Designation: D 3658 – 90 (Reapproved 1995)

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 D 3658; 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 *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:*

A 109 Specification for Steel, Strip, Carbon, Cold-Rolled[2]

A 167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip[2]

B 36 Specification for Brass Plate, Sheet, Strip, and Rolled Bar[3]

B 152 Specification for Copper Sheet, Strip, Plate and Rolled Bar[3]

B 209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate[4]

B 265 Specification for Titanium and Titanium Alloy Strip, Sheet, and Plate[5]

D 907 Terminology of Adhesives[6]

D 1002 Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)[6]

3. Terminology

3.1 *Definitions*—Definitions of terms in this test method may be found in Terminology D 907.

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 The apparatus is schematically shown in Fig. 1.

5.2 The apparatus shall be capable of transferring a uniform and continuous torque to the bonded hexagonal block.

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

5.4 A safety shield or other safety device shall be incorporated as part of the system to prevent injury from possible shattering glass.

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 D 1002):

Metal	Specification
Brass	B 36, Alloy 8
Copper	B 152, Type A
Aluminum	B 209, Alloy 2024, T3 Temper
Steel	A 109, Grade 2
Corrosion-resisting steel	A 167, Type 302
Titanium	B 265

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

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[1] This test method is under the jurisdiction of ASTM Committee D-14 on Adhesives and is the direct responsibility of Subcommittee D 14.80 on Metal Bonding Adhesives.

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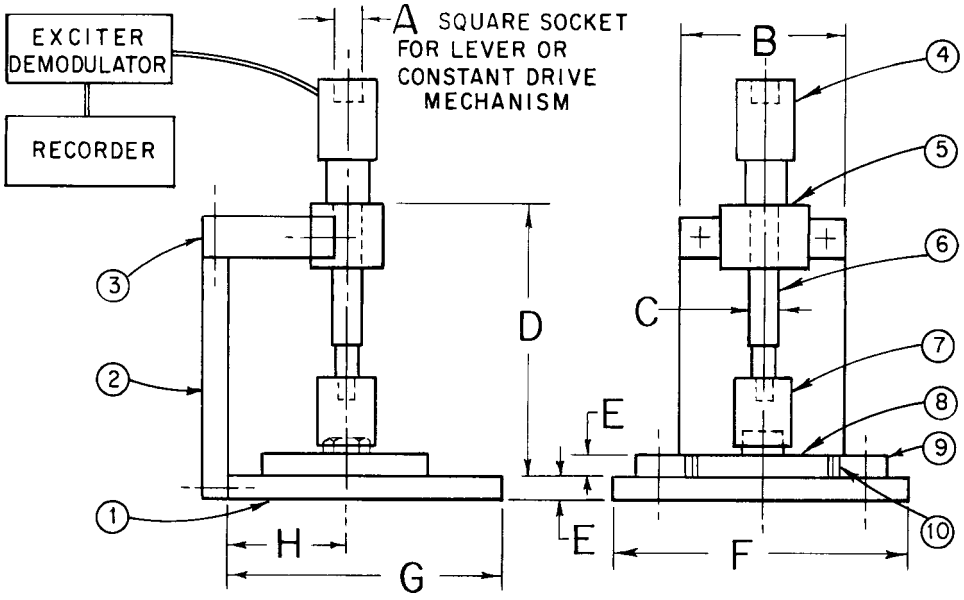
[2] *Annual Book of ASTM Standards*, Vol 01.03.

[3] *Annual Book of ASTM Standards*, Vol 02.01.

[4] *Annual Book of ASTM Standards*, Vol 02.02.

[5] *Annual Book of ASTM Standards*, Vol 02.04.

[6] *Annual Book of ASTM Standards*, Vol 15.06.



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

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.[7] 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 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.

