



Designation: C1856/C1856M – 17

# Standard Practice for Fabricating and Testing Specimens of Ultra-High Performance Concrete<sup>1</sup>

This standard is issued under the fixed designation C1856/C1856M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 1. Scope

1.1 This practice covers procedures for fabricating and testing specimens in the laboratory and the field using a representative sample of ultra-high performance concrete (UHPC), for the purpose of determining the properties of the material. This practice is applicable to UHPC with a specified compressive strength of at least 120 MPa (17 000 psi), with nominal maximum size aggregate of less than 5 mm [ $\frac{1}{4}$  in.] and a flow between 200 and 250 mm [8 and 10 in.] as measured by the modified flow table test described in Section 6.

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 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.

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 (1).<sup>2</sup>

1.4 *The text of this standard references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this 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 and health practices and determine the applicability of regulatory limitations prior to use. [WARNING—Fresh hydraulic cementitious mixtures are caustic and may cause chemical burns to exposed skin and tissue upon prolonged exposure.<sup>3</sup> Hand protection should be worn when handling UHPC.]*

<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 C09.61 on Testing for Strength.

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<sup>2</sup> The boldface numbers in parentheses refer to the list of references at the end of this standard.

<sup>3</sup> See section on Safety Precautions, *Manual of Aggregates and Concrete Testing, Annual Book of ASTM Standards, Vol. 04.02.*

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>4</sup>

C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field

C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens

C42/C42M Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

C125 Terminology Relating to Concrete and Concrete Aggregates

C157/C157M Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

C191 Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle

C192/C192M Practice for Making and Curing Concrete Test Specimens in the Laboratory

C219 Terminology Relating to Hydraulic Cement

C230/C230M Specification for Flow Table for Use in Tests of Hydraulic Cement

C341/C341M Practice for Preparation and Conditioning of Cast, Drilled, or Sawed Specimens of Hydraulic-Cement Mortar and Concrete Used for Length Change Measurements

C469/C469M Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

C512/C512M Test Method for Creep of Concrete in Compression

C666/C666M Test Method for Resistance of Concrete to Rapid Freezing and Thawing

C944/C944M Test Method for Abrasion Resistance of Concrete or Mortar Surfaces by the Rotating-Cutter Method

<sup>4</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.

**C1202/C1202M** Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration  
**C1437** Test Method for Flow of Hydraulic Cement Mortar  
**C1609/C1609M** Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading)

### 3. Terminology

#### 3.1 Definitions:

3.1.1 For definitions of terms used in this practice, refer to Terminologies **C125** and **C219**.

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

3.2.1 *concrete, ultra-high performance, n*—a cementitious mixture that has a specified compressive strength of at least 120 MPa [17 000 psi], generally containing fibers and has other properties measured by standard test methods that comply with specified durability, ductility and toughness requirements.

### 4. Significance and Use

4.1 This practice includes procedures for measuring properties of fresh UHPC and procedures for making and testing specimens of hardened UHPC. The practice refers to existing practices and test methods and includes modifications to these referenced standards for application to UHPC.

### 5. Sampling of Fresh UHPC

5.1 The sample shall be taken from the mixer following the completion of the mixing cycle.

5.2 The sample shall be of sufficient size to complete the testing and shall be at least 10 L [0.35 ft<sup>3</sup>].

### 6. Testing of Fresh Properties

#### 6.1 Flow:

6.1.1 Determine the flow of freshly mixed UHPC in accordance with Test Method **C1437**, with the following exceptions.

6.1.1.1 The mold and flow table shall meet the requirements of Specification **C230/C230M**. The concrete pedestal and cork gasket are not required.

6.1.1.2 Fill the mold in a single layer with the fresh UHPC.

6.1.1.3 Do not tamp the UHPC in the mold and do not drop the table.

6.1.1.4 After lifting the mold, wait until a time of 2 min ± 5 s has elapsed.

6.1.1.5 Measure the diameter of the UHPC along the lines of maximum and minimum diameter, with a ruler or tape measure, recording each diameter to the nearest 1 mm [ $\frac{1}{16}$  in.]. Calculate the average of the two diameters measured. The flow value is this average.

#### 6.2 Time of Setting:

6.2.1 Determine the time of setting in accordance with Test Method **C191**, except the material used shall be UHPC poured into the conical ring without consolidation and at the given consistency referenced.

NOTE 1—The consistency of the UHPC sample used to determine time of setting should be the consistency specified for the mix or project and not the normal consistency in Test Method **C191**.

### 7. Making and Curing Test Specimens

#### 7.1 General Requirements:

7.1.1 If making test specimens of UHPC in the field, make and initially cure the specimens in accordance with Practice **C31/C31M**, with the exceptions described in this Practice.

7.1.2 Make and cure test specimens made in the laboratory in accordance with Practice **C192/C192M**, with the exceptions described in this Practice.

7.1.3 Obtain specimens from structures in accordance with Test Method **C42/C42M**.

7.1.4 The size of specimens shall comply with Section 8, as summarized in **Table 1**.

#### 7.2 Molding of Specimens:

7.2.1 Fill cylinder molds in one layer.

7.2.2 Fill prism molds from one end, in one layer.

7.2.3 Consolidate all specimens by tapping the sides of the mold 30 times with the mallet.

7.2.4 Tamping rods and internal vibrators shall not be used in fabricating and consolidating specimens from UHPC.

#### 7.3 Curing:

7.3.1 Cure field-fabricated specimens in accordance with Practice **C31/C31M** and cure laboratory-fabricated specimens in accordance with Practice **C192/C192M**, with the following exception.

7.3.1.1 Within 1 min after finishing the top surface, cover the specimen to prevent drying of the top surface.

NOTE 2—UHPC contains low quantities of mixing water and virtually no bleed water, resulting in surface drying that may impact the hardened properties, therefore it is important to cover the surface of the specimen with a plastic sheet or equivalent as quickly as possible.

#### 7.4 Thermal Treatment:

7.4.1 If required by the specifier of tests, specimens shall be thermally treated after demolding.

7.4.2 If thermal treatment is required, place a temperature sensor at the center of at least one cylinder.

7.4.3 Thermal treatment shall be conducted in accordance with **Table 2**.

**TABLE 1 Summary of Specimen Sizes**

Property	Test Method	Nominal Specimen Sizes	Comments
Compressive Strength	<b>C39/C39M</b>	75 mm by 150 mm [3 in. by 6 in.]	
Flexural Strength	<b>C1609/ C1609M</b>	See <b>8.2.2</b>	Sizes change with fiber length
Static Modulus of Elasticity and Poisson's Ratio	<b>C469/C469M</b>	75 mm by 150 mm [3 in. by 6 in.]	
Creep in Compression	<b>C512/C512M</b>	75 mm by 150 mm [3 in. by 6 in.]	At least six specimens
Length Change	<b>C157/C157M</b> or <b>C341/C341M</b>	75 mm by 75 mm by 285 mm [3 in. by 3 in. by 11¼ in.]	
Resistance to Abrasion	<b>C944/C944M</b>	Minimum size to accommodate the device	
Resistance to Freezing and Thawing	<b>C666/C666M</b>	No limits	Refer to <b>C666/ C666M</b>
Penetration of Chloride Ions	<b>C1202/ C1202M</b>	100 mm [4 in.] diameter	