SECTION 700

MATERIALS

MATERIALS AND TESTS

700-1 GENERAL

This section includes general data regarding materials and tests. Specific information pertaining to particular materials or items is contained in applicable Sections of this Manual.

700-2 DEFINITIONS FOR STANDARD TESTING

PROCESS CONTROL: Samples and tests performed on materials that are to be incorporated into a project, the results of which may be used to establish a standard or a basis for Acceptance testing. EXAMPLES: Bituminous Mix Designs, Qualities, Proctors, and Degradations.

ACCEPTANCE: Samples and tests performed by, or under the direction of, State personnel, including materials randomly sampled and tested for Quality Assurance Projects, to ascertain whether the quality of the materials incorporated into the construction process are in conformity with specifications.

INDEPENDENT ASSURANCE: Samples and observations used for the purpose of making independent checks of the reliability of the results obtained in acceptance sampling and testing, and not for determining the quality of materials directly. State personnel who do not have direct responsibility for acceptance sampling and testing normally accomplish this.

VERIFICATION: Samples and tests performed by or under the direction of State personnel to verify Contractor quality control tests, certificates of analysis, and or certificates of compliance for manufactured materials.

QUALITY CONTROL: Samples and tests performed by the Contractors or their representatives to determine if materials meet specifications before being incorporated into a project, or materials randomly sampled and tested by the contractor on Quality Assurance Projects.

QUALITY ASSURANCE: Quality Assurance is used with statistical specification and a Quality Assurance Program. It includes Quality Control (QC) by the Contractor, Acceptance by the MDOT, Independent Assurance by the MDOT, and the use of Qualified Laboratories and Personnel by both parties.

The objectives of sampling and testing on construction projects are:

(1) To determine whether the construction operations and materials used or proposed for use in the construction work, that are controlled by sampling and testing, are in reasonably close conformity with approved Plans and Specifications, including approved changes.

(2) To provide Independent Assurance Sampling and Testing as a check for reliability of Process Control and Acceptance sampling and testing.

(3) To provide opportunity for timely remedial action when results of sampling and testing indicate materials used or proposed for use and the construction work, accomplished or in progress, are not in reasonably close conformity with the approved Plans and Specifications including approved changes.

When Residents are assigned to a project, they will be supplied with a guide schedule entitled "Estimated Minimum Testing Requirements", and a complete indexing system for proper record keeping. Each item on the list of estimated minimum testing requirements will be reviewed and unusual items explained in detail by the Resident's Supervisor or the Testing Engineer (or their representative) at the time of the pre-construction conference. The Resident will make certain that the specified acceptance tests as outlined are completed. Residents should bear in mind that the number and frequency of tests described is only an estimate, and if quantities change then adjustments need to be made to the Estimated Minimum Testing Requirements. When the Resident determines that the project conditions are unusual (such as when materials from a pit vary considerably), the Resident should increase the number of samples and tests, as deemed necessary, to obtain the results intended by the Specifications.

All testing records will be kept in a ring binder in the field office. It is imperative that these testing records be kept current, and the project testing files maintained in such a manner that a person unfamiliar with the project can easily review the reports and determine that all materials used to date meet Specification requirements.

The responsibility for proper materials control has been delegated to the Resident. Tests and references, which prescribe sampling and testing procedures, are available to the Resident. Area Testing Supervisors and all MDOT testing labs have been supplied with copies of the AASHTO Highway Materials Texts, Part I, Specifications, and Part II, Tests.

The assigned testing personnel shall be qualified, or NETTCP certified, and have been trained in the latest technical procedures regarding proper sampling, testing and reporting relative to control of construction materials. To insure continual compliance, the Area Testing Supervisor and Independent Assurance personnel review their work procedures. It is also essential that there be continual cooperation between the Resident and the Testing Technician so that the required field tests are completed. The Testing Supervisor and the Resident

will evaluate the effectiveness of the project testing program and resolve any problems related to testing or testing procedures.

Requests for testing assistance should be made through the Resident's Supervisor or by calling the Testing Office in Bangor, Telephone at 941-4545, or the Freeport Lab at 865-0164. Residents should also call the Bangor or Freeport labs to schedule HMA or PCC plant monitoring and inspections. When field or laboratory tests are required, as much advance notice as possible is desired. Once assigned, the Technician reports directly to the Resident.

