Designation: D 4508 – 98

# Standard Test Method for Chip Impact Strength of Plastics[1]

This standard is issued under the fixed designation D 4508; 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 The purpose of this test method is to provide an impact test that can be performed on small specimens of plastics of different thicknesses. This test method is especially suited for observing the effects of microcracks caused by weathering, or by exposure to solvents or other hostile environments, on the surface of plastic materials. It is not meant to be used as a replacement for any existing impact test, but can be used to measure impact on coupons machined from finished parts that cannot be tested by the drop-weight, Izod, or Charpy method because of shape or thickness limitations.

1.2 The chip-impact test is run on small, flat, unnotched specimens using a standard pendulum-impact device. The test places the impacted surface in tension and, for notch-sensitive materials, is extremely sensitive to the presence of surface microcracks. Thus, for plastics that develop surface cracks when exposed outdoors, the chip-impact test is a severe test of the weathered impact strength.

1.3 Round-robin testing has indicated that materials that break at total energy values of less than 0.17 joules (1.5 in.-lbf) have within-laboratory coefficients of variation of approximately 30 %. Therefore, such values are considered out of the normal testing range for this test.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 There is no ISO equivalent to this test method.

1.6 *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:*

D 256 Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics[2]

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing[2]

D 883 Terminology Relating to Plastics[2]

D 1600 Terminology for Abbreviated Terms Relating to Plastics[2]

D 4000 Classification System for Specifying Plastic Materials[3]

D 4066 Specification for Nylon Injection and Extrusion Materials[3]

E 380 Practice for Use of the International System of Units (SI) (the Modernized Metric System)[4]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[4]

## 3. Terminology

3.1 Definitions—For definitions of plastic terms see Terminology D 883 and for abbreviations see Terminology D 1600. There are no terms in this test method that require new or other-than-dictionary definitions.

## 4. Significance and Use

4.1 The chip-impact test is a variation of the Izod impact test described in Test Methods D 256.

4.2 The specimen geometry has been chosen to fit three basic criteria as follows:

4.2.1 The specimen is relatively thin and is struck on the broad surface so that the test result is sensitive to the condition of the surface,

4.2.2 The specimen is relatively small for efficient utilization of space in accelerated testing media or devices and to minimize amounts of material needed for testing, and

4.2.3 The specimen can be tested using a standard Izod pendulum tester.

4.3 It has been found that a 12.7-mm (0.500-in.) wide strip with a thickness in the range from 1.02 to 3.18 mm (0.040 to 0.125 in.) meets the above criteria. Much experimental work on 1.78-mm (0.070-in.) strips has demonstrated the utility of the chip-impact test to track weather aging of a variety of materials.

4.4 The distance ($L$) between clamping and impact points (striker height) will affect test results. Extensive experimental work has established that a ratio of $L = 2.182\ h$ (where $L$ is the

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[2] *Annual Book of ASTM Standards*, Vol 08.01.

[3] *Annual Book of ASTM Standards*, Vol 08.02.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

distance between clamping and impact points and *h* is the thickness of the specimen) will provide accurate and sensitive chip-impact values. Increasing this ratio (that is, raising the striker height for a given thickness) lowers chip-impact values and reduces sensitivity of the test. Decreasing the above ratio (that is, lowering the striker height for a given thickness) results in a shearing of the specimen rather than the desired bending and breaking.

4.5 In general, the chip-impact value during weathering varies according to specimen thickness, even after adjusting striker heights for constant deflection, as given in Table 1. The thickness of the specimen should always be reported, along with the test values, and comparisons should only be made among samples of similar thickness.

4.6 The standard Izod Methods A, C, D, and E require that the type of failure for each specimen be recorded as one of the four coded categories defined as follows:

C = *complete break*—a break in which the specimen separates into two or more pieces,

H = *hinge break*—an incomplete break such that one part of the specimen cannot support itself above the horizontal when the other part is held vertically (less than 90° included angle),

P = *partial break*—an incomplete break that does not meet the definition for a hinge break, but has fractured at least 90 % of the distance between the surface of the impact side and the opposite side.

NB = *non-break*—an incomplete break where the fracture extends less than 90 % of the distance between the impacted surface and the opposite side. Non-break data shall not be reported as a standard result, but may be used to establish a relative sensitivity to aging on a time basis.

4.6.1 Impact values cannot be directly compared for any two materials that experience different types of failure as defined in the method for this code.

4.7 Before proceeding with this test method, reference should be made to the specification of the material being tested. Any test specimen preparation, conditioning, dimensions, or testing parameters, or a combination thereof, covered in the material specification shall take precedence over those mentioned in this test method. If there are no material specifications, then the default conditions apply.

