
Standard Practice for Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories

AASHTO Designation: R 18-23¹

Technically Revised: 2023

Technical Subcommittee: 5c, Quality Assurance and Environmental



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Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories

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1. SCOPE

- 1.1. This document contains criteria and guidelines for establishing and implementing a quality management system (QMS) for use by a construction materials testing (CMT) laboratory.
- 1.2. The criteria in this document only apply to the following testing areas: soil, aggregate, asphalt binder, cutback asphalt, emulsified asphalt, asphalt mixtures, hydraulic cement, portland cement concrete, unit masonry, metals, plastic pipe, and sprayed fire-resistive material.

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
 - M 152M/M 152, Flow Table for Use in Tests of Hydraulic Cement
 - R 28, Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)
 - R 39M/R 39, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
 - R 59, Recovery of Asphalt Binder from Solution by Abson Method
 - R 61, Establishing Requirements for Equipment Calibrations, Standardizations, and Checks
 - R 68, Preparation of Asphalt Mixtures by Means of the Marshall Apparatus
 - R 100M/R 100, Making and Curing Concrete Test Specimens in the Field
 - T 19M/T 19, Bulk Density ("Unit Weight") and Voids in Aggregate
 - T 22M/T 22, Compressive Strength of Cylindrical Concrete Specimens
 - T 48, Flash Fire Points of Asphalt Binder by Cleveland Open Cup
 - T 49, Penetration of Bituminous Materials
 - T 50, Float Test for Bituminous Materials
 - T 51, Ductility of Asphalt Materials
 - T 53, Softening Point of Bitumen (Ring-and-Ball Apparatus)
 - T 59, Emulsified Asphalts
 - T 79, Flash Point with Tag Open-Cup Apparatus for Use with Material Having a Flash Point Less Than 93°C (200°F)
 - T 84, Specific Gravity and Absorption of Fine Aggregate
 - T 88, Particle Size Analysis of Soils

- T 89, Determining the Liquid Limit of Soils
- T 96, Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- T 98M/T 98, Fineness of Portland Cement by the Turbidimeter
- T 99, Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
- T 100, Specific Gravity of Soils
- T 104, Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- T 106M/T 106, Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in. Cube Specimens)
- T 119M/T 119, Slump of Hydraulic Cement Concrete
- T 121M/T 121, Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- T 129, Amount of Water Required for Normal Consistency of Hydraulic Cement Paste
- T 131, Time of Setting of Hydraulic Cement by Vicat Needle
- T 134, Moisture–Density Relations of Soil–Cement Mixtures
- T 135, Wetting-and-Drying Test of Compacted Soil–Cement Mixtures
- T 136, Freezing-and-Thawing Tests of Compacted Soil–Cement Mixtures
- T 137, Air Content of Hydraulic Cement Mortar
- T 152, Air Content of Freshly Mixed Concrete by the Pressure Method
- T 153, Fineness of Hydraulic Cement by Air Permeability Apparatus
- T 154, Time of Setting of Hydraulic Cement Paste by Gillmore Needles
- T 162, Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
- T 167, Compressive Strength of Hot Mix Asphalt
- T 176, Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- T 179, Effect of Heat and Air on Asphalt Materials (Thin-Film Oven Test)
- T 180, Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- T 186, Early Stiffening of Hydraulic Cement (Paste Method)
- T 190, Resistance R-Value and Expansion Pressure of Compacted Soils
- T 192, Fineness of Hydraulic Cement by the 45- μ m (No. 325) Sieve
- T 193, The California Bearing Ratio
- T 196M/T 196, Air Content of Freshly Mixed Concrete by the Volumetric Method
- T 201, Kinematic Viscosity of Asphalts (Bitumens)
- T 202, Viscosity of Asphalts by Vacuum Capillary Viscometer
- T 209, Theoretical Maximum Specific Gravity (G_{mm}) and Density of Hot Mix Asphalt (HMA)
- T 228, Specific Gravity of Semi-Solid Asphalt Materials
- T 231, Capping Cylindrical Concrete Specimens
- T 240, Effect of Heat and Air on a Moving Film of Asphalt Binder (Rolling Thin-Film Oven Test)
- T 245, Resistance to Plastic Flow of Asphalt Mixtures Using Marshall Apparatus
- T 246, Resistance to Deformation and Cohesion of Hot Mix Asphalt (HMA) by Means of Hveem Apparatus
- T 247, Preparation of Test Specimens of Hot Mix Asphalt (HMA) by Means of California Kneading Compactor
- T 300, Force Ductility Test of Asphalt Materials
- T 301, Elastic Recovery Test of Asphalt Materials by Means of a Ductilometer



