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INTERNATIONAL
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SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J840

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Submitted for recognition as an American National Standard

TEST PROCEDURES FOR BRAKE SHOE AND LINING ADHESIVES AND BONDS

Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. Scope—This SAE Recommended Practice covers equipment and procedures for qualification of bonded brake shoe and lining assemblies and for quality control on materials and processes used in their manufacture.

2. Reference

2.1 Applicable Publication—The following publication forms a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D471—Tentative Method of Test for Change in Properties of Elastomeric Vulcanizates Resulting From Immersion in Liquids

3. Qualification Tests

3.1 Scope—The following tests cover equipment and procedures used to verify the structural integrity of the brake shoe, adhesive, and brake lining assembly. The Bond Plane Shear Test and either the Dynamometer Test or the Vehicle Abuse Test are used for qualification.

3.2 Bond Plane Shear Test

3.2.1 PURPOSE—The purpose of this test is to provide values of lining-to-brake-shoe shear strength by measuring the load required to cause shear failure on complete shoe and lining assemblies, under both ambient and elevated temperature conditions.

3.2.2 EQUIPMENT—The equipment for performing this test consists of a compression test machine of sufficient capacity to shear the lining from the shoe, a fixture which shall provide means to hold the shoe firmly, and a movable ram through which the shear load is applied to the lining. Additional fixture requirements are:

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3.2.2.1 *Drum Brake Shoes*—Fixture (Figure 1) shall be so designed that the ram contacts the edge of the lining for its full length and thickness to within 0.005–0.020 in (0.13–0.51 mm) of the shoe table or rim. Load application on the ram shall be in a direction perpendicular to the plane of the shoe web and the shoe shall be supported to maintain uniform loading along the length of the lining.

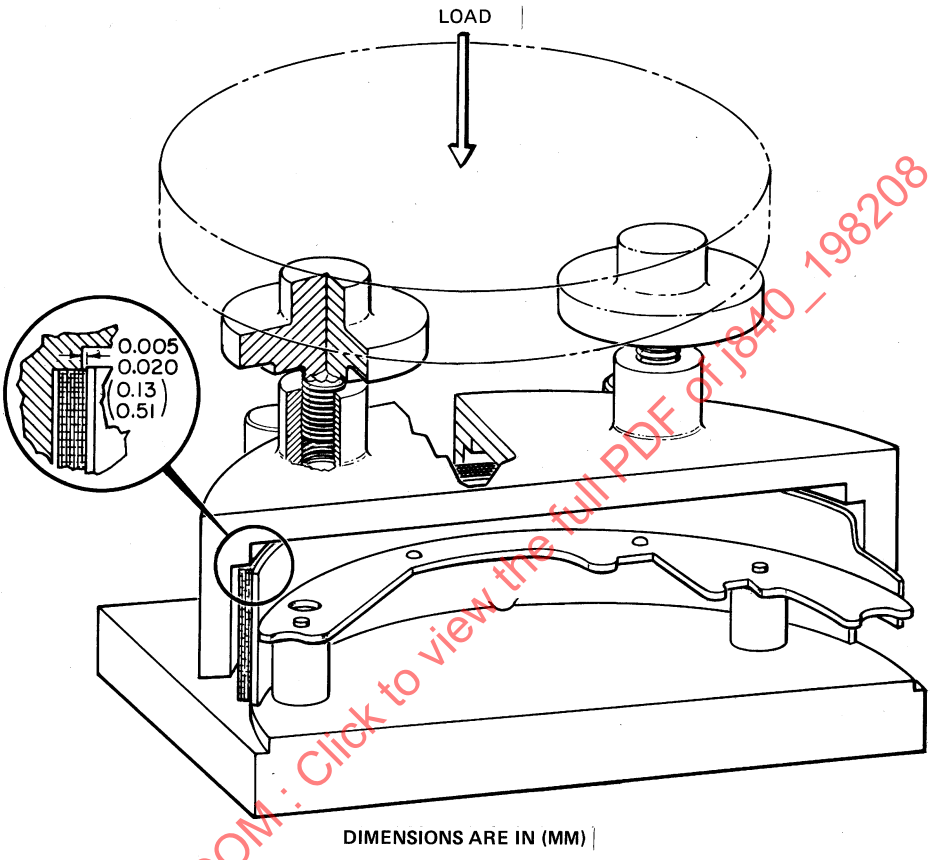


FIGURE 1—BOND PLANE SHEAR TEST—DRUM BRAKE

3.2.2.2 *Disc Brake Shoes*—Fixture (Figure 2) shall be so designed that the ram contacts the edge of the lining within 0.005–0.020 in (0.13–0.51 mm) of the shoe and conforms adequately to the lining edge contour to avoid crushing of the lining edge prior to failure. Normally, the ram shall contact the edge parallel to the long axis of the lining; the edge parallel to the short axis may be used if premature crushing of the lining is not incurred.

3.2.3 PROCEDURE

3.2.3.1 *Ambient Destructive Shear Test*—The brake shoe and lining assembly shall be placed in the shear test fixture and the load shall be applied at a rate of 1000 ± 100 lb (453 ± 48 kg) per second, or 0.40 ± 0.04 in (10 ± 1 mm) per minute after the ram is in contact with the lining edge. Loading shall be continued until failure has occurred. The load at which observable lining movement or complete shear occurs and the shear pattern (paragraph 3.2.5) shall be recorded. Also, a check shall be made for state of cure using the Cotton Tack Test (paragraph 4.2.5).

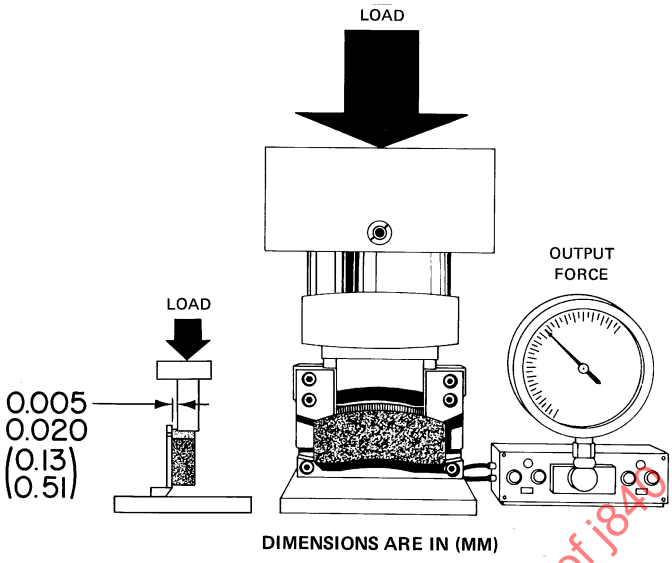


FIGURE 2—DISC BRAKE SHEAR TEST FIXTURE

3.2.3.2 *Hot Destructive Shear Test*—The brake shoe and lining assembly shall be placed in a heating fixture or oven that will bring the temperature up to the specified value uniformly throughout the bond line within ±10 °F (±5.5 °C). This specified temperature must be reached within 30 min. When the temperature is reached, the shoe assembly should be placed in the shear test fixture and tested as in paragraph 3.2.3.1. The load at which observable lining movement or complete shear occurs shall be recorded.

