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

METHOD OF EVALUATION OF NON-STANDARD OR NON-CONFORMING MATERIALS IN CONSTRUCTION VIA DMIR

1. PURPOSE

1.1 Provide a method for evaluating material that does not meet the requirements of the Contract Documents ~~the above-mentioned documents~~ and is not otherwise~~-~~ addressed in those documents~~addressed in those documents~~.

1.2 Provide guidelines and/or a course of action~~/inaction~~ when a material test has not been performed or has been performed incorrectly.

2. DEFINITIONS

2.1 ST-1: Special Testing Form 1~~-~~ The ST-1 is a historic WVDOH document which has been used to provide an acceptance method for a material that does not have a prescribed acceptance method or is otherwise outside the scope of the normal acceptance procedure. ~~This form has evolved over the years but is still used for the original purpose.~~ An ST-1 is to be done before the material is placed.

2.2 DMIR: District Materials Inspection Report – A DMIR is ~~an~~a materials investigation~~,~~ ~~typically~~ specifically into a material failure or ~~any other~~a situation where there is no prescribed method for the resolution of ~~a~~ failing material on a project. A DMIR can have several outcomes including, but not limited to: Remove and replace, a price reduction, or accept in place~~ etc~~.

2.3 AWP: (AASHTOWare Project Management Software) – This is the generic term for the suite of software used by the WVDOH to manage and process projects. This system manages contracts, samples, tests and other aspects of projects.

~~2.4 Authorize a Sample – This is a technical AWP term in which the user closes or locks the sample. Authoring a sample indicates that the sample has been resolved in the system and the system will allow the project to proceed through certification. This does not have any indication of whether the sample has passed or failed.~~

~~2.5~~2.4 Concur/Non-Concur of Sample – This is a technical AWP term in which the reviewer indicates their acceptance of a sample. A “Non-Concur” typically requires additional action to accept the material in the AWP system.

~~2.6~~2.5 District ~~Sample ID~~Lab Number – This is the tracking number and database ~~a technical AWP term which refers to the “key”~~ field for the WVDOH ~~a record in the~~materials management system ~~AWP database~~.

3. SCOPE

3.1 This procedure applies to situations where the resolution of a non-conformance ~~issue~~ is not clearly defined or described by ~~the Standard Specifications or other WVDOH documents, or if District wishes to diverge from these documents~~Contract Documents.

3.1.1 The DMIR shall be submitted to MCS&T for consideration and either concurrence/non-concurrence for the following situations:

3.1.1.1 The Material did not meet the Standard Specifications or other Division Testing Requirements.

3.1.1.2 The Material is not addressed in the Standard Specifications or other Division Documents and has been placed before testing (ST-1 or evaluation methods were not utilized).

3.1.1.3 Sampling and/or testing was not done correctly, samples or documentation was lost, or testing otherwise cannot be used to represent or accept the material.

3.1.1.4 The resolution of the material has not been addressed in a change order or other contractual document.

3.2 As per Section 105.3 of the Standard Specifications, the District may accept materials that do not conform to Contract Documents. In this instance, material acceptance shall be processed via DMIR.

~~**4. procedure**~~

~~**5.**~~**4.** DMIR Documentation and Submission to MCS&T

~~5.1~~4.1 The DMIR form is available on the WVDOH MCS&T Webpage[1]. All required fields must be completed before submitting the DMIR to MCS&T.

~~5.1.1~~4.1.1 The preparer of the DMIR, typically the Materials Supervisor or their designee, shall clearly state all details that initiated the DMIR and shall include the following categories of information:

1. General/Project information
2. Materials information
3. Type of deviation
4. Situation
5. Review
6. Conclusion
7. Review and Signatures from Construction Engineer and Materials Supervisor
8. Supporting Documentation

~~5.1.2~~4.1.2 A description of the material, known quantities, technical issues, or any requirement from the applicable Specifications, Contract Proposal, Project Plans, Material Procedures (MPs), Standard Details, Special Provisions, AASHTO, ASTM, or any Non-Specification issues shall be provided.

~~5.1.3~~4.1.3 A justification and any supporting and/or relevant detail shall be provided.

~~5.1.4~~4.1.4 The conclusion shall clearly state and justify the final price assessment resolution (which may be $0.00), including all applicable fees and penalties.

~~5.1.5~~4.1.5 The assessment fees should be listed individually and with a final total price assessment. Justification of the price assessment shall be provided.

~~5.1.6~~4.1.6 The ~~Supporting~~ supporting ~~Documentation~~ documentation shall provide the necessary information and evidence for the materials inspection.

4.2 The DMIR shall be sent to the ST-1/DMIR mailbox (St1dmir@wv.gov).

4.2.1 DMIR Request Email files shall be submitted in the following format for both the subject of the email and the file name for the submission: DMIR-District Lab Number-CID Contract ID. An example follows,

4.2.1.1 DMIR-MXZXXXX-CID 20XX00XXXX

~~5.2~~4.3 The sample shall be logged and sent to the applicable MCS&T section to review. If the subject material(s) meets the project requirements, MCS&T will concur with the sample and the reviewer will then ~~authorize the~~process sample in AWP.

~~5.2.1~~4.3.1 The District must electronically send the fillable PDF form. This cannot be hand-written and scanned (the Sample ID must be able to be selected for Copy and Paste).

4.4 After MCS&T has reviewed ~~and authorized~~ the DMIR ~~sample~~ (whether be concur or non-concur), the DMIR will be sent to Contract Administration Division for final evaluation. Contract Administration will finish processing the sample in AWP.

_____

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

RLS:B

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

MATERIALS PROCEDURE

BASIS OF CHARGES FOR ADDITIONAL ACCEPTANCE TESTING

1. SCOPE

1.1 To provide a unit cost per test to be assessed the Contractor when additional acceptance testing is performed by the Division on reworked LOTS and subLOTS, limited to those tests ~~listed~~ in ~~Table 9-1~~Attachment 1 of MP 109.00.21 (formerly Table 9-1) ~~of this procedure.~~ .

2. BASIS OF CHARGES

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

3. GENERAL

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

3.2 In those cases where final acceptance testing has shown that the product does not meet the Division's criteria of acceptance and the contractor elects to rework the product with the approval of the Engineer, the cost of any additional acceptance testing done by the Division on the reworked product will be assessed to the contractor in the form of a deduction from the amount due the contractor. The amount, or cost, for each additional acceptance test for the applicable ~~item~~ material is $700 per test. In the instance where a single test comprises of a prescribed series of sub-tests (typically 5), the cost of each infraction will be the standard rate divided by the total number of required sub-tests. This is only applicable in the certain circumstances as noted in Attachment 1~~is listed in Table 9-1.~~ of MP 109.00.21.

3.3 Also, the rate of $700, in conjunction with ~~Table 9-1~~Attachment 1 of MP 109.00.21 may be used as a guide for the amount, or cost~~,~~ for deduction in those cases where additional acceptance samples are needed for final acceptance of a construction ~~item~~ a material resulting from a special investigation.

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

MP 109.00.20 Steward – Materials Control Section
RLS:B

Proposed Spec Change

109.2.2-Basis of Charges for Additional Testing: When additional acceptance testing is performed by the Division for reworked lots or sublots in accordance with 106.3.1.2, the cost of such testing will be deducted on current estimates from the amount due the Contractor by the Division. The cost of such testing will be determined in accordance with ~~the unit costs per test as shown in Table 9-1, published in~~ MP 109.00.20.

From MP 109.00.21
Attachment 1

Cost Penalties Per Test

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

*T - Standard timeframe as described in Section 2.1
*Rate - Standard rate as described in Section 2.2
#Cost/Ea - Unless there is rate in this column, each infraction results in the full rate

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

MATERIALS PROCEDURE

GUIDE TO DESIGNING ~~HOT-MIX~~ ASPHALT MIXTURES USING THE SUPERPAVE VOLUMETRIC DESIGN METHOD

1. PURPOSE

1.1 To establish an approved Superpave volumetric design method, test procedures, and evaluation criteria for ~~hot-mix~~ asphalt mixtures ~~(HMA)~~. If reclaimed asphalt pavement (RAP) is used in the design, refer to Materials Procedure (MP) 401.02.24 for additional guidelines.

2. SCOPE

2.1 This procedure is applicable to design tests conducted for the purpose of establishing mixture proportions for ~~HMA~~ asphalt mixtures using the Superpave mix design method. Superpave designs previously approved under the March 2000 version of this MP may continue to be used only if they were designed and approved within the volumetric and gradation parameters of Table 1, Table 2, and Table 3, and the quality control requirements of MP 401.02.29 can ~~continue to~~ be maintained.

2.2 Any approved mix design that exhibits poor field performance may be rejected from further use by the Division.

3. REFERENCED DOCUMENTS

3.1 *AASHTO Standards:*

- M-323, Superpave Volumetric Mix Design
- R-30, Mixture Conditioning of ~~Hot Mix~~ Asphalt Mixtures ~~(HMA)~~
- R-35, Standard Practice for Superpave Volumetric Design for ~~Hot Mix~~ Asphalt Mixtures ~~(HMA)~~
- T-11, Materials Finer Than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing
- T-27, Sieve Analysis of Fine and Coarse Aggregates
- T-30, Mechanical Analysis of Extracted Aggregate
- T-84, Specific Gravity and Absorption of Fine Aggregate
- T85, Specific Gravity and Absorption of Coarse Aggregate
- T-166, Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using

Saturated Surface-Dry Specimens

- T-176, Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- T-209, Theoretical Maximum Specific Gravity and Density of ~~Hot Mix~~ Asphalt Mixtures ~~(HMA)~~
- T-269, Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
- T-283, Resistance of Compacted ~~Hot Mix~~ Asphalt Mixtures ~~(HMA)~~ to Moisture-Induced Damage
- T-304, Uncompacted Void Content of Fine Aggregate
- T-308, Determining the Asphalt Binder Content of ~~Hot Mix~~ Asphalt Mixtures ~~(HMA)~~ by the Ignition Method (Test Method A)
- T-312, Preparing and Determining the Density of ~~Hot Mix~~ Asphalt Mixture ~~(HMA)~~ Specimens by Means of the Superpave Gyratory Compactor

3.2 *ASTM Standards*

- D-4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

3.3 *Material Procedures*

- MP 401.02.24, Guide To Designing ~~Hot-Mix~~ Asphalt Mixtures with Reclaimed Asphalt Pavement
- MP 401.02.29, Guide for Quality Control and Acceptance Requirements for Superpave ~~Hot-Mix~~ Asphalt Mixtures

4. TESTING REQUIREMENTS

4.1 The laboratory performing the design shall be a Division approved laboratory. To obtain Division approval, a laboratory must demonstrate that they are equipped, staffed, and managed for batching and testing asphalt mixtures ~~HMA~~ in accordance with this MP. This shall be accomplished by submitting a copy of their latest report of inspection by ~~the~~ AASHTO re:source ~~Materials Reference Laboratory (AMRL)~~ to the District Materials Section. The laboratory must also submit a letter detailing the

actions taken to correct any deficiencies noted in the test procedures listed below. The District will forward this information to Materials Control, Soils and Testing Division (MCS&T). It is also required that the design laboratory request to be included on the ~~AMRL's~~ routine schedule of inspections by AASHTO re:source, which ~~is~~ are usually every 18 to 24 months ~~in order~~ to maintain their approval status.

4.1.1 AASHTO Test Procedures

- T-30, Mechanical Analysis of Extracted Aggregate
- T-84, Specific Gravity and Absorption of Fine Aggregate
- T85, Specific Gravity and Absorption of Coarse Aggregate
- T-166, Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
- T-209, Theoretical Maximum Specific Gravity and Density of ~~Hot Mix~~ Asphalt Mixtures ~~(HMA)~~
- T-283, Resistance of Compacted ~~Hot Mix~~ Asphalt Mixtures ~~(HMA)~~ to Moisture-Induced Damage (specimens prepared using T-312)
- T-308, Determining the Asphalt Binder Content of ~~Hot Mix~~ Asphalt Mixtures ~~(HMA)~~ by the Ignition Method (Test Method A)
- T-312, Preparing and Determining the Density of ~~Hot Mix~~ Asphalt Mixture (HMA) Specimens by Means of the Superpave Gyratory Compactor

4.2 The laboratory is required to have a technician who has attended and successfully completed a Division approved Superpave mix design class. In addition to the class ~~that is~~ offered through the Division in conjunction with the Asphalt Pavement Association (APA) of West Virginia ~~University Asphalt Technology Program~~, hands-on Superpave mix design classes offered by the Asphalt Institute, National Center for Asphalt Technology (NCAT), and National Asphalt Pavement Association (NAPA)~~, Chicago Testing Laboratory, and various state DOTs~~ have been approved. ~~Also,~~ Superpave design classes offered by ~~all of the~~ other state DOTs ~~that border West Virginia are~~ may be approved at the discretion of the Division. Classes offered by other state DOTs ~~may~~ will be evaluated for approval, as needed. Proof of successful completion of all class requirements (including a written examination) must be provided. Approval of an older design class that did not require a written examination will be on a case-by-case basis including a review of the designer's experience. MCS&T will maintain a list of the approved design laboratories and design technicians.

4.3 The mix design properties shall meet the requirements of Table 1, and shall consist of the following:

4.3.1 Percent Air Voids: T-269

4.3.2 Percent Voids in Mineral Aggregate (VMA): R-35

4.3.3 Percent Voids Filled With Asphalt (VFA): R-35

4.3.4 Fines to effective asphalt (FA) ratio: R-35

4.3.5 Tensile Strength: T-283

TABLE 1—SUPERPAVE METHOD VOLUMETRIC MIX DESIGN CRITERIA

Design air void content, percent	4.0
Fines-to-effective asphalt (FA) ratio (Note 1)	0.6 – 1.2
Tensile strength ratio, percent (T-283) (Note 2)	80 (minimum)

	Nominal Maximum Size, mm (in.)					
	37.5 (1½)	25 (1)	19 (¾)	12.5 (½)	9.5 (⅜)	4.75 (No.4)
Percent Voids in Mineral Aggregate (VMA) (Note 3)	11.5	12.5	13.5	14.5	15.5	16.5
Percent Voids Filled with Asphalt (VFA)	65 – 75	68 – 76	70 – 78	72 – 79	74 – 80	75 – 81

Note 1: When the design aggregate gradation falls within the coarse graded requirement of Table 4, the FA ratio criteria shall be 0.8 – 1.6. For all 4.75 mm (No. 4) mixes, the FA ratio shall be 0.9 - 2.0.

Note 2: Test specimens shall be compacted using a gyratory compactor in accordance with T-312. If the 80 percent minimum tensile strength ratio is not met, a new design will be required. A Division approved antistripping additive, such as hydrated lime, conforming to the requirements of M-303 or a liquid antistripping additive, may be added to the mixture if needed. The additive must be identified on the T400~~SP~~ Form. T-283 shall be waived when a new mix design is developed using ~~all of~~ the exact aggregate sizes, percentages, and sources of a previously approved mix design that has met the required tensile strength ratio of at least 85 percent. This waiver information should be noted on the submitted design package along with the previously approved design T400~~SP~~ number to inform ~~the~~ MCS&T why T-283 test data has not been included. If the approved design contained an antistripping additive, then the new design must also contain this additive. MCS&T may request the tensile strength ratio be checked at any time on any design that is shown to exhibit signs of stripping.

Note 3: Mixtures designed with the VMA exceeding the minimum value by more than two percent may be susceptible to flushing and rutting, especially when used on pavements subjected to slow moving traffic conditions. They may also be difficult to compact as they often have a tendency to shove under the roller.

4.4 The mix design shall be developed using the volumetric design guidelines provided in M-323 and R-35 with the exception of any variations or additions that are noted in this MP. All laboratory prepared design test specimens shall be conditioned in an oven for 2 hours ± 5 minutes in accordance with R30. The gyratory compaction criteria shall be in accordance with Table 2 based on the projected 20-year design traffic ESAL value supplied in the contract documents. If the traffic ESAL value is not supplied in the contract documents, contact the District to obtain this information. The design PG Binder shall normally be selected in accordance with Section 401.2 of the Standard Specifications. However, the laboratory's mix designer should refer to the contract documents to see if a nonstandard binder grade has been specified for the project.

TABLE 2 - GYRATORY COMPACTION CRITERIA (NOTE 4)

20-Year Projected design ESALs (millions)	Compaction Parameters	
	Gyration Level-1	Gyration Level-2
	N_{design} for Binder < PG 64E76-XX	N_{design} for Binders ≥ PG 64E76-XX or Mixes Below Top Two Lifts(Note 5)
< 0.3	50	50
0.3 to < 3	65	65
3 to < 30	80	65
≥ 30	100	80

Note 4: Unless otherwise specified in the contract documents, a PG 64S-22 binder shall be used in mixtures located below the top two pavement lifts. The use of a different binder grade must be approved by the Engineer.

Note 5: The Gyration Level-2 criteria for mixes placed below the top two lifts applies only to mainline paving. Multi-lift base failure and other pavement repairs shall fall under the criteria of Gyration Level-1 unless otherwise specified in the contract documents.

4.5 The design gradation shall meet the requirements of Table 3 for the specified mix type. Table 4 shall be used to distinguish between the gradation criteria for each mix type. The percent passing each sieve listed in Table 3, from one sieve larger than the nominal maximum size down to the 75 µm (No. 200), shall be included in all gradation calculations.