- T 304, Uncompacted Void Content of Fine Aggregate
- T 308, Determining the Asphalt Binder Content of Asphalt Mixtures by the Ignition Method
- T 312, Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor
- T 313, Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)
- T 315, Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)
- T 316, Viscosity Determination of Asphalt Binder Using Rotational Viscometer

2.2.

ASTM Standards:

- A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products
- C29/C29M, Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
- C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field
- C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C67/C67M, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
- C88/C88M, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- C109/C109M, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
- C115/C115M, Standard Test Method for Fineness of Portland Cement by the Turbidimeter (withdrawn 2018; no replacement)
- C128, Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate
- C131/C131M, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- C138/C138M, Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete
- C173/C173M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- C185, Standard Test Method for Air Content of Hydraulic Cement Mortar
- C187, Standard Test Method for Amount of Water Required for Normal Consistency of Hydraulic Cement Paste
- C191, Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle
- C192/C192M, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
- C204, Standard Test Methods for Fineness of Hydraulic Cement by Air-Permeability Apparatus
- C230/C230M, Standard Specification for Flow Table for Use in Tests of Hydraulic Cement
- C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- C266, Standard Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles
- C305, Standard Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
- C430, Standard Test Method for Fineness of Hydraulic Cement by the 45- μ m (No. 325) Sieve

- C451, Standard Test Method for Early Stiffening of Hydraulic Cement (Paste Method)
- C470/C470M, Standard Specification for Molds for Forming Concrete Test Cylinders Vertically
- C617/C617M, Standard Practice for Capping Cylindrical Concrete Specimens
- C778, Standard Specification for Standard Sand
- C1072, Standard Test Methods for Measurement of Masonry Flexural Bond Strength
- C1252, Standard Test Methods for Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)
- C1506, Standard Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters
- D5/D5M, Standard Test Method for Penetration of Bituminous Materials
- D36/D36M, Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
- D70, Standard Test Method for Density of Semi-Solid Asphalt Binder (Pycnometer Method)
- D92, Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
- D113, Standard Test Method for Ductility of Asphalt Materials
- D139, Standard Test Method for Float Test for Bituminous Materials
- D244, Standard Test Methods and Practices for Emulsified Asphalts
- D422, Standard Test Method for Particle-Size Analysis of Soils (withdrawn 2016; no replacement)
- D558/D558M, Standard Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures
- D559/D599M, Standard Test Methods for Wetting and Drying Compacted Soil-Cement Mixtures
- D560/D560M, Standard Test Methods for Freezing and Thawing Compacted Soil-Cement Mixtures
- D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12400 ft-lbf/ft³ (600 kN-m/m³))
- D854, Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer
- D1074, Standard Test Method for Compressive Strength of Asphalt Mixtures
- D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
- D1560, Standard Test Methods for Resistance to Deformation and Cohesion of Asphalt Mixtures by Means of Hveem Apparatus
- D1561/D1561M, Standard Practice for Preparation of Bituminous Mixture Test Specimens by Means of California Kneading Compactor
- D1754/D1754M, Standard Test Method for Effects of Heat and Air on Asphaltic Materials (Thin-Film Oven Test)
- D1856, Standard Test Method for Recovery of Asphalt from Solution by Abson Method
- D1883, Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils
- D2041/D2041M, Standard Test Method for Theoretical Maximum Specific Gravity and Density of Asphalt Mixtures
- D2170/D2170M, Standard Test Method for Kinematic Viscosity of Asphalts
- D2171/D2171M, Standard Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer
- D2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
- D2844/D2844M, Standard Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils

