Designation: D8160 – 20

Standard Test Method for Un-notched Cantilever Beam Impact Resistance (Izod Impact) Testing of Thermoplastic Pavement Marking Materials[1]

This standard is issued under the fixed designation D8160; 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 sample preparation for cantilever beams and test methodology of thermoplastic pavement marking materials, similar to the "Izod Impact" method listed in Test Method D4812.

1.1.1 Some methods call for results in inch pound-force (in.·lbf) as opposed to the common foot pound-force/inch (ft·lbf/in.) or Joule/meter (J/m) (energy absorbed per unit of specimen of similar cross-section). This method does not purport to cover all the issues involved with the pendulum impact of cantilever beams and suggests that Test Method D4812 and Test Methods D256 be reviewed before this methodology is attempted.

1.1.2 Thermoplastic pavement marking materials are a highly filled polymer matrix. Depending on the formula the resulting matrix may be brittle, therefore possibly resulting in inconsistent test results.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *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]

D256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics

D883 Terminology Relating to Plastics

D4812 Test Method for Unnotched Cantilever Beam Impact Resistance of Plastics

D7307 Practice for Sampling of Thermoplastic Traffic Marking Materials

D7308 Practice for Sample Preparation of Thermoplastic Pavement Marking Materials

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E284 Terminology of Appearance

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 *ISO Standard:*[3]

ISO 180:2019 Plastics — Determination of Izod impact strength

3. Terminology

3.1 The terms and definitions in Terminology D883 and Terminology E284 apply to this method.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *impact tester, n*—"standardized" (see Test Methods D256) pendulum-type hammers, mounted in "standardized" machines, in breaking standard specimens with one pendulum swing.

3.2.2 *thermoplastic pavement marking (materials), n*—a highly filled 100 % total solids pavement marking system that when heated to the manufacturer's recommended temperature under agitation can be applied onto a pavement surface and when cooled forms a solid durable delineator or marking.

[1] This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.44 on Traffic Coatings.

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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.

[3] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

4. Summary of Test Method

4.1 This test method is similar to Test Method D4812, but instead covers the sample preparation and testing methodology specific to the impact testing of the unique material which is thermoplastic pavement marking. Since thermoplastic pavement marking materials are not designed to be injection molded and need to be poured into molds for testing, sample preparation is different. Also, since the normally accepted pendulum impact result notations are not being used in the road marking industry, an alternate calculation will be covered. This method is not intended for any type of material other than thermoplastic pavement marking materials.

4.1.1 The thermoplastic pavement marking materials impact test specimen is prepared by first melting a sample to its application temperature under continuous agitation. The molten thermoplastic is then poured into silicone molds containing sample cavities with dimensions of 0.75 in. by 0.75 in. and 2.5 in. long. The specimens are removed from the mold after allowing them to cool to 75°F ± 2°F. The cross-sectional area of the middle section is measured and tabulated. Each sample bar is broken with a 1-lb hammer on a pendulum (from a height of 2 ft) impact tester and the resistance in foot-pounds (ft-lbs) is measured. Using the cross-sectional area, the impact is calculated in inch-pounds (in.-lbs). The machine shall be provided with a basic pendulum capable of delivering an energy of 2.7 J ± 0.14 J (2.00 ft·lbf ± 0.10 ft·lbf).

5. Significance and Use

5.1 The significance of this test is to determine the thermoplastic pavement marking material's resistance to impact, under laboratory conditions. The method provides a numerical result for impact failure which can be used to assess quality and determine relative performance between materials.

5.2 When the pendulum-impact test is performed on thermoplastic pavement marking materials, the results can indicate the strength and brittleness properties helpful in researching and improving their field durability. Anyone attempting to perform this test should initially review Test Methods D256 and Test Method D4812; especially the equipment setup.

5.3 The following sample preparation and testing setup method is important so inconsistencies in sample preparation do not cause more inconsistency in the results that are inherent when testing thermoplastic pavement marking materials.

6. Interferences

6.1 Thermoplastic pavement marking materials can be brittle in nature and therefore impact testing results can be inconsistent. Reproducibility of results may be difficult to achieve.

6.2 The North American standard for unnotched Izod Impact testing of plastics is Test Method D4812. The results are expressed in energy lost per unit of thickness (such as ft-lb/in. or J/cm) at the break point, or be reported as energy lost per unit cross-sectional area at the break point (J/m^2 or ft-lb/$in.^2$). In Europe, ISO 180 methods are used and results are based only on the cross-sectional area at the notch (J/m^2). The dimensions of a standard specimen for Test Method D4812 are 63.5 mm × 12.7 mm × 3.2 mm (2.5 in. × 0.5 in. × 0.125 in.) thick. The most common Test Method D4812 specimen thickness is 3.2 mm (0.125 in.), but the width can vary between 3.0 mm and 12.7 mm (0.118 in. and 0.500 in.).

