

Materials Procedures Committee Regular Meeting

Meeting Time/Date: October 6, at 10:00 AM

Meeting Location: MCS&T (Library Room) – 190 Dry Branch Drive, Charleston, WV 25306

Online Meeting: Google Meet Video Conference

Online Link - (Online Meeting)

Files Available on Webpage:

<https://transportation.wv.gov/mp-committee-page>

Materials Procedures – Approved at Last Meeting

1. 100.00.00 – Preparing Materials Procedures
2. 106.03.50 – General Information Guide for Technician and Inspector Certification Program (TICP)

Materials Procedures - Old Business

Number	Champion	Title	Description
1 - 106.03.50	Shane Harper	General Information Guide for Technician and Inspector Certification Program (TICP)	Simplify intent and add minor grammar edits since last meeting.
2 - 688.02.20	Lorah Ford	Guide for contractor's and fabricator's quality control plan for painting.	Updated Section 2 reference documents, Updated section 3 to be more concise and update to correct specifications, renamed section 4 to Submission of QC plan and updated to be the actual submission requirements, added section 5, Approval and added attachment
3 - 688.03.20	Lorah Ford	Guide for development of the contractor's environmental control plan for spent material prior to painting existing structures.	Updated Section 2 reference documents renamed section 3 to Requirements and Guidelines and updated to make more concise, renamed section 4 to Submission of Environmental Control Plan and updated to be the actual submission requirements, added section 5, Approval, and added attachment.
4 - 109.00.21	Ian Shaffer	Basis For Charges For Non-Submittal of Sampling & Testing Documentation by the Established Deadline	Update Concrete Section on Attachment page, remove "Rapid Chloride Permeability" replace with Surface Resistivity
5 - 700.00.53	Ian Shaffer	Procedure For The Independent Assurance Program	Update the PCC section 7, add Surface Resistivity testing and frequency details
6 - 700.00.54	Ian Shaffer	Procedure for Evaluating Quality Control Sample Test Results with Verification	Update the scope section, 4.2.4 Portland Cement Concrete, adding Surface Resistivity

		Quality Assurance Sample Test Results	
7 - 700.00.56	Thomas Ross	Commercial and Potential Skid Resistant Aggregate Source Approval Procedures	This is a new MP- to provide procedure for approval and monitoring any aggregate producers/suppliers intending on supplying aggregates to any WVDOH projects.

Materials Procedures – Editorial Edits

Number	Champion	Title	Description
8 - 601.00.49	Ian Shaffer	Method of Test for Determining the Condition of Concrete Bridge Decks	Original lettering was 5.5.1.1, made an editorial change to 5.5.1
9 - 601.03.50	Ian Shaffer	Guide for quality control and acceptance requirements for Portland cement concrete.	Fixed a mention of site manager to AWP. Changed Division of materials and products to MCS&T. Added AASHTO T 358 to the reference section.
10 - 601.03.52	Ian Shaffer	Procedural guidelines for maintaining control charts for Portland cement concrete.	Editorial updates completed on grammatical structure.
11 - 601.03.53	Ian Shaffer	Standard method for determination of optimized aggregate gradation in Portland cement concrete.	Updated the Attachment headers the document needs a reconfirmed date added. A reference section was added.
12 - 601.04.20	Ian Shaffer	Curing concrete test specimens in the field.	Fixed formatting errors within the reference section.
13 - 601.05.50	Ian Shaffer	Quality assurance procedures for Portland cement concrete.	Moved the purpose section to the top of the document and moved the definitions to where they go in accordance with MP 100.00.00. Created a reference section.
14 - 603.02.10	Ian Shaffer	Guide for approval of component and ship loose materials pertaining to precast and prestressed concrete items.	Bolded titles. Fixed numbering issue. Created a reference section.
15 - 603.06.20	Ian Shaffer	Test method for the determination of bond strength between prestressing steel strand and self-consolidating concrete (SCC).	Removed repetitive language. Added Reference section.

16 - 603.10.40	Ian Shaffer	Inspection and acceptance procedures for prestressed concrete bridge members.	Added to the reference section
17 - 604.02.40	Ian Shaffer	Inspection and acceptance procedures for precast concrete products.	Updated links to Division pages. Created reference section.
18 - 707.04.10	Ian Shaffer	Guide for approval of supplementary cementitious materials (SCMS).	Updated headers.
19 - 709.01.50	Ian Shaffer	Acceptance criteria for corrosion resistant steel reinforcement bars for concrete.	Updated headers and add subparagraph numbering to section 3. Changed the name of section 3 to references.
20 - 711.03.23	Ian Shaffer	Mix design for Portland cement concrete.	Updated links to Division webpages. Added to the reference section.
21 - 711.03.26	Ian Shaffer	Maintaining specified level of strength in Portland cement concrete.	Created a reference section.
22 - 714.03.30	Ian Shaffer	Quality assurance of reinforced concrete culvert, storm drain, and sewer pipe.	Created a reference section.
23 - 715.07.20	Ian Shaffer	Standard method of test for determining the quality of water used with hydraulic cement.	Changed section 2 to Scope and named the two tables in the document.

Materials Procedures - New Business with Significant or Process Updates

Number	Champion	Title	Description
24& - 601.04.21	Ian Shaffer	Acceptance Use of the Maturity Method for the Estimation of Concrete Strength on WVDOT Projects	Updated the headers and reference section. Removed mention of 6" x 12" cylinders.
25& - 679.03.00	Lorah Ford	Percent of Solids in the Latex Used in Latex Modified Compositions.	Updating formatting, updated the equipment used and adding Fahrenheit (F) to the oven temperature.
26& - 711.40.10	Lorah Ford	Acceptance of Glass Beads for Traffic Marking Paint.	This is a new MP to provide procedure for acceptance of glass beads.

Note 1: * Denotes this MP is up for Vote

Note 2: & Denotes this MP is not up for Vote

Comments

Comments are due September 29th, so the Champion may review and address them.
Submit comments to Kristy Huffman (kristy.j.huffman@wv.gov)

Next Meeting

New or Updated MPs due to the MP Chair 3 weeks before the next meeting: November 9th

Meeting Time/Date: 11:00 AM, December 1, 2026

Meeting Location: MCS&T Library Room

Online Meeting: Google Meet Video Conference (Link TBD)

Additional MP Committee Meeting Information

For details of previous meetings, please visit the MCST MP Committee Webpage
<https://transportation.wv.gov/mp-committee-page>

Tentative MP Committee Dates for 2026:

December 1

Tentative MP Committee Dates for 2027:

February 2, April 6, June 1, August 3, October 5, December 7

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

GENERAL INFORMATION GUIDE FOR TECHNICIAN AND INSPECTOR
CERTIFICATION PROGRAM (TICP)

1. PURPOSE

- 1.1. The purpose of the West Virginia Division of Highways (WVDOH) Technician and Inspector Certification Program is to improve the quality assurance of various materials by the certification of Industry and WVDOH personnel. This procedure is to establish guidelines for this purpose.
- 1.2. The purpose of the schools is to provide helpful information and instruction for people preparing to take the WVDOH Technician/Inspector examinations. These courses are designed to provide instruction for people with a basic foundation in the subject matter. Work experience in the subject matter is encouraged before attending classes.

2. GENERAL

- 2.1. It is WVDOH's intent to conduct a cooperative program of training, study, and examination so that personnel of the producer, contractor, and the WVDOH will be able to better assure, by their increased technical knowledge, the level of quality required by the governing Specifications.
- 2.2. **Hands-On-Training** is performing the tests outlined in this MP for the certification the technician is seeking, for a minimum of 40 hours. These tests may be performed on a state project, private project, or any place the company has available but are not to be submitted for the actual project. Acceptance tests must be performed by certified technicians.
- 2.3. **A Responsible Person** is an individual, such as a Project Engineer, Quality Control Manager, Supervisor, or other personnel, who is familiar with the testing procedures set by the WVDOH, AASHTO, and ASTM but is not necessarily "certified" in West Virginia.

3. REFERENCED DOCUMENTS

- 3.1. MP 106.03.51 - Policy for Materials Certification Reciprocity with PCC Inspector, PCC Technician, and Aggregate Technician

4. SCOPE

- 4.1. This procedure is applicable to all requirements, guidelines, and other support documents of the WVDOH that reference conditions, methods, and levels of qualification specific to the WVDOH Training and Certification Program.

5. POLICIES AND ADMINISTRATION

- 5.1. Certification Board - The board shall be responsible for administering the Certification Program in accordance with general policy guidelines established or approved by the State Highway Engineer. It will be composed of the following members:
1. Deputy State Highway Engineer - Construction
 2. General Counsel
 3. Director of MCS&T - hereafter referred to as "Director"
 4. Quality Assurance Program Administrator
 5. Applicable MCS&T Supervisor(s)

6. CERTIFICATION CLASSES

- 6.1. The Technician and Inspector Certification Program (TICP) offers certification classes in the following disciplines:
1. Aggregate Sampling Inspector, refer to Section 7
 2. Aggregate Technician, refer to Section 8
 3. Asphalt Field & Compaction Technician, refer to Section 9
 4. Asphalt Plant Technician, refer to Section 10
 5. Asphalt Preservation Technician, refer to Section 11
 6. Inertial Profiler Operator, refer to Section 12
 7. Portland Cement Concrete Inspector, refer to Section 13
 8. Portland Cement Concrete Technician, refer to Section 14
 9. Radiation Safety, refer to Section 15
 10. Soils & Aggregate Compaction Technician, refer to Section 16

Details of these classes are available on the MCS&T Webpage¹

7. AGGREGATE SAMPLING INSPECTOR

- 7.1. Certification as an Aggregate Sampling Inspector qualifies the technician to perform sampling of aggregates for both Quality Control and Quality Assurance.
- 7.2. The web-based examination for an Aggregate Sampling Inspector consists of the following areas:
1. Specifications
 2. Sampling Fundamentals
 3. Sampling Methods and Equipment
 4. AASHTO T 27 Sieve Analysis of Fine and Coarse Aggregates
 5. AASHTO T 11 Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

¹ <https://transportation.wv.gov/technician-and-inspector-certification-program>

The Aggregate Sampling Inspector requires the successful completion of an online examination.

- 7.3. No practical examination or Hands-On-Training is required for this certification.

8. AGGREGATE TECHNICIAN

- 8.1. Certification as an Aggregate Technician qualifies the technician to perform sampling and/or testing of aggregates for both Quality Control and Quality Assurance.

- 8.2. The written examination for Aggregate Technician consists of the following areas:

1. Aggregate Specifications and Procedures
2. Aggregate Fundamentals
3. Sampling, Control, and Inspection of Aggregates
4. Aggregate Testing

- 8.2.1. The applicant shall complete Hands-On-Training, refer to section 18.2. After successful completion of the written examination, the applicant will be required to pass the practical examination. The technician must be able to perform the routine tests associated with aggregate quality assurance.

- 8.3. American Concrete Institute (ACI) Aggregate Testing Technician - Grade I certification will be accepted as a portion of ~~for the practical portion of the~~ West Virginia Aggregate Technician training. However, the applicant must pass the online West Virginia Aggregate Technician written provisional certification test before a certification is issued. Refer to MP 106.03.51.

8.4. **HANDS-ON-TRAINING REQUIREMENTS**

- 8.4.1. Before scheduling the Practical Exam, each participant shall complete a Hands-On Training under the supervision of a Responsible Person in the eight different aggregate tests on which the participant will be tested. The tests to be trained in are:

1. AASHTO T 11 Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
2. AASHTO T 19 Bulk Density ("Unit Weight") and Voids in Aggregate
3. AASHTO T 27 Sieve Analysis of Fine and Coarse Aggregates
4. AASHTO T 84 Specific Gravity and Absorption of Fine Aggregate
5. AASHTO T 85 Specific Gravity and Absorption of Coarse Aggregate
6. AASHTO T 89 Determining the Liquid Limit of Soils
7. AASHTO T 90 Determining the Plastic Limit and Plasticity Index of Soils
8. MP 703.00.21 Standard Method of Test for Percent Crushed Particles

9. ASPHALT FIELD AND COMPACTION TECHNICIAN

- 9.1. Certification as an Asphalt Field and Compaction Technician qualifies the technician to oversee or inspect asphalt pavement construction. In addition, the class hand-out material is a valuable reference tool for each stage of the construction process. The required radiation safety training is included in this class and will certify attendees with a passing score to perform nuclear density testing on asphalt pavements.

- 9.2. The written examination for this class consists of the following areas:
1. Specifications
 2. Surface Preparation
 3. Mix Delivery and Placement
 4. Joint Construction
 5. Percent Within Limits (PWL)
 6. Troubleshooting
 7. Compaction Test Procedures
 8. Radiation Safety and Nuclear Gauge
 9. Testing Forms
- 9.2.1. With gauge endorsement, applicants must complete Hands-On-Training, please refer to section 18.2. After successful completion of the written examination, the applicant will be required to pass the practical examination. The technician must be able to perform the routine tests associated with asphalt compaction quality assurance.
- 9.2.2. Without gauge endorsement participants will only take a written exam.
- 9.3. HANDS-ON-TRAINING REQUIREMENTS
- 9.3.1. Each participant shall complete Hands-On Training under the supervision of a Responsible Person in the two Asphalt Field and Compaction Technician tests on which the participant will be tested. The tests to be trained in are:
1. AASHTO T 355 Standard Method of Test for In-Place Density of Asphalt Mixtures by Nuclear Methods
 2. Specification 401 Gauge Comparison
- 9.3.2. The practical exam may be attempted prior to the completion of the Hands-On-Training.
- 9.4. A technician that does not demonstrate proper radiation safety training shall not be allowed to continue testing on a WVDOH Project. They must be replaced by another qualified technician. Anyone who does not meet the applicable safety standards must provide proof of additional WVDOH approved radiation safety training before another evaluation will be conducted.

10. ASPHALT PLANT TECHNICIAN

- 10.1. Certification of the Asphalt Plant Technician qualifies the technician to take asphalt mixture samples, perform quality control or quality assurance testing on plant produced asphalt mixtures, make plant and mix adjustments, aggregate proportioning, and other duties.
- 10.2. The written examination for this class consists of the following areas:
1. Specifications
 2. Fundamentals
 3. Sampling and Testing

4. Control and Inspection
 5. Mix Proportioning and Adjustment
- 10.2.1. The applicant shall complete Hands-On-Training, please refer to section 18.2. After successful completion of the written examination, the applicant will be required to pass the practical examination. The technician must be able to perform the routine tests associated with asphalt plant quality assurance.
- 10.3. HANDS-ON-TRAINING REQUIREMENTS
- 10.3.1. Each participant shall complete Hands-On Training under the supervision of a Responsible Person in the nine tests on which the participant will be tested. The tests to be trained in are:
1. AASHTO R68 – Preparation of Asphalt Mixtures by Means of the Marshall Apparatus
 2. AASHTO T 312 – Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor
 3. AASHTO T 166 – Bulk Specific Gravity (GMB) of Compacted Hot-Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
 4. AASHTO T 331 – Bulk Specific Gravity (GMB) and Density of Compacted Hot-Mix Asphalt (HMA) Using Automatic Vacuum Sealing Method
 5. AASHTO T 209 – Theoretical Maximum Specific Gravity (GMM) and Density of Hot-Mix Asphalt (HMA)
 6. AASHTO T 245 – Resistance to Plastic Flow of Asphalt Mixtures Using Marshall Apparatus
 7. AASHTO T 308 – Determining the Asphalt Binder Content of Hot-Mix Asphalt (HMA) By the Ignition Method, (Method A)
 8. AASHTO T 30 – Mechanical Analysis of Extracted Aggregate
 9. AASHTO T 269 – Standard Method of Test for Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
- 10.3.2. The practical exam may be attempted prior to the completion of the Hands-On-Training

11. ASPHALT PRESERVATION TECHNICIAN

- 11.1. Certification of the Asphalt Preservation Technician is currently optional. This certification is for technicians who want to be more prepared for asphalt preservation style projects.
- 11.1.1. Details of this certification are available on the MCS&T Webpage²
- 11.2. This exam is based on web-based training found in the [AASHTO Technical Training Solutions courses](https://transportation.org/technical-training-solutions/)³.
- 11.2.1. The required courses are as follows:

² <https://transportation.wv.gov/asphalt-preservation-technician>

³ <https://transportation.org/technical-training-solutions/>

1. Flexible Pavement Preservation Treatment Introduction (1 PDH)
 2. Flexible Pavement Preservation Treatment Selecting the Right Treatment (0.5 PDH)
 3. Flexible Pavement Preservation Treatment Materials (2 PDH)
 4. Flexible Pavement Preservation Treatment Localized Pavement Repairs (1.5 PDH)
 5. Flexible Pavement Preservation Treatment Crack Sealing and Fillings (1.5 PDH)
 6. Flexible Pavement Preservation Treatment Fog Seals (1 PDH)
 7. Flexible Pavement Preservation Treatment Chip Seals (1.5 PDH)
 8. Flexible Pavement Preservation Treatment Slurry Seals (1.5 PDH)
 9. Flexible Pavement Preservation Treatment Micro-Surfacing (1.5 PDH)
 10. Flexible Pavement Preservation Treatment Thin Functional HMA Overlay (2 PDH)
- 11.2.2. A printed copy of the Certificates of Training from these courses is required to be presented for registration on the day of the exam.
- 11.3. The written examination for an Asphalt Preservation Technician consists of the following areas regarding chip seals, micro surfacing, thin overlays, and crack sealing
1. Fundamentals of Preservation
 2. Pavement Conditions and Treatment Selection
 3. Performance Characteristics
 4. Inspection and Best Practices
- 11.3.1. No practical examination or Hands-On-Training is required for this certification.

12. INERTIAL PROFILER OPERATOR

- 12.1. This certification allows a technician to operate a lightweight/low-speed and high-speed inertial profiler.
- 12.2. This certification does not have a class, nor does the test need to be proctored by the WVDOH. The exam is provided upon request. Details are in MP 720.10.01 - Guide for Using a High-Speed Inertial Profiler to Measure the Longitudinal Profile of Pavement.
- 12.3. The written examination for the inertial profiler operator covers the following areas:
1. Specifications
 2. AASHTO and ASTM Specifications
 3. Knowledge of operation and analysis of collected data.
- 12.3.1. No practical examination or Hands-On-Training is required for this certification.

13. PORTLAND CEMENT CONCRETE INSPECTOR

- 13.1. Certification as a Concrete Inspector qualifies the technician to perform sampling and/or testing of concrete for Quality Control and/or Quality Acceptance.
- 13.2. The written examination for this class consists of the following areas:
1. Specifications
 2. Fundamentals
 3. Sampling and Testing
 4. Control and Inspection

- 13.2.1. The applicant must complete Hands-On-Training, please refer to section 18.2. After successful completion of the written examination, the applicant will be required to pass the practical examination. The technician must be able to perform the routine tests associated with Portland Cement Concrete quality assurance.
- 13.3. American Concrete Institute (ACI) Field Testing Grade I certification will be accepted as ~~a the practical~~ portion of the West Virginia PCC Inspector training. However, the applicant must pass the online West Virginia PCC Inspector written provisional certification test before a certification is issued. Refer to MP 106.03.51.
- 13.4. HANDS-ON-TRAINING REQUIREMENTS
- 13.4.1. Each participant shall complete the required Hands-On-Training under the supervision of a Responsible Person in the seven tests on which the participant will be tested. The tests to be trained in are:
1. AASHTO R60 Standard Practice for Sampling Freshly Mixed Concrete
 2. ASTM C1064 Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
 3. AASHTO T119 Standard Method of Test for Slump of Hydraulic Cement Concrete
 4. AASHTO T196 Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method
 5. AASHTO T152 Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method
 6. AASHTO T121 Standard Method of Test for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
 7. AASHTO R100 Standard Method of Making and Curing Concrete Test Specimens in the Field
- 13.4.2. The practical exam may be attempted prior to the completion of the Hands-On-Training.

14. PORTLAND CEMENT CONCRETE TECHNICIAN

- 14.1. Certification of the Concrete Technician qualifies the technician to make plant and mix adjustments, proportioning, and other concrete related duties.
- 14.2. The written examination for this class consists of the following areas:
1. Specifications
 2. Fundamentals
 3. Sampling and Testing
 4. Control and Inspection
 5. Mix Proportioning and Adjustment
- 14.2.1. The Concrete Technician requires only the successful completion of the written examination; no practical examination test is required.
- 14.3. National Ready Mixed Concrete Association (NRMCA) Concrete Technologist Certification Course, "Short Course," will be accepted as a portion of the West Virginia PCC Technician training. However, the applicant must pass the online West Virginia

- PCC Technician written provisional certification test before a certification is issued. Refer to MP 106.03.51.
- 14.4. HANDS-ON-TRAINING REQUIREMENTS
- 14.4.1. PCC Inspector certification is a required prerequisite for the PCC Technician certification, and the NRMCA reciprocal certification. However, a participant may take the PCC Technician class, and exam prior to completing the required 40 hours of Hands-On-Training, and or the PCC Inspector practical exam if they have passed the PCC Inspector written exam, but the PCC Technician Certification will not be granted until the participant has obtained the PCC Inspector Certification.

15. RADIATION SAFETY

- 15.1. This certification is required by the Nuclear Regulatory Commission (NRC) before operating a portable nuclear gauge. The course and exam will cover the following areas:
1. Proper storage and security of portable nuclear gauges
 2. Transportation of portable nuclear gauges
 3. Personal safety while operating a portable nuclear gauge.
- 15.2. No practical examination or Hands-On-Training is required for this certification.
- 15.3. This certification expires three years from the date of certification. This is regulated by the NRC.

16. SOIL AND AGGREGATE COMPACTION TECHNICIAN

- 16.1. Certification of the Soil and Aggregate Compaction Technician qualifies the technician to conduct tests on all Soil and Aggregate construction materials that require compaction testing.
- 16.2. The written examination for this class consists of the following areas:
1. Specifications
 2. Soil & Aggregate Compaction Test Procedures
 3. Radiation Safety and Nuclear Gauge
 4. Test Procedure Problems
- 16.2.1. The applicant must complete Hands-On-Training, please refer to section 18.2. After successful completion of the written examination, the applicant will be required to pass the practical examination. The technician must be able to perform the routine tests associated with soil and aggregate compaction quality assurance.
- 16.3. HANDS-ON-TRAINING REQUIRMENTS
- 16.3.1. Before scheduling for the Practical Exam, each Participant shall complete Hands-On Training under the supervision of a Responsible Person in the three different tests on which the participant will be tested. The tests to be trained in are:
1. MP 700.00.24 Nuclear Density Test by Roller Pass Method

2. MP 712.21.26 Procedure for Determining Random Location of Compaction Lots
3. MP 207.07.20 Nuclear Field Density/Moisture Test for Random Material Having Less than 40% + 3/4-inch Material

16.3.2. A technician that does not demonstrate proper radiation safety shall not be allowed to continue testing on a WVD OH Project. They must be replaced by another qualified technician. Anyone who does not meet the applicable safety standards must provide proof of additional WVD OH approved radiation safety training before another evaluation will be conducted.

17. TESTING PROTOCOL

17.1. The TICP has a testing protocol that must be followed. The protocol includes testing environment, time limits, proctoring exams, etc. The entire protocol will be covered with attendees prior to testing.

17.2. SPECIAL NEEDS AND REQUESTS

17.2.1. Applicants with special needs should notify the QA Program Administrator prior to the class to ensure that the training location is prepared to accommodate their needs.

18. CERTIFICATION, HANDS-ON-TRAINING, AND RE-CERTIFICATION

18.1. CERTIFICATION

18.1.1. An individual must pass the written examination in each level for which they are requesting certification. Unless otherwise noted, to pass the written examinations, the applicant must obtain a minimum score of 70 ~~percent~~%.

18.1.2. If an applicant fails to receive a minimum score of 70% on the first written exam, they will be given another attempt at a later date to score 70% or higher. This second attempt shall be a subsequent, scheduled make-up written exam. Failure to attend any scheduled written examination, practical examination, or to ~~bring-submit~~ the Hands-On-Training form ~~to the practical~~ counts as a failed exam, if the Hands-On-Training is required prior to taking the practical exam for that certification.-

18.1.2.1. If the applicant fails the second written exam, they may not attempt the written examination again until they retake the class or wait one calendar year.

18.1.2.2. If an applicant seeking any certification disagrees with a certification decision, they may file a written appeal with the Certification Board.

18.1.3. If required by the certification, a practical exam must be successfully completed. Specific requirements for the practical exam are included in the respective sections. If a participant fails the practical exam, they may not retake the practical exam until they have attended the respective class and successfully passed the written examination again. An exception may be made at the discretion of the section head and the QA Program Administrator.

- 18.1.4. Upon successfully completing the requirements for certification, applicants may view their certification information on the Division's Webpage, Materials Certification Directory
- 18.1.5. This certification is not transferable. A certification is valid for 5 years and expires December 31, of the 5th year ~~of~~ after the year of certification. For example, if a technician is certified in January of 2026, it will expire on December 31, 2031. Radiation Safety must be renewed every 3 years from the certification date. For example, if a technician is certified on January 15, 2026, it will expire on January 15, 2029.
- 18.1.6. Instructors who participate in certification classes shall have their certification extended by one year for each unique certification. This only applies once per calendar year. This does not apply to Radiation Safety.
- 18.2. HANDS-ON-TRAINING
- 18.2.1. For the initial certification of an applicant technician, the Technician must pass a written exam, participate in and verify Hands-On-Training if required by the certification, and pass a hands-on practical exam ~~(if when required by the class certification)~~. The Technician shall complete the tests outlined in each certification under the supervision of a Responsible Person for a minimum of 40 hours of Hands-On-Training. This must be completed up to one year before and ninety days after the written exam and verified by a signed letter on company letter head from a Responsible Person. See Attachment 1 for what must be submitted. –The Hands-On-Training requirement shall not apply to a technician who has previously been certified, if the technician can provide proof of prior certification.
- When required for the certification, Aan applicant who seeks certification via reciprocity shall provide a minimum of 40 hours of experience verified by a Responsible Person by submitting a signed letter of verification on company letter head, (verification letter can be downloaded from the [WVDOH MCST Webpage Toolbox](#)⁴). Hours spent shadowing or observing others do not count. The signed Hands-On-Training verification letter shall be submitted to the QA Program Administrator at gaschoolscoordinator@wv.gov.
- 18.2.2. Hands-On-Training requirements vary between certifications. See the respective section for details.
- 18.2.3. All Practical Examinations must be completed within 90 days from the date of the original written test date. If the participant fails, they will be denied the Certification. The practical exam dates are set at the discretion of the appropriate Section Supervisor and are based on the availability of the Lab. When they are required prior to taking the practical exam, Hands-On-Training reports must be submitted ~~at the time of the technician's scheduled before scheduling the practical exam if it has not been submitted prior.~~

⁴ <https://transportation.wv.gov/tool-box>

18.3. RECERTIFICATION

- 18.3.1. The responsibility for obtaining re-certification shall lie with the certified individual.
- 18.3.2. Certification holders are responsible for ensuring that their certifications stay current. The WVDOH will no longer mail reminder letters to certification holders.
- 18.3.3. The renewal of all certifications shall require a written exam and a hands-on practical exam, where applicable.
- 18.3.4. Independent Assurance (IA) test scores of 3 or better can be used in place of the hands-on practical for the following re-certifications:
1. PCC Inspector – Air and Slump tests
 2. Soil and Aggregate Compaction – Moisture/Density Test, and pass the 1-point proctor
 3. Asphalt Field and Compaction with Gauge
- 18.3.5. Applicants will be given two scheduled attempts to pass ~~each the~~ written recertification exam and one attempt to pass ~~each the~~ practical exam ~~–(each, respectively)~~. Any applicant that fails to acquire a minimum score of 70% on ~~both the~~ recertification exam ~~and or who fails the~~ subsequent practical exam, if required by the certification, will not have their certification renewed. The applicant will be required to take the respective certification classes at the next available time given by MCS&T.
- 18.3.6. Any failed recertification examination taken prior to the expiration date of the current certification, either practical or written, will not result in termination of any current certification prior to the expiration date of that certification.
- 18.3.7. The certification holder is responsible for updating their personal information on the [online learning website](#)⁵.
- 18.3.8. If an applicant seeking recertification disagrees with a recertification decision, they may file a written appeal with the Certification Board.
- 18.3.9. If recertification is not complete by December 31, the Technician's respective certification will be revoked, and the technician shall complete the full certification examination and practical.

19. RECIPROCAL CERTIFICATIONS

- ~~19.1. Acceptance of WVDOH Certifications by other state agencies is at the sole discretion of the other agency. Refer to MP 106.03.51.~~
- ~~19.2.~~ 19.1. ACI and NRMCA certifications are accepted as the practical portion of the West Virginia Aggregate Technician, PCC Inspector, and PCC Technician training. However, the applicant must pass a provisional supplemental online West Virginia written certification test and complete a minimum of 40 hours of Hands-On-Training before a certification is issued. Refer to MP 106.03.51.

⁵ <http://www.onlinelearning.wv.gov/student/home.html>

20. CODE OF CONDUCT

- 20.1. The purpose of this Code of Conduct establishes expectations for behavior throughout the training course and during the end-of-course written exam. Its goal is to create a respectful productive, and fair learning environment for all participants.
- 20.2. Professional behavior is always expected. Participants are expected to treat instructors and fellow learners with courtesy and respect. Disruptive behavior, harassment, or discrimination of any kind will not be tolerated. Active participation is encouraged, but learners should allow others the opportunity to contribute.
- 20.3. Attendance and engagement are important to successful completion of the course. Arrive on time for all sessions and return promptly from breaks. Stay engaged during instruction, group work and activities. If you anticipate an absence, notify the instructor when possible.
- 20.4. Use of technology during training is encouraged. Laptops, tablets, and phones may be used for documentation, note taking, taking pictures, and searching documents. Please keep devices on silent ring during class, and if you must take a call, please excuse yourself from class to complete the conversation.
- 20.5. Academic integrity during exams is taken seriously. Cell phones, spreadsheets, and AI tools are prohibited during the written exam. Only approved materials may be used during the exam. These materials include notes taken during class, course manuals, MPs, current Specification book, Supplemental Specifications book, and the WVDOH Website. Talking, sharing answers, or attempting to access unauthorized resources will result in disciplinary action, which may include exam failure or removal from the course.
- 20.6. Confidentiality must be observed. Course materials, discussions, and assessments may contain sensitive or proprietary information. Participants must not share or distribute course content without permission.
- 20.7. Safety must always be observed. Follow all safety guidelines provided by the instructor. Report any unsafe conditions or concerns immediately.
- 20.8. Failure to follow this Code of Conduct may result in the following disciplinary actions: a verbal warning, removal from the classroom, disqualification from the exam, and dismissal from the course. Consequences will be applied by the QA Program Administrator's discretion in consultation with the class instructor based on the severity of the violation.

21. REVOCATION OF CERTIFICATION

- 21.1. Generally, certifications may be revoked if in the opinion of the certifying authority, an individual has knowingly committed acts detrimental to the integrity of the Certification Program or transportation industry. Examples of situations that warrant revocation include, but are not limited to:
1. Deliberate falsification of field or quality control test results or records.

2. Deliberate falsification of calculations, test results or materials.
 3. Cheating on certification/re-certification exams.
 4. Submittal of false information on certification applications.
 5. Submitting trial mix mixture and/or calculations completed by someone other than the signatory or knowingly supplying trial mix mixture and/or calculations for another individual's certification.
- 21.2. The Quality Assurance Training Program Administrator will take the lead in gathering facts and investigating any allegations which may require revocation of a certification. The Certification Board will notify the individual in writing of intent to revoke certification(s).
-

22. APPEALING A DECISION

- 22.1. Any individual who disagrees with a decision by the Certification Board has 10 business days from the date of receipt of the notification to respond in writing to the board and present documentation to support their continued certification and/or request an opportunity for a meeting to present their case.

Appeals should be mailed to:

Certification Board
ATTN: Quality Assurance Program Administrator
West Virginia Division of Highways
190 Dry Branch Dr.
Charleston, WV 25306

- 22.2. If the individual fails to respond within 10 days of receipt of the original notification of revocation letter, the revocation becomes final.
- 22.3. Not later than 20 business days after receiving a request for a meeting from the individual, the Certification Board will schedule a meeting in which the appellant can present their case. If the Certification Board was not persuaded by the documentation provided by the appellant and believes that revocation of the certification is warranted, the appellant may file a written appeal to the State Highway Engineer for review. All information including any letter(s) of explanation from the appellant will accompany the documents submitted to the State Highway Engineer. The board will mail the decision of the State Highway Engineer to the appellant. The decision by the State Highway Engineer is final.
-

23. THE LENGTH OF REVOCATION:

- 23.1. First Offense: Revocation of all certifications for one (1) year.
- 23.2. Second Offense: Revocation of all certifications for five (5) years.
- 23.3. Third Offense: Revocations of all certifications for life.
- 23.4. In the event of a serious violation as determined by the Division, the case may be referred to the Department of Justice.

24. CONTACT INFORMATION

- 24.1. If an applicant/technician/appellant has any questions about the DOH program or needs more information. Please contact: Qaschoolscoordinator@wv.gov.

Michael A Mance, PE
Director
Materials Control, Soils & Testing Division

MP 106.03.50 Steward – Lab Support Section
MAM:Bh
Attachment

Example



WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

Division of Highways

1900 Kanawha Boulevard East • Building Five • Room 110
Charleston, West Virginia 25305-0430 • (304) 558-3505

Stephen T. Rumbaugh, P.E.
Secretary of Transportation
Commissioner of Highways

DATE

Quality Assurance Program Administrator
190 Dry Branch Dr.
Charleston, WV 25306

Mr. Harper,

I am a Responsible Person representing the West Virginia Division of Highways. I am familiar with WVDOH, AASHTO and ASTM procedures related to the (Certification) Certification. I hereby authorize and verify that 40 hours of Hands-On-Training was completed by (name of technician in training) according to WVDOH, AASHTO and ASTM procedures.

Sincerely,

Signature

Printed Name

Job Title

Date

OLD BUSINESS

MP 106.03.50
SIGNATURE DATE
ATTACHMENT - PAGE 2 OF 2

Company Letterhead

Quality Assurance Program Administrator
190 Dry Branch Dr.
Charleston, WV 25306

Mr. Harper,

I am a Responsible Person representing (company).
I am familiar with WVDOH, AASHTO and ASTM procedures related to the
(Certification) Certification. I hereby authorize and verify that
40 hours of Hands-On-Training was completed by
(name of technician in training) according to WVDOH,
AASHTO and ASTM procedures.

Sincerely,

Signature

Printed Name

Job Title

Date

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION
MATERIALS PROCEDURE

GUIDE FOR CONTRACTOR'S AND FABRICATOR'S
QUALITY CONTROL PLAN FOR PAINTING

1. SCOPE

- 1.1 This materials procedure shall serve as a guide for the design of the Prime Contractor's or Fabricator's ~~(Submitter's)~~ Quality Control (QC) Plan for surface preparation, application of coatings, and inspection procedures.
- 1.1.1 This procedure shall be applicable to all structures that include, but are not limited to those being fabricated, erected, fully repainted, and/or zone painted.

~~2.~~ **2. REFERENCED DOCUMENTS**

- ~~2.1~~ ~~WEST VIRGINIA DEPARTMENT OF TRANSPORTATION, DIVISION OF HIGHWAYS STANDARD SPECIFICATIONS ROAD AND BRIDGES AND THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION, DIVISION OF HIGHWAYS SUPPLEMENTAL SPECIFICATIONS INTENDED TO~~

~~SUPPLEMENT THE LATEST VERSION OF THE STANDARD SPECIFICATIONS~~

- a. ~~107-LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC~~
- b. ~~601-STRUCTURAL CONCRETE~~
- e. ~~685-BRIDGE CLEANING~~
- d. ~~688-FIELD PAINTING OF METAL STRUCTURES~~
- 2.2 ~~SOCIETY FOR PROTECTIVE COATINGS (SSPC)~~
 - a. ~~MONITORING AND CONTROLLING AMBIENT CONDITIONS DURING COATING OPERATIONS.~~
 - b. ~~PA 1-SHOP, FIELD AND MAINTENANCE COATING OF METALS~~
 - e. ~~PA 2-PROCEDURE FOR DETERMINING CONFORMANCE TO DRY COATING THICKNESS REQUIREMENTS~~
 - d. ~~PA 17-PROCEDURE FOR DETERMINING CONFORMANCE TO STEEL PROFILE/SURFACE ROUGHNESS/PEAK COUNT REQUIREMENTS.~~
 - e. ~~SP 13-SURFACE PREPARATION OF CONCRETE~~
 - f. ~~SP 14-INDUSTRIAL BLAST CLEANING~~
 - g. ~~THE FUNDAMENTALS OF CLEANING AND COATING CONCRETE 2001~~
 - h. ~~TECHNOLOGY GUIDE 6: GUIDE FOR CONTAINING DEBRIS GENERATED DURING PAINT REMOVAL OPERATIONS.~~
 - i. ~~TECHNOLOGY GUIDE 7: GUIDE TO THE DISPOSAL OF LEAD-CONTAMINATED SURFACE PREPARATION DEBRIS~~
 - j. ~~TECHNOLOGY GUIDE 16: GUIDE TO SPECIFYING AND SELECTING DUST COLLECTORS~~

2.1 West Virginia Department of Transportation, Division of Highways Standard Specifications Road and Bridges and the West Virginia Department of Transportation, Division of Highways Supplemental Specifications intended to supplement the latest version of the Standard Specifications.

2.2 MP 110.00.410 – Preparing Material Inspection Reports

2.3 The Association for Materials Protection and Performance (AMPP) / Society for Protective Coatings (SSPC):

1) Monitoring and Controlling Ambient Conditions during Coating Operations.

2) PA 1-Shop, Field and Maintenance Coating of Metals

3) PA-2 Procedure for Determining Conformance to Dry Coating Thickness Requirements

4) PA 17-Procedure for Determining Conformance to Steel Profile/Surface Roughness/Peak Count Requirements.

— SP 13-Surface Preparation of Concrete

— SP 14 Industrial Blast Cleaning

5) The Fundamentals of Cleaning and Coating Concrete 2001

6) Technology Guide 6: Guide for Containing Debris Generated During Paint Removal Operations.

7) Technology Guide 7: Guide to the Disposal of Lead-Contaminated Surface Preparation Debris

8) Technology Guide 16: Guide to Specifying and Selecting Dust Collectors

2.32.4 International Organization for Standardization

a.1) 8501- Preparation of Steel Substrates before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness.

2.42.5 Other SSPC, ASTM, ISO, or WVDOT Documents that may be applicable to the application, surface preparation or inspection of applied coatings on any substrate, concrete or steel, not mentioned above.

3. REQUIREMENTS AND GUIDELINES

3.1 General Requirements

3.1.1 The Submitter-Contractor or Fabricator shall provide and maintain a QC System that will assure that the coatings have been applied in accordance with the Specification. The Contractor or Fabricator shall provide and maintain a Quality Control System that will provide assurance that the paints have been applied in accordance with the specification requirements.

3.1.2 The Contractor or Fabricator Submitter shall conduct or have conducted inspections and tests required to substantiate that the coatings have been applied in accordance with the specification requirements. The Contractor or Fabricator shall conduct or have

~~conducted inspections and tests required to substantiate that the paints have been applied in accordance with the specification requirements.~~

3.1.3 ~~The Submitter's QC inspections and testing performed shall be documented daily and provided to the Engineer for review at the end of each workday. These documents shall be maintained for the life of the contract. The Contractor's or Fabricator's Quality Control inspections and testing shall be documented daily and provided to the Engineer for review at the end of the work day. These documents shall be maintained for the life of the contract.~~

3.2 Quality Control Plan

3.2.1 The QC Plan shall follow Specification 688.5 Section 688.2.5-Contractor Certifications and Submittals, Specification 687: Section 687.4-Submittals, and Specification 601.13: Section 5, and 601.13.3.7.1-Quality Control Plan for Painting.

4. SUBMISSION OF QC PLAN FORMAT

4.1 ~~The plan Submitter shall complete~~include the completed the form: "688.02.20 – West Virginia Division of Highways QC Plan for Painting." A sample of this document is provided with this MP in the Attachment; the live document is available on the WVDOH MCS&T Webpage under the "Tool Box¹." ~~The Contractor/Fabricator shall complete the form: "688.02.20 – West Virginia Division of Highways Quality Control Plan for Painting." A sample of this document is provided with this MP, however the live document is available on the WVDOH MCS&T Webpage under the "Tool Box²."~~

4.1.1 ~~This form is a fillable PDF form and shall be submitted electronically. This PDF must be downloaded; it cannot be submitted from the webpage browser. This form is a fillable PDF form and shall be submitted electronically.~~ The plan shall will be submitted to DOHQCPaintEnvMonPlan@wv.gov³. All form fields in RED shall be completed at a minimum. Once completed the submit button may be activated and an e-mail will generate with the form attached and the e-mail address populated. At this time the supporting documentation shall be added as an attachment to the email and submitted with the plan.

4.1.2 ~~Alternatively, the Submitter may use the webpage application may be used: "QC Paint Plan and Environmental Monitoring App"~~Quality Control Plan for Painting" linked on the WVDOH MCS&T Toolbox. This is a standalone application that submits the requisite data to MCS&T with no email required.

4.1.3 The submission shall ~~must~~ include all the applicable information on the form, including:

1) The name of each coating product of the paint system.

¹ <https://transportation.wv.gov/tool-box>

² <https://transportation.wv.gov/highways/mest/Pages/tbox.aspx>

³ DOHQCPaintEnvMonPlan@wv.gov

- 2) The manufacturer of the paint system coatings.
- 3) The APL number for the paint system to be used
- 4) The color of the topcoat, including the five-digit AMS Standard Color number.
- 5) The name of the concrete coating to be used
- 6) The manufacturer of the concrete coating
- 7) The APL number for the concrete coating
- 8) The color of the concrete coating, including the five-digit AMS Standard Color number.
- 9) Quantities to be applied

4.2 QC Plan documentation for field painting:

4.2.1 The Submitter plan shall also include the following supporting documentation data for the chosen paint or paint systems:

- 1) Paint System Technical Data Sheets
- 2) Contractor's Quality Control Manual
- 3) Coater's AMPP QP1 and QP2 Certifications (If area to be coated is 1000 square feet or more)

4.3 QC Plan documentation for shop painting/fabrication:

4.3.1 For painting jobs completed in a controlled environment including but not limited to the contractor's own workshop, the contractor does not need to include their quality control manual. The plan shall also include the following supporting documentation for the chose paint or system:

- 4.1.1) Paint System Technical Data Sheets

5. APPROVAL

5.1 If the Quality Control plan is found acceptable, a Material Inspection Report (MIR) shall be issued to the District. The MIR shall follow the format as described in MP 110.00.410.

5.2 The MIR shall include the following information in the provided format:

<u>Bridge Number</u>	
<u>Primer Coat Product</u>	
<u>Intermediate Coat Product</u>	
<u>Topcoat Product</u>	
<u>Topcoat Color (Name and 5-digit number)</u>	
<u>Paint System APL Number</u>	
<u>Concrete Coating Name</u>	
<u>Concrete Coating APL Number</u>	
<u>Concrete Coating Color (Name and 5-digit number)</u>	
<u>Dry Film Thickness Determination</u>	

5.3 The MIR shall also indicate the letting date, and if the QC plan has been approved.

5.4 The MIR shall be signed by the approving entity.

Michael A. Mance, PE
Director
Materials Control, Soils & Testing Division

MP 688.02.20 Steward – Environmental and Coatings Section

MAM:BFr

ATTACHMENTSS



West Virginia Division of Highways Quality Control Plan for Painting



I. Project Information

Project Name

Contract ID

State/Federal Project Number

Bridge Number

District

County

II. Contractor/Fabricator Information

Contractor/Fabricator Name

Contractor/Fabricator Phone Number

Contractor/Fabricator Address

Contact Person

Official Responsible for Quality Control

Liaison With Division of Highways Personnel

III. Coating Information

Name of Coating Supplier

Primer Name/Quantity

Quantity of Coatings to be Used

Intermediate Name/Quantity

WV DOH Material/System Approval Number

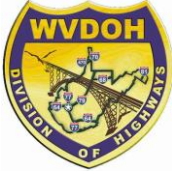
Top Coat Name/Quantity

Type and Amount of Thinner, if Needed

Concrete Coating Name/Quantity

Area of Steel to be Coated Per Plans

Area of Concrete to be Coated Per Plans



West Virginia Division of Highways Quality Control Plan for Painting



IV. Corrective Action Information

Correction of Coating Flaws

Procedure for Equipment Clean Up

Procedure for Spillage Clean Up

V. Inspection Information

Person(s) Conducting Inspection

Level of Surface Preparation Required

Areas to be Inspected

Instrument Used for Profile Height/Anchor Pattern

Method for Determining Relative Humidity

Ambient Temperature

Steel Temperature/Concrete Temperature

Dew Point

Magnification Inspection

Wet Film/Dry Film Thickness Gauge

Dry Film Thickness Measurement Documentation

Upon completion of this form, please submit to the West Virginia Division of Highways, Materials Control, Soils and Testing through the electronic submit button below. An e-mail will be generated with the plan attached and the address populated for sending. Please attach any supporting documentation at that time.

Person Completing Form

Date of Form Completion

Submit

Reset

Created 11/2019

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

GUIDE FOR DEVELOPMENT OF THE CONTRACTOR'S ENVIRONMENTAL
CONTROL PLAN FOR SPENT MATERIAL PRIOR TO PAINTING EXISTING
STRUCTURES

1. ~~1.0~~—SCOPE

1.1. ~~1.1~~—This materials procedure shall be used as guidance for the development of the Contractor's (Submitter's) Environmental Control Plan for "Spent Material" prior to painting existing structures. This procedure is applicable for all structures having a coating system removed prior to field painting.

1.2. ~~1.2~~—Spent Material: This shall include material generated by surface preparation operations and shall be sampled and tested in accordance with the current revision of SSPC Guide 7, Guide to the Disposal of Lead-Contaminated Surface Preparation Debris, available at the SSPC.org Webpage¹. 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 Environmental Control Plan.

1.2.1. ~~1.2.1~~—The hazardous waste transporter named within the plan shall have a US EPA Identification Number.

2. ~~2.0~~—REFERENCED DOCUMENTS

2.1. ~~2.1~~—West Virginia Department of Transportation, Division of Highways Standard Specifications Road and Bridges and the West Virginia Department of Transportation, Division of Highways Supplemental Specifications intended to supplement the latest version of the Standard Specifications.

2.2. ~~MP 110.00.410 – Preparing Material Inspection Reports~~ ~~Reference to standard specifications and other standard procedures shall be the latest edition of the published document.~~

2.3. ~~2.1.1~~—The Association for Materials Protection and Performance (AMPP) / Society for Protective Coatings (SSPC) Technology Guides:

¹ <http://www.sspc.org/>

1) Technology Guide 6: Guide for Containing Debris Generated During Paint Removal Operations

2) SSPC Technology Guide 7: Guide to the Disposal of Lead-Contaminated Surface Preparation Debris

3) SSPC Technology Guide 16: Guide to Specifying and Selecting Dust Collectors

2.4. Any SSPC, ASTM, ISO, AASHTO or WVDOH documents that may be applicable, not previously mentioned.

~~— West Virginia Department of Transportation, Division of Highways Standard Specifications Road and Bridges~~

~~a. — 107 Legal Relations and Responsibility to Public~~

~~b. — 601 Structural Concrete~~

~~e. — 685 Bridge Cleaning~~

~~d. — 688 Field Painting of Metal Structures~~

~~— 2.1.2 Society for Protective Coatings (SSPC) Technology Guides~~

~~a. — Technology Guide 6: Guide for Containing Debris Generated During Paint Removal Operations.~~

~~b. — SSPC Technology Guide 7: Guide to the Disposal of Lead-Contaminated Surface Preparation Debris~~

~~c. — SSPC Technology Guide 16: Guide to Specifying and Selecting Dust Collectors~~

~~2.2 Any SSPC, ASTM, ISO, AASHTO or WVDOH documents that may be applicable, not previously mentioned.~~

3. 3.0 — REQUIREMENTS AND GUIDELINES ENVIRONMENTAL CONTROL PLAN

3.1. 3.1 — General Requirements~~As stated in Specification 688, Section 688.2.5- Submittals and 601.13.3.7.1 Quality Control Plan for Painting, a Quality Control Plan shall be designed by the Contractor and submitted for acceptance/approval by the Engineer prior to commencement of the subject work. The plan shall clearly describe the methods by which the Contractor's Environmental Control Plan will be implemented. An acceptable plan should include the following:~~

3.1.1. 3.1.1 The Contractor/Fabricator-Submitter shall provide and maintain a Quality Control System that will assure that the environmental monitoring have been applied in accordance with the Specification 688 and SSPC Guide 6.

3.2. 3.2 — Environmental Control Plan:

3.2.1. 3.2.1 The Plan shall follow Section 688.2.5- Contractor Certifications and Submittals and 688.5.42.5.2-Containment/Disposal Control Plan for Existing Steel Structures of the Specification, as well as Section 601.13.3.7-Submittals and 601.13.3.7.2-Containment/Disposal Environmental Control Plan for

Existing Concrete Structures.

3.2.2. ~~3.2.2~~ A Quality Control Plan shall be designed by the Contractor and submitted for acceptance/approval by the Engineer prior to the commencement of the subject work.

3.2.3. ~~3.2.3~~ The plan shall clearly describe the methods by which the Contractor's Environmental Control Plan will be implemented.

4. ~~4.0~~ SUBMISSION OF ENVIRONMENTAL CONTROL PLANFORMAT

4.1. ~~4.1~~ The ~~Submitter plan Contractor/Fabricator~~ shall include the completed ~~the~~ form: "688.03.20 — West Virginia Division of HighwaysWVDOH QC Plan for Environmental Monitoring." A sample of this document is provided with this MP in the Attachment; ~~however~~ the live document is available on the WVDOH MCS&T Webpage under the "Tool Box²."

~~1.1.1. 4.1.1~~ This form is a fillable PDF form and shall be submitted electronically. This PDF must be downloaded; it cannot be submitted from the webpage browser. The plan ~~will~~ shall be submitted to DOHQCPaintEnvMonPlan@wv.gov³. All form fields in RED shall be completed at a minimum. Once completed the submit button may be activated and an e-mail will generate with the form attached and the e-mail address populated. At this time the supporting documentation shall be added as an attachment to the email and submitted with the plan. Additional information shall be provided as separate documents attached to the Environmental Control Plan.

~~4.1.1.~~

~~1.1.2. 4.1.2~~ Alternatively, ~~the Submitter may use the webpage application may be used:~~ "Quality Control Plan for Environmental Monitoring" QC Paint Plan and Environmental Monitoring App" linked on the WVDOH MCS&T Toolbox. This is a standalone application that submits the requisite data to MCS&T with no email required.

