecutive random samples from a lot. A sublot is the quantity of material represented by a single gradation test as defined in MP 700.00.06. A lot shall be considered the quantity of material represented by an average test value, not to exceed five sublots. In the case where only one sample is needed for the total plan quantity, the sublot shall be considered the lot.

The average shall start on the second sample result. The average is continued for the third through fifth sample result, averaging all previous sample results. Thereafter, only

the last consecutive five sample results will be averaged, i.e., second test value through sixth test value, third test value through seventh test value, and so forth as defined in MP 300.00.51.

When the test value of a lot and the test value of the last sublot, or when the last three consecutive individual test values of a lot fall outside the gradation limits of Table 704.6.2A the lot of material represented will be considered nonconforming to the extent that the last of its sublots are nonconforming. When this occurs, the last sublot shall have its price adjusted in accordance with Table 609.10.1.

609.3-SUBGRADE PREPARATION:

DELETE THE FIRST PARAGRAPH AND REPLACE WITH THE FOLLOWING.

The subgrade shall be constructed true to grade and cross section as shown on the Plans or directed by the Engineer. It shall be watered, if required, and thoroughly compacted before placing the concrete or bed course material. All soft or yielding material shall be removed and replaced with suitable material.

609.6-MIXING AND PLACING CONCRETE:

ADD THE FOLLOWING PARAGRAPH TO THE END OF THE SUBSECTION.

Curb ramp and adjacent curb or curb and gutter may be constructed monolithically, with the approval of the Engineer. The monolithic or integral curb ramp threshold and adjacent curb are required to be poured at the proper depth as per PVT-6.

609.7-EXPANSION JOINTS:

DELETE THE THIRD PARAGRAPH AND REPLACE WITH THE FOLLOWING.

Expansion Joints shall be provided around all curb ramps and ramp flares.

609.8-FINISHING:

609.8.1-Concrete:

DELETE THE THIRD PARAGRAPH AND REPLACE WITH THE FOLLOWING.

The surface of sidewalks shall be marked into rectangles of not less than 12 sq. ft. (1 sq. m) with a scoring tool which will form contraction joints and rounded sidewalk edges. The contraction joints shall extend into the concrete 1 inch (25 mm) depth and shall be approximately 1/8 inch (3 mm) wide.

609.8.2 Detectable Warning Surface:

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

All curb ramps shall include detectable warning surface across the full width of the curb ramp where the flush threshold meets the gutter or pavement (excluding any flared sides) or as shown on the plans or established by the Engineer. A set-in- place anchored detectable warning surface shall be installed at the time of the placement of the curb ramp, while the concrete is still plastic. The panel shall contrast visually with adjacent gutter, street or highway, or curb ramp surface, either light-on-dark or dark-on-light. A concrete border, if necessary for installation, shall not exceed 2 inches. Detectable warning surfaces are intended to provide a tactile equivalent underfoot of the visible curb line. If detectable warning surfaces are placed too far from the curb line because of a large curb radius, the location may compromise effective crossing. Detectable warning surfaces should be placed at the back of the curb line (or as shown on the plans or established by the engineer) and shall not be placed on paving or expansion joints. A single detectable warning surface panel shall be used with curb ramp widths of 5 feet or less. Where detectable warning surface panels are cut to conform to a specific shape of ramp and anchoring devices become part of the waste, the anchor will be removed and reattached into the detectable warning surface at the original edge offset as per manufacturer. The joints between the panels shall not exceed 1/8 inch. The panels shall not deviate more than 1/16" from the finished grade of the ramp surface. The grade will be measured from the top of the panel excluding any texture. The panels shall be installed and cut as recommended by the manufacture. Where parts of more than one panel are used to conform to a specific shape, all panel pieces shall be of the same color. Where possible, the domes shall be aligned in the direction of pedestrian travel.

609.9-METHOD OF MEASUREMENT:

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

Sidewalks will be measured in square yards (meters), complete in place and accepted, which will be determined by the length measured upon the surface times the width constructed, as authorized by the Engineer. Removal of existing sidewalks and any excavation shall be considered Unclassified Excavation and shall be paid as specified in Section 207. Sidewalk bed course material will be measured by the cubic yard (meter), complete in place and accepted.

Curb Ramps will be measured and paid for separately complete in place and accepted. Curb Ramp item includes all concrete for curb ramp (including curb, curb and gutter, curb wall or cheek wall, etc.) as shown in Standard Details. Removal of existing curb ramp, existing partial sidewalks necessary for curb ramp replacement, and any excavation shall be incidental. Curb Ramp bed course material will be measured by cubic yard, complete in place and accepted on new curb ramp construction. Detectable warning surfaces shall be measured and paid for separately complete in place and accepted.

Where a driveway crosses a sidewalk, the intersecting area shall be constructed to the driveway typical section and shall be measured and paid for the entire length of the driveway and transitions by the pay items shown in the driveway typical section or the Standard Details.

609.10-BASIS OF PAYMENT:

609.10.1-Price Adjustment:

DELETE THE FIRST SENTENCE OF THE SUBSECTION AND REPLACE WITH THE FOLLOWING.

Bed course material not conforming to the gradation requirements as described in 609.2.5.1 will be paid for at the adjusted contract price based on the degree of nonconformance as specified in Table 609.10.1.

SECTION 614
PILING WALLS

DELETE THE ENTIRE CONTENTS AND REPLACE THE FOLLOWING:

614.1-DESCRIPTION:

This work shall consist of furnishing and placing steel piles in predrilled holes, concrete or grout, backfill and lagging, of the kinds and dimensions designated, in accordance with these provisions and in reasonably close conformity with the lines, grades, dimensions, and locations shown on the Plans or established by the Engineer. Painting of the exposed steel is required.

Careful attention shall be given to assuring the pile wall be embedded directly into existing stable ground or bedrock. Prior to ordering any materials, the Contractor in conjunction with the Engineer shall conduct a project site review in order to verify the limits of the pile wall.

614.2-MATERIALS:

Materials shall conform to the requirements specified in the following Subsections of Division 700:

MATERIAL	SUBSECTION
Fine Aggregate	702.1
Fly Ash	707.4
Portland Cement	701.1
Reinforcing Steel	709.1
Steel Piles and Splices	709.12
Wales	709.12

614.3-DRILLING:

A drilled hole is required for the buried length of the pile. A minimum of 10 feet (3 m) of the pile, is to be placed in bedrock/shale. Deviation from this requirement will be controlled by a Plan note. The total estimated pile lengths and the depths to the estimated bedrock/shale line are shown in the plans. Should the elevation of the actual bedrock/shale vary from the estimated elevation by more than 2.5 feet (0.8 m), the Engineer must approve the hole prior to placement of the pile. The material from the drilled hole shall be removed and disposed of by the Contractor.

Particular care must be taken in the drilling operation to avoid deflecting the bit along a sloping bedrock/shale line. To verify proper alignment, the Contractor shall measure and record the vertical alignment of the hole using a plumb bob or other acceptable method. Pile alignment shall allow direct welding of wale to piles.

Preferably, the diameter of the drilled hole shall be a size that will allow the pile, while being slowly lowered into the hole, to reach the bottom of the hole under the impetus of the pile weight. The minimum hole diameter shall be 2 inches (50 mm) larger than the diagonal distance across the pile cross section.

Temporary casing of holes may be needed to maintain an open clean hole through the soil overburden. There will be no additional compensation for temporary casing. The cost of any casing used shall be included in the unit price bid for piling.

614.4-INSTALLATION OF PILES:

Piles shall be located as shown on the Plans or as directed by the Engineer. Piles shall be installed with the pile center within 1 inch (25 mm) of the Plan location. The piles must be prevented from rotating, so that the pile axis is within five (5) degrees of the position shown on the Plans.

Boreholes that have collapsed shall be re-drilled or cleaned to the satisfaction of the Engineer. Obstacles that impede the placement of the piles shall be removed. Tapping on the pile(s) to reach its intended tip elevation(s) is prohibited. Driving piles with a hammer is prohibited unless required in the Plans.

It is desirable that piles be installed without splicing; however, at the direction of the Engineer splices may be made. Splice lengths at the top of the piles may be butt welded provided the splice lengths are less than the required splice plates. No payment will be made for cut-offs. Welding shall be in accordance with 615.5.7.

The drilled hole shall be pumped free of water and shall be reasonably free of fall-in soil or other debris prior to the placement of the concrete or grout. When unable to remove the water, the concrete or grout shall be pumped or tremied through a pipe beginning at the bottom of the drilled hole. The pipe shall be slowly raised ensuring the pipe end remains at least 2 feet (600 mm) below the surface of the concrete or grout. A means of positively measuring the elevation of the concrete or grout as it is placed shall be provided by the Contractor. After placing the concrete or grout below water table, the Contractor has the option of either pumping or pouring directly into the hole the remainder of the concrete or grout provided the hole can be pumped to remove remaining water. Placing the concrete or grout from the bottom of the hole to the bottom of the lagging shall be accomplished in one continuous operation.

Accurate records shall be maintained by the Contractor showing the depth to which each pile was placed, the plumbness, the amount of material used, depth of bedrock/shale, and any unusual conditions encountered during the pile installation. These records shall be given to the Engineer at the competition of the project.

614.5-CONCRETE OR GROUT:

Piles will be protected from corrosion and sealed by the placement of concrete or grout, from the bottom of the hole to the bottom of the lagging or as directed by the Engineer. Vibration of the concrete or grout is not required. The Contractor shall complete all concrete or grout operations within 24 hours of drilling each hole.

The Contractor will inform the Engineer, at the preconstruction conference, as to whether grout or concrete will be used. Intermixing of concrete and grout will not be allowed, unless approved by the Engineer.

Concrete shall be in accordance with Section 601, Class B. The job site and A-bar testing are waived.

Grout shall be furnished, tested and placed in accordance with the requirements specified herein.

Quality Control of the grout is the responsibility of the Contractor as designated in Materials Procedure MP 601.03.50. The Contractor shall maintain equipment and qualified personnel, who shall direct all field inspection, sampling, and testing necessary to determine the magnitude of the various properties of the grout governed by the Specifications and shall maintain these properties within the limits of this Specification. The Quality Control Plan designated in MP 601.03.50 shall be submitted to the Engineer at the pre-construction conference. Work shall not begin until the Plan is reviewed for conformance with the contract documents.

The required 7-day compressive strength of the grout shall be a minimum of 1,600 psi (11 MPa). Piling which has been installed with grout which does not attain the 1,600 psi (11 MPa) strength in 7 days shall be paid for at a reduced unit price equal to 80% of the unit bid price for steel pile. The penalty would include the entire length of each pile which has been installed with failing grout. Grout with compressive strength of less than 1,000 psi (7 MPa) shall be evaluated by the Engineer as to the adequacy for the use intended. All grout evaluated as unsatisfactory for the use intended shall be removed and replaced or otherwise corrected by, and at the expense of, the Contractor as required in 105.3.

A grout strength test shall consist of testing three 6 in x 12 in (150 mm x 300 mm) cylindrical specimens. The test results shall be the average of the three specimens. A minimum of one set of three specimens shall be made for each day's operations.

614.6-PAINTING:

All surfaces from the top of the steel pile, down to and including 2.0 feet (600 mm) below the top of the anticipated concrete or grout line shall be cleaned and painted prior to installation. The method of surface preparation shall be hand tool cleaning to SSPC-SP-2. The paint system shall consist of one-coat of epoxy mastic meeting the requirements of 711.12 applied at a minimum dry film thickness of 5 mils (125 μm). If no concrete or grout is required in the Plans, the entire pile shall be painted.

614.7-LAGGING AND BACKFILLING:

Lagging of the type and size as specified on the Plans shall be installed between the piles. Timber or steel lagging shall not be use unless otherwise shown in the plans. Backfilling and restoration of the roadway template shall be as shown on the Plans. Precast concrete lagging shall be fabricated in accordance with the requirements of MP 604.02.40 and shall have a minimum 28-day concrete compressive strength of 3,000 psi (21 MPa) and an entrained air content of 7% +/- 2.5%.

Precast concrete lagging shall be used to the maximum exposed height as follows: For exposed heights of up to 8 feet, 6-inch (minimum) lagging thickness shall be used. For exposed heights greater than 8 feet and less than 16 feet, 8-inch (minimum) lagging thickness shall be used. These minimum thicknesses are applicable up to a maximum center to center piles spacing of 6 feet.

Other spacings, exposed heights, and minimum thicknesses shall be allowed as shown on the plans.

614.8-METHOD OF MEASUREMENT:

The quantity of piles will be measured in linear feet (meters) of piles installed and accepted

for the wall.

The quantity of lagging will be measured in square feet (meters) installed and accepted as measured by the total area of lagging as measured through all wall elements, without deductions for gaps between lagging, piles, etc.

614.9-BASIS OF PAYMENT:

The quantities will be paid for at the contract unit prices bid for the items listed below, which prices and payments shall be full compensation for furnishing all materials and doing all the work herein prescribed in a workmanlike and acceptable manner, including all labor, tools, equipment, supplies, and incidentals necessary to complete the work. The cost of drilling, concrete, grout, wales, and painting shall be included in the price bid for the piles. Payment will be made after receiving and accepting the record of piling installation as described in Section 614.4.

614.10-PAY ITEMS:

ITEM	DESCRIPTION	UNIT
614001-*	"size" Steel Pile	Linear Foot (Meter)
614003-*	Concrete Lagging, Thickness "thickness"	Square Foot (Meter)

* Sequence number

SECTION 615
STEEL STRUCTURES

615.3-MATERIALS:

615.3.2-High-Strength Fasteners:

615.3.2.1-Weathering Steel Bridges:

DELETE THE CONTENTS OF SUBSECTION 615.3.2.1 AND REPLACE WITH THE FOLLOWING:

High strength fasteners shall meet Section 709.24 and shall be Type 3 (weathering steel), per ASTMF3125 Grade A325. High strength fasteners used in regions of the structure that require painting shall be Type 1, per ASTMF3125 Grade A325, and mechanically galvanized in accordance with ASTM B695.

ASTM F3125, Grade A490, high strength fasteners shall only be used when indicated on the plans.

615.5-ASSEMBLY:

615.5.6-Connections Using High-Strength Bolts:

615.5.6.3-Installation:

DELETE THE FIRST PARAGRAPH OF SUBSECTION 615.5.6.3 AND REPLACE WITH THE FOLLOWING:

Fasteners shall be protected from dirt and moisture at the job site. Only the fasteners anticipated to be installed and tightened during a work shift shall be removed from protected storage. Fasteners not used shall be returned to protected storage at the end of the shift. Lot identification of all components shall be maintained at all times. Galvanized and zinc coated nuts shall be checked to verify that a visible lubricant is on the threads and nut faces. Fasteners shall not be cleaned of lubricant that is present in the delivered condition. Where galvanized fasteners must be tensioned by turning the bolt head, a visible lubricant that meets the requirements of ASTM F3125, shall be applied to the washer that will be placed under the bolt head. The lubricant may be applied to the washer by the manufacturer prior to shipment, by the fabricator at the fabrication shop, or by the erector in the field. Fasteners which have accumulated rust, dirt or have been wet, shall be cleaned and relubricated, prior to installation. Bolt, nut and washer combinations as installed shall be from the same rotational-capacity lot.

615.6-ERECTION:

615.6.9-Final Cleaning of Weathering Steel Bridges:

DELETE THE SECOND AND THIRD PARAGRAPHS AND REPLACE WITH THE FOLLOWING (See Note):

Note: the sentence "do not use acids to remove stains" is shown in 2017 standard spec book on the line below paragraph two. The intent of the instruction above is to get only this sentence added to paragraph two (and to not modify/delete the paragraph below it starting with "areas of the shop…".

Upon completion of all concrete curing operations, the contractor shall clean all steel surfaces to remove all grease, oil, concrete residue, dirt, and other foreign substances in accordance with SSPC SP 1, Solvent Cleaning, to the satisfaction of the Engineer. Do not use acids to remove stains.

SECTION 616
PILING

DELETE THE ENTIRE CONTENTS AND REPLACE WITH THE FOLLOWING:

SECTION 616
STEEL BEARING PILING

616.1-DESCRIPTION:

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

616.2-MATERIALS:

Materials shall conform to the requirements specified in the following sections/subsections:

MATERIAL	SUBSECTION
Steel Bearing Piles and Splices*	709.12
Steel Pile Points	709.50

* The piling section shall be of the H form and with total flange width substantially equal to the depth of the section. No section shall have a thickness of metal less than 0.4 inches (10 mm), nor a depth less than 8 inches (200 mm).

CONSTRUCTION METHODS

616.3-PREPARATION FOR DRIVING:

Unless the Contractor demonstrates to the Engineer for site access reason, piles shall not be driven until required excavation or embankment is completed. Pre-drilled boreholes shall be drill and backfilled with sand prior to placement of the pile and driving. Material forced up between the piles shall be removed to correct elevation, without cost to the Division, before concrete for the foundation is placed. Piling driven within 75 feet of any privately owned structure, that is not being dismantled during the project, shall require pre-construction and post-construction survey to assure damages are not caused by the selected driving method.

616.4-EQUIPMENT FOR DRIVING:

616.4.1-General: When a diesel hammer is used for driving piles, both the fuel setting and stoke height of the hammer, shall be maintained at refusal to insure full energy of the driving blows and the target capacity as noted on the Plans is achieved. All hammers shall be in good working order, in the opinion on the Engineer, and be warmed up prior to refusing any pile.

Before pile driving is started, the Contractor shall provide written certification to the Engineer of the pile hammer type(s) and rated energy, and that the hammer has been inspected and found to be in good working condition.

In case the required penetration is not obtained using a hammer complying with the minimum requirements in 616.4.2 the Contractor shall provide a heavier hammer or resort to predrilling at their own expense.

616.4.2-Hammers for Steel Piles: Open and closed end diesel hammers are commonly required to drive steel piles. Vibratory hammers can be used to extract piles. Vibratory hammers shall not be used to set the piles to the tip elevations and target capacity, unless specified in the Plans. External combustion hammers shall not be used to set the piles to the tip elevations and target capacity, unless specified in the Plans. All hammers used to drive steel piles shall have a minimum equivalent energy rating of 25,000 ft-lbs or as specified on the Plans. Gravity hammers for driving steel piles shall not be allowed unless noted otherwise on the Plans.

616.4.3-Leads, Cushion Material, and Helmet: Pile driver leads, cushion material, and helmet shall be in accordance with the hammer manufacture's specifications. Substitute materials will only be allowed at the Engineers discretion.

616.5-METHOD OF DRIVING:

Drive the piles at the locations and to the vertical or battered lines shown in the Plans. Use full-length piles where practicable. Unless otherwise approved by the Engineer, driven piles shall

reach the required tip elevations and blows per inch at refusal. Harden steel pile point shall be used for all piles driven to refusal on bedrock. Pile points shall be welded as required in these specifications. Unless the Contractor demonstrates to the Engineer for site access reasons, piles shall not be driven until the required excavation or embankment is complete. Piling driven within 20 feet of freshly placed concrete, shall not be ed until after the minimum compressive strength has been achieved per Table 601.8.7 for Superimposed Concrete Elements. When required, pre-drilled borehole diameters shall be as specified on the Plans. Drill the holes accurately so that the piles are set at the locations as shown in the Plans. Place clean, dry sand in all borehole before placing and driving the piles, unless otherwise noted on the Plans.

616.6-ACCURACY OF DRIVING:

All piles shall be driven with a variation of not more than 2% from the vertical or from the batter line indicated. The plan elevation for cut off shall be measured from the lowest point of the pile head with a maximum deviation of 2 inches (50 mm) above plan cut off providing this deviation does not interfere with other construction requirements. The cut off shall be made at right angles to the pile. The concrete cover from the face of the concrete to any face of the pile shall not be less than 9 inches (225 mm) except on the side the pile penetrates the structure. Additional concrete cover may be monolithically added to the structure to maintain the minimum 9 inches (225 mm) cover at no cost to the Division.

616.6.1-Foundations: The location in plan for piles in foundations may have a maximum deviation of 6 inches (150 mm) from that shown in the contract documents except as provided in 616.6.2.

616.6.2-Abutments with Single Lines of Piles: The location in plan for piles in an abutment with a single line of piles may have a maximum deviation of 3 inches (75 mm) from that shown in the contract documents.

616.6.3-Combination Pile and Trestle Bents: The location of the top of a combination pile and trestle bent may have a maximum plan deviation of 1 1/2 inches (38 mm).

616.7-DEFECTIVE PILES:

The procedure incident to the driving of piles shall not subject them to excessive and undue abuse producing deformation of the steel. Any pile driven out of the tolerances required in 616.6, or any pile damaged by reason of internal defects or by improper driving shall be removed or, at the option of the Engineer, a second pile may be driven adjacent thereto if this can be done without detriment to the structure. All piles so driven shall be at the expense of the Contractor.

616.8-DETERMINATION OF BEARING VALUES:

616.8.1-From Blow Count at Refusal: The size of piles, energy rating of hammer, fuel setting, stoke height, and target capacity will be designated on the Plans. All piles shall be driven to refusal into bedrock as indicated by the estimated pile lengths or pile tip elevations. Refusal is defined as the blows for 1 inch (25 mm) of penetration for the hammers as listed on the Plans. The minimum number of blows in the last inch of penetration shall be as specified on the Plans. If a different hammer or fuel setting is used the Contractor shall submit driving criteria using a wave equation analysis, such as that provided by GRLWEAP. The driving

criteria shall be submitted to the engineer at least 14 days prior to installation of the first pile. The driving criteria shall include the fuel setting(s), stoke height(s), and required blows per 1 inch to achieve the target capacity. The maximum compressive driving stress shall be submitted and shall not exceed 45 ksi at the target capacity. A minimum of 6 blows per 1 inch may be allowed by the Engineer based on the wave equation analysis. As an alternate to blow count at refusal to control pile driving, the Contractor, or the Engineer, may allow the use of a Saximeter to determine the refusal stoke height. Any wave equation analysis performed by the Contractor and associated costs due to delays and driving equipment mobilization shall be at the Contractor's expense.

616.9-STEEL PILING:

616.9.1-General: Steel piles shall consist of structural steel shapes of the kind and size specified. Only new piles shall be furnished and used by the Contractor. Full-length steel piles shall be used where practicable. Splicing of piles is permitted subject to the approval of the Engineer and shall be in accordance with this Specification. The number of welded connections in the length of a pile shall be preferably as few as practicable.

616.9.2-Splicing Steel Piles: If splices are made in steel piles by welding, the abutting surfaces must be true planes. The top surface of the lower pile shall be straightened if bent during the driving process or cut off (flame cutting permitted, 615.4.3.2.2) below the bent portion if it cannot be satisfactorily straightened. The bottom surface of the upper pile shall be beveled on the inside edges of the flanges and along one edge of the web. The bevel shall be made at an angle of approximately 40° with the horizontal. A surface of 1/8 inch (3 mm) may be left unbeveled. The upper pile shall be securely clamped to the lower pile and separated there from 1/8 inch (3 mm), care being taken to make the axis of the two piles coincide. The entire periphery of the pile joint shall then be butt welded, by properly certified welders, with sufficient passes to completely fill the joint, the slag of each pass being removed before beginning the next pass.

616.10-PREDRILLED PILING:

Holes shall be drilled or bored to the diameter and depth as specified on the Plans. Prior to placement of the pile or the driving operations, the Contractor shall fill the open borehole with concrete sand Test requirements for this material are waived, except that the material shall be dry and free flowing. After driving, the Contractor shall fill the voids around the piles with additional concrete sand to the satisfaction of the Engineer.

616.11-METHOD OF MEASUREMENT:

The number of linear feet (meters) of piles of the type specified to be paid for will be the actual length of piles remaining in the finished structure. All cut-offs remain the property of the Contractor for disposition.

616.12-BASIS OF PAYMENT:

The quantities, determined as provided above, will be paid for at the contract unit prices bid for the items listed below, which prices and payments shall be full compensation for furnishing all 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. The cost of

pre-drilling, filling of borehole and voids with sand, splicing, and hardened steel pile points shall be included in the price bid for the piles.

616.13-PAY ITEMS:

ITEM	DESCRIPTION	UNIT
616004-*	"size" Steel Bearing Piles, Driven	Linear Foot (Meter)
616005-*	Steel Bearing Piles, Pre-Drilled and Driven	Linear Foot (Meter)
616016-*	Sheet Piling Left in Place	Linear Foot (Meter)
616017-*	Sheet Piling, Driven	Linear Foot (Meter)

* Sequence Number

SECTION 618
CAST BRONZE AND ROLLED COPPER-ALLOY EXPANSION PLATES

DELETE THE ENTIRE SECTION.

SECTION 620
THREE-SIDED REINFORCED CONCRETE BRIDGE/CULVERT

620.3-DESIGN CRITERIA:

620.3.2-Precast Three-Sided Bridge/Culverts:

DELETE PARAGRAPH ONE AND REPLACE WITH THE FOLLOWING:

The bridge/culvert unit dimension and reinforcement details shall be as prescribed in the plan and the shop drawings provided by the manufacturer. The minimum concrete compressive strength shall be 4000 psi (28MPa). The minimum steel yield strength shall be 60 ksi (414 MPa). The minimum required strength for form removal and handling shall be 70% of Design Strength unless otherwise specified by the Designer. The precast three-sided bridge/culvert unit shall also conform to MP 604.02.40.

620.5-MATERIALS:

620.5.1-Concrete:

DELETE SUBSECTION 620.5.1.9 AND REPLACE WITH THE FOLLOWING:

620.5.1.9-Supplementary Cementitious Materials (SCMs): Shall conform to Section 707.4.

SECTION 622
TIMBER BRIDGE STRUCTURES

622.2-MATERIALS:

DELETE THE CONTENTS OF SUBSECTION 622.2.4 AND 622.2.6, AND REPLACE WITH THE FOLLOWING:

622.2.4-Preservative Treatment: Treatment of all sawn timber and umber shall be in accordance with the American Wood Protection Association (AWPA) Standard U1, UC4B.

To the extent practical, all lumber and timber members shall be fabricated prior to preservative treatment. Items that are field fabricated shall be treated in accordance with AWPA Standard M4.

All surfaces shall be free of excess treatment solutions at the time of delivery to the job site.

622.2.6-Structural Glued-Laminated Timber (Glulam): All Structural Glued-Laminated Timber members shall be visually graded Southern Pine or visually graded Douglas Fir-Larch as shown on the drawings and specified below.

Materials, manufacture and quality control shall be in accordance with American National Standards Institute/American Institute of Timber Construction (ANSI/AITC) Standard A 190.1, Structural Glued-Laminated Timber, and shall provide allowable design values as shown on the Plans. All design values are based on wet condition of service. Adhesives shall meet the requirements of wet-use for wet conditions of service. Appearance of the members shall be industrial grade. Surfaces of members shall be not sealed and members shall not be wrapped. Members shall be marked with a Quality Mark and, in addition, a Certificate of Conformance shall be provided to the Engineer to indicate conformance with ANSI/AITC A 190.1, Structural Glued-Laminated Timber.

All Structural Glued-Laminated Timber members shall be preservative treated in accordance with AITC Standard 109, Standard for Preservative Treatment of Structural Glued-Laminated Timber and AWPA Standard U1, UC4B, Commodity Specification F.

All surfaces shall be free of excess treatment solution at the time of delivery to the job site.

To the extent practical, all Structural Glued-Laminated Timber members shall be fabricated prior to preservative treatment. Items that are field fabricated shall be treated in accordance with AWPA Standard M4.

SECTION 623
PNEUMATICALLY APPLIED MORTAR

DELETE THE ENTIRE CONTENTS AND REPLACE WITH THE FOLLOWING:

SECTION 623
PNEUMATICALLY APPLIED MORTAR OR CONCRETE (SHOTCRETE)

623.1-DESCRIPTION:

This work shall consist of repair of concrete structures, protection of structural steel, or any other type of work as may be designated on the Plans by applying one or more layers of concrete conveyed through a hose pneumatically projected at a high velocity against a prepared surface in conformity with the dimensions and design shown on the Plans. It shall include removal of all loose, soft, honeycombed, and disintegrated concrete, the preparation of the surface, the furnishing

and placing of reinforcing steel including wire fabric, dowels, and any other steel items noted on the Plans, and the mixing and applying of shotcrete as outlined in this sub-section.

623.1.1-Definitions:

Dry-mix shotcrete-shotcrete in which the mixing water is added to concrete materials at the nozzle.

Nozzle Operator-craftsman on shotcrete crew who manipulates the nozzle, controls consistency with the dry process, and controls final deposition of the material.

Shotcrete-This is mortar or concrete conveyed through a hose and pneumatically projected at high velocity onto a surface.

Wet-mix shotcrete-shotcrete in which all the ingredients, including water, are mixed before introduction into the delivery hose; compressed air accelerates to the material flow at the nozzle.

623.2-MATERIALS:

Materials shall meet the requirements specified in the following Sections, Subsections, or Standards and other requirements as noted below:

MATERIAL	SUBSECTION OR STANDARD
Accelerating Admixtures	707.13
Air-Entraining Admixtures	707.1
Coarse Aggregate	703.1, 703.2
Curing Materials	7076.-707.10
Fibers*	ASTM C1116
Fine Aggregate	702.1
Portland Cement	701.1, 701.3
Supplementary Cementitious Materials**	707.4
Reinforcing Steel	709.1, 709.3, 709.4
Water	715.7
Water Reducing Admixtures	707.3
Water Reducing, Accelerating Admixtures	707.14
Water Reducing, Retarding Admixtures	707.2

* ASTM C 1116, Type II or III. Provide a minimum dosage of 1.5 pounds per cubic yard. Use fibers that are a minimum of 1/2-inch (13 mm) length, monofilament or collated-fibrillated microfibers.

** The use of a supplementary cementitious materials will not be permitted when a blended hydraulic cement is used.

Gradation: The aggregate gradation shall comply with the following requirements.

Sieve Size	Percent By Mass Passing Each Individual Sieve
½ inch (12.5 mm)	100
3/8 inch (9.5 mm)	90-100
No. 4 (4.75 mm)	70-85
No. 8 (2.36 mm)	50-70
No. 16 (1.18 mm)	35-55
No. 30 (600 µm)	20-35
No. 50 (300 µm)	8-20
No. 100 (150 µm)	2-10

CONSTRUCTION METHODS

623.3-QUALIFICATIONS:

The Contractor shall maintain necessary equipment and qualified personnel to perform all work, sampling, and testing. The minimum qualifications are listed below:

Contractor: The contractor will have completed at least five shotcrete projects of similar size, scope, and shotcrete process used (dry or wet-mix). The contractor must provide proper documentation, including full contact information for owner/engineer/construction manager/general contractor who contracted the contractor to perform the shotcrete work, a project description, scope, and outcome of previous 5 structural shotcrete projects.

Superintendent, Project Engineer, or Project Manager: The Project Engineer, Project Manager, or Superintendent will have a minimum of 3 years of relevant experience on structural shotcrete projects. The contractor must provide proof of the previous shotcrete experience.

Foreman: The foreman will have a proficiency in all positions. The foreman will be required to have at least two years of experience on structural shotcrete projects. The foreman must provide references of the previous shotcrete projects that can be contacted to verify the experience and outcome of these projects. The contractor must provide proof of the foreman's previous shotcrete experience.

Nozzleman: The nozzleman will be required to be ACI certified as required by the current ACI Shotcrete Nozzleman certification policy (CCP 660.1) in the shotcrete delivery method that is chosen for the project, either dry-mix process or wet-mix process. The Nozzle Operator must have at least 300 hours of experience as a nozzle operator on projects with a similar application and scope. The contractor must provide proof of the Nozzleman's previous shotcrete experience. The nozzleman will also be able to demonstrate, by test, an ability to satisfactorily perform the required duties and to apply the shotcrete as required by specifications.

623.4-PROPORTIONING:

Unless otherwise specified, the proportioning and mix design of shotcrete shall conform to Section 601.3. At least 30 days prior to the start of construction, the Contractor shall design and submit, to the Engineer, for approval, the proportions of materials, including cement, aggregate, admixtures, fibers, and supplementary cementitious materials, to be used which will result in a mixture conducive to effective shotcreting, and a mixture having the desired properties. A mix

design shall be required for each different type of shotcrete to be used in the work. The mix design shall be accompanied by a statement giving the source of materials and components used in the mix. All shotcrete mix designs will be accepted based on the results of preconstruction testing.

When using the wet-mix process the air content of the concrete must be 10 ± 2% before shooting.

Dry-mix shotcrete may be used provided that the in-place air entrainment shall be checked at least once at the beginning of the operation, once in the middle, and once after restarting the shotcrete process after any breaks each day and found that the in-place mixture has a minimum of 4% air entrainment.

The maximum allowable w/c ratio for any shotcrete mix design will be 0.45. Shotcrete shall achieve a minimum compressive strength of 2000 psi in 3-days and 4000 psi in 28-days when tested using cores in accordance with ASTM C1140.

Compressive strength and plastic air content test results from at least one test panel for each mix design shall be submitted to the Engineer prior to construction.

623.5-PRE-CONSTRUCTION TESTING:

Prior to the start of construction, the contractor will shoot two test panels. Two panels will be shot for every different mix design that is going to be used on the project. The same ACI certified nozzleman, crew, and equipment that will be performing shotcreting operations on the project must be used to shoot the test panels. The same shooting positions that will be used in the project must be used in shooting the test panels. All form materials and procedures will comply with ASTM C 1140.

One of these two test panels will have reinforcement which is the same as the most congested section on the shotcrete project and shall use the same mix design designated for that section of the project. The finish that is selected for the section of the project, which the panel with reinforcement represents, will be applied to the panel with reinforcement, to indicate whether that finish has any effect on the shotcrete encasement around the reinforcement. This will be used to qualify the nozzleman and shotcreting feasibility. The minimum diameter for the cores taken from the panel with reinforcement will be 3.75-inches (95 mm) and will be the entire thickness of the panel. The panel with reinforcement will be large enough so that actual project conditions can be simulated. The other panel will have no reinforcement and will be used to qualify the properties of the mix design. The size of the panel without reinforcement, for qualifying the mix design, will be such so that cores can be drilled allowing for 3-inches (75 mm) diameter and length of 5.5-inches (140 mm) or the thickness of the panel, whichever is greater. This process shall follow the guidelines of ASTM C 1604. A WVDOH representative must be present when the test panels are constructed and tested, and the WVDOH representative must inspect the performance of the test panels with reinforcement for quality of shotcrete placement, quality of nozzleman, and encasement.

Three cores shall be taken from the test panel with reinforcement and will be visually inspected to ensure proper shotcrete placement and consolidation around the reinforcement. Three cores shall be taken from the test panel without reinforcement and will be tested in accordance with ASTM C 1604. Cores that are damaged from drilling must be immediately discarded.

If any preconstruction testing panel fails the contractor will be allowed to shoot another test panel with the same nozzleman, equipment, and mix design. If the second panel also fails, the contractor must make changes until the shotcrete panel passes the testing. These changes must be implemented during the entire shotcreting process during construction.

If permitted by the Engineer on small projects, where preconstruction testing is cost prohibitive, the requirement for constructing test panels may be waived if the contractor provides results of previous tests with the same materials, mix designs, qualified personnel, and similar project application. The requests must be made to the Engineer and approved before pre-construction testing may be omitted.

623.6-TESTING DURING CONSTRUCTION:

The Contractor must notify the Engineer at least 48 hours prior to beginning any shotcreting operations.

The Contractor shall perform Quality Control Testing as outlined in this sub-section.

623.6.1-Sampling and Testing Methods:

Sampling Materials for Shotcrete	ASTM C1385
Temperature of Freshly Mixed Hydraulic Cement Concrete	ASTM C1064
Testing of Air Content	ASTM C231 or AASHTO T152
Preparing and Testing Specimens from Shotcrete Test Panels	ASTM C1140
Obtaining and Testing Drilled Cores of Shotcrete	ASTM C1604

623.6.2-Temperature: Testing of the temperature will be performed hourly and shall be within the allowable temperature ranges specified in Section 601.9.

623.6.3-Air Content: For wet-mix shotcrete, the air content must be 10 ± 2% when tested prior to placement. The testing frequencies of air content for wet-mix shotcrete, prior to placement, will be as required in MP 601.03.50 Table 1 Section C.

Dry-mix shotcrete may be used if air entraining admixture is used.

A, "as shot shotcrete", air test shall be performed one per ½ day of operation for both wet-mix and dry-mix shotcrete as follows. The shotcrete nozzle operator will shoot a sample of shotcrete into a wheelbarrow or at the wall or floor, then place the shotcrete sample into the air meter using a scoop. The subsequent sample will follow guidelines of ASTM C231 or AASHTO T152. The minimum air entrainment of the "as shot shotcrete" will be 4.0%.

623.6.4-Compressive Strength: During construction, test panels shall be shot for each different mix in the project. The panels will have a minimum dimension of 16 inches x 16 inches (400 mm x 400 mm) and have enough depth to allow cores to be 5.5-inches (140 mm) long. One test panel will be shot for each mix every day or every 50 yd^3 (38 m^3), whichever produces the greatest number of panels. The panels will then be cured using the procedures in ASTM C1140. Three cores with a diameter of 3 inches (75 mm) and a length of 5.5- inches (140 mm) will obtained from each panel and tested for compressive strength following the guidelines of ASTM C1604.

The minimum 28-day average compressive strength for each set of cores from each panel shall be 3,500 psi (24 Mpa) with no single core strength less than 3,000 psi (21 MPa).

When testing in-place concrete that has been placed using shotcrete, cores will be obtained at the location specified by the Engineer and tested as outlined in ASTM C1604.

623.7-EQUIPMENT AND TOOLS:

The Contractor shall maintain a clean, dry, oil-free supply of compressed air sufficient for maintaining adequate nozzle velocity at all times. The equipment shall be capable of delivering the premixed material accurately, uniformly and continuously through the delivery hose. To prevent sagging or sloughing of freshly-applied shotcrete, control must be taken with the application thickness, nozzle technique, air pressure and rate of shotcrete placement. A minimum 600 CFM compressor capable of producing 120 psi air pressure exiting the compressor is required.

The internal diameter of the hose shall be at least three times larger than the largest particle in the mixture. For shotcrete containing steel fiber-reinforcement, the internal hose diameter shall be a minimum of 1.5 times the length of the fiber, and for shotcrete containing synthetic fibers, the internal hose diameter shall be a minimum of the same length as the fiber.

623.8-HANDLING, MEASURING AND BATCHING OF MATERIALS:

The batch aggregate and cement by weight or by volume must be in accordance with the requirements of Section 601 and AASHTO M157 or AASHTO M241. The mixing equipment must thoroughly blend the materials in sufficient quantity to maintain placing continuity. The batch, delivery and placement of shotcrete must be completed within 90 minutes of mixing. The use of retarding admixtures may extend application time beyond 90 minutes if approved by the Engineer

Dry-mix shotcrete shall be sufficiently damp prior to shotcreting. Site-batched dry-mix shotcrete typically does not need to be pre-dampened, since the aggregate usually contains sufficient moisture. However, pre-bagged dry-mix shotcrete must be pre-dampened.

623.9-CLEANING:

All surfaces must be free from damaged material. The surfaces must be clean from dirt, oil, or other contaminants that could inhibit the bond of shotcrete. Concrete or masonry surfaces will be chipped prior to the placement of shotcrete to make surfaces even, sawcut surfaces must be roughened.

In concrete repair work, disintegrated concrete shall first be removed with pneumatic or hand tools. The surfaces shall then be thoroughly blasted to remove all dirt and loose materials, special care being taken in concrete repair work to thoroughly clean exposed reinforcing steel. Any unsound concrete, on which shotcrete will be placed, shall be removed. Prior to applying each layer of shotcrete, the concrete surfaces shall be cleaned and washed with water and dried to a saturated surface dry condition with compressed air.