NOTE— The heating fixture may be incorporated in the shear test fixture or external to it. If external to it, not more than 15 s should elapse between removal of the shoe assembly from the heating fixture and failure. Temperature of the bond line shall be observed by means of the bond line thermocouple shown in Figures 4A and 4B.

3.2.3.3 *Resistance to Fluids Test*—This procedure is designed for testing adhesives for resistance to fluids encountered in service, and provides for reporting loss in shear strength after immersion in the test fluids. Individual specimens shall be totally immersed in each test liquid (paragraph 3.2.3.3(a)) in a separate container for 7 days at room temperature. The liquid shall be agitated every 24 h by moderate manual rotation of the container. The individual specimens shall be removed from the containers, blown off or wiped with a clean dry cloth, and tested immediately at room temperature; or, in the event of adverse effect on the lining, longer drying periods may be used. The brake shoe and lining assembly shall be placed in the shear fixture and loaded to destruction at the prescribed loading rate as per paragraph 3.2.3.1.

a. Immersion Fluids:

1. Reference fuels A and B as specified in ASTM D471, Tentative Method of Test for Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids.
2. ASTM Oil No. 1, as specified in ASTM D 471.
3. ASTM Oil No. 3, as specified in ASTM D 471.
4. Calcium chloride 20% solution.
5. Hypoid oil.
6. Butyl cellosolve (brake fluid grade).
7. Tap water.

3.2.4 REPORT

3.2.4.1 Ambient Destructive Shear Test

3.2.4.1.1 Record load at which observable movement or complete shear fracture of the lining relative to the shoe occurs.

3.2.4.1.2 Establish and record type of shear fracture pattern.

NOTE— Note: Refer to paragraph 3.2.5.

3.2.4.1.3 Record results of Cotton Tack Test (paragraph 4.2.5).

3.2.4.2 Hot Destructive Shear Test—Record load at which observable movement or complete shear of the lining relative to the shoe occurs.

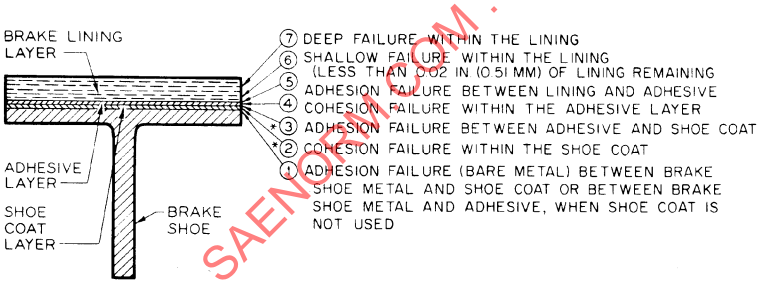
3.2.4.3 Resistant to Fluids Test

Record load at which observable movement or complete fracture of the lining relative to the shoe occurs.

3.2.4.3.1 Establish and record type of shear fracture.

3.2.4.3.2 Report any visible adverse effects on the adhesive from the immersion fluid.

3.2.5 REPORT, STANDARD METHOD OF REPORTING BOND FRACTURE—Figure 3 shows the seven possible planes of fracture between the brake lining and the brake shoe. Each of these planes has been assigned a number from 1 to 7. The report should include the type of fractures encountered, by indicating the appropriate number from 1 to 7, together with the relative areas of each fracture type expressed as a percentage of the total area in decreasing order. (Example: 60 No. 4, 30 No. 6, 10 No. 7—Note that the percent mark is not used.)



*ELIMINATE WHEN SHOE COAT IS NOT USED.
TO REPORT FRACTURE PATTERN, EXAMINE THE DESTROYED BOND TO DETERMINE EXACTLY WHERE THE FRACTURE TOOK PLACE, IE, BETWEEN THE ADHESIVE AND THE SHOE COAT (3), OR BETWEEN THE LINING AND THE ADHESIVE (5). SHOULD THE EXAMINATION SHOW MORE THAN ONE TYPE OF FRACTURE, REPORT, IN DECREASING ORDER, ALL OF THE DIFFERENT TYPES THAT ARE PRESENT, AND INDICATE THIER APPROXIMATE PERCENTAGE OF THE TOTAL AREA, IE 60 6, 40 2, OR 50 1, 30 3, 20 4.

FIGURE 3—STANDARD METHODS OF BOND FRACTURE

3.3 Dynamometer Test—High Temperature Bond Abuse

3.3.1 PURPOSE—The purpose of this test is to determine the effectivenss of the bond of a combination of lining and adhesive when the brake shoe and lining assembly is subjected to high temperature and brake loads, as may be encountered in severe vehicle service reproduced on a dynamometer.

3.3.2 INSTRUMENTATION—The complete brake, assembled with the test set of brake shoes, is mounted in the dynamometer, along with the proper brake drum or rotor. The thermocouple from the bond line of the shoe is connected to the temperature recording instrument. The flywheel loading shall correspond with the work load imposed on the brake as it is used in the specific vehicle. Adjust brake shoe to drum clearance or brake shoe to rotor clearance as recommended by the manufacturer.

3.3.3 PROCEDURE

3.3.3.1 *Preparation of Specimens*—Sufficient shoes for dynamometer tests shall be prepared. Test shoes and lining assemblies shall be processed over regular production equipment. For the purpose of recording the bond line temperature, drill a 1/16 in (1.59 mm) diameter hole edgewise in the brake lining and at the bond line to a depth of approximately one-half the lining width, as shown in Figure 4A for the drum brake or Figure 4B for the disc brake. The thermocouple must be imbedded in the adhesive layer. When testing a drum brake shoe and lining assembly, locate the hole at approximately the high pressure point of the lining on the shoe which is producing the maximum brake effectiveness and install the thermocouple to the bottom of the hole. For a disc brake shoe and lining assembly, the thermocouple should be located in the bond line at the center of the inboard shoe.