~~4.1.2.~~

~~4.1.3. 4.1.3~~ The submission for Field Painting shall ~~must~~ include all the applicable information on the form, including:

- 1) Trade Name of Abrasive
- 2) Manufacturer of Abrasive
- 3) Environmental Containment per Plans
- 4) Environmental Monitoring Methods per Plans
- 5) Hazardous waste disposal information

~~4.2. 4.1.4~~ The ~~Submitter~~ plan shall also include the following supporting documentation attachments for their Environmental Monitoring plan:

² <https://transportation.wv.gov/tool-box>
<https://transportation.wv.gov/highways/mest/Pages/tbox.aspx>

³ DOHQCPaintEnvMonPlan@wv.gov

- 1) QC Plan set that includes the containment design drawings and plan notes.
- 2) Containment calculations that include load design requirements that support the workers and scaffolding.
- 3) Contractor's Environmental Protection and Work Plan.

4.3. 4.2—Shop Painting

4.3.1. 4.2.1 No supporting containment documentation is required.

5. 5.0—APPROVAL

5.1. 5.1—If the Quality Control Environmental Plan is found acceptable, a Material Inspection Report (MIR) shall be issued to the District. The MIR shall follow the format as described in MP 110.00.410.

5.2. 5.2—The MIR shall include the following information in the provided format:

<u>Abrasive Used</u>	
<u>Abrasive Manufacturer</u>	
<u>Environmental Containment</u>	
<u>Environmental Monitoring Method</u>	

5.3. 5.3—The MIR shall also indicate the letting date, and if the QC plan has been approved.

5.4. 5.4—The MIR shall be signed by the approving entity.

Michael A. Mance, PE
Director
Materials Control, Soils & Testing Division

MP 688.03.20 Steward – Environmental and Coatings Section

MAM:BFr

ATTACHMENTS



West Virginia Division of Highways Quality Control Plan for Environmental Monitoring



I. Project Information

Project Name

Contract ID

State/Federal Project Number

Bridge Number

District

District

County

II. Contractor Information

Contractor Name

Contractor Phone Number

Contractor Address

Contractor Contact Person

Official Responsible for Quality Control

Liaison With Division of Highways Personnel

III. Abrasives/Additives

Trade Name of Abrasive

Recyclable

Manufacturer of Abrasive

Size of Abrasive

Abrasive Additive (If any)

Trade Name of Additive (If any)

Manufacturer of Additive (If any)

IV. Environmental Controls

Environmental Containment as Per Plans

Environmental Monitoring Methods as Per Plans



West Virginia Division of Highways
Quality Control Plan for Environmental Monitoring



V. Hazardous Waste/Non Hazardous Waste Disposal

Hazardous Waste Disposal Company

Contact Person for Hazardous Waste Disposal Company

Address of Hazardous Waste Disposal Company

Hazardous Waste Transporter Company

Contact Person for Hazardous Waste Transporter Company

Address of Hazardous Waste Transport Company

Hazardous Waste Disposal Site

Non-Hazardous Waste Material Company

Contact Person for Non-Hazardous Waste

Address of Non-Hazardous Waste Material Company

Upon completion of this form, please submit to the West Virginia Division of Highways, Materials Control, Soils and Testing through the electronic submit button below. An e-mail will be generated with the plan attached and the address populated for sending. Please attach any supporting documentation at this time.

Person Completing Form

Date of Form Completion

Submit

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

BASIS FOR CHARGES FOR NON-SUBMITTAL OF SAMPLING &
TESTING DOCUMENTATION BY THE ESTABLISHED DEADLINE

1. PURPOSE

- 1.1 To provide a unit cost per test to be assessed to the Contractor when testing documentation or samples are not submitted by the Contractor by the established deadline. Periodic updates of this Attachment shall be the responsibility of the Director of Materials Control, Soils and Testing Division or their designee (Director).
-

2. REFERENCED DOCUMENTS

- 2.1 MP 109.00.22 – Procedure for the Submission and Documentation of Test Results
-

3. SCOPE

- 3.1 This procedure is applicable to circumstances where a construction item's testing documentation or samples are not submitted by the deadline established in this document. In the case of a general item, this timeframe is seven (7) days from the sampling date. The timeframe for special-case items such as gradations and cylinder breaks is noted in Attachment 1.
- 3.1.1 All of the following requirements shall be met to meet the above-defined timeframe:
- 3.1.1.1 Documentation submission includes: (A) generating the sample in the Division Approved Sampling and Testing software (SiteManager, AASHTOWare Projects, etc.), (B) entering all data into this system, (C) presenting the data to the District for review and (D) providing all testing documentation. The process for the submittal of test results is documented in MP 109.00.22.
- 3.2 The penalty for an infraction as described in Section 3.1 is \$700 per test. In the instance where a single test comprises of a prescribed series of sub-tests (typically 5), the cost of each infraction will be the standard rate divided by the total number of required sub-tests. This is only applicable in the certain circumstances as noted in Attachment 1.
- 3.2.1 This procedure is not limited to tests listed in Attachment 1, but applicable to any material test required by the Standard Specifications and/or Materials Procedures. For this case, the Director will establish the timeframe for the test or may utilize the standard timeframe as described in Section 3.1. The rate shall follow Section 3.2.

4. ABSENT TESTING DOCUMENTATION OR FAILURE TO TEST

- 4.1 In no case shall this Materials Procedure allow for the acceptance of non-tested material. In the case where no testing was performed, or no documentation was submitted for the material, the resolution for the acceptance of the material shall be in accordance with the applicable section(s) of the Standard Specifications and Materials Procedures. Additionally, and regardless of the outcomes of this resolution, a price assessment in accordance with Attachment 1 shall also be assessed.

Michael A. Mance, PE
Director
Materials Control, Soils & Testing
Division

MP 109.00.21 Steward – Materials Control Section
MAM:Bhs
ATTACHMENT

Cost Penalties Per Test

Material Category	Test and Rate	Testing Time Frame (Days)	#Cost/Sub Test Cost
Soil and Aggregate	In-Place Density (5 tests)	*T	*Rate
	Gradation (Each Test)	14	*Rate
	Liquid and Plastic Limits	*T	*Rate
	Crushed Particle Analysis	14	*Rate
Asphalt	Asphalt Mixture Test	*T	*Rate
	In-Field Density Testing	*T	0.2 (*Rate)
Chip Seal	Gradation (Each Test)	*T	*Rate
Concrete	Abar	14	*Rate
	Optimized Gradation	14	*Rate
	Cylinder Test	35	*Rate
	Surface Resistivity	*T	*Rate
	Air and Slump (1 test)	*T	*Rate
Grout	Grout Break Report (Each Test)	*T	*Rate
	Grout Strength Report	*T	*Rate
CLSM	Cylinder Test	35	*Rate
	Flow Test	35	*Rate

*T - Standard timeframe as described in Section 3.1

*Rate - Standard rate as described in Section 3.2

#Cost/Ea - Unless there is rate in this column, each infraction results in the full rate

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

PROCEDURE FOR THE INDEPENDENT ASSURANCE PROGRAM

1. PURPOSE

- 1.1 To provide a procedure for the WVDOH to meet FHWA's requirements for the Independent Assurance (IA) program.
-

2. SCOPE

- 2.1 This procedure applies to the following IA Materials:
- 2.1.1 Portland Cement Concrete (PCC)
- 2.1.2 Asphalt
- 2.1.3 Aggregate
- 2.1.4 Compacted Soil, Aggregate and Asphalt Materials
- 2.1.4.1 The WVDOH is in the process of evaluating the method to incorporate this testing into the IA program.
-

3. REFERENCED DOCUMENTS

- 3.1 Office of Pavement Technology Publication No. [FHWA-HIF-12-001](#)¹, October 2011. Included as Attachment 2.
- 3.2 23 CFR - [PART 637—CONSTRUCTION INSPECTION AND APPROVAL](#)²
- 3.3 MP 106.03.50 - General Information Guide for Technician and Inspector Certification Program (TICP).
- 3.4 MP 700.00.54 - Procedure for Evaluating Quality Control Sample Test Results with Verification Sample Test Results
- 3.5 AASHTO R44-07.
-

4. DEFINITIONS

- 4.1 QA – Quality Acceptance: The Division test used for the acceptance of material on a project.
- 4.2 IA Sampler: The employee(s) at MCS&T Division who oversees the IA program. This person may perform 1:X testing when the population (X) is not large enough to compare samples statistically or comparing samples statistically is not practical. The IA Sampler may, at the discretion of the Director of MCS&T, delegate this task to a qualified Division employee.

¹ <https://www.fhwa.dot.gov/pavement/materials/hif12001.pdf>

² <https://www.ecfr.gov/current/title-23/chapter-I/subchapter-G/part-637>

- 4.3 Evaluation Period: The calendar year in which the IA program is evaluated. This begins on January 1st and ends on December 31st of the same year.
- 4.4 IA Material: Each unique material that is evaluated by the IA program. These materials are listed in Section 2.1 of this document.
- 4.5 IA Test: A test that is performed by a QA Tester which is evaluated either directly or indirectly by the IA sampler to demonstrate both the QA Tester and their QA Testing Equipment's proficiency.
- 4.6 QA Tester: Each individual who performs an IA Test on an IA Material for QA, during the Evaluation Period. Each unique instance of these must be evaluated based on the frequency noted in Section 5.
- 4.7 QA Testing Equipment: Each primary piece of equipment used to perform an IA Test on an IA Material for QA, during the Evaluation Period. This equipment is noted in the respective sections of this document. Each unique instance of these must be evaluated based on the frequency noted in Section 5.
- 4.8 AASHTO: The American Association of State Highway and Transportation Officials, a nonprofit organization that sets technical standards for highway systems and acts as a liaison between state and federal transportation departments.
- 4.9 [AASHTO re:source](https://aashtoresource.org/)³: A technical services program that provides audits and accreditation to material testing laboratories. This program distributes proficiency samples nationally and evaluates the results. The WVDOT uses the evaluations from this program for both asphalt and aggregate IA Tests.
- 4.10 Proficiency Sample: A single (homogeneous) sample that is distributed by an agency or designated agent to be tested at multiple laboratories. The distributing agency will provide a "score", which statistically compares results amongst the laboratories.
- 4.11 Split Sample: A single sample taken by a single entity that is divided into two or more separate sub-samples for subsequent laboratory analysis. The division shall be done such that these sub-samples are equivalent.
- 4.12 Satisfactory Evaluation: If the results of a test fall within the guidelines established in Section 13 of this document, the test will be considered satisfactory.
- 4.13 Non-Satisfactory Evaluation: If the results of a test do not fall within the guidelines established in Section 13 of this document, the test will be considered non-satisfactory.
- 4.14 Corrective Action Report (CAR): An action report identifying the probable source of a Non-Satisfactory Evaluation. This report identifies the non-conformance, explains issues which lead to this non-conformance, and explains corrective actions to address this non-conformance.

5. SYSTEM APPROACH FOR IA SAMPLING AND TESTING

- 5.1 The WVDOT IA program shall operate under the system approach as described in Office of Pavement Technology Publication No. [FHWA-HIF-12-001 and AASHTO R44-07](#).

³ <https://aashtoresource.org/>

- 5.2 Each QA Test Equipment and each QA Tester shall be evaluated for each Evaluation Period. Redundant testing shall be avoided unless a failure or faulty testing is reported during the testing.
- 5.2.1 If a QA Tester is testing and the equipment fails, they shall complete the test on another piece of equipment. If this occurs, it shall be noted in a corrective action report.
- 5.3 The goal of the IA program is to meet a 90% evaluation threshold for each QA Tester and QA Test Equipment. Each of these entities is considered separate and independent of each other.
- 5.3.1 QA Testers shall be evaluated for each unique IA Material they test during the evaluation period. If a person tests multiple IA Materials during the evaluation period, they will be required to be evaluated for each material independently.
- 5.3.2 The evaluation procedure for tests is described in Section 13 of this document.
- 5.4 If the 90% evaluation threshold is not met, a corrective action summary shall be included in the IA report.

6. POPULATION OF QUALITY ACCEPTANCE TESTERS AND EQUIPEMENT

- 6.1 Once per year, before any work is performed by District QA Testers, a signed letter stating the names of each of their QA Testers shall be submitted by the District Construction Engineer to the Director of MCS&T Division. In lieu of this letter, Districts may utilize an MCS&T provided online form.
- 6.2 If, during the calendar year, additional QA Testers are added to the District's roster, the District Construction Engineer shall submit an amended list to the Director of MCS&T Division. This shall be done before any quality assurance work is performed by the tester.
- 6.3 In the event where a project incorporates non-DOH QA Testers and/or QA Testing Labs, the District Construction Engineer shall submit to the Director of MCS&T a signed letter stating the names of each of the QA Testers. As part of their duties, this person must participate in the IA program for each evaluation period.
- 6.4 All QA Testing Equipment shall be inventoried yearly and entered into the Division's approved equipment tracking system. If additional testing equipment is acquired, it shall be added to this system.

7. PORTLAND CEMENT CONCRETE (PCC)

- 7.1 Each QA Tester who tests PCC during the evaluation period shall perform an IA Test corresponding to the test they performed during that evaluation period.
- 7.2 The minimum required IA Sample test frequency for each QA Tester and QA Test Equipment is as follows:

PCC IA Samples Frequency	
Air – AASHTO T 152	1/Year
Compressive Strength Testing - AASHTO T 22	1 Set/Year

Slump – AASHTO T 119	1/Year
<u>Surface Resistivity AASHTO - T 358</u>	<u>1 Set/Year</u>

- 7.3 For PCC, the Division will host at least one in-house proficiency sample style test of plastic concrete. This event shall be a group event where plastic concrete is provided, and each QA Tester is present. The QA Tester will test the material using the equipment they typically use to test concrete. If a QA Tester cannot attend this event, they shall attend a make-up event or be individually evaluated by the IA sampler.
- 7.4 Plastic Concrete Testing:
- 7.4.1 For plastic concrete testing, each QA Tester, their testing equipment, as well as their results shall be recorded.
- 7.4.2 Plastic concrete testing at a minimum includes AASHTO T 152 (air content) and AASHTO T 119 (slump).
- 7.4.3 During the event described in Section 7.3, the IA Sampler as well as representatives from MCS&T Division will observe the QA Testers to ensure proper testing procedures are followed.
- 7.4.4 If a QA Tester is observed deviating significantly from testing procedures, the IA Sampler or an MCS&T Division representative may note that test as a Non-Satisfactory Evaluation, regardless of the QA Tester's results. In this case, the test shall be considered Non-Satisfactory, and a CAR will be required. Also, the QA Tester's results shall be discarded from the population of results.
- 7.5 Cylinder Testing:
- 7.5.1 For each set of cylinders in cylinder testing, the cylinder fabricator, the Tester, testing equipment, and results shall be recorded and sent to the IA sampler.
- 7.5.2 Cylinder testing at a minimum includes AASHTO T 22 (compressive strength).
- 7.5.3 At the event described in Section 7.3, a standard set of 4"x8" cylinders shall be created for each of the QA Testers who performs the AASHTO T22 test at each District. This set of cylinders shall be fabricated by a tester from that District, if one is present. If a District has more than 1 QA Tester or more than 1 set of testing equipment, additional sets of cylinders shall be fabricated for each instance.
- 7.5.4 In the instance of a non-DOH testing laboratory, a certified individual from the lab's primary District shall fabricate the cylinders as they would for their own District testing laboratory.
- 7.5.5 If a QA Tester for a particular District does not attend, a set of cylinders shall be fabricated for that District by either the IA Sampler or another District. This set of cylinders will be tested by that District but will only be considered a "back-up" case if that District cannot attend another session

7.6 Surface Resistivity Testing:

- 7.6.1 For each set of cylinders in surface resistivity testing, the cylinder fabricator, the Tester, testing equipment, and results shall be recorded and sent to the IA sampler.

- 7.6.2 Surface Resistivity testing at a minimum includes AASHTO T 358 (surface resistivity).
- 7.6.3 Curing in accordance with section 601.4.5 of the supplemental specifications.
- 7.6.4 At the event described in Section 7.3, a standard set of 4"x8" cylinders shall be created for each of the QA Testers who performs the AASHTO T358 test at each District. This set of cylinders shall be fabricated by a tester from that District, if one is present. If a District has more than 1 QA Tester or more than 1 set of testing equipment, additional sets of cylinders shall be fabricated for each instance.
- 7.6.5 In the instance of a non-DOH testing laboratory, a certified individual from the lab's primary District shall fabricate the cylinders as they would for their own District testing laboratory.
- 7.7 If a QA Tester for a particular District does not attend, a set of cylinders shall be fabricated for that District by either the IA Sampler or another District. This set of cylinders will be tested by that District but will only be considered a "back-up" case if that District cannot attend another session.
- 7.6.7.8 For PCC the QA Testing Equipment is as follows:
1. Compressive Strength Testing Machine
 2. Type B Pressure Meter
 3. Slump Cone
 - 3.4. Surface Resistivity Meter

8. ASPHALT CONTENT – IGNITION OVEN – BURN OFF

- 8.1 Each QA Tester who tests for Asphalt Content during the evaluation period shall perform a yearly burn off IA Test.
- 8.2 The minimum required IA Sample test frequency for each QA Tester and QA Test Equipment is as follows:

Asphalt IA Samples	
Asphalt Content by Ignition - AASHTO T 308	1/year
Percent Passing the #200 Sieve - AASHTO T 30	1/year

- 8.3 AASHTO re:source:
- 8.3.1 Each QA Tester shall participate in the AASHTO re:source proficiency program for Asphalt Mixture Ignition Oven (HMI). This shall apply to all the tests listed in Section 8.2.
- 8.3.2 If there are more QA Testers in a District than distributed samples, the District shall request additional AASHTO re:source aggregate samples.
- 8.4 MCS&T Distributed Samples:
- 8.4.1 Since most Districts operate multiple ignition ovens, in addition to the AASHTO re:source samples, MCS&T Division shall obtain and distribute a homogeneously split sample for each of the District's ignition ovens.

- 8.4.2 MCS&T shall also distribute a sample of this material to Non-DOH laboratories for each QA Tester and QA testing equipment.
- 8.5 For AASHTO re:source and MCS&T distributed samples, the QA Tester, QA Testing Equipment, and test results shall be recorded and sent to the IA Sampler. This shall apply to all the tests listed in Section 8.2.
- 8.6 For Ignition Oven Asphalt tests the QA Testing Equipment is as follows:
1. Ignition Oven

9. SUPERPAVE ASPHALT CONCRETE

- 9.1 Each QA Tester who tests SuperPave Asphalt Concrete during the evaluation period, in addition to the yearly burn off IA test, shall perform an IA Test corresponding to each test they performed during that evaluation period.
- 9.2 The minimum required IA Sample test frequency for each QA Tester and QA Test Equipment is as follows:

SuperPave IA Samples	
Air Voids - AASHTO T 269	1/year
Bulk Specific Gravity, Vacuum - AASHTO T 331	1/year
Bulk Specific Gravity, SSD - AASHTO T 166	1/year
Maximum Specific Gravity - AASHTO T 209	1/year

- 9.3 Each QA Tester shall participate in the AASHTO re:source proficiency program for Asphalt Mixture Gyratory (HMG) for SuperPave Asphalt Material. This shall apply to all the tests listed in Section 9.2.
- 9.3.1 If a District has multiple QA Testers and/or QA Testing Equipment, that District shall request additional AASHTO re:source samples to ensure that all QA Testers and QA Testing Equipment are evaluated.
- 9.4 The QA Tester, QA Testing Equipment, and test results shall be recorded and sent to the IA Sampler. This shall apply to all the tests listed in Section 9.2.
- 9.5 For SuperPave Asphalt Concrete the QA Testing Equipment is as follows:
1. Gyratory Compactor
 2. Core Lok - Asphalt Density Measurement System

10. MARSHALL ASPHALT CONCRETE

- 10.1 Each QA Tester who tests Marshall Asphalt Concrete during the evaluation period, in addition to the yearly burn off IA test, shall perform an IA Test corresponding to each test they performed during that evaluation period.
- 10.2 The minimum required IA Sample test frequency for each QA Tester and QA Test Equipment is as follows:

Marshall IA Samples	
Bulk Specific Gravity, SSD - AASHTO T166	1/year

Maximum Specific Gravity - AASHTO T209	1/year
Air Voids - AASHTO T 269	1/year
Marshall Stability/Flow - AASHTO T245	1/year

- 10.3 Each QA Tester shall participate in the AASHTO re:source proficiency program for Asphalt Mixture Marshall Design (MAR) for Marshall Asphalt Material. This shall apply to all the tests listed in the Table in Section 10.2.
- 10.3.1 If a District has multiple QA Testers and/or QA Testing Equipment, that District shall request additional AASHTO re:source samples to ensure that all QA Testers and QA Testing Equipment are evaluated.
- 10.4 The QA Tester, QA Testing Equipment, and test results shall be recorded and sent to the IA Sampler. This shall apply to all the tests listed in Section 10.2.
- 10.5 For Marshall Asphalt Concrete the QA Testing Equipment is as follows:
1. Marshall Hammer
 2. Marshall Stabilometer

11. AGGREGATE GRADATION

- 11.1 Each QA Tester who tests Aggregate during the evaluation period shall perform an IA Test corresponding to the test they performed during that evaluation period.
- 11.2 The minimum required IA Sample test frequency for each QA Tester and each piece of QA Testing Equipment is as follows:

Aggregate Gradation Samples	
AASHTO T27 (Sieve Analysis of Aggregates)	1/year
AASHTO T11 (Materials Finers than No. 200 Sieve)	1/year

- 11.3 AASHTO re:source
- 11.3.1 Each District QA Tester shall participate in the AASHTO re:source proficiency program for Aggregate.
- 11.3.2 If there are more QA Testers in a District than distributed samples, the District shall request additional AASHTO re:source aggregate samples.
- 11.4 MCS&T Distributed Samples:
- 11.4.1 Because the Districts have multiple shakers, in addition to the AASHTO re:source samples, MCS&T shall distribute a homogeneously split sample to each testing lab

for each set of QA testing equipment. Any QA Tester in the District may test these samples.

- 11.4.2 MCS&T shall also distribute a sample of this material to Non-DOH laboratories for each QA Tester and QA testing equipment.
- 11.4.3 The specific class and type of material shall be selected by the IA Sampler. The material shall consist of AASHTO specified gradation.
- 11.5 All specified sieves will be evaluated for the material passing. For the AASHTO re:source proficiency sample, all scored sieves will be evaluated.
- 11.6 For AASHTO re:source and MCS&T distributed samples, the QA Tester, QA Testing Equipment, and test results shall be recorded and sent to the IA Sampler. This shall apply to all the tests listed in Section 11.2.
- 11.7 For Aggregate Gradations the QA Testing Equipment is as follows:
 - 1. Aggregate Shaker

12. COMPACTION

- 12.1 The WVDOT is currently evaluating the process of adding Asphalt and/or Aggregate/Soil Compaction to the IA program. The goal is to add this to the program for the 2026 evaluation period.

13. EVALUATION PROCEDURE

- 13.1 IA Samples will be evaluated statistically when the population of results is 5 or greater. If the IA Sample is not provided by AASHTO re:source in the form of a Proficiency Sample, it will be evaluated by the WVDOT IA Sampler. The calculation method used by ASHTO re:source shall be followed. The calculation method is shown in Attachment 3.
- 13.2 If the samples are provided by AASHTO re:source a rating of 3, 4, 5, as assigned by the testing agency, shall be considered satisfactory.
- 13.3 In the event where the population is less than 5, samples will be evaluated by averaging the test results and using the respective AASHTO Precision and Bias Table as the acceptable range of values between the IA Sampler and the QA Tester(s). In this event, the evaluation method will be specifically described in that year's IA report.
- 13.3.1 For example, if the average is 5.0 and the table provides a precision and biased of 1.2, the test values must fall between 3.8 and 6.2 to be considered satisfactory.
- 13.4 If the results of an evaluation are satisfactory, the evaluation will be considered successful. A successful evaluation will verify both the QA Tester and the QA Testing Equipment used during the IA Test.
- 13.5 If the results of an evaluation are deemed non-satisfactory, the IA Test will be reviewed by the IA Sampler and/or the respective District Materials Supervisor. Within 30 days of notification of the non-satisfactory evaluation, the reviewer shall submit a Corrective Action Report to the Director of Materials Control Soils and Testing Division. This Corrective Action Report will be included in the yearly IA

Report. A sample of this Corrective Action Report is provided in Attachment 1. The live version of the file is in the [WVDOH MCS&T Toolbox](#)⁴.

- 13.5.1 If possible, an additional IA Sample will be tested by the QA Tester in that calendar year, using the same QA Testing Equipment. This IA Test will be closely observed by the IA Sampler or their designee to help establish the root cause.
- 13.5.2 If this cannot be accomplished during the calendar year, the process will be followed for the subsequent calendar year's IA Sample.
- 13.5.3 If the QA Tester's evaluation for a given test is non-satisfactory for two or more successive evaluation periods, and is not caused by QA test equipment or sampling methods, then actions outside a CAR shall be taken by the IA Sampler to confirm the Tester's proficiency for the given test.
- 13.6 The evaluation criteria in this section shall be evaluated every three years. The most recent evaluation of this criterion was on :

_____ by _____ (Director of MCS&T)**.

** Note: This document shall be effective as per the signature date at the end of this document. However, the live version of this document will be updated as indicated above. This review date will not affect the signature nor effective date of the procedure, but rather provide documentation of WVDOH's compliance with Federal guidelines.

14. RECIPROCITY OF IA TESTING AND TECHNICIAN CERTIFICATION

- 14.1 If the practical exam portion of the technician certification program (as described in MP 106.03.50) is equivalent to that of an IA Sample, reciprocity between these tests can be applied if agreed upon by both the Technician Certification Coordinator and the IA Sampler.
- 14.2 At the discretion of the Technician Certification and Training Coordinator, a successful IA sample may be considered the "Practical" portion of a technician's recertification for the respective material.
- 14.3 At the discretion of the IA sampler, the practical portion of either a certification or recertification may be considered a successful IA sample.

15. REPORTING

- 15.1 The evaluation period shall be the calendar year, starting with January 1st and ending December 31st.
- 15.2 The annual IA report shall be submitted to FHWA. The due date for the report is April 1st of the year following the evaluation year. The annual report shall include the following information: the number of certified technicians, the number of testing equipment used for QA, the number of active technicians, the number of technicians covered by the IA program, the number of IA Samples that were Non-Satisfactory, and a summary of the Corrective Action Reports along with the potential systematic solutions to reoccurring deficiencies (FHWA-HIF-12-001).

⁴ <https://transportation.wv.gov/highways/mest/Pages/tbox.aspx>

<https://transportation.wv.gov/agencies/highways/divisions/materials-control-soils-and-testing-division/tool-box>

- 15.2.1 The report shall also include a summary of the Division's performance verifying QC samples with QA samples during as per MP 700.00.54. The evaluation shall be for each of the required tests for each material during the evaluation period.

Michael A Mance, PE
Director
Materials Control, Soils & Testing Division

MP 700.00.53 Steward – Materials Control Section
MAM:Bb
ATTACHMENTS

Attachment 1: Sample Corrective Action Report

WVDOH Independent Assurance Corrective Action Report		
Form 2025-IA-CAR		
Date of Occurrence:		
Date Submitted:		
Name of Tester:		
Testing Equipment:		
Material Tested:		
Describe the issue reported:		
Sample		
What was the root cause of the issue?		
What actions have been done to correct this issue?		
Signature of QA Tester		
Signature of District Materials Supervisor		
Signature of District Construction Engineer		Review: MCST

Attachment 2: Office of Pavement Technology Publication No. [FHWA-HIF-12-001](#)⁵, October 2011.

⁵ <https://www.fhwa.dot.gov/pavement/materials/hif12001.pdf>

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

PROCEDURE FOR EVALUATING QUALITY CONTROL SAMPLE TEST
RESULTS WITH VERIFICATION QUALITY ASSURANCE SAMPLE TEST RESULTS

1. PURPOSE

- 1.1. To provide a procedure to statistically compare Quality Control (QC) and Quality Assurance (QA) tests to verify the validity of the QC samples.
 - 1.2. To ensure adequate QA coverage of QC samples for required materials and tests.
-

2. REFERENCED DOCUMENTS

- 2.1. MP 700.00.53 - Procedure for Evaluating Independent Assurance Samples with Acceptance Samples
 - 2.2. MP 307.00.50 - Guide for Quality Control and Acceptance Plans for Base Course
 - 2.3. MP 401.03.50 - Guide for Contractor's Quality Control of Bituminous Concrete
 - 2.4. MP 601.03.50 - Guide for Quality Control and Acceptance Requirements for Portland Cement Concrete
-

3. DEFINITIONS

- 3.1. System: The Division Approved Materials Tracking System.
- 3.2. Sample: The sample record test which has been documented in the System.
- 3.3. Quality Assurance (QA) Sample: Samples performed by the Division to evaluate for acceptance, a material on a Project.
- 3.4. Quality Control (QC) Sample: Samples performed by the Contractor for a material on a Project to demonstrate the material's compliance with the Specifications.
- 3.5. Verification: The process of statistically comparing a QA sample to a series of QC samples. This comparison serves to verify the validity of the QC testing. There are two approaches to this comparison:
 - 3.5.1. Project Approach: A verification Data Set must contain all of the following data. Each of these fields must match. For example, samples from different Projects may not be combined for the Project Approach:
 - 1. Material Source
 - 2. Mix Design (If Applicable)
 - 3. Aggregate Class (If Applicable)
 - 4. Project

- 3.5.2. System Approach: A verification Data Set must contain all of the following data. Each of these fields must match. For example, samples from different Mix Designs may not be combined for the System Approach:
1. Material Source
 2. Mix Design (If Applicable)
- 3.6. Data Set: The test results in the linked QC and QA sample record tests. This test data must having matching categories as specified in Sections 3.5.1 and 3.5.2. Examples are provided in Attachment 3.
- 3.7. Linked Samples: This is a technical term for a process in the System which creates a data set among joined samples.
-

4. SCOPE

- 4.1. On all Projects, all QC samples for the following tests must be represented by a QA sample. These are to be evaluated in chronological order by a QA sample. No more than 10 QC samples shall be evaluated by 1 QA sample.
- 4.1.1. All QA samples and linked QC samples must contain matching data for all the fields in Sections 3.5.1 and 3.5.2. Examples are provided in Attachment 3.
- 4.2. The following materials and their respective test(s) and test result(s) are evaluated by the specified approach.
- 4.2.1. Aggregate Gradations – Project Approach
1. Specification Sieves (each)
 2. Pan (if applicable)
- 4.2.2. Marshall Asphalt Mixture – System Approach
1. Asphalt Content
 2. Air Voids
 3. VMA
 4. Stability
 5. Flow
 6. Gradation (each Specification Sieve and Pan if applicable)
- 4.2.3. SuperPave Asphalt Mixture – System Approach
1. Asphalt Content
 2. Air Voids
 3. VMA
 4. Gradation (each Specification Sieve and Pan if applicable)
- 4.2.4. Portland Cement Concrete – Project Approach
1. Air Content
 2. Consistency
 3. Strength
 - 3-4. Surface Resistivity

5. PROCEDURE

- 5.1. After completion of the QA sample, the test data shall be entered into the System. The QA sample shall be linked to the appropriate QC sample(s) as specified in Section 4.2. Note that all samples being linked must contain all respective test results for the material shown in Section 4 and meet the criteria stated in Sections 3.5.1 and 3.5.2.
- 5.1.1. If a system approach QA sample is performed and it covers multiple Districts, the QA sample shall be performed by the District in which the plant is located.
- 5.2. The samples shall be linked by the person creating the QA sample, based on the total number of QC samples. This will allow the System to create a data set and perform an evaluation (if applicable). For QA samples evaluating QC samples in the system approach, all QC samples taken after the last QA sample and up to the current QA sample shall be evaluated.
- 5.2.1. 1-4 QC Sample(s)
If there are less than five QC samples, they shall be linked, but no calculation shall be performed; The evaluation will be conducted as specified in Section 6.1
- 5.2.2. 5-10 QC Samples
If there are five to ten QC samples, they shall be linked; the data set shall consist of all of the available tests. The evaluation shall be conducted as specified in Section 6.2
- 5.2.3. 11 + Quality Control Samples
If there are eleven or more QC samples available, they shall be organized sequentially by date/time; only the first ten shall be linked. The data set shall consist of these ten samples. The evaluation shall be conducted as specified in Section 6.2.
An additional QA sample shall be completed, and the process shall be restarted independent of the prior evaluation. This extra data set shall be linked and evaluated according to the remaining QC samples.
- 5.2.3.1. For example, if 16 QC samples are taken, there shall be a QA sample for QC samples 1-10 and then another QA sample for QC samples 11-16, which would be evaluated as "5-10" QC samples.

6. EVALUATION

- 6.1. If the data set contains less than 5 linked QC samples, no calculation shall be made. The test data shall be visually evaluated for significant variance. If a significant variance is noted, appropriate action shall be taken by the District as specified in Section 7.3.2.1. If there is no significant variance, the report shall indicate: "This sample, <sample number recorded here> has been reviewed in accordance with MP 700.00.54, and judged to be similar." If it is not similar, it's handled in accordance with Section 7.3.2.1.
- 6.2. If the data set contains 5 or more linked QC samples, they shall be evaluated by the System. No more than 10 QC samples shall be linked; if there are more than 10 QC samples, the System shall return an error.

- 6.2.1. The calculation and evaluation criteria used in the System are documented in Attachment 1.
- 6.3. Based on the calculation and evaluation criteria, the System shall report as follows:
 - 6.3.1. If all the test results are evaluated as “Similar”, the entire data set shall be judged “Similar”.
 - 6.3.2. If any of the test results in the set are evaluated as “Non-Similar”, the entire data set shall be judged as “Non-Similar”.
 - 6.3.2.1. If the data set is “Non-Similar”, the District Materials Supervisor shall perform and document the following for QC:
 - 1. Review the sampling procedure.
 - 2. Review the testing procedures.
 - 3. Check testing equipment.
 - 4. Review documentation.
 - 5. Perform any additional investigations that may clarify the discrepancy.

7. REPORTING AND SAMPLE SUBMISSION

- 7.1. Once the evaluation is completed, the result shall be noted by the District on the QA sample.
- 7.2. If applicable, the sample shall also be marked by the District as “Pass” or “Fail” along with whether the data is “Similar” or “Non-Similar” as defined in Section 7.2.1 and 7.2.2.
 - 7.2.1. If the data set is found to be “Similar”, the QA Sample shall be marked “Similar” in the System by the District.
 - 7.2.2. If the data set is found to be “Non-Similar” the QA sample shall be marked “Non-Similar” in the System by the District.
 - 7.2.2.1. If the Sample is marked “Non-Similar”, the documentation from Section 6.3.2.1 shall be submitted with the sample by the District, including the corrective action when applicable.
 - 7.2.2.2. In the event that other documentation is needed to resolve the material, that information shall also be provided with the sample by the District.
- 7.3. The sample shall then be submitted by the District to the respective MCS&T Materials Regional Coordinator for final evaluation and approval.
- 7.4. A sample report is shown in Attachment 2.

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Director
Materials Control, Soils & Testing Division

Attachment 1: Sample Calculations

To determine the range (R) of the QC samples, subtract the smallest test value from the largest test value.

Compute the interval (I) by substituting the values into the proper equation below.

Number of Samples Used in Calculating the Average	Equation for Computing the Interval (I)
10	$I = \bar{X}_{10} \pm 0.91 \times R$
9	$I = \bar{X}_9 \pm 0.97 \times R$
8	$I = \bar{X}_8 \pm 1.05 \times R$
7	$I = \bar{X}_7 \pm 1.17 \times R$
6	$I = \bar{X}_6 \pm 1.33 \times R$
5	$I = \bar{X}_5 \pm 1.61 \times R$

The interval (I) is determined by first adding the average ($\bar{X}_n$) to the product of the range (R) times the given constant. This determines the upper limit of the interval. If the result obtained is greater than 100%, it will be recorded as 100%. Next, subtract the product of the range (R) times the given constant from the average ($\bar{X}_n$). This determines the lower limit of the interval. If the result is less than zero, it will be recorded as zero.

For aggregate gradations, the average for each sieve must be calculated separately.

All data must fall within the range to be judged "Similar". Otherwise, the data set is "Non-Similar".

Attachment 2: Sample Evaluation Report

West Virginia

Department of Transportation

Marshall Verification Sample Evaluation Computation Sheet

Sample Record: TKrat20241205122921

Material Name: Base 2/Wearing 4 Asphalt Mix, Marshall

Material Code: 401.002.000.05

Facility: F-JFA4.02.704 - J.F. Allen Co. - Lorentz

Laboratory ID: D07-ASP

Sample Date: 10/17/2024

Contract ID:

Sample Record Name	% Asphalt	% Air Voids	% VMA	Stability	Flow	Lab Reference Number	Open Sample Record
TKrat20241018080012	5.0	4.5	14.1	11,648	15.0	C7B2440	Click Here
TKrat20241022120955	5.1	2.2	12.3	12,642	15.3	C7B2441	Click Here
TKrat20241022121156	4.8	3.2	12.5	11,529	14.3	C7B2442	Click Here
TKrat20241022121345	5.0	2.0	12.0	11,633	15.5	C7B2444	Click Here
TKrat20241022121524	4.9	2.9	12.5	12,417	14.8	C7B2445	Click Here
TKrat20241108123059	5.3	2.0	12.5	12,337	15.7	C7B2448	Click Here
Average:	5.02	2.8	12.65	12034.33	15.1		Records: 6
Range:	0.5	2.5	2.1	1113	1.4		
Upper Limit Interval:	5.69	6.13	15.44	13514.62	16.96		
Lower Limit Interval:	4.36	0	9.86	10554.04	13.24		

% Asphalt	% Air Voids	% VMA	Stability	Flow	Lab Reference Number
4.9	2.2	11.8	12,480	12.9	M7B2443
✓	✓	✓	✓	✗	

Attachment 3 – Examples of Samples Which Can and Cannot Be Linked:

Project Approach:

All the following must match:

1. Material Source (Enforced by Mix Design for Concrete).
2. Mix Design (If Applicable)
3. Aggregate Class (If Applicable)
4. Project

The following example shows an incorrect data set contains an errant Mix Design and Project.

Lab Number	Contract ID	Project Name	Material	QC/QA	Mix Design
M1N8745	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QA	2406546
C1N2312	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QC	2406546
C1N2313	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QC	2406546
C1N2314	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QC	2508546
C1N2315	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QC	2406546
C1N2316	2024060004	Sharp Dr.	Class B Concrete with Fly Ash	QC	2406546
C1N2317	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QC	2406546

The following example shows a correct data set. All the required fields match.

Lab Number	Contract ID	Project Name	Material	QC/QA	Mix Design
M1N8745	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QA	2406546
C1N2312	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QC	2406546
C1N2313	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QC	2406546
C1N2314	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QC	2408546
C1N2315	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QC	2406546
C1N2316	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QC	2406546
C1N2317	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QC	2406546
C1N2318	2025087334	Knollwood Dr	Class B Concrete with Fly Ash	QC	2406546

System Approach:

All the following must match:

1. Material Source (Enforced by Mix Design for Asphalt).
2. Mix Design (If Applicable)

The following example shows an incorrect data set containing an errant Material and Mix Design.

Lab Number	Contract ID	Project Name	Material	QC/QA	Mix Design
M1N8745	2025087334	Knollwood Dr	Base 2/Wearing 4 Asphalt Mix, Marshall	QA	2406546
C1N2312	2024034008	University Ave	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546
C1N2313	2025087334	Knollwood Dr	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546
C1N2314	2025080008	Dunlap Drive	Wearing 1 Skid Asphalt Mix, Marshall	QC	2508526
C1N2315	2025080008	Dunlap Drive	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546
C1N2316	2024034008	University Ave	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546
C1N2317	2024034008	University Ave	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546
C1N2318	2025087334	Knollwood Dr	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546
C1N2319	2025087334	Knollwood Dr	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546

The following example shows a correct data set. All the required fields match.

Lab Number	Contract ID	Project Name	Material	QC/QA	Mix Design
M1N8745	2025087334	Knollwood Dr	Base 2/Wearing 4 Asphalt Mix, Marshall	QA	2406546
C1N2312	2024034008	University Ave	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546
C1N2313	2025087334	Knollwood Dr	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546
C1N2315	2025080008	Dunlap Drive	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546
C1N2316	2024034008	University Ave	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546
C1N2317	2024034008	University Ave	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546
C1N2318	2025087334	Knollwood Dr	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546
C1N2319	2025087334	Knollwood Dr	Base 2/Wearing 4 Asphalt Mix, Marshall	QC	2406546

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION
MATERIALS PROCEDURE

COMMERCIAL AND POTENTIAL SKID RESISTANT
AGGREGATE SOURCE APPROVAL PROCEDURES

1. PURPOSE

- 1.1 To provide a uniform procedure for the following:
 - 1.1.1 Approval of producers/suppliers of aggregates for the West Virginia Department of Transportation's Division of Highways (WVDOH) Approved Material Source/Product List.
 - 1.1.2 Monitoring of producers/supplier's ongoing compliance with the governing specifications for use of their products in WVDOH projects.

2. SCOPE

- 2.1 This procedure shall apply to any aggregate producers/suppliers intending on supplying aggregates to any WVDOH projects.

3. APPLICABLE DOCUMENTS

- 3.1 MP 106.00.02 Procedure for Evaluating Products for Use in Highway Construction
- 3.2 MP 700.00.01 Sampling and Testing of Materials at the Source

4. DEFINITIONS

- 4.1 Commercial Source List: WVDOH List of Approved Commercial and Potential Skid Resistant Aggregate Sources
- 4.2 Specifications – refers to the WV DOH Standard Specifications Roads and Bridges most current revision.
- 4.3 Section – refers to the Section of the WV DOH Standard Specifications Roads and Bridges most current revision.
- 4.4 Producer – An aggregate quarry who is actively producing aggregate.
- 4.5 Production – When a quarry is blasting Rock to be crushed
- 4.6 Crushing – When the quarry is crushing and separating the rock into particle size.

- 4.7 Full Quality – The full battery of aggregate tests which consists of but not limited to the following:
 - 4.7.1 Fine Aggregate
 - 1) Deleterious Substances – Section 702
 - 2) Soundness – Section 702.1.3
 - 3) Organic Impurities – Section 702.1.4
 - 4.7.2 Coarse Aggregate
 - 1) Deleterious Substances – Section 703.1
 - 2) Percent of Wear – Section 703.1.3
 - 3) Soundness – Section 703.1.4

5. CONSIDERATION FOR THE LIST OF COMMERCIAL AND POTENTIAL SKID RESISTANT AGGREGATE SOURCES LIST

- 5.1 If a producer of aggregates wants to be placed on the WV DOH Approved Commercial and Potential Skid Resistant Aggregate Source List and has had no previous dealings with WV DOH, they shall submit a HL-468 New Products Evaluation form to the Materials Control, Soils and Testing Division (MCS&T). The producer shall describe the type of stone they intend to sell, what type of aggregates they intend on supplying, when they intend on starting production and test results from an AASHTO accredited laboratory showing the aggregates to be supplied to WV DOH meet the Full Quality Specifications. The submission, upon review by MCS&T, will be forwarded to the nearest adjacent WV DOH District Materials Supervisor for notification purposes.
 - 5.1.1 Once the HL-468 and documentation have been reviewed by MCS&T for compliance with the Specifications the producer will be contacted to arrange an onsite visit of the production and crushing process. Records of manufacturing ,Core logs, Geological reports and any Historical data concerning the aggregate and test results signifying compliance with Specifications shall be available for review.
- 5.2 Independent testing data from an AASHTO accredited laboratory shall be evaluated by MCS&T to ensure compliance with the Full Quality Specifications. All data submitted shall be reviewed in the approval process and at the discretion of MCS&T may be included in the testing data compiled by MCS&T.
- 5.3 The new Producer shall demonstrate that they can produce an E-Ticket as defined in Section 109.20.1 of the Specifications. A sample ticket shall be provided to MCS&T
- 5.4 To be placed on the commercial source list test data from a minimum of 20 samples shall be tested and evaluated by MCS&T for compliance with the Full Quality Specifications. The 20 samples must be completed within a 12-month period.
 - 5.4.1 During the onsite visit MCS&T will take two samples to be tested for Full Quality. These samples will be one coarse and one fine aggregate sample. At this time MCS&T shall set up a sampling regimen to evaluate the material over the course of production.

- 5.4.2 The Sampling regimen shall be set up in such a manner to obtain samples from different production blasts to ensure the producer is able to consistently produce aggregate that meets Full Quality Specifications. MCS&T or a representative of MCS&T will visit the quarry for observation and sampling purposes. The producer shall give MCS&T a notice of 24 hours before blasting takes place for record keeping and sampling. (Full Quality samples will not be taken less than every 7th day of crushing.)
- 5.4.3 At their discretion, MCS&T may sample stockpiles with no more than 2000 Tons of material for Full Quality. If the material sampled meets the Specifications, the stockpile can be approved for use by WV DOH if no further material has been or will be added to the stockpile from the time of sampling. This data may be included in the required 20 sets of data for source approval at the discretion of MCS&T.
- 5.4.4 After 20 passing full quality samples results have been examined by MCS&T and it has been demonstrated the producer can consistently produce aggregate meeting the Full Quality Specifications the producer will be placed on the Commercial Source List.
- 5.4.5 After being placed on the Commercial Source List the Director of MCS&T shall notify the 10 District Material Supervisors, the Regional Construction Engineers, the Director of Contract Administration, shall be notified of addition of the new producer to the Approved Source List via electronic communication (i.e., email).

6. MAINTENANCE OF THE LIST OF COMMERCIAL AND POTENTIAL SKID RESISTANT AGGREGATE SOURCES

- 6.1 To remain on the WVDOH List of Approved Commercial and Potential Skid Resistant Aggregate Sources, the following criteria shall apply:
- 6.1.1 The Producer shall maintain aggregates in accordance with the Full Quality Specifications of Sections 702, 703, and 704. The producer shall permit random, intermittent sampling and testing for compliance with those Specifications by MCS&T or a representative of MCS&T. This testing will determine if the Producer's approved products meet the WVDOH Specifications. (see MP 106.00.03; Guidelines for Establishing and Maintaining Approved Lists of Materials and Sources, Section 6)
- 6.1.2 The random intermittent sampling and testing shall be done at a minimum rate of one sample of coarse and fine aggregate per year. The random samples will be collected at random times and dates according to the availability of MCS&T.
- 6.1.3 MCS&T or a representative of MCS&T will arrive at the scale house for check-in and onsite training as prescribed by the producer. The onsite representative shall be notified of MCS&T's presence. MCS&T will inform the onsite representative of the reason for the site visit. The onsite representative shall then escort MCS&T for the duration of the site visit.
- 6.1.4 If a Producer has not provided any material to the WVDOH over a period of 3 consecutive years from the same facility, that Facility will be removed from Commercial Sources List. If an inactive Producer re-establishes production and desires to regain admittance to the

Commercial Sources List, Section 5 of this MP shall apply.

7. REMOVAL FROM LIST OF COMMERCIAL AND POTENTIAL SKID RESISTANT AGGREGATE SOURCES

- 7.1 In the event the Producer does not provide materials in compliance with Full Quality Specifications, the following actions shall be taken by the Producer and MCS&T, up to and including removal from the Commercial Sources List.
- 7.1.1 Upon testing of a random aggregate sampled by MCS&T or a representative of MCS&T for full quality from a producer, that fails to meet the minimum WV DOH Specification requirements, the test results and methods of testing shall then be reviewed for accuracy and precision. If no errors are found a second sample will be obtained from the producer.
- 7.1.2 The second field sample shall be obtained by MCS&T within ten working days from the test completion date of the first failing sample. At the time the second field sample is taken, MCS&T shall notify the onsite representative of the Producer in writing of the failing results from the initial field sample and supply the Producer's representative with a copy of the test results. The results from this sample will determine if further action is needed.
- 7.1.3 The second field samples obtained in Section 7.1.2 shall be tested for the failed Specification requirements of the first sample. If the second field sample does not meet the Specification requirements, MCS&T will contact the Producer representative by phone to inform them of the failing test results. An email will follow the phone call to include the failing test results of the second sample.
- 7.1.4 If the Producer has had zero failing test results over the last 3 years (not including the most recent two tests described in Sections 7.1.1 and 7.1.3), the producer will be suspended from supplying aggregate to the WVDOH till such time as a third sample can be obtained and tested for compliance with WVDOH Specifications.
- 7.1.5 If a third field sample shall be obtained by MCS&T it shall be within ten working days from the test completion date of the second failing sample. At the time the second field sample is taken, MCS&T shall notify the onsite representative of the Producer in writing of the failing results from the second field sample and supply the Producer's representative with a copy of the test results. At the time the third field sample is taken, MCS&T shall make a thorough evaluation of the producer's production site, crushing area, and stockpiles of aggregate. Core reports, and any testing performed on the producers material shall be available for review from the producer.
- 7.1.6 The third sample obtained in section 7.1.5 from the Producer by MCS&T shall be tested for the failed Specification requirements of the first two samples. If the third field sample does not meet the WV DOH Specification requirements the producer will be removed from the WVDOH List of Commercial and Potential Skid Resistant Aggregate Sources.
- 7.1.7 In the event the Producer does have failing results during the previous 3 years as

- described in Section 7.1.4, the facility will be contacted with the results and informed they have been removed from the Commercial Source List. Written communication of this removal will be sent to the facilities address on the facilities web page.
- 7.2 Communication of sample information shall be implemented as follows:
- 7.2.1 The Producer shall be notified of what aspect(s) of Full Quality samples did not meet Specification requirements, as prescribed in sections 7.1.2 and 7.1.5.
- 7.2.2 In the event a Producer is removed from the Commercial Source List, the Producer is no longer permitted to ship material to be used in any aspect of the WV DOH. This includes Asphalt and Concrete plants who supply material to WV DOH.
- 7.2.3 When a producer is removed from the Commercial Source List MCS&T shall notify the Producer, Deputy State Highway Engineer, Director of Contract Administration, Regional Construction Engineers, District 1-10 Engineers and Material Supervisors of what aspect(s) of the samples which did not meet Specification requirements via electronic communication (i.e., email).
- 7.3 The Producer of the material in question is then responsible for mitigating the deficiency and improving the production quality to comply with the Specifications to be reinstated to the Commercial Source List. Mitigation of substandard materials is not the responsibility of MCS&T; only the verification of the quality of material provided by the Producer shall be the responsibility of MCS&T.

**8. REINSTATEMENT TO THE LIST OF COMMERCIAL AND POTENTIAL
SKID RESISTANT AGGREGATE SOURCES**

- 8.1 The following procedure shall be used by a Producer desiring to return to the Commercial and Potential Skid Resistant source list:
- 8.2 The Producer shall supply three (3) passing test results with a minimum of five working days between each test. The test shall show the aggregate being produced meet the WV DOH Full Quality Specifications.
- 8.3 All sampling and testing performed in section 8.1.1 must be completed by an AASHTO re:source accredited laboratory. Once the passing tests have been reviewed and verified by MCS&T personnel, a sampling regimen will be implemented by MCS&T to resample the Producer.
- 8.3.1 The sampling regimen will consist of six (6) samples. The Sampling regimen shall be set up in such a manner to obtain samples from different production blasts to ensure the producer is able to once again consistently produce aggregate that meets Full Quality Specifications. MCS&T or a representative of MCS&T will visit the quarry for observation and sampling purposes. The producer shall give MCS&T a notice of 24 hours before blasting takes place for record keeping and sampling. (Full Quality samples will not be taken less than every 7th day of crushing.)

