Agenda - Materials Procedure Committee

September 19, 2017

Begin: 9:00am
Brief review of Open Meetings Act

Items approved at last meeting, August 22, 2017, were:

- MP 603.10.40 INSPECTION AND ACCEPTANCE PROCEDURES FOR PRESTRESSED CONCRETE BRIDGE MEMBERS
- MP 604.02.40 INSPECTION AND ACCEPTANCE PROCEDURES FOR PRECAST CONCRETE PRODUCTS

For Committee Review:

1. MP 688.02.20 - GUIDE FOR CONTRACTOR'S AND FABRICATOR'S QUALITY CONTROL PLAN FOR PAINTING STRUCTURAL STEEL – Revised, Third time to committee.

2. MP 688.03.20 – GUIDE FOR DEVELOPING THE CONTRACTOR'S CONTAINMENT/DISPOSAL CONTROL PLAN FOR SPENT MATERIAL PRIOR TO PAINTING EXISTING STEEL STRUCTURES – Revised, Third time to committee.

3. MP 109.00.20 – BASIS FOR CHARGES FOR NON-TESTING, NON-SAMPLING OR ADDITIONAL ACCEPTANCE TESTING – Updated "Charges List" and certain revisions. Fourth time to committee.

4. MP 709.01.50 - ACCEPTANCE CRITERIA FOR CORROSION RESISTANT STEEL REINFORCEMENT BARS FOR CONCRETE – New Materials Procedure. Second time to Committee.

5. MP 711.03.23 – MIX DESIGN FOR PORTLAND CEMENT CONCRETE – Second time to Committee. While several changes have been made, approval is expected this meeting

6. MP 401.05.20 – COMPACTION TESTING OF HOT-MIX ASPHALT PAVEMENTS – Second time to Committee. No changes to previous submission(?)

7. MP 700.00.00 – PREPARING A MATERIALS PROCEDURE – Revised by Kimberly Hoover to clarify areas of creating a materials procedure. First time to committee.

Deletion of MPs:

1) MP 688.03.21 – Procedures for Sampling "Spent Material" During Removal or Cleaning of Existing Steel Structures Prior to Repainting – No longer needed
2) MP 688.03.22 – Procedure for Testing "Spent Material" Recovered During Paint Removal or Cleaning of Existing Steel Structures – No longer needed
3) MP 688.03.23 – Evaluation and Approval for Laboratory Testing of Solid Waste – No longer needed

New Business

MPs to be made Inactive:

1) MP 711.00.21 – Procedure for Approving Paint Formulations and Production Batches
2) MP 711.20.59 – Inorganic Zinc Primer Quality Assurance Procedures
3) MP 711.20.60 – Intermediate Field Coat for Zinc Rich Systems
4) MP 711.22.22 – Zinc Rich Low VOC System

Adjourn

All proposed Materials Procedure (MP) changes will be submitted to the Materials Procedures Committee Chairperson. A brief description of the new MP or changes proposed should accompany the submittal.

The Materials Procedures Committee Chairperson will review all recommendations received and transmit them to the Materials Procedures Committee for necessary action.

A proposed publication must be presented at two consecutive committee meetings before the MP can be recommended or rejected by the Committee. The MP Committee Chairperson shall have the authority to cast the deciding vote when a tie occurs. A proposed Materials Procedure (MP) can be recommended or rejected after being presented at a single committee meeting if all committee members (voting and non-voting) have been notified by receiving a copy of the proposed MP at least fourteen (14) days in advance of the proposed MP's presentation. This proposed MP can either be an electronic version or written copy and shall clearly be designated as to be voted on for approval at the indicated Materials Procedures Review Committee meeting date.

All new MPs or changes recommended for approval by the Materials Procedures Review Committee will be formally submitted to the FHWA for approval. If there is no response from the FHWA within thirty (30) days of receipt the Materials Procedure shall be deemed accepted by the FHWA and the Materials Division Director shall sign the MP and publish it to the Materials Division website, or other appropriate location, for use.

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

1.0 SCOPE

1.1 This materials procedure shall serve as a guide for the design of the Contractor's or Fabricator's Quality Control Plan for surface preparation, application of coatings, and inspection procedures.

1.1.1 This procedure is applicable to structures that are being fabricated, erected, fully repainted, and/or zone painted.

2.0 REFERENCED DOCUMENTS

2.1 Reference to standard specifications and other standard procedures shall be the latest edition of the published document.

2.1.1 *West Virginia Department of Transportation, Division of Highways Standard Specifications Road and Bridges 2017*

a. 107-Legal Relations and Responsibility to Public
b. 601-Structural Concrete
c. 685-Bridge Cleaning
d. 688-Field Painting of Metal Structures

2.1.2 *Society for Protective Coatings (SSPC)*

a. Monitoring and Controlling Ambient Conditions during Coating Operations.
b. PA 1-Shop, Field and Maintenance Coating of Metals
c. PA-2Procedure 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

2.1.3 *International Organization for Standardization*

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

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

3.0 REQUIREMENTS AND GUIDELINES

3.1 General Requirements

3.1.1 The Contractor or Fabricator shall provide and maintain a Quality Control System that will give reasonable assurance that the paints have been applied in accordance with the specification requirements.

3.1.2 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 Contractor's or Fabricator's Quality Control inspections and testing shall be documented and made available for review by the Engineer for the life of the contract.

3.2 Quality Control Plan

3.2.1 As stated in Specification 688, Section 688.2.5-Submittals, a Quality Control Plan shall be designed by the Contractor or Fabricator and submitted for acceptance/approval to the Engineer prior to commencement of the subject work. The plan shall clearly describe the methods by which the Quality Control Program will be conducted. Electronic submittals will be accepted. As a minimum, an acceptable plan should include the following:

a. Name of the company official responsible for Quality Control and for liaison with Division personnel.

b. Name of person(s) conducting the inspection.

c. Type of paint, name and address of the paint supplier, and the type and amount of thinner, if necessary, to thin or adjust the solvent balance of the paint as recommended by the manufacturer. Include a product data sheet for each product listed.

3.3 Surface Preparation

3.3.1 Appearance of the surface after blast cleaning shall correspond with the pictorial standard as specified in the contract. Specify the instrument used for determining the height of the profile of the anchor pattern produced on the surface.

3.3.2 Specify the methods for determining the relative humidity, ambient temperature, temperature of the steel, and dew point.

3.4 Applied Coatings

3.4.1 Visually inspect the applied film for runs, sags, and other flaws.

3.4.2 Inspect for bubbles and pinholes by eight power (8x) magnification.

3.4.3 Measure the dry film thickness of each coat of paint and, the accumulated total dry film thickness of the paint system. These measurements shall be taken and documented in accordance with SSPC PA-2.

3.5 A detailed plan of action regarding correction of flaws in the painted surface shall be included.

4.0 ENVIRONMENTAL CONDITIONS

4.1 The field Contractor shall submit to the Engineer his procedure for equipment cleanup, as well as his plan of action for any cleanup in the event of paint spillage.

5.0 FORMAT

5.1 The Quality Control Plan for Painting shall be submitted in the format shown in Attachment # 1.

ATTACHMENT # 1

PROJECT INFORMATION

State/Federal Project Number:

Bridge Name/Number:

District:

County:

CONTRACTOR INORMATION

Name:

Address:

Contact Person:

Official responsible for Quality Control:

Liaison with Division of Highways personnel:

COATING INFORMATION

Areas to be coated:

Name and address of coating supplier:

Estimated quantity of material (in gallons) for each type of coating:

Type and amount of thinner for each type of coating:

Documentation that material has been approved by the Division of Highways, MCS&T:

INSPECTION

Person(s) conducting the inspection:

Areas to be inspected:

Appearance of surface after blast cleaning:

Instrument for measuring the height of the profile of the anchor pattern:

Method for determining relative humidity:

Ambient temperature:

Temperature of the steel:

Dew point:

Magnification inspection:

Wet film thickness gauge/Dry film thickness gauge:

Dry film thickness measurement documentation:

CORRRECTIVE ACTIONS AND CLEAN UP

Action regarding correction of coating flaws:

Procedure for equipment cleanup

Procedure for spillage cleanup:

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

1.0 SCOPE

1.1 This materials procedure shall be used as guidance for the development of the Contractor'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 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. 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. The hazardous waste transporter named within the plan shall have a US EPA Identification Number.

