Designation: D3658 – 01 (Reapproved 2016)

Standard Test Method for Determining the Torque Strength of Ultraviolet (UV) Light-Cured Glass/Metal Adhesive Joints[1]

This standard is issued under the fixed designation D3658; 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 simplistic comparison of strengths of glass/metal joints when the adhesive is cured by ultraviolet (UV) radiation and standard specimens are used and tested under specified conditions of preparation, radiation, and load.

1.2 This test method involves torque loading UV-bonded hexagonal metal blocks to glass plates.

1.3 This test method may be used to obtain comparative torque strength-to-failure data for other bonded joint systems, radiation cured or not.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A109/A109M Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled

A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip (Withdrawn 2014)[3]

B36/B36M Specification for Brass Plate, Sheet, Strip, And Rolled Bar

B152/B152M Specification for Copper Sheet, Strip, Plate, and Rolled Bar

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)

3. Terminology

3.1 *Definitions*—Many of the terms in this test method are defined in Terminology D907.

4. Significance and Use

4.1 This test method provides reasonably accurate information with regard to the ability of UV curing adhesives to withstand torsional shearing forces. It may be used to determine the effect of environment on torsional shear strength.

5. Apparatus

5.1 Test system consisting of apparatus capable of transferring a uniform and continuous torque to the bonded hexagonal block (schematically shown in Fig. 1), and a safety shield or other safety device to prevent injury from possible shattering glass.

5.2 An accurate and reliable means of recording load to failure, that is, x-y or strip chart recorder, should also be part of the test system.

6. Test Specimens

6.1 Recommended specimens are as shown in Fig. 2.

6.2 Selection of the test metal for hexagonal blocks is at the discretion of the user; however, the following grades are recommended (see Test Method D1002):

Metal	Specification
Brass	B36/B36M, Alloy 8
Copper	B152/B152M, Type A
Aluminum	B209, Alloy 2024, T3 Temper
Steel	A109/A109M, Grade 2
Corrosion-resisting steel	A167, Type 302
Titanium	B265

[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.

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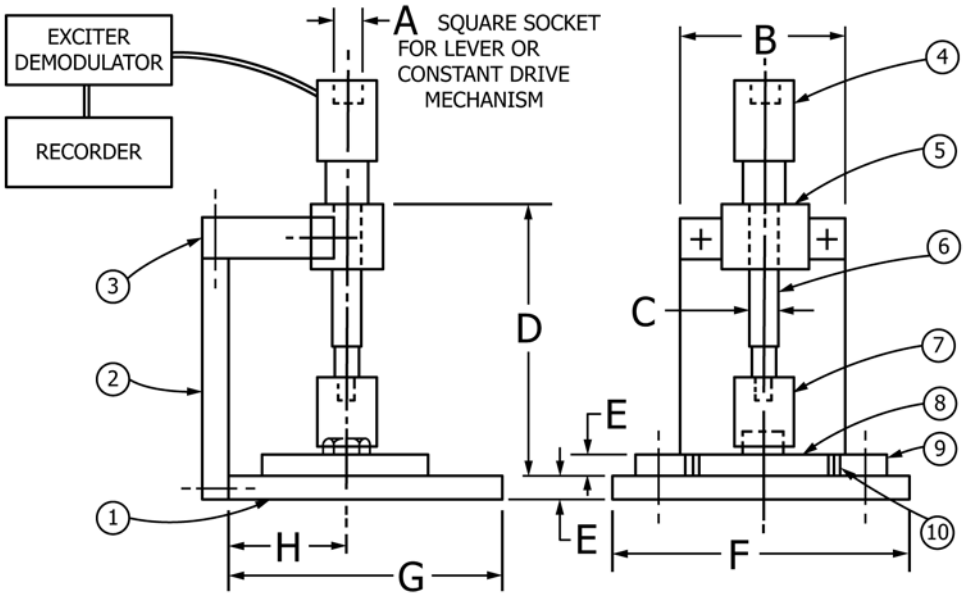
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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



Details

1—Base plate
2—Upright
3—Mounting bracket
4—Lebow socket wrench sensor Model 2133-103
5—Pillow block—Boston #PPB10
6—Extension—Armstrong #4-105 A
7—1-in. (25.4-mm) hexagonal socket–Armstrong #A4-632
8—UV specimen (see Fig. 2)
9—Adjustable side guides (Fig. 2)
10—Neoprene pad (bonded to Detail 9) (Fig. 2)

Dimensions

	in.	mm
A	0.50	13
B	3.75	95
C	0.62	16
D	5.50	140
E	0.50	13
F	6.75	170
G	6.25	160
H	2.62	66

FIG. 1 UV Testing Apparatus

6.3 Hexagonal blocks may be reused after testing by bonding the opposite end of the block or by cleaning the original bonded end by sanding or grinding and taking care to ensure that ends are smooth and parallel.

