



Designation: F 1362 – 97

Standard Test Method for Shear Strength and Shear Modulus of Aerospace Glazing Interlayer Materials¹

This standard is issued under the fixed designation F 1362; 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 is used to determine the shear strength and shear modulus of interlayer materials that are restrained by relatively high modulus plies in laminated transparencies. This test method can be used with single or multiple plies of the same interlayer materials.

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.*

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

2. Referenced Documents

2.1 ASTM Standards:

- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²
- E 4 Practices for Force Verification of Testing Machines³
- E 229 Test Method for Shear Strength and Shear Modulus of Structural Adhesives⁴
- E 691 Practice for Conducting an Interlaboratory Study⁵
- F 734 Practice for Shear Strength of Fusion-Bonded Polycarbonate Aerospace Glazing Material⁶

3. Terminology

3.1 Definitions:

3.1.1 *adherend*—relatively higher modulus plies that restrain interlayer materials.

3.1.2 *shear modulus*—the ratio of the shear stress to the corresponding shear strain for the initial straight-line portion of the curve.

3.1.3 *shear strength*—the maximum shear stress existing in the interlayer prior to failure. Represents the shear strength of the system either as a cohesive or adhesive failure mode.

4. Summary of Test Method

4.1 Torsional shear forces are applied to the interlayer through a circular section that produces a peripherally uniform stress distribution. The maximum stress in the interlayer at failure represents the apparent shear strength of the interlayer. By measuring the interlayer strain as a function of load, a stress-strain curve can be established. The test specimen should be made from the same materials that are to be used in production, and production processes should be used when applicable. It is also possible to fabricate specimens from the finished/formed transparency.

5. Significance and Use

5.1 The basic material properties obtained from this test method can be used in the control of the quality of interlayers, in the theoretical equations for designing laminated transparencies, and in the evaluation of new interlayers.

6. Apparatus

6.1 *Testing Machines*—Machines used for shear testing shall conform with the requirements of Practices E 4. The loads used in determining shear strength shall be within the loading range of the testing machine as defined in Practices E 4.

6.2 *Torsional Shear Apparatus*—The torsional shear jig should apply a torsional shear load to the specimen without inducing bending, peeling, or transverse shear stresses in the test section. Loading can be accomplished with torsion-test equipment or by means of a jig that can be used in a universal testing machine. A jig is shown in Fig. 1 (see Practice F 734) and Figs. 2 and 3 show the adaptations required for the various specimens. Adequate precautions should be taken to ensure a minimum of frictional loss of torque (as by careful bearing design) or to provide a direct measurement of the applied torque (as by a load cell), or both, and to prevent the application of axial forces. Also, take care to take up the slack in the system prior to start of each test.

¹ This test method is under the jurisdiction of ASTM Committee F-7 on Aerospace and Aircraft and is the direct responsibility of Subcommittee F07.08 on Transparent Enclosures and Materials.

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² Annual Book of ASTM Standards, Vol 08.01.

³ Annual Book of ASTM Standards, Vol 03.01.

⁴ Annual Book of ASTM Standards, Vol 15.06.

⁵ Annual Book of ASTM Standards, Vol 14.02.

⁶ Annual Book of ASTM Standards, Vol 15.03.

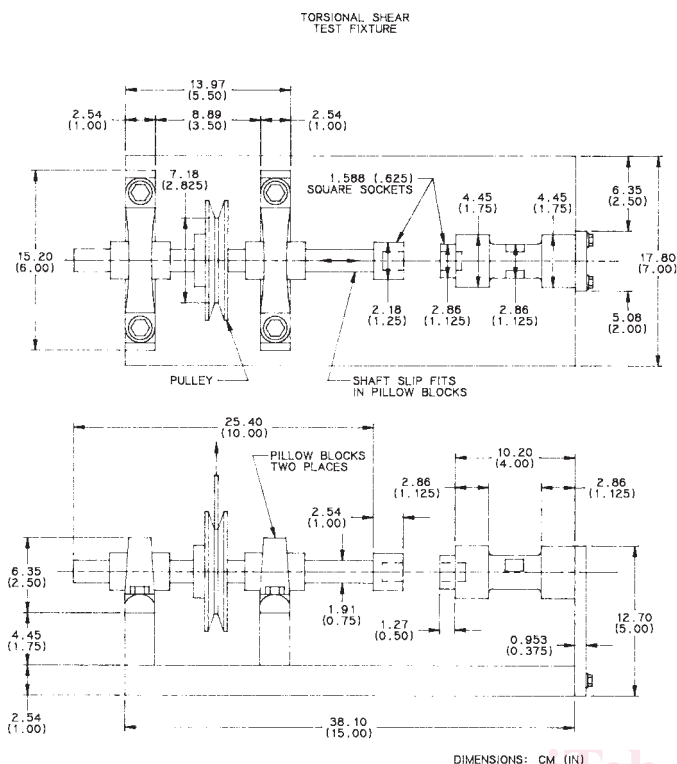


FIG. 1 Torsional Shear Test Fixture (See Fig. 1, Practice F 734).