2.0 REFERENCED DOCUMENTS

2.1 Reference to standard specifications and other standard procedures shall be the latest edition of the published document.

2.1.1 *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
c. 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.

3.0 ENVIRONMENTAL CONTROL PLAN

3.1 As stated in Specification 688, Section 688.2.5-Submittals, 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. Electronic submittals will be accepted. As a minimum, an acceptable plan should include the following:

3.2 Name of the company employee who has been designated as the "Competent Person" for the project. A "Competent Person" shall be as defined in 29 CFR 1926.62. A "Competent Person" means one who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has authorization to take prompt corrective measures to eliminate them.

3.3 Level of containment and monitoring methods required by the project plans/specifications.

3.4 Name, type, size, and manufacturer of the abrasive to be used.

3.5 Name, type, manufacturer, and percentage of any additive included with the abrasive.

3.6 Specifics of the pollution control system proposed for the containment, collection, storage, transport and disposal of the spent materials.

Commented [HKD1]: Ron, do we want to add in a signature requirement for these docs??

4.0 FORMAT

4.1 The Contractor is encouraged to explain in detail all items noted on Attachment # l. Additional information may be provided on separate documents attached to the Environmental Control Plan.

ATTACHMENT # 1

PROJECT INFORMATION

State/Federal Project Number:
Bridge Number/Name:
District:
County:

CONTRACTOR INFORMATION:

Name:
Address:
Contact:
Contractor's "Competent Person":

ENVIRONMENTAL CONTROLS

Environmental containment level as per plans:
Environmental containment monitoring methods:

ABRASIVES

Trade Name:
Company:
Recyclable:
Size:

Abrasive Additives:
Trade Name:
Company:

HAZARDOUS/NON-HAZARDOUS DISPOSAL

Waste Disposal Company:
Address:
Contact Person:

Waste Transporter Company:
Address;
Contact person:
Waste Disposal Site:

Non-Hazardous Material:
Company:
Address:
Contact Person:

Hazardous Material:
Company:
Address:
Contact Person

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

MATERIALS PROCEDURE

BASIS FOR CHARGES FOR NON-TESTING, NON SAMPLING OR ADDITIONAL ACCEPTANCE TESTING

1. PURPOSE

1.1 To provide a unit cost per test to be assessed the Contractor when additional acceptance testing is performed by the Division on reworked lots and sublots, non-sampling, or documentation not submitted, limited to those tests listed in Table 9-1 of this procedure.

2. SCOPE

2.1 This procedure is applicable to those circumstances where a construction item by necessity is sampled and/or tested for final acceptance by the Division in excess of what would be considered normal for that item, and is intended to reflect Division costs only. There is no reference in this procedure that charges by private firms offering the same tests are the same or comparable.

3. GENERAL

3.1 As stated in Section 106.3.1.2 of the Standard Specifications, it is the intent of the specification that lots and sublots of materials, products, items of construction or completed construction meet testing specification requirements at the time of submission. In this case submission refers to the time when the contractor has completed the work and offers the finished 'product' to the Division for final acceptance testing.

3.2 In the case where no test was run or no documentation was submitted for material placed according to the required quality control per specifications the price will be assessed in accordance with table 9-1. If there are cases where final acceptance testing has shown that the product does not meet the Division's criteria of acceptance and the contractor elects to rework the product with the approval of the Engineer, the cost of any additional acceptance testing done by the Division on the reworked product will be assessed to the contractor in the form of a deduction from the amount due the contractor.

3.2.1 The amount, or cost, for each additional acceptance test for the applicable item is listed in Table 9-1.

3.3 Also, Table 9-1 may be used as a guide for the amount, or cost, for deduction in those cases where additional acceptance samples are needed for final acceptance of a construction item resulting from a special investigation.

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Ronald L. Stanevich, P.E.
Director
Materials Control, Soils and Testing Division

RLS

Attachment

TABLE 9-1

COSTS FOR ADDITIONAL OR NO TESTING

ITEM#	TEST	COST
207	IN-PLACE DENSITY (5 TESTS)	$300.00
	GRADATION (EACH TEST)	$300.00
	PLASTIC INDEX, LIQUID LIMITS	$300.00
212	IN-PLACE DENSITY (5 TESTS)	$300.00
	GRADATION (EACH TEST)	$300.00
307 & 308	IN-PLACE DENSITY (5 TESTS)	$300.00
	GRADATION (EACH TEST)	$300.00
311	CRUSHED PARTICLE ANALYSIS	$300.00
	GRADATION (EACH TEST)	$300.00
401 & 402	CORING (EACH CORE) PWL	$300.00
	PAVEMENT SMOOTHNESS	$300.00
	(PER LANE MILE)	$300.00
	ASPHALT CONTENT FAILURES	$300.00
	AIR VOIDS FAILURES	$300.00
601	ABAR (EACH TEST)	$300.00
	CYLINDER BREAK REPORT	$300.00
	PERMABILITY	$300.00
603	GROUT BREAK REPORT (EACH TEST)	$300.00
604	IN-PLACE DENSITY (5 TESTS)	$300.00
	GRADATIONS > 60”	$300.00
606	GRADATION (EACH TEST)	$300.00
626	IN-PLACE DENSITY (5 TESTS)	$300.00
	GRADATION (EACH TEST)	$300.00
	PLASTIC INDEX, LIQUID LIMITS	$300.00

All price reductions for failing to perform tests required could also include the actual cost of the material placed.

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. APPLICABLE DOCUMENTS

ASTM A1035 Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement

ASTM A955 Standard Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement

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 WVDOH Materials Control, Soils and Testing Division indicating intention to be included on the WVDOH approved source list as an approved source of corrosion resistant steel reinforcement bar 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 WVDOH specifications. Five samples each two feet in length of different sizes or heats are to be tested in department laboratories annually to confirm WVDOH 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 WVDOH 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 WVDOH requirement conformance. This approval number shall be active for one year. Acceptance of manufacturer's facility can be verified by accessing the WVDOH 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 feet 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 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.

Ronald L. Stanevich, P.E.
Director
Materials Control, Soils and Testing Division

MP 711.03.23
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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 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.

3. TEST PROCEDURE

3.1 With the exception of SCC produced in accordance with Section 603, the mix design shall be performed in accordance with the applicable requirements of ASTM C 192 by a Division Approved Laboratory. To obtain Division approval, a laboratory must demonstrate that they are equipped, staffed, and managed so as to be able to batch and test portland cement concrete in accordance with applicable ASTM Methods of Test. The most expeditious means of demonstrating such ability is by submission of a copy of the laboratory's latest report of concrete and aggregate inspection by the Cement and Concrete Reference Laboratory, National Bureau of Standards, together with a letter detailing the actions taken to correct any deficiencies noted therein. A listing of approved laboratories is available on the WVDOT internet site.

3.2 The following information for each of the materials listed below that are to be used in the proposed mix design shall be listed in Attachment 1. Attachment 1 S-P shall be used for SCC produced in accordance with Section 603.

3.2.1	Cement:	Type, Materials Code, Sitemanager Materials Code, Source and Location, Source Code, Producer/Supplier Code, Specific Gravity
	Pozzolan:	Type, Materials Code, Sitemanager Materials Code, Source and Location, Source Code, Producer/Supplier Code, Specific Gravity
	Chemical Admixtures:	Type, Materials Code, Sitemanager Materials Code, Source and Location, Source Code, Producer/Supplier Code
	Coarse Aggregate:	Type, Materials Code, Sitemanager Materials Code, Size, Source and Location, Source Code, Producer/Supplier Code, Specific Gravity, Absorption, A-Bar, Unit Weight
	Fine Aggregate:	Type, Materials Code, Sitemanager Materials Code, Source and Location, Source Code, Producer/Supplier Code, Specific Gravity, Absorption, A-Bar, Fineness Modulus

The mass and volume of each material that is to be used in each batch shall be listed in Attachment 2. Attachment 2 S-P shall be used for SCC produced in accordance with Section 603.

3.2.2 The aggregate correction factor, as defined in AASHTO T 152, shall be listed in Attachment 3. Attachment 3 S-P shall be used for SCC produced in accordance with Section 603.