TABLE 3– DESIGN AGGREGATE GRADATION REQUIREMENTS FOR SUPERPAVE MIXTURES (NOTE 7)

Type of Mix	37.5	25	19 (Patch & Level)	12.5	9.5 (Scratch)	4.75 (Scratch)
Standard Sieve Size	Nominal Maximum Size					
	37.5 mm (1 ½ inch)	25 mm (1 inch)	19 mm (3/4 inch)	12.5 mm (1/2 inch)	9.5 mm (3/8 inch)	4.75 mm (No. 4)
50 mm (2")	100					
37.5 mm (1½")	90 – 100	100				
25 mm (1")	90 max	90 – 100	100			
19 mm (3/4")		90 max	90 – 100	100		
12.5 mm (1/2")			90 max	90 – 100	100	100
9.5 mm (3/8")				90 max	90 – 100	95 – 100
4.75 mm (No.4)			(Note 6)		90 max	90 – 100
2.36 mm (No.8)	15 – 41	19 – 45	23 – 49	28 - 58	32 - 67	
1.18 mm (No.16)						30 – 60
600 µm (No.30)						
300 µm (No. 50)						
75 µm (No.200)	0.0 – 6.0	1.0 - 7.0	2.0 – 8.0	2.0 - 10.0	2.0 - 10.0	6.0 – 12.0

Note-6: When a 19 mm mix is specified for use as a heavy-duty surface mix, it shall be designed as a fine-graded mix with the additional requirement of a minimum of 47% passing the 4.75 mm (No.4) ~~screen~~ sieve. The allowable tolerance limit shall be the JMF ± 5% on the 4.75 mm (No.4) sieve, but not below the minimum requirement.

Note 7: For quality control of the mixture, the allowable tolerances for each JMF shall be the specified design control points shown in Table-3 with the exception that a 4.75 mm mix shall have a tolerance limit of the JMF ± 5% on the 1.18 mm (No. 16) sieve and all other mix types shall have a tolerance limit of the JMF ± 6% on the 2.36 mm (No.8) sieve. These tolerances shall also be applied to the mix design and shall be documented on the T-400~~SP~~ Form. The tolerances shall not fall outside of the specified control points of Table-3.

TABLE 4–COARSE AND FINE GRADED ~~HMA~~ MIXTURE CRITERIA

Mixture Nominal Maximum Size	Coarse Graded % Passing / Sieve Size	Fine Graded % Passing / Sieve Size
37.5 (1½)	< 47% / 9.5 mm	≥ 47% / 9.5 mm
25 (1)	< 40% / 4.75 mm	≥ 40% / 4.75 mm
19 (¾)	< 47% / 4.75 mm	≥ 47% / 4.75 mm
12.5 (½)	< 39% / 2.36 mm	≥ 39% / 2.36 mm
9.5 (3/8)	< 47% / 2.36 mm	≥ 47% / 2.36 mm
4.75 (No. 4)	No distinction between coarse and fine grading	

4.6 The aggregate used in the mix design shall meet the requirements of Sections 702.3, 702.4, 703.1, 703.2, and 703.3 of the Standard Specifications with exceptions and additions as noted in Table 5. If a mix contains reclaimed asphalt pavement (RAP), the asphalt must be removed from the RAP for gradation analysis by the ignition oven method (T-308) or a solvent extraction process (T-164). If the T-164 solvent extraction test method is used, a non-chlorinated solvent may be substituted for the standard specified solvent, and the test method may be modified as per the recommendations of the solvent supplier. The solvent must be a product that has been tested for use in extracting asphalt from ~~HMA~~ asphalt mixtures. The RAP aggregate shall be proportionally blended into the samples submitted to MCS&T as described in Section 4.8. The RAP used for designing a mix must come from the plant stockpile from which it will be produced.

4.7 Test results for fine aggregate angularity, recorded on Design Attachment Number 13, shall be submitted along with the mix design package (JMF). Testing shall be conducted in accordance with T-304 (Method A) on a sample blended in accordance with the methods described in Section 4.8.1 and 4.8.2. This testing may be performed by a WVDOH certified Aasphalt Plant Ttechnician or Aaggregate Iinspector. The name of the testing laboratory and the technician conducting the test shall be indicated on the worksheets.

4.8 Other than the exception noted in Section 4.9, to obtain final approval of the mix design, coarse and fine aggregate samples ~~must~~ shall be submitted to ~~the~~ MCS&T through the District Materials Section. These samples ~~will~~ shall be tested and used as part of the overall approval process for the mix design, therefore, they should be submitted well in advance of the earliest anticipated use of the mix. The aggregate property requirements of Table 5 shall be applied to the blend of coarse and fine aggregates within the mixture.

4.8.1 For each mix design, a minimum 30,000-gram sample (40,000-gram sample for a 37.5 mm mix) of the coarse and fine aggregates shall be blended to the mix design proportions. The blended sample shall then be separated into plus 4.75 mm (No. 4) and minus 4.75 mm (No. 4) portions. The fine aggregate sample shall then be further prepared in accordance with Section 4.8.2. Mixtures shall be designed in accordance

with the criteria set forth in Table 1, 2 and 3 unless otherwise indicated in a special provision or as a note in the contract documents. All samples shall be submitted by the design laboratory in appropriate containers to prevent sample loss or contamination.

4.8.2 Fine Aggregate Sampling Procedure: The minus 4.75 mm (No. 4) portion of the blended aggregate sample shall be split into two separate samples. One of these split samples shall be bagged and labeled as the unwashed portion of the fine aggregate blended sample. The other split sample shall be washed, oven dried, and graded to remove all plus 2.36 mm (No. 8) and minus 150 µm (No. 100) material. This washed sample shall then be split and placed into two sample bags. One bag shall be labeled as washed fine aggregate specific gravity sample and the other shall be labeled as washed fine aggregate angularity sample.

4.9 If a new mix design uses the exact aggregate design structure and sources as a previously approved mix design, the aggregate evaluation used to accept the previous mix design will apply to the new mix design. A note of the testing waiver along with the T400~~SP~~ lab number from the previous design shall be included in the remarks of the T400~~SP~~ worksheet submitted along with the documentation of the new mix design.

TABLE 5 – AGGREGATE CONSENSUS PROPERTY REQUIREMENTS

20 Year Projected Design ESALs (millions)	Coarse Agg. Angularity (% Minimum) ASTM D5821 (Note 8)		Fine Agg. Angularity (% Minimum) AASHTO T304, Method A (Note 10)		Fine Agg. Sand Equivalent AASHTO T176	Coarse Agg. Flat and Elongated ASTM D4791
	Top Two Pavement Lifts (Note 9)	Below Top Two Pavement Lifts	Top Two Pavement Lifts	Below Top Two Pavement Lifts	% Minimum	% Maximum (Note 13)
< 0.3 (Note 11)	55 / -	- / -	-	-	40	-
0.3 to < 3 (Note 11)	75 / -	50 / -	40	40	40	10
3 to < 10	85 / 80	60 / -	45	40	45	10
10 to < 20 (Note 12)	90 / 85	80 / 75	45	40	45	10
20 to < 30	95 / 90	80 / 75	45	40	45	10
≥ 30	100/100	100/100	45	45	50	10

Note 8: "85/80" denotes that a minimum of 85 percent of the coarse aggregate has one fractured face and a minimum of 80 percent has two fractured faces.

Note 9: The referenced "top two pavement lifts" does not include a scratch course or patching-and- leveling course that may be placed between these lifts. When a scratch or patching-and-leveling course is placed between the top two lifts, the aggregate requirements for the mix shall fall under the "top two pavement lifts" criteria.

Note 10: For design traffic levels of 3 million ESALs or greater, any mix composed of a 100 percent crushed aggregate blend that will be used in the top two lifts of the pavement structure will be acceptable with an FAA value of 43 percent or greater. The 43 percent FAA criteria shall also apply to the 30 million or greater traffic level for mixtures below the top two lifts. It shall also apply to 100 percent crushed aggregate blends that contain no more than 15 percent RAP.

Note 11: The minimum requirement for coarse aggregate angularity for any Section 402 skid resistant mix design with a projected ESAL value of 0.3 to less than 3 million shall be 85/80. For skid resistant mix designs with a projected ESAL value of less than 0.3 million it shall be 75/-.

Note 12: The 10 to less than 20 million design ESAL aggregate criteria only applies to Section 402 skid resistant mix designs.

Note 13: Flat and elongated particles in coarse aggregates shall be tested in accordance with D–4791 with the exception that the material passing the 9.5 mm (⅜ in.) sieve and retained on the 4.75 mm (No. 4) sieve shall be included. The aggregate shall be measured using the ratio of 5:1, comparing the length (longest dimension) to the thickness (smallest dimension) of the aggregate particles.

4.10 At the beginning of each paving season in subsequent years the aggregate consensus properties of Table 5 shall be tested on blended aggregate samples prepared in accordance with Section 4.8. These tests may be conducted by a WVDOH certified Aasphalt Plant Ttechnician or Aaggregate Iinspector. These test results shall be submitted to the District Materials Section for the purpose of maintaining approval of the mix design. The name of the testing laboratory, date tested, and signature of the technician conducting the tests shall be indicated on the worksheets. These test results must be submitted before the mix is used on any Division project each year.

4.10.1 During the time that the annual aggregate consensus testing is being performed, the Division may periodically request that a duplicate set of blended aggregate samples be prepared for submittal to MCS&T for testing. The Division will identify the mix design in advance so that sufficient material is obtained for preparation of duplicate samples. Nonconforming test results on these samples will require further investigation by the Division. No corrective action will be required by the Contractor unless the investigation concludes that it is necessary. If corrective action is required, the contractor will be notified, and further use of the mix design shall be discontinued until the Division has determined that the problem has been properly addressed.

4.11 If the aggregate consensus property test results submitted to the District~~s~~ meet~~s~~ specification requirements, the District shall forward the results to MCS&T for the purpose of maintaining approval of the mix design. If any of the required aggregate tests fail to meet specification requirements, retesting by the contractor will be permitted, and the District shall submit a sample of the blended aggregate to MCS&T to verify the consensus property test that failed.

4.12 If the mix is comprised of 100 percent crushed blended aggregates that contain no more than 15 percent RAP, and it met both the coarse and fine aggregate angularity requirements, the flat-and-elongated requirement, and the sand equivalent requirement during the initial design approval, and any annual follow-up testing, then retesting each year by MCS&T will not be required. However, fine aggregate samples of mixes containing rounded natural sand and/or greater than 15 percent RAP must be prepared by a certified A~~a~~sphalt Plant T~~t~~echnician in accordance with Section 4.8 and 4.8.1, and a sample of sufficient size required for testing the fine aggregate angularity shall be submitted to MCS&T on an annual basis.

4.13 Full mix design testing will not be required when a mix design is developed using the exact aggregate structure, sources, and compaction level as a prior Division approved design, along with a different neat binder grade. The designer may instead ~~s~~elect to make a set of bulk specific gravity test specimens and a maximum specific gravity test specimen with the approved aggregate structure and the new binder grade at the optimum asphalt content of the approved design. Since these samples are laboratory produced design specimens, they must be oven aged for 2 hours ± 5 minutes before testing in accordance with R-30 (Mix Conditioning of Asphalt Mixtures~~HMA~~) as specified in R-35 (Superpave Volumetric Design for Asphalt Mixtures~~HMA~~). Mix and compaction temperature will be based on the requirements of the new binder grade. The percent air voids shall ~~must~~ be 4.0 ± 0.3 percent. The voids-in-mineral aggregate shall ~~must~~ be within ± 0.5 percent of the original approved job mix formula design target (but not outside of the limits of this MP). All other mix design criteria shall ~~must~~ be within the limits specified in this MP. If the mix design meets all of these requirements, then this test data may be submitted along with a new T400~~SP~~ form for approval as a new mix design. A copy of the approved T400~~SP~~ on which this new design is based shall ~~should~~ also be included. If the mix design fails to meet all of the requirements, then a new mix design shall ~~must~~ be developed.

5. REPORT

5.1 The T-400~~SP~~ JMF form shall include the design property information required in Section 401.4 of the Standard Specification. JMF submittals shall include all Superpave mix design software printouts from the specimen compaction and analysis covering the required mix properties. In addition, if not automatically generated through the mix design software, the following information shall ~~must~~ be included.

5.1.1 A summary sheet (Superpave Package Attachment #1) showing the optimum asphalt content determination plus the design properties compared to the design

criteria of Table 1. This attachment shall be signed and dated by the mix design technician.

5.1.2 Worksheet for calculating the effective gravity of the blended aggregates (Attachment #4 or #4A).

5.1.3 Worksheets showing calculations for maximum specific gravities of the mix at the different asphalt contents (Attachment #5). For any mix that contains any single coarse aggregate component with the water absorption of 1.5 percent or greater, follow the supplemental procedure of T-209 to determine if a dry-back is necessary. Because the dry-back procedure is addressing an aggregate coating issue, this same supplemental procedure shall be used on quality control and verification samples of mixes containing these high absorptive aggregates to determine if the dry--back procedure is necessary.

5.1.4 Worksheet for calculating the bulk and apparent specific gravities of the total aggregate, and the percent VMA in the compacted mixture (Attachment #6 or #6A).

5.1.5 Worksheet for determining the maximum specific gravity of the mixture, including the dry-back procedure when required (Attachment #7). Note that AASHTO R-35 specifies that the maximum specific gravity shall be based on the average of at least two tests.

5.1.6 Worksheets showing calculation for bulk and apparent specific gravities and absorption of the coarse and fine aggregates used in the mix design (Attachments #8 or #8A).

5.1.7 The 0.45 power gradation chart (Attachment #9) developed for each mix design. This chart shall include the maximum density line, aggregate control points, and a gradation plot showing each screen used in the design.

5.1.8 A worksheet showing the calculations for the combined aggregate of the mix design (Attachment #10).

5.1.9 Worksheets showing the washed sieve analysis results for each aggregate used in the mix design (Attachment #11).

5.1.10 A worksheet showing the calculations for the fine aggregate angularity test (Attachment #13).

5.1.11 A worksheet showing the calculations for absorbed asphalt and effective asphalt content (Attachment #14).

5.1.12 The temperature-viscosity chart for the asphalt used in the mix design. A supplier issued chart or document containing the mix and compaction temperature recommended for the specific grade of asphalt will be acceptable.

5.2 The entire ~~printed~~ T400 JMF package shall be submitted, in Excel format, to the local District Materials Section in which the ~~HMA~~ mixtures plant is located. After reviewing, the District shall attach a memo to the JMF package requesting approval of the

design and submit it electronically to the MCS&T Asphalt Section (DOHAsphalt@wv.gov).

5.2.1 ~~The JMF package can also be submitted electronically by scanning it into an Adobe Acrobat Reader file and e-mailing the file to the appropriate District Materials Section and the MCS&T Asphalt Section. After reviewing the JMF package, the District will send an e-mail to the MCS&T Asphalt Section verifying that the JMF package has been reviewed. The District will also note any problems that they find with the JMF.~~ The MCS&T Asphalt Section will conduct a final review of~~n~~ the design package and assign a laboratory number to each approved mix design. MCS&T will contact the mix designer if there are any problems or concerns with the JMF package that will delay final approval. An electronic copy of the approved T400~~SP~~ form shall be e-mailed to the District and Producer for distribution.

5.3 All applicable mix design worksheets can be found on the MCS&T's Webpage[1] under the "Toolbox."

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

MP 401.02.28 Steward – Asphalt Section
RLS:J

[1] http://www.transportation.wv.gov/highways/mcst

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

MATERIALS PROCEDURE

GUIDE FOR QUALITY CONTROL AND ACCEPTANCE REQUIREMENTS FOR SUPERPAVE ~~HOT-MIX~~ ASPHALT MIXTURES

1. PURPOSE

1.1 To provide a method for daily monitoring and quality assurance of Superpave ~~hot-mix~~ asphalt mixtures ~~(HMA)~~.

1.2 To provide guidelines for adequate acceptance plans.

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

1.4 To provide field personnel with criteria upon which to base decisions of accepting or rejecting material.

1.5 To provide an equitable and uniform method for determining price adjustments in those instances where adequate production control has not been maintained and non-specification material has found its way into the completed work.

2. SCOPE

2.1 This acceptance procedure shall be applicable to all Superpave ~~hot-mix~~ asphalt mixture types relative to compliance with job mix formula (JMF) acceptance 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 used on a single project or on multiple projects if the basic design criteria (design compaction level and PG Binder grade) are the same.

3.2 Lot - The quantity of material represented by the average of four (4) consecutive test values.

3.3 Sublot – The quantity of material represented by an individual test value within the Lot.

3.4 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 ~~re~~verification. These samples should not be confused with the Division verification samples that are used to determine specification compliance.

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

3.6 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 types of deficiencies found, and the nature of corrective actions taken. The Contractor's documentation procedures will be subject to the review and approval of the Division and shall be available to 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 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 Specification unless specified otherwise in contract documents. Asphalt content and gradation test results shall be recorded on form T417. Mix design property test results shall be recorded on form T419. To ~~be~~ maintain an effective quality control program, tests shall ~~must~~ be completed in a regular and timely manner. If QC test results are not completed and submitted within 4~~8~~2 working ~~hours~~days, the Division will reserve the right to stop further production until tests are completed, submitted, and reviewed by District Materials staff. Field design ~~V~~verification test results must be performed and submitted daily during production.

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 applicable Specifications, Materials Procedures, or 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 asphalt mixture ~~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. JOB 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 6.0 and the sample shall meet the gradation requirements set forth in Table 401.02.29B. The sample shall also meet the design asphalt content within ± 0.4%, a minimum VMA of 0.5% below the design criteria, and the VFA design criteria specified in MP 401.02.28.

