Designation: D 2838 – 95

Standard Test Method for Shrink Tension and Orientation Release Stress of Plastic Film and Thin Sheeting[1]

This standard is issued under the fixed designation D 2838; 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 determination of the shrink tension and related characteristics, that is, shrink force and orientation release stress, of heat-shrinkable plastic film and sheeting of less than 0.8 mm (0.03 in.) thickness. Two procedures are described that permit the measurement of shrink forces at predetermined temperatures. They are as follows:

1.1.1 *Procedure A* is designed to measure the maximum force exerted by a specimen that is totally restrained from shrinking as it is heated rapidly to a specific temperature.

1.1.2 *Procedure B* is designed to measure the maximum force exerted by a specimen that is permitted to shrink a predetermined amount prior to restraint while being heated rapidly to a specific temperature.

1.2 Orientation release stress can be determined from the data obtained using Procedure A.

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

NOTE 1—There is no equivalent ISO test method.

1.4 *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 374 Test Methods for Thickness of Solid Electrical Insulation[2]

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing[3]

D 1898 Practice for Sampling of Plastics[3]

E 1 Specification for ASTM Thermometers[4]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *orientation release stress*—the maximum shrink tension developed by a film in a specified direction throughout its range of shrink temperatures while totally restrained from shrinking.

3.1.2 *sheeting*—as defined for this test method, material having a maximum thickness of 0.8 mm (0.03 in.).

3.1.3 *shrink force*—the force per original unit width developed by a film in a specified direction and at a specified temperature in its attempt to shrink while under restraint.

3.1.4 *shrink tension*—the force per original average cross-sectional area developed by a film in a specified direction and at a specified temperature in its attempt to shrink while under restraint.

4. Summary of Test Method

4.1 The ends of a 25.4-mm (1-in.) wide strip of film or sheeting are clamped in the arms of a shrink tension holder (see Fig. 1), one arm of which contains strain gages. The holder is immersed in a hot bath and the force exerted by the film is detected by strain gages attached to one arm and recorded by a fast action strip chart recorder. The tests may be carried out with or without free shrinkage of the material before restraint. Other properties may be calculated from the measured forces, sample parameters, and temperatures used.

5. Significance and Use

5.1 As a result of the manufacturing process, internal stresses are locked into the film and these can be released by heating. For any given type of film or sheeting, the temperatures at which shrinkage will begin are related to processing techniques employed to manufacture the film and also may be related to a phase transition in the base resin.

5.2 Shrink tension affects the appearance and performance of a film in a shrink-packaging application. It may also be used to determine the degree and direction of orientation. The orientation exerts a great influence upon important physical

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The latest version of this document differs only from the previous document in that Keywords and an ISO equivalency statement have been added.

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

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

[4] *Annual Book of ASTM Standards*, Vol 14.03.