3.2.3 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.

3.2.4 Information (i.e. raw data) pertaining to the compressive strength tests 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.

3.3 All classes of the 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 ~~four~~ separate batches. Two of the batches shall be proportioned to produce a mix having a minimum cement factor.~~, and~~ T~~t~~wo 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) that 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 w/c than the previous four batches. The slump tolerance in Section 3.4 shall not apply to this fifth batch.

3.3.1 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. Two rapid chloride permeability tests, in accordance with AASHTO T 277, 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 of 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. Two rapid chloride permeability tests specified in Section 679.2.2 shall be performed, at the same test age, on each of these batches, and the same method of curing shall be used for all of the test specimens.

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.

3.4 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, ± ½ percent; Consistency, ± ½ in. (± 12 mm) of slump; Yield, ± 2 percent.

3.4.1 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, 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.

3.5 When the properties of a concrete batch have been established within acceptable limits, seven 6 by 12 in. (150 by 300 mm) cylinders shall be made from each batch produced in Section 3.3 (or 3.3.1)~~ and 3.3.2~~ 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 3.3 (or 3.3.1) 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 w/c~~each of the two batches produced in Section 3.3 (or 3.3.1)~~. 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.

3.5.1 For any class of concrete other than SCC produced in accordance with Section 603, if it is desired to use 4 by 8 in. (100 by 200 mm) cylinders as the basis for acceptance or early strength determination in the field, in accordance with Section 601.4.4, then seven 4 by 8 in. (100 by 200 mm) cylinders shall be fabricated and tested as outlined in Section 3.5 for the first two ~~both of the~~ trial batches at the minimum cement factor in addition to the seven 6 by 12 in. (150 by 300 mm) cylinders.

3.5.1.1 If the average compressive strength of the six 28-day 4 by 8 in. (100 by 200 mm) cylinders for the batches at the minimum cement factor is not more than 10.0 percent greater than the average compressive strength of the six 28-day 6 by 12 in. (150 by 300 mm) cylinders for the batches at the minimum cement factor, then 4 by 8 in. (100 by 200 mm) cylinders will be permitted to be used in the field. Otherwise, any cylinders fabricated in the field for acceptance or early strength determination must be 6 by 12 in. (150 by 300 mm) cylinders.

3.5.1.2 The following formula shall be used during the mix design approval process to determine if the average compressive strength of the three 28-day 4 by 8 in. (100 by 200 mm) cylinders is greater than 110.0 percent of the average compressive strength of the three 28-day 6 by 12 in. (150 by 300 mm) cylinders:

If $\bar{X}_{4x8} > \bar{X}_{6x12} \times 1.10$, then 4 by 8 in. (100 by 200 mm) cylinders are not permitted to be used in the field.
Where:
$\bar{X}_{6\times12}$ = Average 28-day compressive strength of 6 by 12 in. (150 by 300 mm) cylinders.
$\bar{X}_{4\times8}$ = Average 28-day compressive strength of 4 by 8 in. (100 by 200 mm) cylinders.

3.5.2 The following properties of each batch of concrete produced in Sections 3.3 (or 3.3.1) ~~and 3.3.2~~ shall be listed in Attachment 2: A-bar of total solids, consistency, air content, unit weight and yield, water-cement ratio, and temperature.

3.5.3 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 rapid chloride permeability 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.

3.6 Mix design submittal packages including Attachments 1, 2, and 3, A-bar worksheet(s), and raw data pertaining to the compressive strength 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, 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, and 3 S-P.

3.6.1 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 of 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. 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.

4. ACCEPTANCE CRITERIA

4.1 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 6 by 12 in. (150 by 300 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.

4.2 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.

4.2.1 Note that the "Design 28-Day Compressive Strength" required by the Specifications is the minimum field strength sought in 6 by 12 in. (150 by 300 mm) or 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 4.1 or 4.2 for mix design approval, shall be noted as the "Mix Design Approval Strength".

4.3 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, with the exception of the compressive strength "overdesign" requirements. SCC mix designs, produced in accordance with Section 603, shall meet the compressive strength "overdesign" requirements of ACI 3014~~18~~ Chapter 4~~5~~.

5. PROPORTIONING DESIGN MIX

5.1 If the average of the batches produced in Section 3.3 (or 3.3.1), with the specified minimum cement factor, satisfies the acceptance criteria of Section 4, then it will be considered acceptable as the mix design for the class of concrete being designed.

5.2 If the average of the batches produced in Section 3.3 with the specified minimum cement factor does not satisfy the acceptance criteria of Section 4, then a linear compressive strength-cement factor relationship will be established using the average 28-day compressive strength, based on the 6 by 12 in. (150 by 300 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 (2.2 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.

5.2.1 If neither of the averages of the batches produced in Section 3.3 satisfies the acceptance criteria of Section 4, then that proposed mix design cannot be considered as acceptable, and a new mix design will be required.

5.2.2 Section 5.2 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 3.3.1 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.

5.3 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 ~~, and~~ 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 w/c (i.e. fifth batch), when applicable. 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 of the 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 3.4.1, shall be submitted also.

5.4 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.

5.4.1 Using the three different water-cement ratios from the batches produced in Section 3.3 and the corresponding 28-day compressive strengths from Section 3.5, the Excel file in Attachment 4 of this MP shall be used to create a best-fit line through these three points.

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5.4.2 The water-cement ratio (w/c) that corresponds to the Mix Design Approval Strength, as outlined in Section 4.1 or 4.2, 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 w/c (i.e. the w/c 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 w/c in Table 601.3.1A be exceeded).

5.4.3 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.

~~5.4~~5.4.4 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.

6. MIX DESIGN RE-APPROVAL

6.1 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 6.2 and conducted at the Concrete Producer. 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.

6.1.1 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 number. The WVDOH District Materials personnel shall verify whether or not there are a minimum of fifteen air content, slump, and compressive strength tests for that mix design in the previous three year period.

6.1.2 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 6.1. MCS&T Division shall then update the approval date of the subject mix design.

6.1.3 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 6.2.

6.2 The following procedures shall be used to re-approve concrete mix designs that do not meet the criteria in Section 6.1.

6.2.1 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.

6.2.2 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 to establish a new target A-bar for the mix design and, if necessary, to adjust any batch volumes.

6.2.3 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 yd^3 (4.6 m^3) of the concrete mix subject for re-approval. This batch shall be tested for air content, slump, unit weight and yield. Also, three 6 by 12

in. (150 by 300 mm) 28-day compressive strength specimens, and if applicable, two rapid chloride permeability specimens (each to be tested at an age of 90 days or earlier and the average result used) shall be fabricated and tested from this batch.

6.2.4 If a Concrete Producer desires to have the option of using 4 by 8 in. (100 by 200 mm) cylinders in the field for a mix design which has already been approved, then at the time of mix design re-approval, or at any time prior to that time three additional 6 by 12 in. (150 by 300 mm) 28-day compressive strength specimens and six 4 by 8 in. (100 by 200 mm) 28-day compressive strength specimens shall be fabricated and tested from the batch produced in Section 6.2.3. The six 6 by 12 in. (150 by 300 mm) cylinders shall then be compared to the six 4 by 8 in. (100 by 200 mm) cylinders as outlined in Section 3.5.1.1 in order to determine if 4 by 8 in. (100 by 200 mm) cylinders will be permitted in the field for the subject mix design.

6.3 The Concrete Producer shall record the results of all tests required and the proportions used in the batch outlined in Section 6.2 in the applicable sections of Attachments 1, 2, and 3. The Concrete Producer shall then submit those attachments, along with the test data required in Section 6.2.2 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.

6.3.1 For mix design re-approval purposes, the compressive strength of the representative batch produced in Section 6.2.3 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 4.

6.3.2 For mix design re-approval purposes, the average of the two rapid chloride permeability test results from the representative batch produced in Section 6.2.3 must be 1,000 coulombs or less in order for the mix design to be re-approved.

6.3.3 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.

7. CHANGING A COMPONENT MATERIAL USED IN A MIX DESIGN

7.1 Whenever more than one component material in an approved mix design is changed simultaneously, a new laboratory mix design, in accordance with Section 3 shall be

required. This option is not permitted for SCC mix designs produced in accordance with Section 603.

