

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

PROCEDURE FOR EVALUATING PROCESS CONTROL TEST RESULTS OF
AGGREGATE GRADATIONS, ASPHALT MIXES AND PORTLAND CEMENT CONCRETE

- 1.0 PURPOSE
 - 1.1 To provide a procedure for the comparison of the contractors process control test results with the District's acceptance test results.
 - 2.0 SCOPE
 - 2.1 This procedure for the comparison of the contractors process control test results with the Division's acceptance test results.
 - 2.2 Asphalt Mixes
 - 2.2.1 Grading of Extracted Aggregates
 - 2.2.2 Asphalt Content
 - 2.3 Portland Cement Concrete
 - 2.3.1 Air Content
 - 2.3.2 Consistency (Slump)
 - 3.0 PROCEDURE
- The following procedure shall be implemented by the Division Materials Engineer/Supervisor.
- 3.1 Immediately after completion of the acceptance sample test results, they shall be compared with process control test data for the same item. The comparisons shall be made in the following manner (also see sample computation sheets. pages 6,7, and 8).

3.1.1 If there are more than ten process control samples available, determine the average of the ten consecutive process control samples ($\bar{X}_{10}$) whose midpoint is nearest, chronologically, to the acceptance sample. Should there only be five to ten process control samples, then determine the average of all of the available consecutive process control test results. When comparing the grading characteristics of aggregate and asphalt mixes, the average ($\bar{X}$) for each sieve will be determined.

3.1.1.1

In the event there are less than five process control samples available when the acceptance sample is complete, the District Materials Supervisor will make an informal review of the data. If the data is such that a dissimilarity appears obvious (even without the formal comparison), then Section 3.4 of this procedure would still apply. If, however, the acceptance sample results appear to be similar to the process control sample results, then the acceptance sample would be judged at this point by the District Materials Supervisor to be similar, and the applicable portions of Section 4.1 of this procedure would apply with the following statement: "This acceptance sample (acceptance sample number) has been judged to be similar in accordance with Section 3.1.1.1 of MP 700.00.54."

3.1.2

Determine the range (R) of the process control samples used in Section 3.1.1 by subtracting the smallest test value from the largest test value. When comparing the grading characteristics of aggregate and asphalt mixes, the range (R) for each sieve will be determined.

3.1.3

Compute the interval (I) by substituting into the proper equation below the values calculated in Sections 3.1.1 and 3.1.2. When comparing the grading characteristics of aggregate and asphalt mixes, the interval (I) for each sieve will be determined.

No. of Samples Used in
 Calculating the Average
 in Section 3.1.1
 Equation for Computing
 the Interval (I)

10	$I = \bar{X}_{10} \pm 0.91 R$
9	$I = \bar{X}_9 \pm 0.97 R$
8	$I = \bar{X}_8 \pm 1.05 R$
7	$I = \bar{X}_7 \pm 1.17 R$
6	$I = \bar{X}_6 \pm 1.33 R$
5	$I = \bar{X}_5 \pm 1.61 R$

The interval (I) is determined by, (1) adding the average $(\bar{x})$ to the product of the range (R) times the given constant (this determines the upper limit of the interval/ if the result obtained here is greater than 100, it shall be recorded as 100), and (2) subtracting the product of the constant times the range (R) from the average $(\bar{x})$. This determines the lower limit of the interval (I). If the result obtained here is a negative value, it shall be recorded as zero.

3.1.4

Compare the acceptance sample test result with the calculated interval (I). When comparing the grading characteristics of aggregate and aggregate in asphalt mixes, a comparison for each sieve will be determined.

3.2

If the acceptance sample is Portland Cement Concrete, and both air content and consistency coincide with or lie between the upper and lower limits of their interval, the process control samples will be considered to be similar to the acceptance sample.

If the acceptance sample is an aggregate or an aggregate or asphalt mix, and the asphalt content and all sieve results coincide with or lie between the upper and lower limits of their interval, the process control samples will be considered to be similar to the acceptance sample.

3.3

If the acceptance sample is Portland Cement Concrete, and one or both of the compared test results are not similar to the process control data, the process control samples would be considered to be dissimilar to the acceptance sample.

