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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Practice for Design of Molds for Test Specimens of Plastic Molding Materials[1]

This standard is issued under the fixed designation D 647; 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. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

1. Scope

1.1 This practice covers the design of molds for test specimens of plastic materials. Designs are shown for compression molds (Figs. 1-4), a transfer mold (Fig. 5) for use in producing bar, disk, and tensile test specimens in thermosetting plastic materials primarily, and an injection mold (Fig. 5) for use in producing bar, disk, and tensile test specimens in either thermoplastic or thermosetting materials. The plastic and mold temperatures, pressure and cycle timing used for the molding material should conform to the appropriate molding practice, if available, or to the material specification. If such information is not available, the recommendations of the material supplier should be followed.

1.2 Designs shown have been found suitable for a broad range of plastics but may not be optimum for any given material. Only the specimen dimensions are actually standardized.[2]

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

1.4 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems 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 Methods for Impact Resistance of Plastics and Electrical Insulating Materials[3]

D 570 Test Method for Water Absorption of Plastics[3]

D 638 Test Method for Tensile Properties of Plastics[3]

D 651 Test Method for Tensile Strength of Molded Electrical Insulating Materials[4]

D 648 Test Method for Deflection Temperature of Plastics Under Flexural Load[3]

D 790 Test Methods for Flexural Properties of Plastics and Electrical Insulating Materials[3]

D 955 Method for Measuring Shrinkage From Mold Dimensions of Molded Plastics[3]

3. Significance and Use

3.1 A material is subjected during the molding process to a complex interaction of many variables. Standardization of the mold design can assist in the control of some of these variables by controlling the uniformity of the specimen geometries. A standardized mold design does not necessarily equate to uniform and equivalent test specimens because of processing variables and the effect of these variables on property results.

4. Compression Molds for Bar Test Specimens

4.1 Compression molds for bar test specimens 12.7 mm (½ in.) in width by 127 mm (5 in.) or 64 mm (2½ in.) in length, and 12.7 (½ in.), 6.4 mm (¼ in.), or 3.2 mm (⅛ in.) in thickness may be the single-bar, single-cavity, positive mold shown in Fig. 1.[2]

5. Compression Molds for Disk Test Specimens

5.1 Compression molds for the disk test specimens 51 mm (2 in.) or 102 mm (4 in.) in diameter may be of the design shown in Fig. 2.

6. Compression Molds for Tension Test Specimens

6.1 Compression molds for the test specimen for determining the tensile strength of molded electrical insulating materials (Note 1) shall be of the design shown in Fig. 3.[2]

NOTE 1—See Test Method D 651 for additional information.

6.2 Compression molds for the test specimen for determining the tensile properties of plastics (Note 2) shall be of the design shown in Fig. 4.[2]

NOTE 2—See Test Method D 638 for additional information.

7. Mold for Injection Molding of Test Specimens

7.1 *Layout*—A four-cavity mold has been designed as a suitable means of preparing frequently used test specimens with most injection molding machines of 55-g or greater capacity. The arrangement shown in Fig. 5 can be adapted to most mold bases 22.5 by 30.0 cm and larger.

7.1.1 The cavities for the 3.2 by 12.7 by 127-mm (⅛ by ½ by 5-in.) bar, the 6.4 by 12.7 by 127-mm (¼ by ½ by 5-in.) bar, and the tension specimen are parted on the diagonal. This eliminates side draft in the test area and provides for

[1] This practice is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.09 on Specimen Preparations.

