



Designation: **C1157/C1157M – 20a C1157/C1157M – 23**

## Standard Performance Specification for Hydraulic Cement<sup>1</sup>

This standard is issued under the fixed designation C1157/C1157M; 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 reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

### 1. Scope\*

1.1 This performance specification covers hydraulic cements for both general and special applications. There are no restrictions on the composition of the cement or its constituents (see **Note 1**).

NOTE 1—There are two related hydraulic cement standards, Specification **C150/C150M** for portland cement and Specifications **C595/C595M** for blended cements, both of which contain prescriptive and performance requirements

1.2 This performance specification classifies cements based on specific requirements for general use, high early strength, resistance to attack by sulfates, and heat of hydration. Optional requirements are provided for the property of low reactivity with alkali-silica-reactive aggregates and for air-entraining cements.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard. Values in SI units [or inch-pound units] shall be obtained by measurement in SI units [or inch-pound units] or by appropriate conversion, using the Rules for Conversion and Rounding given in **IEEE/ASTM SI 10**, of measurements made in other units [or SI units]. Values are stated in only SI units when inch-pound units are not used in practice.

1.4 The text of this performance specification 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:<sup>2</sup>

- C109/C109M** Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens)
- C114** Test Methods for Chemical Analysis of Hydraulic Cement

<sup>1</sup> This performance specification is under the jurisdiction of ASTM Committee C01 on Cement and is the direct responsibility of Subcommittee C01.10 on Hydraulic Cements for General Concrete Construction.

Current edition approved Dec. 15, 2020/Sept. 1, 2023. Published January 2021/September 2023. Originally approved in 1992. Last previous edition approved in 2020 as C1157/C1157M – 20/C1157/C1157M – 20a. DOI: 10.1520/C1157-C1157M-20A.10.1520/C1157-C1157M-23.

<sup>2</sup> 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

- C150/C150M Specification for Portland Cement
- ~~C151/C151M Test Method for Autoclave Expansion of Hydraulic Cement~~
- C183/C183M Practice for Sampling and the Amount of Testing of Hydraulic Cement
- C185 Test Method for Air Content of Hydraulic Cement Mortar
- C188 Test Method for Density of Hydraulic Cement
- 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
- C227 Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method) (Withdrawn 2018)<sup>3</sup>
- C359 Test Method for Early Stiffening of Hydraulic-Cement (Mortar Method)
- C430 Test Method for Fineness of Hydraulic Cement by the 45- $\mu\text{m}$  (No. 325) Sieve
- C441/C441M Test Method for Effectiveness of Pozzolans or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction
- C451 Test Method for Early Stiffening of Hydraulic Cement (Paste Method)
- C595/C595M Specification for Blended Hydraulic Cements
- C1012/C1012M Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution
- C1038/C1038M Test Method for Expansion of Hydraulic Cement Mortar Bars Stored in Water
- C1702 Test Method for Measurement of Heat of Hydration of Hydraulic Cementitious Materials Using Isothermal Conduction Calorimetry
- C1891 Test Method for Fineness of Hydraulic Cement by Air Jet Sieving at 45- $\mu\text{m}$  (No. 325)
- IEEE/ASTM SI 10 American National Standard for Use of the International System of Units (SI): The Modern Metric System

### 3. Terminology

#### 3.1 Definitions:

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

### 4. Classification and Use

4.1 The types of hydraulic cement covered by this specification are given in 4.2.1 – 4.2.6 and are classified in accordance with specific properties defined in Table 1 (see Note 2).

NOTE 2—This specification is based on hydraulic cement attributes related to concrete performance, including strength development, sulfate resistance, heat of hydration, and resistance to alkali-silica reactivity. Concrete performance is dependent on many factors such as characteristics of other concrete materials, mix design, production, handling, and environmental conditions. For performance properties of concrete, including permeability, resistance to freeze-thaw cycles and deicer salt scaling, additional information may be obtained through the use of comparative testing of concretes.

4.2 Cements conforming to this specification shall be designated in accordance with the nomenclature with special characteristics indicated by type in accordance with the types in 4.2.1 – 4.2.6. When the type is not specified, the requirements of type GU shall apply.

4.2.1 *Type GU*—Hydraulic cement for general construction. Use when one or more of the special types are not required.

4.2.2 *Type HE*—High Early-Strength.

4.2.3 *Type MS*—Moderate Sulfate Resistance.

4.2.4 *Type HS*—High Sulfate Resistance.

4.2.5 *Type MH*—Moderate Heat of Hydration.

4.2.6 *Type LH*—Low Heat of Hydration.

4.3 *Additional Options*—The following additional purchase options apply for any of the principal types listed. When one or both of these options is invoked, its letter designation and title shall follow immediately after the respective letter designation and title of the principal type (for example, Type MS(R) or Type MS(A)).

