



Designation: D2557 – 98 (Reapproved 2010)^{ε1}

Standard Test Method for Tensile-Shear Strength of Adhesives in the Subzero Temperature Range from -267.8 to -55°C (-450 to -67°F)¹

This standard is issued under the fixed designation D2557; 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 8.6.4 was editorially corrected in October 2010.

1. Scope

1.1 This test method covers the determination of the comparative shear strength of adhesives for bonding metals when tested on a standard specimen and under specified conditions of preparation and testing at extreme subzero temperatures.

1.2 This test method is applicable to the temperature range from -267.8 to -55°C (-450 to -67°F).

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

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.* Specific precautions are given in 8.3.

2. Referenced Documents

2.1 ASTM Standards:²

[A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip](#) (Withdrawn 2014)³

[B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate](#)

[B265 Specification for Titanium and Titanium Alloy Strip, Sheet, and Plate](#)

[D907 Terminology of Adhesives](#)

[D1002 Test Method for Apparent Shear Strength of Single-](#)

[Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading \(Metal-to-Metal\)](#)
[D4896 Guide for Use of Adhesive-Bonded Single Lap-Joint Specimen Test Results](#)

3. Terminology

3.1 *Definitions*—Many terms in this test method are defined in Terminology [D907](#).

4. Significance and Use

4.1 This test method may be used as an accelerated screening test for assessing the strength properties of adhesives and adhesive joints at subzero temperatures. This test method may also be used to determine the effects of various surface preparations, substrates, or adhesive systems on the durability of the adhesive joints at subzero temperatures.

4.2 Tensile shear strengths of various adhesives, surface preparations, and substrates may be compared by using this test method for uniform sets of conditions. To assess the overall tensile shear strength of a given adhesive, surface preparation, and substrate should be tested under a range of stress and temperatures. For a specific end use, the needed strength properties using only one set of test conditions may be obtained.

4.3 The misuse of strength values obtained from this test method as design-allowable stress values for structural joints could lead to product failure, property damage, and human injury.

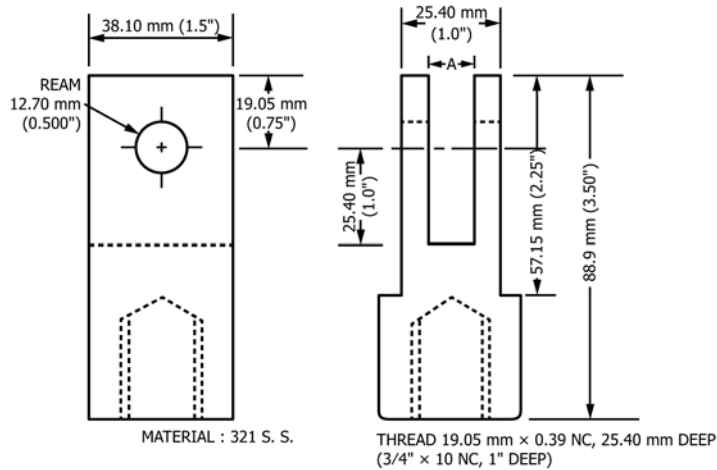
4.3.1 The apparent shear strength of an adhesive obtained from a given small single-lap specimen may differ from that obtained from a joint made with different adherends or by a different bonding process. The normal variation of temperature and moisture in the service environment causes the adherends and the adhesive to swell or shrink. The adherends and adhesive are likely to have different thermal and moisture coefficients of expansion. Even in small specimens, short-term environment changes can induce internal stresses of chemical changes in the adhesive that permanently affect the apparent strength and other properties of the adhesive.

¹ This test method is under the jurisdiction of ASTM Committee D14 on Adhesives and is the direct responsibility of Subcommittee D14.80 on Metal Bonding Adhesives.

