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

MATERIALS PROCEDURE

GUIDE FOR QUALITY CONTROL OF COMPACTION

1. PURPOSE

1.1 This procedure sets forth minimum guidelines for the Contractor's Quality Control (QC) Plan for embankment, subgrade, pipe and random fill used as structure backfill material and aggregate base courses. It is intended that these requirements be used as a procedural guide in detailing the inspection, sampling, and testing necessary to maintain compliance with the specification requirements.

1.2 To establish procedural guidelines for approval and documentation of a Master QC Plan.

2. SCOPE

2.1 This procedure is applicable to all items requiring compaction control except bituminous concrete pavements. This outlines the QC procedures Compaction items and includes procedures for approving and using Master and/or Project Specific QC Plans. This procedure also aids in documentation and retention of QC Plans in ProjectWise.

3. REFERENCED DOCUMENTS

a) MP 700.00.24
b) MP 207.07.20
c) MP 712.21.26
d) MP 700.00.50
e) WV Division of Highways Construction Manual, Current Edition
f) WV Division of Highways Standard Specifications, Current Edition & Supplementary

4. GENERAL REQUIREMENTS

4.1 The Contractor shall provide and maintain a QC system that will provide assurance that all materials submitted to the Division for acceptance will conform to the contract requirements whether natural, manufactured or processed by the Contractor, or procured from suppliers. The QC Plan should clearly describe the methods by which the QC Program will be conducted. For example, the items to be controlled, tests to be performed, testing frequencies, sampling locations and techniques all should be included etc. Each item should be listed separately.

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4.1.1 A detailed plan of action regarding disposition of non-specification material shall be included. Such a plan shall provide for immediate notification of the Division in the event a non-conforming situation or instance.

4.2 Inspection and testing records shall be maintained, kept current, and made available for review by the Engineer throughout the life of the contract. All other documentation, such as date of inspections, tests performed, temperature measurements, and any accuracy, calibration, or re-calibration checks performed on production or testing equipment shall be recorded and kept.

4.3 The Contractor shall maintain standard calibrated equipment and qualified personnel in accordance with the contract and Specification requirements for the applicable material.

5. QUALITY CONTROL PLAN

5.1 The Contractor shall prepare a QC Plan detailing the type and frequency of inspection, sampling, and testing necessary to measure and control the the compaction properties of materials and construction governed by the Specifications. As a minimum, the sampling and testing plan should detail sampling location, sampling techniques, and test frequency. QC sampling and testing performed by the Contractor may be utilized by the Division for acceptance.

5.1.1 A QC Plan shall be developed by the Contractor and submitted to the Engineer prior to the start of construction on every project. Acceptance of the QC Plan by the Engineer will be contingent upon its concurrence with these guidelines as listed in section 5.2 thru 5.4.5.2.

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

5.2 QC PLAN MINIMUM REQUIREMENTS

5.2.1 The QC Plan should be on Company Letterhead, be addressed to the District which it pertains, and include the items to be controlled. An example/template is provided in **Attachment 1**.

5.2.2 Provide the name of the Person who is responsible for the Company's Quality Control operations/program and will be liaison with the Division's personnel.

5.2.3 List all inspector's names performing compaction tests on the project and their date becoming a Certified Soils Compaction Inspector as per WVDOH Specification Section 106 Control of Materials.

5.2.4 Compaction field tests will be performed according to MP 207.07.20, MP 700.00.24, and Standard Specification 716.32.3

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5.2.5 Soft shale tests are to be done as per Section 716 of the Standard Specifications.

5.2.6 Specify in the plan the methods by which each item will be tested. Table A and Table B summarizes the different materials, minimum frequencies, and the appropriate test procedure or method for controlling each material.

Table A- COMPACTION CONTROL OF AGGREGATE BASE COURSES

TEST PROCEDURE	LOT SIZE	NUMBER OF TEST	MATERIAL TYPE			
			PORTLAND CEMENT TREATED AGGREGATE BASE COURSE	CRUSHED AGGREGATE BASES AND SUBBASE COURSES	HOT-MIX HOT-LAID BITUMINOUS TREATED BASE COURSE	SOIL CEMENT BASE COURSE
MP 700.00.24	2000 FEET	1 PER SUBLOT 5 PER LOT	X	X	X	
MP 207.07.20	2000 FEET	1 PER SUBLOT 5 PER LOT				X

Table B - COMPACTION CONTROL OF EMBANKMENT BACKFILL AND SUBGRADE

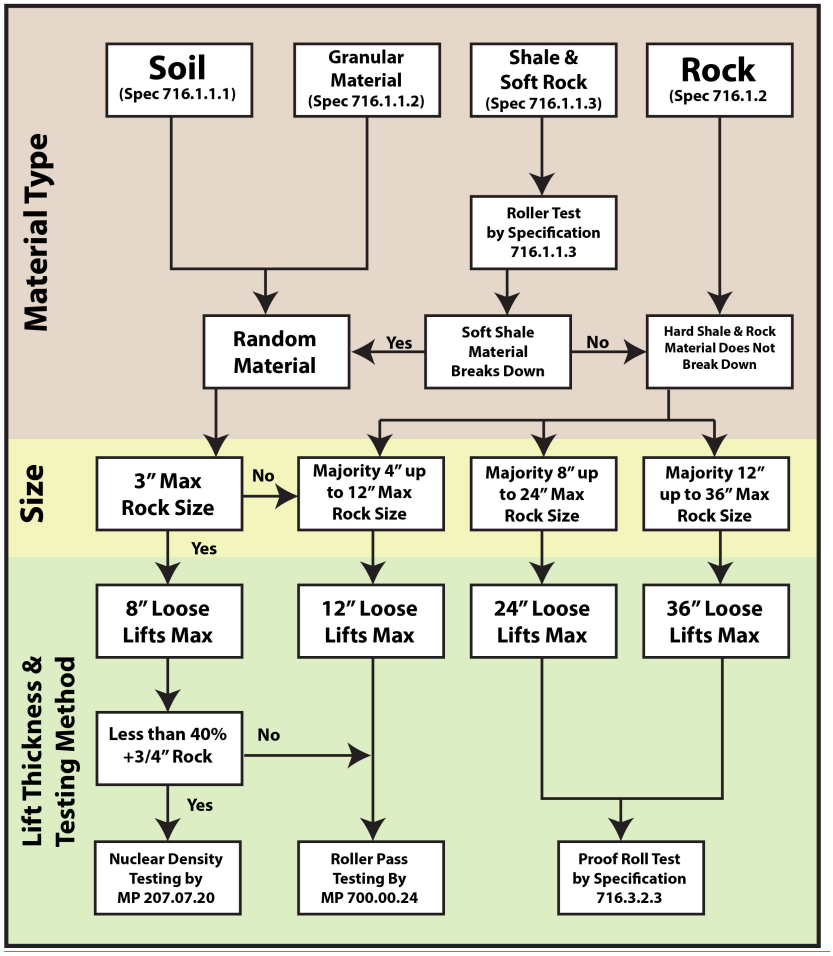
TEST	LOT SIZE	NUMBER OF TESTS	MATERIAL WITH LESS THAN 40% RETAINED ON ¾" (19.0 mm) SIEVE	MATERIAL WITH 40% OR MORE RETAINED ON ¾" (19.0 mm) SIEVE AND CAN BE PLACED IN A 12" (300 mm) LOOSE LIFT OR LESS		MATERIAL THAT CAN BE PLACED IN A LOOSE LIFT GREATER THAN 12" (300 mm)		GRANULAR SUBGRADE	SELECT MATERIAL FOR BACKFILLING AND CLASS1 AGGREGATE
				UNIFORM	NON-UNIFORM	ROCK	HARD SHALE		
MP 207.07.20	SEE STD. SPECS.	1 PER SUBLOT 5 PER LOT	X						
MP 700.00.24	SEE STD. SPECS.	1 PER SUBLOT, 5 PER LOT		X [1]	X [1], [2]			X	X
PROOF Rolling		1 REPORT PER LIFT				X	X		

1. If a hole for a direct transmission density reading cannot be readily made due to the coarse material, proof roll the lift.

2. If density readings are varying above 105 percent or below 95 percent and the material appears to be non-uniform, proof roll the lift.

5.2.7 A flow chart for embankment material, Table C , shall serve as a guide for identifying material types, maximum rock size, lift thickness and compaction test method. This table shall be included in the QC Plan for making field decisions to ensure that each type of material is properly placed and compacted.

Table C – Guide for Quality Control of Embankment Material



5.2.8 The plan shall include a statement that all necessary testing equipment will be provided to perform the procedures MP 700.00.24, MP 207.07.20, and Specification 716.3.2 and lists the required testing equipment for compaction tests. The plan shall list the make and model of equipment for proof rolling and its weight per Specification 716.3.2. The plan shall list the make and mole and operating

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weight of the roller(s) to be used for the soft shale tests and per Specification 716.1.1.3.

5.2.9 List the type of gauge to be used (…i.e., Troxler 3430, etc). The calibration frequency must be acceptable to the Division. Gauges must be calibrated as per the manufacture's requirements. This information shall be given to the Division upon their request.

5.2.10 If applicable, outline the procedure for performing a stability check on gauges which are not within the tolerance range for standard counts during the interval between calibrations. Standard counts derived during the stability check for stable gauges may be used in lieu of the manufacturer's standards. Gauges found to be unstable cannot be used until repaired and calibrated.

5.2.11 Include in the plan the lot and sublot sizes to be used for testing each type of installation. During construction, some flexibility in lot sizes may be made if the situation warrants in order to maintain a workable system. For example, two or more areas containing small quantities of embankment material might be combined into one lot at the Contractor's option and subject to the Division's approval.

5.2.12 Specify the maximum time period for completion of a lot of embankment material. As a guide, if the desired lot size cannot be obtained within seven calendar days, then the material placed up to that time would constitute the lot and the specified number of tests for a lot would still be performed.

5.2.13 Specify in the plan when quality control tests for base and subgrade will be performed. QC tests are to be performed after the material has been shaped and final rolling has been completed.

5.2.14 The Contractor is responsible for the accuracy of their individual testing and calculations.

5.2.15 List the forms and method of distribution for tests and measurements.

5.2.16 Compaction test results are reported on forms specified in MP 207.07.20 and MP700.00.24. The forms are supplied by the Division and available on the MCS&T webpage[1]. Each form consists of an original and one copy. The original of a completed form is submitted to the Division's project supervisor and the other copy is for the Contractor's records.

5.2.17 Indicate the length of time after tests and measurements are completed that documentation will be provided.

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[1] https://transportation.wv.gov/highways/mcst/Pages/tbox.aspx

5.2.17.1 Test results and measurements are made available to project personnel for review on a daily basis. Formal submission of measurements should be made within 24 hours after the measurements are taken and test results within 24 hours after testing of a lot is completed.

5.2.17.2 Tests performed in a lot before final rolling is completed should be submitted to the Project Supervisor and retained in the project files. This includes test documents for failing lots, moisture checks, etc.

5.2.18 List the compaction equipment giving the quantity, make, model, and weight or applied force at which each roller will be operated. If ballast will be added to a roller, indicate the type and quantity of ballast and the method for verifying the gross weight. Attach the manufacturer's specifications for compaction capabilities for each roller to the plan or state the procedure for verifying the compaction capabilities of each roller in cases where the manufacturer's specifications are not available. This equipment shall meet the requirements as per 207.7.5 of the Standards and Specifications

5.2.19 Indicate in the plan that a minimum of a 10-ton (9.07 Mg) roller will be used for testing as per MP 700.00.24 for soil and granular material only.

5.2.20 Rollers used to breakdown soft shale shall be in accordance with 716.1.1.3 of the Standard Specifications and shall have a minimum of 1.5 tons per linear foot of roller or drum.

5.2.21 Specify the method by which proof rolling will be conducted on embankment materials. The materials to be proof rolled are summarized in Table B (attached).

5.2.22 List the number of passes to be made and corrective measures if soft areas are detected. Documentation should include the type of material, number of passes, and corrective action if soft areas are detected.

5.2.23 For equipment used for proof rolling explain how the gross weight will be determined for any ballast added to the operating weight. For alternate proof rollers, attach to the QC Plan the calculations used to determine that the roller meets specifications. Also, attach the manufacturer's specifications for all proof rollers to the Plan. The following calculation is used to determine if an alternate proof roller meets specifications:

	ENGLISH	Metric
	$c = \frac{\tilde{A}(abπ)}{2}$	$c = \frac{\tilde{A}(abπ)}{50.8}$

Where:

a = weight (force) on a single tire = pounds (kg x .009807 = kN)
b = operating tire pressure = psi (kPa)

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c = weight (force) per inch (mm) width of tire = pounds per inch (Nm)
The weight (force) per inch (mm) width of tire must be equal to or greater than 1315 pounds (9.067 kN/mm).

5.2.24 Outline the procedure for notifying the Division when the test section in MP 700.00.24 will be performed. The Division should be notified a minimum of 24 hours in advance unless other arrangements acceptable to the Division can be made.

5.2.25 Laboratory testing for random material is not required unless the material has unusual characteristics or differs from the soil and rock data used to develop the design. Testing to develop density curves, specific gravities, organic content, etc. may be required.

5.2.26 A list of test procedures is contained in Section 716 of the WVDOH Standard Specifications as a guideline for required testing should the need arise for random material.

5.2.27 Design a plan of action for the disposition of non-specification material, such as material with excessive moisture, excessive organic content, etc. These materials shall be stockpiled away from the embankment or fill placement areas. The Project Supervisor should be immediately notified in the event a nonconformance situation is detected.

5.2.28 List the method(s) and frequencies per Table E (attached) by which lift thickness measurements will be taken. If surveying of compacted lifts is not utilized, then the maximum loose lifts per Table C shall be measured.

5.3 TYPES OF QC PLAN

5.3.1 QC Plans which are intended for use on more than one project shall be defined as Master QC Plans. Section 5.4 outlines the procedures for Master QC Plan submittal and approval.

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

5.3.3 A contractor may submit a Master QC Plan for field operations instead of a Project Specific QC Plan.

5.3.4 Once any QC Plan is approved for a project, the key date shall be entered in ASSHTOWare software by the appropriate District Materials personnel. The first date entered shall be the date the Project QC Plan letter is received. The second date shall be when the district approves the QC Plan for use on the project.

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5.4 MASTER QUALITY CONTROL PLAN

5.4.1 The intent of Master QC Plans is to facilitate the approval process in a more uniform manner. A Master QC Plan can be submitted to the Division/District by the Contractor when their work in a given District is routinely repetitive for the year. The Master Quality Control Plan is applicable for only the calendar year for which it has been approved.

5.4.2 The Contractor shall submit the Master Compaction QC Plan yearly to each District in which they have work in. If the Contractor does not have work in a given District for the year then no Master QC Plan shall be submitted to that District.

5.4.3 The District will review the submitted Master QC Plan and assign a laboratory reference number upon approval for future referencing. The District will acknowledge approval of Master QC Plan to the Contractor by letter (see **Attachment #2** for an example), which will include the laboratory reference number and a copy of the approved Master QC Plan attached. This will then be scanned and placed in ProjectWise under the appropriate District's Org for that Contractor.

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5.4.4 Once a project has been awarded, if a contractor elects to use the approved Master Compaction QC Plan on that project, the Contractor shall submit a letter requesting to use the Master QC Plan for that project. This letter must be on the Contractor's letterhead, be addressed to the District Engineer/Manager or their designee, and contain the following information: project number, CID#, project name/ description, type of Quality Control Plan and the laboratory reference number for the Master QC Plan (See **Attachment #3** for an example).

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5.4.5 The District shall review the referenced Master QC Plan to ensure that it covers all items in the project. If the referenced Master QC Plan is found to be insufficient for some items on the project, the District shall request the Contractor to submit additional information for QC of those items as an addendum on a project specific basis. When the District is satisfied with the QC Plan for this project, a letter shall be sent to the Contractor acknowledging approval (see **Attachment #4** for an example), with the following attached: the Contractor's project QC Plan request letter and the Master QCP approval letter. This shall then be placed in the project's incoming-mail mailbox in ProjectWise.

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5.4.5.1 A Master QC Plan that has been approved for project use shall be acceptable for the duration of that project, even if that project continues into subsequent calendar years, unless otherwise directed by the District.