Earth surfaces shall be dug to line and grade. The surface will be dampened prior to the placement of shotcrete. There will no pools of standing water prior to the shooting of shotcrete.

623.10-PLACING REINFORCING STEEL:

Lap adjacent sheets of reinforcing wire or reinforcing bars and install anchors as directed on the Plans.

623.11-PLACING SHOTCRETE:

Shotcrete shall not be installed on frozen surfaces or ground. Shotcrete shall be deposited with a material temperature of not less than 50° F (10° C) or more than 90° F (32° C), and unless otherwise stated, shotcrete temperature requirements will comply with Section 601.9.

During high wind or rain, unless suitable protective covers, enclosures or wind breaks are installed, shotcrete application shall be suspended. Any newly placed shotcrete that has been exposed to rain making the shotcrete unacceptable shall be removed and replaced. A polyethylene film or equivalent shall be used to protect the work from exposure to adverse weather.

Shotcrete may not be placed during precipitation that will disturb the finish or cause the shotcrete to run. Shotcrete will not be placed when wind conditions will disturb the stream of shotcrete before hitting the receiving surface. The Contractor shall maintain the face of the surface on which the shotcrete is to be applied and other surfaces, such as reinforcing steel, clean of loose materials, mud, rebound, overspray or other foreign matter that could prevent or reduce shotcrete bond. Any surface materials that are loosened or damaged, to a sufficient depth should be removed. Any material that loosens during application shall be removed. The adjacent surfaces shall be protected from overspray during shooting. Water flow shall be diverted, and standing water shall be removed so that shotcrete placement will not be affected.

Unless otherwise required, shotcrete will be placed in one layer to eliminate the possibility of cold joints and laminations. If shotcrete is placed in multiple layers, precautions will be taken in order to lessen the chance of cold joints and laminations. The shotcrete shall be applied from the lower part of the area upward to prevent accumulation of rebound. The placement of the nozzle shall be at a distance and approximately perpendicular to the working face so that rebound will be minimal and compaction will be maximized.

Rebound shall not be worked back into the construction. Shotcrete crews must always keep area around nozzleman clean and clear using compressed air to removed impurities and shoveling overspray before that area is shot.

A clearly defined pattern of continuous horizontal or vertical ridges or depressions at the reinforcing elements after they are covered with shotcrete will be considered as indication of insufficient reinforcement cover or poor nozzle techniques. In this case, immediately suspend the application of shotcrete and implement corrective measures. Correct the shotcreting procedure by adjusting the nozzle distance and orientation, insuring adequate cover over the reinforcement and adjusting the water content of the shotcrete mix or other means.

Any shotcrete surface defects shall be repaired after placement as soon as possible. Any shotcrete that exhibits segregation, honeycombing, lamination, void or sand pockets, or excessive shrinkage cracking shall be removed and replaced. In-place shotcrete not meeting the specified strength requirement will be subject to remediation. Possible remediation options include placement of additional shotcrete thickness or removal and replacement, at no additional cost to the WVDOH.

623.12-FINISHING SHOTCRETE SURFACES:

The finish shall be completed as per the contract documents. When specified, a pre-construction mockup panel representing the desired finish shall be provided and evaluated by the WVDOT for conformance with the contract documents. When using a troweled or rod finish, the shotcrete must sufficiently set to avoid sagging or sloughing.

623.13-CURING AND PROTECTING SHOTCRETE:

Shotcrete shall be cured as outlined in Section 601.12.

623.14-METHOD OF MEASUREMENT:

The quantity of shotcrete to be paid for will be the number of square yards (meters) complete in place and accepted.

623.15-BASIS OF PAYMENT:

The quantities, determined, as provided above, will be paid for at the contract unit price, and shall constitute full compensation for furnishing and preparing of all materials, including reinforcing steel, all items incorporated into the shotcrete work as shown in the Plans such as anchors and bolts, placing, finishing, testing, and curing shotcrete, and all labor, equipment, tools, supplies, and incidentals necessary to complete the work.

623.16-PAY ITEMS:

ITEM	DESCRIPTION	UNIT
623001-*	Shotcrete	Square Yard (Meter)

***** Sequence Number

SECTION 625
DRILLED CAISSON FOUNDATIONS

DELETE THE ENTIRE CONTENTS AND REPLACE WITH THE FOLLOWING.

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 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 Division, DOHMCSnTcaission@wv.gov , thirty (30) days in advance of construction of drilled shafts. This projected schedule will be used by the MCS&T 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 (31 Mpa) 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 (175 mm) plus-or-minus 1 inch (25 mm). 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. (43 kg) from the original design cement factor, the slump shall be 8 inches (200 mm) plus-or-minus 1 inch (25 mm) and shall maintain a slump in excess of 4 inches (100 mm) 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 (400). Reinforcing steel for use as spirals shall conform to Section 709.1, plain type, grade 60 (400).

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 A 252/A 252M, 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 (50 mm) 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.

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 (12 mm per 300 mm). 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 (6 mm), 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 Area: Rock socketed drilled shaft construction in the river 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 and for obtaining any permits that are required by his river 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 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 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 (3000 mm) 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 (75 mm) 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 (75 mm) and a maximum of 24 inches (600 mm) 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 (600 mm) 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 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

Drilled shaft Diameter	Number of CSL Tubes	Number of TIP wires	Tube / Wire Spacing
< 42" (1049 mm)	3	0	120º
42" to ≤ 60" (1050 mm to 1499 mm)	4	0	90º
> 60" to ≤ 96" (1500 mm to 2399 mm)	6	6	60º
> 96" (2400 mm)	8	8	45º

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 (35 mm) 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 (1 000 mm), 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 (150 mm) above the drilled shaft bottom to at least 40 inches (1 000 mm) 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 ft (600 mm) 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 (1500 mm) 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 (75 mm) 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 ft (3000 mm) of each rock socketed drilled shaft shall be vibrated except when more than 10 ft (3000 mm) is to be exposed above the ground line or the riverbed, 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 Division via e-mail (DOHMCSnTcaisson@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 (3000 mm) 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 (1500 mm) 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 (150 mm) or less on bedrock. The recovered core sample size will be approximately 2-inch (50 mm) 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 (300 mm) 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 Division via e-mail (DOHMCSnTcaisson@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 (75 mm) from its project plan location. The maximum deviation of the finished top of shaft from the plan elevation shall be minus 1 inch (25 mm) or plus 3 inches (75 mm). An absolute minimum cover of 3 inches (75 mm)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 Division via e-mail (DOHMCSnTcaisson@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 Division via e-mail (DOHMCSnTcaisson@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 (12 mm) 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(38 mm) 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.

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) 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 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 Division e-mail address: (DOHMCSnTcaisson@wv.gov). This will allow MCS&T 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:

TABLE 625.7.2.6.1.2

Rating	Criteria
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 (100 mm) 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 (meter). 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 (300 mm) 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 (meter); 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 (Meter)
625003-*	"D" Rock Socket	Linear Foot (Meter)

* Sequence number
D = Diameter of shaft, in inches (millimeters)

SECTION 626
RETAINING WALL SYSTEMS

626.5-MATERIALS:

626.5.1-Mechanically Stabilized Earth Components:

626.5.1.1-Facing Elements:

626.5.1.1.1-Reinforced Concrete Facing Elements:

DELETE THE LAST PARAGRAPH OF THIS SUBSECTION 626.5.1.1.1 AND REPLACE WITH THE FOLLOWING:

All reinforcing steel shall be in accordance with Section 602 and shall be epoxy coated. Precast concrete Mechanically Stabilized Earth wall facing elements shall also conform to MP 604.02.40.

626.5.1.1.2-Modular Block Facings:

626.5.1.1.2.1-Modular Block Mix Design:

DELETE THE FIRST PARAGRAPH IN THE SUB-SECTION AND REPLACE WITH THE FOLLOWING:

Each manufacturing facility shall provide a copy of their mix design, including test results and material sources, to MCS&T Division for each type of block that they manufacture. A separate mix design shall be required for each type of block, as the compaction of each type of block may vary and affect the various test results. An approved independent laboratory shall perform the testing when establishing the mix design. After initial approval, each mix design shall remain approved for a period of three years after the date of initial approval. If there are any changes in the mix, such as changes in material sources, any materials such as pigments are added, or the pigment color is changed, then a new mix design shall be required. The modular block units shall conform to the following:

626.5-MATERIALS:

626.5.1-Mechanically Stabilized Earth Components:

626.5.1.1.5-Metal Soil Reinforcing or Attachment Devices:

DELETE ITEM E OF SUBSECTION 626.5.1.1.5 AND REPLACE WITH THE FOLLOWING:

E. Bolts shall meet the requirements of ASTM F3125, Grade A325. Nuts shall meet the requirements of ASTM A563 Grade DH or ASTM A194 Grade 2. Fasteners shall be galvanized in accordance with ASTM B695.

626.7-METHOD OF MEASUREMENT:

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

626.7.1-General: The unit of measurements shall be the area in square feet (meters) lying in a plane outside the front face of the structure as determined by the dimensions in the contract documents. The area is taken from the top of the leveling pad to the top of the wall and shall include coping but shall not include barriers, footings, or leveling pads. The area shall be subject to adjustment as provided in Sections 104.2 and 109.2 of the Specifications. No adjustments of pay quantity shall be allowed for changes in wall design to facilitate the Contractor's methods of construction of wall type.

Unless otherwise specified in the contract documents, items such as concrete barriers that are not part of normal retaining wall construction shall be measured separately for payment.

The quantity of earthwork shown in the plans does not include any work within the wall pay limits shown in the plans. Any adjustments to the required amount of embankment or select granular backfill due to the particular wall system proposed by the contractor shall be considered incidental to the project. No separate payment shall be made for increased embankment or increased select granular backfill requirements. The Contractor shall be responsible for any of the cost of changes in waste, borrow, or earthwork quantities from those shown in the plans caused by the requirements of the proposed wall system.

626.7.2-Mechanically Stabilized Earth: The unit price shall include in place: facing elements, soil reinforcing and attachment devices and associated hardware, coping and trim, or similar items that are normal parts of wall construction. No separate payment of these items shall be made.

The unit price shall also include, in place, all the following items shown within the wall pay limits in the plans: select granular backfill, fabric for separation, excavation, embankment, foundation preparation, and leveling pads. No separate payment of these items shall be made.

626.7.3-Cast-in-Place Reinforced Concrete: The unit price shall include in place: concrete, reinforcing, joint materials, underdrains, weepholes, or similar items that are normal parts of wall construction. No separate payment of these items shall be made.

The unit price shall also include in place: all the following items shown within the wall pay limits in the plans: select material for backfilling, excavation, embankment, fabric for separation, and foundation preparation. No separate payment of these items shall be made.

SECTION 634
CONCRETE CRIBBING

DELETE THE ENTIRE SECTION.

SECTION 635
METAL CRIBBING

DELETE THE ENTIRE SECTION.

SECTION 636
MAINTAINING TRAFFIC

636.1-DESCRIPTION:

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

This work shall consist of all necessary measures to maintain and to protect vehicular and pedestrian traffic, to protect the work in process, and to maintain traffic through, around or adjacent to the construction area, in accordance with these Specifications or as directed. The work shall include the furnishing and maintaining of all traffic control devices, flaggers and pilot truck; construction of temporary structures when required; labor, equipment and materials to keep the traveled road smooth, passable, and safe.

636.2-MATERIALS:

DELETE CALCIUM CHLORIDE FROM THE TABLE AND ADD THE FOLLOWING SUBSECTION:

636.2.1-Materials Certification: The Contractor will furnish a notarized Letter of Certification for all traffic control items.

This letter shall state that the Contractor has inspected all materials upon arrival and that where applicable the materials are supplied from pre-approved DOH sources with respective lab numbers included on all invoices. The Contractor's letter shall state that all traffic control devices, flaggers, pilot trucks, signs, temporary pavement marking materials, materials for temporary structures, aggregate for temporary roads, and dust palliatives all conform to the requirements specified in Section 636 of the Standard Specifications and all related Contract Documents.

This Letter of Certification is not allowed to be from any Subcontractor, nor will the Division accept any pass-through letters.

636.3-CONTROL OF TRAFFIC THROUGH WORK AREAS:

DELETE THE ELEVENTH PARAGRAGH AND REPLACE WITH THE FOLLOWING:

Positive barriers shall be either Temporary Barrier, or Temporary Guardrail Barrier, as specified in the Plans. Temporary Guardrail Barrier shall be installed with 6 feet 3 inches (1.905

meter) post spacing with block outs, unless otherwise specified. The end treatment for Temporary Guardrail Barrier shall be FET, TET, or STET as specified on the Standard Details. Payment for the end treatment shall be made under the regular pay item. The ends of the Temporary Barrier shall be either flared or protected, as shown on the Plans. Where Temporary Guardrail Barrier is used, a minimum clearance behind the guardrail of 4 feet (1.2 m) from the back of the guardrail post shall be provided.

For Temporary Barriers, the required Test Level and Deflection requirements shall be supported from accredited crash test facilities with complete modeling, simulations and crash testing at said test levels. Temporary Barriers that control impacting vehicles by gating, capturing, or allowing the vehicle to penetrate the barrier shall not be acceptable.

636.4-AGGREGATES AND DUST PALLIATIVES:

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

Aggregates required for the maintenance of traffic, water for use as dust palliatives, shall be furnished and applied as directed by the Engineer. Water shall be used on haul roads and any location on the project to minimize pollution from dust, when dust is creating a nuisance to the traveling public or adjacent property owners. No payment will be made for other dust control. Temporary roads shall be constructed when called for, and such roads, as well as the road under construction, shall be surfaced and maintained with aggregates, as shown on the Plans or as directed by the Engineer.

636.6-PILOT TRUCK AND DRIVER OR SHADOW VEHICLE:

636.6.2-Shadow Vehicle:

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE 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.

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 SUBSECTION 636.9 AND REPLACE THE FOLLOWING:

Traffic control devices for work areas include, but may not be limited to, signs, barricades, drums, cones, channelizer cones, delineators, and flashers. They shall be installed in accordance with standards detailed in the manual "*Manual on Temporary Traffic Control for Streets and Highways*", latest version, published by the Division, or as shown on the plans.

If the Total Contact Bid Amount is over $500,000 or otherwise noted on the plans Traffic Control Devices also include work area signs indicating fines. These signs shall be installed 500' (150 m) after the first maintenance of traffic sign installed for each project. The signs shall be installed in both directions on the road under construction. The sizes, messages, and designs shall as shown in the Sign Fabrication Manual or as directed by the Engineer. With the larger size used for four lane expressway roadways with speeds of 55 MPH or greater and the smaller sign used for two lane roadways with speeds of 50 MPH or greater and with an ADT at 3,000 or greater. A 12' x 6' expressway sign (Item 636011-* - 300 units) placed behind guardrail on 3-4 #BB U-Channel or on 3 - 4" x 4" wood post or 8' x 4' - two lane highway sign (Item 636011-* - 180 units) placed behind guardrail on 2 - 4 #BB U-Channel or on 2 - 4" x 4" wood post. The u-channel supports used shall be from the Division Approved Products List.

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, Traffic Control Devices shall include work area signs designated "GIVE 'EM A BRAKE" (GEAB). The sign size, message, and design shall be as shown on Sign Fabrication G30-1 or as directed by the Engineer.

The sign (Item 636011-*, 300 units) 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. At no time shall the GEAB sign be closer than 500' from any other work area signing. The sign shall be installed in both directions on the right side of the highway. All GEAB signs not behind guardrail shall be installed on three, 3 pound per foot u-channel posts driven to a depth of 3 ½ feet. The posts shall utilize stubs driven to a depth of 3-1/2 feet and shall not extend above ground level more than four (4) inches. An appropriate length upper support u-channel shall be connected to each stub using a breakaway mechanism, appropriate for the operating speed of the roadway, recommended by the u-channel manufacturer which will result in the assembly meeting the crashworthiness requirements of National Cooperative Highway Research Program Report 350 (NCHRP-350) or the AASHTO Manual for Assessing Safety Hardware, 2016 Edition (MASH). If the assembly is installed behind guardrail, the supports may be direct driven without a splice, or stubs may be used with the upper supports connected using a method approved by the Engineer, or 2 – 4 #BB U-

channel supports may be used. The u-channel supports used shall be from the Division Approved Products List.

GEAB sign 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 sign(s) shall be covered or removed.

Except as allowed for herein, temporary traffic control drums, channelizer cones, surface mounted flexible tubular markers, soil anchored flexible delineator posts, portable barricades, and portable sign stands used on projects let after December 31, 2019 shall be listed on the Division's MASH APL's for such devices. Cones used on such projects shall also be MASH compliant. Such devices manufactured on or before and meeting the below requirements for projects let on or before December 31, 2019 may be used on projects let on or before December 31, 2022. For projects let on or before December 31, 2019, devices meeting the requirements described above may be used; otherwise, such devices shall be listed on the Division's NCHRP-350 APL's for such devices, if a NCHRP-350 APL exists, or shall otherwise be NCHRP-350 compliant. Specific device requirements, including APL qualification requirements and documentation required to demonstrate compliance with the applicable crash testing performance standard, are contained in Materials sections 715.9.3 for the above described channelization devices and section 715.9.5 for portable sign stands.

All 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.

636.12-TEMPORARY IMPACT ATTENUATING DEVICE:

DELETE THE 2ND, 3RD, AND 4TH PARAGRAPHS OF THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

Except as allowed for herein, 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.

All Temporary Impact Attenuating Devices shall be installed and maintained fully in accordance with the specifications and recommendations of the device manufacturer. This shall include, but shall not be limited to, lateral slope and changes to lateral slope within the length of the device, anchoring (base to be anchored to as well as the anchoring system), backup, attachment to the obstacle being shielded, transitioning to the obstacle being shielded, winterization, delineation, repair, and cleaning.

636.14-TEMPORARY BARRIER:

636.14.1-Materials:

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE THE FOLLOWING:

Temporary Barrier manufactured before December 31,2019 shall meet the requirements of NCHRP Report 350 and/or MASH-09 for the different test levels as shown in Table 3.1 "Test Matrix for Longitudinal Barriers" in NCHRP Report 350. Temporary Barrier manufactured after December 31, 2019, must have been successfully tested to the 2016 edition of MASH. Specific types of temporary barrier will not be used unless crash tested and approved by the Engineer. Historical performance will help determine use of a product. Poor performance may be grounds for non-acceptance.

Temporary Barriers shall have adequate drainage slots to allow runoff to pass through.

Temporary Barrier shall have 8" x 12" Type B-1 Delineators (white or yellow as appropriate) facing traffic at 40 foot centers.

636.14.2-Installation:

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE THE FOLLOWING:

This barrier type shall conform to the details on the Plans, set as directed on the Plans, with the barrier sections securely connected together by satisfactory fastening devices to provide a more stable structure against impact.

A Temporary Barrier Installation Plan shall be approved according to Section 105.2.1.2 "Contractor Approval Method". It shall have information adequate to ensure it meets the installation conditions below and shall include barrier type, barrier connection type, NCHRP/MASH test approval and data, individual segment length, anchorage details, end treatments, and transition details.

The temporary barrier shall be placed to match test conditions as determined by the Engineer. These conditions may include, but not be limited to, anchorages, total length of barrier, individual segment length and connection details. Only one type of temporary barrier shall be used for any one continuous run of barrier in a project. To clarify, the entire length of temporary barrier shall not be intermixed in regard to type of barrier, connection type, or individual barrier length unless that configuration has been tested.

Anchorage spacing and installation, if required, shall be per manufacturer subject to shop drawing review and approval and meet or exceed test conditions. Shop drawing information

shall include details for anchor removal and patching and /or repair of pavement or bridge deck.

Where temporary barrier adjoins guardrail barrier, regardless if one is temporary and the other is permanent (newly constructed or previously in existence) or if both are temporary, they must be connected with a Temporary Guardrail Connector conforming to 636.16.2.

Where temporary barrier adjoins bridge parapet or other essentially non-yielding barrier or obstacle, they must be joined in a manner to maintain barrier continuity and prevent vehicle snagging during impact. If they cannot be joined in this manner, a connection device must be used to assure barrier continuity and to prevent vehicle snagging during impact.

When the temporary barriers are no longer needed, they will become the property of the Contractor, unless otherwise noted on the Plans.

J-J Hook connections shall be tensioned by pulling the barrier segments apart to make this type connection "tight".

Vehicles, materials or any other equipment shall not be stored in the Temporary Barrier buffer area. Unless required as a part of the contract, vehicles and equipment shall not work in the Temporary Barrier buffer area and if required, shall be limited to that time that it is necessary to be in that area.

636.23-METHOD OF MEASUREMENT:

DELETE SUBSECTION 636.23.2 AND 636.23.3, AND REPLACE WITH THE FOLLOWING:

636.23.2: Blank through 636.23.3: Blank

DELETE THE CONTENTS OF SUBSECTIONS 636.23.8, 636.23.9, AND 636.23.10 AND REPLACE WITH THE FOLLOWING:

636.23.8-Eradication of Pavement Marking: The quantity of "Eradication of Pavement Markings" shall be the square feet (meters) of line, symbol, and arrow material removed from the pavement. Quantity calculations shall be based on design widths of markings and the following tables, and shall not be based on field measurements of actual line widths which may be slightly less or greater than the design width due to overspray or spray guns being slightly out of adjustment. Additional quantity shall not be added for additional effort required for removal of remnants of previously applied markings left exposed due to non-precise retracement.

Description	Value of Square Feet
Edge Lines, Lane Lines, Centerline, Channelizing Lines, Stop and Crosswalk Lines, Stripes, Curb and Island Markings	
6-inch Line	= # of feet of 6-inch line removed / 2 Example: 10 feet of 6-inch line removed / 2 = 5 SF
8-inch Line	= # of feet of 8-inch line removed / 1.5 Example: 10 feet of 8-inch line removed / 1.5 = 6.7 SF
12-inch Line	= # of feet of 12-inch line removed x 1 Example: 10 feet of 12-inch line removed x 1 = 10 SF
24-inch Line	= # of feet of 24-inch line removed x 2 Example: 10 feet of 24-inch line removed x 2 = 20 SF

Description	Standard Detail Sheet *	Value of Square Feet
Symbol Markings		
Yield Triangle	TEM-3 (sh 2 of 3)	2.8
Handicapped Symbol	TEM-5	16.0
Bicycle Symbol	TEM-3 (sh 2 of 3)	6.0
Arrows		
One Direction (Left/Right Turn) Arrow	TEM-3 (sh 1 of 3)	17.0
Straight Arrow	TEM-3 (sh 1 of 3)	12.0
Multi Direction Arrow	TEM-3 (sh 1 of 3)	29.0
Wrong Way Arrow	TEM-3 (sh 1 of 3)	24.0
Lane Drop Arrow	TEM-3 (sh 1 of 3)	42.0
Roundabout with One Arrow, LE	TEM-3 (sh 3 of 3)	28.0
Roundabout with One Arrow, TE	TEM-3 (sh 3 of 3)	31.0
Roundabout with One Arrow, RE	TEM-3 (sh 3 of 3)	15.0
Roundabout with Multiple Arrows, LTRE	TEM-3 (sh 3 of 3)	43.0
Roundabout with Multiple Arrows, LRE	TEM-3 (sh 3 of 3)	36.0
Roundabout with Multiple Arrows, LTE	TEM-3 (sh 3 of 3)	39.0
Roundabout with Multiple Arrows, TRE	TEM-3 (sh 3 of 3)	39.0
Lane Letter		

"R X R"	TEM-3 (sh 2 of 3)	59.0
"SCHOOL"	**	34.0
"X-ING"	**	21.0
"ONLY"	TEM-3 (sh 2 of 3)	22.0
"STOP"	TEM-3 (sh 2 of 3)	23.0
"RIGHT"	TEM-3 (sh 2 of 3)	26.0
"LEFT"	TEM-3 (sh 2 of 3)	20.0
"TURN"	TEM-3 (sh 2 of 3)	24.0
"LANE"	TEM-3 (sh 2 of 3)	24.0
"YIELD"	**	24.0

* WVDOH Standard Details Vol. II, latest edition

** Marking not included in the Standard Details. Value is based on 8 foot height lettering shown in the FHWA Standard Highway Signs and Markings book.

636.23.9-Temporary Pavement Markings-Paint: The quantity of "Temporary Pavement Markings-Paint" shall be the linear feet of 6 in. (150 mm) or 8 in. (200 mm) solid line actually placed on the pavement.

636.23.10-Temporary Pavement Markings-Tape: The quantity of "Temporary Pavement Markings-Tape" shall be the linear feet of 6 in. (150 mm) or 8 in. (200 mm) solid line actually placed on the pavement.

DELETE SUBSECTION 636.23.26 AND REPLACE WITH THE FOLLOWING:

636.23.26-Shadow Vehicle: A "Shadow Vehicle" shall be on a per-month basis and shall include the flashing beacon, fuel, crew and truck-mounted attenuator used in conjunction with the vehicle.

The Department will measure the item by actual number of months the vehicle is used on the project. Partial months will be paid for as a full month.

636.24-BASIS OF PAYMENT:

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE THE FOLLOWING:

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. When aggregate for maintaining traffic, dust palliatives, flagger, traffic director, cleaning of traffic control devices or the electric arrow are contained in the contract as pay items, payment for such pay items will not be made subsequent to the date of required completion of the project.

"Temporary Structure for Maintaining Traffic" will be paid as partial payments with the following schedule:

i. The Contractor will be paid 75% of the bid price for this item after all the temporary structure work is complete and it is being used to maintain traffic.

ii. The remaining 25% will be paid when it is all removed.

If during the prosecution of the work, additional items under this Section, not included in the contract, are found to be necessary as determined by the Engineer, payment for such additional items will be made under the provisions of 104.3.

636.25-PAY ITEMS:

DELETE ITEM 636003 AND 636004 FROM THE TABLE.

DELETE ITEM 636007 "ERADICATION OF PAVEMENT MARKINGS'; THE FIVE ITEMS FOR 636017 "TEMPORARY BARRIER"; ITEM 636023 "TEMPORARY TRAFFIC SIGNAL; ITEM 636028 "SHADOW VEHICLE"; AND ITEM 636060 "TEMPORARY IMPACT ATTENUATING DEVICE" AND REPLACE WITH THE FOLLOWING:

ITEM	DESCRIPTION	UNIT
636007-*	Eradication of Pavement Marking	Square Foot (Meter)
636017-*	Temporary Barrier, TL-2, **	Linear Foot (Meter)
636017-*	Temporary Barrier, TL-3, **	Linear Foot (Meter)
636023-*	Temporary Traffic Signal, "location" Note 1	Month
636028-*	Shadow Vehicle	Month
636060-*	Temporary Impact Attenuating Device, C-"Class Number", TL-"MASH Test Level" Note 2	Each

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 "Class Number" shall be 1 or 3
"MASH Test Level" shall be 2 or 3

SECTION 639
CONSTRUCTION SURVEYING

639.5-BASIS OF PAYMENT:

ADD THE FOLLOWING AS PARAGRAPH TWO:

When "Construction Layout Stake" or "As-Built Utility Survey" begins on a section of the project, the payment shall be per lump sum on a monthly basis at partial payments equal to months of contract time remaining. Upon completion of all work on each section, the remaining amount will be released.

SECTION 640
FIELD OFFICE AND STORAGE BUILDING

640.4-FIELD OFFICE:

640.4.5-Minimal Field Office:

DELETE CONTENTS OF SUBSECTION 640.4.5 AND REPLACE WITH THE FOLLOWING:

The field office shall have a minimum floor space of 100 square feet (9.3 square meters) with a minimum plan dimension in one direction of 6 ft. (1.8 m). When a sanitary enclosed toilet is not provided, a chemically treated portable toilet shall be provided. The office shall be furnished with a desk, chair, one fireproof filing cabinet equipped with locks, and a phone, fax and answering (message) machine that utilizes the same phone line. The door for the field office shall be provided with a suitable lock. A sanitary water cooler using bottled water or approved equal shall be provided. The requirements of sections 640.10 shall not apply.

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), 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.

642.2-MATERIALS:

DELETE BULLET i AND REPLACE THE FOLLOWING.

i. Mulches may be hay, straw, wood cellulose fiber, wood chips, bark, matting or other material acceptable to the Engineer. Mulch materials shall be reasonably free of noxious weeds. Chemical mulch binders shall conform to the requirements in 715.27.1.

642.4-GENERAL REQUIREMENTS:

DELETE THE FIRST PARAGRAPH AND REPLACE THE FOLLOWING.

The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, to limit the surface area of erodible earth material exposed by excavation, borrow and fill operations and to direct the Contractor to provide immediate permanent or temporary pollution control measures as necessary to prevent contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment. Such work may involve the construction of temporary berms, rock check dam, sediment structures (traps, ponds or dams),

slope drains, and use of temporary mulches, mats, seeding or other control devices or methods as necessary to control erosion.

642.5-SEEDING AND MULCHING:

642.5.4-Mulch, Fertilizer and Lime:

DELETE THE CONTENTS AND REPLACE THE FOLLOWING.

Mulching, fertilizing and liming shall be in accordance with the following requirements:

i. Two tons per acre (4.5 Mg per ha) of straw or hay mulch shall be applied on slopes of 1½ to 1 or flatter. Other types of chemical mulch binders may be used; these mulch binders shall be applied according to the manufacturer's specifications.
   Wood cellulose fiber mulch shall be applied on slopes steeper than 1½ to 1 at the rate of 1,500 lb. per acre (1 680 kg per ha).
   Fertilizer shall be applied at the rate of 800 lb. per acre (900 kg per ha) of 10-20-10 fertilizer or equivalent.
   Lime application rate will be determined by the Engineer based upon pH test conducted in accordance with MP 700.04.10.
ii. Wood chips, recovered from clearing and grubbing operations, or bark will be acceptable as a mulch for seeding and shall be used at a rate of 35 cubic yard per acre (66 cubic meters per hectare) in lieu of straw or hay.
iii. Mulch Alone - For embankments or cuts 1½ to 1 or flatter, susceptible to critical erosion during periods of cold weather, the Engineer may require a two ton per acre (4.5 Mg per ha) application of straw or hay mulch for temporary erosion control and later seeding. The straw or hay may be rolled immediately with a sheep foot roller to anchor the mulch. A chemical mulch binder may be used for anchoring mulch in accordance with the provisions in paragraph i. above.
   When the weather becomes favorable in the spring, these areas shall be seeded using the normal application rates of seed, fertilizer and lime. If additional mulch is needed, wood cellulose fiber, hay or straw shall be used; the rate of application and areas to be mulched with wood cellulose fiber, hay or straw shall be as determined by the Engineer.

642.6-TEMPORARY PIPE, CONTOUR DITCHES, BERMS, SLOPE DRAINS, DITCH CHECKS, SILT FENCE, PREMANUFACTURED DITCH CHECKS AND SUPER SILT FENCE:

DELETE THE TITLE OF SUBSECTION 642.6 AND REPLACE WITH THE FOLLOWING:

642.6-TEMPORARY PIPE, CONTOUR DITCHES, BERMS, SLOPE DRAINS, ROCK CHECK DAM, SILT FENCE, AND SUPER SILT FENCE:

642.6.4-Ditch Checks:

DELETE THE TITLE AND CONTENTS OF SUBSECTION 642.6.4 AND REPLACE WITH THE FOLLOWING:

642.6.4-Rock Check Dam (Ditch Checks): A barrier constructed of clean, non-erodible rock or other manufactured devices (i.e. – triangular silt dikes, coir logs, etc.) across a cut or median ditch. Rock Check Dams shall be constructed to control velocities, reduce erosion, and aid in sediment control.

642.7-METHOD OF MEASUREMENT:

DELETE THE CONTENTS AND REPLACE THE FOLLOWING.

The work will be measured for payment at the unit bid prices for the items specified in 642.9.

Berms constructed prior to suspension of construction operations and slope drains will be measured in linear feet (meters); sediment traps, ponds, or dams and sediment removal will be measured by the cubic yard (meter); for sediment dams, risers will be measured by the unit and conduit for principal spillway under the dam will be measured in linear feet (meters) and included under Item 642008-*; seed will be measured by the pound (kilogram); straw, hay and wood cellulose fiber mulch will be measured by the ton (megagram); wood chips or bark mulch will be measured by the cubic yard (meter); fertilizer and agricultural limestone will be measured by the ton (megagram); matting will be measured by the square yard (meter); contour ditching will be measured by the linear foot (meter). 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 (meter) 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.

Berms constructed at the end of each day's operation will not be measured for payment but their cost shall be included in the unit bid price for Item 207001-*, "Unclassified Excavation."

Rock check dams will be measured by the unit. Inlet Protection and Dewatering Device will be paid per each device used.

Wood chips or bark will be measured by the cubic yard (meter). It is assumed that 17.5 cubic yards (14.75 cubic meters) of chips or bark are equal to one ton (megagram) of straw for seeding. Wood chips or bark mulch will be measured by the truck load or other loose volume measurement, and payment will be made on a one ton (megagram) equivalent of straw for each 17.5 cubic yards (14.75 cubic meters) of wood chips or bark mulch.

Quantities reseeded, refertilized, or remulched will be measured and included for payment.

The bid price for fertilizer shall be based on 10-20-10 ratio. When other ratios of fertilizer are used, pay quantities will be determined using the following table:

Type of Fertilizer	Actual Quantity Used Pounds (kg)	Pay Quantity Pounds (kg)
5-10-5	100	50
8-16-8	100	80
10-20-10	100	100

Type of Fertilizer	Actual Quantity Used Pounds (kg)	Pay Quantity Pounds (kg)
12-24-12	100	120
15-30-15	100	150

When fertilizer ratios other than those shown above are used, the relationship between the pay quantity and the actual quantity used will be established by the Engineer.

Silt fence will be measured by the linear foot (meter) at the bottom of the fence, excluding laps. Decomposed or ineffective fabric in the silt fence which is required to be replaced after six months from the installation date will be measured and paid for, however, such replacement prior to six months after installation will not be measured for payment.

In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled, or as ordered by the Engineer, such work shall be performed by the Contractor at their own expense. Temporary erosion and pollution control work required, which is not attributed to the Contractor's negligence, carelessness or failure to install permanent controls, shall be performed as ordered by the Engineer. Where the work to be performed is not attributed to the Contractor's negligence, carelessness or failure to install permanent controls and falls within the Specifications for a work item that has a contract price, the units of work will be paid for at the proper contract price. Should the work not be comparable to the project work under the applicable contract items, the Contractor shall perform the work in accordance with 104.3.

In case of repeated failure on the part of the Contractor to control erosion, pollution, or siltation, the Engineer reserves the right to employ outside assistance or to use their own forces to provide the necessary corrective measures. Such incurred direct costs plus project engineering costs will be charged to the Contractor and appropriate deductions made from the Contractor's monthly progress estimate.

Temporary pollution control may include construction work outside the right-of-way where such work is necessary as a result of roadway construction such as borrow pit and waste site operations, haul roads and equipment storage sites.

Super Silt Fence will be measured by the linear foot complete and in place.

642.9-PAY ITEMS:

DELETE ITEM 642031 “DITCH CHECK” AND REPLACE WITH THE FOLLOWING:

ITEM	DESCRIPTION	UNIT
642031-*	Rock Check Dam	Each

DELETE ITEM 642011 (HAY OR STRAW BALE) AND ITEM 642032 (CHECK DAM) FROM THE TABLE.

ADD ITEM 642040 TO THE TABLE:

ITEM	DESCRIPTION	UNIT
642040-*	Inlet Protection	Each

* Sequence number

SECTION 651
FURNISHING AND PLACING TOPSOIL

651.2-MATERIALS:

DELETE THE CONTENTS AND REPLACE THE FOLLOWING:

Topsoil shall consist of the uppermost layers of fertile and friable soil that contains humus material. This material varies in thickness in accordance with soil groups and usually possesses a darker color than the subsoil. The texture of the topsoil may vary within the range of natural loam, silty clay loam, and sandy loam. Acceptable topsoil shall contain organic matter in the range of 2% to 20% and be sampled at least once per project using AASHTO T267 method; multiple sources or change of sources shall also be sampled.

SECTION 652
SEEDING AND MULCHING

652.2-MATERIALS:

DELETE THE FOURTH PARAGRAPH AND REPLACE WITH THE FOLLOWING:

Chemical mulch binders shall conform to the requirements in 715.27.1.

652.6-APPLYING MULCH AND FERTILIZER:

652.6.2-Straw Mulch:

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

Straw shall be applied at the rate of approximately two tons per acre (4.5 Mg per hectare). Straw mulch around buildings, sidewalks or other structures may be held in place with a form of netting or chemical mulch binders applied according to the manufacturers' specifications.

652.9-METHOD OF MEASUREMENT:

DELETE THE FOURTH PARAGRAPH AND REPLACE WITH THE FOLLOWING:

Chemical mulch binders will not be measured separately, but their cost shall be included in the unit price bid for mulch.

SECTION 657
ROADWAY SIGN SUPPORTS

DELETE THE ENTIRE CONTENTS AND REPLACE WITH THE FOLLOWING:

657.1-DESCRIPTION:

This work shall consist of the fabrication and erection of all supports for roadside mounted signs in accordance with the requirements of the Plans and of these Specifications. This shall include the supports for all signs which are located outside of the shoulder and do not extend over the shoulder.

All details not specified or not shown on the Plans shall conform to the details and requirements set forth in the following specifications and publications:

i. West Virginia Department of Transportation, Division of Highways, Standard Details Book Vol. II, Signing, Signals, Lighting, Markings, and ITS, latest issue, including revisions (further referenced to herein as the Standard Details).
ii. The Manual on Uniform Traffic Control Devices for Streets and Highways, latest issue, as printed by the Federal Highway Administration, U.S. Department of Transportation. (Referred to as the MUTCD).
iii. Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition, including revisions, American Association of State Highway and Transportation Officials.

657.2-MATERIALS:

Materials furnished shall be of new stock, shall be the product of reputable manufacturers of signing supports and accessories, shall conform to the Specifications, and shall meet the approval of the Engineer.

657.2.1-Beams: Steel Beams such as shown on Standard Detail sheets TE1-3A through TE1-3C shall be standard wide flange shapes fabricated from steel conforming to ASTM A36 or ASTM A572 Grade 50. Steel conforming to ASTM A992 and dual certified to ASTM A572 Grade 50 may also be used. The beams shall be galvanized in accordance with ASTM A123.

657.2.2-Plates: Flat steel plates such as stiffener plates, base plates, hinge plates, arm plates, and gusset plates shown on various Standard Detail sheets shall conform to ASTM A36 and shall be galvanized in accordance to ASTM A123.

657.2.3-Structural Connection Bolts: Steel structural connection bolts and associated hardware shown on various Standard Detail sheets shall conform to the following requirements. Bolts: ASTM F3125 Grade A325, Type I. Nuts: ASTM A563, Grade DH with lubricant contrasting with the color of the galvanizing. Washers: ASTM F436, Type I. All galvanized in accordance to ASTM F 2329.

657.2.4-Keeper Plates: Steel keeper plates such as shown on Standard Detail sheets TE1-3A through TE1-3C and TE1-5A through TE1-5C shall conform to ASTM A653, designation CS, and shall be galvanized. Thickness for use with Steel Beam supports shall be 20 gauge. Thickness for use with Pipe Post supports shall be 28 gauge.

657.2.5-Brass Shims: Brass shims such as shown on Standard Detail sheets TE1-3A through TE1-3C and TE1-5A through TE1-5C shall be fabricated from brass shim stock or strip meeting ASTM B36.

657.2.6-Pipe: Steel pipe such as shown on Standard Detail sheets TE1-5A through TE1-5C shall conform to the requirements of ASTM A53, TYPE E or S, Grade B.

657.2.7-Friction Caps: Steel friction caps such as shown on Standard Detail sheets TE1-5A through TE1-5C shall conform to ASTM A653, designation CS, and shall be zinc electrodeposited coated in accordance with ASTM B633, Class 12.

