



Designation: D 3111 – 99

Standard Test Method for Flexibility Determination of Hot-Melt Adhesives by Mandrel Bend Test Method¹

This standard is issued under the fixed designation D 3111; 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 flexibility of a hot-melt adhesive in sheet form under specific test conditions. This is a working test. Its results are useful for comparing adhesives, not for absolute characterization of adhesives.

1.2 *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 907 Terminology of Adhesives²

D 1737 Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus³

E 171 Specification for Standard Atmospheres for Conditioning and Testing Flexible Barrier Materials⁴

2.2 Other Method:

Federal Test Specification U.S. 141C, Peat, Varnish, Lacquer, and Related Materials: Methods of Inspection, Sampling and Testing⁵

NOTE 1—Although no tests related specifically to flexibility of unsupported hot-melt adhesives in sheet form, the above tests concerned with film flexibility of coatings (supported films) are similar.

3. Terminology

3.1 *Definitions*—Many terms in this test method are defined in Terminology D 907.

¹ This test method is under the jurisdiction of Committee D-14 on Adhesives and is the direct responsibility of Subcommittee D14.50 on Hot Melt and Pressure Sensitive Adhesives.

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² *Annual Book of ASTM Standards*, Vol 15.06.

³ Discontinued—see 1988 *Annual Book of ASTM Standards*, Vol 06.01. Replaced by Test Method D 522.

⁴ *Annual Book of ASTM Standards*, Vol 15.09.

⁵ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *flexibility, n*—that property of a material by virtue of which it may be flexed or bowed repeatedly without undergoing rupture.

3.2.2 *hot-melt adhesive*—an adhesive that is applied in a molten state and forms a bond on cooling to a solid state.

4. Summary of Test Method

4.1 Test strips of a hot-melt adhesive properly sized and conditioned, are bent 180° over a mandrel (rod). Using a fresh specimen for each test, the test is repeated with smaller diameter mandrels until the adhesive fails on bending. The flexibility of the adhesive is the smallest diameter mandrel over which four out of five test specimens do not break.

5. Significance and Use

5.1 The “Mandrel Bend” test is simple and fast. It requires little investment in equipment and little operator training. The prime purpose is to determine whether a hot-melt adhesive meets flexibility requirements. This test is also useful for comparing flexibility of several adhesives. It can be used to design adhesives by comparing the flexibility of various formulations to meet specific end use parameters. The adhesive flexibility can be determined at temperatures other than ambient by conditioning the test apparatus and test specimens at the desired temperature and performing the test under these temperature conditions.

6. Apparatus

6.1 The test apparatus consists of a series of different diameter cylindrical rods or mandrels supported at each end. There shall be enough space to permit placement of the flat side of a test specimen tangentially at right angles to the longitudinal axis of the test mandrel. Individual requirements determine the diameter and lengths of the rods needed. For most tests, 3.2 mm (~1/8 in.), 6.4 mm (~1/4 in.), and 12.8 mm (~1/2 in.) diameter by 75 to 150-mm (~3 to 6-in.) long rods made of brass or stainless steel are satisfactory. Fig. 1 describes two simple test frames, one with fixed mandrels and the other designed to take any diameter mandrel.