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5.4.5.2 For the use of Division Personnel, the District approval letter for this project must state the ProjectWise link to the referenced Master QC Plan for that Contractor. (i.e., WVDOT ORGS > District Organization #> Materials > Year>Master QC Plans …)

6. CERTIFICATION & ACCEPTANCE SAMPLING AND TESTING

6.1 The Contractor shall certify that compaction testing and sampling is in conformance with the approved QC plan, referenced MP's and referenced Standard Specifications in a letter format on the company's letterhead. The certification shall summarize what materials where encountered and the compaction method/lift thickness utilized. The letter shall state whether any deviations from the requirements of the QC plan, MP's, and Standard Specifications exists, and why.

6.2 Acceptance sampling and testing is the responsibility of the Division. QC tests by the Contractor may be used for acceptance.

6.3 The Division shall sample and test for applicable items completely independent of the contractor at a frequency equal but not limited too to approximately ten (10) percent of the frequency for testing given in the approved Quality Control Plan. Witnessing the contractor's sampling and testing activities may also be a part of the acceptance procedure, but only to the extent that such tests are considered "in addition to" the ten (10) percent independent tests.

6.4 MP 700.00.50, MP 207.07.20, and Standard Specification 716.3.2.3 outlines the procedures to be followed for acceptance of compaction testing.

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

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Attachments

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QUALITY CONTROL PLAN

AS REQUIRED BY THE SPECIFICATIONS, A QUALITY CONTROL PLAN MUST BE DESIGNED BY THE CONTRACTOR

1.

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List all nuclear gauges

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Proof Rolling

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5.8.2.2 Specify the make, model, and type of

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Test Section

ATTACHMENT 1 - EXAMPLE GUIDE FOR COMPACTION QUALITY CONTROL PLAN

The Acme Company
20 First St.
Somewhere, WV XXXXXXX

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

RE: (YEAR) Master Compaction QC Plan
DISTRICT: _____

Dear Mr./Ms/Mrs. _____

We are submitting our Compaction Quality Control Plan for field control, developed in accordance with sections 716 and 717 of the (year) WVDOH Standards and Specifications, (year) WVDOH Supplemental specifications, MP 700.0024, MP 207.07.20, MP 712.21.26 and MP 700.00.50.

The Quality Control Program is under the direction of _____ . He/She can be contacted by telephone number _____, email _____ and/or in person.

1.) All testing will be performed by qualified personnel as per WVDOH Specification Section 106 Control of Materials. Proof of personnel certification shall be provided to WVDOH inspectors upon request.

2.) Specify the methods by which each item will be tested .(IE.. 207,307…etc). Table A and Table B (attached) summarizes the different materials, minimum frequencies, and the appropriate test procedure or method for controlling each material. A flow chart for embankment material, Table C (attached), is intended to serve as a guide for making field decisions to insure that each type of material is properly placed.

3.) Testing Equipment used will be as required in MP 700.00.24 and MP 207.07.20.

4.) Type of gauge to be used (IE…. Troxler 3430, etc). State that calibration information is available upon request by the Division/District.

5.) Outline the procedure for performing a stability check on nuclear gauges which are not within the tolerance range for standard counts during the interval between calibrations. Gauges found to be unstable cannot be used until repaired and calibrated.

6.) Include in the plan the lot and sublot sizes to be used for testing each type of installation.

7.) Specify the maximum time period for completion of a lot of embankment material.

8.) Specify in the plan when quality control tests for base and subgrade will be performed.

9.) List the forms and method of distribution for tests and measurements. (The forms are specified in MP 207.02.20 and MP 700.00.24.) State that test results will be made available to WVDOH personnel on a daily basis.

10.) List the compaction equipment giving the quantity, make, model, and weight or applied force at which each roller will be operated. If ballast will be added to a roller, indicate the type and quantity of ballast and the method for verifying the gross weight. Attach the manufacturer's specifications for compaction capabilities for each roller to the plan or state the procedure for verifying the compaction capabilities of each roller in cases where the manufacturer's specifications are not available.

11.) Indicate in the plan that a minimum of a 10 ton (9.07 Mg) roller will be used for testing as per 700.00.24.

12.) Indicate in the plan that when shale materials are encountered, the shale hardness test will be performed to determine if material is a soft shale as per 716.1.1.3 of the WVDOH Standards and Specifications.

13.) Specify the method by which proof rolling will be conducted on embankment materials. The materials to be proof rolled are summarized in Table B (attached).

14.) Laboratory testing for random material is not required unless the material has unusual characteristics or differs from the soil and rock data used to develop the design. Testing to develop density curves, specific gravities, organic content, etc. may be required. The Yearly Quality Control Plan should state that these additional tests must be performed by qualified Aggregate testing personnel as per as per WVDOH Specification Section 106 Control of Materials.

15.) Design a plan of action for the disposition of non-specification material.

16.) List the method(s) and frequencies by which the lift thickness measurements will be taken.

Very Truly Yours,

_____
Title

ATTACHMENT 2

**** WVDOH LETTERHEAD ****

THE ACME COMPANY INC.
20 First St.
Somewhere, WV XXXXX

RE: Compaction Master QCP
Description: 2016 Year

Dear Sir,

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

- 207001-001 Unclassified Excavation		- 207002-001 Subgrade
- 211-001	- 307001 Items	- 604 items
- 212 Items	- 605 items	-etc….

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

Very Truly Yours,

_____
Title

ATTACHMENT 3

The ACME COMPANY
20 First St.
Somewhere, WV XXXXX

********** **EXAMPLE** **********

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

RE: Compaction Quality Control plan
for Field ---- Project

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

Dear Mr./Ms/Mrs. _____,

We would like to use our approved Yearly Master Quality Control Plan, reference number _____ for the project referenced above. All Compaction items on the referenced project are covered by the Master Quality Control Plan.

The QC Plan is under the direction of _____, _____(title), and will be the company's contact representative to the Department of Highways District Materials and Construction Departments. He/She can be contacted in person at the project, by telephone _____ or at email account _____.

Very Truly Yours,

_____
Title

ATTACHMENT 4

**** WVDOH LETTERHEAD ****

THE ACME COMPANY INC.
20 First St.
Somewhere, WV XXXXX

RE: Compaction QC Plan
Project CID#: ########
Fed/State Project #: NHPP- ## - ####.##
Description: Falling Slide
County : XXXXXXX

Dear Sir,

Your request to use Master Quality Control Plan **(M# - ######)** for compaction on the project referenced above, has been reviewed and found to be acceptable for the following items on the referenced project:

- 207001-001 Unclassified Excavation - 207002-001 Subgrade
- 307001 Items - 604 items - 212 Items -etc….

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

For Division/District
The Master Quality Control Plan can be reviewed in ProjectWise folder shown below:

WVDOTORG> D0# > year > MASTERQCPLANS > Contractors >Contractor Name >
Name of Quality Control Plan

Very Truly Yours,

_____
Title

MP 307.00.50 P
ORIGINAL ISSUANCE: NOVEMBER 1976
REVISED: XX,XX 2018

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

MATERIALS PROCEDURE

GUIDE FOR QUALITY CONTROL AND ACCEPTANCE PLANS FOR SUBGRADE, BASE COURSE, AND AGGREGATE ITEMS

1. PURPOSE

1.1 The purpose of this Materials Procedure (MP) is to establish minimum requirements for the Contractor's Quality Control (QC) Program and Acceptance Plan. It is intended that these requirements be used as a procedural guide in detailing the inspection, sampling, and testing deemed necessary to maintain compliance with the material and Specification requirements.

1.2 To establish procedural guidelines for approval and documentation of the Master QC Plan.

2. SCOPE

2.1 This procedure is applicable to Aggregate items placed in the field. It outlines the quality control procedures for items used and includes procedures for approving and using a Master and/or Project Specific Quality Control (QC) Plan. This procedure also aids in documentation and retention of the QC Plan in ProjectWise.

3. REFFERENCED DOCUMENTS

3.1 **Material Procedures**:

a) MP 300.00.51, Procedural Guidelines for Maintaining Control charts for Aggregate Gradations

b) MP 700.00.54, Procedure for Evaluating Quality Control Sample Test Results with Verification Sample Test Results

c) MP 700.00.06 Aggregate Sampling Procedures

3.2 **Materials Letter (ML)**:

a) ML-25, Procedure for Monitoring the Activities Related to Sieve Analysis of Fine and Coarse Aggregate

3.3 WV Division of Highways Construction Manual, Current Edition

3.4 WV Division of Highways Standard Specifications, Current Edition & Supplementary

4. GENERAL REQUIREMENTS

4.1 The Contractor shall provide and maintain a QC system that will provide reasonable assurance that all materials and products submitted to the District for acceptance will conform to the contract requirements whether natural, manufactured or processed by the Contractor or procured from suppliers, subcontractors, or vendors. The Contractor shall perform or have performed the inspections and tests required to substantiate product

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conformance to contract document requirements and shall also perform or have performed all inspections and tests otherwise required by the contract. The Contractor's QC inspections and tests shall be documented and shall be available for review by the Engineer/District throughout the life of the contract. The Contractor shall maintain standard equipment and qualified personnel as required by the Specifications to assure conformance to contract requirements. Procedures will be subject to the review of the District before the work is started.

5. QUALITY CONTROL PLAN

5.1 The Contractor shall prepare a QC Plan detailing the type and frequency of inspection, sampling, and testing deemed necessary to measure and control the various properties of materials and construction governed by the Specifications. As a minimum, the sampling and testing plan should detail sampling location, sampling techniques, and test frequency to be utilized. **Attachment #1** shows guidelines for the QC Plan. QC sampling and testing performed by the Contractor may be utilized by the District for acceptance.

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

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

5.3 **QC Plan Guidelines**: The QC plan shall include but not be limited to the following information:

5.3.1 Name of company official responsible for QC program. Contact phone number(s) and email(s) shall be included in the cover letter.

5.3.2 List certified personnel as specified in Section 106 of the Specifications, whether from the submitting company, consultant testing firm, or both.

5.3.3 List of the Aggregate items to be controlled by QC Plan.

5.3.4 **Sampling and Testing Plan**: As a minimum, the sampling and testing plan should detail sampling locations, test methods, and test frequencies to be used. To facilitate the District's monitoring activities, which are described in Section 7.1, all completed gradation samples must be retained by the Contractor until further disposition is designated by the District Materials Supervisor. The QC Plan should state where and how these samples will be maintained. Applicable sections of Materials Letter ML-25 should be used for guidance.

5.3.5 **Testing Facility**: The plan shall state the specific location where the samples(s) will be tested and retained.

5.3.6 **Documentation Plan**: The Contractor's plan to document and distribute test results shall be described.

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5.3.7 **Forms and Distribution**: Approved processing forms available on the MCS&T Webpage[1] shall be used to record the test data. Gradation tests will be recorded on Form T300. The laboratory reference number will always start with a "C" for all QC samples taken and tested by the Contractor. One copy of each completed form should be retained by the Contractor until the work is completed and accepted. The original signed copy of the test data is to be delivered to the District Materials Supervisor. To be an effective QC function, tests must be completed and results distributed in a regular and timely manner. The plan, therefore, must state what action will be taken in the event that testing and reporting are not completed in a reasonable period of time - preferably within72 hours after the sample is taken (at the discretion of the District.)

5.3.8 **Control Charts**: The Specifications require the plotting of gradation test results on control charts using the moving average concept as described in MP 300.00.51. The QC Plan should state where and how the charts shall be maintained and made available to District personnel. These charts are part of the District's acceptance procedures and must be available to the District when the project is completed or at the request of the District personnel. At the contractor's request, the requirement of Control Charts may be waived on a per project basis. The Contractor will submit a written request to the District asking that the Control Charts be waived. The District will make a determination based on the size of the project and the number of gradation tests required.

5.3.9 **Disposition of Non-Specification Material**: The Contractor shall provide a detailed plan of action for the immediate notification of all parties involved in the event that nonconforming situations are detected.

5.3.10 Types of QC Plans

5.3.10.1 QC Plans which are intended for use on more than one project shall be defined as Master QC Plans. Section 6.1 outlines the procedures for Master QC Plan submittal and approval.

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

5.3.10.3 A contractor may submit a Master QC Plan instead of a Project Specific QC Plan.

5.3.10.4 Once any QC Plan is approved for a project, the key-date shall be entered in Site Manager by the appropriate District Materials personnel. The first date entered shall be the date the Project QC Plan letter is received. The second date shall be when the District approves the QC Plan for use on the project.

[1] https://transportation.wv.gov/highways/mcst/Pages/tbox.aspx

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6. MASTER QUALITY CONTROL PLAN

6.1 The intent of a Master QC Plan is to facilitate the approval process in a more uniform manner. The contract may submit a Master QC when their workload in a given District is routinely repetitive for the year.

6.1.1 The Contractor may submit a new Master Aggregate Items QC Plan each year to each District in which they have or expect to have work (see **Attachment #2** for an example.) If the Contractor does not have work or does not have a history of work in a given District for the year, then a Master Field QC Plan shall not be submitted to that District.

6.1.2 The District will review the submitted Master QC Plans to see if they meet the requirements for the Aggregate Items in the QC Plan as per Section 5.3. If accepted, the District shall assign a laboratory reference number to the Master QC for future referencing. The District will acknowledge approval of each Master QC Plan to the Contractor by letter (see **Attachment #3** for an example), which will include the laboratory reference number and a copy of the approved Master QC Plan. This will then be scanned and placed in ProjectWise under the appropriate District's Org for that Contractor and/or Producer/Supplier.

6.1.3 Once a project has been awarded, if a Contractor elects to use the approved Master Aggregate Items QC Plan on that project, the Contractor shall submit a letter requesting to use the Master QC Plan for that project. This letter must be on the Contractor's letterhead, be addressed to the District Engineer/Manager or their designee, and contain the following information: project number, CID#, project description, type of QC Plan, and the laboratory reference number for the Master QC Plan. (See **Attachment #4** for an example.)

6.1.4 The District shall review the referenced Master QC Plan to ensure it covers all items in the project. If the referenced Master QC Plan is found to be insufficient for some items on the project, the District shall request the Contractor to submit additional information for QC of those items as an addendum on a project specific basis. When the District is satisfied with the QC Plan for this project, a letter shall be sent to the Contractor acknowledging approval (see **Attachment #5** for an example), with the following attached: the Contractor's project QC Plan request letter and the Master QCP approval letter. This shall then be placed in the project's incoming-mail mailbox in ProjectWise.

6.1.5 A Master QC Plan that has been approved for project use shall be good for the duration of that project, even if that project continues into future calendar years.

6.1.6 For the use of District Personnel, the District approval letter for this project must state the ProjectWise link to the referenced Master QC Plan for that Contractor. For example, WVDOT ORGS > District Organization #> Materials > Year>Master QC Plans, etc.

6.1.7 The Master Aggregate items QC Plan shall be valid for the duration of one calendar year beginning on January 1st and ending on December 31st.

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7. ACCEPTANCE PLAN

7.1 The Specifications state that acceptance (verification) sampling and testing is the responsibility of the District and QC tests are the responsibility of the Contractor. Acceptance activities (sampled and tested at the frequency given in Section 7.1.2) may be accomplished by conducting verification sampling and testing completely independent of the Contractor and, in some cases, by witnessing tests performed by the Contractor, or by a combination of the two. The following guidelines provide a system, which should result in sufficient confidence in the Contractor's documentation of their QC operations to permit acceptance of the material in accordance with the procedure set forth in the Specifications.

7.1.1 The District shall review all information supplied by the Contractor on the QC Plan. Note, in particular, the qualifications of the sampler, tester, the location, and other qualifying statements about the testing facility. In the event that little qualifying information is supplied or has been demonstrated by the testing facility; Prior to work, the District (or their representative) shall review the availability, type, and suitability of the testing equipment and verify all calibrations. This information should be documented and kept available at the District Materials Section.

7.1.2 The District shall sample and test, completely independent of the Contractor, at a frequency equal to or greater than ten (10) percent of the frequency for testing given in the approved QC Plan. Witnessing the Contractor's sampling and testing activities may also be a part of the acceptance procedure, but only to the extent that such tests are considered "in addition to" the ten (10) percent independent tests.