6.3 Test Methods D256 allows for up to a 0.5-in. × 0.5-in. cross-sectional area for bars that are notched. A 0.75-in. × 0.75-in. bar can be broken on a "standard D256-type device" with a milling of the clamp back ¼ in.

6.4 For the impact testing, to convert the measured impact in ft-lbs of a cross-sectional area of a 0.75-in. × 0.75-in. sample ($0.5625\ in.^2$), a value of 0.5625 is used to normalize the result, but the $in.^2$ notation is not used (as in Test Method D4812, where the width is normalized and therefore not used in the calculation).

7. Apparatus

7.1 The instrument shall consist of a heavy base on which is mounted a vise for holding the specimen, and to which is connected, through a rigid frame and bearings, a pendulum-type hammer. (See Test Methods D256 or Test Method D4812.)

FIG. 1 Thermoplastic Pavement Marking Sample in Impact Device

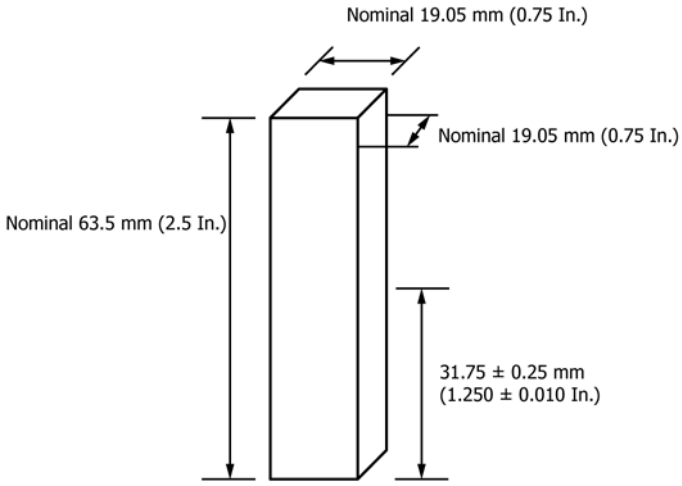


FIG. 2 Measurement Specifications of Sample

The instrument shall also have a mechanism for holding and releasing the pendulum, as well as a mechanism for indicating the breaking energy of the specimen.

8. Sampling, Test Specimens, and Test Units

8.1 Sample the thermoplastic pavement marking by following Practice D7307.

8.2 Perform initial melting of the thermoplastic pavement marking by following Practice D7308.

8.3 The molten sample shall then be poured into the silicone mold cavities one at a time (Fig. 4). Each cavity shall be 0.75 in. deep, 0.75 in. wide, and 2.5 in. long.

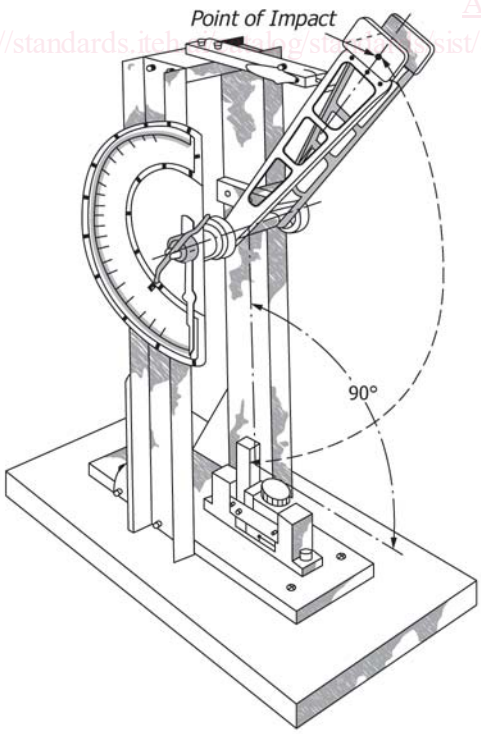
8.4 The samples shall be allowed to cool to 75°F ± 2°F before testing.

8.5 Once cooled, label each bar with a sample number before testing.

9. Preparation of Apparatus

9.1 The instrument used shall meet the requirements, and be set up, according to Test Method D4812. The exception for this method is the vise adjustment for holding a 0.75-in. × 0.75-in. cross-sectional.