657.2.8-Anchor Bolts: Anchor bolts for cast-in-place applications such as shown on Standard Detail sheets TE1-5A through TE1-5C and TE2-2 shall conform to the following requirements. Bolts: ASTM F1554 Grade 55. Nuts: ASTM F563 Grade A. Washers: ASTM F436. All galvanized in accordance with ASTM B695.

657.2.9-Low Carbon Steel Bolts: Small diameter, typically 5/16-inch, low carbon steel bolts and associated components shown on various Standard Detail sheets shall conform to the following requirements. Bolts: ASTM A307 Grade A. Nuts: ASTM A563A Hex. Flat washers: ASTM F844. Lock washers: ASME B18.21.1. All galvanized in accordance to ASTM F2329.

657.2.10-Tubular Steel: Tubular steel such as shown on Standard Detail sheets TE2-1A through TE2-1B and TE2-3 shall conform to ASTM A500, Grade B, seamless or welded. Galvanized in accordance to ASTM A123.

657.2.11-U-Channel Supports and Breakaway Splice Devices: U-channel supports utilized shall be listed on the Division Approved Products List (APL) for U-Channel Posts. MP 707.02.13 shall be followed.

When required, Breakaway Splice Devices shall be supplied with the u-channel supports; such as shown on Standard Detail TE1-7B.

657.2.12-Square Tube Supports: Square tube supports shall conform to the requirements of 709.53.

657.2.13-Omni-Directional Breakaway Devices: Omni-Directional Breakaway Devices shall be designed for use with Steel Beam supports shown on Standard Detail sheets TE1-3A, TE1-3B, and TE1-3C. When required in the project plans, Omni-Directional Breakaway Devices shall be utilized with specified Steel Beam type support assemblies in order to convert the breakaway connection from bi-directional to omni-directional.

The device used shall be listed on the WVDOH Approved Products Listing (APL) for Roadside Sign Support Accessories. Omni-Directional Breakaway Devices shall conform to requirements of 709.52.

657.2.14-Back to Back U-Channel Breakaway Devices: Back to Back U-Channel Breakaway Devices shall be designed for use with 4-lb/ft and/or 6-lb/ft back to back supports shown on Standard Details sheets TE1-7A and TE1-7B. When required in the project plans, Back to Back U-Channel Breakaway Devices shall be utilized with specified back to back support assemblies in order to create a breakaway base connection.

The device used shall be listed on the WVDOH Approved Products Listing (APL) for Roadside Sign Support Accessories. Back to Back U-Channel Breakaway Devices shall conform to 709.54.

657.2.15-Surface Mount Breakaway Devices: Surface Mount Breakaway Devices shall be designed for use with 2-lb/ft and/or 3-lb/ft u-channel supports shown on Standard Details sheets TE1-7A and TE1-7B, and/or 2" x 14-gauge Square Tube Supports. When required in the project plans, Surface Mount Breakaway Devices shall be utilized with specified u-channel support assemblies which are located on asphalt or concrete surfaces.

The Contractor shall select the Surface Mount Breakaway Device to be used following the guidance on Standard Detail TE1-7B.

The device used shall be listed on the WVDOH Approved Products Listing (APL) for Roadside Sign Support Accessories. Surface Mount Breakaway Devices shall conform to 709.51.

A complete anchoring system for securing the device on the asphalt or concrete is also required.

657.2.16-Types A and B Barrier Wall Sign Support Brackets: Types A and B Barrier Wall Sign Support Brackets shall be designed for use with 2-inch x 14-gauge Square Tube Supports. When required in the project plans, Types A and/or B brackets shall be utilized with specified assemblies to be installed on top of a median barrier wall or parapet. Type A brackets are intended to be specified for use with barriers less than 10-inches in width at the top. Type B brackets are intended to be specified for use with barriers 10-inches or greater in width at the top.

A complete anchoring system for connecting the bracket to the concrete and hardware for connecting the square tube support to the bracket are required.

The bracket used shall be listed on the WVDOH Approved Products Listing (APL) for Roadside Sign Support Accessories. The requirements for Types A and B Barrier Wall Sign Support Brackets are specified in 709.55.

657.2.17-Anchors for Brackets: It shall be the responsibility of the bracket fabricator to select and specify an appropriate anchoring system for retrofit installations of the following sign brackets: Types C and D Barrier Wall Sign Support Brackets as shown on Standard Detail sheets TP3-2 and TE2-3; Types K and L Bridge or Retaining Wall Sign Mounting Brackets as shown on Standard Detail sheets TE2-1A, TE2-1B, and TE2-2.

Mechanical or chemical anchoring systems may be used. The anchors and associated hardware components of the anchoring system shall be galvanized steel. The anchoring system shall be selected based on the design loading information provided on the previously referenced Standard Detail sheets. It shall be the fabricator's responsibility to verify the dimensions of the barrier, parapet, or retaining wall if necessary in order to select the anchoring system.

All specifications and details related to the anchoring system shall be included as part of the fabricator's shop drawings. All necessary materials to install the anchoring system shall be provided by the fabricator with the bracket.

657.2.18-Concrete: All concrete shall be Class B in accordance with Section 601.

657.2.19-Reinforcing Steel: All reinforcing steel shall be meet the requirements of Section 602.

CONSTRUCTION METHODS

657.3-FABRICATION:

657.3.1-General: Fabrication of all parts of supports shall be in accordance with dimensions shown on the Plans and Standard Drawings. Work shall be done in a uniform workmanlike manner.

657.3.2-Shop Drawings: The Contractor shall submit Shop Drawings showing all dimensions, quantities, and fabrication details for all supports and brackets for the Engineer's approval. All associated accessories and hardware to be supplied with the supports and brackets shall be included, including details and specifications for retrofit anchors as described in Section 657.2.17. Eight copies of the Shop Drawings shall be submitted. Multiple submissions will be permitted. However, all Shop Drawings for Steel Beam Supports shall be submitted in one submission; all Shop Drawings for Pipe Post Supports shall be submitted in one submission; and all Shop Drawings for Parapet, Retaining Wall, and Barrier Brackets shall be submitted in one submission.

657.3.3-Structural Bolt Tightening: When fully tightening structural connection bolts as part of the shop fabrication process, only un-weathered hardware components in new condition shall be used. All nuts shall be pre-coated with a lubricant as specified herein. After pre-assembly of the connections, the bolts shall be brought to a "snug tight" condition. Prior to snug tightening the nuts, if the threads of the bolts have not been lubricated, were last lubricated more than twenty-four hours prior, or have gotten wet since they were last lubricated, lubricant shall be applied to the bolt threads. Beeswax or toilet ring wax may be used. The assembler may turn the nuts while holding the heads of the bolts or vice versa. If the heads of the bolts are turned, the assembler shall apply lubricant to the face of the washer that the bottom of the bolt head is to be tightened against.

The bolts shall be snug tightened in a star pattern. "Snug Tight" condition is defined by the Research Council on Structural Connections (RCSC) as "the tightness that is attained with a few impacts of an impact wrench or the full effort of an ironworker using an ordinary spud wrench to bring the plies into firm contact".

After the snug tightening process, no less than seventy-five percent of the surface areas of the faces being connected should be in visible contact. The assembler shall take care during the snug tightening process to ensure that components being assembled remain properly aligned, loosening the connection and repeating the snug tightening process if necessary.

After the snug tightening process has been completed, each nut or bolt head shall be fully tightened by the turn-of-the-nut method. This shall require further tightening each fastener one-third (1/3) of a turn, which shall be equivalent to two flats of a typical nut or bolt head with five flats. This shall be verifiable by first marking the nut or bolt head on one of the flats and placing a corresponding mark on the component two flats away. The fasteners shall be fully tightened in a star pattern and incrementally by fully tightening each over at least two cycles.

657.3.4-Welding: The welding of steel shall be in accordance with the requirements of American Welding Society Specification D1.1 and shall be done by qualified welders.

657.4-ERECTION:

657.4.1-General: All sign supports shall be installed at the points designated on the Plans or by the Engineer in accordance with these specifications, the Plans, and approved shop drawings and shall be erected in reasonably close conformity to the locations, elevations, and angles shown on the Plans or established by the Engineer.

The Contractor shall take full responsibility for checking all cross sections at approved sign locations to determine final support lengths. Lateral placement of sign assemblies and necessary support lengths shall be determined in accordance with the offset and mounting height requirements shown in the Plans or Standard Details TP3-1A through TP3-1C.

Before proceeding further, the Contractor shall initially establish the location of each sign in accordance with the Plans or as directed by the Engineer and shall mark each site with construction stakes. The Contractor shall furnish stakes, paint, other materials, and labor for performing the locating and staking as described. When the sites have been staked and are ready for inspection, the Contractor shall inform the Engineer, who will check and approve the site or make necessary changes. Centerline station information will be furnished to the Contractor by the Engineer.

All existing or proposed assembly locations are approximate. In cases where an existing assembly, including supports, is to be removed and replaced with a new assembly, the new assembly shall be located as close as possible to the original and within 10-feet unless otherwise approved by the Engineer.

In cases where existing roadside sign supports are to remain in place with new signs to be installed, the Contractor shall plumb the supports as necessary, and shall clear any existing breakaway connection of any obstructions. Costs associated with this work shall be in incidental to the Contract bid items.

The Contractor shall take into consideration the Sign Orientation Requirements shown on Standard Detail TP3-1B when determining the final proposed location for each assembly support. Unique orientation requirements for chevron and R4-7 signs are shown on Standard Details TP3-2 and TE11-3C, respectively.

657.4.2-Excavation: The Contractor shall perform excavations for each support requiring a concrete foundation to the depths and dimensions shown on the Plans or as directed by the Engineer to obtain a suitable foundation. Excavation may be accomplished manually or by mechanical means. The Contractor is advised that the grading specifications permit the construction of embankment of rock fill to at least 12-inches below the bottom of the subbase.

If solid rock or large boulders are encountered in excavation, it shall be removed, to the satisfaction of the Engineer, to a sufficient depth in order to obtain the stability which would have been obtained had the excavation been made in earth to the depth required by the Plans or Standard Details.

The Contractor shall remove all excavated material from the site that is not needed for backfill or, if permitted by the Engineer, shall spread this material out in the area immediately surrounding the foundation location to the satisfaction of the Engineer. The Contractor shall restore all disturbed areas to within reasonable conformity of their original conditions by

grading, seeding, mulching, and/or fertilizing as directed by the Engineer. No separate payment will be made for these operations or required materials.

The Standard Detail drawings are compiled on the basis of average soil conditions. Soil conditions surrounding specific foundations may warrant lesser foundations or may require larger foundations. In these cases, the Contractor may adjust the size of specific foundations with the written approval of the Engineer. The Engineer may direct the Contractor to adjust the foundation dimensions if determined to be necessary. Any work in such cases shall be performed without change in the unit bid price.

If the sides of the excavation are determined by the Engineer to be unstable, forms shall be used to support the sides of the excavation. The forms shall be placed in such a manner as not to disturb the adjacent soil. If the Contractor elects to remove the form, the removal shall be done immediately after the concrete is placed so that the flowing concrete may fill the space occupied by the form. Otherwise, the form shall become a permanent part of the installation. In the latter case all portions of the form above ground level shall be removed after the concrete has cured. The Engineer will make the final determination as to when forms are necessary. This form work shall be performed at the expense of the Contractor and no compensation will be allowed therefor.

If a support foundation is to be installed within the area of an existing concrete or asphalt surface and requires a concrete foundation, the concrete or asphalt shall be carefully opened by drilling, saw cutting, or other suitable methods approved by the Engineer that will not cause unnecessary damage to the surrounding surface. The Contractor shall be responsible for removal and proper disposal of all excavated materials.

The Contractor shall contact WV 811 and shall notify all applicable non-WV 811 participating utilities prior to beginning excavation, support driving, or conduit jacking activities. The Contractor shall hand dig to locate lines or open cut in areas of possible conflict, as determined by the Engineer. The Contractor shall also be responsible for locating and verifying Division owned underground conduit to avoid conflict or damage. All such work shall be incidental to the Contract bid items. All costs associated with any disruption of services as a result of the Contractor's activities shall be the Contractor's sole responsibility.

657.4.3-Foundation Placement: All concrete for each foundation shall be placed in one placement with no cold joints. All concrete footings shall be flush with the uphill side of the ground line, with the edges of the foundation being level. The top of concrete for each foundation shall be finished neatly and smooth, including the outside edges. The edges of foundations placed within areas of existing concrete or asphalt surfaces shall be finished neatly and smoothly to match with the edges of the area of asphalt or concrete surface which was removed. The concrete shall be finished such that it slopes slightly down and away from the stub or the bolt circle of the anchor bolts for drainage purposes. The Contractor shall take care in order to install all anchor bolts and stub supports as level as possible and with the proper embedment. Specific details pertaining to support foundations are contained in the Standard Details or shall be shown in the project Plans.

If the foundation is being placed on a slope that is 4:1 or greater and it is not possible to build up the downhill side of the ground slope as shown in the Standard Details to allow the edges of the top of the foundation to be placed level, the Contractor shall utilize a suitable concrete form which allows the round cross-sectional shape of the foundation to be maintained above ground level. The form shall also allow for the portion of the form above ground level

to be removed after the concrete has sufficiently cured. After the concrete has cured, the portions of the form above ground level shall be removed. No additional compensation shall be paid for the use of and removal of a form, if required.

657.4.4-Backfilling: If any backfilling is required, excavations shall be backfilled with random material, approved by the Engineer, in horizontal layers not to exceed 4-inches after compaction. Each lift shall be compacted to the satisfaction of the Engineer. Testing is not required.

All surplus material shall be removed from the right-of-way and the backfill finished flush with surrounding natural ground, including replacement of any damaged facilities or appurtenances. The Contractor shall restore all areas disturbed by this excavation or other operations within reasonable conformity to their original conditions including grading, seeding, mulching and/or fertilizing as directed by the Engineer. The cost of backfilling materials or operations shall be incidental to the Contract bid items.

657.4.5-Support, Breakaway Device, and Bracket Installation:

657.4.5.1-General: All supports requiring concrete foundations shall not be installed until the concrete has cured for a period of seven days unless otherwise approved by the Engineer. All sign posts and their stubs or anchor bolts shall be set plumb so that the sign will be level and shall be set at the proper angle with the roadway as shown in the Standard Details.

Protective coatings for any supports, brackets, or associated components damaged for any reason prior to or during installation shall be repaired. For galvanized surfaces, the repair shall be accomplished by the application of a zinc-rich paint conforming to Military Specification MIL-P 21035, applied as recommended by the manufacturer including surface preparation, or as directed by the Engineer.

Various Standard Details sheets referenced herein require the use of a "click" type torque wrench meeting the specifications herein. The wrench used shall be a "click" type manual torque wrench and shall meet either the requirements of International Organization for Standardization (ISO) Specification 6789 or American Society of Mechanical Engineers (ASME) Specification B107.300. Prior to tightening any fasteners on the project which require the use of a wrench meeting this specification, the Contractor shall provide the Engineer with a copy of a calibration certificate for each wrench to be used on the project. The date of the calibration shall be one (1) year or less prior to the letting date of the Contract. The certificate provided shall be from a calibration lab that is ISO 17025 accredited, with the certificate indicating as such. Both the certificate and wrench shall display matching serial numbers.

657.4.5.2-Soil Anchored U-Channel Supports: When installing soil anchored u-channel supports not requiring a foundation, the supports shall be driven either manually or by mechanical means to the required line and grade and shall be installed as plumb as possible. The Engineer may direct the Contractor to increase the required driving depth if determined to be necessary due to soil conditions. During driving, the support end shall be protected by a special driving cap if driven manually. If driven by a mechanical device, an appropriate driving head shall be used that is designed not to damage the support. Any support bent or otherwise damaged and determined by the Engineer to be unfit for use in

the finished work shall be removed from the site and replaced by the Contractor at their expense. Except in cases where a breakaway splice device is required per Standard Detail TE1-7B, soil anchored supports may be directly driven without a stub and splice connection, or the Contractor may use an approved breakaway splice device at their option with no additional compensation.

Soil anchored supports shall be sufficiently plumb after installation. Otherwise, this shall be cause for rejection at the discretion of the Engineer requiring the Contractor to straighten or remove and reinstall the supports at the Contractor's expense if directed.

657.4.5.3-Back to Back U-Channel Supports: U-channel supports which are to be erected back-to-back shall be stitch bolted together in accordance with Standard Detail TE1-7B. All back to back supports shall require a concrete foundation as shown on Standard Detail TE1-7B.

Assemblies not requiring a breakaway device shall require the concrete to cure with the entire support installed. The Contractor shall be responsible for utilizing a method to hold the supports secure and plumb during the curing process. No additional compensation shall be paid for this.

After installation and curing, the support shall be plumb within ten degrees of vertical in all directions. This shall equate to no more than 3/16-inch horizontally out of level over 1-foot of length. Otherwise, this shall be cause for rejection at the discretion of the Engineer requiring the Contractor to relocate and reinstall the foundation and support if directed. This shall include removing the foundation for the rejected support to a minimum of 6-inches below ground level.

657.4.5.4-Steel Beam and Types 1-5 Pipe Post Supports: Steel Beam and Types 1-5 Pipe Post Supports shall be plumbed in accordance with the Standard Details as needed. No more than 1/4-inch of shims in total thickness may be used for any one connection bolt of the support. The Contractor shall shim the assembly within the allowances described above to be as plumb as possible.

All base connection bolts shall be tightened to within the torque ranges specified on the Standard Details using a wrench meeting the requirements of Section 657.4.5.1, unless an Omni-Directional Breakaway Device is specified and requires the base connection bolts to be eliminated. The procedure specified in Section 657.3.3 shall be used for field assembly of any hinge plate connections.

Upon final installation, the support shall be plumb within ten degrees of vertical in all directions. This shall equate to no more than 3/16-inch horizontally out of level over 1-foot of length. Otherwise, this shall be cause for rejection at the discretion of the Engineer requiring the Contractor to relocate and reinstall the foundation and support if directed. This shall include removing the foundation for the rejected support to a minimum of six 6-inches below ground level.

In cases where the Contractor is required to replace the portion of a Steel Beam support above the hinge plate with the lower portion to remain in place, the length of the new upper support shall be the height required by the specified sign(s) plus an additional 4-inches. All plates and hardware associated with the hinge plate connection shall be new. The hinge plate connection shall be field tightened as specified herein.

657.4.5.5-Types 6-9 Pipe Post Supports: Leveling of Types 6-9 Pipe Post Supports installed on concrete foundations shall be accomplished using leveling nuts and washers on each anchor bolt. One leveling nut with washer shall be installed on each anchor bolt to its approximate position. After setting the support in place, the support shall be adjusted as closely as possible to a plumb vertical position by adjusting the lower nuts. After leveling, the entire top face of all washers placed under the base plate shall be engaged with the base plate. The top anchor bolt nuts shall then be fully tightened in accordance with the anchor bolt tightening procedures specified in Section 658. After fully tightening, the entire length of all top nuts shall be engaged on the anchor bolts. The procedure specified in Section 657.3.3 shall be used for field assembly of the support arms.

After installation, the vertical portion of the support shall be plumb within ten degrees of vertical in all directions. This shall equate to no more than 3/16-inch horizontally out of level over 1-foot of length. Otherwise, this shall be cause for rejection at the discretion of the Engineer requiring the Contractor to relocate and reinstall the foundation and support if directed. This shall include removing the foundation for the rejected support to a minimum of six 6-inches below ground level.

657.4.5.6-Omni-Directional Breakaway Devices: Omni-Directional Breakaway Devices for use with Steel Beam supports shall be installed in accordance with the manufacturer's specifications. A copy of the manufacturer's installation specifications shall be provided to the Engineer prior to proceeding with installation. Any hardware components of the device for which the manufacturer specifies a particular torque requirement shall be tightened using a wrench meeting the requirements of Section 657.4.5.1.

657.4.5.7-Back to Back U-Channel Breakaway Devices: Back to Back U-Channel Breakaway Devices shall be installed in accordance with the manufacturer's specifications. A copy of the manufacturer's installation specifications shall be provided to the Engineer prior to proceeding with installation. Any hardware components of the device for which the manufacturer specifies a particular torque requirement shall be tightened using a wrench meeting the requirements of Section 657.4.5.1.

657.4.5.8-Surface Mount Breakaway Devices: Surface Mount Breakaway Devices shall be installed in accordance with the manufacturer's specifications. A copy of the manufacturer's installation specifications shall be provided to the Engineer prior to proceeding with installation.

The anchoring system used shall be that which is supplied by the manufacturer. The underside of the base of the device shall be shimmed if necessary in order for the support to be as plumb as possible in all directions after installation. Material used for shimming shall be materials approved by the Engineer such as brass shims or galvanized steel. Any hardware components of the device for which the manufacturer specifies a particular torque requirement shall be tightened using a wrench meeting the requirements of Section 657.4.5.1.

Upon final installation, the support shall be plumb within ten degrees of vertical in all directions. This shall equate to no more than 3/16-inch horizontally out of level over 1-

foot of length. Otherwise, this shall be cause for rejection at the discretion of the Engineer requiring the Contractor to add additional shims at the Contractor's expense if directed.

657.4.5.9-Bridge, Retaining Wall, and Barrier Wall Brackets: This specification shall include Types K and L Bridge or Retaining Wall Sign Mounting Brackets and Types A, B, C, and D Barrier Wall Sign Support Brackets. The anchorage for Type L Bridge or Retaining Wall Sign Mounting Brackets shall be cast-in-place or retrofitted, as specified in the Plans. Details for cast-in-place anchors are shown in the Standard Details. The anchorage for all Barrier Wall Sign Support Brackets specified above and Type K Bridge or Retaining Wall Sign Mounting Brackets shall be retrofitted.

Anchors to be retrofitted into newly placed concrete shall not be installed without approval of the Engineer. The Contractor shall obtain approval from the Engineer before installing brackets on cast-in-place anchors. The Contractor shall insure that anchor chemical adhesive used for retrofit installations has sufficiently cured before placing the brackets.

Mechanical or chemical adhesive type anchors for retrofit applications shall be installed strictly in accordance with the instructions provided by the bracket manufacturer or fabricator. This shall include recommended procedures for cleaning the drilled holes and recommended ambient air and mounting surface conditions in the case of chemical adhesive systems.

Once the bracket is placed into the position on the anchors, the anchors shall be tightened. Cast-in-place anchors for Type L Bridge or Retaining Wall Sign Mounting Brackets shall be tightened in accordance with the anchor bolt tightening procedures specified in Section 658, except the amount of nut tightening rotation shall be one-half the amount specified. Retrofit anchors for all bracket types shall be tightened in accordance with the instructions provided by the manufacturer or fabricator.

After the bracket anchors are tightened, supports to be attached to the brackets may be installed in accordance with the Standard Details and the specifications herein. Note, the bracket to pipe post connection bolts for Type L Bridge or Retaining Wall Sign Mounting Brackets shall be fully tightened in accordance with the procedure specified in Section 657.3.3.

Vertical support installation hardware for Types A and B Barrier Wall Sign Support Brackets shall be that which is supplied by the bracket manufacturer and shall be installed in accordance with the instructions provided by the bracket manufacturer. Any hardware components for which a particular torque requirement is specified shall be tightened using a wrench meeting the requirements of Section 657.4.5.1.

Hardware used to connect the vertical supports of Type C Barrier Wall Sign Support Bracket shall be as specified in Section 657.2.9. The fasteners shall be tightened in accordance with the Standard Detail. Note, it is required to install spacers between the u-channel welded to the bracket base plate and the support. Spacers shall be additional nuts and/or washers. The Contractor shall be responsible for determining the necessary quantity of additional nuts and/or washers such that when the fasteners are tightened, the support nested inside of the welded stub comes into firm contact with the angled web portions of the welded stub but does not cause undue stress on the angled webs. No additional compensation shall be paid to the Contractor for the additional nut and/or washer spacers.

657.4.6-Support or Bracket Removal: Removal of roadside sign supports shall include removing the support and foundation to a minimum of 6-inches below ground level and restoring the ground surface to its' original condition. This shall include grading, seeding, mulching, and/or fertilizing as determined to be necessary by the Engineer.

Removal of parapet, retaining wall, and barrier brackets shall include removing the bracket and supports attached to it. Mounting anchors shall be cut off flush with the concrete.

The cost of this item shall also include the removal of attachments to the supports as required by the Plans or otherwise directed by the Engineer. In cases where the Contractor is required to remove signs or other attachments from roadside sign supports or any other structure that is to remain in place, the cost of this shall be incidental to the Contract bid items. This shall include removing signs, vertical supports, sign lighting and arms, and associated hardware from overhead sign structures which are to remain in place.

657.5-METHOD OF MEASUREMENT:

657.5.1-Class B Concrete Footing, Plain: The quantity of work done for Class B Concrete Footing, Plain will be measured in cubic yards, complete in place and accepted, as determined by the dimensions on the Plans or Contract documents, subject to adjustment as provided for in 104.2 and 109.2.

Payment will be made at the contract unit price per cubic yard for "Class B Concrete Footing Plain". Such price will be full compensation for furnishing all labor, materials, and equipment necessary to construct all footings, including staking out footings and stakes for this purpose; excavation for footings regardless of the type of material encountered; constructing and removing forms when required; furnishing, placing, finishing, and curing the concrete; and all other incidentals necessary to complete the work.

657.5.2-Class B Concrete Footing, Reinforced, Roadside: The quantity of work done for Class B Concrete Footing, Reinforced, Roadside will be measured in cubic yards, complete in place and accepted, as determined by the dimensions on the Plans or Contract documents, subject to adjustment as provided for in 104.2 and 109.2.

Payment will be made at the concrete unit price per cubic yard for "Class B Concrete Footing, Reinforced, Roadside". Such price will be full compensation for furnishing all labor, materials, and equipment necessary to construct all footings, including staking out footings and stakes for this purpose; excavation for footings regardless of the type of material encountered; constructing and removing forms; furnishing and installing reinforcing steel, anchor bolts, washers and nuts; furnishing and installing electrical grounding and conduit sleeves when required; furnishing, placing, finishing, and curing the concrete; furnishing and placing grout as required by the Plans; and all other incidentals necessary to complete the work.

657.5.3-Channel Posts: Measurement for payment of "Channel Posts" will be based on the linear feet of steel channel post of each size necessary to complete the work. The length will be the Plan quantity unless otherwise directed by the Engineer.

In cases where a Square Tube Post is used in lieu of a Channel Post specified in the Plans, as required or allowed for by the Standard Details, measurement of the support shall be the same as specified above and payment will be made using the Plan specified Channel Post bid item at the Contract unit price.

In cases where a Breakaway Splice Device is used, the footage within the length of the splice shall not be counted twice in determining the footage to be paid. All material and installation labor costs associated with the Breakaway Splice Device shall be incidental to the Contract bid items.

Payment will be made at the Contract unit price per linear foot for each size of post required by the Plans. For back to back installations the price per linear foot shall include the material and installation labor costs for the stitch hardware. Such price and payment shall be full compensation for furnishing and erecting the posts, and all labor, equipment, tools, materials, and incidentals necessary to complete the work.

657.5.4-Square Tube Supports: Measurement for payment of "Square Tube Supports" will be based on the linear feet of square tube support of each size necessary to complete the work. The length shall be the Plan quantity unless otherwise directed by the Engineer.

Payment will be made at the Contract unit price per linear foot for each size of support required by the Plans. Such price and payment shall be full compensation for furnishing and erecting the supports, and all labor, equipment, tools, materials, and incidentals necessary to complete the work.

657.5.5-Steel Beam Supports: Measurement for payment of "Steel Beam Supports" will be based on the number of linear feet of supports for each size necessary to complete the work. The supports shall be measured from the bottom of the base plate, and along the centerline of the web, to the top of the support. The quantity to be paid for shall include the supports, hinge plate connections including hardware, and the base plate connection including hardware except as noted herein. The length shall be the Plan quantity unless otherwise directed by the Engineer. Lengths will be computed to the nearest 1/2-foot for each installation and the nearest 1-foot for the total length.

In cases where an Omni-Directional Breakaway Device is specified to be used with the assembly, all material and labor costs associated with the device shall be paid for under the provided Omni-Directional Breakaway Device bid item.

Payment will be made at the contract unit price per linear foot of support for each size and shall be full compensation for furnishing and erecting all supports and materials, tools, labor, and equipment necessary to complete the work.

657.5.6-Pipe Post Supports: Measurement for payment of "Pipe Post Supports" will be based on the actual number of pipe posts necessary to complete the work. This quantity shall be the Plan quantity unless otherwise directed by the Engineer. The quantity to be paid for shall include the supports, arm connections including hardware, and the base plate connection including hardware.

In cases where a pipe post support is to be installed using a Type L Bridge or Retaining Wall Sign Mounting Bracket, all material and labor costs associated with the bracket shall be paid for under the provided Bridge or Retaining Wall Bracket bid item.

Payment will be made at the contract unit price per support and shall be full compensation for furnishing and erecting all supports and materials, tools, labor, and equipment necessary to complete the work.

657.5.7-Omni-Directional Breakaway Devices: Measurement for payment of "Omni-Directional Breakaway Devices" will be based on the actual number of devices necessary to complete the work. This shall equate to the total number of individual supports requiring the installation of an Omni-Directional Breakaway Device. The total cost of each device shall include all components of the device including hardware. The number of units paid for shall be the Plan quantity unless otherwise directed by the Engineer.

Payment will be made at the Contract unit price per unit, and shall be full compensation for materials, tools, labor, and equipment necessary to complete the work.

657.5.8-Back to Back U-Channel Breakaway Devices: Measurement for payment of "Back to Back U-Channel Breakaway Devices" will be based on the actual number of devices necessary to complete the work. This shall equate to the total number of individual supports requiring the installation of a Back to Back U-Channel Breakaway Device. The total cost of each device shall include all components of the device including hardware. The number of units paid for shall be the Plan quantity unless otherwise directed by the Engineer.

Payment will be made at the Contract unit price per unit, and shall be full compensation for materials, tools, labor, and equipment necessary to complete the work.

657.5.9-Surface Mount Breakaway Devices: Measurement for payment of "Surface Mount Breakaway Devices" will be based on the actual number of devices necessary to complete the work. This shall equate to the total number of individual supports requiring the installation of a Surface Mount Breakaway Device. No differentiation in payment shall be made based on differentiation in cost of the device for each different size support. The total cost of each device shall include all components of the device including hardware. The number of units paid for shall be the Plan quantity unless otherwise directed by the Engineer.

Payment will be made at the Contract unit price per unit, and shall be full compensation for materials, tools, labor, and equipment necessary to complete the work.

657.5.10-Bridge, Retaining Wall, and Barrier Wall Brackets: Measurement for payment of "Bridge or Retaining Wall Brackets" and "Barrier Wall Brackets" will be based on the actual number of brackets necessary to complete the work. The total cost of each bracket shall include all components of the bracket including parapet, wall, or barrier connection hardware. With the exception of the Type D Barrier Wall Bracket, the vertical support(s) of each bracket shall be paid for separately under the applicable bid item. The number of units paid for shall be the Plan quantity unless otherwise directed by the Engineer.

Payment will be made at the Contract unit price per unit, and shall be full compensation for materials, tools, labor, and equipment necessary to complete the work.

657.5.11-Support or Bracket Removal: Measurement for payment of "Support or Bracket Removal" will be based on the actual number of supports and/or brackets that are required to be removed. This quantity shall be the Plan quantity unless otherwise directed by the Engineer. In cases where a bracket is designated for removal, any supports attached to the bracket shall not be counted as additional quantities.

Payment will be made at the contract unit price per support or bracket. This price shall also be full compensation for the removal and disposal of the signs and sign assemblies, including hardware and bracing, the removal and disposal of the supports and the restoration

of the ground surface to its original condition. No differentiation in payment shall be made based on support size, bracket type, or the method that was originally used to anchor the support.

657.6-BASIS OF PAYMENT:

The quantities, determined as provided, 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 material and doing all the work prescribed in a workmanlike and acceptable manner, including all tools, equipment, supplies and incidentals necessary to complete the work. All incidental work and materials for which no basis of payment is provided will be considered as completely covered by the prices bid for the items included in the Contract.

657.7-PAY ITEMS:

ITEM	DESCRIPTION	UNIT
657006-001	S4X7.7 Steel Beam Support	Linear Foot
657006-005	W6X12 Steel Beam Support	Linear Foot
657006-010	W8X18 Steel Beam Support	Linear Foot
657006-015	W10X22 Steel Beam Support	Linear Foot
657008-001	2.00 LB Channel Post	Linear Foot
657010-001	3.00 LB Channel Post	Linear Foot
657012-001	4.00 LB Back to Back Channel Post	Linear Foot
657014-001	6.00 LB Back to Back Channel Post	Linear Foot
657016-001	Class B Concrete Footing, Plain, Roadside	Cubic Yard
657017-001	Class B Concrete Footing, Reinforced, Roadside	Cubic Yard
657018-001	Support or Bracket Removal	Each
657019-001	Pipe Post	Each
657035-001	Square Tube Support, 2.00X14GA	Linear Foot
657040-001	Omni-Directional Breakaway Device	Each
657041-001	Back to Back U-Channel Breakaway Device	Each
657042-001	Surface Mount Breakaway Device	Each
657050-001	Bridge or Retaining Wall Bracket, Type	Each
657060-001	Barrier Wall Bracket, Type	Each

SECTION 658
OVERHEAD SIGN STRUCTURES

658.1-DESCRIPTION:

DELETE THE CONTENTS OF SUBSECTION 658.1 AND REPLACE WITH THE FOLLOWING:

This item shall consist of the fabrication and erection of overhead frame, cantilever, butterfly, and span structure sign supports and fastening accessories in accordance with the requirements of the Plans and of these Specifications. All details not specified or not shown on

the Plans shall conform to the details and requirements set forth in the following Specifications and publications:

i. West Virginia Department of Transportation, Division of Highways, Standard Details Book Vol. II, Signing, Signals, Lighting, Markings, and ITS, latest issue, including revisions (further referenced to herein as the Standard Details).
ii. The Manual on Uniform Traffic Control Devices for Streets and Highways, latest issue, as printed by the Federal Highway Administration, U.S. Department of Transportation (Referred to as the MUTCD).
iii. Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition, including revisions, American Association of State Highway and Transportation Officials.

All material, fabrication, and installation requirements for overhead frame structures shall be included in the project Plans and shop drawings.

658.2-MATERIALS:

DELETE THE CONTENTS OF SUBSECTION 658.2 AND REPLACE WITH THE FOLLOWING:

Materials furnished shall be of new stock conforming to the requirements of the Specifications, and shall meet the approval of the Engineer.

658.2.1-Pipe: Non-tapered steel pipe used for arms, chords, support legs, and bracing shown on various Standard Detail sheets shall be seamless or welded pipe conforming to A500 Gr. B or C, API 5L X42 or X52, A53 Grade B, or A252 Grade 3.

Non-tapered aluminum pipe used for chords and bracing shown on Standard Detail sheets TE5-1A and TE5-1B shall conform to ASTM B221, ASTM B429, or ASTM B241, all Alloy 6061, temper T6.

Tapered steel pipe used for arms and support legs shown on Standard Detail sheet TE4-4B shall be manufactured from steel having a min. yield strength of 55,000 PSI after fabrication. Galvanized in accordance with ASTM A123.

658.2.2-Plate: Flat steel plate used for chord plates, base plates, arm end plates, arm splice plates, and box flange plates shown on various Standard Detail sheets shall conform to ASTM A 572, Grade 42. Galvanized in accordance to ASTM A 123.

Flat steel plate used for gusset plates, saddle plates, hand hole plates, and stiffener plate shown on various Standard Detail sheets shall conform to ASTM A 36. Galvanized in accordance to ASTM A 123.

Flat aluminum plate used for gusset plates and chord plates shown on Standard Detail sheets TE5-1A and TE5-1B shall conform to ASTM B209, Alloy 6061, temper T6.

658.2.3-Structural Connection Bolt: Carbon steel structural connection bolts and associated hardware shown on various Standard Detail sheets shall conform to the following requirements. Bolts: ASTM F3125 Grade A325, Type I. Nuts: ASTM A563, Grade DH with

lubricant contrasting with the color of the galvanizing. Washers: ASTM F436, Type I. All galvanized in accordance to ASTM B695.

658.2.4-Friction Caps: Steel friction caps shown on various Standard Detail sheets shall conform to ASTM A653, designation CS, and shall be zinc electrodeposited coated in accordance with ASTM B633, Class 12.

Aluminum friction caps shown on Standard Detail sheets TE5-1A and TE5-1B shall conform to ASTM B26, Alloy 356, temper F.

658.2.5-Structural Shapes: Steel W10x77 beams as shown on Standard Detail sheets TE3-1 and TE3-2 shall be standard wide flange shapes fabricated from steel conforming to ASTM A36 or ASTM A572 Grade 50. Steel conforming to ASTM A992 and dual certified to ASTM A572 Grade 50 may also be used. The beams shall be galvanized in accordance with ASTM A123.

Steel WT8x25 tees as shown on Standard Detail sheets TE5-1A and TE5-1B shall be standard WT shapes fabricated from steel conforming to ASTM A36 or ASTM A572 Grade 50. Steel conforming to ASTM A992 and dual certified to ASTM A572 Grade 50 may also be used. The tees shall be galvanized in accordance with ASTM A123.

658.2.6-U-Bolts: Carbon steel u-bolts and associated hardware shown on various Standard Detail sheets shall conform to the following requirements: Bolts: ASTM A307 Grade A. Nuts: ASTM A563A Hex. Flat washers: ASTM F844. All galvanized in accordance to ASTM F2329.

658.2.7-Anchor Bolts: Steel anchor bolts and associated hardware shown on various Standard Detail sheets shall conform to the following requirements: Bolts: ASTM F1554 Grade 55. Nuts: ASTM F563 Grade A. Washers: ASTM F436. All galvanized in accordance with ASTM B695.

658.2.8-Concrete: All concrete shall be Class B in accordance with Section 601.

658.2.9-Reinforcing Steel: All reinforcing steel shall be meet the requirements of Section 602.

658.5-ERECTION:

DELETE THE CONTENTS OF SUBSECTION 658.5 AND REPLACE WITH THE FOLLOWING:

658.5.1-General: All structures shall be installed at the points designated on the Plans or by the Engineer in accordance with these specifications, the Plans, and approved shop drawings and shall be erected in reasonably close conformity to the locations, elevations, and angles shown on the Plans or established by the Engineer.

Erection of sign structures shall be in accordance with the applicable provisions of the current edition of the Standard Specifications and the requirements given below. The Contractor shall provide all tools, equipment and appliances necessary for the expeditious

handling of the work, all of which shall be subject to the approval of the Engineer. Materials and workmanship not previously inspected will be inspected on the site of the work and all rejected material shall be removed from the site of the work.

The Contractor shall take full responsibility for checking all cross sections at approved structure locations to determine final support lengths. Necessary support lengths shall be determined in accordance with the roadway overhead clearance requirements shown in the Plans or Standard Details.

Before proceeding further, the Contractor shall initially establish the location of each structure in accordance with the Plans or as directed by the Engineer and shall mark each site with construction stakes. The Contractor shall furnish stakes, paint, other materials, and labor for performing the locating and staking as described. When the sites have been staked and are ready for inspection, the Contractor shall inform the Engineer, who will check and approve the site or make necessary changes. Centerline station information will be furnished to the Contractor by the Engineer.

All existing or proposed assembly locations are approximate. In cases where an existing assembly, including supports, is to be removed and replaced with a new assembly, the new assembly shall be located as close as possible to the original with a minimum of 20-feet of clearance between the existing foundation and the new foundation unless otherwise approved by the Engineer.

658.5.2-Excavation: The Contractor shall perform excavations for each concrete foundation to the depths and dimensions shown on the Plans. The excavation shall be made in accordance with the applicable provisions of the Standard Specifications.