7.1.3 Plot the results of gradation tests performed by the District on the Contractor's QC charts with a red circle, but do not include these values in the moving average. When the Contractor's tests are witnessed, circle the Contractor's test result on the control chart with red. These values are used in the moving average calculations. The laboratory number will always start with an "M" for all acceptance (verification) samples taken and tested in this manner by the District, and will always start with a "0" for all of the Contractor's tests, which are witnessed by the District.

7.1.4 Evaluate the results of acceptance (verification) tests, whether performed or witnessed by the District, in accordance with MP 700.00.54.

7.2 If the evaluation indicates similarity with the QC test(s), the control chart will be considered acceptable to that point.

7.2.1 If dissimilarity is determined, an immediate investigation shall be conducted in an effort to determine the cause. Until the situation is resolved, any samples held in accordance with ML-25 will be retained and may be used in whatever manner deemed appropriate during the investigation.

7.3 Implement ML-25 for aggregate gradations.

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

RLS: Mbe
ATTACHMENTS

ATTACHMENT #1 - GUIDELINES FOR CONTRACTOR'S QUALITY CONTROL

Item Description	Property	Minimum Frequency
207 Subgrade	Gradation	One (1) sample per day of placement. Note 1
	Atterburg Limits	From an approved aggregate source: one (1) test at the beginning of placement and then each 10,000 tons. Not from an approved aggregate source a minimum of one (1) test per 6 days placement.
212 select Material for Backfill	Gradation	Minimum of one (1) sample per day of Placement. Note 1
307 Crushed Aggregate	Gradation	One (1) sample per each one-half (1/2) day placement. Note 1
	Atterburg limits	One(1) test at the beginning of placement and then each 10,000 tons thereafter
	Other tests as requested by the Division or required by the contract documents: percent crushed particles, unit weight, etc.	As requested by the Division or required by the contract documents.
307 Aggregate Shoulder course for Resurfacing Projects	Gradation	One (1) sample per day of placement. Note 1
	Atterburg limits	One (1) test at the beginning of placement and then each 10,000 tons thereafter
	Other tests as requested by the Division or required by the contract documents: percent crushed particles, unit weight, etc.	As requested by the Division or required by the contract documents.

ATTACHMENT #1 GUIDELINES FOR CONTRACTOR'S QUALITY CONTROL (CONTINUED)

604 Class 1 Aggregate	Gradation	Minimum of one (1) sample per day of placement. Note 1
606 Aggregate for Underdrain	Gradation	Minimum of one (1) sample per day of placement. Note 1
609 Bed Course Material	Gradation	Minimum of one(1) sample per day of placement. Note 1
626 Aggregate	Gradation	Minimum of one (1) sample per day of placement. Note 1
	Atterburg Limits	From an approved aggregate source: one (1) test at the beginning of placement and then each 10,000 tons. Not from an approved aggregate source a minimum of one (1) test per 6 days placement.
636 Aggregate	Gradation	One (1) sample per each one-half (1/2) day of placement. Note 1: Note 2
	Atterburg Limits	One (1) test at beginning of placement and then each 10,000 tons thereafter. Note 2

Note 1: In the event project activities are such that relatively small quantities of material are being placed per placement date, and to prevent over sampling, the Engineer may approve the following alternate sampling method: A minimum of One (1) sample per six (6) consecutive days shall be taken to represent up to each 170 cubic yards (250 tons). Sampling is to be done on the first day of aggregate placement. In this case the sample shall be taken at a random time and place

Note 2: When Aggregate for maintaining traffic is not to be part of any succeeding base or pavement course, the appropriate aggregate size shall be determined by the Engineer. If the aggregate is from an approved source, then it shall be accepted by visual inspection. If the Contractor elects to use aggregate from an unapproved source, test results shall be provided to show that the liquid limit and plasticity index meet the requirements in Table 704.6.2B

***** ATTACHMENT #2 - EXAMPLE GUIDE FOR AGGREGATE ITEMS QUALITY CONTROL PLAN *****

The Acme Company
20 First St.
Somewhere, WV XXXXXXX

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

RE: "year" Master Aggregate Items QC Plan
DISTRICT: _____

Dear Mr./Ms/Mrs. _____

We are submitting our Master QC Plan for Aggregate Items , developed in accordance with the (year) WVDOH Standards and Specifications, (year)WVDOH Supplemental specifications, MP300.00.51, MP 700.00.54, ML-25, and AASHTO Testing standards.

The Quality Control Program is under the direction of _____ . They can be contacted by telephone number _____, email _____ and/or in person.

1.) All testing will be performed by qualified personnel as per WVDOH Specification Section 106 Control of Materials. Proof of personnel certification shall be provided to WVDOH inspectors upon request.

2.) Specify items to be controlled and the methods by which each item will be tested (For example:207,307…etc) Attachment #1 summarizes the different materials, minimum frequencies, and the appropriate test procedure or method for controlling each material.

- 207 Items - 212 Items -307 Crushed Aggregate Items - ETC>>>>>

3.) List the location (address) and lab where testing will be performed.

4.) State the method and means by which that Contractor will document and distribute test results.

5.) State what forms will be used for tests the time frame for completing testing and distributing of test information to District Materials.

6.) Specify in the QC Plan where and how the charts will be maintained and made available to Division/District personnel. Control Charts will use the moving average concept as described in MP 300.00.51.

7.) Specify a plan of action providing for immediate notification of all parties involved in the event that nonconforming material situations are detected.

Very Truly Yours,

_____
Title

********** ATTACHMENT #3 WVDOH LETTERHEAD **********

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

RE: Aggregate Items Master QC Plan
Description: (Year) Construction Season

Dear Sir/Madam,

Your Master Aggregate Quality Control Plan **(M#-#####)** for _____has been reviewed and found to be acceptable for the following items:

- 207 Aggregate Items
- 212 Aggregate Items
- 307 Aggregate Items
- ETC

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

Very Truly Yours,

_____
Title

********** ATTACHMENT #4 - EXAMPLE **********

THE ACME COMPANY INC.
20 First St.
Somewhere, WV XXXX

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

Subject: Aggregate Items QC plan
For project

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

Dear Mr./Ms/Mrs. _____,

We would like to use our approved Aggregate Items Master Quality Control Plan, reference number _____ for the project referenced above. We feel that all items on the referenced project are covered by the Master Quality Control Plan for Aggregate Items.

The QC Plan is under the direction of _____, _____(title), and will be the Company's contact representative to the Department of Highways District Materials and Construction Departments. He/She can be contacted in person at the project, by telephone _____ or at email account _____.

Very Truly Yours,

_____
Title

********** ATTACHMENT #5 - WVDOH LETTERHEAD **********

THE ACME COMPANY INC.
20 First St.
Somewhere, WV XXXXX

RE: _____ Aggregate Items QC Plan

Project CID#: ########
Fed/State Project #: ####- ## - ####.##
Description: Falling Slide
County : XXXXXXX

Dear Sir/Madam,

Your request to use your Master Aggregate Items Quality Control Plan **(M# - ######)** for Aggregate Items on the project referenced above, has been reviewed and found to be acceptable for the following items:

- 207 Aggregate Items
- 212 Aggregate Items
- 307 Aggregate Items
- ETC

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

For Division/District use

The Master Quality Control Plan can be reviewed in Projectwise at this Link:

WVDOT ORG>D0#>year>MASTER QC PLANS>Contractors or Plant>Contractor Name>Name of Quality Control Plan

Very Truly Yours,

_____
Title

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

MATERIALS PROCEDURE

GUIDE FOR QUALITY CONTROL PLANS FOR ASPHALT CONCRETE

1. PURPOSE

1.1 This procedure presents uniform Quality Control (QC) guidelines for Contractor (and/or Producer(s)) to develop their QC Plan. All items listed are believed necessary to assure adequate product QC.

1.2 This procedure also creates a more uniform process for District Materials to review and approve Quality Control Plans for use on projects.

2. SCOPE

2.1 This Material Procedure (MP) is applicable to, but not limited to the following Asphalt Concrete Items:

a. Base
b. Wearing
c. Patching and Leveling Courses
d. All P.W.L. Items
e. Skid

3. GENERAL REQUIREMENTS

3.1 As stated in the Specifications, a QC Plan must be developed by the producer and submitted to the Engineer prior to construction. Acceptance of the Quality Control Plan by the Engineer will be contingent upon its concurrence with these guidelines. For this reason, the plan should clearly describe the methods by which the Quality Control Program will be conducted. For example, the items to be controlled, tests to be performed, testing frequencies, sampling locations and techniques all should be included and each item should be listed separately. Also, a detailed plan of action regarding disposition of non-specification material should be included. Such a plan should provide for immediate notification of all parties involved in the event non-conforming situations are detected. **Attachment #1** may be used as an example Quality Control Plan for plant operations using all items that are applicable to the specific type of plant items produced. **Attachment #2** may be used as an example Quality Control Plan for field operations using all items that are applicable to field work.

3.2 Inspection and testing records shall be maintained, kept current, and made available for review by the Engineer throughout the life of the contract. All other documentation, such as date of inspections, tests performed, temperature measurements, and any accuracy, calibration, or re-calibration checks performed on production or testing equipment should be recorded.

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3.3 The Contractor shall maintain standard calibrated equipment and certified personnel in accordance with contract and specification requirements for the item(s) being produced.

3.4 The Division reserves the right to review all pertinent documents concerning equipment calibration used for testing and proof of certified personnel performing tests.

4. MASTER QUALITY CONTROL PLAN

Dan 4/10/19 6:25 AM
Comment [1]: I moved this over from the other QC MPs and adapted it to match Asphalt. I deleted the old one (Project QC plans which said the same thing, but wasn't the same wording)

4.1 The intent of a Master QC Plan is to facilitate the approval process in a more uniform manner. The contract may submit a Master QC when their workload in a given District is routinely repetitive for the year.

4.1.1 The Contractor may submit a new Master Asphalt Items QC Plan each year to each District in which they have or expect to have work. If the Contractor does not have work or does not have a history of work in a given District for the year, then a Master Field QC Plan shall not be submitted to that District.

4.1.2 The District will review the submitted Master QC Plans to see if they meet the requirements for the Asphalt Items in the QC Plan as per Section 5.3. If accepted, the District shall assign a laboratory reference number to the Master QC for future referencing. The District will acknowledge approval of each Master QC Plan to the Contractor by letter (see **Attachment #3** for an example), which will include the laboratory reference number and a copy of the approved Master QC Plan. This will then be scanned and placed in ProjectWise under the appropriate District's Org for that Contractor and/or Producer/Supplier.

4.1.3 Once a project has been awarded, if a Contractor elects to use the approved Master Asphalt Items QC Plan on that project, the Contractor shall submit a letter requesting to use the Master QC Plan for that project. This letter must be on the Contractor's letterhead, be addressed to the District Engineer/Manager or their designee, and contain the following information: project number, CID#, project description, type of QC Plan, and the laboratory reference number for the Master QC Plan. (See **Attachment #4a and 4b** for Plant and Field operations respectively for examples.)

4.1.4 The District shall review the referenced Master QC Plan to ensure it covers all items in the project. If the referenced Master QC Plan is found to be insufficient for some items on the project, the District shall request the Contractor to submit additional information for QC of those items as an addendum on a project specific basis. When the District is satisfied with the QC Plan for this project, a letter shall be sent to the Contractor acknowledging approval (see **Attachment #5** for an example), with the following attached: the Contractor's project QC Plan request letter and the Master QCP approval letter. This shall then be placed in the project's incoming-mail mailbox in ProjectWise.

4.1.5 A Master QC Plan that has been approved for project use shall be good for the duration of that project, even if that project continues into future calendar years.

4.1.6 For the use of District Personnel, the District approval letter for this project must state the ProjectWise link to the referenced Master QC Plan for that Contractor. For example, WVDOT ORGS > District Organization #> Materials > Year>Master QC Plans, etc.

4.1.7 The Master Asphalt items QC Plan shall be valid for the duration of one calendar year beginning on January 1st and ending on December 31st.

5. ASPHALT CONCRETE FOR MAINTENANCE

5.1 The provisions of this MP will also apply to asphalt concrete plant run purchase orders that is picked up at the plant by the Division's Maintenance forces. Yearly Master Plant and Field QCP's apply to Laydown Asphalt Concrete Purchase Orders awarded to vendors. Exceptions to this are as specified in the Purchase Order Maintenance Contract.

6. ACCEPTANCE PLAN

6.1 The Asphalt Concrete Material shall be accepted in accordance with material's specific MP and the Standard Specifications.

6.2 Key Dates for Site Manager

6.2.1 Once the Quality Control Plan is approved for the project the key date shall be entered in Site Manager by the appropriate District Materials personnel. The first date entered shall be the date the Project Quality Control Plan letter is received. The second date shall be when the district approves the quality control plan for use on the project.

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

RLS: CBe
ATTACHMENTS

Dan 4/9/19 9:24 AM
Deleted: procedure

updates 4/9/19 9:00 AM
Deleted: hot-mix

Dan 4/9/19 9:25 AM
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updates 4/9/19 9:00 AM
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Dan 4/10/19 6:22 AM
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Dan 4/9/19 9:25 AM
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Dan 4/9/19 9:31 AM
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ATTACHMENT #1 – EXAMPLE QC PLAN FOR PLANT OPERATIONS

Mr./Ms/Mrs _____
West Virginia Division of Highways
District: ____Engineer/Manager
_____,West Virginia

Dear Mr/Ms./Mrs _____

Subject: Asphalt Concrete Yearly Master Quality Control Plan for Plant Operations

Crane, John E 2/11/16 10:17 AM
Deleted: Hot-Mix Asphalt

We are submitting our asphalt concrete hot-mix asphalt Quality Control Plan, developed in accordance with Section 401 of the _____ Standard Specifications, the _____ Supplemental Specifications, MP 401.03.50 and the _____Special Provisions.

1. Make of Plant Type Location

   _____

2. The Quality Control program is under the direction of _____ to be contacted at Plant/Office in person, by telephone # and /or email address:_____

3. Sampling and testing will be performed by qualified personnel as per WVDOH Specification Section 106 Control of Materials.

   ,

4. The types of asphalt paving materials to be produced and controlled are as follows:
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____
   f. _____

5. Prior to production of the items, we will submit (on Division Form T-400) our plant mix formula for each type of mix. Only approved materials will be incorporated in the mix.

6. During the production operations of the asphalt concrete we will perform at a minimum Quality Control tests in accordance with the attached schedule.

7. All testing and evaluation will be completed within 24 hours of sampling and all documentation will be completed and submitted to the Division on approved processing forms within 72 hours or production will be halted until these items are current.

ATTACHMENT #1 – EXAMPLE QC PLAN FOR PLANT OPERATIONS (CONTINUED)

8. Material found to be noncomplying shall not be incorporated into the roadway. In the event that non-specification material is incorporated into the project, the Division of Highways District Materials Supervisor will be notified immediately.

9. We will notify all appropriate Division of Highways personnel at least 24 hours before the scheduled work is to begin.

