Designation: D 732 – 99

# Standard Test Method for Shear Strength of Plastics by Punch Tool[1]

This standard is issued under the fixed designation D 732; 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.

*This standard has been approved for use by agencies of the Department of Defense.*

## 1. Scope *

1.1 This test method covers the punch-type of shear test and is intended for use in determining the shear strength of test specimens of organic plastics in the form of sheets and molded disks in thicknesses from 0.127 to 12.7 mm (0.050 to 0.500 in.).

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

NOTE 1—There is no known ISO equivalent to this standard.

## 2. Referenced Documents

2.1 *ASTM Standards:*

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

D 4000 Classification System for Specifying Plastic Materials[3]

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

E 4 Practices for Load Verification of Testing Machines[4]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[5]

## 3. Terminology

3.1 *Definition:*

3.1.1 *shear strength*—the maximum load required to shear the specimen in such a manner that the moving portion has completely cleared the stationary portion. It is expressed in megapascals (or pounds-force per square inch) based on the area of the sheared edge or edges.

## 4. Significance and Use

4.1 Shear strength obtained by a tool of the punch type is one of the recognized methods of comparing materials or obtaining data for engineering design. However, it must be recognized that for end-use application there may be many factors not taken into account in this test method, such as stress-concentrating geometries and rates of shear, which can profoundly affect shear strength. Moreover, the fact that the shear strength is calculated by dividing the load by the area of the sheared edge (circumference *X* thickness) should not be interpreted as indicating that the shear strength value so obtained is solely a material property, independent of thickness.

4.2 For many materials, there may be a specification that requires the use of this test method, but with some procedural modifications that take precedence when adhering to the specification. Therefore, it is advisable to refer to that material specification before using this test method. Table 1 of Classification System D 4000 lists the ASTM materials standards that currently exist.

## 5. Apparatus

5.1 *Testing Machine*—Any suitable testing machine of the constant-rate-of-crosshead movement type. The testing machine shall be equipped with the necessary drive mechanism for imparting to the crosshead a uniform, controlled velocity with respect to the base. The testing machine shall also be equipped with a load-indicating mechanism capable of showing the total compressive load carried by the test specimen. This mechanism shall be essentially free from inertia-lag at the specified rate of testing and shall indicate the load with an accuracy of ±1 % of the indicated value or better. The accuracy of the testing machine shall be verified in accordance with Practices E 4.

5.2 *Shear Tool*—A shear tool of the punch type which is so constructed that the specimen is rigidly clamped both to the stationary block and movable block so that it cannot be deflected during the test. A suitable form of shear tool is shown in Fig. 1.

5.3 *Micrometers*—Suitable micrometers for measuring the thickness of the test specimen to an incremental discrimination of at least 0.025 mm (0.001 in.).

[1] This test method is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D 20.10 on Mechanical Properties.