The Contractor shall contact WV 811 and shall notify all applicable WV 811 non-participating utilities prior to beginning excavation or conduit jacking activities. The Contractor shall hand dig to locate lines or open cut in areas of possible conflict, as determined by the Engineer. The Contractor shall also be responsible for locating and verifying Division owned underground conduit to avoid conflict or damage. All such work shall be incidental to the Contract bid items. All costs associated with any disruption of services as a result of the Contractor's activities shall be the Contractor's sole responsibility.

Earth augers, if used shall be of the same diameter as the footings. Where a trench is required, it shall be only as wide and long as is necessary to accommodate the work.

If rock or boulders are encountered during the excavation, they shall be removed to a depth sufficient, in the judgement of the Engineer, to obtain the stability necessary to support the sign structure. The Standard Detail drawings are compiled on the basis of average soil conditions. Soil conditions surrounding specific foundations may require larger foundations. The Contractor shall adjust the foundation dimensions if directed to do so by the Engineer. Any work in such cases shall be performed without change in the unit bid price.

If a foundation is to be installed within the area of an existing concrete or asphalt surface, the concrete or asphalt shall be carefully opened by drilling, saw cutting, or other suitable methods approved by the Engineer that will not cause unnecessary damage to the surrounding surface.

The Contractor shall remove all excavated material from the site that is not needed for backfill or, if permitted by the Engineer, shall spread this material out in the area immediately surrounding the foundation location to the satisfaction of the Engineer. The Contractor shall restore all disturbed areas to within reasonable conformity of their original conditions by

grading, seeding, mulching, and/or fertilizing as directed by the Engineer. These operations and required materials shall be paid for incidental to the Contract bid items.

658.5.3-Conduit and Ground Rods: All overhead sign structures shall have conduit and ground rods, regardless of whether they have sign lighting or other electrical components.

A 2-inch diameter galvanized conduit shall be furnished and installed in the support foundations at locations as specified on the Plans. The conduit shall terminate above the top of the foundation and shall be fitted with a 2-inch capped grounding bushing above the foundation. The lower end of the conduit shall emerge from the side of the footing to be joined to conduit from the junction box.

Ground rods shall be copper clad steel, 3/4- inches in diameter with a minimum length as noted on the Plans and shall be one piece. Sectional or segmented ground rods are not permitted. The ground rods shall be complete with ground clamp and square head bolt.

658.5.4-Foundation Placement: The foundations shall be of Class B concrete, reinforced, of the types shown on the Plans. Steel reinforcement, anchor bolts and conduit for the footings shall be as shown on the Plans.

All concrete for each foundation shall be placed in one placement with no construction joints.

Each foundation shall typically be installed with a pedestal as shown on the Standard Details. All pedestals shall be square to a depth of 6-inches minimum below ground level. Each of the two pedestals on each end of box truss span structures shall be constructed at the same elevation. For foundations which are within or project into a concrete or asphalt surface utilized by pedestrians, Americans with Disabilities Act (ADA) walkway specification requirements shall be met as directed by the Engineer. In such cases, the following guidelines shall be followed:

i. Unless unachievable due to right of way restrictions, the foundation shall be placed such that a 48-inch minimum wide walkway is maintained from the edge of the foundation to the roadside edge of the walkway. This measurement shall not include curbs constructed with a joint separating the curb and walkway.

ii. If it is not possible to maintain a 48-inch wide walkway, the pedestal portion of the foundation above grade shall be eliminated, and the top of the foundation shall be constructed flush with the walkway. In this case, the width of the walkway shall be measured from the roadside edge of the structure base plate to the roadside edge of the walkway. This measurement shall not include curbs constructed with a joint separating the curb and walkway. This measurement shall not be restricted to less than 32-inches, and the continuous longitudinal length over which the walkway is restricted to less than 48-inches shall be for no more than twenty-four 24-inches. The width of the restriction shall be minimized as much as possible within the available right of way.

The anchor bolts shall be set accurately by means of a template in the position shown on the drawings and held rigidly in the forms so as to avoid displacement during the placement of concrete. The steel reinforcement and conduit shall be properly placed and secured before the placement of concrete. The Contractor shall make periodic checks of the bolt positions and elevations during concrete placement operations. It is essential that the distance between the

centers of anchor bolt groups of the two foundations of a span structure be exactly the span lengths shown on the Plans.

The exposed surfaces of all foundations constructed with pedestals as shown in the Standard Details shall be given a Class 1, ordinary finish as defined in Section 601.

658.5.5-Backfilling: If any backfilling is required, excavations shall be backfilled with random material, approved by the Engineer, in horizontal layers not to exceed 4-inches after compaction. Each lift shall be compacted to the satisfaction of the Engineer. Testing is not required.

All surplus material shall be removed from the right-of-way and the backfill finished flush with surrounding natural ground, including replacement of any damaged facilities or appurtenances. The Contractor shall restore all areas disturbed by this excavation or other operations within reasonable conformity to their original conditions including grading, seeding, mulching and/or fertilizing as directed by the Engineer. No separate payment will be made for backfilling materials or operations.

658.5.6-Structure Installation:

658.5.6.1-General: All structures depicted in the Standard Details shall have the support legs installed with the anchor bolts fully tightened before installation of the arms or chords.

The individual sections of any box truss span structure made up of multiple sections shall be spliced together for the full length of one span before lifting into place. In addition, all sign panels, lighting and other accessories required thereon, as described elsewhere in the Standard Specifications, shall be fully installed before lifting the box truss into place.

Two-Tube-Span and One-Tube-Span structures as shown on Standard Detail sheets TE3-1 and TE3-2 shall have the entire span assembled and fully tightened before lifting the span into place. The arm splice connections of Heavy Single Arm Cantilevers and Light Single Arm Cantilevers as shown on Standard Detail sheets TE4-4A and TE4-4B may be assembled after lifting the section attaching to the support leg into place and fully tightening the structural connection bolts.

The field assembling of the component parts of a structure shall be done in a manner not likely to produce damage by twisting, bending, or otherwise deforming the metal. Signs required to be installed prior to erection or immediately after erection as described herein shall be covered in a manner approved by the Engineer if determined to be necessary due to operational considerations.

658.5.6.2-Installation Preparation: Proper condition and lubrication of hardware associated with anchor bolts and structural bolted connections is critical to proper installation. Only un-weathered hardware components in new condition shall be used. Fastener components shall be protected from dirt and moisture in closed containers at the site of installation. Fastener components shall not be cleaned of lubricant that is present in the as delivered condition. Components that accumulate rust or dirt resulting from plant or job-site conditions shall not be incorporated into the work. Galvanized bolts that have been fully pretensioned shall not be reused.

All nuts shall be pre-coated with a lubricant as specified herein. Prior to snug tightening of any nuts or bolts, lubricant shall be applied to the bolt threads if the threads of the bolts

have not been lubricated, were last lubricated more than twenty-four (24) hours prior, or have gotten wet since they were last lubricated. Beeswax or toilet ring wax may be used. If the bolt heads are turned in order to tighten a connection, the Contractor shall apply lubricant to the face of the washer that the bottom of the bolt head is to be tightened against. If pre-coated nuts have gotten wet, lubricant shall be reapplied to the threads and the bearing surface face of the nut.

Prior to erection, the following steps shall be taken by the Contractor:

1. Inspect the separate components of the structure for bent or damaged members, damaged coatings, distortion, blemishes, scratches, cracks, and defective fabrication that would affect proper erection, durability, or structure performance. Localized defects in the galvanizing coating shall be repaired in accordance with the requirements of ASTM A780. Any member slightly bent or twisted shall have all defects corrected in an approved manner before being placed. The Engineer may direct the Contractor to not proceed with the erection of any structure if any serious defects warranting further assessment and possible rejection are found.
2. Verify that there will be no potential fit-up problems when the components of the structure are assembled. Insure connecting plates will fit with no burrs or other seating inhibitors. If more than 25-percent of the surface area of the face of a flange bolted to the face of another component, or surface area of the underside of a structural bolt head or nut, is visible after snugging of the bolts this shall be cause for rejection.
3. Apply protective coating materials if aluminum components are to be attached to concrete, masonry, or steel if the steel is neither galvanized nor stainless. If to be attached to steel which is neither galvanized nor stainless, the aluminum points of contact shall be coated with a zinc chromate primer or as called for on the Plans, and the steel shall be coated at the points of contact with a suitable priming paint followed by a coat of aluminum paint. If to be attached to concrete or masonry, the points of contact shall be coated with a heavy coat of an alkali-resistant bituminous paint.
4. Verify that the foundations are set to the proper elevation and anchor bolts are set in the correct pattern and orientation, are of the correct size, and are plumb with the specified extension and thread length above the top of concrete.
5. Just prior to erection, the aluminum shall be thoroughly cleaned, and any accumulations of oil, grease, dirt or foreign materials shall be removed using an approved solvent cleaner.

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. Place and level the foundation leveling nuts with washers on top. Initial placement of the leveling nuts shall be no more than 1/4-inch above the top of the foundation.

3. 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. 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. 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. 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 3/4-inch to 1-1/4-inches in diameter shall be 23-inches. The handle length used for bolts 1-1/2-inches to 2-1/4-inches in diameter shall be 36-inches.
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. The procedure for fully tightening the bolts is described in Section 658.5.6.3.2. 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 1/3 of a turn for bolts 1-1/2-inches in diameter or less and shall be 1/6 of a turn for bolts greater than-1-1/2 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.

$$\mathbf{T_v = 0.12\ (D_b)\ F_i}$$

Where:

T_v = verification torque (inch-kips)
D_b = nominal body diameter of the anchor bolt (inches)
Fi = 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-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.

658.8-PAY ITEMS:

DELETE THE TABLE AND REPLACE WITH THE FOLLOWING:

ITEM	DESCRIPTION	UNIT
658001-*	Class B Concrete Footings, Reinforced, Overhead	Cubic Yard
658005-*	Overhead Sign, Two Tube Span	Each
658006-*	Overhead Sign, One Tube Span	Each
658007-*	Overhead Sign, Double Arm Cantilever	Each
658008-*	Overhead Sign, Butterfly Cantilever	Each
658009-*	Overhead Sign, Single Arm Cantilever (Heavy)	Each
658010-*	Overhead Sign, Single Arm Cantilever (Light)	Each
658011-*	Overhead Sign, Steel Box Truss Span	Each
658012-*	Overhead Sign, Aluminum Box Truss Span	Each
658013-*	Overhead Sign, Frame	Each

* Sequence Number

SECTION 660
TRAFFIC SIGNALS

660.19-METHOD OF MEASUREMENT:

660.19.2-Traffic Detectors:

DELETE THE ENTIRE 660.19.2 SUBSECTION AND REPLACE WITH THE FOLLOWING:

660.19.2-Detectors:

660.19.2.1-Traffic Detectors: Traffic detectors shall be measured per unit complete and in place, mounted in a cabinet or enclosure as required. This item shall consist of the detector tuning unit only. The roadway traffic sensors, such as loops, and associated cables outside of cabinet, shall be included in "Miscellaneous Signal" items. Any supplementary cabinets or other enclosures as required for the detector tuning units shall also be included in "Miscellaneous Signal".

660.19.2.2-Pedestrian Detector: Audible Pedestrian Detector Push Buttons will be measured as a complete unit in place in accordance with the Plans and these Specifications. The item shall include but not limited to power service, electrical conduit, audible pedestrian detector push button, and all wiring, appurtenances and work.

660.19.7-Miscellaneous Signal:

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

Miscellaneous signal items as required to complete a traffic signal system in accordance with the Plans or these Specifications shall be measured complete in place by intersection or control location. This item shall include but not be limited to power services, electrical conduit, vehicle sensors (loops, probes, etc.), and all wiring, appurtenances and work not included in other Contract items.

660.20-BASIS OF PAYMENT:

660.20.2-Traffic Detectors:

DELETE THE ENTIRE SUBSECTION 660.20.2 & 660.20.3 AND REPLACE WITH THE FOLLOWING:

660.20.2-Detectors: Pay item codes shall be as follows:

660.20.2.1-Traffic Detectors:

(LPS)-Loops
(VTDS)-Video Detection
(PAS)-CCTV (Closed Circuit Television)
(RADD)-Radar Advance Digital Detection

660.20.2.2-Pedestrian Detector:

(APS)-Accessible Pedestrian Stations

660.20.3-Signal Sections: Pay item codes shall be as follows:

(V-12)--12" ((V-305) -- 305 mm) Vehicle Signal Sections (R, Y, G or ARROW)
(V-12P)--12" ((V-305) -- 305 mm) Programmed Vehicle Signal Sections (R, Y, G or Arrow)
(G-16)--16" ((G-405) – 405 mm) Pedestrian Control Signal Heads (W-DW)

SECTION 661
TRAFFIC SIGNS AND DELINEATORS

DELETE THE ENTIRE SECTION AND REPLACE WITH THE FOLLOWING:

661.1-DESCRIPTION:

This item shall consist of the fabricating, furnishing, and erecting of a complete system of traffic signs and delineators in accordance with the requirements of the Plans and of these

specifications. All details not specified or not shown on the Plans shall conform to the details and requirements set forth in the following specifications and publications:

i. West Virginia Department of Transportation, Division of Highways, Standard Details Book Vol. II, Signing, Signals, Lighting, Markings, and ITS, latest issue, including revisions (further referenced to herein as the Standard Details).
ii. West Virginia Division of Highways, Sign Fabrication Details, latest issue, including revisions (further referenced to herein as the Fabrication Manual).
iii. Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition, including revisions, American Association of State Highway and Transportation Officials.
iv. The Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), latest issue, as printed by the Federal Highway Administration, U.S. Department of Transportation.
v. Standard Alphabets for Highway Signs, latest issue, as printed by the Federal Highway Administration, U.S. Department of Transportation.

661.2-MATERIALS:

The criteria for sampling, inspection, and acceptance of signing materials are documented in MP 661.02.40.

Materials furnished shall be of new stock conforming to the requirements of the Specifications and shall meet the approval of the Engineer.

661.2.1-Flat Sheet Aluminum Substrate: Flat sheet aluminum substrate for flat sheet signs, reflective post strips, XS-1 delineators, demountable copy, demountable border, and sign shims shall be either Alloy 6061 T6 or 5052 H38 per ASTM B209. Material shall meet the ASD fabrication requirements for mill products.

The surface of blanks to which sheeting is to be applied shall be degreased and etched in accordance with the sheeting manufacturer's recommendations. All blank exposed surfaces shall be given a chromate type chemical conversion treatment conforming to ASTM B449 Class I or Class II.

Blanks shall be free of buckles, warp, dents, and burrs prior to the application of reflective sheeting or other background material. Dimples or indentations shall not be noticeable from a distance of 10-feet normal to the panel.

With the exception of XS-15 signs and demountable copy, borders, and shields riveted to the faces of extruded panel signs, all flat sheet aluminum for the items described above shall be 0.080 inches thick. For the exceptions specified above, the material shall be 0.040 inches thick.

661.2.2-Extruded Panel Substrate: Extruded panel substrate for extruded sign panels shall be Alloy 6063 T6 per ASTM B221.

The surface of panels to which sheeting is to be applied shall be degreased and etched in accordance with the sheeting manufacturer's recommendations. All panel exposed surfaces shall be given a chromate type chemical conversion treatment conforming to ASTM B449 Class I or Class II.

Cross sectional dimensioning of extruded sign panels should be per the details provided on Standard Detail sheet TE7-1, within the established commercial tolerances of the aluminum

industry. An alternate extruded panel section of equal or greater section modulus and having dimensions suitable to utilize the hardware shown on sheet TE7-1 may be supplied by the Contractor with written approval of the Engineer.

Each panel shall be flat and true within 1/4-inch tolerance on an 8-foot length, with proportionately greater allowance on longer lengths. Flatness across the face of each panel shall be limited to 0.004 inches per inch of width.

661.2.3-Retroreflective Sheeting and Matched Components: Retroreflective sheeting and matched components used on flat sheet signs, extruded panel signs, delineators, reflective sign support strips, and all other products requiring such shall meet the requirements of 715.9.2.

Fluorescent-yellow Type ASTM-XI sheeting shall be used when fabricating the following signs: W1-6 through W1-8, all 48-inch diamond W Series, all W Series supplemental plaques installed below a 48-inch diamond W Series, all XR Series, all XS Series, all yellow panels of extruded panel signs, any yellow flat sheet sign attached to a yellow extruded panel sign background, and any other signs designated in the Plans to have a fluorescent-yellow background.

Fluorescent-yellow-green Type ASTM-XI sheeting shall be used when fabricating the following signs: all S Series requiring a yellow background and any other signs designated in the Plans to have a fluorescent-yellow-green background.

Sheeting for extruded panel sign demountable copy, border, and shields shall be Type ASTM-XI.

Unless specified otherwise in the Plans, all other sheeting for signs shall be Type ASTM-IV. Sheeting to be utilized with other devices shall be as specified herein.

661.2.4-Low Carbon Steel Bolts: Small diameter, typically 5/16-inch, low carbon steel bolts and associated components shown on various sign and delineator Standard Detail sheets shall conform to the following requirements. Bolts: ASTM A307 Grade A. Nuts: ASTM A563A Hex. Flat washers: ASTM F844. Lock washers: ASME B18.21.1. All galvanized in accordance to ASTM F2329.

Nylon washers, if required, shall be manufactured of commercial grade nylon. Nylon washers for use with 5/16-inch bolts shall have an outside diameter of 7/8-inch.

If vandal resistant assemblies are required, the bolt shall have a domed round head with a one-way slot for tightening, and the nuts shall be cone shaped with a hex shaped drive head designed to shear off at a predetermined torque of no less than 4-ft-lbs and no greater than eight 8-ft-lbs when sampled in accordance with Materials Procedure 661.20.00.

661.2.5-Aluminum Structural Shapes: Aluminum structural shapes shown on various sign and delineator Standard Detail sheets, including but not limited to auxiliary angles as shown on Standard Detail sheet TE8-1, zee bar supports as shown on sheet TE6-3D, and extruded rib sign bracing as shown on sheet TE17-1 shall meet ASTM B221, alloy 6061-T6 or 6063-T6.

661.2.6-Banding and Components: Banding and associated components, as specified on Standard Detail sheet TE9-1 or elsewhere, shall meet the requirements specified herein. Banding shall be 3/4-inch width with a minimum thickness of 0.030-inch. Banding shall be

manufactured of stainless steel meeting the requirements of ASTM A666, Alloy 201 with a minimum tensile strength of 100,000-PSI.

Flared leg brackets shall be manufactured of stainless steel and shall include a stainless steel bolt, nylon washer, and 5/16-18 x 3/4" stainless steel hex head bolt with metal and fibre washer. Buckles shall be manufactured of stainless steel meeting the requirements of ASTM A666, Alloy 201.

661.2.7-Gaskets: Gaskets, as specified on Standard Detail sheet TE9-1 or elsewhere, shall be manufactured of material meeting the requirements of specification MIL-C-882, cotton duck fabric reinforced pad. Thickness shall be 1/16-inch minimum.

661.2.8–Reflective Sign Support Strips: Materials used to fabricate Reflective Sign Support Strips, as detailed on Standard Detail sheet TE12-1, shall meet the requirements specified herein. Retroreflective sheeting shall be Type ASTM-XI for fluorescent-yellow or fluorescent-yellow-green colored strips. Otherwise, the sheeting shall be Type ASTM-IV.

Reflective Sign Support Strips shall conform to the requirements of 715.9.4.

661.2.9-Post Clip and Extruded Panel Stitch Bolt Assemblies: Post clip and extruded panel stitch bolt assemblies, as detailed on Standard Detail sheet TE7-1, shall meet the requirements specified herein.

Clip shall meet ASTM B108, Alloy 356-T6, aluminum base alloy permanent mold castings. Bolts shall meet ASTM F593, Alloy Group 1, Condition CW. Washers shall meet ASTM F594, Alloy Group 1, Condition CW. Lock Nuts shall be nylon top insert type manufactured of the same stainless-steel alloy group, as defined by ASTM F593, as the bolts and washers, and otherwise shall be manufactured fully in accordance with IFI-100/107.

Dimensioning of components, heads, threads, and marking of the clip shall meet sheet TE7-1. Nuts and washers shall have a specified minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the bolts.

661.2.10-Rivets: Rivets to be used for attaching demountable copy, border, and shields to extruded panel signs shall be blind, dome head, self-plugging or pull through type mandrel rivets made of an aluminum alloy that will not produce streaking or discoloring of the sign face. The manufacturer of the rivets shall determine the method of rivet application.

Rivets to be used for attachment of Reflective Sign Support Strips as shown on Standard Detail TE12-1 shall be button head stainless steel blind rivets meeting the requirements of ASME B18.1.1.

661.2.11-Square Post Clamp Assemblies: Square post clamp assemblies, as shown on Standard Detail sheets TE16-1A, TE16-1B, and TE17-1 or elsewhere shall meet the requirements specified herein.

The clamp shall be manufactured from 7/8-inch wide, Type 304, #2B finish stainless steel. The assembly shall include a 3/8-inch stainless steel carriage bolt and serrated flange nut supplied as part of the clamp.

661.2.12-U-Bolts: U-bolts, as shown on Standard Detail sheet TE9-1 or elsewhere, shall be galvanized carbon steel when attaching to a steel support. Bolts shall meet ASTM A307

Grade A. Nuts shall meet ASTM A563A. Washers shall meet ASTM F844. All components shall be galvanized in accordance to ASTM F2329.

If attaching to an aluminum support, the u-bolts shall be stainless steel. Bolts shall meet ASTM F593 Condition CW2. Nuts shall meet ASTM F594 Condition CW2. Flat washers shall be industry standard. All components shall be alloy 316.

661.2.13-XS-2 Offset Bracket: The XS-2 offset bracket detailed on Standard Detail TP5-2 shall be fabricated using steel plate meeting the requirements of ASTM A36 and shall be galvanized in accordance with ASTM A123.

661.2.14- Sign Supports: Sign supports shown on various sign and delineator Standard Detail sheets, including u-channel, square tube, and steel beam type sign supports shall meet the requirements of Section 657.

661.2.15- Delineators: Materials used to fabricate XS-1 delineators, as detailed on Standard Detail TE11-2B, shall meet the requirements specified herein. Retroreflective sheeting shall be Type ASTM-XI. Fluorescent-yellow shall be used when yellow is specified.

Material requirements for Surface Mounted Flexible Tubular Markers, Soil Anchored Flexible Delineator Posts, Guardrail Mounted Delineator Posts, and Type B-1 Delineators as shown on Standard Detail sheets TE11-2A and TE11-2B shall conform to 715.9.3.

CONSTRUCTION METHODS

661.3-FABRICATION:

661.3.1-General: Fabrication of all parts shall be in accordance with the dimensions shown on the Plans and approved shop drawings. Work shall be done in a uniform workmanlike manner.

661.3.2- Shop Drawings: The Contractor shall submit to the Engineer for approval eight (8) sets of shop drawings for the items specified below. For the purposes of this section, standard message signs shall be considered to be flat sheet signs shown in the Fabrication Manual.

661.3.2.1-Extruded Panel, Non-Standard Message Signs, Standard Message Signs, Reflective Sign Support Strips, Delineators: Drawings shall show overall dimensioning including corner radiuses. Drawings shall indicate the color and WVDOH type sheetings, inks, and overlay films; the manufacturer and manufacturer's product number for the sheetings, inks, and overlay films; quantities to be supplied; material specifications for aluminum components; substrate thickness; cross sectional dimensions and lengths for extruded panels and shaped components such as reinforcing ribbing; reinforcing ribbing attachment details; punching details; and hardware to be supplied including material specifications.

Drawings for non-standard message signs shall also show the arrangement, spacing, font style, and size of all letters, symbols, shields, and borders. This shall include all extruded panel signs.

661.3.3-Metal Cutting and Preparation:

661.3.3.1-Cutting: Flat sheet aluminum shall be cut by one of the following methods: sheared, blanked, sawed or milled. Extruded Panels shall be sawed or milled. Re-entrant cuts shall be filleted by drilling prior to cutting. No flame cutting will be permitted. Cut edges shall be refinished to present a true and smooth edge that is free from burrs and ragged breaks. Holes shall be made in such a manner as not to affect the finished surface.

661.3.3.2-Preparation: All cutting, cornering, and punching of aluminum blanks shall be completed prior to final preparation for sheeting application. Before applying retroreflective sheeting, the surface of the material must be totally free of any contamination, dust, residue, loose scale and, in particular, traces of oil, grease or wax. Aluminum blanks should be handled by the edges using clean cotton or canvas gloves. In case of doubt as to cleanliness of the substrate, the substrate shall be tested by methods recommended by the sheeting manufacturer.

Immediately prior to the application of the sheeting, if it is necessary to remove any fingerprints or residue from the blanks, solvent wiping in accordance with the sheeting manufacturer's recommendations shall be used.

661.3.4–Fabrication of Signs, Reflective Sign Support Strips, and Delineators:

661.3.4.1-General: Fabrication of all parts shall be in accordance with the dimensions shown on the Plans and approved shop drawings. Work shall be done in a uniform workmanlike manner.

Any material permanently adhered over the sign background layer of sheeting, such as another layer of sheeting, ink, or film, shall be a "matched component", as defined in 715.9.2, of the background layer of sheeting. Sheeting used on demountable legend, border, and shields riveted to extruded panel signs shall not be required to be a matched component of the extruded panel sign background sheeting. However, the material used for all demountable components on each sign shall be the same series number of sheeting from a single manufacturer. All materials used shall be materials approved by the Division.

All legend, borders, and shields applied to extruded panel signs shall be demountable. All flat sheet signs shall be fabricated using inks and/or overlay films. Direct applied reflective legend and border shall not be allowed. Standard message signs displayed within a sign, such as with W3-1 and W3-2 signs as shown in the Fabrication Manual, may be direct applied.

The fabricator shall take due care to ensure that all sign backgrounds remain clean prior to application of inks and films, solvent wiping the sheeting in accordance with the manufacturer recommendations if necessary.

Materials for fabricating signs shall be stored and conditioned in accordance with the sheeting manufacturer recommendations prior to application. Environmental conditions under which the signs are fabricated shall be in accordance with the sheeting manufacturer recommendations.

661.3.4.1.1-Flat Sheet Fabrication General Requirements: Flat sheet signs, reflective sign support strips, and delineators shall be fabricated of a single piece of sheet material without joints. The height and width of the blank shall be within plus or minus 1/8-inch tolerance of the approved shop drawing dimensions. Corner radii shall be within

plus or minus 1/16-inch tolerance of the dimensions shown on the approved shop drawings. Thickness of flat sheet material shall be in accordance with the requirements stated herein.

Blanks shall have dimensions, corner radii, and hole punching in accordance with Standard Detail sheets TP1-1A through TP1-2B, or as otherwise shown in the Plans. All flat sheet signs shall be punched for reinforcing ribbing attachment, with the exception of signs to be attached to a single u-channel or square tube support and Type 1 pole mounts as shown on Standard Detail TE9-1, unless the Standard Details or Plans specify otherwise for a specific assembly or specific assembly type such as the single support GS-1C route marker arrangement shown on Standard Detail TP4-1B.

661.3.4.1.2-Extruded Panel Fabrication General Requirements: Extruded panel signs shall be fabricated of extruded aluminum channel sections, bolted together at the flanges, to form a surface of the length, width, and depth required, to which the legend, border, and background have been applied. The width of the sign shall be within plus or minus 1/4-inch tolerance of the approved shop drawing dimensions. No splicing of sections will be permitted. Unless the required height of the sign is a specified number of feet plus an additional 6-inches, all panels shall be 12-inches in height. Only the minimum number of required 6-inch height panels shall be used. If a 6-inch panel is required, it shall be placed at the top of the sign.

The panels shall be assembled in the shop and firmly bolted to form a sign of the length and width required. Additional stitch bolt holes shall be punched or drilled in the shop when required per Standard Detail TE8-1. Before bolting, the webs of the panels shall be in the same plane to form a smooth and uniform surface and the ends shall be free from projections. Adjacent panels shall be color matched both day and night.

It is intended that the signs shall be fabricated as single units. If the largest signs cannot be shipped as a single unit, they may be sectionalized after being fully assembled in the shop. Legend, shields, and borders which overlap the joints where the signs are sectionalized shall be removed and reinstalled in the field.

661.3.4.2-Application of Retroreflective Sheeting: The application of retroreflective sheeting to the aluminum shall be done mechanically and in full accordance with the instructions of the manufacturer of the sheeting. When manufacturing components such as demountable copy, demountable border, and reflective sign support strips, the fabricator may apply reflective sheeting to a large blank and then cut such components from the sheeting covered blank as permitted by and in accordance with the recommendations of the sheeting manufacturer.

Sheeting shall cover one entire side of each flat sheet blank, which side shall be the sign face. When applied to extruded sign panels, reflective sheeting shall be rolled over each edge of the extrusion 3/8-inch to prevent an opened surface on the sign face. The fabricator shall take due care and follow all manufacturer recommendations in order to ensure that the portion of sheeting rolled over the edges of extruded panels does not fracture at the edge of the panel face and will remain permanently adhered. Manufacturer recommendations typically require the use of heat in addition to edge rollers to provide pressure. On 6-inch wide extruded panels, the fabricator may roll the reflective sheeting over one edge only, provided the trimmed edge is completely adhered and sealed. In

addition, the untrimmed edges of 6-inch panels shall face downward upon final fabrication of the sign.

Signs 48-inches and less on the shorter side shall be covered by a single piece of reflective sheeting. On signs larger than 48-inches on the shorter side, horizontal splicing shall be allowed. In this case, the section of sheeting on top shall overlap the bottom section. Adjacent pieces shall be carefully matched for color to provide uniform reflective quality. All seams shall be straight, and the edges of adjustment pieces shall be overlapped a minimum of 3/16-inch the length of the seam.

When manufacturing signs, demountable components, and other products described herein using sheeting material that is "rotationally sensitive", as defined in 715.9.2, the manufacturing process shall result in the sheeting being oriented optimally, as specified by the sheeting manufacturer, to retroreflect the light from vehicle headlights upon final field installation.

661.3.4.3-Application of Demountable Copy: Each letter, symbol and border shall be secured to the sign surface with rivets meeting the requirements of 661.2.10. The use of tape, glue or other substance to secure the copy to the sign face during fabrication or in its final form shall not be allowed.

Demountable copy, border, and shields shall be attached flush against sign faces after background material has been applied. Spacing and placement of all demountable components shall be as specified on the approved shop drawings. A sufficient number of rivets shall be used to securely fasten demountable components to sign panels.

661.3.4.4-Application of Overlay Films: Signs manufactured using opaque or transparent overlay films shall be manufactured by applying the films in accordance with all sheeting manufacturer recommendations. All films shall be cut on computer sign cutting equipment incorporating a knife cutting (blade) system.

For signs utilizing transparent overlay film for the background and being greater than 48-inches on the shorter side, splicing of sections of film shall be allowed if required. Each of the sections of film shall be carefully matched for color to provide uniform reflective quality. The method of splicing shall be a butt splice and no overlap shall be allowed for transparent films.

661.3.4.5-Screen Processing: All screening shall be done in a workmanlike manner and as recommended by the manufacturer of the reflective sheeting. All legends, symbols, shields, and borders shall be of the color specified and screened on the sign as shown on the Plans. Finished colors after screening shall be in accordance with the color requirements specified in the MUTCD.

The fabricator shall adhere to all sheeting manufacture screening recommendations pertaining to, but not limited to, ink thinning; printing equipment including fabric, stencil, and squeegee; and screening method. Finished signs shall have a uniform color and tone, with sharply defined edges of legend and border and without blemishes on the sign background. Free hand painting will not be permitted.

661.3.4.6-Packaging: All signs shall be protected by packaging during shipment and storage. The packing shall be adequate to prevent moisture, abrasive, or excessive pressure damage to any part of the sign, including any demountable legends or borders.

Before packaging, all signs shall be free of moisture and all inks shall be thoroughly dry. All screen-printed signs shall be allowed to dry for a minimum of 24-hours inside of the fabrication facility before packaging. Plastic wrapping which may trap moisture shall not be used. Signs shall be packaged face-to-face and back-to-back placing slip sheeting (silicone side of liner) against each sign face and a non-permeable separator (such as a piece of plastic) shall be placed between signs.

Finished signs shall be shipped on edge and shall not be stacked. Packaging methods which will result in heavy pressure on the face of the signs shall not be used. All packaged signs shall be kept entirely dry until installation. If the sign packaging becomes wet at any time prior to installation, remove the signs, thoroughly dry off and repackage with dry materials. Adhesive tapes shall not be applied to any sign surfaces. Signs shall be adequately protected and supported to avoid scuffing.

Signs delivered for use on the Project shall be stored off the ground. The signs shall be stored in a manner meeting the recommendations of the fabricator and the approval of the Engineer which will prevent moisture on the sign faces and excessive ambient temperatures.

661.4-ERECTION:

661.4.1-General: All signs and delineators shall be installed at the points designated on the Plans or by the Engineer in accordance with these specifications, the Plans, and approved shop drawings and shall be erected in reasonably close conformity to the locations, elevations, and angles shown on the Plans or established by the Engineer.

Sign assembly placement requirements are specified in Section 657. All delineators shall be installed at the points designated on the Plans or in the Standard Details unless otherwise directed by the Engineer.

After installation of the signs, they shall be inspected at night by the Engineer. If specular reflection is apparent on any sign, its positioning shall be adjusted by the Contractor at his expense to correct this condition.

661.4.2-Signs: Signs shall be attached in accordance with the applicable Standard Detail drawings using hardware meeting the specifications herein or details and hardware specified in the Plans. All signs shall be level after installation. Any appreciable buckling, warping, or other defects in the sign panels due to improper installation shall be cause for rejection of the entire sign.

Signs to be mounted to round poles shall be installed in accordance with Standard Detail TE9-1. All banding for Type 1 pole mount installations shall be double wrapped.

Sign designated in the Plans to be reused shall be carefully removed and stored to prevent damage and shall be reinstalled in accordance with the Standard Details or as specified in the Plans.

661.4.3-Reflective Sign Support Strips: Reflective Sign Support Strips shall be located and installed on assemblies called for in the Plans. Strips shall be installed as shown on

Standard Detail TE12-1. Strips shall be installed in accordance with the strip manufacturer's recommendations.

When installing Reflective Sign Support Strips having a flat cross-sectional shape on the flange side of u-channel supports, the Contractor shall take care in order to not over tighten the hardware causing deformation of the face of the strip.

661.4.4-Delineators:

661.4.4.1-Location: Delineators shall be spaced and placed in accordance with Standard Details TE11-1 through TE11-3C unless otherwise specified in the Plans.

Color of delineators shall be in accordance with the Standard Details. Delineator color shall match the color of the pavement marking that the delineator is intended to supplement, with the exception of red sheeting intended to warn wrong direction traffic.

Where an obstruction intrudes into the space between the pavement edge and the extension of the line of the delineators, the delineators should be transitioned to be in line with or inside the innermost edge of the obstruction. When uniform spacing is interrupted by such features as driveways and intersections, delineators which would ordinarily be located within the features may be relocated in either direction for a distance not exceeding one quarter of the uniform spacing. Delineators still falling within such features may be eliminated.

661.4.4.2-Installation: Surface Mounted Flexible Tubular Markers, Soil Anchored Flexible Delineator Posts, Guardrail Mounted Delineator Posts, and Type B-1 Delineators shall be installed in accordance with the manufacturer's recommendations. All Surface Mounted Tubular Markers and permanent B-1 Delineators shall be fastened to the surface using the recommended hardware supplied by the manufacturer.

XS-1 delineators shall be installed in accordance with the provided details. XS-1 delineators installed on bridges with a bicycle railing shall be installed in accordance with Standard Detail TE11-2B.

661.4.5-Final Clean Up: Before final inspection, the Contractor shall perform any touching up on paint finishes, cleaning of exposed sign and support surfaces, and leveling and repair of the site as may be deemed necessary by the Engineer to insure the effectiveness and neat appearance of the work.

661.5-METHOD OF MEASUREMENT:

661.5.1-Signs: Measurement for payment for all types of signs will be based on the area in square feet of the sign faces. Areas shall be calculated to the nearest 0.01 square foot for each sign and to the nearest square foot for the total quantity. The area of any sign shall be the area of the smallest rectangular, triangular or trapezoidal shape that will encompass the entire sign; except for extruded panel signs, which shall have an area equal to the smallest combination of rectangular, triangular, or trapezoidal shapes that constitute the sign.

661.5.2-Reflective Sign Support Strips: Measurement for payment for Reflective Sign Support Strips will be based on the actual number of strips necessary to complete the work. The presence of a strip or combination of strips on any one face of a support shall constitute one unit.

661.5.3-Delineators: Measurement for payment for Surface Mounted Flexible Tubular Markers, Soil Anchored Flexible Delineator Posts, Guardrail Mounted Delineator Posts, Type B-1 Delineators, and XS-1 Delineators will be based on the actual number of such devices necessary to complete the work.

661.5.4-XS-2 Offset Bracket: Payment for any required XS-2 Offset Brackets shall be paid for incidental to the Contract bid items. Payment shall include hardware necessary to install the bracket.

661.5.5-Installation of Reusable Signs: Measurement for payment for installation of reusable signs will be based on the actual number of signs the Contractor is required to remove and reinstall.

661.6-BASIS OF PAYMENT:

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

All incidental work and materials for which no basis of payment is provided will be considered as completely covered by the prices bid for the items included in the Contract.

661.6.1-Signs: Payment will be made at the contract unit price per square foot of sign for the appropriate type of sign. This price shall be full compensation for fabricating, furnishing, and attaching the sign or sign assembly to the post or posts as shown on the Plans or specified. It shall include the furnishing of the aluminum sign panels; all framing, bracing, attachment, and connections necessary to attach the signs to the supports; furnishing and applying the reflective sheeting, or other sign facing material; furnishing and applying the demountable copy or the process material and screens for screening the legend and border to the sign face as required by the Plans; and furnishing all hardware required for the above. This item does not include posts.

661.6.2-Reflective Sign Support Strips: Payment will be made at the contract unit price per each Reflective Sign Support Strip. This price shall be full compensation for fabricating, furnishing, and attaching the strip to the support as shown on Standard Detail TE12-1 or as recommended by the manufacturer. It shall include the furnishing of the strips and all hardware necessary to attach the strip to the support.

661.6.3-Delineators: Payment will be made at the contract unit price per installation for Surface Mounted Flexible Tubular Markers, Soil Anchored Flexible Delineator Posts, Guardrail Mounted Delineator Posts, Type B-1 Delineators, and XS-1 Delineators. Payment shall include all materials, including u-channel supports, anchors, and hardware necessary to install the delineators. The same unit price shall be paid for delineators of the same type having sheeting on one or both faces.

661.6.4-Installation of Reusable Signs: Payment will be made at the contract unit price per installation of reusable sign. This price shall be full compensation for transporting the sign to the nearest possible location shown on the Plans and erection of the sign, including

furnishing the necessary hardware and all other material, labor, equipment and tools necessary to complete the installation.

661.7-PAY ITEMS:

ITEM	DESCRIPTION	UNIT
661001-*	0.080 Flat Sheet Sign	Square Foot
661002-*	Extruded Panel Sign	Square Foot
661003-*	Reflective Sign Support Strip	Each
661011-*	Installation of Reusable Sign	Each
661014-*	Surface Mounted Flexible Tubular Marker	Each
661015-*	Soil Anchored Flexible Delineator Post	Each
661016-*	Guardrail Mounted Delineator Post	Each
661017-*	XS-1 Delineator	Each
661020-*	Delineator, Type B-1	Each

* Sequence Number

SECTION 663
PAVEMENT MARKINGS

RENAME THIS SECTION AS FOLLOWS:

SECTION 663
PAVEMENT MARKINGS AND RUMBLE STRIPS

663.1-DESCRIPTION:

DELETE THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

663.1-DESCRIPTION:

663.1.1-Pavement Markings: Pavement markings shall consist of furnishing and installing various types of markings. It shall include, but is not limited to, edge lines, lane lines, center lines, channelizing lines, intersection markings, stripes, curb markings, island markings, and raised markers, or combinations thereof, in accordance with Contract plans and the following specifications or as directed by the Engineer.