10. (Statement of disposition of nonconforming material)

_____

_____

_____

_____

Very truly yours,

_____
Company Representative

ATTACHMENT #1 – EXAMPLE QC PLAN FOR PLANT OPERATIONS (CONTINUED)

GUIDE FOR QUALITY CONTROL PLANS FOR ASPHALT CONCRETE

Crane, John E 2/11/16 10:17 AM
Deleted: HOT-MIX ASPHALT

TEST OR ACTION	FREQUENCY	TEST METHOD	METHOD OF DOCUMENTATIO
Construction of stockpile to prevent segregation intermingling	Constant	Visual	Diary
Coarse aggregate unit weight	One test before start of operation	AASHTO T19	T304
Stockpile & cold bin gradations	Plant setup and as needed to control production	AASHTO T27 and T11	T300
Calculate % aggregate from each bin, calibration cold bin	Plant setup		T415
Check feeder gate output at gate setting to be used	Plant setup. If bins overflow or run dry.		Plant Inspection Form and Diary
Select screen sizes	Plant setup		Plant Inspection Form
Determine hot bin gradation, calculate combined gradations	Weekly during production	AASHTO T27 and T11	T300 and T415
Calibrate hot bins, select gate openings, and calculate batch weights	Plant setup and change in material source		Plant Inspection Form and Diary
Check accuracy of scales	Plant setup and weekly accuracy checks. Zero balance and sensitivity each ½ day of operation	Construction Manual – 700 Series	Plant diary and T603
Calibrate asphalt pump, calculate settings	Plant setup		Plant Inspection Form
Check metering pump at setting to be used	Plant setup and monthly		Plant Inspection Form and Diary
Reset metering pump to compensate for temperature change	Plant setup and each temperature change of 10 °F (6 °C)		Plant Inspection Form and Diary
Adequate heated storage for liquid asphalt	Plant setup		Plant Inspection Form

ATTACHMENT #1 – EXAMPLE QC PLAN FOR PLANT OPERATIONS (CONTINUED)

GUIDE FOR QUALITY CONTROL PLANS FOR MARSHALL DESIGNED ASPHALT CONCRETE

TEST OR ACTION	FREQUENCY	TEST METHOD	METHOD OF
Calculating mixing time	Plant setup and when paddle pitch or dam gate changed		Plant Inspection Form and Diary
Ross Count (degree of coating)	Only if mixing time is less than 45 seconds	AASHTO T195	Diary
Coarse aggregate face fracture (Gravel only)	One test before start of operation Every 10,000 ton (9,000 Mg) thereafter	MP 703.00.21	T302
Complete mix face fracture (When using gravel)	One per week	MP 703.00.21	T302
Check moisture content of aggregate	Plant setup and daily		Diary
Temperature check	Minimum of one check of mix per hour at plant		Plant Control Chart and Diary
Asphalt Content	In accordance with WVDOH MP 401.02.27	AASHTO T308 (Method A)	T417, T423 and Control Charts
Aggregate Gradation (cold feed, hot bins, or completed mix)		AASHTO T27 plus T11 or AASHTO T30	T300, T404, or T417 Plus T425
Daily Mix Property Testing: Stability and Flow, % Air Voids, and % Voids-in-Mineral Aggregate (VMA)		AASHTO T245 or ASTM D5581, AASHTO T269, T166, T209, and MS-2 Manual	T406 and T423

Crane, John E 2/11/16 10:11 AM
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Crane, John E 2/11/16 10:05 AM
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Crane, John E 2/11/16 10:05 AM
Deleted: , or automated plant printout

Crane, John E 2/11/16 10:06 AM
Deleted: T402, T403, T411, T417, or automated plant printout. Plus T423

Crane, John E 2/11/16 9:58 AM
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Crane, John E 2/11/16 9:58 AM
Deleted: Minimum of one sample per 5000 tons one sample every three days of production, whichever occurs Minimum of one sample per day up to ... [2]

Crane, John E 2/11/16 9:58 AM
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ATTACHMENT #1 – EXAMPLE QC PLAN FOR PLANT OPERATIONS (CONTINUED)

GUIDE FOR QUALITY CONTROL PLANS FOR SUPERPAVE DESIGNED ASPHALT CONCRETE

Crane, John E 2/11/16 10:10 AM
Deleted: HOT-MIX ASPHALT

TEST OR ACTION	FREQUENCY	TEST METHOD	METHOD OF DOCUMENTATIO
Calculating mixing time	Plant setup and when paddle pitch or dam gate changed		Plant Inspection Form and Diary
Ross Count (degree of coating)	Only if mixing time is less than 45 seconds	AASHTO T195	Diary
Coarse aggregate face fracture (Gravel only)	One test before start of operation Every 10,000 ton (9,000 Mg) thereafter	ASTM D5821	T302
Complete mix face fracture (When using gravel)	One per week	ASTM D5821	T302
Check moisture content of aggregate	Plant setup and daily		Diary
Temperature check	Minimum of one check of mix per hour at plant		Plant Control Chart and Diary
Gyratory Compaction	In accordance with WVDOH MP 401.02.29	AASHTO TP4	T419
Aggregate Gradation		AASHTO T30	T417 and T425
Asphalt Content		AASHTO T308 (Method A)	T417 and Control Charts
Percent Air Voids		AASHTO T166, T209, and T269	T419 and Control Charts
Percent Voids in Mineral Aggregate (VMA)		AASHTO PP-28	
Percent Voids Filled With Asphalt (VFA)		AASHTO PP-28	

Crane, John E 2/11/16 9:59 AM
Deleted: - ... [4]

ATTACHMENT #2 – EXAMPLE QC PLAN FOR FIELD OPERATIONS

Mr./Ms/Mrs _____
West Virginia Division of Highways
District: ____Engineer/Manager
_____,West Virginia

Subject: Asphalt Concrete Yearly Master Quality Control Plan for Field Operations

Crane, John E 2/11/16 10:17 AM
Deleted: Hot-Mix Asphalt

Dear Mr./Ms/Mrs. _____

We are submitting our asphalt concrete hot-mix asphalt Quality Control Plan, developed in accordance with Section 401 of the _____ Standard Specifications, the _____ Supplemental Specifications, MP 401.03.50 and the _____ Special Provisions.

1. The field operation is under the direction of _____ by telephone # and /or email address:_____

2. _____ will be responsible for insuring that all items of work will comply with Division specifications.

3. During the placement operation of the asphalt concrete pavement we will perform, at a minimum, Quality Control tests as per the attached schedule. Sampling and testing will be performed by qualified personnel as per WVDOH Specification Section 106 Control of Materials.

Crane, John E 2/11/16 10:18 AM
Deleted: hot-mix asphalt

4. All sampling and testing will be completed within the time limits specified by the Division or work will be halted.

5. Material found to be non-complying shall not be incorporated into the roadway. In the event that non-specification material is incorporated into the project, the Division representative will be notified immediately.

6. We will notify all appropriate Division personnel at least 24 hours before work is scheduled to begin.

Very truly yours,

_____
Company Representative

ATTACHMENT #2 – EXAMPLE QC PLAN FOR FIELD OPERATIONS (CONTINUED)

GUIDE FOR QUALITY CONTROL PLANS FOR FIELD

TEST OR ACTION	FREQUENCY	TEST METHOD	METHOD OF DOCUMENTATI
Temperature of mix	1 per hour	Section 401 of Standard Specifications	Diary
Temperature of base	1 per hour	Section 401 of Standard Specifications	Diary
Temperature of mat	1 test per hour of placement	Section 401 of Standard Specifications	T401
Density	5 tests per 1000 feet (300 meters) of paving width or rollerpass when applicable.	Section 401 of Standard Specifications	T401 or T407
Tack/Prime Application Rate	Each load or per ½ day of operation whichever occurs first	Section 408/409 of Standard Specifications	Diary
Calibration of Nuclear Gauge	As per MP 717.04.21	As per MP 717.04.21	Factory Data Sheet
Distribution of Test Data	Within 24 hours of completion of testing of a Lot	As per MP 717.04.21	As per MP 717.04.21

Crane, John E 2/11/16 10:02 AM
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Crane, John E 2/11/16 10:01 AM
Deleted: Pavement application rate ... [5]

ATTACHMENT #3 – MASTER PLAN ACCEPTANCE FOR CONSTRUCTION SEASON

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

RE: Asphalt Items Master QC Plan
Description: (Year) Construction Season

Dear Sir/Madam,

Your Master Asphalt Quality Control Plan **(M#-#####)** for _____has been reviewed and found to be acceptable for the following items:

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

Very Truly Yours,

_____
Title

ATTACHMENT #4A – REQUEST TO USE MASTER QC FOR PLANT

Mr/./Ms/Mrs. _____
WV Department of Highways
District ___ Engineer
_____, WV _____

RE: Asphalt Concrete Quality Control plan for Plant - Project
Fed. Project No. _____
State Project No. _____
Contract ID No. _____
County : _____
Description _____

Dear Mr./Ms/Mrs. _____,

We would like to use our approved master quality control plan, reference number _____ for the project referenced above.

The Quality control plan is under the direction of _____, _____(title), and will be the company's contact representative to the Department of Highways district materials and construction departments. He/She can be contacted in person at the plant, by telephone _____ or at email account _____

Very Truly yours,

_____
Company Representative

ATTACHMENT #4B – REQUEST TO USE MASTER QC FOR FIELD

EXAMPLE

Mr./Ms/Mrs _____
WV Department of Highways
District ___ Engineer
_____, WV _____

RE: Asphalt Concrete Quality Control plan for Field - Project
Fed. Project No _____
State Project No. _____
Contract ID No. _____
County : _____
Description _____

Dear Mr./Ms/Mrs. _____,

We would like to use our approved Master Quality Control Plan, reference number _____ for the project referenced above.

The Quality control plan is under the direction of _____, _____(title), and will be the company's contact representative to the Department of Highways district materials and construction departments. He/She can be contacted in person at the project, by telephone _____ or at email account _____.

Very Truly yours,

_____
Company Representative

Crane, John E 2/11/16 10:18 AM
Deleted: Hot-Mix Asphalt

ATTACHMENT #5 – DISTRICT ACCEPTANCE OF MASTER QC PLAN FOR SPECIFIC PROJECT

THE ACME COMPANY INC.
20 First St.
Somewhere, WV XXXXX

RE: _____ Asphalt Items QC Plan

Project CID#: ########
Fed/State Project #: ####- ## - ####.##
Description: Falling Slide
County : XXXXXXX

Dear Sir/Madam,

Your request to use your Master Asphalt Items Quality Control Plan **(M# - ######)** for Asphalt Items on the project referenced above, has been reviewed and found to be acceptable for the following items:

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

For Division/District use

The Master Quality Control Plan can be reviewed in Projectwise at this Link:

WVDOT ORG>D0#>year>MASTER QC PLANS>Contractors or Plant>Contractor Name>Name of Quality Control Plan

Very Truly Yours,

_____
Title

MP 703.00.24
REPLACES ML-10
SUPERCEDGES: JANUARY 1995
REVISED: April 10, 2019

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

SOURCE CONTROL OF AGGREGATES

1. PURPOSE

1.1 To assure continued quality of aggregates from Division-Approved Sources.

2. PROCEDURE

2.1 Division inspectors are urged to be alert at all times to the possibility that a previously-approved commercial aggregate supplier may, due to unforeseen circumstances, ship non-specification material to Division projects.

2.2 Under present quality assurance procedures, a quality check of all commercial sources supplying aggregates to the Division is conducted on a yearly basis. This check indicates the potential of a source to produce specification materials. Thus, when the material from a particular source is approved by MCS&T, it is understood that the supplier will continue to provide materials which meet the quality specifications detailed in the most recent edition of the West Virginia Department of Transportation Division of Highways Standard Specifications of Roads and Bridges. It is the obligation of the supplier to see that these corresponding specifications are continually met throughout the Division project. However, due to unforeseen events, the quality of a particular material may be subject to change.

2.3 Field personnel are responsible for quality assurance of materials previously approved by MCS&T and should be observant of the general appearance of materials supplied to Division projects. If the quality of the material being supplied to Division projects (through field observation) appears to meet quality specifications, no further investigation is warranted, and the material shall be acceptable for use in Division projects.

2.4 If a situation occurs in which the quality of the material cannot be verified through field observation and the issue cannot be resolved by District Personnel, a request shall be given to MCS&T to conduct an investigation. After the investigation is completed, a materials investigation report shall be issued, making any necessary recommendations to both the Construction Division and the supplier.

2.4.1 If an MCS&T materials investigation is warranted:

Shuman, Randy L 4/10/19 2:05 PM
Deleted: FEBUARY 7, 2019

Dan 2/7/19 7:52 AM
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Dan 2/7/19 7:52 AM
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Shuman, Randy L 4/10/19 1:45 PM
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Shuman, Randy L 4/10/19 1:44 PM
Deleted: haste, lack of planning, negligence, etc.

Stanevich, Ron L 2/21/19 1:26 PM
Comment [1]: Do we really want to use this language here? Why are we accusing suppliers of negligence?

Shuman, Randy L 4/10/19 1:45 PM
Deleted: periodically

Shuman, Randy L 4/10/19 1:47 PM
Deleted: is with the understanding

Shuman, Randy L 4/10/19 1:46 PM
Deleted: utilize the potential of his source

Shuman, Randy L 4/10/19 1:49 PM
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Shuman, Randy L 4/10/19 1:48 PM
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Shuman, Randy L 4/10/19 1:49 PM
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Shuman, Randy L 4/10/19 1:50 PM
Deleted: carelessness and other

Stanevich, Ron L 4/11/19 6:36 AM
Comment [2]: What are we doing with this language.. this seems we are allowing visual inspection on appearance then requiring testing.. Who wrote this???

Dan 4/11/19 6:36 AM
Comment [3]: Can you give examples of what a field person may see that would indicate that the aggregate would fail a test? And to answer your question Ron, I have a pretty good idea, though they have since retired.

Shuman, Randy L 4/10/19 2:05 PM
Deleted: FEBUARY 7, 2019

2.4.1.1 An investigation conducted by MCS&T would include re-sampling of the materials for full quality testing. The testing would be done in accordance to the corresponding Specifications from the most recent edition of the West Virginia Department of Transportation Division of Highways Standard Specifications of Roads and Bridges for the materials in question.

2.4.1.2 In the event that the investigation reveals the material currently being produced at a Commercial Source is not of acceptable quality, the source will be removed from the list of Approved Sources until action is taken by the producer to ensure that any subsequent material produced for Division projects is of specification quality.

Stanevich, Ron L 2/21/19 1:30 PM
Comment [4]: Can we be more specific in describing this investigation.

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

RLS:MFs

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

MATERIALS PROCEDURE

GUIDE FOR CONTRACTOR QUALITY CONTROL OF ASPHALT CONCRETE

1. PURPOSE

1.1 To provide a method for daily monitoring and quality control of hot-mix asphalt (HMA).

1.2 To provide plant personnel with criteria upon which to base decisions of continuing or ceasing plant production.

2. SCOPE

2.1 This materials procedure shall be applicable to all Sections 401 and 402 HMA types relative to compliance with job mix formula (JMF) control limits as specified in the governing specifications.

3. DEFINITIONS

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

3.2 Field Design Verification Samples and Tests - Those samples taken and tests conducted by the contractor to verify that a mix design can be produced within the limits of the criteria set forth by this Materials Procedure. These samples are taken during the initial use of each mix design or whenever circumstances described in this MP require a new field design reverification. These samples should not be confused with the Division verification samples that are used to determine specification compliance.

3.3 Quality Control Samples and Tests - Those samples taken and tests conducted by the Producer/Contractor to monitor and control the production of this product.

3.4 Verification Samples and Tests - Those samples taken and tests conducted by the Division to determine specification compliance.

4. DOCUMENTATION

4.1 The Contractor shall maintain adequate records of all testing and records of any production changes required to control their product. The records shall indicate the nature and number of observations made, the number and type of deficiencies found, and the nature of corrective action taken. The Contractor's documentation procedures will be subject to the review and approval of the Division at any time during the progress of the work being performed.

4.2 Forms and Distribution: All test data shall be documented on forms provided by the Division. The original copy of the completed form shall be delivered to the District Materials Supervisor. One copy of each completed form is to be retained by the contractor until the project is completed. Testing shall be conducted using only the approved test methods listed in Section 401.5.1 of the Standard Specification unless specified otherwise in contract documents. Asphalt content and gradation test results shall be recorded on T417. Mix design property test results shall be recorded on form T406. To be an effective quality control program, tests must be completed in a regular and timely manner.

4.3 The Contractor shall take prompt action to correct conditions that have resulted, or could result, in the submission to the Division of materials and products that do not conform to the requirements of the Contract documents. The Contractor shall establish a detailed plan of action regarding the disposition of non-specification material. In the event that non-specification material is incorporated into the project, the Division shall be notified immediately.

4.4 All HMA component materials shipped to the plant must have proper documentation which identifies the type and source of each material. This information shall be made accessible to the Division for review at any time.

5. PLANT MIX FORMULA FIELD DESIGN VERIFICATION

5.1 For each JMF, a field design verification shall be conducted during the first days of plant production for the purpose of demonstrating that the mix can be produced within the specified tolerances set forth in this MP.

5.2 This field design verification shall consist of a randomly selected HMA sample taken in accordance with AASHTO T168 for each three hours of production, with no more than three samples in one day. A minimum of three samples are required for verification, however, three additional samples are required if none of the first three samples are completely within the specification limits. Samples used for gradation analysis during the verification process shall be obtained from the asphalt ignition oven samples (AASHTO T308, formerly TP53). If there is a problem with major aggregate breakdown affecting the gradation test results when using the ignition oven, gradation samples may be obtained from hot bins, cold feeds, or extracted HMA samples.