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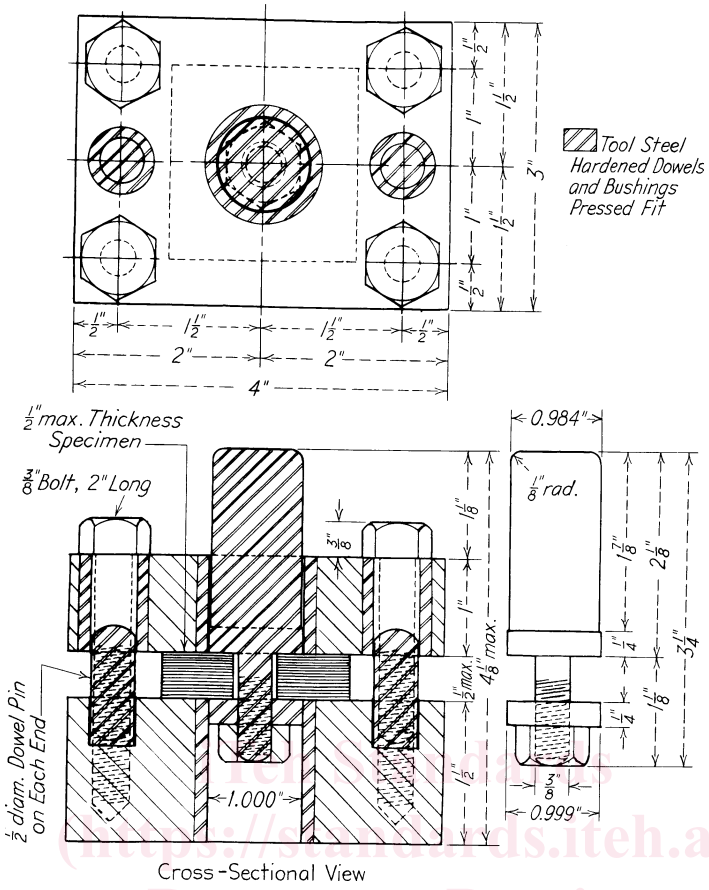
[2] *Annual Book of ASTM Standards*, Vol 08.01.

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

[4] *Annual Book of ASTM Standards*, Vol 03.01.

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

***A Summary of Changes section appears at the end of this standard.**




NOTE 1—In case of difficulty in obtaining hardened dowels and bushings, the entire shear tool may be made from a fairly good grade of steel, eliminating all of the bushings shown. The actual working surfaces will wear faster than when hardened tool steel is used. When they show signs of appreciable wear, the shear tool can then be bored out to take either hardened or unhardened bushings, depending upon which are available.

Table of Metric Equivalents

| in. | ⅛ | ¼ | ⅜ | ½ | 0.984 | 0.999 | 1 | 1⅛ | 1½ | 1⅞ | 2 | 2⅛ | 3 | 3¼ | 4 | 4⅛ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 3.2 | 6.4 | 9.5 | 12.7 | 24.9 | 25.1 | 25.4 | 28 | 38 | 47 | 51 | 54 | 76 | 82 | 102 | 105 |

**FIG. 1 Punch-Type Shear Tool for Testing Specimens 0.127 to 12.7 mm (0.050 to 0.500 in.) in Thickness**

## 6. Test Specimen

6.1 The specimen shall consist of a 50-mm (2-in.) square or a 50-mm (2-in.) diameter disk cut from sheet material or molded into this form. The thickness of the specimen may be from 0.127 to 12.7 mm (0.050 to 0.500 in.). The upper and lower surfaces shall be parallel to each other and reasonably flat. A hole approximately 11 mm (7⁄16 in.) in diameter shall be drilled through the specimen at its center.

## 7. Conditioning

7.1 *Conditioning*—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 Procedure A of Practice D 618, for those tests where conditioning is required. In cases of disagreement, the tolerances shall be ±1°C (±1.8°F) and ±2 % relative humidity.

7.1.1 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 the above routine preconditioning to 50 % relative humidity and require sealing the specimens in water vapor-impermeable containers as soon as molded and not removing them until ready for testing.

7.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity, unless otherwise specified in the test method. In cases of disagreement, the tolerances shall be ±1°C (±1.8°F) and ±2 % relative humidity.

## 8. Procedure

8.1 Use five specimens.

8.2 Measure the thickness of the test specimen with a suitable micrometer to the nearest 0.025 mm (0.001 in.) at several points 12.7 mm (0.500 in.) from its center.

8.3 Place the specimen over the 9.5-mm (⅜-in.) pin of the punch and fasten tightly to it by means of the washer and nut. Then assemble the tool jig and tighten the bolts.

8.4 Maintain the crosshead speed of the machine during the test at 1.25 mm (0.05 in.)/min, measured when the machine is running idle. The tolerances should be 1.3 ± 0.3 mm (0.050 ± 0.010 in.)/min.

8.5 Push down the punch far enough so that the shoulder