



Designation: D 4255/D 4255M – 83 (Reapproved 1994)^{ε1}

Standard Guide for Testing In-plane Shear Properties of Composite Laminates¹

This standard is issued under the fixed designation D 4255/D 4255M; 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.

^{ε1} NOTE—Section 12 was added and other editorial changes were made in December 1994.

1. Scope

1.1 The in-plane shear properties are determined by imposing edgewise shear loads on the specimen using Method A, a fixture consisting of two pairs of rails tensile loaded; or Method B, a fixture consisting of three pairs of rails in tension or compression loading.

1.2 Two methods are presented as follows:

1.2.1 *Method A*—Test of in-plane shear shall be made on specimens clamped between two pairs of steel loading rails. See Fig. 1. This fixture, when loaded in tension, introduces shear forces in the specimen that produce failures across the panel. With most composite sheet materials, failure is due to a combination of diagonal tension and compression forces.

1.2.2 *Method B*—Test of in-plane shear shall be made on specimens clamped securely on opposite edges and a load applied to a third pair of steel rails in the center. See Fig. 2. The center load of either tension or compression will produce a shear load in each section of the specimen. With most composite sheet materials, failure is due to a combination of diagonal tension and compression forces.

NOTE 1—Strain gages at $\pm 45^\circ$ have shown significantly different shear strains on the same specimen. This may be due to differences in shear behavior with a tensile force at one 45° angle and compression force at the opposite 45° angle.

1.3 *In-plane Shear*—The shear associated with shear forces applied to the edges of the laminate so that the resulting shear deformations occur in the plane of the laminate rather than through the thickness.

1.4 In-plane shear specimens normally fail by buckling out of plane. The measured values of ultimate shear strength and shear modulus may be affected by sample dimensions or physical constraints, or both, that cause the sample to resist this out-of-plane buckling. Because of the above, this method is a standard guide instead of a standard method. Data obtained should be judged on this basis. For similar materials of the same sample dimensions in the same test system, consistent results are possible.

1.5 These methods cover the determination of the in-plane

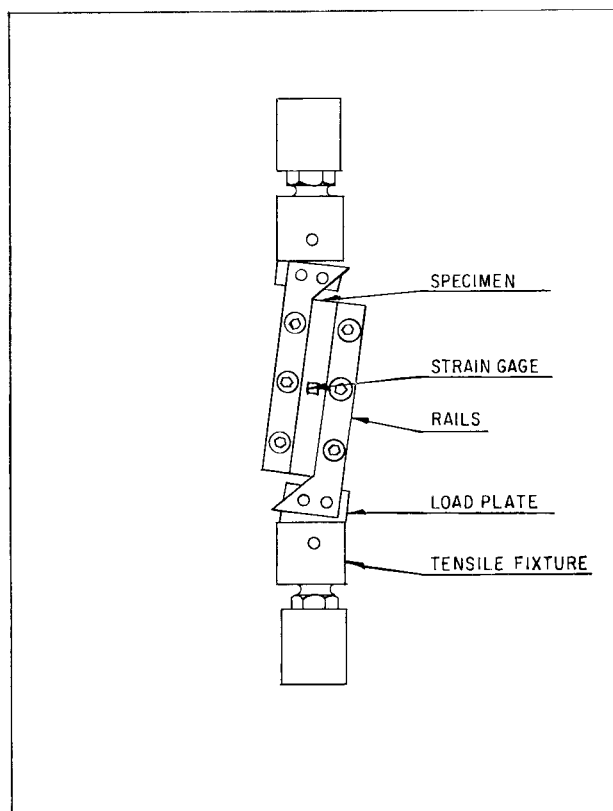


FIG. 1 Method A Assembly Rail Shear Apparatus

shear properties of resin-matrix composites reinforced by continuous or discontinuous high-modulus, 20 GPa [3×10^6 psi] or greater, fibers. This includes the following:

1.5.1 *Unidirectional*—Continuous or discontinuous reinforcing fibers, 0° and 90° properties.

1.5.2 *Laminates of Symmetric, Orthotropic Construction* (Note 2)—Continuous or discontinuous reinforcing fibers.

NOTE 2—Difficulties may arise when using this method in conjunction with $\pm 45^\circ$ angle-ply laminates. In particular, detailed stress analysis has shown that a uniform state of shear is not attained for this orientation. Test Method D 3518/D 3518M is recommended as an alternative.

1.5.3 Random-oriented fibrous laminates.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the*

¹ This guide is under the jurisdiction of ASTM Committee D-30 on High Modulus Fibers and Their Composites and is the direct responsibility of Subcommittee D 30.04 on High-Performance Fibers and Composites.

Current edition approved May 27, 1983. Published September 1983.