6.4 Selection of the glass plate is at the discretion of the user. Standard ½-in. (13-mm) thick pressed plate glass is recommended.

7. Preparation of Test Specimens

7.1 The assembly and cure of the specimen is recommended as shown in Fig. 3.

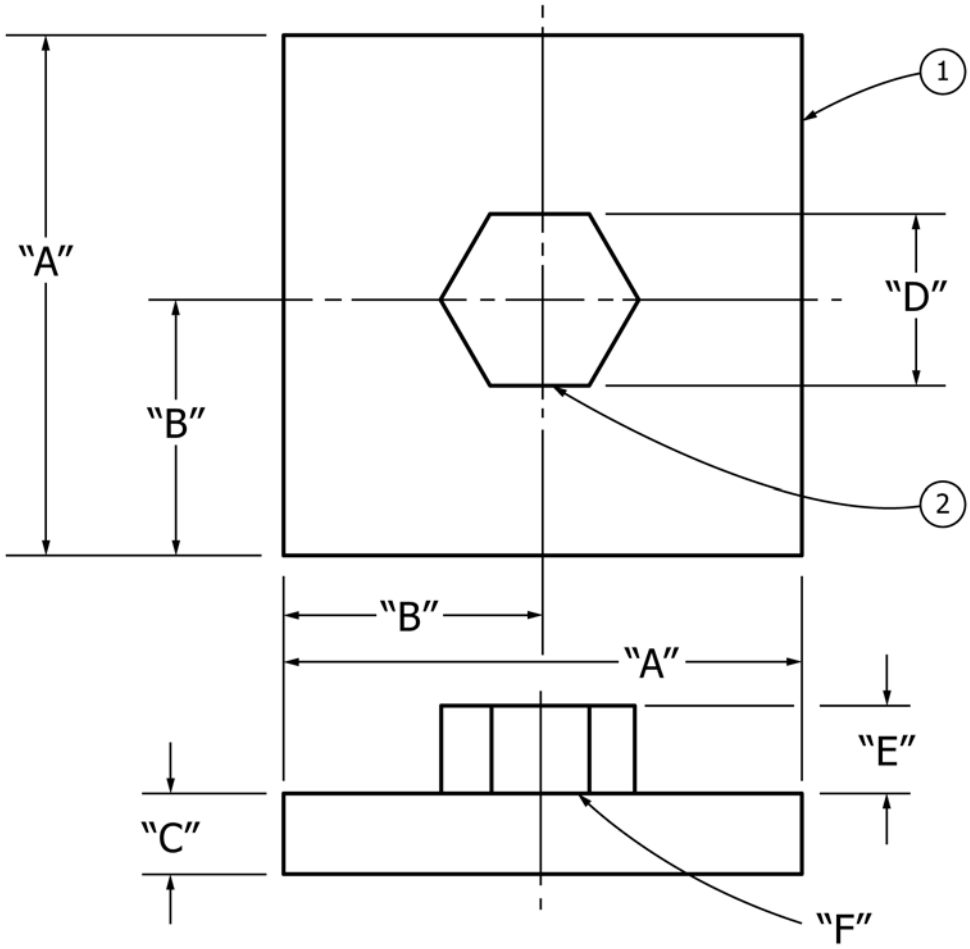
7.2 Cut glass plates 3 by 3 in. (76 by 76 mm) square to fit the holding fixture without lateral movement.

7.3 A recommended cleaning procedure is to soak the glass plates in a dilute detergent solution for 2 to 3 min, followed by light scrubbing with an absorbent cleaning tissue.[4] Then thoroughly rinse the glass plates with distilled or deionized water and air dry.

7.4 Metal hexagonal blocks, ½ in. (13 mm) high, may be prepared by light sanding with 400 grade wet or dry emery paper, followed by solvent wiping, such as 1,1,1-trichloroethane.

NOTE 1—Preparation of adherends are recommended only. Users may

[4] Kimwipes, available from Kimberly-Clark Corp., 128 N. Lake, Neenah, Wisc. 54956, or equivalent, have been found satisfactory for this purpose.



Details

1—Glass plate
2—Hexagonal metal block

	Dimensions			Dimensions	
	in.	mm		$in.^2$	mm^2
A	3.00	76	Bond Area F	0.866	559
B	1.50	38			
C	0.47	12			
D	1.00	25			
E	0.50	13			

FIG. 2 UV Specimen Configuration

employ methods conducive to actual practice. Reported data should be qualified as to the method of surface preparation.