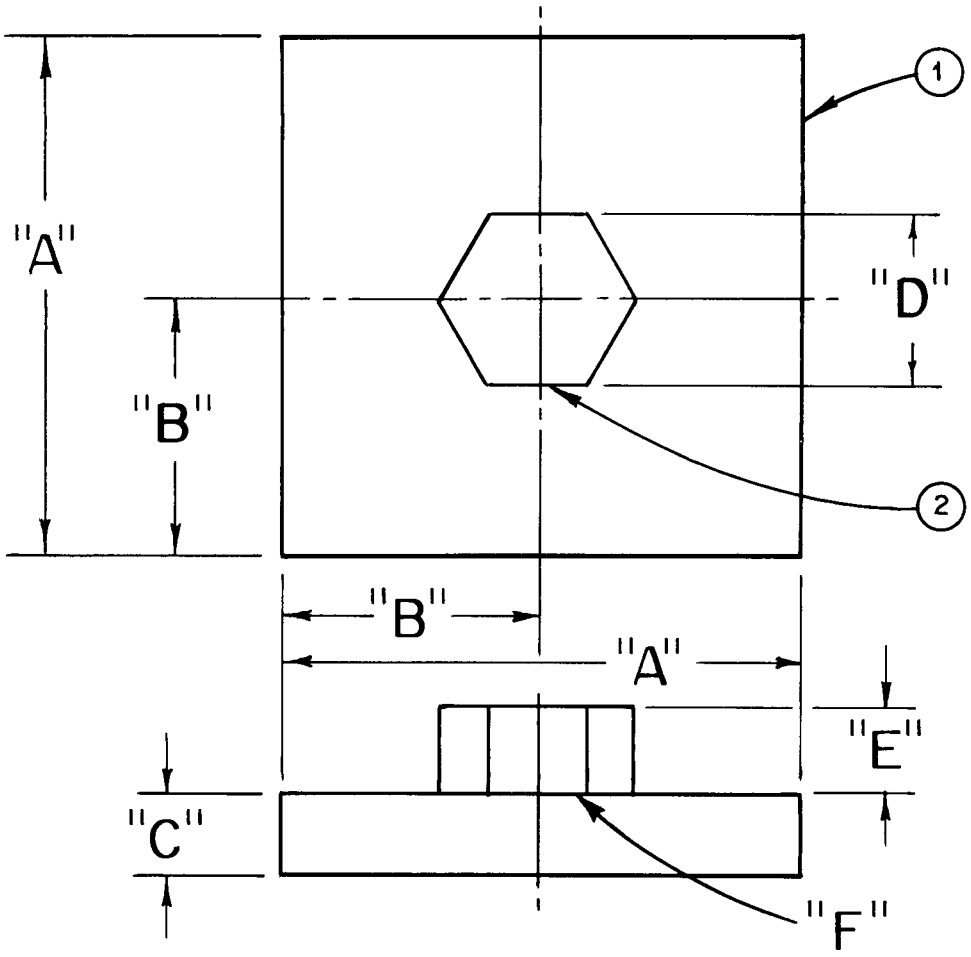
8.4 Fully cured specimens may be subjected to environmental exposure such as weathering, humidity, temperature, or combinations thereof, prior to testing.

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

[7] 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

or by means of a constant drive loader at a rate of 0.5 rpm (suggested) until failure occurs.

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.

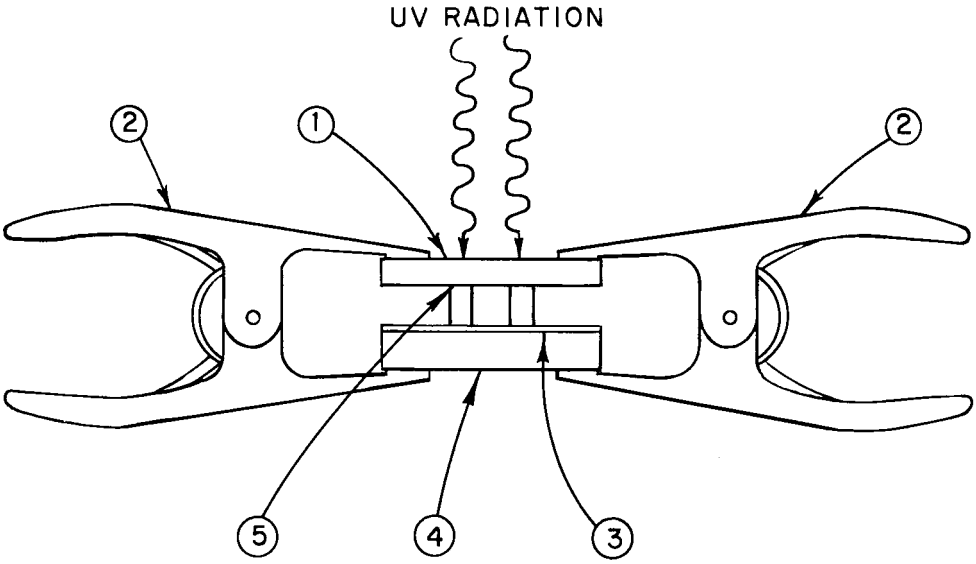
9.1.6 Number of specimens tested.

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,



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

FIG. 3 Adhesive Joint Preparation

glass-cohesive, interface failure (glass/adhesive or metal/adhesive).

10. Precision and Bias

10.1 At the present time there is no basis for a statement of precision or bias concerning the reproducibility of results among laboratories. Such information may be available in the future following round-robin testing.

11. Keywords

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