6.3 Measurement of Angular Displacement—Since the shear strains of an interlayer will normally be very large, the angular displacement should be measured using an angular displacement transducer. This transducer can be either internal to the torsion-test machine or attached to the jig.

7. Test Specimens

7.1 The specimen shall consist of laminated transparency material machined in such a way as to produce an annular test ring. The laminated transparency material can be either flat or curved, and typical of the materials used in production where applicable. Take adequate precautions to ensure test specimen uniformity.

7.2 Determine the interlayer thickness within an accuracy of 5 %. This can be determined by subtracting the thickness of the structural plies from the total thickness, except when all plies are not loaded (see Fig. 3, Type II).

7.3 Specimens are to be fabricated using one of the three specimen geometries shown in Figs. 4-6. The test specimen geometry should be selected to maximize the accuracy of the results within the guidelines. Types 1 and 2 specimens are smaller and can be used to test curved materials. The type 3 specimens are to be used in the testing of flat material where larger specimen sizes are desirable.

7.4 Other specimens not conforming to 7.3 can be sized in accordance with the capability of the test machine in order to ensure failure of the specimen; this can be either a load limitation or displacement limitation. Generally, for flat material, the larger the specimen size the greater the consistency and accuracy of the test results. Test specimens removed from a

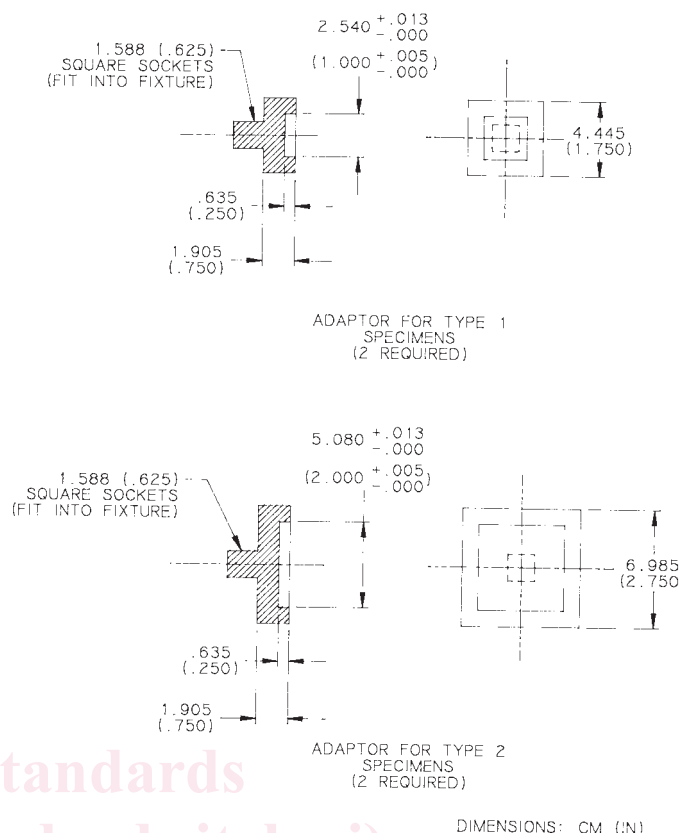


FIG. 2 Adapters Required for Testing Type I and Type II Specimens

curved sheet should be sized to limit the effects of curvature. Guidelines are provided in Table 1.

8. Conditioning

8.1 Condition the test specimens at $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$) and $50 \pm 5\%$ relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D 618 unless otherwise specified.

9. Procedure

9.1 Measurement of Specimens—Measure the loading fixturing and specimens to ensure concentricity and conformance to the dimensional tolerances.

9.2 Load and Deflection—Make simultaneous measurements of load (torque) and deflection and record the data. Take care to correct for jig deflections if any occur.

9.3 Speed of Testing—Load the specimen so as to produce failure in 2 to 5 min for static properties. This test method is valid for high strain rate testing conducted using a constant displacement rate.

9.4 Test Conditions—Conduct tests in the standard laboratory atmosphere of $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$) and $50 \pm 5\%$ relative humidity unless otherwise specified.