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

MATERIALS PROCEDURE

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

1. PURPOSE

1.1. To provide a procedure to statistically compare Quality Control (QC) and Quality Assurance (QA) tests to verify the validity of the QC samples.

2. DEFINITIONS

2.1. System: The Division Approved Materials Tracking System.

2.2. Sample: The sample record test which has been documented in the System.

2.3. Quality Assurance (QA) Sample: Samples performed by the Division to evaluate for acceptance, a material on a Project.

2.4. Quality Control (QC) Sample: Samples performed by the Contractor for a material on a Project to demonstrate the material's compliance with the Specifications.

2.5. Verification: The process of statistically comparing a QA sample to a series of QC samples. This comparison serves to verify the validity of the QC testing. There are two approaches to this comparison:

2.5.1. Project Approach: A verification Data Set must contain all of the following:

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

2.5.2. System Approach: A verification Data Set must contain all of the following:

1. Material Source
2. Mix Design (If Applicable)

2.6. Data Set: The series QC and linked QA test result data that is statistically compared for verification. This data set includes all linked test data that follows the inclusion specified in Sections 2.5.1 and 2.5.2.

2.7. Linked Samples: This is a technical term for a process in the System which creates a data set among joined samples.

3. SCOPE

3.1. All QC samples for the following tests must be represented by a QA sample. These are to be evaluated in chronological order by a QA sample. No more than 10 QC samples shall be evaluated by a QA sample.

3.2. The following materials and their respective test(s) and test result(s) are evaluated by the specified approach.

3.2.1. Aggregate Gradations – Project Approach

1. Specification Sieves (each)
2. Pan (if applicable)

3.2.2. Marshall Asphalt Mixture – System Approach

1. Asphalt Content
2. Air Voids
3. VMA
4. Stability
5. Flow
6. Gradation (each Specification Sieve and Pan if applicable)

3.2.3. SuperPave Asphalt Mixture – System Approach

1. Asphalt Content
2. Air Voids
3. VMA
4. Gradation (each Specification Sieve and Pan if applicable)

3.2.4. Portland Cement Concrete – Project Approach

1. Air Content
2. Consistency
3. Strength

4. PROCEDURE

4.1. After completion of the QA sample, the test data shall be entered into the System. The QA sample shall be linked to the appropriate QC sample(s) as specified in Section 4.2. Note that all samples being linked must contain all respective test results for the material shown in Section 3 and meet the criteria stated in Sections 2.5.1 and 2.5.2.

4.1.1. If a system approach QA sample is performed and it covers multiple Districts, the QA sample shall be performed by the District in which the plant is located.

4.2. The samples shall be linked by the person creating the QA sample, based on the total number of QC samples. This will allow the System to create a data set and perform an evaluation (if applicable). For QA samples evaluating QC samples in the system approach, all QC samples taken after the last QA sample and up to the current QA sample shall be evaluated.

4.2.1. 1-4 QC Sample(s)

If there are less than five QC samples, they shall be linked, but no calculation shall be performed; The evaluation will be conducted as specified in Section 5.1

4.2.2. 5-10 QC Samples

If there are five to ten QC samples, they shall be linked; the data set shall consist of all of the available tests. The evaluation shall be conducted as specified in Section 5.2

4.2.3. 11 + Quality Control Samples

If there are eleven or more QC samples available, they shall be organized sequentially by date/time; only the first ten shall be linked. The data set shall consist of these ten samples. The evaluation shall be conducted as specified in Section 5.2.

An additional QA sample shall be completed, and the process shall be restarted independent of the prior evaluation. This extra date set shall be linked and evaluated according to the remaining QC samples.

4.2.3.1. For example, if 16 QC samples are taken, there shall be a QA sample for QC samples 1-10 and then another QA sample for QC samples11-16, which would be evaluated as "5-10" QC samples.

5. EVALUATION

5.1. If the data set contains less than 5 linked QC samples, no calculation shall be made. The test data shall be visually evaluated for significant variance. If a significant variance is noted, appropriate action shall be taken by the District as specified in Section 5.3.2.1. If there is no significant variance, the report shall indicate: "This sample, <sample number recorded here> has been reviewed in accordance with MP 700.00.54, and judged to be similar." If it is not similar, it's handled in accordance with Section 5.3.2.1.

5.2. If the data set contains 5 or more linked QC samples, they shall be evaluated by the System. No more than 10 QC samples shall be linked; if there are more than 10 QC samples, the System shall return an error.

5.2.1. The calculation and evaluation criteria used in the System are documented in Attachment 1.

5.3. Based on the calculation and evaluation criteria, the System shall report as follows:

5.3.1. If all the test results are evaluated as "Similar", the entire data set shall be judged "Similar".

5.3.2. If any of the test results in the set are evaluated as "Non-Similar", the entire data set shall be judged as "Non-Similar".

5.3.2.1. If the data set is "Non-Similar", the District Materials Supervisor shall perform and document the following for QC:

1. Review the sampling procedure.
2. Review the testing procedures.
3. Check testing equipment.
4. Review documentation.
5. Perform any additional investigations that may clarify the discrepancy.

6. REPORTING AND SAMPLE SUBMISSION

6.1. Once the evaluation is completed, the result shall be noted by the District on the QA sample.

6.2. If applicable, the sample shall also be marked by the District as “Pass” or “Fail” along with whether the data is “Similar” or “Non-Similar” as defined in Section 6.2.1 and 6.2.2.

6.2.1. If the data set is found to be “Similar”, the QA Sample shall be marked “Similar” in the System by the District.

6.2.2. If the data set is found to be “Non-Similar” the QA sample shall be marked “Non-Similar” in the System by the District.

6.2.2.1. If the Sample is marked “Non-Similar”, the documentation from Section 5.3.2.1 shall be submitted with the sample by the District, including the corrective action when applicable.

6.2.2.2. In the event that other documentation is needed to resolve the material, that information shall also be provided with the sample by the District.

6.3. The sample shall then be submitted by the District to the respective MCS&T Materials Regional Coordinator for final evaluation and approval.

6.4. A sample report is shown in Attachment 2.

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MP 700.00.54 Steward – Materials Control Section
MAM:B

Attachment 1: Sample Calculations

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

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

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

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

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

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

Attachment 2: Sample Evaluation Report

West Virginia
Department of Transportation

Marshall Verification Sample Evaluation Computation Sheet

Sample Record:
Material Name: Base 2/Wearing 4 Asphalt Mix, Marshall
Material Code: 401.002.000.05
Facility:

Laboratory ID:
Sample Date: 10/17/2024
Contract ID:

Sample Record Name	% Asphalt	% Air Voids	%VMA	Stability	Flow	Lab Reference Number	Open Sample Record
TKraf20241018080012	5.0	4.5	14.1	11,648	15.0	C7B2440	Click Here
TKraf20241022120955	5.1	2.2	12.3	12,642	15.3	C7B2441	Click Here
TKraf20241022121156	4.8	3.2	12.5	11,529	14.3	C7B2442	Click Here
TKraf20241022121345	5.0	2.0	12.0	11,633	15.5	C7B2444	Click Here
TKraf20241022121524	4.9	2.9	12.5	12,417	14.8	C7B2445	Click Here
TKraf20241108123059	5.3	2.0	12.5	12,337	15.7	C7B2448	Click Here
Average:	5.02	2.8	12.65	12034.33	15.1		**Records:** 6
Range:	0.5	2.5	2.1	1113	1.4		
Upper Limit Interval:	5.69	6.13	15.44	13514.62	16.96		
Lower Limit Interval:	4.36	0	9.86	10554.04	13.24		

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