



Designation: **C374 – 70 (Reapproved 2009) C374 – 14**

Standard Test Methods for Fusion Flow of Porcelain Enamel Frits (Flow-Button Methods)¹

This standard is issued under the fixed designation C374; 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.

INTRODUCTION

This test provides a procedure to compare the fluidity of a glass frit or a porcelain enamel powder to a standard reference material at a fixed temperature above the sample's glass temperature.

1. Scope

1.1 These test methods cover evaluation of the relative fusion flow characteristics of samples of a given porcelain enamel frit by comparison with an established standard for that frit.

1.2 Two test methods are included, differing only in certain details of the samples and in the apparatus and procedure for preparation of test specimens. Both test methods give equally reproducible results and provide a satisfactory basis for comparison of fusion flow of the sample with that of the established standard.

1.2.1 *Test Method A* employs granular particles of frit to which a bonding agent has been added. Button specimens are formed under high pressure in a hydraulic press.

1.2.2 *Test Method B* employs crushed, sized particles of frit to which a bonding agent has been added. Button specimens are formed in a steel mold by hand.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *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 Document

2.1 *ASTM Standards*:²

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

TEST METHOD A

3. Apparatus

3.1 *Mortar*, of hard steel, resistant to abrasion by the porcelain enamel frit, and conforming to the dimensions shown in **Fig. 1**.

NOTE 1—Suitable mortars are available commercially under the designation “tool steel crushing mortar.”

3.2 *Sieves*—No. 12 (1.70-mm) and No. 200 (75- μ m) sieves conforming to Specification **E11**.

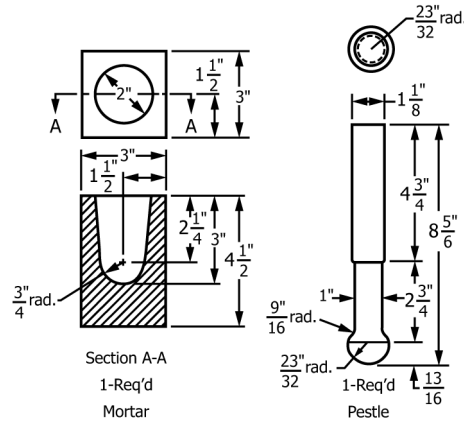
NOTE 2—Tyler Standard Series sieves No. 12 (0.0060-in. (0.152-mm) openings) and No. 200 (0.029-in. (0.07-mm) openings) correspond to ASTM sieves Nos. 12 and 200 (U.S. Standard Sieves series numbers).

3.3 *Hydraulic Press*, capable of developing 3500-lbf (15 600 N) force (**Fig. 2**).

¹ These test methods are under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and are the direct responsibility of Subcommittee B08.12 on Materials for Porcelain Enamel and Ceramic-Metal Systems.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.



NOTE 1—1 in. = 25.4 mm.

FIG. 1 Mortar

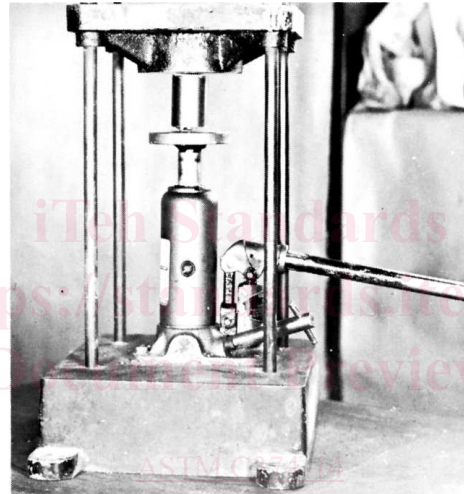


FIG. 2 Hydraulic Press

3.4 *Steel Mold Assembly*, consisting of a die and plunger, and having an inside diameter of 1/2 in. (12.7 mm) over its length of 2 1/8 in. (54 mm) as illustrated in Fig. 3.

3.5 *Fusion Flow Rack*, preferably constructed of heat-resisting alloy and conforming to the detailed requirements shown in Fig. 4.