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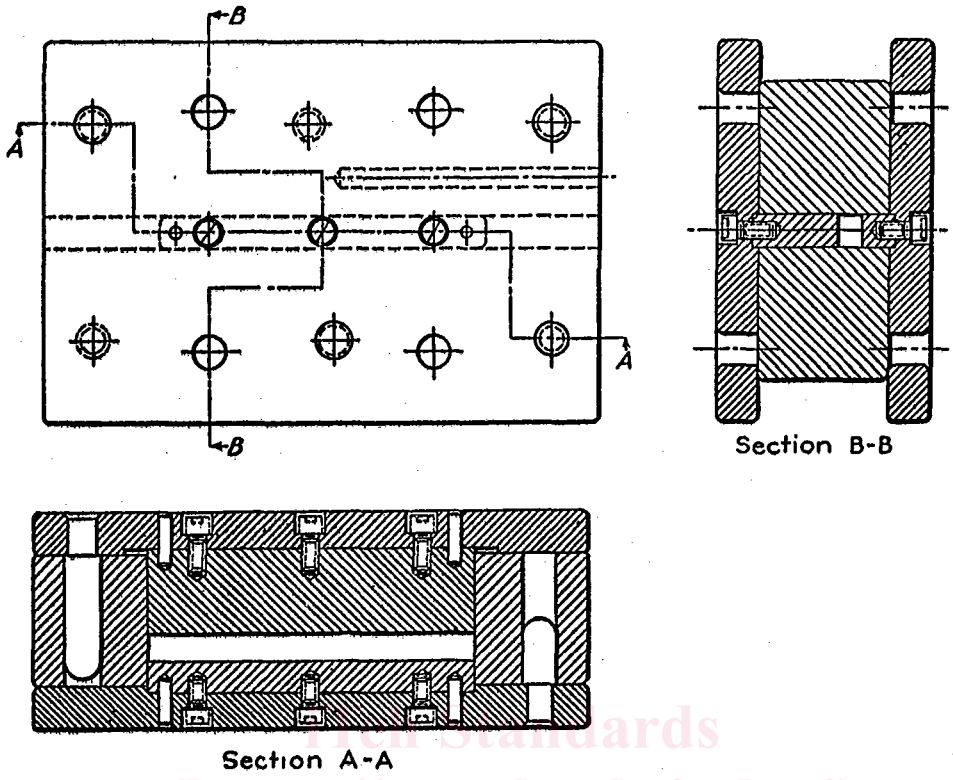
[2] Blueprints of detailed drawings for the construction of the molds shown in Figs. 1, 3, 4, and 6 are available at a nominal cost from ASTM Headquarters. Request PCN 12-406470-10, 30, 60, and 70.

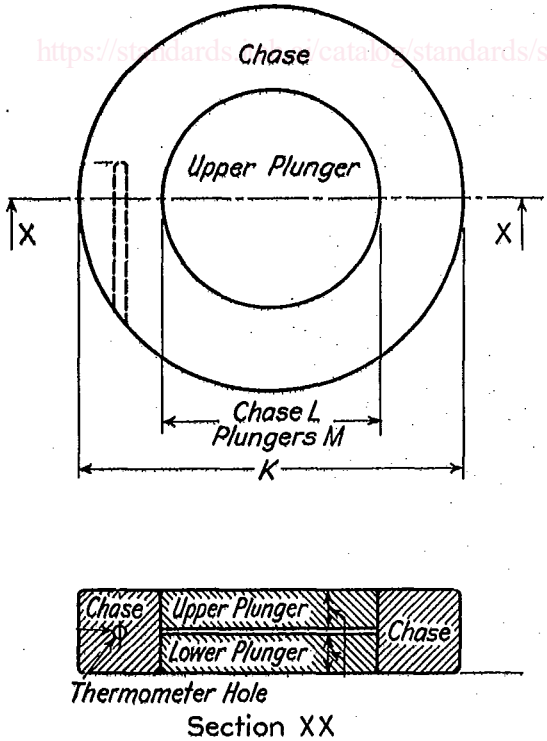
[3] *Annual Book of ASTM Standards*, Vol 08.01.

[4] *Annual Book of ASTM Standards*, Vol 10.01.



NOTE—Thermometer wells shall be 8 mm (5/16 in.) in diameter to permit use of a readily available thermometer.

