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SURFACE VEHICLE RECOMMENDED PRACTICE

An American National Standard

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Test Procedures for Brake Shoe and Lining Bonds

1. ***Scope—***This SAE Recommended Practices covers equipment and procedures for qualification of bonded or integrally molded drum and disc shoe and lining assemblies. It also provides some short, semi-quantitative test procedures for checking bonding or molding process control.

2. ***References—***There are no referenced publications specified herein.

3. ***Bond Plane Shear Test***

3.1 **Scope—**The following tests cover equipment and procedures used to verify the structural integrity of the brake shoe and lining assembly except heavy-duty brake block.

3.2 **Purpose—**The purpose of this test is to quantify lining to brake shoe shear strength by measuring the load required to cause shear failure on complete shoe and lining assemblies under new part, ambient conditions and after thermal exposure.

3.3 **Equipment—**The equipment for performing this test consists of a compression test machine, a fixture which holds the shoe firmly and a movable ram through which the shear load is applied to the lining. The compression test machine must be capable of generating a constant ram speed from zero (0) load to a load sufficient to shear the lining from the shoe. It is required that the apply rate is fixed and continuous within ±1.0mm/min (±0.04 in/min). Force measurement accuracy must be within ±1% of the failure load. Hand pump actuated rams give unreliable results and are not to be used.

3.3.1 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 0.25 to 0.51 mm (0.010 to 0.020 in) 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.

3.3.2 DISC BRAKE SHOES—Fixture (Figure 2) shall be so designed that the ram contacts the edge of the lining within 0.25 to 0.51 mm (0.010 to 0.020 in) of the shoe and conforms adequately to the lining edge contour to avoid crushing of the lining edge prior to failure. The ram shall contact the edge parallel to the long axis of the lining.

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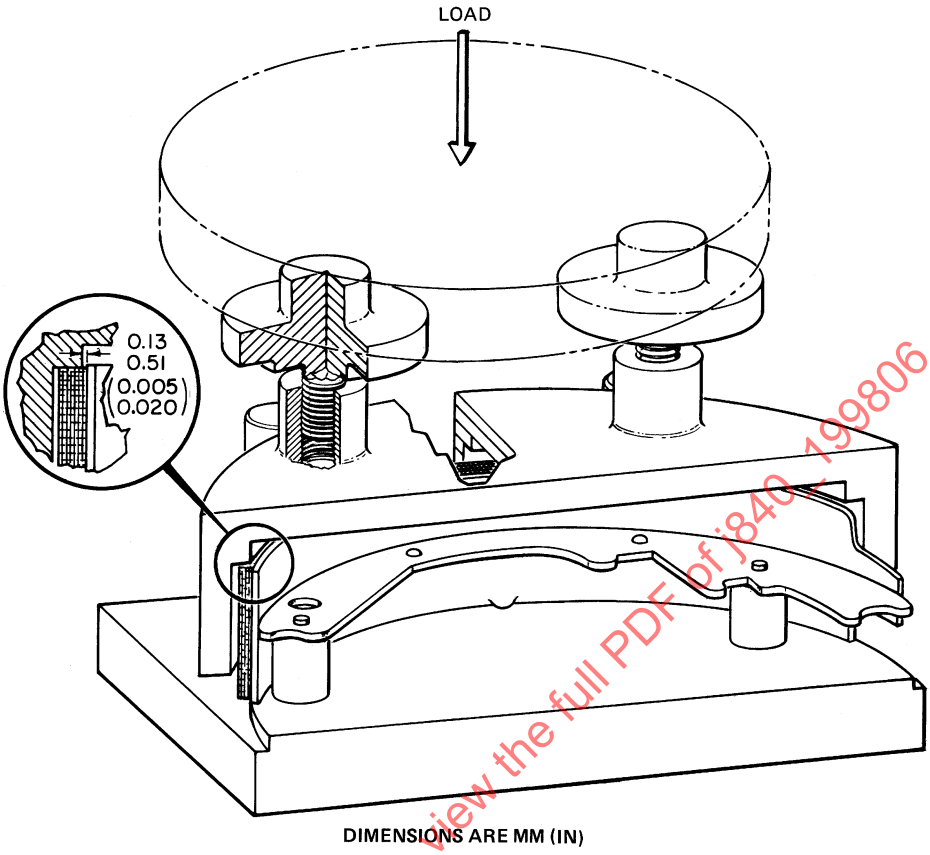

