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**UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON, D.C. 20234**

**AASHTO MATERIALS
REFERENCE LABORATORY**

**AMERICAN ASSOCIATION OF STATE HIGHWAY
AND TRANSPORTATION OFFICIALS**



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MATERIALS REFERENCE LABORATORY

1. INTRODUCTION

Testing laboratories that have had no previous contact with the American Association of State Highway and Transportation Officials (AASHTO) Materials Reference Laboratory frequently inquire about its purpose, function and services. This pamphlet has been assembled to provide an informative reply to those inquiries regarding the origin, development and responsibilities of the AASHTO Materials Reference Laboratory (AMRL).

2. DEVELOPMENT OF THE AASHTO MATERIALS REFERENCE LABORATORY

2.1 BACKGROUND INFORMATION

The AASHTO Materials Reference Laboratory was established at the National Bureau of Standards on October 1, 1965, under the sponsorship of the Subcommittee on Materials of the American Association of State Highway and Transportation Officials. Its primary responsibility is to promote uniformity in the testing of construction materials by the laboratories of our Departments of Transportation or Highways, the Federal Highway Administration, and the U. S. Forest Service. This is an important objective because standardization in testing is an essential part of the process for controlling quality of construction in our national transportation system.

2.2 FUNCTIONS OF THE AMRL

The principal functions of the AASHTO Materials Reference Laboratory are considered to be (1) Inspection of apparatus and procedures used in the testing of aggregates, soils, and bituminous materials; and (2)

Distribution of proficiency test samples and statistical analysis of test results. The principal complementary activities are (1) Study of testing problems and (2) Participation in the work of technical committees. The sponsors have clearly stipulated that in carrying out these functions the AMRL shall not act as a referee in disputes concerning the quality of materials, the suitability of testing apparatus, or the ability of a testing laboratory to do testing work in a satisfactory manner. Because of these prohibitions, all of the services rendered to the participating laboratory are essentially advisory in nature.

3. LABORATORY INSPECTION SERVICES

Inspection of testing laboratories is considered to be the most important function of the AASHTO Materials Reference Laboratory. Utilization of the service is on a voluntary basis and visits are scheduled only in those instances where a request has been received from a responsible official of an eligible laboratory. To be eligible the laboratory must be equipped to make the standard AASHTO tests for soils, aggregates, and/or bituminous materials, or the equivalent thereof. In general the ASTM standards are equivalent to the AASHTO standards, particularly where requirements for apparatus are concerned. If the laboratory is other than a primary testing facility operated by one of the member departments of the AASHTO Subcommittee on Materials, the management must also be willing to authorize payment of the current prescribed inspection fee.

The inspection program is designed to provide for the reinspection of regularly participating laboratories at intervals of less than two years. It is customary to refer to each completed circuit of

laboratories as an inspection tour and presently a tour is approximately eighteen months in duration. In order to make efficient use of both men and equipment inspection itineraries are laid out in accordance with long range plans, and in general only one visit is made to a given locality during a tour. The inspectors travel widely and visits have been made to laboratories in all fifty states, the District of Columbia, Puerto Rico and Canada.

The inspection equipment carried by each inspector weighs approximately 250 pounds and includes vacuum gages, calipers, micrometers, scales, electronic timers, a portable balance, precision weights, a tachometer, and an assortment of thermometers and miscellaneous items. The inspectors transport themselves and their equipment from place to place in station wagon or a van.

The inspection of a laboratory consists of an observation of the procedures and an examination of the apparatus used in making the physical tests of materials set forth in designated AASHTO methods of test. Procedures are checked for conformance with specified practices. Each piece of apparatus presented for inspection is checked to determine whether it meets or fails to meet specification requirements and whether it is in satisfactory operating condition.

