Designation: C1905/C1905M – 23

# Standard Specification for Cements that Require Carbonation Curing[1]

This standard is issued under the fixed designation C1905/C1905M; 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.

## 1. Scope

1.1 This specification covers cements that require controlled exposure to carbon dioxide to achieve strength, referred to as carbonation curing. These cements are for use in concrete that does not contain steel reinforcement. There are no restrictions on the constituents of the cement. The producer is required to demonstrate that carbon dioxide is chemically bound by the cement.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined. Values are stated in only SI units when inch-pound units are not used in practice.

1.3 If required results obtained from another standard are not reported in the same system of units as used by this standard, it is permitted to convert those results using the conversion factors found in the SI Quick Reference Guide, Annex A in Form and Style for ASTM Standards, www.astm.org/COMMIT/Blue_Book.pdf.

1.4 The text of this standard refers to notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) are not requirements of the standard.

1.5 *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.*

1.6 *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:*[2]

C114 Test Methods for Chemical Analysis of Hydraulic Cement

C183/C183M Practice for Sampling and the Amount of Testing of Hydraulic Cement

C204 Test Methods for Fineness of Hydraulic Cement by Air-Permeability Apparatus

C219 Terminology Relating to Hydraulic and Other Inorganic Cements

C1910/C1910M Test Methods for Cements that Require Carbonation Curing

2.2 *IEEE/ASTM:*[3]

SI 10 Standard for Use of the International System of Units (SI): the Modern Metric System

2.3 The standards referenced in this specification that are intended for use with hydraulic cement are applicable for testing and specifying materials covered by this standard as modified herein.

## 3. Terminology

3.1 *Definitions:*

3.1.1 Terms used in this specification are defined in Terminology C219.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *curing, carbonation, n*—action taken to maintain moisture, temperature, and carbon dioxide conditions in a freshly-placed cement mixture so the potential properties of the mixture that require carbonation reactions may develop.

3.2.1.1 *Discussion*—Carbonation curing requires a confined chamber and control of temperature and moisture conditions as well as carbon dioxide concentration in the chamber.

## 4. Ordering Information

4.1 Orders for cement meeting the requirements of this specification shall include:

[1] This specification is under the jurisdiction of ASTM Committee C01 on Cement and is the direct responsibility of Subcommittee C01.14 on Non-hydraulic Cements.

Current edition approved June 15, 2023. Published July 2023. DOI: 10.1520/C1905_C1905M-23.

[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.

[3] Available from Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Ln., Piscataway, NJ 08854-4141, http://www.ieee.org.

4.1.1 The specification designation, Specification C1905/C1905M, and date; and

4.1.2 Manufacturer's certification, if required.

## 5. Chemical Composition

5.1 Cement meeting this specification shall conform to the respective standard chemical requirements shown in Table 1. In addition, analyze the cement in accordance with Test Methods C114 and report all elements that are present in quantities greater than 0.50 % of the total mass of the cement.

NOTE 1—Test Methods C114 are intended for use with hydraulic cement. However, rapid analysis methods used to comply with Test Methods C114, such as x-ray fluorescence spectroscopy (XRF), atomic absorption spectroscopy (AAS), and inductively coupled plasma spectroscopy (ICP), have been shown to provide acceptable characterization of these materials.

5.2 The manufacturer of a cement meeting this specification shall state in their certification the amount of carbon dioxide chemically bound by the cement when carbonation cured in accordance with Test Methods C1910/C1910M. Report the chemically bound carbon dioxide as a percent of the total mass of the cement in accordance with Test Methods C1910/C1910M.

5.2.1 The bound carbon dioxide shall be determined in accordance with the bound carbon dioxide test procedure provided in Test Methods C1910/C1910M.

## 6. Physical Properties

6.1 The cement shall conform to all of the applicable standard physical requirements of Table 2.

6.2 The compressive strength shall be determined in accordance with the compressive strength test procedure provided in Test Methods C1910/C1910M, which includes the required carbonation curing conditions and duration.

## 7. Sampling

7.1 When purchaser requires that the cement be sampled and tested to verify compliance with this specification, sample in accordance with Practice C183/C183M.

7.2 Practice C183/C183M is not designed for manufacturing quality control and is not required for manufacturer's certification.

## 8. Testing by Manufacturer

8.1 Test samples of cement for compliance with this specification. Location and frequency of sampling are at the discretion of the manufacturer and are permitted to be changed upon agreement between the purchaser and supplier. Sampling and testing shall be either part of, or in addition to, the manufacturer's normal quality control.

**TABLE 1 Standard Chemical Requirements**

| Chemical Requirement | Applicable Test Method | |
|---|---|---|
| Sulfur trioxide ($SO_3$), max, % | C114 | 3.0 |
| Bound carbon dioxide, min, % | C1910/C1910M | 8.0 |

**TABLE 2 Standard Physical Requirements**

| Physical Requirement | Applicable Test Method | Test Limit |
|---|---|---|
| Fineness | C204 | Report only |
| Compressive strength, min, MPa | C1910/C1910M | 28 MPa [4000 psi] |

## 9. Inspection

9.1 Inspection of the material shall be as agreed upon between the purchaser and the seller as part of the purchase contract.

## 10. Rejection

10.1 At the option of the purchaser, material that fails to conform to the applicable requirements of this specification for the type specified shall be rejected. Report rejection to the manufacturer or supplier promptly and in writing, stating the specific reasons for rejection.

10.2 At the option of the purchaser, packages more than 2 % below the mass marked thereon shall be rejected, and if the average mass of packages in any shipment, as shown by determining the mass of 50 packages taken at random, is less than that marked on the packages, reject the entire shipment.

## 11. Certification

11.1 Upon request of the purchaser in the contract or order, a manufacturer's report shall be furnished at the time of shipment stating the results of tests made on samples of the material taken during production or transfer and certifying that the cement conforms to applicable requirements of this specification.

## 12. Package Marking

12.1 When the cement is delivered in packages, words stating it is a carbonation-curing cement, the name and brand of manufacturer, the mass of cement contained therein, and a list of ingredients, using generic names in decreasing order of abundance shall be plainly marked on each package. Provide similar information with the manufacturer's certification accompanying the shipment of packaged or bulk cement.

## 13. Storage

13.1 The cement shall be stored in such a manner as to permit reasonable access for proper inspection and identification of each shipment and in a suitable weather-tight building, container, or package that will protect the cement from dampness.

## 14. Keywords

14.1 carbonation curing; chemically bound carbon dioxide