3.4

If the acceptance sample is dissimilar to the process control samples, the following actions should be taken:

If the acceptance sample is an aggregate or an aggregate or asphalt mix, and any one of the compared values are not similar to the process control data, the process control samples would be considered to be dissimilar to the acceptance sample.

- (a) Process control sampling procedures (are, are not) in accordance with the applicable directives.
- (b) Process control testing procedures (are, are not) in accordance with applicable directives.
- (c) Testing equipment (is, is not) in proper working order.

If the acceptance sample is dissimilar to the process control samples, the investigation described under Subsection 3.4 shall be documentation the reverse side, or attached to, the original acceptance test report in the following manner, omitting the word(s) in parentheses which do not apply. A copy of all calculations specified in Subsections 3.1.1 through and including 3.1.3 using the format illustrated on the sample computation sheets should also accompany this test report.

If the acceptance sample is found to be similar to the process control samples, proof of the similarity must be shown on the back of, or attached to, the original acceptance sample test report, showing all the calculations specified in 3.1.1 through 3.1.3 using the format illustrated on the appropriate sample computation sheet. The report should be signed by the District Materials Supervisor and distributed as specified in Sections 4.5 and 4.6.

REPORTING

- (a) Review the process control sampling procedures.
- (b) Review the process control testing procedures.
- (c) Check testing equipment.
- (d) Review computations.
- (e) Review documentation.
- (f) Perform any additional investigations which might clarify the dissimilarity.

- (d) Computations (are, are not) correctly performed.
- (e) Documentation (is, is not) properly performed.
- (f) Report any other information that may have been determined in accordance with Section 3.4 (f).

4.3 All negative replies noted above must be explained. This would include a brief statement of the action taken to correct the deficiency. In the event other documentation is needed - such as a District Materials Inspection Report - to explain and/or support the final resolution of a dissimilarity, the dissimilar acceptance sample number should be referenced thereon.

4.4 Results of the investigation reported will be signed by the District Materials Engineer/Supervisor.

4.5 On the test report at the bottom should be typed the following: "Issued by District (Number), per MP 700.00.54, (Date)".

4.6 The signed, issued report should be prepared in triplicate and distributed as follows:

4.6.1 Original copy to Materials Control, Soil and Testing Division, 312 Michigan Ave., Charleston, WV 25311.

4.6.2 One copy to the project or source file, whichever is applicable.

4.6.3 One copy to the District Materials file.

Gary L. Robson, Director
Materials Control, Soil
and Testing Division

GLR:kh

ATTACHMENTS

MP 700.00.54
 REPLACES ML 27 AND ML 31
 ORIGINAL ISSUANCE: JULY 1991
 REISSUED: JANUARY 1995
 ATTACHMENT 1
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COMPUTATION SHEET
 (PORTLAND CEMENT CONCRETE)
 (SAMPLE)

Process Control
 Consistency
 ID or Laboratory Number
 Date
 Content
 (Slump)

Average	(X ₁₀)	Average	(X ₁₀)	Constant	X	Range	(I)	A.S.	Result	Similarity
01	09-15-1987	6.2	60							
02	09-16-1987	7.0	66							
03	09-16-1987	5.2	60							
04	09-17-1987	6.4	78							
05	09-17-1987	5.0	66							
06	09-18-1987	5.8	54							
07	09-22-1987	5.4	60							
08	09-22-1987	4.4	66							
09	09-23-1987	6.0	78							
10	09-24-1987	6.0	60							
Average		5.74	64.8							

Property	Average	(X ₁₀)	+	Constant	X	Range	(I)	A.S.	Result	Similarity
Air	5.74	0.91	2.6	8.1**	7.6	Yes				
Content	5.74	0.91	2.6	8.1**	7.6	Yes				
Consistency	64.8	0.91	34	99 ***	78	Yes				

NOTE: If ID of field sample number is recorded only on the ST-12 form, record in sequence the date and time the tests were conducted.
 NOTE: If all replies in the "Similarity" column are "Yes", take action specified in Section 4.1. If one or more replies in this column are "No", take action specified in Section 4.2.

