METHODS OF SAMPLING AND TESTING
MT 602-23
ACCEPTANCE, INDEPENDENT ASSURANCE, AND FINAL RECORD SAMPLING

1 SCOPE

1.1 This test method describes the Acceptance and Independent Assurance program portions of MDT's Quality Assurance Program as required by 23 CFR § 637, laboratory proficiency testing and inspections, and final record sampling.

1.2 The Acceptance Program consists of the sampling frequency and testing requirements as provided in MT 601.

1.3 The Independent Assurance (IA) Program consists of comparison samples (IACs) as outlined in MT 601 and procedural samples (IAPs) as described in this test method.

2 REFERENCE DOCUMENTS

ASTM
D5821 Determining the Percentage of Fractured Particles in Coarse Aggregate

MT Materials Manual
MT 226 Maximum Acceptable Deviations in Sieve Analysis of IA Samples
MT 601 Materials Sampling, Testing and Acceptance Guide
MT 606 Random Sampling Techniques

3 ACCEPTANCE PROGRAM

Acceptance sampling and testing are the principal means to assure materials and workmanship are in accordance with the contract specifications. Random sampling and testing are performed in accordance with MT 601 to ensure the quality of materials being incorporated, or proposed for incorporation, into a construction project meet contract specifications. The number of samples and the distribution of the locations from which samples are taken should be representative of the materials incorporated to ensure the materials are acceptable and in accordance with the contract requirements.

Sampling and testing frequencies listed in MT 601 are a minimum. As job conditions vary, such as the uniformity of materials at the source, the methods and equipment used, or weather conditions, additional sampling and testing can be requested by MDT personnel.

Acceptance sampling and testing may be any of the following:

- Samples of materials witnessed, taken, and/or tested by MDT personnel or delegated inspection agency.
- Samples taken and/or tested by the manufacturer or supplier with test results or certificates submitted to the Department.

4 INDEPENDENT ASSURANCE (IA) PROGRAM

4.1 Per 23 CFR § 637, an Independent Assurance Program is defined as activities that are an unbiased and independent evaluation of all the sampling and testing procedures used in the acceptance program.

IA test results are not used directly for determining the quality and acceptability of the materials and workmanship on a project; instead, IA test results serve as checks on the reliability of the results obtained from project acceptance sampling and testing.

The elements of the Department's IA Program are as follows.

- Comparison sample sampling and testing frequencies as established in MT 601.
- Prompt comparison and documentation of test results obtained from comparison sample and proficiency sample evaluations.
- Department established tolerances for the comparison of test results of comparison samples and proficiency samples.
- Evaluation of testing personnel and procedures through observation.
- Testing equipment evaluation using calibration checks, comparison samples, and proficiency samples.

4.2 Independent Assurance Comparison (IAC) Samples

4.2.1 Description

IAC samples are performed to verify conformance with testing procedures through comparison of test results on equivalent samples.

4.2.2 Purpose

IACs are used to assess accuracy among all personnel performing acceptance sampling and testing on behalf of MDT through evaluating testing procedures and equipment. IACs are conducted on a project basis.

IAC results are not used directly for determining the quality and acceptability of the materials on a project. Acceptance test results take precedence in the event of conflicting results unless extenuating circumstances are identified.

4.2.3 Frequency

MT 601 lists the minimum frequencies at which IAC samples are conducted and the test methods to be performed. IAC frequencies in MT 601 are reviewed and approved by the FHWA.

4.2.4 Responsibility

IACs are a joint effort between Field Construction technicians, District/Area Materials Lab technicians, and MDT Materials Headquarter technicians. IAC requirements apply to all persons conducting acceptance sampling and testing on behalf of MDT.

4.2.5 Sampling

IAC samples are taken at random following the procedures in MT 606 from materials or from construction work in progress and are not intended to check compliance with specifications. They are taken and tested to provide an independent spot check of the accuracy and effectiveness of the results obtained in acceptance sampling and testing.

Independent assurance samples must be the same sample, or taken at the same place, by the same method as routine acceptance samples.

If the sample is to be used for acceptance testing and an IAC sample is required, the technician performing acceptance testing will take a sample, perform the initial acceptance test, and document the results. This sample then becomes the IAC sample that will be tested by the District/Area Materials Lab or MDT Materials Headquarters lab, or both. To maintain the integrity of the sample, it is critical that all materials used for testing (with the exceptions of the wash sample and fracture sample) be recombined to their original configuration prior to transferring to the next testing facility.

IAC samples are to be continuously in the custody or under the observation of properly trained personnel not associated with acceptance sampling until they are shipped or delivered to the District/Area Laboratory or the Materials Bureau for testing.

4.2.6 Fracture Samples

Once a fracture sample is split from the original field sample to an appropriate size, prepared, and tested, that discreet sample will be bagged separately, to eliminate inherent variability in splitting the sample and sent to the next lab, either District or HQ, for continued IA testing.