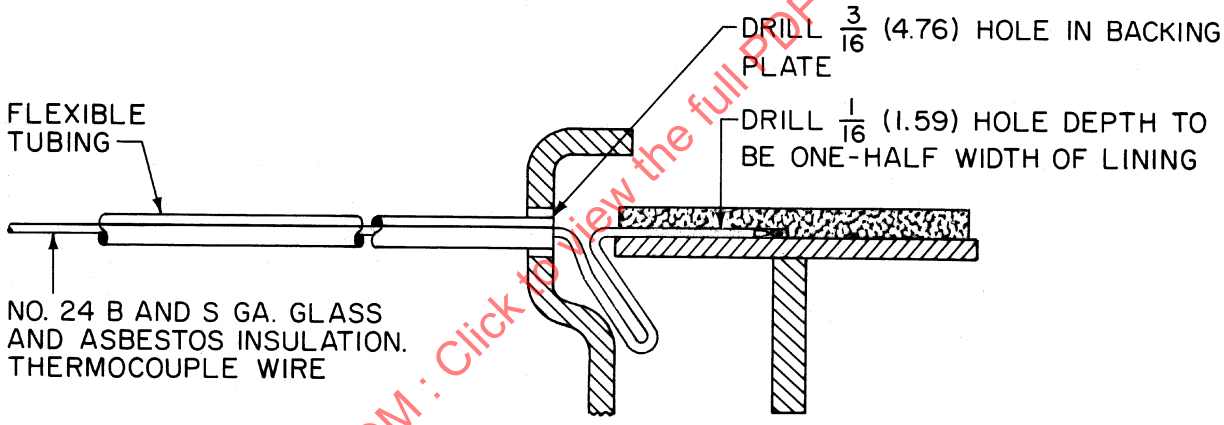


FIGURE 4A—DRAWING OF THERMOCOUPLE LOCATION—DRUM BRAKE

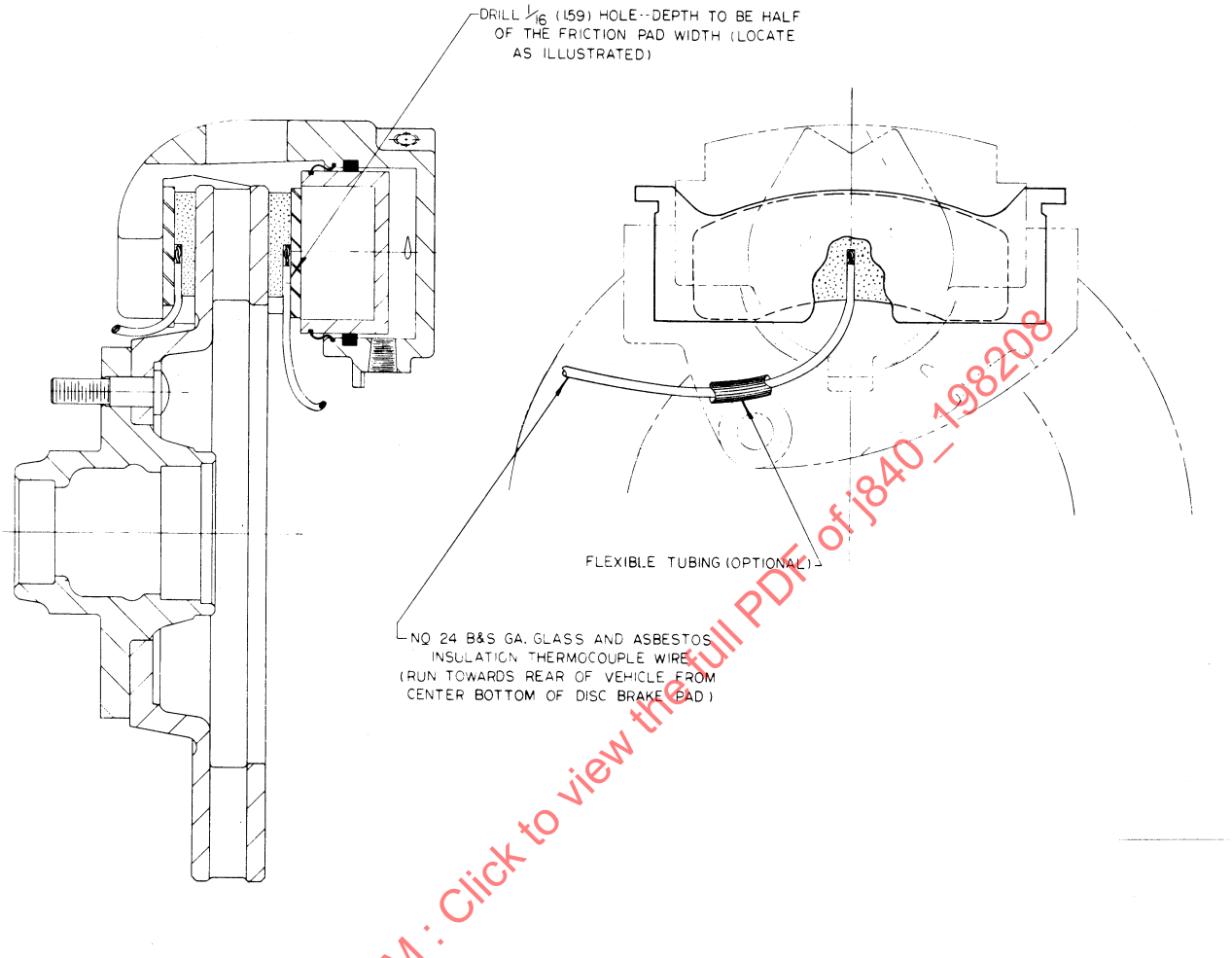


FIGURE 4B—DRAWING OF THERMOCOUPLE LOCATION—DISC BRAKE

3.3.3.2 *Burnish*—Turn blower on. Make consecutive stops from a flywheel speed corresponding to 60mph (96.5 km/h) at an average rate of deceleration of 10 ft/s/s (3.66 m/s/s) allowing the temperature to drop to approximately 200 °F (93.5 °C) between applications until linings show at least 80% contact.

3.3.3.3 *Bond Test, Constant Temperature, 650 °F (343.3 °C)*—Turn blower on at 100 °F (37.8 °C) below test temperature. Make stops from a flywheel speed corresponding to 70 mph (112.66 km/h) at an average rate of deceleration of 15 ft/s/s (4.57 m/s/s) until the bond line temperature reaches 650 °F (343.3 °C). Make as many stops as possible, a maximum of 50 or until the lining wears out, at 650 °F (343.3 °C) at a deceleration rate of 15 ft/s/s. Make applications at time intervals that will result in maintaining the predetermined average temperature throughout the test. If the 15 ft/s/s deceleration rate cannot be maintained, continue the test at the maximum line pressure encountered during the previous 15 ft/s/s stops.

