



Designation: C140/C140M – 23

# Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units<sup>1</sup>

This standard is issued under the fixed designation C140/C140M; 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.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope\*

1.1 These test methods provide various testing procedures commonly used for evaluating characteristics of concrete masonry units and related concrete units. Methods are provided for sampling, measurement of dimensions, compressive strength, absorption, unit weight (density), moisture content, flexural load, and ballast weight. Not all methods are applicable to all unit types, however.

1.2 Specific testing and reporting procedures are included in annexes to these test methods for the following specific unit types:

- Annex A1**—Concrete masonry units (Specifications **C90**, **C129**)
- Annex A2**—Concrete and calcium silicate brick (Specifications **C55**, **C73**, **C1634**)
- Annex A3**—Segmental retaining wall units (Specification **C1372**)
- Annex A4**—Concrete interlocking paving units (Specification **C936/C936M**)
- Annex A5**—Concrete grid paving units (Specification **C1319**)
- Annex A6**—Concrete roof pavers (Specification **C1491**)
- Annex A7**—Dry-cast articulating concrete block (Specification **D6684**)
- Annex A8**—Segmental concrete paving slabs (Specification **C1782/C1782M**)
- Annex A9**—Concrete ballast block (Specification **C1884**)

1.3 The test procedures included in these test methods are also applicable to other types of units not referenced in these test methods, but specific testing and reporting requirements for those units are not included.

1.4 These test methods include the following sections:

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<sup>1</sup> These test methods are under the jurisdiction of ASTM Committee **C15** on Manufactured Masonry Units and are the direct responsibility of Subcommittee **C15.03** on Concrete Masonry Units and Related Units.

Current edition approved June 1, 2023. Published June 2023. Originally approved in 1938. Last previous edition approved in 2022 as C140/C140M – 22c. DOI: 10.1520/C0140\_C0140M-23.

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Worksheet and Test Report for Concrete Masonry Units	Appendix X1
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NOTE 1—The testing laboratory performing these test methods should be evaluated in accordance with Practice **C1093**.

1.5 The text of this test method 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 the standard.

1.6 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.

1.7 *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.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the*

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

*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>

- C55 Specification for Concrete Building Brick
- C73 Specification for Calcium Silicate Brick (Sand-Lime Brick)
- C90 Specification for Loadbearing Concrete Masonry Units
- C129 Specification for Nonloadbearing Concrete Masonry Units
- C143/C143M Test Method for Slump of Hydraulic-Cement Concrete
- C936/C936M Specification for Solid Concrete Interlocking Paving Units
- C1093 Practice for Accreditation of Testing Agencies for Masonry
- C1232 Terminology for Masonry
- C1319 Specification for Concrete Grid Paving Units
- C1372 Specification for Dry-Cast Segmental Retaining Wall Units
- C1491 Specification for Concrete Roof Pavers
- C1552 Practice for Capping Concrete Masonry Units, Related Units and Masonry Prisms for Compression Testing
- C1634 Specification for Concrete Facing Brick and Other Concrete Masonry Facing Units
- C1716/C1716M Specification for Compression Testing Machine Requirements for Concrete Masonry Units, Related Units, and Prisms
- C1782/C1782M Specification for Segmental Concrete Paving Slabs
- C1884 Specification for Manufactured Concrete Ballast Units
- D1056 Specification for Flexible Cellular Materials—Sponge or Expanded Rubber
- D6684 Specification for Materials and Manufacture of Articulating Concrete Block (ACB) Systems
- E4 Practices for Force Calibration and Verification of Testing Machines
- E6 Terminology Relating to Methods of Mechanical Testing

### 2.2 Other Documents:

- SP 960-12 NIST Recommended Practice Guide – Stopwatch and Timer Calibration<sup>3</sup>

## 3. Terminology

3.1 Terminology defined in Terminologies C1232 and E6 shall apply for these test methods.

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

3.2.1 *lot, n*—any number of concrete masonry units or related units, designated by the producer, of any configuration

<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.