7.1.1 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 in order for that component material change to be approved, are outlined in the following sections.

7.2 The changes, outlined below, to any of the following component materials are permitted provided the requirements in Section 7.3 are met. Only one component material may be changed at a time, otherwise a new laboratory mix design in accordance with Section 3 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, in order to maintain desired mix properties.

7.2.1 Cement: The source of cement may be changed provided the requirements of Section 7.3 are met.

7.2.2 Pozzolan: The source and/or type of pozzolan may be changed provided the requirements of Section 7.3 are met.

7.2.3 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 7.3 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.)

7.2.4 Latex Admixture: The source of latex admixture may be changed provided the requirements of Section 7.3 are met.

7.2.5 Fine Aggregate: The source of fine aggregate may be changed provided the requirements of Section 7.3 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.

7.2.6 Coarse Aggregate: The source of coarse aggregate may be changed provided the requirements of Section 7.3 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 3 shall be required.

7.3 When a change to any individual component material in an approved mix design, as outlined in Sections 7.1.1 and 7.2, 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 yd^3 (2.3 m^3), 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.

7.3.1 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.

7.3.2 In lieu of the two batches produced at the Producer's facility, as outlined in Section 7.3, two batches may be produced at a Division Approved Laboratory, meeting the requirements of Section 3.1. 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 7.3.1.

7.3.3 All of the information pertaining to the materials used in these batches shall be listed in Attachments 1, 2, and 3 as outlined in Section 3.2.

7.3.4 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.

7.3.4.1 If laboratory batches are produced in lieu of batches at the Producer, as outlined in Section 7.3.2, then the batch tolerances specified in Section 3.4 shall apply.

7.3.5 When the properties of a concrete batch have been established within acceptable limits, three 6 by 12 in. (150 by 300 mm) cylinders shall be made from each batch produced in Section 7.3 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 7.3. 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 7.3 shall be listed in Attachment 2: A-bar of total solids, consistency, air content, unit weight and & yield, water-cement ratio, and temperature.

7.4 When it is desired to change a component material in a mix which requires the rapid chloride permeability test (Class H concrete and specialized concrete overlays as outlined in Section 679), a minimum of one permeability specimen shall be fabricated from each of the batches produced in Section 7.3. The average value of these permeability specimens shall be no more than 10 percent greater than the mix design permeability value, required in the applicable specification, when tested at the time frame specified in the applicable specification.

7.4.1 If laboratory batches are produced in lieu of batches at the Producer, as outlined in Section 7.3.2, then the average value of these permeability specimens shall be less than or equal to the mix design permeability value required in the applicable specification, when tested at the time frame specified in the applicable specification.

7.5 If 4 by 8 in. (100 by 200 mm) cylinders were approved for use with the mix design which was approved prior to the component material change, then 4 by 8 in. (100 by 200 mm) cylinders shall also be approved for use with the new mix (with the component material change) with no further testing required.

7.5.1 Otherwise, if it is desired to use 4 by 8 in. (100 by 200 mm) cylinders as the basis for acceptance or early strength determination in the field with the new mix (with the component material change) then three 4 by 8 in. (100 by 200 mm) 28-day compressive strength specimens shall be fabricated and tested from each of the batches produced in Section 7.3. The six 6 by 12 in. (150 by 300 mm) cylinders from these batches shall then be compared to the six 4 by 8 in. (100 by 200 mm) cylinders from these batches as outlined in Sections 3.5.1.1 and 3.5.1.2 in order to determine if 4 by 8 in. (100 by 200 mm) cylinders will be permitted in the field for the subject mix design.

7.6 The average compressive strength of the two batches produced at the Producer in Section 7.3 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 4.1.

$f'_{cr} = f'_c + 2.33\sigma - 500$

Where:
f'_{cr} = Required average compressive strength of the batches produced in Section 7.3 (expressed in psi)
f'_c = Design 28-Day Compressive Strength (expressed in psi)
σ = Concrete Plant Standard Deviation (outlined in Section 4.1)

7.6.1 If laboratory batches are produced in lieu of batches at the Producer, as outlined in Section 7.3.2, 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 4.1.

$f'_{cr} = f'_c + 2\sigma$

7.6.2 If the average compressive strength of the two batches produced in Section 7.3 (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 7.7 are met.

7.7 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 7.3 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 yd^3 (2.3 m^3), 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.

7.7.1 In lieu of the two batches produced at the Producer's facility, as outlined in Section 7.7, 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 3.1. 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.

7.7.2 Production of these two additional batches is not an option for Class H concrete or specialized overlay concrete.

7.7.3 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.

7.7.3.1 If laboratory batches are produced in lieu of batches at the Producer, as outlined in Section 7.7.1, then the batch tolerances specified in Section 3.4 shall apply.

7.7.4 When the properties of a concrete batch have been established within acceptable limits, three 6 by 12 in. (150 by 300 mm) cylinders shall be made from each batch produced in Section 7.7 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 7.7. These values shall be listed in the column for the mix with the "Minimum Cement Factor + 1 Bag" in Attachment 3.

The following properties of each batch of concrete produced in Section 7.7 shall be listed in Attachment 2: A-bar of total solids, consistency, air content, unit weight and yield, water-cement ratio, and temperature.

7.7.5 If the average of the batches produced in Section 7.3, with the specified target cement factor, does not satisfy the acceptance criteria set forth in Section 7.6, then a linear compressive strength-cement factor relationship will be established using the average 28-day compressive strength [based on the 6 by 12 in. (150 by 300 mm) cylinder results] of the batches with the target cement factor (Section 7.3) and the average 28-day compressive strength of the batches with the target cement factor plus one bag of cement (Section 7.7). This relationship will be interpolated to determine a cement factor [to the nearest 1 lb (2.2 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.

7.7.6 If neither of the averages of the batches produced in Sections 7.3 or 7.7 satisfy the acceptance criteria in Section 7.6, then that proposed component material change cannot be considered as acceptable, and a new laboratory mix design will be required in order to make a change in component materials.

7.8 The submittal for a proposed mix design change, as outlined in Section 7, 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 7. All pertinent information supporting these attachments and pertaining to the information in them shall be submitted also. 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.

7.9 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 7.

8. REPLACEMENT OF FLY ASH WITH CEMENT IN A MIX DESIGN

8.1 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, and not substitute another source of fly ash for the one being discontinued, an equal volume of cement 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.

8.1.1 This option of replacing fly ash with cement does not apply to Class H concrete and concrete for specialized overlays, as set forth in Section 679 of the specifications.

8.2 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. 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.

8.3 Two batches of concrete, produced with this mix containing all cement and no fly ash 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.

8.3.1 Three 6 by 12 in. (150 by 300 mm) cylinders shall be made from each batch outlined in Section 8.3 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 8.3. 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 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.

8.4 The average compressive strength of the two batches produced in Section 8.3 must have an average compressive strength which exceeds the "Design 28-Day Compressive Strength" required by the specifications.

8.5 The submittal for a mix design change from a mix containing fly ash to a mix using only cement as the cementitious material, 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 8.3. 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.

9. ADDITION OF HYDRATION CONTROL STABILIZING ADMIXTURES TO EXISTING MIX DESIGNS

9.1 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.

9.2 Two separate batches of concrete shall be produced as outlined in Section 7.3. These concrete batches shall be tested as outlined in Sections 7.3 and 7.4.

9.2.1 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 in order to verify that the allowable concrete discharge time may be extended.

9.3 If the requirements set forth in Section 7.6 are met, then the procedures set forth in Sections 7.8 and 7.9 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.

9.4 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.

