



# Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete<sup>1</sup>

This standard is issued under the fixed designation C 42/C 42M; 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 Department of Defense.*

## 1. Scope

1.1 This test method covers obtaining, preparing, and testing ( $I$ ) cores drilled from concrete for length or compressive strength or splitting tensile strength determinations and ( $\epsilon$ ) beams sawed from concrete for flexural strength determinations.

1.2 The values stated in either inch-pound units or SI units shall be regarded separately as standard. SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 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 the standard.

1.4 *This standard does not purport to address 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.*

## 2. Referenced Documents

### 2.1 ASTM Standards:

- C 39/C 39M Test Method for Compressive Strength of Cylindrical Concrete Specimens<sup>2</sup>
- C 78 Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)<sup>2</sup>
- C 174/C 174M Test Method for Measuring Length of Drilled Concrete Cores<sup>2</sup>
- C 496 Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens<sup>2</sup>
- C 617 Practice for Capping Cylindrical Concrete Specimens<sup>2</sup>

C 642 Test Method for Density, Absorption, and Voids in Hardened Concrete<sup>2</sup>

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials<sup>2</sup>

C 823 Practice for Examination and Sampling of Hardened Concrete in Constructions<sup>2</sup>

C 1231/C 1231M Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders<sup>2</sup>

### 2.2 ACI Standards:

318 Building Code Requirements for Structural Concrete<sup>3</sup>

## 3. Significance and Use

3.1 This test method provides standardized procedures for obtaining and testing specimens to determine the compressive, splitting tensile, and flexural strength of in-place concrete.

3.2 Generally, test specimens are obtained when doubt exists about the in-place concrete quality due either to low strength test results during construction or signs of distress in the structure. Another use of this method is to provide strength information on older structures.

3.3 Concrete strength is affected by the location of the concrete in a structural element, with the concrete at the bottom tending to be stronger than the concrete at the top. Core strength is also affected by core orientation relative to the horizontal plane of the concrete as placed, with strength tending to be lower when measured parallel to the horizontal plane.<sup>4</sup> These factors shall be considered in planning the locations for obtaining concrete samples and in comparing strength test results.

3.4 The strength of concrete measured by tests of cores and beams is affected by the amount and distribution of moisture in the specimen at the time of test. There is no standard procedure to condition a specimen that will ensure that, at the time of test, it will be in the identical moisture condition as concrete in the

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.61 on Testing Concrete for Strength.

Current edition approved Jan. 10, 2003. Published April 2003. Originally approved in 1921. Last previous edition approved in 1999 as C 42/C 42M-99.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.02.

<sup>3</sup> Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333.

<sup>4</sup> Neville, A., "Core Tests: Easy to Perform, Not Easy to Interpret," *Concrete International*, Vol. 23, No. 11, November 2001, pp. 59-68.

structure. The moisture conditioning procedures in this test method are intended to provide reproducible moisture conditions that minimize within-laboratory and between-laboratory variations and to reduce the effects of moisture introduced during specimen preparation.

3.5 There is no universal relationship between the compressive strength of a core and the corresponding compressive strength of standard-cured molded cylinders. The relationship is affected by many factors such as the strength level of the concrete, the in-place temperature and moisture history, and the strength gain characteristics of the concrete. Historically, it has been assumed that core strengths are generally 85 % of the corresponding standard-cured cylinder strengths, but this is not applicable to all situations. The acceptance criteria for core strength are to be established by the specifier of the tests. ACI 318 provides core strength acceptance criteria for new construction.

#### 4. Apparatus

4.1 *Core Drill*, for obtaining cylindrical core specimens with diamond impregnated bits attached to a core barrel.

4.2 *Saw*, for cutting beam specimens to size for flexural strength tests and to trim ends of cores. The saw shall have a diamond or silicon-carbide cutting edge and shall be capable of cutting specimens that conform to the prescribed dimensions, without excessive heating or shock.