9.2 Because the standard pendulum impact testers are designed for a maximum 0.5-in. thick sample the movable side of



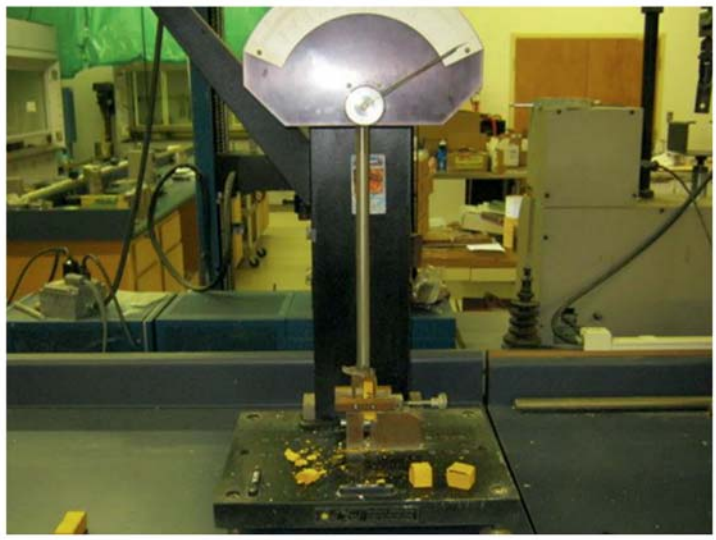


FIG. 3 Pendulum Hammer

FIG. 4 Silicone Mold with Cooled Samples

the vise will need to be milled by 0.25 in. to accommodate the test sample to be impacted when the hammer is completely vertical.

10. Calibration and Standardization

10.1 Calibration shall be performed as stipulated by Test Methods D256 on a regular basis.

10.2 Before testing a series of samples, perform a zeroing of the instrument per manufacturer's instructions. As a recommended practice, recheck the zeroing after completion of the test series.

11. Conditioning

11.1 Test samples shall stabilize to 75°F ± 2°F before testing. Any temperature outside of these limits could give inconsistent results.

12. Procedure

12.1 Make at least four test samples by pouring the molten thermoplastic pavement marking materials into silicone molds at the temperature of processing.

12.1.1 The pours should be to the to the top level of the mold. A small amount of vibration may be needed in order to smooth the surface of the samples.

12.1.2 Allow the samples to cool to 77°F ± 2°F.

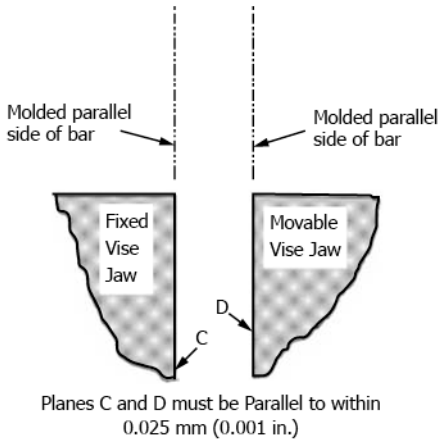
12.2 Place the test sample bars in the vise where the molded sides of the bar connect to the rigid and movable side of the vise and where the molded bottom of the bar is facing to the back of the vise (pendulum support section).

12.2.1 1.25 in. ± 0.010 in. (31.75 mm ± 0.25 mm) of the specimen should project above the top surface of the vise (see 9.5 of Test Method D4812).

12.2.2 Position the specimen precisely and rigidly but not too tightly clamped in the vise. Finger tightening is usually enough.

12.3 Break each impact bar with a 1-lb pendulum head, record the resistance from the 2 ft-lb scale, and calculate an average.

