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Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation¹

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 (ϵ) 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 evaluation authority in the inspection or accreditation of a laboratory or by other parties to determine if the laboratory is qualified to conduct the specified tests.

NOTE 1—Specification E 329 provides criteria for the evaluation of laboratories that perform the inspection of concrete during placement.

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:²

C 31/C 31M Practice for Making and Curing Concrete Test Specimens in the Field

C 39/C 39M Test Method for Compressive Strength of Cylindrical Concrete Specimens

C 40 Test Method for Organic Impurities in Fine Aggregates for Concrete

C 117 Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing

C 125 Terminology Relating to Concrete and Concrete Aggregates

C 127 Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

C 128 Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate

C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates

C 138/C 138M Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

C 143/C 143M Test Method for Slump of Hydraulic-Cement Concrete

C 172 Practice for Sampling Freshly Mixed Concrete

C 173/C 173M Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

C 617 Practice for Capping Cylindrical Concrete Specimens

C 802 Practice for Conducting an Interlaboratory Test Program to Determine the Precision of Test Methods for Construction Materials

C 1064/C 1064M Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

C 1231/C 1231M Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders

D 75 Practice for Sampling Aggregates

¹ 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.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

D 2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate
 E 4 Practices for Force Verification of Testing Machines
 E 11 Specification for Wire Cloth and Sieves for Testing Purposes
 E 329 Specification for Agencies Engaged in Construction Inspection and/or Testing
 E 1301 Guide for Proficiency Testing by Interlaboratory Comparisons

2.2 *ACI Standards:*

ACI 214-77 Recommended Practice for Evaluation of Strength Test Results of Concrete³
 SP-19 (116R) Cement and Concrete Terminology³

3. Terminology

3.1 *Definitions:*

3.1.1 *evaluation authority, n*—an independent entity, apart from the testing laboratory being evaluated, that has the capability to provide an unbiased evaluation of the professional and technical activities of concrete and concrete aggregates testing laboratories.

3.1.1.1 *Discussion*—Two acceptable methods of evaluation are inspection and accreditation, and these evaluations are offered by many evaluation authorities. An inspection is an evaluation of equipment and procedures based on the Test Methods and Procedures section, along with a review of the quality system. An inspection report is the final step in the process for an inspection agency. The testing laboratory being evaluated performs corrective actions for any deficiencies noted, and these corrections are to be placed with the other inspection documentation as part of the permanent record of the inspection. An accreditation agency uses the results of the inspection report or the results of their own onsite assessment as one phase of the accreditation process. As a separate phase, the accreditation agency also reviews the testing laboratory’s corrective actions for the deficiencies noted and issues a certificate of accreditation once all of the deficiencies have been corrected. There is no universally accepted evaluation authority in the construction materials testing field; therefore, testing laboratories should give careful consideration when selecting an evaluation authority to gain the most benefit from the evaluation. In most cases, a testing laboratory will select an evaluation authority as a result of requirements in a project specification, or contract, or in response to local codes, or other industry requirements. In those circumstances, the requirements will stipulate the acceptable evaluation authorities. If there are no specific requirements and the evaluation is in anticipation of future work or to compete with other local testing laboratories, then the laboratory should contact the organization(s) most likely to use their services for a list of acceptable evaluation authorities. A list of evaluation authorities is provided in the Qualification of Personnel and Laboratory Evaluation section of the Manual of Aggregate and Concrete Testing.⁴ The list is merely a collection of organizations willing to provide this service and is not an endorsement of any particular organization. Other organizations may also be available to provide this service.

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

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

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

3.1.5 *quality systems, n*—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, n*—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:

³ Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, <http://www.aci-int.org>.

⁴ Manual of Aggregate and Concrete Testing, *Annual Book of ASTM Standards*, Vol 04.02.

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.

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 that 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 technicians who only test concrete, the applicable relevant tests are the concrete tests listed in the group. Where the supervising laboratory technician is supervising technicians 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- μm (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 other tests on concrete and concrete aggregates in addition to those listed in The *Required Test Methods and Practices* Section. These optional test methods and practices could include any of the test methods or practices developed by Committee C09 and contained in volume 04.02, as well as other related standards such as Practice D 75 and Test Method D 2419. The laboratory shall have evidence of proper facilities, equipment, and trained personnel to comply with the applicable test method or practice, if it is included in the scope of services as defined by the laboratory. The laboratory and the evaluation authority will mutually agree upon which optional test methods or practices will be included in the laboratory's evaluation. The evaluation authority shall then select which of the optional test methods or practices offered by the laboratory need to be demonstrated by the personnel.

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 *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*—Verification of sieve accuracy shall be performed at least annually on each sieve used in the test for sieve analysis (Test Methods C 117 and C 136). Any one of the following three methods of verification is acceptable. Each method of sieve verification shall include an inspection of the sieve cloth for punctures or obvious defects.

8.4.1.1 Verification of each sieve used according to the procedures prescribed in the Annex of Specification E 11.

8.4.1.2 A comparison of the results of a split sample sieved on different sieve sets. Results shall be verified for single operator precision to be within the acceptable range of two results stated in the test method.

8.4.1.3 Participation in the sieve analysis test in an aggregate proficiency sample program, as described in the Quality Systems section. Results shall be verified for multilaboratory precision to be within the acceptable range of two results stated in the test method.

8.4.2 *Mechanical Sieve Shaker*—When mechanical sieving devices are used, the period of mechanical agitation shall be checked at least annually for adequacy of sieving as described in Test Method C 136. Mechanical agitation periods must be established for each different type of aggregate tested.

NOTE 2—Different types of aggregate refer to shape and composition, not supplier. For example, agitation periods for elongated materials may need to be extended, while softer materials that break down easily may require a shorter period to minimize alteration of the particle size distribution.

8.4.3 *Relative Density (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 the tolerance stated in the respective test method. Participation in a proficiency sample program with relative density (specific gravity) and absorption testing is an acceptable alternative.

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

8.5 *Procedures Related to Optional Test Methods:*

8.5.1 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.

8.5.2 In the event that the laboratory borrows or rents equipment to perform an optional test method, the laboratory must be able to document that it obtained the appropriate equipment and that the equipment was calibrated, standardized, or verified.