3.3.3.4 *Bond Test—Ultimate Temperature*—Repeat burnish and bond test above except at increased temperature levels in increments of 50 °F (27.7 °C). Run three tests, each with new samples, at each temperature level until a failure occurs. Bond line temperature at which consistent failures occur in less than 50 stops is considered the ultimate temperature resistance of the adhesive being investigated.

NOTE— This test is generally used as a research evaluation method for adhesive, and is recommended to be used in testing new adhesive formulations to gain comparative values only.

3.3.4 REPORT—Record pertinent data and test results on the form as shown in Figure 5.

3.4 Vehicle Abuse Test

3.4.1 PURPOSE—The purpose of this test is to determine the effectiveness of the bond for a combination of lining and adhesive when the brake shoes have been subjected to the stresses of shock loading and heat, as may be encountered in severe vehicle service.

3.4.2 EQUIPMENT—The equipment for performing this test shall consist of an appropriate test vehicle modified to receive a thermocouple or thermocouples at the bond line of the brake shoe and lining assembly, a thermocouple or thermocouples, and a pyrometer.

3.4.3 PROCEDURE

3.4.3.1 Select and prepare brake shoe and lining assemblies as in paragraph 3.3.3.1 except that in testing a disc brake shoe and lining assembly, the lining should be ground to 0.100 in (2.54 mm) in thickness before installation to accelerate the heat transfer to the bond line.

3.4.3.2 A complete test for bonded brake shoe and lining assembly shall consist of:

3.4.3.2.1 Shock Test—Cold

3.4.3.2.2 Heat Test

3.4.3.2.3 Repeat Shock Test—Intermediate

3.4.3.2.4 Continued Heat Test

3.4.3.2.5 Repeat Shock Test—Hot

3.4.3.3 *Test Procedure*—Install a set of shoes and adjust brakes according to manufacturer's recommendations.

3.4.3.3.1 Shock Test—Cold—Make one forward and one reverse stop from approximately 15-20 mph (24.1-32.2 km/h) at maximum rate of deceleration and minimum time interval. Repeat two more times. Be alert for wheel drag. A heavy drag or rubbing noise may indicate lining slippage due to bond failure.

3.4.3.3.2 Heat Test at 250-300 °F (121-149 °C)—In any appropriate gear, drive the vehicle while dragging the service brakes. Continue until a bond line temperature at 250-300 °F (121-149 °C) is reached within 3-5 min (suggested speed 20-40 mph (32.2-64.4 km/h).

3.4.3.3.3 Repeat Shock Test—Intermediate—When the bond line temperatures of the shoes are above 250 °F (121 °C), but not over 300 °F (149 °C), immediately repeat Shock Test as in paragraph 3.4.3.3.1.

3.4.3.3.4 Continued Heat Test—Immediately continue, dragging the service brakes as in paragraph 3.4.3.3.2 for 30 min. Record bond line temperatures in 2 min intervals and plot on the chart shown in Figure 6A. During the test, the bond line temperature curve must stay within the limits of the envelope of the two curves shown or the test is not to be considered valid.

NOTE— It may be possible to stay within this envelope only on either the two front wheels or the two rear wheels but not both (suggested speed 20-40 mph (32.2-64.4 km/h).

DYNAMOMETER TEST OF BONDED SHOE AND LINING ASSEMBLIES

GENERAL
TEST NUMBER _____ PURPOSE _____ DATE _____

BRAKE TYPE _____ SIZE _____ WHEEL CYLINDER DIAMETER _____

ADHESIVE
SOURCE _____ COMPOUND _____ BATCH NO. _____

LINING
SOURCE—PRIMARY OR FORWARD DRUM SHOE OR OUTER DISC SHOE COMPOUND IDENT. _____
(strike out one)
SOURCE—SECONDARY OR REVERSE DRUM SHOE OR INNER DISC SHOE COMPOUND IDENT. _____
(strike out one)

DRUM OR DISC (strike out one)
SOURCE _____ TYPE _____ PART NO. _____

SAMPLE PREPARATION
ADHESIVE PATTERN _____ TYPE _____ PART NO. _____

ROOM TEMP. DRY TIME _____ FORCE DRY TIME _____°F (___°C)

BOND CURE _____ MINUTES AT _____°F (_____°C) AT APPROX.

_____ PSI (_____ N/M^2)

DYNAMOMETER FLYWHEEL EQUIVALENT OF ___ FT-LB K.E. AT ___MPH

(___ N/M^2 AT _____ KM/H)

