



Designation: C 1077 – 03

## Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation<sup>1</sup>

This standard is issued under the fixed designation C 1077; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

### 1. Scope\*

1.1 This practice identifies and defines the duties, responsibilities, and minimum technical requirements of testing laboratory personnel and the minimum technical requirements for laboratory equipment utilized in testing concrete and concrete aggregates for use in construction.

1.2 This practice provides criteria for the evaluation of the capability of a testing laboratory to perform designated ASTM test methods on concrete and concrete aggregates. It can be used by an accrediting agency in the accreditation of a laboratory or by other parties to determine if the laboratory is qualified to conduct the specified tests.

1.3 If the laboratory requires external technical services to conduct tests, the external agency shall be subject to separate evaluation.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- C 29/C 29M Test Method for Bulk Density (Unit Weight) and Voids in Aggregate<sup>2</sup>
- C 31/C 31M Practice for Making and Curing Concrete Test Specimens in the Field<sup>2</sup>
- C 39/C 39M Test Method for Compressive Strength of Cylindrical Concrete Specimens<sup>2</sup>
- C 40 Test Method for Organic Impurities in Fine Aggregates for Concrete<sup>2</sup>
- C 42/C 42M Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete<sup>2</sup>
- C 70 Test Method for Surface Moisture in Fine Aggregate<sup>2</sup>

- C 78 Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)<sup>2</sup>
- C 87 Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar<sup>2</sup>
- C 88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate<sup>2</sup>
- C 116 Test Method for Compressive Strength of Concrete Using Portions of Beams Broken in Flexure<sup>3</sup>
- C 117 Test Method for Material Finer than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing<sup>2</sup>
- C 123 Test Method for Lightweight Particles in Aggregate<sup>2</sup>
- C 125 Terminology Relating to Concrete and Concrete Aggregates<sup>2</sup>
- C 127 Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate<sup>2</sup>
- C 128 Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate<sup>2</sup>
- C 131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine<sup>2</sup>
- C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates<sup>2</sup>
- C 138/C 138M Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete<sup>2</sup>
- C 142 Test Method for Clay Lumps and Friable Particles in Aggregates<sup>2</sup>
- C 143/C 143M Test Method for Slump of Hydraulic Cement Concrete<sup>2</sup>
- C 157/C 157M Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete<sup>2</sup>
- C 172 Practice for Sampling Freshly Mixed Concrete<sup>2</sup>
- C 173/C 173M Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method<sup>2</sup>
- C 174 Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores<sup>2</sup>
- C 192/C 192M Practice for Making and Curing Concrete Test Specimens in the Laboratory<sup>2</sup>

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.98 on Evaluation of Laboratories.

Current edition approved July 10, 2003. Published October 2003. Originally approved in 1987. Last previous edition approved in 2002 as C 1077 – 02.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.02.

<sup>3</sup> Discontinued. See 1998 *Annual Book of ASTM Standards*, Vol 04.02.