5.3 Field design verification testing shall not be conducted if less than 200 tons (180 Mg) of material is to be produced in a single day. In such cases daily quality control testing shall be conducted in accordance with Section 6. and shall meet the gradation requirements of the Table 401.02.27B, the design asphalt content within ± 0.4%, and a minimum VMA of 0.5% below the design criteria specified in MP 401.02.22. The percent air voids shall be within the range of 2.5 – 6.5 percent for Base-I and 2.5 – 5.5 percent for all other mixes. Stability and flow shall be within the design limits specified in MP 401.02.22.

5.4 The field design verification mix property requirements are listed in Table 401.02.27A. Field design verification test results shall be documented on Form T408. Gradation

requirements for the field design verification samples shall be as indicated in Table 401.02.27B. The gradation results shall fall within the limits of each specified control point with the exceptions as noted on the No. 8 and No. 16 sieves. Gradation results for all sieves listed in this table for each mix type shall be documentedon Form T421.

TABLE 401.02.27A

Mix Property Field Design Verification Requirements

Property	Field Verification Tolerances
Asphalt Content (%)	JMF ± 0.4 %
Air Voids (%) – Base-I	3.0 – 6.0 %
Air Voids (%) – All other mix types	3.0 – 5.0 %
Voids in Mineral Aggregate (VMA) %	Min. of 0.5 % Below Design Criteria
Stability (Newtons)	Minimum Design Criteria
Flow (0.25 mm)	Limits of Design Criteria

TABLE 401.02.27B
MASTER RANGE FOR HOT-MIX ASPHALT
TOTAL PERCENT PASSING EACH SIEVE

TYPE OF MIX	Base-I	Base-II (Patch & Level) Wearing-IV	Wearing-I (Scratch)	Wearing-III	Gradation Tolerances Shall Be The Design Control Points With The Exceptions As Listed Below
SIEVE SIZE	Nominal Max Size 1 ½ in (37.5 mm)	Nominal Max Size ¾ in (19 mm)	Nominal Max Size 3/8 in (9.5 mm)	Nominal Max Size No. 4 (4.75 mm)	
2 in (50 mm)	100				-
1 ½ in (37.5 mm)	90 – 100				-
1 in (25 mm)	90 max	100			-
¾ in (19 mm)	-	90 – 100			-
½ in (12.5 mm)	-	90 max	100		-
3/8 in (9.5 mm)	-	-	85 - 100	100	-
No. 4 (4.75 mm)	-	-	80 max	90 – 100	-
No. 8 (2.36 mm)	15 – 36	20 – 50	30 – 55	90 max	JMF ± 6 (Note 1)
No. 16 (1.18 mm)	-	-	-	40 – 65	JMF ± 5 (Note 2)
No. 30 (600 µm)	-	-	-	-	-
No. 50 (300 µm)	-	-	-	-	-
No. 200 (75 µm)	1.0 – 6.0	2.0 – 8.0	2.0 – 9.0	3.0 – 11.0	-

Note 1: All mixes except Wearing-III. **Note 2:** Wearing-III only.

5.5 After each of the field design verification samples is tested, the results shall be evaluated to determine conformance to the verification requirements. If any test results fall outside the allowable tolerance limits established in Table 401.02.27A or Table 401.02.27B then steps must be taken to make any necessary production adjustments to bring the mix back to within specification limits. If, after three samples, all of the design criteria and gradation requirements are within the allowable tolerance limits on at least one sample, then verification of the design is complete. If all criteria is not met, then three additional samples shall be tested. If, after six samples, the Division determines that the mix cannot be produced within specification limits, then a new mix design will be required.

5.6 The verified JMF target for asphalt content shall be selected at a value within ± 0.2% of the approved design asphalt content using the results of the field verification testing to determine the appropriate value. The VMA production target shall be determined from the field verification test data at a value which also provided an air void content that was at or near the JMF target air void content based on the results of the field verification testing. This value may be adjusted to optimize the ± 1.0 tolerance of Table 401.02.27C if the result is near the minimum allowable requirement. The production target for air voids shall remain at the medium value of the design.

5.7 If the field design verification process is successful, then a new target maximum density shall be established for compaction control by averaging the maximum density results of all of the samples used for verification of the mix. The District will forward the verification test data to the Contract Administration Division, Materials Section.

5.8 The maximum allowable blend change for a mix design shall be ten percent on any single aggregate component. If an aggregate blend change of more than five percent on any single aggregate component is required, the Contractor shall evaluate the mix to determine whether or not the volumetric properties, FA ratio, and coarse aggregate angularity are adversely affected by the change in blended aggregates. The Contractor shall also determine whether or not the aggregate gradation requirements are still being maintained. The calculations used in this evaluation shall be provided to the District. The District will review and verify the results of this evaluation. If the District determines that any of the above-mentioned properties are adversely affected by the blend adjustment, then they may revoke the change in the JMF. If the JMF volumetric properties cannot be maintained without these non-approved changes, then the contractor will be required to provide a new mix design.

5.9 After the field design verification has been successfully completed and quality control testing (as described in Section 6.) has begun, the Contractor shall monitor the maximum specific gravity of the mix for any consistent change. If, over a five-sample period, there is an average change in the maximum specific gravity of ± 0.02 or greater from the verified value of the mix then a field design reverification may be required. A reverification shall not be conducted if the averages of the % asphalt, % air voids, %VMA, stability and flow of the five quality control samples do not meet the requirements of Table 401.02.27C. The District will review the Contractor's test data, compare it to their verification sample test data, and determine if a reverification is necessary. If the District determines that a reverification of the mix is needed, a new blended aggregate bulk specific gravity shall also be determined for the mix before the field reverification begins. The District will forward the reverification and bulk aggregate specific gravity test results to the Contract Administration Division, and Materials Section.

5.10 All approved mix designs shall be reverified on the first project on which they are used in any subsequent years as long as there are no changes to the design specifications that would require a new mix design. In addition, the blended aggregate bulk specific gravity shall be determined before reverification begins.

6. QUALITY CONTROL REQUIREMENTS

6.1 After the field design verification has been successfully completed, quality control sampling and testing shall begin. If production is to continue for four hours or more after the last field design verification sample was taken, then the first randomly selected quality control sample shall be taken within that remaining time period. If production continues for less than four hours after the last field design verification sample was taken, then the first randomly selected quality control sample will not be required until the next production day.

6.2 The allowable design property tolerances for each JMF shall be as set forth in Table 401.02.27C. The gradation of the mix shall continue to pass through the control points within the tolerances established in Table 401.02.27B.

6.3 Adjustments to the accepted JMF aggregate proportions shall be made only for the purpose of maintaining the gradation requirements of Table 401.02.27B and/or the design properties of Table 401.02.27C. The maximum allowable adjustment shall be as indicated in Section 5.8. The minimum sample requirements of the approved quality control plan will be sufficient when the allowable adjustments are made as a result of deficient or borderline test properties of the previous test sample.

TABLE 401.02.27C

Quality Control Mix Property Tolerances

Property	Production Tolerances
Asphalt Content (%)	Verified JMF ± 0.4 %
Air Voids (%)	JMF ± 1.5 %
Voids in Mineral Aggregate (VMA) %	Verified JMF ± 1.0 % with a minimum of 0.5 % below the minimum design criteria
Stability (Newtons)	Minimum Design Criteria
Flow (0.25 mm)	Limits of Design Criteria

6.4 If the previous test sample meets all specification requirements, but the Contractor later determines that the gradation of the material entering the plant has changed, then an aggregate proportion adjustment up to two percent will be allowed without requiring an additional test sample. However, if more than one such change is made during the production day, then an additional test sample beyond that specified in the approved quality control plan will be required for each adjustment.

6.5 Minimum Sampling and Testing Frequency: During each day of plant production a minimum of one sample shall be taken for production periods of six hours or less. When the production period exceeds six hours, a minimum of one sample for each half of the production period shall be taken. If the production period exceeds twelve hours, a third sample shall be taken. The Contractor's sampling frequency shall be in accordance with their approved Quality Control Plan.

6.6 For the purpose of administration, the quantity of material represented by an individual test shall be determined as follows: the first sample taken after the field design verification has been approved shall represent the quantity produced from the beginning of production after field design verification until the time the sample was taken. The second sample shall represent the material produced between the time that the first and second samples were taken and so on. The last sample taken prior to a halt in production under a given JMF shall represent that quantity of material produced from the time that the next to last sample was taken until production was stopped.

6.7 Sampling and testing for evaluation of compliance with the verified JMF shall be as follows: Obtain a sample large enough for determining the percent asphalt, percent air voids, percent VMA, and gradation of the mix in accordance with the specified test methods listed in Section 401.5.1 of the Specifications. If excessive aggregate breakdown in the ignition oven prevents proper gradation analysis, aggregate samples may be obtained from hot bins, cold feeds, or extracted HMA samples.

6.8 A four-sample average shall be used for the purpose of determining whether or not the material meets specification requirements. The test results of the first four samples shall be averaged. After the fifth sample is taken a four-sample moving average shall begin. This first moving average shall consist of the average of the second through fifth test samples. Each time a new sample is taken a new moving average shall be calculated by

averaging the new sample with the previous three samples. The moving average shall continue through a single paving season (one calendar year).

6.9 In cases where production is limited and less than four samples of the specified mix design are taken, then the average shall consist of the total number of samples taken during the paving season in accordance with the Quality Control Plan. A new four sample average shall be established at the first startup of a new paving season after the field design verification has been completed.

6.10 The Contractor shall maintain control charts for percent asphalt, percent air voids, and percent VMA. These control charts shall be prepared in accordance with the guidelines of MP 300.00.51. As an alternative method, the control charts may be prepared with a personal computer using software that can generate such charts and provide a distinct graphic representation of all data points. Data points required on the control charts are the daily individual Contractor quality control tests, district verification sample tests, and the moving average of every four Contractor quality control tests. All data points shall be calculated to the nearest 0.1 percent.

6.11 For hand drawn charts, the quality control test data points shall be represented by a small blue circle symbol and connected by a dashed line. The four sample moving average data points shall be represented by a small red square symbol and connected by a solid line. District verification sample test data points shall be represented by a small red circle symbol, but shall not be connected. The upper and lower tolerance limits of the test properties which were established through the field design verification described in Section 6. shall be represented by solid horizontal lines. Show below is an example of this, showing the expected format

←----------→ get an example here

6.12 If the computer-generated control chart cannot be produced using the symbols and lines described above, then a graph legend shall be included which shall indicate the graphic symbols used to represent the required data points and lines.

6.13 The quality control charts shall be kept up to date and placed in a location that is easily accessible to the Division for review at any time.

7. DEGREE OF NONCONFORMANCE

7.1 Should the four-sample average of test values for percent asphalt, percent air voids, or percent VMA fall outside the verified JMF tolerances by more than the allowable deviation of Table 401.02.27C then production shall be halted until the Contractor takes necessary steps to bring production under control. Production shall also be halted if three consecutive aggregate gradation tests fall outside the tolerance limits of Table 401.02.27B. Actions taken by the Contractor to bring production back in control shall be documented in the plant diary.

7.2 When the four sample average of the Contractor's quality control tests for percent asphalt or percent air voids falls outside the JMF tolerances of Table 401.02.27C, the Sublot of material represented by the last individual test value in the moving average shall have its price reduced in accordance with the schedule set forth in Section 7.3. In the case where the average is nonconforming and the last tested Sublot is conforming, then there would be no price adjustment.

7.3 The degree of nonconformance shall be determined using the following relationship:

When the moving average is greater than the upper control limit Q_U

$= X_n - UL$

When the moving average is less than the lower control limit

$Q_L = LL - X_n$

Where Q_U = Percent of non-conformance at Upper Limit Q_L
= Percent of non-conformance at Lower Limit UL = Upper Limit
LL = Lower Limit
X_n = Average of four consecutive test values (less than four when production is limited)

If it is decided by the Division that the material is to be allowed to remain in place, then the Sublot shall have its price reduced in accordance with Tables 401.02.27D and/or 401.02.27E as applicable.

TABLE 401.02.27D
ADJUSTMENT OF CONTRACT PRICE FOR MIX NOT WITHIN TOLERANCE LIMITS OF PERCENT ASPHALT

QU or QL	Percent of Contract Price to be Paid
0.0	100
0.1	98
0.2	96
0.3	92
Greater Than 0.3	*

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

TABLE 401.02.27E
ADJUSTMENT OF CONTRACT PRICE FOR MIX NOT WITHIN TOLERANCE LIMITS OF PERCENT AIRVOIDS

QU or QL	Percent of Contract Price to be Paid
0.0	100
0.1	98
0.2	96
0.3	92
Greater Than 0.3	*

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

7.4 Should the moving average of both the test properties for the same Sublot fall outside of the JMF tolerance, thus resulting in a reduced price for each, then the following procedure shall be used. The quantity of material represented by the last Sublot in the moving average will have an adjusted unit price which is the product of the original price times the percent as a result of non-conformance of the first test property times the percentage unit price as a result of non-conformance of the second test expressed in the following formula.

AUP = OUP x PUPAC x PUPAV *

Where: AUP = Adjusted Unit Price OUP = Original Unit Price
PUPAC = Percent Unit Price as a result of Asphalt Content Analysis expressed as a decimal
PUPAV = Percent Unit Price as a result of Air Void

Analysis expressed as a decimal

* PUPAC and PUPAV are used in the formula as needed as a single non-conforming item or together for both non-conforming items as shown.

7.5 A new moving average shall start with the fourth sample that is taken after production is resumed (less than four when production is limited). If, at any time, the Division determines that a mix cannot be consistently produced within the tolerance limits of the verified design properties, approval of the mix may be revoked and the contractor will be required to provide a new mix design.

8. SMALL QUANTITY TESTING

8.1 In the event that project activities are such that not more than 75 tons (70 Mg) of a specific mix design are being produced per day during the period of an entire calendar week, then the following small quantity testing requirements shall apply.

8.2 If the plant source rating is A-1, as determined per MP 700.00.52, Guide To Source Rating System Relative To Maintenance Contracts, then the minimum quality control sample requirements shall be one sample per week. The sample shall be taken on the first day of use during the week. If the plant source rating is A-2, as determined per MP 700.00.52, then the normal testing requirements of this MP shall apply.

9. DIVISION VERIFICATION SAMPLING AND TESTING

9.1 Verification sampling and testing is the responsibility of the Division. Quality control tests conducted by the Contractor may be used as a part of the verification process. Verification activities may be accomplished in any of three ways: 1) By conducting sampling and testing completely independent of the Quality Control activities, 2) by witnessing tests performed by the Contractor, or 3) by a combination of both the above. In all cases, those samples and tests taken by the Division completely independent of the Contractor will be taken at a frequency approximately equal to 10% of the frequency required in the Contractor's approved Quality Control Plan for the applicable item.

9.2 The verification samples taken by the Division will be statistically evaluated for similarity to the Contractors quality control tests in accordance with the guidelines set forth in MP 700.00.54. If the evaluation indicates that the Division’s test results are similar to the Contractor’s test results, then the material represented by this evaluation will be considered acceptable. Those properties to be evaluated, as referenced in MP 700.00.54, will consist of percent asphalt, percent air voids, stability, flow, and gradations. In addition, the VMA test results will be evaluated using the guidelines of MP 700.00.54.

9.3 If a dissimilarity is detected, an immediate investigation will be conducted to determine the cause. The intent of the investigation is to define and correct any testing deficiencies that may cause a misrepresentation of the tested material.

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

MATERIALS PROCEDURE

PORTLAND CEMENT MILL CERTIFICATION

1. PURPOSE

1.1 To provide the Division's acceptance procedures for portland cement.

2. SCOPE

2.1 This procedure shall apply to all portland cement production mills which furnish cement to Division projects, except that the Division may elect to use other control procedures when special conditions dictate the need for more stringent control.

3. APPLICABLE SPECIFICATIONS

3.1 All items under this procedure shall meet the requirements of Section 701 of the WVDOH Standard Specifications for Roads and Bridges. This section specifically includes ASTM Specification C150. In addition, samples will be obtained in accordance with ASTM C183.