- D2872, Standard Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)
- D3143/D3143M, Standard Test Method for Flash Point of Cutback Asphalt with Tag Open-Cup Apparatus
- D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- D4402/D4402M, Standard Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
- D6084/D6084M, Standard Test Method for Elastic Recovery of Bituminous Materials by Ductilometer
- D6307, Standard Test Method for Asphalt Content of Asphalt Mixture by Ignition Method
- D6521, Standard Practice for Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)
- D6648, Standard Test Method for Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)
- D6925, Standard Test Method for Preparation and Determination of the Relative Density of Asphalt Mix Specimens by Means of the Superpave Gyratory Compactor
- D6926, Standard Practice for Preparation of Asphalt Mixture Specimens Using Marshall Apparatus
- D6927, Standard Test Method for Marshall Stability and Flow of Asphalt Mixtures
- D7000, Standard Test Method for Sweep Test of Emulsified Asphalt Surface Treatment Samples
- D7115, Standard Test Method for Measurement of Superpave Gyratory Compactor (SGC) Internal Angle of Gyration Using Simulated Loading
- D7175, Standard Test Method for Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer
- E10, Standard Test Method for Brinell Hardness of Metallic Materials
- E18, Standard Test Methods for Rockwell Hardness of Metallic Materials
- E290, Standard Test Methods for Bend Testing of Material for Ductility
- E376, Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy Current (Electromagnetic) Testing Methods
- F3125/F3125M, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
- G62, Standard Test Methods for Holiday Detection in Pipeline Coatings

3. TERMINOLOGY

- 3.1. *calibration*—a process that, under specified conditions, establishes metrological traceability by determining: (1) the relation between the quantity values provided by measurement standards and the corresponding indications from a measuring instrument or system, and (2) the resulting measurement uncertainty (Note 1).

Note 1—This definition for calibration and the following definitions for check, standardization, traceability, uncertainty, and verification of calibration are based on the definitions in R 61.

- 3.1.1. *Examples*—analytical balances (measurement instrument) and dynamic shear rheometer (measurement system).

- 3.1.2. *Discussion*—the purpose of calibration is to establish the traceability of a measurement. Uncertainty estimates obtained during calibration are used to judge if an instrument is suitable for

its intended purpose. There is a need to re-establish traceability or recalibrate only when instrument measurements drift out of control (as determined through verification of calibration).

- 3.2. *check*—a specific type of inspection and/or measurement performed on equipment and materials to indicate compliance or otherwise with stated criteria.
 - 3.2.1. *Example*—specimen molds.
 - 3.2.2. *Discussion*—Stated criteria can be dimensional tolerances.
- 3.3. *date*—the month, day, and year in which an event takes place.
- 3.4. *maintenance*—a regularly scheduled preventive measure taken to preserve the effective working condition of test equipment.
- 3.5. *measurement standard*—The embodiment of the definition of a given quantity, with a stated value and measurement uncertainty, used as a reference.² This term is often called “reference standard.”
- 3.6. *metrological traceability*—the property of a result of a measurement whereby it can be related to stated references, usually national or international standards, through a documented, unbroken chain of calibrations, each contributing to the measurement uncertainty.
 - 3.6.1. *Discussion*—There is a need for traceable measurements. Measurements, not the instrument, can be traceable. Measurement traceability is established through calibration. Measurement traceability is maintained through verification of calibration (a regular check of instrument output using a control standard).
- 3.7. *quality management system (QMS)*—the organizational structure, staff responsibilities, policies, standard operating procedures, processes, and records that assist the laboratory in achieving its quality objectives.
- 3.8. *standardization*—a process that determines (1) the correction to be applied to the result of a measuring instrument, measuring system, material measure, or measurement standard when its values are compared with the values realized by standards, or (2) the adjustment to be applied to a piece of equipment when its performance is compared with that of an accepted standard or process.
 - 3.8.1. *Discussion*—Standardization in case (1) is a simplified form of calibration that estimates systematic error but does not identify random error. Standardization, therefore, does not address all of the elements of uncertainty of measurement and does not lead to traceable measurements. An example of case (2) standardization is adjusting the number of blows of a mechanically operated hammer so it applies the energy equivalent to that of a manually operated hammer.
- 3.9. *subcontracting*—the practice of a testing agency utilizing another testing agency to perform testing due to unforeseen circumstances such as temporary increased workload, personnel shortage, equipment malfunction, damage to facilities, or other reasons.
 - 3.9.1. *Discussion*—Using an outside agency for the purchase or calibration of equipment is not considered subcontracting.
- 3.10. *top management*—the most senior level of laboratory management personnel with the authority to make decisions on policies and allocation of resources.
- 3.11. *uncertainty*—a parameter associated with the result of a measurement that defines the range of the values that could be attributed to the measured quantity.

