



Standard Test Method for Impact Resistance of Ceramic Tableware¹

This standard is issued under the fixed designation C 368; 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 following tests:

1.1.1 Impact tests at the center of both flatware and hollow ware and at the rim of hollow ware, and

1.1.2 Chipping tests at the rim of flatware. Specimens may be either glazed or unglazed.

NOTE 1—The impact test at the center of the specimen is used to determine: (1) the magnitude of a blow that will produce initial fracture, and (2) the amount of energy necessary to produce complete failure. In the first case, the initial fracture shows on the side of the piece opposite from that being struck and appears to be a function of the square of the thickness and of the inherent brittleness of the body or body-glaze combination; it is relatively independent of the size or design of the specimen. The second factor is more dependent upon design and often is subject to wide variation within a given group of pieces.

NOTE 2—The impact test at the rim of hollow ware is similar to a chipping test, and the type of failure that is obtained is useful in evaluating the effect of the shape of the object.

NOTE 3—In addition to the inherent strength of the body, chipping test results are greatly affected by contour of rim and to a lesser extent by thickness of rim, inclination of leaf, and fit of glaze.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI (metric) units given in parentheses are for information purposes 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. Significance and Use

2.1 The purpose of this test method is to predict product resistance to impact breakage in service.

3. Apparatus

3.1 *Impact Tester, Pendulum Type*—The impact test apparatus (Figs. 1 and 2)² shall consist of a device having the following essential features:

¹ This test method is under the jurisdiction of ASTM Committee C-21 on Ceramic Whitewares and Related Products and is the direct responsibility of Subcommittee C21.03 on Test Methods of Whiteware Properties.

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² Detailed working drawings of the apparatus are available from ASTM Headquarters. Request Adjunct No. ADJC0368.

3.1.1 A steel tup of specified size and of hardness Rockwell C 55,

3.1.2 Support of a tup by a V-suspension,

3.1.3 Provision for a means of release from fixed heights so as to give reproducible results, independent of the operator, and

3.1.4 Provision for holding the test specimen in place by spring clamps against rigid metal supports.

3.2 *Micrometer*—For measuring thickness of test specimens, a micrometer caliper that can be read to 0.001 in. (0.03 mm) shall be used.

4. Test Specimens

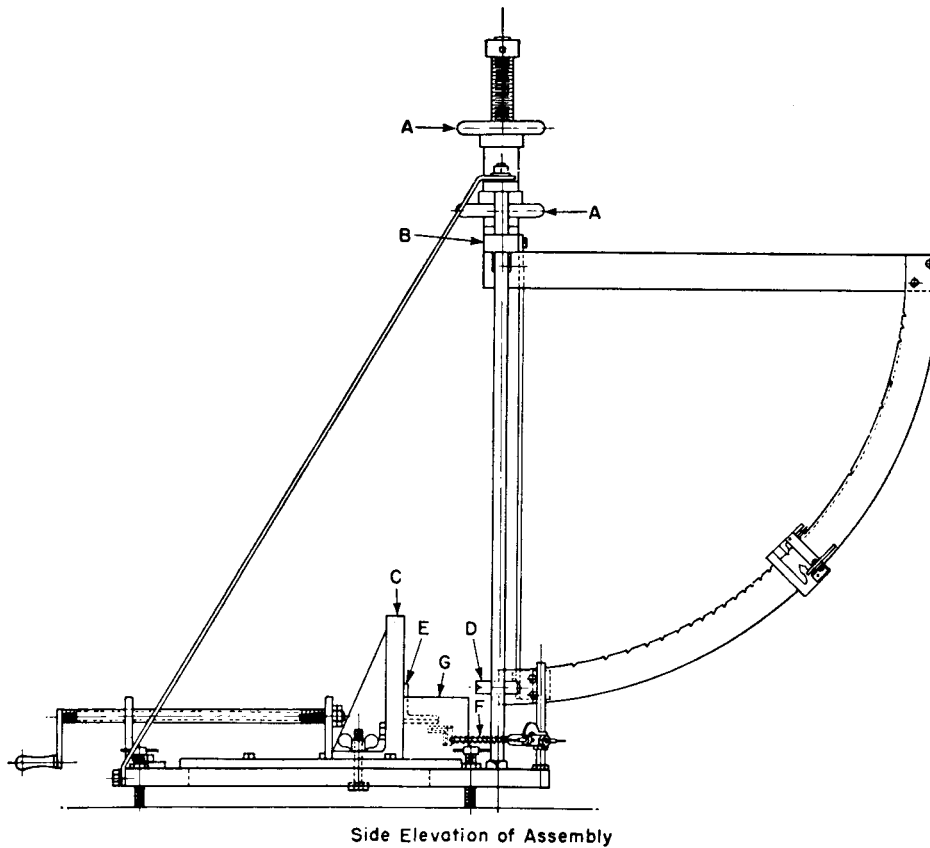
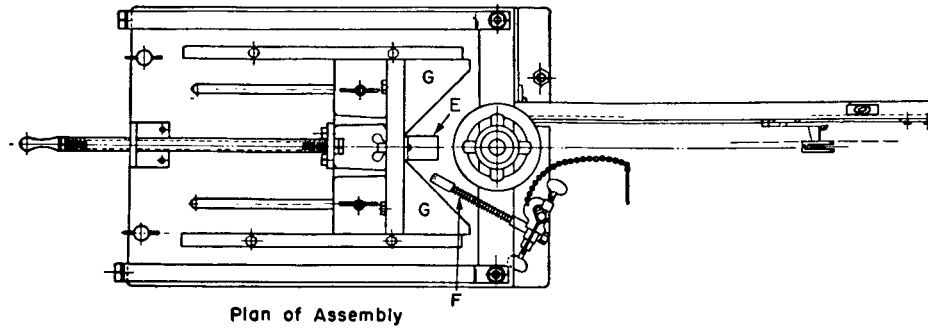
4.1 Specimens shall be selected so as to be representative of the lot being sampled. In general, impact tests shall be based on a minimum of ten specimens and chipping tests on at least five specimens. Specimens shall be inspected for soundness and obvious physical defects before testing.