12.4 Measure the thickness at the point of the break to the nearest thousandth of an inch.



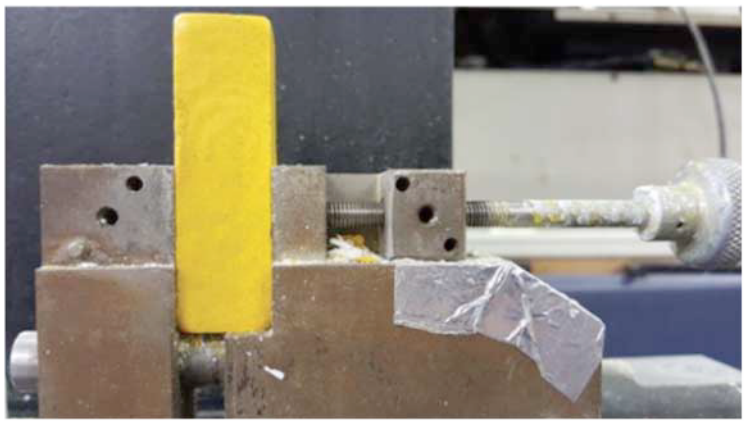


FIG. 5 Test Sample Bar in a Vise

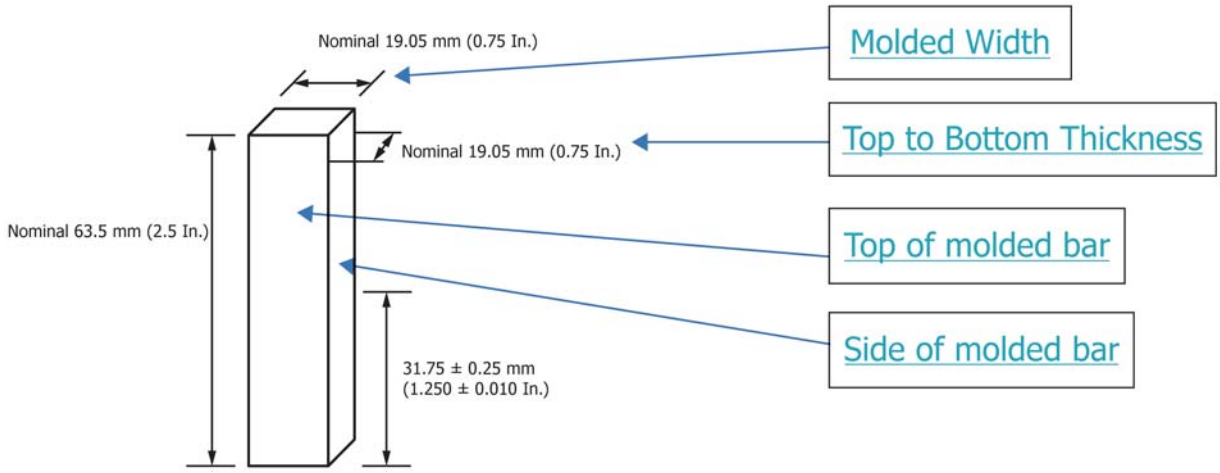


FIG. 6 Measurement Specifications for Molded Bar

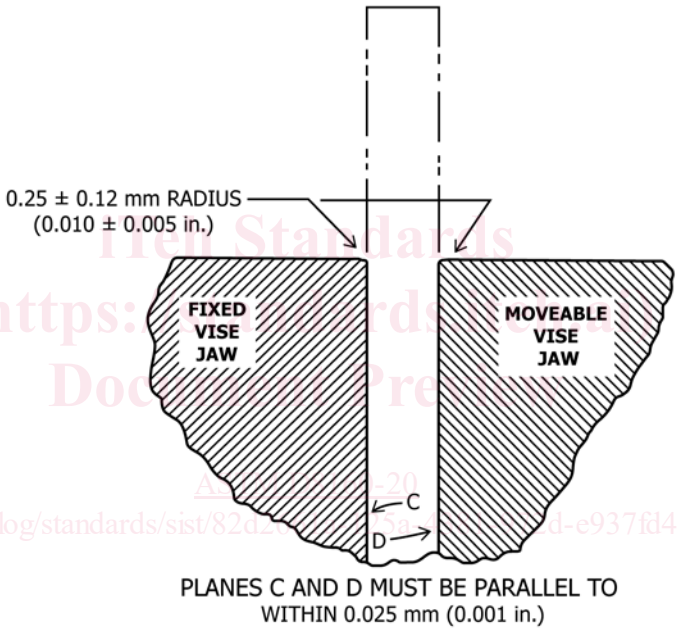


FIG. 7 Vise Jaw Specifications

12.4.1 *Sample Thickness*—Top and bottom of the sample from the mold at the breaking point.

12.4.2 *Sample Width*—The thickness from side to side in the mold at the breaking point.

12.5 As a recommended practice, recheck the zeroing after completion of the test series.

13. Calculation or Interpretation of Results

13.1 Multiply the average dial readings (ft-lbs) by 12 in./ft. and divide by the sample thickness (top to bottom) times 0.75 in. width (side to side in the mold). Record the results in inch-pounds (in.-lbs).

$$\text{EXAMPLE: } \frac{\text{recorded average resistance ft-lbs} \times \ 12 \text{ in./ft}}{\text{sample top to bottom thickness} \times \ 0.75 \text{ in. molded width}} = \text{in. lbs.} \quad (1)$$

$$\text{EXAMPLE: } \frac{0.47 \text{ ft. lbs.} \times \ 12 \text{ in./ft}}{\sim 0.75\text{in. thickness} \times \ 0.75 \text{ in.width}} = 9.89 \text{ in. lbs.} \quad (2)$$

14. Report

14.1 Report the number of samples tested.

14.2 Report the weight of the hammer used.

14.3 Report the average width and thickness of the samples.

14.4 Report the average impact from the acceptable failures (minimum of four).

14.4.1 Because of the brittle nature of these materials, any failure is valid if the pendulum swings freely. Although, within a set of four test samples, some may have a passing result, and some may fail. This instance may require more test samples to be run in order to glean a conclusion.