7.5 Apply adhesive to the hexagonal button in sufficient quantity to cause wetting of the entire surface when clamping pressure is applied by means of two 10-lb (0.9-kg) spring clamps.

8. Procedure

8.1 The level of the radiation and time of exposure should be within the tolerances specified for the cure.

8.2 Measure the intensity of the radiation with a suitable meter sensitive to the radiation used. Place the meter in a position related to the bond line.

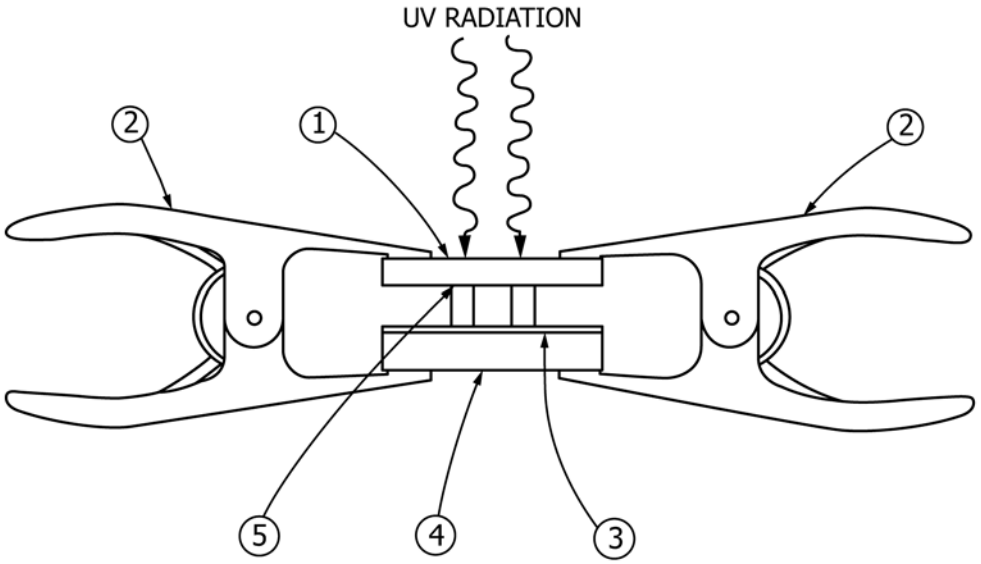
8.3 If the material is subject to post curing, it must remain at specified conditions of temperature, humidity, etc, prior to testing.

8.4 Fully cured specimens may be subjected to environmental exposure such as weathering, humidity, temperature, or combinations thereof, prior to testing.

8.5 Test the bonded specimen as follows:

8.5.1 Place the specimen in the holding fixture, ensuring that no lateral movement is evident.

8.5.2 Mechanically apply a torque on the hex nut assembly or by means of a constant drive loader at a rate of 0.5 rpm (suggested) until failure occurs.



Details
1—UV specimen
2—Clamp
3—Neoprene cushion
4—Clamp support (glass or metal)
5—Bond surface (Ref.)

FIG. 3 Adhesive Joint Preparation

8.5.3 Record the load at failure and the nature and amount of the failure (cohesive in adhesive or glass or adhesive at metal/adhesive or glass/adhesive interface). Express all failure loads in lbf·in. (or N·m).

9. Report

9.1 Report the following information:

9.1.1 Complete identification of the adhesive tested, including type, source, manufacturers' code numbers, form, etc.

9.1.2 Complete identification of the metal used, its thickness, and the method of cleaning and preparing its surfaces prior to bonding.

9.1.3 Complete identification of the glass used, as in 9.1.2.

9.1.4 Application and bonding conditions used in preparing specimens, including the type intensity (watts per steradian), and exposure time of the radiation used.

9.1.5 Conditioning procedure prior to testing.

9.1.6 Number of specimens tested.

9.1.7 Maximum, minimum, and average values for load at failure.

9.1.8 Standard deviation and coefficient of variation for the specimens tested.

9.1.9 Average thickness of the adhesive layer after cure of the joint. Subsequent measurements should be obtained if the specimens are exposed to environmental conditioning.

9.1.10 The nature of the failure, including the average estimated percentages of failure; that is, adhesives-cohesive, glass-cohesive, interface failure (glass/adhesive or metal/adhesive).

10. Precision and Bias

10.1 Precision and bias for this test method are being determined and will be available by April 2005.

11. Keywords

11.1 adhesive; glass; light-cured; metal; torque; ultraviolet