4. PROCEDURE

Cement mills which produce cement for use in Division projects shall be identified as Certified or Non-Certified, as outlined below.

4.1 CERTIFIED

To be considered for certification, the manufacturer shall do the following:

4.1.1 Submit a certified statement to Materials Control, Soils and Testing Division that all cement shipped to Division projects will conform to the specification requirements. The certified statement shall be signed by a representative of the manufacturer having legal authority to bind the company.

4.1.2 Maintain records of production control tests, for each type of cement which may be supplied to WVDOH projects, for a period of at least five years and make them available to the Division upon request.

4.1.3 Have mill laboratory facilities periodically inspected by the Bureau of Standards Cement and Concrete Reference Laboratory (CCRL). A copy of the CCRL report on the mill laboratory inspection shall be provided to the Division, accompanied by documentation of resolution of any discrepancies noted in the CCRL report.

4.1.4 Submit to the Materials Division test data developed on the type(s) of cement to be certified. This data must consist of test results developed from each day's production over the most recent fifty production days. The required tests are for all the standard chemical and physical requirements listed in ASTM C150. Each complete battery of tests shall represent not more than twenty-four hours of continuous production per finish mill.

4.1.4.1 In the case of Type III cement, or other cement which is not produced on a regular basis, if there are not fifty production days for that type of cement in the previous two-year period, then the data for that type of cement shall consist of test results from each day's production during the last two-year period.

4.1.5 The quality history of a cement plant seeking certification will be determined using the data submitted by the manufacturer as specified in 4.1.4 or 4.1.4.1. Statistical limits, as defined in ASTM C183, will be developed from this data from this data. When an acceptable quality history has been determined, the Division will compare test data developed on production grab samples taken by Division representatives, to the statistical limits established by the mill's production data.

4.1.6 When a cement mill has met the above criteria and has been designated by the Division as Certified, the manufacturer will be required to submit test data on a monthly basis in the same manner as described in 4.1.4.

4.1.6.1 As required in Section 4.1.4, all Certified cement mills shall submit test results, for all tests, developed from each day's production, to Materials Division, except for the results for the Insoluble Residue test. Once a cement mill has been Certified, and if, during the previous three-month period, none of the Insoluble Residue test results from that Certified cement mill exceed 0.75%, then that Certified cement mill may reduce the frequency of Insoluble Residue test result submittal to one test per week of production, instead of one test per day of production. If any Insoluble Residue test result from that Certified cement mill (including results from samples obtained by the Division), is greater than 0.75%, then the frequency of Insoluble Residue test result submittal from that Certified cement mill shall immediately be increased back to one test per day of production, until another three-month period has elapsed, with no Insoluble Residue test results greater than 0.75% from that Certified cement mill.

4.1.6.2 When ASTM C1038 testing is performed due to higher SO_3 content, as outlined in Table 1 of ASTM C150, the Certified cement mill performing that testing shall perform a minimum of one test per month on the sample with the highest SO_3 content for that month.

4.1.6.3 In the case of Type III cement, or other cement, which is not produced on a regular basis, if no cement of this type was produced in a particular month(s), then the Cement Manufacturer shall submit a written statement noting this to Materials Division.

4.1.7 Division representatives will take paired samples from a certified plant's production at a frequency dependent upon the variability of test data. The frequency will generally be such that the sampling is accomplished at least once a quarter.

4.1.7.1 In the case of Type III cement, or other cement, which is not produced on a regular basis, if no cement of this type was produced in a quarter, then the Cement Manufacturer shall submit a written statement noting this to Materials Division, and Division representatives will not be required to take paired samples that quarter.

4.1.7.2 The paired samples will be obtained, tested, and evaluated in accordance with applicable ASTM procedures.

4.1.7.3 Two consecutive pairs of test values failing to meet the statistical control criteria may be considered cause to remove the mill from the certified group.

4.1.7.4 If any individual sample fails to meet the requirements of the applicable ASTM Specification, the mill may be removed from the certified group.

4.1.7.5 If a certification is removed, it may be reinstated at the discretion of the Division when sufficient sampling and testing has been conducted to ensure statistical control.

4.1.8 When all requirements for certification have been met, the manufacturer may ship cement of the type certified to Division projects. Records of quantities of cement shipped to West Virginia projects must be maintained by the manufacturer for a minimum of three years and made available to the Division upon request.

4.1.9 The manufacturer and the Division's District Materials offices will be notified of all changes in the status of a mill's certification.

4.1.10 Once each quarter, or anytime the list is updated, the Materials Division will provide the District with a list of all currently certified cement mills.

4.2 Non-Certified

A cement mill defined as non-certified may supply cement to the Division projects from approved LOTs.

4.2.1 The Division will sample, test, approve, and seal LOTs of cement for use in Division projects. Samples will be obtained in accordance with ASTM C183 except that one grab sample shall be secured for each 400 tons (360 Mg) in the sampling of bulk storage at points of discharge, while the cement is flowing through the openings. All of the applicable chemical and physical tests noted in ASTM C150 will be conducted by the Division laboratories.

4.2.1.1 Any individual sample failing to meet all of the applicable ASTM requirements will result in rejection of the entire LOT of cement.

4.2.2 When a LOT of cement has been sampled, tested, and found to meet all specification requirements, the Division will notify the manufacturer of approval and a WVDOH approval number will be assigned to the LOT.

4.2.3 A manufacturer may make shipments from approved LOTs upon notification of Division approval. When such shipments are made, the manufacturer shall provide documentation as follows:

a) Project to which material is shipped (if available)
b) Silo number from which material drawn
c) Location of shipping origin
d) Contractor (i.e. consignee)
e) WVDOH approval number assigned to silo
f) Identification of carrier
g) Quantity of material in shipment
h) Type of material

4.2.3.1 This documentation may be provided in the form of bills of lading and shall have the following distribution:

a) 1 copy sent to Materials Control, Soils and Testing Division
b) 1 copy sent to accompany shipment and to be left at the destination to become the property of the Division

4.2.3.2 Records of quantities of cement shipped to West Virginia projects must be maintained by the manufacturer for a minimum of three years and made available to the Division upon request.

4.2.3.3 A balance sheet shall be maintained by the manufacturer for each LOT of cement approved for shipment to West Virginia projects. This balance sheet shall provide the following information:

a) The silo number
b) The Division approval number assigned to the silo
c) The test quantity
d) Separate entries for each shipment made from the silo showing bill of lading number and quantity.
e) The balance left in the test quantity after each shipment

The manufacturer may not ship material in excess of the test quantity plus five percent (5%).

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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 Mix Design Component Materials

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 test results of each cylinder shall be included in the mix design submittal package. This raw data shall include the specimen test age, date tested, cylinder ID, average cylinder diameter, maximum load applied to the cylinder, type of fracture, and compressive strength of the cylinder.

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 separate batches. Two of the batches shall be proportioned to produce a mix having a minimum cement factor. Two of the batches shall be proportioned to produce a mix having a minimum cement factor equal to the specified minimum cement factor plus one bag of cement [94 lb. (42.6 kg)]. These batches at

the minimum cement factor plus one bag of cement shall be proportioned at a different water-cement ratio (w/c) 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 information (i.e. raw data), from which each rapid chloride permeability test result was derived, shall also be included in the mix design submittal package.

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

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 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. 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 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) 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 and rapid chloride permeability 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 301 Chapter 4.

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 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.

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.

5.4.4 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 or a Division Approved Laboratory, meeting the requirements of Section 3.1. If a mix design is used often enough (at least fifteen air content, slump, and compressive strength tests for the previous three year period), the re-qualification tests shall not be required, and the mix design may be re-approved based on the actual field tests performed during the previous three year period.

Re-approval of SCC mix designs, produced in accordance with Section 603, shall be re-approved as outlined in Section 603.6.2.

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 or a Division Approved Laboratory, 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 6.2.3.1 In lieu of the batch produced at the Producer's facility, as outlined in Section 6.2.3, a batch may be produced at a Division Approved Laboratory. This batch does not need to be witnessed by WVDOH personnel. The size of this batch shall be the same as the size of the batches produced for new laboratory mix designs. If there are any changes to either the coarse or fine aggregate, certified laboratory personnel may perform the testing and mix adjustments as stated in Section 6.2.2.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 or 6.2.3.1. 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 or Division Approved Laboratory Personnel 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 or Division Approved Laboratory Personnel 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 at the Producer, as outlined 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.

6.3.1.1 If a laboratory batch is produced in lieu of a batch at the Producer, as outlined in Section 6.2.3.1, then the compressive strength of that batch must have a compressive strength which exceeds the "Design 28-Day Compressive Strength" required by the specifications by the value (f'_{cr}) obtained from the formula below. The criteria used to establish the standard deviation is outlined in Section 4.1.

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

Where:
f'_{cr} = Required compressive strength of the batch produced in Section 6.2.3.1 (expressed in psi)
f'_c = Design 28-Day Compressive Strength (expressed in psi)
σ = Concrete Plant Standard Deviation (outlined in Section 4.1)

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 or 6.2.3.1 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, 3 - 6 in 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:Fm

Attachments

MP 711.03.23
ORIGINAL ISSUANCE: APRIL 1971
REVISED: FEBRUARY 2017
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		

MP 711.03.23
ORIGINAL ISSUANCE: APRIL 1971
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ATTACHMENT 1 S-P

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		
Absorption		
Fineness Modulus		
Unit Weight		

MP 711.03.23
ORIGINAL ISSUANCE: APRIL 1971
REVISED: FEBRUARY 2017
ATTACHMENT 3 S-P

SUMMARY

Source: _____

Source Location: _____

Design Laboratory: _____

Class of Concrete: _____

Date: _____

	Mix Properties	
Material	Average Value from Two Trial Batches	Units
Cement		lb (kg)
Pozzolan 1		lb (kg)
Pozzolan 2		lb (kg)
Water	gal (L)	lb (kg)
Coarse Aggregate 1		lb (kg)
Coarse Aggregate 2		lb (kg)
Fine Aggregate		lb (kg)
Total Batch Weight		lb (kg)
Air Entrain. Admixture		oz/Cwt (mL/100kg)
Chemical Admixture 1		oz/Cwt (mL/100kg)
Chemical Admixture 2		oz/Cwt (mL/100kg)
Chemical Admixture 3		oz/Cwt (mL/100kg)
Water Cement Ratio		
Cement Factor		ft^3 (m^3)
Temperature		^{O}F (^{O}C)
Slump Flow		inches (mm)
Air Content		%
Unit Weight		lb/ft^3 (kg/m^3)
Yield		ft^3 (m^3)
T_{50}		seconds
VSI		
J-Ring		inches (mm)
Rapid Assessment of Static Segregation Resist.		inches (mm)
Segregation Resistance		%
Aggregate Correction Factor per AASHTO T 152		%

Compressive Strength, psi (Mpa)	Avg.Compressive Strength of both Trial Batches
24 ± 2 hours	
3 Days	
7 Days	
14 Days	
28 Days	
28 Days	
28 Days	
Avg. 28 Day Strength	#DIV/0!

Prestressing Strand Bond Strength Test (in accordance with MP 603.06.20) Check Applicable Box	
Pass:	
Fail:	

MP 711.03.23
ORIGINAL ISSUANCE: APRIL 1971
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ATTACHMENT 2 S-P

Source:
Source Location:
Design Laboratory:
Class of Concrete:
Date:

Check the Appropriate Box for the Designated Batch:	Batch 1	Batch 2	Additional Batch

Material	Mass	Units	Volume	Units
Cement		lb (kg)		ft^3 (m^3)
Pozzolan 1		lb (kg)		ft^3 (m^3)
Pozzolan 2		lb (kg)		ft^3 (m^3)
Water		lb (kg)	gal (L)	ft^3 (m^3)
Air Content, by volume		%		ft^3 (m^3)
Coarse Aggregate 1		lb (kg)		ft^3 (m^3)
Coarse Aggregate 2		lb (kg)		ft^3 (m^3)
Fine Aggregate		lb (kg)		ft^3 (m^3)
Total		lb (kg)		ft^3 (m^3)
Air Entrain. Admixture		oz/Cwt (mL/100kg)		fl. oz. (mL)
Chemical Admixture 1		oz/Cwt (mL/100kg)		fl. oz. (mL)
Chemical Admixture 2		oz/Cwt (mL/100kg)		fl. oz. (mL)
Chemical Admixture 3		oz/Cwt (mL/100kg)		fl. oz. (mL)

Mixture Test Data at T_0

W/C Ratio	Cement Factor, ft^3 (m^3)	Concrete Temperature, °F (°C)	Slump Flow, in. (mm)	Air Content, %	Unit Weight, lb/ft^3 (kg/m^3)	Yield, ft^3 (m^3)	$T_{50,\ seconds}$
VSI	J-Ring, in. (mm)	Rpd. Asmnt. of Static Seg. Resist., in. (mm)	Segregation Resistance, %	Workable Period, minutes			

Compressive Strength Test, psi (Mpa)

Test Age:	24 ± 2 hours	3 days	7 days	14 days	28 days	28 days	28 days
Actual Test Age (hours)							
Compressive Strength							
Average 28-day Compressive Strength:					#DIV/0!		

Modulus of Elasticity Test, psi (Mpa)

Test Age:	3 days	7 days	14 days	28 days	28 days	28 days
Actual Test Age (hours)						
Modulus of Elasticity						
Average 28-day Modulus of Elasticity:				#DIV/0!		

Length Change (Shrinkage), % Length Change

Test Age	Initial Reading	Reading at End of 28-day Curing Period	4 days after 28-day curing period	7 days after 28-day curing period	14 days after 28-day curing period	28 days after 28-day curing period
Specimen 1						
Specimen 2						
Specimen 3						
Average Length Change (Shrinkage) after 28-days of water curing and 28-days of Air Storage:						#DIV/0!

Rapid Chloride Permeability Testing

	Age at Time of Test (days)	Total Adjusted Charge Passed (coulombs)
Specimen 1		
Specimen 2		
Specimen 3		
Average Total Charge Passed (coulombs):		#DIV/0!

Freeze-Thaw Resistance

	# of Cycles Completed	Durability Factor
Specimen 1		
Specimen 2		
Specimen 3		
Average Durability Factor:		#DIV/0!

Creep Testing

Age at Initial Loading (hours):		Comp. Str. Cylinder 1, psi (Mpa):		Comp. Str. Cylinder 2, psi (Mpa):		Initial Load, psi (Mpa):	
Initial Elastic Strain at Time of Initial Loading (Determined within 2 minutes after Initial Loading):							
	Loaded Cylinders - Total Strain	Control Cylinders - Drying Strain	Load Induced Strain	Load Induced Strain per Unit Stress	Creep Strain	Creep Strain per Unit Stress	Creep Coefficient
90 days After Initial Loading:							

MP 711.03.23
ORIGINAL ISSUANCE: APRIL 1971
REVISED: FEBRUARY 2017
ATTACHMENT 4

Fields will be Automatically Filled After Attachment 3 is Completed	28-day Compressive Strength (Known Y-Value)	Water/Cementitious Material Ratio (Known X-Value)
Average Strength of Two Batches at Target (Minimum) Cement Factor (from Field D49 in Attachment 3)	#DIV/0!	0
Average Strength of Two Batches at Target (Minimum) Cement Factor + 1 Bag (from Field H49 in Attachment 3)	#DIV/0!	0
Strength of Batch at Target (Minimum) Cement Factor but with Different w/c (from Field L49 in Attachment 3)	#DIV/0!	0
	Result of Best-Fit Line (Slope) #VALUE!	Result of Best-Fit Line (Y-Intercept) #VALUE!

Class of Concrete =	0
Maximum Water Content from Table 601.3.1A =	0
Target (Minimum) Cement Factor (lbs.) = (from Fields D19, D20, and D21 of Attachment 3)	0
Design Compressive Strength (psi) from Table 601.3.1A =	0
Plant Compressive Strength Standard Deviation (psi) =	0
Mix Design Approval Strength (psi) =	0
w/c that corresponds to the Mix Design Approval Strength =	#VALUE!
Maximum w/c Allowed in the Field =	**#VALUE!**
Total Maximum Pounds of Water Allowed in the Mix (Including Field Adjustments), at the Target (Minimum) Cement Factor) =	**#VALUE!**
Total Maximum Gallons of Water Allowed in the Mix (Including Field Adjustments), at the Target (Minimum) Cement Factor) =	**#VALUE!**

MP 711.03.23
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ATTACHMENT 5

Fields will be Automatically Filled After Attachment 3 is Completed	28-day Compressive Strength (Known Y-Value)	Water/Cementitious Material Ratio (Known X-Value)
Average Strength of Two Batches at Target (Minimum) Cement Factor (from Field D49 in Attachment 3)	#DIV/0!	0
Average Strength of Two Batches at Target (Minimum) Cement Factor + 1 Bag (from Field H49 in Attachment 3)	#DIV/0!	0
	Result of Best-Fit Line (Slope) #VALUE!	Result of Best-Fit Line (Y-Intercept) #VALUE!