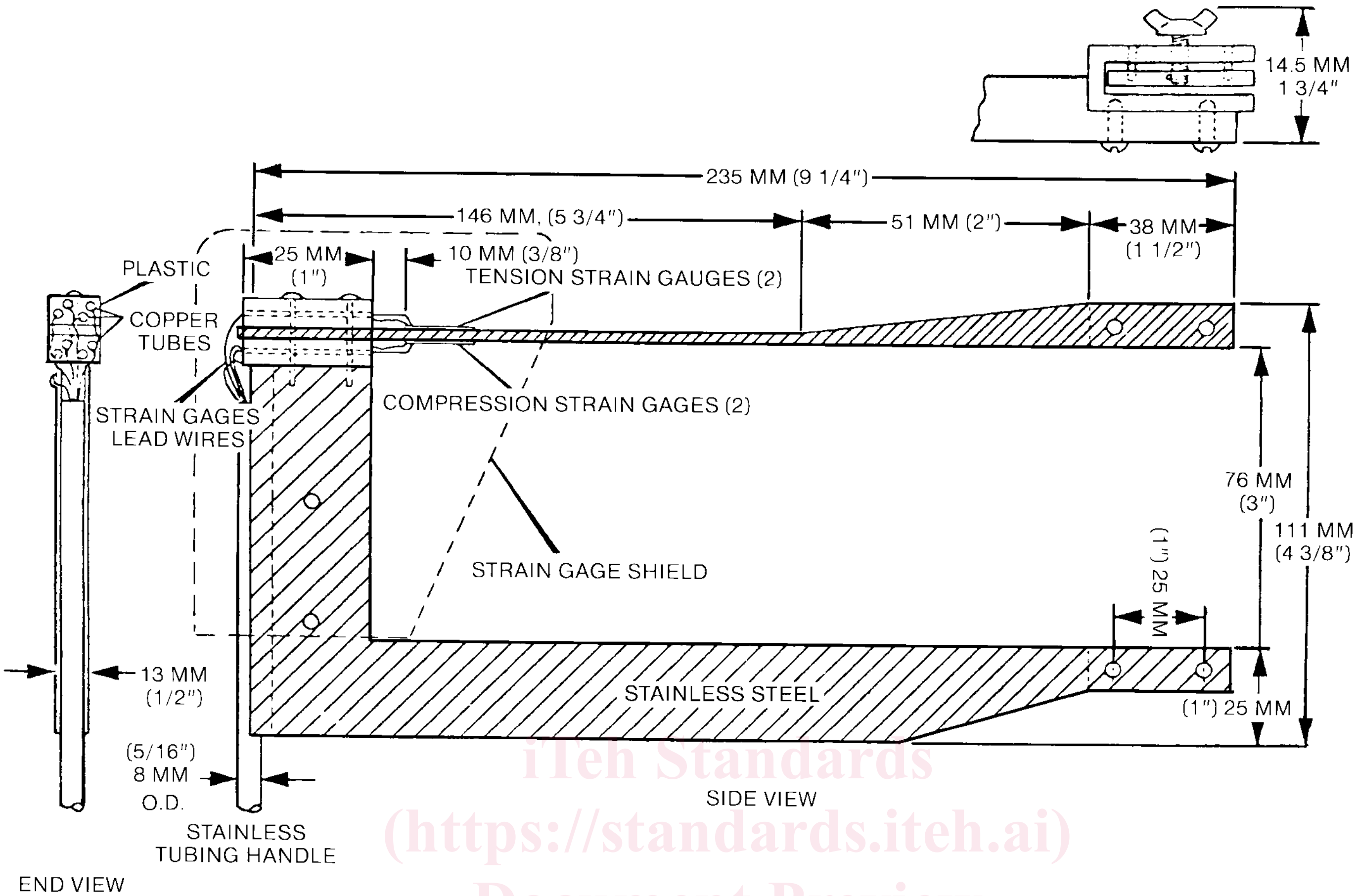

FIG. 1 Design for Shrink Tension Holder

characteristics such as tensile strength, stiffness, tear resistance, and impact strength.

5.3 Data from Procedure A are most useful for determining the degree and direction of orientation, orientation release stress, and the maximum force that the film can exert at a given temperature.

5.4 Since, in actual applications, film is seldom, if ever, totally restrained, data from Procedure B are useful in estimating the force an item to be packaged will actually receive and in predicting appearance of packaged items.

5.5 The characterization of shrink tension as a function of temperature, and the resultant determination of orientation release stress and its corresponding temperature, is usually carried out only on an audit basis for a particular material of specified thickness for a defined fabrication process. For purposes of quality control and of determining conformity to specification limits, the measurement of shrink tension at only one or two specified temperatures is normally sufficient.

6. Apparatus

6.1 *Shrink Tension Holder*[5]—A suggested design is portrayed in Fig. 1 and Fig. 2.

6.2 *Strain Gage Conditioner*,[6] applicable to a 120-Ω four-arm bridge.

6.3 *Recorder*,[6] having a pen response of no more than 30 ms from 10 to 90 % of full-scale deflection. A chart width of at least 100 mm is preferable.

6.4 *Sample Cutter*, capable of cutting 25.4 ± 0.2-mm (1 ± 0.01-in.) wide strips of at least 127 mm (5 in.) in length.

6.5 *Constant-Temperature Liquid Bath*, capable of controlling accurately to ±0.5°C and covering the range of interest, usually from 50 to 175°C.

6.6 *Thermometer*, covering the range of interest and conforming to the requirement of Specification E 1.

6.7 *Liquid Bath*, which will not plasticize or react with specimens. Polyethylene glycol, glycerin, and water have been found to have wide applicability. Silicone oils are useful for samples requiring temperatures above 175°C.

6.8 *Thickness Gage*, capable of measuring the thickness of samples in compliance with Test Methods D 374.

7. Sampling

7.1 Sampling must be performed in a manner that ensures

[5] Model CS-205 Shrink Tension Holder, supplied by Custom Scientific Instruments, 13 Wing Drive, Whippany, NJ 07981, has been found satisfactory for this purpose.

[6] The following systems have been found satisfactory: Daytronics Model 9005 Mainframe equipped with a Model 9178 strain gage conditioner, a Model 9259 peak-track-hold unit, and a Model 9530 digital indicator interfaced to an appropriate recorder. Honeywell Model 1858 Recorder equipped with a Model 1885A strain gage control module. Other systems may function equally well.