FIG. 1 Single Bar, Single Cavity Positive Compression Mold for 12.7 mm (½ in.) in width by 127 mm (5 in.) or 64 mm (2½ in.) in length by 12.7 mm (½ in.), 6.4 mm (¼ in.), or 3.2 mm (⅛ in.) in thickness Bar Test Specimens



NOTE—Thermometer wells shall be 8 mm (5/16 in.) in diameter to permit use of a readily available thermometer.

FIG. 2 Compression Mold for Disk Test Specimens

easy ejection particularly of the thicker specimen. Alternatively, flat cavities, which are somewhat less expensive to machine may be employed with ejector pins. Locations for these pins are indicated in the recommended design. Ejector tabs are desirable for preventing damage to the test area of the specimen.

7.1.2 Tipping the 51-mm (2-in.) or 102-mm (4-in.) disk specimen cavity is not considered advantageous. Appropriate means of ejection have been provided.

7.2 *Cavity Dimensions*—Proper dimensions for each cavity should be obtained by considering the desired or specified dimensions and tolerances of the finished specimen and the mold shrinkage encountered with the material(s) being processed.

7.3 *Gates*—Rectangular gates have been selected for simplicity of machining. All are large, to accommodate the great variety of plastics which can be injection molded. End gates or side gates not located within the test area can be used. The mold can be designed with gate inserts for each cavity to allow for gate size changes with different materials. Gate land lengths of less than 0.8 mm are advised. Recommended gate sizes are given in Table 1.

7.4 *Vents*—Vents are required to release air from each of the mold cavities.

7.5 *Runners:*

7.5.1 Full round runners 8 mm in diameter have been used for easy filling and ejection. Trapezoidal runners of the same cross-sectional area should also be satisfactory; ejector pins may be required, however. Separate runners for each cavity are provided.

TABLE 1 Recommended Gate Sizes for Injection Molds

Specimen	Gate Size	ASTM Method
Type I Tension specimen	3.2 by 9.6 mm	D 638
3.2 by 12.7 by 127-mm bar	3.2 by 6.4 mm	D 256, D 648
6.4 by 12.7 by 127-mm bar	6.4 by 6.4 mm	D 256, D 648, D 790
3.2 by 51-mm disk	3.2 by 3.2 mm	D 570
3.2 by 102-mm disk	3.2 by 12.7 mm	D 955

7.5.2 Runner shut-offs have been incorporated. Critical-specimen preparation may require that only one specimen be molded at a time. On other occasions it may be desirable to mold two or more simultaneously. This should only be done if it can be shown that the property being measured is not affected. It should be realized, however, that optimum fill of each of two or more dissimilar cavities will generally not be possible.

7.6 *Temperature Control*—Mold-surface temperature is usually controlled by circulating a heat-transfer fluid through the mold. The suggested coring should provide for a range of no more than 5° over the entire mold surface.

8. Mold for Transfer Molding of Thermosetting Test Specimens

8.1 *Mold*—The cavities of this mold are designed to mold in one shot the following test specimens: a 6.4 by 12.7 by 127-mm (¼ by ½ by 5-in.) bar, a 12.7 by 12.7 by 127-mm (½ by ½ by 5-in.) bar, a 3.2 by 51-mm (⅛ by 2-in.) diameter disk, a 3.2 by 102-mm (⅛ by 4-in.) diameter disk, and a 3.2 by 216-mm (⅛ by 8½-in.) tension test specimen. The mold for these specimens shall be of the design shown in Fig. 6[2] and shall conform to the requirements prescribed in 8.2 to 8.5.

8.2 *Gate Size*—The gate shall have a rectangular cross section 6.4 mm wide by 1.52 mm deep (¼ by 0.060 in.).