5.4 The percent air voids shall be within the range of 2.8 – 5.2 percent.

5.5 The field design verification mix property requirements are listed in Table 401.02.29A. Field design verification test results shall be documented on Form T419.

TABLE 401.02.29A
Mix Property Field Design Verification Requirements

Property	Field Verification Tolerances
Asphalt Content (%)	JMF ± 0.4 %
Air Voids (%)	3.0 – 5.0 %
Voids in Mineral Aggregate (VMA) %	Min. of 0.5% Below Design Criteria
Voids Filled With Asphalt (VFA) %	Limits of Design Criteria

5.6 Gradation requirements for the field design verification samples shall be as indicated in Table 401.02.29B. The gradation results shall fall within the limits of each listed control point with the exceptions as noted on the 2.36 mm (No. 8) sieve. The gradation must also pass beneath the restricted zone as described in Table 401.02.29B. Gradation results for all sieves listed in this table for each mix type shall be documented on Form T421.

5.7 After each of the field design verification samples are~~is~~ tested, the results shall be evaluated to determine conformance to the requirements of Tables 401.02.29A and 401.02.29B. If any test results fall outside the allowable tolerance limits, then steps must be taken to make any necessary production adjustments to bring the mix back to within specification limits. If, after three samples the design criteria and gradation requirements of at least one of the samples is within all of the allowable tolerance limits then verification of the design is complete. If the criteria are 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, the~~n~~ mix design shall be rejected, and a new mix design will be required. If the mix design is rejected the average percent asphalt and the average percent air voids of the six verification samples shall be determined. If either or both average values are outside the allowable tolerance limits of Table 401.02.29C then the material represented by these samples shall have its price reduced in accordance

with the schedule set forth in Section 7.0. District Materials shall notify MCS&T immediately upon the rejection of any mix design.

TABLE 401.02.29B
Design Aggregate Gradation Requirements (Note 1)

Nominal Max. Size	37.5 mm (1 ½ inch)	25 mm (1 inch)	19 mm (3/4 inch)	12.5 mm (1/2 inch)	9.5 mm (3/8 inch)	Gradation Tolerances Shall Be The Design Control Points With Exception As Noted Below
Standard Sieve Size	**Base-I**		**Base-II (P&L) Wearing-IV**		**Wearing-I (Scratch)**	
50 mm (2")	100.0					-
37.5 mm (1½")	90.0 – 100.0	100				-
25 mm (1")	90.0 max	90.0 – 100.0	100.0			-
19 mm (3/4")		90.0 max	90.0 – 100.0	100.0		-
12.5 mm (1/2")			90.0 max	90.0 – 100.0	100.0	-
9.5 mm (3/8")				90.0 max	90.0 – 100.0	-
4.75 mm (No.4)					90.0 max	-
2.36 mm (No.8)	15.0 – 41.0	19.0 - 45.0	23.0 - 49.0	28.0 - 58.0	32.0 - 67.0	JMF ± 6
1.18 mm (No.16)						-
600 µm (No.30)						-
300 µm (No. 50)						-
75 µm (No.200)	0.0 - 6.0	1.0 - 7.0	2.0 - 8.0	2.0 - 10.0	2.0 - 10.0	-

Sieve Size	Restricted Zone					
	37.5 mm (1 ½ inch)	**25 mm (1 inch)**	**19 mm (3/4 inch)**	**12.5 mm (1/2 inch)**	**9.5 mm (3/8 inch)**	
4.75 mm (No.4)	34.7	39.5				Mix gradation 45 power plot must fall below the restricted zone
2.36 mm (No.8)	23.3 - 27.3	26.8 – 30.8	34.6	39.1	47.2	
1.18 mm (No.16)	15.5 - 21.5	18.1 – 24.1	22.3 - 28.3	25.6 – 31.6	31.6 - 37.6	
600 µm (No.30)	11.7 - 15.7	13.6 - 17.6	16.7 - 20.7	19.1 – 23.1	23.5 - 27.5	
300 µm (No. 50)	10.0	11.4	13.7	15.5	18.7	

Note 1: Allowable tolerances for each JMF shall be the specified design control points shown in Table 401.02.29A with the exception as indicated on the 2.36 mm (No.8) sieve. These tolerances shall be applied to both the field verification testing of the JMF and the daily contractor quality control testing. The gradation of the mix shall also continue to pass beneath the restricted zone.

5.8 Volumetric production targets shall be established at the end of the field design verification process. The production target 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. This VMA value may be adjusted to optimize the ± 1.0 % tolerance of Table 401.02.29C if the result is near the minimum allowable requirement. The production target for VFA shall be the limits of the design criteria. The production target for air voids shall remain at 4.0 %.

5.9 When new plant production targets are established from the field verification process, a new target maximum density shall also be determined for compaction control by averaging the maximum density results of all of the samples used for verification of the mix. The District shall ~~will~~ forward the verification test data to MCS&T ~~the~~ Division.

5.10 An approved mix design (JMF) may be used on other projects during the year without reverification if all of the mix design criteria are the same.

5.11 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 aggregate properties (coarse and fine aggregate angularity, clay content, and flat and elongated particles) are adversely affected by the change in blended aggregates. The Contractor shall also determine whether ~~or not~~ the aggregate gradation still passes between the control points and beneath the restricted zone. The calculations used in this evaluation shall be provided to the District. The District shall ~~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 changes, then the contractor will be required to provide a new mix design.

5.12 After the field design verification has been successfully completed and quality control testing (as described in Section 6.0) 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, and % VFA 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 MCS&T ~~the~~ Division.

5.13 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 material produced shall conform to the verified plant production target values established and controlled within the tolerances of Table 401.02.29C. The aggregate gradation shall conform to the requirements of Table 401.02.29B.

6.3 Adjustments to the accepted JMF aggregate proportions shall be made only for the purpose of maintaining the gradation requirements of Table 401.02.29B and/or the design properties of Table 401.02.29C. The maximum allowable adjustment shall be as indicated in Section 5.10. 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 401.02.29C
Quality Control Mix Property Tolerances

Property	Production Tolerances
Asphalt Content (%)	Verified JMF ± 0.4 %
Air Voids (%)	4.0 ± 1.2 %
Voids in Mineral Aggregate (VMA) %	Verified JMF ± 1.0 % with a minimum of 0.5% below the minimum design criteria
Voids Filled With Asphalt (VFA) %	Design Criteria ± 2 %

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, percent VFA, 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, percent VMA, and percent VFA. 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. VFA data points shall be calculated to the nearest one percent and all other 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 "O" 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 "O" 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 6.0 shall be represented by solid horizontal lines.

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~~ updated daily 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, percent VMA, or percent VFA fall outside the verified JMF tolerances by more than the allowable deviation of Table 401.02.29C 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 401.02.29B. 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 and/or percent air voids falls outside the JMF tolerances of Table 401.02.29C, 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 401.02.29D and/or 401.02.29E, as applicable.

TABLE 401.02.29D
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 determine the appropriate action.

TABLE 401.02.29E
ADJUSTMENT OF CONTRACT PRICE FOR MIX NOT WITHIN TOLERANCE LIMITS OF PERCENT AIR VOIDS

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 determine 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 If 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 has a current inspection and approval by District Materials and has successfully verified the mix design being produced~~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 has not verified the mix design being produced and quantities do not meet the minimum threshold for verification sampling~~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 testing of asphalt mixtures~~HMA~~ 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 or reviewing 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 of 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, and gradation. In addition, the VMA and VFA 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.

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

MP 401.02.29 Steward – Asphalt Section
RLS:J

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

MATERIALS PROCEDURE

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

1. PURPOSE

1.1 To set forth the procedures for the approval of component materials used in the fabrication of precast and prestressed concrete items and ship loose materials incidental to precast and prestressed concrete items.

1.2 Ship loose materials are defined as the loose materials that are used in conjunction with various precast or prestressed concrete items. These ship loose materials are normally paid for under the same bid item number as the primary precast or prestressed concrete item.

1.2.1 ~~Examples of ship loose materials include bearing pads and shims that are shipped along with prestressed concrete beams.~~ Materials such as (but not limited to) metal soil reinforcing devices, metal attachment devices, bearing pads, shims, and geotextile fabrics that are used for prestressed concrete beams, and retaining wall systems are ~~also~~ classified as ship loose materials.

2. SCOPE

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

3. SAMPLING

3.1 Approved Sources

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

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

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

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

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

3.1.4 Mixing water for precast concrete items shall be tested in accordance with the requirements of ~~section~~ Section 715.7 of the ~~standard s~~Specifications.

3.2 Frequency of Sampling

3.2.1 Aggregates (both coarse and fine) and other component and ship loose materials not obtained from a Division approved source will be sampled by the Division~~,~~ at the fabricator (or other location as noted in section 3.1.2), as shown in Table 1.

TABLE 1

Material	Sampling Frequency	Sample Size
Cement	Semi-Annually	10 lb (4 kg)
Pozzolanic Additives	Semi-Annually	4 lb (2 kg)
Fine Aggregate	Semi-Annually	25 lb (10 kg)
Coarse Aggregate	Semi-Annually	110 lb (50 kg)
Mixing Water	Semi-Annually	1 quart (1 liter)
Reinforcing Steel		
Epoxy	Annually	5 ft (2 m)
Black Bar	N/A (Accepted on NTPEP Compliance)	NA
Prestressing Steel	Only Sampled at the Source	N/A
Hot-Poured Elastic Type Concrete Joint Sealer	Only Sampled at the Source	N/A
Preformed Expansion Joint Filler	Only Sampled at the Source	N/A
Elastomeric Bearing Pads and Shims	Only Sampled at the Source	N/A
Welded Wire Fabric	Each Lot (if Not NTPEP Compliant)	1 pc. 3 ft x 3 ft (1 m x 1 m)
Bright Wire for Welded Wire Fabric	Reference MP 709.04.40 or in accordance with Q-Cast Certification Requirements	1 pc 5 ft
Concrete Sealant	Only Sampled at the Source	N/A
Steel Inserts & Miscellaneous Steel Hardware	Annually	2 Pieces
Asphalt Plastic Cement	Each Lot or at the Source	N/A
Metal Soil Reinforcing Strips	Each Lot (Either at the Source or At the Point of use Prior to Installation)	N/A (NDT of Random Pieces)
Geotextile Fabric	N/A (Accepted on NTPEP Compliance)	N/A
Steel Diaphragms	N/A (Inspected at the Fabricator)	N/A

Commented [BDA1]: Remove Metric

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

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

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

3.3 Non-Specification Material

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

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

3.3.3 If an amount of material finer than the No. 200 (75 µm) sieve, greater than what is allowed by specifications, is present in either the coarse or fine aggregate, then the total amount of material finer than the No. 200 (75 µm) sieve for the entire mix shall be evaluated. The fabricator shall have previously provided a copy of all mix designs as outlined in section 3.2.3, and the total amount of material finer than the No. 200 (75 µm) sieve for the entire mix will be evaluated as outlined in section 3.3.3.1.

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

3.3.4 If it is determined that a ship loose material does not meet specification requirements, use of that ship loose material shall not be permitted.

3.4 Re-Testing of Non-Specification Component Material

3.4.1 When tests of the first sample indicate that one or more properties of a material do not meet specification requirements, the Division shall re-sample the material as soon as possible after the fabricator has taken corrective action, and one of the following two scenarios will occur (3.4.1.1 or 3.4.1.2).

3.4.1.1 If the second sample meets specifications, the Division will immediately notify the fabricator. Upon ~~this~~ notification ~~(whether written or verbal)~~, the fabricator may resume the use of this component material.

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

3.4.2 Once a component material in question has been shown to not meet specifications by more than one sample and test, the Division will only re-sample that component material once during the next sampling period (as set forth in Table 1), and one of the following two scenarios will occur (3.4.2.1 or 3.4.2.2).

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

3.4.2.2 The material in question is sampled again during the next sampling period, and again it does not meet specifications. The Division will not re-sample the material in question again until the next sampling period specified in Table 1 (see section 3.4.2). Until a sample is obtained that meets specifications~~, this non-specification~~ the component material may not be used.

3.4.3 For an aggregate in which an excessive amount of material finer than the No. 200 (75 µm) sieve is the only reason for not meeting specifications, there are two possible scenarios. When the first scenario, given in section 3.3.3.1, occurs, that particular combination of fine and coarse aggregate will be considered as meeting specifications. The second scenario is if the total percentage of material finer than the No. 200 (75 µm) sieve present in the entire mix exceeds the total percent of material finer than the No. 200 (75 µm) sieve that would exist if both aggregate fractions in the mix contained their specified maximum percentage passing the No. 200 (75 µm) sieve. In this case, that particular combination of fine and coarse aggregate will be considered as not

meeting specifications. ~~At this point, the~~ ~~Then~~When this second scenario occurs, the Division shall immediately notify the fabricator. ~~Upon~~ ~~u~~Upon receipt of this notification ~~(whether written or verbal)~~, the fabricator shall discontinue the use of this combination of material until further notice by the Division. Situations in which the second scenario occurs will be handled as outlined in section 3.4.4.

Commented [MMA2]: I think that this should be a separate sentence and not combined with the previous sentence.

3.4.4 During any re-sampling of a failing combination of aggregates, both the fine and coarse aggregate shall be re-sampled (so that a current evaluation of the total amount of material finer than the No. 200 (75 µm) sieve present in the entire mix may be performed). The Division will re-sample both the fine and coarse aggregate as soon as possible, and one of the following two scenarios will occur (3.4.4.1 or 3.4.4.2).

3.4.4.1 If the second sample meets specifications, the Division will immediately notify the fabricator. ~~Upon this notification (whether written or verbal),~~ and the fabricator may resume the use of this combination of fine and coarse aggregate.

3.4.4.2 If the second sample does not meet specifications (as outlined in section 3.3.3.1), the Division will immediately notify the fabricator, but the Division will not re-sample that combination of fine and coarse aggregate until the next sampling period specified in Table 1 (see section 3.4.2). Until a sample is obtained that meets specifications, this non-specification combination of fine and coarse aggregate may not be used.

4. ALTERNATE MATERIALS

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

4.1.1 This new material shall be sampled as set forth in section 3.0 or 3.2 (whichever is applicable).

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

4.2 If either a new source of coarse or fine aggregate is used because of an inability of the former combination of material to meet specifications due to an excessive amount of material finer than the No. 200 (75 µm) sieve, both the coarse aggregate and fine aggregate portions of this new combination shall be re-sampled, and evaluated as set forth in section 3.4.3.

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

MP 603.02.10 Steward – ~~Aggregate and Soils~~Cement and Concrete Section
RLS:M

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

PROCEDURE

STANDARD METHOD OF TEST FOR DETERMINING THE QUALITY OF WATER USED WITH HYDRAULIC CEMENT

1. PURPOSE

1.1 To establish a standard method of test and acceptance criteria to be used in determining the quality of water used with hydraulic cement.

2. PURPOSE

2.1 This procedure is applicable to untreated water sources used in combination with mixtures containing hydraulic cement. An untreated water source may be defined as a source other than a treated public water system.

2.2 Treated water systems may be used without testing.

3. APPLICABLE DOCUMENTS

3.1 *MP 642.40.20*

3.2 *AASHTO T 106*

3.3 *AASHTO T 154*

3.4 *AASHTO T 162*

4. PROCEDURE

4.1 Untreated water shall be tested at the source for pH. When the pH of the water is between 4.5 and 8.5 no further testing is necessary.

4.2 If the pH is less than 4.5 or more than 8.5, all tests listed in this procedure will be conducted. A water source whose pH is determined to be within the limits defined ~~above~~ in section 4.1 ~~,may~~but appears to be contaminated with foreign material which could have an adverse effect on the ~~p~~Portland cement concrete shall have a sample forwarded to the Materials Division and all tests listed in this procedure will be conducted. ~~If the sampler has reason to believe that this may be the case, a sample shall be forwarded to the Materials Division for further tests as defined below.~~ The sample shall be accompanied with the required documentation indicating the sampler's reasons for requesting testing. These tests shall be conducted before first use and thereafter once every 6 months, or more often when there is reason to believe that a change has occurred in the characteristics of the water source.

5. TEST METHODS

5.1 Total Solids Content, Chloride as Cl^-, Sulfate as SO_4, and Alkalies as (Na2O + 0.658 K2O)

5.1.1.1 Tests shall be conducted in accordance with MP 642.40.20.

Commented [MMA1]: Where in MP 642.40.20 are these tests currently referenced, or is that one of the updates that will need to be made to MP 642.40.20? It doesn't look like T263 & T264 are current AASHTO standards any longer.

Commented [PMD2]: Mike,

This one of the updates that will have to be made in MP642.40.20. ASTM C1602 has the test methods that will have to be added. Testing for Total Solids Content, Chloride as Cl-, Sulfate as SO4, and Alkalies as (Na2O + 0.658 K2O) .

5.2 Compressive Strength

5.2.1 The water under test shall be compared, in mortar, with distilled water. The proportions of dry materials in the mortar shall be 500 grams of Type III Cement, 1500 grams of graded OTTAWA sand and the amount of water sufficient to produce a flow of 110 ± 5 in 25 drops in accordance with AASHTO T 106 using the sample under test and compared to three specimens made using distilled water.

5.3 Time of Setting by ~~Gillmore Needle~~ Vicat Needle

5.3.1 Time of set will be prepared with the test sample and Type III Cement in accordance with ~~AASHTO T 154.~~ ASTM C191. A control specimen will be made with distilled water for basis comparison.