- 8.3.2 If the field samples in Section 8.1.3 all meet the Specification requirements, the Producer shall be notified of compliance, and they shall be reinstated on the WVDOH List of Commercial and Potential Skid Resistant Aggregate.
- 8.3.3 Once the Producer has been placed back on the approved source list a memorandum shall be sent from MCS&T to notify Producer, Deputy State Highway Engineer, Director of Contract Administration, Regional Construction Engineers, District 1-10 Engineers and Material Supervisors of the facilities reinstatement to the List of Commercial and Potential Skid Resistant Aggregate

9. DOCUMENTATION

- 9.1 All samples obtained by MCS&T shall be assigned a corresponding laboratory reference number for record keeping, ensuring proper access by MCS&T personnel to pertinent information regarding the materials provided by the Producers.
- 9.2 In the event of recurring failure to meet WVDOH Specifications, the following procedure shall be implemented:
- 9.2.1 A record of communication between the Division and the Producer's contact shall be retained for future reference, for no more than one year.
- 9.2.2 The sample (or samples) failing to meet Specification requirements shall be packaged and stored for later access by MCS&T personnel for future reference. Such samples will be stored for no longer than one year from the date the material was sampled. The sample containers shall display the lab reference number, the date on which the material was sampled, and the Specification requirements not met.

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Director
Materials Control, Soils & Testing Division

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIAL CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

METHOD OF TEST FOR DETERMINING THE
CONDITION OF CONCRETE BRIDGE DECKS

1. PURPOSE

- 1.1. To provide a method of testing to determine the condition of concrete bridge decks.
-

2. SCOPE

- 2.1. This procedure is applicable to concrete bridge decks.
-

3. REFERENCE DOCUMENTS

- 3.1. ASTM C39: Test Method for Compressive Strength of Cylindrical Concrete Specimens
- 3.2. ASTM C42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- 3.3. ASTM C876: Standard Test Method for Corrosion Potentials of Uncoated Reinforcing Steel in Concrete
- 3.4. ASTM C1152: Standard Test Method for Acid-Soluble Chloride in Mortar and Concrete
- 3.5. ASTM D4580: Standard Practice for Measuring Delamination in Concrete Bridge Decks by Sounding
- 3.6. ASTM D4788: Standard Practice for Measuring Delamination in Concrete Bridge Decks Using Infrared Thermography
- 3.7. ASTM D6432: Standard Guide for Using the Surface Ground Penetrating Radar Method for Subsurface Investigation
- 3.8. ASTM E11: Standard Specifications for Woven Wire Test Sieve Cloth and Test Sieves
- 3.9. AASHTO T-260: Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials
-

4. EQUIPMENT

- 4.1. Chain Drag Test
- 4.1.1. Chains, steel rods, or hammers capable of producing a clear ringing sound when dragged or tapped over non-delaminated concrete and a dull or hollow sound over delaminated concrete.
- 4.1.2. Measuring tape capable of measuring 150 to 300 ft.

- 4.1.3. Measuring tape capable of measuring 12 to 25 ft.
- 4.1.4. Chalk for marking delaminated areas.
- 4.2. Potential Corrosion Test
 - 4.2.1. Potential corrosion meter capable of generating the data required to produce the report seen in Section 11 of ASTM C876.
 - 4.2.2. Minimum 2-gallon container of distilled water, free of contaminants.
 - 4.2.3. Handheld rebar detector capable of locating rebar embedded in concrete at a minimum depth of 7 inches.
- 4.3. Core Sampling
 - 4.3.1. Core drill capable of obtaining cylindrical core specimens through steel reinforced concrete.
 - 4.3.2. 4 in. diameter diamond impregnated drill bit.
 - 4.3.3. Saw capable of trimming ends of cores and sectioning cores into 1 in. high cylindrical specimens. This saw shall be capable of cutting cores without introducing cracks or dislodging aggregate particles. Ensure cores are properly stabilized using core holders to prevent movement during sawing.
 - 4.3.4. A grinder or pulverizer capable of grinding concrete and aggregate material fine enough to pass through an 850- μ m (No. 20) sieve.
 - 4.3.5. 850- μ m (No. 20) sieve complying with ASTM E11.
 - 4.3.6. Containers capable of maintaining samples in an uncontaminated state.
- 4.4. Crack Mapping
 - 4.4.1. Measuring tape capable of measuring 150 to 300 ft.
 - 4.4.2. Measuring tape capable of measuring 12 to 25 ft.
 - 4.4.3. Crack width gauge
- 4.5. Ground Penetrating Radar
 - 4.5.1. A transmitter and receiver antenna in compliance with ASTM D6432
 - 4.5.2. A radar control unit in compliance with ASTM D6432
 - 4.5.3. Suitable data storage and display devices in compliance with ASTM D6432

5. PROCEDURE

- 5.1. The bridge deck and all lanes should be surveyed before beginning tests to create a plan of action and ensure the safest approach with traffic control.
- 5.2. Chain Drag Test
 - 5.2.1. Run the 150 to 300 ft measuring tape longitudinally along bridge, repositioning if bridge length exceeds tape length.

- 5.2.2. Drag chains over the entirety of the deck surface. Delaminated areas produce a dull or hollow sound. Any detected delaminated areas shall be outlined using chalk.
- 5.2.3. Using a 12 to 25 ft. measuring tape, locate the exact location and record delaminated area on grid paper seen in Attachment 3.
- 5.3. Potential Corrosion Test
 - 5.3.1. Unpack and assemble the concrete corrosion potential meter.
 - 5.3.2. Unscrew the top of the reference electrode and add sufficient copper sulphate crystals into the tube. Fill the tube with distilled water, cap and shake to mix. Ensure the mixture is in a supersaturated state by adding enough copper sulphate to have undissolved crystals after shaking.
 - 5.3.3. Connect the electrode to the meter by pressing the adapter plate onto the bottom of the LC-4.5, securing it with Velcro pads. Screw the 15 in. intermediate electrode extension into the threaded receptacle on the adapter plate. Add more extensions until the meter is at comfortable height, reaching from the ground to the hands of the operator.
 - 5.3.4. Plug the adaptor plate pigtail into the negative (black) terminal on the meter.
 - 5.3.5. Place the function switch of the LC-4.5 meter to the DC position. Place the range selector switch to the 2V scale. Place the input resistance selector switch to the 200 meg-ohm position.
 - 5.3.6. Clamp the vice-grip pliers onto any exposed rebar on the bridge, and clip one end of the 250-foot test lead to the pliers. Plug the end of the lead into the positive (center, red) terminal on the LC-4 meter.
 - 5.3.7. This connection must be made to an exposed rebar that is tied into the rebar mat of the bridge deck. When an access shaft is needed to expose the embedded steel; a rebar detector shall be used to locate rebar; and a minimum 4" core shall be drilled to the depth of the reinforcement without cutting the rebar.
 - 5.3.8. Place the reference electrode assembly against the prepared location on the concrete surface adjacent to the marked spot. If the electrical connection to the rebar is good, and the concrete and interface sponge are wet enough, a steady reading (measurement) between -0.010V and -0.600V should be obtained on the meter within 3-5 seconds. A slight variation in the last digit (thousandth place) can be normal. If the test setup is working satisfactorily, it should be possible to go back to a location and obtain an identical reading within $\pm 0.020V$ of the original reading.
 - 5.3.9. Placing tape measures longitudinally and laterally, lay out a grid of the test location covering the entire area which is to be tested. (Tests do not have to be made directly over the rebars).
 - 5.3.10. Take potential readings every 3 ft. by 3 ft. over the entire bridge deck. The sponge contacting the electrode must be kept moist during the entire test.
 - 5.3.11. Record the results of each reading on the grid paper in Attachment 4.
 - 5.3.12. Results generated shall be presented according to Section 9 of ASTM C876.

5.4. Core Samples

5.4.1. Compressive Strength Test

5.4.1.1. At least 1 location per lane shall be selected to obtain compressive strength cores. If the bridge deck only contains 1 lane of traffic, at least 2 locations shall be selected to obtain compressive strength cores. The chosen location should avoid the wheel path of traffic and permit the retrieval of the core underneath the bridge. The selected location will not be over the support beams of the bridge. The cores should be 4 in. diameter and the entire thickness of the bridge deck.

5.4.1.2. Each core shall be labeled with its core number, bridge name, route, lane type, and direction of traffic. Locations of cores shall be mapped per Attachment 5.

5.4.1.3. MCS&T shall coordinate with the District to have any core holes repaired.

5.4.1.4. Once the cores are obtained, using diamond impregnated bits, the compressive strength should be tested following the procedures of ASTM C42 and ASTM C39

5.4.2. Chloride Content

5.4.2.1. At least 1 location per lane shall be selected to obtain cores for chloride testing. The chosen location should avoid the wheel path of traffic and permit the retrieval of the core underneath the bridge. The selected location will not be over the support beams of the bridge. The cores should be 4 in. diameter and the entire thickness of the bridge deck. Each core shall be labeled with its core number, bridge name, route, lane type, and direction of traffic. Locations of cores shall be mapped per Attachment 5.

5.4.2.2. MCS&T shall coordinate with the District to have any core holes repaired.

5.4.2.3. Cores obtained in the field in 5.4.2.1 will be cut into one (1) in. thick disc specimens maintaining their four (4) in. diameters once received in the laboratory. Successive (1) in. sections will be cut from the core starting with the section that represents the top surface of the bridge deck to the bottom approximately at a depth of 8.0 inches. Each section will be labeled with the core number and depth.

5.4.2.4. Each 1 in. cylindrical slice shall be pulverized individually into material fine enough to pass through a 850-µm (No. 20) sieve and placed into its own individual container. Do not mix or contaminate the sample with material from another sample disc. Each individual container should be labeled with the core number and the depth it represents.

5.4.2.5. The concrete dust in the labeled sample container will be tested for chloride content following Sections 9 and 10 of ASTM C1152.

5.4.2.6. Record the test results in the format of the table in Attachment 8.

~~5.5. Crack Mapping~~

~~5.5. Crack Mapping~~

~~5.5.1.1.5.5.1.~~ Walk the entire area of the bridge deck looking for any cracks, longitudinally and transversely.

- 5.5.2. Using a tape measure, record the location and length of each crack on the grid paper in Attachment 3.
- 5.5.3. Using a crack width gauge, record the average width of each crack on the grid paper in Attachment 3.
- 5.6. Subsurface Investigation Requests
 - 5.6.1. A Subsurface Investigation may be requested as part of the bridge deck assessment.
 - 5.6.1.1. Ground Penetrating Radar may be used in accordance with ASTM D6432, or Infrared Thermography may be used in accordance with ASTM D4788 to perform the subsurface investigation.

6. CALCULATIONS

- 6.1. Chain Drag Test
 - 6.1.1. The total area of delamination, spalls, and patched shall be calculated against the total area of the bridge deck. Refer to Attachment 5 for example.
- 6.2. Potential Corrosion Test
 - 6.2.1. The total area of potential readings greater than -0.20V shall be calculated against the total area of the bridge.
 - 6.2.2. The total area of the potential readings in the range of -0.20V to -0.35V shall be calculated against the total area of the bridge.
 - 6.2.3. The total area of potential readings less than -0.35V shall be calculated against the total area of the bridge.
 - 6.2.4. Potentials greater than -0.20V indicate a 90% or higher probability of no corrosion taking place at the time of measurement.
 - 6.2.5. Potentials in the range of -0.20V to -0.35V are inconclusive.
 - 6.2.6. Potentials less than -0.35V generally indicate a 90% or higher probability of active corrosion taking place at the time of measurement. Refer to Attachment 8 for example.
- 6.3. Compressive Strength Cores
 - 6.3.1. The compressive strength of the cores shall be calculated according to ASTM C39
- 6.4. Crack Mapping
 - 6.4.1. The total area of cracks shall be calculated against the total area of the bridge. Refer to Attachment 6 for example.

7. REPORTING

- 7.1. The results will be presented through a Materials Inspection Report (MIR) by an official Memorandum. An example Memorandum and MIR can be found in Attachments 1 and 2.

- 7.2. The MIR shall include the following sections: Introduction, Accounting Data, Purpose of Report, Results of Bridge Deck Condition Survey, Conclusion, and Recommendations. In additions Attachments 5-9 shall be completed and provided as attachments with the MIR.

Michael A Mance, PE

Director

Materials Control, Soils & Testing Division

MP 601.00.49 Steward – Cement and Concrete Section

MAM:T

ATTACHMENTs

Example



WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

Division of Highways

1900 Kanawha Boulevard East • Building Five • Room 110
Charleston, West Virginia 25305-0430 • (304) 558-3505

Deputy Secretary of Transportation
Deputy Commissioner of Highways

Secretary of Transportation
Commissioner of Highways

MONTH DAY, XXXX

MEMORANDUM

**TO: NAME
DISTRICT CONSTRUCTION ENGINEER
DISTRICT NUMBER**

**FROM: NAME
DIRECTOR
MATERIALS CONTROL, SOILS AND TESTING DIVISION**

THRU: HF

**SUBJECT: BRIDGE DECK CONDITION SURVEY
BRIDGE NUMBERS:
BARS NUMBERS:
BRIDGE NAME, COUNTY, DISTRICT NUMBER**

Attached for your review and further handling is a copy of Materials Inspection Report (MIR) Number XXXXXXXX. This MIR documents our findings regarding the subject bridge and will serve as a bridge deck condition survey.

Should you have any questions, please feel free to contact NAME at XXX-XXX-XXXX.

MAM:Td

Attachment

CC: (District Bridge Engineer, Regional Construction Engineer)

Example

Materials Inspection Report: XXXXXXXX
Authorization Number: XXXXXXXX
Subject: Bridge Deck Condition Survey
BARS Number:
County:
District:
Date of Report: Month Day, Year

1. **ACCOUNTING DATA**

1.1 Project Name:
State Project No.: Contract ID: XXXXXXXXXXXX
Federal Project No.: Authorization No.:
ORG No.:

2. **INTRODUCTION**

2.1 As requested in MONTH of YEAR by the District NUMBER Regional Construction Engineer, a bridge deck condition survey was performed beginning on MONTH DAY, YEAR, and was concluded on MONTH DAY, YEAR. The tests that were performed were as follows: chain drag test, crack mapping, compressive strength cores, chloride core content and corrosion potential.

3. **PURPOSE OF REPORT**

3.1 This report provides the data developed regarding the bridge deck condition.

4. **RESULTS OF BRIDGE DECK CONDITION SURVEY**

4.1 Surface Condition

4.1.1 The bridge deck surfaces exhibited spalling and delamination.

4.2 Subsurface Condition

4.2.1 The bridge deck subsurface condition survey was not performed because it was not requested.

4.3 Delamination Survey (ASTM D-4580)

4.3.1 The chain drag test was used to locate subsurface delamination in the bridge deck. Bridge number _____ was found to have delamination affecting ____% of the

entire bridge deck. Bridge number _____ was found to have delamination affecting _____% of the entire bridge deck.

4.3.2 See Attachment No. 6 for the plotted delamination of the bridge decks.

4.4 Bridge Deck Surface Cracking

4.4.1 The transverse and longitudinal cracks were measured and mapped. Bridge number _____ was found to have cracking on _____% of the bridge deck. Bridge number _____ was found to have surfacing cracking on _____% of the bridge deck. The transverse and longitudinal crack widths ranged from _____ to _____ throughout the top surface of the deck.

4.4.2 See Attachment No.6 for the plotted locations of the concrete cracks on the bridge deck.

4.5 Compressive Strength Cores (ASTM C39).

4.5.1 _____ compressive cores were taken in total. _____ bridge cores were used to determine the compressive strength of the deck.

4.5.2 Results from northbound and southbound lanes:

Core	NB-F-2	NB-S-4	SB-SL-C1	SB-FL-C4
Length (in.)	5.428			
Diameter 1 (in.)	3.982			
Diameter 2 (in.)	3.997			
Correction Factor	0			
Load (lbs.)	95240			
Force (psi)	7579			
Break Type	D,E etc.....			

Average Force
(psi)

psi

4.5.3 The depth of the overlay, from each of the _____ cores, was measured using visual indications of the different concrete layers:

NB-F-1	NB-F-2	NB-S-3	NB-S-4	SB-SL-1	SB-SL-2	SB-FL-3	SB-FL-4
2.5in.							

4.5.4 See Attachment No. 3 for the visual locations and a photograph of each core.

4.6 Chloride Content of Bridge Deck Concrete (AASHTO T-260)

4.6.1 _____, one-inch layers were cut from the cored cylinders to determine the Chloride Content of the Bridge Deck. The one-inch layers were cut from four of the _____, compressive strength cylinders. _____ of the one-inch layers in the northbound cores were unable to be chloride tested because the presence of rebar compromised their ability to hold during the slicing process.

4.6.2 Results from northbound and southbound lanes:

Core Number	Location of Sample on Core	Lbs./yd ³
NB-F-1 (Lab No.)	0.5 – 1.5 inches from bottom	0.8
	1.5 – 2.5 inches from bottom	
	2.5 – 3.5 inches from bottom	
	3.5 – 4.5 inches from bottom	
	4.5 – 5.5 inches from bottom	
	5.5 – 6.5 inches from bottom	
	6.5 – 7.5 inches from bottom	
	Average for Cylinder	1.25
NB-S-3 (Lab No.)	0.5 – 1.5 inches from bottom	
	1.5 – 2.5 inches from bottom	
	2.5 – 3.5 inches from bottom	
	3.5 – 4.5 inches from bottom	
	4.5 – 5.5 inches from bottom	
	5.5 – 6.5 inches from bottom	
	6.5 – 7.5 inches from bottom	
	Average for Cylinder	
SB-SI-C2	0.5 – 1.5 inches from bottom	
	1.5 – 2.5 inches from bottom	
	2.5 – 3.5 inches from bottom	
	3.5 – 4.5 inches from bottom	

(Lab No.)	4.5 – 5.5 inches from bottom	
	5.5 – 6.5 inches from bottom	
	6.5 – 7.5 inches from bottom	
	Average for Cylinder	
SB-FL-C3 (Lab No.)	0.5 – 1.5 inches from bottom	
	1.5 – 2.5 inches from bottom	
	2.5 – 3.5 inches from bottom	
	3.5 – 4.5 inches from bottom	
	4.5 – 5.5 inches from bottom	
	5.5 – 6.5 inches from bottom	
	6.5 – 7.5 inches from bottom	
	Average for Cylinder	

4.6.3 The average chloride content for each layer across these four cylinders are:

Location of Sample on Core	Lbs./yd ³
6.5 – 7.5 inches from bottom	0.8
5.5 – 6.5 inches from bottom	1.2
4.5 – 5.5 inches from bottom	1.2
3.5 – 4.5 inches from bottom	1.4
2.5 – 3.5 inches from bottom	2.0
1.5 – 2.5 inches from bottom	0.8
0.5 – 1.5 inches from bottom	0.8

4.6.4 As expected, the middle layers have the highest chloride content because these layers were exposed on the surface before it was overlayed. However, the data in the overlay layers suggest a higher chloride content than when the concrete was originally placed. With data missing from the higher layers due to the rebar

interference, it is predicted that the overlaid surface layer should have a more consistent chloride content with the surrounding layer

4.7 Corrosion Potential of Uncoated Reinforcing Steel in Bridge Deck (ASTM C876)

4.7.1 The corrosion potential was determined by measuring the potential difference between a reference electrode and embedded steel. In this case, the meter was connected to the steel beam beneath the concrete bridge. The corrosion potentials are documented every 3 feet longitudinally and laterally.

4.7.2 Potentials less negative than -0.20V generally indicate a 90% or higher probability of no corrosion taking place at the time of measurement. Potentials in the range of -0.20V to -0.35V are inconclusive. Potentials greater than -0.35V generally indicate a 90% or higher probability of active corrosion in the area at the time of testing.

4.7.3 Bridge number (NB) was found to have a ____% or higher probability of corrosion on ____% of the bridge deck. Bridge number _____ (SB) was found to have a ____% or higher probability of corrosion on ____% of the bridge deck.

4.7.4 See Attachment No. 9 for the plotted corrosion potentials found on the bridge decks.

5. **CONCLUSION**

5.1 The bridge deck condition survey revealed delamination in the bridge deck concrete to the depth of the top line of reinforcing steel in the bridge deck. The bridge deck concrete did exhibit transverse and longitudinal cracking. The bridge deck concrete did exhibit the probability of steel corrosion. The bridge deck concrete did exhibit an increase in chloride content closer to the surface.

6. **RECOMMENDATIONS**

- 6.1 Due to the severity and extent of damage found during the bridge deck condition survey, replacement of the deck overlay is recommended.

Signature

Cement and Concrete Section

Signature

Cement and Concrete Section Supervisor

Field Defect Map

LOCATION: _____ BRIDGE NO.: _____ M.P. _____ DATE: _____

↑

SPALL

PATCH

DELAMINATION

M.P

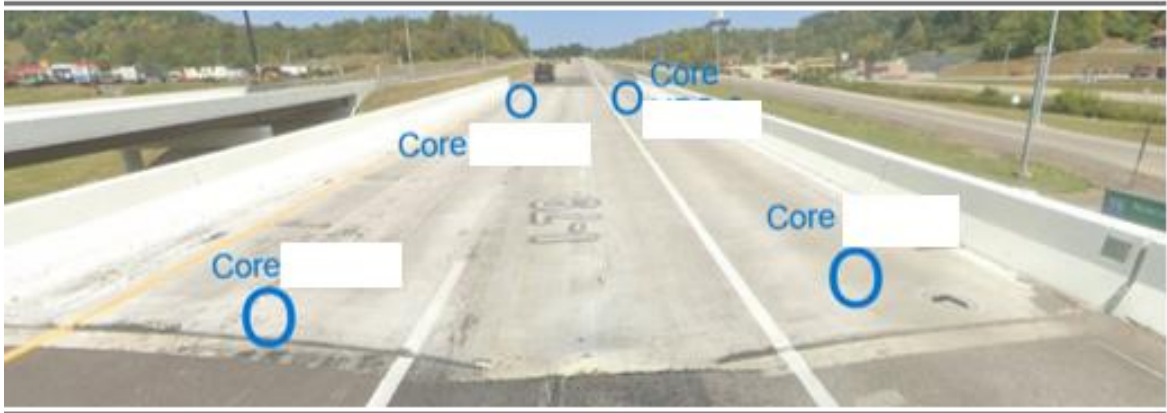
BRIDGE NO.:

Potentials

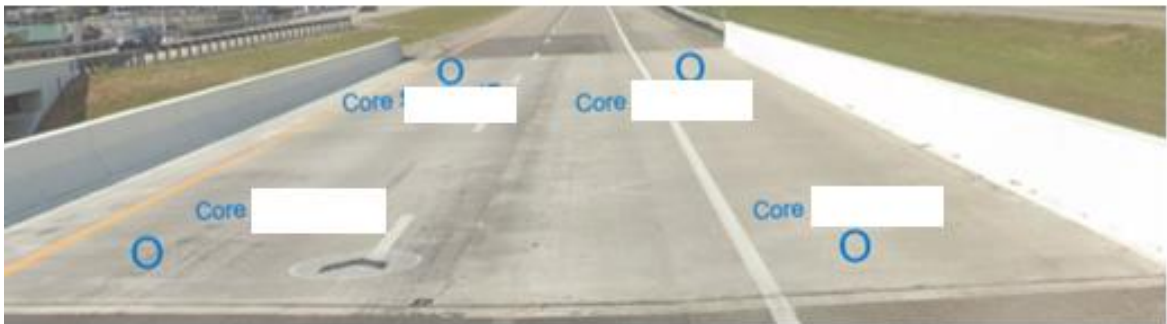
↑

Core Location Maps

Northbound Core Locations

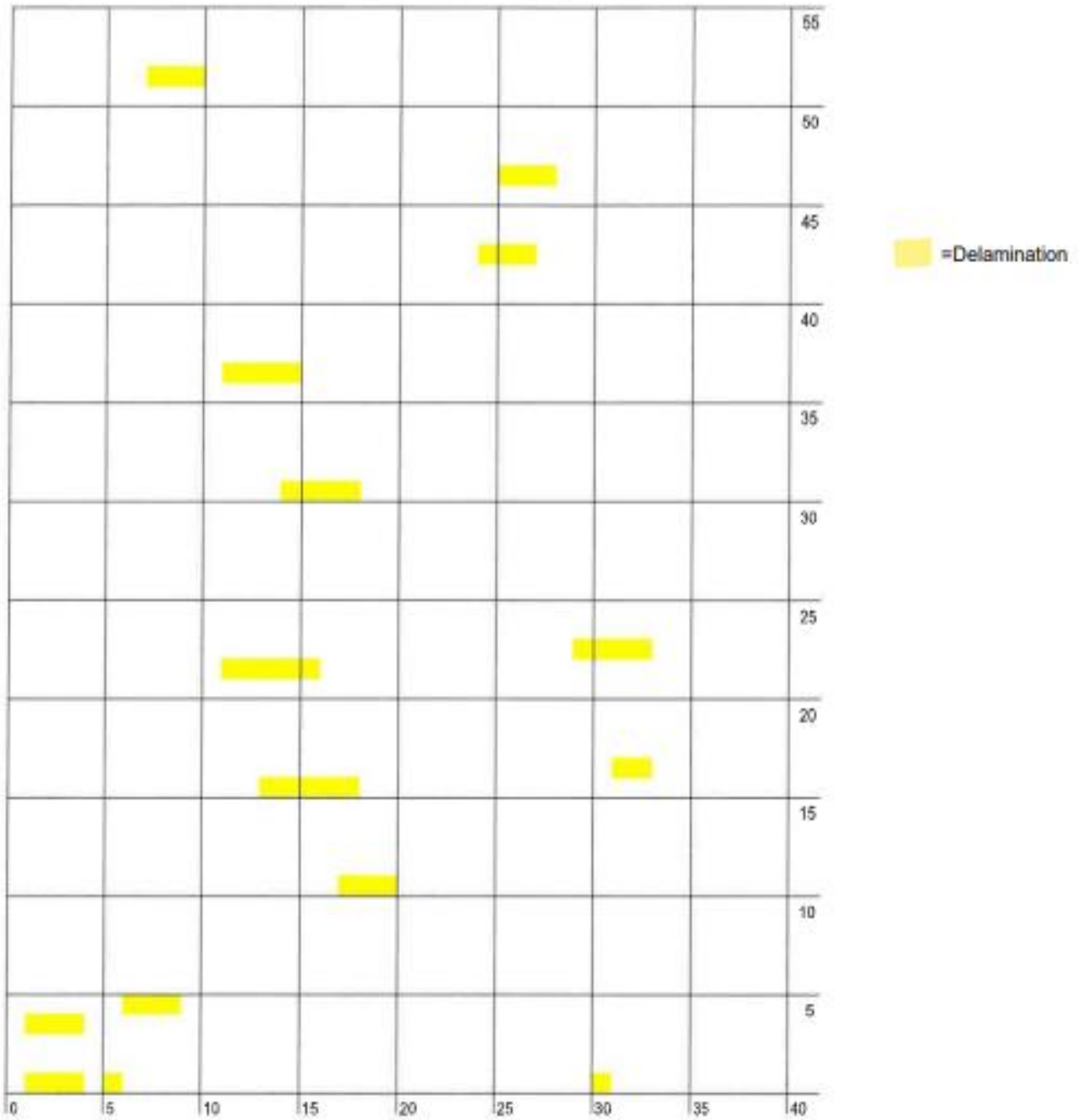


Southbound Core Locations

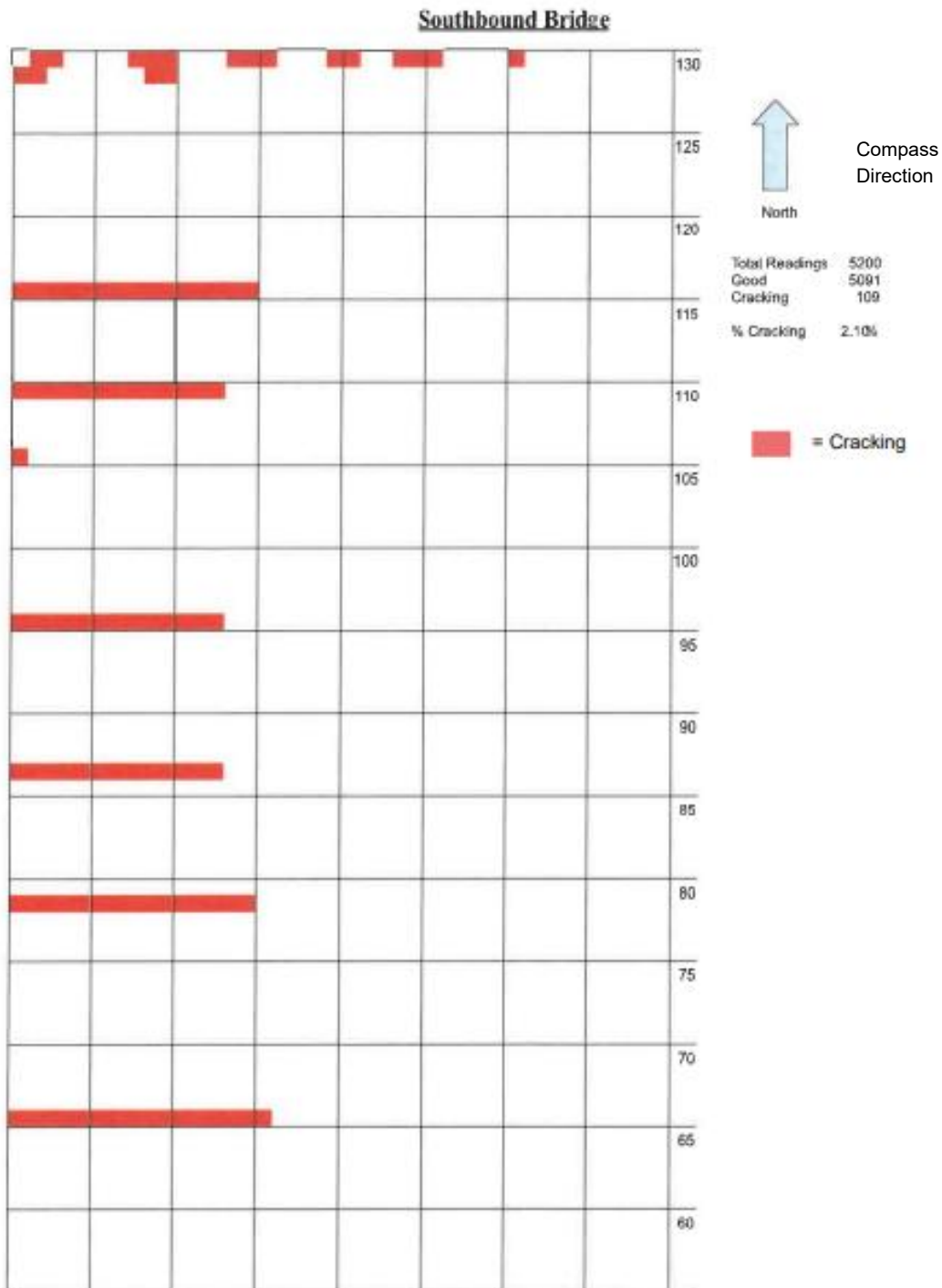


Delamination Plotting

Southbound Bridge Continue



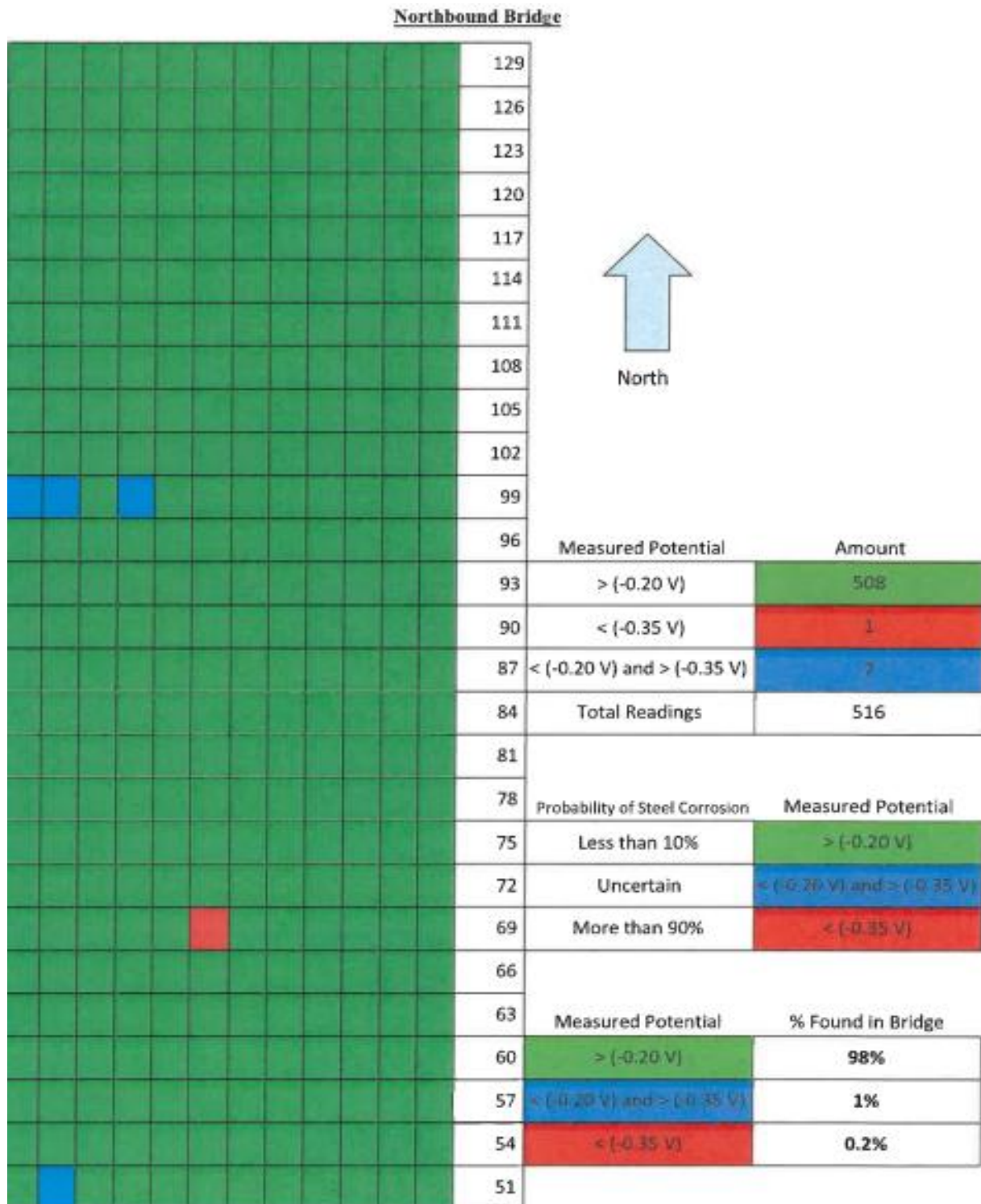
Crack Mapping



Chloride Content Results Table

Core #	Depth in inches	lbs. of Chloride per CY of Concrete
C1	0.5 to 1.5	3
C1	1.5 to 2.5	1
C1	2.5 to 3.5	0
C1	3.5 to 4.5	0
C1	4.5 to 5.5	0
C1	5.5 to 6.5	0
C2	0.5 to 1.5	0
C2	1.5 to 2.5	0
C2	2.5 to 3.5	0
C2	3.5 to 4.5	0
C2	4.5 to 5.5	0
C2	5.5 to 6.5	0
C2	6.5 to 7.5	2
C3	0.5 to 1.5	2
C3	1.5 to 2.5	1
C3	2.5 to 3.5	1
C3	3.5 to 4.5	0
C3	4.5 to 5.5	1
C3	5.5 to 6.5	0
C4	0.5 to 1.5	2
C4	1.5 to 2.5	1
C4	2.5 to 3.5	1
C4	3.5 to 4.5	0
C4	4.5 to 5.5	0
C4	5.5 to 6.5	0
C4	6.5 to 7.5	0

Corrosion Potential Map



WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

GUIDE FOR QUALITY CONTROL AND ACCEPTANCE REQUIREMENTS FOR PORTLAND CEMENT CONCRETE

1. PURPOSE

- 1.1 To establish minimum requirements for Contractor's Quality Control (QC) system and the Division's Acceptance Plan. It is intended that these minimum requirements be followed in detailing the inspection, sampling, and testing deemed necessary to maintain compliance with all Specification requirements.

2. SCOPE

- 2.1 This Materials Procedure (MP) is applicable to all Portland Cement Concrete (PCC) items, and it outlines the quality control procedures for both plant and field operations and includes procedures for approving and using Master and/or Project Specific QC Plans. This procedure also aids in documentation and retention of QC Plans in ProjectWise.

3. REFERENCED DOCUMENTS

- 3.1 AASHTO M 201 - Standard Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes.
- 3.2 AASHTO T 22 - Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens.
- 3.3 AASHTO T 231 - Standard Method of Test for Capping Cylindrical Concrete Specimens.
- 3.4 AASHTO T 358 - Standard Method of Test for Surface Resistivity Indication of Concrete's Ability to Resist Chloride Ion Penetration.
- ~~3.3 AASHTO T 231 - Standard Method of Test for Capping Cylindrical Concrete Specimens.~~
- 3.43.5 ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
- ~~3.53.6~~ ASTM C1231 - Standard Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Cylindrical Concrete Specimens.
- ~~3.63.7~~ ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

- ~~3.73.8~~ ASTM C511 - Standard Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes.
- ~~3.83.9~~ ASTM C617 - Standard Practice for Capping Cylindrical Concrete Specimens.
- ~~3.93.10~~ MP 109.00.21 - Basis for Charges for Non-Submittal of Sampling & Testing Documentation by the Established Deadline.
- ~~3.103.11~~ MP 300.00.51 - Procedural Guidelines for Maintaining Control Charts for Aggregate Gradation.
- 3.12 MP 307.00.51 – Procedure for Monitoring the Activities Related to Sieve Analysis of Fine and Coarse Aggregate.
- ~~3.113.13~~ MP 601.03.52 – Procedural Guidelines for Maintaining Control Charts for Portland Cement Concrete.
- ~~3.123.14~~ MP 601.04.20 - Curing Concrete Test Specimens in The Field.
- ~~3.133.15~~ MP 601.05.50 - Quality Assurance Procedures for Portland Cement Concrete.
- 3.16 MP 700.00.54 - Procedure for Evaluating Quality Control Sample Test Results with Verification Sample Test Results.
- 3.17 WVDOH Specifications – Sections 105.3 and 109.20.1
- ~~3.14~~ ~~MP 700.00.54 – Procedure for Evaluating Quality Control Sample Test Results with Verification Sample Test Results.~~

4. GENERAL REQUIREMENTS

- 4.1 The Contractor shall provide and maintain a quality control system that will provide reasonable assurance that all materials and products submitted to the Division for acceptance will conform to the contract requirements whether manufactured or processed by the Contractor or procured from suppliers, subcontractors, or vendors. The Contractor shall perform or have performed the inspections and tests required to substantiate product conformance to contract document requirements and shall also perform or have performed all inspections and tests otherwise required by the contract. The Contractor's quality control inspections and tests shall be documented and shall be available for review by the Engineer throughout the life of the contract. The Contractor shall maintain standard equipment and qualified personnel as required by the Specifications to assure conformance to contract requirements. Procedures will be subject to the review of the Division before the work is started.

5. QUALITY CONTROL PLAN

- 5.1 The Contractor shall prepare a QC Plan detailing the type and frequency of inspection, sampling, and testing deemed necessary to measure and control the various properties of materials and construction governed by the Specifications. As a minimum, the sampling and testing plan should detail sampling location, sampling techniques, and test

frequency to be utilized. Quality control sampling and testing performed by the Contractor may be utilized by the Division for acceptance.

5.1.1 A QC Plan must be developed by the Contractor and submitted to the Engineer prior to the start of construction on every project. Acceptance of the QC Plan by the Engineer will be contingent upon its concurrence with these guidelines.

5.1.2 As work progresses, an addendum(s) may be required to a QC Plan to keep the QC program current. Personnel may be required to show proof of certification for testing.

5.2 Quality Control Plan Guidelines:

5.2.1 The Plan shall identify the personnel responsible for the Contractor's quality control. This should include the company official who will act as the liaison with Division personnel, as well as the Certified Portland Cement Concrete Technician who will direct the inspection program at the plant or in the field depending if it is a plant or field QC Plan. Their phone number and email address must also be included as a means for contact by the Division personnel.

5.2.2 All classes of concrete and corresponding mix design numbers, which may be used, shall be listed on the Plant QC Plan. All classes of concrete, which may be used, shall be listed on the Field QC Plan.

5.2.3 Process control sampling, testing, and inspection should be an integral part of the contractor's quality control system. In addition to the above requirements, the Contractor's QC Plan should document the process control requirements shown in Table 1 of Attachment 1. The process control activities shown in Table 1 are considered to be normal activities necessary to control the production and placement of a given product or material at an acceptable quality level. To facilitate the Division's activities, the Contractor, as ~~per~~ per MP 307.00.51 ML-25, shall retain all completed gradation samples until further disposition is designated by the Division.

5.2.4 All concrete producers shall provide an E-Ticket that meets the requirements of Section 109.20.1 of the Specifications.

5.2.5 All sampling and testing shall be in accordance with the methods and procedures required by the Specifications. Measuring and testing equipment shall be standard and properly calibrated as per the specified test procedures. If alternative sampling methods, procedures, and inspection equipment are to be used, they shall be detailed in the QC Plan. Any QC testing that is not performed in accordance with the methods and procedures required by the Specifications shall be considered an invalid test, and the applicable penalty for the cost associated with that test, in accordance with MP 109.00.20, will be assessed to the contractor, along with the applicable price adjustment in Section 105.3. The test specimen(s) represented by an invalid test shall be considered as not meeting Specifications and documented accordingly. The Division may, however, use the results of an invalid test to determine if material may be accepted and allowed to remain in place and if payment may be made for the material represented by the invalid test.

- 5.2.5.1 Any individual who samples or tests plastic concrete for quality control purposes shall be certified as a WVDOH PCC Inspector.
- 5.2.5.2 Any Laboratory which tests the hardened concrete cylinders for the Contractor, for quality control purposes, shall be listed in the Contractor's QC Plan for field operations. This Laboratory shall provide evidence that it meets the applicable requirements in ASTM C1077, pertaining to testing hardened concrete cylinders, for a concrete testing laboratory, including curing facilities, testing equipment, technician proficiency, participation in the Cement and Concrete Reference Laboratory (CCRL) Concrete Proficiency Sample Program (PSP), Quality Management System documentation, and recordkeeping. The only test required for these laboratories, in the CCRL Concrete PSP, is ASTM C39 (AASHTO T22), but it is recommended that the laboratory perform all the field test portions of these Proficiency Samples and maintain the results of these tests, in order to evaluate any root cause issues pertaining to compressive strength. Each Laboratory shall be inspected and evaluated initially, and at least once every regular inspection tour cycle (approximately 30 months) by the CCRL. The ASTM standards pertaining to testing concrete cylinders, with which the subject laboratory must comply, include ASTM C39 (AASHTO T22), ASTM C617 (AASHTO T231) or ASTM C1231, and ASTM C511 (AASHTO M201). The Personnel Qualification requirements in Section 6 of ASTM C1077 regarding PE direction, Laboratory Supervisors, and concrete laboratory personnel testing certifications also apply, except that a Laboratory Supervisor with at least five years' experience in construction materials testing shall be a permissible substitution for the licensed professional engineer. Subsequent documentation shall be provided to the Division showing that the subject Laboratory and personnel meet the applicable requirements of ASTM C1077, pertaining to testing concrete cylinders, for a concrete laboratory. In addition any laboratory conducting concrete surface resistivity testing must be evaluated by CCRL for AASHTO T358. Any Laboratory which desires to test Contractor hardened concrete QC specimens on WVDOH projects shall submit the evidence/documentation, required in Section 4.2.4.2, confirming compliance with ASTM C1077, with regards to testing concrete cylinders, to MCS&T Division at the following e-mail address: DOHMCSnTconcretelab@wv.gov. MCS&T Division will review this submittal. In this submittal, the subject Laboratory shall also explain how all deficiencies noted in the CCRL Laboratory Inspection Report have been addressed. All deficiencies noted in the CCRL Laboratory Inspection Report shall be resolved to the satisfaction of the Division within 90 days from the date of the CCRL Laboratory Inspection Report. Once MCS&T Division determines that the subject Laboratory is in compliance with the applicable requirements of ASTM C1077, and all deficiencies have been adequately resolved, that Laboratory will be placed on the Division's Approved List of Concrete Cylinder Testing Labs. All laboratories which test contractor hardened concrete QC specimens on WVDOH projects must be listed on the Division's Approved List of Concrete Cylinder Testing Labs. Laboratories that are certified to run AASHTO T358 will be indicated by an asterisk associated to the applicable footnote on the APL. A

listing of these laboratories is available on the WVDOH MCS&T [Webpage](#)¹. All Division Approved Laboratories shall provide the Division with the CCRL Lab Number for their laboratory and agree to allow DOH, CCRL, and AASHTO re:source to freely share information about assessment reports, proficiency samples, corrective actions, quality management system, and personnel competency and certification records.

- 5.2.6 When calculating the compressive strength of concrete cylinders in accordance with AASHTO T22, the following procedure shall be used:

$$CS = \frac{ML}{0.25 \times \pi \times D^2}$$

Where:

CS = Compressive Strength of the specimen
ML = Maximum load carried by the specimen during the test
 π = Mathematical constant PI
D = Diameter of the cylinder being tested (in accordance with AASHTO T 22)

Note: The calculation for CS shall be performed in one continuous step (without any rounding), either by the testing machine, or by calculating device, and only the final value (CS) is permitted to be rounded (to the accuracy specified in AASHTO T 22). The value for π shall be per the manufacturer's pre-programmed value in a calculating device or the testing machine. When filling out the T-600 Form for compressive strength testing, the value of π used shall be carried out to 4 decimal places. In addition, the average cylinder diameters are calculated to two decimal places, and the cross-sectional areas are calculated to four decimal places.

- 5.2.7 Miscellaneous Concrete:

The contractor is not required to perform the process control testing required by Part C of Table 1 of the Attachment on miscellaneous concrete (as defined in section 5.2.7.1), provided that the concrete in question is being supplied by an A1 or A2 plant (as defined in MP 601.05.50, formerly numbered as IM-18), and provided that the requirements of section 5.2.7.2 are met for each project on which the reduced testing of miscellaneous concrete is applied.

- 5.2.7.1 Miscellaneous concrete shall be defined as relatively small quantities, not exceeding 25 yd³ per day, incorporated into items that will not adversely affect the traffic carrying capacity of a completed facility. Such items would not include any concrete intended

¹ <https://transportation.wv.gov/division-approved-product-lists-apls>
https://transportation.wv.gov/highways/mest/Pages/APL_By_Number.aspx

² DOHMCSnTconcretelab@wv.gov.

for major structures, permanent mainline or ramp pavements, or any other structurally critical items part of, or adjacent to the roadway.

The following items are suggested as a guideline in establishing items that may be categorized as miscellaneous concrete:

Note: Concrete testing for certain items below is waived, in some cases, by the referenced section of the specifications.

1. Sidewalks
2. Curb and Gutter
3. Slope walls for under drain outlet pipes
4. Temporary pavements and pipe crossings
5. Building floors
6. Slope paving and headers
7. Paved ditch or gutter
8. Small (less than 36" diameter) culvert headwalls
9. Catch basins, manhole bases, inlets, and junction boxes (and adjustments of such items) not located in the roadway
10. Foundations for breakaway supports
11. Utility trench fills
12. Cast-in-place survey markers

5.2.7.2 One sample per two days of production (for the same project) shall be tested (beginning on the first day of production) for compressive strength, air content, and consistency. On a minimum of ten percent of the samples outlined above, the Division will observe the batching operation at the plant (that is producing the concrete to be sampled) and check the operational control.

5.2.7.3 When placing miscellaneous concrete and no testing is required, an Approved Source Sample will be generated in ~~AWP~~SiteManager. The C##### representing the test from the previous day of production shall be entered in the intended use field. Miscellaneous Concrete will be entered in remarks. Miscellaneous Concrete will be written on all batch tickets for which testing is not required, per the miscellaneous concrete provisions of this MP, prior to scanning and placing in ProjectWise.

5.2.8 Documentation:

The Contractor shall maintain adequate records of all inspections and tests. The records shall indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and the nature of corrective action taken as appropriate. The Contractor's documentation procedures will be subject to the review and approval of the Division prior to the start of the work and to compliance checks during the progress of the work.

5.2.9 Charts and Forms:

All conforming and non-conforming inspections and test results shall be kept complete and shall be available at all times to the Division during the performance work. Forms shall be on a computer-acceptable medium where required. Batch ticket data shall be

documented in accordance with the applicable section of MP 601.03.50, with a copy to be submitted to the District Materials Section within 72 hours of the concrete placement. Gradation data shall be documented on WVDOT form T300 using the material codes listed in the online computer systems user guide. The original gradation data shall be submitted to the District Materials Section within 72 hours of obtaining the gradation sample. Test data for (PCC) shall be charted in accordance with the applicable requirements of MP 601.03.52. Gradation test data shall be plotted in accordance with the applicable requirements of MP 300.00.51. The Contractor may use other types of control charts as deemed appropriate by the Division. It is normally expected that testing and charting will be completed within 48 hours after sampling. The Contractor shall also ensure that all Material Suppliers prepare and submit the HL-441 form (weekly supplier report) in a timely manner

5.2.9.1 All charts and records documenting the Contractor's quality control inspections and tests shall become property of the Division upon completion of the work.

5.2.10 Batch Tickets:

Each batch of Structural Concrete, including miscellaneous concrete (as defined in section 4.2.6.1), delivered at the project shall be accompanied by one batch ticket with all of the items of information listed in Section 4.2.9.1 pre-populated on the ticket. In the case of (PCC) Pavement, each batch of concrete delivered at the project on which a test in accordance with Table 1 of Attachment 1 is to be performed shall be accompanied by a batch ticket. This batch ticket shall have all of the items listed in section 4.2.9.1 pre-populated on the ticket unless non-agitator trucks or truck agitators are used. In this case, the batch ticket shall have all of the items listed in section 4.2.9.2 pre-populated on the ticket.

5.2.10.1 All batch tickets for Structural Concrete and (PCC) Pavement Concrete transported by truck mixers shall have all the following items pre-populated on the ticket:

1. Producer/Supplier Code
2. Producer/Supplier Name
3. Producer/Supplier Location
4. Mix Design Laboratory Reference Number
5. Date
6. Sequence Number
7. Volume (yd³/m³)
8. Time Batched
9. Contract Identification Number (CID #)
10. Federal Project Number (If applicable)
11. State Project Number
12. Material Code/Name
13. Water Allowed (gal/L)
14. Water at Plant (gal/L)
15. Weight of Ice at Plant (lb/kg)
16. Weight of Cement (lb/kg)
17. Supplementary Cementitious Material(s) (SCM) (lb/kg)

18. Weight of Fine Aggregate (lb/kg)
19. Weight of Coarse Aggregate (lb/kg)
20. *Admixture Name(s) and Dose (oz/L)
21. Cylinder I.D.
22. Initial Counter
23. Target Consistency (in/mm)
24. Target Air (%)
25. License Number of Haul Unit.