Class of Concrete =	0
Maximum Water Content from Table 601.3.1A =	0
Target (Minimum) Cement Factor (lbs.) = (from Fields D19, D20, and D21 of Attachment 3)	0
Design Compressive Strength (psi) from Table 601.3.1A =	0
Plant Compressive Strength Standard Deviation (psi) =	0
Mix Design Approval Strength (psi) =	0
w/c that corresponds to the Mix Design Approval Strength =	#VALUE!
Maximum w/c Allowed in the Field =	**#VALUE!**
Total Maximum Pounds of Water Allowed in the Mix (Including Field Adjustments), at the Target (Minimum) Cement Factor) =	**#VALUE!**
Total Maximum Gallons of Water Allowed in the Mix (Including Field Adjustments), at the Target (Minimum) Cement Factor) =	**#VALUE!**

MP 711.03.23
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ATTACHMENT 3

SUMMARY

Source: _____

Source Location: _____

Design Laboratory: _____

Class of Concrete: _____

Corresponding Design 28-day Compressive Strength from Table 601.3.1A (psi): _____

Corresponding Maximum Water Content from Table 601.3.1A: _____

Date: _____

	Minimum Cement Factor		Minimum Cement Factor + 1 Bag		Minimum Cement Factor with Different w/c	
Material	Mass	Units	Mass	Units	Mass	Units
Cement		lb (kg)		lb (kg)		lb (kg)
Pozzolan 1		lb (kg)		lb (kg)		lb (kg)
Pozzolan 2		lb (kg)		lb (kg)		lb (kg)
Water		lb (kg)		lb (kg)		lb (kg)
Coarse Aggregate		lb (kg)		lb (kg)		lb (kg)
Fine Aggregate		lb (kg)		lb (kg)		lb (kg)
Total		lb (kg)		lb (kg)		lb (kg)
Air Entrain. Admixture		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Chemical Admixture 1		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Chemical Admixture 2		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Chemical Admixture 3		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Total A-Bar Solids						
Water Cement Ratio						
Cement Factor		ft^3 (m^3)		ft^3 (m^3)		ft^3 (m^3)
Temperature		^OF (^OC)		^OF (^OC)		^OF (^OC)
Consistency		inches (mm)		inches (mm)		inches (mm)
Air Content		%		%		%
Unit Weight		lb/ft^3 (kg/m^3)		lb/ft^3 (kg/m^3)		lb/ft^3 (kg/m^3)
Yield		ft^3 (m^3)		ft^3 (m^3)		ft^3 (m^3)
Aggregate Correction Factor per AASHTO T 152		%		%		%

Compressive Strength, psi (Mpa)	Minimum Cement Factor Batch		Minimum Cement Factor + 1 Bag Batch	Minimum Cement Factor with Different w/c
	6" x 12" Cyl. (150x300 mm)	4" x 8" Cyl. (100x200 mm)		
1 Day				
3 Days				
7 Days				
14 Days				
28 Days				
28 Days				
28 Days				
Avg. 28 Day Strength	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
If applicable, are 4" x 8" (100 x 200 mm) cylinders permitted in the field:				#DIV/0!
Plant Standard Deviation at time of Mix Design Approval (psi):				

Average Value of Rapid Chloride Permeability Test (Coulombs):	

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ATTACHMENT 2

Source: _____
Source Location: _____
Design Laboratory: _____
Class of Concrete: _____
Date: _____

Check The Appropriate Box For Designated Batch:	Minimum Cement Factor		Mininimum Cement Factor + 1 Bag		Minimum Cement Factor with Different w/c	Additional Batch
	Batch 1	Batch 2	Batch 1	Batch 2		

Material	Mass	Units	Volume		Units
Cement		lb (kg)			ft^3 (m^3)
Pozzolan 1		lb (kg)			ft^3 (m^3)
Pozzolan 2		lb (kg)			ft^3 (m^3)
Latex Admixture		lb (kg)	gal (L)		ft^3 (m^3)
Water		lb (kg)	gal (L)		ft^3 (m^3)
Air Content, by volume		%			ft^3 (m^3)
Coarse Aggregate		lb (kg)			ft^3 (m^3)
Fine Aggregate		lb (kg)			ft^3 (m^3)
Total		lb (kg)			ft^3 (m^3)
Air Entrain. Admixture		oz/Cwt (mL/100kg)			fl. oz. (mL)
Chemical Admixture 1		oz/Cwt (mL/100kg)			fl. oz. (mL)
Chemical Admixture 2		oz/Cwt (mL/100kg)			fl. oz. (mL)
Chemical Admixture 3		oz/Cwt (mL/100kg)			fl. oz. (mL)

Mixture Test Data							
$\overline{A}$ Total Solids	W/C Ratio	Cement Factor (ft^3)	Temperature	Consistency	Air Content	Unit Weight	Yield

Compressive Stength, psi (MPa)			
Specified Test Age:	Actual Test Age (hours)	6" x 12" (150 x 300 mm) Strengths	4" x 8" (100 x 200 mm) Strengths
24 ± 2 Hours			
3 Days			
7 Days			
14 Days			
28 Days			
28 Days			
28 Days			
Avg. 28 Day Strength		#DIV/0!	#DIV/0!

Rapid Chloride Permeability Testing (When Applicable)		
Method of Curing (Check Applicable Box)	Standard	Accelerated
	Age at Time of Test (Days)	Total Adjusted Charge Passed (Coulombs)
Test 1		
Test 2		
Average		#DIV/0!

MP 714.03.30 P
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WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

QUALITY ASSURANCE OF REINFORCED CONCRETE CULVERT, STORM DRAIN, AND SEWER PIPE

1. PURPOSE

1.1 To set forth the procedures which govern the Quality Assurance of Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

1.2 To set forth manufacturers Quality Control requirements.

1.3 To set forth acceptance inspection procedures.

1.4 To set forth documentation and shipping procedures.

2. SCOPE

2.1 This procedure will apply to all manufacturers of Reinforced Concrete Culvert, storm pipe, and sewer pipe for use in West Virginia projects.

2.2 This procedure will establish the basis for acceptance of reinforced concrete pipe.

3. APPLICABLE SPECIFICATIONS

3.1 All standard types of reinforced concrete pipe are to be manufactured and tested in accordance with Section 714.2 of the Standard Specifications for Roads and Bridges.

3.2 Reinforced concrete pipe having a wall thickness of 115 mm (4.5 inch) or less, which is manufactured in accordance with the applicable specifications is treated in the following manner to determine acceptability.

3.2.1 The three-edge bearing test (AASHTO T-280) shall be used to determine the force required to produce the 0.25 mm (0.01 inch) crack and the minimum specified ultimate load.

3.2.2 The absorption test (AASHTO T-280) shall be conducted on samples selected from the wall of the pipe.

3.2.3 A plant inspection of the finished product is conducted to determine dimensional conformance and freedom from defects.

3.3 Reinforced concrete pipe fabricated with dry cast concrete having a wall thickness greater than 115 mm (4.5 inch), which is manufactured in accordance with the applicable specifications, is treated in the following manner to determine acceptability.

3.3.1 The compressive strength of the concrete will be determined by testing cores taken from the wall of the pipe. The manufacturer may choose to test this pipe as specified in Section 3.2.1, in which event the requirements for the 0.25 mm (0.01 inch) crack and the minimum specified ultimate load shall be met. This choice shall not be applied to a LOT (refer to Table 1) of pipe, which has been previously cored and found unacceptable.

3.3.2 The absorption test (AASHTO T-280) shall be conducted on samples selected from the wall of the pipe.

3.3.3 A plant inspection of the finished product will be conducted by the Division to determine dimensional conformance, and freedom from defects.

3.4 Reinforced concrete pipe fabricated with wet cast concrete can be accepted on the basis of compressive strength from cylinder breaks (cylinders made per AASHTO T-23 and tested per AASHTO T-22) reaching the required 28 day compressive strength or by the three-edge bearing test (AASHTO T-280) as detailed in Section 3.2.1.

4. QUALITY CONTROL REQUIREMENTS

4.1 Quality Control is the responsibility of the manufacturer and shall include the following:

4.1.1 Ensure all component materials used in the fabrication of the pipe have been sampled, tested, and approved (MP 603.02.10).

4.1.2 Ensure quality workmanship as well as a quality product throughout the production.

4.1.3 To scribe into each piece of pipe the following:

(a) Cast Date
(b) Class and Wall Type
(c) Manufacturer's Trademark

4.1.4 Notify the Division's representative upon the completion of casting of a LOT (Refer to Table 1) of pipe so the Division may select a representative sample and witness the testing.

4.1.5 To conduct the three-edge bearing test or to secure cores to ensure strength requirements are met (Section 3.2 and 3.3).

4.1.6 To conduct the absorption test (AASHTO T-280) on samples selected from the wall of the pipe.

4.1.7 Any LOT of pipe or portion of a LOT of pipe failing to meet the specification requirements will be stored separately from acceptable pipe.

4.1.8 Accurate inventory records containing the information required in Section 6.1.2 will be kept and maintained by the manufacturer.

5. ACCEPTANCE CRITERIA

The Division will:

5.1 Sample and test the component materials to be used in the manufacturer of the reinforced concrete pipe in accordance with MP 603.02.10.

5.2 Select representative samples of the LOT to be tested and:

(a) Witness the three-edge bearing test and/or the coring procedure
(b) Verify dimensional conformance
(c) Verify actual steel placement
(d) Determine the steel area

5.3 Ensure each piece comprising the LOT is scribed as stated in 4.1.3.

5.4 Make a visual inspection of the LOT and designate unacceptable units to be removed or set apart from the approved pipe in the LOT.

6. SHIPPING REQUIREMENTS

6.1 The approved LOT of pipe or portion of the LOT can be shipped by the manufacturer providing the following provisions have been met:

6.1.1 The manufacturer will notify the Division's representative prior to each shipment so that the Division may maintain a current inventory with the manufacturing plant.

6.1.2 The manufacturer will supply one copy of the shipping invoice to Materials Control, Soils and Testing Division and one copy to the Division's representative at the project site. The invoice shall contain the following information.

(a) Cast date of the approved LOT
(b) Master laboratory number
(c) Size, class, and wall type
(d) Project number
(e) Number of pieces

7. ACCEPTANCE PRACTICE

7.1 Ensure the information on the shipping invoice, as required in Section 6.1.2, agrees with the shipment it accompanies. (Number of pieces, class, size, and type, etc.).

7.2 Check each piece of pipe for the proper identification markings (Section 5.3) and make a visual inspection of each piece to ensure there is no evidence of damage during shipment.

8. COVERAGE REQUEST FROM PROJECT SITE

8.1 Request for coverage shall include the information as referenced on the shipping invoice, Section 6.1.2

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

RLS:Ma

Attachments

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

MATERIALS PROCEDURE

MIX DESIGN PROCEDURE FOR COLD RECYCLING (CR) WITH ASPHALT EMULSION

1. PURPOSE

1.1 This MP is used to determine the appropriate mix design for an individual asphalt roadway by ensuring the sampled material with corresponding mix design meets specification requirements.

1.2 This MP is used to perform mix design procedure for Cold Recycling with Asphalt Emulsion.

2. SCOPE

2.1 This method covers the procedure for mix design of Cold Recycled pavements with asphalt emulsion, which includes Cold In-Place Recycling (CIR) and Cold Central Plant Recycling (CCPR).

2.2 This MP may involve hazardous materials, operations, and equipment and may not address all of the safety problems associated with the use of the test method. The user of the MP is responsible for establishing appropriate safety and health practices and determining the applicability of regulatory limitations prior to use.

3. REFERENCES

3.1 AASHTO Standards

1. **T11** - Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
2. **T27** - Sieve Analysis of Fine and Coarse Aggregates
3. **T49** - Standard Test Method for Penetration of Bituminous Materials
4. **T59** - Testing Emulsified Asphalts
5. **T166** - Bulk Specific Gravity (G_{mb}) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
6. **T209** - Theoretical Maximum Specific Gravity (G_{mm}) and Density of HMA
7. **T245** - Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
8. **T312** - Preparing and Determining the Density of Hot Mix Asphalt by Means of the Superpave Gyratory Compactor

3.2 ASTM Standards

D7196 Standard Test Method for Raveling Test of Cold Mixed Emulsified Asphalt Samples

4. TERMINOLOGY - DEFINITIONS FOR TERMS AND ABBREVIATIONS SHALL BE IN ACCORDANCE WITH THE DEPARTMENT'S STANDARD SPECIFICATIONS, SECTION 101.

4.1 CIR – Cold In-Place Recycling

4.2 CCPR – Cold Central Plant Recycling

4.3 CR – Cold Recycling, comprised of Cold In-Place Recycling and Cold Central Plant Recycling

4.4 RAP – Reclaimed Asphalt Pavement

4.5 Constant mass – Shall be defined as the mass at which further drying does not alter the mass by more than .05 percent in 2 hours.

4.6 Base Material – Aggregate type material directly below a bituminous pavement

4.7 Mix Design Blend – The selected proportions, by weight, of RAP, aggregate base and/or other additional materials to be used throughout the mix design that accurately represents the chosen depth of treatment, material proportions and material type encountered during CR construction.

4.8 Design gradation – The selected percentage of sized material used in a specimen set for mix design. Use the following sieves: 1-1/2", 1", ¾", ½", 3/8", #4, #8, #16, #30, #50, #100, #200.

5. APPARATUS

5.1 Laboratory, capable of maintaining room temperature 77±9□ (25±5□)

5.2 Mechanical shaker with the appropriate screens to size material based on the gradations provided.

5.3 100 mm Superpave Gyratory mold

5.4 Mechanical Bucket Mixer with a bowl measuring 10-12 inches in diameter shall be used. The bowl should be capable of rotating on its axis at 50 to 75 revolutions per minute. The mixer shall use a paddle which makes contact with the bottom of the bowl and shall rotate on its axis at twice the bowl rotation rate, in the opposite direction of the bowl rotation.

5.5 Laboratory Crushing Machine, capable of crushing sampled material to pass the 1.25-inch sieve. If required by pavement sample type. Field millings do not require further crushing.

5.6 Conditioning Chamber, capable of maintaining a temperature of 50±2□ (10±1□), at specified humidity, if required.

Dan 4/10/19 11:05 AM
Comment [1]: What is this suppose to be?

5.7 Forced Draft Oven, of appropriate size, capable of maintaining temperatures of 104±4□ (40±2□) and 140±2□ (60±1□). Shall be equipped with racks containing slots or holes for circulation of air.

5.8 Scale, capable of showing a reading to the nearest 0.1 gram.

5.9 Miscellaneous lab equipment; scoops, pans, mixing bowls, containers

5.10 Vacuum system, capable of subjecting contents to partial vacuum of 25.0 to 30.0 mm of Hg.

6. SAMPLING

6.1 A mix design shall be performed with the materials to be encountered during construction, including in-place pavements, surface treatments, stockpiled RAP, additional aggregate, aggregate base, asphalt emulsion and other additives. If construction materials change significantly between the time of sampling and construction, additional mix designs shall be performed to establish a representative mix for the project.

6.2 Samples of the existing pavement collected as cores, test pits, milled RAP, or stockpile samples of RAP. Prepare samples in the laboratory to simulate the specific construction process applied in the field.

6.3 Pavement samples are cut in the laboratory to the appropriate depth to represent field treatment, unless milled or stockpiled RAP is provided. For CCPR mix design, if additional processing of CCPR stockpiles is required during construction, such as scalping, screening or crushing, the sample material shall be processed similarly in the laboratory.