6. ACCEPTANCE CRITERIA FOR UNTREATED WATER SOURCES

~~Total Solids Content 2000 ppm* Compressive Strength (Min% Control at 1 day) 90~~
~~Time of Set, (deviation from control) -60 to +90 Minutes~~

Performance Requirements for Untreated Water Source	
Requirements for Mixing Water	Limit
Compressive Strength (Min% Control at 1 day)	90
Time of Set, (deviation from control)	-60 to +90 minutes

	Chemical and Physical Limits for Untreated Water Source	
	Maximum Concentration in Combined Mixing Water, ppm	Limit
A	Chloride as Cl^-, ppm	
	In prestressed concrete or bridge decks	500
	Other reinforced concrete in moist environments or containing aluminum embedments or dissimilar metals or with stay-in-place galvanized metal forms	1,000
B	Sulfate as SO4, ppm	3,000
C	Alkalies as (Na2O + 0.658 K2O), ppm	600
D	Total solids by mass, ppm	50,000

~~*Water containing more than 2000 ppm of total solids may be determined acceptable if compressive strength and time of set tests indicate that the solids will not adversely affect the concrete.~~

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

MP 715.07.20 Steward – Cement and Concrete Section
RLS:T

Commented [MMA3]: We no longer use the Gillmore needle. Can we specify the Vicat test instead in this MP?

Commented [PMD4]: Yes, I went ahead and made the change.

Commented [MMA5]: This test method would need changed if we require Vicat instead.

Commented [MMA6]: Is this number a typo? The * footnote below notes a 2,000 ppm limit, above which would be acceptable based on compressive strength results. The table is allowing 50,000 ppm.

Commented [PMD7]: Mike,

This requirement was from the previous version of this MP and should be removed now that I read it again. The previous MP did not have a limit of total solids of ppm that could be used. I like the list ASTM C1602 has limiting it at 50,000. All of these new requirements are directly from ASTM C1602.

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

MATERIALS PROCEDURE

STANDARD METHOD OF TEST FOR DETERMINING THE PERCENTAGE OF COAL AND LIGHTWEIGHT PARTICLES IN AGGREGATE

1. PURPOSE

1.1 To provide a standard method of testing for coal and lightweight particles in aggregates by means of a sink-float separation in a heavy liquid with a designated specific gravity.

2. SCOPE

2.1 This procedure is applicable to fine and coarse aggregates.

3. APPLICABLE DOCUMENTS

3.1 ASTM C 123 OR AASHTO T 113

3.2 ASTM E 11

3.3 ASTM E 100

3.4 ASTM C 702 OR AASHTO T 248

3.5 MATERIALS PROCEDURE (MP) 700.00.06

3.6 ASTM C 127 OR AASHTO T 85

3.7 ASTM C 128 OR AASHTO T 84

4. APPARATUS

4.1 Sieves—The following sieve sizes conforming to AASHTO M-92; 4.75 mm (No. 4) and 300 μm (No. 50).

4.2 Balance—The balance shall have sufficient capacity, be readable to 0.1 percent of the sample mass, or better, and conform to the requirements of M 231.

4.3 Oven—An oven capable of maintaining a temperature of 110°C ± 5°C (230°F ± 9°F).

4.4 Containers—Large vat/tank for storage of heavy liquid with compatible mesh bucket for immersion of coarse aggregate into heavy liquid, buckets for soaking test portion, Pans for surface drying the aggregates, 600 ml Pyrex beakers for containing fine aggregate test portions.

4.5 Skimmers—Made of 300 µm (No. 50) sieve cloth conforming to ASTM E 11. Fitting one with a handle for scooping floating particles from heavy liquid. The other must be capable of fitting over 600 ml Pyrex beakers.

4.6 Stirring Rods—A glass rod for stirring fine aggregates, a large metal rod for stirring coarse aggregates.

4.7 Heavy Liquid—Consisting of a mixture of zinc bromide and water in such proportions so that a designated specific gravity of 2.00 ± 0.01 can be maintained at all times during the test.

4.8 Hydrometer—Conforming to the requirements of ASTM E 100 and capable of measuring the liquid specific gravity to within ± 0.01.

4.9 Safety Equipment—Industrial type rubber gloves, face shield or goggles.

Note: Although there is no particular hazard from the fumes of zinc bromide solution, precautions shall be taken to avoid inhalation of fumes and contact with eyes and skin. Goggles and gloves shall be worn, and the solution should only be used in a laboratory exhaust hood.

5. SAMPLE PREPARATION

5.1 Secure a field sample of the aggregate in accordance with MP 700.00.06. Samples shall be representative of the sources from which they are obtained and shall be reduced to an appropriate size by use of a sample splitter or by quartering in accordance with ASTM C 702 or AASHTO T 248.

5.2 The samples shall be dried in an oven to a constant mass at a temperature of 110 ± 5°C (230±9°F).

5.2.1 In the following minimum test portions, the oven-dried sample shall be weighed to the nearest one gram and that weight recorded.

Nominal Maximum Size of Aggregate (Sieve Openings)	Minimum Weight of Test Sample (Grams)
No. 4 (4.75 mm)	200 grams
¾ in (19.0 mm)	3,000 grams
1 ½ in (37.5 mm)	5,000 grams
3 in (75.0 mm)	10,000 grams

5.3 The fine aggregate oven dry sample shall be cooled to room temperature and sieved over a 300 µm (No. 50) sieve until less than one percent of the retained material passes through the sieve in one minute of continuous sieving. Discard the minus 300 µm (No. 50) sieve material.

5.3.1 Bring the plus 300 µm (No. 50) test portion to a saturated-surface-dry condition as specified in ASTM C 128 or AASHTO T 84. (See Note 1 and Note 2).

Note 1 – If material undergoes degradation in water, the material does not have to be brought to an SSD condition.

Note 2 – Pit derived silica sand commonly contains soft and easily degradable aggregations of sub-bituminous coal. Because of this possible degrading constituent, pit sand shall not be subjected to SSD condition under this procedure.

5.4 Coarse aggregates shall be sieved over a 4.75 mm (No. 4) sieve. The plus 4.75 mm (No. 4) material shall be thoroughly washed and oven dried to a constant mass at a temperature of 110°C ± 5°C (230 ± 9°F).

5.4.1 Allow oven dry sample to cool to room temperature and weigh a test portion to a minimum test size, to the nearest 1 gram and record weight.

5.4.2 Bring sample to a saturated-surface-dry condition as specified in ASTM C 128 or AASHTO T 84. (See Note 1 and Note 2).

6. PROCEDURE

6.1 Under a ventilation hood or in adequately ventilated area, check the heavy liquid (zinc bromide) for correct specific gravity (2.00 ± 0.01).

6.2 Fine Aggregate - weigh a test portion to a minimum of 200 grams to the nearest 0.1 gram and record weight. This test portion shall be placed in a 600 ml beaker and a volume of heavy liquid poured into the beaker until the liquid level is at least 1 in (25 mm) above the sample level.

6.2.1 Agitate the test portion by means of a glass-stirring rod allowing the lightweight particles to float to the surface.

6.2.2 Pour the liquid and floating lightweight particles into a second beaker, passing through a 300 µm (No. 50) skimmer, making sure that only the floating particles are poured off with the liquid.

6.2.3 Repeat procedure in 6.2.2 until test portion is free from floating particles, then drain heavy liquid from test portion back into vat. Rinse test portion with water to remove heavy liquid from sample and discard.

6.2.4 Wash the decanted particles retained on the 300 µm (No. 50) skimmer with water until all the zinc bromide is removed.

6.2.5 Dry decanted particles to a constant weight and weigh to the nearest 0.1 gram.

6.3 Coarse Aggregate - Place sample into mesh bucket and place into vat of zinc bromide solution.

6.3.1 NOTE: If test portion is sufficiently large, two or more runs may be necessary to complete testing.

6.3.2 Agitate test portion by means of a large metal stirring rod allowing the lightweight particles to float to the surface.

6.3.3 Remove floating pieces from heavy liquid by scooping with a 300 µm (No. 50) skimmer. Repeat process until test portion is free of floating particles.

6.3.4 Raise mesh bucket to drain heavy liquid from test portion into vat. Rinse test portion with water to remove heavy liquid from sample and discard.

6.3.5 Wash lightweight particles with water until all the zinc bromide is removed.

6.3.6 Dry lightweight particles to a constant weight and weigh to the nearest 1.0 gram.

6.4 Slag: Due to the manufacturing process, there is entrapped air in the aggregate. The procedure for slag is the same for any other coarse aggregate; however, a greater number of pieces will come to the surface than with other types of aggregates. The floating particles must be friable before they are considered as deleterious.

7. CALCULATION

7.1 Calculate the percentage of lightweight particles as follows:

Fine Aggregates

$$L = \frac{W_1}{W_2} \times 100$$

L = Percentage of lightweight particles
W_1 = Oven dry mass of lightweight particles
W_2 = Oven dry mass of test portion

7.2 Report results to nearest 0.1 percent.

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

MP 702.01.20 Steward – Aggregate & Soils Section
RLS:Mj

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

MATERIALS PROCEDURE

FIELD CALIBRATION AND OPERATION OF ROLLING Ten F STRAIGHT EDGE ON BRIDGE DECKS

Commented [BDA1]: Clean up ft, feet, in, inch ", ', etc,

1. PURPOSE

1.1 To establish a field calibration procedure for the 10 ft ~~3 m~~ rolling straight edge.

1.2 To establish a procedure for documenting out of tolerance bridge deck sections.

2. FIELD CALIBRATION

~~The marking of high and low sections on the deck is best accomplished by the use of red and green clothes dye. One small package should be mixed with 1.89 L of water. It is suggested the dye be mixed in gallon jugs and poured into the appropriate tank on the machine. Drain the tanks and flush when it is anticipated the machine will not be used for a week or more.~~

~~Before using, ensure the tank valves on the bottom of the tank are open. Use the red dye solution for high areas and green dye solution for low areas. Do not leave fluid in tanks in freezing weather.~~

2.1 Under each set of wheels place a piece of steel or other suitable solid material, with dimensions approximately ~~76 mm x 305 mm x 13 mm~~ 3-in x 12-in x 0.5-in. Stretch a piece of string between the front and rear wheels, across the top of each of the pieces, and adjust the center riding wheel so that it just touches the string.

2.2 When straight edging a deck with a vertical curve, the riding wheel should be adjusted as above and then a final adjustment up or down should be made according to the vertical differences of the curve in a ~~3 m~~10 ft. length.

2.3 When the center wheel is in proper alignment, the dial on the straight edge should read zero. If adjustment is needed, lengthen or shorten the linkage to this center wheel as per the instructions of the manufacturer of the straight edge. ~~This adjustment may be made by removing the top from the control box and loosening the Allen-bolt on the straight gear ram. Move the ram up or down to get the zero adjusted, then tighten the Allen-bolt.~~

~~The adjustment for the high and low valves to open on 3 mm, 6.3 mm or any other designated tolerance is accomplished in the following manner.Fill the tanks with premixed red dye and green dye.Set the dial to read the designated high tolerance.Loosen the two Allen-bolts at the lower front face of the dial marker high side.~~

~~Turn on the electric switch at the side of the control box (on is up), and raise or lower the slide held by the Allen-bolts until the solenoid valve opens. Then secure by tightening the Allen-bolts.Repeat the above procedures for the low side.~~

3. OPERATION

3.1 Preparation

Obtain a bridge deck floor plan from the project plans and place this plan sheet on a hard surface. Cover the deck floor plan with graph paper. Align the graph paper so that the lines are parallel to the centerline of the deck. Draw a centerline and parallel lines, set to scale at 2 ft.~~0.6 m~~ intervals, the length of the deck.

As an alternate method, the bridge floor plan may be printed on graph paper with one set of lines parallel to the centerline or a sketch may be drawn on graph paper.

If the bridge includes a horizontal curve, mark locations on the scale drawing that are 25 feet~~7.6 m~~ to 50 feet~~15.2 m~~, apart along the centerline. Lay off lines at these locations, perpendicular to the centerline. Mark locations that represent 2 ft.~~0.6 m~~ intervals along these lines. Connect these locations to produce lines parallel to the centerline.

3.2 Procedure

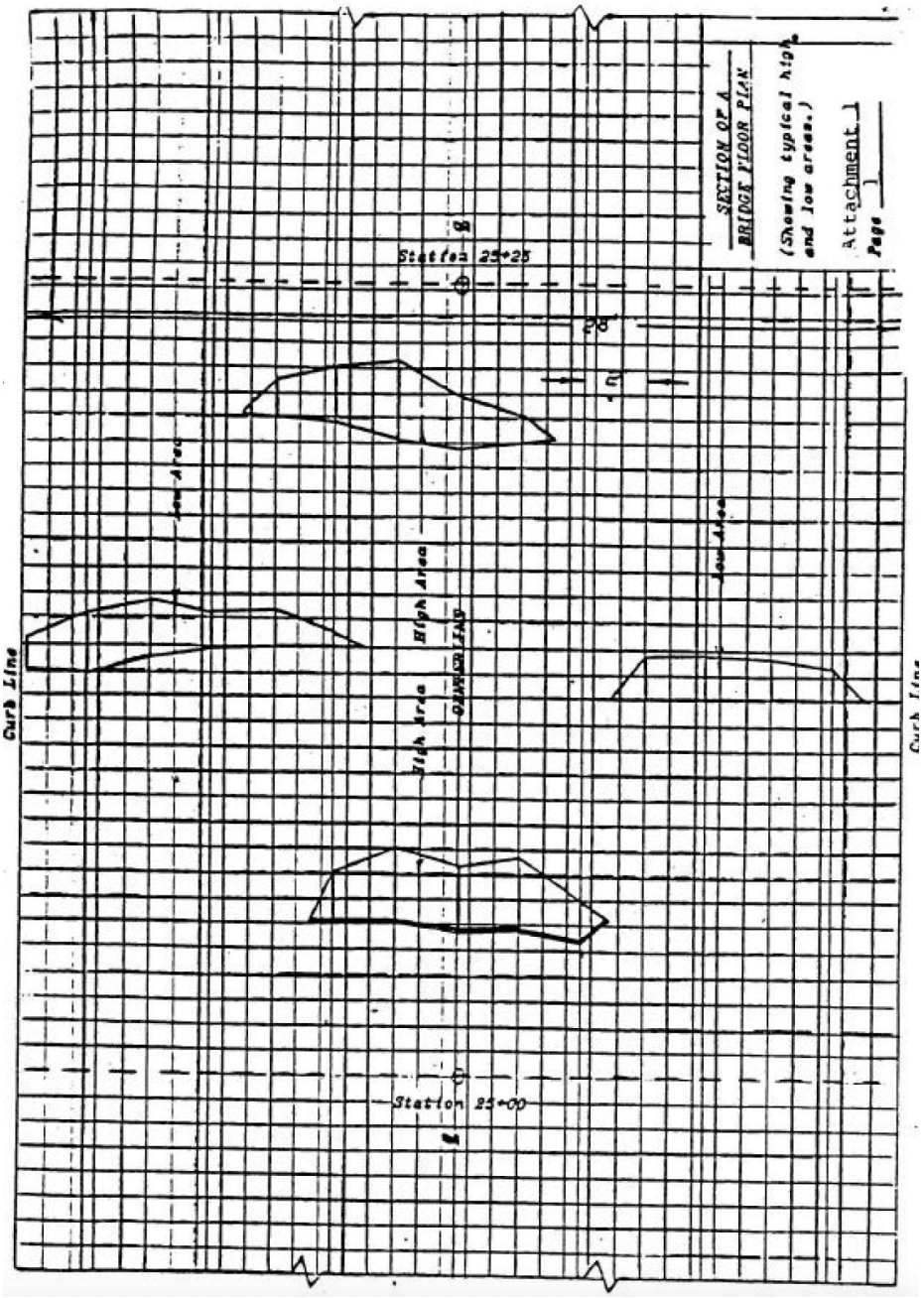
~~3.2.1~~ Mark the centerline of the bridge with suitable~~with a suitable~~ chalk. If stations are available on the bridge, draw a transverse perpendicular line every 25 feett~~7.6 m~~ to 50 feett.~~15.2 m~~. Continue to mark off longitudinal lines parallel to the centerline at 2 ft.~~0.6 m~~ centers. Transfer the location of the transverse perpendicular lines to the bridge deck plans or overlay.

~~3.2.2~~ Pull the rolling straight edge down the bridge centerline with the center wheel running over the chalk line. When the pass is completed, move the straight edge to the next 2 ft.~~0.6 m~~ line and push it back across the bridge. Repeat this operation until all lines have been straight edged. The direction the straight edge is oriented should not be changed.

~~3.2.3~~ Transfer the location of any high or low readings~~dye markings~~ (measure to the nearest 1 inch.~~30 mm~~) from the deck to the overlay paper or other graph paper. Mark red and green (red for high, green for low) lines and tie them together as per the attachment. The lines should be extended and joined approximately 2 ft.~~0.3 m~~ into the next two segments of the bridge deck area. The areas may then be computed by use of a planimeter.