4.2.7 Testing IAC Samples

The IAC sample must be transported/shipped to the laboratory and tested without delay following the method specified in MT 601. Ensure that the testing equipment is calibrated and in good condition before use.

All initial testing should be done between the field, District Lab, and Headquarters lab within 30 calendar days of sample date. If the results are out of tolerance (provided in Table 1 below), all reruns and investigations need to be complete within 30 calendar days of the initial results being reported.

4.2.8 Evaluating IAC Samples

IA sample comparisons will be conducted by the Materials QA Unit. The allowable tolerances for each test method used in the evaluation process are shown in Table 1 below.

Any unsatisfactory results will be reported to the appropriate Laboratory Supervisor to rerun the test, identify the cause, and determine if any corrective action is needed. If a root cause cannot be identified, and the comparison is still outside the allowable tolerance, the Materials QA Unit must be notified within five (5) working days so a follow-up IAC investigation can be initiated to ensure that all equipment was operated correctly and procedures were followed correctly.

Every effort should be made to correct equipment and/or procedural problems immediately. The IAC must be repeated until the problem is corrected, and a satisfactory IAC is obtained. Once a root cause is determined, document the corrective action(s) taken to the respective project file and send a copy to the Inspection Operations Supervisor.

4.2.9 Allowable Tolerances

Department IAC allowable tolerances are provided in the following table.

Table 1. Allowable Tolerances for IACs

Material Category	Test Method	Reference Document	Tolerance
Aggregate	MT 202 Sieve Analysis for Fine and Coarse Aggregate	MT 226	Refer to MT 226 for acceptable deviation
Aggregate Surfacing	MT 202 Sieve Analysis for Fine and Coarse Aggregate	MT 226	Refer to MT 226 for acceptable deviation
Aggregate Surfacing	AASHTO T 89 Determining the Liquid Limit of Soils	N/A	Multi-laboratory results differ by more than 13% of their mean
Aggregate Surfacing	AASHTO T 90 Determining the Plastic Limit and Plasticity Index of Soils	N/A	Multi-laboratory results differ by more than 18% of their mean
Aggregate Surfacing	AASHTO T 335 Determining the Percentage of Fracture in Coarse Aggregate	ASTM D5821	Multi-laboratory results differ by more than 14.7% of their mean

Results of IAC's, including corrective action(s), are recorded in AASHTOWare Project. Tolerances are calculated as follows.

Liquid Limit (AASHTO T 89) Pass/Fail Equation

$$D = \frac{(L1 + L2 + L3)}{N} * 0.13$$

Plastic Limit (AASHTO T 90) Pass/Fail Equation

$$D = \frac{(L1 + L2 + L3)}{N} * 0.18$$

Fracture Test Pass/Fail Equation (AASHTO T 335)

$$D = \frac{(L1 + L2 + L3)}{N} * 0.147$$

Where:
D = Allowable difference between results
L# = Participating labs test result
N = Number of participating labs (will be 2 or 3)

4.3 Independent Assurance Procedural (IAP) Evaluations

4.3.1 Description

IAP evaluations are performed to verify conformance with contract standards and testing criteria through review of test procedures. The IAP will be conducted while the tester is in the process of running normal acceptance testing. The specified procedure must be followed in all cases.

Note – See section 106.01.2(B) Materials Accepted by Department Testing in the Standard Specifications for the order of testing precedence if there is any disagreement as to which test method to use.

4.3.2 Purpose

IAPs are conducted to witness the sampling and testing and to verify that proper procedures are being followed. The calibration and condition of sampling and testing equipment used should be carefully checked. IAPs are conducted on an individual basis systematically.

4.3.3 Frequency

IAP checks should be performed at a minimum of once per calendar year on every individual who performed that specific testing during that calendar year. For example, if John says he did concrete testing on May 12th, he would need a concrete IAP before the end of the year if he hadn't already performed an IAP that calendar year.

4.3.4 Tests Methods

IAP checks are performed on the following materials and test methods.

