



Designation: C1222 – 21

## Standard Practice for Evaluation of Laboratories Testing Hydraulic Cement<sup>1</sup>

This standard is issued under the fixed designation C1222; 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.

### 1. Scope\*

1.1 This practice covers the technical training and experience of laboratory testing personnel and identifies the minimum technical requirements for laboratory equipment used in testing of hydraulic cement as prescribed by ASTM.

1.2 This practice provides minimum criteria for evaluating the capability of a laboratory to perform chemical or physical tests listed in the various specifications on hydraulic cement (see [Note 1](#)).

NOTE 1—Relevant hydraulic cement specifications are Specifications [C91/C91M](#), [C150/C150M](#), [C595/C595M](#), [C845/C845M](#), and [C1157/C1157M](#).

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

- [C91/C91M Specification for Masonry Cement](#)
- [C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars \(Using 2-in. or \[50 mm\] Cube Specimens\)](#)

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee C01 on Cement and is the direct responsibility of Subcommittee C01.95 on Coordination of Standards. Current edition approved Jan. 1, 2021. Published February 2021. Originally approved in 1991. Last previous edition approved in 2019 as C1222 – 19a. DOI: 10.1520/C1222-21.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- [C114 Test Methods for Chemical Analysis of Hydraulic Cement](#)
- [C125 Terminology Relating to Concrete and Concrete Aggregates](#)
- [C150/C150M Specification for Portland Cement](#)
- [C151/C151M Test Method for Autoclave Expansion of Hydraulic Cement](#)
- [C185 Test Method for Air Content of Hydraulic Cement Mortar](#)
- [C187 Test Method for Amount of Water Required for Normal Consistency of Hydraulic Cement Paste](#)
- [C191 Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle](#)
- [C204 Test Methods for Fineness of Hydraulic Cement by Air-Permeability Apparatus](#)
- [C219 Terminology Relating to Hydraulic and Other Inorganic Cements](#)
- [C230/C230M Specification for Flow Table for Use in Tests of Hydraulic Cement](#)
- [C266 Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles](#)
- [C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency](#)
- [C430 Test Method for Fineness of Hydraulic Cement by the 45- \$\mu\$ m \(No. 325\) Sieve](#)
- [C451 Test Method for Early Stiffening of Hydraulic Cement \(Paste Method\)](#)
- [C490/C490M Practice for Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete](#)
- [C511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes](#)
- [C595/C595M Specification for Blended Hydraulic Cements](#)
- [C845/C845M Specification for Expansive Hydraulic Cement](#)
- [C1005 Specification for Reference Masses and Devices for Determining Mass and Volume for Use in Physical Testing of Hydraulic Cements](#)
- [C1157/C1157M Performance Specification for Hydraulic Cement](#)
- [C1506 Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters](#)
- [E4 Practices for Force Verification of Testing Machines](#)

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

### 3. Terminology

#### 3.1 Definitions:

3.1.1 For additional definitions of terms used in this practice, refer to Terminology **C125**, Terminology **C219**, and Practices **E4**.

#### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *evaluation authority, n*—an independent entity, apart from the organization being evaluated, that can provide an unbiased evaluation of the organization and shall have the capability to assess the technical activities of testing laboratories.

3.2.1.1 *Discussion*—One such evaluation authority is the Cement and Concrete Reference Laboratory (CCRL).<sup>3</sup> Laboratory inspection is broadened into accreditation programs by such independent authorities as the National Voluntary Laboratory Accreditation Program (NVLAP),<sup>4</sup> AASHTO Accreditation Program (AAP),<sup>5</sup> American Association for Laboratory Accreditation (A2LA),<sup>6</sup> and others established.

3.2.2 *inspection, n*—a process of measuring, examining, testing, gaging, or using other procedures to ascertain the quality or state, detect errors or defects, or otherwise appraise materials, products, services, systems, or environments when compared to preestablished criteria.