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

**TABLE 1 Standard Physical Requirements**

Cement Type	Applicable Test Method	GU	HE	MS	HS	MH	LH
Fineness	C204, and C430 or C1891	A	A	A	A	A	A
Autoclave length change, max, %	C151/C151M	0.80	0.80	0.80	0.80	0.80	0.80
Time of setting, Vicat test <sup>B</sup>	C191						
Initial, not less than, minutes		45	45	45	45	45	45
Initial, not more than, minutes		420	420	420	420	420	420
Air content of mortar volume, max, % <sup>C</sup>	C185	12	12	12	12	12	12
Compressive strength minimum, MPa [psi] <sup>D</sup>	C109/C109M						
1 day		...	12.0 [1740]	...	...	...	...
3 days		13.0 [1890]	24.0 [3480]	11.0 [1600]	11.0 [1600]	5.0 [725]	...
7 days		20.0 [2900]	...	18.0 [2610]	18.0 [2610]	11.0 [1600]	11.0 [1600]
28 days		28.0 [4060]	...	...	25.0 [3620]	...	21.0 [3050]
Heat of hydration, max, kJ/kg [cal/g]	C1702						
3 days		...	...	...	...	335 [80]	200 [50]
7 days		...	...	...	...	...	225 [55]
Mortar bar expansion	C1038/C1038M						
14 days, % max		0.020	0.020	0.020	0.020	0.020	0.020
Sulfate expansion (sulfate resistance) <sup>E</sup>	C1012/C1012M						
6 months, max, %		...	...	0.10	0.05	...	...
1 year, max, %		...	...	...	0.10	...	...
Optional Physical Requirements							
Option A—Air entraining <sup>C,F</sup>	C185						
Air content of mortar, vol %							
max		22	22	22	22	22	22
min		16	16	16	16	16	16
Option R—Low reactivity with alkali-silica-reactive aggregates <sup>G</sup>	C227						
Expansion at							
14 days, max, %		0.020	0.020	0.020	0.020	0.020	0.020
56 days, max, %		0.060	0.060	0.060	0.060	0.060	0.060
Early stiffening, final penetration, min, %	C451	50	50	50	50	50	50
Compressive strength, <sup>D</sup> 28 days, min, MPa	C109/C109M	...	...	28.0	...	22.0	...

<sup>A</sup> Both amount retained on the 45 µm (No. 325) sieve and specific surface area by air permeability apparatus in m<sup>2</sup>/kg shall be reported on all certificates of test results requested from the manufacturer.

<sup>B</sup> Time of setting refers to initial setting time in Test Method C191.

<sup>C</sup> A given value of air content in mortar does not necessarily assure that the desired air content will be obtained in concrete.

<sup>D</sup> Cements may be shipped prior to later-age test data being available. In such cases, the test value may be left blank. Alternatively, the manufacturer can generally provide estimates based on historical production data. The report shall indicate if such estimates are provided.

<sup>E</sup> In the testing of HS cement, testing at one year shall not be required when the cement meets the six-month limit. An HS cement failing the six-month limit shall not be rejected unless it also fails the one-year limit.

<sup>F</sup> When this option is invoked, it replaces the maximum air content of mortar listed in the default table requirements. The minimum compressive strength of air-entraining cements shall be no less than 80 % of that of the comparable non-air-entraining cement type.

<sup>G</sup> Compliance with this requirement shall not be requested unless the cement will be used with alkali-reactive aggregate.

4.3.1 *Option R (Low Reactivity With Alkali-silica-reactive Aggregates)*—When tested for potential activity with reactive aggregates, the cement shall meet the requirements of **Table 1** for Option R.

4.3.2 *Option A (Air-entraining)*—Air-entraining cements shall meet the air content requirements of **Table 1** for Option A.

## 5. Ordering Information

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

5.1.1 The specification designation ASTM C1157 and date,

5.1.2 The type of cement required. If no type is specified, Type GU shall be supplied,

5.1.3 A statement that an option is invoked, when such is desired, and

5.1.4 Manufacturer's certification, if required.

## 6. Chemical Composition

6.1 The chemical composition for the cement is not specified. However, the cement shall be analyzed for informational purposes.

## 7. Physical Properties

7.1 Cement of the type specified shall conform to all of the applicable standard physical requirements of [Table 1](#).

7.2 When optional requirements are specified, the cement shall conform to the applicable optional limits of [Table 1](#).

## 8. Sampling

8.1 When the purchaser requires that the cement be sampled and tested to verify compliance with this specification, sample in accordance with Practice [C183/C183M](#). Provide adequate facilities for sampling the finished cement. Sample the finished cement at the mill or at the site of transfer of ownership as may be specified by the purchaser.

8.2 Practice [C183/C183M](#) is not designed for manufacturing quality control and is not required for manufacturer's certification.

## 9. Test Methods

9.1 When testing a cement for compliance with this specification, or for general characterization, use the following methods, with modifications or exceptions as indicated.

9.2 *Chemical Analysis*—Chemically analyze the cement using Test Methods [C114](#) for major and minor oxides present in greatest quantity that together, including loss-on-ignition, constitute at least 98 % of the total mass of the cement.

9.3 *Fineness*:

9.3.1 Determine fineness by Test Method [C204](#).

9.3.2 Determine amount retained on the 45  $\mu\text{m}$  (No. 325) sieve by either Test Method [C430](#) or [C1891](#).

9.4 Determine autoclave expansion by Test Method [C151/C151M](#), except that for cements with one-day compressive strengths anticipated to be below 3.4 MPa [500 psi], store the test specimen in a moist cabinet for a period of 48 h before demolding and measuring their length.

9.4 Determine the time of setting using Test Method [C191](#). Only the time of initial setting is required.

9.5 Test the mortar for air content using Test Method [C185](#) using the actual density of the cement, as determined by Test Method [C188](#), if it differs from 3.15  $\text{Mg}/\text{m}^3$  by more than 0.05  $\text{Mg}/\text{m}^3$ .

9.6 Determine compressive strength using Test Method [C109/C109M](#). Tests shall be conducted at each age specified in [Table 1](#).

9.7 Determine heat of hydration using Test Method [C1702](#).

9.8 Determine sulfate resistance using Test Method [C1012/C1012M](#).

9.9 Determine reactivity of cement with alkali-silica-reactive aggregate (Option R) using Test Method [C227](#) using crushed borosilicate glass, as described in Test Method [C441/C441M](#), as aggregate.

9.10 Determine early stiffening using Test Method [C451](#) (see [Note 3](#)).

NOTE 3—Additional characterization information may be obtained with Test Method [C359](#).

9.11 Determine mortar bar expansion using Test Method [C1038/C1038M](#) using a 14-day immersion period.