**\*A Summary of Changes section appears at the end of this standard.**

- C 215 Test Method for Fundamental Transverse, Longitudinal and Torsional Frequencies of Concrete Specimens<sup>2</sup>
- C 227 Test Method for Potential Alkali Reactivity of Cement–Aggregate Combinations (Mortar-Bar Method)<sup>2</sup>
- C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method<sup>2</sup>
- C 232 Test Methods for Bleeding of Concrete<sup>2</sup>
- C 233 Test Method for Air-Entraining Admixtures for Concrete<sup>2</sup>
- C 234 Test Method for Comparing Concretes on the Basis of the Bond Developed with Reinforcing Steel<sup>4</sup>
- C 289 Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)<sup>2</sup>
- C 293 Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)<sup>2</sup>
- C 295 Guide for Petrographic Examination of Aggregates for Concrete<sup>2</sup>
- C 341/C 341M Test Method for Length Change of Cast, Drilled, or Sawed Specimens of Hydraulic-Cement Mortar and Concrete<sup>2</sup>
- C 403/C 403M Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance<sup>2</sup>
- C 418 Test Method for Abrasion Resistance of Concrete by Sandblasting<sup>2</sup>
- C 441 Test Method for Effectiveness of Mineral Admixtures of Pozzolans or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction<sup>2</sup>
- C 457 Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete<sup>2</sup>
- C 469 Test Method for Static Modulus of Elasticity and Poisson’s Ratio of Concrete in Compression<sup>2</sup>
- C 470/C 470M Specification for Molds for Forming Concrete Test Cylinders Vertically<sup>2</sup>
- C 495 Test Method for Compressive Strength of Lightweight Insulating Concrete<sup>2</sup>
- C 496 Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens<sup>2</sup>
- C 511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes<sup>5</sup>
- C 512 Test Method for Creep of Concrete in Compression<sup>2</sup>
- C 535 Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine<sup>2</sup>
- C 566 Test Method for Total Evaporable Moisture Content of Aggregate by Drying<sup>2</sup>
- C 567 Test Method for Unit Weight of Structural Lightweight Concrete<sup>2</sup>
- C 586 Test Method for Potential Alkali Reactivity of Carbonate Rocks for Concrete Aggregates (Rock Cylinder Method)<sup>2</sup>
- C 597 Test Method for Pulse Velocity Through Concrete<sup>2</sup>
- C 617 Practice for Capping Cylindrical Concrete Specimens<sup>2</sup>
- C 641 Test Method for Staining Materials in Lightweight Concrete Aggregates<sup>2</sup>
- C 642 Test Method for Density, Absorption, and Voids in Hardened Concrete<sup>2</sup>
- C 666/C 666M Test Method for Resistance of Concrete to Rapid Freezing and Thawing<sup>2</sup>
- C 671 Test Method for Critical Dilation of Concrete Specimens Subjected to Freezing<sup>6</sup>
- C 672/C 672M Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals<sup>2</sup>
- C 682 Practice for Evaluation of Frost Resistance of Coarse Aggregates in Air-Entrained Concrete by Critical Dilation Procedures<sup>6</sup>
- C 684 Test Method of Making, Accelerated Curing, and Testing of Concrete Compression Test Specimens<sup>2</sup>
- C 702 Practice for Reducing Samples of Aggregate to Testing Size<sup>2</sup>
- C 779/C 779M Test Method for Abrasion Resistance of Horizontal Concrete Surfaces<sup>2</sup>
- C 801 Test Method for Determining the Mechanical Properties of Hardened Concrete Under Triaxial Loads<sup>2</sup>
- C 802 Practice for Conducting an Interlaboratory Test Program to Determine the Precision of Test Methods for Construction Materials<sup>2</sup>
- C 803/C 803M Test Method for Penetration Resistance of Hardened Concrete<sup>2</sup>
- C 805 Test Method for Rebound Number of Hardened Concrete<sup>2</sup>
- C 823 Practice for Examination and Sampling of Hardened Concrete in Constructions<sup>2</sup>
- C 856 Practice for Petrographic Examination of Hardened Concrete<sup>2</sup>
- C 873 Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds<sup>2</sup>
- C 876 Test Method for Half-Cell Potentials of Uncoated Reinforcing Steel in Concrete<sup>2</sup>
- C 900 Test Method for Pullout Strength of Hardened Concrete<sup>2</sup>
- C 918 Test Method for Measuring Early-Age Compressive Strength and Projecting Later-Age Strength<sup>2</sup>
- C 944 Test Method for Abrasion Resistance of Concrete or Mortar Surfaces by the Rotating–Cutter Method<sup>2</sup>
- C 1040 Test Methods for Density of Unhardened and Hardened Concrete In Place by Nuclear Methods<sup>2</sup>
- C 1064/C 1064M Test Method for Temperature of Freshly Mixed Portland Cement Concrete<sup>2</sup>
- C 1074 Practice for Estimating Concrete Strength by the Maturity Method<sup>2</sup>
- C 1084 Test Method for Portland–Cement Content of Hardened Hydraulic–Cement Concrete<sup>2</sup>
- C 1105 Test Method for Length Change of Concrete Due to Alkali-Carbonate Rock Reaction<sup>2</sup>
- C 1137 Test Method for Degradation of Fine Aggregate Due to Attrition<sup>2</sup>
- C 1138 Test Method for Abrasion Resistance of Concrete (Underwater Method)<sup>2</sup>