5. Procedure for Impact Testing of Flatware

5.1 Mount the cylindrical tube shown in Fig. 2 (Note 4) on the backstop, C, Fig. 1, and set at a height such that the three ball bearings mounted in the end of the cylindrical tube are in contact and symmetrical with the central portion of the specimen, which shall be stood on edge on the base plate. The specimen may be tested with either the face or the back toward the hammer; in general, a lower failure value is obtained when the face is struck. Adjust the backstop so that the *spherical surface* of the tup, D, just touches the surface of the specimen when the tup is hanging free (vertically). Tighten the two wing nuts at the base of the backstop.

NOTE 4—In this portion of the test, the cylindrical tube replaces the angle clamp, E, shown in position on the backstop, C, in Fig. 1.

5.2 Adjust the positioning arms, F, held in retracted position by means of their cotter keys so that the forward edges of the sleeve and of the clamp coincide. Adjust the clamps on the vertical posts to grip the specimen at the same height that the pendulum will strike it; that is, halfway up. Adjust the arms so that the rubber-covered surface at right angles to its rod will contact the rim of the sample; remove the cotter keys to permit the positioning arms to hold the specimen against the cylindrical tube. Adjust the pendulum support bar, B, and lock it in position by means of the handwheels, A, so that the tup strikes the center of the specimen.



A—Handwheels.
B—Pendulum support bar.
C—Backstop.
D—Tup.

E—Angle clamp.
F—Positioning arm.
G—Triangular castings for specimen supports.

FIG. 1 Impact Test Apparatus

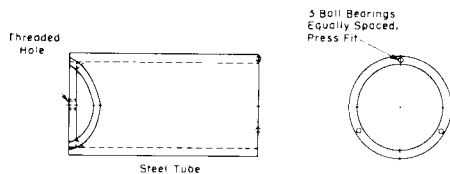


FIG. 2 Tube to Support Flatware Specimen

5.3 With the preliminary adjustments completed, subject the specimen to a schedule of impacts starting at 0.02 ft-lbf (0.027 J) and increasing in increments of 0.01 ft-lbf (0.014 J) until

initial fracture, and in increments of 0.02 ft-lbf thereafter to failure.