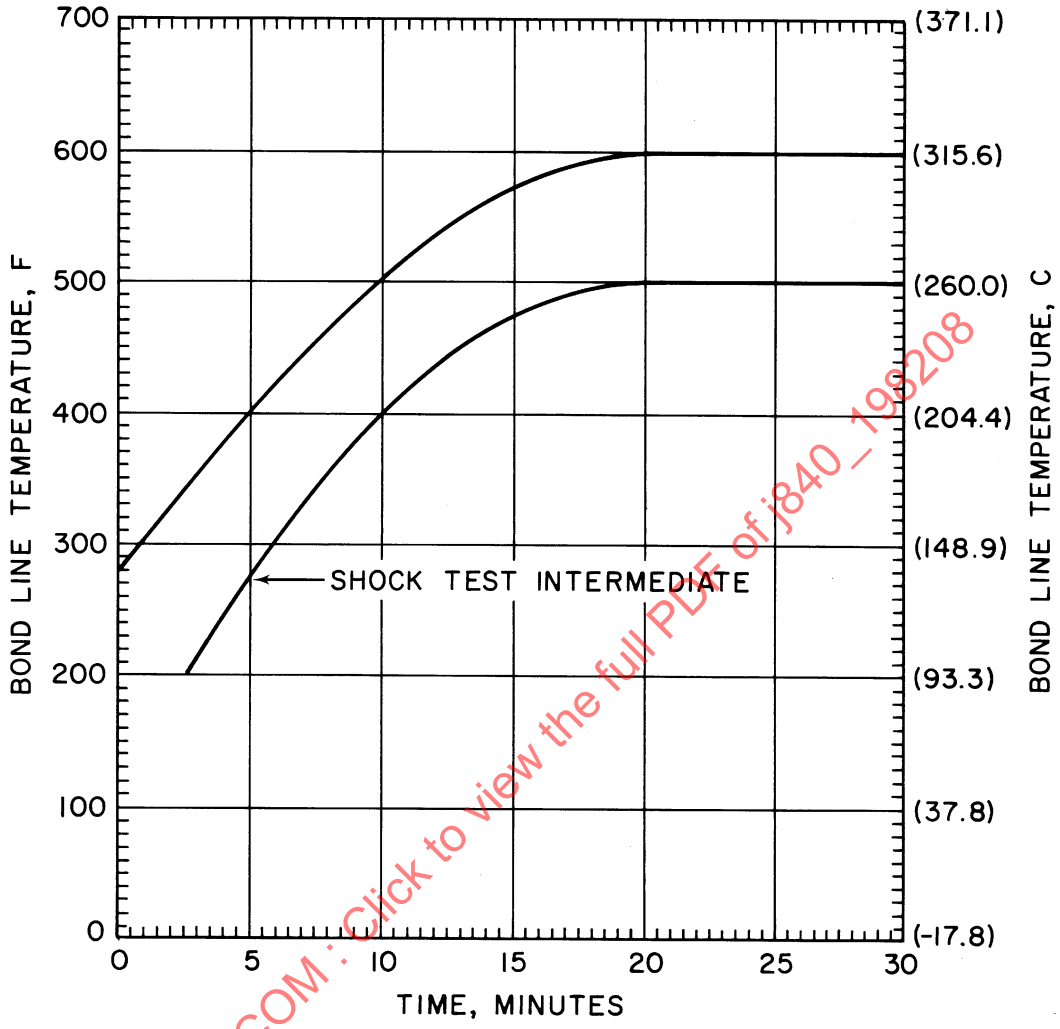
TEST NO.	BURNISH				BOND TEST				REMARKS
	SPEED	DECEL.	TEMP, MIN	STOPS	SPEED	DECEL.	TEST TEMP, AVERAGE	STOPS	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									

FIGURE 5—DYNAMOMETER TEST REPORT

3.4.3.3.5 Repeat Shock Test—Hot—Immediately after completion of Continued Heat Test in paragraph 3.4.3.3.4, repeat paragraph 3.4.3.3.1.

3.4.3.3.6 Lining Test—Shear or chisel lining from test shoes (see paragraph 4.2.3 and 4.2.4), record failing loads and/or fracture pattern.

3.4.4 Report results on the form shown in Figure 6B.



TEST NO. _____ DATE: _____

VEHICLE MAKE: _____ MODEL: _____ YEAR _____

GROSS WEIGHT: _____ BRAKE TYPE: _____

COMMENTS: _____

_____

_____

_____

_____

FIGURE 6A—ENVELOPE VEHICLE ABUSE TEST

VEHICLE ABUSE TEST OF BRAKE SHOE BOND

DATE _____
TEST NO. _____

ADHESIVE MANUFACTURER: _____

COMPOUND _____ Batch: _____

SAMPLE PREPARATION: _____

Wet Film Thickness _____ Dry Film Thickness _____

Air Dry _____ Minutes _____ Force Dry _____ Minutes at _____ F

Cure _____ Minutes at _____ F (_____ C) at approx _____ psi (_____ kg/cm^2)

VEHICLE DATA:
DRUM BRAKE OR DISC BRAKE (STRIKE OUT ONE)

	FRONT (Pri or Fwd) (Outer)	FRONT (Sec or Rev) (Inner)	REAR (Pri or Fwd)	REAR (Sec or Rev)
Size				
Lining Manufacturer				
Lining Compound				
Wheel Cyl Dia				
Drum Type				

RESULTS:

	Load at Failure	psi or kg/cm^2	Fracture Pattern Shear Test; or Fracture Pattern Chisel Test
LF (Pri or Fwd) Outer			
LF (Sec or Rev) Inner			
RF (Pri or Fwd) Outer			
RF (Sec or Rev) Inner			
LR (Pri or Fwd)			
LR (Sec or Rev)			
RR (Pri or Fwd)			
RR (Sec or Rev)			

FIGURE 6B—REPORT FORM FOR VEHICLE ABUSE TEST

4. Quality Control Tests

4.1 Material Tests

4.1.1 SCOPE—These tests are conducted on the adhesive product being used to determine its consistency within the limits established on a qualified product.

4.1.2 VISCOSITY TEST

4.1.2.1 Purpose—This is a quality control test on the bonding agent to determine its viscosity. The viscosity of an adhesive is defined as the internal friction resistance to flow. This viscosity characteristic is important in the development of application techniques.

4.1.2.2 Equipment

4.1.2.2.1 Viscometer—Variable speed, spindle type Synchro-electric viscometer.

4.1.2.2.2 Container—One quart (0.94 L) round, friction topped can, 4.5 in (114.5 mm) in diameter and 4.875 in (124 mm) high, with a 3.25 in (82.5 mm) opening.

4.1.2.2.3 Thermometer—Accurate thermometer to read in the 77 ± 1 °F (25 ± 0.5 °C) range.

4.1.2.2.4 Mixer—High-speed agitator to stir adhesive before testing.

4.1.2.3 Procedure

4.1.2.3.1 Agitate sample before testing. Amount and type of mixing to be determined and specified by adhesive supplier.

4.1.2.3.2 Adjust sample to 77 ± 2 °F (25 ± 0.5 °C).

4.1.2.3.3 Immerse spindle to proper level in adhesive and start motor.

4.1.2.3.4 The reading should be taken when the viscosity reading has stabilized.

4.1.2.4 Report—Make and model of the viscometer, the spindle manufacturer, spindle speed, temperature, viscosity reading, and scale factor.

4.1.3 SOLIDS CONTENT TEST

4.1.3.1 Purpose—This is a quality control test to determine the nonvolatile content of the adhesive. Dry film coverage is directly proportional to the solids content. The test is performed by evaporating the solvent from a sample of known weight and weighing the residue.

4.1.3.2 Equipment

4.1.3.2.1 Circulating hot air oven or vacuum oven equipped with a thermometer.

4.1.3.2.2 A 3.0 oz (85 g) ointment tin with cover 2 3/8 in (60.5 mm) in diameter.

4.1.3.3 Procedure

4.1.3.3.1 Mix sample thoroughly.

4.1.3.3.2 Weigh empty container and cover to 0.01 g.

4.1.3.3.3 As rapidly as possible, pour approximately 5 g of adhesive into the container. Replace cover on ointment tin at once. Weight accurately to 0.01 g.