<sup>4</sup> Discontinued. See 2000 *Annual Book of ASTM Standards*, Vol 04.02.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 04.01.

<sup>6</sup> Discontinued. See 2002 *Annual Book of ASTM Standards*, Vol 04.02.

- C 1150 Test Method for the Break-Off Number of Concrete<sup>7</sup>
- C 1152/C 1152 Test Method for Acid-Soluble Chloride in Mortar and Concrete<sup>2</sup>
- C 1170 Test Methods for Determining Consistency and Density of Roller-Compacted Concrete Using a Vibrating Table<sup>2</sup>
- C 1176 Practice for Making Roller-Compacted Concrete in Cylinder Molds Using a Vibrating Table<sup>2</sup>
- C 1202 Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration<sup>2</sup>
- C 1218/C 1218M Test Method for Water-Soluble Chloride in Mortar and Concrete<sup>2</sup>
- C 1231/C 1231M Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders<sup>2</sup>
- C 1383 Test Method for Measuring the P-Wave Speed and the Thickness of Concrete Plates Using the Impact-Echo Method<sup>2</sup>
- C 1399 Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete<sup>2</sup>
- C 1404/C 1404M Test Method for Bond Strength of Adhesive Systems Used with Concrete as Measured by Direct Tension<sup>2</sup>
- D 75 Practice for Sampling Aggregates<sup>8</sup>
- D 2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate<sup>8</sup>
- E 4 Practices for Force Verification of Testing Machines<sup>9</sup>
- E 11 Specification for Wire Cloth and Sieves for Testing Purposes<sup>10</sup>
- 2.2 *ACI Standards:*
  - ACI 214-77 Recommended Practice for Evaluation of Strength Test Results of Concrete<sup>11</sup>
  - SP-19 (116R) Cement and Concrete Terminology<sup>11</sup>

### 3. Terminology

#### 3.1 Definitions:

3.1.1 *evaluation authority*—an independent entity, apart from the organization being evaluated, that can provide an unbiased evaluation of that organization. The entity must have the capability to assess the professional and technical activities of concrete and concrete aggregate testing laboratories.

3.1.1.1 *Discussion*—Laboratory inspection services are provided by the Cement and Concrete Reference Laboratory (CCRL).<sup>12</sup> Laboratory inspection is broadened into accreditation programs by such independent authorities as the National Voluntary Laboratory Accreditation Program (NVLAP),<sup>13</sup>

American Association for Laboratory Accreditation (A2LA)<sup>14</sup>, Construction Materials Engineering Council (CMEC)<sup>15</sup> AASHTO Accreditation Program (AAP)<sup>16</sup> and other recognized agencies as may be established.

3.1.2 *external technical services*—those services required by a testing laboratory that are provided by another organization.

3.1.3 *field technician*—an employee of the laboratory who is assigned to perform sampling and testing functions outside the laboratory.

3.1.4 *laboratory technician*—an employee of the laboratory who is assigned to perform the actual testing operations primarily conducted in the laboratory.

3.1.5 *quality systems*—those internal procedures and practices that a laboratory utilizes to ensure continued compliance with applicable testing standards for concrete and concrete aggregates.

3.1.6 *testing laboratory*—an organization that measures, examines, performs tests, or otherwise determines the characteristics or performance of materials or products. This may include organizations that offer commercial testing services, an in-house quality control function, an academic institution, or any other organization providing the required testing services.