* If admixtures are added at the jobsite, these shall be entered by the project.

The following information shall be documented on the ticket by the project:

1. Contract Item Number
2. Contract Line Number
3. Time Unloaded
4. Water at Job (gal/L)
5. Concrete Temperature (°F/°C)
6. Final Counter
7. Actual Consistency (in/mm)
8. Actual Air (%)

5.2.10.2 All batch tickets for concrete delivered by means of non-agitator trucks or truck agitators shall have all of the following items pre-populated on the ticket:

1. Producer/Supplier Name
2. Mix Design Laboratory Reference Number
3. Date
4. Sequence Number
5. Volume (yd³)
6. Time Batched
7. Contract Identification Number (CID #)
8. Federal Project Number (If applicable)
9. State Project Number
10. Material Code/Name
11. Water Allowed (gal/L)
12. Water at Plant (gal/L)
13. Weight of Ice at Plant (lb/kg)
14. Weight of Cement (lb/kg)
15. Weight of SCM (lb/kg)
16. Weight of Fine Aggregate (lb/kg)
17. Weight of Coarse Aggregate (lb/kg)
18. *Admixture Name(s) and Weight(s) (oz/L)
19. Target Consistency (in/mm)
20. Target Air (%)
21. License Number of Haul Unit.

* If admixtures are added at the jobsite, these shall be entered by the project

The following information shall be documented on the ticket by the project:

1. Item Number
2. Line Number
3. Time Unloaded
4. Temperature (°F/°C)
5. Actual Consistency (in/mm)
6. Actual Air (%)

5.2.10.3 The batch ticket in the case of either type of concrete shall be a batch ticket prepared by the plant. This ticket must be computer generated with blank fields provided in which all of the required data shall be recorded. The data items listed above that are completed in the field (such as Time Unloaded, Actual Consistency, etc.) must have a field on the batch ticket for completion. Volume is to be reported to the nearest 0.01 yd³. Consistencies are to be reported to the nearest 0.25 inch. Target and Actual Air are to be reported to the nearest 0.1% (to the nearest 0.25% if the volumetric method is used).

5.2.10.4 As per the requirements of Section 109.20.1 of the Specifications, an E-Ticket shall be provided to meet these requirements.

5.2.11 Corrective Action:

The Contractor shall take prompt action to correct conditions, which have resulted, or could result, in the submission to the Division of ~~M~~materials Control, Soils and Testing and products, which do not conform to the requirements of the Contract documents.

5.2.12 Non-Conforming Materials:

5.2.12.1 The Contractor shall establish and maintain an effective and positive system for controlling non-conforming material, including procedures for its identification, isolation and disposition. Reclaiming or reworking of non-conforming materials shall be in accordance with procedures acceptable to the Division. All non-conforming materials and products shall be positively identified to prevent use, shipment, and intermingling with conforming materials and products. Holding areas, mutually agreeable to the Division and the Contractor shall be provided by the Contractor.

5.2.13 Types of QC Plans:

5.2.13.1 QC Plans which are intended for use on more than one project shall be defined as Master QC Plans. Section 4.3 outlines the procedures for Master QC Plan submittal and approval.

5.2.13.2 QC Plans which are intended for use on a single project shall be defined as Project Specific QC Plans. Project Specific QC Plans shall contain a cover letter which includes the following: project description, CID#, Federal and/or State Project Number.

- 5.2.13.3 A Contractor may submit a Master QC Plan for Plant and/or Field operations instead of a Project Specific QC Plan.
- 5.2.13.4 Once any QC Plan is approved for a project, the key date shall be entered in ~~AWP~~SiteManager by the appropriate District Materials personnel. The first date entered shall be the date the Project QC Plan letter is received. The second date shall be when the District approves the QC Plan for use on the project.
- 5.3 Master QC Plan:
 - 5.3.1 The intent of Master QC Plans is to facilitate the approval process in a more uniform manner. Master QC Plans can be submitted to the Division by the Contractor when their workload in a given District is routinely repetitive for the year.
 - 5.3.2 The Contractor shall submit a Master Field QC Plan yearly to each District in which they have work (see Attachment 2). If the Contractor does not have work in a given District for the year, then a Master Field QC Plan does not need to be submitted to that District.
 - 5.3.3 The Producer/Supplier shall submit a Master Plant QC Plan at the beginning of each year to the District in which their plant is located (see Attachment 3).
 - 5.3.4 The District will review the submitted Master QC Plans to see if they meet the applicable requirements of Sections 4.2 thru 4.2.11.1 and assign a Laboratory Reference Number to each QC Plan upon approval, for future referencing. The District will acknowledge approval of each Master QC Plan to the Contractor and/or Producer/Supplier by letter (see Attachment 4), which will include the Laboratory Reference Number and a copy of the approved Master QC Plan. This will then be scanned and placed in ProjectWise under the appropriate District's Org for that Contractor and/or Producer/Supplier.
 - 5.3.5 Once a project has been awarded, if a contractor elects to use the approved Master Plant and Master Field QC Plans on that project, the Contractor shall submit a letter requesting to use the Master QC Plans for that project. This letter must be on the Contractor's letterhead, be addressed to the District Engineer/Manager or their designee, and contain the following information: project number, CID#, project description, type of Quality Control Plan and the laboratory reference number for the Master QC Plan. See Attachment 5 for an example of a plant letter and Attachment 6 for an example of a field letter.
 - 5.3.5.1 The District shall review the referenced Master QC Plans to ensure they cover all items in that project. If the referenced Master QC Plan is found to be insufficient for some items on that project, the District shall request the Contractor to submit additional information for quality control of those items as an addendum on a project specific basis. When the District is satisfied with the QC Plan for that project, a letter shall be sent to the Contractor acknowledging approval (see Attachment 7), with the following attached: the contractor's project QC Plan request letter and the Master QC Plan approval letter. This shall then be placed in the project's incoming-mail mailbox in ProjectWise.

- 5.3.5.2 A Master QC Plan that has been approved for project use shall be good for the duration of that project.
- 5.3.5.3 For the use of Division Personnel, the District approval letter for this project must state the ProjectWise link to the referenced Master QC Plan for that Contractor (for example: WVDOT ORGS > District Organization #> Materials > Year > Master QC Plans).
- 5.3.6 The Master Field and Plant QC Plans shall be valid for the duration of one calendar year beginning on January 1st and ending on December 31st. The Master Plant QC Plan will also cover maintenance purchase order concrete for the year.

6. ACCEPTANCE SAMPLING AND TESTING

- 6.1 Acceptance sampling and testing is the responsibility of the Division. Quality control tests by the Contractor may be used for acceptance.
- 6.2 The Division shall sample and test for applicable items completely independent of the contractor at a frequency equal to approximately ten (10) percent of the frequency for testing given in the approved QC Plan. Witnessing the contractor's sampling and testing activities may also be a part of the acceptance procedure, but only to the extent that such tests are considered "in addition to" the ten (10) percent independent tests.
- 6.3 Results from independent tests conducted by the Division for gradation, entrained air, consistency, and strength will be plotted on the Contractor's quality control charts with a red circle but are not to be included in the moving average. When the Contractor's tests are witnessed, the results are circled on the control chart in red and are to be included in the moving average calculations.
- 6.4 Results from both independent tests and witnessed tests will be evaluated in accordance with MP 700.00.54. If a dissimilarity is detected, an investigation shall be immediately initiated to determine the cause of the dissimilarity.

7. ABSENT TESTING OF MATERIAL

- 7.1 If the Contractor fails to perform testing of the material in accordance with the Contractor's Division Approved Quality Control Plan, payment for the portion of the item represented by the absent test shall be withheld, pending the Engineer's decision whether or not to allow the material to remain in place. Testing includes both performing the test and submitting the results as per MP 109.00.21.

- 7.1.1 If the Engineer allows the material to remain in place, the Division shall not pay for the material represented by the absent test. However, the Division shall pay for the cost of the placement of the material, including labor and equipment. The invoice or material supplier cost (if applicable), determined at the time of shipment, shall be used to calculate the cost of material when evaluating the total cost of labor and equipment.

Michael A. Mance, P.E.
Director
Materials Control, Soils and Testing Division

MP 601.03.50 Steward – Cement and Concrete Section
MAM:T
ATTACHMENTS

TABLE 1
CONTRACTORS PROCESS CONTROL
REQUIREMENTS

STRUCTURAL CONCRETE AND
PORTLAND CEMENT CONCRETE PAVEMENT

Minimum frequency*

A. PLANT AND TRUCKS

- | | |
|--------------------------------------|----------------------------------|
| 1. Mixer Blades | Prior to Start of Job and Weekly |
| 2. Scales | |
| a. Tared | Daily |
| b. Calibrate | Prior to start of Job |
| c. Check Calibration | Weekly |
| 3. Gauges and Meters-Plant and Truck | |
| a. Calibrate | Yearly |
| b. Check Calibration | Weekly |
| 4. Admixture Dispenser | |
| a. Calibrate | Prior to Start of Job |
| b. Check Operation and Calibration | Daily |

B. AGGREGATES

- | | |
|-------------------|---|
| 1. Fine Aggregate | |
| a. Gradation | Per section 601.3.2.4 of the Specifications |
| b. Moisture | Daily |

2. Coarse Aggregates

- | | |
|---|---|
| a. Gradation | Per section 601.3.2.4 of the Specifications |
| b. Percent passing No. 75 μ m | Daily |
| c. $\bar{A}$ for Combined Coarse Aggregates
Fine Aggregates and Cement | Per section 601.3.2.4 of the Specifications |
| d. Moisture | Daily |

3. Optimized Aggregates

- | | |
|--------------|---|
| a. Gradation | Per section 601.3.2.4.1 of the Specifications |
| b. Moisture | Daily |

C. PLASTIC CONCRETE**1. Entrained Air Content**

- | | |
|---|--|
| Pavement Concrete | Two at the beginning of the paving operation, per Section 501.4.2, then one per 500 yd ³ (380 m ³) or fraction thereof, with a minimum of two per day |
| Structural Concrete
(except Bridge Superstructure) | One per 100 yd ³ (75 m ³) or fraction thereof, with a minimum of one per ½ day of operation |
| Bridge Superstructure | One per batch |

2. Consistency**

- | | |
|---|--|
| Pavement Concrete | One per 500 yd ³ (380 m ³) or fraction thereof, with a minimum of two per day |
| Structural Concrete
(except Bridge Superstructure) | One per 100 yd ³ (75 m ³) or fraction thereof, with a minimum of one per ½ day of operation |

Bridge Superstructure	One for first batch and one for every fifth batch thereafter
3. Temperature	Per Specification
4. Yield	
Pavement Concrete	Per Section 501.3 of the Specifications and one for each five days of operation after the first five days of operation
Structural Concrete	Per Section 601.3.2.3 of the Specifications and one for each ten sets of cylinders after the first ten
5. Compressive Strength***	
Pavement Concrete	One set of concrete cylinders for each 350 yd ³ (75 m ³) or fraction thereof
Structural Concrete	For each class concrete delivered and placed on a calendar day from a single supplier, one set of concrete cylinders for each 100 yd ³ (75 m ³) or fraction thereof
6. Permeability	
Pavement Concrete	N/A
Structural Concrete	Per Section 601.4.5 of the Specifications
Specialized Concrete Overlays	Per Section 679.2.2 of the Specifications

* Frequency for Process Control will vary with the size and type of aggregate or mixture and the batch-to-batch variability of the item.

** When superplasticizer is added to the concrete in the field, additional consistency testing is required as per Section 601.3.2.1 of the Specifications.

*** All cylinders shall be made, cured, and shipped to the Laboratory in accordance with AASHTO R 100 and MP 601.04.20. They shall be tested in accordance with AASHTO T 22 and the applicable section of the Specifications.

Example

COMPANY LETTERHEAD

Mr./Ms./Mrs. _____
West Virginia Department of Highways
District ____ Engineer/Manager
_____, WV #####

RE: Master PCC Field QC Plan

Dear _____,

We are submitting our PCC Field Quality Control Plan, developed in accordance with Sections 501 and 601 of the (year) WVDOH Standard Specifications, the (year) WVDOH Supplemental Specifications, and MP 601.03.50.

1. The Quality Control program is under the direction of _____, who can be contacted in Field/Office, by telephone number _____, cell# _____, and/or e-mail address _____.
2. Sampling and testing will be performed by qualified personnel as per WVDOH specifications Section 106.
3. Class(es) of Concrete to be controlled are listed as follows:
 - All types Class A - All types Class B - All types Class C
 - All types Class D - All types Class K - All types Class H
 - Etc.
4. All items in this QC Plan will be sampled at a minimum frequency as specified in Table 1 of Attachment 1. We acknowledge that additional sampling may be required by the Division in addition to the minimum frequency stated.
5. All sampling and testing will be in accordance with the methods and procedures required by the Specifications. All measuring and testing equipment shall be standard and properly calibrated as per the specified test procedure. *(If alternative sampling methods, procedures and inspection equipment are to be used please state in detail what they are and how they will be utilized.)*
6. Batch ticket data shall be documented in accordance with the applicable section of MP 601.03.50, with a copy to be submitted to the District Materials Section within 72 hours of the concrete placement.

7. Calculation of the compressive strength of concrete cylinders will be done as shown in Section 5.2.5 of MP 601.03.50.
8. Testing of Miscellaneous Concrete will be as specified in Section 5.2.6 and Sub-Sections 5.2.6.1 thru 5.2.6.3 of MP 601.03.50.
9. We will maintain adequate records of all inspection and tests. The records will indicate the type of test, number of observations made, the amount and type of deficiency's found, the quantities approved and rejected, and the nature of corrective actions taken as appropriate.
Our documentation procedures will be subject to the review and approval of the Division prior to the start of the work and to compliance checks during the progression of the work.
10. Our company will take prompt action to correct conditions, which have resulted or could result, in the submission to the Division/District of materials and products, which do not conform to the requirements of the contract documents.
11. Non-Conforming Materials -- *State how you will establish an effective and positive system for controlling non-conforming material. This shall include the following:*

- *procedures for non-conforming material identification*
- *isolation and disposition of this material*

Reclaiming or reworking of non-conforming materials shall be in accordance with procedures acceptable to the Division.

Our company will specify and provide holding areas, which shall be mutually agreeable by the Division and Contractor.

Very Truly Yours,

Company Official, Title

Example

COMPANY LETTERHEAD

Mr./Ms./Mrs. _____
West Virginia Department of Highways
District ____ Engineer/Manager
_____, WV #####

RE: Master PCC Plant QC Plan

Dear _____,

We are submitting our PCC PLANT Quality Control Plan, developed in accordance with Sections 501 and 601 of the (year) WVDOH Standard Specifications, the (year) WVDOH Supplemental Specifications, and MP 601.03.50.

1. The Quality Control program is under the direction of _____, who can be contacted in Field/Office, by telephone number _____, cell# _____, and/or e-mail address _____.
2. Sampling and testing will be performed by qualified personnel as per Specifications Section 106.
3. The PCC Mix Designs and class of concrete to be controlled are listed below:

Mix Design Number		Class of Concrete
1.	#####	Class B
2.	_____	_____
3.	_____	_____
4.	_____	_____
Etc.		

4. All items in this QC Plan will be sampled at a minimum frequency as specified in Table 1 of Attachment. We acknowledge that additional sampling may be required by the Division in addition to the minimum frequency stated.
5. All sampling and testing will be in accordance with the methods and procedures required by the Specifications. All measuring and testing equipment shall be standard and properly calibrated as per the specified test procedure. *(If alternative sampling methods, procedures and inspection equipment are to be used please state in detail what they are and how they will be utilized.)*

6. Charts and forms
Our Company will make sure all conforming and non-conforming inspections and test results shall be kept complete and shall be available at all times to the Division during the performance work. Forms shall be on a computer-acceptable medium where required. Gradation data shall be documented on WVDOH form T300 using the material codes listed in the online computer systems user guide. The original gradation data shall be submitted to the District Materials Section within 72 hours of obtaining the gradation sample. Test data for Portland cement concrete shall be charted in accordance with the applicable requirements of MP 601.03.52. Gradation test data shall be plotted in accordance with the applicable requirements of MP 300.00.51. We may use other types of control charts as deemed appropriate by Division. It is normally expected that testing and charting will be completed within 48 hours after sampling. Our Company shall also ensure that all Material Suppliers prepare and submit the HL-441 form (weekly supplier report) in a timely manner. All charts and records will be turned over to the Division upon completion of work for a given WVDOH project.
7. *State that batch tickets will conform to requirements of MP 601.03.50 Section 5.3.9 and its applicable subsections.*
8. Our company will take prompt action to correct conditions, which have resulted or could result, in the submission to the Division of materials and products, which do not conform to the requirements of the contract documents.
9. Non-Conforming Materials - *State how you will establish an effective and positive system for controlling non-conforming material. This shall include the following:*
 - *procedures for non-conforming material identification*
 - *isolation and disposition of this material*

Reclaiming or reworking of non-conforming materials shall be in accordance with procedures acceptable to the Division.

Our company will specify and provide holding areas, which shall be mutually agreeable by the Division and Contractor.

Very Truly Yours,

Company Official, Title

WVDOH District Master QCP Approval Letter

*** EXAMPLE ***

WVDOH LETTERHEAD

ACME Company
20 First St.
Somewhere, WV #####

RE: PCC Plant or PCC Field (*whichever is applicable*)
Master QC Plan
Description: (YEAR)
P/S code: (only if a plant QCP)

Dear Sir,

Your Quality Control Plan (M#-#####) for _____ has been reviewed and found to be acceptable for the following items:

- All WVDOH approved Designs for PCC Classes of Concrete controlled by the referenced QC plan.

As work progresses throughout the season an addendum(s) may be required to this QCP to keep the QC program current. Also note that personnel may be required to show proof of certification for testing. Please use Lab Reference # M#-##### when corresponding about this QC plan. Please make sure that all appropriate personnel have a copy of this plan in their possession.

Very truly yours,

Name, Title

Example

COMPANY LETTERHEAD

Mr./Ms./Mrs. _____
WV Department of Highways
District ____ Engineer/Manager
_____, WV #####

RE: PCC Quality Control Plan
for Plant ---- Project

Federal Project No. _____
State Project No. _____
Contract ID No. _____
Description _____

Dear Mr./Ms./Mrs. _____,

We would like to use our Producer/Supplier's name Master PCC Plant QC Plan, reference number _____ for the project referenced above. All PCC items on the referenced project are covered by the Master PCC Plant QC Plan. *(if needed state the Special Provision and that the addendum is attached for Quality Control of Special Provision Item)*

The Quality Control Plan is under the direction of _____,
_____(title), and will be the company's contact representative to the Division of Highways District Materials and Construction Departments. They can be contacted in person at the plant, by telephone _____ or at e-mail at _____.

Very truly yours,

Company Representative

Example

COMPANY LETTERHEAD

Mr./Ms./Mrs. _____
WV Department of Highways
District ____ Engineer/Manager
_____, WV #####

Re: PCC Quality Control Plan
for Field ---- Project

Federal Project No. _____
State Project No. _____
Contract ID No. _____
Description _____

Dear Mr./Ms./Mrs. _____,

We would like to use our approved Master PCC Field QC Plan, reference number _____ for the project referenced above. All PCC items on the referenced project are covered by the Master PCC Field QC Plan. *(if needed state the Special Provision and that the addendum is attached for Quality Control of Special Provision Item)*

The Quality Control Plan is under the direction of _____, _____ (title), and will be the company's contact representative to the Division of Highways District Materials and Construction Departments. They can be contacted in person at the plant, by telephone _____ or at e-mail at _____.

Very truly yours,

Company Representative

WVDOH District Master QCP Approval Letter

*** EXAMPLE ***

WVDOH LETTERHEAD

ACME Company
20 First St.
Somewhere, WV #####

RE: PCC Field or PCC Plant (*whichever is applicable*) QC Plan

Project CID#: #####
Fed/State Project #: NHPP- ## - #####-##
Description: Falling Slide
County: XXXXXXXX
P/S Code: (If a Plant)

Dear Sir,

Your request to use Master Quality Control Plan (M# - #####) for PCC Plant or PCC Field (*whichever is applicable*) on the project referenced above, has been reviewed and found to be acceptable for the following items:

- All WVDOH approved designs and classes of PCC controlled by this QCP listed below:
- Class B - Class B modified - Class K -etc.

As work progresses throughout this project an addendum(s) may be required to this QCP to keep the QC program current. Please use M# - ##### when corresponding about this QC Plan. Also note that personnel may be required to show proof of certification for testing. Please make sure that all appropriate personnel have a copy of this plan in their possession.

For Division Reference: The Master Quality Control Plan can be reviewed in ProjectWise at the folder shown below:

WVDOH ORG>D0#>year>MASTER QC PLANS>Contractors or Plant>Company
>folder>Name of file (i.e.: 2016 04 05 M#160001 PCC Plant QCP)

Very truly yours,

Name, Title

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

PROCEDURAL GUIDELINES FOR MAINTAINING CONTROL CHARTS
FOR PORTLAND CEMENT CONCRETE

1. PURPOSE

- 1.1 To establish guidelines for developing and maintaining control charts to evaluate consistency, percent entrained air, strength characteristics, and the total solids A of ~~portland~~Portland cement concrete.
-

2. SCOPE

- 2.1 These procedures shall be applicable in all instances in which they can be reasonably and logically applied. For consistency, air, and strength, the applicability will normally depend on the quantity of material used, the continuity of delivery, etc. Control charts for total solids A shall be maintained for all concrete designs used on state work by a concrete producer.
-

3. GENERAL PROCEDURE

- 3.1 Control charts will be maintained at locations where the test samples are taken.
- 3.2 Control charts will be prepared on a 10 x 10 cross section paper with a width of approximately 560 mm for the sheet presenting the charts for consistency, percent entrained air, and strength characteristics. A separate sheet of sufficient width shall be used to accommodate the control charts for the total solids A for concrete mix designs. A chart length of approximately 760 mm should be displayed at all times. When standard cross section sheets are used, the most recent sheet will be displayed and the previous sheets will be placed chronologically in a holder.
- 3.3 Charts for consistency, air, and strength shall have the item number and/or description of the material noted on the top of the chart and will be visible at all times. charts will have the design number and class of concrete visible at all times.
-

4. CHART PREPARATION

- 4.1 At the beginning and end of each sheet (or the length of the displayed portion), vertical red lines will be drawn between the limits of the specification or tolerance; an arrow will be placed at the end of the vertical lines; the specification limits will be written above and below the arrows and the name of the property being graphed and the scale will be indicated between the limits on the left edge of the chart. See Appendix 1 and 2 for typical arrangements.

4.2 Scale

- 4.2.1 Consistency - One division of vertical scale will represent 5.0 mm of slump, or
- 4.2.2 5.0 mm of ball penetration (25 mm - 50 mm).
- 4.2.3 Air Content - One division of vertical scale will represent one-tenth of a percentage point of entrained air (25 mm - 1%).
- 4.2.4 Strength - One division of vertical scale will represent 1 MPa (25 mm = 10 MPa) compressive or 69 KPa (25 mm = 1 MPa) flexural strength.
- 4.2.5 Total solids A - One division of vertical scale will represent .01 (25 mm = 0.1) when the coarse aggregate size is 57, 7, 78, or 8 and .02 (25 mm = 0.2) when the coarse aggregate size is Number 3.
- 4.3 **Plotting Test Data**
- 4.3.1 Symbols and Color Code - Individual test values will be plotted in blue using the symbol “○”, with the circle being approximately 2.5 mm in diameter. Average test values for consistency, percent air, and strength as well as the averages of consecutive five test values for total solids A shall be plotted in red using the symbol, “◻” with the square being approximately 2.5 mm on each side. Independent Assurance test values developed by the Division, including record samples, will be plotted in green using the symbol “△” with the sides of the triangle being approximately 2.5 mm.
- 4.3.2 Arrangement of Data - All data developed on a production day will be plotted on one heavy, vertical line, however, when two or more individual test values developed on the same production day have the same magnitude, the symbols may be plotted side-by-side on the same horizontal division line. All test data for a characteristic developed on a production day, exclusive of any independent testing conducted by the Division, will be averaged, and the average value plotted on the same vertical line as the individual test values. When an average value and an individual test value have the same magnitude, the plotted symbols may be superimposed.
- 4.3.3 When individual test values fall outside the specification limits, an arrow will be placed on the plotted symbol pointing in the direction of the specification limit.
- 4.3.4 As test data are developed on following production days, it will be plotted on successive heavy vertical lines, 25 mm apart, progressing from left to right across the control chart. As successive averages for consistency, percent air, and strength characteristic are plotted, the symbol “◻” will be connected with a heavy red solid line. For total solids A control chart the moving average is the average of five consecutive test values and is determined by starting with the fifth test value and averaging it with the four preceding test values. The moving average of five symbol “◻” will be connected with a heavy red solid line. Individual test values will have the symbol “○” connected with a dashed blue line.
- 4.3.5 At the bottom of the cross section paper and immediately to the left of the heavy vertical line on which the test data are plotted, the date of sampling and initials of the individual plotting the test data will be recorded.

EDITORIAL

MP 601.03.52

~~JANUARY 1995~~ Effective Date:
~~RECONFIRMED: JULY 20, 2022~~

PAGE 3 OF 3

5. FAILING TESTS

- 5.1 When individual test values fall outside the specification limits, this information will immediately be made available to the supervisory personnel of both the Contractor and the Division.
- 5.2 Should the moving average of five fall outside the design mix A tolerance, action required by the Specification will be taken. When appropriate action has been taken to bring the A back within tolerance the first individual production sample that is within tolerance shall be used to start a new moving average.

Michael A. Mance, P.E.

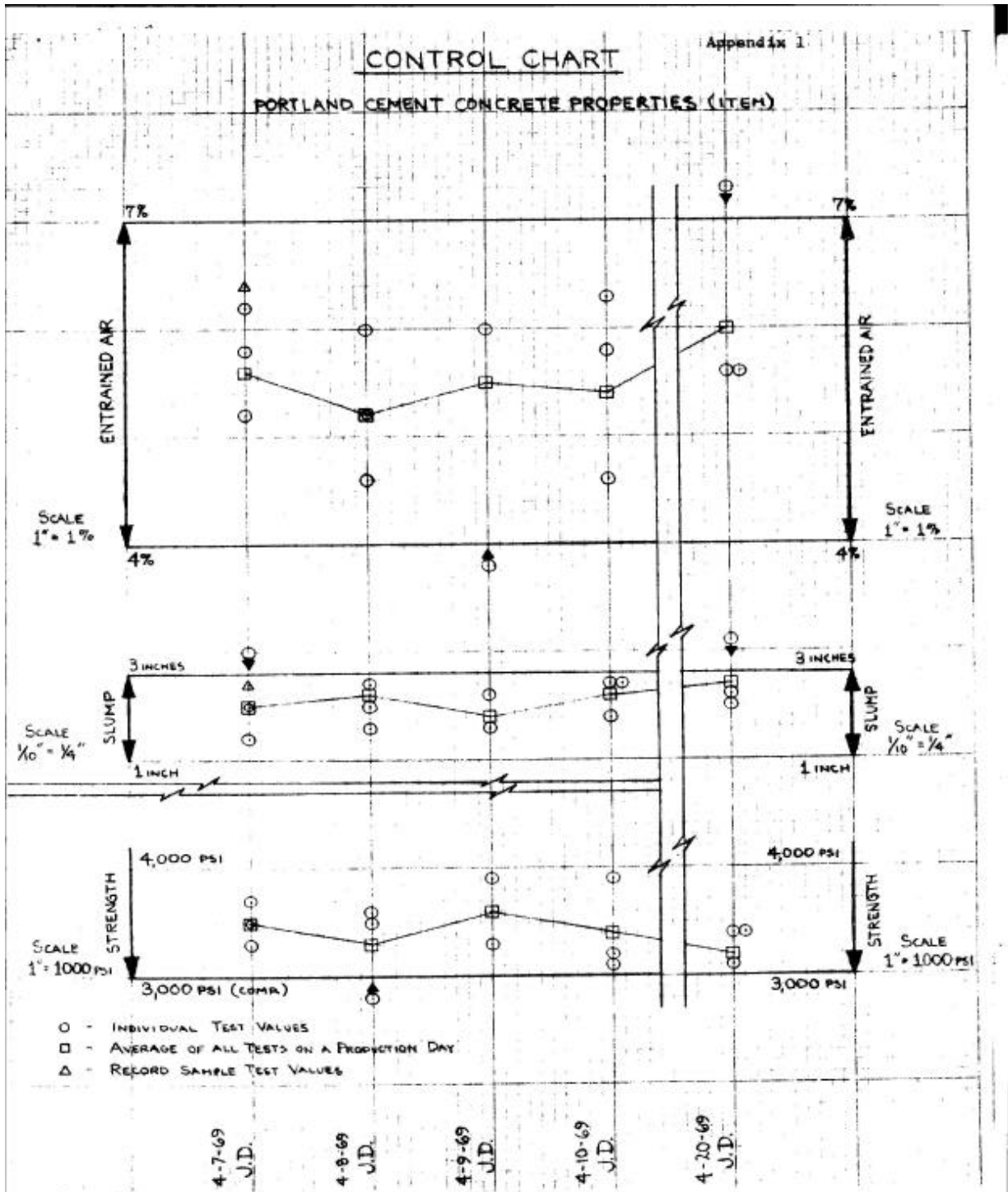
Director

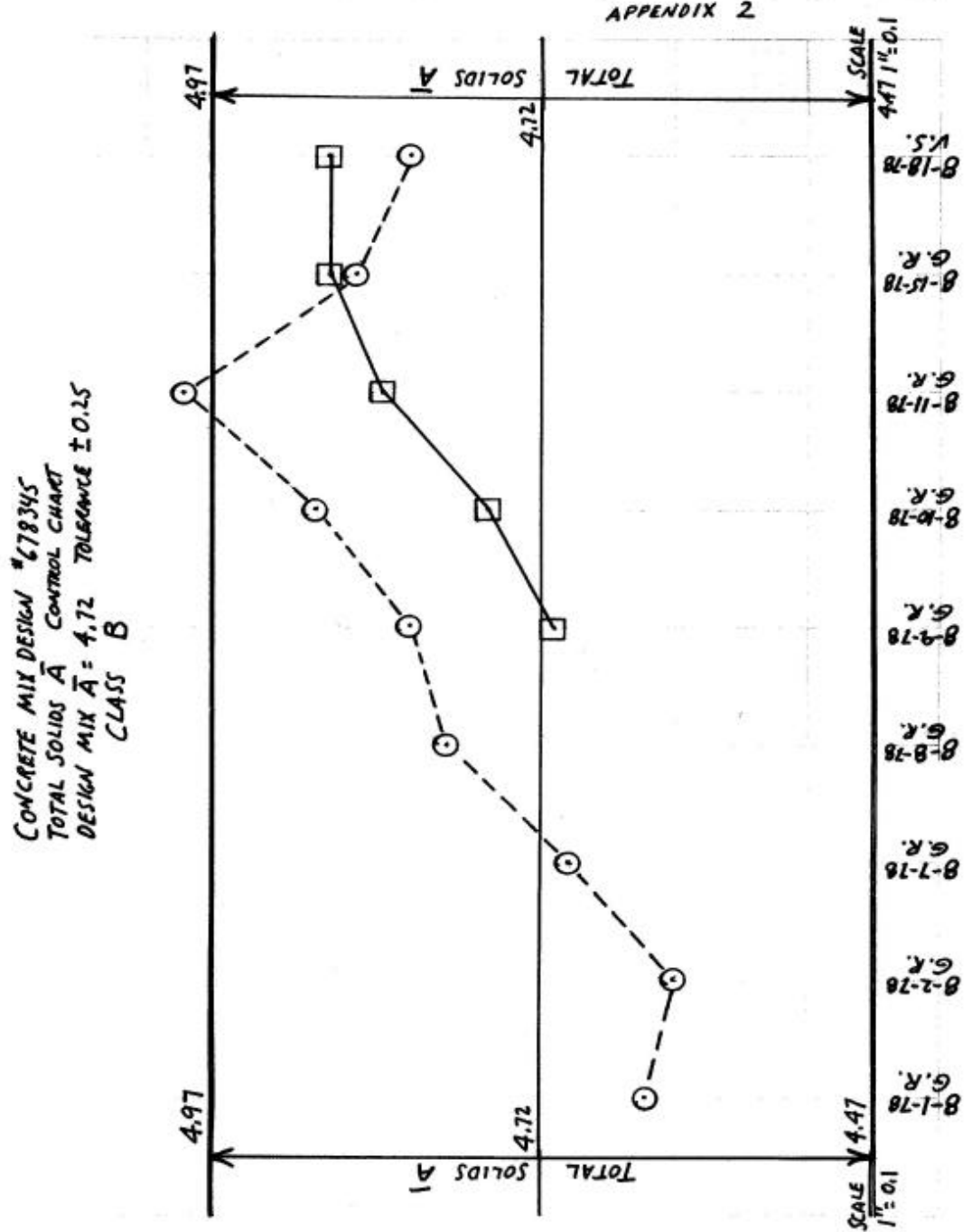
Materials Control, Soils & Testing Division

MP 601.03.52 Steward – Cement and Concrete Section

MAMRLS:T

ATTACHMENT





WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

STANDARD METHOD FOR DETERMINATION
OF OPTIMIZED AGGREGATE GRADATION -IN
PORTLAND CEMENT CONCRETE

1. PURPOSE

- 1.1 To establish a procedure for determination of optimized aggregate gradation in portland cement concrete.
- 1.2 To establish a uniform definition of optimized aggregate gradation.

2. SCOPE

- 2.1 This procedure shall apply in all cases where the specification allows the combined aggregate gradation test in ~~portland~~Portland cement concrete.
- 2.2 The combined aggregate gradation test is used to determine if the optimized aggregate gradation has been achieved.

3. REFERENCES

- 3.1 AASHTO T 27: Standard Method of Test for Sieve Fine and Coarse Aggregates.
- 3.2 AASHTO T 11: Standard Method of Test for Materials Finer Than 75 -µm (No. 200) sieve in mineral aggregates by washing.
- 3.3 WVDOH Specifications – Section 601.3.2.4.1

3.4. DEFINITIONS

Optimized aggregate gradation characterizes the proportions of different sizes of aggregates in concrete mix designs. Optimized aggregate gradation helps to improve aggregate packing which involves minimizing the paste content while still producing a workable mixture.

4.5. PROCEDURE

~~4.15.1~~ Since the aggregates in a ~~portland~~ **Portland** cement concrete mix consist of coarse and fine aggregates, this procedure will address the determination of optimized aggregate gradation through the combined aggregate gradation test.

~~4.1.15.1.1~~ The mass of each aggregate used in the concrete mix shall be used to determine the percent of each constituent aggregate in the optimized aggregate gradation.

~~5.1.1.14.1.1.1~~ —Determine the total mass of aggregate:

$$M_{ca(I)} + M_{ca(II)} + M_{fa(I)} + M_{fa(II)} = M_t$$

Where:

$M_{ca(I)}$ = mass of coarse aggregate (I) (SSD) used in one cubic yard of concrete.

$M_{ca(II)}$ = mass of coarse aggregate (II) (SSD) used in one cubic yard of concrete.

$M_{fa(I)}$ = mass of fine aggregate (I) (SSD) used in one cubic yard of concrete.

$M_{fa(II)}$ = mass of fine aggregate (II) (SSD) used in one cubic yard of concrete

M_t = mass of total aggregate used in one cubic yard of concrete.

~~5.1.1.24.1.1.2~~ Determine the relative percent (R_A) of each type of aggregate.

$$\text{Coarse aggregate (I) percent} = \frac{M_{ca(I)}}{M_t} * 100$$

$$\text{Coarse aggregate (II) percent} = \frac{M_{ca(II)}}{M_t} * 100$$

$$\text{Fine aggregate (I) percent} = \frac{M_{fa(I)}}{M_t} * 100$$

$$\text{Fine aggregate (II) percent} = \frac{M_{fa(II)}}{M_t} * 100$$

~~4.1.25.1.2~~ Determine the gradation of each type of aggregate using AASHTO T 27 and T 11. Submit gradation reports showing the combined percent passing and the combined percent retained as shown in the attached example. Include in the report, each individual aggregate gradation starting with the largest appropriate sieve for that material and including all the consecutive smaller sizes through the No. 200 sieve. The passing percent of each type of aggregate shall be reported to nearest hundredth percent.

~~65.~~ CALCULATIONS

~~65.1~~ Calculate the combined % passing on each sieve using the following equation:

$$C_P = \sum [\{(P_A)(R_A)\} / 100]$$

where:

C_P = Combined % Passing

P_A = % Passing of each type of Aggregate

R_A = Relative % of each type of Aggregate (See Section ~~54.1.1.2~~)

~~65.2~~ Calculate the combined % retained on each sieve using the following equation:

$$C_R = C_{RX} - C_P$$

Where:

C_R = Combined % Retained

C_{RX} = Combined % Passing of next larger sieve size

C_P = Combined % Passing

~~65.3~~ The attached spreadsheet shall be used to calculate the values of the mass of total aggregate (M_t), relative percent (R_A) of each type of aggregate, combined percent passing (C_P), and combined percent retained (C_R). Once the percent passing of each type of aggregate is entered into the attached spreadsheet, the spreadsheet will automatically perform all the required calculation for optimized aggregate gradation. The spreadsheet will also plot the tarantula chart for optimized aggregate gradation.

7. EVALUATION

7.1 If the combined aggregate gradation meets the requirements of Section 601.3.2.4.1 of the Specification, the combined aggregate gradation shall be considered as Optimized Aggregate Gradation.

~~Michael A. Mance~~~~Ronald L. Stanevich~~, P. E.
Director
Materials Control, Soils & Testing Division

~~MAMRLS:TMtd~~
Attachment

EXAMPLE OF DETERMINATION OF OPTIMIZED AGGREGATE GRADATION IN PORTLAND CEMENT CONCRETE

1. Total mass of aggregates in one cubic yard of concrete:

$M_{ca(I)}$ = Mass of SSD Coarse Aggregate (I) = 1511 lb.

$M_{ca(II)}$ = Mass of SSD Coarse Aggregate (II) = 265 lb.

$M_{fa(I)}$ = Mass of SSD Fine Aggregate (I) = 1260 lb

$M_{fa(II)}$ = Mass of SSD Coarse Aggregate = 0

M_t = Total mass of aggregates

- 1.1 Enter the mass of each type of aggregate in the attached spreadsheet. The spreadsheet will calculate the relative percent (R_A) of each type of aggregate.

2. Percent Passing of each type of aggregate from individual gradation.

Sieve Size	Coarse Aggregate (I)	Coarse Aggregate (II)	Fine Aggregate (I)
2 in	100.00	100.00	100.00
1½ in	100.00	100.00	100.00
1 in	98.00	100.00	100.00
¾ in	70.31	100.00	100.00
½ in	45.21	100.00	100.00
⅜ in	21.93	96.31	100.00
No. 4	4.93	19.18	99.12
No. 8	1.00	3.12	85.63
No. 16	1.00	1.00	65.32
No. 30	1.00	0.00	31.02
No. 50	1.00	0.00	12.21
No. 100	1.00	0.00	1.62
No. 200	0.80	0.90	0.60

- 2.1 Enter the percent passing of each type of aggregate in the attached spreadsheet. The spreadsheet will calculate the combined % passing (C_P) on each sieve, the combined % retained (C_R) on each sieve, Coarse Sand % Retained (#8 - # 30 Sieve), and Fine Sand % Retained (#30 - #200 Sieve). The spreadsheet will also plot the tarantula chart.

Table 1A

Aggregate Classification				
	Coarse Aggregate (I)	Coarse Aggregate (II)	Fine Aggregate (I)	Fine Aggregate (II)
Mass (lb)	1511	265	1260	0
Total Mass (M _t) (lb)	3036			
Relative (R _A) (%)	49.77	8.73	41.50	0.0

Table 1B: Sieve Analysis Example

Sieve Size	Coarse Aggregate (I)	Coarse Aggregate (II)	Fine Aggregate (I)	Fine Aggregate (II)	Combined % Passing (C _P)	Combined % Retained (C _R)	Meet Spec
Relative (R _A) %	49.77	8.73	41.50	0.00			
	% Passing (P _A)						
2 in	100.00	100.00	100.00	0.00	100.00	0.00	Yes
1½ in	100.00	100.00	100.00	0.00	100.00	0.00	Yes
1 in	98.00	100.00	100.00	0.00	99.00	1.00	Yes
¾ in	70.31	100.00	100.00	0.00	85.22	13.78	Yes
½ in	45.21	100.00	100.00	0.00	72.73	12.49	Yes
⅜ in	21.93	96.31	100.00	0.00	60.82	11.91	Yes
No. 4	4.93	19.18	99.12	0.00	45.26	15.56	Yes
No. 8	1.00	3.12	85.63	0.00	36.31	8.96	Yes
No. 16	1.00	1.00	65.32	0.00	27.69	8.61	Yes
No. 30	1.00	0.00	31.02	0.00	13.37	14.32	Yes
No. 50	1.00	0.00	12.21	0.00	5.57	7.81	Yes
No. 100	1.00	0.00	1.62	0.00	1.17	4.40	Yes
No. 200	0.80	0.90	0.60	0.00	0.73	0.44	Yes

Coarse Sand % Retained (#8 - # 30 Sieve)

31.89

Yes

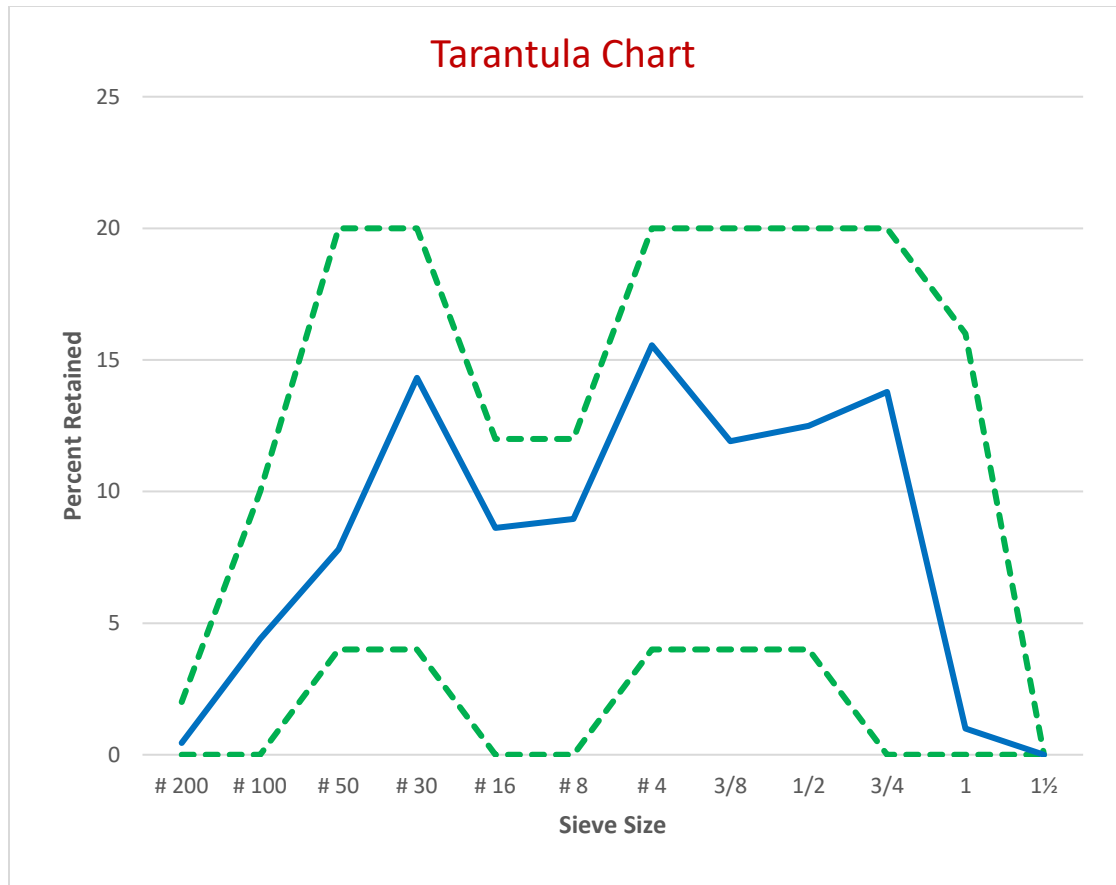
This range amount is a minimum of 15%

Fine Sand % Retained (#30 - #200 Sieve)

27.0

Yes

This allowable range amount is between 24 - 34%



WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

CURING CONCRETE TEST SPECIMENS IN THE FIELD

1. PURPOSE

- 1.1 The purpose of this procedure is to modify the curing requirements for cylindrical and prismatic specimens that have been made in the field.

2. ~~SCOPE~~

- ~~2.1 This method is modifying the curing method in section 10.1.2 and section 11.1 in AASHTO R100-21 for cylindrical and prismatic specimens made in the field.~~

3. ~~REFERENCES~~

- ~~3.1 WVDOH Standard Specifications for Roads and Bridges and/or Supplemental Specifications (501.4, 511.3.6.1, 514.4., 601.4, 603.6.4, 620.5.5, and 679.2.2)~~
- ~~3.2 AASHTO Designation R100 – Standard Practice for Casting and Curing Concrete Strength Test Specimens in the Field~~

~~3.4.~~ BACKGROUND

- ~~3.1 The WVDOH Standard Specifications for Roads and Bridges and/or Supplemental Specifications (501.4, 511.3.6.1, 514.4., 601.4, 603.6.4, 620.5.5, and 679.2.2) require that the making and curing of concrete test specimens in the field be done in accordance with AASHTO Designation R100.~~

- ~~3.24.1~~ Section 10 of AASHTO Designation R100 covers curing of the test specimens until time of test.

~~4.~~ APPLICABLE DOCUMENT

- ~~4.1 WVDOH Standard Specifications for Roads and Bridges and/or Supplemental Specifications~~
- ~~4.2 AASHTO Designation R100~~

5. PROCEDURE

- 5.1 Curing of cylindrical and prismatic specimens made in the field shall be in accordance with Section 10 of AASHTO Designation R100 with modifications as follows.

- 5.1.1 Delete the section that covers initial curing (10.1.2 in R100-21) and substitute the following:

10.1.2 Initial Curing - Immediately after molding and finishing, the specimens shall be stored for a period of 24 ± 8 hours in a temperature range from 60 to 80°F, and in an environment preventing moisture loss from the specimens. For concrete mixtures with a specified strength of 6000 psi or greater, the initial curing temperature shall be between 68 and 78°F. Various procedures are capable of being used during the initial curing period to maintain the specified moisture and temperature conditions. An appropriate procedure or combination of procedures shall be used (Note 8). Shield all specimens from direct sunlight and, if used, radiant heating devices. The storage temperature shall be controlled by the use of heating and cooling devices, as necessary. Record the temperature using a maximum-minimum thermometer.

- 5.2 Delete the section that covers transportation of specimens to the laboratory (11.1 in R100-21) and substitute the following:

11.1 Prior to transporting, cure and protect specimens as required in Section 10. When standard curing is used, specimens shall be transported within 24 ± 8 hours after molding. When field curing is used, specimens shall not be transported to the laboratory until just prior to testing. During transporting, protect the specimens with suitable cushioning material to prevent damage from jarring. During cold weather, protect the specimens from freezing with suitable insulation material. Prevent moisture loss during transportation by wrapping the specimens in plastic, wet burlap, by surrounding them with wet sand or tight-fitting plastic caps on plastic molds. Transportation time shall not exceed 4 hours.

Michael A Mance, PE
Director
Materials Control, Soils & Testing Division

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURES

QUALITY ASSURANCE PROCEDURES FOR PORTLAND CEMENT CONCRETE

1. PURPOSE

- 1.1 The purpose of this procedure is to establish guidelines which will aid Division personnel in implementing in a prescribed and uniform manner the Division's Quality Assurance Program for portland cement concrete, said program being directed primarily to maintaining a predetermined and acceptable level of assurance that portland cement concretes do conform to their governing specification.

2. DEFINITION OF TERMS

2.1.1 QUALITY ASSURANCE

Quality Assurance is an expression of confidence which the Division has in its program of acceptance testing and inspection which determines conformance of materials and construction to governing specification. A Quality Assurance Program is a planned program of acceptance testing and inspection which is conducted by the Division for the express purpose of maintaining a predetermined and acceptable level of assurance that construction materials do conform to governing specifications. Part of any Quality Assurance Program, is an awareness and knowledge of the Producer's Quality Control Program and the level of Quality Control maintained by that Producer.

2.1.2 QUALITY CONTROL

Quality Control is a planned program of testing, inspection and related activities conducted by a concrete Producer for the purpose of measuring the various properties of concrete and its component materials which are governed by the specification and controlling these properties within the limits of the specification.

3. REFERENCES

- 3.1 MP 601.03.50 – Guide for Quality Control and Acceptance Requirements for Portland Cement Concrete.
- 3.2 MP 711.03.26 – Maintaining Specified Levels of Strength in Portland Cement Concrete.
- 3.3 WVDOH Specifications – Sections 109.20.1, 501.3, 501.4.2, 501.5.1, 601.3.1, 601.4.2, and 601.5.1

4.4. PLANT AND EQUIPMENT INSPECTION STICKERS

- 4.4.1 Physical plants and equipment, which prepare materials for, or deliver materials to, applicable projects shall be regularly inspected and approved by an authorized representative of the Division. The process for this inspection is shown in the Plant Inspection Flow Chart in Attachment 1.
- 4.4.2 The inspections and approval shall be documented on the MC-4 Form (sample show in Attachment 2 and live form available on the MCS&T webpage) and confirmed by an inspection sticker supplied by the Materials Control, Soils & Testing Division (MCS&T). The inspection sticker will indicate the following:
 - 1. Name of inspector
 - 2. Plant or portion thereof, or singular piece of equipment inspected.
 - 3. Date of inspection
 - 4. Date of expiration of approval
 - 5. Lab Number
- 4.4.3 Inspections may be made at any time at the discretion of the Division, and the status of the inspected facility shall be determined by the latest inspection. The date of expiration of approval, as noted on latest inspection sticker, shall be the last day on which the facility is considered to be approved by Division, and such facility must have an approved status at time of preparing materials for or delivering materials to applicable projects.
- 4.4.4 The sole purpose of the inspection sticker is to inform all concerned that a plant, or portion thereof, or a singular piece of equipment has been inspected. The sticker indicates that it has been found to substantially meet all requirements of the specifications and is approved to supply materials to applicable projects. Said inspection sticker shall therefore be affixed to the equipment or displayed in other manners so that the purpose as above stated will be fulfilled.
- 4.4.5 The stickers shall be applied and each District shall maintain records of these inspections in ProjectWise. The records shall include all the items listed in 4.2.
- 4.4.6 A plant or portion thereof, or a singular piece of equipment, shall be approved for a period not to exceed six (6) months. The period of approval shall be determined, in general, by the age, physical condition, or durability of the plant or equipment, and the inspection interval shall be such that the Division will have reasonable assurance that the plant or equipment is maintained in an acceptable manner.

