Colorado Procedure 13-22

Standard Procedure for

Check Testing

1.   SCOPE

1.1   The purpose of check testing is to compare the testing equipment and personnel that will be used according to the contract. With the successful completion of check testing within acceptable limits, both the Engineer and the Contractor should have confidence in test results. This procedure can be used at any time the Engineer needs to determine a level of confidence in test results between two or more sets of testing equipment and personnel.

2.   REFERENCED DOCUMENTS

CDOT Quality Assurance Program for Construction and Materials Sampling and Testing.
An Investigative Study of the CDOT Asphalt Mixture Design Procedure, October 1993, Aguirre Engineers, Inc.
Spring 1998 Round Robin Results, October 1998, by Bob LaForce, CDOT.
Sixth Annual Report: HBP QC&QA Projects Constructed in 1997 Under QPM2 Specifications, May 1998, by Bud A. Brakey, CDOT.

HBP QA/QC Pilot Projects Constructed in 1993, May 1994, by Bud A. Brakey, CDOT.

HBP Pilot Void Acceptance Projects in Region 2 in 1997, May 1998, by Bud A. Brakey, CDOT.

ASTM C 39, Compressive Strength of Cylindrical Concrete Specimens.

AASHTO T 97, Flexural Strength of Concrete Using Simple Beam with Third-Point Loading.

AASHTO T 99, The Moisture-Density Relations of Soils Using a 2.5 kg Rammer and a 305 mm Drop.

Surface Moisture-Density Gauges, November 1992, Troxler Electronic Laboratories, Inc.

Gyratory Task Force, MAC Minutes of 03/08/00

ASTM E177, Standard Practice for Use of the Terms Precision and Bias in ASTM Test Methods.

ASTM E 691, Standard Practice for Conducting an Inter-Laboratory Study to Determine the Precision of a Test Method.

3. DEFINITIONS

3.1 Base Data - The historical standard deviation (σ) between two operators performing a test on split samples of the same material. This is shown in Column 1 of Table 13-1.

3.2 Maximum Difference - The expected difference between two operators performing a test on split samples of the same material (δ) is calculated by multiplying σ by 1.96 times the square root of two. This is shown in Column 2 of Table 13-1.

3.3 Acceptable Check Test Limit - The limit for check tests is the maximum difference between the averages of the absolute values of differences of five tests performed by two different operators on split samples (δ′) and is calculated by dividing δ by the square root of five. This is shown in Column 3 of Table 13-1. For any given element and number of tests (n) greater than 1 performed on a split sample, the acceptable check test limit can be calculated by dividing Column 2 of Table 13-1 by the square root of n.

3.4 Check Test Limit / HMA In-Place Density - Since seven split samples are used to correlate nuclear gauges on HMA pavements, the acceptable limit for check tests is the difference between the averages of the absolute values of the differences of seven tests performed by two different operators on split samples and is calculated by dividing δ (Column 2) by the square root of seven. This is shown in the junction of the row In-Place Density HMA and Column 3 of Table 13-1.

4. APPARATUS, SAMPLING, AND TESTING PROCEDURES

4.1 Apparatus, sampling, and testing procedures are described in the specified procedure for the subject tests. Samples used in check testing do not need to be from random samples nor do they need to represent any certain project of location. Samples should be split samples or as close to identical as possible. Samples are split according to splitting procedures for the subject material. If tests are to be taken on the material in place, then the tests shall be taken at the same place.

4.2 When successful check test results are derived from previous check testing efforts, the results may be used instead of new check testing as agreed upon in writing by the Engineer and the Contractor, and as approved by the Region Materials Engineer. This will only be allowed when the same equipment and same testers are used out of a fixed lab.

5. PROCEDURE

5.1 The subject test is performed on at least five split samples. In the case of in-place density of HMA pavements, seven test locations are used.

5.2 Calculate the absolute values of the differences between test results on each sample.

5.3 Calculate the average of the absolute values determined in 5.2.

5.4 Results of 5.3 are compared to acceptable limits for check tests as shown in Column 3 of Table 13-1.

5.5   Column 3 of Table 13-1 shows the acceptable limits for check tests of some materials used in roadway construction. Other values for the acceptable limits for check tests can be derived by following the procedure used to derive values for Table 13-1 and stated in the Definitions.

Example: Check Testing Program results and calculations for Asphalt Content

Split Sample "n"	PC Tester	OA Tester	Absolute Value of Difference $|PC_n - OA_n|$
1	6.03%	6.19%	0.16%
2	6.15%	5.97%	0.18%
3	6.09%	6.20%	0.11%
4	5.92%	6.25%	0.33%
5	6.20%	6.11%	0.09%

A. **Compare each $|PC_n - OA_n|$ with appropriate value from Column 2 of Table 13-1**
   Each $|PC_n - OA_n|$ < 0.69% (Column 2 for Asphalt Content), so each test is within the necessary range.