3.1.7 Additional definitions can be found in Terminology C 125, Practices E 4, and ACI SP-19.

### 4. Significance and Use

4.1 The testing and inspection of concrete and concrete aggregates are important elements in obtaining quality construction. A testing laboratory specializing in these services must be selected with care.

4.2 A testing laboratory shall be deemed qualified to perform and report the results of its tests if the laboratory meets the requirements of this practice. The testing laboratory services shall be provided under the technical direction of a registered professional engineer.

4.3 This practice establishes essential characteristics pertaining to the organization, personnel, facilities, and quality systems of the laboratory. This practice may be supplemented by more specific criteria and requirements for particular projects.

### 5. Organization

5.1 The following information shall be readily available for review:

5.1.1 Description of the organization, including:

5.1.1.1 Complete legal name and address of the main office and each laboratory location,

5.1.1.2 Names and positions of the principal officers and the responsible, registered professional engineer in charge, and

5.1.1.3 Description of the organization management structure.

<sup>7</sup> Discontinued. See 2001 *Annual Book of ASTM Standards*, Vol 04.02.

<sup>8</sup> *Annual Book of ASTM Standards*, Vol 04.03.

<sup>9</sup> *Annual Book of ASTM Standards*, Vol 03.01.

<sup>10</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>11</sup> Available from American Concrete Institute, P.O. Box 9094, Farmington Hills, MI 48333.

<sup>12</sup> CCRL, National Institute of Standards and Technology, Bldg. 226, Rm. A365, Gaithersburg, MD 20899.

<sup>13</sup> NVLAP, National Institute of Standards and Technology, Bldg. 820, Rm. 282, Gaithersburg, MD 20899.

<sup>14</sup> American Association for Laboratory Accreditation, Quince Orchard, Gaithersburg, MD 20878.

<sup>15</sup> Construction Materials Engineering Council, 649 Vassar St., Orlando, FL 32804.

<sup>16</sup> American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capital St. NW, Suite 225, Washington, DC 20001.

5.1.2 Listing of the relevant technical services offered, and  
5.1.3 All external technical services normally utilized.

5.2 The laboratory shall designate an individual with access to management who has the responsibility of seeing that procedures required in this document are being carried out.

## 6. Human Resources

6.1 Information shall be made available to substantiate personnel qualifications as follows:

6.1.1 All relevant testing services are provided under the full-time technical direction of a registered professional engineer with at least 5 years experience in construction materials testing.

6.1.2 Supervising laboratory technicians shall possess a minimum of 3 years relevant experience and current technician certification. The technician certification program must include a written examination and performance evaluation of relevant tests. Relevant tests which must be covered by the certification program are: Practice C 31/C 31M, Test Methods C 39/C 39M, C 40, C 117, C 127, C 128, C 136, C 138/C 138M, C 143/C 143M, Practice C 172, Test Methods C 173/C 173M, C 231, and Test Method C 1064/C 1064M. In cases where the supervising laboratory technician is supervising those who only test concrete, the applicable relevant tests are the concrete tests listed in the group. Where the supervising laboratory technician is supervising those who only test aggregates, the applicable relevant tests are the aggregate tests listed in the group. The certification requirement is satisfied by being certified as (1) both an ACI Concrete Laboratory Testing Technician-Grade 1 and an ACI Concrete Field Testing Technician-Grade 1, or (2) a NICET Construction Materials Testing - Concrete Level 1 Engineering Technician or higher, or (3) by an equivalent certification program.

6.1.3 Supervising field technicians shall possess a minimum of 3 years relevant experience and current technician certification. The technician certification program must include a written examination and performance evaluation of relevant tests. Relevant tests which must be covered by the certification program are: Practice C 31/C 31M, Test Methods C 138/C 138M, C 143/C 143M, Practice C 172, Test Methods C 173/C 173M, C 231, and C 1064/C 1064M. The certification requirement is satisfied by being certified as (1) an ACI Concrete Field Testing Technician-Grade 1, or (2) a NICET Construction Materials Testing-Concrete at Level 1 Engineering Technician or higher, or (3) by an equivalent certification program.