4.1.3.3.4 Remove cover, heat sample in the oven at 220 ± 5 °F (105 ± 3 °C) for 30 min.

4.1.3.3.5 Reweigh sample, container, and cover to 0.01 g.

4.1.3.3.6 Calculations:

$$\frac{\text{Weight sample after heating}}{\text{Weight sample before heating}} \times 100 = \text{Total solids, \%} \qquad \text{(Eq. 1)}$$

4.1.3.4 Report—Total solids in percent, time of heating, temperature of heating, and type of oven.

4.1.4 FLOW TEST

4.1.4.1 Purpose—This test is used to determine the flow properties of the bonding agent. The flow of the dried adhesive film under bonding or curing conditions indicates its ability to wet the surfaces.

4.1.4.2 Equipment

4.1.4.2.1 Steel discs 0.250 in (6.3 mm) thick, 1.125 in (28.6 mm) in diameter, SAE 1010.

4.1.4.2.2 Steel strip 0.250 x 1.250 x 4.250 in (6.3 x 31.8 x 110.8 mm), SAE 1010.

4.1.4.2.3 SAE disc shear bonding press.

4.1.4.2.4 Alternate equipment for bonding—use spring loaded fixtures and circulating air oven.

4.1.4.2.5 Micrometer capable of measuring 0.0001 in (0.0025 mm).

4.1.4.2.6 Doctor blade (Figure 7).

4.1.4.3 Procedure

4.1.4.3.1 If the adhesive is a liquid, a dry film must be cast; if a tape, use as supplied.

4.1.4.3.2 Pour a portion of the liquid adhesive on a clean glass or metal plate covered with a polyethylene film or directly onto a polytetrafluoroethylene coated plate.

4.1.4.3.3 Draw the doctor blade (Figure 7) across the adhesive, casting a sufficiently thick wet film to give a dry film 0.008-0.010 in (0.20-0.25 mm) thick.

4.1.4.3.4 In lieu of a specific recommendation, dry 3 h minimum at room temperature or as required to obtain a smooth film. Follow by heating for 20 min at an oven air temperature of 175 ± 5 °F (80 ± 3 °C).

4.1.4.3.5 Using a circular die, cut a 0.75 in (19 mm) diameter circle from the dried film. Remove the polyethylene film. Measure the film thickness to 0.0001 in (0.0025 mm) with the spring micrometer. Use an average of five readings.

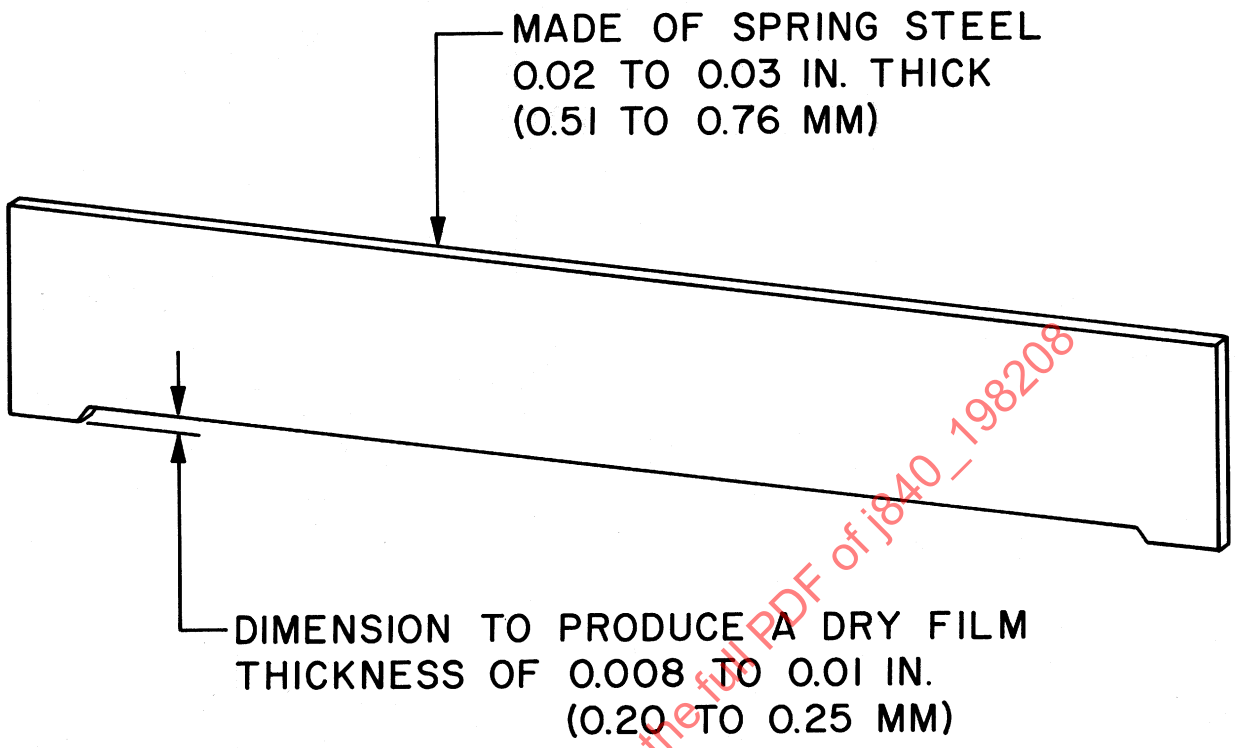


FIGURE 7—DOCTOR BLADE

4.1.4.3.6 Place a 1.125 in (28.6 mm) diameter circle of heat resistant cellophane over the center of the 0.250 x 1.125 x 4.250 in (6.3 x 28.6 x 108.0 mm) steel bar used in the Disc Shear Test. Mount the film specimen in the center of the cellophane. Cover the specimen with a second circle of cellophane 1.125 in (28.6 mm) in diameter. Use the 1.125 in (28.6 mm) steel shear disc to complete the assembly.

4.1.4.3.7 Place the assembly in the standard SAE disc bonding press (Figure 8) or in a spring loaded fixture if an oven is to be used for heating. Load to 100 psi (7.0 kg/cm^2). Heat at the recommended temperature and time cycle. In lieu of a specific recommendation, use rate as shown in Figure 9. As a supplemental test, the pressure and rate of heating could be the same as that used in paragraph 3.2.

4.1.4.3.8 Remove the assembly from the press or oven and cool to room temperature. Remove the adhesive disc from the plate.

4.1.4.3.9 Soak the disc in water to remove the cellophane.

4.1.4.3.10 Measure the new film thickness with a micrometer to the nearest 0.0001 in (0.0025 mm). Use average of five readings. As an alternate method, measure the area using a planimeter.

