Designation: C554 – 93 (Reapproved 2020)

Standard Test Method for Crazing Resistance of Fired Glazed Ceramic Whitewares by a Thermal Shock Method[1]

This standard is issued under the fixed designation C554; 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 to crazing of fired, glazed, ceramic whitewares when stresses residual after glost firing may cause a tendency to craze, such stresses being induced by factors other than moisture expansion.

1.2 This test is not intended to induce moisture expansion, which fact should be kept in mind if the materials to be evaluated may exhibit moisture expansion.

NOTE 1—Test Method C424 covers a method for determining resistance to crazing induced by moisture expansion. Its use is generally confined to testing nonvitreous and semivitreous ceramic whitewares because these products may be subject to such expansion. For whitewares with negligible moisture expansion (such as vitreous and impervious ware), the thermal shock method described herein is generally to be preferred.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For a specific hazard statement, see **Warning** in 6.3.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C424 Test Method for Crazing Resistance of Fired Glazed Whitewares by Autoclave Treatment

3. Significance and Use

3.1 Unless there is a proper match between the expansions of the glaze and the body, all glazed whitewares may contain residual stresses from the firing that bonded the glaze to the body. In addition, whitewares are increasingly subjected to thermal stresses in service. Hence, an important use criterion for a glazed whiteware is adequate resistance to repeated abrupt thermal changes. In most cases, the result of inadequate resistance to thermal shock is the appearance of a craze pattern in the glaze. This craze pattern is visible by inspection with oblique lighting and application of a suitable ink or dye.

3.2 This test method is applicable to vitreous whitewares that have negligible crazing as a result of moisture expansion. For nonvitreous and semivitreous bodies, refer to Test Method C424.

4. Apparatus

4.1 *Oven*—An oven suitable to operate in the range 250 to 450 °F (121 to 232 °C) while holding the required temperatures within ±5 °F (±3 °C) and being capable of recovering temperature within 20 min after being loaded with the desired number of specimen(s).

4.2 *Water Containers*—Containers to hold water at 68 ± 5 °F (20 ± 3 °C) before quenching; the capacity of the containers shall be large enough so that the water temperature does not exceed 85 °F (29 °C) after quenching a single specimen. Two or more specimens may be quenched simultaneously in a single container provided they do not overlap on the bottom of the container and provided that the water

[1] This test method is under the jurisdiction of ASTM Committee C21 on Ceramic Whitewares and Related Productsand is the direct responsibility of Subcommittee C21.03 on Methods for Whitewares and Environmental Concerns.

Current edition approved Nov. 1, 2020. Published December 2020. Originally approved in 1964. Last previous edition approved in 2016 as C554 – 93 (2016). DOI: 10.1520/C0554-93R20.

[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.

temperature does not exceed 85 °F (29 °C) after quenching. As a general rule, it will be found that 10 cm^3 of water/g of ware, or 1 gal of water/lb of ware will be adequate to keep the temperature within the required limits. There shall be enough containers to quench all the specimens loaded in the oven. The containers shall be deep enough so that at least ½ in. (13 mm) of water will cover the quenched specimen(s).

5. Test Specimens

5.1 The specimen(s) shall preferably be whole pieces of ware; cut or broken specimen(s) shall be used only when whole pieces are impractical or impossible to test. If the specimen(s) are cut or broken from whole ware, they shall be selected so as to be representative of the item to be tested. In cutting or breaking specimen(s), cracks may be induced, therefore, broken or cut specimens shall be inspected for cracks by oblique lighting and application of a suitable ink or dye before the test. Only broken or cut specimen(s) free from cracks shall be used. The number of specimens shall not be less than five, which number shall constitute a sample.

6. Procedure

6.1 Set the oven to 250 °F (121 °C). When the oven temperature has reached equilibrium, place the specimen(s) in the oven in a manner that will allow ample heat penetration of all specimen(s). The specimen(s) should be placed on edge in a custom metal rack that is made to meet the needs of the test. A custom metal rack is one that will permit surrounding air circulation so that the specimen(s) are separated to allow at least ½ in. of air space on all sides. Let the specimen(s) remain in the closed oven for not less than 45 min. Ascertain by observation for each heating that the oven has achieved the test temperature within 20 min.

6.2 Place a sufficient number of water containers near the oven.

6.3 After the specimen(s) have been heated the required time, transfer them all, as quickly as possible from the oven to the quenching water. (**Warning—**Wear safety glasses when transferring samples from the oven to the quenching water.

6.4 When the quenched specimen(s) have cooled to approximately the temperature of the water, remove and dry them, and carefully examine the glazed surface for craze marks. Use oblique lighting and apply a suitable ink or dye solution upon the glazed surface to aid in the detection of crazing. Consider only those failures that are visible to the naked eye.

6.5 Eliminate specimen(s) that exhibit crazing from further testing, but subject any undamaged specimen(s) to another heating and quenching cycle.

6.6 As long as the specimen(s) continue to resist crazing, heat and quench them repeatedly for three cycles at oven temperatures which increase by increments of 25 °F (13.9 °C) until a temperature of 450 °F (232 °C) is attained.

6.7 In examining the specimen(s), take care to distinguish between body cracks and craze marks. A few pieces of unglazed bisque may be included in the test to enable the discernment of body cracks caused by thermal shock. If the unglazed bisque is cracked by thermal shock, the glazed specimen(s) may have cracked also without necessarily crazing. Experience and judgment are necessary to distinguish body cracks from craze marks.

7. Report

7.1 The report shall include the following:

7.1.1 Identification of specimens, and statement whether they are whole pieces or cut and broken,

7.1.2 Number of specimens tested,

7.1.3 Identification of ink or dye solutions used in examination of specimens, and

7.1.4 Table listing each quenching as to oven temperature and cycle number together with number of specimens failing at each quenching; separate listings shall be made of failures caused by crazing and failures caused by body cracking.

NOTE 2—Conventional whitewares (not subject to moisture expansion) that do not craze after being subjected to all phases of this test, up to and including three cycles at 300 °F (149 °C), can be expected to resist crazing under all normal conditions of service. If special compositions are to be tested, or if the resistance to abnormal service conditions is to be evaluated, a logical adaption of this test method may be made to suit the need. If it is desired to use this procedure in conjunction with a product specification, the test may be limited to one or more of these specified temperatures.

8. Precision and Bias

8.1 No justifiable statements can be made either on the precision or on the bias of this test method for testing crazing resistance of fired, glazed, ceramic whitewares by a thermal shock method since the test result merely states whether there is conformance to the criteria for success specified in the procedure.

9. Keywords

9.1 crazing resistance; fired glazed ceramic whiteware; thermal shock method