<sup>3</sup> Available at <http://tf.nist.gov/general/pdf/2281.pdf>

or dimension manufactured by the producer using the same materials, concrete mix design, manufacturing process, and curing method.

3.2.2 *web, n*—any portion of a hollow concrete masonry unit connecting the face shells.

3.2.2.1 *Discussion*—A web can be either an end web or interior web connecting face shells. All portions of a unit connecting face shells are considered webs.

## 4. Significance and Use

4.1 These test methods provide general testing requirements for application to a broad range of concrete products. Those general testing requirements are included in the body of this standard.

NOTE 2—Consult manufacturer, supplier, product specifications, or other resources for more specific measurement or testing guidelines for those products not addressed with the annex of this standard.

4.2 These test methods provide specific testing requirements in two distinct sections, the requirements applicable to all units covered by these test methods and those applicable to the specific unit types. The requirements applicable to all units are included in the body of these test methods and those applicable to the specific unit types are included within the annexes.

## 5. Sampling

### 5.1 Selection of Test Specimens:

5.1.1 For purposes of testing, full-sized units shall be selected by the purchaser or authorized representative. The selected specimens shall be of similar configuration and dimensions. Specimens shall be representative of the whole lot of units from which they are selected.

### 5.2 Number of Specimens:

5.2.1 Unless specified otherwise in the applicable annex, a set of units shall consist of six full-size units.

5.3 Remove loose material from the specimens (including the cores) prior to determining the received weight.

NOTE 3—An abrasive stone or wire brush is typically used to remove loose material.

5.4 *Identification*—Mark each specimen so that it may be identified at any time. Markings shall cover not more than 5 % of the surface area of the specimen.

5.5 *Received Weight*—Prior to performing tests, weigh each full-size specimen after sampling and marking, and record as  $w_r$  (received weight) to the accuracy required in Table 1. Record time and place  $w_r$  was measured.

NOTE 4—Received weights often have direct relationships with other

**TABLE 1 Required Accuracy for Recording and Reporting Specimen Weights<sup>A</sup>**

Weight of Smallest Specimen Tested	Required Accuracy
Less than 10 lb [4 kg]	0.002 lb [0.001 kg]
10 lb [4 kg] to less than 20 lb [10 kg]	0.005 lb [0.002 kg]
20 lb [10 kg] to less than 50 lb [25 kg]	0.05 lb [0.02 kg]
50 lb [25 kg] or more	0.1 lb [0.04 kg]

<sup>A</sup>These accuracy requirements are to be used for all specimens unless specified separately in the applicable annex.

unit properties and are therefore a useful method of evaluating results or for sorting purposes. It is good laboratory practice to separate sampled units for strength and absorption testing by received weight, such that the averages of the subsets of specimens are similar and representative of the sampled units. Received weight may also be useful in evaluating inconsistency in test results or unit production issues. The weight of a concrete masonry unit and related unit changes with time and exposure conditions, primarily as a result of the moisture within the unit. Therefore, to understand the context of a received weight value, it is also important to understand the point in time and the frame of reference when that weight was determined. “Time and place” should not refer to when and where the unit was sampled but when and where the received weights were determined. In addition to date and time references, it is also important to know if those weights were determined after units reached equilibrium with lab environment, or before units were shipped, or after delivery to the job site, and so forth. Moisture content is not a physical property requirement of concrete masonry units, therefore field measurement of received weight is not necessary (unless specifically specified for a particular job).

## 6. Measurement of Dimensions

### 6.1 Apparatus:

6.1.1 *Measurement Devices*—Devices used to measure specimen dimensions shall have divisions not greater than 0.1 in. [2.5 mm] when the dimension is to be reported to the nearest 0.1 in. [2.5 mm] and not greater than 0.01 in. [0.25 mm] when the dimension is to be reported to the nearest 0.01 in. [0.25 mm].

6.1.2 Measuring devices shall be readable and accurate to the division required to be reported. Accuracy shall be verified at least once annually. Verification record shall include date of verification, person or agency performing verification, identification of reference standard used, test points used during verification, and readings at test points.