Ronald L. Stanevich, P. E.
Director
Materials Control, Soils & Testing Division

RLS:Fml

Attachments

MP 711.03.23
ORIGINAL ISSUANCE: APRIL 1971
REVISED: 2017 DRAFT REVISION
ATTACHMENT 1

Source:		Source Code:	
Source Location:		Producer/Supplier Code:	
Class of Concrete:		Materials Code:	
		SiteManager Mat. Code:	
Design Laboratory:		Date:	

Cementitious Material Data			
Data	Cement	Pozzolan 1	Pozzolan 2
Name			
Type			
Materials Code			
SiteManager Mat. Code			
Source			
Source Location			
Source Code			
Producer/Supplier Code:			
Specific Gravity			

Admixture Data				
Data	Air Entrainment	Additional Admixture 1	Additional Admixture 2	Additional Admixture 3
Name				
Type				
Materials Code				
SiteManager Mat. Code				
Source				
Source Location				
Source Code				
Producer/Supplier Code:				

Aggregate Data		
Data	Coarse Aggregate	Fine Aggregate
Class/Size		
Type		
Materials Code		
SiteManager Mat. Code		
Source		
Source Location		
Source Code		
Producer/Supplier Code:		
Specific Gravity		
A-Bar		
Absorption		
Fineness Modulus		
Unit Weight		

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

MATERIALS PROCEDURE

COMPACTION TESTING OF HOT-MIX ASPHALT PAVEMENTS

1.0 PURPOSE

1.1 The purpose of this procedure is to establish the test methods for quality control testing by the Contractor and verification testing by the Division.

2.0 SCOPE

2.1 This procedure is applicable for all items of hot-mix asphalt pavements requiring compaction testing.

3.0 DEFINITIONS

3.1 Quality Control Testing – Testing conducted by the Contractor to monitor and control the production of their product.

3.2 Verification Testing – Testing conducted by the Division to determine specification compliance.

3.3 Tender Mix - An internally unstable mix that tends to displace laterally and shove rather than compact under roller loads. Rolling may need to be stopped within a particular temperature range (determined at the project) and continued at a lower temperature. Additional densification may be achievable at temperatures below the standard 175 °F (80 °C). If problems persist and adequate density cannot be achieved on a tender mix the Division should consider requiring a new mix design.

4.0 APPLICABLE DOCUMENTS

MP 717.04.21

MP 712.21.26

5.0 EQUIPMENT

5.1 Nuclear density gauges of the backscatter type.

5.2 One measuring tape of approximately 50 feet (20 meters).

5.3 Lime or other suitable material to mark test sites.

5.4 Dry mortar sand.

5.5 Supply of appropriate worksheets required for documentation.

6.0 ROUNDING OF DATA

6.1 Test data must be rounded according to AASHTO R11.

6.2 Test data and calculations are rounded to the following nearest significant digit.

Station Number	1 ft (0.1 m)
Offset	1 ft (0.1 m)
Wet Density	0.1 lb/ft^3 (1 kg/m^3)
Target Density	0.1 lb/ft^3 (1 kg/m^3)
Lift Thickness Compacted	0.25 inch (1 mm)
Relative Density	1 %
Average Relative Density	1 %
Average Wet Density	0.1 lb/ft^3 (1 kg/m^3)

7.0 STANDARDIZATION OF NUCLEAR GAUGE

7.1 Warm up the gauge in accordance with the manufacturer's recommendations.

7.2 Standardization must be performed away from metal and other objects.

7.3 Clean the top of the standard block and the bottom of the gauge with a cloth.

7.4 Make sure the gauge is turned the correct way on the block.

7.5 After making the necessary adjustments on the gauge for standardization, take a four minute count for density.

7.6 Compare the standard count to the manufacturer's standard count. The standard count must be within ± 2% from the manufacturer's standard.

7.7 If the gauge is not within the specified tolerance, repeat the standardization. If the gauge will not standardize after four attempts, there may be something wrong with the gauge. Perform stability and drift testing as per manuafcturer's recommendations. Refer to MP 717.04.21, Section 5.4.3 regarding the establishment of a new standard count from stability checks at intervals between gauge calibrations.

7.7.1 If a gauge does not satisfy the requirements of stability and drift tests, there may be electronics problems, and/or the gauge needs calibrated. Do not use a gauge that has been determined to be operating incorrectly.

7.8 A gauge must be standardized before testing and at least every four hours during testing.

8.0 COMPARISON OF GAUGES

8.1 Unless the control strip density requirements of Section 9.0 apply to a project, the gauge used for the Contractor's quality control testing shall be compared with the gauge used for the Division's verification testing. This comparison procedure shall be documented on Form T428.

8.2 Standardize both gauges according to 7.1 through 7.8.

8.3 Place the aluminum plate provided by the Division on the standard block used for verification testing. Place the standard block on material weighing a minimum of110 lb/ft^3 (1762 kg/m^3). The block must not be near metal or other objects during testing and must not be moved. Keep the gauges separated a minimum of 30 feet (9.1 meters) during testing.

8.4 Take 5 one minute wet density readings with each gauge in the backscatter position. The gauges are to be oriented on the block the same as for standardization.

8.5 Record the wet density readings exactly as shown on the gauge. The range of the five readings shall not exceed 1.5 lb/ft^3 (24 kg/m^3). If the readings exceed this

range, perform a new set of five readings. A gauge should not be used if the repeatability of the gauge is not within this range.

8.6 Average the five readings for each gauge. The gauges are considered similar if the averages of the readings are within 3 lb/ft^3 (48 kg/m^3).

8.7 The density readings for verification testing will not be adjusted to compensate for any differences in readings between gauges.

9.0 CONTROL STRIP DENSITY

9.1 When required by the specifications, a control strip shall be constructed for the purpose of determining pavement density and rolling pattern. When this type of control strip is used on the lift, the gauge comparison procedure of Section 8.0 will not be required.

9.2 The control strip shall be constructed using the approved job mix formula that was selected for the lift being placed. The equipment proposed for use in placing and compacting the control strip shall be the same as that which will be used on the project for constructing the remainder of the pavement lift.

9.3 The pavement upon which the control strip is constructed shall be approved by the Engineer prior to the construction of the control strip. The control strip should be laid out by WVDOH personnel. Each control strip shall commence a minimum of 200 feet (61 meters) past the start of paving, consist of the width of the paving lane, and be a minimum of 240 feet (73 meters) in length.

9.4 A control strip shall not be constructed on a paved shoulder. The shoulder compaction test method shall be as set forth in Section 401, Table 401.7.3B. When Lot-by-Lot compaction testing is required on the shoulder the corrected nuclear gauge readings established from the paving lane shall be used to determine density, as long as the mix design used on the shoulder is the same as that used for the traffic lanes. If a different mix design is used on the shoulder then the nuclear gauge comparison procedure from Section 8.0 shall be used. Quality control density testing shall proceed as per Section 10.0, and acceptance testing shall proceed as per Section 11.0.

9.5 A control strip shall be constructed at the beginning of the work on each of the pavement lifts on the project. If a new job mix formula (JMF) is used on a lift where a control strip has already been constructed, then a new control strip shall be

constructed using the new JMF. The Engineer may also require an additional control strip at any time during the project if the frequency and severity of failing density test results becomes a concern. If failing density test results continue to be a significant problem, then the Engineer may decide to require a new JMF in addition to a new control strip.

9.6 Upon completion of the control strip compaction, a minimum of 8 randomly located test sites shall be selected for the purpose of determining the average in-place density of the control strip. In order to assure the nuclear gauge can be properly rotated as described in Section 9.7, disregard any random test site that is closer than one foot (0.3 meters) from any longitudinal edge of the pavement and simply move the gauge back to one foot (0.3 meters) away from the pavement edge before testing. Each test site shall be adequately marked and individually identified. The density shall be determined with a nuclear density gauge using the following procedure.

9.6.1 Density testing at the random test locations shall be performed with two each (a primary and a secondary) of both the Contractor and Division nuclear density gauges, and individual T426 Forms shall be used to record the respective data. Testing should begin with the Contractor's primary guage and then the Division's primary acceptance gauge in order that these gauges can complete the testing and begin testing of full production lots as soon as practical. Testing should also be staggered throughout the control strip so that there is no interference from gauge to gauge. In order to comply with this, it is best that the second gauge to begin taking readings on the core locations should not be used until the Contactor's primary gauge is positioned on the core location in the third sublot. This manner of testing should then continue with the third and fourth gauges to be used for evaluation as the first two gauges progress within the sublot.

9.7 Place the gauge on the pavement with the source rod pointing in the direction of the paving operation and the gauge positioned such that the core location is situated at the center of the gauge footprint. Take a one minute wet density reading. Rotate the gauge 90° and take another one minute wet density reading. Continue this process for two additional readings until you have four readings at the test site. The four gauge positions are shown on Figure-1.

NOTE: Templates have been fabricated for use within each District for laying out gauge positioning with respect to each core location.