All details not specified or shown on the Plans shall conform to the details and requirements set forth in the following publications. These publications shall collectively be referred to as the "pavement marking standards" throughout the remainder of this Section:

1. The WVDOH Standard Details Book, Vol. II, Signing, Signals, Lighting, and Marking, latest issue date
2. The Manual on Uniform Traffic Control Devices for Streets and Highways, latest issue, as printed by the Federal Highway Administration, U.S. Department of Transportation. (Referred to as the MUTCD.)

663.1.2- Rumble Strips: This work consists of cutting or milling rumble strips on the centerline or edge of roadways in accordance with the details and notes on the plans, or referenced herein, and as directed by the Engineer.

Unless otherwise specified in the plans, edge line rumble strips shall be installed in accordance with sheet PVT2 of the WVDOH Standard Details Book, Vol. I, Drainage, Guardrail, Pavement, Fence, Markers and Mailbox, latest issue date.

The Contractor shall pre-mark the location of the center of each cut, and the beginning and ending points of the sections, prior to the installation of the Rumble Strips. The Engineer shall review and approve the locations.

Rumble Strips shall not be installed on bridge decks, loop detector saw-cut locations, structures, approach slabs or in other areas identified by the Engineer.

The method and equipment for constructing rumble strips shall be selected by the Contractor and shall meet the requirements of 663.5.10.

Rumble Strips shall be constructed within two (2) inches of the required alignment.

Rumble Strips shall not vary from the dimensions shown on the plans or sheet PVT2, as applicable, by more than 0.10 inch in depth and five percent (5%) in width.

Finished Rumble Strips not meeting the specified tolerances shall be brought within tolerance by either abrasive grinding, or removal and replacement. The corrective method will be selected by the Engineer. Ground surface areas shall be neat and uniform in appearance. The corrective work shall be at the Contractor's expense.

All removed material shall become the property of the Contractor and disposed of in conformance with provisions in Section 415, "Milling of Asphalt Surfaces" of the Standard Specifications or as approved by the Engineer. Rumble Strip slots shall be properly cleaned after installation.

663.3-TYPES OF PAVEMENT MARKINGS:

663.3.8-Arrows:

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

Arrows shall be white beaded markings located as shown on the Plans or otherwise in the pavement marking standards. Dimensioning shall be in accordance with the pavement marking standards. Arrows may be one of the following:

1. One Directional Lane Assignment Arrows
2. Multi Directional Lane Assignment Arrows
3. Ramp Wrong Way Arrows
4. Lane Drop Arrows
5. Roundabout Arrow with One Arrow
6. Roundabout Arrow with Multiple Arrows

663.5-APPLICATION:

ADD THE FOLLOWING SUBSECTION:

663.5.10- Rumble Strip Equipment: Equipment utilized for installing Rumble Strips shall be suitable for the application and shall allow for the efficient installation of Rumble

Strips that are uniform, consistent, and accurately placed. Cutting equipment shall provide a relatively smooth cut per milled section without tearing or snagging.

663.6-METHOD OF MEASUREMENT:

DELETE THIS SECTION AND REPLACE WITH THE FOLLOWING:

663.6-METHOD OF MEASUREMENT:

663.6.1-Pavement Markings: Pavement markings shall be measured complete in place in the units designated below. Length measurements shall exclude gaps. Calibrated and verified odometer measurements will be acceptable as method of measurement on edge lines (mainline only), lane lines, and centerlines only for plan quantities in excess of 10,000 linear feet (3 000 m) or two linear miles (3.2 km).

Island marking will be measured by the square foot (meter) of island area painted.

Type P-2 markers, Type S markers, and Type R-4 markers shall be measured in units of each, completely installed as specified herein. Payment for the installation of Type P-2 and Type S markers shall include payment for the marker lens, regardless of whether the lens is factory or field installed.

Yield Triangle, Handicapped symbol, Bicycle Symbol, Arrow, Lane Letter, and Railroad Crossing Marking intersection markings shall be measured in units of each, completely installed as specified herein. One unit of the Railroad Crossing Marking shall consist of the large "X" and the two "R" letters necessary to install the complete marking in one direction.

663.6.2-Rumble Strips: This work shall be measured for payment by the actual linear feet of Rumble Strips placed and accepted, without regard to the width of the strip. This distance shall be measured longitudinally along the centerline of pavement with deductions for bridge decks, drainage structures, raised pavement markers, loop detector saw-cut locations, and any other sections where Rumble Strips were not installed.

663.7-BASIS OF PAYMENT:

ADD THE FOLLOWING SUBSECTION:

663.7.2-Rumble Strips: The Contract unit price per foot for Rumble Strips will be paid for the pay items listed in Section 663.8. The price shall include furnishing all equipment, tools, labor, and work incidental thereto and also disposal of any waste material resulting from this operation.

663.8-PAY ITEMS:

ADD THE FOLLOWING ITEMS TO THE TABLE:

ITEM	DESCRIPTION	UNIT
663010-*	Roundabout Arrow with One Arrow, Type V	Each
663010-*	Roundabout Arrow with Multiple Arrows, Type V	Each
663040-*	Edge Line Rumble Strip, "pavement"	Linear Foot
663041-*	Centerline Rumble Strip, "pavement"	Linear Foot

SECTION 664
TRAFFIC SAFETY DEVICES

DELETE THE ENTIRE CONTENTS AND REPLACE WITH THE FOLLOWING:

SECTION 664
IMPACT ATTENUATORS

664.1-DESCRIPTION:

This work shall consist of the furnishing, assembly, and installation of Impact Attenuators in accordance with these Specifications, Plans, device manufacturer specifications and Installation Drawings, or as established by the Engineer. All work shall be done in a uniform, workmanlike manner.

All details not specified or not shown on the Plans shall conform to the details and requirements set forth in the following specifications and publications:

i. American Association of State and Highway Transportation Officials (AASHTO), Roadside Design Guide, latest issue including revisions, hereinafter referred to in this Section as the RDG

664.2-MATERIALS:

Materials furnished shall be of new stock, shall be the product of reputable manufacturers, shall conform to the Specifications, and shall meet the approval of the Engineer. Materials shall conform to the general requirements of subsection 715.41 and the requirements of the following subsections:

MATERIALS	SUBSECTION
Class 1 Impact Attenuator	715.41.1
Class 2 Impact Attenuator	715.41.2

Approved devices are listed on the Division Approved Products List (APL) for Impact Attenuators – MASH.

The design width and tapered or non-tapered characteristics of each device are noted on the APL. In cases where a device with tapered sides would normally be required to properly shield an object, the Contractor may at their option choose to provide and install a Class 1 device with non-tapered sides and a rigid tapered transition from the device to the obstacle being shielded, provided specific criteria are met. Criteria to be met and additional drawings to be included with the Contractor's Installation Drawing submittal are provided in Appendix A of WVDOH Design Directive 666, Impact Attenuators. In addition, the transition shall be MASH compliant at the same Test Level as is required for the Impact Attenuator. The Contractor shall provide documentation sufficient in the WVDOH's determination to support this upon request.

664.3-INSTALLATION DRAWINGS:

The Contractor shall submit eight (8) sets of installation drawings for all permanent Class 1 and 2 Impact Attenuators for approval prior to installation. Drawings shall be site specific providing an accurate representation of the obstacle being shielded, approach area, concrete pads

and backups to be installed, as well as any required transitions. The drawings shall clearly specify required concrete strength, reinforcement requirements, anchoring requirements, connection to existing barrier requirements, as well as the device brand name and model number. The drawings shall include assembly details.

The installation drawings shall also include all applicable details previously described for any rigid transition to be used to achieve a greater width as allowed for in Section 664.2.

Installation drawings will be reviewed and, if approved, stamped and returned to the Contractor. Multiple devices of the same design to be installed under identical conditions may be represented by one (1) set of drawings.

664.4-CONSTRUCTION METHODS:

All Impact Attenuators shall be placed, assembled, and installed in accordance with the manufacturer specifications and Installation Drawings.

Class 1 devices shall be installed on a concrete foundation, this being a bridge deck or concrete pad fully designed and specified by the manufacturer.

If the manufacturer Installation Drawings require a concrete block backup separate from any concrete backup structure constructed under other provisions of the Specifications, the backup shall be constructed by the Contractor in accordance with the Installation Drawing requirements.

If adhesive type anchors are required to anchor the device, the Contractor shall not fully tighten the device anchors until after the adhesive has fully cured.

When installing a Class 2 Impact Attenuator, the Contractor shall assess the need for soil plates in accordance with the recommendations of the manufacturer and utilize such if recommended. Soil plates shall be utilized regardless of manufacturer recommendations if directed by the Engineer.

The nose or impact head of all devices shall be delineated with a striped, retroreflective panel or decal. The retroreflective material shall meet the requirements for fluorescent yellow Type ASTM-XI retroreflective sheeting, as provided elsewhere within the Specifications. The design of the panel or decal shall be in substantial conformance with the XS-15 design provided in the WVDOH Sign Fabrication Details manual, except all right shoulder mounted devices shall have all stripes sloping down and to the left, and all left shoulder mounted devices shall have all stripes sloping down and to the right.

664.5-METHOD OF MEASUREMENT:

Attenuators will be measured as a unit, complete and in place.

664.6-BASIS OF PAYMENT:

The quantities, determined as provided above, shall 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 work prescribed in a workmanlike and acceptable manner, including all tools, equipment, supplies, and incidentals necessary to complete. All incidental work and materials for which no basis of payment is provided will be considered as completely covered by the prices bid for the items included in the contract.

664.7-PAY ITEMS:

ITEM	DESCRIPTION	UNIT
664015-*	Impact Attenuator, C-1, TL-2, "Design Width in Inches"	Each
664016-*	Impact Attenuator, C-1, TL-2, 36+"	Each
664020-*	Impact Attenuator, C-1, TL-3, "Design Width in Inches"	Each
664021-*	Impact Attenuator, C-1, TL-3, 36+"	Each
664025-*	Impact Attenuator, C-2, TL-3, 24"	Each

* Sequence number
C = Class Number shall be designated as C-1 or C-2
TL = MASH Test Level shall be designated as TL-2 or TL-3
"Design Width in Inches" shall be 24", 30", or 36"

SECTION 679
OVERLAYING OF PORTLAND CEMENT CONCRETE BRIDGE DECKS

679.1-DESCRIPTIONS:

679.1.2-Definitions:

DELETE SUBSECTION 679.1.2.1 AND REPLACE WITH THE FOLLOWING:

679.1.2.1-Specialized Concrete Overlay: Two types of specialized concrete overlay are permitted as follows:

1) **Latex Modified Concrete:** A Portland cement concrete to which an approved styrene butadiene latex admixture has been added.
2) **Silica Fume Concrete:** A Portland cement concrete to which an approved silica fume admixture has been added.

679.2-MATERIALS:

679.2.1-General:

679.2.1.4-Microsilica Admixture:

DELETE SUBSECTION TITLE AND CONTENTS OF 679.2.1.4 AND REPLACE WITH THE FOLLOWING:

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

679.2.2-Specialized Concrete Mix Design and Testing:

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

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

The Contractor shall determine mixture proportions in general accordance with ACI 211.1, "Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete." Establishment of mixture proportions shall be coordinated with the manufacturer of the latex or silica fume admixture.

Prior to the start of construction, the Contractor shall design and submit to the Engineer for approval the proportion of materials, including admixtures, to be used which will result in a workable concrete having the applicable properties enumerated below, including those of section 679.2.2.1 or 679.2.2.2. This mix design shall be prepared in accordance with MP 711.03.23.

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

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

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

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

The Contractor shall obtain a written statement from the manufacturer of the latex or silica fume admixture that confirms the compatibility of the material combination and the sequence in which they are combined. The written statement, along with the results of all required tests,

shall be furnished to the Engineer prior to the pre-construction meeting (refer to 679.2.2.3). Substantiating data showing compliance with the requirements of this specification shall also be submitted. This data shall also include the sources of coarse and fine aggregates as well as the brands of all admixtures to be used.

Contractor's Quality Control: Quality control of the specialized concrete is the responsibility of the Contractor as designated in MP 601.03.50. The Contractor shall maintain equipment and qualified personnel, including at least one certified Portland Cement Concrete Technician who shall direct all field inspection, sampling, and testing necessary to determine the magnitude of the various properties of concrete governed by the Specifications and shall maintain these properties within the limits of this Specification. The Contactor's personnel who conduct the field sampling and testing shall be a certified Portland Cement Concrete Inspector. The quality control plan designated in MP 601.03.50 shall be submitted to the Engineer at the preconstruction conference. Work shall not begin until the plan is reviewed for conformance with the contract documents.

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

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

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

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

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

Gradation testing shall be performed in accordance with Section 601.3.2.4.

679.2.2.2-Microsilica Concrete:

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

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

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

Table 679.2.2.2

Silica Fume Content (e) (Dry Weight)	50 lb./cu. yd., minimum (30 kg/m³, minimum)

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

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

679.2.3-Equipment:

679.2.3.3-Proportioning and Mixing Equipment:

679.2.3.3.2- Microsilica Concrete:

DELETE SUBSECTION TITLE AND CONTENTS OF 679.2.3.3.2 AND REPLACE WITH THE FOLLOWING:

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

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

679.2.3.4-Mobile Mixer Units:

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

Coarse Aggregate	±2%
Fine Aggregate	±2%
Cement + fly ash	0% to +4%
Water	±1%
Cement + silica fume powder	1%
Latex Admixture	1%
Other Admixtures	3%

679.3-CONSTRUCTION METHODS:

679.3.1-Removal of Existing Deck Surface:

679.3.1.1-Removal of Existing Deck Surface Phase I:

DELETE THE CONTENTS OF SUBSECTION 679.3.1.1 AND REPLACE WITH THE FOLLOWING:

The Contractor shall determine the depth to the top mat of reinforcing steel using methods acceptable to the Engineer. The existing deck shall be removed so as to expose the topmost components of rebar in the upper mat of reinforcement. Full exposure of the upper mat of reinforcement is not required. The deck removal shall be accomplished by roto-milling, hydrodemolishing, or any means acceptable to the Engineer.

After removal of the deck is complete as described above, the Contractor shall sound the deck using chain drags and delineate remaining areas of delaminated and unsound concrete for removal subject to the approval of the Engineer. Aerosol spray paint for delineating shall be provided by the Contractor. Edges around these concrete removal areas shall be vertical or slightly undercut. Upon completion of removal, the Contractor shall provide a hydrodemolished surface on which to install the new concrete Overlay.

When full depth removal of material is necessary, the forming shall be performed in accordance with Sections 104.3 and 109.4 of the Specifications.

679.3.6-Placing, Finishing and Curing Slab Reconstruction Concrete:

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

Overlay Type	Slab Reconstruction Concrete
Latex Modified	Latex Modified or Class K
Silica Fume	Silica Fume or Class K

679.3.6.1-Slab Reconstruction Concrete Curing Requirements:

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

Curing shall be accomplished in the following manner:

Latex Modified Concrete. Curing shall be performed in accordance with 679.3.7.5.1.

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

The use of membrane curing compounds shall not be allowed.

679.3.7-Placing and Finishing Specialized Concrete Overlay:

679.3.7.1-General:

DELETE THE CONTENTS OF SUBSECTION 679.3.7.1 AND REPLACE THE FOLLOWING:

The following requirements shall apply for specialized concrete overlay placements:

a) The overlay thickness shall be determined in accordance with Section 679.3. The Contractor shall restore the concrete overlay in a uniform manner to match existing grade unless otherwise directed by the Engineer. Under no circumstance, the overlay thickness shall not be less than 1 ¼ inches.
b) The prepared surface of the structural slab shall be protected from contamination by any source and shall be in a saturated surface dry condition immediately prior to concrete placement.
c) Concrete may be mixed at the point of deposition.
d) When placing Specialized Concrete Overlays on a newly placed deck, the deck concrete shall be a minimum of 28 days old. The sidewalks, parapets, or curbs shall be a minimum of 7 days old.

679.3.7.5-Curing:
679.3.7.5.2-Curing Microsilica Concrete:

DELETE SUBSECTION 679.3.7.5.2 AND REPLACE WITH THE FOLLOWING:

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

679.4-CONSTRUCTION LIMITATIONS AND REQUIREMENTS:
679.4.8-External Heat Provisions:

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

d. Continuous wetting will not be required, but the burlap shall be kept wet by wetting at regular intervals in a manner satisfactory to the Engineer for silica fume concrete.

679.5-FINAL BRIDGE DECK FINISH:
679.5.1-Straightedge Test:

DELETE THE CONTENTS OF SUBSECTION 679.5.1 AND REPLACE THE FOLLOWING:

After defective or damaged concrete has been repaired and cured in accordance with 679.4.9 and before opening to traffic, the bridge deck shall be grooved as set forth in 679.5.2. Prior to grooving, the entire deck shall be checked with an approved 10 foot rolling straightedge or approved inertial profiler and inertial profile operator as outlined in section 720.2.

679.5.2-Finished Deck Grooving:

DELETE THE ENTIRE CONTENTS OF SUBSECTION 679.5.2 AND REPLACE THE FOLLOWING:

679.5.2-Finished Deck Grooving:

679.5.2.1-Transverse Grooving: After corrective grinding and before opening to traffic, grooves shall be cut into the concrete using a mechanical saw. These grooves shall be 0.10 inch (2.5 mm) wide and 0.25inch (6 mm) deep. Groove spacing shall be 1.5 inches (37 mm) center to center. No later than one week prior to grooving operations, the Contractor shall provide the Engineer with two accurate, easily readable gauges with which to verify groove dimensions. Groove depth and spacing tolerances are limited to ±1/16 inch (1.5 mm). Groove width tolerances are +0.02 inch (0.5 mm) and -0.0 inch (0 mm). Grooves shall be cut continuously across the deck to within 1 ft. (300 mm) of gutter lines or drainage structures. Grooves shall also be continuous across the full width of the deck surface including construction joints. Grooves shall terminate within 1 in. (25 mm) of any exposed metal component or elastomeric concrete of an expansion joint. When the deck is skewed and the contractor is using gang blades to saw the grooves, the maximum distance (measured perpendicular to the centerline of the expansion joint) from the last groove termination in the pass to the expansion joint shall be 1ft., 8 inches (200 mm). Radial grooving shall be performed in increments limited to 12 ft. (3.6 m) of bridge length.

679.5.2.2-Longitudinal Grooving: Use diamond blades mounted on a multi-blade arbor on self-propelled machines that were built for grooving of concrete surfaces. The groove machines shall have depth control devices that detect variations in the pavement surface and adjust the cutting head height to maintain the specified depth of the groove. The grooving machines shall have devices to control alignment. Do not use flailing or impact type grooving equipment. More than one size grooving machine may be required in order to saw the grooves as specified.

Provide an experienced technician to supervise the location, alignment, layout, dimension, and grooving of the surface.

Saw grooves parallel to the bridge centerline in a continuous pattern across the surface. Begin and end sawing 9 to 12 inches (220 to 300 mm) from any device in place in a bridge deck, such as scuppers or expansion joints. Stop sawing a minimum of 2 inches (50 mm) to a maximum of 24 inches (600 mm) from skewed expansion joints. Maintain a clearance of a minimum of 2 inches (50 mm) and a maximum of 4 inches (100 mm) from the grooves to longitudinal joints in the deck. Maintain a minimum clearance of 9 inches (220 mm) to a maximum of 30 inches (750 mm) clearance between the grooves and the curb or parapet toe. However, at no point shall un-grooved portions of deck extend beyond edge line and into the temporary or permanent travelled lanes. Saw grooves in a uniform pattern spaced at 3/4 inch minus 1/4 inch or plus 0 inches (19 mm minus 6 mm or plus 0 mm). Saw grooves 0.15 inches (4 mm) deep and 0.10 inches (3 mm) wide. Groove tolerances for depth are +0.0625 inches (2 mm) and minus 0 inches (0 mm). Groove tolerances for width are +0.02 inches (0.5 mm) and minus 0 inches (0 mm).

For staged, or phased bridge deck work, saw the grooves parallel to the final, permanent bridge centerline. If the different stages or phases of the bridge deck work occur within one

construction season, any stage opened to traffic shall receive an interim coarse broom finish during placement, then saw the longitudinal grooves after the final stage. The interim broom finish will not be allowed as a surface texture when opened to traffic over a winter season. Saw longitudinal grooves in the deck prior to opening to traffic for a winter season.

For bridge decks that widen from one end to the other, saw the longitudinal grooves parallel to the centerline of the roadway. On the side of the bridge that widens, saw the longitudinal grooves to follow the edge line. Saw longitudinal grooves in the gore areas, avoiding the overlapping of grooves.

At the beginning of each work shift, furnish a full complement of grooving blades with each saw that are capable of cutting grooves of the specified width, depth, and spacing.

If during the work, a single grooving blade on a machine becomes incapable of cutting a groove, continue work for the remainder of the work shift. The Contractor is not required to cut the groove omitted because of the failed blade. Should two or more grooving blades on a machine become incapable of cutting grooves, cease operating the machine until it is repaired.

Continuously remove all slurry and remaining residue from the grooving operation and leave the deck surface in a clean condition. Prevent residue from grooving operations from flowing across shoulders or across lanes occupied by public traffic or from flowing into gutters or other drainage facilities. Remove solid residue before the residue is blown by passing traffic or by wind.

Provide water as necessary to saw grooves according to this subsection.

679.7-BASIS OF PAYMENT:

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

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

SECTION 687
SHOP PAINTING METAL STRUCTURES

687.2-GENERAL:

687.2.1-Surface Preparation:

687.2.1.2-Blasting:

DELETE SUBSECTIONS 687.2.1.2.1, 687.2.1.2.2, 687.2.1.2.3, AND 687.2.1.2.4 AND REPLACE WITH THE FOLLOWING:

687.2.1.2.1-Commercial Blast: Shall meet the requirements of SSPC-SP 6/NACE 3 prior to painting. The appearance of the steel surface after blast cleaning shall correspond to the applicable and current SP 6 pictorial standards of SSPC Vis 1.

687.2.1.2.2-Brush-Off Blast: Shall meet the requirements of SSPC-SP 7/ NACE 4 prior to painting. The appearance of the steel surface after brush off blast cleaning shall correspond to the applicable and current SP 7 pictorial standards of SSPC Vis 1.

687.2.1.2.3-Near White Metal Blast: Shall meet the requirements of SSPC-SP 10/ NACE 2 prior to painting. The appearance of the steel surface after blast cleaning shall correspond to the applicable and current SP 10 pictorial standards of SSPC Vis 1.

687.2.1.2.4-White Metal Blast: Shall meet the requirements of SSPC-SP 5/ NACE 1 prior to painting. The appearance of the steel surface after blast cleaning shall correspond to the applicable and current SP 5 pictorial standards of SSPC Vis 1.

SECTION 688
FIELD PAINTING METAL OF METAL STRUCTURES

688.2-GENERAL:

687.2.1-Surface Preparation:

688.2.2.2-Blasting:

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

688.2.2.2.1-Commercial Blast: Shall meet the requirements of SSPC-SP 6/NACE 3 prior to painting. The appearance of the steel surface after blast cleaning shall correspond to the applicable and current SP 6 pictorial standards of SSPC Vis 1.

688.2.2.2.2-Brush-Off Blast: Shall meet the requirements of SSPC-SP 7/NACE 4 prior to painting. The appearance of the steel surface after brush-off blast cleaning shall correspond to the applicable and current SP 7 pictorial standards of SSPC Vis 1.

688.2.2.2.3-Near White Metal Blast: Shall meet the requirements of SSPC-SP 10/NACE 2 prior to painting. The appearance of the steel surface after blast cleaning shall correspond to the applicable and current SP 10 pictorial standards of SSPC Vis 1.

688.2.2.3-Water Jetting: Shall meet the requirements of SSPC-SP WJ-1/ NACE WJ and visual standard condition WJ-1 prior to painting.

688.3-COMPLETE PAINTING OF EXISTING STRUCTURES:

688.3.4-Painting Sequence:

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

FULL PRIME COAT:

The structure shall receive one coat of a primer meeting the requirements of Section 711. The full prime coat shall be applied before the stripe coat. The primer used for the full prime coat and the stripe prime coat shall be of the same type and shall be from

the same manufacturer. Dry film thickness requirements shall be as specified by the manufacturer's recommendations, or as specified in the contract documents.

STRIPE COAT:

All edges, outside corners, seams, bolt heads and nuts, all rivet heads, edges of flanges and plates, welds, sharp edges, in general all edges, shall receive one stripe coat, by brush or roller application, of the same primer as the Full Prime Coat. Striping shall extend a minimum of one inch (2 cm) from the edge. The prime coat shall at a minimum, be set-to-touch before the stripe coat is applied. No dry film thickness is specified for this coat. This coat shall be tinted as allowed by the manufacturer to be in contrast to the full prime coat and intermediate coat. The tinting agent shall be the paint manufacturer's approved tinting agent.

INTERMEDIATE COAT:

The structure shall receive one uniform coat of a paint meeting the requirements of Section 711. The color shall be in contrast to the prime and top coats. If tinting is required, the tinting agent shall be the paint manufacturer's approved tinting agent. The intermediate coat shall not be applied until the primer and stripe coat have fully cured according to the manufacturer's recommendations. Dry film thickness requirements shall be as specified by the manufacturer's recommendations, or as specified in the contract documents.

CAULKING:

Caulking shall be applied before the application of the topcoat. This includes all seams between diaphragm connections to stiffeners and splices and seams between any connection that is riveted or bolted. Any welded connections that are not fully sealed by the weld shall be caulked with a paste type caulk. The caulk shall be pressed into the seams between the adjoining surfaces, by wetted finger or specialty tool, to insure bond and provide a smooth uniform surface. Bottom seams shall not be caulked on vertical surfaces.

Caulking in a 3-coat system shall be applied after the intermediate coat has cured. Caulking on a 2-coat system shall be applied after prime coat has cured. The top coat shall not be applied until the caulking has fully cured in accordance with the manufacturer's recommendations.

The caulking material shall be compatible with the paint system being applied and shall be by written recommendation of the paint manufacturer. The caulking material shall be tested for compatibility with the paint system at the same time that the paint is tested for intercoat compatibility. Caulking operations shall be performed only when weather conditions are within the parameters as specified in section 688.2.3.1.

TOP COAT:

The structure shall receive one uniform coat of paint as designated in the plans meeting the requirements of Section 711. The color shall be as designated in the plans and shall be in accordance with current SAE-AMS-STD-595. Dry film thickness requirements shall be as specified by the manufacturer's recommendations, or as specified in the contract documents.

DIVISION 700
MATERIALS DETAILS

SECTION 703
COARSE AGGREGATE

703.4-GRADING OF COARSE AGGREGATES:

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE THE FOLLOWING:

Coarse aggregate shall be uniformly graded to conform to the requirements of Table 703.4. The gradations for coarse aggregates required by AASHTO M 43 shall be determined in accordance with AASHTO T 27.

The gradation of coarse aggregates in the production of concrete shall be controlled by the Ā value as specified in 501.3 and 601.3. In addition, coarse aggregates to be used in Portland cement concrete shall have no more than one percent by weight passing the No. 200 (75 μm) sieve, except that this percentage may be increased to 1.5 in the case of crushed aggregate if the material finer than the No. 200 (75 μm) sieve consists of the dust of fracture, essentially free from clay or shale. The gradation shall be determined in accordance with AASHTO T 27 and T 11.

When the coarse aggregate is to be used in Portland cement concrete, larger percentages passing the No. 200 (75 μm) sieve in the coarse aggregate fraction will be permitted if the percent passing the No. 200 (75 μm) sieve in the fine aggregate fraction (702.1) is less than the specified maximum. In no event, however, shall the percent passing the No. 200 (75 μm) sieve in the total concrete aggregate be greater than an amount which would exist if both aggregate fractions contained their specified maximum percentage passing the No. 200 (75 μm) sieve.

SECTION 704
STONE AND CRUSHED AGGREGATE

704.7-FILTER MATERIAL:

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

Filter material shall consist of sand, other approved inert material, or a combination thereof, having hard, strong, durable particles. The material shall contain no more than a total of five percent coal, clay lumps, shale, soft fragments, organic matter, and other local deleterious substances.

The material shall conform to the following gradation:

U.S. Standard Sieve Size	Percent Passing, by Weight
2 in. (50 mm)	100
No. 4 (4.75 mm)	65-100
No. 40(425 μm)	25-50
No. 200 (75 μm)	0-25

704.8-SHOT ROCK:

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

Shot rock shall be limestone, sandstone, or other inorganic material acceptable to the Division, having dimensions similar to that which exists after final blasting at the quarry site and prior to crushing. It shall contain material that would generally be retained on a 6 inch (150 mm) sieve, and not larger than that which could be tailgated from a single axle 8 to 10 ton (7 to 9 Mg) dump truck. In addition, some 10 inch to 12 inch (250 to 300 mm) material shall be represented as an intermediate size. Shot rock shall have a maximum weighted loss of 30 percent when subjected to five cycles of the Sodium Sulfate Soundness test, MP 703.00.22.

Acceptance shall be by visual inspection; a written explanation of the manufacturing process shall be provided if requested by the Engineer.

SECTION 705
ASPHALT MATERIALS

705.5-PERFORMANCE GRADED ASPHALT BINDERS:

DELETE THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

Performance Graded (PG) Asphalt Binders shall conform to the requirements in Table 1 of AASHTO M-332, with the following deviations:

1. Manufacturers are not required to meet the requirements of AASHTO T-314 in Direct Tension.
2. For Binders grades with a $J_{nr\ 3.2}$ max requirement of 0.5 kPa^{-1} the manufacturer is not required to meet the 75% requirements for J_{nr} Diff.
3. The indication of elastic response for PG 64E – 22 binders shall be determined using the Appendix X1-Indications of Elastic Response in AASHTO M 332.
4. For Standard Testing Temperatures see Table 705A below.

Table 705A – Performance Graded Asphalt Binders

Binder Grade Designations	Testing Temperature	Non-recoverable creep compliance at 3.2kPa, Jnr (3.2), kPa^{-1}, Max	% Difference in Non-Recoverable Creep Compliance, Jnr(diff), %, Max
PG 58S – 28	58°C	4.5	75%
PG 64S – 22	64°C	4.5	75%
PG 64H – 22	64°C	2.0	75%
PG 64E – 22	64°C	0.5	-

A certified producer or distribution terminal will be the last source to handle/manipulate a PG binder before being shipped to an asphalt concrete plant or project. The producer or terminal will provide the PG binder certification report with the shipment.

SECTION 707
CONCRETE ADMIXTURES, CURING AND COATING MATERIALS

707.1-AIR-ENTRAINING ADMIXTURES FOR CONCRETE:

707.1.1-Acceptance Requirements for Air-Entraining Admixtures:

707.1.1.1:

DELETE THE CONTENTS OF SUBSECTION 707.1.1.1 AND REPLACE WITH THE FOLLOWING:

In the event that the Contractor elects to use an air-entraining admixture, evidence based on testing by NTPEP (National Transportation Product Evaluation Program) shall be submitted to the Division to show that the material conforms to the requirements of AASHTO M 154. Tests for bleeding, bond strength and volume change will not be required unless specifically called for in the Plans.

707.2-WATER-REDUCING AND RETARDING ADMIXTURES FOR CONCRETE:

707.2.1-Acceptance Requirements for Approval of Retarders:

DELETE THE CONTENTS OF SUBSECTION 707.2.1 AND REPLACE WITH THE FOLLOWING:

Water reducing and retarding admixtures for concrete shall be tested by NTPEP (National Transportation Product Evaluation Program). The NTPEP testing results shall meet the requirements of AASHTO M 194, Type D or Type G.

707.3-WATER-REDUCING ADMIXTURES FOR CONCRETE:

707.3.1-Acceptance Requirements for Approval of Water-Reducers:

DELETE THE CONTENTS OF SUBSECTION 707.3.1 AND REPLACE WITH THE FOLLOWING:

Water-reducing admixtures for concrete shall be tested by NTPEP (National Transportation Product Evaluation Program). The NTPEP testing results shall meet the requirements of AASHTO M 194, Type A or Type F.

707.4-POZZOLANIC ADDITIVES FOR USE IN PORTLAND CEMENT CONCRETE:

DELETE SUBSECTION 707.4 TITLE AND CONTENTS AND REPLACE WITH THE FOLLOWING:

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

All SCMs shall be approved in accordance with MP 707.04.10.

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

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

i. 50% minimum reduction in mortar bar expansion when tested in accordance with ASTM C441. The alkali content of test mix shall be equal to or greater than the control mix. The weight of fly ash shall be 20-30 % of weight of cementitious materials.
ii. 0.1% maximum mortar bar expansion, at 16 days after casting, when tested in accordance with ASTM C1567. Very highly reactive aggregate (R3 Class from AASHTO R 80) shall be used as fine aggregate. The weight of fly ash shall be ≤ 35% of the weight of total cementitious materials.

707.4.2-Slag Cement: Slag cement shall conform to the requirements of AASHTO M302.

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

707.4.4-Natural Pozzolans: Natural pozzolans shall conform to the requirements of ASTM C618, Class N.

707.9-LIQUID MEMBRANE-FORMING COMPOUNDS FOR CURING CONCRETE:

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

Curing compounds shall conform to the requirements of ASTM C309, Type 2, Class A.

All curing compound must be tested by NTPEP and shown to meet the specification listed in the paragraph above.

707.13-ACCELERATING ADMIXTURES FOR CONCRETE:

707.13.1-Acceptance Requirements for Approval of Accelerators:

DELETE THE CONTENTS OF SUBSECTION 707.13.1 AND REPLACE WITH THE FOLLOWING:

Accelerating admixtures for concrete shall be non-chloride and shall be tested by NTPEP (National Transportation Product Evaluation Program). The NTPEP testing results shall meet the requirements of AASHTO M 194, Type C.

707.14-WATER-REDUCING AND ACCELERATING ADMIXTURES FOR CONCRETE:

707.14.1-Acceptance Requirements for Approval of Water-Reducing and Accelerating Admixtures:

DELETE THE CONTENTS OF SUBSECTION 707.14.1 AND REPLACE WITH THE FOLLOWING:

Water-reducing and accelerating admixtures for concrete shall be tested by NTPEP (National Transportation Product Evaluation Program). The NTPEP testing results shall meet the requirements of AASHTO M 194, Type E.

707.15-HYDRATION CONTROL STABILIZING ADMIXTURES FOR CONCRETE:

707.15.1-Acceptance Requirements for Approval of Hydration Control Stabilizing Admixtures:

DELETE THE CONTENTS OF SUBSECTION 707.15.1 AND REPLACE WITH THE FOLLOWING

Hydration control stabilizing admixtures for concrete shall be tested by NTPEP (National Transportation Product Evaluation Program). The NTPEP testing results shall meet the requirements of AASHTO M 194, Type B or D.

707.15.2-Performance Requirements for Concrete Hydration Control Stabilizing Admixtures:

DELETE THE CONTENTS OF SUBSECTION 707.15.2 AND REPLACE WITH THE FOLLOWING:

707.15.2.1-The effects of using hydration control stabilizing admixtures may vary widely with different types of cement, cement from different mills, aggregate proportions, aggregates from different sources and of different gradation, and changes in water-cement ratio. Therefore, no hydration control stabilizing admixture shall be used until the concrete of the specified class, designed in accordance with these Specifications and made with the ingredients proposed for use by the Contractor, including hydration control stabilizing admixtures as specified or permitted under this Specification, is shown to meet the requirements of AASHTO M 194 for water reduction and compressive strength increases at ages 3, 7, and 28 days.

707.15.2.2-In order for a concrete mix design, containing a hydration control stabilizing admixture, to be considered for the allowable concrete discharge time extension for excessive haul time, as outlined in Section 601.7, the additional following extended discharge time testing is required in that subject mix design.

Upon completion of the mixing of at least one of the trial batches at the minimum cement factor, for the subject mix design, as required in MP 711.03.23, air content and slump tests in accordance with Section 601.4.1 shall be performed on that trial batch of plastic concrete. A test to establish the initial and final times of setting of the concrete mix shall also be performed, in accordance with ASTM C403. The air content and slump tests shall then be repeated at 45-minute intervals, until a period of 3-hours after the completion of mixing has elapsed.

The value obtained by any of the air content tests during the 3-hour period shall not vary, from the value obtained by the initial air content test, by more than 2.5 percentage points.

The value obtained by any of the slump tests during the 3-hour period shall not vary, from the value obtained by the initial slump test, by more than 1.75 inches (445 mm).

The results of all these tests shall be included, along with all the other information required in MP 711.03.23, when the subject mix design is submitted for approval.

When more than one mix design, for the same Producer/Supplier, is submitted for approval on the same day, only one set of extended discharge time tests, as outlined in paragraphs two through five of this sub-section, will be required for that entire group of mix designs. That one set of extended discharge time tests, for the subject group of mix designs, shall be performed on the mix design, in that group of mix designs, which has the highest cementitious material content. If the results of that set of extended discharge time tests meet the requirements of this sub-section, then all of the mix designs, in that group of mix designs submitted on that same day for that Producer/Supplier, shall be approved for use with the extended discharge time.

707.15.2.3-The subject concrete mix design, and the concrete mix used during construction, shall contain the quantity of admixture recommended by the manufacturer at the prevailing temperature.

707.17-SPECIFIC PERFORMANCE ADMIXTURES FOR CONCRETE:

707.17.1-Acceptance Requirements for Approval of Specific Performance Admixtures:

DELETE THE CONTENTS OF SUBSECTION 707.17.1 AND REPLACE WITH THE FOLLOWING

Specific performance admixtures for concrete shall be tested by NTPEP (National Transportation Product Evaluation Program). The NTPEP testing results shall meet the requirements of AASHTO M 194, Type S.

ADD THE FOLLOWING SUBSECTION:

707.18-FOAMING AGENT ADMIXTURES:

The foaming agent admixtures shall meet the requirements of ASTM C869.

SECTION 708
JOINT MATERIALS

DELETE THE CONTENTS OF SUBSECTION 708.5, 708.6, 708.7, AND 708.8 AND REPLACE WITH THE FOLLOWING:

708.5 through 708.8: Blank

DELETE THE CONTENTS OF SUBSECTION 708.9 AND REPLACE WITH THE FOLLOWING:

708.9-BITUMEN SEALANT:

Bitumen Sealant used as a joint sealer for concrete and masonry shall meet the requirements of ASTM C990.

SECTION 709
METALS

709.1-STEEL BARS FOR CONCRETE REINFORCEMENT:

ADD THE FOLLOWING:

709.1.1-Stainless Steel Bars for Concrete Reinforcement: For corrosion resistant stainless steel, the material shall meet testing requirements of tensile, yield, elongation, and bend requirements listed in ASTM A955/955M and meet requirements set forth in MP 709.1.50 unless otherwise stated in the project plans.

709.1.2-High Chromium Steel Bars for Concrete Reinforcement: For corrosion resistant high chromium steel, the material shall meet testing requirements of tensile, yield, elongation, and bend requirements listed in ASTM A1035/1035M and meet requirements set forth in MP 709.1.50 unless otherwise stated in the project plans.

709.4-WELDED WIRE REINFORCEMENT FOR CONCRETE:

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

Welded and non-welded wire reinforcement for concrete shall conform to the requirements of ASTM A1064, as referenced in MP 709.04.40, except as modified.

Fabric reinforcement for pavement shall be not less than 5 feet (1.5 meters) in width and shall be shipped in sheets and not in rolls. Wire for the slope protection, gutters and miscellaneous items may be shipped in rolls. Sheets shall be bent in the shop as shown on the Plans. Epoxy coating shall meet the requirements of ASTM A 884/A 884M.