**TABLE 1 Striker Height Adjustment for Constant Deflection**

| $h^A$ | | $L^B$ | |
|---|---|---|---|
| mm | in. | mm | in. |
| 1.016 | (0.040) | 2.21 | (0.09) |
| 1.143 | (0.045) | 2.49 | (0.10) |
| 1.270 | (0.050) | 2.77 | (0.11) |
| 1.397 | (0.055) | 3.05 | (0.12) |
| 1.524 | (0.060) | 3.33 | (0.13) |
| 1.651 | (0.065) | 3.61 | (0.14) |
| 1.778 | (0.070) | 3.89 | (0.15) |
| 1.905 | (0.075) | 4.17 | (0.16) |
| 2.032 | (0.080) | 4.45 | (0.18) |
| 2.159 | (0.085) | 4.72 | (0.19) |
| 2.286 | (0.090) | 5.00 | (0.20) |
| 2.413 | (0.095) | 5.28 | (0.21) |
| 2.540 | (0.100) | 5.56 | (0.22) |
| 2.667 | (0.105) | 5.84 | (0.23) |
| 2.794 | (0.110) | 6.10 | (0.24) |
| 2.921 | (0.115) | 6.38 | (0.25) |
| 3.048 | (0.120) | 6.66 | (0.26) |
| 3.175 | (0.125) | 6.93 | (0.27) |

## 5. Apparatus

5.1 The apparatus shall be a cantilever beam (Izod-type) impact machine as described in the Annex and Test Methods D 256, Method A. The following modifications must be made to the specimen holder and impacting hammer (see Fig. 1). The specimen holder shall be constructed from a 12.7 by 12.7-mm (0.5 by 0.5-in.) steel bar, the front face of which shall be recessed 1.9 mm (0.075 in.) deep and 7.94 mm (0.312 in.) long from the top surface to accept the chip-impact specimen. Corresponding to this recessed area is an adjustable clamp to hold the specimen in place. This specimen holder is clamped into the standard Izod vise and adjusted to proper height based on specimen thickness. This adjustment is made by positioning the adjustment screw in the vertical portion of the specimen holder.

5.2 The chip-impact striker (see Fig. 2) has a flat face and bevelled bottom edge to facilitate clearance of specimens that do not completely break-off on impact (hinge or partial breaks). The standard Izod striker may also be used with no significant change in impact strength.

5.3 Calibration of the cantilever beam impact machine may be carried out as described in Test Methods D 256.

## 6. Test Specimen

6.1 The standard test specimen shall be 12.7 mm (0.5 in.) wide by 19.05 mm (0.750 in.) long by 1.02 to 3.175 mm (0.040 to 0.125 in.) in depth. The preferred depth is (1.778 mm (0.070 in.)). These may be cut from molded plaques, extruded sheets, or finished products and should be cut or milled to the proper 12.7-mm (0.5-in.) width. Smooth edges are necessary to minimize edge effects.

6.2 For determining the effect of aging or environmental exposure, cut the material to be tested into a convenient size for the exposure apparatus. Expose these sections for the required time in the desired environment. After exposure, cut each section into 12.7 by 19.05-mm (0.5 by 0.75-in.) chips for impacting testing. Test each chip by striking it on the exposed side.