9.8 Average the four readings at each site. If any single reading is outside the four test average by more than ±2 lb/ft^3 (±32 kg/m^3) place the nuclear gauge back in the same

position and repeat the one minute wet density test. If one of the four readings is still out by more than ±2 lb/ft^3 (±32 kg/m^3) then drop that reading and average the remaining three readings. If two or more gauge readings are outside the four test average, and repeated testing does not remedy the situation, eliminate this location and use the remaining test sites. No more than two test sites can be eliminated in this manner. If more than two test sites are eliminated, randomly locate replacement test locations and test them in accordance with Section 9.7 and average the four readings at the new locations. A minimum of six locations shall be used to calculate gauge correction factors for application throughout the project.

9.9 Additionally, if cores obtained after gauge testing are damaged during transport or otherwise, the values for those cores should be carefully considered before use to develop gauge correction factors. If it is determined that such values would be erroneous, they may be thrown out. In any case, a minimum of six location shall be used to calculate gauge correction factors for application throughout the project.

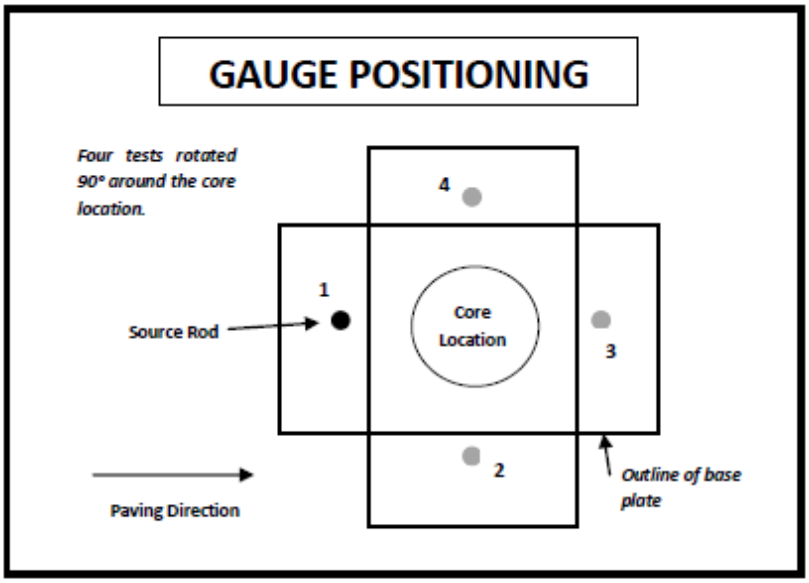

Figure-1

9.10 After completion of the control strip nuclear gauge testing, both the Contractor and the Engineer should review density results determined on Form T426 from the Contractor's and the Division's nuclear gauges. Although nuclear gauge correction factors have not yet been determined, low nuclear gauge densities may indicate a

potential problem with the roller pattern or equipment. Adjustments may be necessary for the remainder of the paving operation on the lift.

9.11 Immediately after the completion of the control strip, the Contractor shall obtain cores at the marked test sites that have been tested with the nuclear density gauge. Each core location should be cooled prior to drilling using a small bag of ice or other suitable means. Core specimens shall be six inches (150 mm) in diameter and shall be from the full layer depth of the compacted lift. If the cores are taken at a depth that results in other pavement layers being attached, the Contractor is responsible for separating the layer of mix to be tested in a manner such that it is not damaged. Efforts should be taken jointly by Division and Contractor's personnel to identify the depth at which the layer to be evaluated is present in the core so that the cores can be properly sawn to separate this layer.

9.12 If a core is damaged during the extraction process or otherwise, and the minimum number of test locations as described in Section 9.8 is not met, then additional nuclear density test sites will be required in order to complete the coring process. These cores shall be used for the purpose of correlating core density and nuclear density test results. If additional control strips are constructed as noted in Section 9.5 the core density results from the first control strip on this lift may still be used to correlate core density and nuclear density test results as long as the JMF does not change.

9.13 Core holes should not be left open after work within the current shift. All core holes shall be back filled during the corresponding shift with a sufficient amount of compacted asphalt mix from production during that shift, and compacted to the level of the surrounding area. Efforts should be taken to remove all standing water and other debris from the core holes prior to placement of asphalt mix into the hole.

9.14 Cores shall be taken back to the quality control lab for testing. A qualified person from the District Materials Section shall monitor the density testing of the cores. Since the cores specimens will be wet due to the drilling operation, the dry weight shall be determined by one of the following drying methods.

9.14.1 Drying Method 1: The cores shall be dried in an oven set at a temperature of 125 ± 5 °F (52 ± 3 °C). At one hour drying intervals the cores shall be weighed until the mass does not change by more than 0.05% from previous weighing. Core samples that have the saturated surface-dry weight determined before drying must be dried overnight at a temperature of 125 ± 5 °F (52 ± 3 °C) and then weighed at two-hour drying intervals until the mass does not change by more than 0.05%

from the previous weighing. In either case, the cores shall be cooled to room temperature before determining the final dry weight.

9.14.2 Drying Method 2: An automated vacuum drying system such as the CoreDry device may be used to speed up the drying process of the cores.

9.15 Core samples from mix types with a nominal maximum aggregate size of ¾ inch (19 mm) or less may be tested using AASHTO T166 unless they contain open or interconnected voids and/or are determined to absorb more than 2.0 percent of water by volume as determined through the test calculations contained in the procedure. Alternative test methods are described below. All core specimens from the test strip shall be tested using the same test method. To avoid retesting some or all of the cores, it may be advisable to use one of the two alternative methods listed below if even one of the cores appears to be questionable.

9.16 Cores taken from Marshall Base-1, Superpave 37.5 mm, and Superpave 25 mm mix types, or those cores that don't meet the AASHTO T166 water absorption criteria described above, shall be tested by either the AASHTO T275 Paraffin Coating Test Procedure, or by using an automatic vacuum sealing device using AASHTO T331 along with any manufacturer's instructions specific to the equipment.

9.17 When using AASHTO T166, record the test data on a T427A form. When using AASHTO T275, record the test data on a T427B form. When using a vacuum sealing device, perform the density calculations on the manufacturer's worksheets. Record the core density and nuclear gauge density comparison data on a T427C form and attach manufacturer's worksheets.

9.18 Using separate copies of the appropriate T427 forms, both the Contractor and Division will compare each core density to their average nuclear gauge density for each test location. The difference between the two densities at each location shall be individually calculated to indicate the range of differences between the cores and the nuclear gauge readings. The average core density and the average nuclear gauge density for each location shall be determined to the nearest whole unit. The average nuclear gauge density shall be subtracted from the average core density to determine the correction factor that will be applied to all quality control or quality assurance nuclear density testing for the JMF on the tested lift for the remainder of the project. However, this correction factor only applies to that tested lift, using the same JMF, and the same nuclear density gauge. Any change to either of these three requirements will require a new control strip.

NOTE: It is possible that some of the individual core densities may be higher or lower than the nuclear gauge readings. If the core density is higher the difference is a positive value. If the core density is lower then it shall be designated as a negative value. If the calculated correction factor is a positive value then it shall be added to each individual nuclear gauge reading. If the calculated correction factor is a negative value then it shall be subtracted from the individual nuclear gauge reading.

9.19 Lots for Quality Control testing and Division Verification testing shall be performed as per Sections 10.0 and 11.0 of this Materials Procedure. Development of a gauge correction factor within a section of pavement identified for use as a control strip shall be considered a separate activity and the test results will not be used to determine any payment adjustment for that material. The material placed within control strip shall be considered part of any overall lot being identified for standard compaction evaluation as per Sections 10.0 and 11.0 below. .

9.20 In the event that a LOT was determined to meet specification requirements based on a single unadjusted nuclear density gauge test result and is later determined to fail based on the correction factor adjustment, the Division shall retest the LOT by dividing it into five equal sublots and randomly locating a test site within each Sublot as described in Section 11.0.

9.21 The control strip core specimens shall be retained in case there are any testing discrepancies that need to be resolved. The Division shall determine when the core specimens can be discarded. Additional cores may be required if the control strip cores are disposed of before Division approval.