709.12-STRUCTURAL AND EYEBAR STEEL:

DELETE THE CONTENTS OF SUBSECTION 709.12 AND REPLACE WITH THE FOLLOWING:

All structural and eyebar steel shall conform to AASHTO M270, Grade 50.

709.15-COATED DOWEL BARS & DOWEL BASKET ASSEMBLIES:

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

Coated dowel bars shall meet the requirements of AASHTO M254 except that the steel used to make the dowel bars shall meet the requirements of Section 709.1. Additionally, the saw

cut ends of the coated dowel bars shall be touched-up with a coating material in accordance with the requirements of Section 602.6.2.

709.24-HIGH-STRENGTH BOLTS FOR STRUCTURAL STEEL JOINTS, INCLUDING SUITABLE NUTS AND HARDENED WASHERS:

DELETE THE ENTIRE SUBSECTION 709.24.1, 709.24.2, 709.24.3, AND 709.24.5 AND REPLACE WITH THE FOLLOWING:

709.24.1-Bolts, Nuts and Washers: All bolts, nuts and washers shall bear the manufacturer's markings and all markings specified in the applicable ASTM specifications. All bolts, nuts and washers supplied shall be domestic, as defined in 106.1.1.1, and the manufacturer and identification marks shall be registered in the Industrial Fastener Institute's Technical Information Report IFI-122.

709.24.2-High-Strength Bolts: High-Strength bolts, black, galvanized or zinc rich coated, shall meet the requirements of ASTM F3125-Grade A325 with the following exceptions. Zinc rich coated fasteners shall also meet the requirements of 709.24.10.

709.24.2.1: Blank

709.24.2.2: Proof load tests (ASTM F606, Method #1) are required for all bolts except as excluded in Section 10.1.3 of ASTM F3125. Minimum frequency of tests shall be as specified in ASTM F3125 paragraph 9.6.1.

709.24.2.3: Wedge tests on full size bolts (ASTM F606, paragraph 3.5) are required. If bolts are to be galvanized or zinc rich coated, tests shall be performed after galvanizing or coating. Minimum frequency of tests shall be specified in ASTM F3125 paragraph 9.6.1.

709.24.2.4: If galvanized or zinc rich coated bolts are supplied, the thickness of the zinc coating shall be measured. Measurements shall be taken on the wrench flats or top of bolt head. If bolts are required to be galvanized, they shall be done so in accordance with ASTM B695

709.24.3-Nuts: Nuts plain, galvanized or zinc rich coated shall meet the following requirements.

709.24.3.1: Nuts to be galvanized or zinc rich coated shall be grade DH or DH3 meeting ASTM A563 or shall be grade 2H meeting ASTM A194. Nuts shall be galvanized according to ASTM B695.

709.24.3.2: Plain (black) nuts shall be grade C, D or C3 meeting ASTM A563 or shall be grade 2 meeting ASTM A194 and shall have a minimum Rockwell hardness of 89 HRB (or Brinell hardness 180 HB). Plain nuts may also be supplied to grades listed in paragraph 709.24.3.1 above.

709.24.3.3: Blank

709.24.3.4: Galvanized and zinc rich coated nuts shall be coated with a lubricant containing a dye of any color that contrasts with the color of the coating.

709.24.3.5: Proof load tests (ASTM F606, paragraph 4.2) are required for all nuts. Minimum frequency of tests shall be as specified in ASTM A563, paragraph 9.3 or ASTM A194 paragraph 8.1.2.1. If nuts are to be galvanized or zinc rich coated, tests shall be performed after coating, overtapping and lubricating.

709.24.3.6: If galvanized or zinc rich coated nuts are supplied, the thickness of the coating shall be measured. Measurements shall be taken on the wrench flats.

709.24.5-Rotational Capacity Testing: Rotational-capacity tests are required and shall be performed on all black (plain), galvanized (after galvanizing) bolt, nut and washer assemblies by the manufacturer or distributor prior to shipping. Washers are required as a part of the test. The following shall apply:

709.24.5.1: Except as modified, the rotational-capacity test shall be performed in accordance with the requirements of ASTM F3125.

709.24.5.2: Each combination of bolt production lot, nut lot and washer lot shall be tested as an assembly.

709.24.5.3: A rotational-capacity lot number shall be assigned to each combination of lots tested.

709.24.5.4: The minimum frequency of testing shall be two assemblies per rotational-capacity lot.

709.24.5.5: The bolt, nut and washer assembly shall be assembled in a Skidmore-Wilhelm Calibrator or an acceptable equivalent device. For short bolts which are too short to be assembled in the Skidmore-Wilhelm Calibrator see Section 709.24.5.9.

709.24.5.6: The minimum rotation, from an initial condition (10% of the specified bolt proof load), shall be:

240° (2/3 turn) for bolt lengths up to and including 4 diameters.
360° (1 turn) for bolt lengths over 4 diameters up to an including 8 diameters.
480° (1-1/3 turn) for bolt lengths over 8 diameters.

709.24.5.7: The tension reached at the above rotation shall be equal to or greater than 1.15 times the required installation tension. The installation tension and the tension for the turn test are shown below:

ENGLISH

Diameter (Inches)	⅝	¾	⅛	1	1⅛	1¼	1½
Required Installation Tension (kips)	19	28	39	51	56	71	103
Turn Test Tension (kips)	22	32	45	59	64	82	118

METRIC

Diameter (mm)	16	20	22	24	27	30	36
Required Installation Tension (kN)	91	142	176	205	276	326	475
Turn Test Tension (kN)	105	163	202	236	317	375	546

709.24.5.8: After the required installation tension listed above has been exceeded, one reading of tension and torque shall be taken and recorded. The torque value shall conform to the following:

Torque (T) $\leq$ 0.25 PD

Where:

Torque (T) = measured torque (foot-pounds) (kN m)
P = measured bolt tension (pounds) (kN)
C = Contractor's total overhead for contract period
D = bolt diameter (feet) (m)

709.24.5.9: Bolts that are too short to test in a Skidmore-Wilhelm Calibrator may be tested in a steel joint. The tension requirement of Section 709.24.5.7 need not apply. The maximum torque requirement of Section 709.24.5.8 shall be computed using a value P equal to the turn test tension shown in the Table in Section 709.24.5.7.

709.51-U-CHANNEL BREAKAWAY MOUNTING DEVICES:

DELETE THE ENTIRE 709.51 SUBSECTION AND REPLACE WITH THE FOLLOWING:

709.51-SURFACE MOUNT SIGN SUPPORT BREAKAWAY DEVICES:

Surface Mount Sign Support Breakaway Devices shall be designed for use with 2-lb/ft and/or 3-lb/ft u-channel supports shown on Standard Details Book Volume II (Standard Details) sheets TE1-7A and TE1-7B, and/or 2" x 14-gauge Square Tube Supports as described in Section 657. The purpose of the device shall be to create an omni-directional breakaway, low maintenance support installation on asphalt and concrete surfaces which does not require any portion of the support to be installed below grade. The device shall be designed for use with one or more of the support types/sizes specified above. Differences in the dimensioning of components used with each type/size support is permissible.

The device shall be designed and tested to meet the following requirements:

i. Withstand loading which meets or exceeds that which will be generated based on the Support Size Selection Chart on Sheet TE1-7A, as well as cyclical loading, without failure.
ii. Shall be compatible with one or more of the u-channel supports listed on the Division Approved Products List (APL) for U-Channel Posts, and/or square tube support which meet the requirements of Section 709.55.
iii. Shall be designed to be surface mounted on both asphalt and concrete surfaces of nominal minimum thickness. Concrete foundations shall not be required.
iv. Components shall be manufactured using aluminum, stainless steel, galvanized steel, exterior grade epoxy coated steel, or similar material exhibiting weather resistance equal to or greater than those described.
v. Shall not require modification of the support for installation.
vi. Shall be designed to be anchored to the surface and shall not require saw cutting, jackhammering, etc. of the asphalt or concrete.
vii. Shall be acceptable for use with supports of the types/sizes that the device is approved for use with regardless of the number of supports. The manufacturer may limit the number of supports within a seven 7-foot path when the device is used. However, a minimum of two supports shall be permissible within a 7-foot path.
viii. Allows the support to break away when impacted from any angle.
ix. Minimizes the risk to pedestrians during and after impacts by not incorporating components which become independent projectiles, or which become potentially hazardous shards projecting above grade.
x. No component not designed to breakaway or yield upon impact shall project more than 4-inches above the surface, providing the device is installed flush to the surface in accordance with the manufacturer's specifications.
xi. May require the replacement of a portion of, or up to all of the system components after impact; however, repair or replacement after impacts shall not be time consuming or labor intensive. The required use of power equipment or expensive, highly specialized equipment to remove damaged components and/or to complete repairs, including instances where the device has been impacted directly by a vehicle tire or undercarriage, shall be unacceptable.
xii. Shall be "crashworthy" when utilized and installed in accordance with the manufacturer's specifications such as brand supports, maximum number of supports within a 7-foot path, etc., and with traffic signs securely mounted to the supports in accordance with the mounting height guidelines provided on Sheet TP3-1A of the Standard Details.

"Crashworthy", as specified herein, shall be defined as compliance with the crash testing 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 the crash testing requirements of the AASHTO Manual for Assessing Safety Hardware (MASH) at Test Levels I, II, and III for projects let after December 31, 2019.

Mandatory guidelines applying to the device such as, but not limited to, the type/size supports it is permitted to be used with, brand supports it is permitted to be used with, and the maximum number of supports permitted within a seven 7-foot path when the device is used, shall be noted on the APL.

The manufacturer shall supply installation instructions and all required components and hardware to the Contractor. This shall include a complete anchoring system to secure the device to the asphalt or concrete surface. The manufacturer shall make available device installation instructions for posting and dissemination by the Division to inspection and maintenance personnel.

709.51.1-Product Submission and Approval: Surface Mount Breakaway Devices to be considered for inclusion on the Division Roadside Sign Support Accessories APL shall be submitted to the Materials Division following the current procedures specified by the Division in MP 106.00.02. The manufacturer should include all relevant documentation and information, including but not limited to Product Data Sheets, Product Flyers, Manufacturer Product Specifications, Product Bulletins, Engineering Drawings, and crash testing performance documentation. The crash testing performance documentation to be submitted shall be in accordance with official guidance issued by the WVDOH.

In addition to the above, field evaluation installations shall be required prior to approval. In order for the device to be approved, evaluation installations installed by or for the Division shall demonstrate levels of durability, reliability, performance, and ease of installation/repair determined to be acceptable to Division evaluation personnel. The duration of the field evaluations shall typically be a minimum of six months to one year. Specific details related to this testing, such as locations and quantities, shall be determined by the Division. Initial and typical repair material costs associated with the device shall also be considered as part of the evaluation.

ADD THE FOLLOWING SUBSECTION:

709.52-STEEL BEAM SIGN SUPPORT OMNI-DIRECTIONAL BREAKAWAY DEVICE:

Steel Beam Sign Support Omni-Directional Breakaway Devices shall be designed for use with Steel Beam roadside sign supports shown on Standard Detail Book Volume II (Standard Details) sheets TE1-3A, TE1-3B, and TE1-3C. The purpose of the device shall be to transform the bi-directional slip base breakaway mechanism of Steel Beam supports into an omni-directional breakaway connection. The device may be designed for use with one or more of the standard size Steel Beam supports shown in the Standard Details.

The device shall be designed and tested to meet the following requirements:

i. Withstand loading which meets or exceeds that which will be generated based on the Support Size Selection Chart on Sheet TE1-3B, as well as cyclical loading, without failure.
ii. Components shall be manufactured using aluminum, stainless steel, galvanized steel, exterior grade epoxy coated steel, or similar material exhibiting weather resistance equal to or greater than those described.
iii. Other than elimination of the keeper plate and/or elimination of the standard connection hardware between the support base plate and the stub post base plate, the device shall require no modifications to the design of the support. This shall include the stub post and the support hinge plates.
iv. Shall be acceptable for use with supports of the sizes that the device is approved for use with regardless of the number of supports connected by the sign(s) or

bracing above the hinge plates. However, the manufacturer may limit the number of supports within a 7-foot width when the device is used. However, in order to be approved for use with S4x7.7 or W6x12 supports, a minimum of two supports within a 7-foot path shall be permissible.

v. Allow the support to break away from the stub support when impacted from any angle.

vi. Minimizes the risk to pedestrians during and after impacts by not incorporating components which become independent projectiles, or which become potentially hazardous shards projecting above grade.

vii. No component not designed to breakaway or yield upon impact shall project more than ½ inch above the top of the support stub.

viii. May require the replacement of a portion of, or up to all of the system components after impact; however, repair or replacement after impacts shall not be time consuming or labor intensive. The required use of power equipment or expensive, highly specialized equipment to remove damaged components and/or to complete repairs, including instances where the device has been impacted directly by a vehicle tire or undercarriage, shall be unacceptable.

ix. Shall not affect the support's compliance with the crash testing 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 31st 2019, and the crash testing requirements of the AASHTO Manual for Assessing Safety Hardware (MASH) at Test Levels I, II, and III for projects let after December 31st 2019. This shall be demonstrable by crash testing performance documentation as described herein.

Mandatory guidelines applying to the device such as, but not limited to, the size supports it is permitted to be used with and the maximum number of supports permitted within a 7-foot span when the device is used, shall be noted on the Approved Products List (APL).

The manufacturer shall supply installation instructions and all required components and hardware to the Contractor. The manufacturer shall make available device installation instructions for posting and dissemination by the Division to inspection and maintenance personnel.

709.52.1-Product Submission and Approval: Omni-Directional Breakaway Devices to be considered for inclusion on the Division Roadside Sign Support Accessories APL shall be submitted to the Materials Division following the current procedures specified by the Division in MP 106.00.02. The manufacturer should include all relevant documentation and information, including but not limited to Product Data Sheets, Product Flyers, Manufacturer Product Specifications, Product Bulletins, Engineering Drawings, and crash testing performance documentation. The crash testing performance documentation to be submitted shall be in accordance with official guidance issued by the WVDOH.

In addition to the above, field evaluation installations shall be required prior to approval. In order for the device to be approved, evaluation installations installed by or for the Division shall demonstrate levels of durability, reliability, performance, and ease of installation/repair determined to be acceptable to Division evaluation personnel. The duration of the field evaluations shall typically be a minimum of six months to one year. Specific details related to this testing, such as locations and quantities, shall be determined by the Division. Initial and

typical repair material costs associated with the device shall also be considered as part of the evaluation.

ADD THE FOLLOWING SUBSECTION:

709.53-SQUARE TUBE SIGN SUPPORTS:

Square Tube Sign Supports shall be manufactured of steel conforming to ASTM Specification A653, Designation SS, Grade 50, Class 1, or ASTM Specification A1011, Grade 50. Square tube supports shall be welded at the corner. The supports shall be galvanized per ASTM A653. A minimum coating thickness as indicated by the G90 designation shall be applied. Supports manufactured using base material conforming to the A1011 specification shall meet the Grade 50 physical requirements after the galvanization process.

Support sizes shall be defined by the outside dimensions and wall thickness of the support. The supports shall be available in wall thicknesses of 10-gauge (0.135" U.S.S. Gauge), 12-gauge (0.105" U.S.S. Gauge), and 14-gauge (0.083" U.S.S. Gauge). 10-gauge supports shall be available in 2-3/16 inch and 2-1/2 inch sizes. 12-gauge supports shall be available in 1-1/2 inch through 2-1/2 inch sizes in ¼-inch increments. 14-gauge supports shall be available in 1-3/4 inch through 2-1/4 inch sizes in ¼-inch increments.

The supports shall be straight and shall have a smooth uniform finish. Each size support shall be telescopable into the next larger size support of the same gauge thickness. In addition, each size support shall be telescopable into the next larger size support of the next thicker gauge size. Supports shall telescope freely and with a minimum amount of play. The supports shall be pre-punched on all four sides on one 1-inch center to center spacing. Holes shall be 3/8-inch (+ 1/16 inch /- 0 inch) diameter after galvanizing.

The manufacturer's square tube support system shall be "crashworthy" under the following conditions:

i. Supports are driven into strong soil, as defined in National Cooperative Highway Research Program Report 350 (NCHRP-350) or the AASHTO Manual for Assessing Safety Hardware (MASH), as applicable, to the manufacturer recommended depth. Supports shall not be required to be driven more than 30-inches in the soil described.

ii. Supports are either directly driven or with a stub that the upper support is telescopable into as described herein. The upper support shall be telescoped into the stub a distance equal to or greater that which is recommended by the manufacturer.

iii. No limit shall be placed on the total number of supports. However, no more than two supports of size 2-inch x 12-ga. or less shall be placed laterally within a 7-foot wide path; and no more than one support of size 2-1/4-inch x 14 or 12-ga., 2-1/2-inch x 12-ga., or 2-3/16-inch x 10-ga. shall be placed laterally within a 7-foot wide path.

iv. Traffic signs are securely mounted to the supports in accordance with the mounting height guidelines provided on Sheet TP3-1A of the WVDOH Standard Details Book Volume II.

"Crashworthy" shall be defined as compliance with the crash testing requirements of NCHRP-350 Test Levels I, II and III for projects let on or prior to December 31. 2019, and the crash testing requirements of the AASHTO MASH at Test Levels I, II, and III for projects let after December 31, 2019. FHWA eligibility letters, crash testing reports, or other supporting documentation shall be provided upon request.

The manufacturer shall make available installation instructions for posting and dissemination by the Division to inspection and maintenance personnel.

ADD THE FOLLOWING SUBSECTION:

709.54-BACK TO BACK U-CHANNEL SIGN SUPPORT BREAKAWAY DEVICE:

Back to Back U-Channel Sign Support Breakaway Devices shall be designed for use with 4-lb/ft and/or 6-lb/ft back to back supports shown on Standard Detail Book Volume II (Standard Details) sheets TE1-7A and TE1-7B. The purpose of the device shall be to create an omni-directional breakaway base connection. The device shall be designed for use with a stub and upper support of one or both of the back to back size supports specified above. Differences in the dimensioning of components used with each size support is permissible.

The device shall be designed and tested to meet the following requirements:

i. Withstand loading which meets or exceeds that which will be generated based on the Support Size Selection Chart on Sheet TE1-7A, as well as cyclical loading, without failure.
ii. Shall be compatible with one or more of the supports listed on the Division Approved Products List (APL) for U-Channel Posts.
iii. Shall function with the stub support installed in a concrete foundation as shown on Standard Detail Sheet TE1-7B.
iv. Components shall be manufactured using aluminum, stainless steel, galvanized steel, exterior grade epoxy coated steel, or similar material exhibiting weather resistance equal to or greater than those described.
v. Shall not require modification of the stub or upper support for installation.
vi. Shall be acceptable for use with supports of the sizes that the device is approved for use with regardless of the number of supports. The manufacturer may limit the number of supports within a seven 7-foot width when the device is used. However, a minimum of two 4-lb/ft or 6-lb/ft back to back supports within a 7-foot width shall be permissible.
vii. Allows the upper support to break away from the stub support when impacted from any angle.
viii. Minimizes the risk to pedestrians during and after impacts by not incorporating components which become independent projectiles, or which become potentially hazardous shards projecting above grade.
ix. Shall allow for installation after concrete is placed around the stub to grade.
x. No component not designed to breakaway or yield upon impact shall project more than 4-inches above ground level, providing the projection of the stub support is in accordance with the manufacturer's recommendations.
xi. May require the replacement of a portion of, or up to all of the system components after impact; however, repair or replacement after impacts shall not be time consuming or labor intensive. The required use of power equipment or expensive,

highly specialized equipment to remove damaged components and/or to complete repairs, including instances where the device has been impacted directly by a vehicle tire or undercarriage, shall be unacceptable.

xii. Shall be "crashworthy" when utilized and installed in accordance with the manufacturer's recommendations such as brand supports, size supports, maximum number of supports within a 7-foot width, etc., and with traffic signs securely mounted to the supports in accordance with the mounting height guidelines provided on Sheet TP3-1A of the Standard Details.

"Crashworthy", as specified herein, shall be defined as compliance with the crash testing 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 31st 2019, and the crash testing requirements of the AASHTO Manual for Assessing Safety Hardware (MASH) at Test Levels I, II, and III for projects let after December 31st 2019.

Mandatory guidelines applying to the device such as, but not limited to, the size supports it is permitted to be used with, brand supports it is permitted to be used with, and the maximum number of supports permitted within a 7-foot path shall be noted on the APL.

The manufacturer shall supply installation instructions and all required components and hardware to the Contractor. The manufacturer shall make available device installation instructions for posting and dissemination by the Division to inspection and maintenance personnel.

709.54.1-Product Submission and Approval: Back to Back U-Channel Breakaway Devices to be considered for inclusion on the Division Roadside Sign Support Accessories APL shall be submitted to the Materials Division following the current procedures specified by the Division in MP 106.00.02. The manufacturer should include all relevant documentation and information, including but not limited to Product Data Sheets, Product Flyers, Manufacturer Product Specifications, Product Bulletins, Engineering Drawings, and crash testing performance documentation. The crash testing performance documentation to be submitted shall be in accordance with official guidance issued by the WVDOH.

In addition to the above, field evaluation installations shall be required prior to approval. In order for the device to be approved, evaluation installations installed by or for the Division shall demonstrate levels of durability, reliability, performance, and ease of installation/repair determined to be acceptable to Division evaluation personnel. The duration of the field evaluations shall typically be a minimum of six months to one year. Specific details related to this testing, such as locations and quantities, shall be determined by the Division. Initial and typical repair material costs associated with the device shall also be considered as part of the evaluation.

ADD THE FOLLOWING SUBSECTION:

709.55-TYPE A AND B BARRIER WALL SIGN SUPPORT BRACKETS:

Type A and B Barrier Wall Sign Support Brackets (Type A and B Brackets) shall be designed for use with 2" x 14-gauge Square Tube Supports meeting the requirements of Section 709.55. The purpose of the device shall be for mounting specified sign assemblies on top of a median barrier wall or parapet.

The brackets shall be designed and tested to meet the following requirements:

i. Type A Brackets and anchoring shall withstand loading which meets or exceeds that which will be generated based on the Support Size Selection Chart on Sheet TE1-7A for the 3-lb/ft u-channel support size, as well as cyclical loading, without failure. The bracket shall meet this requirement with the bracket installed on a 6-inch wide, non-tapered, unreinforced barrier manufactured with concrete meeting a design strength of 3,000-PSI.

ii. Type A Brackets shall be permitted to include side anchors on one or both faces of the barrier. However, the bracket shall not extend more than 4-inches down the face of the barrier. When installed on a barrier with no taper, the bracket shall not extend more than 3/8-inch from the face of the barrier. This requirement does not include the bracket side anchors. However, the anchoring system supplied by the manufacturer for the side anchors shall utilize domed head bolts to minimize the potential for snagging.

iii. Type A Brackets shall be designed such that upon final installation as designed, it shall be possible to install the bracket vertical anchors at the centerline of the wall. The bracket shall meet this requirement when installed on barriers with the following characteristics:

   a. Barrier width at the top is a minimum of 6-inches and is less than 10-inches. Taper on one or both faces of the barrier is as little as 0-inches per foot of height to as much as 1-1/4-inches per foot of height.

   b. Barrier width at the top is a minimum of 6-inches and is 8-inches or less. Taper on one or both faces of the barrier is greater than 1-1/4-inches per foot of height and as much as 2-3/4-inches per foot of height.

iv. Type B Brackets and anchoring shall withstand loading which meets or exceeds that which will be generated based on the Support Size Selection Chart on Sheet TE1-7A for the 3-lb/ft u-channel support size, as well as cyclical loading, without failure. The bracket shall meet this requirement with the bracket installed on a 10-inch wide, non-tapered, unreinforced barrier manufactured with concrete meeting a design strength of 3,000 PSI.

v. Type B brackets shall not incorporate side anchors. All anchoring shall be vertical and no components of the bracket shall extend below the top of the wall.

vi. The width (portion on top of the wall) and length of Type A and B brackets shall not exceed 7-inches.

vii. Type A and B bracket components shall be manufactured using galvanized steel, exterior grade epoxy coated steel, or similar material exhibiting weather resistance equal to or greater than those described. This shall include the bracket and the anchoring system.

viii. Type A and B brackets shall not require modification of the support for installation.

ix. Type A and B brackets shall minimize the risk to motorists and pedestrians during and after impacts by not incorporating components which become independent projectiles.

The manufacturer shall supply installation instructions and all required components and hardware to the Contractor. This shall include the complete system to be used for anchoring the brackets as well as hardware for securing the square tube support to the bracket. The manufacturer

shall make available device installation instructions for posting and dissemination by the Division to inspection and maintenance personnel.

709.55.1-Product Submission and Approval: Type A and B Brackets to be considered for inclusion on the Division Roadside Sign Support Accessories APL shall be submitted to the Materials Division following the current procedures specified by the Division in MP 106.00.02. The manufacturer should include all relevant documentation and information, including but not limited to Product Data Sheets, Product Flyers, Manufacturer Product Specifications, Product Bulletins, and Engineering Drawings.

In addition to the above, field evaluation installations shall typically be required prior to approval. In order for the device to be approved, evaluation installations installed by or for the Division shall demonstrate levels of durability, reliability, performance, and ease of installation/repair determined to be acceptable to Division evaluation personnel. The duration of the field evaluations shall typically be a minimum of six months to one year. Specific details related to this testing, such as locations and quantities, shall be determined by the Division.

SECTION 710
WOOD MATERIALS

710.3-PRESERVATIVE TREATMENT:

DELETE THE CONTENTS OF SUBSECTIONS 710.3 AND REPLACE WITH THE FOLLOWING:

All wood products and preservative treatments used for highway and commercial use shall meet the requirements of AWPA Standard U1 and AASHTO M133.

The retention of preservative shall be as required above, or as otherwise defined in these specifications, the plans or purchase order.

710.5-WOOD POSTS:

DELETE THE CONTENTS OF SUBSECTIONS 710.5 AND REPLACE WITH THE FOLLOWING:

Wood posts shall meet the requirements of AASHTO M168, AASHTO M133, and AWPA UC4B.

710.5.1: Blank

710.5.2-Rectangular posts for guardrail shall be No. 1 major or minor species of Southern Pine as defined in Section 400 of the SPIB grading rules.

710.5.3-Dimensions of all guardrail posts except as noted on the Plans shall be as follows:

Rectangular Guardrail Posts

Size:	6” ±¼” X 8”±¼” (152 mm ±6 mm by 203 mm ±6 mm) throughout the length except as noted on Plans
Length:	6’ ±½” (1 828 mm ±13 mm)

710.5.4-Dimensions of wood posts for fence and signs shall be as shown on the Plans.

710.7-COMMON LUMBER:

DELETE THE CONTENTS OF SUBSECTIONS 710.7 AND REPLACE WITH THE FOLLOWING:

Common lumber is untreated and suitable for general construction and utility purposes. Common lumber is from 2 inches (50 mm) to, but not including, 5 inches (125 mm) thick and is 2 inches (50 mm) or more in width. Common lumber shall be grade 2 or better, unless otherwise specified in the plans, when graded by the Board of Review of the American Lumber Standards Committee.

710.8-SERVICE AND LIGHTING POLES:

DELETE THE CONTENTS OF SUBSECTIONS 710.8 AND REPLACE WITH THE FOLLOWING:

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

SECTION 711
PAINTS, COATING, OILS, AND INKS

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

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

711.1-711.4: Blank

711.5-CONCRETE PROTECTIVE COATINGS AND STAIN:

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

must have protective and corrosion resistance properties. The storage life will be based on manufacturer recommendations.

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

i. **Freeze-Thaw Test:** Cast and cure 3 concrete specimens no less than 4 by 6 by 6 inches (100 by 150 by 150 mm). Moist cure specimens for 14 days and then dry in room air at 60° to 80° F (15° to 27° C) for 24 hours before applying protective coating. Ensure that there is no excessive oil on specimen forms. Coat sides of specimens (brush permitted) according to the manufacturer's directions at a rate of 50± 10ft2/gal (1.75± 0.35 m2/L) and cure at room temperature for 48 hours, after which:
    1. Immerse in water at room temperature 60° to 80° F (15° to 27° C) for 3 hours and remove.
    2. Place in cold storage at 5° F (-15° C) for one hour and remove.
    3. Thaw at room temperature, 60° to 80° F (15° to 27° C) for one hour.
    4. Repeat steps 1), 2) and 3) to complete a total of 50 cycles. At the end of 50 cycles of the Freeze/Thaw Test, ensure that the coated specimens show no visible defects.

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

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

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

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

711.6-ZINC PRIMERS:

711.6.1-Organic Zinc Primer:

711.6.1.1-General: This specification provides the requirements for an organic zinc rich primer. The Organic Zinc Primer may be used in the shop on new steel or in the field on existing steel. The steel shall be capable of being blast cleaned to a near-white finish, meeting SSPC-SP-10 requirements for new steel, and SSPC-SP-6, for existing steel. When used as a shop primer, the material shall have a minimum slip coefficient of 0.50 (Class B) when tested in accordance with "Test Method to Determine the Slip Coefficient for Coatings used in Bolted Joints" as adapted by the Research Council on Structural Connections. Acceptance for field painting will be based on batch testing of materials that do not meet the minimum of 0.50 (Class B) slip coefficient. Initial approval of all material will be based on complete Division testing to assure specification compliance. The primer may be top coated with materials meeting the requirements of Subsections 711.22.3 and 711.22.4. The dry film thickness requirement will be based on manufacturer recommendations. The paint storage life will be based on manufacturer recommendations.

711.6.1.2-Physical Requirements: Shall be as per SSPC Paint 20, Type II with the following exceptions:

i. The VOC shall not exceed 3.5 lbs /gal (420 g / l).
ii. Viscosity of the mixed paint shall be in accordance with ASTM D 562. Variance shall be within ±10 Krebs Units of the viscosity of the previously qualified paint.
iii. Weight per gallon of the mixed paint shall be in accordance with ASTM D 1475. Variance shall be within ±0.5 pounds (225 g) of the weight per gallon of the previously qualified paint.

711.6.2-Inorganic Zinc Primer:

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

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

i. The VOC shall not exceed 3.5 lbs /gal (420 g / l).
ii. The adhesion shall be a minimum of 4B when tested in accordance with ASTM D3359, Method B.
iii. Viscosity of the mixed paint shall be in accordance with ASTM D 562. Variance shall be within ±10 Krebs Units of the viscosity of the previously qualified paint.
iv. Weight per gallon of the mixed paint shall be in accordance with ASTM D1475.Variance shall be within ±0.5 pounds (225 g) of the weight per gallon of the previously qualified paint.

711.7-711.11: Blank

711.12-EPOXY COATINGS:

711.12.1-General: This specification provides the requirements for a two component, modified epoxy coating for use as a spot primer or a one coat system for use on poorly prepared surfaces on most existing structures. The coating may be used as a primer over steel that has been cleaned to a minimum of SSPC-SP-2. If it is used as a primer, it may then be coated with the manufacturer's recommended intermediate and/or top coat from the Division's approved list of Zinc Rich Low VOC Systems (711.22). This coating shall also be suitable for use over zinc rich primers. All ingredients are not specified; however, the finished product shall comply with the requirements prescribed. The paint storage life will be based on manufacturer recommendations.

711.12.2-Composition: The pigment shall not react with the vehicle or interfere with the cure. The pigment may be aluminum flake powder or paste. The metallic aluminum pigment may be replaced by other pigments and coloring agents necessary to provide the specified color. The vehicle shall be modified epoxy resin and curing agent. The vehicle shall be formulated to permit trouble free application during normal humidity conditions.

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

711.12.3-Physical Requirements: Steel panels shall meet the requirements of ASTM D609, Type III. Steel panels shall be sandblasted to a white metal blast finish in accordance with SSPC-SP-5, exposed to the atmosphere for 30 days so uniform rusting occurs, and then hand cleaned with a wire brush in accordance with SSPC-SP-2. The panel shall then be spray applied with epoxy maintenance coating according to manufacturers' recommendations.

i. Dry to touch @ 5 mils, (125 μm) dry, 24 Hours Maximum
ii. Dry hard @ 5 mils, (125 μm) dry, 72 Hours Maximum
iii. Weight per gallon, 10.5 Lbs. Minimum
iv. Accelerated Weathering: Panels shall be tested in accordance with ASTM G 154. After 1,000 hours exposure, the coating shall show no rusting, blistering, or loss of adhesion to the test panel.
v. Salt Fog: Panels shall be scribed to the base metal with an X of at least two inch (50 mm) legs. The test panels shall then be tested in accordance with ASTM B 117. After 1,000 hours of continuous exposure, the coating shall show no loss of bond, nor shall it show rusting or blistering beyond 1/16 inch (2 mm) from the center of the scribe mark.

711.12.4-Application Properties: The mixed paint, when thinned in accordance with manufacturer's recommendations, shall be capable of being sprayed in one coat at a wet film thickness of 10 mils (250 μm) without runs or sags. The properly thinned paint shall be capable of brush and roller application. The manufacturer's current printed instructions for application

of the epoxy maintenance coating shall be submitted to the Division for review and approval prior to application. The paint storage life will be based on manufacturer recommendations.

711.13 through 711.20: Blank

711.21-REPAIR OF DAMAGED GALVANIZED SURFACES:

Repair of damaged galvanized surfaces will be done using a primer meeting the requirements Section 711.6.

711.22-ZINC RICH LOW VOC SYSTEM:

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

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

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

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

711.22.4.1-Physical Requirements:

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

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

711.22.5.1-System Requirements:

i. **Intercoat Adhesion**-The adhesion of the system shall be a minimum of 4B when tested in accordance with ASTM D3359, Method B.
ii. **Accelerated Weathering**-After cycling 1000 hours there shall be no evidence

of checking, cracking, rusting, or blistering. The degree of chalking shall not be less than No. 6 when tested according to ASTM G 154. The color difference after 1000 hours shall be no more than five ΔE units.

iii. **Salt Fog-**Testing shall be in accordance with ASTM B117. After 1000 hours of continuous exposure, there shall be no evidence of checking, cracking, rusting, or blistering.

SECTION 712
GUARDRAIL AND FENCE

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

712.1 through 712.3: Blank

712.4-GALVANIZED STEEL DEEP BEAM GUARDRAIL, FASTENERS AND ANCHOR BOLTS:

Galvanized steel deep beam guardrail, fasteners and anchor bolts shall conform to AASHTO M180, Type II, Class A.

712.5-ZINC-ALUMINUM-MAGNESIUM ALLOY COATING GUARDRAIL, FASTENERS AND ANCHOR BOLTS:

Zinc-aluminum-magnesium alloy-coating deep beam guardrail shall conform to AASHTO M180, Type V or VI, Class A.

712.6 through 712.7: Blank

712.8-CHAIN-LINK FENCE:

Chain-link fence shall conform to the requirements of AASHTO M 181. Fence height, gage and details shall be as specified on the Plans.

712.9-ZINC-COATED (GALVANIZED) IRON OR STEEL FARM-FIELD AND RAILROAD RIGHT-OF-WAY WIRE FENCING:

This fencing shall meet the requirements of AASHTO M 279 and details shown on the Plans. Either of the following styles and coating classes may be used.

1. Style 1047-6-9 with Class 1 coating
2. Style 1047-6-11 with Class 3 coating

Zinc coating for miscellaneous steel fittings and hardware shall conform to the requirements of AASHTO M 232. Zinc coating for clips used for securing fence or wire shall conform to AASHTO M 279, Class 1 coating.

712.10-COATED STEEL BARBED WIRE:

Barbed wire shall meet the requirements of AASHTO M 280, Class 1 or AASHTO M 305, Type I.

712.11-SAFETY FENCE:

Safety Fence shall be orange in color, commercially manufactured from UV stabilized high-density polyethylene or a suitable substitute approved by the Engineer.

SECTION 713
METAL PIPE

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

713.1: **Blank**

713.2-METALLIC COATED CORRUGATED STEEL PIPE AND PIPE ARCH:

Metallic coated corrugated steel pipe and pipe arch shall conform to the requirements of AASHTO M 36 for Type I and Type II pipe.

Special sections, such as elbows, for these conduits shall be of the same gage as the conduit to which they are jointed, and shall conform to the applicable requirements of AASHTO M 36.

713.3-ASPHALT COATED CORRUGATED STEEL PIPE AND PIPE ARCH:

Asphalt coated corrugated steel pipe, pipe arches, coupling bands, elbows, and other special sections shall conform to the requirements of AASHTO M 190. Coating and invert paving shall be of the type specified.

713.4 through 713.17: Blank

713.18-ALUMINUM ALLOY STRUCTURAL PLATE FOR BOX CULVERT:

Box culvert and the bolts and nuts for connecting plates shall conform to the requirements of AASHTO M 219.

713.19: Blank

713.20-END SECTIONS FOR CORRUGATED STEEL PIPE AND PIPE ARCHES:

End sections for corrugated iron or steel pipe and pipe arches shall be of the thickness recommended by the manufacturer, and they shall conform to the applicable requirements of AASHTO M 36 and the details shown on the Plans.

713.21 through 713.23: Blank

713.24-ALUMINUM COATED CORRUGATED STEEL PIPE AND PIPE ARCH:

These conduits shall conform to AASHTO M 36 requirements for aluminum coated or aluminum-zinc coated corrugated steel pipe and pipe arch.

SECTION 714
CONCRETE, CLAY, FIBER AND PLASTIC PIPE

DELETE THE ENTIRE CONTENTS AND HEADING AND REPLACE WITH THE FOLLOWING:

SECTION 714
CONCRETE AND PLASTIC PIPE

714.1: Blank

714.2-REINFORCED CONCRETE CULVERT, STORM DRAIN AND SEWER PIPE:

This pipe shall conform to the requirements of AASHTO M 170 or ASTM C 76, AASHTO R 73, and MP 714.03.30. Class III, IV, and V reinforced concrete pipe are to be used.

714.2.1–Special Design: When reinforced concrete pipe pay item includes Special Design designation, the following shall apply per designation in the plans.

714.2.1.1-Structural: High fill cover heights, minimal cover heights, or excessive loads, which require special reinforcing and design of reinforced concrete pipe.

714.2.1.2-Cement Content: Corrosive environments, which require special concrete mix to improve the sulfate resistance. Table 714.2.1.2 illustrates the material requirements for a given sulfate concentration.

Table 714.2.1.2
Sulfate Concentration for Reinforced Concrete Pipe

Relative Degree of Sulfate Attack	% Water-Soluble Sulfate in Soil Samples	PPM Sulfate in Water Samples	Min. Cement Content (lbs/cy)	Max. Water/ Cement Ratio
Negligible	0.00 – less than 0.1	0 – less than 150	470	0.53
Positive	0.10 – less than 0.2	150 – less than 1,500	470	0.53
Severe	0.20 - 2.00	1,500 - 10,000	517	0.4
Very Severe	Greater than 2.00	Greater than 10,000	658	0.35

714.3-REINFORCED CONCRETE ARCH CULVERT, STORM DRAIN AND SEWER PIPE:

This pipe shall conform to the requirements of AASHTO M 206 or ASTM C 506.

714.4-REINFORCED CONCRETE ELLIPTICAL CULVERT, STORM DRAIN AND SEWER PIPE:

This pipe shall conform to the requirements of AASHTO M 207 or ASTM C 507 and AASHTO R 73.

714.5-PERFORATED CONCRETE PIPE:

This pipe shall conform to the requirements of AASHTO M 175 or ASTM C 444.

714.6: Blank

714.7-PRECAST REINFORCED CONCRETE BOX CULVERTS:

Precast reinforced concrete box culverts shall conform to the requirements of ASTM C1577. Interstate live load design shall be provided for Interstate highway facilities and HL93 live load design shall be provided for other locations. Precast reinforced concrete box culverts shall also conform to MP 604.02.40.