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

MP 601.11.20 Steward – Pavement Analysis and Evaluation Section
RLS:A
ATTACHMENT


SECTION OF A
BRIDGE FLOOR PLAN
(Showing typical high and low areas.)
Attachment 1
Page 1
Station 25+25
Station 25+00
Curb Line
Curb Line
Low Area
High Area
High Area
Low Area

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

MATERIALS PROCEDURE

SAMPLING COMPACTED ASPHALTIC MIXTURES FROM THE ROADWAY

1. PURPOSE

1.1 This procedure has been written to provide a means for sampling compacted roadway asphalt~~ic~~ mixtures.

2. SCOPE

2.1 This method covers the procedure for sampling of asphaltic paving mixtures taken from the finished pavement for determination of the characteristics of the compacted mixture. ~~Alternative methods of sampling may be found in AASHTO T-230.~~

2.2 Samples obtained using this method will be collected for several reasons including but not limited to the following:

2.2.1 Visual examination.

2.2.2 Measurement for layer thickness.

2.2.3 Determination of bulk specific gravity, air voids, and other volumetric properties.

2.2.4 Determination of bond strength between constructed layers.

3. REFERENCED DOCUMENTS

3.1 *WVDOH Standard Specifications – Current Edition*

a) Section 410: Asphalt and Wearing Courses, Percent Within Limits (PWL)

3.2 *Materials Procedures*

a) MP 401.02.31, Quality Control and Acceptance of Asphalt Mixtures
b) MP 401.07.20, Sampling Loose Asphaltic Mixtures
c) MP 401.07.22, Measurement for Thickness of Asphalt Pavement Using Drilled Cores
d) MP 401.07.23, Interface Bond Shear Strength of Multi-layered Asphalt Pavement Specimens
e) MP 401.13.50, Determination of Percent Within Limits

3.3 *AASHTO Procedures*

a) AASHTO T331, Bulk Specific Gravity and Density of Compacted ~~Hot Mix~~ Asphalt Mixtures~~(HMA)~~ Using Automatic Vacuum Sealing Method

4. EQUIPMENT AND TOOLS

4.1 Powered core drill, water cooled, equipped to core cylindrical samples.

4.2 Diamond drill bit of six (6) inch *inside diameter* size.

4.3 Incidental materials and equipment.

4.4 Hand-held core sample extraction tool capable of grasping and removing a drilled cylindrical pavement core sample from the pavement without damage to the core sample.

Note: Worn drill bits of the same size as those used for coring have been successfully used by cutting slots vertically along the side of the casing to allow for expansion.

4.5 An ice cooler large enough to hold the sample without distortion after it is removed from the pavement.

Note: Large ice coolers (approximately 150 quart) have been used successfully to store and transport multiple pavement cores.

4.6 Small plastic bags for core specimens

4.7 Masking tape

4.8 A marking pencil, paint pen, lumber crayon, or other means suitable for labeling cores.

4.9 Markers for labeling the plastic bags.

5. MAT DENSITY, BOND STRENGTH, AND THICKNESS CORE SAMPLES

5.1 Density acceptance of the asphalt~~ic~~ mixture from the roadway shall be determined on the basis of test results from core samples for each Lot. One sample shall be taken from each Sublot. Samples are to be selected by means of a random sampling plan.

5.1.1 Random numbers used shall be generated from a calculator, software capable of generating random numbers, or from the Random Number Table attached to this MP. All random numbers shall be recorded and maintained in order to verify the means of sample locations.

5.2 At the Pre-Paving Meeting, WVDOH and Contractor personnel shall confer and agree on the sequence and widths of the paving operation in order for a sampling plan to be developed by the Division. The plan shall begin at the intended starting point and progress continuously until the end of the paving operation. Lots for mainline travel lanes should not be extended onto outside shoulders. As paving progresses onto the outside shoulders, new lots shall be established along the shoulders. Ramps, turning lanes, and truck lanes are traveled lanes and shall be considered as mainline pavements.

5.3 All lots shall be calculated and laid out based on converting 2500 tons to square yardage using the project plan lift thickness and a project theoretical yield. The theoretical yield

shall be based on 94% of the design maximum theoretical density from the approved JMF (Form T400) for asphaltic mixture designs. The lots shall be laid out using the full width of placement for each pull. However, no samples shall be taken from the inside shoulder adjacent to the median (generally four feet in width), or the outside 12 inches (one foot) of the unsupported or supported edge of a paving mat. The remaining dimension of width shall be considered testable and used to determine the random location of each sample. Partial lots shall be laid out and either considered separate lots or combined with the previous lots as per Table 410.7.1 of the WVDOH Standard Specifications.

5.3.1 Sample locations determined using random numbers shall be rounded to the nearest 1ft for both length and offset. If it is determined that the offset is zero or the maximum dimension in the testable width, the samples should be taken within either the first or last one foot respectively of material at each side of the testable width. Additionally, samples determined to fall at the same location as a sample removed from an underlying paving lift should be recalculated using a new random number for either width or length.

NOTE: *It is likely that some lots will be laid out in the field beginning with a mat that is a different dimension than that where the lot ends. Such would be the case for a lot that starts within a mat being pulled along the median where the fast lane and inside shoulder are being pulled simultaneously (approximately 16'), but ends along the outside or slow lane (approximately 12') on the other side of the median. In such a case, it will be necessary to calculate the area on the side of the median where the lot is started, then use the remaining area for the lot to determine the length of the remaining portion of the lot on the other side of the median.*

5.4 Refer to the Illustrative Example included in this MP for examples of how to select samples using a random sampling plan for pavement courses. Density acceptance samples and bond strength samples should be cross-referenced to a corresponding mixture acceptance sample as per MP 401.07.20.

5.4.1 For purposes of identification, the sampling ID shall be consistent for projects. Along with the pertinent project identification data (as indicated in Section 410 of the Standard Specifications) that is needed for processing test results, it will be necessary to discern all samples on the project by lot, sublot, and type of sample. For mat density and bond strength samples obtained from the mat, and for joint density samples obtained from the longitudinal joint, they should follow the convention shown below. Please note that mat density and bond strength samples shall also be measured for thickness.

Layer/Lot Designation	Lot #	Sub Lot #	Type of Sample	Example Sample ID
B – Base I – Intermediate S – Surface/Wearing J – Joint Density Core	2	5	M – Mat B – Bond Core D – Density Core	B2-5M J2-5

5.5 Samples for mat density shall be used to determine the percent compaction of the finished mat by first determining the bulk specific gravity of each specimen as per AASHTO T331,

and then by dividing by the corresponding daily theoretical maximum density of the paving mixture.

6. LONGITUDINAL JOINT DENSITY CORE SAMPLES

6.1 Samples shall be taken on the basis of a random sampling plan established for each lot. Lots shall be established as specified in Standard Specifications 410.7 - Acceptance Testing and will consist of 10,000' of constructed longitudinal joint. Each lot will be further divided into sublots consisting of 2,000'. Partial lots shall be addressed as described within Section 410.7 of the Standard Specifications. Lots along constructed joints between travel lanes shall not extend onto the constructed joint adjacent to the outside shoulders. New lots shall begin with the constructed joint adjacent to the outside shoulders.

6.2 One sample shall be taken from each sublot. Refer to Figure 3 for an example of how to select samples using a random sampling plan.

6.3 A core sample taken from a longitudinal vertical joint shall be centered on the line where the joint between the two adjacent lifts abut at the surface as illustrated in Figure 1 below. The center of all vertical joint cores shall be within one (1) inch of this joint line.

6.4 When the two lanes forming the longitudinal joint have daily theoretical maximum specific gravity values differing by more than 0.050, particular attention should be paid to these core locations. Examine each longitudinal joint core sample to ensure that approximately one-half of the longitudinal joint core sample is from each lane. If the materials in the longitudinal joint core are unbalanced, take a replacement sample at a location within twelve (12) inches longitudinally of the original sample location and adjust the location of the core drill relative to the joint line to ensure approximately equal material on each side of the joint will be obtained in the core sample.

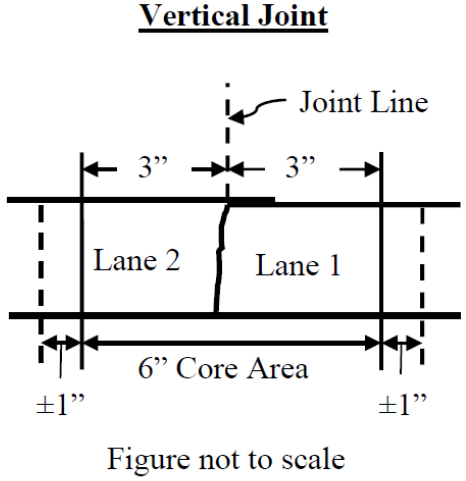


Figure 1 – Cross-sectional View, Position of Core Along Longitudinal Joint

6.5 Samples for joint density shall be used to determine the percent compaction of the finished mat by first determining the bulk specific gravity of each specimen as per AASHTO T331,

and then by dividing by the corresponding daily theoretical maximum densities of the paving mixture.

7. GENERAL CORING AND SAMPLING PROCEDURE

7.1 In the presence of the Engineer's representative, the contractor shall core and identify the density acceptance samples as specified in Section 410.7 of the Standard Specifications.

7.2 Efforts should be taken to cool the pavement with ice or other suitable means prior to coring. Using the powered core drill, drill core samples to the specified diameter (6.0 ±0.125 inches) and to a depth sufficiently below the depth of the pavement course to be sampled. Ensure sufficient water is dispersed through the core bit during drilling to keep the drill bit and core sample cool enough in order to allow cutting through the pavement without damaging the sample and the core bit. Carefully and slowly lower the drill bit to the surface of the pavement course at the start of drilling to prevent the drill bit from moving and to obtain a smooth clean initial drill cut at the surface of the core sample. After drilling to a sufficient depth, carefully raise the core drill bit to prevent any damage to the core sample.

7.2.1 Additional care should be taken when laying out and drilling samples for bond strength testing. Prior to drilling the sample, mark the pavement within the area to be cored using a lumber crayon or other suitable means to indicate the direction of traffic. Efforts shall~~need to~~ be taken to ensure ~~that~~ the core location has cooled sufficiently, and the drill bit is plumb so the~~that a~~ sample is not skewed after removal. Skewed samples will likely not be suitable for testing in the shear testing apparatus. Drilling depth shall be such that the core is cut completely through the material immediately underlying the surface lift to prevent the core from pulling apart at the bonded surface during the removal process.

7.3 Carefully dislodge or break the core sample away from the underlying pavement layer. Do not distort, bend, crack, damage or physically change the physical condition of the core sample during this operation.

7.4 Using a hand-held core sample extraction tool, carefully grasp and remove the core sample from the pavement. Do not distort, bend, crack, damage or physically change the physical condition of the core sample during removal from the pavement.

7.5 Immediately after removing the core sample from the pavement, wash off the core sample with water to remove the fine material generated from the drilling operation. Air dry or towel dry the core sample sufficiently to allow identification of the Lot and sublot number on each core sample by using a paint pen, or other suitable means.

7.6 If a core sample includes materials other than the material or pavement course to be tested, clearly show and mark with a paint pen the section(s) of each core sample to be discarded. Core samples suspected of including more than one material and not clearly showing the section to test, and the section(s) to discard, will be considered non-conforming samples and will not be tested until the section to test is identified.

7.7 Once the core sample has been obtained and identified, the Division will take immediate possession of the core sample and store it in a proper environment. Overheating or impact can damage core samples and prevent accurate test results.

7.8 Samples should be placed in separate small plastic bags and stored out of direct sunlight and/or placed in a cooler with enough ice to prevent them from warming up. The sample bags can be marked ahead of time to further help identify individual samples once transported to the lab. Core samples should then be laid in the cooler with the top surface (flat) down on the bottom of the cooler to prevent movement.

7.9 During the same work shift for placement of the sampled asphalt concrete mix, each core hole location ~~should~~ shall be backfilled with compacted mixture of the same material being used for paving, or other preapproved method. Efforts ~~should~~ shall be taken to clean the hole of loose debris and any standing water shall~~should~~ be removed. If asphalt mixture is used for backfilling, the material shall be placed in lifts, as necessary, and substantial compactive effort shall be applied to each lift using a device comprised of a suitable handle with an attached tamping foot of a size slightly smaller than the core hole. Fuel or solvent based release agents are strictly prohibited during this process. Each core location shall be sealed with an approved crack/joint sealant prior to contract completion.

7.10 After the Lot is completed or has been terminated, or at the end of each day~~s~~ of placement, the Division personnel will transport the core samples from each day~~'s~~ of production to the District Materials Laboratory or Materials Control, Soils & Testing Division for additional processing and evaluation.

Illustrative Example – Project and Lot Layout

An exactly four-mile-long project is to commence paving within the next couple of weeks along an interstate roadway. The division has contacted the contractor to determine the paving sequence and widths and has confirmed that the approved JMF maximum theoretical density is 2501 kg/m3. For theoretical yield on the project, 94% of 2501 kg/m3 is 2351 kg/m3. Dividing by 1000 and then multiplying by 62.4 PCF, the corresponding density in English units is 146.7 PCF. Using this value, and selecting the proper conversion factor from Table 1 below, the corresponding application rate per square yard at 1.5 inches thick is determined as follows:

Table 1 - Conversion of Design Bulk Density to In-Situ Application Rate

Project Design Thickness (inches)	Conversion for Application Rate (psy)
1.00	0.750
1.25	0.938
1.50	1.125
1.75	1.313
2.00	1.500
2.25	1.688
2.50	1.875
2.75	2.063
3.00	2.250

(Use English units) 146.7 pcf x 1.125 cf/SY = 165 psy *(nearest pound)*

The corresponding lot area for placement of the material in square yards is then calculated as follows:

(2500 tons x 2000 pounds per ton)/165 psy = 30,303 sy *(nearest sy)*

Work will begin on the inside fast lane next to the median. The first pull will be 16’ wide. The length of the lot, length per sublot, and total area per sublot is calculated as follows:

30,303 SY x 9 = 272,727 sf

272,727 sf/16 = 17,045’ Total lot length *(nearest linear foot)*

17,045/5 = 3409’ length per sublot

30,303/5 = 6,061 sy per sublot *(nearest sy)*

These values will be used to lay out the station for the beginning of each sublot, and to keep track of the breakdown of a sublot that begins on one side of median and then continues on the other side in an opposite direction. The area for each sublot is used when the situation above occurs and there is a change within the sublot to a pull of a different width.

The beginning and ending stations for each lot and sublot shall then be calculated and plotted in continuous fashion. Figure 2 shows a clean project layout using the widths for each pull, beginning and ending stations and how each lot/sublot progress for a complete project. Daily stops can also be approximated and then actual stops shown on a diagram to help keep track of the entire project. Partial mat and joint lots were addressed along the main travel lanes and new lots were started along the shoulder.

Project Layout By Area - With Estimated Daily Paving Stops

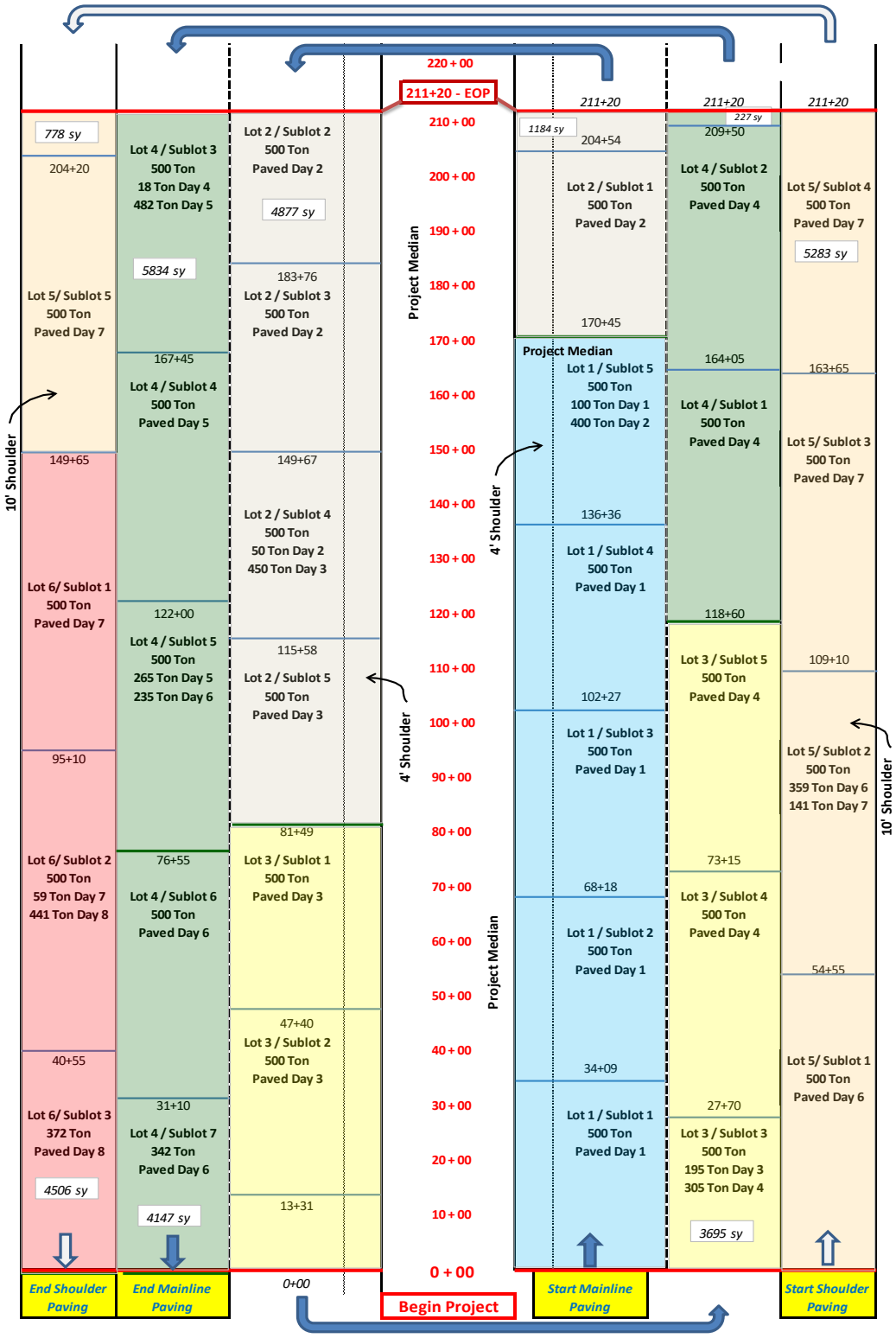


Figure 2

Using Lot 1 from Figure 2, the random sample locations are determined as shown below:

Lot #1-Density Cores

Sublot	Random Numbers		Length	Width
	X (length)	Y (width)		
1	0.632	0.287	0.632 (3409') = 2,155'	0.287 (11') = 3'
2	0.534	0.264	0.534 (3409') = 1,820'	0.264 (11') = 3'
3	0.871	0.159	0.871 (3409') = 2,969'	0.159 (11') = 2'
4	0.753	0.177	0.753 (3409') = 2,567'	0.177 (11') = 2'
5	0.277	0.530	0.277 (3409') = 944'	0.530 (11') = 6'

Lot #1- Bond Strength Cores

Sublot	Random Numbers		Length	Width
	X (length)	Y (width)		
1	0.149	0.155	0.149 (3409') = 508'	0.155 (11') = 2'
2	0.239	0.992	0.239 (3409') = 815'	0.992 (11') = 11'*
3	0.295	0.480	0.295 (3409') = 1,006'	0.480 (11') = 5'
4	0.517	0.473	0.517 (3409') = 1,762'	0.473 (11') = 5'
5	0.805	0.741	0.805 (3409') = 2,744	0.741 (11') = 8'

* *Sample should be taken between 10'-11' offset*

Using the offsets and lengths within each sublot, the stations and offsets for Mat Density and Bond Strength Core samples are determined as shown below.