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

3.2.4 *quality systems, n*—those internal procedures and practices that a laboratory utilizes to ensure continued compliance with applicable testing standards.

3.2.5 *subcontracting, n*—employing another organization to provide testing services that the laboratory contracted to provide.

3.2.6 *testing laboratory*—an organization that measures, examines, performs tests, or otherwise determines the characteristics or performance of materials or products.

3.2.6.1 *Discussion*—This may include organizations that offer commercial testing services, an in-house quality control function, an academic institution, or any other organization providing the specified testing services.

### 4. Significance and Use

4.1 The testing of hydraulic cement is an important element in obtaining quality construction. A testing laboratory 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.

4.3 This practice provides guidance for evaluating the organization, personnel, facilities, and quality systems of the laboratory. This practice may be supplemented by criteria and requirements for particular projects.

### 5. Documentation of Organization

5.1 The following information shall be readily available for review:

5.1.1 A description of the organization, including the complete legal name and address of the main office and each laboratory location, names and positions of the principal officers and the individual in charge of the laboratory,

5.1.2 A description of the organization management structure, and

5.1.3 A listing of the range of services offered.

### 6. Human Resources

6.1 The manager of the laboratory shall be a chemist, materials analyst, or an engineer and a full-time employee of the organization having at least three years supervisory experience in the testing of hydraulic cement; however, a person with equivalent science-oriented education or experience having satisfactorily directed testing of hydraulic cement is acceptable.

### 7. Testing and Additional Requirements

7.1 *Testing Requirements*—The organization shall have the capability of performing tests associated with its range of services (see **Note 2**). The laboratory shall have the facilities and equipment required for preparing, storing, conditioning, and testing specimens.

**NOTE 2**—The range of services of a testing laboratory may involve either chemical testing or physical testing, or both. The laboratory need not perform all tests listed in the applicable ASTM specification, but rather have the required equipment and demonstrate the ability to perform the procedures within its reported range of services.

7.1.1 The laboratory shall use the latest version of each referenced ASTM standard within one year of its publication in the *Annual Book of ASTM Standards* except where an earlier version is specifically required.

7.1.2 Laboratory personnel shall have convenient access to applicable standards.

7.2 *Additional Requirements*—The following requirements apply to only those tests performed by the laboratory. They are intended to supplement certain provisions of the standard test methods.

7.2.1 Analytical balances and reference masses shall be checked at least annually and shall conform to the requirements of Test Methods **C114**.

7.2.2 Air-permeability apparatus and related accessory equipment shall be calibrated and checked for conformance to Test Methods **C204** at least every 2½ years.

7.2.2.1 Check determinations shall be made against standard or secondary standard reference samples every six months. If the results exceed the precision of the test method, the apparatus shall be recalibrated.

<sup>3</sup> NVLAP, Standards Services Division, National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 2140, Gaithersburg, MD 20899-2140.

<sup>4</sup> American Association for Laboratory Accreditation (A2LA), 5202 Presidents Ct Suite 220, Frederick, MD 21703, www.a2la.org.

<sup>5</sup> Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, www.transportation.org.

<sup>6</sup> American Association for Laboratory Accreditation (A2LA), 5202 Presidents Ct Suite 220, Frederick, MD 21703, www.a2la.org.

## 8. Subcontracting

8.1 Subcontracting for the performance of part or all of a test method is permitted. When subcontracting is used the quality of the work provided must be ensured. The requirements for evaluation differ depending on the permanence of the subcontracting.

8.2 *Permanent Subcontracting*—When all or a portion of a test method is subcontracted on a permanent basis then the subcontracted organization must be subjected to separate evaluation according to this practice for the methods subcontracted. The laboratory shall retain a copy of this evaluation for review by the evaluation authority.