6.1.4 Concrete laboratory technicians shall possess current technician certification. The technician program must include a written examination and performance evaluation of relevant tests. Relevant tests which must be covered by the certification program are: Test Method C 39/C 39M and Practice C 617 or C 1231/C 1231M. The certification requirement is satisfied by being certified as (1) an ACI Concrete Laboratory Testing Technician-Grade 1 or (2) an ACI Concrete Strength Testing Technician, or (3) a NICET Construction Materials Testing-Concrete Level 1 Engineering Technician or higher, or (4) by an equivalent certification program.

6.1.5 Aggregate laboratory technicians shall possess current technician certification. The technician certification program must include a written examination and performance evaluation

of relevant tests. Relevant tests which must be covered by the certification program are: Test Methods C 40, C 117, C 127, C 128, and C 136. The certification requirement is satisfied by being certified as (1) an ACI Concrete Laboratory Testing Technician-Grade 1, or (2) a NICET Construction Materials Testing-Concrete Level 1 Engineering Technician or higher, or (3) by an equivalent certification program.

6.1.6 Concrete field technicians shall possess current technician certification. This technician certification program must include a written examination and performance evaluation of relevant tests. Relevant tests which must be covered by the certification program are: Practice C 31/C 31M, Test Methods C 138/C 138M, C 143/C 143M, Practice C 172, Test Methods C 173/C 173M, C 231, and C 1064/C 1064M. The certification requirement is satisfied by being certified as (1) an ACI Concrete Field Testing Technician-Grade 1, or (2) a NICET Construction Materials Testing-Concrete Level 1 Engineering Technician or higher, or (3) by an equivalent certification program.

6.1.7 Equivalency of other certification programs not listed in the Human Resources Section shall be determined by an evaluation authority. The following criteria shall be used in the determination:

6.1.7.1 The written examination shall be of sufficient length and detail to cover the entire test method,

6.1.7.2 The performance evaluation shall adequately cover procedures of the test method, and

6.1.7.3 The written examination and performance evaluation shall include all relevant test methods which are listed in the section above for the type of technician being certified.

## 7. Test Methods and Procedures

7.1 The testing laboratory shall be capable of performing the required ASTM test methods, guides, or practices in 7.2 and may request additional evaluation for the optional methods in 7.3 to the extent that those services are provided by the laboratory.

7.2 *Required Test Methods and Practices:*

7.2.1 *For Laboratories Testing Concrete:*

7.2.1.1 *Sampling*, Practice C 172,

7.2.1.2 *Slump*, Test Method C 143/C 143M,

7.2.1.3 *Unit Weight, Yield, and Air Content*, Test Method C 138/C 138M,

7.2.1.4 *Air Content*, Test Method C 173/C 173M (volumetric method), or Test Method C 231 (pressure method), or both.

7.2.1.5 *Temperature*, Test Method C 1064/C 1064M,

7.2.1.6 *Making and Curing Test Specimens*, Practice C 31/C 31M,

7.2.1.7 *Compressive Strength*, Test Method C 39/C 39M,

7.2.2 *For Laboratories Testing Concrete Aggregates:*

7.2.2.1 *Sieve Analysis*, Test Method C 136,

7.2.2.2 *Material Finer Than 75- $\mu$ m (No. 200) Sieve*, Test Method C 117,

7.2.2.3 *Specific Gravity and Absorption*, Test Method C 127 (Coarse Aggregate) and Test Method C 128 (Fine Aggregate), and

7.2.2.4 *Organic Impurities in Fine Aggregate*, Test Method C 40.