8.3 *Mold Cavity for Tension Specimens*—The cavity of the mold for tension specimens for Test Method D 638 shall have dimensions for the Type I specimen as shown in that method except for the following thickness:

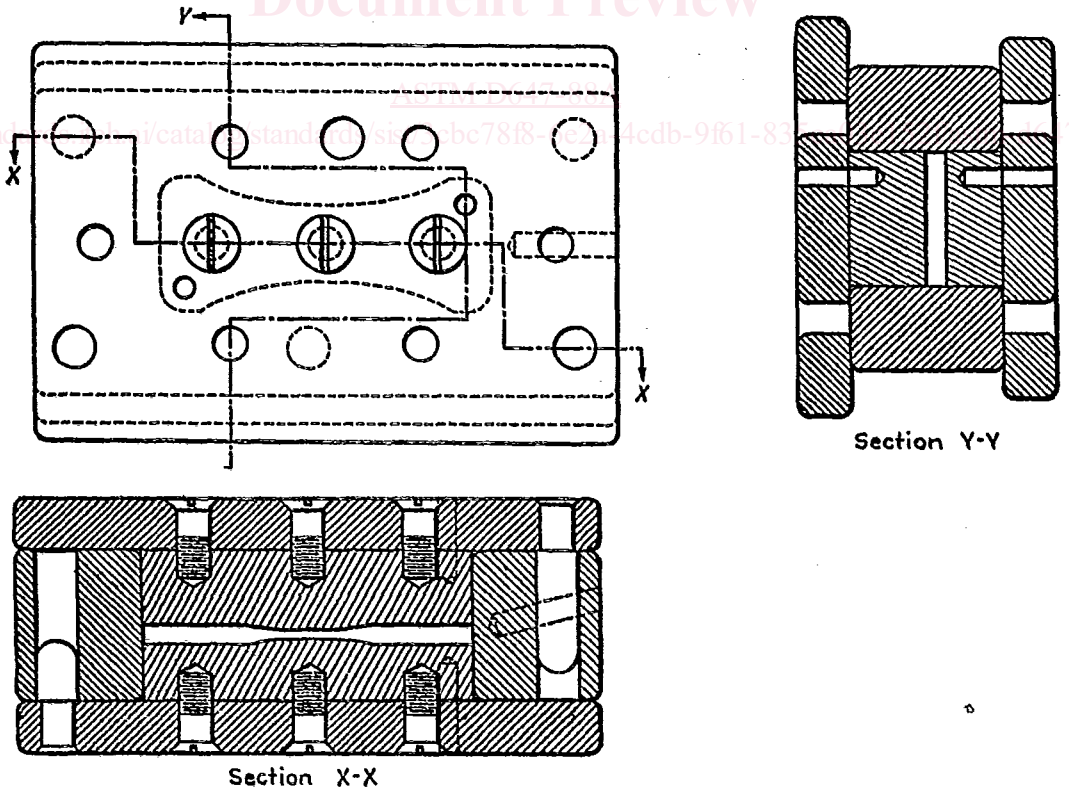
3.175 mm	+0.0076 −0.000
(0.125 in.)	(+0.003) (−0.000)

8.4 *Mold Cavities for Bar Specimens*—The cavities of the mold for the bar specimens shall have tolerances consistent with the demands of the test method and the shrinkage properties of the material being molded.

8.5 *Mold Cavities for Disk Specimens*—The cavities of the mold for the disk specimens shall have dimensions consistent with the demands of the test method and the shrinkage properties of the material being molded.

9 Mold for Injection Molding of Thermosetting Test Specimens

9.1 This mold may be of the same design as that described in 8.1 to 8.5 and shown in Fig. 6 except that a sprue bushing replaces the transfer pot and the runners to the cavities are extended to connect to the sprue bushing.



NOTE—Thermometer wells shall be 8 mm (5/16 in.) in diameter to permit use of a readily available thermometer.

FIG. 3 Compression Mold for Tension Test Specimens Specified in D 651