* Acceptance Sample
 ** Round calculated air content to nearest 0.1%
 *** Round calculated consistency values to nearest 1 mm

COMPUTATION SHEET
(ASPHALT MIXES)
(SAMPLE)

Process	Control	Lab. No.	Date	50	37.5	19.0	9.5	4.75	1.18	300	75	Bitumen
C3-68282	10-01-87	100	90	60	40	36	22	4	1.1	3.8		
C3-68321	10-01-87	100	91	73	50	32	23	7	3.0	4.3		
C3-68342	10-02-87	100	90	66	43	33	24	7	1.6	3.5		
C3-68351	10-06-87	100	90	67	47	38	28	9	2.5	4.0		
C3-68357	10-06-87	100	98	68	46	35	25	7	1.5	4.2		
C3-69384	10-07-87	100	93	62	42	35	24	7	1.8	4.0		
C3-69400	10-08-87	100	88	64	40	32	24	7	1.2	4.0		
C3-69417	10-09-87	100	94	63	40	34	25	6	1.6	4.0		
C3-69428	10-13-87	100	86	65	46	37	24	8	1.8	4.5		
C3-69427	10-14-87	100	95	67	48	39	29	9	1.6	4.3		
Average	(X ₁₀)	100	91.5	65.5	44.2	35.1	24.8	7.1	1.77	4.06		
Property	Average	(X ₁₀)	Constant	Range	Interval	A.S.*	Result	Similarity	Yes/No			

50	mm	100	0.91	0	100	100	Yes
37.5	mm	91.5	0.91	12	100	81	Yes
19.0	mm	65.5	0.91	13	77	54	Yes
9.5	mm	44.2	0.91	10	53	35	Yes
4.75	mm	35.1	0.91	7	41	29	Yes
1.18	mm	24.8	0.91	7	31	18	Yes
300	µm	7.1	0.91	5	12	3	Yes
75	µm	1.77	0.91	1.9	3.5	0.0	Yes
Asphalt		4.06	0.91	1.00	5.0	3.2	Yes

NOTE: If all replies in the "Similarity" column are "Yes", take action specified in Section 4.1. If one or more replies in this column are "No", take action specified in Section 4.2.

* Acceptance Sample

** All calculated intervals are rounded to the nearest whole number except the 75 µm sieve and the asphalt content which are rounded to the nearest 0.1.

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 ATTACHMENT 3
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COMPUTATION SHEET
 (AGGREGATE GRADATIONS)
 (SAMPLE)

Process Control Laboratory Number Date 37.5 25.0 12.5 4.75 2.36 75 µm

C1-57698	08-10-87	100	100	25	4	2	0.6
C1-57972	08-10-87	100	100	30	2	2	0.6
C1-58793	08-11-87	100	99	28	2	1	0.4
C1-58845	08-11-87	100	99	49	8	2	1.0
C1-76068	08-12-87	100	100	32	2	1	0.5
C1-76271	08-12-87	100	100	36	1	1	0.6
C1-78174	08-12-87	100	100	42	2	2	0.7
C1-78232	08-12-87	100	100	19	1	1	0.5
C1-78496	08-12-87	100	100	36	2	2	0.3
C1-78541	08-12-87	100	100	43	1	1	0.5

Sieve Size	Average $(X_{10}) \pm$	Constant $(0.91) \times$	Range (R) =	Interval (I)	A.S.* Result	Similarity Yes/No
37.5 mm	100	0.91	0	100	100	Yes
25.0 mm	99.8	0.91	1	100	100	Yes
12.5 mm	34.0	0.91	30	61	24	Yes
4.75 mm	2.5	0.91	7	9	2	Yes
2.36 mm	1.5	0.91	1	2	1	Yes
75 µm	0.57	0.91	0.7	1.2	0.4	Yes

NOTE: If all replies in the "Similarity" column are "Yes", take action specified in Section 4.1. If one or more replies in this column are "No", take action specified in Section 4.2.

* Acceptance Sample

** All calculated intervals are rounded to the nearest whole number except the 75 µm sieve is rounded to the nearest 0.1.