Table 2. Materials and Test Methods for IAPs

Material Category	MT Test Method	AASHTO Test Method
Asphalt Mixtures and Binder	N/A	AASHTO R 47 Reducing Samples of Asphalt Mixtures to Testing Size
	N/A	AASHTO T 166 Bulk Specific Gravity (Gmb) of Compacted Asphalt Mixtures Using Saturated Surface Dry Specimens
	MT 319 Determining the Asphalt Binder Content of PMS by the Ignition Method	AASHTO T 308 Determining the Asphalt Binder Content of Asphalt Mixtures by the Ignition Method
	MT 320 Mechanical Analysis of Aggregate Recovered from Ignition Oven Burn	AASHTO T 30 Mechanical Analysis of Extracted Aggregate
	MT 321 Determining Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures – “Rice Gravity”	AASHTO T 209 Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt (HMA) Paving Mixtures
	MT 332 Determining the Percent of Adhesion of Bituminous Materials to Aggregate	AASHTO T 312 Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor
	MT 302 Sampling and Testing Bituminous Materials	AASHTRO R 66 Sampling Asphalt Mixtures
Concrete	N/A	AASHTO R 60 Sampling of Fresh Concrete
	N/A	AASHTO T 152 Air Content of Freshly Mixed Concrete by the Pressure Method
	N/A	AASHTO T 121 Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete
	N/A	AASHTO T 119 Slump of Hydraulic Cement Concrete
	N/A	AASHTO T 309 Temperature of Freshly Mixed Portland Cement Concrete
	MT 101 Making and Curing Concrete Compressive and Flexural Strength Test Specimens in the Field	AASHTO R 100 Making and Curing Concrete Test Specimens in the Field
	MT 117 Making and Curing Concrete Compressive and Flexural Strength Test Specimens in the Field for Self-Consolidating Concrete (SCC)	AASHTO R 100 Making and Curing Concrete Test Specimens in the Field
Embankment	MT 212 Determination of Moisture and Density of In-Place Materials	AASHTO T 310 In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

4.3.5 Responsibility

IAP evaluations are a joint effort between the District/Area Materials Lab Supervisors, Area Lab Coordinators, District and Area Lab Technicians, and MDT Materials Headquarter personnel. IAP requirements apply to all persons conducting acceptance sampling and testing on behalf of MDT. IAP's must be performed by personnel not normally involved in the acceptance testing of the project.

4.3.6 Unsatisfactory IAP

IAP evaluations that are considered unsatisfactory must be reviewed and investigated as necessary by the appropriate District Materials Supervisor or MDT Materials Headquarter personnel to identify the cause and corrective action needed. Document any corrective action(s) and send a copy to the Inspection Operations Supervisor. Unsatisfactory IAP evaluations should be brought to the attention of the respective Project Manager.

Any of the following situations are typical causes of an unsatisfactory IAP.

- Tester not having proper certification (WAQTC and/or radiation safety) to perform testing
- Improper equipment to conduct sampling and testing
- Equipment improperly calibrated or not in good working condition
- Sampling and testing not conducted according to specified methods
- Reluctance to participate in an IAP (Indicate refusal in the remarks section of the IAP report)

Personnel evaluating the IAP will explain to the tester at the time of testing why the test was unsatisfactory and how it needs to be corrected. At the discretion of the evaluator, the IAP can be repeated one time to achieve a satisfactory IAP. If a satisfactory IAP cannot be achieved due to tester deficiencies, notification and documentation will be provided to the Materials QA Unit; additional training may be provided and a follow-up IAP conducted. If the follow-up IAP is unsatisfactory, revocation of certification may be required.

4.3.7 Reporting

Results of IAP's, including corrective action(s), are recorded in AASHTOWare Project.

4.4 Laboratory Proficiency Sample Program

4.4.1 Description

The laboratory proficiency sample program is a tool used to monitor the quality of the District/Area laboratories and the Materials Headquarters laboratory.

4.4.2 Purpose

The purpose is to assess laboratories by comparing test results to a large body of results performed on the same material. Demonstrating quality test results through the proficiency sample program reduces the risk of disputes due to errors. The program also provides laboratories with the means to check both the testing apparatus and the operator under actual testing conditions.

4.4.3 Frequency

Proficiency samples are distributed to participants at least once per year; some proficiency samples are distributed more often. External proficiency samples will come as pairs and internal proficiency samples will come as individual samples, unless otherwise stated. When testing is complete, laboratories submit their testing results for analysis in accordance with Section 4.4.6 Reporting.

4.4.4 Tests Methods

Proficiency tests are performed on the following procedures.

External (All Labs)

AASTHO T 11 Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
AASTHO T 27 Sieve Analysis of Fine and Coarse Aggregate
AASHTO T 84 Specific Gravity and Absorption of Fine Aggregate
AASHTO T 85 Specific Gravity and Absorption of Coarse Aggregate
AASHTO T 89 Determining the Liquid Limit of Soils
AASHTO T 90 Determining the Plastic Limit & Plasticity Index of Soils
AASHTO T 99 Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and 305-mm (12-in.) Drop
AASHTO T 176 Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
AASHTO T 180 Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and 457-mm (18-in.) Drop

External (Headquarters ONLY)

AASHTO T 30 Mechanical Analysis of Extracted Aggregate
AASHTO T 166 Bulk Specific Gravity (Gmb) of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens
AASHTO T 209 Theoretical Maximum Specific Gravity (Gmm) and Density of Asphalt Mixtures
AASHTO T 308 Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
AASHTO T 312 Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor

Internal (All Labs)