All fabricators of precast reinforced concrete box culverts shall maintain an adequate level of quality control. Plant certification by NPCA (National Precast Concrete Association), ACPA (American Concrete Pipe Association) plant certification for box culverts, or other approved equal certification program will be required to verify this level of quality control. Plant approval must be obtained prior to the start of fabrication. All Fabricators shall then submit evidence of Plant approval to the MCS&T Division on an annual basis.

All box culverts shall be cured in accordance with section 601.12 or 603.8 except that curing may be discontinued once 70% of the design strength is achieved. All box culverts shall meet design strength prior to shipment.

714.7.1-Trial Fitting: For box culverts, trial fitting of adjacent pieces, prior to shipping, will be required as part of the final inspection process, at a minimum of twenty-five percent (25%) of the project total. Adjacent box culverts will either be stacked in pairs vertically or placed horizontally as to be installed. The gaps between each pair will be measured, and dunnage will be placed below the culvert(s) to prevent damage. The maximum gap between the adjacent pieces shall not exceed ½ inch (13 mm), unless otherwise stated in the construction plans.

714.7.2-Price Adjustments: Box culverts not achieving the 28 day shipping strength, but for which evaluation indicates may still be used, will be paid for at a reduced price in accordance with the following formulas, depending on who purchased the box culverts:

Formula 1: Use the following price reduction formula when the box culverts are used in a project constructed by the Contractor:

$$\text{Price Reduction} = \left(\frac{f_c^{'} - \bar{X}}{0.5 f_c^{'}} \right) \text{ x 40\% of the Contract Unit Bid Price}$$

Formula 2: Use the following price reduction formula when the box culverts are used in a project constructed by the Division:

$$\text{Price Reduction} = \left(\frac{f_c^{'} - \bar{X}}{0.5 f_c^{'}} \right) \text{ x IC}$$

Where:

$f_c^{'}$ = 28-Day Compressive Strength, psi (MPa)

$\bar{X}$ = Average 28-Day Compressive Strength as determined by a minimum of 2 compressive strength test cylinders fabricated from a batch of concrete as it was placed in the forms for the box culverts

$IC_{\text{(Formula 2 only)}}$ = The invoiced cost of the box culvert itself, as billed to the Division by the Fabricator. This cost shall not include other items associated with the box culverts such as a gaskets or etc.

714.8-CONCRETE SAFETY SLOPE END SECTIONS:

Precast concrete safety slope end sections shall conform to the requirements of the cited Specifications for the pipe to the extent to which they apply and to the details shown on Standard Detail Drawing DR 4.

714.9 through 714.16: Blank

714.17-POLYPROPYLENE PIPE:

For nominal pipe sizes of 12 inches to 60 inches (150 to 1500 mm) dual wall pipe and fittings meet the requirements of ASTM 2881M or AASHTO M 330.

714.18-HIGH DENSITY POLYETHYLENE PIPE, STEEL REINFORCED:

The pipe and fittings of nominal sizes 12 inch (150 mm) through 60 inches (1500 mm) shall conform to the requirements of AASHTO MP20.

714.19-HIGH DENSITY POLYETHYLENE PIPE, PROFILE WALL:

Corrugated polyethylene pipe shall be accordance with the following:

1. For nominal pipe sizes of 3 to 6 inches (75 to 150 mm) when perforations are required the pipe shall meet the requirements of AASHTO M 252 with class 2 perforations.
2. For nominal pipe sizes of 3 to 10 inches (75 to 250 mm) when perforations are not required the pipe shall meet the requirements of AASHTO M 252 type "S" only.
3. For nominal pipe sizes of 12 to 60 inches (300 to 1 500 mm) the pipe shall meet the requirements of AASHTO M 294 type "S" or type "D" only.

714.20-PERFORATED PLASTIC SEMICIRCULAR PIPE:

Perforated plastic semicircular pipe shall be extruded or molded using a high density, flexible plastic.

The pipe shall have a smooth or corrugated top and a smooth semicircular bottom, averaging 4-5/8 inches (116 mm) in diameter, with perforations uniformly distributed along the top of the semicircular section. The perforations shall be not less than ¼ inch (6 mm) nor more than 3/8 inch (10 mm) in diameter, and shall provide a minimum intake area of one square inch per linear foot (2100 sq. mm per m). Minimum material thickness shall be 1/8 in. (3 mm). The top flange shall extend a minimum of ½ in. (13 mm) beyond the top of the semi-circular section.

A one foot (300 mm) section of pipe shall deflect no more than 1½ at an applied load of 900 lb. (38 mm), using the Parallel Plate Load Test of ASTM D 2412. Fifteen minutes after removal of the load, the pipe section shall have recovered not less than 50 percent of its deflection at 900 lb. (4 kN).

714.21: Blank

714.22-POLYVINYL CHLORIDE (PVC) PIPE:

The pipe and fittings shall conform to the requirements of AASHTO M278, ASTM D3034 or ASTM F949.

SECTION 715
MISCELLANEOUS MATERIAL

715.4-CONCRETE REPAIR MATERIALS:

DELETE CONTENTS OF SUBSECTION 715.4 AND REPLACE WITH THE FOLLOWING.

715.4.1-Cementitious and Polymer-Modified Materials for Concrete Repairs: Material to be used in concrete repair applications shall be tested through AASHTO's National Transportation Evaluation Program (NTPEP) and meet the requirements in Table 715.4.1. In addition, they must remain current with NTPEP's policy regarding periodic re-testing as required by the program. Product submittals shall include: a completed Form HL-468 (available on the WVDOH Materials Division Web Page), a copy of the technical data sheet, the current Material Safety Data Sheet (MSDS), and the results of NTPEP testing. Any incomplete submittals will not be evaluated for inclusion on WVDOH approved list of concrete patching Materials.

TABLE 715.4.1

Performance Requirements for Cementitious & Polymer-Modified Concrete Materials

	Test Method	Performance Requirements
3-hour compressive strength	ASTM C39	R1-500 psi (3.5 MPa)
		R2-1,000 psi (7.0 MPa)
		R3- 3,000 psi (21 MPa)
1-day compressive strength	ASTM C39	R1-2,000 psi (14 MPa)
		R2-3,000 psi (21 MPa)
		R3-5,000 psi (35 MPa)
7-day compressive strength	ASTM C39	R1-4,000 psi (28 MPa)
		R2-4,000 psi (28 MPa)
		R3-5,000 psi (35 MPa)
Bond Strength by Slant Shear, 1 Day	ASTM C 882	1,000 psi (7 MPa)
Bond Strength by Slant Shear, 7 Day	ASTM C 882	1,500 psi (10 MPa)
Rapid Freezing & Thawing Durability Factor (DF)	ASTM C 666 (Procedure A)	Minimum Durability Factor 90% at 300 cycles
Length Change	ASTM C 157	allowable increase after 28 days in water: +0.15 allowable decrease after 28 days in air: —0.15

715.4.2-Polymer Concrete Materials for Concrete Repairs: A Polymer Product is a composite material formed by polymerization of a monomer and an aggregate mixture, in which the polymerized monomer acts as the sole binder for the aggregate. Polymer concrete uses a polymer binder in place of Portland cement. These materials are required to be tested through AASHTO's National Transportation Evaluation Program (NTPEP) and meet the requirements in Table 715.4.2. In addition, they must remain current with NTPEP's policy regarding periodic re-testing as required by the program. Product submittals shall include: a completed Form HL-468 (available on the WVDOH Materials Division Web Page), a copy of the technical data sheet, the current Material Safety Data Sheet (MSDS), and the results of NTPEP testing. Any incomplete submittals will not be evaluated for inclusion on WV DOH approved list of patching Materials.

TABLE 715.4.2
Performance Requirements for Polymer Concrete Materials

	Test Method	Performance Requirements
Bond Strength Using Slant Shear @ 1 Day	ASTM C 882	1,000 psi (7.0 MPa)
Bond Strength Using Slant Shear @ 7 Days	ASTM C 882	1,500 psi (10.4 MPa)
1-hour compressive strength	ASTM C 579	2,500 psi (17.3 MPa)
24-hour compressive strength	ASTM C 579	3,500 psi (24.1 MPa)
28-day compressive strength	ASTM C 579	5,000 psi (35 MPa)
Chloride Ion Penetration	AASHTO T 277	Less than 750 coulombs @ 28 days
Bond Strength by Direct Tension @ 28 days	ASTM C 1583	Minimum of 300 psi (2.1 MPa)
Linear Shrinkage	ASTM C 531	Maximum Linear Length Change +/- 0.10% at 3 Days
Coefficient of Thermal Expansion	ASTM C 531	2×10^{-6} to 8×10^{-6} in/in/°F (4×10^{-6} to 14×10^{-6}/ °C)
Rapid Freezing & Thawing Durability Factor (DF)	ASTM C 666 (Procedure A)	Minimum Durability Factor 90% at 300 cycles

715.9-WARNING DEVICES:

715.9.3-Channelizing Devices and Auxiliary Barriers:

DELETE THE HEADING AND ENTIRE SUBSECTION 715.9.3 AND REPLACE WITH THE FOLLOWING:

715.9.3-Channelizing Devices: Channelizing Devices shall include Drums, Channelizer Cones, Cones, Barricades, Surface Mounted Flexible Tubular Markers, Soil Anchored Flexible Delineator Posts, Guardrail Mounted Delineator Posts, and Type B-1 Delineators. Requirements in order to be listed on the Division APL are contained within this section for applicable devices.

Devices which are included as part of the AASHTO National Transportation Product Evaluation Program (AASHTO-NTPEP), and for which an APL is maintained, shall be tested as part of the AASHTO-NTPEP in order to be considered for approval.

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.

Device manufacturer instructions shall be within the scope of the successful crash testing. Scope shall include parameters such as size, weight, placement, and material makeup of potential device attachments; location, weight, and material makeup of additional device ballast; etc. Manufacturer instructions regarding such parameters may be outside the scope of testing only if allowed for in the FHWA eligibility letter or by written guidance or policy issued by the FHWA or AASHTO.

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.

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.

References within this section to the "Traffic Control Manual" shall be interpreted as referencing the WVDOH Manual on Temporary Traffic Control for Streets and Highways Traffic Control Manual, latest edition.

715.9.3.1-Drums: Drums shall be designed, tested, and supplied in accordance with the following requirements:

i. Material shall be lightweight, typically plastic such as polyethylene, designed to yield and separate from the base upon impact, and to be returned to its' original shape if deformed. Metal or otherwise rigid drums shall not be approved. Material shall be colored bright orange and shall be resistant to deterioration and fading from UV light exposure.

ii. Device shall appear cylindrical from any direction and shall have a closed top.

iii. Device height and width shall be in accordance with the requirements shown in the Traffic Control Manual.

iv. Device shall be equipped with retroreflective sheeting placed as required by the Traffic Control Manual. Retroreflective sheeting shall be Type ASTM-IV material noted for use on Drums on the WVDOH APL for retroreflective sheeting.

v. Device base design shall be solid rubber snap-on, sand filled plastic snap-on, or tire ring collar. Note, if a manufacturer submits a tire ring collar base model drum to the WVDOH for evaluation, the manufacturer shall be required to certify in their MASH self-certification letter that the device is in compliance with the crash performance requirements of MASH with up to two (2) tire ring collars used with the device.

vi. Device drum and base shall incorporate anti-roll mechanisms to prevent continuous rolling if knocked over.

715.9.3.2-Channelizer Cones: Channelizer Cones shall be designed, tested, and supplied in accordance with the following requirements:

i. Material shall be lightweight, typically plastic such as polyethylene, designed to yield and separate from the base upon impact, and to be returned to its' original shape if deformed. Metal or otherwise rigid Channelizer Cones shall not be approved. Material shall be colored bright orange and shall be resistant to deterioration and fading from UV light exposure.

ii. Device shall appear cylindrical from any direction and shall have a closed top.

iii. Device diameter at the top edge of the top band of sheeting shall be approximately 4-inches. Device diameter at the bottom edge of the bottom band of sheeting shall be approximately 5-1/2 inches. The device may be constructed such that the diameter transitions from the top to the bottom uniformly or tiered such that the section of the device that each band of sheeting is attached to is of a different constant diameter.

iv. Device retroreflective markings shall be horizontal, circumferential, alternating orange and white retroreflective stripes 6-inches wide. A minimum of two orange and two white stripes shall be used with the top stripe being orange. The top edge of the top band shall be approximately 43-inches above ground level and non-retroreflectorized gaps between the orange and white stripes shall not exceed 1-inch.

v. Retroreflective sheeting shall be Type ASTM-IV material noted for use on Channelizer Cones on the WVDOH APL for retroreflective sheeting.

vi. Two different subcategories of Channelizer Cones are recognized: Devices for use on roadways with a normal posted speed limit of 55 MPH or less, and devices for use on all roadways. The device shall be approved under one or both subcategories based on the acceptable bases available. Base requirements for use on roadways 55 MPH or less are as follows:

   a. Base shall be drop-on type manufactured of solid rubber and shall not be round.
   b. Minimum weight of 15 lbs.

c. The square or rectangular footprint defined by the outer extremes of the base shall not exceed 20-inches x 20-inches if square and shall not exceed 18-inches in one direction or 24-inches in the other if rectangular.

vii. Base requirements for use on all roadways are as follows:
   a. Base shall be drop-on type manufactured of solid rubber and shall be rectangular.
   b. Minimum weight of 20 lbs.
   c. The dimension of the base on the short side shall be a minimum of 12-inches and a maximum of 20-inches. The dimension of the base on the long side shall be a minimum of 24-inches.

715.9.3.3-Cones: Cones shall be designed, tested, and supplied in accordance with the following requirements:

i. Material shall be lightweight, typically polyvinyl chloride, designed to yield upon impact and returned to its' original shape if deformed. Metal or otherwise rigid cones shall not be allowed. Material shall be colored fluorescent orange and shall be resistant to deterioration and fading from UV light exposure.
ii. Device height and overall general shape shall be in accordance with the Traffic Control Manual.
iii. Device shall be equipped with retroreflective sheeting as required by the Traffic Control Manual. Sheeting placement shall be in accordance with the requirements of the Traffic Control Manual. Retroreflective sheeting shall be Type ASTM-IV material noted for use on Cones on the WVDOH APL for retroreflective sheeting.
iv. Device shall be adequately designed to resist displacement and tipping from wind and vibrations, as well as slumping due to heat.

715.9.3.4-Barricades: Type I, II, and III Barricades shall be designed, tested, and supplied in accordance with the following requirements:

i. Barricade rail material shall be a lightweight, typically polymer material such as polyethylene, polyurethane, or engineered thermoplastic. Other materials such as aluminum or wood shall not be approved. Support frame components shall be manufactured of materials similar to those described above or may be metal. Wood shall not be approved.
ii. Minimum Barricade height, rail length, and individual rail height shall be in accordance with the requirements of the Traffic Control Manual.
iii. Device rails shall be white.
iv. Device shall be equipped with retroreflective sheeting designed and placed as required by the Traffic Control Manual. Retroreflective sheeting shall be Type ASTM-IV material noted for use on Barricades on the WVDOH APL for retroreflective sheeting.
v. Type III Barricades shall incorporate horizontal skids for stability.

715.9.3.5-Surface Mounted Flexible Tubular Markers: Surface Mounted Flexible Tubular Markers (SMFTM's) shall be designed, tested, and supplied in accordance with the following requirements:

i. Material shall be a lightweight, typically polymer material such as polyethylene, polyurethane, or engineered thermoplastic, and shall be designed to yield upon impact and to be returned to its' original position and, if designed to be deformable, shape when impacted from any direction. Except for components as allowed for herein, SMFTM's shall not be manufactured of metal. SMFTM's manufactured of rigid material shall not be approved without a mechanism, such as a spring, included as part of the device design which allows the entire tube above the base to yield when impacted. Material shall be resistant to impact as well as deterioration and fading from UV light exposure. Device shall be available with white, yellow, and orange tubes.

ii. No metal or otherwise rigid components shall become projectiles upon impact.

iii. Tubes shall provide 360-degree visibility for their entire length with a minimum profile of 2-inches. Cross-sectional shape at the reflective portion shall be uniform.

iv. Device shall be manufactured such that the top of the SMFTM is 36-inches above the bottom of the base after installation.

v. For white and yellow tubes, device shall include a white or yellow 6-inch wide band of retroreflective sheeting matching the SMFTM tube color, preinstalled by the manufacturer. The band shall be wrapped completely around the tube, with the bottom edge of the sheeting no less than 28-inches above the bottom of the base. For temporary orange applications, device shall include retroreflective sheeting sized and placed in accordance with the Traffic Control Manual.

vi. Retroreflective sheeting shall be Type ASTM-IV material noted for use on SMFTM's on the WVDOH APL for retroreflective sheeting.

vii. Hardware shall be supplied by the manufacturer and shall be manufactured using stainless, zinc plated, or galvanized steel; aluminum; or similar material exhibiting weather resistance equal to or greater than those described.

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. 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.

715.9.3.6-Soil Anchored Flexible Delineator Posts: Soil Anchored Flexible Delineator Posts (SAFDP's) shall be designed, tested, and supplied in accordance with the following requirements:

i. Material shall be a lightweight, typically polymer material such as polyethylene, polyurethane, or engineered thermoplastic, and shall be designed to yield upon impact and to be returned to its' original position and, if designed to be deformable, shape when impacted from any direction. Except for

components as allowed for herein, SAFDP's shall not be manufactured of metal. SAFDP's manufactured of rigid material shall not be approved without a mechanism, such as a spring, included as part of the device design which allows the entire portion of the post above the base to yield when impacted. Material shall be resistant to impact as well as deterioration and fading from UV light exposure. Posts shall be available in white and yellow.

ii. No metal or otherwise rigid components shall become projectiles upon impact.

iii. Device shall be manufactured such that the top of the delineator is 54-inches above the ground surface after installation.

iv. Post cross sectional shape may be flat, convex, or round. Post shall be of a uniform cross-sectional shape at the reflective portion with a flat or convex shaped front face.

v. Retroreflective sheeting shall be a Type ASTM-XI material on the WVDOH APL for retroreflective sheeting. Yellow sheeting shall be fluorescent.

vi. Device shall include one 3-inch wide by 9-inch tall strip of retroreflective sheeting on the front face matching the SAFDP color. If required by the Plans, device shall accommodate and include one 3-inch wide by 9-inch tall strip of fluorescent-yellow or red retroreflective sheeting on the back face. The top edge of the sheeting shall be 2-inches or less from the top of the post. All sheeting shall be preinstalled by the manufacturer.

vii. Device anchor shall be galvanized steel designed for 18-inch minimum embedment.

viii. Hardware shall be supplied by the manufacturer and shall be manufactured using stainless, zinc plated, or galvanized steel; aluminum; or similar material exhibiting weather resistance equal to or greater than those described.

715.9.3.7- Guardrail Mounted Delineator Posts: Guardrail Mounted Delineator Posts (GMDP's) shall be designed, tested, and supplied in accordance with the following requirements:

i. Material shall be a lightweight, typically polymer material such as polyethylene, polyurethane, or engineered thermoplastic. Device shall be designed to yield upon impact and to return to its' original position and shape when impacted from the front or back. Except for components as allowed for herein, GMDP's shall not be manufactured of metal. GDMP's manufactured of rigid material shall not be approved without a mechanism, such as a spring, included as part of the device design which allows the entire portion of the device above the top of the guardrail to yield when impacted. Material shall be resistant to impact as well as deterioration and fading from UV light exposure. Posts shall be available in white and yellow.

ii. No metal components shall become projectiles upon impact.

iii. Device shall be manufactured such that the top of the post sheeting is 20-inches minimum above the top of the guardrail after installation.

iv. Cross sectional shape may be flat, convex, or round. Post shall be of a uniform cross-sectional shape at the reflective portion with a flat or convex shaped front face.

v. Designs which are entirely made up of a single flat or convex shaped piece of material shall allow for installation as shown on Sheet TE11-2A of the West Virginia Department of Transportation, Division of Highways, Standard Details Book Vol. II, Signing, Signals, Lighting, and Marking.

vi. Retroreflective sheeting shall be a Type ASTM-XI material on the WVDOH APL for retroreflective sheeting. Yellow sheeting shall be fluorescent.

vii. Device shall include one 3-inch wide by 9-inch tall strip of retroreflective sheeting on the front face matching the GMDP color. If required by the Plans, the device shall accommodate and include one 3-inch wide by 9-inch tall strip of fluorescent-yellow or red retroreflective sheeting on the back face. All sheeting shall be preinstalled by the manufacturer.

viii. Any required hardware other than that shown on Standard Detail TE11-2A shall be supplied by the manufacturer and shall be manufactured using stainless, zinc plated, or galvanized steel; aluminum; or similar material exhibiting weather resistance equal to or greater than those described.

715.9.3.8-Type B-1 Delineators: Type B-1 Delineators shall be designed, tested, and supplied in accordance with the following requirements:

i. Material shall be a lightweight, typically polymer material such as polyethylene, polyurethane, or engineered thermoplastic. Except for components as allowed for herein, Type B-1 Delineators shall not be manufactured of metal. Material shall be resistant to impact as well as deterioration and fading from UV light exposure.

ii. No metal components shall become projectiles upon impact.

iii. The front and back faces of the device substrate to which the reflective sheeting is to be applied shall be white or yellow to match the color of the sheeting or shall be a neutral color such as black or grey.

iv. Device may be a one-piece design or two-piece design utilizing a separate bracket with the reflective portion attached to the bracket using one or more fasteners. The bracket portion may be metal but shall not extend more than three-inches above the top of the barrier. In addition, the bracket shall not obscure more than ten-percent of the reflective face.

v. The cross-sectional shape of the reflective portion of the device shall be flat.

vi. Retroreflective sheeting shall be a Type ASTM-XI material on the WVDOH APL for retroreflective sheeting. Yellow sheeting shall be fluorescent.

vii. Front face of device shall accommodate reflective sheeting 8-inches wide by 12-inches tall, in white or fluorescent yellow as specified. If required by the Plans, device shall accommodate and include one 8-inch wide by 12-inch tall strip of fluorescent-yellow or red retroreflective sheeting on the back face. All sheeting shall be preinstalled by the manufacturer.

viii. In order to be approved for permanent applications, the device shall be designed to allow mechanical fastening to the top of a concrete barrier wall as narrow as 6-inches.

ix. All required hardware and other metal components shall be supplied by the manufacturer and shall be manufactured using stainless, zinc plated, or galvanized steel; aluminum; or similar material exhibiting weather resistance

equal to or greater than those described. Anchors shall be suitable for use in concrete. If the use of an adhesive material for attachment is allowed for by the manufacturer for temporary applications, the adhesive shall be provided by the manufacturer.

715.9.3.9-Product Submission and Approval: Drums, Channelizer Cones, Barricades, Surface Mounted Flexible Tubular Markers, Soil Anchored Flexible Delineator Posts, Guardrail Mounted Delineator Posts, and Type B-1 Delineators to be considered for inclusion on the Division's APL's shall be submitted to the Materials Division following the current procedures specified in MP 106.00.02.

The manufacturer should include all relevant documentation and information, including but not limited to product data sheets, product flyers, manufacturer product specifications and recommendations, product bulletins, engineering drawings, AASHTO-NTPEP test results, and crash testing performance documentation.

In addition to the above, field evaluation installations may be required prior to approval. In order for the device to be approved, evaluation installations installed by or for the Division shall demonstrate levels of durability, reliability, performance, and ease of installation/repair determined to be acceptable to Division evaluation personnel. Details related to this testing, such as locations, quantities, and duration shall be determined by the Division. Initial and typical repair material costs associated with the device shall also be considered as part of the evaluation.

715.9.4: Blank

DELETE SUBSECTION 715.9.4 AND REPLACE WITH THE FOLLOWING:

715.9.4-Reflective Sign Support Strips: Reflective Sign Support Strips (strips) for use on WVDOH projects are listed on the Materials Division "Reflective U-Channel Strips" Approved Products List (APL).

Strips shall be manufactured using polymer materials such as polyethylene, polyurethane, or engineered thermoplastics, and shall be manufactured to be resistant to impact as well as deterioration and fading from UV light exposure and the elements. The color polymer shall be white, black, or grey. Strips may alternatively be manufactured of aluminum no thicker than 0.080 inches. If manufactured of aluminum, the strips shall include no sharp corners.

The width of reflective sheeting on the face of strips shall be a minimum of four 4-inches. If manufactured of aluminum, the entire face of the strips shall be covered by sheeting. Plastic strips may be manufactured to an overall maximum width equal to the width of sheeting applied to the face of the strips plus 1/2-inch with a maximum of 1/4-inch of the face of the strips extending beyond the edge of the reflective sheeting on each side. All strips shall have reflective sheeting applied completely to the end of the strips on the top and bottom.

Different combinations of different length strips will be allowed in order to meet the 72-inch typical overall length shown on the Standard Detail; however, the shortest standard-length strip allowed shall be 18-inches. The strip system shall be designed to allow adjacent strips to be butted end to end and fastened in place with no gap between the ends of the strips. Different models of strips designed to attach to the web side only, flange side only, or either the web or flange side of u-channel posts shall be allowed with a description of each specific model to be

posted on the APL. Completely flat panels shall also be allowed and shall be required for S or W beam post, as well as square tube applications. Strips intended for application to the flange side of u-channel posts shall be designed to resist warping when fastened in place.

The retroreflective sheeting used on strips shall be a material listed on the latest WVDOH APL for retroreflective sheeting. The color sheeting to be applied to the strips will be specified in the Plans. The sheeting shall be Type ASTM-XI if the sheeting is to be colored fluorescent-yellow or fluorescent-yellow-green. Otherwise, the sheeting shall be Type ASTM-IV. Strips shall be supplied with sheeting pre-installed by the manufacturer.

The manufacturer shall supply or provide specifications for all hardware required for installation. All metal hardware shall be manufactured of stainless, zinc plated, or galvanized steel, or shall be manufactured of aluminum.

715.9.4.1-Product Submission and Approval: Strips to be considered for inclusion on the Division APL shall be submitted to the Materials Division following the current procedures specified by the Division in MP 106.00.02. The manufacturer should include all relevant documentation and information, including but not limited to Product Data Sheets, Product Flyers, Manufacturer Product Specifications, Product Bulletins, and Engineering Drawings.

As part of the approval process, the strip manufacturer shall be required to submit a copy of a letter of assurance which addresses reflective sheeting compatibility and application procedures. This letter shall be addressed from the reflective sheeting manufacturer to the strip manufacturer. A separate letter shall be required from each sheeting manufacturer that the manufacturer anticipates utilizing. The language of the letter shall provide sufficient indication, in the Division's judgement, that a) the sheeting manufacturer is aware of the intended application and has determined that the reflective sheeting to be utilized is suitable for use with the product, and b) the reflective sheeting manufacturer has reviewed their recommended reflective sheeting application procedures with the manufacturer.

In addition to the above, field evaluation installations may be required prior to approval. In order for the device to be approved, evaluation installations installed by or for the Division shall demonstrate levels of durability, reliability, performance, and ease of installation/repair determined to be acceptable to Division evaluation personnel. The duration of the field evaluations shall typically be a minimum of six months to one year. Specific details related to this testing, such as locations and quantities, shall be determined by the Division. Initial and typical repair material costs associated with the device shall also be considered as part of the evaluation.

ADD THE FOLLOWING SUBSECTION:

715.9.5-Portable Sign Stands: Portable sign stands shall be designed for use with temporary traffic control signs manufactured of rigid aluminum, rigid composite, and/or flexible roll-up materials. Portable sign stands shall be designed and tested to meet the following requirements:

i. Shall provide for a minimum sign mounting height of one (1) foot for thirty-six (36) inch and forty-eight (48) inch diamond signs above the surface that the base of the stand is resting on.

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.
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 the retracted position.
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.
v. Shall be "crashworthy" when utilized in accordance with the manufacturer's recommendations, and when impacted from any angle.

"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.

Manufacturer recommendations for use of the stands shall be within the scope of the successful crash testing. Scope shall include parameters such as size, weight, placement, and material makeup of potential device attachments, including signs; location, weight, and material makeup of additional device ballast; etc. Manufacturer instructions regarding such parameters may be outside the scope of testing only if allowed for in a supporting FHWA eligibility letter or by written guidance or policy issued by the FHWA or AASHTO.

715.9.5.1-Product Submission and Approval: Stands to be considered for inclusion on the Division's Approved Products List (APL) shall be submitted to the Materials Division following the current procedures specified in MP 106.00.02. The Division maintains an APL of MASH compliant stands only. Stands utilized based on compliance with NCHRP-350 are not required to be listed on an APL.

The manufacturer should include all relevant documentation and information, including but not limited to Product Data Sheets, Product Flyers, Manufacturer Product Specifications, Product Bulletins, Engineering Drawings, and crash testing performance documentation. The crash testing performance documentation to be submitted shall be in accordance with official guidance issued by the WVDOH.

Approvals of stands may be rescinded based on performance on Division projects determined to be non-compliant with these specifications.

715.11-ENGINEERING FABRIC:

715.11.2-Acceptance:

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

All engineering fabric shall be approved before use. NTPEP test data shall be furnished for the engineering fabric to be approved. The test data must be for the current 3-year cycle for the manufacturer or private labeler providing the material. The engineering fabric shall have a manufacture date within the current three-year NTPEP evaluation cycle of the manufacturer's, or private labeler's facility providing the material. The manufacturer or private labeler must be listed as NTPEP compliant for the current calendar year or be listed as compliant for the previous calendar year and have an application for audit during the current year.

The West Virginia Division of Highways may sample and test materials from a project or facility at any time to verify compliance with WVDOH specification requirements. Failure of the product, or failure to supply the required information may result in the product not being accepted or removed from the approved list.

DELETE SUBSECTIONS 715.11.4, 715.11.5, 715.11.6, 715.11.7, 715.11.8, AND 715.9 OF THE SECTION AND REPLACE WITH THE FOLLOWING:

715.11.4-Engineering Fabric for Subsurface Drainage: Engineering fabric for subsurface drainage shall meet the applicable requirements of AASHTO M 288, Section 8, Class 2. Additionally, the permittivity shall be a minimum of 0.2 sec^{-1} and the apparent opening size shall be no larger than No. 60 (250μm) sieve.

715.11.5-Engineering Fabric for Sediment Control (Silt Fence): Engineering fabric for sediment control shall meet the applicable requirements of AASHTO M 288, Section 9.

715.11.6-Engineering Fabric for Erosion Control: Engineering fabric for erosion control shall meet the applicable requirements of AASHTO M 288, Section 8, Class 1.

715.11.7-Engineering Fabric for Paving: Engineering fabric for paving shall meet the applicable requirements of AASHTO M 288, Section 10.

715.11.8-Engineering Fabric for Separation: Engineering fabric for separation shall meet the applicable requirements of AASHTO M 288, Section 8, Class 2.

715.11.9-Engineering Fabric for Stabilization: Engineering fabric for stabilization shall meet the applicable requirements of AASHTO M 288, Section 8, Class 1.

715.19-PRECAST CONCRETE UNITS FOR MANHOLES AND INLETS:

DELETE PARAGRAPH ONE AND REPLACE WITH THE FOLLOWING:

Precast concrete units for manholes shall conform to the requirements in AASHTO M 199 and MP 604.02.40. In addition, air entrainment in the concrete shall be seven percent plus or minus two percent.

715.22-PRECAST CONCRETE MEDIAN BARRIERS (PERMANENT):

715.22.2-Materials:

DELETE THE LAST SENTENCE OF SUBSECTION 715.22.2 AND REPLACE WITH THE FOLLOWING:

Sampling and testing of materials shall be in accordance with the minimum frequency stated in MP 603.02.10.

715.39-ELASTOMERIC GASKET AND SEALING MATERIAL:

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

These Specifications cover those elastomeric materials intended for use as, but not restricted to, such noncritical applications as gaskets, sealing materials, miscellaneous drainage items, etc. The elastomeric material shall meet the following requirements:

Tensile Strength, minimum psi (MPa), ASTM D 412.....1,200 (8.3)
Elongation at Break, minimum percent, ASTM D 412 350
Shore Durometer Hardness, ASTM D 2240
Minimum.....35
Maximum.....65
Compression Set, max percent, ASTM D 395,
Method B.....25
Accelerated Aging, ASTM D 573 (96 hr. at 70EC):
Decreased Tensile Strength, maximum percent.....15
Decreased Elongation, maximum percent.....20
Water Absorption by Weight, maximum percent, ASTM D 471 10

715.41-TRAFFIC SAFETY DEVICES:

DELETE THE ENTIRE CONTENTS OF SUBSECTION 715.41 AND REPLACE WITH THE FOLLOWING:

715.41-TRAFFIC SAFETY DEVICES:

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

715.41-IMPACT ATTENUATORS:

All Impact Attenuators and associated components furnished shall be crashworthy when assembled, installed, and utilized in accordance with the device manufacturer's instructions. Crashworthy shall be defined as meeting all crash testing performance requirements of MASH at Test Level 2 or 3, as specified in the Plans. This shall include the requirement for detached

elements, fragments, or other debris from the device to not penetrate or show potential for penetrating the occupant compartment, or present undue hazard to other traffic, pedestrians, or personnel in a work zone.

All Class 1, 2, and 3 approved devices, as described herein, shall be certified by the manufacturer to meet all applicable requirements contained herein. In addition to requirements contained in the subsections below, this shall include the following:

i. The device shall perform as designed within the following parameters pertaining to the approach areas to the device. The approach areas shall include the area immediately adjacent to the sides of the device, an area extending fifty (50) ft. in front of the device for front approach impacts, and an area extending fifty (50) ft. to the rear of the device for rear approach impacts:
    a. Maximum six (6) inch high mountable curb a minimum of eight (8) feet outside of the near face of the device when operating speeds are less than forty-five (45) MPH.
    b. Maximum four (4) inch high mountable curb a minimum of thirteen (13) feet outside of the near face of the device when operating speeds are forty-five (45) to fifty (50) MPH.
    c. No curb when operating speeds are greater than fifty (50) MPH.
    d. Lateral slope 1V:10H or flatter. Lateral slope at the placement location of the device 1V:12H or flatter.

ii. All components shall be designed, treated, and/or protected to insure long term durability and as-designed performance of the device in all varieties of environmental conditions expected within the State and from deterioration from UV rays. This shall include all metal components, steel cables, connection hardware, crushable materials and containers for such, hydraulic fluid, piston seals, etc. All steel components shall be galvanized.

Except as otherwise allowed for in the herein, all Impact Attenuators furnished shall be listed on the Division's Approved Products List (APL) "Impact Attenuators – MASH". Impact Attenuators to be furnished shall be defined in the Plans by Class, MASH Test Level, and/or Design Width as further described herein or within Sections 636 and/or 664, with these characteristics of each device noted on the APL.

715.41.1-Class 1 Impact Attenuator: Class 1 Impact Attenuators shall be non-gating Impact Attenuators installed on a concrete pad or bridge deck meeting the manufacturers requirements for permanent applications, or concrete pad, bridge deck, asphalt, base stone, or combination thereof meeting the manufacturers requirements for temporary or emergency applications. Class 1 Impact Attenuators shall be designed to be repairable after impacts within the parameters of those required in MASH, with a substantial portion of the device components being reusable.

Class 1 devices shall consist of a steel base designed to be secured using anchors, associated hardware, and adhesive if required, all of which shall be completely specified by the manufacturer. Class 1 devices shall also consist of a steel framework attached to the base and a mechanism using sacrificial or reusable components designed to dissipate the kinetic energy of vehicles impacting the front of the device head on. Such mechanisms shall utilize cartridges or cylinders designed to be crushed or compressed, steel or other metal components designed to be cut or deformed, devices designed to generate high friction, hydraulic cylinders, or other similar methods. The design of the device may incorporate either proprietary or AASHTO

standard versions of the components described. The base and framework shall be designed to typically be reusable except for in the event of severe impacts.

During head on impacts to the front of the device, Class 1 devices shall be designed to collapse rearward with the energy dissipation mechanism bringing the vehicle to a controlled stop. Except for any gating portion at the front of the device, Class 1 devices shall be designed to safely redirect front and rear approaching vehicles diverging off the roadway and impacting into the side of the device. Such vehicles shall be redirected in their original direction of travel and at a low angle of divergence from the side of the device.

Class 1 devices may be designed with a built-in backup mechanism or may be required to be installed with the rear of the device against a solid backup structure such as a concrete block. The manufacturer shall offer and provide various transition designs and components to protect rear approaching vehicles by providing a safe transition from highway industry standard concrete barrier shapes to the rear of the device. The manufacturer shall also offer and provide transition designs and components for transitioning the device to thirty-one (31) inch height double faced w-beam and thrie beam guardrail with off-post splices.

Any portion of the front of a Class 1 Impact Attenuator which is gating shall be no greater than three (3) ft., measured from the nose of the device. The maximum overall length of Class 1 devices, measured from the nose of the device to the rear and not including any transition sections, shall be twenty (20) ft. for MASH Test Level 2 devices and twenty-five (25) ft. for MASH Test Level 3 devices.

The manufacturer shall supply all proprietary components for complete installation of the device, including transition to thirty-one (31) inch height off-post splice double faced w-beam guardrail.

Class 1 Impact Attenuators shall be designed to be repairable by trained maintenance personnel in a reasonable time frame when subjected to impacts similar in nature to those described in the MASH criteria without requiring removal and repairs to the device off-site.

715.41.2-Class 2 Impact Attenuator: Class 2 Impact Attenuators shall be a non-gating Impact Attenuator designed to be anchored into soil using driven or drilled support posts, and to be transitioned to thirty-one (31) inch height double faced w-beam guardrail with off-post splices without modification. Below grade components of Class 2 Impact Attenuators such as post sleeves and soil plates shall be reusable after impacts within the parameters of those required in MASH.

Class 2 devices shall consist of support posts, a steel impact head, steel side rails, a mechanism using sacrificial or reusable components designed to dissipate the kinetic energy of vehicles impacting the front of the device head on, and any other components required for the device such as post blockouts, post sleeves, soil plates, tension struts, cables, etc. The kinetic energy dissipation mechanism may include those described in Section 715.41.2 or other similar methods. The design of the device may incorporate either proprietary or AASHTO standard versions of the components described. In cases where the manufacturer offers options in regard to support post material and/or post sleeves, steel posts with post sleeves shall be supplied and utilized.

During head on impacts to the front of the device, Class 2 devices shall be designed to collapse rearward with the energy dissipation mechanism bringing the vehicle to a controlled stop. Except for any gating portion at the front of the device, Class 2 devices shall be designed to safely redirect front and rear approaching vehicles diverging off the roadway and impacting

into the side of the device. Such vehicles shall be redirected in their original direction of travel and at a low angle of divergence from the side of the device.

The manufacturer shall supply all proprietary components for complete installation of the device, including transition to thirty-one (31) inch height off-post splice double faced w-beam guardrail.

Any portion of the front of a Class 2 Impact Attenuator which is gating shall be no greater than twenty (20) ft., measured from the impact head of the device. The maximum overall length of Class 2 devices measured from the impact head of the device to the off-post splice connection with the thirty-one (31) inch height w-beam to be transitioned to shall be fifty (50) feet.

715.41.3-Class 3 Impact Attenuator: Class 3 Impact Attenuators shall be a gating Impact Attenuator designed to be placed on various pad foundation types meeting the manufacturer's requirements, not require anchoring, and to shield wide objects.

During head on and side impacts into the device, Class 3 devices shall be designed to collapse and capture the vehicle, bringing it to a controlled gradual stop by transfer of momentum into an expendable mass of material.

Sand Barrel Class 3 Impact Attenuators shall be designed and provided in standard industry weights, which shall include 200 lb., 400 lb., 700 lb., 1400 lb., and 2100 lb. Sand Barrels shall be approximately thirty-six (36) inches in diameter and shall be designed to facilitate the drainage of excess sand moisture out of the sand mass. The manufacturer shall have and make available complete instructions on proper array design and layout, as well as pre-designed layouts for various operating speed and object width combinations. The manufacturer shall also provide material, weight/volume, ratio, and mixing specifications for the sand and anti-freeze agent(s) to be added to the barrels. Manufacturer specifications in regard to anti-freeze agents shall be in compliance with all applicable environmental laws and regulations.