B. **Calculate Average of Absolute Value of Differences:**
   (0.16% + 0.18% + 0.11% + 0.33% + 0.09%) / 5 = 0.17%

C. **Compare value from "B" with appropriate value in Column 3 of Table 13-1**
   0.17% < 0.31% (from Column 3 for Asphalt Content); therefore, results of the Check Testing Program for this element are acceptable.

Note 1: The values in Table 13-1 were reviewed at the 2018 FMM Meeting for accuracy and intent. There is no direct correlation between Table 13-1 and Table IA-1, IA Comparison Precision Guide.

Note 2: Compressive Strength and Flexural Strength Elements (Procedures) are performed per Standard Specification Subsection 106.06 (d).

Note 3: For inter-laboratory (multiple laboratories) test results, the expected difference shall be calculated by multiplying Column 1 by the factor 1.96 times the square root of 2.

TABLE 13-1
Acceptable Limits of Two Laboratory Test Precision

Element (Procedure)	Column 1 σ (Base Data, two operators, split sample)	Column 2 δ (Maximum Difference, split-sample)	Column 3 δ´ (Acceptable Check Test Limit)
Asphalt Content [Nuclear Method] (CP 85)	0.25%	0.69%	0.31%
Asphalt Content [Ignition Method] (CP-L 5120)	0.25%	0.69%	0.31%
HMA #4 Sieve (CP 31)	2.04%	5.65%	2.53%
HMA #8 Sieve (CP 31)	1.92%	5.32%	2.38%
HMA #200 Sieve (CP 31)	0.56%	1.55%	0.69%
HMA Voids in the Mineral Aggregate (CP 48)	0.40%	1.11%	0.50%
HMA Air Voids (CP-L 5115)	0.37%	1.03%	0.46%
HMA Hveem Stability (CP-L 5106)	3.9	10.8	4.8
HMA Maximum Specific Gravity (CP 51)	.009	.025	.011
In-Place Density HMA (CP 44) (CP 81)	0.70% 0.72%	1.94% 2.00%	0.87% 0.89%
Longitudinal Joint Density (CP 44)	1.29 %	3.58%	1.60%
Compressive Strength PCCP (ASTM C 39)	192 psi (1324 KPa)	532 psi (3670 KPa)	238 psi (1641 KPa)
Sand Equivalent (CP 37)	3 points	8 points	4 points
Flexural Strength PCCP (AASHTO T 97)	44 psi (303 KPa)	122 psi (840 KPa)	55 psi (376 KPa)
In-Place Density Soils (CP 80)	0.34 pcf (5450 g/m^3)	0.94 pcf (15107 g/ g/m^3)	0.42 pcf (6756 g/m^3)
In-Place Soil Moisture (CP 80)	0.45 pcf (7210 g/m^3)	1.25 pcf (19985 g/m^3)	0.56 pcf (8938 g/m^3)

FIELD MANAGEMENT OF TEST RESULTS
ASPHALT CHECK TESTING

CP 16: Management of Consultant Materials Testing	**CP 10**: Qualifications of Testing Personnel and Laboratories	**CP-L 5101**: Verification of Laboratory Equipment	To be completed prior to production

Phone numbers, Distribution lists, Third party testing (split cost 50/50)

Current LabCAT

CP 13: Procedure for check testing %AC, VMA, Voids, Density — To be completed prior to or in conjunction with first 500 tons

Comparative tests within tolerance? → No → Cycle 1 / Cycle 2 / Cycle 3

Yes

Density
Iterate in field until favorably compare

%AC, VMA, Voids
Check sample splitting. Recommend Gilson large sample splitter. Discuss and check test methods and specimen preparation (e.g. scoop vs. quartering)

Check Rice, calculations, weights, oven temperatures, loading methods & timing. Visual inspection of samples

Notify Prime Contractor, Supplier, Project Engineer, Region Materials Engineer

Check Thermometers, Rice vacuum, obvious probable causes. Test results available. Inspect PC/OA Lab (possibly CDOT IAT)

Cycle 3:
Identify factors that do not agree. Establish priority of test results; Rice, Voids, %AC, VMA, Hveem

Notify Third Party Tester. Arrange a split of new sample

Establish time & date for formal PC/OA Lab visit. Check gyratory compactor calibration

Conduct formal PC/OA Lab visit. (Knowledgeable parties with representatives from supplier, CDOT & third party lab).

Proceed with production. Conduct weekly meetings per **CP16**

If no resolution on 3rd Cycle, redo Cycle 3 with Lab Prepared Sample (prepared by third party).