



Designation: C 1404/C 1404M – 98

## Standard Test Method for Bond Strength of Adhesive Systems Used With Concrete as Measured by Direct Tension<sup>1</sup>

This standard is issued under the fixed designation C 1404/C 1404M; 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 test method covers the laboratory determination of the bond strength of adhesive systems used to adhere freshly mixed mortar to hardened portland-cement concrete.

1.2 The values stated, in either SI units or other units shall be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore each system must be used independently of the other, without combining values in any way.

1.3 *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.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- A 333/A 333M Specification for Seamless and Welded Steel Pipe for Low-Temperature Service<sup>2</sup>
- C 33 Specification for Concrete Aggregates<sup>3</sup>
- C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens<sup>3</sup>
- C 42 Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete<sup>3</sup>
- C 109 Test Method for Compressive Strength of Hydraulic Cement Mortars using 2-in. [50 mm] Cube Specimens<sup>4</sup>
- C 150 Specification for Portland Cement<sup>3</sup>
- C 171 Specification for Sheet Materials for Curing Concrete<sup>3</sup>
- C 192 Practice for Making and Curing Concrete Specimens in the Laboratory<sup>3</sup>
- C 305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency<sup>4</sup>
- C 494 Specification for Chemical Admixtures for Concrete<sup>3</sup>

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee C-9 on Concrete and Concrete Aggregates, and is the direct responsibility of Subcommittee C09.25 on Organic Materials for Bonding, Patching, and Decking.

Current edition approved Sept. 10, 1998. Published April 1999.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 01.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 04.02.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 04.01.

C 881 Specification for Epoxy-Resin-Base Bonding Systems for Concrete<sup>3</sup>

C 670 Practice for Preparing Precision Statements for Test Methods for Construction Materials<sup>3</sup>

### 3. Summary of Test Method

3.1 Each specimen consists of a base and overlay, bonded together with the adhesive being tested. The base is half of a 3-in. [75-mm] by 6-in. [150-mm] hardened-concrete cylinder mounted inside of a steel-pipe nipple. The overlay consists of freshly mixed mortar placed in a steel-pipe nipple positioned on top of the base.

3.2 The prepared surface of the base is coated with the adhesive, onto which freshly mixed mortar is applied. After curing, the assembly is pulled in tension to measure the bond strength of the adhesive. The tensile strength is calculated, and the location of failure is determined visually.

### 4. Significance and Use

4.1 The bonding properties of adhesives are important for concrete repair applications. This test method provides a means to measure the adhesive characteristics of materials used to bond freshly mixed mortar to hardened concrete.

4.2 In addition to providing information on bond strength, the location of failure is determined visually and is thus instructive regarding the weakest element in the composite tested.

4.3 The bond strength that is measured is limited by the tensile strength of the base concrete and mortar. While an attempt has been made to choose materials that are strong enough to force a bond failure, there may be cases where failure occurs in concrete or mortar. In these situations, the actual bond strength exceeds the measured result.

### 5. Apparatus

5.1 *Testing Machine*—The testing machine shall be of the hydraulic or screw-type and capable of measuring tensile loads up to 5000 lbf [22 kN] in increments of 45 lbf [200 N] at rates described in 9.3.

5.2 *Steel-Pipe Nipples*—The steel-pipe nipples shall conform to Specification A 333/A 333M, be nominally 3 in. [75 mm] in diameter by 3 in. [75 mm] long Schedule 40, threaded;

**ASTM C 1404/C 1404M**

two per specimen. The inside surface of the steel-pipe nipples shall be clean and free of oil or other contaminants that could inhibit bond. The inside surface shall be sandblasted to gray metal condition.

5.3 *Steel-Pipe Cap*—Two steel-pipe caps nominally 3 in. [75 mm] in diameter, and threaded to fit the steel-pipe nipple molds. Each cap shall be fitted with a steel rod or eye bolt with at least one universal joint for connection to the testing machine. The assembly shall have a tensile capacity of at least 5000 lbf [22 kN]. See Fig. 1 for details of preparation.

5.4 *Base Assembly*—Concrete cylinder and steel pipe nipple, prepared according to Section 7; one for each specimen.

5.5 *O-rings*—Rubber, 2-7/8 in. [73 mm] inside diameter × 3-1/4 in. [83 mm] outside diameter; 3/16 in. [5 mm] thick; one for each specimen.

5.6 *Concrete Mixer*—As described in Practice C 192.

5.7 *Mixer, Bowl, and Paddle*—A mechanical mortar mixer, as described in Practice C 305.