Class 3 Impact Attenuators shall not be supplied for permanent installations and are approved only for temporary work zone or emergency use under applicable circumstances.

715.41.4-Truck Mounted Attenuator (TMA) and Trailer Truck Mounted Attenuator (TTMA): TMA's and TTMA's shall be devices designed for attachment to the rear of a large commercial vehicle, intended to offer protection for the occupants of a work zone and to lessen the severity of a rear end impact for the occupants of the impacting vehicle and the commercial host vehicle.

TMA's and TTMA's shall consist of a metal framework and shall incorporate a mechanism designed to dissipate the kinetic energy of vehicles impacting the front of the device head on using sacrificial or reusable component, typically cartridges or cylinders designed to be crushed or compressed, steel or other metal components designed to be cut or deformed, devices designed to generate high friction, or other similar methods.

During head on impacts to the front of the device, TMA and TTMA devices shall be designed to collapse rearward with the energy dissipation mechanism bringing the vehicle to a controlled stop.

TMA's shall be designed to be attached directly to and cantilevered off the rear of the host vehicle. TTMA's shall incorporate an axle and shall be designed to be towed behind the host vehicle.

The manufacturer shall make adequate requirements and recommendations available for necessary modifications to be made to host vehicles to adequately support the device. The manufacturer shall also make available recommended buffer distances for the devices based on expected post impact roll-ahead distances taking into consideration a variety and range of factors such as host vehicle weight, host vehicle speed, impacting vehicle speed, vertical grade, etc.

TMA's and TTMA's shall be equipped with all necessary safety features required for legal highway use such as brake lights, taillights, turn signals and ICC bar lights. The front of the device shall be adequately delineated to provide high conspicuity for approaching traffic.

715.41.5- Product Submission and Approval: Impact Attenuator devices described in Sections 715.41.1 through 715.41.4 to be considered for inclusion on the Division's Impact Attenuator - MASH APL shall be submitted to the Materials Division following the current procedures specified in MP 106.00.02.

The manufacturer should include all relevant documentation and information, including but not limited to product data sheets and bulletins, product specifications and recommendations, product manuals, engineering drawings, and any other requested information.

Devices shall be demonstrable to be crashworthy by means specified in official guidance issued by the WVDOH.

715.42-TRAFFIC SIGNAL MATERIALS AND EQUIPMENT:

715.42.2-Solid State Traffic Actuated Signal Controllers:

715.42.2.1-Definition of Terms:

DELETE PEDESTRIAN DETECTOR AND ADD THE FOLLOWING:

Audible Pedestrian Detector: A detector, usually of the push button type installed near the roadway, capable of being operated by hand, and having audible and vibratory features for both the purposes of location of the device and notification of the operations of the device.

715.42.5-Traffic Detectors:

715.42.5.1-General Design Requirements:

DELETE THE NOTE AT THE END OF THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

NOTE: The above general design requirements do not apply to audible pedestrian detectors. Audible pedestrian push buttons are covered in 715.42.5.4.

ADD THE FOLLOWING SUBSECTIONS:

715.42.5.3: Blank

715.42.5.4-Audible Pedestrian Push Buttons: A solid-state digital, pole-mounted, pedestrian push button detector and appurtenances with audible and vibratory features to assist disabled users who have hearing and/or sight impairments. Appurtenances are to include the associated signal power interface or control board assembly to be mounted in the corresponding pedestrian signal head with the associated cabling.

The push button detector is to be MUTCD 2009, NEMA TS2 and ADA compliant, made of sturdy construction consisting of a base housing with a removeable cover, a pushbutton with normally open contacts and include all electrical and mechanical parts required for operation. The detector shall include an adjustable automatic gain control with the associated microphone to keep audio output from 0 to 5 dB above ambient conditions.

The push button detector and its associated contacts and housing are to be resistant to mechanical shocks and abuse. The unit shall be able to withstand a concentrated force of 50 pounds (225 Newtons) applied to the button or any exposed portion without damage. Furnish a housing with geometry and/or hardware suitable for mounting on poles of various diameters. The removeable cover assembly is to be fastened to the base housing with stainless steel machine screws resulting in a weatherproof and shockproof assembly.

The maximum force required to operate the pushbutton is 5 pounds (22.5 Newtons). Furnish a raised or flush pushbutton with a minimum of 2 inches (51 mm) at its smallest dimension.

Furnish pedestrian pushbutton signs that are a minimum thickness of 0.07-inch (1.8 mm) for steel or 0.10-inch (2.5 mm) for aluminum with baked enamel paint for steel signs and baked enamel paint or non-reflective sheeting for aluminum signs.

715.42.8-Cabinets:

DELETE THE ENTIRE SUBSECTION 715.42.8 AND REPLACE WITH THE FOLLOWING:

715.42.8-Cabinets: The following are minimum design requirements for a TS2 Type 1 traffic control cabinet assembly. As a minimum, the cabinet assembly shall meet all applicable sections of the NEMA Standard publication No.TS2-2003 or most recent version. Where differences occur, this specification shall govern.

715.42.8.1-Cabinet Design and Construction: The cabinet shall be constructed from type 5052-H32 aluminum with a minimum thickness of 0.090 to 0.125 inches. The cabinet shall be designed and manufactured with materials that will allow rigid mounting, whether intended for pole, base or pedestal mounting. The cabinet must not flex on its mount. A rain channel shall be incorporated into the design of the main door opening to prevent liquids from entering the enclosure. The cabinet door opening must be a minimum of 80 percent of the front surface of the cabinet. A stiffener plate shall be welded across the inside of the main door to prevent flexing. Top of the cabinet shall incorporate a slope toward the rear to prevent rain accumulation.

Unless otherwise specified, the cabinet shall be supplied with a natural aluminum finish. Sufficient care shall be taken in handling to ensure that scratches are minimized. All surfaces shall be free from weld flash. Welds shall be smooth, neatly formed, free from cracks, blowholes and other irregularities. All sharp edges shall be ground smooth. Where

painted cabinets are specified, the exterior shall be degreased and primed with a spray applied iron phosphate coat- equivalent to a four-stage iron phosphate coat prior to painting. The final coat shall consist of a powder coat paint (TGIC or equivalent) applied with a minimum thickness of 2 mils.

All seams that are not welded shall be sealed with RTV sealant or equivalent material on the interior of the cabinet. All cabinets shall be supplied with a minimum of two (2) removable shelves manufactured from 5052-H32aluminum. Shelves shall be a minimum of 10 inches deep. Shelves to be designed to accommodate a minimum 50 pound loading.

The shelves shall have horizontal slots at the rear and vertical slots at the front of the turned down side flange. The shelves shall be installed securely by first inserting the rear edge of the shelf on the cabinet rear sidewall mounting studs, then lowering the shelf on the front sidewall mounting studs. The front edge of the shelf shall have holes punched every 6 inches to accommodate tie-wrapping of cables/harnesses. A minimum of two (2) sets of vertical "C" channels shall be mounted on each interior wall of the cabinet for the purpose of mounting the cabinet components. The channels shall accommodate spring mounted nuts or studs. All mounting rails shall extend to within 7 inches of the top and bottom of the cabinet. Sidewall rail spacing shall be no more than 9.0 inches center-to-center. Rear wall rail spacing shall be 19.0 inches center-to-center.

The main door and police door-in-door shall close against a weatherproof and dust-proof, closed-cell neoprene gasket seal. The gasket material for the main door shall be a minimum of 0.250 inches thick by 1.00 inch wide. The gasket material for the police door shall be a minimum of 0.250 inches thick by 0.500 inches wide. The gaskets shall be permanently bonded to the cabinet. The cabinet shall be equipped with a louvered air entrance. The air inlet shall be large enough to allow sufficient air flow per the rated fan capacity. Louvers must satisfy the NEMA rod entry test for 3R ventilated enclosures. A non-corrosive, vermin- and insect-proof, removable air filter shall be secured to the air entrance. The filter shall fit snugly against the cabinet door wall. The roof of the cabinet shall incorporate an exhaust plenum with a vent screen. Perforations in the vent screen shall not exceed 0.125 inches in diameter.

The main door cabinet shall be equipped with a three-point latching mechanism. The handle on the main door of the cabinet shall be manufactured from cast aluminum or stainless steel. The handle shall include a hasp for the attachment of an optional padlock. The cabinet door handle shall rotate counter-clockwise to open. The handle shall not extend beyond the perimeter of the main door at any time. The lock assembly shall be positioned so that the handle shall not cause any interference with the key when opening the cabinet door. The main door hinge shall be a one-piece, continuous piano hinge with a stainless steel pin running the entire length of the door. The hinge shall be attached in such a manner that no rivets or bolts are exposed. The main door shall include a mechanism capable of holding the door open at approximately 90, and/or (165 or 180) degrees under windy conditions. The main door shall be equipped with a standard Corbin #2 or exact equivalent. Minimum of two keys shall be supplied.

The police door-in-door shall be provided with a treasury type lock Corbin No. R357SGS or exact equivalent and have a minimum of one key. All base mounted cabinets require anchor bolts to properly secure the cabinet to its base. The cabinet flange for securing the anchor bolts shall not protrude outward from the bottom of the cabinet. Four anchor bolts shall be required for proper installation.

Each cabinet shall be of sufficient size to accommodate all equipment. At a minimum, the cabinet sizes are as follows:

Pole Mounted Cabinets	Ground Mounted Cabinets
Height - 50 Inches	Height – 55 Inches
Width – 36 Inches	Width – 44 Inches
Depth – 17 Inches	Depth – 26 Inches
Dimensions shall not exceed these minimum dimensions by more than 2 inches.	

Main door shall incorporate a shroud to cover the filtered louvered openings as appropriate for the design. The assembly is secured on the interior of the door over the filtered Louvers. The Shroud is louvered downward and matches the door louvers. All enclosures must be constructed, approved and marked in accordance with the requirements for Type 1 Industrial Control Panel Enclosures contained in UL 508A, the Standard for Industrial Control Panels. Enclosure must meet NEMA 3R rating requirements and be marked with UL approval sticker.

715.42.8.2-Terminals and Facilities/Main panel Design and Construction: The main panel shall be constructed from 5052-H32 brushed aluminum of 0.125 inches minimum thickness and installed so as to minimize flexing when plug-in components are installed. All main panels are provided with a mounting mechanism which allows easy access to all wiring on the rear of the panel without the removal of any cabinet shelves. Lowering of the main panel can be accomplished. Complete removal can be accomplished by the use of simple hand tools.

The terminals and facilities shall be available as a minimum in the following configuration:

- Sixteen load switch sockets, six flash transfer relay sockets, one flasher socket, 2-BIU sockets (expandable to 4), one 16-channel detector rack (expandable to 4) with one BIU, and one Type-16 MMU.

All load switch and flash transfer relay socket reference designators shall be silk-screen labeled on the front and rear of the main panel to match drawing designations. Socket pins shall be marked for reference on the rear of the panel. A maximum of eight load switch sockets may be positioned horizontally or stacked in two rows on the main panel. Main panels requiring more than eight load switch sockets shall be mounted in one horizontal or two vertical rows. All load switches shall be supported by a bracket, extending at least half the length of the load switch. The 16 load switch position main panels shall have all field wires contained on two rows of horizontally mounted terminal blocks. The upper row shall be wired for the pedestrian and overlap field terminations. The lower row shall be reserved for phase one through phase eight vehicle field terminations.

All field output circuits shall be terminated on a non-fused barrier type terminal block with a minimum rating of 10 amps. All field input/output (I/O) terminals shall be identified by permanent alphanumerical labels. All labels shall use standard nomenclature per the NEMA TS2 specification. It shall be possible to flash either the yellow or red indication on any vehicle movement and to change from one color indication to the other by use of a screwdriver. Field terminal blocks shall be wired to use four positions per vehicle or

overlap phase (green, yellow, and red, flash). It shall not be necessary to de-buss field terminal blocks for flash programming.

The main panel shall contain at least one flasher socket (silk screen labeled) capable of operating a 15-amp, 2-pole, NEMA solid-state flasher. The flasher shall be supported by a bracket, extending at least half its length. One RC network shall be wired in parallel with each group of three flash-transfer relays and any other relay coils. All logic-level, NEMA-controller and Malfunction Management Unit input and output terminations on the main panel shall be permanently labeled. Cabinet prints shall identify the function of each terminal position. At a minimum, three 20-position terminal blocks shall be provided at the top of the main panel to provide access to the controller unit's programmable and non-programmable I/O. Terminal blocks for DC signal interfacing shall have a number 6-32 x 7/32 inch screw as minimum.

All main panel wiring shall conform to the following wire size and color:

a. Green/Walk load switch output - brown wire - 14 gauge
b. Yellow load switch output - yellow wire - 14 gauge
c. Red/Don't Walk load switch - red wire output - 14 gauge
d. MMU (other than AC power) - violet wire - 22 gauge
e. Controller I/O - blue wire - 22 gauge
f. AC Line (power panel to - black wire main panel) - 8 gauge
g. AC Line (main panel) - black wire - 10 gauge
h. AC Neutral (power panel to - white wire main panel) - 8 gauge
i. AC Neutral (main panel) - white wire - 10 gauge
j. Earth ground (power panel) - green wire - 8 gauge
k. Logic ground - gray wire - 22 gauge
l. Flash programming - Orange wire
m. Flasher terminal - Black wire red or yellow field terminal - 14 gauge

All wiring, 14 AWG and smaller, shall conform to MIL-W-16878/1, type B/N, 600V, 19-strand tinned copper. The wire shall have a minimum of 0.010 inches thick PVC insulation with clear nylon jacket and rated to 105 degrees Celsius. All 12 AWG and larger wire shall have UL listed THHN/THWN 90 degrees Celsius, 600V, 0.020 inches thick PVC insulation and clear nylon jacketed. Connecting cables shall be sleeved in a braided nylon mesh or poly-jacketed. The use of exposed tie wraps or interwoven cables is unacceptable. All Terminals and Facilities configurations shall be provided with BIU wiring assignments consistent with NEMA TS2-2003 specifications. All Terminals and Facilities configurations shall be provided with sufficient RS-485 Port 1 communication cables to allow for the intended operation of that cabinet. Each SDLC communication cable connector shall be a 15-pin metal shell D subminiature type. The cable shall be a shielded cable suitable for RS-485 communications. All main panels shall be pre-wired for a Type-16 Malfunction Management Unit.

All wiring shall be neat in appearance. All cabinet wiring shall be continuous from its point of origin to its termination point. Butt type connections or splices are not acceptable. All connecting cables and wire runs shall be secured by mechanical clamps. Stick-on type clamps are not acceptable. The grounding system in the cabinet shall be divided into three

separate circuits (AC Neutral, Earth Ground, and Logic Ground). These ground circuits shall be connected together at a single point as outlined in the NEMA TS2 Standard.

The main panel shall incorporate a relay, to be designed as K1, to remove +24 VDC from the common side of the load switches when the intersection is placed into mechanical flash. The relay shall have a momentary pushbutton located on the relay to apply power to the load switch inputs for ease of troubleshooting. All pedestrian push button inputs from the field to the controller shall be opto-isolated through the BIU and operate at 12 VAC. All wire (size 16 AWG or smaller) at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity. Lap joint soldering is not acceptable.

715.42.8.3-Power Panel Design and Construction: The power panel shall integrated into the main panel and be located on the lower right portion of the cabinet. The power panel shall be wired to provide the necessary filtered power to the load switches, flasher(s), and power bus assembly. The power components shall be equipped with a removable plastic front cover for protection. The design will allow a technician to access the main and auxiliary breakers without removing the protective front cover.

The power panel portion of the main panel shall include the following components:

a. A minimum of one (1) 40-amp main breaker for 16 position cabinets. This breaker shall supply power to the controller, MMU, signals, cabinet power supply and auxiliary panels. Breakers shall be at minimum, a thermal magnetic type, UL listed for HACR service, with a minimum of 10,000 amp interrupting capacity.
b. A minimum of one (1) 15-amp auxiliary breaker. This breaker shall supply power to the fan, light and GFI utility outlet.
c. An EDCO model SHP-300-10 or exact approved equivalent surge arrester.
d. A 50 amp, 125 VAC radio interference line filter.
e. A normally-open, 50-amp, Solid State Relay (SSR). Shall be Crydom Model Number HA4875H or approved equal.
f. A minimum of one (1) 8-position neutral bus bar is capable of connecting three #12 wires per position.
g. A minimum of one (1) 6-position ground bus bar capable of connecting three #12 wires per position.
h. A minimum of one (1) NEMA type 5-15R GFI utility outlet.
i. The cabinet shall have a roll-out/swing-out concealable shelf/platform that can be used as platform for a laptop computer or other tools when the cabinet door is opened.

715.42.8.4-Power and SDLC Bus Panel: The Power and SDLC BUS Panel shall be manufactured from 0.090 - 0.125", 5052-H32 aluminum. It shall provide a central location to supply filtered power for the controller, malfunction management unit, cabinet power supply, and all auxiliary equipment. It shall include the SDLC Bus connecting cables wired to a barrier type terminal block. As an alternate, SDLC Bus connections may be made via an SDLC Hub Assembly. All cabinet equipment requiring filtered power to operate shall be hardwired directly to the supplied barrier type terminal blocks on the Power and SDLC BUS Panel. All AC+ power sources shall be protected with a removable plastic cover plate. The SDLC Hub Assembly shall accommodate all D-Subminiature Female 15

(DB15) connectors as required, and a minimum of five (5) SLDC connections shall be provided.

715.42.8.5-Auxiliary Cabinet Equipment: The cabinet shall be provided with a thermostatically controlled (adjustable between 55-160 degrees Fahrenheit) ventilation fan in the top of the cabinet plenum. The fan plate shall be removable with the use of simple hand tools for serviceability. A minimum of one, maximum of two, exhaust fans shall be provided. The fan shall be a ball bearing type fan and shall be capable of drawing a minimum of 100 cubic feet of air per minute (CFM). The Fan/Thermostat assembly shall be connected to the Power panel by means of a 4 position plug-in cable or hardwired to an appropriate circuit breaker.

A LED cabinet lighting system may be used to illuminate the internal structure of the cabinet assembly. The LED cabinet lighting shall be a Luxem Bright LED module Model #772-Woo13 and approved power supply, or approved equivalent. This lighting system shall be wired directly to a door active switch mounted near the top of the door. Alternately, a fluorescent lighting fixture shall be mounted on the inside top of the cabinet near the front edge. The fixture shall be rated to accommodate at minimum a F15T8 lamp operated from a normal power factor UL or ETL listed ballast. The lamp shall be wired on the power panel or to a door activated switch mounted near the top of the door.

A re-sealable print pouch shall be mounted to the door of the cabinet. The pouch shall be of sufficient size to accommodate one complete set of folded cabinet prints. A minimum of two sets of complete and accurate cabinet drawings shall be supplied with each cabinet.

715.42.8.6-Vehicle Detection: A minimum of one Loop Detector rack shall be provided in each cabinet.

a. Shall support up to 16 channels of loop detection (either eight 2 channel detectors or four 4 channel detectors), two 2-channel preemption devices and one BIU.

All connections to the back of the detector racks to the detector cards shall be soldered to a 44 terminal, double row, 3.962 mm (0.156 in.) contact spacing, Cinch Jones card edge connector 50-44A-30M, or equivalent centered vertically for each detector module. All designations shall correspond to the requirements of the TS2-2003 specification. Card Guides shall be provided on the top and bottom of the card rack for each connector position. Each cabinet shall contain a detector interface panel per each detector rack for the purpose of connecting field loops and vehicle detector amplifiers. The panels shall be manufactured from 0.090 or 0.125” thick 5052- H32 Aluminum and use barrier type terminal blocks.

One 16-position interface panel shall be provided for a 16-channel rack cabinet. The interface panel shall be secured to the left wall of the cabinet. Each interface panel shall allow for the connection of eight or sixteen independent field loops. A ground bus terminal shall be provided between each loop pair terminal to provide a termination for the loop lead-in cable ground wire. Each interface panel shall provide a barrier style terminal block to terminate the field wires for up to two 2-channel preemption devices.

Lightning protection device mounting holes shall be provided to accommodate the potential usage of an EDCO LCA-6, lightning protection device. A cable consisting of 20 AWG twisted pair wires shall be wired directly from the interface panel to the detector

rack. The twisted pair wires shall be color coded red and white wire. No connectors shall be used to connect the interface panel to the detector rack.

All termination points shall be identified by a unique number and silk screened on the panel. Each detector rack shall accommodate rack mountable preemption devices such as EMTRAC or Opticom.

715.42.8.7-Cabinet Test Switches and Police Panel: A test switch panel shall be mounted on the inside of the main door. The test switch panel shall provide as a minimum the following**:**

a. Signals On/Off Switch - In the OFF position, power shall be removed from signal heads in the intersection. The controller shall continue to operate. When in the OFF position, the MMU shall not conflict or require reset.

b. Auto/Flash Switch - When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall not be stop timed when in flash. Wired according to NEMA-TS2-2003 the MMU forces the controller to initiate the start-up sequence when existing flash.
c. Stop Time Switch - When applied, the controller shall be stop timed in the current interval.
d. Control Equipment Power On/Off - This switch shall control the controller, MMU, and cabinet power supply AC power. The TS2 controller to be provided with the cabinet assembly shall provide vehicular and pedestrian call inputs from its keyboard while in the standard status display.

The police door switch panel shall contain the following:

a. Signals On/Off Switch - In the OFF position, power shall be removed from signal heads within the intersection. The controller shall continue to operate. When in the OFF position, the MMU shall not conflict or require reset.
b. Auto/Flash Switch – When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall be stop timed when in flash. Wired according to NEMA-TS2-1998 the MMU forces the controller to initiate the start-up sequence when exiting flash.
c. Auto/Manual Switch - Cabinet wiring shall include provisions for an Auto/Manual switch and a momentary push button or hand cord. The Auto/Manual switch and push button or hand cord shall not be provided unless it is called for in the Customer Specification.

All toggle type switches shall be heavy duty and rated 15 amps minimum. Single- or double-pole switches may be provided, as required. Any exposed terminals or switch solder points shall be covered with a non-flexible shield to prevent accidental contact. All switch functions must be permanently and clearly labeled. All wire routed to the police door-in-door and test switch push button panel shall be adequately protected against damage from repetitive opening and closing of the main door.

715.42.8.8-Auxiliary Devices:

715.42.8.8.1-Load Switches: Load switches shall be solid state and shall conform to the requirements of Section 6.2 of the NEMA TS2 Standard. Signal load switches shall have a minimum rating of 10 amperes at 120 VAC for an incandescent lamp load. The front of the load switch shall be provided with three indicators to show the input signal from the controller to the load switch. Load switches shall be dedicated per phase. The use of load switches for other partial phases is not acceptable. The full complement of load switches shall be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.

715.42.8.8.2–Flashers: The flasher shall be solid state and shall conform to the requirements of section 6.3 of the NEMA TS2 Standard. Flashing of field circuits for the purpose of intersection flash shall be accomplished by a separate flasher. The flasher shall be rated at 15 amperes, double pole with a nominal flash rate of 60 FPM. A full complement of flasher shall be provided.

715.42.8.8.3-Flash Transfer Relays: All flash transfer relays shall meet the requirements of Section 6.4 of the NEMA TS2 Standard. The coil of the flash transfer relay must be de-energized for flash operation. The full complement of relays shall be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.

715.42.8.8.4-Malfunction Management Units (MMU): Each cabinet assembly shall be supplied with one MMU as defined by the requirements of Section 4 of the NEMA TS2 Standard.

Malfunction Management Units shall be a Type 16. The MMU shall be Model MMU-16 (EDI Model MMU-16) or approved equal.

715.42.8.8.5-Bus Interface Units (BIU): All BIUs shall meet the requirements of Section 8 of the NEMA TS2 Standard. A full complement of BIUs meeting Section 5.3.1.4 if the NEMA Publication No. TS2-2003 shall be supplied per cabinet. Bus Interface Units shall be supplied with each cabinet to allow for maximum phase and function utilization for which the cabinet is designed. A minimum of 3 BIUs shall be provided for each cabinet. Each Bus Interface Unit shall include power on, transmit and valid data indicators - all indicators shall be LEDs. A Type 1 Interface shall be defined as defined by Section 5.3, the controller interface shall conform to the Standard Publication NO. TS2-2003.

715.42.8.8.6-Cabinet Power Supply: The Cabinet power supply shall meet the requirements of Section 5.3.5 of the NEMA TS2 Standard. The Cabinet Power supply shall provide LED indicators for the line frequency, 12 VDC, 12 VAC, and 24 VDC outputs. The cabinet power supply shall provide (on the front panel) jack plugs for access to the +24 VDC for test purposes. Cabinet power supply shall be provide with each cabinet assembly per manufacturer's specifications. And be wired directly to the Power Bus Assembly via a 12-pin Molex Robotic type connector Model# 54332-1270 or exact equivalent.

715.42.8.9-Testing: Each controller and cabinet assembly shall be tested as a complete entity under signal load for a minimum of 48 hours. Each assembly shall be delivered with a signed document detailing the cabinet final tests performed. The cabinet shall be assembled and tested by the controller manufacturer or authorized local distributor to ensure proper component integration and operation.

715.42.8.10-Warranty: The controller and Malfunction Management Unit shall be warranted by the manufacturer against mechanical and electrical defects for a period of two years from date of shipment. The manufacturer's warranty shall be supplied in writing with each cabinet and controller. Second party extended warranties are not acceptable. The cabinet assembly and all other components shall be warranted for a period of one year from date of shipment. Any defects shall be corrected by the manufacturer at no cost to the owner.

715.42-TRAFFIC SIGNAL MATERIALS AND EQUIPMENT:

715.42.11-Junction Boxes:

715.42.11.2-Type H-(Heavy Duty):

DELETE PARAGRAPH TWO OF SUBSECTION 715.42.11.2 AND REPLACE WITH THE FOLLOWING PARAGRAPH.

Precast concrete junction boxes shall be fabricated in accordance with the requirements of MP 604.02.40.

SECTION 716
EMBANKMENT AND SUBGRADE MATERIAL

DELETE SUBSECTION 716.1 AND REPLACE WITH THE FOLLOWING:

716.1-GENERAL:

Material for embankment shall be: random material, rock, hard shale, or borrow material. Material for subgrade shall be granular material.

716.1.1-Random Material: Random material shall be considered as a mixture of any or all of soil, granular material, or soft shale as described which are permitted by the Engineer to be used in embankment. These are materials that can be incorporated in a 6 inch (150 mm) compacted layer.

716.1.1.1-Soil: Soil material shall be considered as layers or deposits of disintegrated rock, lying on or near the surface of the earth; which has resulted from natural processes, such as weathering, decay or chemical action or a combination of these processes. Material shall be considered as soil when more than 25 percent by weight of the grains or particles pass the No. 200 (75 μm) sieve.

716.1.1.2-Granular Material: Granular material shall be considered as natural or synthetic mineral aggregate, such as broken or crushed rock, gravel, sand, or slag. Shale

or fly ash shall not be considered granular material. Granular material shall have not more than 25 percent by weight of grains or particles passing the No. 200 (75 µm) sieve (determined by AASHTO T-11 and AASHTO T-27) and the plasticity index shall not be more than 6 (determined by AASHTO T-90). The plasticity index shall be determined using a separate unwashed portion of the field sample. Granular material shall not contain particles larger than 3 inches (75 mm), by visual inspection.

716.1.1.3-Soft Shale: Soft shale shall be considered as any of the shales, weak sandstone, weak limestone, claystones or siltstones that break down using the following roller test. Rock which break down under three complete coverages with a steel drum roller, meeting the following requirement, shall be classified as soft shale to be placed as specified in 207.7.3.2.1. Smooth drum rollers shall provide a minimum 1.5 tons per linear foot of roller width and drum rollers with any type of feet (sheep's foot, tamping foot, and etc.) shall provide the same minimum of 1.5 tons per linear foot of roller drum width. This criteria applies to single and multiple drum rollers as well as vibratory rollers with the vibration set to maximum. This criteria shall be calculated for each roller and test combination by dividing the operating weight of the roller in tons by the total measured width of the drum in feet, or the total of all drums if more than one drum. This calculation shall be provided to the Engineer in writing prior to the test. The contractor shall provide the roller or rollers and any other necessary equipment for this test without additional compensation.

716.1.2-Rock: Rock is defined as sandstone, limestone, or concrete that cannot be incorporated in a 6 inch (150 mm) compacted lift and shall be medium hard or harder.

716.1.3-Hard Shale: Material that meets the description of shale in 716.1.1.3 except that is does not break down under the hardness test shall be considered as hard shale and placed as specified in 207.7.3.2.2 when used as embankment material.

716.1.4-Borrow Material: Borrow shall consist of approved material required for the construction of embankments and other portions of the work and shall be subject to the applicable provisions of 211.

716.2-TEST METHODS:

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

Plastic Limit	AASHTO T 90 or ASTM D 424
Grain Size Analysis	AASHTO T 88 or ASTM D 422
Sieve analysis of fine and coarse aggregate	AASHTO T 27
Amount of material finer than 200 sieve (0.075 mm) in aggregate	AASHTO T 11
Specific Gravity of Soils	AASHTO T 100 or ASTM D854

Specific Gravity and Absorption of Coarse Aggregate	AASHTO T 85 or ASTM C 127
Organic Content	AASHTO T 267
Moisture and density of soil and material having less than 40 percent of particles by weight retained on the ¾ inch (19 mm) sieve	MP 207.07.20
Moisture and density of material having 40 percent or more of the particles by weight retained on the ¾ inch (19 mm) sieve and that are relatively uniform in gradation and can be incorporated in a 12-inch (300 mm) lift or less, and granular subgrade	MP 700.00.24 (See MP 717.04.21, Table B)
Reclaimed asphalt pavement can be incorporated in a 6-inch (150 mm) lift or less, in subgrade	MP 700.00.24 MP 717.04.21, Table B)
Liquid Limit	AASHTO T 89 or ASTM D 423

716.3-MOISTURE AND DENSITY REQUIREMENTS:

716.3.2-Embankment and Subgrade Density:

716.3.2.3:

DELETE THE CONTENTS OF SUBSECTION 716.3.2.3 AND REPLACE WITH THE FOLLOWING:

Material, as outlined in MP 717.04.21, Table B, shall be proof rolled with a pneumatic tire roller having an effective weight of 50 tons (45.5 Mg). Alternate proof rollers, acceptable to the Engineer, may be used in lieu of a 50-ton (45.5 Mg) pneumatic tired roller provided the weight per tire and tire pressure is maintained so that a minimum of 1315 pounds per inch (9.067 KN/mm) width of tire is maintained. The roller shall be operated at a speed of not more than five miles per hour (8 km/hr.). The designated areas to be proof rolled shall have two or more passes and the entire area shall be systematically covered with the proof rolling. During the proof rolling and after the proof rolling is completed, the area shall be checked for unstable areas or soft spots disclosed by the operation of the proof roller. These unstable areas or soft spots shall be corrected prior to placement of the overlying lifts of material. The Contractor may propose an alternate approach for small areas that are impractical to roll with the proof roller.

ADD THE FOLLOWING SECTION:

SECTION 720
SMOOTHNESS TESTING

720.1-DESCRIPTION:

To measure and evaluate the ride quality of pavement surfaces in accordance with the International Roughness Index (IRI), as well as the most recent forms of AASHTO R-56, AASHTO M328, and AASHTO R-57.

720.2-EQUIPMENT:

720.2.1-High-Speed or Low Speed Inertial Profiler: Provide a high-speed or low speed inertial profiler for measuring and evaluating the ride quality of pavement surfaces. The inertial profiler shall be certified at a facility approved by the Materials Control, Soils and Testing Division (MCS&T). Certification facilities should conduct the evaluation in accordance with the most recent edition of AASHTO R-56 "Standard Practice for Certification of Inertial Profiling Systems". All inertial profilers shall be maintained in accordance with the most recent edition of AASHTO M328 "Standard Specifications for Inertial Profiler" Calibration and verification shall be done in accordance with MP 720.10.0. The Contractor shall submit equipment certification documentation after becoming certified or after recertification. Proof of equipment certification shall be available upon request.

720.2.2-Inertial Profiler Operator Certification: Certification through the Material Control, Soils and Testing Division shall be required to operate an inertial profiler in the State of West Virginia. The operator shall pass a written exam administered by MCS&T. All operators receiving a passing score on the written exam will be placed on the WVDOH Materials Certification Directory that is found on the MCS&T webpage. Certification shall be for a period of three years. Certified operators shall contact MCS&T for certification renewal.

720.3-RIDE QUALITY TESTING

720.3.1-Quality Control (QC) Testing: QC testing on NHS routes is the responsibility of the Contractor. QC testing shall be completed in accordance with MP 720.10.01 Section 8 no later than fourteen (14) calendar days after all lanes are continuously open to traffic. Data collection shall be done by a certified inertial profiler and certified inertial profiler operator (See 720.2.1 and 720.2.2,). Collected profile data shall be submitted to the project engineer in accordance with MP 720.10.01 Section 10within five (5) calendar days of testing.

720.3.2-Quality Assurance (QA) Testing: QA testing is the responsibility of the Division. The Engineer shall submit a "Bridge and Pavement Testing Request Form" form to MCS&T via email, within five (5) calendar days after all lanes are continuously open to traffic. Within 14 (14) calendar days from receiving the request, the Division will conduct QA testing. The Division will l use a certified inertial profiler and certified operator for QA testing.

720.3.3-Quality Assurance Verification (QAV) Testing: QAV testing is the responsibility of the Division. The Division's profile data and the Contractor's profile data will be compared to

determine the IRI differences. Final project price adjustments will be made using the Contractor's profile data if the IRI differences are within the allowable limits outlined in Table 720.3.3.

TABLE 720.3.3
QAV Testing Allowable IRI Differences

Contractor's IRI Mean (in/mi)	Maximum Allowable Differences
50.0 or Less	8.5% of Contractor's IRI Mean
50.1 to 150.0	6.0% of Contractor's IRI Mean
150.1 or Greater	7.0% of Contractor's IRI Mean

720.3.4-Referee Testing: Referee testing is the responsibility of the Division. If the QAV testing IRI differences does not meet the maximum allowable difference from Table 720.4.3, the Division will perform referee testing using a certified inertial profiler and a certified inertial profiler operator in accordance with the most recent edition of AASHTO R56 "Standard Practice for Certification of Inertial Profiling Systems". The profile data from the referee test shall be used in determining the final project price adjustments.

720.3.4.1-Referee Data: If the referee test data still does not meet the allowable IRI differences MCS&T can recommend the Contractor recertify their inertial profiler and inertial profiler operator that was used on the project.

720.3.5-Testing After Repairs: Should repairs be needed to the surface from the defects in the pavement prior to project closeout, QA and QAV testing shall be conducted after all repairs are made. This will be the final tested value for the lot.

720.4-RIDE QUALITY ANALYSIS:

720.4.1-Data Location: The average IRI number used in ride quality analysis shall be the mean roughness index (MRI) which is the average IRI of both the left and right wheel path. Analysis shall be done in accordance with MP 720.10.01 Section 9.

720.4.2-Omitted Sections: Bridge Structures and any sections tested which are not included in the pavement project shall be removed from the Smoothness Analysis. These removed bridges and sections shall also include a Lead-In and Lead-Out distance to be removed from the Ride Quality Analysis. The Lead-In distance shall be two hundred (200) feet and the Lead-Out distance shall be two hundred (200) feet.

720.4.3-Sampling Lots: The pavement shall be divided into sampling lots of one-tenth (0.1) lane mile each. Each Lot shall have a smoothness measurement, expressed in inches per mile (in./mi.).

720.4.3.1-Special Cases for Sampling Lots Less Than One-Tenth (0.1) Lane Mile: In some cases, sampling, lots of one tenth (0.1) lane mile will not be attainable. These cases include areas at the end of the project as well as areas that are before the 'lead in" length of bridges. If these areas are less than five-hundredths (0.05) of a lane mile that will be eliminated from Smoothness analysis. If these areas are more than five-hundredths (0.05 mile) lane mile these areas will be included in analysis and pay adjustments will be prorated to the nearest one hundredth (0.01) mile. This shall apply to all projects governed by Section 720.

720.5-NATIONAL HIGHWAY SYSTEM (NHS) PAVEMENT PROJECT:

Pavement projects located on any NHS route and greater than 0.2 miles of continuous new pavement shall be tested with a high-speed or low speed inertial profiler certified in accordance with Section 720.2.

720.5.1-Determining National Highway System Routes: The "West Virginia NHS Routes by County" Section of the most recent Annual Roadway Inventory Statistics document should be used when determining if a route is on the National Highway System. This document can be found online at:

http://www.transportation.wv.gov/highways/programplanning/gti/Highway_Data_Services/Pages/DataResources.aspx

720.5.2-Schedule 1 NHS Pavement Projects: NHS pavement projects with a pavement thickness of four (4) inches or greater shall be classified as Schedule 1 NHS Pavement Projects. The final price adjustments for Schedule 1 NHS Pavement Projects shall be determined using the calculations shown in Table 720.5.2.

TABLE 720.5.2
Schedule 1 NHS Pavement Projects

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

720.5.2.1-Corrective Action for Schedule 1 NHS Pavement Projects: Corrective action shall be required for Schedule 1 NHS Pavement Projects having an IRI greater than 95.1 in/mi. Corrective action shall be performed using diamond grinding, micro milling, or other work methods approved by the Engineer.

720.5.3-Schedule 2 NHS Pavement Projects: NHS pavement projects with a pavement thickness three (3) inches or greater and less than four (4) inches shall be classified as Schedule 2 NHS Pavement Projects. The final price adjustments for Schedule 2 NHS Pavement Projects shall be determined using the calculations shown in Table 720.5.3.

TABLE 720.5.3
Schedule 2 NHS Pavement Projects

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

720.5.4-Schedule 3 NHS Pavement Projects: 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. 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 ($)
46.0 or Less	+300
46.1 to 76.0	-10 (IRI) + 760
76.1 to 80.0	0
80.1 to 120.0	1,200 – 15 (IRI)
120.1 or Greater	-600

720.6-NON-NATIONAL HIGHWAY SYSTEM PAVEMENT PROJECTS:

Pavement projects located on any Non-NHS routes shall be tested with equipment outlined in 720.2.1, 720.2.2 and 720.3 if the project meets all four of the following requirements:

1. Resurfacing is the primary project type
2. Greater than 1 mile of continuous pavement,
3. Edge lines and center line on the new pavement in accordance with Section 663.
4. Thickness of one inch (1) or more of new pavement (including scratch if used)

720.6.1-Ride Quality Analysis Before Project: Non-NHS pavement projects shall be tested before the pavement project begins. Any new construction of a Non-NHS route will be evaluated as an NHS route according to 720.5.

720.6.2-Data Source Collection After Project Completion: The data source collection after project completion shall be collected by the Division's high-speed or low speed inertial profiler as referenced in 720.3.2. On non-NHS routes Quality Control Testing is optional for the contractor.

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	18 (Percent Improvement) – 700
50.0 or Less	0
Where: $\text{Percent Improvment (\%)} = \frac{\text{Before IRI of Lot} - \text{After IRI of same Lot}}{\text{Before IRI of Lot}} \text{ X } 100$	

720.7-PROJECT THAT DO NOT FALL UNDER PREVIOUS CHARACTERIZATIONS:

At the discretion of the Engineer pavement projects not falling into any of the other classifications shall be measured and evaluated for ride quality analysis under the direction of the Engineer. If recommended by the Engineer this shall be done by the Contractor with a 10-foot straightedge. There will not be any pay adjustments based on Smoothness for these projects.