10.0 MAT AND LONGITUDINAL JOINT QUALITY CONTROL TESTING

10.1 Record the mat density test data on form T401. If the project also requires joint density testing, record both mat and joint density data on form T401B.

10.2 Divide the LOT into five equal sublots.

10.3 Randomly locate a test site within each Sublot according to MP 712.21.26. <u>If a random location falls less than one foot (0.3 meters) from any edge of the paving lane then move the gauge back to one foot (0.3 meters) away from the pavement edge before testing.</u>

10.4 Check each test site to determine if there are surface voids. Fill the voids with dry mortar sand. Avoid a build-up of fines on the surface to no more than 0.1 inch (3 mm).

10.5 Take a one minute wet density reading on each test site.

10.6 Perform the calculations on the Division approved form.

10.7 Compare the percent relative density of each LOT to the specification requirements.

10.8 The results of the quality control tests should be used by the Contractor to judge if the LOT will meet specifications when verification tests are performed by the Division. If the quality control tests indicate that a nonconformance situation exists, and the mat is still sufficiently hot enough for additional rolling, then corrective measures should be taken to bring the LOT into specifications. If additional rolling is not possible, the failing quality control tests will indicate that additional rolling may be needed on the remaining LOTs.

10.9 Longitudinal Joint Density: For the purpose of testing, a longitudinal joint shall be defined as the joint between two traffic lanes. The joint between a traffic lane and a shoulder will not require testing. Joint density testing is not required until both lanes of the joint are constructed. The first lane constructed shall be referred to as the cold side and the second lane shall be referred to as the hot side. Joint density testing will only be required on the hot side. The joint density testing requirement shall be applied to the surface lift only.

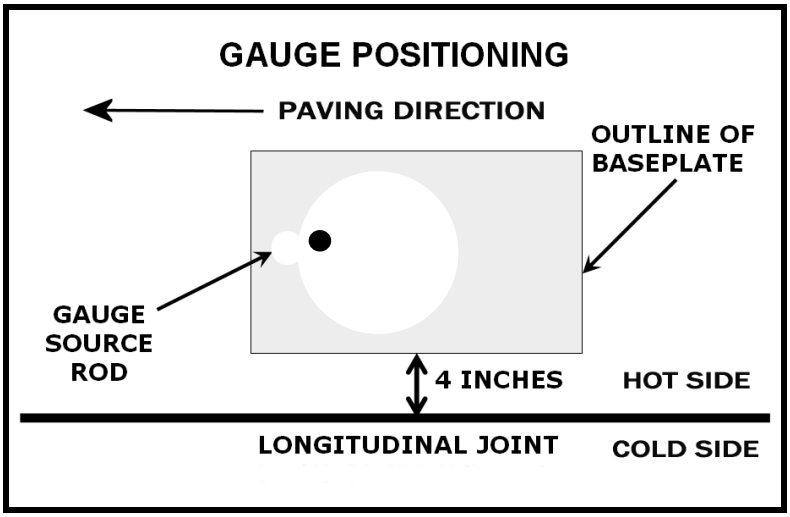

Figure-2

10.10 Projects requiring longitudinal joint density testing: After the mat density testing is completed on the first randomly chosen test site, move the nuclear density gauge in a perpendicular direction across the pavement to the longitudinal joint. For testing purposes, the nuclear gauge shall be positioned four inches (100 mm) from the joint (hot side). Record the wet density reading on Form T401B. See the nuclear gauge positioning diagram in Figure-2. Proceed with testing as per Sections 10.4 through 10.7 to determine the longitudinal joint density for each Sublot. Any additional lanes on the project that create longitudinal joints as defined in Section 10.9 will require the same sequence of testing.

11.0 MAT AND LONGITUDINAL JOINT LOT-BY-LOT DIVISION VERIFICATION TESTING

11.1 Once the Contractor offers a LOT of material to the Division for testing, verification testing will be performed to determine compliance to the specifications.

11.2 Randomly locate a single test site within the LOT according to MP 712.21.26. <u>If a random location falls less than one foot (0.3 meters) from any edge of the paving lane then move the gauge back to one foot (0.3 meters) away from the pavement edge before testing.</u>

11.3 Check the test site to determine if there are surface voids. Fill the voids with dry mortar sand. Avoid a build-up of fines on the surface to no more than 0.1 inch (3 mm).

11.4 Take a one minute wet density reading in the backscatter position.

11.5 Perform the calculations on the Division approved form.

11.6 Compare the percent relative density of the LOT to the specification range. If the value is within the range, the LOT is accepted for density.

11.7 *Projects requiring longitudinal joint density testing:* After the mat density testing is completed on the randomly chosen test site for the LOT, move the nuclear density gauge in a perpendicular direction across the pavement to the longitudinal joint. For testing purposes, the nuclear gauge shall be positioned four inches (100 mm) from the joint (hot side). Record the wet density reading on Form T401B. See the nuclear gauge positioning diagram in Figure-2. Proceed with testing as per Sections 11.3 through 11.6 to determine the longitudinal joint density for the LOT. Additional lanes that create longitudinal joints as defined in Section 10.9 will require the same sequence of testing.

11.8 When the percent relative density is outside the specification range for either the mat or the longitudinal joint, divide the LOT into five equal Sublots and randomly locate a test site within each Sublot according to MP 712.21.26. If only the mat density falls outside the specification range, continue as per Sections 11.9 through 11.12. If only the longitudinal joint density falls outside the specification range, continue as per Sections 11.13 through 11.16. If both the mat density and longitudinal joint density fall outside the specification range, continue as per Sections 11.9 through 11.16.

11.9 Take a one minute wet density reading at each mat test site.

11.10 Average the five wet densities.

11.11 Calculate the percent relative density.

11.12 The LOT will be acceptable if the average percent relative density falls within the specification range. A nonconformance situation exists if the value is outside the range.

11.13 When additional testing for longitudinal joint density is required, move the nuclear density gauge in a perpendicular direction from the randomly chosen test site across the pavement to the hot side of the longitudinal joint. Position the gauge four inches from the joint as illustrated in Figure-2. Record the wet density reading on Form T401B. Proceed with testing as per Sections 11.14 through

11.16 to determine the final longitudinal joint density for each sublot. Proceed with testing of all five longitudinal joint Sublots. Additional lanes that create longitudinal joints as described in Section 10.9 will require the same sequence of testing.

11.14 Average the five longitudinal joints Sublot wet densities.

11.15 Calculate the percent relative density.

11.16 The LOT will be acceptable if the average percent relative density falls within the specification range. A nonconformance situation exists if the value is outside the range.

12.0 ROLLERPASS COMPACTION PROCEDURE

12.1 In accordance with Section 401.7.3 of the Standard Specifications, some asphalt pavement construction situations may require that compaction testing will be performed on a test section in accordance with the rollerpass procedure described in this section. This compaction testing shall be performed by the Contractor. The Division will closely monitor all compaction testing on the test section. The Division may also conduct their own density testing for verification if desired. The Contractor is responsible for having qualified personnel available to perform the required testing. If qualified personnel are not available, then the Engineer shall decide whether or not construction will be allowed to continue. If construction continues without a test section, then it shall be the responsibility of the Contractor to prove that adequate density was obtained on the project. This proof may include, but not necessarily be limited to, nuclear density testing and/or coring conducted randomly throughout the project as directed by the Engineer.

12.2 At the beginning of the work, a test section shall be constructed with a length of approximately 200 feet (60 meters) and the width of the paving operation except in restricted areas. If the 200 feet (60 meters) length cannot be obtained, then the test section shall be the maximum obtainable length. The test section shall be constructed using the approved JMF that was selected for the lift being placed. The equipment proposed for use in placing and compacting the test section shall be the same as that which will be used on the project for constructing the remainder of the pavement lift. If the JMF or equipment changes during the construction of the lift, then a new test section shall be constructed.

12.3 If there is a concern that the existing pavement conditions may cause difficulty in obtaining the specified density requirement then the Division may either monitor

or conduct density testing of the existing pavement before the test section is constructed. Five randomly located wet density tests will be conducted within the test section area and the results will be recorded on a T401 form. Additional testing may also be conducted on other sections of the existing pavement if it is considered necessary for later evaluation.