7.3 *Optional Test Methods or Practices:*

7.3.1 Some laboratories conduct many other tests on concrete and concrete aggregates and these should be evaluated if they are offered in the scope of that laboratory's services. The laboratory shall have evidence of proper facilities, equipment, and trained personnel to comply with the applicable test method or practice. The evaluation authority shall select which of the optional test methods or practices offered by the laboratory need to be demonstrated by the personnel. Some of these ASTM test methods and practices grouped into four categories are as follows:

7.3.1.1 *Freshly Mixed Concrete*—Test Methods C 232, C 233, C 403/C 403M, C 1040, and C 1170, and Practices C 192/C 192M and C 1176.

7.3.1.2 *Concrete Aggregates*—Test Methods C 29/C 29M, C 70, C 87, C 88, C 123, C 131, C 142, C 227, C 289, C 441, C 535, C 566, C 586, C 641, C 1105, C 1137, C 1138, and D 2419, Practices C 682, C 702, and D 75, and Guide C 295.

7.3.1.3 *Hardened Concrete for Strength*—Test Methods C 42/C 42M, C 78, C 116, C 234, C 293, C 495, C 496, C 684, C 873, C 900, C 918, C 1399, and Practices C 617, C 1074, C 1150 and C 1231/C 1231M.

7.3.1.4 *Hardened Concrete for Other Than Strength*—Test Methods C 157/C 157M, C 174, C 215, C 341/C 341M, C 418, C 457, C 469, C 512, C 567, C 597, C 642, C 666/C 666M, C 671, C 672/C 672M, C 779/C 779M, C 801, C 803/C 803M, C 805, C 876, C 944, C 1084, C 1152/C 1152M, C 1202, C 1218/C 1218M, C 1383, and C 1404/C 1404M, and Practices C 823, and C 856.

7.4 The laboratory shall use the latest version of each referenced method within one year of its publication unless an earlier version of the standard is required by the client.

7.5 Laboratory personnel shall have convenient access to applicable standards.

## **8. Facilities, Equipment, and Supplemental Procedures**

8.1 *General*—The laboratory shall have facilities and equipment conforming to the requirements of the applicable test method. This section contains equipment requirements and procedures that clarify certain provisions of the test methods.

8.2 *Procedures Related to Required Test Methods*—In addition to standard test method requirements, the conditions listed in 8.3 and 8.4 must be met.

8.3 *For Laboratories Testing Concrete*:

8.3.1 *Slump Cones*, used with Test Method C 143/C 143M, shall be checked for conformance with the required dimensions when they are purchased and at least annually thereafter.

8.3.2 *Pressure Air Meters*, used with Test Methods C 231, shall be calibrated at least every 3 months.

8.3.3 *Metallic Reusable Molds*, used with Practice C 31/C 31M, shall be checked at least annually for compliance with the requirements of Test Method C 39/C 39M and Specification C 470/C 470M. All nonmetallic reusable molds, such as plastic, shall produce a specimen at each casting that meets the dimensional criteria of Test Method C 39/C 39M. At least three randomly selected single-use molds shall be inspected for compliance from each shipment of molds. Moist room or water storage tanks shall conform to the requirements of Specification C 511 and temperature shall be verified with recording thermometers.

8.3.4 *Compressive Strength Testing Machines*, shall conform to the applicable requirements of Test Method C 39/C 39M and have a capacity, loading range, and the appropriate heads for specimens to be tested. Testing machines shall be verified at least annually in accordance with Practices E 4 and a report giving details of the verification shall be readily available.

8.4 *For Laboratories Testing Concrete Aggregates*:

8.4.1 *Sieve Accuracy*:

8.4.1.1 When performing the procedures of Method C 136, a method of confirming sieve accuracy is required, such as the use of a set of calibrated sieves (see the Appendix of Specification E 11) reserved for that purpose, or a comparison of results of split samples sieved on different sieve sets, or participation in the AMRL Aggregate Proficiency Sample Program.<sup>17</sup>

8.4.1.2 When mechanical sieving devices are used, the period of mechanical agitation shall be checked at least annually. More frequent checks will be required if large numbers of tests are being made and if unusually rough, angular, or elongated materials are being tested. Materials sieved by hand shall be checked for thoroughness of sieving during each test.