700-3 TESTING AND CERTIFICATION

It is a responsibility of the Resident to make sure that the specified acceptance tests indicated in the various sections of this Manual are completed. Even though this Manual establishes a testing frequency for various materials, rigid conformity to a uniform pattern should be discouraged. The frequency of testing may vary for individual projects or phases of projects in accordance with job conditions, such as the uniformity of materials at the source, the methods and equipment used, and weather conditions.

The sampling and testing should be supplemented by visual inspection of the materials as a whole to ascertain whether the samples and tests are reasonably representative of the entire mass of materials. There should also be sufficient observation of the actual construction operations and processes to ascertain that they can be expected to consistently produce uniformly satisfactory results.

Reliance should not be placed wholly on the results of sampling and testing in determining the acceptability of the materials and construction work. Whenever a change in material or questionable work by the Contractor is observed, the Resident should arrange for additional samples and tests.

Although each project may have a qualified Technician assigned for sampling and testing, the Resident (if qualified) may submit samples to the Central Laboratory for testing. The importance of promptness in submitting samples of material in time to be tested and the results returned to the Project cannot be over-emphasized. Instructions for selecting and shipping samples to the Central Laboratory are outlined in Exhibit 700-A at the end of this Section. Reports of test results should be received and on file before use of the material is authorized and it is incorporated into the work.

Details of the classes of tests are as follows:

a. PROCESS CONTROL TESTS

These are tests performed at the request of the Resident. They are samples taken and tested for the purpose of establishing standards for Acceptance testing such as proctors and materials that need HMA or PCC aggregate Quality tests.

If any of the soil/aggregate materials being incorporated into the project have compaction requirements, the Resident must arrange for sampling of these materials for proctor testing as soon as each source is available. Proctor tests are time-consuming, and must be completed before any in-place density testing can occur. (See 105.3.1)

b. ACCEPTANCE TESTS

These are samples and tests performed to ascertain on a day-to-day basis whether the quality and acceptability of the materials and workmanship of the construction work being produced are in reasonably close conformity with the Plans and Specifications. They constitute the principal means of determining whether the materials and workmanship are satisfactory prior to, or at the time of, the construction operations, or whether corrective action should be taken before the work proceeds further. They also serve as the principal basis for determining the acceptability of the completed construction.

Concrete aggregates, underdrain backfill material, aggregate surface materials, granular borrow for underwater backfill and French drain materials may be sampled for acceptance testing from stockpiles. Material should not be used until it has been tested and found to meet the Specification requirements. HMA and PCC shall be sampled and tested as per their respective 401 and 502 specifications.

When material is field tested, the original test data sheet of the test results must be given to the Resident for their files. Results of tests performed on samples forwarded to the Central Laboratory will be electronically transmitted to the Resident. Failing aggregate test results will also be reported by phone.

When test results are outside the specification limits on materials which are under the direct control of the Resident, such as aggregates used for embankment and base courses, the following procedures will apply: (Refer also to 304)

(1) Whenever a failing aggregate test occurs, the Contractor or his appointed representative must immediately be notified in writing by the Resident. A copy of the "Notice of Failing Materials Test" will be attached to the original Sieve Analysis Data Sheet, Laboratory Test Report, or

Compaction Test Data Sheet, and filed under the appropriate item. (Form letters of "Notice of Failing Material Test" may be obtained from the Program Office.)

(2) Another test will be performed on a sample taken from the area where the Contractor is presently placing base or subbase to ascertain the continuation or suspension of the Contractor's operation.

(3) The results of the test taken in (2) above will determine which of the following options will be used:

(a) If the test taken in (2) above passes, the Contractor's operation may continue if the following is adhered to:

i. The limits of the material represented by the failing test will be determined by the Resident.

ii. The area determined in (i) above must be corrected by the Contractor and the corrective action substantiated by a passing test.

(b) If the test taken in (2) above fails, the Contractor's operations in the area will be suspended until corrective measures are taken and passing material obtained.