Lot #1 - Corresponding Sample Stations for Mat Density –

Sublot	Beginning Station	Length	Sample Station
1	0+00	2,155	21+55, 3' offset
2	34+09	1,820'	52+29', 3 offset
3	68+18	2,969'	97+87, 2' offset
4	102+27	2,567'	127+94, 2' offset
5	136+36	944'	145+80, 6' offset

Lot #1 - Corresponding Sample Stations for Bond Strength

Sublot	Beginning Station	Length	Sample Station
1	0+00	508’	5+08, 2’ offset
2	34+09	815’	42+24, 10’ offset
3	68+18	1,006’	78+24, 5’ offset
4	102+27	1,762’	119+89, 5’ offset
5	136+36	2,744’	163+80, 8’ offset

For purposes of illustration, all locations for loose samples, mat density cores, and bond strength cores are shown in Figure 3 below. Refer to MP 401.07.20 for more information on obtaining loose samples of asphaltic mixture for determination of asphalt content and gradation.

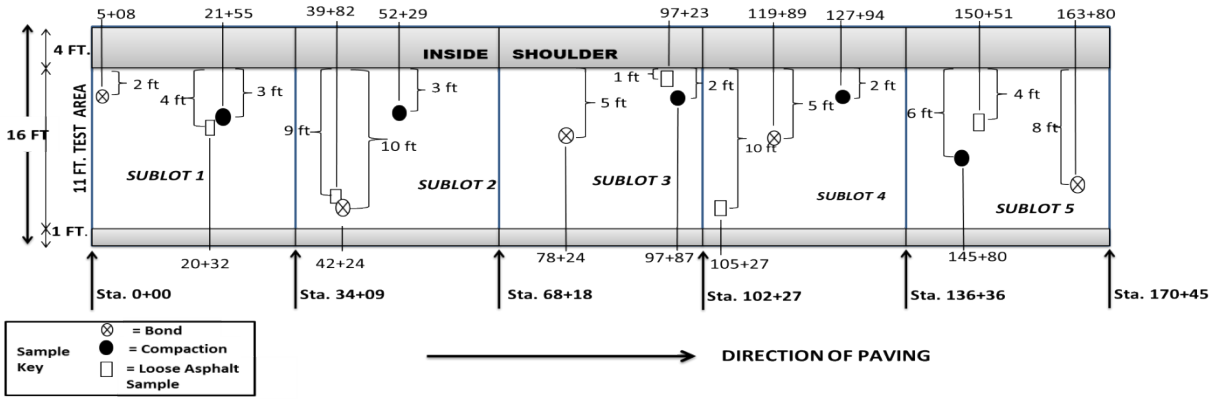


Figure 3

Using the same methodology and following the continuous lots in correspondence to paving sequence, the entire project layout for sampling can be completed as shown in Figure 4. Longitudinal joint lots begin at Station 0+00 between the fast and slow lanes and Joint Lot 1 ends at 10+00. Joint Lot 3 begins at Sta. 20+00 and continues to the other side of the median and extends the amount of the lot remaining.

After Figure 4, a summary is shown to help quantify the daily and total sampling efforts for the project.

Project Layout with Sampling Plan - Density and Bond Cores, Loose Mix Samples

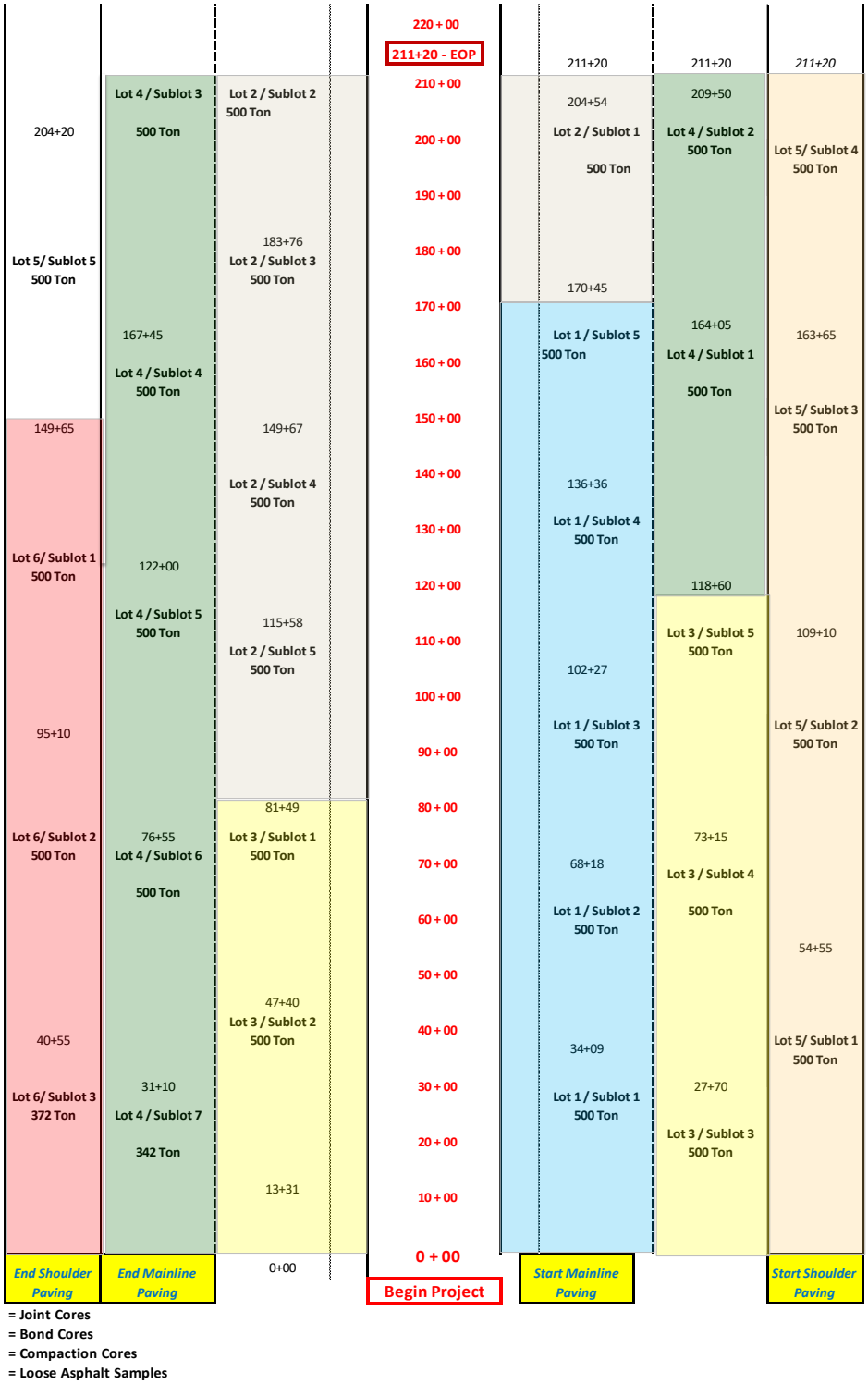


Figure 4

Table 2 – Testing Summaries from Daily and Total Production

	Loose Sample	Density Core *	Bond Core *	Joint Cores
Day 1	4	4	4	0
2100 Ton	4 --> Lot 1	4 --> Lot 1	4 --> Lot 1	
Day 2	4	5	4	0
1950 Ton	1 --> Lot 1	1 --> Lot 1	1 --> Lot 1	
	3 --> Lot 2	4 --> Lot 2	3 --> Lot 2	
Day 3	4	3	5	0
2145 Ton	2 --> Lot 2	1 --> Lot 2	2 --> Lot 2	
	2 --> Lot 3	2 --> Lot 3	3 --> Lot 3	
Day 4	5	5	4	11
2323 Ton	3 --> Lot 3	3 --> Lot 3	2 --> Lot 3	5 --> Lot 1
	2 --> Lot 4	2 --> Lot 4	2 --> Lot 4	5 --> Lot 2
				1 --> Lot 3
Day 5	2	2	3	5
1265 Ton	2 --> Lot 4	2 --> Lot 4	3 --> Lot 4	4 --> Lot 3
				1 --> Lot 4
Day 6	5	4	3	9
1918 Ton	3 --> Lot 4	3 --> Lot 4	2 --> Lot 4	5 --> Lot 4
	2 --> Lot 5	1 --> Lot 5	1 --> Lot 5	4 --> Lot 5
Day 7	3	5	4	13
2200 Ton	1 --> Lot 5	2 --> Lot 5	2 --> Lot 5	1 --> Lot 5
	2 --> Lot 6	3 --> Lot 6	2 --> Lot 6	5 --> Lot 6
				5 --> Lot 7
				2 --> Lot 8
Day 8	3	2	3	4
812 Ton	3 --> Lot 6	2 --> Lot 6	3 --> Lot 6	4 --> Lot 8
		* *Measured for Thickness*		
Totals :	**30**	**30**	**30**	**42**
	6 Lots	**6 Lots**	**6 Lots**	**8 Lots**
	60 Cores Measured for Thickness			

Table 3 - Random Numbers

.858	.082	.886	.125	.263	.176	.551	.711	.355	.698
.576	.417	.242	.316	.960	.819	.444	.323	.331	.179
.687	.288	.835	.636	.596	.174	.866	.685	.066	.170
.068	.391	.739	.002	.159	.423	.629	.631	.979	.399
.140	.324	.215	.358	.663	.193	.215	.667	.627	.595
.574	.601	.623	.855	.339	.486	.065	.627	.458	.137
.966	.529	.757	.308	.025	.836	.200	.055	.510	.656
.608	.910	.944	.281	.539	.371	.217	.882	.324	.284
.215	.355	.645	.460	.719	.057	.237	.146	.135	.903
.761	.883	.771	.388	.928	.654	.815	.570	.539	.600
.869	.222	.115	.447	.658	.989	.921	.924	.560	.447
.562	.036	.302	.673	.911	.512	.972	.576	.838	.014
.481	.791	.454	.731	.770	.500	.980	.183	.385	.012
.599	.966	.356	.183	.797	.503	.180	.657	.077	.165
.464	.747	.299	.530	.675	.646	.385	.109	.780	.699
.675	.654	.221	.777	.172	.738	.324	.669	.079	.587
.279	.707	.372	.486	.340	.680	.928	.397	.337	.564
.338	.917	.942	.985	.838	.805	.278	.898	.906	.939
.316	.935	.403	.629	.130	.575	.195	.887	.142	.488
.011	.283	.762	.988	.102	.068	.902	.850	.569	.977
.683	.441	.572	.486	.732	.721	.275	.023	.088	.402
.493	.155	.530	.125	.841	.171	.794	.850	.797	.367
.059	.502	.963	.055	.128	.655	.043	.293	.792	.739
.996	.729	.370	.139	.306	.858	.183	.464	.457	.863
.240	.972	.495	.696	.350	.642	.188	.135	.470	.765

_____

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

RLS:J

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

GUIDE TO DETERMINING INTERFACE BOND SHEAR STRENGTH OF MULTI-LAYERED ASPHALT PAVEMENT SPECIMENS

1. PURPOSE

1.1 To establish an approved method for determining the interface bond shear strength between layers of asphalt concrete pavement in cored samples taken from the roadway.

2. SCOPE

2.1 This test method covers the determination of the interface bond shear strength between layers of asphalt concrete pavement in cored samples of both Marshall and Superpave mixes.

2.2 This test method is applicable for cores obtained from both newly constructed and previously existing asphalt concrete pavements. It could also be used to determine the interface bond strength between asphalt concrete and Portland cement concrete.

2.3 This test is applicable on six-inch diameter cores that are not less than two inches thick.

3. REFERENCED DOCUMENTS

3.1 *AASHTO Standards:*

~~a) T-168, Standard Practice for Sampling Hot-Mix Asphalt Paving Mixtures~~

~~b)~~a) T245, Standard Method of Test for Resistance to Plastic Flow of Asphalt~~Bituminous~~ Mixtures Using Marshall Apparatus

3.2 ASTM Standards

a) D5581, Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6 in. Diameter Specimen)

4. APPARATUS

4.1 Bond Test Device – The device used for the bond shear test shall be designed to accommodate six-inch diameter test specimens. The specimen shall have a nominal diameter of 6.0 ± 0.125 inch. The device shall have a cylindrical metal specimen holder (reaction frame) and a movable specimen holder (shearing frame). The reaction frame shall have the capabilities to tightly hold samples slightly smaller than

six-inches. The shearing frame shall move freely through the use of friction reducing bearings. The shearing frame shall have a spherical loading head. The gap between the reaction frame and the shearing frame shall be ¼ inch ± 1/32 inch.

4.2 Loading Machine – The loading machine shall produce a uniform vertical movement of two inches per minute. The Marshall Stability test apparatus or other mechanical or hydraulic testing machine may be used provided the rate of movement is maintained at two inches per minute while the load is being applied.

4.3 Wet masonry saw.

4.4 White or silver paint (See 6.3)

4.5 Infrared temperature gun (capable of measuring to 0.1 °F)

4.6 Supply of MP 401.07.23 data sheets available on the MCS&T Toolbox Webpage[1]

5. ROUNDING OF DATA

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

Station Number	1ft (not on data sheet)
Diameter	0.05 in
Thickness of Overlay	0.05 in
Thickness of Existing HMA	0.05 in
Max Load Applied	1 lb
Cross Section Area	1 in^2
Bond Shear Strength	1 psi
Average Bond Shear Strength	1 psi
Standard Deviation	0.1 psi
Internal Temperature	0.1 °F

6. PREPARATION OF TEST SPECIMENS

~~6.1 Number of Test Specimens – a single test procedure shall consist of at least three specimens.~~

~~6.2~~6.1 Each roadway core specimen shall be six inches in diameter with the entire surface of the perimeter perpendicular to the top surface of the core within ¼ inch. If the height of the core above or below the interface being tested is greater than three inches, it shall be trimmed with a wet masonry saw to a height of approximately three inches.

~~6.3~~6.2 Identify the location of the interface layer with white or silver paint with three equally spaced marks approximately one inch long around the perimeter of each core.

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

7. PROCEDURE

7.1 Specimen dimensions – measure the diameter of the core and the thickness of the overlay and existing HMA layer to the nearest 0.05 inch. Measure the diameter in at least three locations and average the readings. For more details, see MP 401.07.22.

7.2 Specimen conditioning – allow the specimens to stabilize at the test temperature of 75±5°F (24±2°C) in a water bath or oven; this stabilizing process should take a minimum of 120 minutes.

7.3 Specimen positioning – orient the core in the bond strength device so that the direction of traffic marked on the core is vertically pointing downward and the marked interface is centered between the edge of the reaction frame and the edge of the shearing frame.

7.3.1 Align the loading head adjacent to the bonded interface. The loading head shall rest parallel to the bonded interface on the asphalt overlay portion of the specimen. Sample positioning and loading is shown in Figure 1.

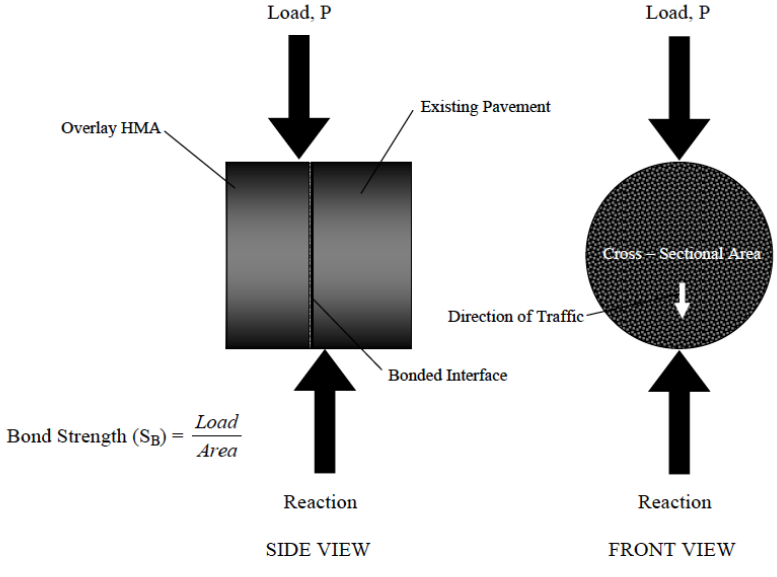


Figure 1. Loading Scheme Used for the Bond Strength Test

Note: Thinner layer of the sample should be placed in the loading side of the frame.