AASHTO T 166 Bulk Specific Gravity (Gmb) of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens
AASHTO T 209 Theoretical Maximum Specific Gravity (Gmm) and Density of Asphalt Mixtures
AASHTO T 312 Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor
AASHTO T 308 Determining the Asphalt Binder Content of Asphalt Mixtures by the Ignition Method
AASHTO T 30 Mechanical Analysis of Extracted Aggregate
AASHTO T 335 Determining the Percentage of Fracture in Coarse Aggregate
AASHTO T 89 Determining the Liquid Limit of Soils
AASHTO T 90 Determining the Plastic Limit & Plasticity Index of Soils

4.4.5 Responsibility

The Materials QA Unit is responsible for composition, distribution, analysis, and reporting of internal proficiency samples. AASHTO re:source provides and is responsible for external proficiency samples.

4.4.6 Reporting

For internal proficiency samples, when an individual laboratory completes the proficiency sample testing, the technician reports results to the Materials QA Unit. Results from all laboratories are then compiled and reports are distributed to each individual laboratory. If corrective actions are required due to a deficient result, a notification will be sent out by the Materials QA Unit with an additional sample to be analyzed for proficiency. If results are still deficient, a member of the Materials QA Unit will travel to the laboratory to inspect the personnel performing the procedure to help identify any corrective actions.

Results for external proficiency samples are reported to AASHTO re:source. AASHTO re:source then evaluates and issues a final report.

4.4.7 Tolerance

For each laboratory and sample, a Z score is determined. The Z score, or standard score, indicates how many standard deviations a test result is from the average. Any Z Score below a 3 will require corrective action. If any laboratory fails an analysis twice in a row, the QA Unit will travel to that laboratory to investigate the equipment and procedures to determine any root cause for the failures. Random procedural checks may be performed throughout the year within all laboratories to verify procedures and corrective actions are continuing to be followed.

4.5 Laboratory and Equipment Calibrations

4.5.1 Description

As part of MDT's 23 CFR § 209 mandated Central Laboratory accreditation, AASHTO re:source,conducts on-site assessments of MDT Materials Headquarters Laboratories and the Materials QA Unit conducts annual inspections on District, Area, and MDT Materials Headquarters Laboratories and equipment used for acceptance testing.

4.5.2 Purpose

Laboratory and equipment inspections are performed to demonstrate competency in the performance of specific test procedures and the testing equipment is within the relevant procedural requirements.

4.5.3 Frequency

Equipment and procedural inspections are performed annually.

4.5.4 Responsibility

Equipment calibrations and verifications are a joint effort between the Materials QA Unit and MDT Materials Laboratory Supervisors (Headquarters, District, and Area).

4.5.5 Reporting

Procedures observed by the Materials QA Unit personnel are entered into AASHTOWare Project or the Materials Bureau's Quality Management System software (R18LabQMS). An electronic file is saved to the network for the Material Laboratory Supervisors to access.

Equipment calibrations and verifications are entered into AASHTOWare or R18LabQMS by the applicable Materials Laboratory Supervisor or a designated representative. Each laboratory is responsible for maintaining up to date calibration/verification of testing equipment. An equipment status report may be generated by AASHTOWare or R18LabQMS.

5 FINAL RECORD (FR)

5.1 Description

FR samples are physical comparisons between design plan dimensions and those actually achieved during construction.

5.2 Purpose

FR core samples are taken and analyzed for the following purposes.

- To determine the adequacy of pavement thickness and other construction requirements. These samples are taken to verify conformity with plans and specification requirements applicable to the completed construction.

- To furnish information relative to the amounts of change in properties of the material used in the work. FR samples and tests are for physical research purposes to ascertain the need and basis for possible improvements in future designs and specifications.
- To determine if corrective measures may be necessary. FR samples and tests serve to indicate whether previously unknown or unsuspected conditions may exist on the project that may have a detrimental effect on the completed construction.

5.3 Frequency of Sampling

The frequency of FR samples is provided in MT 601.

5.4 Responsibility

Samples must be witnessed by or under the direct supervision of the District/Area Lab Supervisor or their designated representative and must not be scheduled on such an inflexible and regular routine that its frequency can be predicted. Sufficient samples must be submitted to satisfy the frequency intended.

5.5 Sampling and Testing

FR samples are taken at random per MT 606 from completed construction work or completed portions thereof.

FR samples should be taken at each individual stage of the construction work as it is completed and before it is covered or disturbed by a subsequent construction stage. This minimizes damage to finished work and facilitates the satisfactory procurement of samples. FR core sample locations will be referenced to centerline.

Whenever test results indicate that significant changes have occurred (because of processing, contamination, or other reasons, after the materials were incorporated into the construction), these changes should be reported with an explanation.

5.6 Reporting

Results of FR samples including corrective action(s) are recorded in AASHTOWare Project.