4.1.4.3.11 Calculate flow by:

$$\text{Flow, \%} = \frac{\text{Original thickness} - \text{New thickness} \times 100}{\text{Original thickness}} \qquad \text{(Eq. 2)}$$

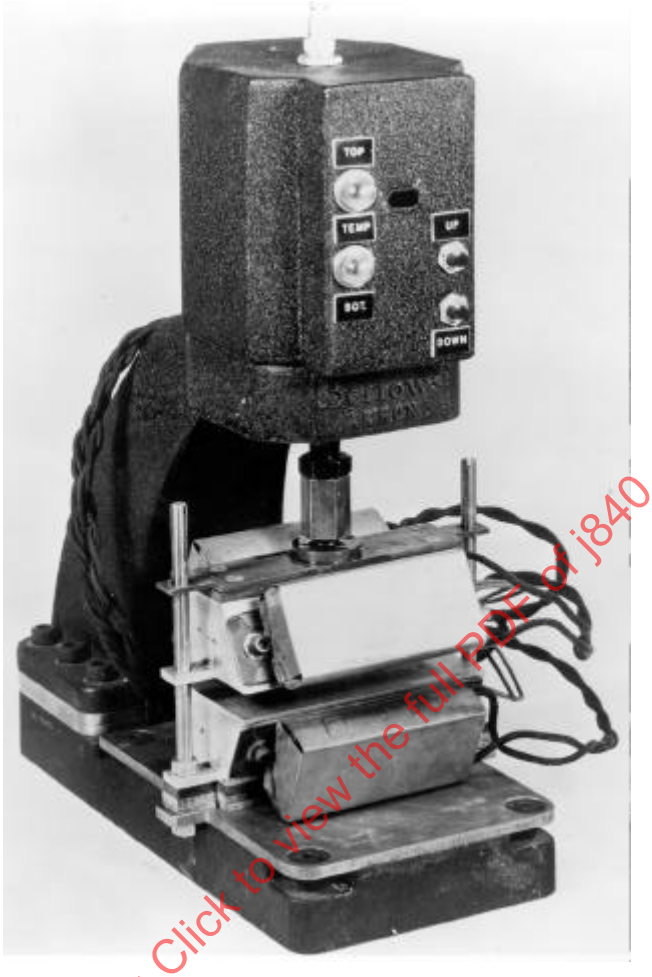


FIGURE 8—DISC SHEAR BONDING PRESS

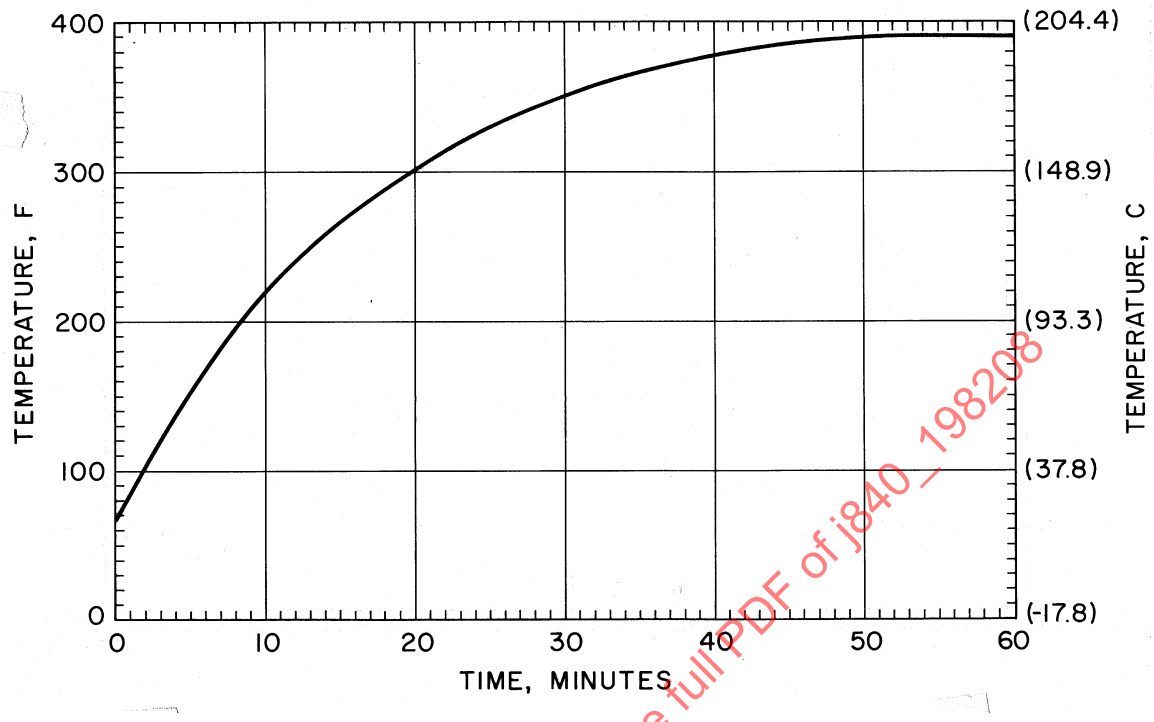


FIGURE 9—RATE OF HEATING CHANGE

4.1.4.3.12 Alternate calculation:

$$\text{Flow, \%} = \frac{\text{New area} - \text{Original area} \times 100}{\text{Original area}} \qquad \text{(Eq. 3)}$$

4.1.4.4 Report—Percent flow and method of measurement and calculation (based on thickness or area change).

4.1.5 DISC SHEAR TEST

4.1.5.1 Purpose—This test is used to determine the shear strength of an adhesive intended for bonding brake linings to brake shoes. Disc shear specimens are tested at room temperature and at elevated temperature.

4.1.5.2 Equipment

4.1.5.2.1 Testing Machine—The testing machine shall be capable of compression loading and shall be so selected that the breaking load of the specimens falls between 15 and 85% of the full-scale capacity. The testing machine shall be capable of maintaining a uniform rate of loading of 1200 psi (85 kg/cm^2) per minute. This rate of loading will be approximately obtained by a free crosshead speed of 0.05 in (1.27 mm) per minute.

4.1.5.2.2 Disc Shear Fixture—The shear fixture (Figure 10) consists of a semicircular anvil and a rectangular opening to receive the bonded test disc and strip.