5.8 *Small Tools*—Tools and items such as a straightedge, scoops, rubber gloves, and metal mixing bowls.

5.9 *Tamping Rod*—The tamping rod shall be a round steel rod, 3/8 in. [10 mm] in diameter, conforming to Practice C 192.

5.10 *Saw*, as described in Test Method C 42, with diamond saw blade and plain water as the only cutting fluid.

5.11 *Cylinder Molds*—The cylinder molds shall be 3-in. [75-mm] diameter by 6-in. [150-mm] long, as described in Practice C 192.

**6. Materials**

6.1 *Cement*—The cement shall be portland cement meeting the requirements of Specification C 150.

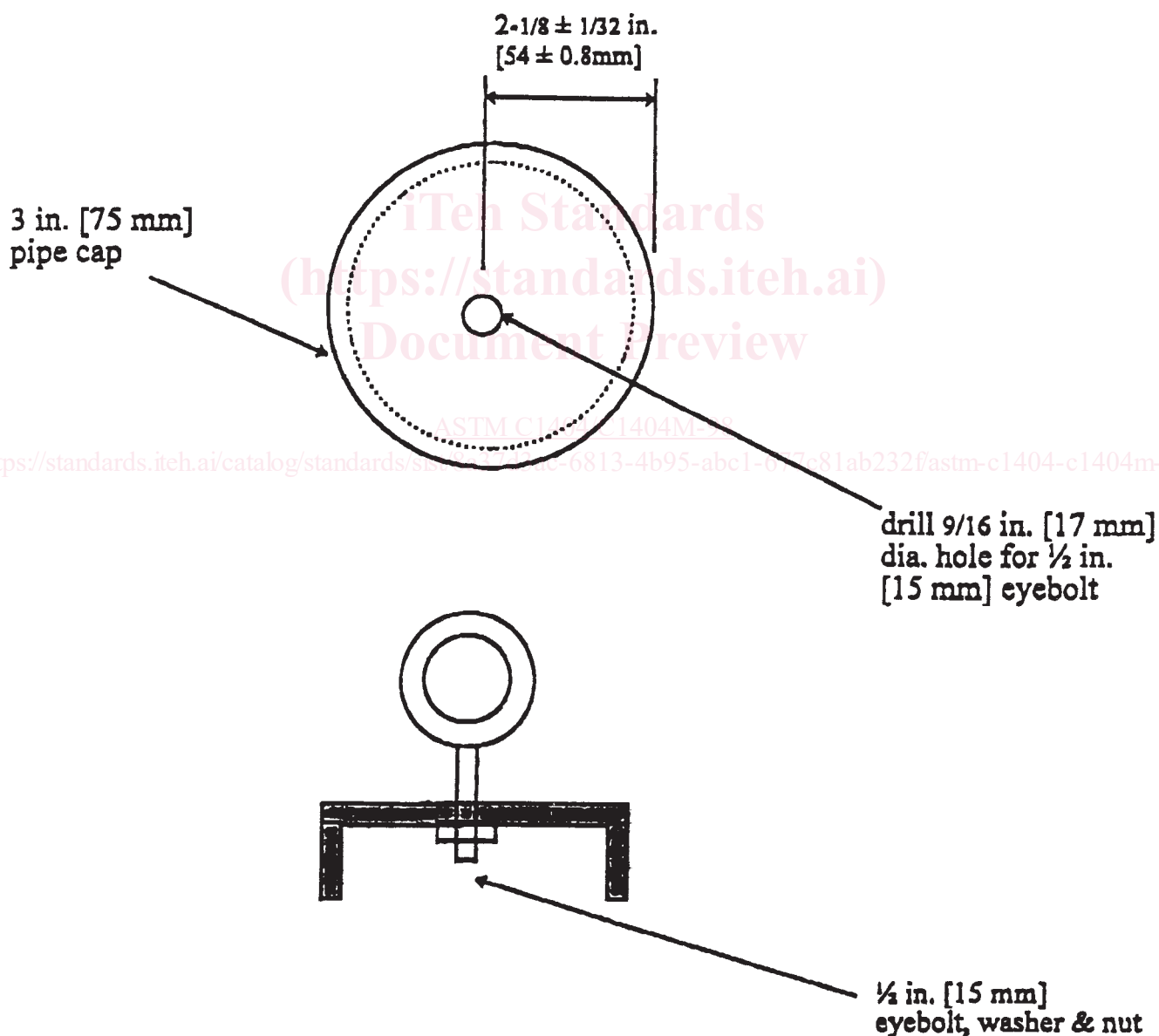


FIG. 1 Pipe Cap Detail