6.4 The composition of in-place pavement should be examined. Location and placement of collected pavement shall accurately reflect minor variations in the pavement and form a representative sample of the entire project. Each mix design requires a minimum sample size of 350 lbs.

6.5 Samples from significantly different pavement sections or stockpiles shall be grouped separately, with separate mix designs performed for each. Examples of these variations include: large patches, and significantly different asphalt mixes.

7. PREPARATION OF TEST SPECIMENS

7.1 Sample Preparation Procedure

7.1.1 Pavement samples shall be cut to a depth that accurately represents the CR treatment to take place, also accounting for pre-milling that may take place in the field.

7.1.2 Sampled pavement shall be crushed using a laboratory crusher or other methods. All material shall be crushed to pass the 1.5-inch sieve, although care should be taken to avoid fracturing the aggregate. Heat shall not be applied to the sampled pavement during the crushing process.

7.1.3 Ensure materials, including RAP, aggregate base and/or other additional materials are stored and prepared separately. Prior to batching specimens ensure material has been dried in a forced draft oven and thoroughly mixed.

7.1.4 Materials containing bituminous material shall be dried to constant mass at 104±4□ (40±2□) in a forced draft oven. Materials without bituminous material may be dried at temperatures up to 230±9□ (110±5□) in a forced draft oven.

7.1.5 Using Laboratory Screen Shaker, screen and separate sized material to prepare batching procedure.

7.2 **Asphalt Emulsion Content Selection**

7.2.1 Mix designs shall be performed using an asphalt emulsion that meets all requirements detailed in Table 1.

Table 1. CR Asphalt Emulsion Material Specification

Test	Procedure	Minimum	Maximum
Viscosity, Saybolt Furol, at 77□ (25□), SFS	AASHTO T 59	20	100
Sieve Test, No. 20 (850 µm), retained on sieve, %	AASHTO T 59		0.10
Storage Stability Test, 24 hr, %	AASHTO T 59		1
Distillation Test, Residue from distillation % (See Note 1)	AASHTO T 59	64.0	
Oil Distillate by volume, %	AASHTO T 59		1
Penetration, 77□ (25□), 100 g, 5 s, dmm	AASHTO T 49	50	200

Note 1 – Modified AASHTO T 59 procedure – distillation temperature of 350±9□ (177±5□) with a 20-minute hold.

7.2.2 Select at least three asphalt emulsion contents in increments of 0.5 to 1.0 percent within a suggested range of 1.0 to 4.0 percent by dry weight of RAP.

7.3 **Batching Procedure**

7.3.1 Select the design gradation for two specimen sets. Design gradations shall be selected according to the gradation of at least two of the three gradation bands detailed in Table 2. The gradation bands selected shall be the two that best match the field gradation expected by the CR type. For CCPR mix designs, when mix design materials are collected from a pre-existing stockpile, the mix design may be completed with a single gradation set, using a design gradation that best matched the anticipated construction gradation.

7.3.2 For a CR treatment that incorporates materials other than RAP, batch the percentage, or mix design blend, by weight, of RAP, aggregate base and/or other additional materials for each specimen in a set. Ensure a representative sample is obtained from the additional incorporated materials when batching specimens.

7.3.3 The design gradation of each specimen within a specimen set shall be identical for wash gradation, Theoretical Maximum Specific Gravity, and Marshall Stability Testing specimens. Only material passing the 1-inch sieve shall be used to manufacture specimens when using 100mm gyratory molds.

Table 2. CR Mix Design Blend Gradation Criteria

Sieve Size		Percent Passing		
		Fine	Medium	Coarse
1 ½ in.	37.5 mm	100%	100%	100%
1 in.	25 mm	100%	100%	85-100%
¾ in.	19 mm	95-100%	85-96%	75-92%
No. 4	4.75 mm	55-75%	40-55%	30-45%
No. 30	600 µm	15-35%	4-14%	1-7%
No. 200	75 µm	1-7%	0.6-3%	0.1-3%

7.3.4 Batch the following specimens from the sized material for the selected asphalt contents according to each design gradation.

1. Prepare 2 washed gradation specimens for each design gradation with a minimum of 2500g specimens for each gradation. Tested according to Washed Gradation Sieve Analysis Procedure in 8.1
2. Prepare 4 Theoretical Maximum Specific Gravity Specimens for each design gradation. Two specimens each will be tested at the highest selected asphalt emulsion content and at the lowest selected asphalt emulsion content. Minimum weight requirement for Theoretical Maximum Specific Gravity Specimens is 2500 g per specimen, using only material passing the 1" sieve. Prepared according to Theoretical Maximum Specific Gravity Specimen Preparation in 8.2
3. Prepare 4 pills per selected emulsion content for each design gradation for Marshall Stability Testing. 1000 g or more per specimen is typical, using only material passing the 1" sieve. The total specimen weight shall be the amount that will produce a 60 to 65 mm tall specimen using a 100-mm diameter gyratory mold, using 30 gyrations.
4. Prepare 2 raveling pills per selected asphalt emulsion content only when selected gradation follows medium gradation band. 2500 g or more per specimen is typical. The total specimen weight shall be the amount that will produce a 65 to 75 mm tall specimen using a 150-mm diameter gyratory mold, using 20 gyrations.

7.4 **Mixing Procedure**

7.4.1 Mixing occurs at room temperature. One specimen shall be mixed at a time. Design Moisture Content shall be the amount of water added to the mixture during coating procedure. The Design Moisture Content chosen for each selected asphalt emulsion content represents the in-situ moisture and additional water combined during CR construction. The design moisture content does not include water in the asphalt emulsion, and is typically 1.5 to 3.0 percent by dry weight of material. Ay other additives are combined in a manner and order similar to field production.

7.4.2 Record design moisture content selected for each gradation.

7.4.3 Using a mechanical bucket mixer, begin mixing batched material at 50-75 revolutions/minute.

7.4.4 Add design moisture content to batched material.

7.4.5 Mix for no less than 60 seconds.

7.4.6 Add asphalt emulsion to mixer.

7.4.7 Mixing time with asphalt emulsion shall be 55±5 seconds.

7.5 **Theoretical Maximum Specific Gravity Specimen Preparation**

7.5.1 After mixing procedure detailed in 7.4, spread and transfer each specimen to individual shallow containers.

7.5.2 Cure in a 140±2□ (60±1□) forced draft oven, for at least 16 hours but no more than 48 hours. Care should be taken not to over-dry the specimens.

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7.5.3 Remove specimens from oven once reaching constant mass.

7.5.4 After curing, gently break up clusters that have formed in the specimen. Care should be taken to avoid fracturing aggregate.

7.5.5 Let cool to room temperature before continuing to Theoretical Maximum Specific Gravity Test procedure detailed in 8.2.

7.6 **Marshall Stability and Raveling Test Specimen Conditioning Procedure – CCPR Only**

7.6.1 If preparing a CIR specimen, skip conditioning procedure and immediately proceed to pill preparation in 7.7.

7.6.2 If preparing a CCPR specimen, immediately after mixing procedure detailed in 7.4, transfer material into an individual container measuring 4 to 7 inches (100 to 175 mm) in height and 6 inches (150 mm) in diameter.

7.6.3 Place container in a 104±4□ (40±2□) forced draft oven 30±3 minutes.

7.6.4 Upon removal from oven, immediately proceed to pill preparation in 7.7.

7.7 **Marshall Stability Pill Preparation**

7.7.1 Superpave Gyratory Compactor shall be prepared in accordance with AASHTO T 312, preparation of apparatus. Use the following machine settings: 1.16" internal angle, 87 psi (600 kPa) ram pressure, 30 gyrations. Only final specimen height is to be monitored.

7.7.2 Compact specimens using the Superpave gyratory compactor with a 100mm diameter, room temperature mold.

7.7.3 Extrude pill from mold immediately after compaction.

7.7.4 Cure compacted pills in a 140±2□ (60±1□) forced draft oven, at least 16 hours but no more than 48 hours.

7.7.5 Remove pill from oven once reaching constant mass. Let cool to room temperature before continuing.

7.8 **Raveling Pill Preparation**

7.8.1 Superpave Gyratory Compactor shall be prepared in accordance with AASHTO T 312, preparation of apparatus. Use the following machine settings: 1.16" internal angle, 87 psi (600 kPa) ram pressure, 20 gyrations. Only final specimen height is to be monitored.

7.8.2 Compact material in the Superpave gyratory compactor using a 150-mm diameter, room temperature mold.

7.8.3 Extrude specimen from mold immediately after compaction.

7.8.4 Place on a flat surface.

7.8.5 Condition compacted specimens in conditioning chamber for 4 hours± 5 minutes at 50±2□ (10±1□), at specified humidity if required.

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7.8.6 Begin Raveling Test Procedure per 8.4.

8. PROCEDURE

8.1 Washed Gradation Sieve Analysis

8.1.1 Perform Sieve Analysis on washed gradation specimens in accordance with AASHTO T 11 and T 27 with the following exception:

Washed gradations shall be dried at no greater than 104±4□ (40±2□) in a forced draft oven.

8.1.2 Remove specimens from oven once constant mass is reached.

8.1.3 Record gradation results for each gradation at the following sieves 1-1/2", 1", ¾", ½", 3/8", #4, #8, #16, #30, #50, #100, #200. Ensure sample gradation is within recommended gradation bands limits.

8.1.4 Calculate Total % of Material Passing for the recorded sieves per AASHTO T 27.

8.2 Theoretical Maximum Specific Gravity Test Procedure

8.2.1 Theoretical Maximum Specific Gravity Specimens shall be prepared according to Mixing Procedure per 7.4 and Theoretical Maximum Specific Gravity Specimen Preparation per 7.5.

8.2.2 Determine and record Theoretical Maximum Specific Gravity of each specimen in accordance with AASHTO T 209.

8.2.3 Calculate and Record the Average Theoretical Maximum Specific Gravity for each asphalt emulsion content measured.

8.2.4 Calculate Average Theoretical Maximum Specific Gravities for remaining asphalt emulsion contents using interpolation of the measured Maximum Theoretical Specific Gravities.

8.3 Marshall Stability Testing Preparation and Procedure

8.3.1 Measure and record pill heights to be used for Stability calculation.

8.3.2 Determine and Record Bulk Specific Gravity (G_{mb}) of each specimen in accordance with AASHTO T 166.

8.3.3 Calculate and Record % Air Voids of each specimen in accordance with AASHTO T 269.

8.3.4 Dry and Moisture Conditioned Marshall Stability Pills are to be conditioned and tested concurrently. Moisture Conditioned specimens shall be conditioned using Vacuum Saturation.

8.3.5 <u>Moisture Conditioned Pill Procedure</u>

1. Using the vacuum system in accordance with AASHTO t 209, place specimen in vacuum container using a spacer to support specimen 1 in. (25 mm) above bottom of container.
2. Fill container with water to a level at least 1 in. (25 mm) above top of specimen.
3. Apply vacuum for a short time (typically 5 to 15 seconds).

4. Release vacuum.
5. Remove specimen from water and record mass of container and water.
6. Damp dry the specimen by blotting it with a damp towel and record saturated surface dry (SSD) mass.
7. Calculate the volume of air voids, Va, as follows:

$$Va = \frac{Pa\ X\ E}{100}$$

Where:

Va = volume of air voids, cm^3
Pa = percent air voids as determined in 8.3.3
E = volume of the specimen, cm^3

8. Calculate degree of saturation of the specimen as follows:

$$S' = \frac{100\ (B' - A)}{Va}$$

Where:

S' = degree of saturation, %
B' = mass of the SDD specimen after partial vacuum, g
A = mass of the dry specimen in air, g
Va = Volume of air voids, cm^3

If degree of saturation is below 55%, repeat previous steps to reach appropriate degree of saturation. If saturation is above 75%, sample is damaged and must be discarded.

If saturation is between 55 and 75 percent, proceed to the following step.

9. Immediately submerge correctly saturated specimens in a 77±2□ (25±1□) water bath for 23 hours.
10. Transfer specimens into a 104±4□ (40±2□) water bath for one hour.
11. See step 8.3.7 for testing of conditioned specimens.

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8.3.6 Dry Pill Procedure

1. Ensure dry specimens are at constant mass prior to conditioning.
2. Dry specimens are conditioned in a forced draft oven at 104±4□ (40±2□) for 2 hours prior to Marshall Stability Testing.

8.3.7 Marshall Stability Testing – Follow procedure for testing Marshall Stability in accordance with AASHTO T 245, except as previously noted for specimen preparation, compaction and conditioning.

8.4 **Raveling Test**

8.4.1 Immediately after conditioning is complete, record the mass of each specimen.

8.4.2 Proceed directly to testing of specimen in accordance with ASTM D7196 test procedure.

8.4.3 Follow calculation for % Mass Loss in accordance with ASTM D7196.

8.4.4 Calculate Average % Mass Loss for each asphalt emulsion content tested.

9. CALCULATIONS

9.1 **Marshall Stability Calculations**

9.1.1. Using the previously measured height of each pill, calculate corrected maximum load (Marshall Stability) for each Marshall Stability pill as detailed in AASHTO 245 Table 2.

9.1.2 Calculate and Record average corrected maximum load (average Stability) at each asphalt emulsion content for moisture conditioned and dry pills separately.

9.1.3 Calculate and Record Retained Marshall Stability (%) for each asphalt emulsion content at each gradation using the following equation:

$$Retained\ Marshall\ Stability = \frac{Average\ Moisture\ Conditioned\ Specimen\ Stability}{Average\ Dry\ Specimen\ Stability}$$

9.2 **Selecting a Final Design Asphalt Emulsion Content**

9.2.1 Select and Report one asphalt emulsion content per design gradation that meets or exceeds all mix design requirements detailed in table 3.

Table 3. CR with Asphalt Emulsion Mix Design Requirements

CR Test	Passing Criteria
Marshall Stability, lbs (kg), AASHTO T 245	1250 lbs (567 kg) minimum
Retained Stability, %	70% minimum
Raveling Test, 50□ (10□), %, ASTM D7196	2% maximum
Additional Additive(s) (See Note 2) Cement, %	1.0% maximum
Emulsified Asphalt[1] Residual Asphalt to Cement Content Ratio	3:1 minimum

Note 2 – Report shall include type/gradation and producer/supplier.

10. **REPORT –** ALL MIX DESIGN TEST RESULTS SHALL BE REPORTED TO THE DEPARTMENT PER TABLE 4. ALL ADDITIONAL ADDITIVES AND BITUMINOUS MATERIAL SHALL BE REPORTED TO THE DEPARTMENT.

Table 4. Reported Results

Cold Recycling with Emulsified Asphalt – Mix Design Requirements		
Initial Selected Criteria	Test Purpose	Reported Results
Tested Asphalt Emulsion Contents (%)	Establish a complete dataset	Each Content selected
Design Moisture Contents (%)	Dispersion of Asphalt Emulsion	Each Content selected
Gradation Bands	Match field gradation	Each Band selected
Test Method	Test Purpose	Reported Results
Washed Gradation, AASHTO T 11, T 27	Ensure proper lab pulverization	Average for each material tested
Superpave Gyratory Compaction, 1.25° external angle, 87 psi (600 kPa), AASHTO T 312	Standardize Lab Compaction Effort	Report Compliance for all compacted specimens
Rice (Maximum Theoretical) Specific Gravity, AASHTO T 209		
Bulk Specific Gravity (Density), AASHTO T 166		
Air Voids, AASHTO T 269, %	Laboratory Density Indicator	Average at each Asphalt Emulsion Content Tested
Marshall Stability, lbs (kg)	Strength Indicator	
Retained Stability, %	Moisture Damage Resistance	
Raveling Test, 50□ (10□), %	Raveling Resistance	
Additional Additive(s) (See Note 3) Coarse Aggregate Fine Aggregate RAP Cement, %		Report Quantities
Emulsified Asphalt (See Note 3) Distillation Residue, % (See Note 4) Residue Penetration, dmm Optimum Emulsion Content, % Residual Asphalt to Cement Content Ratio		Report Results
Final Selected Criteria	Test Purpose	Reported Results
Final Design Asphalt Emulsion Content (%)	Select Highest Performing Asphalt Emulsion Content	Content for each Design Gradation

Note 3 – Report shall include type/gradation and producer/supplier

Note 4 – Modified AASHTO T 59 procedure – distillation temperature of 350±9□ (177±5□) with a 20-minute hold.

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