If the moisture content of embankment material (common borrow) obtained during compaction tests exceeds optimum by more than 4%, the Resident will require that corrective action be taken by the Contractor to decrease the moisture content of the embankment material.

NOTE: Refer to Section 203 for more detailed data regarding embankment compaction and to Section 304 for examples of various situations that most commonly occur regarding gradation and density tests on aggregate base and subbase materials.

Whenever the results of an acceptance test indicate that material does not meet Specifications, the Resident will document under "Remarks", or on the back of the Sieve Analysis Data Sheet, Laboratory Test Report, or if applicable, on the back of the Compaction Test Data Sheet, what disposition was made of the material represented by the failing test.

Examples of acceptable documentary comments currently being used on failing gradation and/or compaction tests are as follows:

"Material removed and replaced."
"Contractor applied more compactive effort."

"Contractor increased moisture content."
"Contractor decreased moisture content."
"Quantity of material as represented by the test removed from stockpile."
"Quantity of material as represented by this test not used."
"Rejected all material in this stockpile."
"Quantity represented by this test not reasonable representative of material as placed."

Other documentary notation will be made under "Remarks" on the Gradation Summary Sheet and/or on the Compaction Summary Sheet. These notations will refer to the applicable passing follow-up test number.

When the Contractor actually removes and replaces embankment and/or base material, appropriate project diary entries under the applicable item will include the station limits, offset, and the day the work was performed.

c. INDEPENDENT ASSURANCE TESTS

These are inspections performed on samples/tests to provide an independent check on the reliability of the results obtained in Acceptance sampling and testing. Independent Assurance will inspect Quality Control sampling and testing that is part of a Quality Assurance specification if the test results are included in the pay factor. Samples/Tests are periodically taken at the same locations and time in the production process as Acceptance samples. They may be taken from materials delivered but not incorporated in the work and/or from work in progress.

Independent Assurance Inspections are applicable to materials such as soils and aggregates (gradation and compaction tests), hot mix asphalt, portland cement concrete, and reinforcing steel. Independent Assurance inspections are keyed to individual inspector/testers and are completed on a per person, per type of test, per time frame, per number of tests basis.

Independent Assurance Inspections are a service performed by personnel of the MDOT Central Laboratory IA Staff.

Independent Assurance Inspectors will confer with the Resident prior to sampling/ testing to determine the work schedule and persons sampling/testing so as to schedule their work. The Resident is responsible for assuring their inspectors/testers have an Independent Assurance inspection when necessary.

Independent Assurance Samples will be shipped to the Central Laboratory for testing and comparing with the Acceptance/Quality Assurance tests. Field tests will be compared at the project or test site.

When corrective action is necessary due to non-comparing test results, errors in test procedures, or equipment, a corrective action report will be completed by the IA Supervisor and forwarded to the Acceptance/Quality Control inspector's supervisor and the IA inspector for their comments and any action to correct deficiencies. This report will be completed and returned to the IA supervisor on a timely basis.

Independent Assurance Test results will be reported on a variety of forms. The Independent Assurance files will be maintained at the MDOT Central Laboratory in Bangor. Due to the systematic approach to IA now used by the MDOT it is not necessary to maintain project files of Independent Assurance activities.

d. VERIFICATION

These are samples, tests and inspections performed by the MDOT to verify certificates and Contractor quality control tests. Normally, Independent Assurance personnel will be responsible for all pipes (concrete, plastic and metal), catch basins and manholes at the precast plants, rebar, emulsions and guardrail. Acceptance testing personnel assigned to the Testing Section are responsible for verification items at HMA and PCC plants. Independent Assurance or the Acceptance testing personnel should be contacted for sampling and/or testing of verification items prior to their incorporation into the project.

e. QUALITY CONTROL

These are samples and tests performed by the contractor. Passing QC test results should be sent to the Resident before the item is incorporated into the project and before it is tested by the MDOT. This includes project aggregates such as underdrain stone, underdrain sand, granular borrow, aggregate subbase materials, etc. Quality Control samples and tests that are part of a Quality Assurance Specification will be governed by the particular specification in use.