~~1.6.14.6.1~~ During the plant inspection, the plant must demonstrate their capability to produce an E-Ticket as defined in Section 109.20.1 of the Specifications. A sample ticket shall be provided to the inspector, and compliance with this requirement shall be documented on the MC-4 form.

~~1.6.24.6.2~~ After each time a plant has been inspected, the District shall notify the Director of MCS&T, or their designee. MCS&T will generate a list of approved plants and post these on the [Division Webpage](#)¹.

~~1.74.7~~ Additional information regarding inspections and a sample of an inspection sticker is contained in Attachment 3.

~~2.5.~~ **QUALITY ASSURANCE IN PORTLAND CEMENT CONCRETE**

~~2.1~~ **PURPOSE**

~~— The purpose of this procedure is to establish guidelines which will aid Division personnel in implementing in a prescribed and uniform manner the Division's Quality Assurance Program for portland cement concrete, said program being directed primarily to maintaining a predetermined and acceptable level of assurance that portland cement concretes do conform to their governing specification.~~

~~2.2~~ **DEFINITION OF TERMS**

~~2.2.1~~ **QUALITY ASSURANCE**

~~— Quality Assurance is an expression of confidence which the Division has in its program of acceptance testing and inspection which determines conformance of materials and construction to governing specification. A Quality Assurance Program is a planned program of acceptance testing and inspection which is conducted by the Division for the express purpose of maintaining a predetermined and acceptable level of assurance that construction materials do conform to governing specifications. Part of any Quality Assurance Program, is an awareness and knowledge of the Producer's Quality Control Program and the level of Quality Control maintained by that Producer.~~

~~2.2.2~~ **QUALITY CONTROL**

~~— Quality Control is a planned program of testing, inspection and related activities conducted by a concrete Producer for the purpose of measuring the various properties of concrete and its component materials which are governed by the specification and controlling these properties within the limits of the specification.~~

¹ <https://transportation.wv.gov/division-approved-product-lists-apls> <https://transportation.wv.gov/highways/mest/pages/default.aspx>

2.3.5.1 GENERAL DISCUSSION

The Division and the Contractor-Supplier industry have jointly participated in a program whose primary objective is to improve the quality of concrete in highway construction. One of the outcomes of this program is that the Division will run a smaller risk of having non-conforming materials incorporated into the work, and the Contractor-Supplier industry will run a smaller risk of having suitable materials rejected.

The following major developments are outgrowths of the program just mentioned:

2.3.45.1.1 Portland cement concrete technician's certification is available in the Contractor-Supplier industry to implement a program of Quality Control.

2.3.25.1.2 The requirement for a Contractor (or his authorized representative, a subcontractor or a commercial supplier) to do Quality Control of portland cement concrete and to have in his service a Certified Portland Cement Concrete Technician is specified in Sub-articles 501.4.2 and 601.4.2 of the Standard Specifications.

2.3.35.1.3 The requirement for a Contractor (or his authorized representative, a subcontractor or a commercial supplier) to have a field laboratory which is equipped and maintained in specified manner so as to aid in the conduct of a Quality Control Program is specified in Sub-articles 501.5.1 and 601.5.1 of the Standard Specifications.

2.3.45.1.4 Concrete batch plants and hauling equipment are regularly inspected by the Division, and their approval as conforming to requirements of governing specification is attested to by an inspection sticker (See Section 44 of this MP for details).

2.3.55.1.5 The requirement to do concrete design, using the particular sources of materials that are to be used in the work, is specified in articles 501.3 and 601.3.1 of the Standard Specifications. This requirement allows commercial concrete suppliers to have laboratory design work done for the various classes of concrete to be supplied, and it guards against the possibility of source materials changing appreciably and affecting the quality of subsequent concrete work.

Although all producers should maintain an acceptable level of Quality Control, it is reasonable to assume that a number of producers will maintain a level of Quality Control well above the minimum accepted level.

It is generally agreed that an acceptable level of Quality Assurance may be maintained with less acceptance testing and inspection when the level of Quality Control is increased.

The capability to perform a positive and sustained level of Quality Control in practically all producer plants today is now well established. Also, the Division has the means for measuring the level of Quality Control maintained by each producing plant. Accordingly, it would be desirable to pursue a Quality Assurance Program which takes into account the level of Quality Control in a Producer's plant so that an acceptable level of Quality Assurance could be maintained with a minimum cost (man-hours and dollars) to the Department. As previously

stated the purpose of this procedure is to establish guidelines which will aid Department personnel in implementing, in a prescribed and uniform manner, such a Quality Assurance Program.

2.4.5.2 DIRECTIVE

Concrete plants will be inspected in accordance with Section ~~41~~ of this MP and the condition of conformance will be determined. Those plants which are found to conform to the specifications will be identified as Class A plants, and those which do not conform will be identified as Class B plants. The level of Quality Control at each concrete plant will also be evaluated.

Those plants which have a high level of Quality Control will be considered to have a Level 1 Quality Control, and those plants which have a lower level of Quality Control will be considered to have a Level 2. All concrete plants will then be rated with one of the following classification numbers A1, A2 or B.

2.4.1.5.2.1 LEVEL 1 QUALITY CONTROL

All plants producing concrete which reasonably conforms to the specification requirements, and which satisfies the following additional requirements, will be considered to have LEVEL 1 Quality Control:

2.4.1.5.2.1.1 The compressive strength of the concrete produced by the plant shall have a coefficient of variation of 0.15 or less and the average compressive strength shall be equal to or greater than the specified requirement plus 2 1/2 standard deviations.

2.4.1.5.2.1.2 The air content of the concrete produced by the plant shall have a coefficient of variation of 0.18 or less, and the average air content shall not differ from the specified optimum value by more than one standard deviation.

2.4.1.5.2.1.3 The consistency of the concrete produced by the plant shall have a coefficient of variation of 0.20 or less, and the average consistency shall not differ from the specified optimum value by more than two standard deviations.

2.4.1.5.2.1.4 The plant shall maintain an adequate Quality Control Program for aggregate gradation.

2.4.5.2.2 LEVEL 2 QUALITY CONTROL

All plants which fail to meet one or more of the requirements specified in ~~52~~.4.1 will be considered to have LEVEL 2 Quality Control.

2.4.5.2.3 PHYSICAL PLANT-EVALUATION

District personnel will inspect and evaluate concrete plants in conformance with Section 1 of this MP. A copy of the inspection data, which is specified in Subsection ~~41~~.5, will be

transmitted to the Materials Division immediately after the inspection is completed.

2.4.45.2.4 LEVEL OF QUALITY CONTROL - EVALUATION

The evaluation of the level of Quality Control maintained by concrete plants will be performed and maintained current by the Materials Division. The initial evaluation of the level of Quality Control will be based on an analysis of historical data. There after, tests for strength, entrained air, and consistency will be made by certified personnel on random samples taken from plant production. This test data will be used by the Materials Division to update the statistical parameters and maintain a current and valid evaluation of each plant's Quality Control level. The Materials Division will publish a list of concrete plants with their rating numbers, said publication to be updated monthly.

2.4.55.2.5 CLASS A1 PLANTS - TEST AND INSPECTION REQUIREMENTS

Concrete from Class A1 concrete plant shall be sampled and tested by certified personnel on a project-by-project basis, at random, with the frequency specified in Table 1 of MP 601.03.50.

Plant inspection and monitoring of batching operations at Class A1 concrete plants shall be performed by District personnel on a random basis during production for Division Projects.

A concrete batch ticket, as defined in Section 5.2.9 of MP 601.03.50, shall be initiated and signed at the plant and accompany each delivery to the project.

2.4.65.2.6 CLASS A2 PLANTS - TEST AND INSPECTION REQUIREMENTS

Concrete from Class A2 concrete plants shall be sampled and tested by certified personnel on a project- by-project basis, at random, with the frequency specified in Table 1 of MP 601.03.50.

Plant inspection and monitoring of batching operations at Class A2 concrete plants shall be performed by District personnel on a continual basis during the time that concrete for items other than miscellaneous concrete are being produced for Division projects.

2.4.75.2.7 CLASS B PLANTS

Concrete purchased by a Contractor for use on Division projects shall be supplied from Class A1 or A2 plants. Concrete purchased through competitive bidding with Purchase order contracts shall be supplied from Class A1 or A2 plants. Class B plants are not considered to be eligible to compete with Class A plants in the furnishing of concrete to applicable projects.

In the event it is not practical to obtain small quantities of concrete for miscellaneous items (See 52.4.8) from a Class A1 or A2 plant and a survey reveals that a Class B plant is conveniently situated with respect to the construction site, then a direct purchase of concrete by the Division from the Class B plant may be accomplished in conformance with the

applicable Division procedures. The direct purchase of concrete from Class B plants shall also be made to conform to the requirements set out in Subsection 52.5 entitled QUALITY ASSURANCE OF DIRECT PURCHASE CONCRETES FROM CLASS B PLANTS. Plant inspection at Class B plants and the sampling, testing and documentation of concrete from Class B plants shall also conform to the requirements set out in Subsection 52.5.

2.4.85.2.8 SMALL QUANTITIES FOR MISCELLANEOUS ITEMS

Miscellaneous concrete shall be defined as relatively small quantities incorporated into items that will not adversely affect the traffic carrying capacity of a completed facility. Such items would not include any concrete intended for major structures permanent mainline or ramp pavements, or other structurally critical items.

The following items are suggested as a guideline in establishing miscellaneous concrete:

1. Sidewalks
2. Curb and gutter
3. Slope walls for under drain outlet pipes
4. Temporary pavements and pipe crossings
5. Building floors
6. Slope paving and headers
7. Paved ditch or gutter
8. Small (less than 36" diameter) culvert headwalls
9. Catch basins, manhole bases, inlets, and junction boxes (and adjustments of such items) not located in the roadway
10. Foundations for breakaway supports
11. Utility trench fills
12. Cast-in-place survey markers

2.55.3 QUALITY ASSURANCE OF DIRECT PURCHASE CONCRETE FROM CLASS B PLANTS

2.5.15.3.1 PURPOSE

The purpose of this instruction is to provide guidance in specifying direct purchase of concrete and for inspection and testing of direct purchase concrete from Class B plants, so that a predetermined and acceptable level of Quality Assurance may be maintained by Division personnel. This instruction is set apart from the main directive in Subsection 52.4 because it is the intent to have concrete from Class B plants used in highway work only when it is not practical or economical to obtain concretes from Class A1 or A2 plants.

2.5.25.3.2 DEFINITION OF TERMS

2.5.2.15.3.2.1 Direct Purchase - Direct purchase is a formal procedure used to purchase materials for government agencies, including the Division of Highways) when it is not practical or economical to use the procedure of competitive bidding. Direct purchase requisitions will always specify the name of the proposed supplier as well as product name, quantity, specifications, etc.

2.5.35.3.3 GENERAL DISCUSSION

When highway work requiring portland cement concrete is being done by Division forces, and it is found to be impractical or uneconomical to obtain concrete from a Class A1 or A2 plant but that it would be practical to obtain it from a Class B plant, then the purchase of concrete from a Class B plant shall be made to conform to the requirements of article 52.5.4.

2.5.45.3.4 INSTRUCTION

The purchase of portland cement concrete from a Class B plant will be permitted only after a field condition survey has been conducted and properly documented which indicates that it would be impractical and uneconomical to obtain concrete from a Class A1 or A2 plant, and that a Class B plant does exist from which a direct purchase of concrete could practically and economically be made.

Procedures for making direct purchases of concrete shall be as prescribed by the appropriate State Agency. The method of specifying direct purchase concrete shall be as follows:

1. Specify the class of concrete.
2. Specify that the concrete mix design will be approved by the Division.
3. Specify that a Division inspector will be at the plant during the full time that concrete is being batched to direct the batching operation, and that batching shall not commence until the inspector is present.

In addition to the Quality Assurance activity performed at the plant, the Division will sample and test as deemed necessary all direct purchase order LOTS of concrete used in highway maintenance work.

3.6. PLANT APPROVAL STATUS

3.16.1 PLANT CERTIFICATION

3.1.16.1.1 When District Personnel determine that a Concrete Plant, which is not already listed as a Class A1, A2, or B plant on the Division's Approved Source Page, has met the requirements of this Materials Procedure, the Specifications, and all other applicable Materials Procedures, they shall notify MCS&T Division and provide all applicable documentation and information to MCS&T Division.

3.1.26.1.2 MCS&T Division shall then notify the subject Concrete Plant that they are approved to begin production for WVDOT projects. MCS&T Division shall also add that Concrete Plant to the Division's Approved Source Page and begin monthly evaluations of that Concrete Plant as outlined in this MP and MP 711.03.26.

3.26.2 PLANT DE-CERTIFICATION

3.2.16.2.1 When District Personnel determine that a Concrete Plant, which is listed as a Class A1, A2, or B plant on the Division's Approved Source Page, is not complying with the requirements of this MP, the Specifications, or any other applicable Materials Procedure, they shall immediately notify MCS&T Division and provide all applicable

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documentation and information to MCS&T Division. This information shall include a summary of the reason(s) for the de-certification of the subject Concrete Plant.

~~3.2.26.2.2~~ MCS&T Division shall then immediately notify the subject Concrete Plant and all applicable WVDOT District and Divisions that the subject Concrete Plant is no longer approved to supply concrete for WVDOT projects.

~~3.2.36.2.3~~ If the subject Concrete Plant, which has been de-certified and removed from approved status, desires re-approval, they shall initiate the re-approval process by submitting a plan of corrective action, which addresses all of the reasons for which that Plant was de-certified. This plan of corrective action shall be submitted to the District in which the Concrete Plant is located and to MCS&T Division.

Michael Mance, P.E.

Director

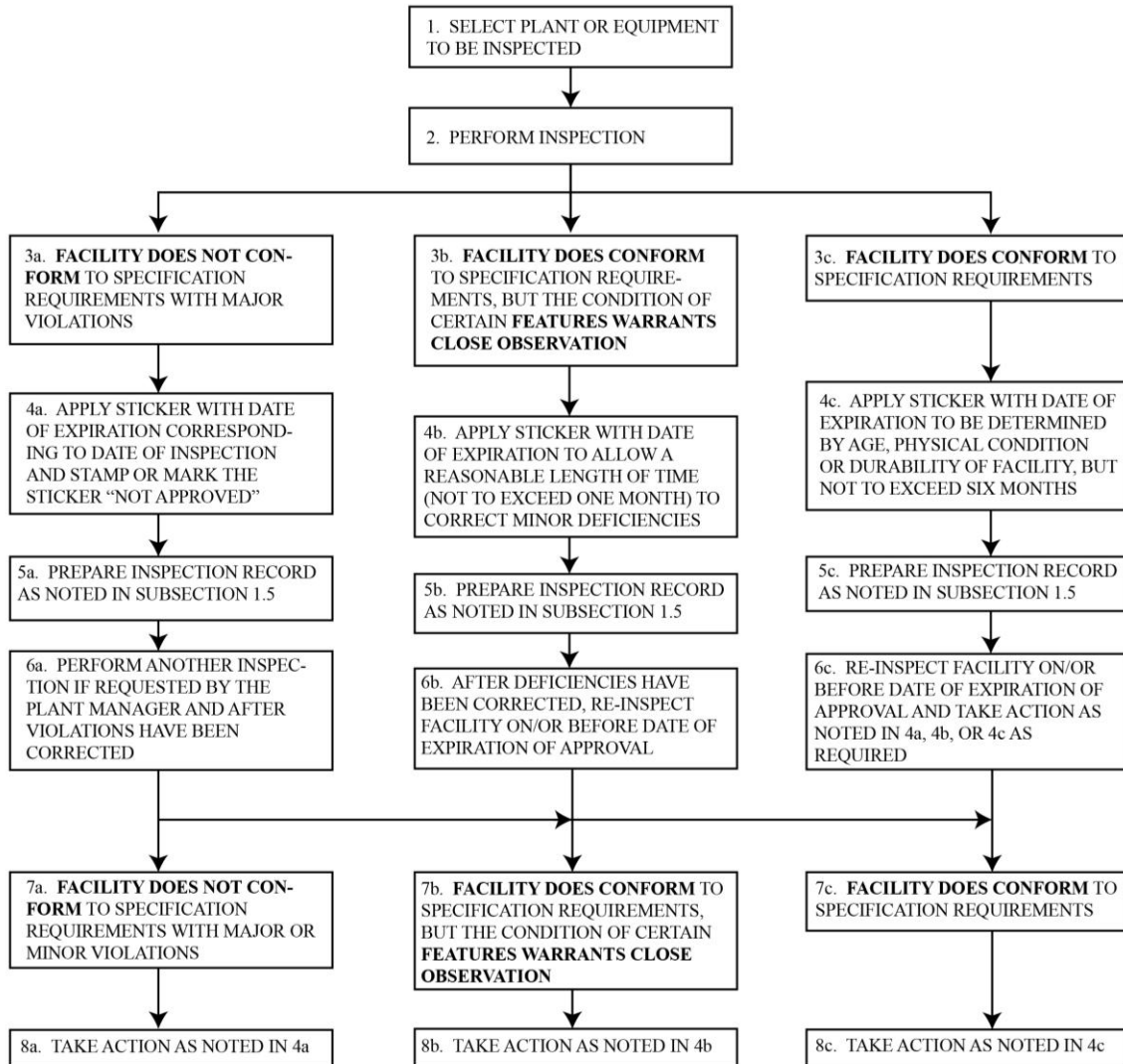
Materials Control, Soils & Testing Division

MP 601.05.50 Steward – Cement and Concrete Section

MAM:T

ATTACHMENT

Plant Inspection Flow Chart



MC-4 Plant Inspection Form

Form MC-4
Rev 4/24/23

Page 1

West Virginia Division of Highways
Materials Control, Soils and Testing Division
Checklist For Inspection of Transit Mix & Central Mix Concrete Plants

Plant Inspected:	Date:	Date Sticker Expires:
Location:	Facility Code:	Sticker No. Assigned:
Plant Officials:		
E-Ticketing Requirements Met: Yes: ☐ No: ☐		

I. Plant Type:	Transit Mix: ☐	Central Mix: ☐	Combination: ☐
-----------------------	---------------------------------------	---------------------------------------	---------------------------------------

II. Aggregates:			
Are the Stockpiles Segregated:	Yes ☐	No ☐	Any Foreign Matter in the Stockpiles: Yes ☐ No ☐
Stockpiles Properly Separated:	Yes ☐	No ☐	Type of Base:
Method of Handling Aggregates:			
Does Concrete Plant Stockpile Non-specification Materials:			Yes ☐ No ☐
If Yes, Are These Materials Properly Segregated From Specification Materials:			Yes ☐ No ☐
Source of Supply of Fine Aggregate:			
Source of Supply of Coarse Aggregate:			
Are all materials ordered to comply with West Virginia Division of Highways Specifications:			Yes ☐ No ☐

III. Scales:			
Cement:			
Dial ☐	Capacity:	Increments:	
Load Cell ☐	Capacity:	Increments:	
Do Scales Comply With Specifications:			Yes ☐ No ☐
Aggregates:			
Dial ☐	Capacity:	Increments:	
Load Cell ☐	Capacity:	Increments:	
Do Scales Comply With Specifications:			Yes ☐ No ☐
Separate Scales for Cement and Aggregates:			Yes ☐ No ☐
Overall Condition of Scales:			
Date Sealed By Dept. of Weights & Measures:		Cement:	Aggregate:

IV. Bins and Hoppers:			
Number of Bin Compartments for Fine Aggregate:		Number of Bin Compartments for Coarse Aggregate:	
Maximum Size Batch:	Is the Cement Hopper Equipped with a Vibrator: Yes ☐ No ☐		
Is the Aggregate Hopper Equipped with a Vibrator:			Yes ☐ No ☐
Operation of the Hoppers Satisfactory: Yes ☐ No ☐ If "No", Why?			
Type of Cement Bin:		Number of Bins:	Capacity of Each Bin:

V. Water:			
Type of Water Measuring Device:	Scales ☐	Meter ☐	Truck Mixer Tanks ☐
Automatic ☐	Manual ☐	Does Device Meet Specifications: Yes ☐ No ☐	
Date Sealed by Dept. of Weights & Measures:		Scales:	Meter:

VI. Admixtures:			
Brands Used:			
Air Entrainment:	Automatic Dispenser:	Yes ☐	No ☐
Retarder:	Automatic Dispenser:	Yes ☐	No ☐
Other Admixtures (Name & Type):	Automatic Dispenser:	Yes ☐	No ☐

VII. Central Mixer:	
Condition of Drum:	Condition of Blades:
Does Automatic Timing Device Meets Specifications:	Yes ☐ No ☐
Remarks:	

VIII. Truck Mixers:			
Trucks Equipped with Electronic Counters:	Yes ☐	No ☐	Number of Trucks Added to Fleet Since Last Inspection:
Number of Trucks Deleted From Fleet Since Last Inspection:			
Truck Mixers Now Failing to Meet Specifications:			
TRUCK NUMBER	REASON FOR FAILURE		

IX. Testing of Materials:			
Tests of Aggregates Performed at Plant by:	Qualified:	Yes ☐	No ☐
Does Testing Equipment Comply with Specifications:	Yes ☐	No ☐	
If "No", What Equipment Fails:			
Approved Test Weights Available in the Plant:	Yes ☐	No ☐	Date Last Checked:

X. General Condition of Plant:

XI. Any Further Remarks:

XII. Rating Assigned:	A ☐	B ☐	Plant Inspected By:
------------------------------	----------------------------	----------------------------	---------------------

Sample Plant Inspection Sticker

West Virginia Division of Highways	
CHECKED & ACCEPTED	
INSPECTOR: _____	
DATE: _____	
LAB NUMBER: _____	
DISTRICT: _____	
DATE OF EXPIRATION	
MONTH/DAY/YEAR _____/_____/_____	
PLANT / TRUCK	

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WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

GUIDE FOR APPROVAL OF COMPONENT AND SHIP LOOSE MATERIALS PERTAINING TO PRECAST AND PRESTRESSED CONCRETE ITEMS

1. PURPOSE

- 1.1. To set forth the procedures for the approval of component materials used in the fabrication of precast and prestressed concrete items and ship loose materials incidental to precast and prestressed concrete items.
 - 1.2. Ship loose materials are defined as the loose materials that are used in conjunction with various precast or prestressed concrete items. These ship loose materials are normally paid for under the same bid item number as the primary precast or prestressed concrete item.
 - 1.1.1 Materials such as (but not limited to) metal soil reinforcing devices, metal attachment devices, bearing pads, shims, and geotextile fabrics that are used for prestressed concrete beams, and retaining wall systems are classified as ship loose materials.
-

2. SCOPE

- 2.1. This procedure will apply to all precast concrete fabricators and prestressed concrete fabricators that supply material for use on West Virginia Division of Highways projects. It shall also apply to suppliers of any other precast concrete items (such as retaining wall system suppliers), which require the use of ship loose materials.

3. REFERENCES

- 3.1** MP 700.00.1 – Sampling and Testing of Materials at the Source
- 3.2** MP 709.04.40 – Acceptance Criteria for Steel Wire Reinforcement Used in Concrete.
- 3.3** AASHTO M 6 – Standard Specification for Fine Aggregate for Hydraulic Cement Concrete.
- 3.4** WVDOH Specifications – Sections 703, 703.4, and 715.7

2.4. DEFINITIONS

- 2.14.1** [APEAS: AASHTO Product Evaluation and Audit Solutions](https://transportation.org/product-evaluation-and-audit-solutions/)¹

3.5. SAMPLING

3.1.5.1. Approved Sources

3.1.1.5.1.1. With the exception of coarse and fine aggregate, component materials obtained from a West Virginia Division of Highways approved source and component materials pre-tested at the source in a manner set forth in MP 700.00.01 (or other established procedures) may be used at the precast, or prestressed concrete fabricator without further sampling and testing.

3.1.1.1.5.1.1.1. Any ship loose materials that are obtained from an approved source will not require any further sampling or testing. However, the approved source laboratory number shall be listed on all shipping documents related to that material.

3.1.2.5.1.2. All component materials that are not obtained from a Division approved source or otherwise pre-approved shall be sampled at the precast or prestressed concrete fabricator and subsequently tested. Ship loose materials that are not obtained from a Division approved source may be sampled at a variety of locations (material fabricator, precast concrete fabricator, material distributor, or whichever location is most convenient), but they must be sampled, tested, and approved prior to shipment to the project. All materials must meet the requirements of the appropriate section of the Specifications.

3.1.2.1.5.1.2.1. Certain ship loose materials may, at the discretion of MCS&T Division, be accepted based on certification rather than sampling and testing.

3.1.3.5.1.3. When AASHTO M 6 is the applicable specification for fine aggregate, natural sand shall meet the requirements of Class A with respect to material finer than the No. 200 (75 µm) sieve. Natural sand shall meet the remainder of the Class B requirements. All other fine aggregate types shall meet all of the requirements of Class B.

3.1.4.5.1.4. Mixing water for precast concrete items shall be tested in accordance with the requirements of Section 715.7 of the Specifications.

¹ <https://transportation.org/product-evaluation-and-audit-solutions/>

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3.2.5.2. Frequency of Sampling

3.2.1.5.2.1. Aggregates (both coarse and fine) and other component and ship loose materials not obtained from a Division approved source will be sampled by the Division, at the fabricator (or other location as noted in Section 53.1.2), as shown in Table 1.

TABLE 1

<u>Material</u>	<u>Sampling Frequency</u>	<u>Sample Size</u>
Cement	Semi-Annually	10 lb.
Pozzolan Additives	Semi-Annually	4 lb.
Fine Aggregate	Semi-Annually	25 lb.
Coarse Aggregate	Semi-Annually	110 lb.
Mixing Water	Semi-Annually	1 quart
Reinforcing Steel		
Epoxy	Annually	5 ft
Black Bar	N/A (Accepted on PEAS Compliance)	NA
Prestressing Steel	Only Sampled at the Source	N/A
Hot-Poured Elastic Type Concrete Joint Sealer	Only Sampled at the Source	N/A
Preformed Expansion Joint Filler	Only Sampled at the Source	N/A
Elastomeric Bearing Pads and Shims	Only Sampled at the Source	N/A
Welded Wire Fabric	Each Lot (if not PEAS Compliant)	1 pc. 3 ft x 3 ft
Bright Wire for Welded Wire Fabric	Reference MP 709.04.40 or in accordance with Q-Cast Certification Requirements	1 pc 5 ft
Concrete Sealant	Only Sampled at the Source	N/A
Steel Inserts & Miscellaneous Steel Hardware	Annually	2 Pieces
Asphalt Plastic Cement	Each Lot or at the Source	N/A
Metal Soil Reinforcing Strips	Each Lot (Either at the Source or At the Point of use Prior to Installation)	N/A (NDT of Random Pieces)
Geotextile Fabric	N/A (Accepted on PEAS Compliance)	N/A
Steel Diaphragms	N/A (Inspected at the Fabricator)	N/A

3.2.2.5.2.2. The fabricator may not use any component material in the fabrication process until the material has been shown to meet specifications. Until otherwise notified by the Division, the fabricator may continue to use materials that are sampled on a semi-annual basis (and that were approved during the prior sampling period) while these materials are being tested during the current sampling period.

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~~3.2.2.1.5.2.2.1.~~ An approved laboratory reference number shall be issued to each ship loose material that meets specifications. Approved laboratory reference numbers must be issued to all ship loose materials that are to be paid for under the same bid item number as a precast or prestressed concrete item before an approved laboratory reference number can be issued to that precast, or prestressed concrete item.

~~3.2.3.5.2.3.~~ At the time of component material sampling, the fabricator shall provide the Division with a current copy of each concrete mix design (and a list of all items that are produced from each mix design) that may be used in production of precast or prestressed concrete items for the Division during the next six months.

~~3.3.5.3.~~ Non-Specification Material

~~3.3.1.5.3.1.~~ If a material is removed from the Division's approved list, use of that material shall be immediately discontinued, and the material shall be sampled and tested in the same manner as any other material that is not on the approved list (i.e. it shall be sampled and tested at the frequency shown in Table 1) until it regains status on the Division's approved list.

~~3.3.2.5.3.2.~~ If tests conducted on a component material sample indicate that one or more properties of a material do not meet specification requirements, the Division shall immediately notify the fabricator. Upon receipt of this notification, the fabricator shall discontinue the use of the component material in question until further notice by the Division.

~~3.3.3.5.3.3.~~ If an amount of material finer than the No. 200 (75 μ m) sieve, greater than what is allowed by Section 703.4 of the Specifications, is present in either the coarse or fine aggregate, then the total amount of material finer than the No. 200 (75 μ m) sieve for the entire mix shall be evaluated. The fabricator shall have previously provided a copy of all mix designs as outlined in section ~~53.2.3~~, and the total amount of material finer than the No. 200 (75 μ m) sieve for the entire mix will be evaluated as outlined in section ~~53.3.3.1~~.

~~3.3.3.1.5.3.3.1.~~ As long as the total percentage of material finer than the No. 200 (75 μ m) sieve present in the entire mix does not exceed the total percent of material finer than the No. 200 (75 μ m) that would exist if both aggregate fractions in the mix contained their specified maximum percentage passing the No. 200 (75 μ m) sieve, then that combination of aggregates will be considered as meeting Section 703.4 of the Specifications.

~~3.3.4.5.3.4.~~ If it is determined that a ship loose material does not meet Section 703.4 of the Specifications, use of that ship loose material shall not be permitted.

~~3.4.5.4.~~ Re-Testing of Non-Specification Component Material

~~3.4.1.5.4.1.~~ When tests of the first sample indicate that one or more properties of a material do not meet specification requirements, the Division shall re-sample the material as soon as possible after the fabricator has taken corrective action, and one of the following two scenarios will occur (section ~~53.4.1.1~~ or ~~53.4.1.2~~).

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~~3.4.1.1~~5.4.1.1. If the second sample meets Section 703 of the Specifications, the Division will immediately notify the fabricator. Upon notification, the fabricator may resume the use of this component material.

~~3.4.1.2~~5.4.1.2. If the second sample does not meet Section 703 of the Specifications, the Division will immediately notify the fabricator, but the Division will not re-sample the material in question (from the particular source that did not meet specifications) until the next sampling period specified in Table 1 only after corrective action has been taken by the fabricator. Until a sample is obtained that meets specifications component material may not be used.

~~3.4.2~~5.4.2. Once a component material in question has been shown to not meet specifications by more than one sample and test, the Division will only re-sample that component material once during the next sampling period (as set forth in Table 1), and one of the following two scenarios will occur (section ~~53~~.4.2.1 or ~~53~~.4.2.2).

~~3.4.2.1~~5.4.2.1. The material is sampled again during the next sampling period, and it meets specifications. The use of this component material may be resumed.

~~3.4.2.2~~5.4.2.2. The material in question is sampled again during the next sampling period, and again it does not meet specifications. The Division will not re-sample the material in question again until the next sampling period specified in Table 1 (see section ~~53~~.4.2). Until a sample is obtained that meets specifications the component material may not be used.

~~3.4.3~~5.4.3. For an aggregate in which an excessive amount of material finer than the No. 200 (75 µm) sieve is the only reason for not meeting specifications, there are two possible scenarios. When the first scenario, given in section ~~53~~.3.3.1, occurs, that particular combination of fine and coarse aggregate will be considered as meeting specifications. The second scenario is if the total percentage of material finer than the No. 200 (75 µm) sieve present in the entire mix exceeds the total percent of material finer than the No. 200 (75 µm) sieve that would exist if both aggregate fractions in the mix contained their specified maximum percentage passing the No. 200 (75 µm) sieve. In this case, that particular combination of fine and coarse aggregate will be considered as not meeting Section 703.4 of the Specifications. When this second scenario occurs, the Division shall immediately notify the fabricator. Upon receipt of this notification, the fabricator shall discontinue the use of this combination of material until further notice by the Division. Situations in which the second scenario occurs will be handled as outlined in section ~~53~~.4.4.

~~3.4.4~~5.4.4. During any re-sampling of a failing combination of aggregates, both the fine and coarse aggregate shall be re-sampled (so that a current evaluation of the total amount of material finer than the No. 200 (75 µm) sieve present in the entire mix may be performed). The Division will re-sample both the fine and coarse aggregate as soon as possible, and one of the following two scenarios will occur (section ~~53~~.4.4.1 or ~~53~~.4.4.2).

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~~3.4.4.1.~~5.4.4.1. If the second sample meets Section 703.4 of the Specifications, the Division will immediately notify the fabricator and the fabricator may resume the use of this combination of fine and coarse aggregate.

~~3.4.4.2.~~5.4.4.2. If the second sample does not meet specifications (as outlined in section ~~53.3.3.1~~53.3.3.1), the Division will immediately notify the fabricator, but the Division will not re-sample that combination of fine and coarse aggregate until the next sampling period specified in Table 1 (see section ~~53.4.2~~53.4.2). Until a sample is obtained that meets Section 703.4 of the Specifications, this non-specification combination of fine and coarse aggregate may not be used.

~~4.6.~~4.6. ALTERNATE MATERIALS

~~4.1.6.1.~~4.1.6.1. The prestressed or precast concrete fabricator may use a different source of material if the current material has been shown to not meet specifications.

~~4.1.1.6.1.1.~~4.1.1.6.1.1. This new material shall be sampled as set forth in section ~~53.0~~53.0 or ~~53.2~~53.2 (whichever is applicable).

~~4.1.2.6.1.2.~~4.1.2.6.1.2. In the case of component materials, new concrete mix design (in the case of prestressed items) containing this material shall be approved by the Division prior to the use of this new material. In the case of precast items, a new mix design containing this material shall be provided to the Division at the time of sampling.

~~4.2.6.2.~~4.2.6.2. If either a new source of coarse or fine aggregate is used because of an inability of the former combination of material to meet specifications due to an excessive amount of material finer than the No. 200 (75 µm) sieve, both the coarse aggregate and fine aggregate portions of this new combination shall be re-sampled and evaluated as set forth in section ~~53.4.3~~53.4.3.

Michael A. Mance PE,
Interim Director
Materials Control, Soils & Testing Division

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

TEST METHOD FOR THE DETERMINATION OF BOND STRENGTH BETWEEN
PRESTRESSING STEEL STRAND AND SELF-CONSOLIDATING CONCRETE (SCC)

1. PURPOSE

- 1.1 To establish a test method for the determination of the bond strength between prestressing steel strand and self-consolidating concrete (SCC).
-

2. SCOPE

- 2.1 The test method set forth in this MP shall be used as part of the mix design qualification and approval process for SCC mixes used in the fabrication of prestressed concrete bridge members fabricated for the WVDOH.
-

3. REFERENCES

- 3.1 AASHTO M 203- Standard Specification for Steel Strand, Uncoated Seven-Wire for Concrete Reinforcement.
-

3.4. PETERMAN BEAM TEST

- 3.14.1 The Peterman Beam Test shall be used to determine the bond capacity of AASHTO M203 Grade 270 0.520-inch (½-inch “oversize”) diameter 7-wire steel strand (area of steel = 0.167 in²) and AASHTO M203 Grade 270 0.600-inch diameter 7-wire steel strand (area of steel = 0.217 in²) when used in conjunction with SCC. Each size of strand which will be used during the fabrication of prestressed concrete bridge members for the WVDOH must be tested.
- 3.24.2 An 8-inches wide x 6-inches tall x 11-ft 6-inches long concrete test beam, containing a single prestressing strand of the size being qualified, shall be constructed as shown in Figures 1, 2, & 3. The SCC mix being qualified and the Fabricator’s standard batching, placement, curing, and de-tensioning methods shall be used to fabricate this test beam. The single prestressing strand shall be embedded along the centerline of the beam at a depth of 4.5-inches from the top.

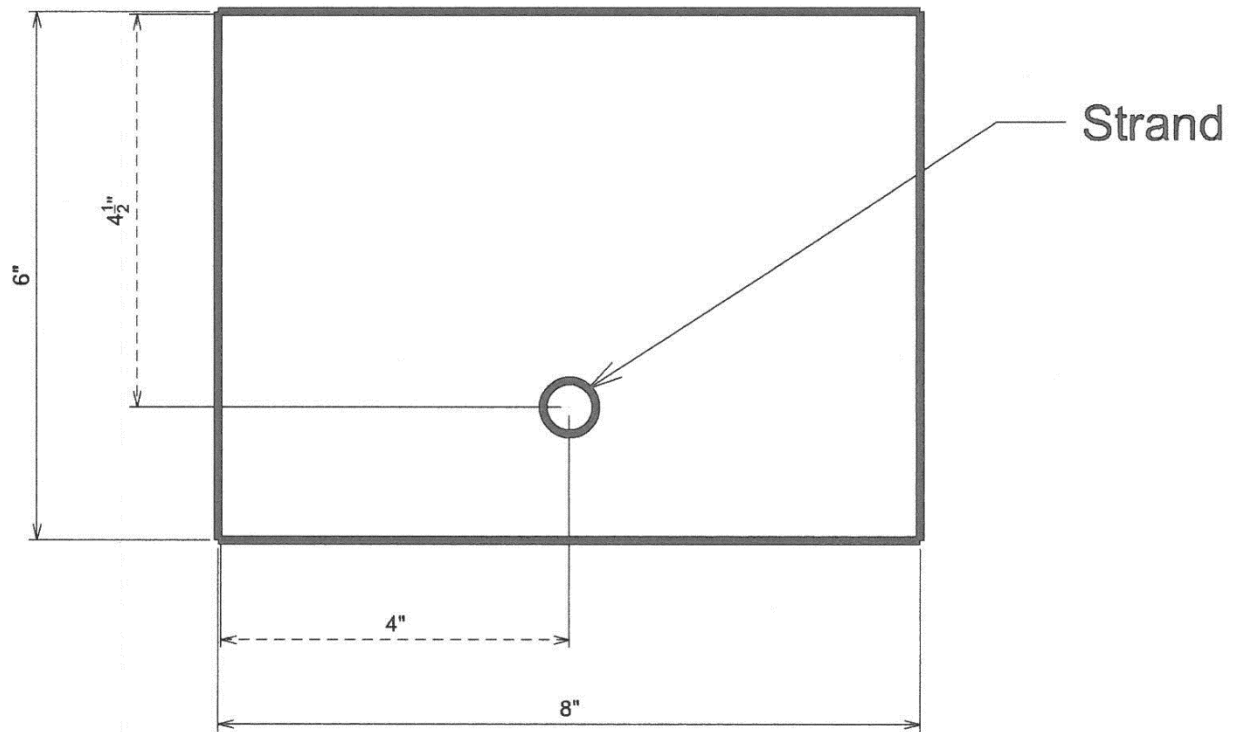


Figure 1. This drawing shows a cross section of the quality assurance test beam.
(1 in = 25.4 mm) Dimensional tolerance: +/- 1/8 inch

- 3.34.3 After de-tensioning, the ends of the strand shall be ground flush with the concrete at the ends of the test beam. Figure 1 shows the cross section at the end of beam.
- 3.44.4 Once 28-day design strength has been achieved, gradually load the test beam to $P_{85\%}$, which is the load necessary to produce 85% of the calculated nominal moment capacity of the section as shown in Figure 2. This can be accomplished by slowly lowering concrete dead-weight blocks using a forklift or other lifting device. The use of nylon slings to suspend the blocks facilitates the gradual loading process as the nylon stretches during the loading process. Alternatively, several smaller weights may be sequentially loaded onto the beam.

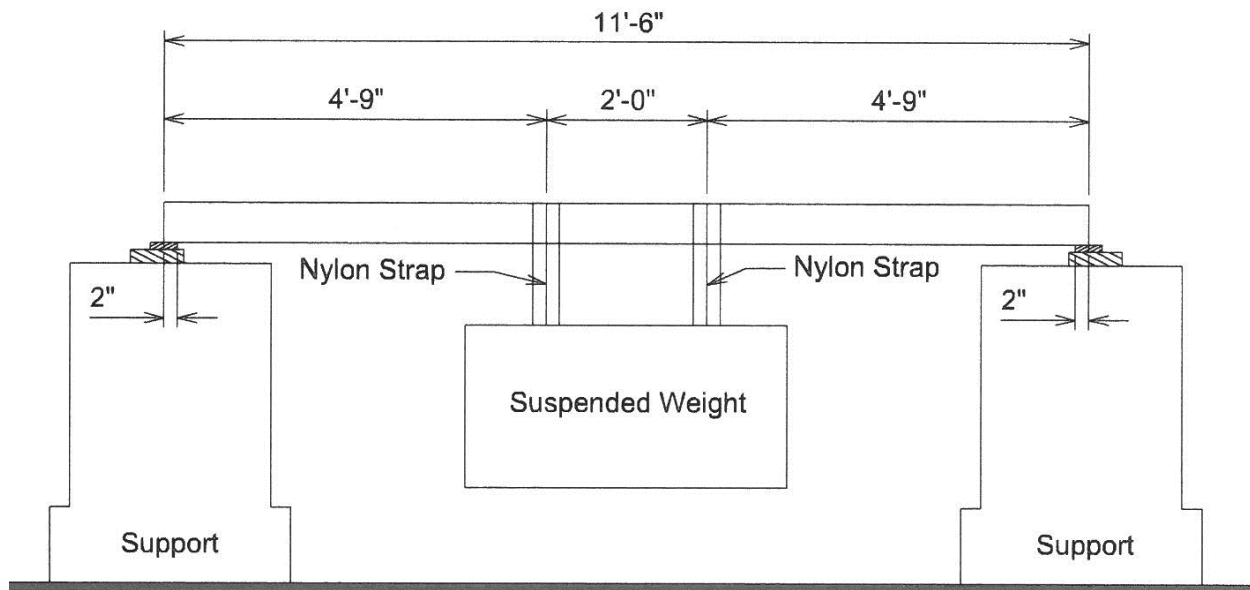


Figure 2. Test Setup

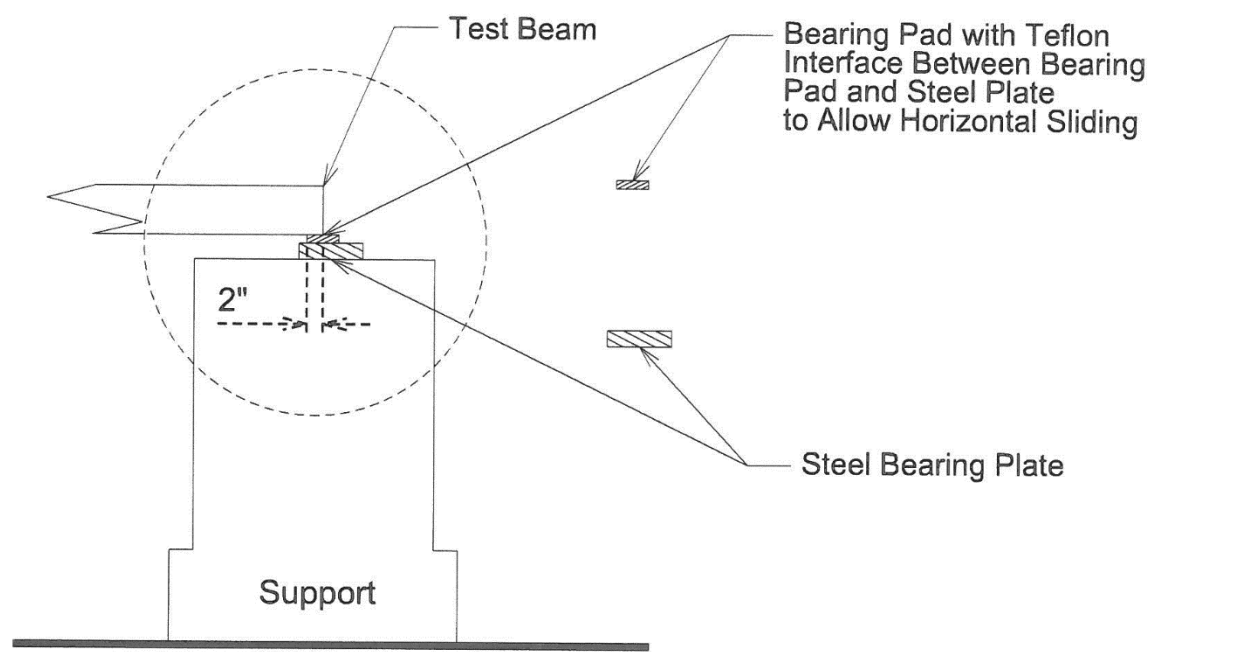


Figure 3. The test setup can be with neoprene bearing pads and bearing plates at each end, or one end of the test setup can have a slide bearing or roller (3 inches diameter minimum), while the other end has a standard neoprene bearing pad. The bearing pad (1 inch thickness minimum) has a Teflon interface on top of a stainless-steel bearing plate (1/2 inch thickness minimum). When this test is carried out at an actual facility, a protective fence and other safety measures should be used. (1 in = 25.4 mm. 1 ft = 0.305m). Dimensional Tolerance: $\pm 1/4$ inch

- 3.54.5 Inspect the beam and document cracks and strand end-slip if present. With the ends of the strand ground initially flush with the end of the beam end, additional strand slip can be visually detected by noting any draw-in at the ends.
- 3.64.6 Sustain the load for a minimum of 24 hours to see if there are increasing signs of distress, such as increased strand slippage at the ends, increased cracking, concrete crushing, and the like.
- 3.74.7 Load the beam with the additional 15% of the load ($P_{15\%}$) which will give the total load ($P_{100\%}$) required to give a full nominal moment (M_n) of the section and hold that load for at least 10 minutes. If the beam has not collapsed, it has successfully passed the test, and the SCC mix being qualified shall be considered to have acceptable bonding characteristics to the size of strand being tested.
- 3.84.8 Tables 1 and 2 are the prescribed loads for specified compressive strengths ~~of concrete for Areas of Steel Reinforcement of 0.167 inch² and 0.217 inch² respectively.~~ Note the specified minimum compressive strength of concrete at the time of initial prestress is 4000 psi.

Table 1. Prescribed Loadings for Reinforcement Area of 0.167 inch² per specified compressive strength.

f_c (psi)	$P_{85\%}$ (lbs)	$P_{15\%}$ (lbs)	$P_{100\%}$ (lbs)
5000	4440	840	5280
6000	4560	860	5420
7000	4650	880	5530
8000	4720	890	5570
9000	4770	900	5670
10000	4820	910	5730

Table 2. Prescribed Loadings for Reinforcement Area of 0.217 inch² per specified compressive strength.

f_c (psi)	$P_{85\%}$ (lbs)	$P_{15\%}$ (lbs)	$P_{100\%}$ (lbs)
5000	5580	990	6570
6000	5780	1020	6800
7000	5920	1040	6960
8000	6020	1060	7080
9000	6100	1080	7180
10000	6170	1090	7260

Michael A. Mance, P.E.
Director
Materials Control, Soils and Testing
Division

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WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

INSPECTION AND ACCEPTANCE PROCEDURES
FOR PRESTRESSED CONCRETE BRIDGE MEMBERS

1. PURPOSE

- 1.1 To set forth procedures for the inspection and acceptance of prestressed concrete bridge members, including beams, pier caps, deck panels, and any other prestressed members, and the approval of the plants at which they are fabricated.

2. SCOPE

- 2.1 This procedure will apply to all prestressed concrete bridge members supplied for use on West Virginia Division of Highways projects and to all prestressed concrete bridge member fabricators that supply material for use on West Virginia Division of Highways projects.

3. REFERENCED DOCUMENTS

- 3.1 MP 603.02.10 - Guide for Approval of Component Materials at Precast and Prestressed Concrete Plants

- 3.2 MP 700.00.30 - Certification of Batch Scales and Calibration of Standard 50 Pound Test Weights

- 3.23.3 WVDOH Specifications – Section 109.20.1
-

4. INSPECTION

- 4.1 All prestressed concrete bridge member fabricators (hereafter referred to as the Fabricator) shall be approved by Materials Control, Soils and Testing MCS&T Division prior to the start of any work for the WVDOH. If not listed on the WVDOH Approved List of Precast Concrete Fabricators, a Fabricator shall contact MCS&T Division a minimum of six weeks prior to the planned date on which fabrication is to begin.

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- 4.1.1 The process for approving a Fabricator shall include, but not be limited to, an on-site visit to the fabrication plant by a WVDOH representative from MCS&T Division. During this visit, the WVDOH Quality Assurance (QA) personnel shall inspect the fabrication facility and Quality Control (QC) lab, meet with QC and other key personnel from the Fabricator, and sample component materials which will be used in fabrication of precast items. In addition, all fabricators must set up their invoicing as an E-Ticket that meets the requirements of Section 109.20.1 of the Specification prior to approval.
- 4.1.2.1 Sampling and testing of component materials shall be done in accordance with MP 603.02.10. All component materials shall be approved prior to the start of fabrication. Batch scales shall be calibrated in accordance with MP 700.00.30 at a minimum once per year.
- 4.1.2.2 Shipping invoices shall document the assigned Laboratory Reference Number, type of material, number of pieces, size, and cast dates. All Division invoicing must be submitted as an E-Ticket to the project that meets the requirements of Section 109.20.1 of the Specifications.
- 4.1.2.3 Any fabricator which does not produce for the WVDOH for a period of 2 years shall be removed from the approved fabricator list and the fabricator will need to be approved again before they can do work. Sampling of component materials will not continue when the plant is removed from the approved fabricator list.
- 4.1.2.4 Personnel from the Fabricator required to be present during the initial on-site visit and meeting between WVDOH and Fabricator personnel shall include representatives from Production and Quality Control. Any questions and concerns regarding WVDOH requirements, including applicable Specifications, Materials Procedures, Standard Details, and QC/QA Inspections shall be addressed at this meeting.
- 4.1.2.5 Prior to beginning fabrication of any prestressed concrete bridge members, the Fabricator shall provide written notification to MCS&T Division at least one calendar week in advance of the date on which fabrication is to begin. After fabrication has begun, the Fabricator shall keep MCS&T Division and the Inspector (whether a WVDOH employee or a contract employee representing the WVDOH) informed in advance of the days on which fabrication will take place.
- 4.1.2 Shop Drawings must be approved by the West Virginia Division of Highways prior to the start of any work by the Fabricator. The Inspector must have a copy of these approved shop drawings prior to the start of any work by the Fabricator.