- 3.11.1. *Discussion*—The uncertainty of a measurement is required in order to establish its traceability. The uncertainty estimates obtained during calibration are used to judge if an instrument is suitable for its intended purpose.
- 3.12. *verification of calibration*—a process that establishes whether the results of a previously calibrated measurement instrument, measurement system, or material measure are stable.
- 3.12.1. *Discussion*—Verification of calibration is used to maintain the traceability of a measurement and to determine when to recalibrate. Control charts are often used to plot the results and determine whether instrument measurements have drifted out of control.

4. SIGNIFICANCE AND USE

- 4.1. This document provides guidance to laboratories in the establishment and implementation of a quality management system. By use of the concepts in this document, a laboratory may prepare policies, procedures, and records that describe the elements and functions of its quality management system.
- 4.2. This document is not intended to prescribe the methods by which a laboratory achieves the desired level of quality, but does provide acceptable approaches.
- 4.3. This document is intended to be used as a basis for laboratory assessment and accreditation along with the policies and procedures of an assessment or accreditation body such as *The AASHTO Accreditation Program Procedures Manual for the Accreditation of Construction Materials Testing Laboratories*.
- 4.4. The user is cautioned that a QMS prepared by following this document can only serve a useful purpose if it describes or references procedures that are practiced on a routine basis by the laboratory. A QMS only describes the elements of the system and how they are intended to be implemented. It is not the existence but the implementation of an effective quality management system that is important.

5. MANAGEMENT REQUIREMENTS

- 5.1. *Quality Management System (QMS):*
- 5.1.1. The laboratory shall establish, implement, and maintain a quality management system (QMS) appropriate to the scope of its activities. The QMS shall be available for use and understood by laboratory staff.
- Note 2**—A QMS may be documented and distributed in hard copy or accessible electronic format.
- Note 3**—Examples of some QMS documents are provided in the Appendix. The laboratory may establish methods other than those shown in the Appendix to meet QMS requirements.
- 5.2. *Document Control:*
- 5.2.1. Each QMS document shall indicate its preparation date. When a document is revised, the date of revision shall be indicated on the document.
- 5.2.2. *Test Methods, Practices, Procedures, and Specifications*—The laboratory shall maintain copies of standards for the testing performed and shall ensure that the procedures are the most current and are readily accessible to the employees performing the testing.

5.3. *Organization:*

- 5.3.1. The legal name and address of the laboratory—and that of the main office or company, if different—and any other information needed to identify the organization shall be documented.
- 5.3.2. The ownership and management structure of the laboratory shall be documented. Names, affiliations, and positions of principal officers and directors shall be listed.
- 5.3.3. The laboratory shall maintain an organization chart showing relevant internal organizational components, including positions and names, which are part of the organization. The organization chart shall clearly define relationships with other partner organizations where applicable.

5.4. *Staff:*

- 5.4.1. The laboratory shall maintain a position description for each technical operational position shown on the laboratory's organization chart. Position descriptions shall identify the position and include a description of the duties, required skills, and education and experience associated with the position.
- 5.4.2. The laboratory shall maintain a brief biographical sketch, noting the education, work experience, licensure, certifications, and current position for each supervisory technical staff.
- 5.4.3. *Technical Manager*—The laboratory shall have a technical manager (however named) who has overall responsibility for the technical operations of the laboratory. In addition, the laboratory shall nominate an individual to serve in the technical manager's absence.
- 5.4.4. *QMS Management*—The laboratory shall designate a person(s) having responsibility for determining whether quality management system activities are being implemented by laboratory staff. This individual(s) shall have direct access to top management (Note 4).
Note 4—This individual(s) may have other responsibilities (e.g., laboratory manager).