700-3 AGGREGATE FOR BITUMINOUS MIXES

Sampling and testing for HMA designs and qualities is the responsibility of the MDOT Testing Section. Contact the HMA section of the Central Lab in Bangor to obtain the quantity of materials to be sampled for qualities. During production, HMA aggregates should be sampled from the "collector belt" for quality testing at the rate of once per 15,000 Mg [16,500 ton]. If a sample fails a quality test, the Resident and the Contractor shall be notified, and a second sample taken as soon as practical. If the second sample fails, production shall cease until the Contractor demonstrates that passing material is being produced. New HMA designs will not be approved with failing qualities.

700-4 AGGREGATES FOR PORTLAND CEMENT CONCRETE

Aggregates shall not be used unless they have been laboratory tested for quality within one year prior to the date of their proposed use.

When the results of laboratory or field tests (verification or acceptance) indicate failing materials, immediate action must be taken to prevent incorporation of the failing material in the work. The following procedure will apply:

a. Whenever a failing test occurs, the Contractor or his appointed representative must immediately be notified in writing. A copy of the "Notice of Failing Materials Test" shall be attached to the original sieve analysis data sheet filed under the appropriate item. (Form letters of "Notice of Failing Materials Test" may be obtained from the Program Offices.)

b. If the second test fails, this material will not be used until corrective measures are taken.

c. If the second test passes, the material may continue to be used, but the frequency of assurance tests should be increased to insure compliance of the material to the Specifications.

d. Should a visual inspection reveal detrimental amounts of deleterious material as described in Standard Specifications Section 703.02, 2nd paragraph, the operation should be suspended immediately and not be resumed until corrective measures are taken, and/or passing material is obtained.

EXHIBIT 700-A

INSTRUCTIONS FOR SELECTING AND SHIPPING SAMPLES OF HIGHWAY MATERIALS

Type of Material	Type of Test	Min Amt Material	Containers	Remarks
Agg Sub Gravel & Other Project Aggs	Gradation	60 lbs. (1.5 bags)	MDOT Sample Bags w/ Plastic Liners	Fill Sample Bags w/ Approx. 40 lbs of Material
ASG, Borrow and Dense Graded Crushed Agg	Proctor, Degradation, LA Wear	120 lbs. (3 Bags)	MDOT Sample Bags w/ Plastic Liners	Fill Sample Bags w/ Approx. 40 lbs of Material
PCC Aggregates	Gradation & or Quality	40 lbs. (1 Bag ea. Size)	MDOT Sample Bags w/ Plastic Liners	Put PCC Design # on ID Tag
Cement	Standard Tests	1 Gal Can	Clean Tight Covered Can	
PCC Cylinders	Strength	2 per Age	6"X 12" Molds	Protect from Drying Cold / Rough Handling
PCC Cylinders	Permeability	2 per Age	4"X 8" Molds	Protect from Drying Cold / Rough Handling
HMA Agg (stockpiles)	Quality	120 lbs (3 Bags ea size)	40 lbs per bag	Check w/ Bit Mix Lab for Stockpile Sizes & Quantity
HMA Agg Belt Samples	Quality	80 lbs (2 Bags)		Put Design # on Tags
HMA	Standard Tests	50 lbs	(4) 8" Square Boxes	Use 4 Way splitter to put HMA into Boxes
PGAB	Standard Tests	(2) 1 qt cans	Clean Tight Covered Can	Prevent spills, Wear Heat-Resistant Gloves Contractor gets sample
Asphalt Emulsion	Standard Tests	0.5 Gal	Clean sealed plastic container	Pack to prevent spills Avoid Excessive Cold
Salt	Standard Tests	10 lbs	MDOT Sample Bag w/ Plastic Liners	Use Clean Liner