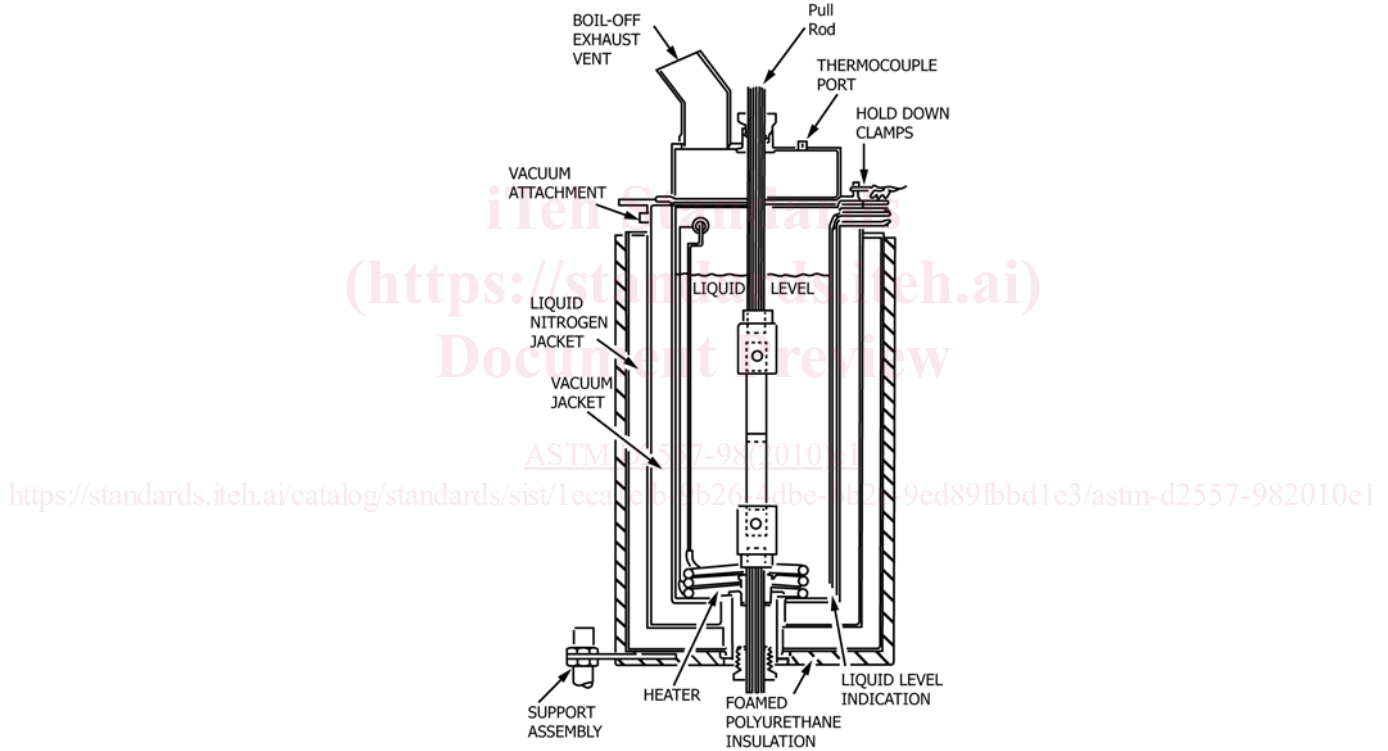
Current edition approved Oct. 1, 2010. Published October 2010. Originally approved in 1966. Last previous edition approved in 2004 as D2557 – 98 (2004). DOI: 10.1520/D2557-98R10E01.

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.

³ The last approved version of this historical standard is referenced on www.astm.org.



NOTE 1—"A" dimension varies with specimen thickness.
FIG. 1 Clevis for Holding "Pin-Type" Lap Shear Coupons



NOTE 1—Cold box configurations are commercially available which can be used from room temperature to -185°C . These utilize chilled gaseous nitrogen or gaseous carbon dioxide.

FIG. 2 Diagrammatic View of Cryostat and Accessories

4.3.2 The problem of predicting joint behavior in a changing environment is even more difficult if a different type of adherend is used in a larger structural joint than was used in the small specimen.

4.3.3 The apparent shear strength measured with a single-lap specimen is not suitable for determining design-allowable stresses for designing structural joints that differ in any manner

from the joints tested without thorough analysis and understanding of the joint and adhesive behaviors.

4.3.4 Single-lap tests may be used for comparing and selecting adhesives or bonding processes for susceptibility to fatigue and environmental changes, but such comparisons must be made with great caution since different adhesives may respond differently in different joints. See Guide D4896 for