5.5. *Technician Training and Evaluation:*

- 5.5.1. The laboratory shall maintain a procedure that describes the method used to ensure that laboratory personnel are trained to perform tests in accordance with standard procedures. In addition to the description of training methods, the document shall indicate what position or employee is responsible for the laboratory training program and the maintenance of training records (see Figure X1.1).
Note 5—There may be several different methods employed for differing levels of staff experience, including (1) on-the-job apprentice training (one-on-one) for new employees with little or no experience in laboratory or inspection work; (2) formal in-house training sessions for certification, rating, or competency evaluation; and (3) training by external organizations. An individual with prior experience performing a specific test need only have competency evaluated by the laboratory (see Section 5.5.2).
- 5.5.2. The laboratory shall maintain a procedure describing the method used to evaluate staff competency to ensure that each technician is qualified to perform the tests they perform in accordance with standard procedures. This procedure shall include the frequency of competency evaluations for each technician and indicate the position or employee responsible for evaluating staff competency and maintaining records (see Figure X1.2). The frequency selected may be based on experience and competency of each technician.
Note 6—Multiple intervals may be established based on the experience of the technician being evaluated and the methods used for administering the competency evaluation activities. For example, an experienced technician who consistently performs at a high level of competency may

not need to have their competency evaluated as frequently as a less-experienced technician who is still actively learning how to perform the sampling and testing activities.

- 5.5.3. Evaluations of staff competency shall be conducted through observation of test demonstration by the laboratory technicians for the tests they are qualified to perform. The demonstrations shall be evaluated either by in-house personnel, a representative of a certification program, a representative of an assessment body, or a consultant person or company used to provide objective evaluations of testing competency.
- 5.5.4. The laboratory shall maintain records of technician training and competency evaluation activities. The records shall include the following information:
 - 5.5.4.1. Test method designation for which the technician was evaluated;
 - 5.5.4.2. Date on which competence was evaluated;
 - 5.5.4.3. Name of the individual who evaluated the technician's competency; and
 - 5.5.4.4. A field for recording comments about the training or competency evaluation activity.
- 5.5.5. If an external certification or assessment program is used as a means of evaluating competency, the date of the evaluation (referred to in Section 5.5.4.2) and the name of the evaluator (referred to in Section 5.5.4.3) shall be reported on the competency evaluation record.
- 5.6. *Internal Audits:*
 - 5.6.1. The laboratory shall maintain a document describing the scope of internal audits. Internal audits shall verify that the laboratory's operations continue to comply with its policies and procedures and the requirements of this standard (see Figure X1.3).
 - 5.6.2. The document shall include the frequency of the reviews and identification of the individual(s) responsible for the review. The internal audit program shall address all elements of the quality management system and shall be conducted at least every 12 months by trained personnel independent of the activity being audited, where possible.
 - 5.6.3. Findings from internal audits shall be recorded (see Figure X1.4).
- 5.7. *Management Reviews:*
 - 5.7.1. The laboratory's top management shall review its QMS at planned intervals at least every 12 months to ensure its continuing adequacy and effectiveness in satisfying the relevant requirements, including those specified in this standard. The results of the management reviews shall be recorded (see Figures X1.5 and X1.6). The following information shall be included as part of the management reviews:
 - 5.7.1.1. Results of internal and external audits;
 - 5.7.1.2. Proficiency sample performance;
 - 5.7.1.3. Status of corrective actions;
 - 5.7.1.4. Personnel staffing changes and training needs;
 - 5.7.1.5. Updates to QMS policies and procedures; and

5.7.1.6. Complaints.

5.8. *Corrective Action:*

5.8.1. The laboratory shall maintain a procedure for implementing corrective action when nonconforming work or departures from policies and procedures have been discovered (Note 7). The procedure shall identify the individual responsible for implementing corrective action and shall begin with an investigation to determine the root cause of the problem. Records of corrective action shall be maintained (see Figure X1.7).

Note 7—The corrective action procedure should be implemented for nonconformities in the following areas: internal audits, customer complaints, equipment calibrations, standardizations, checks and maintenance, external assessments, and proficiency sample testing.

5.8.2. The laboratory shall maintain a procedure used in responding to customer complaints (see Figure X1.8). Records of customer complaints and the resulting actions shall be maintained.