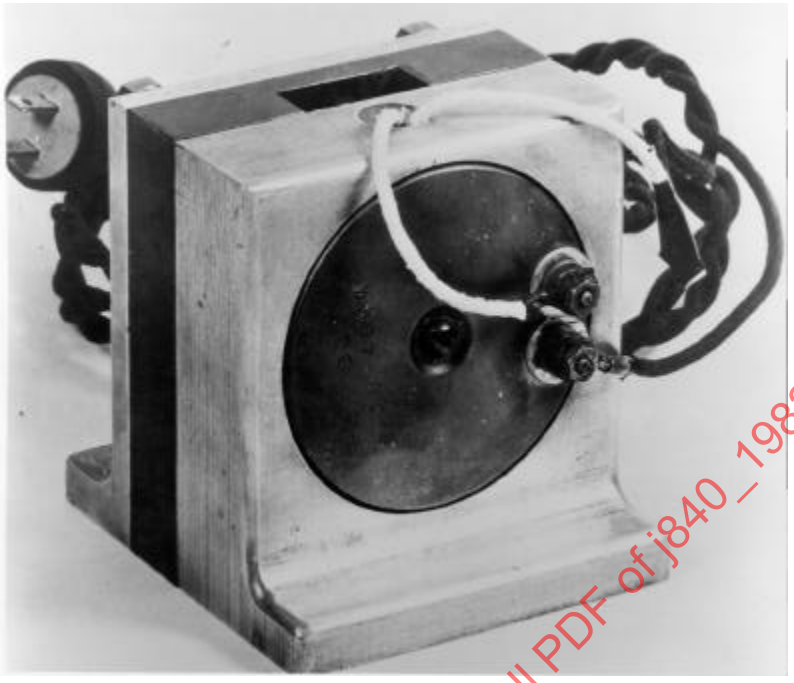


FIGURE 10—DISC SHEAR FIXTURE

4.1.5.2.3 SAE Bonding Press—A suitable press for bonding the disc shear specimens is shown in Figure 8. It consists of upper and lower heated platens and an air cylinder for applying pressure during the bonding cycle. The bonding of the disc shear specimens may be done in any suitable manner which conforms to the bonding conditions specified.

4.1.5.2.4 Test Specimens—Disc and strip specimens shall conform to the shape and dimensions shown in Figure 11.

4.1.5.3 Procedure

4.1.5.3.1 Preparation of Test Specimens—Test strips and discs shall be made of a mild steel, such as SAE 1010. Both strips and discs shall have an initial thickness of 0.252 in (6.4 mm) maximum. They shall be ground flat and parallel within 0.001 in (0.03 mm). Discs and strips may be reused by removing the old adhesive and refinishing the surfaces as described, but the thickness shall not be reduce to less than 0.240 in (6.10 mm).

The bonding surfaces of the strips and discs shall be prepared as follows:

1. Clean with a hot degreasing solvent such as trichlorethylene.
2. The surfaces to be bonded shall be finished with 180 grit aluminum oxide cloth or grit blasted. (G 40 grit has been found satisfactory.)
3. Follow with a methyl-ethyl-ketone rinse.
4. Apply adhesive to the prepared surface immediately.

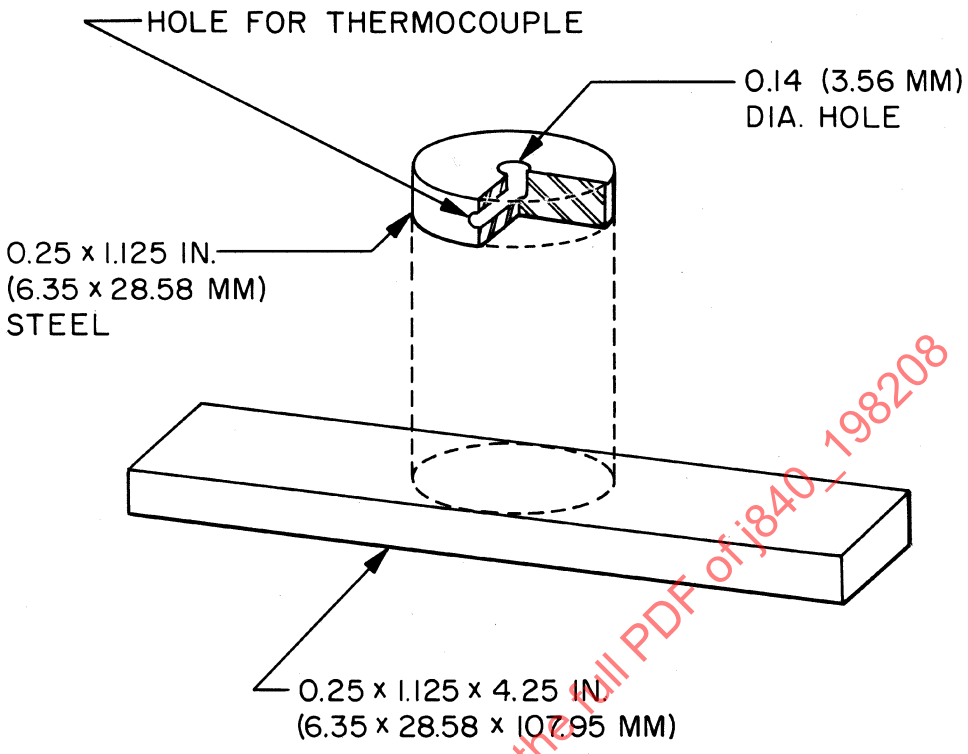


FIGURE 11—STEEL DISC AND STRIP

The adhesive shall be applied as follows:

1. If a tape adhesive is used, a 1¼ in (31.75 mm) diameter disc of adhesive shall be cut and placed between the disc and the strip. Record dry film thickness.

2. If a liquid adhesive is used, the adhesive shall be spread on the surface of the disc and the appropriate portion of the strip. The wet film thickness shall be sufficient to produce a dry film thickness of 0.002-0.003 in (0.05-0.08 mm) on each surface. The adhesive on the disc and strip shall be air dried for 3 h minimum. Follow by heating for 20 min at an oven air temperature of 175 ± 5 °F (80.4 ± 3 °C). The mating surfaces shall then be placed together.

   The bonding procedure shall be as follows. The specimens shall be bonded at the recommended temperature, pressure, and bonding time. They shall be allowed to cool to room temperature before shear testing.

4.1.5.3.2 Testing of Specimens

1. Room Temperature Shear—The bonded test specimen shall be inserted in the slot at the top of the shear fixture with the bottom of the disc resting on the semicircular anvil.
2. Elevated Temperature Shear—The shear fixture shall be heated to the specified temperature before the specimen is inserted; then the specimen shall be inserted, and when the bond line reaches the specified temperature, the load is applied. A thermocouple inserted in the disc as shown in Figure 11 is used to check temperature.