3.1 INSPECTION OF A SOILS TESTING LABORATORY

The procedures for testing soils that are customarily observed include Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test (T87), Particle Size Analysis of Soils (T88), Determining the Liquid Limit of Soils (T89), Plastic Limit of Soils (T90), Determining the Shrinkage Factors of Soils (T92), Moisture Density Relations of

Soils Using a 5.5-lb. Rammer and a 12 in. Drop (T99), Specific Gravity of Soils (T100), Moisture Density Relations of Soil Cement Mixtures (T134), Wetting-and-Drying Test Compacted Soil-Cement Mixtures (T135), Freezing-and-Thawing Test of Compacted Soil-Cement Mixtures (T136), Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Method (T176), Moisture-Density Relations of Soils Using a 10-lb. Rammer and an 18-in. Drop (T180), Resistance R-Value and Expansion Pressure of Compacted Soils (T190), The California Bearing Ratio (T193), Unconfined Compressive Strength of Cohesive Soils (T208), One-Dimensional Consolidation Properties of Soils (T216), and Strength Parameters of Soils by Triaxial Compression (T234).

In addition to the special purpose equipment used in performing specific tests, the following general laboratory equipment is normally examined: sample shipping containers, pulverizers, sample splitters, sieves, mechanical sieving apparatus, testing ovens, scales, general purpose balances, and balance weights.

3.2 INSPECTION OF AN AGGREGATE TESTING LABORATORY

The procedure for testing aggregates that are customarily observed are Amount of Material Finer than 0.075 mm Sieve in Aggregate (T11), Unit Weight of Aggregate (T19), Organic Impurities in Sands for Concrete (T21), Sieve Analysis of Fine and Coarse Aggregate (T27), Sieve Analysis of Mineral Filler (T37), Specific Gravity and Absorption of Fine Aggregate (T84), Specific Gravity and Absorption of Coarse Aggregate (T85), Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine (T96), Soundness of Aggregate by Use of Sodium Sulfate of Magnesium Sulfate (T104), Clay Lumps and Friable Particles in Aggre-

gate (T112), Lightweight Pieces in Aggregates (T113), and Reducing Field Samples of Aggregates to Testing Size (T248).

The list of aggregate apparatus normally examined includes: Splitters, sieving devices, evaporating ovens, unit weight measures, water baths, specific gravity balances, abrasion machines, heavy liquids and exhaust hoods.

3.3 INSPECTION OF A BITUMINOUS TESTING LABORATORY

The inspection of a bituminous laboratory consists of an observation of the procedures and an examination of apparatus used in making the tests for asphalt cement, liquid asphalts, and/or bituminous paving mixtures as set forth in the referenced AASHTO test methods.

3.3.1 ASPHALT CEMENT AND CUTBACK ASPHALT CEMENT

The procedures for testing asphalt cement that are customarily observed include Solubility of Bituminous Material in Organic Solvents (T44), Flash and Fire Points by Cleveland Open Cup (T48), Penetration of Bituminous Materials (T49), Ductility of Bituminous Materials (T51), Softening Point of Bituminous Materials (T53), Water in Petroleum Products and Other Bituminous Materials (T55), Distillation of Cut-Back Asphaltic Products (T78), Flash Point with Tag Open Cup (T79), Thin Film Oven Test (T179), Kinematic Viscosity of Asphalts (T201), Absolute Viscosity of Asphalts (T202), Specific Gravity by Pycnometer (T228), Rolling Thin Film Oven Test (T240), Residue of Specified Penetration ASTM D243, Specific Gravity of Liquid Asphalts by Hydrometer Method ASTM D3142 and Specific Gravity of Bituminous Materials by Nickel Crucible ASTM D3289.

In addition to the special purpose equipment used in performing specific tests, the following general equipment is normally examined:

fume hoods, timing devices, thermometers, analytical weighing equipment, muffle furnaces, thin film ovens, penetrometers, distillation apparatus, viscometers, centrifuges, and controlled temperature baths.

