

## Designation: C 353 – 97

# Standard Test Method for Adhesion of Dried Thermal Insulating or Finishing Cement<sup>1</sup>

This standard is issued under the fixed designation C 353; 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 (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers the measurement of the relative adhesion of dried thermal insulating or finishing cement to a particular test surface. While this test method is valuable in rating these products generally, the adhesion of cement to one type of surface cannot be construed as being fully indicative of its adhesion to another type of surface.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

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:

C 163 Practice for Mixing Thermal Insulating Cement Samples<sup>2</sup>

C 168 Terminology Relating to Thermal Insulating Materials<sup>2</sup>

## 3. Terminology

3.1 **Definitions**—Terminology C 168 shall apply to the terms used in this test method.

### 3.2 Definition of Term Specific to This Standard:

3.2.1 **adhesion**—of dried thermal insulating cement to a test surface, the perpendicular force required to detach the cement, expressed in pounds-force per square inch (or kilopascals) of the contact area. The detachment of the cement may occur at the cement-test surface interface, or it may occur within the dried cement if the cohesive strength of the cement is less than the adhesive strength of the cement to the test surface.

## 4. Significance and Use

4.1 Where the adhesive strength of thermal insulating or finishing cement is low, the cement cannot withstand the force

of gravity and other normal mechanical forces such as those incident to vibration. In addition, accidental mechanical forces such as bumping or jarring should not cause separation of the cement from the insulated structure. The adhesion test, which measures the force required to separate the dried cement from a suitable test surface, will indicate the ability of the cement to remain in place during normal service conditions.

4.2 Many factors will affect the adhesion of thermal insulating or finishing cement, such as the quality and amount of mixing water used, the method of mixing and applying the cement, the type and condition of the surface to be insulated, the method of drying, the length of time required for drying, and the ambient conditions surrounding the dried cement.

## 5. Apparatus

5.1 **Test Plate**—A rectangular stainless steel plate (Fig. 1) 17 by 8 by ½ in. (432 by 203 by 13 mm), provided with three 3.73-in. (94.7-mm) top diameter circular openings bevelled at a 20° angle to a larger bottom diameter.

5.2 **Test Disks**—Three ½-in. (13-mm) thick stainless steel disks (Fig. 1), each having a surface area of 10 in.<sup>2</sup> (64.5 cm<sup>2</sup>) (3.57 in. (90.7 mm) in diameter). One surface shall be smoothly finished, and a ⅜-in. (10-mm) deep hole threaded to fit a ⅜-in. (10-mm) eye bolt, shall be centered in the other surface.

5.3 **Mold Frame**—A demountable mold frame to control the wet cement to a ¾-in. (19-mm) thickness during application to the disk surfaces.

5.4 **Small Pointing Trowel**.

5.5 **Special Sheeps-Foot Roller** (Fig. 2), 3 in. (76 mm) in diameter, 6 in. (152 mm) in width, weighing 9 lb (4.1 kg), and having twelve rows of nubs. The nubs shall be ⅜ in. (about 10 mm) in diameter, shall extend ⅛ in. (3 mm) from the face of the roller, and shall be 1 in. (25 mm) apart. Alternate rows shall be staggered.

## 6. Sampling, Test Specimens, and Test Units

6.1 Sample at least 3 lb (1.4 kg) of dry cement. The specimen for test is to be taken from the middle of a bag, so as to be representative of material from the entire bag.

6.2 The cement shall be mixed in accordance with Practice C 163. The temperature of the mixing water shall be between 70 and 75°F (21 and 24°C).

6.3 Carefully clean the test disks with soap and water, rinse in water, air-dry, and assemble with the threaded portion of the

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.06.

## C 353

is well filled to a depth of approximately  $\frac{3}{4}$  in. (19 mm).

6.5 Place a strip of wet, medium-heavy canvas over the filled mold and pass the sheeps-foot roller 15 times over the length of the mold. A pass shall consist of pulling the roller across the length of the mold in one direction. Do not lift the roller until the compression and working of the cement has been completed, and always pull the roller in the direction of travel rather than pushing it in one direction and pulling it in the other.

6.6 Lift the roller and remove the canvas and mold frame.

6.7 For hydraulic setting cements, allow the specimen to cure for 48 h or until it has set at a temperature of  $70 \pm 2^\circ\text{F}$  ( $21 \pm 1^\circ\text{C}$ ) and at a relative humidity of  $50 \pm 5\%$ .

6.8 Place the plate, disk, and cement assembly, still mounted on the heavy gage plate (or jig), in a dryer at  $215$  to  $250^\circ\text{F}$  ( $102$  to  $121^\circ\text{C}$ ) until it reaches constant weight.

6.9 When thoroughly dry, carefully invert the assembly and, with a sharp-pointed instrument, clean out dried material in the opening around each test disk to prevent wedging or edge adhesion. Allow the assembly to stand at room conditions for  $\frac{1}{2}$  h.

**FIG. 1 Adhesion Test Plate and Disks**

## 7. Procedure

7.1 Align the assembly in a hold-down jig on a testing machine capable of measuring the load to an accuracy of 1 lbf (4.4 N), and pull each disk to failure at a rate not to exceed 50 lbf (220 N)/min.

## 8. Report

8.1 Report the adhesive strength in pounds-force per square inch (load in newtons at rupture divided by 10) or kilopascals (load in newtons at rupture divided by 6.45) for each disk, and report the average for the three disks.

8.2 If the adhesion of any single disk varies more than 20 % from the average of the three disks, the test shall be repeated except where strengths are below 5.0 psi (34 kPa), when a maximum variation from the average of 1.0 psi (7 kPa) shall be considered an acceptable test.

## 9. Precision and Bias <sup>3</sup>

9.1 The precision of this test method is not known because interlaboratory data are not available. This test method may not be suitable for use in specifications or in case of disputed results as long as these data are not available.

9.2 A standard deviation ( $\sigma$ ) of 8.7 % of mean ( $\bar{X}$ ) was determined with a sample size of six data points and a statistical participation of one laboratory.

9.3 *Bias*—There is currently no estimate of bias because no standards are available and statistical input was received from only one laboratory.

## 10. Keywords

10.1 finishing cement; thermal insulating; wet adhesion

Total weight = 9 lb (4.1 kg)  
Nub size:  $\frac{3}{8}$  in. (9.5 mm) in diameter by  $\frac{1}{8}$  in. (3 mm) high  
Material: brass  
Cylinder drilled through length to proper length  
Roll turns freely on axis  
Twelve rows of nubs—alternate rows staggered

**FIG. 2 Sheeps-Foot Roller**

test disk down and with the rectangular plate and mold frame on a supporting plate of flat, heavy-gage steel. Take care not to touch the cleaned test surfaces of the disks with the fingers during assembly. Center the test disks in the holes of the rectangular test plate. A jig may be used for this purpose, in which case it may also be used as the support for the assembly.

6.4 Loosely pack the properly mixed cement in the mold frame, then press and trowel it lightly in place until the frame

<sup>3</sup> Supporting data are available on loan from ASTM Headquarters. Request RR: C16-1002.