## 7. Conditioning

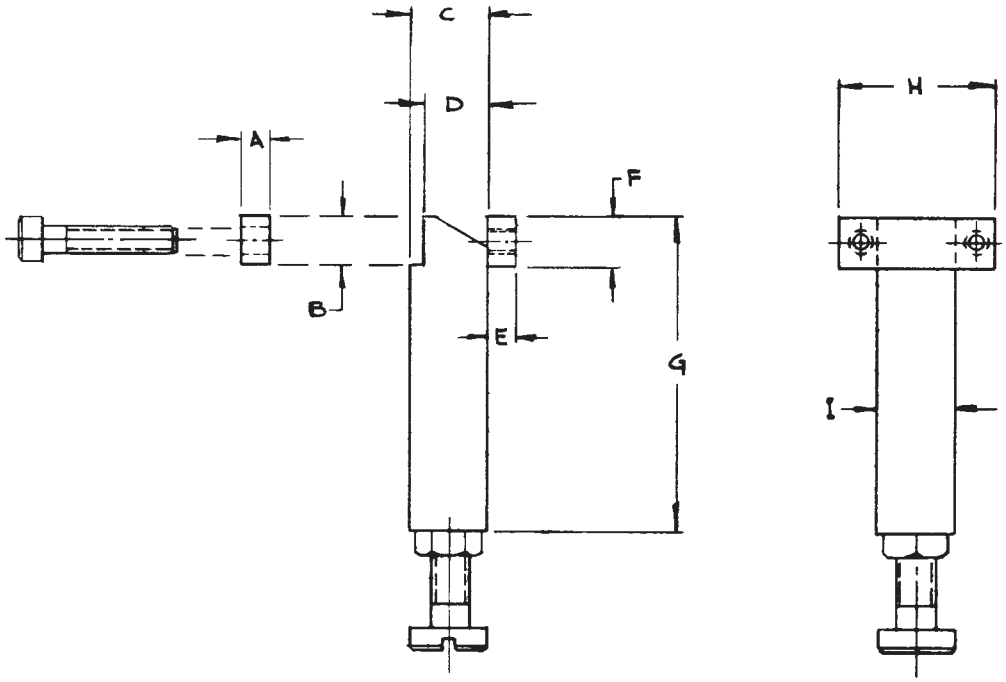
7.1 Condition the test specimens at 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity for not less than 40 h prior to test, in accordance with Method A of Practice D 618, unless otherwise specified.

7.2 Conduct tests in the standard laboratory atmosphere of 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity, unless otherwise specified.

7.3 Note that for some hygroscopic materials, such as nylons, the material specifications (for example, Specification D 4066) call for testing "dry as molded specimens." Such requirements take precedence over routine preconditioning to 50 % relative humidity and require sealing specimens in water vapor-impermeable containers as soon as molded or extruded, and not removing them until ready for testing.

7.4 *Post-Conditioning of Specimens After Exposure to Hostile Environment*:

7.4.1 Specimens shall be conditioned in accordance with section 7.1 or 7.3 prior to subjecting the specimens to the hostile environment, unless otherwise specified.

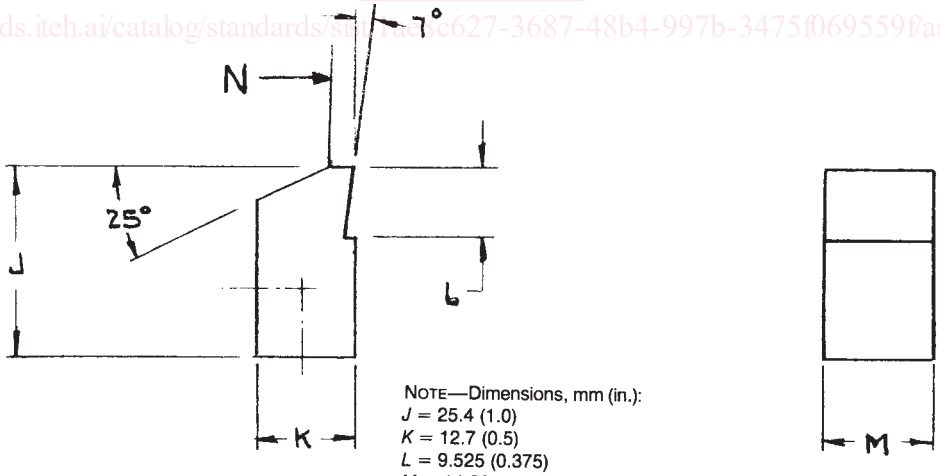



NOTE—Dimensions, mm (in):
*A* = 4.7625 (0.1875)
*B* = 7.9375 (0.3125)
*C* = 12.700 (0.500)
*D* = 10.795 (0.425)
*E* = 4.7625 (0.1875)
*F* = 7.9375 (0.3125)
*G* = 50.8 (2.0)
*H* = 25.4 (1.0)
*I* = 12.7 (0.5)



**FIG. 1 Specimen Holder**






NOTE—Dimensions, mm (in.):
*J* = 25.4 (1.0)
*K* = 12.7 (0.5)
*L* = 9.525 (0.375)
*M* = 14.2875 (0.5625)
*N* = 3.2 (0.125)

**FIG. 2 Striker**

7.4.2 The post-conditioning of specimens which have been exposed to hostile environments requires careful consideration. The ultimate purpose of the exposure and test must be considered. The post-conditioning requirements for the specimen shall be agreed upon by seller and purchaser for the purpose of referee testing. One cannot expect comparable results unless all details of sampling, specimen preparation, specimen conditioning, and exposures as well as testing conditions are identical in all laboratories trying to make a comparison or settle a disagreement. Specimens subjected to