12.4 To determine the number of roller passes for lift thicknesses of less than 1.5 inches (38 mm), immediately after placement start the rolling operation on the test section and continue this process until the mat temperature reaches 175 °F (80 °C). If the mat begins to show signs of distress (such as excessive surface aggregate breakage or mat cracking) before reaching 175 °F (80 °C), then discontinue rolling and record the number of roller passes completed before the stress signs occurred. If a tender mix, as defined in Section 3.3, is encountered the Contractor may be allowed to continue rolling at lower temperatures if it can be demonstrated that additional densification can be achieved at a lower temperature without causing any pavement distress. Conduct density testing as per Section 12.6.

12.5 If the lift thickness is 1.5 inches (38 mm) or greater, the rolling operation may be stopped at around 200 °F (93 °C) to conduct density testing as per Section 12.6. If additional rolling is needed then continue as per Section 12.4. If the air temperature is below 60 °F (16 °C), the rolling operation should normally not be halted until the mat temperature reaches 175 °F (80 °C) unless pavement distress is encountered. Project conditions and environmental factors may require the Engineer to determine the proper rolling application and testing sequence for lift thicknesses of 1.5 inches (38 mm) or greater for the purpose of obtaining the specified mat density.

12.6 Divide the test section into two equal sublots and randomly locate a test site within each according to MP 712.21.26. Disregard any random test site that is closer than one foot (0.3 meters) from the edge of the pavement lane and simply move the gauge back one foot (0.3 meters) away from the pavement edge before testing. Also, disregard any random test site that falls within the first ten feet (3 meters) of the test section, and generate a new random test site. Take a wet density reading on each sublot using the procedure described in Section 11.3 and 11.4. Determine the average wet density obtained from the two sublots and use this average to calculate the percent relative density of the test section. Record all rollerpass density test data on a T407 form.

12.7 If the percent relative density of the test section is within 92 – 96 % of the maximum density of the approved mix design, or the maximum density

established by the most recent plant mix formula verification, then adequate density has been achieved and the number of roller passes has been established for the remainder of the project.

12.8 If the percent relative density of the test section is above 96 % the Division will make a visual evaluation of the mat and the mixture to look for any appearance of excessive asphalt or an extremely fine mix which may result from such high density readings. If available, a review of any density test results obtained from the existing pavement will be made to determine if the existing pavement density was significantly higher than the target density of the mix. The Division will determine whether additional test sections are needed or that the pavement is compacted to the satisfaction of the Engineer with the established number of roller passes. If it is later determined, through the Contractor's daily quality control testing, that the mix had an air void content below 2.5% then proper adjustments shall be made to the mix to bring the air voids back into the allowable tolerance limits.

12.9 If the percent relative density of the test section is below 92 %, then a new test section shall be established and the Contractor shall make adjustments to his rolling operation in an attempt to achieve a higher density level.

12.10 If the density requirement is not met after two consecutive test sections are completed, the Division will determine whether additional test sections are needed or that the pavement is compacted to the satisfaction of the Engineer with the established number of roller passes. To help with this decision, an evaluation will be made of the existing pavement condition and any density test results obtained prior to construction of the test section will be reviewed. If it is later determined, through the Contractor's daily quality control testing, that the mix had an air void content above 5.5% then proper adjustments shall be made to the mix to bring the air voids back into the allowable tolerance limits. The Division may require the Contractor to construct a new test section if such mix adjustments are required.

12.11 The established number of roller passes shall continue for the remainder of the project unless the Division determines that environmental conditions or changes in the condition of the existing roadway are affecting the rolling operation. Under such circumstances, the Division may request that a new roller pattern be established through a new test section.

12.12 The designated number of roller passes shall continue to be completed before the mat temperature falls below 175 °F (80 °C) unless the conditions of Section 12.4 have been established.

12.13 The Contractor shall designate a person to monitor and document the number of roller passes and the mat temperature through the duration of the project.

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Aaron C. Gillespie, 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

PREPARING A MATERIAL PROCEDURE

1.0 SCOPE

1.1 This material procedure shall serve as a guide for West Virginia Division of Highway's personnel in the drafting of Material Procedures. This procedure was established to illustrate a standard method, consistent and structured for creating, naming, indexing, and approving Material Procedures (MPs).

2.0 REFERENCED DOCUMENTS

Commented [HKD1]: The references should be checked to see if anything further applies.

2.1 *AASHTO*

a. Standard Specifications for Transportation Materials, 35th Edition, 2015

2.2 *Federal Highways Administration*

a. Technical Advisory-March 2010

2.3 *West Virginia Department of Transportation, Division of Highways, Standard Specifications Roads and Bridges, Current Edition*

3.0 NUMBERING

3.1 All MP's shall conform to the AASHTO format described within Section 5.0

3.2 Section and Subsection lists: Any list under Section or Subsection shall be listed using small alphabetical characters.

4.0 NAMING MATERIAL PROCEDURES

4.1 The name and title of the MP should give the user a clear idea of the procedure, material, process, test, sample, etc. that is addressed. The writer of the MP should revisit the title toward the end of the writing process to make sure that the title does in fact fit the subject.

5.0 NUMBERING AND INDEXING SYSTEM

5.1 The letters MP shall appear first, defining the document as a Material Procedure.

5.1.1 MP XXX.00.00

5.2 The first set of digits denotes the section of the West Virginia Department of Transportation, Division of Highways, Standard Specifications Roads and Bridges,to which the procedure applies.

Commented [HKD2]: Not sure how this should be cited??

5.2.1 MP XXX.00.00

a. 100– 199 General Provisions
b. 200– 299 Earthwork
c. 300– 399 Bases
d. 400– 499 Bituminous Pavements
e. 500– 599 Rigid Pavement
f. 600– 699 Incidental Construction
g. 700 – 799 Material Details

Commented [HKD3]: These should be checked to be sure the numbers are still applicable

5.3 The second set of digits denotes the sub-section of the West Virginia Department of Transportation, Division of Highways, Standard Specifications Roads and Bridges,to which the procedure applies

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5.3.1 MP 000.XX.00

5..4 The third set of digits is defined by MCS&T as per the following:

5..4.1 MP 000.00.XX

a. 00 – 09 Field Sampling
b. 10 – 19 Pre-sampling (source or intermediate points)
c. 20 – 29 Testing
d. 30 – 39 Evaluations
e. 40 – 49 Inspection
f. 50 – 59 Quality Assurance System
g. 60 – 69 Reporting (laboratory)
h. 70 – 79 Reporting (issuance under master control)
i. 80 – 89 FUTURE
j. 90 – 99 Miscellaneous

Commented [HKD5]: These numbers should be checked to be sure all are up to date

6.0 LAYOUT

6.1. Section 1.0 Scope: In this section, the writer should clearly, and concisely state the reason for the MP. Use as few words as possible, making sure that the reader knows why this MP exists. Define the limits of the application of the MP. For example, categorical limits include: Asphalt Mixtures, Superpave mix designs, Asphalt Mixtures with RAP, Concrete, Aggregates, Testing, and Sampling

6.2 Section 2.0 References: This section is intended to list technical references, standards, procedures, etc. from ASTM, AASHTO, West Virginia Division of Highways Standard Specifications, other Material Procedures, etc.

6.3 Section 3.0 Terminology: This section is intended to define the terminology applicable to the MP.

6.4 Following Numerical Sections: The following sections beyond 3.0 are intended for information such as, but not limited to; equipment, classifications, significance and use, ordering information, materials, testing procedure, etc. Any information needed to provide the reader with a clear understanding of the procedure to be followed.

7.0 BODY OF THE MP

7.1 The information comprising these sections should be contemplated, discussed, and reviewed prior to inclusion. Whenever possible, educated, experienced, valid perspectives should be considered as the MP is drafted.

7.2 Calculations should cite technical references to document their origin.

7.3 Cross referencing of specifications, special provisions, and other MPs is encouraged.

7.4 Tables, lists, and charts are encouraged and should be in a neat, orderly format.

7.5 Writing technique should be of a technical nature not narrative. It is more important to precisely make points, by repeating words/phases than by creatively using different words to say the same thing throughout the body of the MP.

7.6 Be concise using only as many words as required to de scribe the procedure or method. Verboseness may lead to contradictions and opens the document to interpretation by the reader.

8.0 APPROVAL PROCESS

8.1 The approval process will follow the current version of Design Directive (DD) 105