6.2 *Specimens*—Three full-size units shall be selected for measurement of dimensions.

6.3 *Measurements*—Measure specimens in accordance with the applicable annex of this standard. For those products not covered by the annexes of this standard, measure overall dimensions (width, height, length) in at least two locations on opposite sides of the specimen to the nearest division required to be reported. Document location of each measurement on a sketch or photograph of the specimen.

NOTE 5—Specimens used for measurement of dimensions may be used in other tests.

NOTE 6—Calipers, micrometers, and steel scales and dividers of the appropriate accuracy and readability have been shown to be adequate for these measurements.

## 7. Compressive Strength

7.1 *Test Apparatus*—The compressive strength testing machine shall conform to Specification C1716/C1716M.

NOTE 7—Previous versions of this standard have contained specific requirements for compressive strength test machines. These requirements have been replaced with reference to Specification C1716/C1716M.

### 7.2 Test Specimens:

7.2.1 Unless specified otherwise in the applicable annex, test three specimens in compression.

7.2.2 Unless specified otherwise in the applicable annex, specimens shall be full-sized units except when the units cannot be tested full-size due to specimen configuration or

testing machine requirements. In these cases, reduce the specimen size in accordance with Annex A1.

7.2.3 After delivery to the laboratory, store compression specimens (unstacked and separated by not less than 0.5 in. [13 mm] on all sides) continuously in air at a temperature of  $75 \pm 15^\circ\text{F}$  [ $24 \pm 8^\circ\text{C}$ ] and a relative humidity of less than 80 % for not less than 48 h. Alternatively, if compression results are required sooner, store units unstacked in the same environment described above with a current of air from an electric fan passing over them for a period of not less than 4 h. Continue passing air over the specimens until two successive weighings at intervals of 2 h show an increment of loss not greater than 0.2 % of the previously determined weight of the specimen and until no moisture or dampness is visible on any surface of the unit. Specimens shall not be subjected to oven-drying.

NOTE 8—In this test method, net area (other than certain solid units, see 9.5) is determined from specimens other than those subjected to compression testing. The compressive strength method is based on the assumption that units used for determining net volume (absorption specimens) have the same net volume as units used for compression testing. Sampled split face units, which have irregular surfaces, should be divided at the time they are sampled from the lot, such that the absorption test specimens have a net volume that is visually representative and a weight that is representative of the compression test specimens.

7.2.4 Where saw-cutting of test specimens is allowed or required by the standard or applicable annex, sawing shall be performed in an accurate, competent manner, subjecting the specimen to as little saw vibration as possible. Use a diamond saw blade of proper hardness. Following cutting, residue from the cutting operation shall be removed prior to continuing testing (see Note 9). If the specimen is wetted during sawing, allow the specimen to dry to equilibrium with laboratory air conditions before testing, using the procedures outlined in 7.2.3.

NOTE 9—For specimens cut with a wet saw, rinsing with clean water is typically sufficient for removing cutting residue. For specimens cut with a dry saw, brushing with a soft-bristle brush is typically sufficient for removing cutting residue.

7.2.5 If compression test specimens have been saw-cut from full-sized units and the net area of the compression test specimens can not be determined by 9.5.1, saw-cut an additional three units to the dimensions and configuration of the three compression test specimens. The average net area for the saw-cut compression specimens shall be taken as the average net area of the additional three saw-cut units calculated as required in 9.5. Calculated net volumes of saw-cut specimens shall not be used in calculating equivalent thickness.

7.3 *Capping*—Cap test specimens in accordance with Practice C1552.

### 7.4 Compression Testing Procedure:

7.4.1 *Determination of Mass Centroid*—Determine the mass centroid, which is used to correctly align the specimen in the compressive testing machine, in accordance with 7.4.1.1 or 7.4.1.2.

7.4.1.1 For masonry units that are symmetrical about an axis, determine the location of the centroidal axis geometrically by dividing the dimension perpendicular to that axis (but