#### 5. Sampling

##### 5.1 General:

5.1.1 Samples of hardened concrete for use in the preparation of strength test specimens shall not be taken until the concrete is strong enough to permit sample removal without disturbing the bond between the mortar and the coarse aggregate (see Note 1 and Note 2). When preparing strength test specimens from samples of hardened concrete, samples that have been damaged during removal shall not be used unless the damaged portion(s) are removed and the resulting test specimen is of suitable length (see 7.2). Samples of defective or damaged concrete that cannot be tested shall be reported along with the reason that prohibits use of the sample for preparing strength test specimens.

NOTE 1—Practice C 823 provides guidance on the development of a sampling plan for concrete in constructions.

NOTE 2—It is not possible to specify a minimum age when concrete is strong enough to withstand damage during removal, because the strength at any age depends on the curing history and strength grade of the concrete. If time permits, the concrete should not be removed before it is 14 days old. If this is not practical, removal of concrete can proceed if the cut surfaces do not display erosion of the mortar and the exposed coarse aggregate particles are embedded firmly in the mortar. In-place test methods may be used to estimate the level of strength development prior to attempting removal of concrete samples.

5.1.2 Specimens containing embedded reinforcement shall not be used for determining compressive, splitting tensile, or flexural strength.

5.2 *Core Drilling*—A core specimen shall be drilled perpendicular to the surface and not near formed joints or obvious edges of a unit of deposit. Record and report the approximate angle between the longitudinal axis of the drilled core and the

horizontal plane of the concrete as placed. A specimen drilled perpendicular to a vertical surface, or perpendicular to a surface with a batter, shall be taken from near the middle of a unit of deposit when possible.

5.3 *Slab Removal*—Remove a slab sufficiently large to secure the desired test specimens without the inclusion of any concrete that has been cracked, spalled, undercut, or otherwise damaged.

### DRILLED CORES

#### 6. Measuring the Length of Drilled Cores

6.1 Cores for determining the thickness of pavements, slabs, walls or other structural elements shall have a diameter of at least 3.75 in. [95 mm] when the lengths of such cores are stipulated to be measured in accordance with Test Method C 174/C 174M.

6.2 For cores that are not intended for determining structural dimensions, measure the longest and shortest lengths on the cut surface along lines parallel to the core axis. Record the average length to the nearest 1/4 in. [5 mm].

#### 7. Cores for Compressive Strength

7.1 *Diameter*—The diameter of core specimens for the determination of compressive strength in load bearing structural members shall be at least 3.70 in. [94 mm]. For non-load bearing structural members or when it is impossible to obtain cores with length-diameter ratio (L/D) greater than or equal to 1, core diameters less than 3.70 in. [94 mm] are not prohibited (see Note 3). For concrete with nominal maximum aggregate size greater than or equal to 1 1/2 in. [37.5 mm], the core diameters shall be as directed by the specifier of the tests (see Note 4).

NOTE 3—The compressive strengths of nominal 2-in. [50-mm] diameter cores are known to be somewhat lower and more variable than those of nominal 4-in. [100-mm] diameter cores. In addition, smaller diameter cores appear to be more sensitive to the effect of the length-diameter ratio.<sup>5</sup>

NOTE 4—The preferred minimum core diameter is three times the nominal maximum size of the coarse aggregate but it should be at least two times the nominal maximum size of the coarse aggregate.

7.2 *Length*—The preferred length of the capped or ground specimen is between 1.9 and 2.1 times the diameter. If the ratio of the length to the diameter (L/D) of the core exceeds 2.1, reduce the length of the core so that the ratio of the capped or ground specimen is between 1.9 and 2.1. Core specimens with length-diameter ratios equal to or less than 1.75 require corrections to the measured compressive strength (see 7.9.1). A strength correction factor is not required for L/D greater than 1.75. A core having a maximum length of less than 95 % of its diameter before capping or a length less than its diameter after capping or end grinding shall not be tested.

7.3 *Moisture Conditioning*—Test cores after moisture conditioning as specified in this test method or as directed by the specifier of the tests. The moisture conditioning procedures

<sup>5</sup> Bartlett, F.M. and MacGregor, J.G., "Effect of Core Diameter on Concrete Core Strengths," *ACI Materials Journal*, Vol. 91, No. 5, September-October 1994, pp. 460-470.