EXHIBIT 700-B

Sample Tag – HMA and PCC

Maine Department of Transportation	**HMA and PCC Sample Identification Form**			*Materials Testing and Exploration*
Sample Type ❑ Accept. Method A ❑ Accept. Method B ❑ Accept. Method C ❑ Indep. Assurance ❑ Verification ❑ Maintenance ❑ Other	Reference Number	Sample Description		
	Date Sampled	Sampler		PIN
	Town		Contractor	
	Plant		Plant Location	
	Item No.	Lot No.	Sublot No.	Sublot Size
	Mix Design No.		IA Comparison No.	
HMA Mix Samples				
Ticket No.	Temperature ❑°F ❑°C		Station	Offset ❑ Lt. ❑ Rt. ❑ CL
HMA Cores				
Station	Offset ❑ Lt. ❑ Rt. ❑ CL	❑ Meth. A Standard ❑ Meth. A Reduced ❑ Informational (shoulder, test strip)		Mix Sample Reference No.
Portland Cement Concrete				
Admixture Type	**oz / yd³**	Ticket No.	Slump in	Air %	Temp. ❑°F ❑°C	Actual w/c Ratio
		Age to Break: ❑ 3 ❑ 7 ❑ 14 ❑ 21 ❑ 28 ❑ _____			Permeability: ❑ 14 ❑ 28 ❑ 56 ❑ 120 ❑ _____	
		Represents _____ of _____yd³ (total placement size)				
		Comments:				

EXHIBIT 700-C

Sample Tag – Other than HMA and PCC

SAMPLE IDENTIFICATION FORM
Maine Department of Transportation—Materials Testing & Exploration

Sample Type: ❑ Acceptance ❑ Geotechnical ❑ Indep. Assurance ❑ Maintenance ❑ Process Control ❑ Verification ❑ Other	Reference Number	IA Comparison Reference No.		Retest of Ref No.:	
	Sample Description				
	Date Sampled	Sampler		Contractor	
	PIN	Town			
	Sampled from	Station	Offset	❑ Lt. ❑ Rt. ❑ CL	
Aggregate Type: ❑ Bituminous	Temp., °C	Truck No.	Item No.	DBFG/ Sample Depth	
	Boring No.		Geotechnical Sample No.		
Plant Name		Location			
❑ Pit Name ❑ Shed Name		Location			
Supplier		Location			
Manufacturer		Location			
Cert. No.	Batch No.	Fastener Lot No.	Inv. No.	Trailer/ Dist. No.	Terminal Tank No.
Silo No.	Hauler	Comments:			

REQUESTED TESTS

❑ STANDARD ❑ SUPERPAVE CONSENSUS QUALITIES ❑ OTHER QUALITIES ❑ Proctor (❑ T99 or ❑ T180)
❑ Gradation (no wash) ❑ Gradation (wash) ❑ Grain Size (w/hydro) ❑ L.A. Wear ❑ Wash. Degradation
❑ Std. Tube Opening ❑ Consolidation ❑ Direct Shear ❑ Atterburg Limits ❑ Water Content
❑ Other_____
_____
Date Results Needed:

MINIMUM TESTING FREQUENCY GUIDELINES

701-1 GENERAL

The following are recommended guidelines for testing frequencies for commonly found items on most projects. In addition, you should also review the Contract Bid Book for changes in Specification requirements, testing and submittals by the Contractor, Manufacturers' Certifications, and other special requirements. For items that are not listed here, contact the Project Review Engineer for the testing frequency rate.

The "Minimum Testing Requirements" which are part of your Resident's packet are made up from these guidelines. Testing may be increased or decreased on your Project if you have changes in quantities. Look at the testing frequency on the "Minimum Testing Requirements" to determine the new total of tests required. It is also important to remember that these are the minimum number of tests required. The Resident may increase the testing frequency if it is felt necessary. If the source of the aggregate materials to be used on your project was recently used on an MDOT project (within the past year), you may use proctor and degradations test results that are on file. Acceptance testing supervisors, Wade McClay (865-0164) and Jim Osgood (941-4532) will provide you with test results from other jobs and provide other assistance, as you need it. Reasons must be documented in detail in the Project Diary.

Item 203 Embankment

Control density fill - Two compactions per 300 m [1000 ft] per layer except in fills less than 150 m [500 ft] where it will be one passing compaction every layer.

Bridge Approaches, Box Culverts and Structural Plate Pipes - Generally one passing compaction every other layer each side of the approach. You may relax the number of tests taken if the Contractor continues to provide the same compactive effort throughout the entire backfill operation. Notes should be made in the Project Diary pertinent to the matter.