8.4.1.3 When performing the procedures of Test Method C 117, a method of confirming sieve accuracy is required, such as a calibrated 75- $\mu$ m (No. 200) sieve (see the Appendix of Specification E 11) reserved for that purpose, or comparison of results on split samples tested on different sieve sets. Sieve accuracy shall be checked at least annually and efficiency of washing shall also be checked at least annually.

8.4.2 *Specific Gravity and Absorption Tests*—When performing the procedures of Test Methods C 127 and C 128, duplicate tests shall be made at least once every 6 months. Results shall be verified for single operator precision within tolerance stated in the respective test method.

8.4.3 Balances or scales for all concrete and aggregate tests shall be calibrated annually.

8.5 *Procedures Related to Optional Test Methods*—If the applicable test method requires equipment calibration and does not specify a frequency, then the laboratory shall establish a frequency in its quality assurance program and conform thereto.

8.6 All equipment listed in this section shall be calibrated or verified before being placed in service. Equipment not in operating condition or out of tolerance shall be marked as such and taken out of service until corrected.

## **9. Laboratory Records and Reports**

9.1 The laboratory shall maintain a system of records that permits verification of any issued report.

9.2 The records of the laboratory shall contain the following information:

9.2.1 Standard operating procedures, which include identification of the test sample, transfer of the sample from the field to the laboratory, recording of test results,

<sup>17</sup> AMRL, National Institute of Standards and Technology, Bldg. 226, Rm. 365, Gaithersburg, MD 20899.

9.2.2 Calibrations or verifications which include the identification of the specific piece of equipment and the date performed; the name of the individual performing the calibration or verification; and the specific criteria required for each piece of equipment. The list in 9.2.3 and 9.2.4 of specific criteria for the calibration or verification of the test equipment must appear on the calibration record.

9.2.3 *For Laboratories Testing Concrete:*

9.2.3.1 *Slump Cones*—Dimensions.

9.2.3.2 *Density (Unit Weight) Scales*—Test points used and the accuracy of the results.

9.2.3.3 *Pressure Air Meters*—Determination of expansion factor; size of the calibration vessel used; and the reading of the meter at the calibration test point(s).

9.2.3.4 *Cylinder Molds*—Dimensions and the results of the watertightness test.

9.2.3.5 *Compression Machines*—Test points, corresponding percentage of error, the calibration date, and the device used.

9.2.4 *For Laboratories Testing Concrete Aggregates:*

9.2.4.1 *Sieve Accuracy*—Results of the split sample or interlaboratory testing program.

9.2.4.2 *Mechanical Sieving Devices*—Length of time for the proper efficiency of sieving.

9.2.4.3 *Specific Gravity Tests*—Results of the duplicate samples, and

9.2.4.4 *Aggregate Balances*—Test points, corresponding percentage of error, the calibration date, and the device used.

9.2.5 Records on laboratory personnel that document work experience, education, on-the-job training, and methods used to ensure continued competence in performing the required test methods,

9.2.6 Audits and inspections by outside agencies and all reports or certifications, with applicable dates, of any evaluation or accreditations issued by any evaluating authorities,

9.2.7 Current standard test methods and other pertinent reference material in a library,

9.2.8 Identification of the person performing the field tests, and

9.2.9 Documents that establish the traceability to an acceptable reference standard or a national standard for load cells, proving rings, thermometers, test weights, and test equipment used for verification or calibration of laboratory equipment.

9.3 Laboratory test reports shall accurately and clearly present the specified test results and all pertinent data.

9.4 Test reports shall include the following information:

9.4.1 Name and address of the laboratory,

9.4.2 Identification of the report and the date issued,

9.4.3 Name of the client,

9.4.4 Project identification,

9.4.5 Sample identification,

9.4.6 Identification of the standard test method used, a notation of all known deviations from the test method, and all requirements of the test method that were not performed by the laboratory (Note 1),

9.4.7 Test results and other pertinent data required by the standard,

9.4.8 Name of the registered professional engineer or his designee, and

9.4.9 Identification of results obtained from tests performed by other laboratories.

9.5 Corrections or additions to reports shall clearly reference the report being amended.

9.6 A record of each test report and related records shall be retained for at least 3 years.

NOTE 1—Deviation from standard test methods may adversely affect results.