3.3.2 EMULSIFIED ASPHALTS

The procedures for testing emulsified asphalts that are customarily observed include Residue by Distillation, Residue by Evaporation, Particle Charge, Saybolt Viscosity, Demulsibility, Settlement, Cement Mixing, Coating Ability-Water Resistance, and Storage Stability. All of these tests are described in AASHTO Standard T59.

The list of emulsion apparatus normally examined includes metal stills, glass stills, traps, condensers, heat sources and solvents.

3.3.3 ASPHALT MIXTURES

The procedures for testing of bituminous mixtures that are customarily observed include Mechanical Analysis of Extracted Aggregate (T30), Quantitative Extraction of Bitumen From Bituminous Paving Mixtures (T164), Effect of Water on Compacted Bituminous Mixtures (T165), Specific Gravity of Compacted Bituminous Mixtures (T166), Compressive Strength of Bituminous Mixtures (T167), Recovery of Asphalt from Solution by Abson Method (T170), Maximum Specific Gravity of Bituminous Paving Mixtures (T209), Resistance to Flow by Marshall Method (T245), Resistance to Deformation and Cohesion of Bituminous Mixtures by Hveem Apparatus (T246), and Preparation of Test Specimen by California Kneading Compactor (T247).

In addition to special purpose equipment used in performing specific tests, the following apparatus is normally examined: ovens, balances, ignition dishes, muffle furnaces, controlled temperature baths,

testing machines, flow meters, vacuum systems and compactors.

3.4 REPORTS

While the inspection is in progress, the inspector brings to the attention of laboratory personnel each departure from specification requirements that is noted in order that on-the-spot corrections may be made whenever possible. Other pertinent observations that may be of interest to the laboratory are also mentioned. At the completion of the inspection, a comprehensive oral report is presented to the laboratory supervisor or his representative. At this time the special work sheets, on which all observations were recorded, are made available for review by members of the laboratory staff. Within a short time after the inspection, a written confirmatory report is sent to the officials who requested the visit and to such other persons as the laboratory may designate. The report is treated in a confidential manner, but this does not preclude subsequent distribution of copies to all interested parties if the inspected laboratory is agreeable to such action. This provision for the dissemination of inspection information is valued because it makes it possible for an interested third party to assess the capability of a given laboratory to do testing work in a satisfactory manner.

4. PARTICIPATION IN THE INSPECTION PROGRAM

The AASHTO Materials Reference Laboratory has completed ten inspection tours (circuits) of the United States since its inception in 1965. The number of laboratories participating in these tours and their various areas of interest are shown in the accompanying Table I. This record reflects the fact that in addition to state and federal labora-

tories of few private laboratories wishing to avail themselves of the consulting services of the AMRL have been covered as time permitted.

5. REFERENCE SAMPLE PROGRAM

Distribution of proficiency test samples is a second important function of the AASHTO Materials Reference Laboratory. It is believed that laboratories subscribing to these cooperative testing programs find participation to be of great assistance to them in evaluating the quality of their work.

(a) Bituminous Reference Sample Program

The Bituminous Reference Sample Program was inaugurated in 1966. Pairs of samples are customarily distributed in March, June and September. The March and September samples are asphalt cement. The June samples are cut-back asphalts. Selective participation is permissible.

(b) Aggregate Reference Sample Program

The Aggregate Reference Sample Program was inaugurated in 1968. Pairs of samples are customarily distributed in April and October. The April samples are of fine aggregate and the October samples are of coarse aggregates. Selective participation is permissible.

(c) Soil Reference Sample Program

The Soil Reference Sample Program was inaugurated in 1967. Pairs of samples are customarily distributed in February and August.

(d) Bituminous Concrete Reference Sample Program

The Bituminous Concrete Reference Sample Program was inaugurated

in 1974. A pair of samples is customarily distributed in December.

All four programs are open to any interested laboratory that wishes to participate. However, requests for participation from new applicants are handled on a "when and if available" basis due to physical limitations imposed by preparation facilities. Fees for registration are charged in accordance with a fee schedule established by the AASHTO Subcommittee on Materials.