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- 4.1.3 The Inspector, as a minimum, shall be registered with the Precast/Prestressed Concrete Institute (PCI) as a Level II Quality Control Technician.
- 4.2 The Inspector shall be present at any or all times during fabrication including casting bed layout, steel placement, stressing operations, concrete testing, placing, and finishing, detensioning operations, camber measurements, testing hardened concrete cylinders, post-pour inspections, and repairs.
- 4.2.1 Fabricators must provide adequate lighting to illuminate the casting bed to allow for visual inspection of the entire rebar assembly and setup. Fabricators must make forms safely accessible for visual inspection of the setup down in the form for the entire length of the bed.
- 4.3 After fabrication is completed and prior to shipment, the Fabricator shall provide MCS&T Division with a written request for Final Inspection a minimum of one calendar week prior to the desired date of inspection. This written request may be in the form of an e-mail. Upon receipt of the written request for Final Inspection from the Fabricator, MCS&T Division will notify the Fabricator of the earliest possible date of this inspection. Effective communication from the Fabricator to MCS&T Division and Consultant Inspection Agency is key to avoiding any scheduling conflicts regarding Final Inspection.
- 4.4 At Final Inspection, the Inspector shall witness any compressive strength tests which may be required, inspect repairs as needed, and conduct a thorough visual examination of each member. After the Final Inspection is completed, the Inspector shall provide the Fabricator with a copy of the inspection report. This report shall include the findings of the Final Inspection and any other observations or notes taken by the Inspector during fabrication, including a completed copy of the Inspector's checklist. A copy of the Inspector's daily reports, a copy of the final inspection report, and all other pertinent information provided to the Inspector by the Fabricator shall be kept on file by MCS&T Division.
- 4.5 The Inspector shall use the checklist and inspection forms which are included as Attachments to this MP. The Fabricator shall also document all required information on the applicable Attachments.

5. ACCEPTANCE

- 5.1 Upon completion of the inspection of a member, the subject member shall be classified in one of two ways. The first way is that the member does not contain any defects. The second way is that the member contains some type of defect.

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- 5.1.1 If a member meets all specification requirements and does not contain any defects, the Inspector will stamp the subject member as accepted by MCS&T Division.
- 5.2 If a member contains some type of defect, it will be classified into one of the following three categories. These categories are Category I (Cosmetic Defects), Category II (Dimensional Tolerances), and Category III (Structural Defects).
 - 5.2.1 Category I defects include cosmetic defects such as minor spalls with no exposed reinforcing steel or prestressing strand, bug holes, and minor surface irregularities, etc. Category I defects also include cracks up to and including 16 mils in width for which repair procedures are addressed by the standard specifications. Prior to the start of fabrication, the Fabricator shall submit to MCS&T Division, for approval, the proposed repair procedures for Category I defects which may be encountered.
 - 5.2.1.1.0 Any Category I defect(s) will first be noted by the Inspector and may be subsequently repaired by the Fabricator as per the Fabricator's pre-approved repair procedure. The Inspector shall inspect the repair(s), and if the repair(s) is satisfactory, and if all other aspects of the member meet specifications, the Inspector will stamp the subject member as accepted by MCS&T Division.
 - 5.2.2 Category II addresses any aspect of a member which exceeds the dimensional tolerances set forth in the Specifications. The Inspector will document the variance(s) and notify the Fabricator. At this point, the Fabricator may seek acceptance of the subject member by sending a written notification to the Contractor including a copy of the Inspector's report and any other pertinent data.

If the Contractor agrees to accept the subject member with the defect at the original contract price, then the Contractor shall provide a written statement to District Construction personnel and MCS&T Division stating such.
- 5.2.2.1 The Contractor, or his designated representative (i.e. the Fabricator), shall then contact MCS&T Division and provide them with a report containing all relevant information and a detailed summary of the dimensional variation(s) in the subject member for which the Fabricator is seeking acceptance. MCS&T Division shall then contact the Designer (either Engineering Division, or the appropriate District, or Engineer of Record) and District Construction personnel and forward this information to them. If the member was designed by a Consultant, Engineering Division may forward the information to the appropriate Consultant. The Designer will then analyze the dimensional variation(s) and provide a written statement to the Contractor, the Fabricator, MCS&T Division, and District Construction personnel as to whether it will affect the structural performance of the subject member. After receipt of that statement from the Designer,

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District Construction personnel shall then provide a written statement to the Contractor, the Fabricator, and MCS&T Division as to whether the dimensional variation will create construction difficulties.

5.2.2.2 If the Designer states that this dimensional variation(s) will adversely affect the structural performance of the member, or if District Construction states that it will create construction difficulties, or if the Contractor does not agree to accept the subject member with the defect at the original contract price, MCS&T Division will not accept the subject member. MCS&T Division will assign a laboratory number to this subject member, which notes that the member does not meet specifications, and will include a thorough explanation as to why the member does not meet specification requirements. If rejected by MCS&T, the subject member may be accepted by the District by means of a District Materials Inspection Report (DMIR).

5.2.2.3 If the Designer does not feel qualified to perform the analysis outlined in Section ~~4.2.2~~ 5.2.2 and make the decision as to whether the dimensional variation will affect the structural performance of the subject member, the Designer shall inform MCS&T Division of this fact, and MCS&T Division will relay this to the Fabricator. The Fabricator may then elect to have the defect(s) evaluated by a Division approved, qualified, independent Engineer in the same manner that the Designer would analyze the defect(s). The Division would then review and take into consideration this Engineer's analysis as part of the acceptance decision.

~~5.2.25.2.3~~ Category III defects include structural defects (spalls that expose prestressing strand or reinforcing steel, honeycombed areas, etc.) and cracks for which the specifications require evaluation by the Designer. If a member contains any structural defect(s), the defect(s) will be noted in the Inspector's report. The Fabricator shall then provide the Contractor with detailed information regarding the type, size, and location of the defect(s). It is then the Contractor's, or his designated representative's, responsibility to contact MCS&T Division and provide them with a report containing all relevant information and a detailed summary of the structural defect(s) in the subject member for which the Fabricator is seeking acceptance. MCS&T Division shall then contact the Designer (either Engineering Division, or the appropriate District) and forward this information to them. MCS&T Division shall also contact District Construction to inform them of the situation. In situations when the member(s) was designed by a Consultant, Engineering Division may forward the information to the appropriate Consultant. The Designer will then analyze the subject defect(s) and provide a written statement to the Contractor, the Fabricator, District Construction, and to MCS&T Division as to the effect of the defect(s), if the member will be structurally adequate, if a repair may be made, and if, in the Designers opinion, the service life of the member will be reduced because of the defect. It shall also be documented in the Inspector's

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report whether, in the opinion of the Inspector, the service life of the member will be reduced because of the defect.

~~5.2.2.1~~5.2.3.1 If the Designer does not feel qualified to make the decision concerning the effect of the defect(s), they shall inform MCS&T Division of this fact, and MCS&T Division will relay this to the Fabricator. The Fabricator may then elect to have the defect(s) evaluated by a Division approved, qualified, independent Engineer in the same manner that the Designer would analyze the defect(s). The Division would then review and take into consideration this Engineer's analysis as part of the acceptance decision.

~~5.2.2.2~~5.2.3.2 Category III defect Scenario 1 – Category III defect which will adversely affect the structural performance of the member:

If the Designer states that the defect(s) will adversely affect the structural performance of the subject member, the Division will not accept the subject member.

~~5.2.2.3~~5.2.3.3 Category III defect Scenario 2 – Category III defect which will not adversely affect the structural performance of the member and will not reduce the service life of the member:

If the Designer states that the defect(s) will not adversely affect the structural performance of the subject member, and that a repair should be made, and if MCS&T Division and the Designer agree that the service life of the member will not be reduced, the Fabricator shall submit a repair procedure to MCS&T Division for approval. If the repair procedure is approved, the Fabricator may proceed with the approved repairs in the presence of the Inspector. If the repair(s) is satisfactory, the Inspector will stamp the subject member as accepted by MCS&T Division.

~~5.2.2.4~~5.2.3.4 Category III defect Scenario 3 – Category III defect which will not adversely affect the structural performance of the member, but which will reduce the service life of the member:

If the Designer states that the defect(s) will not adversely affect the structural performance of the subject member, and that a repair should be made, but if either MCS&T Division or the Designer feels that the service life of the member will be reduced, the Fabricator may submit a repair procedure to MCS&T Division for approval. If the repair procedure is approved, the Fabricator may proceed with the approved repairs in the presence of the Inspector. After the inspection of the repair(s), the Inspector will document whether the repair(s) is satisfactory. Since the service life of the member will be reduced, MCS&T Division will not accept the subject member. MCS&T Division will assign a laboratory number to this

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member, which notes that the member does not meet specifications, and will include a thorough explanation as to why the member does not meet specification requirements. MCS&T Division will then contact District Construction, forward all information relevant to the subject member to the District, and based on the quality of the repairs and the degree to which the service life of the member will be reduced, it is the District's option whether or not to accept the subject member. If the District decides to accept the member it will be paid for at a reduced price based on 40% of the Contract Unit Bid Price. . This cost does not include the cost of items such as bearing pads, guardrail items, delivery charges, etc., which are incidental to the cost of the member. If the District accepts the subject member with this type of defect and reduced service life, it shall be accepted by means of a DMIR.

Michael A. Mance, P.E.
Director
Materials Control, Soils and Testing Division

| MAM:~~A~~T
MP 603.10.40 Steward – Cement and Concrete Section
ATTACHEMENT

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ATTACHMENT: PRESTRESSED CONCRETE BRIDGE BEAMS WVDOT DIVISION OF HIGHWAYS MCS&T DIVISION *INSPECTION CHECKLIST*

PROJECT NAME: _____ AUTHORIZATION: _____
PROJECT NUMBER: (State) _____ (Fed.) _____
BRIDGE NUMBER: _____ COUNTY: _____ DISTRICT: _____
MANUFACTURER: _____ JOB NUMBER: _____
PROPOSED PRODUCTION DATE(S): _____
INSPECTION AGENCY: _____ INSPECTOR(S): _____

Preliminary Verifications

SHOP DRAWING REVIEW

Approval Date: _____ Approved By: _____
Concrete Strength Requirements: _____ at release _____ at 28 days
Beam Type: _____ Total Number of Beams: _____
Finish Requirements: Top: _____ Bottom/Sides: _____ Ends: _____
Notes: _____

CONCRETE COMPONENTS

Cement Source: _____ Mix Design Lab Number: _____
Cement Type: _____ Lab Number: _____
Coarse Aggregate: _____ Lab Number: _____
Fine Aggregate: _____ Lab Number: _____
Batch Water Source: _____ Lab Number (if applicable): _____
Admixtures: _____

STEEL COMPONENTS

Bearing Plate: Fabricator: _____
Mill Certs: _____ Galvanize Cert.: _____ Lab Number: _____
Reinforcement: Supplier(s): _____
Description: _____ Lab Number: _____

Prestressing Strand: Manufacturer: _____ Description: _____
Coil Numbers: _____
Lab Numbers: _____

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Inserts: _____

Supplier(s): _____

Description: _____ **Lab Number:** _____

SHIPLOOSE MATERIAL

Sole Plate: Fabricator: _____

Mill Certs.: _____ **Galvanize Cert.:** _____ **Lab Number:** _____

Bearing Pad: Fabricator: _____

Inspected at: _____ Lab Number: _____

Diaphragm: Fabricator: _____

Inspected at: _____ Lab Number: _____

Angles: Mill Certs.: _____ Galvanize Cert.: _____ Lab Number: _____

Anchor Rod: **Supplier:** _____ **Description:** _____

Mill Certs.: _____ Galvanize Cert.: _____ Lab Number: _____

Repairs: **Approved Repair Procedure:** _____

Approved by: _____ Approval Date: _____

Repair Witnessed: _____

Repair Satisfactory? _____

Comments:

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Form Inspection (*Pre-Placement*)

BEAM NUMBER					
Formwork constructed of metal w/ concrete foundation					
Form clean & free of debris					
Form dimensionally correct					
Length (bulkhead to bulkhead)					
Depth of form					
Width at top flange					
Width at bottom flange					
Width of web					
End square					
Skew dimensions					
Location of inserts, sleeves, blockouts, etc.					
Reinforcing steel (condition)					
Size and grade					
Location & lapping lengths					
Spacing & Clearances					
Chairs, spacers properly used					
Hold Down locations (draped strand)					
Form properly sealed at joints & edges					
Release agent applied					
Strand Placement					
Number of strand					
Strand location (vertical & horizontal)					
Strand free of damage or contaminants					
Strand Tensioning					
Jack & gauge calibration					
Initial load					
Final Load					
Elongation					
Theoretical vs. Actual (within 5%)					
Strand symmetrically loaded					
Check for strand slippage					
Bearing plate location					

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Concrete Placement

Ambient temperature, weather conditions					
Concrete Temperature					
Concrete quality (appearance)					
Placement (start/completion times)					
1 st Lift					
2 nd Lift					
3 rd Lift					
QC Tests performed per specification					
Slump					
Air content					
Compressive strength cylinders					
Concrete placed within specified time restrictions					
Concrete properly vibrated					
External vibration applied					
Internal vibration per specification					
Top surface per specification					
Lifting loops per specification					
Curing per specification					
Heat sensors properly installed					
Beams adequately covered					
Compressive strength cylinders stored with beams					
Stress Transfer					
Cylinders loaded to failure per specification					
Release strength met – record average of 2 tests (psi)					
Strands properly cut					
Strands detensioned in specified sequence					

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Product Inspection (*Post-Placement*)

Visual inspection for damage					
Note size & location of cracks, spalls, honeycomb, etc.					
Discuss damaged areas with QC Manager					
Beams in need of repair					
Repair method approved?					
Dimensional Tolerances met?					
Length					
Width(s)					
Depth					
Inserts, sleeves, etc.					
Stirrups (horizontal. & vertical within tolerance)					
Finish per specification					
Top scored per specification					
Fascia finish as specified					
Camber					
Lifting loops OK					
Beams properly transported					
Beams stored on proper dunnage at bearing points					
Sweep					
Design shipping strength (28 day) met? (avg of 2 tests)					
Repairs satisfactory					
Beam stamped for shipment					
Concrete Sealer (Silane) applied as specified					
Interior Sides blast cleaned (within 5 days of shipment)					

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

INSPECTION AND ACCEPTANCE PROCEDURES
FOR PRECAST CONCRETE PRODUCTS

1. PURPOSE

- 1.1. To set forth procedures for the inspection and acceptance of precast concrete products, including inlets, manholes, box culverts, 3-sided bridge units, retaining wall panels, headwalls, wingwalls, lagging, junction boxes, and any other precast products, and the approval of the plants at which they are fabricated.
-

2. SCOPE

- 2.1. This procedure will apply to all precast concrete products supplied for use on West Virginia Division of Highways projects and to all precast concrete product fabricators that supply material for use on West Virginia Division of Highways projects.
- 2.2. For prestressed concrete members refer to MP 603.10.40 "Inspection and Acceptance Procedure for Prestressed Concrete Bridge Beams."

3. REFERENCES

- 3.1. AASHTO T 303 – Standard Method of Test for Accelerated Detection of Potentially Deleterious Expansion of Mortar Bars Due to Alkali-Silica Reaction
 - 3.2. AASHTO R 100 – Standard Practice for Casting and Curing Concrete Strength Test Specimens in the Field
 - 3.3. ASTM C497 – Standard Test Method for Concrete Pipe, Concrete Box Sections, Manhole Sections, or Tile
 - 3.4. ASTM C642 – Standard Test Method for Density, Absorption, and voids in Hardened Concrete
 - 3.5. ASTM C1577 – Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASTO LRFD
 - 3.6. ASTM C1610 – Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique
 - 3.7. ASTM C1611 – Standard Test Method for Slump Flow of Self-Consolidating Concrete
 - 3.8. MP 106.03.50 – General Information Guide for Technician and Inspector Certification Program (TICP)
 - 3.9. MP 603.02.10 – Guide for Approval of Component and Ship Loose Materials Pertaining to Precast and Prestressed Concrete Items
 - 3.10. MP 700.00.30 – Certification of Batch Scales and Calibration of Standard 50 Pound Test Weights
 - 3.11. WVDOH Specifications – Sections 109.20.1 and 601.3.1.1
-

3.4. FABRICATOR APPROVAL

- 3.1.4.1. All precast concrete product fabricators (hereafter referred to as the Fabricator) shall be approved by Materials Control Soils and Testing MCS&T Division prior to the start of any work for the WVDOH. If not listed on the WVDOH Approved List of Precast Concrete Fabricators, a Fabricator shall contact MCS&T Division a minimum of six weeks prior to the planned date on which fabrication is to begin to initiate the approval process.
- 3.2.4.2. In order for a Fabricator to be approved and listed on the WVDOH Approved List of Precast Concrete Fabricators, they must be NPCA (National Precast Concrete Association) certified, QCAST (American Concrete Pipe Association) Certified, or have an equivalent type of certification.

- 3.2.4.2.1. All fabricators must set up their invoicing as an E-Ticket that meets the requirements of Section 109.20.1 of the Standard Specification prior to approval.
- 3.3.4.3. The process for approving a Fabricator shall include, but not be limited to, an on-site visit to the fabrication plant by a WVDOT representative from MCS&T Division. During this visit, the WVDOT Quality Assurance (QA) personnel shall inspect the fabrication facility, the Quality Control (QC) lab, and meet with QC and other key personnel from the Fabricator. Component materials which will be used in the fabrication of precast items shall be sampled for testing. Batch scales shall be calibrated in accordance with MP 700.00.30 at a minimum once per year.
- 3.3.4.3.1. Sampling and testing of component materials shall be done in accordance with MP 603.02.10. Copies of recent component delivery tickets should be presented on the day of sampling. All component materials must be approved prior to the start of fabrication.
- 3.3.4.3.1.1. At the discretion of the MCS&T Director, any Fabricator which does not produce for the WVDOT or Project utilizing WVDOT Specifications for a period of 2 years shall be removed from the Approved Fabricator list. After removal from the approved list, before a Fabricator can again produce for the WVDOT, they must repeat the approval process. Sampling of component materials will not continue when the plant is not listed on the Approved Fabricator list.
- 3.3.4.3.2. Personnel from the Fabricator required to be present during the initial on-site visit and meeting between WVDOT and Fabricator shall include representatives from Production and Quality Control. Any questions and concerns regarding WVDOT requirements, including applicable Specifications, Materials Procedure (MP's), Standard Details, and QC/QA Inspections shall be addressed at this meeting.
- 3.3.4.3.3. The Fabricator must submit the Quality Control Manual/Plan for review at this meeting.
- 3.4.4.4. All Concrete Mix Designs which will be used on products fabricated for the WVDOT must be submitted for review & approval, prior to the start of fabrication. Any design mix with an aggregate(s) that has a reactivity classes R1, R2, or R3, as shown as in Approved Aggregates Source List, shall be developed in accordance with WVDOT specifications, 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 WVDOT 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 WVDOT project.
- 3.5.4.5. The Fabrication Plant QC Personnel, as a minimum, shall be a certified ACI Grade I Concrete Field Testing Technician and meet the requirements of Section 14 of MP 106.03.50 or hold current WVDOT PCC Inspector Certification. In addition, if Self-Consolidating Concrete (SCC) is used, Fabrication Plant QC Personnel shall be a certified ACI SCC Testing Technician.

3.6.4.6. All Precast Concrete items shall be accepted by Direct or Master Coverage except when a Fabricator is certified as an Approved Source of concrete lagging as defined in Section 87.

4.5. **FABRICATION & INSPECTION OF PRODUCTS FOR DIRECT & MASTER COVERAGE**

4.1.5.1. Prior to beginning fabrication of any precast concrete products, the Fabricator shall provide written or email notification to MCS&T Division at least one calendar week in advance of the date on which fabrication is to begin.

4.1.1.5.1.1. Depending upon the precast items being fabricated, MCS&T Division may choose to monitor fabrication. Fabrication of structurally significant products such as box culverts and 3-sided bridge units shall be monitored. Other items may be monitored at the discretion of MCS&T.

4.1.2.5.1.2. After fabrication has begun, the Fabricator shall keep MCS&T Division and the Inspector (whether a WVDOH employee or a contract employee representing the WVDOH) informed in advance of the days on which fabrication will take place.

4.2.5.2. Shop Drawings must be approved by the West Virginia Division of Highways prior to the start of any work by the Fabricator. The Inspector must have a copy of these approved shop drawings prior to start of any work by the Fabricator.

4.3.5.3. Concrete cylinders shall be made for compressive strength testing with 4-inch by 8-inch molds. The cylinders are to be cured in the same area as the products for which they represent (Field Cured as outlined in AASHTO R100) until tested to create a curing environment similar to the product that they represent. A compressive strength test shall consist of the average result of a set of cylinders, which is at least two cylinders. Form removal for wet cast concrete is not permitted until concrete has reached 50% of the design strength, unless otherwise specified. If forms are stripped from box culverts at 50% of the design strength, another curing method from section 601.12, or ASTM C1577 must be used until 70% of the design strength is obtained. Form removal limitations do not apply to elements fabricated with dry cast concrete. Dry cast concrete is defined as concrete with a slump less than 1-inch.

4.3.1.5.3.1. For both conventional wet cast concrete and SCC mixes, a minimum of one set of compressive strength cylinders shall be fabricated from every 7 cubic yards of concrete, or fraction thereof, with a minimum of one set per day per mix design. Both the form removal strength and the 28-day strength must be confirmed by a set of cylinders. Cylinders shall be the same size as those used in the initial approved mix design. For conventional concrete, slump, temperature, and air content tests shall be conducted on the first batch of concrete each day and every time that cylinders are fabricated. For SCC mixes, spread, temperature, and air content tests shall be conducted on every batch. For all types of concrete, unit weight and yield tests shall be conducted on the first batch of concrete each day and thereafter as deemed necessary by Quality Control and Quality Assurance Personnel.

4.3.2.5.3.2. For dry cast mixes, the 28-day strength shall be confirmed by a set of compressive strength cylinders. Compressive strength testing for form removal is not required for dry cast mixes. A minimum of one set of 28-day compressive strength cylinders shall be fabricated from every 20 cubic yards of concrete, or fraction thereof, with a

minimum of one set per day per mix design. The cylinders are to be fabricated in the molds on the vibration table in accordance with ASTM C497. For dry cast mixes, slump testing is not required, and concrete temperature testing shall be performed on the first batch of concrete each day and every time that cylinders are fabricated.

4.4.5.4. For precast manholes fabricated with wet cast and SCC mixes, absorption tests are to be conducted in accordance with ASTM C642. Tests should be conducted on a weekly basis for each mix design used, at a minimum, unless otherwise specified.

4.5.5.5. For precast products fabricated with dry cast mixes, absorption tests are to be conducted in accordance with ASTM C642, and tests should be conducted on a weekly basis for each mix design used. The maximum allowable absorption shall be 9%.

4.6.5.6. Unless otherwise specified, for conventional wet cast and SCC mixes, plastic concrete shall have an air content measured at $7.0 \pm 2.0\%$. For dry cast concrete, the air content test requirement is waived.

4.6.1.5.6.1. Prior to the use of Self-Consolidating Concrete in precast items, all mix designs must be submitted to MCS&T for approval and meet the requirements of the following table. Test results from trial batches produced by the laboratory which designed it shall be included in the submittal. The compressive strength of the design mix shall be at least 15% above the specified design strength.

Table 5.6.14.6.1 - SCC Mix Design Acceptance

Fresh Property	Mix Design Batch Acceptance Criteria
Air Content	$7.0 \pm 1.5\%$
Spread (ASTM C1611)	Target ± 1.5 inches $2 \text{ seconds} \leq T_{50} \leq 7 \text{ seconds}$ Visual Stability Index ≤ 1.0
Passing Ability (ASTM C1621)	J-Ring Value ≤ 1 inch
Segregation Resistance (ASTM C1610)	Segregation $\leq 12\%$
Unit Weight and Yield	$\pm 2\%$ of Theoretical

4.6.2.5.6.2. The following table lists the criteria for SCC production.

Table 5.6.2-4.6.2 - SCC Production Acceptance

Fresh Property	Production Acceptance Criteria
Air Content	$7.0 \pm 2.0\%$
Spread (ASTM C1611)	Target ± 2 inches $2 \text{ seconds} \leq T \leq 7 \text{ seconds}$ Visual Stability Index ≤ 1.0
Concrete Temperature	$< 90^{\circ}\text{F}$
Unit Weight and Yield	$\pm 2\%$ of Theoretical

~~4.6.3.5.6.3.~~ SCC should only be given minimal vibration; and shall not be dropped from a distance greater than 4 feet relative to the top of the form.

~~4.6.4.5.6.4.~~ Precast products fabricated with dry cast concrete shall be limited to a maximum wall thickness of 12 inches when single sided vibration is used and 18 inches when double sided vibration is used.

~~5.6.~~ FINAL INSPECTION

~~5.1.6.1.~~ After fabrication is completed and prior to shipment, the precast items will be stored on dunnage. The Fabricator shall provide MCS&T Division with a written or email request for final inspection a minimum of 5 business days prior to the desired date of inspection. Effective communication from the Fabricator to MCS&T Division and Consultant Inspection Agency is the key to avoiding any scheduling conflicts regarding final inspection.

~~5.2.6.2.~~ At the final inspection, the fabricator shall provide the inspector with documentation of required data pertinent to the product(s) being produced. Attached to this document is a sample inspection sheet to be used as a guide for presenting this information. This documentation is also available on the [MCS&T Division Website](#)¹.

~~5.2.1.6.2.1.~~ For the final inspection, the Inspector may witness compressive strength tests if required, inspect repairs as needed, and conduct a thorough visual examination of each member. A copy of the Inspector's daily reports, a copy of the final inspection report, and all other pertinent information provided to the Inspector by the Fabricator shall be kept on file by MCS&T Division.

~~5.2.2.6.2.2.~~ For box culverts, trial fitting of adjacent pieces, prior to shipping, will be required as part of the final inspection process. Each adjacent box culvert will be trial fitted in pairs horizontally or vertically; the gaps between each pair will be measured. Dunnage will be placed on a smooth level surface below the bottom of the culvert to prevent damage. The maximum gap between the adjacent pieces shall not exceed ½ inch (13 mm), unless otherwise stated in the construction plans.

~~6.7.~~ ACCEPTANCE & REJECTION

~~6.1.7.1.~~ Upon completion of final inspection, if a precast product meets all specification requirements and does not contain any defects, the Inspector will stamp the precast product as accepted by MCS&T Division and provide a 7-digit Laboratory Reference Number for shipment.

~~6.1.1.7.1.1.~~ Shipping invoices shall document the assigned Laboratory Reference Number, type of material, number of pieces, size, and cast dates. All Division invoicing must be submitted as an E-Ticket to the project that meets the requirements of Section 109.20.1 of the Specifications.

~~6.2.7.2.~~ If, however, the precast product does not meet all specification requirements due to damage, defect, or dimensional tolerance, the product must be further evaluated before

¹ <https://transportation.wv.gov/wvdoh-materials-procedures>
<https://transportation.wv.gov/highways/mest/Pages/WVDOH-Materials-Procedures.aspx>

potential acceptance by the MCS&T Division as described in the following subsections.

~~6.2.1.7.2.1.~~ Minor defects may be repaired in accordance with the pre-approved repair procedures which should be incorporated within the Fabricator QC Plan. Cracks 4 mils or less shall be sealed by silane; and cracks between 4 mils and 16 mils shall be repaired by epoxy injection in accordance with Section 603.10.2. Any crack exceeding 16 mils shall be considered a major defect and the item shall be rejected by MCS&T. If repairs have been approved, and appear satisfactory and all other specifications are met, the Inspector shall stamp the product as approved for shipment and issue a 7-digit Laboratory Reference Number for acceptance.

~~6.2.2.7.2.2.~~ Major defects shall include dimensions that exceed tolerances, failure to reach required compressive strength, cracks greater than 16 mils, and any defect that could be considered structural. Lagging dimensions shall be within $\pm \frac{1}{4}$ " from the specified dimension, and all other items must meet relevant tolerances in AASHTO and ASTM Standards. Items with major defects shall be rejected by MCS&T Division, and a 7-digit Laboratory Reference Number will be assigned documenting MCS&T Division's rejection. When items are load bearing, they shall be evaluated by the Designer for structural adequacy and then may be accepted by DMIR, pending concurrence by the District, and or the Engineer of Record. If a product is approved for repair, and if repairs appear satisfactory, the Inspector shall proceed with a final shipping inspection of the piece. Any items found to be not acceptable by the Engineer of Record, Designer, or the District/Division; shall be rejected by the Division.

~~6.2.3.7.2.3.~~ When an item does not achieve the specified 28-day compressive strength prior to shipment, and if it is accepted by a DMIR, the following formula for the price adjustment shall be used in the DMIR, plus any administrative fee.

f'_c – 28 Day Compressive Strength (psi)

$\bar{X}$ – Average 28 – day Compressive Strength (psi)

IC - The invoiced cost of the precast item only

Formula 1 (Constructed by Contractor)

$$\text{Price Reduction} = \left[\frac{f'_c - \bar{X}}{.5 f'_c} \right] \times 40\% \text{ Unit Bid Price}$$

Formula 2 (Constructed by Division)

$$\text{Price Reduction} = \left[\frac{f'_c - \bar{X}}{.5 f'_c} \right] \times IC$$

~~7.8.~~ **PROCEDURE FOR APPROVED SOURCE OF PRECAST CONCRETE LAGGING**

~~7.1.8.1.~~ Precast concrete Fabricators may be classified as an Approved Source of precast concrete lagging if they have met the requirements of Section ~~43~~ and are producing lagging which is made in accordance with the relevant WVDOH Standard Details.

Once classified as an Approved Source of precast concrete lagging, an Approved Source Lab Number will be assigned to the Fabricator for material tracking.

7.2.8.2. MCS&T Division may perform regular quality assurance inspections prior to shipment and/or, monitor fabrication of lagging from a Fabricator that is an Approved Source. The Approved Source Lab Number shall be noted on all shipping documents from the fabricator, and material coverage will be requested under the assigned Approved Source Lab Number. All relevant concrete test data, component material information, QC inspection data, and shipping information shall be kept on file at the Fabricator for the last three years of fabrication and shall be available upon request by the Division. Failure to produce requested documentation may result in revocation of the Fabricator's Approved Source certification status.

7.3.8.3. Approved Sources will be evaluated by the Division by random audits on at least a yearly basis. For Approved Sources that have not previously produced lagging for WVDOH projects there will be an initial acceptance audit upon approval. Audits will be conducted on the material that is available to the Inspector at the time of the audit. All documentation and records for the pieces must be made available to the Inspector on the day of the audit and must be complete, current, and accurate. Failure to produce records shall be a cause for decertification. The Approved Lagging Source Audit Sheet is attached to this document.

7.3.1.8.3.1. All shipping documentation, concrete test data, and component material certifications shall be made available to the Inspector for review. These documents shall include all documents from material that has been shipped to state projects since the last audit. If data indicates that any material did not conform to this MP, the applicable Specifications, or Standard Detail; and was used in a state project, then the Fabricator will be de-certified as an Approved Source of precast concrete lagging.

7.3.2.8.3.2. In addition to documentation, the audit will consist of fabrication monitoring, test observance, and a visual inspection of material that is stocked for shipping on the day of the audit.

7.3.2.1.8.3.2.1. Each material test monitored during the audit must be performed in accordance with the applicable Standards and Specifications. Visual inspection of stocked material will include quality checks of surface finish for cracks, spalls, and other surface blemishes after all repairs have been performed and dimensional checks. The material shall be properly stored to avoid handling damage and be accessible to the Inspector. Audits shall be graded on a point system deducted from 100 and weighted based on the Non-Conformance Points found per Table 78-3. A minimum score of 75 shall be considered passing.

TABLE 78-3

Audit Category	Non-Conformance Points
Material Test Data Review	10 (per error)
Component Material Certification Review	10 (per error)
Shipping Documentation	10 (per error)
Stocked Material Visual Inspection	15 (per defect)
Dimension Check	20 (per error)
Test Performance Check	15 (per Test)

7.4.8.4. When a Fabricator, which is an Approved Source, fails an audit, the Fabricator must submit a written corrective action plan to bring their QC program back into compliance with this MP and corresponding Specifications during a probationary period of one month during which time the fabricator must prove they have fulfilled the corrective actions they submitted before supplying the material again. If the Fabricator fails to bring their material back into compliance within the probationary period, the Approved Source status will be revoked for a minimum of one year from the date of the end of the probationary period, or until the Fabricator has corrected the nonconformances listed during the failed audit. Two failing audits in a year shall result in revocation of the Fabricator's Approved Source status for one year from the date of the last failed audit. Any evidence of document falsification shall result in immediate loss of Approved Source status, and removal from the Approved List of Concrete Fabricators for a minimum 2 years. Depending on the severity and the legality of the falsified documents the removal may be permanent. If severity warrants, the case may be referred to the Department of Justice.

7.5.8.5. Non-Conforming material received by WVDOT projects and reported to MCS&T shall result in an immediate failing audit and will require the Fabricator to submit corrective actions. If the Fabricator fails the subsequent audit, it will result in the loss of their Approved Source status.

Michael A. Mance, P.E.

Director

Materials Control, Soils and Testing Division

MP 604.02.40 Steward – Cement and Concrete Section

MAM:Tf

ATTACHMENT

PRECAST CONCRETE PRODUCTS WVDOT DIVISION OF HIGHWAYS MCS&T DIVISION

SAMPLE FABRICATION CHECKLIST

Preliminary Verifications

NPCA (National Precast Concrete Association) Certification _____

CONCRETE COMPONENTS

Mix Design Lab # (if applicable): _____

Cement Source: _____

Fly Ash Source: _____

Coarse Aggregate Source 1: _____

Coarse Aggregate Source 2: _____

Cement Type: _____

Approved/Tested: _____

Fly Ash Type: _____

Approved/Tested: _____

Coarse Aggregate 1: _____

Approved/Tested: _____

Coarse Aggregate 2: _____

Approved/Tested: _____

Fine Aggregate 1: _____

Approved/Tested: _____

Fine Aggregate 2: _____

Approved/Tested: _____

Batch Water Source: _____

Approved/Tested: _____

Admixtures: _____

STEEL COMPONENTS

Reinforcement: Supplier(s): _____

Description: _____

Lab Number: _____

Description: _____

Lab Number: _____

Description: _____

Lab Number: _____

Inserts: Supplier(s): _____

Description: _____

Lab Number: _____

SHIPLOOSE MATERIAL

Grates: Fabricator: _____

Mill Certs.: _____ Galvanize Cert.: _____ Lab Number: _____

Mastic: Fabricator: _____

Inspected at: _____ Lab Number: _____

SHOP DRAWING REVIEW

Approval Date: _____ Approved By: _____

Preliminary Verifications

[illegible]

Sample Form Inspection (Pre-Placement of Concrete)

Product Type (s)				
Criteria	Design Dimension	Tolerance (±)	Actual Measurement	Within Tolerance
Fill in Form Information (if applicable)				
Height of Product (ft-inch)				
Depth of form (ft-inch)				
Inside Width of form (inch)				
Outside Width of form (inch)				
Inside Length of form (inch)				
Outside Length of form (inch)				
Wall Thickness (inch)				
Forms Square and Level (✓)				
Skew dimensions [if applicable (ft-inch)]				
Locations of inserts, sleeves, block outs, etc. (✓)				

Product Type(s)		Form Properly sealed at joints & edges (✓)	
Framework Constructed of metal on concrete foundation (✓)		Form Clean & Free of debris (✓)	
Form dimensionally correct (✓)		Release Agent applied (✓)	
Other Information:			

Reinforcing Steel	
Reinforcing Steel (Condition)	
Fill in steel information (if applicable)	
Size & Grade	
Location & Lapping Length (✓)	
Spacing and Clearances (✓)	
Chairs, Spacers properly used	

Sample Concrete Placement & Curing

Quality Control Concrete Testing			
Concrete Truck Arrival Time		Concrete Truck Departure Time	
Concrete Temp		Ambient Temp, Weather Conditions	
Slump/Spread (inch)		Air Content (%)	
QC Tests performed per Specifications & Passing		Number & diameter (inch) of Cylinders	
Comments:			

Placement of Concrete			
Lift	Start Time	Completion Time	Vibrated (External/Internal/Both)
1 st			
2 nd			
3 rd			
4 th			
Placement of Concrete Completion Time			
Comments:			

Curing/Finishing of Concrete	
Top Surface Finished Per Specification	
Lifting loops/inserts accessible	
Product Curing Location (Inside/Outside)	
Product Covered & Heat Applied (Time Start & Time Finished)	
Heat Sensors Installed (✓)	
Compressive Strength Cylinders Stored with Product under Curing/Normal Environment (✓)	
Compressive Strength Test Conducted when curing was discontinued (✓)	
Comments:	

Sample Concrete Post Pour Product Inspection

Product	
Visual Inspection for Damage (✓)	
Notes (Size & Location of cracks, spalls, honeycomb, etc.)	
Products in Need of Repair (✓)	
Repair Method Approved (✓)	
Comments:	

Product Type (s)				
Criteria	Design Dimension	Tolerance (±)	Actual Measurement	Within Tolerance
Fill in Form Information (if applicable)				
Height of Product (ft-inch)				
Inside Width of product (inch)				
Outside Width of product (inch)				
Inside Length of product (inch)				
Outside Length of product (inch)				
Wall Thickness (inch)				
Product Square and Level (✓)				
Skew dimensions [if applicable (ft-inch)]				
Locations of inserts, sleeves, block outs, etc. (✓)				

Product	
Dimensional Tolerances Met? (yes or no)	
Heights (yes or no)	
Widths (yes or no)	
Depths (yes or no)	
Wall Thickness(es) (yes or no)	
Inserts, sleeves, lifting points, etc. (yes or no)	
All Concrete Finishes per specification (yes or no)	
Product properly transported (yes or no)	
Product stored on proper dunnage (yes or no)	
Design Shipping Strength met (yes or no)	

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Comments:

Sample Inspection Sheet

Inspection Date _____ QC Personnel _____ QC Signature _____

Fabricator _____ Location _____

Project Name _____ WV State Project # _____ Federal Project # _____

Authorization # _____ Inspection done by _____
Steel Reinforcement

Reinforcement Supplier _____

Description _____ Approved Lab # _____

Description _____ Approved Lab # _____

Description _____ Approved Lab # _____

Product Description	Quantity	Date Cast	Slump/Spread (inch)	Air Content (%)	Design Strength (psi)	Cylinder Breaks (psi)	Date Of Break	Absorption (%)
Type “D” inlet								
Type “G” inlet								
36-inch Manhole (base, riser, top)								
48-inch Manhole (base, riser, top)								
10’0”x 12’0” Box Culvert								NA
Lagging 8”x24”x54”								NA
Type A Reinforced Panel								NA
6’0” Coping								NA
24-inch Wing wall								

Approved Lagging Source Audit Sheet

Facility Name: _____ Facility Code: _____

Approved Lagging Lab Number: _____

Date of Audit: _____ Audit Score: ____/100 (Minimum of 75)

Date of Last Audit: _____ Previous Score: ____/100

Inspector: _____ Report Lab#: _____

Materials Used in Lagging				
Type of Material	Supplier of Material	Lab#/AP L	Cert	Buy America
Cement				
Fine Aggregate				
Coarse Aggregate				
Coarse Aggregate				
Admixture				
Admixture				
Admixture				
Reinforcement				
Lifting Fixture				
Tie Wire				
Rebar Chairs				
Hold Downs				

Document Control			☐
Lab Number on shipments since last audit? (BOL/Invoice)			
Concrete Test data?			
QC Pre and Post Pour Inspections			
Monitored Fabrication	Size:		
Visual Inspection of Stock Lagging	Size:		
Dimensional Check of Stock Lagging	Size:		

Audit Category	Number of Errors	Non-Conformance Points
Material Test Data Review		10 (per error)
Component Material Certification Review		10 (per error)
Shipping Documentation		10 (per error)
Stocked Material Visual Inspection		15 (per defect)
Dimension Check		20 (per error)
Test Performance Check		15 (per Test)

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

GUIDE FOR APPROVAL OF SUPPLEMENTARY CEMENTITIOUS MATERIALS (SCMs)

1. PURPOSE

- 1.1 To set forth the Division's approval procedures for Supplementary Cementitious Materials (SCMs) used in portland cement concrete.
-

2. SCOPE

- 2.1 This procedure will apply to all SCMs used in portland cement concrete that are used on West Virginia Division of Highways projects.
-

3. INITIAL APPROVAL

- 3.1 In order for a SCM to be initially approved for use, the producer of the SCM shall first submit a certified statement to the Materials Control, Soils and Testing (MCS&T) Division that all SCMs shipped to Division projects will conform to the applicable specification requirements. The certified statement shall be signed by a representative of the producer having legal authority to bind the company.
- 3.2 The producer shall also submit, to MCS&T Division, quality control test data on the SCM to be certified. This data shall consist of test results developed from production samples during the last six months. There shall be at least one set of quality control test data for each month in that six-month period. These test results shall include results of all tests that are required by the specifications.
- 3.3 After the Producer has completed Sections 3.1 and 3.2, and if all test data submitted in Section 3.2 meet the applicable specification requirements, a representative of MCS&T Division shall obtain a sample of the SCM from the source of production. The MCS&T Division shall test this sample, and if it meets specification requirements, a representative of the MCS&T Division shall obtain a second sample of the SCM from the source of production or distribution (i.e. terminal). The MCS&T Division shall then test this second sample.
- 3.3.1 If either of the two samples obtained in Section 3.3 does not meet specification requirements, the SCM will not be approved. If, at this time, the producer still seeks Division approval of the subject SCM, a minimum of ninety calendar days (from the date the non-conforming sample was obtained) must elapse before the approval process may begin again (starting with Section 3.1).
- 3.4 If the second sample obtained in Section 3.3 also meets specification requirements, the SCMs will be placed on the Division's approved list and the producer may begin to supply the subject material for use on Division projects.

4. APPROVED LIST

- 4.1 Once each quarter, or any time the list is updated, the MCS&T Division shall provide a list of all currently approved SCMs.
- 4.2 The producer and the District Materials Sections will be notified of any changes in the approved status of a SCM.
- 4.3 No SCM may be used in portland cement concrete that is supplied to West Virginia Division of Highways projects unless it is on the Division's approved list of SCMs.

5. MAINTAINING APPROVED STATUS

- 5.1 In order to maintain approved status of the subject SCM, the producer shall submit test data on a monthly basis in the same manner as described in Section 3.2.
- 5.2 Also, Division representatives from each District Materials Section shall obtain samples of the subject SCM at every point of use (i.e. ready-mix plants, etc.) that is located within their District. A minimum of one sample shall be obtained from each particular location every six (6) months. Within one week of obtaining these samples, the District personnel shall forward them to the MCS&T Division, where they shall be tested.
 - 5.2.1 If any of the samples, obtained by District Personnel as outlined in Section 5.2, fail to meet the specification requirements, personnel from the MCS&T Division shall immediately obtain a sample of the subject material at the source of production or distribution (i.e. terminal). The MCS&T Division shall then test this sample.
 - 5.2.2 If the sample obtained in Section 5.2.1 meets specification requirements, personnel from the MCS&T Division shall obtain a second sample at the source of production or distribution (i.e. terminal). If this second sample meets specification requirements, no further action is required, and the subject source may remain on the Division's approved list.
 - 5.2.3 If either of the samples obtained in Sections 5.2.1 or 5.2.2 do not meet specification requirements, the subject material shall be removed from the Division's approved list.
 - 5.2.4 If, within a twelve-month period, two or more samples obtained as outlined in Section 5.2 (of the same material from the same approved source) fail to meet specification requirements, personnel from the MCS&T Division shall conduct an investigation into the possible reasons for the non-specification material. If the outcome of this investigation indicates a problem with material from the subject approved source, removal of that source from the approved list shall be permitted.
 - 5.2.5 If a SCM is removed from the approved list, it may be reinstated at the discretion of the Division when sufficient sampling and testing (at the source of production or distribution) has been conducted to ensure that material being produced is once again within the limits of the specifications.

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~~REVISED: OCTOBER 2021~~

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- 5.3 If, in a two-year period, no samples from an approved source of a SCM, as outlined in Section 5.2, are received by MCS&T from the Districts, then that source of SCM shall be considered as inactive, and it may be removed from the Division's approved list of SCMs.
- 5.3.1 If the Division elects to keep an inactive source of SCM on the approved list of SCMs, then MCS&T shall obtain additional samples at that source, as outlined in Sections 3.3 and 3.4.

Michael A Mance, PE

Director

Materials Control, Soils & Testing Division

MP 707.04.10 Steward – Cement and Concrete Section

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WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS & TESTING DIVISION

MATERIALS PROCEDURE

ACCEPTANCE CRITERIA FOR CORROSION RESISTANT STEEL REINFORCEMENT
BARS FOR CONCRETE

1. PURPOSE

- 1.1 To establish procedures for qualifying corrosion resistant steel reinforcement bars as acceptable for use on West Virginia Division of Highways (WVDOH) projects.
 - 1.2 To establish a procedure for maintaining a record of such information.
 - 1.3 To establish a procedure for transmitting such information to the districts and to contractors of WVDOH projects.
-

2. SCOPE

- 2.1 This procedure shall apply to all manufacturers of hot drawn corrosion resistant low-carbon chromium steel bars to produce a finished product used in concrete reinforcement.
 - 2.2 This procedure shall apply to all corrosion resistant low-carbon chromium steel bars or stainless-steel bars furnished to West Virginia Division of Highways (WVDOH) projects and purchase orders. The Division may elect to use other control procedures when special conditions dictate.
-

3. REFERENCES~~APPLICABLE DOCUMENTS~~

- 3.1 ASTM A1035 Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement
 - 3.2 ASTM A955 Standard Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement
 - 3.3 WVDOH standard specifications for roads and bridges
-

4. ACCEPTANCE PROCEDURE

- 4.1 With each shipment, the bar manufacturer shall provide shipping documents which contain either the steel bar approved source number, or the approval number that was assigned to the material as per Section 6 below.

5. ACCEPTANCE PROCEDURE (APPROVED SOURCE)

- 5.1 For a producer to be considered an approved source manufacturer of corrosion resistant steel reinforcement bar, the manufacturer must comply with the following requirements where applicable:
- 5.2 The manufacturer is to submit a written statement to the WVDOT Materials Control, Soils and Testing Division indicating intention to be included on the WVDOT approved source list as an approved source of corrosion resistant steel reinforcement bars for concrete.
- 5.3 If the prospective source produces "*low carbon chromium*" steel reinforcement, the prospective source shall submit a certified statement that all material shipped to the Division will conform to Specification ASTM A1035/1035M. The certified statement shall be signed by a representative of the manufacturer who has the authority to bind the company.
- 5.4 If the prospective source produces "*stainless-steel*" reinforcement, the prospective source shall submit a certified statement that all material shipped to the Division will conform to Specification ASTM A955/955M. The certified statement shall be signed by a representative of the manufacturer who has the authority to bind the company.
- 5.5 An evaluation and sampling of material at the manufacturing facility will be conducted by department personnel, or by its designee, for conformance to the appropriate ASTM specification to reinforce confidence in the ability of the facility to produce a quality product within WVDOT specifications. Five samples each two feet in length of different sizes or heats are to be tested in department laboratories annually to confirm WVDOT specification compliance.
- 5.6 All steel materials at the prospective source must be melted and manufactured domestically, and in accordance to section 106.1.1.5 of the WVDOT Standard Specifications for Roads and Bridges.
- 5.7 Once the above requirements are met, a laboratory approval number will be assigned to the manufacturer to indicate WVDOT requirement conformance. This approval number shall be active for one year. Acceptance of manufacturer's facility can be verified by accessing the WVDOT online approved source list.
- 5.8 Revocation of approved source status may result from tested material that does not comply with the specifications listed above.
- 5.9 "Approved Source" status may be reinstated at the discretion of the Materials Control, Soils and Testing Division based on the findings of an investigation. The reinstatement process will commence upon the receipt of a letter of request from the manufacturer to the Materials Control, Soils and Testing Division. The letter of request should indicate reasons for reinstatement, and documentation to substantiate such reasons.

6. ACCEPTANCE PROCEDURES (NON-APPROVED SOURCE)

- 6.1 Corrosion resistant reinforcement steel bars used for concrete reinforcement will require testing and evaluation, on a lot-by-lot basis per grade and heat of material, provided the material meets the following requirements:
- 6.2 A two foot length sample of steel reinforcement representative of the grades and heats used in the concrete structure shall be obtained by WVDOH department personnel or its representatives to be tested in WVDOH laboratories. This sample(s) shall be from the same heats as those used in the concrete structure.
- 6.3 The physical components of the reinforcement bar shall be tested to conform to the requirements of ASTM A1035 for low carbon chromium steel reinforcement, or ASTM A955 for stainless steel reinforcement for yield, tensile, and reduction.
- 6.4 The material is melted and manufactured domestically conforming to section 106.1.1.5 of the WVDOH standard specifications for roads and bridges.
- 6.5 If the results of the testing reveal that the material complies with all applicable specifications, an approval number will be issued by the Division that shall be affixed to the shipping documents of the corrosion resistant steel reinforcement.

7. DOCUMENTATION REPORT

- 7.1 The approved source list for manufacturers of corrosion resistant steel bars for concrete reinforcement shall be updated once a year, this list can be updated at any time with the addition of a new manufacturing facility, or with the removal of a facility.
- 7.2 A current approved list of corrosion resistant steel reinforcement bars will be available to all contractors, fabricators, and suppliers by accessing the West Virginia Department of Transportation approved source list website.

Michael A. Mance~~Ronald L. Stanevich~~, P.E.

