



Designation: D7248/D7248M – 23

Standard Test Method for High Bearing - Low Bypass Interaction Response of Polymer Matrix Composite Laminates Using 2-Fastener Specimens¹

This standard is issued under the fixed designation D7248/D7248M; 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 determines the uniaxial bearing/bypass interaction response of multi-directional polymer matrix composite laminates reinforced by high-modulus fibers by either double-shear tensile loading (Procedure A) or single-shear tensile or compressive loading (Procedure B) of a two-fastener specimen. The scope of this test method is limited to net section (bypass) failure modes. Standard specimen configurations using fixed values of test parameters are described for each procedure. A number of test parameters may be varied within the scope of the standard, provided that the parameters are fully documented in the test report. The composite material forms are limited to continuous-fiber or discontinuous-fiber (tape or fabric, or both) reinforced composites for which the laminate is balanced and symmetric with respect to the test direction. The range of acceptable test laminates and thicknesses are described in 8.2.1. Test methods for high bypass - low bearing response of polymer matrix composite materials, previously published under Procedure C of this test method, are now published in Test Method D8387/D8387M.

1.2 This test method is consistent with the recommendations of Composite Materials Handbook, CMH-17, which describes the desirable attributes of a bearing/bypass interaction response test method.

1.3 The two-fastener test configurations described in this test method are similar to those in Test Method D5961/D5961M as well as those used by industry to investigate the bearing portion of the bearing/bypass interaction response for bolted joints, where the specimen may produce either a bearing failure mode or a bypass failure mode. Should the test specimen fail in a bearing failure mode rather than the desired bypass mode, then the test should be considered to be a bearing dominated bearing/bypass test, and the data reduction and

reporting procedures of Test Method D5961/D5961M should be used instead of those given in this test method.

1.4 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.4.1 Within the text, the inch-pound units are shown in brackets.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D883 Terminology Relating to Plastics
- D2584 Test Method for Ignition Loss of Cured Reinforced Resins
- D2734 Test Methods for Void Content of Reinforced Plastics
- D3171 Test Methods for Constituent Content of Composite Materials
- D3878 Terminology for Composite Materials
- D5229/D5229M Test Method for Moisture Absorption Properties and Equilibrium Conditioning of Polymer Matrix Composite Materials

¹ This test method is under the jurisdiction of ASTM Committee D30 on Composite Materials and is the direct responsibility of Subcommittee D30.05 on Structural Test Methods.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.



- D5687/D5687M** Guide for Preparation of Flat Composite Panels with Processing Guidelines for Specimen Preparation
- D5766/D5766M** Test Method for Open-Hole Tensile Strength of Polymer Matrix Composite Laminates
- D5961/D5961M** Test Method for Bearing Response of Polymer Matrix Composite Laminates
- D6484/D6484M** Test Method for Open-Hole Compressive Strength of Polymer Matrix Composite Laminates
- D6742/D6742M** Practice for Filled-Hole Tension and Compression Testing of Polymer Matrix Composite Laminates
- D8387/D8387M** Test Method for High Bypass – Low Bearing Interaction Response of Polymer Matrix Composite Laminates
- D8509** Guide for Test Method Selection and Test Specimen Design for Bolted Joint Related Properties
- E4** Practices for Force Calibration and Verification of Testing Machines
- E6** Terminology Relating to Methods of Mechanical Testing
- E83** Practice for Verification and Classification of Extensometer Systems
- E122** Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process
- E177** Practice for Use of the Terms Precision and Bias in ASTM Test Methods
- E251** Test Methods for Performance Characteristics of Metallic Bonded Resistance Strain Gages
- E456** Terminology Relating to Quality and Statistics
- E1237** Guide for Installing Bonded Resistance Strain Gages
- 2.2 Other Document:³
- Composite Materials Handbook, CMH-17 Polymer Matrix Composites, Volume 1, Chapter 7**

3. Terminology

3.1 *Definitions*—Terminology **D3878** defines terms relating to high-modulus fibers and their composites. Terminology **D883** defines terms relating to plastics. Terminology **E6** defines terms relating to mechanical testing. Terminology **E456** and Practice **E177** define terms relating to statistics. In the event of a conflict between terms, Terminology **D3878** shall have precedence over the other documents.

NOTE 1—If the term represents a physical quantity, its analytical dimensions are stated immediately following the term (or letter symbol) in fundamental dimension form, using the following ASTM standard symbology for fundamental dimensions, shown within square brackets: $[M]$ for mass, $[L]$ for length, $[T]$ for time, $[θ]$ for thermodynamic temperature, and $[nd]$ for non-dimensional quantities. Use of these symbols is restricted to analytical dimensions when used with square brackets, as the symbols may have other definitions when used without the brackets.

3.2 *Definitions of Terms Specific to This Standard*—Refer to Guide **D8509**.

3.3 Symbols:

A = cross-sectional area of a specimen

CV = coefficient of variation statistic of a sample population for a given property (in percent)

d = fastener or pin diameter

D = specimen hole diameter

d_{csk} = countersink depth

d_{fl} = countersink flushness (depth or protrusion of the fastener in a countersunk hole)

e = distance, parallel to applied force, from hole center to end of specimen; the edge distance

E_x^{br} = bearing chord stiffness in the test direction specified by the subscript

$F_x^{br_byp}$ = bearing stress at the ultimate bypass strength in the test direction specified by the subscript

$F_x^{gr_byp_c}$ = ultimate compressive gross bypass strength in the test direction specified by the subscript

$F_x^{gr_byp_t}$ = ultimate tensile gross bypass strength in the test direction specified by the subscript

$F_x^{net_byp_c}$ = ultimate compressive net bypass strength in the test direction specified by the subscript

$F_x^{net_byp_t}$ = ultimate tensile net bypass strength in the test direction specified by the subscript

g = distance, parallel to applied force, from hole edge to end of specimen

h = specimen thickness

k = calculation factor used in net bypass strength calculations to determine net force portion

L_g = extensometer gauge length

n = number of specimens per sample population

P = force carried by test specimen

P^f = force carried by test specimen at failure

P^{max} = maximum force carried by test specimen prior to failure

s_{n-1} = standard deviation statistic of a sample population for a given property

w = specimen width

x_i = test result for an individual specimen from the sample population for a given property

$\bar{x}$ = mean or average (estimate of mean) of a sample population for a given property

δ = extensional displacement

ε = general symbol for strain, whether normal strain or shear strain

ε^{br} = bearing strain

σ^{br} = bearing stress

4. Summary of Test Method

4.1 Refer to Guide **D8509** for discussion of bearing/bypass test procedures.

4.2 Procedure A, Bypass/High Bearing Double Shear:

4.2.1 A flat, constant rectangular cross-section test specimen with two centerline holes located near the end of the specimen, as shown in the test specimen drawings of **Figs. 1 and 2**, is loaded at the hole in bearing. The bearing force is normally applied through a close-tolerance, lightly torqued fastener (or pin) that is reacted in double shear by a fixture similar to that shown in **Figs. 3 and 4**. The bearing force is created by pulling the assembly in tension in a testing machine. The difference from a standard “bearing” test is that the expected primary failure mode is net section tension, rather than a bearing mode.

³ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, <http://www.sae.org>.