All four of these programs are carried forward in a similar manner. At intervals of 3, 6, or 12 months quantities of two slightly different materials are procured, specially prepared, and divided into individual samples. A pair of samples (one from each material) is then distributed to each laboratory. Specified tests are performed by the participants and the results reported to the AMRL for review and summation. Approximately six weeks after the samples are distributed, a preliminary report showing the tentative average values and standard deviations for each determination, based on early returns, is sent to all participants. Approximately nine weeks after distribution a detailed report is prepared. This report contains average values and standard deviations based on all available data, plus scatter diagrams, repeatability and reproducibility values, and other statistical information.

A scatter diagram is plotted for each test method in a series by taking the results received from each laboratory and plotting the value for one sample on the X or horizontal axis against the value for the other sample on the Y or vertical axis.

A substantial deviation of its test results from the average results for all participants is of much concern to a laboratory. A

continuous tendency to obtain results that deviate substantially from the average invariably stimulates corrective action by the laboratory concerned.

In the interest of focusing attention on deviations from the average, each laboratory is given a rating on each determination using a rating scale based on the between laboratory standard deviation. These ratings indicate the difference between the individual laboratory result and the average for a particular test. However, summaries of the ratings obtained by a given laboratory over a period of time give a clear picture of that laboratory's over-all proficiency.

In addition to helping improve uniformity in testing, the reference sample programs are making a most important technical contribution as a source of test data from which realistic precision statements can be developed for some of the primary AASHTO methods of tests.

6. STUDY OF TESTING PROBLEMS

Another major function of the AMRL is the study of problems related to, or evolving from, the inspection and proficiency testing work. A very important activity in this area is the annual preparation of a list of possible improvements in methods of test for consideration by the AASHTO Sub-Committee on Materials. Several such lists have been presented and numerous changes have been made in the AASHTO Standards as a result of this input.

7. PARTICIPATION IN THE WORK OF THE TECHNICAL COMMITTEES

Participation in the work of technical committees is an important activity of the AMRL. These relationships are invaluable because they make it possible for the AMRL to provide direct liaison between the

authors and the users of methods of test.

8. CLOSURE

The stated primary responsibility of the AASHTO Materials Reference Laboratory is to promote uniformity in the testing of construction materials. The continuing interest of participating laboratories in the inspection and proficiency testing programs attests to the fact that the desired results are being obtained.

Further information regarding the services described in this pamphlet may be obtained by writing to the:

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AASHTO Materials Reference Laboratory

Office of Testing Laboratory Evaluation Technology

National Engineering Laboratory

National Bureau of Standards

Type of Material	TOUR	TOUR	TOUR	TOUR	TOUR	TOUR	TOUR	TOUR	TOUR	TOUR	TOUR	TOUR
	I	II	III	IV	V	VI	VII	VIII	IX	X		
Aggregate Laboratories	51	60	58	56	59	64	64	66	61	61	61	61
Soils Laboratories	51	60	58	56	59	65	63	66	61	61	61	61
Asphalt Cement Laboratories	50	59	56	55	60	68	63	65	59	59	59	59
Emulsified Asphalt Laboratories					45	61	55	58	57	55	55	55
Bituminous Mix Laboratories			18	54	58	72	66	63	58	58	57	57
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Type of Laboratory												
State Main Laboratories	50	54	55	51	52	52	51	53	52	52	52	52
State Branch Laboratories					2	6	4	6	4	4	2	2
Commercial Laboratories						8	1					
Other Laboratories							2	1				1
Federal Laboratories	<u>1</u>	<u>6</u>	<u>6</u>	<u>5</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>8</u>	<u>7</u>	<u>8</u>	<u>8</u>	<u>8</u>
Total Sites Visited	51	60	61	56	61	74	67	68	63	63	63	63

Laboratory Participation in AMRL Inspection Program

TABLE I