Director

Materials Control, Soils and Testing Division

MP 709.01.50 Steward – Cement and Concrete Section

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WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

MIX DESIGN FOR PORTLAND CEMENT CONCRETE

1. PURPOSE

- 1.1 To establish a procedure for testing the physical properties of a proposed mix design.
 - 1.2 To establish criteria for evaluating the test data to arrive at acceptable batch proportions for an approved mix design.
-

2. SCOPE

- 2.1 This procedure shall apply to the design of all ~~portland~~Portland cement concrete which is required by the specifications to be batched in accordance with an approved mix design. This procedure shall also apply to the design of self-consolidating concrete (~~SCC~~) Specified in Section 603, but not to normal (non-SCC) concrete specified in Section 603. ~~specified in Section 603, but not to normal (non-SCC) concrete specified in Section 603.~~

3. REFERENCED DOCUMENTS

3.1 AASHTO Standards:

- 3.1.1 M 201, Standard Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
- 3.1.2 R 18, Standard Practice for Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- 3.1.3 R 39, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
- 3.1.4 R 76, Standard Practice for Reducing Samples of Aggregate to Testing Size
- 3.1.5 T 11, Standard Method of Test for Materials Finer Than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
- 3.1.6 T 19, Standard Method of Test for Bulk Density (Unit Weight) and Voids in Aggregate
- 3.1.7 T 22, Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens
- 3.1.8 T 27, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
- 3.1.9 T 84, Standard Method of Test for Specific Gravity and Absorption of Fine Aggregate
- 3.1.10 T 85, Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate
- 3.1.11 T 119, Standard Method of Test for Slump of Hydraulic Cement Concrete
- 3.1.12 T 121, Standard Method of Test for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- 3.1.13 T 152, Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method
- 3.1.14 T 196, Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method
- 3.1.15 T 197, Standard Method of Test for Time of Setting of Concrete Mixtures by Penetration Resistance.
- 3.1.16 T 231, Standard Practice for Capping Cylindrical Concrete Specimens
- 3.1.17 T 358, Surface Resistivity Indication of Concrete's Ability to Resist Chloride Ion Penetration
- 3.1.18 T309, Standard Method of Test for Temperature of Freshly Mixed Portland Cement Concrete
- 3.1.19 T 395, Standard Method of Test for Characterization of the Air-Void System of Freshly Mixed Concrete by the Sequential Pressure Method

3.1

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- ~~1. M 201, Standard Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes~~
- ~~2. R 18, Standard Practice for Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories~~
- ~~3. R 39, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory~~
- ~~4. R 76, Standard Practice for Reducing Samples of Aggregate to Testing Size~~
- ~~5. T 11, Standard Method of Test for Materials Finer Than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing~~
- ~~6. T 19, Standard Method of Test for Bulk Density (Unit Weight) and Voids in Aggregate~~
- ~~7. T 22, Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens~~
- ~~8. T 27, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates~~
- ~~9. T 84, Standard Method of Test for Specific Gravity and Absorption of Fine Aggregate~~
- ~~10. ——— T 85, Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate~~
- ~~11. ——— T 119, Standard Method of Test for Slump of Hydraulic Cement Concrete~~
- ~~12. ——— T 121, Standard Method of Test for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete~~
- ~~13. ——— T 152, Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method~~
- ~~14. ——— T 196, Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method~~
- ~~15. ——— T 197, Standard Method of Test for Time of Setting of Concrete Mixtures by Penetration Resistance.~~
- ~~16. ——— T 231, Standard Practice for Capping Cylindrical Concrete Specimens~~
- ~~17. ——— T 358, Surface Resistivity Indication of Concrete's Ability to Resist Chloride Ion Penetration T309, Standard Method of Test for Temperature of Freshly Mixed Portland Cement Concrete~~
- ~~18. ——— T 395, Standard Method of Test for Characterization of the Air Void System of Freshly Mixed Concrete by the Sequential Pressure Method~~

3.2 ASTM Standards:

- 3.2.1 C 29, Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
 - 3.2.2 C 39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - 3.2.3 C 117, Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
 - 3.2.4 C 128, Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate
 - 3.2.5 C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - 3.2.6 C 138, Standard Test Method for Density (Unit Weight) Yield, and Air Content (Gravimetric) of Concrete
 - 3.2.7 C 143, Standard Test Method for Slump of Hydraulic-Cement Concrete
 - 3.2.8 C 173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
 - 3.2.9 C 192, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
 - 3.2.10 C 231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 - 3.2.11 C 403, Standard Test Method for Time of Setting Concrete Mixtures by Penetration Resistance
 - 3.2.12 C 511, Standard Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
 - 3.2.13 C 617, Standard Practice for Capping Cylindrical Concrete Specimens
 - 3.2.14 C 1064, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
 - 3.2.15 C 1231, Standard Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Cylindrical Concrete Specimens
 - 3.2.16 C 1567, Standard Test Method for Determining the Potential Alkali Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar Bar Method)
- 1. ~~C 1231, Standard Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Cylindrical Concrete Specimens~~
 - 2. ~~C 1567, Standard Test Method for Determining the Potential Alkali Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar Bar Method)~~

3.3 [WVDOH Materials Procedures](#)¹:

3.3.1 [MP 700.00.06, Aggregate Sampling Procedures](#)

3.3.2 [MP 603.06.20, Test Method for the Determination of Bond Strength Between Prestressing Steel Strand and Self-Consolidating Concrete \(SCC\)](#)

~~3.3~~

~~1. [MP 700.00.06, Aggregate Sampling Procedures](#)~~

~~2. [MP 603.06.20, Test Method for the Determination of Bond Strength Between Prestressing Steel Strand and Self-Consolidating Concrete \(SCC\)](#)~~

3.4 [WVDOH Forms: WVDOH Specifications: 601.3, 601.6, 601.7, 603, 679, and 707.15](#)

3.5 [WVDOH Form T 301E, A-Bar Calculation Worksheet](#)

3.6 [WVDOH Forms: Optimized Aggregate Gradation \(OAG\) Worksheet](#)

3.7 [WVDOH Forms: Excel Spreadsheet for MP 711.03.23](#)

~~3.4~~

~~1. [WVDOH Form T 301E, A-Bar Calculation Worksheet](#)~~

~~2. [Optimized Aggregate Gradation \(OAG\) Worksheet](#)~~

~~3. [Excel Spreadsheet for MP 711.03.23](#)~~

4. TEST PROCEDURE

- 4.1 With the exception of SCC produced in accordance with Section 603, mix designs shall be performed in accordance with the applicable requirements of AASHTO R39 (ASTM C192) by a Division Approved Laboratory. To obtain Division approval, a laboratory must be accredited by the AASHTO Accreditation Program for AASHTO R18 for the following Standards: AASHTO M201 (ASTM C511), AASHTO R39 (ASTM C192), AASHTO T22 (ASTM C39), AASHTO T119 (ASTM C143), AASHTO T121 (ASTM C138), AASHTO T152 (ASTM C231), AASHTO T196 (ASTM C173), AASHTO T197 (ASTM C403), AASHTO T231 (ASTM C617) or ASTM C1231, , AASHTO T309 (ASTM C1064), AASHTO T11 (ASTM C117), AASHTO T19 (ASTM C29), AASHTO T27 (ASTM C136), AASHTO T84 (ASTM C128), AASHTO T85 (ASTM C127), AASHTO R76 (ASTM C702), AASHTO T358. In addition, all personnel performing the Sequential Air Meter (SAM) test must be certified by the Division for AASHTO T395. A listing of these laboratories, that are approved to develop concrete mix designs for the Division, is available on the WVDOH, MCS&T [Web Page](#)². Requests to be placed on that list of Division Approved Concrete Mix Design Labs shall be sent to the following e-mail address: DOHMCSnTconcretelab@wv.gov. To be placed on that list, all Division Approved

¹ <https://transportation.wv.gov/wvdoh-materials-procedures>

~~https://transportation.wv.gov/highways/mest/Pages/WVDOH_Materials_Procedures.aspx~~

² <https://transportation.wv.gov/division-approved-product-lists-apls>

~~https://transportation.wv.gov/highways/mest/Pages/APL_By_Number.aspx~~

³ DOHMCSnTconcretelab@wv.gov

Laboratories shall agree to allow the WVDOH, CCRL, and AASHTO resource to freely share information about assessment reports, proficiency samples, corrective actions, quality management system, and personnel competency and certification records.

- 4.2 The following information for each of the materials listed below that are to be used in the proposed mix design shall be listed in Attachments 1 and 6-ASR. For mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1, the following information for each of the materials listed below that are to be used in the proposed mix design shall be listed in Attachments 1 OAG and 6-ASR OAG. The A requirements will not apply for those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1. Attachments 1 S-P and 6-ASR shall be used for SCC produced in accordance with Section 603.

4.2.1 Mix Design Component Materials

Cement:	<u>Name</u> , Type, Materials Code, SiteManager Materials Code , Source and Location, Source Code, <u>Facility</u> , <u>Facility Code</u> , -Producer/Supplier Code, Specific Gravity, Alkali Content
Supplementary Cementitious Material (SCM):	<u>Name</u> , Type, Materials Code, SiteManager Materials Code , Source and Location, Source Code, <u>Facility</u> , <u>Facility Code</u> , -Producer/Supplier Code, Specific Gravity, Alkali Content
Chemical Admixtures:	<u>Name</u> , Type, Materials Code, SiteManager Materials Code , Source and Location, Source Code, <u>Facility</u> , <u>Facility Code</u> , -Producer/Supplier Code
Coarse Aggregate:	<u>Name</u> , Type, Materials Code, SiteManager Materials Code , Size, Source and Location, Source Code, <u>Facility</u> , <u>Facility Code</u> , -Producer/Supplier Code, Specific Gravity, Absorption, A-Bar, Unit Weight, ASR Aggregate Reactivity Class
Fine Aggregate:	Type, Materials Code, SiteManager Materials Code , Source and Location, Source Code, Producer/Supplier Code, Specific Gravity, Absorption, A-Bar, Fineness Modulus, ASR Aggregate Reactivity Class

The mass and volume of each material that is to be used in each batch shall be listed in Attachment 2. Attachment 2 OAG shall be used for those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1. Attachment 2 S-P shall be used for SCC produced in accordance with Section 603.

- 4.2.2 The aggregate correction factor, as defined in AASHTO T152, shall be listed in Attachment 3. Attachment 3 OAG shall be used for those mix designs which meet the

requirements for optimized aggregate gradation in Section 601.3.2.4.1. Attachment 3 S-P shall be used for SCC produced in accordance with Section 603.

- 4.2.3 The completed WVDOH form T301E, A-Bar calculation worksheet, used to establish the target A-Bar, shall be included in the mix design submittal package. An A-Bar calculation worksheet is not required to be included with the mix design submittal package for SCC produced in accordance with Section 603 and those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1. The completed optimized aggregate gradation (OAG) worksheet shall be included in the mix design submittal package.
- 4.2.4 Information (i.e. raw data) pertaining to the compressive strength test results of each cylinder shall be included in the mix design submittal package. This raw data shall include the specimen test age, date tested, cylinder ID, average cylinder diameter, maximum load applied to the cylinder, type of fracture, and compressive strength of the cylinder.
- 4.3 All classes of concrete (except Class H, concrete for specialized overlays, and SCC produced in accordance with Section 603) for the proposed mix design shall be batched in at least five separate batches. Two of the batches shall be proportioned to produce a mix having a minimum cement factor. Two of the batches shall be proportioned to produce a mix having a minimum cement factor equal to the specified minimum cement factor plus one bag of cement [94 lb. (42.6 kg)]. These batches at the minimum cement factor plus one bag of cement shall be proportioned at a different water-cement ratio (w/c) than the batches at the minimum cement factor. A fifth batch shall also be proportioned to produce a mix at the minimum cement factor, but this batch shall be proportioned at a different water-cement ratio than the previous four batches. The slump tolerance in Section 4.4 shall not apply to this fifth batch. All batches described above shall maintain the same replacement percentage of SCMs including plus one bag.
- 4.3.1 The Sequential Air Meter (SAM) test shall be performed for each trial batch of any mix design used on bridge decks. The average SAM number shall be recorded on Attachment 3 and must be less than or equal to 0.20 for establishment of the mixture proportions in accordance with AASHTO T 395 for mix design approval.

Class H concrete, concrete for Specialized Overlays, as set forth in Section 679 of the specifications, and SCC produced in accordance with Section 603 for the proposed mix design shall be batched in at least two separate batches.

The batches for Class H concrete shall be produced at the cement factor for Class H concrete that is required in the specifications. The surface resistivity tests shall be performed in accordance with AASHTO T 358, specified in Section 601.3 shall be performed, at the same test age, on each of these batches, and the same method of curing shall be used for all the test specimens.

The batches for specialized concrete overlays shall be produced at or above the minimum cement factor specified in Section 679.2.2.1 or 679.2.2.2. The surface

resistivity test shall be performed, at the same test age, on each of these batches, and the same method of curing shall be used for all the test specimens.

The information (i.e. raw data), from which each surface resistivity test result was derived, shall also be included in the mix design submittal package.

The batches for SCC for prestressed concrete members shall be produced as outlined in Section 603.6.2.1 and at the cement factor required in Section 603.6.3.1.

- 4.4 Each batch of concrete shall be tested in the plastic state for air, consistency and yield. Each batch shall be adjusted as necessary to produce a plastic concrete having an air content, consistency, and yield equal to the specified value plus or minus a reasonable laboratory working tolerance. The following tolerances shall be used as a guide for all classes of concrete except SCC produced in accordance with Section 603: Air Content, $\pm \frac{1}{2}$ percent; Consistency, $\pm \frac{1}{2}$ in. (± 12 mm) of slump; Yield, ± 2 percent.

- 4.4.1 For SCC produced in accordance with Section 603, testing shall begin at the time immediately after the mixing sequence is completed. This time shall be designated as T_0 . Temperature, air content, consistency, T_{50} , VSI (Visual Stability Index), passing ability, rapid assessment of static segregation resistance, segregation resistance, unit weight, and yield tests shall be conducted on these batches and shall be within the tolerances set forth in Table 603.6.2.1A.

Air content, consistency, and passing ability tests shall be conducted every thirty minutes until either the air content falls below the target value by more than 1.5%, the slump flow falls below the target spread by more than 2.0 inches (50 mm), or the J-Ring value falls below the target value by more than 1.5 inches (38 mm). For each time of testing, these values shall be plotted versus time after batching. Linear interpolation shall be used to determine the exact time when either the air content falls below the target value by more than 1.5%, the slump flow falls below the target spread by more than 2.0 inches (50 mm), or the J-Ring value falls below the target value by more than 1.5 inches (38 mm). The elapsed time, after T_0 , when this occurs shall be noted as the "Workable Period" and shall be recorded in Attachment 2 S-P. This workable period shall be used as the time frame in which the entire member shall be construction, reference Section 603.6.7.

- 4.5 When the properties of a concrete batch have been established within acceptable limits, seven 4 by 8 in. (100 by 200 mm) cylinders shall be made from each batch produced in Section 4.3 (or 4.3.1) and tested in compression at the following ages: one cylinder at age 24 hours ± 2 hours (the exact age to the nearest hour at time of test shall be noted on the report); one cylinder at age 3 days; one cylinder at age 7 days; one cylinder at age 14 days; and three cylinders at age 28 days. The values of the physical properties of each mix produced in Section 4.3 (or 4.3.1) shall be the average of the physical properties established in the first two mixes produced at the minimum cement factor, the average of the physical properties established in the two mixes produced at the minimum cement factor plus one bag of cement, and the physical properties of the fifth batch at the minimum cement factor and different water-cement ratio. These values

shall be listed in Attachment 3. 4 by 8 in. (100 by 200 mm) cylinders shall be permitted for SCC produced in accordance with Section 603. The results of these tests shall be listed in Attachment 3 S-P.

4.5.1 The following properties of each batch of concrete produced in Sections 4.3 (or 4.3.1) shall be listed in Attachment 2: A-bar of total solids, consistency, air content, unit weight and yield, water-cement ratio, and temperature. The following properties of each batch of concrete produced in Sections 4.3 (or 4.3.1) shall be listed in Attachment 2 OAG, for those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1: optimized aggregate gradation (OAG) worksheet, consistency, air content, unit weight and yield, water-cement ratio, and temperature.

4.5.2 For SCC produced in accordance with Section 603, from one of the SCC trial batches required in 603.6.2.1, six more cylinders shall be fabricated for modulus of elasticity testing, eight more cylinders shall be fabricated for creep testing, three specimens shall be fabricated for length change testing, three specimens shall be fabricated for surface resistivity testing, and three specimens shall be fabricated for freeze-thaw resistance testing. Casting of all Class S-P specimens to be used for hardened concrete property testing shall be done in one lift without rodding or vibration. Curing and testing parameters for these specimens are noted in Section 603.6.2.1. These results of these tests shall be listed in Attachment 2 S-P.

Also, from one of the SCC trial batches required in 603.6.2.1, a prestressing strand bond strength test, in accordance with MP 603.06.20, shall be conducted, and the result shall be recorded in Attachment 3 S-P.

4.6 Mix design submittal packages including Attachments 1, 2, 3 and 6-ASR, A-bar worksheet(s), and raw data pertaining to the compressive strength and surface resistivity tests shall be submitted to the WVDOH District Materials Section in which the Source (i.e. Concrete Batch Plant) is located. Mix design submittal packages, for those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1 including Attachments 1 OAG, 2 OAG, 3 OAG and 6-ASR OAG, optimized aggregate gradation worksheet, and raw data pertaining to the compressive strength and surface resistivity tests shall be submitted to the WVDOH District Materials Section in which the Source (i.e. Concrete Batch Plant) is located. These submittal packages may be submitted to the District electronically, and MCS&T Division may be copied on the electronic submittal also, as this may expedite the process. All mix concrete mix designs, shall be submitted to MCS&T Division electronically using the following link: <https://webapps.transportation.wv.gov/MaterialForms/Forms/PCCMixDesignSubmittal> ~~All mix concrete mix designs, except SCC mix designs, that are sent to MCS&T Division shall be submitted electronically to the following e-mail address: DOHConcreteMixDesign@wv.gov.~~

~~SCC mix designs, produced in accordance with Section 603, shall be submitted directly to MCS&T Division and shall include Attachments 1 S-P, 2 S-P, 3 S-P and 6-ASR.~~

- 4.6.1 In the case of mix design submittals for a single mix design which is used at multiple concrete plants, one submittal package (for the same design) may be used for multiple concrete plants. All the concrete plants at which the mix design is being used shall be noted on Attachment 1, and each WVDOH Materials Section in which the concrete plants are located shall be included on the submittal. Attachment 1 OAG shall be used in lieu of Attachment 1, for those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1. This submittal will be reviewed by MCS&T Division, and if the mix design is approved, a separate lab number will be assigned to the mix design for each location at which it is approved.

5. ACCEPTANCE CRITERIA

- 5.1 If the standard deviation of the concrete plant production has been established, the mix design must have an average laboratory compressive strength, based on the 4 by 8 in. (100 by 200 mm) cylinder results equal to or greater than the "Design 28-Day Compressive Strength" required by the specifications plus two times the standard deviation. Data used to establish the standard deviation shall be taken from the Division's data bank and shall consist of at least 30 individual test results obtained from recent plant production of concrete with proportions similar to the design mix. Information relative to the statistics for a particular plant will be furnished to the Contractor upon request.
- 5.2 If the standard deviation of the concrete plant production has not been established, or in the case of mobile mixer units, the mix design must have an average laboratory compressive strength equal to or greater than the "Design 28-Day Compressive Strength" plus 1,300 psi (9 MPa). The Division shall note the Plant Compressive Strength Standard Deviation, at the time of the mix design approval, in Attachment 3.
- 5.2.1 Note that the "Design 28-Day Compressive Strength" required by the Specifications is the minimum field strength sought in 4 by 8 in. (100 by 200 mm) cylinders representing the concrete being placed in the field and should not be confused with the laboratory compressive strengths required for design. The compressive strength, required in Section 5.1 or 5.2 for mix design approval, shall be noted as the "Mix Design Approval Strength".
- 5.3 SCC mix designs, produced in accordance with Section 603, shall meet the mix design requirements as set forth in this MP and not the ACI mix requirements as specified in Section 603.6.2, except for the compressive strength "overdesign" requirements. SCC mix designs, produced in accordance with Section 603, shall meet the compressive strength "overdesign" requirements of ACI 301 Chapter 4.

6. PROPORTIONING DESIGN MIX

- 6.1 If the average of the batches produced in Section 4.3 (or 4.3.1), with the specified minimum cement factor, satisfies the acceptance criteria of Section 5, then it will be considered acceptable as the mix design for the class of concrete being designed.
- 6.2 If the average of the batches produced in Section 4.3 with the specified minimum cement factor does not satisfy the acceptance criteria of Section 5, then a linear compressive strength-cement factor relationship will be established using the average 28-day compressive strength, based on the 4 by 8 in. (100 by 200 mm) cylinder results, of the batches with the minimum cement factor and the average 28-day compressive strength of the batches with the minimum cement factor plus one bag of cement. This relationship will be interpolated to determine a cement factor [to the nearest 1 lb. (0.45 kg)] which would cause the acceptance criteria to be satisfied. This interpolated cement factor will be considered acceptable for proportioning the mix design for the class of concrete being designed.
- 6.2.1 If neither of the averages of the batches produced in Section 4.3 satisfies the acceptance criteria of Section 5, then that proposed mix design cannot be considered as acceptable, and a new mix design will be required.
- 6.2.2 Section 6.2 does not apply to Class H concrete, specialized overlay concrete, and SCC produced in accordance with Section 603. Therefore, if the average compressive strength of the Class H, specialized overlay concrete batches, or SCC produced in accordance with Section 603, in Section 4.3.1 does not satisfy the acceptance criteria of Section 4, then that proposed mix design cannot be considered as acceptable, and a new mix design will be required.
- 6.3 The submittal for a proposed mix design shall include completed copies of Attachments 1 and 3. It shall also include a completed copy of Attachment 2 for each of the batches at the minimum cement factor. It shall also include a completed copy of Attachment 2 for each of the batches at the minimum cement factor plus one bag of cement, and a completed copy of Attachment 2 for the batch at the minimum cement factor with a different water-cement ratio (i.e. fifth batch), when applicable. Attachments 1 OAG, 2 OAG, and 3 OAG shall be used in lieu of Attachments 1, 2, and 3 respectively, for those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1. All pertinent information supporting these attachments and pertaining to the information in them shall be submitted also. Upon approval of the subject mix design, the Division shall include a copy of Attachment 4 or 5 in ProjectWise, along with the approved mix design.

SCC mix design submittals, produced in accordance with Section 603, shall include completed copies of Attachments 1 S-P and 3 S-P. They shall also include a completed copy of Attachment 2 S-P for both batches produced in the mix design. All pertinent information supporting these attachments and pertaining to the information in them, including the test results pertaining to the workable period as outlined in Section 4.4.1, shall be submitted also.

- 6.4 Although the Contractor has satisfied all requirements for concrete design and a mix design has been approved by the Engineer, the Contractor may still be required to adjust the approved mix design in the field as necessary to maintain all properties within the limits of the specification. These field adjustments shall include increasing the cement factor above the value specified in the approved mix design if such an adjustment would be necessary to cause the strength of the field placed concrete to conform to the requirements of the specification. These field adjustments shall also include the addition of water in the field for slump adjustment. The procedure for determining the maximum amount of water, which may be added to an approved concrete mix in the field, is outlined in the following sections.
- 6.4.1 Using the three different water-cement ratios from the batches produced in Section 4.3 and the corresponding 28-day compressive strengths from Section 4.5, the Excel file in Attachment 4 of this MP shall be used to create a best-fit line through these three points.
- 6.4.2 The water-cement ratio that corresponds to the Mix Design Approval Strength, as outlined in Section 5.1 or 5.2, shall be determined from the Excel file in Attachment 4 of this MP. The maximum water that is allowed to be added to an approved concrete mix in the field, shall be the amount of water, which corresponds to that water-cement ratio (i.e. the water-cement ratio that corresponds to the Mix Design Approval Strength). This maximum water amount shall be shown in Attachment 4. However, under no circumstance, shall the total amount of water in a mix, including field additions, exceed the amount of water corresponding to the maximum water content noted in Table 601.3.1A (i.e. under no circumstances shall the water-cement ratio in Table 601.3.1A be exceeded).
- 6.4.3 For existing approved mix designs, for which there are only two different water-cement ratios, Attachment 5 shall be used to determine the maximum water, that is allowed to be added to that approved concrete mix in the field. Attachment 4 shall be used to determine the maximum water, that can be added in the field, for all other mixes.
- 6.4.4 For Class H mixes and concrete mixes for specialized overlays, as set forth in Section 679 of the specifications, no additional water beyond what was used in the approved mix designs shall be added in the field.

7. MIX DESIGN RE-APPROVAL

- 7.1 Each mix design shall remain approved for a period of three years from the date of approval, after which the mix design may be re-approved for an additional three years based on re-qualification tests outlined in Section 7.2 and conducted at the Concrete Producer or a Division Approved Laboratory, meeting the requirements of Section 4.1. If a mix design is used often enough (at least fifteen air content, slump, and compressive strength tests for the previous three-year period), the re-qualification tests shall not be required, and the mix design may be re-approved based on the actual field tests performed during the previous three-year period.

Re-approval of SCC mix designs, produced in accordance with Section 603, shall be re-approved as outlined in Section 603.6.2.

The mix design shall meet the ASR requirements in Section 601.3.1.1 according to the most recent aggregate reactivity, alkali content of cement and SCM, and CaO content of fly ash from the Division Approved Products Lists APLs. A mix design using an SCM replacement level below that required in Table 601.3.1.1.4.2b of the Specifications may evaluate the effectiveness of SCM to prevent deleterious expansion as described in Section 601.3.1.1.6 to meet the ASR requirements.

- 7.1.1 When a Concrete Producer desires to have a mix design re-approved, he shall submit a written request to the WVDOH District Materials Section in which that plant is located noting such and including the current mix design lab numbers to be evaluated. The WVDOH District Materials personnel shall verify if there are a minimum of fifteen air content, slump, and compressive strength tests for that mix design in the previous three-year period.
- 7.1.2 If there are at least fifteen air content, slump, and compressive strength tests for that mix design in the previous three-year period, then the WVDOH District Materials personnel shall notify MCS&T Division that the subject mix design may be re-approved based on the criteria in Section 7.1. MCS&T Division shall then update the approval date of the subject mix design.
- 7.1.3 If there are not at least fifteen air content, slump, and compressive strength tests for that mix design in the previous three-year period, then the WVDOH District Materials personnel shall notify the Concrete Producer that the subject mix design must be re-approved as outlined in Section 7.2.
- 7.2 The following procedures shall be used to re-approve concrete mix designs that do not meet the criteria in Section 7.1.
 - 7.2.1 The Concrete Producer shall provide a statement to the Engineer verifying that all sources of materials used in the approved mix designs are unchanged and the same as used in the original approved mix design. All materials shall meet the applicable sections of the specifications. The original mix design shall meet the ASR requirements in Section 601.3.1.1 according to most recent aggregate reactivity, alkali content of cement and SCM, and CaO of fly ash from the Division APLs.
 - 7.2.2 Coarse and fine aggregate samples shall be obtained at the Concrete Producer's facility in accordance with MP 700.00.06, and the following tests shall be conducted on those aggregate samples by a WVDOH certified Aggregate Inspector: specific gravity (both coarse and fine aggregate), combined A-bar of total solids, absorption (both coarse and fine aggregate), fineness modulus (fine aggregate), and unit weight (coarse aggregate). The results of these tests shall be used by a WVDOH certified PCC Technician at the Concrete Producer or a Division Approved Laboratory, to establish a new target A-bar for the mix design and, if necessary, to adjust any batch volumes. Combined aggregate gradation shall be conducted in lieu of combined A-bar of total solids for those mix designs with the optimized aggregate gradation. The working range on each sieve from

cumulative combined percent retained from aggregate gradation shall be in accordance with Table 601.3.2.4.1B from Section 601.3.2.4.1.

- 7.2.3 The Concrete Producer shall then, at the Producer's facility and in the presence of WVDOH District Materials personnel, produce a representative batch (acceptable to both the Producer and the WVDOH personnel) in accordance with Sections 601.6 and 601.7 of no less than 6 yd³ (4.6 m³) of the concrete mix subject for re-approval. This batch shall be tested for air content, slump, unit weight and yield. Also, three 4 by 8 in.(100 by 200 mm) 28-day compressive strength specimens, and if applicable, two surface resistivity specimens (each to be tested at an age of 28 days and the average result used) shall be fabricated and tested from this batch.
- 7.2.3.1 In lieu of the batch produced at the Producer's facility, as outlined in Section 6.2.3, a batch may be produced at a Division Approved Laboratory. This batch does not need to be witnessed by WVDOH personnel. The size of this batch shall be the same as the size of the batches produced for new laboratory mix designs. If there are any changes to either the coarse or fine aggregate, certified laboratory personnel may perform the testing and mix adjustments as stated in Section 7.2.2.
- 7.3 The Concrete Producer or Division Approved Laboratory Personnel shall record the results of all tests required and the proportions used in the batch outlined in Section 7.2 in the applicable sections of Attachments 1, 2, and 3. Attachments 1 OAG, 2 OAG, and 3 OAG shall be used in lieu of Attachments 1, 2, and 3 respectively, for those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1. The Concrete Producer or Division Approved Laboratory Personnel shall then submit those attachments, along with the test data required in Section 7.2.2 to the WVDOH District Materials section, who will then forward them to MCS&T Division for evaluation. Based on these results, the existing mix design will either be re-approved (possibly with slight adjustments), or the current mix design will be considered to have expired, and a new mix design will be required. When a mix design is re-approved by MCS&T Division, the laboratory approval number for that mix shall not be changed, but the approval date (the "Date Sampled") shall be revised.
- 7.3.1 For mix design re-approval purposes, the compressive strength of the representative batch produced at the Producer, as outlined in Section 7.2.3, must meet or exceed the "Design 28-day Compressive Strength" in Section 601.3, but it does not have to meet the "overdesign" acceptance criteria outlined in Section 5.
- 7.3.1.1 If a laboratory batch is produced in lieu of a batch at the Producer, as outlined in Section 7.2.3.1, then the compressive strength of that batch must have a compressive strength which exceeds the "Design 28-Day Compressive Strength" required by the specifications by the value (f'_{cr}) obtained from the formula below. The criteria used to establish the standard deviation is outlined in Section 5.1.

$$f'_{cr} = f'_c + \sigma$$

Where:

f_{cr} = Required compressive strength of the batch produced in Section 7.2.3.1 (expressed in psi)

f'_c = Design 28-Day Compressive Strength (expressed in psi)

σ = Concrete Plant Standard Deviation (outlined in Section 5.1)

- 7.3.2 For mix design re-approval purposes the surface resistivity test results from the representative batch produced in Section 7.2.3 or 7.2.3.1 must be equal to or greater than 30 k Ω -cm in order for the mix design to be re-approved.
- 7.3.3 If a mix design has expired, it may still be used on projects which have started before the mix design expired. However, after its date of expiration, a mix design may not be used on any new projects; a new mix design shall be required for these projects.

8. CHANGING A COMPONENT MATERIAL USED IN A MIX DESIGN

- 8.1 Whenever more than one component material in an approved mix design is changed simultaneously, a new laboratory mix design, in accordance with Section 4 shall be required. This option is not permitted for SCC mix designs produced in accordance with Section 603.
- 8.1.1 There are circumstances when one component material in an approved mix design may be changed to another WVDOH approved component material without requiring a new laboratory mix design. Those circumstances, and the subsequent steps which must be taken for that component material change to be approved, are outlined in the following sections.
- 8.2 The changes, outlined below, to any of the following component materials are permitted provided the requirements in Section 8.3 are met. Only one component material may be changed at a time, otherwise a new laboratory mix design in accordance with Section 4 shall be required. When changing the type and/or source of any one component material, minor adjustments to the quantities of other component materials in the mix design are permitted, to maintain desired mix properties. When changing the type and/or source of any one component material, the mix design shall meet the ASR requirements in Section 601.3.1.1 according to the most recent aggregate reactivity, alkali content of cement and SCM, and CaO of fly ash from the APLs. ASTM C1567 testing in accordance with Section 601.3.1.1.6 may be used to evaluate the effectiveness of SCM to prevent deleterious expansion if the SCM minimum replacement requirements of Table 601.3.1.1.4.2b are not met.
- 8.2.1 Cement: The source of cement may be changed provided the requirements of Section 8.3 are met. A change from a Type I cement to a Type IL cement (or from a Type IL cement to a Type I cement) may also be considered a single component material change.
- 8.2.2 Supplementary Cementitious Material (SCM): The source and/or type of SCM may be changed provided the requirements of Section 8.3 are met.
- 8.2.3 Chemical Admixture: The source and/or type of any individual admixture (*i.e.*, air entraining, water reducing, or water-reducing and retarding, *etc.*) may be changed

- provided the requirements of Section 8.3 are met. If more than one admixture is used in a mix design, a change to an individual component material means a change in only one of those admixtures. If more than one admixture is used in a mix design, and a change to one of these admixtures is desired (a change to an individual component material), then the source of the new admixture must still be the same as the source of the rest of the admixtures in the mix (*i.e.*, water-reducing admixture A from Source X may be changed to water-reducing admixture B from Source X.)
- 8.2.4 Latex Admixture: The source of latex admixture may be changed provided the requirements of Section 8.3 are met.
- 8.2.5 Fine Aggregate: The source of fine aggregate may be changed provided the requirements of Section 8.3 are met. However, if the type of fine aggregate changes (*i.e.*, silica sand to limestone sand or natural sand to manufactured sand), a new laboratory mix design in accordance with Section 3 shall be required.
- 8.2.6 Coarse Aggregate: The source of coarse aggregate may be changed provided the requirements of Section 8.3 are met. However, if the type or size of coarse aggregate changes (*i.e.*, river gravel to limestone or #57 limestone to #67 limestone), a new laboratory mix design in accordance with Section 4 shall be required.
- 8.3 When a change to any individual component material in an approved mix design, as outlined in Sections 8.1.1 and 8.2, is desired, the Concrete Producer shall, at the Producer's facility and in the presence of WVDOH District Materials personnel, produce two separate representative batches (acceptable to both the Producer and the WVDOH personnel) in accordance with Sections 601.6 and 601.7. Each of these batches shall be no less than 3 yd³ (2.3 m³), shall be batched at the target cement factor, and shall consist of the concrete mix with the proposed material change. The proportions for these batches shall be determined by a WVDOH certified PCC Technician.
- 8.3.1 If there is a change to either the coarse or fine aggregate, then a sample of the new material shall be obtained at the Concrete Producer's facility in accordance with MP 700.00.06, and the following tests shall be conducted by a WVDOH certified Aggregate Inspector on that aggregate sample: specific gravity, solid A-bar of the new material and A-bar of total solids, absorption, fineness modulus (fine aggregate), and unit weight (coarse aggregate). The results of these tests shall be used by a WVDOH certified PCC Technician at the Concrete Producer to establish a new target A-bar for the mix and, if necessary, to adjust any batch volumes. Combined aggregate gradation shall be conducted in lieu of solid A-bar of the new material and A-bar of total solids for those mix designs with the optimized aggregate gradation. The results of these tests shall be used by a WVDOH certified PCC Technician at the Concrete Producer to establish a new target Combined % Retained for the mix, if necessary, to adjust any batch volumes.
- 8.3.2 In lieu of the two batches produced at the Producer's facility, as outlined in Section 8.3, two batches may be produced at a Division Approved Laboratory, meeting the requirements of Section 4.1. These batches do not need to be witnessed by WVDOH

- personnel. The sizes of these batches shall be the same as the size of the batches produced for new laboratory mix designs, and their proportions shall be determined by certified laboratory personnel. If there are any changes to either the coarse or fine aggregate, certified laboratory personnel may perform the testing and mix adjustments as stated in Section 8.3.1.
- 8.3.3 All of the information pertaining to the materials used in these batches shall be listed in Attachments 1, 2, 3 and 6-ASR as outlined in Section 4.2. Attachments 1 OAG, 2 OAG, and 3 OAG shall be used in lieu of Attachments 1, 2, and 3 respectively, for those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1.
- 8.3.4 Both batches of concrete shall be tested in the plastic state for air, consistency, and yield. Each batch shall be adjusted as necessary to produce a plastic concrete having an air content, consistency, and yield equal to the specified value plus or minus the following tolerances: Air content, ± 1 percent; Consistency, ± 1 in. (± 25 mm) of slump; Yield, ± 2 percent.
- 8.3.4.1 If laboratory batches are produced in lieu of batches at the Producer, as outlined in Section 8.3.2, then the batch tolerances specified in Section 4.4 shall apply.
- 8.3.5 When the properties of a concrete batch have been established within acceptable limits, 3 - 4 in by 8 in. (100 by 200 mm) cylinders shall be made from each batch produced in Section 8.3 and 28 days. Cylinders may also be tested at 7, 14, and 21 days, and those results may be used as the basis of acceptance as long as the average compressive strength requirements outlined in Section 8.5 are met. The values of the physical properties of this new mix design (with the component material change) shall be the average of the physical properties established in the two batches produced in Section 8.3. These values shall be listed in the column for the mix with the "Minimum Cement Factor" in Attachment 3. Attachment 3 OAG shall be used in lieu of Attachment 3, for those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1.
- The following properties of each batch of concrete produced in Section 8.3 shall be listed in Attachment 2: A-bar of total solids, consistency, air content, unit weight and yield, water-cement ratio, and temperature. For those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1, the following properties of each batch of concrete produced in Section 8.3 shall be listed in Attachment 2 OAG: optimized aggregate gradation (OAG) worksheet, consistency, air content, unit weight and yield, water-cement ratio, and temperature.
- 8.4 When it is desired to change a component material in a mix which requires the surface resistivity test, (Class H, and K concrete and specialized concrete overlays as outlined in Section 679), specimens shall be fabricated from each of the batches produced in Section 8.3. The specimens may be tested for Surface Resistivity at an age of 28 days. Specimens may also be tested at 7, 14, and 21 days, and those results may be used as the basis of acceptance if the requirements in Sections 8.4 and 8.5 are met. The average value of these surface resistivity specimens shall be no less than ten percent of the mix

designs surface resistivity value, required in the applicable specification, when tested at the time frame specified in the applicable specification.

- 8.4.1 If laboratory batches are produced in lieu of batches at the Producer, as outlined in Section 8.3.2, then the average value of these surface resistivity specimens shall be less than or equal to the mix design surface resistivity value required in the applicable specification, when tested at the time frame specified in the applicable specification.
- 8.5 The average compressive strength of the two batches produced at the Producer in Section 8.3 must have an average compressive strength which exceeds the "Design 28-Day Compressive Strength" required by the specifications by the value (f'_{cr}) obtained from the formula below. The criteria used to establish the standard deviation is outlined in Section 5.1.

$$f'_{cr} = f'_c + 2.33\sigma - 500$$

Where:

f'_{cr} = Required average compressive strength of the batches produced in Section 8.3 (expressed in psi)

f'_c = Design 28-Day Compressive Strength (expressed in psi)

σ = Concrete Plant Standard Deviation (outlined in Section 4.1)

- 8.5.1 If laboratory batches are produced in lieu of batches at the Producer, as outlined in Section 8.3.2, then the average compressive strength of these batches must have an average compressive strength which exceeds the "Design 28-Day Compressive Strength" required by the specifications by the value (f'_{cr}) obtained from the formula below. The criteria used to establish the standard deviation is outlined in Section 5.1.

$$f'_{cr} = f'_c + 2\sigma$$

- 8.5.2 If the average compressive strength of the two batches produced in Section 8.3 (f'_{cr}) is less than the "Design 28-Day Compressive Strength" (f'_c) required by the specifications, the new mix (with the component material change) cannot be considered as acceptable, unless the requirements of Section 8.7 are met.
- 8.6 It is not required, but if the Concrete Producer desires, two additional separate batches may be produced, at the same time that the two batches in Section 8.3 are being produced. These two additional batches shall be acceptable to both the Producer and the WVDOH personnel and shall be produced in accordance with Sections 601.6 and 601.7. Each of these batches shall be no less than 3 yd³ (2.3 m³), shall be batched at the target cement factor plus one bag of cement [94 lb. (42.6 kg)], and shall consist of the concrete mix with the proposed material change.
- 8.6.1 In lieu of the two batches produced at the Producer's facility, as outlined in Section 8.7, two batches at the target cement factor plus one bag of cement [94 lb. (42.6 kg)] may be produced at a Division Approved Laboratory, meeting the requirements of Section 4.1. These batches, produced at a Division Approved Laboratory, do not need to be witnessed by WVDOH personnel. The sizes of these batches shall be the same as

the size of the batches produced for new laboratory mix designs, and their proportions shall be determined by certified laboratory personnel.

- 8.6.2 Production of these two additional batches is not an option for Class H concrete or specialized overlay concrete.
- 8.6.3 Both batches of concrete shall be tested in the plastic state for air, consistency, and yield. Each batch shall be adjusted as necessary to produce a plastic concrete having an air content, consistency, and yield equal to the specified value plus or minus the following tolerances: Air Content, ± 1 percent; Consistency, ± 1 in. (± 25 mm) of slump; Yield, ± 2 percent.
- 8.6.3.1 If laboratory batches are produced in lieu of batches at the Producer, as outlined in Section 8.7.1, then the batch tolerances specified in Section 4.4 shall apply.
- 8.6.4 When the properties of a concrete batch have been established within acceptable limits, three 4 by 8 in. (100 by 200 mm) cylinders shall be made from each batch produced in Section 8.7 and tested in compression at an age of 28 days. The values of the physical properties of this new mix design (with the component material change) shall be the average of the physical properties established in the two batches produced in Section 8.7. These values shall be listed in the column for the mix with the "Minimum Cement Factor + 1 Bag" in Attachment 3. Attachment 3 OAG shall be used in lieu of Attachment 3, for those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1.
- The following properties of each batch of concrete produced in Section 8.7 shall be listed in Attachment 2: A-bar of total solids, consistency, air content, unit weight and yield, water-cement ratio, and temperature. For those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1, the following properties of each batch of concrete produced in Section 8.7 shall be listed in Attachment 2 OAG: optimized aggregate gradation (OAG) worksheet, consistency, air content, unit weight and yield, water-cement ratio, and temperature.
- 8.6.5 If the average of the batches produced in Section 8.3, with the specified target cement factor, does not satisfy the acceptance criteria set forth in Section 8.6, then a linear compressive strength-cement factor relationship will be established using the average 28-day compressive strength [based on the 4 by 8 in. (100 by 200 mm) cylinder results] of the batches with the target cement factor (Section 8.3) and the average 28-day compressive strength of the batches with the target cement factor plus one bag of cement (Section 8.7). This relationship will be interpolated to determine a cement factor [to the nearest 1 lb. (0.45 kg)] which would cause the acceptance criteria to be satisfied. This interpolated cement factor will be considered acceptable for proportioning the design mix for the class of concrete being designed.
- 8.6.6 If neither of the averages of the batches produced in Sections 8.3 or 8.7 satisfy the acceptance criteria in Section 8.6, then that proposed component material change

- cannot be considered as acceptable, and a new laboratory mix design will be required to make a change in component materials.
- 8.7 The submittal for a proposed mix design change, as outlined in Section 8, shall include completed copies of Attachments 1 and 3. It shall also include a completed copy of Attachment 2 for each of the batches produced in Section 8. Attachments 1 OAG, 2 OAG, and 3 OAG shall be used in lieu of Attachments 1, 2, and 3 respectively, for those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1. All pertinent information supporting these attachments and pertaining to the information in them shall be submitted also. The lab numbers of the original mix design shall be included in the submittal. This new mix design shall be submitted to the District in the same manner as a normal mix design, and it shall then be forwarded to MCS&T Division for review and approval. If approved, a new lab number will be assigned to this mix design, and it shall, from that point forward be treated as a new mix design.
- 8.8 No additional component material changes are permitted to this mix design (without a new laboratory mix design) until there are a minimum of 20 consecutive field test results, from this new mix design, which meet or exceed the design compressive strength requirements. Once there are 20 consecutive field test results, from this new mix design, which meet or exceed the design compressive strength requirements, this mix design is eligible for another component material change in accordance with Section 8.

9. REPLACEMENT OF FLY ASH WITH CEMENT OR ANOTHER APPROVED SOURCE OF FLY ASH IN A MIX DESIGN

- 9.1 When an issue arises with a fly ash source or any other circumstance arises which causes a Concrete Producer to discontinue the use of a source of fly ash in an approved mix design, -an equal volume of cement, or an equal volume of fly ash from a different WVDOH approved fly ash source, may be substituted for the fly ash in that mix. This option is not permitted for SCC mix designs produced in accordance with Section 603.
- 9.1.1 This option of replacing fly ash with cement, or fly ash from a different approved source, does not apply to Class H concrete and concrete for specialized overlays, as set forth in Section 679 of the specifications.
- 9.2 The Concrete Producer shall notify the WVDOH District Materials personnel that it is desired to replace the fly ash in an approved concrete mix design with an equal volume of cement or fly ash from a different approved source. The WVDOH District Materials personnel may then approve this change on a temporary basis. Field test data, as outlined in the following sections, shall be used to approve this mix design change as a permanent new mix design. The change on a temporary basis and permanent new mix design shall meet the ASR requirements in Section 601.3.1.1 according to the most recent aggregate reactivity, alkali content of cement and SCM, CaO of fly ash from the APLs. Evaluation of the effectiveness of SCM in accordance with 601.3.1.1.1.6 may

- be used if SCM replacement level does not meet the minimum replacement level described in Table 601.3.1.1.1.4.2b.
- 9.2.1 When fly ash from a different approved source is being substituted for the existing source of fly ash in an approved mix design, tests to determine the air content of the plastic concrete shall be performed at the Concrete Producer's facility and at the job site, in the presence of WVDOH personnel, on at least the first three batches of concrete produced with this different approved source of fly ash.
- 9.3 Two batches of concrete, produced with this mix containing either all cement or fly ash from a different approved source shall then be tested in the presence of WVDOH District Materials personnel. Both of these batches of concrete shall be tested in the plastic state for air, consistency, and yield. Each batch shall have an air content, consistency, and yield equal to the specified value plus or minus the following tolerances: Air content, ± 1 percent; Consistency, ± 1 in. (± 25 mm) of slump; Yield, ± 2 percent.
- 9.3.1 Three 4 by 8 in. (100 by 200 mm) cylinders shall be made from each batch outlined in Section 9.3 and tested in compression at an age of 28 days. The values of the physical properties of this new mix design (with the fly ash replacement) shall be the average of the physical properties established in the two batches produced in Section 9.3. These values shall be listed in the column for the mix with the "Minimum Cement Factor" in Attachment 3.
- The following properties of each batch of concrete produced in Section 9.3 shall be listed in Attachment 2: -A-bar of total solids, consistency, air content, unit weight and & yield, water-cement ratio, and temperature. For those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1, the following properties of each batch of concrete produced in Section 9.3 shall be listed in Attachment 2 OAG: optimized aggregate gradation (OAG) worksheet, consistency, air content, unit weight & yield, water-cement ratio, and temperature.
- 9.4 The average compressive strength of the two batches produced in Section 9.3 must have an average compressive strength, which exceeds the "Design 28-Day Compressive Strength" required by the specifications.
- 9.5 The submittal for a mix design change from a mix containing fly ash to a mix using either only cement as the cementitious material or fly ash from a different approved source, as outlined in Section 9, shall include completed copies of Attachments 1, 3 and 6-ASR. It shall also include a completed copy of Attachment 2 for each of the batches produced in Section 9.3. Attachments 1 OAG, 2 OAG, and 3 OAG shall be used in lieu of Attachments 1, 2, and 3 respectively, for those mix designs which meet the requirements for optimized aggregate gradation in Section 601.3.2.4.1. All pertinent information supporting these attachments and pertaining to the information in them shall be submitted also. This mix design change submittal shall be submitted to the District in the same manner as a normal mix design, and it shall then be forwarded to MCS&T Division for review and approval. A new lab number will be assigned to this mix design, and it shall, from that point forward be treated as a new mix design,

using only cement as the cementitious material, or using fly ash from a different approved source along with the original source of cement as the cementitious materials.

-
- 10. ADDITION OF HYDRATION CONTROL STABILIZING ADMIXTURES TO EXISTING MIX DESIGNS**
- 10.1 Approved Hydration Control Stabilizing Admixtures, as specified in Section 707.15, designed to stop the hydration of cement in a concrete mix, enabling an extension to the allowable discharge time from a truck mixer as outlined in Section 601.7 of the Specifications may be added to an existing approved concrete mix design in accordance with the procedures outlined in this Section. This option is not permitted for SCC mix designs produced in accordance with Section 603.
- 10.2 Two separate batches of concrete shall be produced as outlined in Section 8.3. These concrete batches shall be tested as outlined in Sections 8.3 and 8.4.
- 10.2.1 Additional testing, as outlined in the second, third, and fourth paragraphs of Section 707.15.2.1, shall also be performed on one of the batches produced in Section 9.2 to verify that the allowable concrete discharge time may be extended.
- 10.3 If the requirements set forth in Section 8.6 are met, then the procedures set forth in Sections 8.8 and 8.9 shall be followed, and the existing mix shall be approved for use with the hydration control stabilizing admixture, and a new lab number will be assigned to this mix design.
- 10.4 No additional changes to the existing mix design are permitted at the time that these concrete batches are being produced for the acceptance of the addition of the hydration control stabilizing admixture to the existing mix design.

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Director
Materials Control, Soils & Testing Division

MP 711.03.23 Steward – Cement and Concrete Section
MAM:T
ATTACHMENTS

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OCTOBER 6, 2026
ATTACHMENT 1

Source:		Facility:	
Source Code:		Facility Code:	
Class of Concrete:		Material Code:	
Design Laboratory:		Date:	

Cementitious Material Data			
Data	Cement	Supplementary Cementitious Material (SCM) 1	Supplementary Cementitious Material (SCM) 2
Name			
Type			
Material Code			
Source			
Source Code			
Facility			
Facility Code			
Specific Gravity			

Admixture Data				
Data	Air Entrainment	Additional Admixture 1	Additional Admixture 2	Additional Admixture 3
Name				
Type				
Material Code				
Source				
Source Code				
Facility				
Facility Code				

Aggregate Data		
Data	Coarse Aggregate	Fine Aggregate
Class/Size		
Type		
Material Code		
Source		
Source Code		
Facility		
Facility Code		
Specific Gravity		
A-Bar		
Absorption		
Fineness Modulus		
Unit Weight		

Source: _____
Facility: _____
Design Laboratory: _____
Class of Concrete: _____
Date: _____

Check The Appropriate Box For Designated Batch:	Minimum Cement Factor		Minimum Cement Factor + 1 Bag		Minimum Cement Factor with Different w/c	Additional Batch
	Batch 1	Batch 2	Batch 1	Batch 2		

Material	Mass	Units	Volume		Units
Cement		lb (kg)			ft ³ (m ³)
SCM 1		lb (kg)			ft ³ (m ³)
SCM 2		lb (kg)			ft ³ (m ³)
Latex Admixture		lb (kg)	gal (L)		ft ³ (m ³)
Water		lb (kg)	gal (L)		ft ³ (m ³)
Air Content, by volume		%			ft ³ (m ³)
Coarse Aggregate		lb (kg)			ft ³ (m ³)
Fine Aggregate		lb (kg)			ft ³ (m ³)
Total		lb (kg)			ft ³ (m ³)
Air Entrain. Admixture		oz/Cwt (mL/100kg)			fl. oz. (mL)
Chemical Admixture 1		oz/Cwt (mL/100kg)			fl. oz. (mL)
Chemical Admixture 2		oz/Cwt (mL/100kg)			fl. oz. (mL)
Chemical Admixture 3		oz/Cwt (mL/100kg)			fl. oz. (mL)

Mixture Test Data							
A Total Solids	W/C Ratio	Cement Factor (lb)	Temperature	Consistency	Air Content	Unit Weight	Yield

Compressive Stentgh, psi (MPa)		
Specified Test Age:	Actual Test Age (hours)	4" x 8" (100 x 200 mm) Strengths
24 ± 2 Hours		
3 Days		
7 Days		
14 Days		
28 Days		
28 Days		
28 Days		
Avg. 28 Day Strength		#DIV/0!

SAM #

Surface Resistivity Test	
Sample	Result
A	
B	
C	
Batch Average Result (kΩ-cm)	

SUMMARY

Source: _____
 Facility: _____
 Design Laboratory: _____
 Class of Concrete: _____
 Corresponding Design 28-day Compressive Strength from Table 601.3.1A (psi): _____
 Corresponding Maximum Water Content from Table 601.3.1A: _____
 Date: _____

	Minimum Cement Factor		Minimum Cement Factor + 1 Bag		Minimum Cement Factor with Different w/c	
	Mass	Units	Mass	Units	Mass	Units
Material		lb (kg)		lb (kg)		lb (kg)
Cement		lb (kg)		lb (kg)		lb (kg)
SCM 1		lb (kg)		lb (kg)		lb (kg)
SCM 2		lb (kg)		lb (kg)		lb (kg)
Water		lb (kg)		lb (kg)		lb (kg)
Coarse Aggregate		lb (kg)		lb (kg)		lb (kg)
Fine Aggregate		lb (kg)		lb (kg)		lb (kg)
Total		lb (kg)		lb (kg)		lb (kg)
Air Entrain. Admixture		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Chemical Admixture 1		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Chemical Admixture 2		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Chemical Admixture 3		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Total A-Bar Solids						
Water Cement Ratio						
Cement Factor		lb (kg)		lb (kg)		lb (kg)
Temperature		°F (°C)		°F (°C)		°F (°C)
Consistency		inches (mm)		inches (mm)		inches (mm)
Air Content		%		%		%
Unit Weight		lb/ft ³ (kg/m ³)		lb/ft ³ (kg/m ³)		lb/ft ³ (kg/m ³)
Yield		ft ³ (m ³)		ft ³ (m ³)		ft ³ (m ³)
Aggregate Correction Factor per AASHTO T 152		%		%		%

Compressive Strength, psi (Mpa)	Minimum Cement Factor Batch	Minimum Cement Factor + 1 Bag Batch	Minimum Cement Factor with Different w/c
1 Day			
3 Days			
7 Days			
14 Days			
28 Days			
28 Days			
28 Days			
Avg. 28 Day Strength	#DIV/0!	#DIV/0!	#DIV/0!

