Designation: C385 – 58 (Reapproved 2014)

Standard Test Method for Thermal Shock Resistance of Porcelain-Enameled Utensils[1]

This standard is issued under the fixed designation C385; 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 determination of the resistance of porcelain-enameled utensils to thermal shock. This test method is adaptable to any porcelain-enamel utensil that can be filled with water to a depth of 1 in. (25 mm).

1.2 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.

1.3 *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. Apparatus

2.1 *Hot Plate,* capable of maintaining over its entire surface a uniform temperature, that is, less than 20°F (−6.7°C) variation over the entire surface. Surface temperature of the hot plate shall be capable of being adjusted from 475 to 825 ± 10°F (245 to 440 ± 5.5°C). The surface temperature of the hot plate, determined by any suitable surface temperature measuring device, may be varied by changing the wattage input to the hot plate. If the hot plate surface temperature be calibrated to wattage input, the desired temperature may then be set by adjusting wattage input. The wattage input or similar calibration shall be made for each surface temperature (see 6.2 and 6.3).

2.2 *Timing Device,* a clock or similar instrument having a sweep second hand and an integrating minute hand.

2.3 *Container,* suitable for holding approximately 4 gal of water.

2.4 *Container,* for pouring water into utensil.

2.5 *Sponge,* for wiping utensil dry.

3. Quenching Water

3.1 Either tap or distilled water shall be used.

NOTE 1—In areas where tap water is extremely hard, distilled water is recommended.

4. Test Specimens

4.1 The test specimens shall consist of five identical utensils.

NOTE 2—"Identical utensils" signifies utensils of the same size, shape, and finish.

5. Preparations for Test

5.1 Level the hot plate. Switch on the hot plate and adjust the surface temperature to 475 ± 10°F (245 ± 5.5°C). Allow the hot plate to preheat at this temperature for at least 1 h to obtain a uniform temperature over the entire heating surface.

5.2 Place the quenching water in a large container. Adjust the temperature of the water to 70 ± 2°F (21 ± 1°C). Measure out the amount of water required to fill a test utensil to a depth of 1 in. (25 mm); this amount of water shall be used for quenching.

NOTE 3—The test utensils must be at room temperature at the start of the test.

6. Procedure

6.1 Center a dry utensil directly on the preheated hot plate. After 3 min remove the utensil from the hot plate and immediately fill the utensil to a depth of 1 in. (25 mm) with quenching water. After 10 s pour out the quenching water and wipe the inside of the utensil with a wrung-out damp sponge. After a total nonheating period of 20 s replace the utensil on the hot plate.

6.2 Immediately after centering the utensil on the hot plate, adjust the input to the hot plate so that the hot plate surface temperature will reach 500 ± 10°F (260 ± 5.5°C). Allow the utensil to heat dry for 8 min with the hot plate adjusted so that this new surface temperature will be reached.

NOTE 4—Do not remove the utensil for surface temperature measurements during the test. The surface temperature of the hot plate should be calibrated against wattage input before the test is started. The surface temperature of the hot plate is the maximum temperature to be reached during the 8-min heating period (see 2.1).

[1] This test method is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.12 on Materials for Porcelain Enamel and Ceramic-Metal Systems.

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6.3 After the 8-min heating period, remove the utensil and quench as before. Repeat this procedure according to the schedule given in Table 1. Continue the test until the utensil fails or has withstood quenching after the 825°F (440°C) heating period.

NOTE 5—A failure is the removal of the enamel from the utensil, generally accompanied by a cracking noise, during the heating period. Fish-scaling and crazing are not considered thermal-shock failures.

7. Rating Test Specimens

7.1 A cycle begins when the utensil is placed on the hot plate and ends after the quenching and just before the utensil is replaced on the hot plate.

7.2 The utensil shall be rated for the number of cycles it has passed without failure. For example, a utensil failing in the seventh cycle would have a rating of "6." If the utensil fails in the ninth cycle or in a subsequent cycle, the rating shall be that of the previous test cycle.

TABLE 1 Heating Schedule

Time of Quench, min:s	Cycle	Hot Plate Surface Temperature, °F (°C)
3:00	1	475 ± 10 (245 ± 5.5)
11:20	2	500 ± 10 (260 ± 5.5)
19:40	3	525 ± 10 (275 ± 5.5)
28:00	4	550 ± 10 (287 ± 5.5)
36:20	5	575 ± 10 (301 ± 5.5)
44:40	6	600 ± 10 (315 ± 5.5)
53:00	7	625 ± 10 (329 ± 5.5)
61:20	9	675 ± 10 (357 ± 5.5)
69:40	11	725 ± 10 (385 ± 5.5)
78:00	13	775 ± 10 (413 ± 5.5)
86:20	15	825 ± 10 (440 ± 5.5)

NOTE 6—*Example* of typical results and calculation:

Pan No.	Cycle of Failure	Rating
1	9	7
2	11	9
3	9	7
4	7	6
5	9	7
		36

Average = 36/5 = 7.2 cycles

8. Report

8.1 Report the average of the ratings for five identical utensils as the thermal shock resistance value.

9. Precision and Bias

9.1 No justifiable statements can be made regarding the precision and bias of this test method due to the fact that it is applicable to a wide variety of utensils of different design rather than a single, specific size and design of utensil. Since design, base metal composition, fabrication, and processing, as well as porcelain enameling, will give rise to variables in the thermal shock resistance of porcelain-enameled utensils, each design of utensil should be considered separately.

10. Keywords

10.1 glass coating; porcelain enamel; porcelain enameled utensils; thermal shock resistance