7.4 Rate of displacement - Apply the displacement continuously and without shock at a constant strain rate of two inches per minute until failure occurs. Record the maximum load in pounds, P_{MAX}, carried by the specimen during the test.

7.5 Immediately following the shearing of the sample, measure and record the temperature of the sample at the interface using the infrared temperature gun.

8. CALCULATION

Calculate the bond shear strength, S_B, as follows:

$$S_B = P_{MAX} / A$$

Where:

S_B = bond shear strength, pounds per square inch (psi)
P_{MAX} = maximum load applied to the specimen, pounds-force (lbf)
A = cross sectional area of test specimen, square inches (in^2)

And:

$$A = \pi D^2/4$$

Where:

A = cross-sectional area of test specimen, square inches (in^2)
D = average diameter of test specimen, inches (in)

9. REPORT

9.1 Record each core number or identification, sampling date, and test date.

9.2 Failure surface. Identify if failures occurred at the interface, in the existing layer, or in the overlay of each core. If a failure occurs in the existing layer, below the bond interface, and does not meet the minimum requirement of 100 PSI, the core (sublot) shall be eliminated from the lot PWL calculation. If at least 3 sublots remain after core elimination, the lot shall be calculated using the remaining sample results. The bond PWL calculation shall not be performed if two or fewer sublots remain. An investigation shall be conducted by District Materials to determine the cause of the failures and the results reported to Materials Division.

9.3 Note the appearance of the interface including any contaminants, milling striations, stripping, tack coat streaks, or other observations.

9.4 Record the test results for each core.

9.4.1 Specimen dimensions – including thickness of the overlay asphalt, thickness of the existing layer, the average diameter as specified in Section 7.1, and the cross-sectional area.

9.4.2 Maximum load applied.

9.4.3 Temperature of the sample interface, recorded to the nearest 0.1 °F.

9.4.4 Bond shear strength, rounded to the nearest psi.

9.5 Calculate and record the mean and standard deviation of the bond strength for each lot~~the set~~ of cores.

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

RLS:J

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

MATERIALS PROCEDURE

NUCLEAR DENSITY TEST BY THE ROLLER PASS METHOD

1. PURPOSE

1.1 The purpose of this procedure is to determine the density of construction materials by the roller pass method. The procedure consists of two parts, with Part I to determine the required maximum density and Part II to compare field densities to the required maximum density.

2. SCOPE

2.1 This test method or method of testing is applicable to aggregate base courses, select material for backfilling, crushed aggregate backfills, granular material, subgrade, and random material having 40% or more of +3/4 inch ~~(+19 mm)~~ material as specified in MP 717.04.21.

3. REFERENCES

3.1 MP 712.21.26

3.2 MP 717.04.21

4. EQUIPMENT

4.1 One complete nuclear density gauge unit meeting the requirements specified in MP 717.04.21. This would include the manufacturer's printout of standard counts.

4.2 One measuring tape, approximately 50 feet ~~(15 m)~~

4.3 Lime, chalk, lumber crayon, or other suitable material to mark test sites

4.4 Dry silica sand

4.5 Supply of data sheets

4.6 One vehicle meeting the safety and security requirements of the Nuclear Regulatory Commission for transporting nuclear density gauges

5. PERSONNEL TRAINING

5.1 All personnel performing the testing must meet the minimum training requirements specified in MP 717.04.21.

5.2 All personnel must know and follow the requirements of the Nuclear Regulatory Commission.

6. ROUNDING OF DATA

6.1 Test values and calculations are to be rounded according to the following procedure:

6.1.1 If the figure following the last significant number to be retained is ~~larger than~~ five or larger, increase the last significant number to be retained by one.

~~6.1.2 If the figure following the last significant number to be retained is five and there are no figures beyond five except zeros, the last significant number to be retained is increased by one if odd or left unchanged if even.~~

~~6.1.3 If the figure following the last significant number to be retained is five and there are figures following the five, the last significant number to be retained is increased by one.~~

~~6.1.4~~6.1.2 If the figure following the last significant number to be retained is less than five, the last significant number is left unchanged.

6.2 Test values and calculations shall be rounded to the following nearest significant digit:

6.2.1 Form T-313 (Ttest Section)

Lift thickness compacted	0.1 in. ~~(10 mm)~~
Depth below grade Length of test section Width of test section Station number	1 ft ~~(0.1 m)~~
Offset	1 ft ~~(1 m)~~
Dry density (DA) Average density (DB) Maximum density (DC)	1 ft ~~(0.1 m)~~
	1 ft ~~(0.1 m)~~
	1 ft ~~(0.1 m)~~
	1 PCF ~~(1 kg/m^3)~~
	1 PCF ~~(1 kg/m^3)~~
	1 PCF ~~(1 kg/m3)~~

6.2.2 Form T-317 (Quality Control Tests)

Station number	1 ft ~~(0.1 m)~~
Offset	1 ft ~~(0.1 m)~~
Depth below grade	1 ft ~~(0.1 m)~~
Lift thickness compacted	0.1 in. ~~(10 mm)~~
Maximum density (DC)	1 PCF ~~(1 kg/m^3)~~
Dry density (DE)	1 PCF ~~(1 kg/m^3)~~
Relative density (DF)	1%
Average DF *(X)*	0.1%
Target (f)	1%
Quality index (QL)	0.01
Within tolerance (DG)	1%
Minimum percent for 100% Pay (DH)	1%

7. PREPARATION FOR TESTING

7.1 Standardization of the Nuclear Gauge

7.1.1 Warm up the gauge according to the manufacturer's recommendations.

7.1.2 Standardization of the gauge must be performed away from metal and other objects.

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

7.1.4 Standardize according to manufacturer's recommendations.

7.1.5 Compare the standard counts to the manufacturer's standard counts using tolerances acceptable to the Division. For the Troxler 34003~~0~~ series gauge, the standard counts must be within ± 2% for density and ± 4% for moisture from the manufacturer's standards.

7.1.6 If the gauge is not within the specified tolerances for either moisture or density, repeat section 7.1.4 -7.1.5. If the gauge will not standardize for either moisture or density after 4 attempts, ~~there is probably something wrong with the gauge~~a different gauge shall be used. The gauge which failed to standardize may be used again in the future if the procedure referenced in Section 5.2.10 of ~~There may be electronics problems, the gauge needs calibrated or a stability check needs to be performed. Refer to~~ MP 717.04.21 is followed and the gauge is found to be stable. ~~for a more detailed explanation. In any case, do not use a gauge for testing that will not standardize.~~

7.1.7 G~~A g~~auges shall~~must~~ be standardized before testing and at least every four hours during testing.

7.1.8 When a gauge is to be used for testing pipe or structure backfill in a trench, first check the standardization of the gauge according to sections 7.1 - 7.1.5. If the gauge is functioning properly, standardize the gauge in the trench. The standard counts in the trench shall~~would~~ be used for testing in the trench only and the tolerances would not be applied to the standard counts taken in the trench. When the gauge is moved to a non-trench condition for testing, new standard counts shall~~would~~ be required.

8. PART I PROCEDURE FOR DETERMINING THE MAXIMUM DENSITY

8.1 All data and calculations for Part I of this procedure will be recorded on form T-313 (copy attached). Record the Contract ID, project number, lab number etc. before starting the test.

8.2 The test is to be performed at the beginning of placement of an item. However, any problems with the material, placement, or compaction equipment shall be corrected prior to performing the test.

8.3 The test section will be 100 feet ~~(30 m)~~ long by the width being placed in one operation, except in restricted areas.

8.3.1 In restricted areas, where the 100-foot ~~(30 m)~~ length cannot be obtained, check the project's records to determine if a maximum density for the material has been determined on the project. If the material, lift thickness, and compaction equipment remain unchanged, ~~T~~the existing maximum density shall be used for Part II of this procedure, if available. A maximum density determined in a restricted area shall not be used in a non-restricted area. If a maximum density is not available for the material, obtain the~~as~~ largest ~~a~~ test section ~~as~~ possible. For pipe backfill, a lift on both sides of the pipe can be used.

8.4 Divide the test section into 5 equal subsections and number the subsections. Randomly locate a test site within each of the subsections according to MP 712.21.26.

8.5 Water shall be added to untreated aggregates, if necessary, in a quantity satisfactory to the Engineer. The aggregate must visually appear wet ~~in order~~ to properly compact.

8.6 Once the material had been placed in the test section, the material shall be rolled with compaction equipment meeting the following requirements:

8.6.1 All compaction equipment must be in good working condition.

8.6.2 The materials shall be compacted with rollers providing a minimum applied force of 10 tons ~~(9 Mg)~~.

8.6.3 In restricted areas, inaccessible to conventional rollers, the compaction equipment must be satisfactory to the Engineer to provide the desired compactive effort. The Division may request verification that the above compaction equipment meets the specified requirements.

8.7 The test section shall be rolled with 12 roller passes. A roller pass is one complete coverage over the material. In restricted areas, where conventional rollers cannot be used, the material shall be compacted until it appears well densified or to the satisfaction of the Engineer.

8.8 If the material shears or breaks down during rolling, the number of roller passes may need to be reduced. The designated number of roller passes must not be changed without the approval of the Engineer.

8.9 Once the material has been rolled, testing will be performed on test sites ~~numbers~~ 1 and 2.

8.10 Smooth and level the test site. ~~and~~ F~~f~~ill any voids with fines scraped from the surface, but no more than 1/8 inch ~~(3 mm)~~.

8.10.1 Place the guide plate on the test site. Next place the drive rod in the guide plate and while standing on the plate, drive the rod at least two inches ~~(50 mm)~~ deeper than the location where the end of the gauge source rod will be when testing. The gauge source rod can be extended in two-inch (50 mm) increments. The source rod must be as deep as possible within the lift but must not extend beyond the lift. For example, a five-inch ~~(125 mm)~~ lift would be tested with the source rod in the four-inch ~~(100 mm)~~ position and the hole would be six ~~(150 mm)~~ inches deep. Carefully remove the drive rod to prevent material from falling into the hole.

8.10.2 Place the gauge over the test site and insert the source rod to the desired depth. Pull the gauge tight against the side of the hole toward the scaler. Make sure the gauge is sitting flush on the material. Mark the outline of the gauge with lime or other suitable material so the test sites can be relocated.

8.10.3 Take a one-minute density reading.

8.10.3.1 Record the dry density (DA) in Section A of form T-313. Perform the same testing on site 2.

8.11 Average the two dry densities (DA) obtained in 8.10.3.1.

8.12 Roll the material in the test section two additional roller passes. In restricted areas, the compaction equipment would pass over the material the above indicated number of passes.

8.13 After the material has been rolled the additional number of passes, perform tests again on sites 1 and 2 according to 8.10 through 8.10.3 and record the values in section B.

8.14 Average the two densities according to 8.11.

8.15 Compare the value in 8.14 to the value obtained in 8.11. If the increase in density is 1 PCF ~~lb/ft^3 (16 kg/m^3)~~ or less, the material is considered to have achieved its maximum density. If the increase in density is greater than 1 PCF ~~lb/ft^3 (16 kg/m)~~, roll the material two additional passes according to 8.12 and repeat the testing on sites 1 and 2. Continue the rolling and testing sequence until the increase in density between two consecutive rolling sequences is 1 PCF ~~lb/ft3 (16 kg/m^3)~~ or less. The Division may direct~~request~~ the contractor to cease rolling even though the increase is more than 1 PCF ~~lb/ft3 (16 kg/m^3)~~ if the material is breaking down.

8.16 Once the increase in density is 1 PCF ~~lb/ft3 (16 kg/m^3)~~ or less, move the last two density readings to the maximum density determination section on form T-313. T~~hen t~~ake density measurements on sites 3, 4, and 5.

8.17 The average of the five density readings is the maximum density (DC) for thi~~s~~e material.

8.17.1 The maximum density will be used to control the material for Part II of this procedure.

8.17.2 Division personnel may request that Part I be repeated if the test was not performed properly or the maximum density obtained does not appear to be realistic.

9. PART II QUALITY CONTROL TESTING

9.1 All test data and calculations for Part II of this procedure will be recorded on form T-317 (copy attached). Record the Contract ID, project number, item number, etc. on the form before starting the testing.

9.2 The lot number would have a prefix letter based on the following designations for the use of the material being tested:

Embankment :	F
Subgrade:	S
Base:	B
Pipe/Structure Backfill:	p

9.3 Transfer the maximum density (DC) and the lab number from form T-313 to form T-317. Record the lab number in the section for reference lab number.

9.4 Randomly locate the test site according to MP 712.21.26.

9.5 Determine the dry density (DE) with the nuclear gauge according to the procedure described in sections 8.10 through 8.10.3. The test sites do not have to be marked on the roadway.

9.6 Calculate the percent relative density (DF) by using the equation on form T-317.

9.7 Perform the remaining four tests in the lot. Five tests are always required to evaluate a lot.

9.8 Calculate the average relative density (*X*) for the five tests in the lot.

9.9 Obtain the target percentage of dry density (T) from the project's governing specifications.

9.10 Determine the range (R) of the relative densities (DF) by subtracting the smallest value from the largest.

9.11 Calculate the quality index (QL) by using the equation on form T-317.

9.12 Use the Table for Estimating the Percent of a Lot Within Tolerance (copy attached) and determine the percent within tolerance (DG) that corresponds to the QL value calculated in 9.11 above.

9.13 Obtain the minimum percent for 100% pay (DH) from the project's governing specifications.

9.14 ~~In order f~~For a lot to meet specifications, the percent within tolerance (DG) must be equal to or greater than the minimum percent for 100% pay (DH).

10. GENERAL

10.1 Independent tests for similarity checks can be recorded on form T-317. Use only the applicable sections of the form.

10.2 If the material changes or the material is supplied from a new source, repeat Part I to obtain new control data.

10.3 If the percent relative densities are consistently above 105 percent or below 95 percent, and there is no apparent cause for the high or low values, repeat Part I to obtain new control data.

10.4 Test data for several lots can be recorded on form T-317.

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

MP 700.00.24 Steward – ~~Asphalt Section~~Aggregate and Soils Section
RLS:J

ATTACHMENTS: QL Table
Form T-313
Form T-317

TABLE FOR ESTIMATING PERCENT OF LOT WITHIN TOLERANCE

Quality Index (QL) Positive Values	Percent Within Tolerance
.66	99
.65	98
.62	97
.60	96
.58	95
.57	94
.55	93
.53	92
.51	91
.50	90
.48	89
.46	88
.45	87
.44	86
.42	85
.41	84
.40	83
.38	82
.37	81
.36	80
.34	79
.33	78
.32	77
.30	76
.29	75
.28	74
.27	73
.25	72
.24	71
.23	70
.22	69
.21	68
.19	67
.18	66
.17	65
.16	64
.15	63
.14	62
.13	61
.11	60
.10	59
.09	58
.08	57
.07	56
.06	55
.05	54
.04	53
.02	52
.01	51
.00	50

Quality Index (QL) Negative Values	Percent Within Tolerance
.00	50
.01	49
.02	48
.04	47
.05	46
.06	45
.07	44
.08	43
.09	42
.10	41
.11	40
.13	39
.14	38
.15	37
.16	36
.17	35
.18	34
.19	33
.21	32
.22	31
.23	30
.24	29
.25	28
.27	27
.28	26
.29	25
.30	24
.32	23
.33	22
.34	21
.36	20
.37	19
.38	18
.40	17
.41	16
.42	15
.44	14
.45	13
.46	12
.48	11
.50	10
.51	9
.53	8
.55	7
.57	6
.58	5
.60	4
.62	3
.63	2
.66	1

West Virginia Division of Highways
Materials Control Soil and Testing Division

FORM T-313
MP 700.00.24
REV. 09-22

Lab Number _____
Auth. Number _____
Project Number _____
District Number _____
Item Number _____
Date _____ Contract ID _____

Source of Material:			Length of Test Section:		
Roller Type:			Width of Test Section:		
Roller Weight	Static:	Working:	Gauge Number		
Lift Thickness Compacted:			Manufacturer's Standards		
Depth Below Grade:			Density:	Moisture:	
Depth of Gauge Source:			Standard Counts		
Observed	Yes	No	Density:	Moisture:	

Test Site Number	1	2	3	4	5
Station Number					
Offset					

A	Number of Passes		
	Test Site	DA	Dry Density
	1		
	2		
DB	Average		

B	Number of Passes		
	Test Site	DA	Dry Density
	1		
	2		
DB	Average		

C	Number of Passes		
	Test Site	DA	Dry Density
	1		
	2		
DB	Average		

D	Number of Passes		
	Test Site	DA	Dry Density
	1		
	2		
DB	Average		

DB = ∑ DA / 2

DC = ∑ DA / 5

Maximum Density Determination		
Test Site	DA	Dry Density
1		
2		
3		
4		
5		
DC	Max. Density	

Inspector's Name: _____
Inspector's Signature: _____
Project's Evaluation
Checked By: _____
Date: _____

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

LAB NUMBER _____
AUTH NUMBER _____
PROJECT NUMBER _____
DISTRICT _____
ITEM NUMBER _____
CONTRACT ID _____

FORM T-317
MP 700.00.24
REV. 09-22

GAUGE #	DATE						
MANUFACTURER'S DENSITY STANDARD	LOT NUMBER						
	BEGINNING STATION						
	ENDING STATION						
MANUFACTURER'S MOISTURE STANDARD	OFFSET						
	DEPTH BELOW GRADE						
	DEPTH OF GAUGE SOURCE						
	LIFT THICKNESS COMPACTED						
DC FROM TEST SECTION	DENSITY STANDARD						
	MOISTURE STANDARD						

$$DF = \frac{DE\ (100)}{DC}$$

$$\bar{X} = \frac{\sum DF}{5}$$

$$QL = \frac{\bar{X} - T}{R}$$

DC	MAXIMUM DENSITY						
	REFRENCE LAB NUMBER						
TEST NUMBER 1	**DE**	DRY DENSITY					
	DF	% RELATIVE DENSITY					
TEST NUMBER 2	**DE**	DRY DENSITY					
	DF	% RELATIVE DENSITY					
TEST NUMBER 3	**DE**	DRY DENSITY					
	DF	% RELATIVE DENSITY					
TEST NUMBER 4	**DE**	DRY DENSITY					
	DF	% RELATIVE DENSITY					
TEST NUMBER 5	**DE**	DRY DENSITY					
	DF	% RELATIVE DENSITY					
LOT EVALUATION	$\bar{X}$	AVERAGE **DF**					
	T	TARGET	95%	95%	95%	95%	95%
	QL	QUALITY INDEX					
	DG	% WITHIN TOLERANCE					
	DH	MIN. FOR 100% PAY	80%	80%	80%	80%	80%
	DI	PASS / FAIL					

INSPECTOR'S NAME: _____
INSPECTOR'S SIGNATURE: _____

PROJECT'S EVALUATION

CHECKED BY: _____ DATE: _____

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

MATERIALS PROCEDURE

WVDOH BUY AMERICA ACCEPTANCE GUIDELINES

1. PURPOSE

1.1 To set forth instructions for compliance with federally mandated, Buy America, and Buy America Build America (BABA) requirements.