Plant Standard Deviation at time of Mix Design Approval (psi): _____

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ATTACHMENT 4

Fields will be Automatically Filled After Attachment 3 is Completed	28-day Compressive Strength (Known Y-Value)	Water/Cementitious Material Ratio (Known X-Value)
Average Strength of Two Batches at Target (Minimum) Cement Factor (from Field D49 in Attachment 3)	#DIV/0!	0
Average Strength of Two Batches at Target (Minimum) Cement Factor + 1 Bag (from Field H49 in Attachment 3)	#DIV/0!	0
Strength of Batch at Target (Minimum) Cement Factor but with Different w/c (from Field L49 in Attachment 3)	#DIV/0!	0
	Result of Best-Fit Line (Slope) #VALUE!	Result of Best-Fit Line (Y-Intercept) #VALUE!

Class of Concrete = 0
Maximum Water Content from Table 601.3.1A = 0
Target (Minimum) Cement Factor (lbs) = (from 0 Fields D19, D20, and D of Attachment 3)
Design Compressive Strength (psi) from Table 601.3.1A
Plant Compressive Strength Standard Deviation (psi) = 0
Mix Design Approval Strength (psi) =
w/c that corresponds to the Mix Design Approval Strength = #VALUE!
Maximum w/c Allowed in the Field = #VALUE!
Total Maximum Pounds of Water Allowed in the Mix (Including Field Adjustments), at the Target (Minimum) Cement Factor) = #VALUE!
Total Maximum Gallons of Water Allowed in the Mix (Including Field Adjustments), at the Target (Minimum) Cement Factor) = #VALUE!

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ATTACHMENT 5

Fields will be Automatically Filled After Attachment 3 is Completed	28-day Compressive Strength (Known Y-Value)	Water/Cementitious Material Ratio (Known X-Value)
Average Strength of Two Batches at Target (Minimum) Cement Factor (from Field D49 in Attachment 3)	#DIV/0!	0
Average Strength of Two Batches at Target (Minimum) Cement Factor + 1 Bag (from Field H49 in Attachment 3)	#DIV/0!	0
	Result of Best-Fit Line (Slope) #VALUE!	Result of Best-Fit Line (Y-Intercept) #VALUE!

Class of Concrete = 0
Maximum Water Content from Table 601.3.1A = 0
Target (Minimum) Cement Factor (lbs.) = (from Fields D19, D20, and D21 of Attachment 3) 0
Design Compressive Strength (psi) from Table 601.3.1A = 0
Plant Compressive Strength Standard Deviation (psi) = 0
Mix Design Approval Strength (psi) = 0
w/c that corresponds to the Mix Design Approval Strength = #VALUE!
Maximum w/c Allowed in the Mix = #VALUE!
Total Maximum Pounds of Water Allowed in the Mix (Including Field Adjustments), at the Target (Minimum) Cement Factor) = #VALUE!
Total Maximum Gallons of Water Allowed in the Mix (Including Field Adjustments), at the Target (Minimum) Cement Factor) = #VALUE!

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ATTACHMENT 6-ASR

Class of Concrete, Precast/Prestress Member	
--	--

Cementitious Material Data			
Data	Cement	Supplementary Cementitious Materials (SCM) 1	Supplementary Cementitious Materials (SCM) 2
Mass (lb/kg)			
Alkali Content (%)			
CaO (%) (Fly Ash Only)			

Aggregate Material Data		
Data	Reactivity	Most Reactivity
Coarse Aggregate		
Fine Aggregate		

1	Level of Prevention	If Level of Prevention is "V", stop here.
---	---------------------	--

For Class H Concrete, Skip 2, 3, 4, and 5.

For Evaluation of the Effectiveness of SCM or/and Lithium Nitrate Admixture (ASTM C1567), skip 2, 3, 4, and 6. If concrete containing a 100 percent lithium nitrate admixture dosage, skip 3, 4, 5, and 6.

2	Alkali Content of Concrete (Option 1)	0.00	lb/yd ³ (kg/m ³)
3	Replacement Level of SCM (Option 2)	%	

4	For Prevention Level "Z" Only		
	Alkali Content of Concrete		%
	Replacement Level of SCM		%

5	Evaluation of the Effectiveness of SCM or/and Lithium Nitrate Admixture (ASTM C1567)		
	Data	Evaluation with Reactive Fine Aggregate	Evaluation with Reactive Coarse Aggregate
	Expansion results (%)		
	SCM (%)		
	Replacement of SCM in Mix Design (%)		
	Lithium Nitrate Admixture Dosage Rate (%)		

6	Option chosen from Specification Table 601.3.1C for Class H Concrete	
---	--	--

SUMMARY

Source: _____

Facility: _____

Design Laboratory: _____

Class of Concrete: _____

Date: _____

	Mix Properties	
Material	Average Value from Two Trial Batches	Units
Cement		lb (kg)
SCM 1		lb (kg)
SCM 2		lb (kg)
Water	gal (L)	lb (kg)
Coarse Aggregate 1		lb (kg)
Coarse Aggregate 2		lb (kg)
Fine Aggregate		lb (kg)
Total Batch Weight		lb (kg)
Air Entrain. Admixture		oz/Cwt (mL/100kg)
Chemical Admixture 1		oz/Cwt (mL/100kg)
Chemical Admixture 2		oz/Cwt (mL/100kg)
Chemical Admixture 3		oz/Cwt (mL/100kg)
Water Cement Ratio		
Cement Factor		lb(kg)
Temperature		°F (°C)
Slump Flow		inches (mm)
Air Content		%
Unit Weight		lb/ft ³ (kg/m ³)
Yield		ft ³ (m ³)
T ₅₀		seconds
VSI		
J-Ring		inches (mm)
Rapid Assessment of Static Segregation Resist.		inches (mm)
Segregation Resistance		%
Aggregate Correction Factor per AASHTO T 152		%

Compressive Strength, psi (Mpa)	Avg. Compressive Strength of both Trial Batches
24 ± 2 hours	
3 Days	
7 Days	
14 Days	
28 Days	
28 Days	
28 Days	
Avg. 28 Day Strength	#DIV/0!

Prestressing Strand Bond Strength Test (in accordance with MP 603.06.20) Check Applicable Box	
Pass:	
Fail:	

Average SAM Number	
Average Resistivity (kΩ-cm)	

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MP 711.03.23
OCTOBER 6, 2026
ATTACHMENT 1 S-P

Source:		Facility:	
Source Code:		Facility Code:	
Class of Concrete:		Material Code:	
Design Laboratory:		Date:	

Cementitious Material Data			
Data	Cement	Supplementary Cementitious Material (SCM) 1	Supplementary Cementitious Material (SCM) 2
Name			
Type			
Material Code			
Source			
Source Code			
Facility			
Facility Code			
Specific Gravity			

Admixture Data				
Data	Air Entrainment	Additional Admixture 1	Additional Admixture 2	Additional Admixture 3
Name				
Type				
Material Code				
Source				
Source Code				
Facility				
Facility Code				

Aggregate Data		
Data	Coarse Aggregate	Fine Aggregate
Class/Size		
Type		
Material Code		
Source		
Source Code		
Facility		
Facility Code		
Specific Gravity		
Absorption		
Fineness Modulus		
Unit Weight		

Source:

Facility:

Design Laboratory:

Class of Concrete:

Date:

Check the Appropriate Box for the Designated Batch:		Batch 1	Batch 2	Additional Batch
Material	Mass		Units	Volume
Cement			lb (kg)	ft ³ (m ³)
SCM 1			lb (kg)	ft ³ (m ³)
SCM 2			lb (kg)	ft ³ (m ³)
Water			lb (kg)	gal (L)
Air Content, by volume			%	ft ³ (m ³)
Coarse Aggregate 1			lb (kg)	ft ³ (m ³)
Coarse Aggregate 2			lb (kg)	ft ³ (m ³)
Fine Aggregate			lb (kg)	ft ³ (m ³)
Total			lb (kg)	ft ³ (m ³)
Air Entrain. Admixture			oz/Cwt (mL/100kg)	fl. oz. (mL)
Chemical Admixture 1			oz/Cwt (mL/100kg)	fl. oz. (mL)
Chemical Admixture 2			oz/Cwt (mL/100kg)	fl. oz. (mL)
Chemical Admixture 3			oz/Cwt (mL/100kg)	fl. oz. (mL)

Mixture Test Data at T ₀							
W/C Ratio	Cement Factor, lb (kg)	Concrete Temperature, °C	Slump Flow, in. (mm)	Air Content, %	Unit Weight, lb/ft ³ (kg/m ³)	Yield, ft ³ (m ³)	T ₅₀ , seconds
VSI	J-Ring, in. (mm)	Rpd. Asm. Seg. Resist., in. (mm)	Segregation, %	Workable Period, minutes			

Compressive Strength Test (psi (Mpa))						
Test Age:	24 ± 2 hours	3 days	7 days	14 days	28 days	28 days
Actual Test Age (hours)						
Compressive Strength						
Average 28-day Compressive Strength:					#DIV/0!	

Modulus of Elasticity Test, psi (Mpa)					
Test Age:	3 days	7 days	14 days	28 days	28 days
Actual Test Age (hours)					
Modulus of Elasticity					
Average 28-day Modulus of Elasticity:				#DIV/0!	

Length Change (Shrinkage), % Length Change						
Test Age	Initial Reading	Reading at End of 28-day Curing Period	4 days after 28-day curing period	7 days after 28-day curing period	14 days after 28-day curing period	28 days after 28-day curing period
Specimen 1						
Specimen 2						
Specimen 3						
Average Length Change (Shrinkage) after 28-days of water curing and 28-days of Air Storage:					#DIV/0!	

Surface Resistivity Results		Freeze-Thaw Resistance	
Sample	Results (kΩ-cm)		# of Cycles Completed
A			
B			
C			
Average Results (kΩ-cm)		Average Durability Factor:	

Creep Testing							
Age at Initial Loading (hours):		Comp. Str. Cylinder 1, psi (Mpa):		Comp. Str. Cylinder 2, psi (Mpa):		Initial Load, psi (Mpa):	
Initial Elastic Strain at Time of Initial Loading (Determined within 2 minutes after Initial Loading):							
	Loaded Cylinders - Total Strain	Control Cylinders - Drying Strain	Load Induced Strain	Load Induced Strain per Unit Stress	Creep Strain	Creep Strain per Unit Stress	Creep Coefficient
90 days After Initial Loading:							

EDITORIAL

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OCTOBER 6, 2026
ATTACHMENT 1 OAG

Source:		Facility:	
Source Code:		Facility Code:	
Class of Concrete:		Material Code:	
Design Laboratory:		Date:	

Cementitious Material Data			
Data	Cement	Supplementary Cementitious Material (SCM) 1	Supplementary Cementitious Material (SCM) 2
Name			
Type			
Material Code			
Source			
Source Code			
Facility			
Facility Code			
Specific Gravity			

Admixture Data				
Data	Air Entrainment	Additional Admixture 1	Additional Admixture 2	Additional Admixture 3
Name				
Type				
Material Code				
Source				
Source Code				
Facility				
Facility Code				

Aggregate Data				
Data	Coarse Aggregate (I)	Coarse Aggregate (II)	Fine Aggregate (I)	Fine Aggregate (II)
Class/Size				
Type				
Material Code				
Source				
Source Code				
Facility				
Facility Code				
Absorption				
Fineness Modulus				
Unit Weight				

EDITORIAL

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OCTOBER 6, 2026
ATTACHMENT 2 OAG

Source: _____
Facility: _____
Design Laboratory: _____
Class of Concrete: _____
Date: _____

Check The Appropriate Box For Designated Batch:	Minimum Cement Factor		Minimum Cement Factor + 1 Bag		Minimum Cement Factor with	Additional Batch
	Batch 1	Batch 2	Batch 1	Batch 2	Different w/c	

Material	Mass	Units	Volume	Units
Cement		lb (kg)		ft ³ (m ³)
SCM 1		lb (kg)		ft ³ (m ³)
SCM 2		lb (kg)		ft ³ (m ³)
Latex Admixture		lb (kg)	gal (L)	ft ³ (m ³)
Water		lb (kg)	gal (L)	ft ³ (m ³)
Air Content, by volume		%		ft ³ (m ³)
Coarse Aggregate (I)		lb (kg)		ft ³ (m ³)
Coarse Aggregate (II)		lb (kg)		ft ³ (m ³)
Fine Aggregate (I)		lb (kg)		ft ³ (m ³)
Fine Aggregate (II)		lb (kg)		ft ³ (m ³)
Total		lb (kg)		ft ³ (m ³)
Air Entrain. Admixture		oz/Cwt (mL/kg)		fl. oz. (mL)
Chemical Admixture 1		oz/Cwt (mL/kg)		fl. oz. (mL)
Chemical Admixture 2		oz/Cwt (mL/kg)		fl. oz. (mL)
Chemical Admixture 3		oz/Cwt (mL/kg)		fl. oz. (mL)

Mixture Test Data							
	W/C Ratio	Cement Factor (lb)	Temperature	Consistency	Air Content	Unit Weight	Yield

Compressive Strength, psi (MPa)		
Specified Test Age:	Actual Test Age (hours)	4" x 8" (100 x 200 mm) Strengths
24 ± 2 Hours		
3 Days		
7 Days		
14 Days		
28 Days		
28 Days		
28 Days		
Avg. 28 Day Strength		#DIV/0!

SAM #

Surface Resistivity Test	
Sample	Results
A	
B	
C	
Results (kΩ-cm)	

EDITORIAL

MP 711.03.23
OCTOBER 6, 2026
ATTACHMENT 3 OAG

SUMMARY

Source: _____
Facility: _____
Design Laboratory: _____
Class of Concrete: _____
Corresponding Design 28-day Compressive Strength from Table 601.3.1A (psi): _____
Corresponding Maximum Water Content from Table 601.3.1A: _____
Date: _____

	Minimum Cement Factor		Minimum Cement Factor + 1 Bag		Minimum Cement Factor with Different w/c	
	Mass	Units	Mass	Units	Mass	Units
Material		lb (kg)		lb (kg)		lb (kg)
Cement		lb (kg)		lb (kg)		lb (kg)
SCM 1		lb (kg)		lb (kg)		lb (kg)
SCM 2		lb (kg)		lb (kg)		lb (kg)
Water		lb (kg)		lb (kg)		lb (kg)
Coarse Aggregate (I)		lb (kg)		lb (kg)		lb (kg)
Coarse Aggregate (II)		lb (kg)		lb (kg)		lb (kg)
Fine Aggregate (I)		lb (kg)		lb (kg)		lb (kg)
Fine Aggregate (II)		lb (kg)		lb (kg)		lb (kg)
Total		lb (kg)		lb (kg)		lb (kg)
Air Entrain. Admixture		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Chemical Admixture 1		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Chemical Admixture 2		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Chemical Admixture 3		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Water Cement Ratio						
Cement Factor		lb (kg)		lb (kg)		lb (kg)
Temperature		°F (°C)		°F (°C)		°F (°C)
Consistency		inches (mm)		inches (mm)		inches (mm)
Air Content		%		%		%
Unit Weight		lb/ft ³ (kg/m ³)		lb/ft ³ (kg/m ³)		lb/ft ³ (kg/m ³)
Yield		ft ³ (m ³)		ft ³ (m ³)		ft ³ (m ³)
Aggregate Correction Factor per AASHTO T 152		%		%		%

Compressive Strength, psi (Mpa)	Minimum Cement Factor Batch	Minimum Cement Factor + 1 Bag Batch	Minimum Cement Factor with Different w/c
1 Day			
3 Days			
7 Days			
14 Days			
28 Days			
28 Days			
28 Days			
Avg. 28 Day Strength	#DIV/0!	#DIV/0!	#DIV/0!

Plant Standard Deviation at time of Mix Design Approval (psi): _____

Average SAM Number: _____ Average Resistivity (kΩ-cm): _____

EDITORIAL

MP 711.03.23

OCTOBER 6, 2026

ATTACHMENT 6-ASR OAG

Class of Concrete, Precast/Prestress Member	
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Cementitious Material Data			
Data	Cement	Supplementary Cementitious Materials (SCM) 1	Supplementary Cementitious Materials (SCM) 2
Mass (lb/kg)			
Alkali Content (%)			
CaO (%) (Fly Ash Only)			

Aggregate Material Data		
Data	Reactivity	Most Reactivity
Coarse Aggregate (I)		
Coarse Aggregate (II)		
Fine Aggregate (I)		
Fine Aggregate (II)		

1	Level of Prevention	If Level of Prevention is "V", stop here.
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For Class H Concrete, Skip 2,3,4 and 6

For Evaluation of the Effectiveness of SCM or/and Lithium Nitrate Admixture (ASTM C1567), skip 2,3,4, and 6. If concrete mix using a 100 percent lithium nitrate admixture dosage, skip 2,3,4,5 and 6

2	Alkali Content of Concrete (Option 1)	0.00	lb/yd ³ (kg/m ³)
3	Replacement Level of SCM (Option 2)		%

4	For Prevention Level "Z" Only		
	Alkali Content of Concrete		%
	Replacement Level of SCM		%

5	Evaluation of the Effectiveness of SCM or/and Lithium Nitrate Admixture (ASTM C1567)				
	Data	Fine Aggregate (I)	Fine Aggregate (II)	Coarse Aggregate (I)	Coarse Aggregate (II)
	Expansion results (%)				
	SCM (%)				
	Replacement of SCM in Mix Design (%)				
	Lithium Nitrate Ad. Dosage Rate (%)				

6	Option chosen from Specification Table 601.3.1C for Class H Concrete
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WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

MAINTAINING SPECIFIED LEVEL OF
STRENGTH IN PORTLAND CEMENT CONCRETE

1. PURPOSE

- 1.1 The purpose of this procedure is to set forth a method of adjusting the cement content of Portland cement concrete so that a reasonable conformance with the specified level of strength may be assured.

2. SCOPE

- 2.1 The procedure shall apply to all classes of concrete.

3. REFERENCES

- 3.1 MP 711.03.23

3.4. PROCEDURE

3.14.1 Initial Cement Requirement

- 3.1.14.1.1 "Initial Cement Requirement" is the cement requirement determined by the formal laboratory design method outlined in MP 711.03.23.

3.24.2 Reevaluating Cement Requirement

- 3.2.14.2.1 A concrete mix design referred to herein means a combination of particular source and type of materials and a cement factor which satisfies the requirement of the governing specification, said combination of materials and cement factor being formulated for the express purpose satisfying the requirement of a particular class of concrete specified for the work. The cement factor in a particular mix design may be changed without invalidating the design. If source or type of materials in a mix design are changed, then the mix design is considered changed, and two or more mix designs would result from such change(s) as outlined in MP 711.03.23.

Strength data which represents two cement factors in one mix design may be processed collectively in the derivation of statistical parameters, average and standard deviation, for example, if it is felt that such a treatment does not significantly affect the statistics.

- 3.2.24.2.2 For the various classes of concrete which are designed in conformance with MP 711.03.23, the first reevaluation of cement requirement shall be made after at least ten pieces of strength data are available to evaluate the adequacy of the mix design. Thereafter, a reevaluation of cement requirement shall be made at monthly intervals

at which time, the evaluation shall be based on the strength data developed during the preceding two months or on the last ten pieces of data developed, whichever is greater.

3.3.4.3 Method of Evaluating Cement Requirement

3.3.14.3.1 The cement requirement for all classes of concrete governed by this procedure shall be the quantity necessary to maintain the average strength of the concrete within the range of the Design Strength (f'_c) plus K_1 standard deviations and the Design Strength (f'_c) plus K_2 standard deviations $\{(f'_c + K_1\sigma) < \bar{X} < (f'_c + K_2\sigma)\}$. The average strength ($\bar{X}$) and the standard deviation (σ) shall be calculated using the strength data from the previous 3-month period if there are at least 10 samples. If there are less than 10 samples during the previous 3-month period, then the strength data from the previous 12-month period shall be used. If there are not a minimum of 10 samples in the previous 12-month period, then the previous 24-month period shall be used.

3.3.24.3.2 If the average strength of concrete can be maintained at a level which is equal to or greater than the Design Strength plus K_2 standard deviations $\bar{X} > (f'_c + K_2\sigma)$, then the cement factor which causes this level of average strength to be developed may be reduced as indicated in Article 3.3.4.3 except that in no instance shall the cement factor be reduced below a level of the target specified cement factor minus 47 lbs. of cement per cubic yard.

3.3.34.3.3 If the average strength of the concrete is maintained below the level of the Design Strength plus K_1 standard deviations, $\bar{X} < (f'_c + K_1\sigma)$, then the cement factor which causes this level of average strength to be developed shall be increased as indicated in Article 3.3.4.2.

3.3.44.3.4 The relationship between the level of concrete strength (considered to be the average of all data developed during the preceding two months or the average of the last ten pieces of strength data, whichever is greater, and represented by $\bar{X}$), and the action which must be taken regarding the cement factor is as follows:

3.3.4.14.3.4.1 If the average strength is maintained at a level between the Design Strength plus K_1 standard deviations and the Design Strength plus K_2 standard deviations $\{(f'_c + K_1\sigma) < \bar{X} < (f'_c + K_2\sigma)\}$ the cement factor shall be maintained without change.

3.3.4.24.3.4.2 If the average strength falls below the Design Strength, plus K_1 standard deviations $\{\bar{X} < (f'_c + K_1\sigma)\}$ the cement factor shall be increased in accordance with the following formula:

$$C_i = \frac{(f'_c + K_1\sigma) - \bar{X}}{200}$$

Where C_i = Number of 23.5 lb. increments of cement increase per cubic yard, rounded up to a whole number.

f'_c = Design Strength

K_1 = Factor from Table 1

σ = Standard Deviation

$\bar{X}$ = Average Strength

43.3.4.2.1 When the cement factor for a certain mix design, which contains a Supplementary Cementitious Material (SCM), is required to be increased, the Concrete Producer has two options to meet the cement factor increase requirement.

Option 1: Make the cement factor increase entirely with cement.

Option 2: Make the cement factor increase with the same cement/SCM ratio that is used in the subject mix design. For example, if 20% of the cementitious material in the subject mix design is fly ash and 80% of the cementitious material in the subject mix design is cement, and the cement factor was required to be increased by 23.5 pounds, the cement factor increase would consist of an additional 5 lbs. of fly ash and an additional 19 pounds of cement. Fractions of a pound that are 0.5 and above shall be rounded up, and fractions of a pound that are below 0.5 shall be rounded down.

3.3.4.34.3.4.3 If the average strength falls above the Design Strength plus K_2 standard deviations $\{\bar{X} > (f'_c + K_2\sigma)\}$ the cement factor may be decreased in accordance with the following formula:

$$C_d = \bar{X} - \frac{(f'_c + K_2\sigma)}{200}$$

Where C_d = Number of 23.5 lb. increments of cement to be decreased per cubic yard, rounded to the nearest whole number.

K_2 = Factor from Table 1

43.3.4.3.1 When the cement factor for a certain mix design, which contains a SCM, is permitted to be decreased, and if the Concrete Producer elects to decrease that cement factor, the cement factor shall be decreased with the same cement/SCM ratio that is used in the subject mix design. For example, if 20% of the cementitious material in the subject mix design is fly ash and 80% of the cementitious material in the subject mix design is cement, and the cement factor was permitted to be decreased by 23.5 pounds, the cement factor decrease would consist of a reduction of 5 lbs. of fly ash and a reduction of 19 pounds of cement. Fractions of a pound that are 0.5 and above shall be rounded up, and fractions of a pound that are below 0.5 shall be rounded down.

3.44.4 Reporting

Once each month, the Materials Control, Soils and Testing Division will publish a list of concrete producers (Commercial Suppliers and/or Contractors), with all concrete mix designs for each concrete producer, and their corresponding cement factor, determined in conformance with this MP.

3.54.5 Reevaluating Concrete Mix Design

A concrete mix design which is approved for a particular project will remain valid to the extent that it satisfies the requirement for that particular project for its duration.

A concrete mix design which is developed in accordance with MP 711.03.23 and maintained for a period of three years shall be re-approved in accordance with Section 6 of MP 711.03.23. It is the Contractor's responsibility to make adjustments to the design mix as necessary to maintain in the concrete proper placement properties, workability, finishability, yield, consistency, air content, and other requirements of the governing specification. The Contractor should be especially aware of this responsibility when the cement factor is changed in conformance with this procedure.

Michael A Mance, PE

Director

Materials Control, Soils & Testing Division

MP 711.03.26 Steward – Cement and Concrete Section

MAM:T

ATTACHMENT

TABLE 1
VALUES OF "K" FACTORS

NUMBER OF PIECES OF DATA	K1	K2
10	1.604	3.615
11	1.588	3.510
12	1.576	3.429
13	1.565	3.365
14	1.557	3.313
15	1.549	3.270
16	1.543	3.233
17	1.538	3.202
18	1.533	3.175
19	1.528	3.151
20	1.525	3.130
21	1.521	3.112
22	1.518	3.096
23	1.515	3.081
24	1.513	3.067
25	1.511	3.055
26	1.508	3.044
27	1.507	3.034
28	1.505	3.024
29	1.503	3.016
30	1.501	3.008
Above 30	1.500	3.000

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

QUALITY ASSURANCE OF REINFORCED CONCRETE CULVERT,
STORM DRAIN, AND SEWER PIPE

1. PURPOSE

- 1.1 To set forth the procedures which govern the Quality Assurance of Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- 1.2 To set forth manufacturers' Quality Control requirements.
- 1.3 To set forth acceptance inspection procedures.
- 1.4 To set forth documentation and shipping procedures.

2. SCOPE

- 2.1 This procedure will apply to all manufacturers of Reinforced Concrete Culvert, storm pipe, and sewer pipe for use in West Virginia projects.
- 2.2 This procedure will establish the basis for acceptance of reinforced concrete pipe.

3. REFERENCE

- 3.1 WVDOT Specification – 109.20.1 and 714.2
- 3.2 MP 603.02.10
- 3.3 AASHTO T 22 – Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens
- 3.4 AASHTO R 100 – Standard Practice for Casting and Curing Concrete Strength Test Specimens in the Field
- 3.5 AASHTO T 280 – Standard Method of Test for Concrete Pipe, Manhole Sections, or Tile

3.4. APPLICABLE SPECIFICATIONS

- 3.14.1 All standard types of reinforced concrete pipe are to be manufactured and tested in accordance with Section 714.2 of the WVDOT Specifications for Roads and Bridges.
- 3.24.2 Each LOT of reinforced concrete pipe having a wall thickness of 4.5 inches (110 mm) or less, which is manufactured in accordance with the applicable specifications is treated in the following manner to determine acceptability.
 - 3.2.14.2.1 The three-edge bearing test (AASHTO T 280) shall be used to determine the force required to produce the 0.01-inch (0.25 mm) crack and the minimum specified ultimate load.
 - 3.2.1.14.2.1.1 50% of the LOTs of Class III and Class IV concrete pipe 24 inches (610 mm) in diameter and less, and conforming to WVDOT Specifications, will be accepted based

on the Fabricator's certification, provided they are QCast Certified by the American Concrete Pipe Association (ACPA). Testing of Class III and Class IV concrete pipe greater than 24 inches (610 mm) in diameter shall be witnessed by the Division.

3.2.1.24.2.1.2 50% of the LOTs of Class V Concrete Pipe with a diameter less than 24 inches (610 mm), and conforming to WVDOT Specifications, will be accepted based on the Fabricator's certification, provided they are QCast Certified by the ACPA. Testing of Class V Concrete Pipe, with a diameter greater than or equal to 24 inches (610 mm), shall be witnessed by the Division.

3.2.24.2.2 The absorption test (AASHTO T 280) shall be conducted on samples selected from the wall of the pipe.

3.2.34.2.3 A plant inspection of the finished product is conducted to determine dimensional conformance and freedom from defects.

3.2.3.14.2.3.1 For LOTs of concrete pipe accepted on the Fabricator's certification, the inspection, including the three-edge-bearing test, will be performed and recorded by the Fabricator's Quality Control person. These LOTs shall be as defined in Table 1, but the sizes shall be based on the criteria in the QCast Certification program.

3.34.3 Each LOT of reinforced concrete pipe fabricated with dry cast concrete having a wall thickness greater than 4.5 inches (110 mm), which is manufactured in accordance with the applicable specifications, is treated in the following manner to determine acceptability.

3.3.14.3.1 The compressive strength of the concrete will be determined by testing cores taken from the wall of the pipe. The manufacturer may choose to test this pipe as specified in Section 43.2.1, in which event the requirements for the 0.01-inch (0.25 mm) crack and the minimum specified ultimate load shall be met. This choice shall not be applied to a LOT (refer to Table 1) of pipe, which has been previously cored and found unacceptable.

3.3.24.3.2 The absorption test (AASHTO T 280) shall be conducted on samples selected from the wall of the pipe.

3.3.34.3.3 A plant inspection of the finished product will be conducted by the Division to determine dimensional conformance, and freedom from defects.

3.44.4 Each LOT of reinforced concrete pipe fabricated with wet cast concrete can be accepted on the basis of compressive strength from cylinder breaks (cylinders made per AASHTO R 100 and tested per AASHTO T 22) reaching the required 28-day compressive strength or by the three-edge bearing test (AASHTO T 280) as detailed in Section 43.2.1.

3.4.14.4.1 The absorption test (AASHTO T 280) for wet cast pipe shall be conducted on samples cored from the wall of the pipe or by making cylinders (4-inch x 8-inch (100 mm x 200 mm) minimum in accordance with AASHTO R 100).

3.54.5 Flared end sections will be accepted by either the inspection method or Fabricator certification method, with the same size criteria as outlined in Section 43.2.

~~3.5.14.5.1~~ Acceptance by the inspection method of precast concrete flared end sections is to be based on verification of compressive strength of concrete as determined from cylinders or cores. Flared end sections must also meet the dimensional requirements listed on the standard detail and on appearance. The testing frequency for compressive strength cores and steel verification coring is 1 out of every 40 pieces, but cylinders shall be fabricated and tested for each piece, if cylinders are used for strength acceptance instead of cores.

~~3.5.24.5.2~~ In order to accept flared end sections by the Fabricator certification method, the Fabricator must be QCast Certified by the ACPA. The fabricator will take photos/videos showing correct steel placement and cover for one piece in each LOT. All flared end sections must be fabricated within the dimensions listed on the standard detail and have an acceptable finish free of bug holes, spalls, cracks and other surface defects.

TABLE 1

SAMPLING AND TESTING FREQUENCY FOR REINFORCED CONCRETE PIPE

A production "LOT" is defined as follows:

It is a pipe of the same size and class that is manufactured using the same process and similar materials during consecutive days of production, excluding weekends and holidays. The production LOT shall not exceed the specified value of 1% of the LOT and the minimum number tested per LOT is as follows:

Number of Pipe Sections in the LOT	Number of Pipe Sections to be Tested
0 to 300	1
301 to 800	2
801 to 1500	3
over 1500	3 plus 1 section per each 600 pieces or fraction thereof over 1500 pc.

When the tests indicate that a production LOT is acceptable for WVDOH use, the LOT should be inspected by the Division's representative.

~~4.5.~~ **QUALITY CONTROL REQUIREMENTS**

~~4.1.5.1~~ Quality Control is the responsibility of the manufacturer and shall include the following:

~~4.1.15.1.1~~ Ensure all component materials used in the fabrication of the pipe have been sampled, tested, and approved (MP 603.02.10).

~~4.1.25.1.2~~ Ensure quality workmanship as well as a quality product throughout production.

~~4.1.35.1.3~~ To scribe into each piece of pipe the following:

- (1) Cast Date
- (2) Class and Wall Type
- (3) Manufacturer's Trademark

~~4.1.4~~5.1.4 Notify the Division's representative upon the completion of casting of a LOT (Refer to Table 1) of pipe so the Division may select a representative sample and witness the testing.

~~4.1.5~~5.1.5 To conduct the three-edge bearing test or to secure cores to ensure strength requirements are met (Section ~~43.2~~ and ~~43.3~~).

~~4.1.6~~5.1.6 To conduct the absorption test (AASHTO T 280) on samples selected from the wall of the pipe.

~~4.1.7~~5.1.7 Any LOT of pipe or portion of a LOT of pipe failing to meet the specification requirements will be stored separately from acceptable pipe.

~~4.1.8~~5.1.8 Accurate inventory records containing the information required in Section ~~76.1.2~~ will be kept and maintained by the manufacturer.

~~5.6.~~ 5.6. ACCEPTANCE CRITERIA

The Division will:

~~5.46.1~~ Sample and test the component materials to be used in the manufacturer of the reinforced concrete pipe in accordance with MP 603.02.10.

~~5.26.2~~ Select representative samples of the LOT to be tested and:

- (1) Witness the three-edge bearing test and/or the coring procedure
- (2) Verify dimensional conformance
- (3) Verify actual steel placement
- (4) Determine the steel area

~~5.36.3~~ Ensure each piece comprising the LOT is scribed as stated in ~~54.1.3~~.

~~5.46.4~~ Make a visual inspection of the LOT and designate unacceptable units to be removed or set apart from the approved pipe in the LOT.

~~6.7.~~ 6.7. SHIPPING REQUIREMENTS

~~6.17.1~~ The approved LOT of pipe or portion of the LOT can be shipped by the manufacturer providing the following provisions have been met:

~~6.1.17.1.1~~ The manufacturer will notify the Division's representative prior to each shipment so that the Division may maintain a current inventory with the manufacturing plant.

~~6.1.27.1.2~~ The manufacturer will supply one copy of the shipping invoice to Materials Control, Soils and Testing Division and one copy to the Division's representative at the project site. The invoice shall contain the following information.

- (1) Cast date of the approved LOT
- (2) Master laboratory reference number
- (3) Size, class, and wall type
- (4) Project number
- (5) Number of pieces

~~7.8.~~ ACCEPTANCE PRACTICE

~~7.18.1~~ Ensure the information on the shipping invoice, as required in Section ~~76~~.1.2, agrees with the shipment it accompanies. (Number of pieces, class, size, and type, etc.). All Division invoicing must be submitted as an E-Ticket to the project that meets the requirements of Section 109.20.1 of the Specifications.

~~7.28.2~~ Check each piece of pipe for the proper identification markings (Section ~~65~~.3) and make a visual inspection of each piece to ensure there is no evidence of damage during shipment.

~~8.9.~~ COVERAGE REQUEST FROM PROJECT SITE

~~8.19.1~~ Request for coverage shall include the information as referenced on the shipping invoice, Section ~~76~~.1.2

Michael A. Mance, P.E.

~~Interim~~-Director

Materials Control, Soils and Testing Division

MP 714.03.30 Steward – Cement and Concrete Section

MAM:T

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

STANDARD METHOD OF TEST FOR DETERMINING THE QUALITY
OF WATER USED WITH HYDRAULIC CEMENT

1. PURPOSE

- 1.1 To establish a standard method of test and acceptance criteria to be used in determining the quality of water used with hydraulic cement.

2. ~~SCOPE~~PURPOSE

- 2.1 This procedure is applicable to untreated water sources used in combination with mixtures containing hydraulic cement. An untreated water source may be defined as a source other than a treated public water system.
- 2.2 Treated water systems may be used without testing.

3. APPLICABLE DOCUMENTS

- 3.1 ASTM C1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
- 3.2 AASHTO T 106 – Standard Method of Test for Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in. Cube Specimens)
- 3.3 AASHTO T 162 – Standard Method of Test for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
- 3.4 ASTM C191 – Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle

4. PROCEDURE

- 4.1 Untreated water shall be tested at the source for pH. When the pH of the water is between 4.5 and 8.5 no further testing is necessary.
- 4.2 If the pH is less than 4.5 or more than 8.5, all tests listed in this procedure will be conducted. A water source whose pH is determined to be within the limits defined in section 4.1 but appears to be contaminated with foreign material which could have an adverse effect on the Portland cement concrete shall have a sample forwarded to the Materials Division and all tests listed in this procedure will be conducted. The sample shall be accompanied with the required documentation indicating the sampler's reasons for requesting testing. These tests shall be conducted before first use and thereafter once every 6 months, or more often when there is reason to believe that a change has occurred in the characteristics of the water source.

5. TEST METHODS

- 5.1 Total Solids by Mass, Chloride as Cl^- , Sulfate as SO_4 , and ~~Alkalies~~Alkalis as $(\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O})$.
- 5.1.1 Tests shall be conducted in accordance with ASTM C1602.

5.2 Compressive Strength

5.2.1 The water under test shall be compared, in mortar, with distilled water. The proportions of dry materials in the mortar shall be 500 grams of Type III Cement, 1500 grams of graded OTTAWA sand and the amount of water sufficient to produce a flow of 110 ± 5 in 25 drops in accordance with AASHTO T 106 using the sample under test and compared to three specimens made using distilled water.

5.3 Time of Setting by Vicat Needle

5.3.1 Time of set will be prepared with the test sample and Type III Cement in accordance with ASTM C191. A control specimen will be made with distilled water for basis comparison.

6. ACCEPTANCE CRITERIA FOR UNTREATED WATER SOURCES

Table 1: Performance Requirements for Untreated Water

Performance Requirements for Untreated Water Source	Limit
Compressive Strength (Min% Control at 1 day)	90
Time of Set, (deviation from control)	-60 to +90 minutes

Table 2: Maximum Concentration of Chemicals in Untreated Water Sources

Chemical and Physical Limits for Untreated Water Source		
Maximum Concentration in Combined Mixing Water, ppm		Limit
A	Chloride as Cl^- , ppm	
	In prestressed concrete or bridge decks	500
	Other reinforced concrete in moist environments or containing aluminum embedments or dissimilar metals or with stay-in-place galvanized metal forms	1,000
B	Sulfate as SO_4 , ppm	3,000
C	Alkalies Alkalies as $(\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O})$, ppm	600
D	Total solids by mass, ppm	50,000

Michael A Mance, PE

Director

Materials Control, Soils & Testing Division

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

ACCEPTANCE USE OF THE MATURITY METHOD FOR THE ESTIMATION OF
CONCRETE STRENGTH ON WVDOH PROJECTS

1. PURPOSE

- 1.1 To establish a procedure to estimate the compressive strength of concrete, used on West Virginia Division of Highways (WVDOH) projects, with the Maturity Method.
-

2. SCOPE

- 2.1 This procedure shall apply to all Contractors, Sub-contractors, Consultants, and WVDOH Personnel who test concrete on WVDOH projects.
- 2.2 This procedure may be used in place of compressive strength cylinders, for the determination of the compressive strength of concrete, when allowed by the WVDOH Specifications. The Maturity Method shall not be permitted as a substitute for 28-day acceptance cylinders.
-

3. REFERENCED DOCUMENTS

- 3.1 *MP 711.03.23 - Mix Design for Portland Cement Concrete*
- 3.2 *ASTM C192 - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory*
- 3.3 *ASTM C1074 - Standard Practice for Estimating Concrete Strength by the Maturity Method*
- ~~3.1 *ASTM C1074 - Standard Practice for Estimating Concrete Strength by the Maturity Method*~~
-

4. PROCEDURE

- 4.1 The procedure outlined in the following sections shall be applied to each WVDOH approved concrete mix design for which the Maturity Method is desired to be used in place of concrete cylinders for the estimation of the concrete strength in the field. A separate strength-maturity relationship must be developed for each approved concrete mix design.
- 4.2 DEVELOPMENT OF STRENGTH-MATURITY RELATIONSHIP
- 4.2.1 Fabricate a minimum of fifteen concrete cylinders, in accordance with ASTM C192, from each WVDOH approved concrete mix design for which it is desired to establish a strength-maturity relationship. The mixes used to cast these cylinders

shall be batched as closely as possible to the anticipated target air ~~content,~~
~~slump~~~~content, slump~~ value, and chemical admixture dosage rate which will be used in the field. The mixes shall also be batched at a temperature as close as possible to the temperature that is anticipated in the field during concrete placement.

4.2.2 ~~Either 6-inch x 12-inch cylinders or~~ 4-inch x 8-inch cylinders ~~shall~~~~may~~ be used to develop the strength-maturity relationship, ~~but if 4-inch x 8-inch cylinders are going to be used, then 4-inch x 8-inch cylinders must be approved to be used,~~ in accordance with MP 711.03.23, with the mix design for which the strength-maturity relationship is being developed.

4.2.3 Follow the procedure outlined in Section 8 of ASTM C1074-19, and establish a strength-maturity relationship and corresponding Strength-Maturity Curve. The maturity of the subject cylinders shall be recorded to the nearest degree-hour. The axes used to plot this Strength-Maturity Curve shall be Strength, expressed in pounds per square inch on the Y-axis, and Temperature-Time Factor, expressed in °C-hours on the X-axis.

4.2.4 When concrete mixes designed for rapid strength gain are used, the compression tests shall be conducted at ages approved by the Engineer based on the strength development characteristics of that mix. However, a minimum of five test ages shall be used.

4.3 APPLICATION OF STRENGTH-MATURITY RELATIONSHIP

4.3.1 The Strength-Maturity Curve may be used in the field at the Project, in place of compressive strength cylinders, to estimate the compressive strength of the concrete in question.

4.3.2 The strength-maturity relationship and Strength-Maturity Curve shall not be permitted to be used in place of 28-day acceptance cylinders. The strength-maturity relationship and Strength-Maturity Curve shall only be used for the purposes of opening structures to traffic (i.e. Section 501.4.4, Section 506, etc.) and for form removal and construction of superimposed elements (i.e. Section 601.8.7).

4.3.3 When using the Strength-Maturity Curve for these purposes, the procedure outlined in Section 9 of ASTM C1074-19 shall be used for installing temperature sensors within the concrete of which the Strength-Maturity Curve is being used to estimate the compressive strength.

4.4 VALIDATION OF STRENGTH-MATURITY RELATIONSHIP

4.4.1 After five days of production, and every ten days of production after that, seven "Maturity Validation Cylinders" shall be fabricated. One of these cylinders shall have a maturity sensor installed in it within $\pm 5/8$ " (15 mm) of the center of the cylinder. Three of these cylinders shall be tested at an age of three days, and three of these cylinders shall be tested at an age of seven days. The average of each of these sets of three cylinders shall be the average compressive strength at that age.

- 4.4.2 The Maturity Validation Cylinders shall be the same size as the cylinders which were used to develop the original Strength-Maturity Curve.
- 4.4.3 If the average of either the three-day or seven-day compressive strength results, obtained in Section 4.4.1, fall at a point more than 5.0% less than the corresponding compressive strength, at the same Temperature-Time Factor point on the Strength-Maturity Curve, additional maturity validations at three and seven days, as outlined in Section 4.4.1, shall be conducted on the next three concrete placements.
- 4.4.4 The Contractor shall continue to conduct these maturity validations until the average result of the three cylinders in each individual compressive strength test in three consecutive validations (consisting of both three-day and seven-day results) is not more than 10.0% less than the corresponding compressive strength at the same Temperature-Time Factor point on the Strength-Maturity Curve, and the average of all three-day and all seven-day results in those three consecutive validations is not more than 5.0% less than the corresponding compressive strength at the same Temperature-Time Factor point on the Strength-Maturity Curve.
- 4.4.5 If, after five maturity validations, the Contractor has not obtained three consecutive validations for which the criteria in Section 4.4.4 has been met, then a new Strength-Maturity curve shall be established, as outlined in Section 4.5.
- 4.5 ESTABLISHMENT OF NEW STRENGTH-MATURITY CURVE
- 4.5.1 The new average three-day strength shall be established by averaging the five three-day strength results from the five maturity validations conducted in Section 4.4.5. The new average seven-day strength shall be established by averaging the five seven-day strength results from the five maturity validations conducted in Section 4.4.5.
- 4.5.2 The percentages by which the average three-day and average seven-day compressive strength results in Section 4.5.1 are below the corresponding compressive strengths at the same Temperature-Time Factor point on the Strength-Maturity Curve shall be calculated. The greater of these two percentages shall be the percent by which the Strength-Maturity Curve is lowered. This new "lowered" Strength-Maturity Curve shall be used from that point forward for estimating the compressive strength of the concrete from that approved mix design in the field

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Director

Materials Control, Soils & Testing Division

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION
MATERIALS PROCEDURE

PERCENT OF SOLIDS IN THE LATEX USED IN LATEX
MODIFIED COMPOSITIONS

1. PURPOSE

- 1.1 To set forth a procedure for determining the solids content of the latex for use in latex modified compositions.
-

2. SCOPE

- 2.1 This procedure shall be used to determine the solids content of all latex materials used in latex modified compositions.
-

3. EQUIPMENT

- 3.1 Aluminum weighing dishes (approximately ~~six centimeters in diameter and two centimeters deep~~ 45 mm to 55 mm bottom diameter, with 40mL capacity), ~~Fisher 8-732 or equivalent.~~
- 3.2 Glass vials with cork stoppers, (one dram capacity), ~~Owens-Illinois 60900 or equivalent.~~
- 3.3 Analytical balance (accurate to 0.1 milligram)
- 3.3.4 Disposable pipettes, recommended for sample transfer to vials
-

4. PROCEDURE

- 4.1 Weigh three aluminum dishes individually to 0.1 milligram. This is weight A.
- 4.2 Mix sample thoroughly.
- 4.3 Place sample into three vials, fill to approximately 2/3 of capacity, stopper immediately.
- 4.4 Weigh each vial and stopper and record weight. This is weight B.
- 4.5 Place approximately one gram of sample from the vial into the pre-weighed dish. Care should be taken to avoid getting the sample on outside of vial.
- 4.6 Immediately reweigh the vial and stopper and record weight. This is weight C.
- 4.7 Place samples in the oven at 141 $\pm$ 2°C (286° F $\pm$ 4°) for two hours.

4.8 Place samples in desiccator to cool.

4.9 Reweigh samples and record weight. This is weight F.

5. CALCULATIONS

5.1 $D = B - C$

Where D = sample weight

5.2 $E = F - A$

Where E = weight of solids

5.3 $S = \frac{E}{D} \times 100$

Where S = total solids in percent

5.4 The solids content of the sample is the average of the three tests.

5.5 If the range of the three tests exceeds 1.00 percent, repeat the test procedure.

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Materials Control, Soils and Testing Division

MP 679.03.00 Steward – Environmental and Coatings Section

MAM:BFRLS:T

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

ACCEPTANCE OF GLASS BEADS FOR TRAFFIC MARKING PAINT

1. PURPOSE

- 1.1 This procedure defines the laboratory testing requirements and approval criteria for Glass Beads intended for application in traffic marking paint for compliance with both State and Federal requirements, as listed in this document.
- 1.2 For Glass Beads to be listed on the Approved Products List (APL), a product must meet all the requirements of the Specifications and all material and testing requirements outlined in this document.

2. REFERENCED DOCUMENTS

- 2.1 AASHTO M247, "Standard Specification for Glass Beads used in Pavement Markings"
- 2.2 AASHTO T246, "Standard Method for Glass Beads Used in Pavement Markings"
- 2.3 Manual on Uniform Traffic Control Devices (MUTCD)
- 2.4 FHWA FP-24 "Standard Specification for Construction of Roads and Bridges on Federal Highway Projects FP-24", Section 718.19
- 2.5 Moving Ahead for Progress in the 21st Century Act (MAP-21), Section 1504
- 2.6 ASTM D1155, "Standard Test Method for Roundness of Glass Spheres"
- 2.7 ASTM D1214, "Standard Test Method for Sieve Analysis of Glass Spheres"
- 2.8 ASTM D1648, "Standard Guide for Choosing a Method for Determining the Index of Refraction and Dispersion of Glass."
- 2.9 EPA Method 6010C, "Inorganics by ICP-AES (Atomic Emission Spectroscopy)
- 2.10 Build America, Buy America Act (BABA).

3. SUBMITTAL AND TESTING REQUIREMENTS

- 3.1 Manufacturers seeking approval shall submit a documentation package to the Materials Control, Soils and Testing (MCS&T) Division including:

- 3.1.1 Glass Beads Product Data Sheets
- 3.1.2 Certificate of Compliance: Stating that the product meets or exceeds all requirements of AASHTO M 247 and material has been tested in accordance with AASHTO T436. The certification shall include but not limited to the following:
 - 3.1.2.1 Name and location to which the material is supplied
 - 3.1.2.2 Means of definitively identifying the material, such as batch or lot number, purchase number, etc.
 - 3.1.2.3 Statement indicating that the material has been tested in accordance with AASHTO T346 and found in conformity with AASHTO M247
- 3.1.3 Certified laboratory analysis covering performed by an independent testing laboratory:
 - 3.1.3.1 Graduation and roundness to meet requirements of ASTM D1155
 - 3.1.3.2 Sieve Analysis to meet requirements of ASTM D1214.
 - 3.1.3.3 Refractive index to meet requirements of ASTM C1648, Becke Line Method.
 - 3.1.3.4 Coating characteristics (flow, flotation, moisture resistance, and adherence) to meet requirements of AASHTO T246 referee methods.
- 3.1.4 Heavy Metal analysis performed using an EPA-certified laboratory demonstrating lead and arsenic concentration are within MAP-21 limits (< 200 ppm).
- 3.1.5 Buy America Certificate of Compliance, per MP 106.10.50.
- 3.2 If available, but not required, manufactures may be evaluated by AASHTO Product Evaluation and Audit Solutions to meet requirements of AASHTO M 247.

4. EVALUATION AND APPROVAL PROCESS

- 4.1 MCS&T will review the submitted documentation for completeness and compliance.
- 4.2 Manufacturers must provide a sample upon request by materials division.
- 4.3 MCS&T reserves the right to perform independent sampling and testing of the product.
- 4.4 Upon successful review and verification, the product will be added to the Approved Product List (APL).
- 4.5 Annually, manufactures must submit current documentation and test data to remain on the APL.

5. QUALITY ASSURANCE AND REJECTION

- 5.1 Materials supplied to projects can be subject to random sampling and testing at the discretion of the Engineer.

- 5.2 Non-Conformance to any stated specification, including failure to meet heavy metal or gradation requirements, may result in the immediate removal from the APL and rejection of the material lot.
-

6. RECORDS

- 6.1 All approvals and testing correspondence will be maintained by the MCS&T Division in the project/product file.
- 6.2 The Certificate of Compliance shall be placed in the QC Plan Folder in ProjectWise (or the current WVDOH approved document retention software) under the contract.

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