5.9. *Records Retention:*

5.9.1. The laboratory shall establish a policy and procedure for the retention, storage, and disposal of records. The policy shall ensure that records pertaining to the following activities are retained for a minimum of 5 years:

5.9.1.1. External assessments;

5.9.1.2. Internal audits;

5.9.1.3. Management reviews;

5.9.1.4. Proficiency sample testing;

5.9.1.5. Technician training and evaluations;

5.9.1.6. Personnel;

5.9.1.7. Test data and reports;

5.9.1.8. Equipment calibrations, standardizations, checks, and maintenance;

5.9.1.9. Customer complaints; and

5.9.1.10. Corrective actions.

Note 8—Although a 5-year retention schedule is adequate in some instances, there are many circumstances when a longer retention period may be advantageous to the laboratory. Records concerning the calibrations, standardizations, checks, and maintenance of equipment are an example. Retention schedules of this type usually require such records to be held throughout the useful life of the equipment.

6. TECHNICAL REQUIREMENTS

6.1. *Equipment Lists:*

6.1.1. *Inventory List*—The laboratory shall maintain an inventory list of major sampling, testing, calibration, standardization and check equipment, and measurement standards. The list shall

include, where available, the name, date placed in service, manufacturer, and model and serial number.

Note 9—A unique identification number assigned by the laboratory or other unique identifying information may be substituted for the model and serial number if this is the practice normally followed by the laboratory.

Note 10—Major equipment includes all equipment that is normally amortized by a laboratory, such as shakers, physical or chemical testing machines, balances, baths, ovens, microscopes, and computing equipment dedicated to testing. Equipment such as chairs, desks, and file cabinets may be excluded. Major equipment does not usually include expendable items such as miscellaneous glassware, sieves, molds, and viscometers.

6.1.2. *Equipment Calibrations, Standardizations, Checks, and Maintenance List(s):*

- 6.1.2.1. The laboratory shall maintain a list(s) giving a general description of equipment and measurement standards that requires calibrations, standardizations, checks, and maintenance. For each item the list(s) shall include the interval of calibrations, standardizations, checks, or maintenance and either a reference to the procedure used or a statement that an external agency is used to complete the activity (Note 11) (see Figure X1.9).

Note 11—When standard procedures are used, the standard designation should be referenced (e.g., for an aggregate unit weight measure, T 19M/T 19 or C29/C29M would be referenced, if used). When the procedure used has been prepared by the laboratory, the name or identifying number of the in-house procedure should be referenced. If the work is performed by an outside agency, that should be indicated rather than the name of a procedure.

6.2. *General Equipment Procedures:*

- 6.2.1. The laboratory shall have a general procedure that describes the method for ensuring that the calibration, standardizations, checks, and maintenance are performed for all required equipment and measurement standards at the specified intervals. This procedure shall include the name of the individual(s) or position(s) responsible for ensuring that these activities are performed, and procedures for handling equipment that is newly acquired, removed from service, moved to a new location, or defective (see Figure X1.10). The general procedure shall describe how the laboratory meets the following requirements:

- 6.2.1.1. The laboratory shall calibrate, standardize, check, and perform maintenance on significant equipment associated with tests the laboratory performs (Note 12). As a minimum, the applicable equipment listed in Tables A.1 through A.9 shall be included.

Note 12—Refer to R 61 for guidance on performing equipment calibrations, standardizations, and checks.

- 6.2.1.2. Equipment and measurement standards that have been removed from service and newly acquired equipment and measurement standards without a manufacturer's certification shall be calibrated, standardized, or checked before being placed in service. Manufacturer's certification records shall conform to the requirements of Section 6.5 in order to be considered as an acceptable calibration record.

- 6.2.1.3. Equipment and measurement standards that may be affected by moving them to a new location or environment shall be calibrated, standardized, or checked before being placed in service. Examples of equipment that may be affected by a move include, but are not limited to, balances, compression machines, mechanical compaction equipment, and sensitive measurement equipment.

- 6.2.1.4. Measurement standards used to perform calibrations, standardizations, and checks shall be calibrated or shall have a certified value reported by the manufacturer. The calibration record shall include estimates of measurement uncertainty.