NOTE 5—The tests may be performed rapidly by grasping the portion of the releasing device that lies below the dial segment from beneath with the tip of the middle finger of the right hand and moving it back to the correct notch for the next blow immediately after the tup has been released. Catch the pendulum on the rebound with the left hand, reseal the tip of the tup into the jaws of the releasing clamp controlled by the thumb of the right hand, and repeat the above sequence of operations until failure of the specimen occurs.

6. Procedure for Impact Testing of Hollow Ware at Center

6.1 Follow the same procedure as described for flatware in Section 5, except remove the cylindrical tube (Fig. 2) and the two triangular castings, *G*, forming the V to permit the rim of the specimen to be in contact with the surface of the backstop. Strike specimens at the center of the back, and allow the positioning arms to contact the specimen at the foot rather than at the rim.

7. Procedure for Impact Testing of Hollow Ware at Rim

7.1 Place the test specimen in the apparatus so that it rests in the V formed by the two triangular prisms bolted to the backstop and is held by means of the angle clamp, *E*, resting lightly on the rim and by the two positioning arms adjusted so that their lines of pressure are exerted radially and also so that they exert no appreciable downward pressure on the rim. With tups, the handle should be kept out of contact with the apparatus. Adjust the backstop so that the eventual point of contact on the rim is in the same vertical plane as the spherical striking surface of the tup; tighten the wingnuts.

7.2 Adjust the height of the pendulum support bar so that the contact between the rim of the specimen and the end of the tup is at the center of the *spherical surface* of the tup.

7.3 With the preliminary adjustments completed, subject the specimen to a series of impacts starting at 0.02 ft-lbf (0.027 J) and increasing in increments of 0.01 ft-lbf (0.014 J). A straight crack or a symmetrical bow crack will ordinarily result if this test is performed properly.

8. Procedure for Chipping Test³

8.1 Place the test specimen in the apparatus as described in 7.1, except use the *cylindrical end* of the tup as the striking surface and move the sleeves of the positioning arms forward in their clamps so that the back edges of each sleeve and its clamp coincide.

8.2 Adjust the pendulum support bar and lock it in position by means of the handwheels so that the center of the tup surface contacts the edge of the specimen.

8.2.1 Repeatedly strike rolled-edge specimens on the edge with the cylindrical end of the hammer with blows of increasing force until failure occurs, beginning with an initial blow of 0.10 ft-lbf (0.136 J) and increasing the force of each succeeding blow in the increments of 0.02 ft-lbf (0.027 J).

8.2.2 Test plain-edge specimens as described in 8.2.1, except that the initial blow shall be 0.02 ft-lbf (0.027 J) with an increment of 0.01 ft-lbf (0.014 J).

9. Calculation

9.1 Calculate the strength factor for flatware tested for impact, as follows:

$$S = 12I/t^2 \quad (1)$$

where:

S = strength factor, psi;

I = average impact to produce initial fracture, ft-lbf; and

t = average thickness of specimens at point of impact, in.

10. Report

10.1 Report the following information:

10.1.1 Designation of the material tested, including information on type, shape, and whether glazed or unglazed,

10.1.2 Method of selection of specimens,

10.1.3 Identification of type of apparatus used, and

10.1.4 Data sheet showing:

10.1.4.1 Form and essential dimensions of a representative test specimen,

10.1.4.2 Test schedule used, that is, initial impact energy and subsequent increments,

10.1.4.3 Individual and average impact energies to produce initial fracture,

10.1.4.4 Thicknesses of specimens at points of impact and an average thereof,

10.1.4.5 For flatware, strength factor calculated from average impact energies and thicknesses of specimens (Section 9),

10.1.4.6 Individual and average impact energies to produce failure and descriptions of types of failure,

10.1.4.7 Chipping failure values and type of chip from each location of each specimen and average of all failure values, and

10.1.4.8 Representative rim thickness.

10.2 The report may also include:

10.2.1 Brief statement of observed differences, if any, among specimens of unusual characteristics.

10.2.2 Inspector's opinion as to whether ware has passed or failed in respective tests.

11. Precision and Bias

11.1 No justifiable statements can be made either on the precision or bias of this test method since the test result merely states whether there is conformance to the criteria for acceptance specified in this test method.

12. Keywords

12.1 ceramic tableware; impact resistance

³ See Federal Specification M-C-301, China Tableware, available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094 Attn: NPODS.

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