## 10. Quality Systems

10.1 The laboratory shall maintain a quality manual of written procedures for ensuring the quality of the services offered (Note 2). In addition to the following information, each page in the manual shall contain a preparation or revision date to ensure the latest procedure is being followed.

10.1.1 Internal quality assurance program, including:

10.1.1.1 Personnel evaluation including the method of evaluation, the frequency of the review, the criteria used, and the title or name of the individual responsible for administering the evaluations; and technician training including a description of the levels of training, the testing used to determine when a level has been reached and the title or name of the individual responsible for administering the training,

10.1.1.2 Equipment calibration and maintenance,

10.1.1.3 A current library including all relevant test methods, and

10.1.1.4 Inventory and description of all test equipment as described in Section 8 including the equipment name, identification number, and next date of calibration.

10.1.2 Participation in proficiency testing programs, such as CCRL Concrete Proficiency Sample Programs and AMRL<sup>17</sup> Aggregate Proficiency Sample Programs (Note 3).

10.1.3 The laboratory shall establish procedures for handling technical complaints from clients that includes the title or name of the individual responsible for handling the complaint, the review system in the laboratory and the type of reply to be issued.

10.1.4 The laboratory shall establish procedures for ensuring the quality of external technical services, such as: calibration services used by the laboratory, equipment and materials procured by the laboratory from vendors, and subcontractors (that is, a laboratory contracted to perform a standard test method or part of a test method). The laboratory should be able to demonstrate that the subcontractor is competent and is in compliance with the requirements of the test methods. The laboratory should maintain records of the subcontractor and vendor evaluations. The selection and evaluation criteria for the subcontractor should include a review of external audits, inspections, certifications, and laboratory accreditations held by the laboratory.

NOTE 2—Other recommended quality programs for a laboratory include: (1) Conducting within-laboratory statistical computations on concrete tests. Randomly selecting 10 tests per month and determining the within-test standard deviation (see ACI 214 and Practice C 802 for statistical methods); (2) Participation in an interlaboratory proficiency program on concrete tests. A quarterly exchange of samples between laboratories in accordance with Practice C 802 will provide excellent quality assurance data.



NOTE 3—The testing program should have a minimum of 10 participants.

## 11. Laboratory Evaluation

11.1 The testing laboratory shall have its facilities, equipment, personnel, and procedures inspected at intervals of approximately 24 months by an evaluation authority (see Discussion in 3.1.1) to confirm its ability to perform the required tests. The personnel and equipment used by the laboratory during the evaluation shall be representative of the personnel and equipment available during the period between evaluations. Temporary acquisition of personnel or equipment to enhance the results of the evaluation shall not be permitted.

11.2 Deficiencies noted in the final report provided to the laboratory by the evaluation authority shall be corrected within 30 days of receipt of the report.

11.3 The laboratory shall (1) report deficiency corrections to AAP, A2LA, CMEC, NVLAP or other recognized accrediting body who will issue a certificate of accreditation when their requirements are satisfied, or (2) if an inspection service is used, supplement copies of the final report with a statement of corrective actions taken signed by the laboratory's professional engineer.

## 12. Keywords

12.1 aggregates; concrete; criteria; evaluation; laboratory; quality assurance (QA); testing

## SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this standard since the last issue, C 1077 – 02, that may impact the use of this standard. (Approved October 2003.)

(1) Revised certification requirements for supervising laboratory technicians in 6.1.2.  
(2) Added “scales” to 8.4.3.

(3) Deleted 9.2.3.2 on Unit Weight Measures.  
(4) Corrected the title of 9.2.3.3 (now 9.2.3.2).

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