8.3 *Temporary Subcontracting*—When all or a portion of a test method is subcontracted on a temporary basis then the laboratory shall ensure the quality of the subcontracted work. The level and type of assurance will depend on the extent of the subcontracting (see **Note 3**). The laboratory shall retain records of this assurance for review by the evaluation authority.

**NOTE 3**—Some examples of assurance for different levels of temporary subcontracting are (1) a review of calibrations records when the use of a piece of equipment is subcontracted, and (2) a satisfactory rating on a proficiency sample when a method is subcontracted. Other means of assurance are test results from a standard reference material or, in the case of chemical testing records of qualification testing.

## 9. Quality System

9.1 *Quality System Requirements*—The laboratory shall establish a quality system for ensuring the quality of services offered.

9.1.1 The laboratory shall maintain written documentation for the following:

9.1.1.1 Procedures for sampling, handling, and testing the hydraulic cement,

9.1.1.2 Procedures for training and evaluating laboratory personnel,

9.1.1.3 Procedures for calibrating and maintaining test equipment, and

9.1.1.4 Procedures for handling technical complaints from clients about results, procedures, or methods used.

9.1.2 The laboratory shall maintain current standard test methods and other pertinent reference material.

9.1.3 The laboratory shall participate in the appropriate CCRL Cement Proficiency Sample Program (see **Note 4**).

**NOTE 4**—The CCRL offers proficiency sample programs for physical and chemical testing of portland and blended cements and physical testing of masonry cement. The laboratory should participate in the program compatible with its scope.

9.1.4 *Internal Quality System Review*—The quality system shall contain a document describing the scope of internal quality system reviews, establishing the frequency of these reviews, identifying individuals responsible for the review, describing the distribution of reports to managements, procedures for handling deficiencies, and identifying the location of resulting records.

## 10. Laboratory Records and Reports

10.1 *Quality System Records*—The laboratory shall maintain records indicating compliance with the procedures de-

scribed in their quality system documentation. Records shall be maintained for at least five years. The records shall include at least the following:

10.1.1 Results of all calibrations and verifications performed in the laboratory,

10.1.2 Traceability or accuracy of any in-house calibration or verification equipment used,

10.1.3 An inventory and description of all required test equipment,

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

10.1.5 Records of audits and inspections by outside agencies and all reports or certifications, with applicable dates, of any evaluations or accreditations issued by an evaluating authority, and

10.1.6 Records of participation in the appropriate CCRL Cement Proficiency Sample Program.

10.2 *Test Report Records*—The laboratory shall maintain a system of documentation that permits verification of any test report issued. Each test report and supporting documentation shall be retained for at least three years. Corrections or additions to reports shall clearly reference the report being amended. Include in the test report or the supporting documentation the following information:

10.2.1 Name and address of the laboratory,

10.2.2 Identification of the report and the date issued,

10.2.3 Name of the client, if applicable,

10.2.4 Project identification, if applicable,

10.2.5 Sample identification,

10.2.6 Date of receipt of test samples,

10.2.7 Date(s) of test performance,

10.2.8 Identification of the standard test method used, and a notation of all known deviations from the test method observed during the testing of the sample being reported (see **Note 5**),

**NOTE 5**—Deviation from standard test methods may adversely affect results.

10.2.9 Identification of any standard test methods subcontracted and name of the organization that provided such services,

10.2.10 Test results and other pertinent data required by this practice,

10.2.11 Identification of the person performing the tests, and

10.2.12 Name of the person in charge of the laboratory or their designee.

## 11. Laboratory Evaluation

11.1 *Laboratory Evaluation*—The laboratory shall have its facilities, personnel, equipment, and procedures inspected at intervals of approximately two years by an evaluation authority (see **3.2.1.1**) to confirm its ability to perform the required tests.

11.2 The evaluation authority, who performs the inspection of the laboratory, shall report to the manager of the laboratory on all applicable requirements of this practice including deficiencies that existed during the inspection. The laboratory manager is responsible for the correction of any deficiencies.