Common Borrow - One moisture content per 11,400 m^3 [15,000 cy].
One passing gradation per 3,800 m^3 [5,000 cy].

Granular Borrow - One passing gradation per 3,800 m^3 [5,000 cy].

Gravel Borrow - One passing gradation per 3,800 m^3 [5,000 cy].

Item 204 Shoulder Rehabilitation & Item 205 Reconstruct Existing Shoulder

One passing gradation per 6,350 m^2 [15,000 sy].

Item 304 Aggregate Base and Subbase Course

Base - One passing gradation per 1,200 m^3 [1,500 cy]
Subbase - One passing gradation per 1,900 m^3 [2,500 cy]
One passing compaction per 600 m [2000 ft] per lane per layer.

Item 307, 308 and 309 Full Depth Recycled Pavement

One passing compaction per 600 m [2000 ft]. Items 308 and 309 will need to be compacted and tested before the bituminous stabilizer or foamed asphalt processes, and again the same day the bituminous stabilizer or foamed asphalt is added. Testing personnel will assist with running the field proctor necessary for testing the compaction of these materials. For assistance, call the Acceptance Testing Supervisor at the Freeport lab at 865-0164, or at the Bangor lab at 941-4545. Pertinent notes should be made in the Project Diary.

Item 403 Hot Mix Asphalt

See Sections 106, 401 and 403 of the Standard Specifications and Special Provisions. Generally the mix type and testing method (A, B, or C) will be designated in Special Provision 403. Two scale checks and two plant checks are required for each five days of paving. An MDOT-approved HMA mix design and a Plant Acceptability Inspection are required before any HMA is accepted on the project. Normally, testing personnel will perform these checks. Call the Southern Area Acceptance Supervisor at 865-0164 (Freeport) or the Northern Area Acceptance Supervisor at 941-4532 or 941-4545 (Bangor). Hot Mix Asphalt for bituminous curb, around granite curb, around concrete curb, or around catch basins and manholes does not have to be tested. Plant inspections and designs are not required of curb mix or mix used for chinking curb, manholes or catch basins.

Item 411 Untreated Aggregate Surface Course

One passing gradation per 400 m^3 [500 cy].

Item 502 Structural Concrete

See Sections 106 and 502 of the Standard Specifications and Special Provisions. Generally the mix type and testing method (A, B, or C) will be designated in Special Provision 502. One PCC plant check is required for each five sublots of concrete with a minimum of one per lot. Normally, testing personnel will perform these checks. Call the Southern Area Acceptance Supervisor at 865-0164 (Freeport) or the Northern Area Acceptance Supervisor at 941-4532 or 941-4545 (Bangor). An MDOT-approved PCC mix design and a Plant Acceptability Inspection are required before any concrete is accepted on the project.

Concrete Testing In General:

For bridges, box culverts, abutments and abutment patches, piers and pier patches, high retaining walls, bridge joint modifications, end post modifications, high mast pole bases, and overhead sign bases, refer to Item 502.

Steps, ornamental light bases, break-away sign bases, curbs, bridge approach slabs, sidewalks, conduits, pipe collars, wing caps, and medians: Normally these items will be Method C. If they are not so designated in Special Provision 502, see Standard Specification 106.6.

Item 512 French Drain Stone

One passing gradation per project (Residents option if material is visually acceptable).

Item 526 Permanent Concrete Barrier

See 502 above.

Item 535 Precast Prestressed Concrete

If the Supplier is required to perform testing during production, MDOT personnel will observe these tests for conformance to Specifications. The MDOT tester will also obtain one set of cylinders and one set of gradations per 100 m^3 [150 cy] for verification testing.

See Standard and Special Provisions for Item 535.

Item 605 Underdrain Backfill

Sand - One passing gradation per 300 m [1000 ft].
Stone - One passing gradation per 600 m [2000 ft].

Item 608 Sidewalks and Item 626 Foundations, J-Boxes, Highway Signing, Lighting & Signals

See 502 above.

Item 635 Prefabricated Concrete Units- Retaining Walls, T-Walls, etc.

See Standard Specification and Special Provision 712.