4. Sample

4.1 A representative sample of the frit to be tested shall be obtained, mixed thoroughly, and reduced by quartering to about 25 g. This sample shall be crushed in a hard steel mortar to pass a No. 12 (1.70 mm) (1.70 mm) sieve and be retained on a No. 200 (75 μm) (75 μm) sieve.

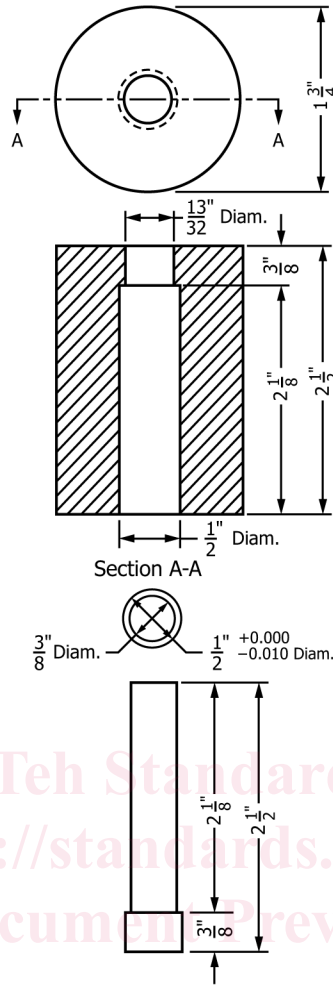
4.2 For wet-ground enamels the sample shall be evaporated to dryness in an evaporation dish. After cooling, the dried enamel shall be loosened and again pulverized using a pestle and mortar or similar apparatus.

4.3 Dry ground samples of frit, ready-to-use powder, or enamel powder for dry electrostatic application may also be tested.

5. Test Specimen

5.1 Weigh 3.5 ± 0.05-g samples of the standard frit and of the material to be tested and thoroughly mix each of these samples with 4four or 5five drops of a 1 % gum arabic solution. Mold fusion button test specimens of the standard and of the sample as directed in 5.2. For dry electrostatic powder samples, use four to five drops of acetone instead of the aqueous gum arabic solution.

5.2 Place the sample in the steel mold. Place the mold assembly containing the sample in a hydraulic press and bring the press up to 3000 to 3500 lbf (13.3 to 15.6 kN) total load, and immediately release (Fig. 2). Force the formed button out of the mold with the plunger, taking care not to damage the button in any way that might change the dimensions.



NOTE 1—Metric Equivalent

<https://standards.iteh.ai/catalog/standards/sist/288f0b74-108f416b-b64e-d0def4aa3b35/astm-c374-14>

| in. | mm | in. | mm |
|-------|------|-------|------|
| 0.010 | 0.03 | | |
| 3/8 | 9.5 | 1 3/4 | 44.0 |
| 13/32 | 10.3 | 2 1/8 | 54.0 |
| 1/2 | 12.7 | 2 1/2 | 63.5 |

FIG. 3 Mold for Test Specimens—Test Method A

5.3 Dry the test specimens in a suitable oven at $\pm 100^{\circ}\text{C}$ – 212°F (100°C) for 1 h.

NOTE 3—Special care must be exercised in drying buttons formed by this method, before firing, in order to prevent bloating and possible eruption of the button when first placed in the furnace.

6. Procedure

6.1 *Mounting*—Place the dried fusion buttons on a fired groundcoat plate. The location of the test specimens with respect to the standard may be modified as desired. Although the gage of metal used for the ground-coated plate is not of critical importance, most satisfactory results will be obtained when the metal is not heavier than 18 gage nor lighter than 22 gage (1.02 to 0.044 mm). Use the same gage of metal consistently from test to test in order to reduce the number of variables to a minimum. The groundcoat enamel used to coat the groundcoat plate shall have a median firing temperature no more than 50°F (28°C) below the median firing temperature for the most refractory frit being tested. Place the groundcoat plate with fusion buttons in place in a horizontal position on the fusion flow rack, which shall previously have been heated to furnace temperature, and place the entire test assembly in the furnace immediately.