1.2 To set forth instructions for compliance with West Virginia State Code requirements for Buy America.

2. REFERENCED DOCUMENTS

2.1 WVDOH Standard Specifications, Current Edition

2.2 23 U.S.C. 313 and 23 CFR 635.410 “Buy America Requirements”

2.3 Chapter 5, Article 19 and Chapter 5A, Article 3 Section 56 of the West Virginia Code “West Virginia American Steel Act of 2001.”

2.4 Buy America, Build America Act, Section 70914

2.5 OMB Memorandum M-22-11 “Construction Materials” (Attachment 3)

3. ACCEPTANCE OF MATERIALS

3.1 This procedure applies to the following:

1. Iron and Steel
2. Manufactured Products
3. Construction Materials

3.2 Unless there is an exception waiver as outlined in this MP, all applicable materials on construction projects shall conform to the guidelines of Section 106.1 of the WVDOH Standard Specifications.

3.3 As defined in OMB Memorandum M-22-11, the Buy America preference only applies to articles, materials, and supplies that are permanent project items. This does not apply to materials brought to the construction site, and removed at, or before the completion of the infrastructure project, such as tools, equipment, temporary scaffolding, or traffic control devices.

3.4 Pursuant to Title 23 U.S.C. 313 and 23 CFR 635.410 “Buy America Requirements”, and Chapter 5A, Article 3, Section 56 and Chapter 5, Article 19 of the West Virginia Code, all manufacturing processes for steel and iron materials must take place in the United States. This includes all processes from the initial melting stage through application of coatings.

3.5 Pursuit to Buy America, Build America Act, Section 70914, all construction materials are required to be produced in the United States. All manufacturing processes for the construction materials shall occur in the United States.

3.5.1 As defined in OMB Memorandum M-22-11, "Construction Materials" includes an article, material or supply, -- that is or consists primarily of: Non-ferrous material; plastic and polymer-based products (including PVC, composite building materials, and polymers used in fiber optic cables.); glass (including optic glass); lumber; or drywall.

3.5.2 "Construction Materials" does not include items of primarily iron or steel; a manufactured product; cement and cementitious materials; aggregate such as stone, sand, or gravel; or aggregate binding agents or additives.

3.5.3 As defined in OMB Memorandum M-22-11, items that consist of two, or more of the materials listed as construction materials that are combined together through a manufacturing process, and items that include at least one of the materials listed above in a manufacturing process, shall be treated as "Manufactured Products."

3.6 Pursuit to Buy America, Build America Act, Section 70914, All "Manufactured Products" must be produced in the United States. The cost of the components of the "Manufactured Product" that are mined, produced, or manufactured in the United States shall be greater than 55 percent of the total cost of all the components of the product, unless another standard for determining the minimum amount of domestic content has been established under applicable law or regulation.

3.6.1 As defined in OMB Memorandum M-22-11, a manufactured process includes both the final manufacturing process and the immediately preceding manufacturing stage for a construction material.

3.7 When there are not any waiver exceptions and when materials on a project fall under the Buy America or BABA criteria, the Contractor shall furnish a notarized certificate of compliance (CoC) signed by the Quality Assurance Manager, or equivalent which covers all materials and products involved with the project, including those of any subcontractors and suppliers certifying compliance. This shall be done prior to the permanent incorporation of the materials into the project.

3.8 The Division shall not authorize or make any payments to any Contractor not fully compliant with this requirement. Any payment made to any Contractor who did not fully comply with this requirement shall be recovered by the Division.

3.9 A notarized certificate of compliance shall contain the following information:

3.9.1 Title: Certification of Buy America, Buy America Compliance

3.9.2 The Name, Address and Contact Information for the Company.

3.9.3 The Name of the Customer

3.9.4 The shipping date of the material

3.9.5 A company statement that demonstrates compliance with Buy America and Buy America Build America

3.9.5.1 The statement "If the event where the material does not meet these requirements, any payments made for the associated materials shall be returned to the Division."

3.9.6 The Contract ID for the Material (If applicable)

3.9.7 Both the Federal and State Project Number for the Material (If applicable.)

3.9.8 The name of the material and/or material code reference in the CoC. This material name shall be a clear, common name of the material that is comparable to the AWP

Material Name. Part Numbers etc. may also be on the document if the company wishes.

3.9.9 The Line Item for the Material (If applicable)

3.9.10 The Quantity of the Material Shipped

3.9.11 Signature of the Company Quality Assurance Manager (or Equivalent) and date.

3.9.12 The document must be notarized.

3.9.13 Attachment 1 show a sample certificate of compliance.

3.10 The project shall file this CoC in each respective Line Item Folder in ProjectWise (or the current Division utilized document retention software) for the project.

3.11 Multiple items may be listed on the CoC, though all the information for each line must be on the document.

4. WAIVER APPLICATION

4.1 As described in M-22-11, when necessary, recipients may apply for, and the agency may grant, a waiver from these requirements. The agency should notify the recipient for information on the process for requesting a waiver from these requirements.[1]

4.2 Pursuant to Section 70914(c) of the Act, the head of a Federal agency may waive the application of a Buy America preference under an infrastructure program in any case in which the head of the Federal agency finds that:

1. Applying the domestic content procurement preference would be inconsistent with the public interest (a "public interest waiver");
2. The types of iron, steel, manufactured products, or construction materials are not produced in the United States in sufficient and reasonably available quantities or of a satisfactory quality (a "nonavailability waiver"); or
3. The inclusion of iron, steel, manufactured products, or construction materials produced in the United States will increase the cost of the overall project by more than 25 percent (an "unreasonable cost waiver").[2]

4.3 To request a waiver, a Buy America Waiver Applicable (BAWA) shall be filled out by the Contractor and submitted to the respective District Construction Engineer for their approval.

[1] M-22-11 – Page 15.
[2] M-22-11 – Page 6.

4.3.1 If the Construction Engineer approves the BAWA, it shall be forwarded via memo to MCS&T, the State Purchasing Officer and FHWA.

4.3.2 The project shall file this BAWA in each respective Line-Item Folder in ProjectWise for the project.

4.3.3 Multiple items may be listed on the BAWA, though a separate request is required for each material being requested. For instance, if the same material is used on multiple lines, one BAWA may be used for that material, with each line listed, though if a line has multiple materials, a BAWA must be done for each material.

4.3.4 See Attachment 2 for a sample BAWA.

_____

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

MP 106.10.50 Steward – Materials Control Section
RLS:Bs
ATTACHMENTS

Certification of Buy America, Build America Compliance

Acme Manufacturing Company
123 Main Street
Charleston, WV 25302

Customer
Stark Construction Company
413 Kanawha Boulevard
Charleston, WV 25305

Ship Date: 10/31/2022

The below listed material meets all the requirements of all Federal and State Laws for Buy America, Build America, including but not limited to: 23 Chapter 5, Article 19 and Chapter 5A, Article 3 Section 56 of the West Virginia Code, 23 U.S.C. 313 Buy America, 23 CFR 635.410 Buy America Requirements and Buy America, Build America Act, Section 70914. If the event where the material does not meet these requirements, any payments made for the associated materials shall be returned to the Division.

This Certification of Compliance is for the material and project listed below:

CID: 22000005R1
Federal Number: B-0010(000)X
State Number: U002-00-1.00

Line: 0020	526.003.004 - Widget, Part Qi	500 Cubits
Line: 0025	596.003.004 - Widget, Part Hr	300 Cubits

_____
Jonathan Doe, Quality Assurance Manager

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA

Charleston, WV 25304
My Commission Expires October 16, 2027

Note: We will create a clean, PDF form for this.

Buy America, Build America Exception Waiver Application

Requesting Company:
Stark Construction Company
413 Kanawha Boulevard
Charleston, WV 25305

Request Date: 10/31/2022

Waiver Type: Unreasonable Cost (Nonavailability, Public Interest)

Stark Construction is requesting a Buy America, Build America Waiver Exception for the following materials for the listed contract. Justification for this exception is as follows:

Based on <Insert Waiver Type, Public Interest, Nonavailability, unreasonable cost>, the cost to use domestic Qi on this project will increase the project cost by 1XX percent. This cost increase includes all shipping. The cost of the material from each alternative source is attached to this application. The total cost of the contract for domestic widgets is $XX,XXX whereas the total cost of the contract for Canadian widgets is $XY,YYY.

CID: 22000005R1
Federal Number: CMAQ-0010(000)X
State Number: U002-00-1.00

Line: 0020	526.003.004 - Widget, Part Qi	500 Cubits
Line: 0120	526.003.004 - Widget, Part Qi	50 Cubits

_____
Jonathan Doe, Quality Assurance Manager

Approved Denied

_____
Jack Jones - District XX Construction Engineering

Note: We will create a clean, PDF form for this.

Location of Attachment 1 – M-22-11 – Will attach to final document.
Link to file: https://www.whitehouse.gov/wp-content/uploads/2022/04/M-22-11.pdf

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

MATERIALS CONTROL, SOILS AND TESTING DIVISION
MATERIALS PROCEDURE

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

1. PURPOSE

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

2. SCOPE

2.1 This procedure is applicable to circumstances where a construction item's testing documentation or samples are not submitted by the deadline established in this document. In the case of a general item, this timeframe is seven (7) days from the sampling date. The timeframe for special-case items such as gradations and cylinder breaks is noted in Attachment 1.

2.1.1 Beginning January 1, 2023, all of the following requirements shall be met to meet the above-defined timeframe:

2.1.1.1 Documentation submission includes (1) generating the sample in the Division Approved Sampling and Testing software (SiteManager, AASHTOWare Projects, etc.), (2) entering all data into this system, (3) presenting the data to the District for review and (4) providing all testing documentation.

~~2.1.1.1~~2.1.1.2 The Contractor may request to the Project, in writing a waiver for the requirements of 1-3. This must be done before any material is sampled or tested. If approved, the Project will be responsible for entering the testing data.

2.2 The penalty for an infraction as described in Section 2.1 is $700 per test. In the instance where a single test comprises of a prescribed series of sub-tests (typically 5), the cost of each infraction will be the standard rate divided by the total number of required sub-tests. This is only applicable in the certain circumstances as noted in Attachment 1.

2.2.1 This procedure is not limited to tests listed in Attachment 1, but applicable to any material test required by the Standard Specifications and/or Materials Procedures. For this case, the Director will establish the timeframe for the test or may utilize the standard timeframe as described in Section 2.1. The rate shall follow Section 2.2.

3. ABSENT TESTING DOCUMENTATION OR FAILURE TO TEST

3.1 In no case shall this Materials Procedure allow for the acceptance of non-tested material. In the case where no testing was performed, or no documentation was submitted for material, the resolution for the acceptance of the material shall be in accordance with the

applicable section(s) of the Standard Specifications and Materials Procedures. Additionally, and regardless of the outcomes of this resolution, a price assessment in accordance with Attachment 1 shall also be assessed.

_____

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

MP 109.00.21 Steward – Materials Control Section
RLS:B
ATTACHMENT

Cost Penalties Per Test

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

*T - Standard timeframe as described in Section 2.1

*Rate - Standard rate as described in Section 2.2

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

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

MATERIALS PROCEDURE

CRITERIA TO APPROVE PLAIN REINFORCING STEEL BARS USED IN CONCRETE

1. PURPOSE

1.1 To establish procedures for qualifying manufactures of plain steel reinforcing bars acceptable for use on West Virginia Division of Highways (WVDOH) projects.

1.2 To establish a procedure for maintaining a record of such information.

1.3 To establish a procedure for transmitting such information to the WVDOH Personnel and contractors on WVDOH projects.

2. SCOPE

2.1 This procedure shall apply to all manufactures who produce plain uncoated reinforcing steel bars.

3. APPLICABLE DOCUMENTS

3.1 *WVDOH Specifications for Roads and Bridges, Section 709.1*

3.2 *National Transportation Product Evaluation Program "NTPEP"*

3.3 *American Association of State Highway and Transportation Officials "AASHTO" Section M31*

3.4 *WVDOH Form HL-468*

4. ACCEPTANCE PROCEDURE

4.1 With each shipment, of plain rebar material to a WVDOH project, the rebar manufacturer or distributor shall provide shipping documents which contain an Approved Source List (APL) source lab number reflecting materials meeting quality specified by the WVDOH.

5. ACCEPTANCE PROCEDURE (APPROVED SOURCE)

5.1 For a new manufacturer to be considered as an approved source of plain rebar, the manufacturer must comply with the following requirements.

5.2 The manufacturer is to complete form HL-468 attainable from the website: https://transportation.wv.gov/highways/mcst/Pages/newproduct_evaluationprocedure.aspx and submit it to the WVDOH Materials Control, Soils and Testing (MCS&T) division new products email address, indicating intention to be included on the WVDOH APL as an approved source manufacturer of plain rebar.

5.3 The manufacturer is to submit a current certificate indicating membership and compliance with the National Transportation Product Evaluation Program "NTPEP" requirements for Reinforcing Steel and Wire. Additionally, audits are to be performed at the product manufacturer's facility and encompass a detailed review of the quality management system, production process, and testing capabilities.

5.4 After the NTPEP compliance documents have been evaluated, the Division will conduct quality assurance (QA) sampling at the source to verify compliance to AASHTO M31. This Division QA sampling and testing shall be performed prior to source approval and once a year thereafter. Division QA sampling shall consist of 3 bars with a minimum length of three feet, from 5 separate heats, all sampling shall be unbiased and sampled randomly from the most recent stocks or straight from production. Sampling may also be done from a WVDOH project location, should material be available at the project site.

5.5 If laboratory testing meets or exceeds the requirements of AASHTO M31, the manufacturer will be assigned a seven-digit approved source number and be placed on the APL for plain rebar. This approval will be active for one year.

5.6 If testing outlined in Section 5.4 is performed on material supplied by a manufacturer who is not on the APL, and the testing does not meet the requirements of AASHTO M31, or the manufacturer is not in compliance with NTPEP requirements, the manufacturer will not be added to the APL.

5.6.1 If testing outlined in Section 5.4 is performed on material supplied by a manufacturer who is on the APL, and the testing does not meet the requirements of AASHTO M31, or the manufacturer is not in compliance with NTPEP requirements, the manufacturer will be removed from the APL. Also, any material from that manufacturer that is supplied to WVDOH projects, after the date on which it was determined that the AASHTO M31 or NTPEP requirements were not met, will be rejected from those WVDOH projects.

5.6.2 If the manufacturer informs the WVDOH MCS&T Division in writing that issues causing noncompliance with NTPTP requirements and/or failure to meet the requirements of AASHTO M31 have been resolved, the manufacturer may request a reevaluation of their facility. That reevaluation shall be in accordance with sections 5.2 thru 5.5. If the results of that reevaluation confirm WVDOH requirements have been met, the manufacturer will be added to the APL.

5.7 If a manufacturer is currently listed on the APL for plain rebar, a yearly renewal evaluation of that manufacturer shall be conducted consisting of the above sections 5.3 thru 5.6.

6 DOCUMENTATION REPORT

6.1 The APL for "plain" reinforcing steel bars "rebar" used on WVDOH projects may be updated at any time with the addition of a new manufacturer, or with the removal of a manufacturer.

6.2 A current APL of reinforcing steel bar manufacturers is available accessing the current West Virginia Department of Transportation approved source list website: https://transportation.wv.gov/highways/mcst/Pages/APL_By_Number.aspx

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

RLS:Hl