FIGURE 1—BOND PLANE SHEAR TEST—DRUM BRAKE

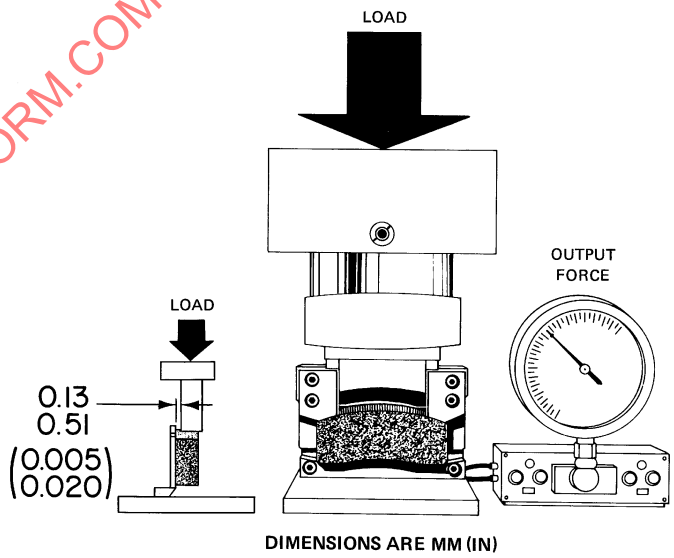

FIGURE 2—DISC BRAKE SHEAR TEST FIXTURE

3.4 Bonded Lining Shear Test Procedure (Drum and Disc)

3.4.1 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 constant rate of 10 mm ± 1 mm (0.40 in ± 0.04 in) per minute after the ram is in contact with the lining edge. Loading shall be continued until failure has occurred. Failure is defined as observable lining movement or complete shear from the shoe. If partial shear occurs, check the fixture alignment and rerun the test. The maximum load attained (e.g., Newtons or lbf) and the shear pattern (3.4.3) shall be recorded. The adhesive state-of-cure may be checked using the Cotton Tack Test (Section 4).

3.4.2 HOT DESTRUCTIVE SHEAR TEST—The brake shoe and lining assembly shall be placed in a heating fixture or oven that will bring the sample bondline to 205 °C ± 5 °C (400 °F ± 10 °F) within 30 min. When the temperature is reached, the shoe and lining assembly shall be placed in the shear test fixture and tested as in 3.4.1.

NOTE—The heating fixture may be incorporated in the shear test fixture or external to it. If heating is performed external to the shear test fixture, the bond temperature must be no lower than 190°C (375 °F) at time of shear failure. Furthermore, the sample should not be held at temperature for more than 5 min. Temperature of the bond line shall be observed by means of the bond line thermocouple shown in Figure 3A for Drum Brake and Figure 3B for Disc Brake.

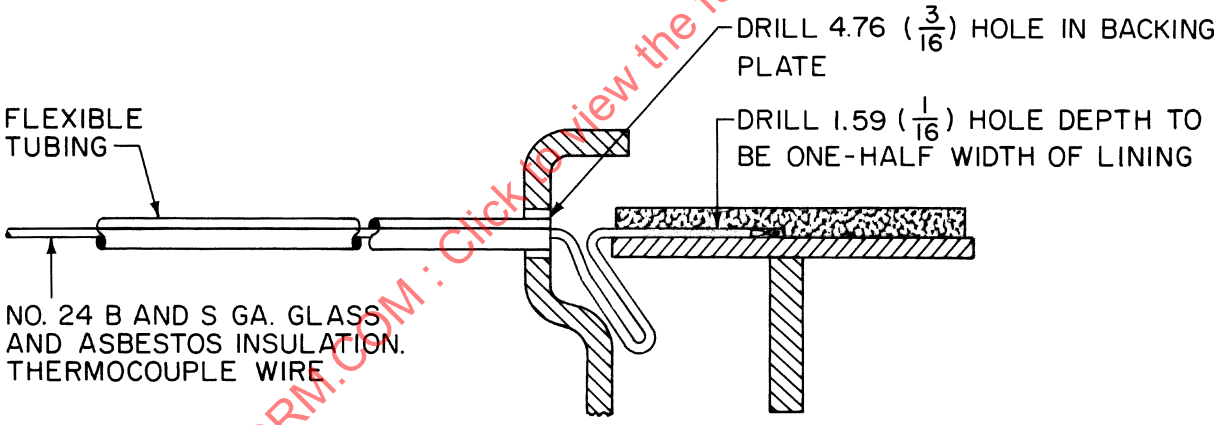

FIGURE 3A—DRAWING OF THERMOCOUPLE LOCATION—DRUM BRAKE

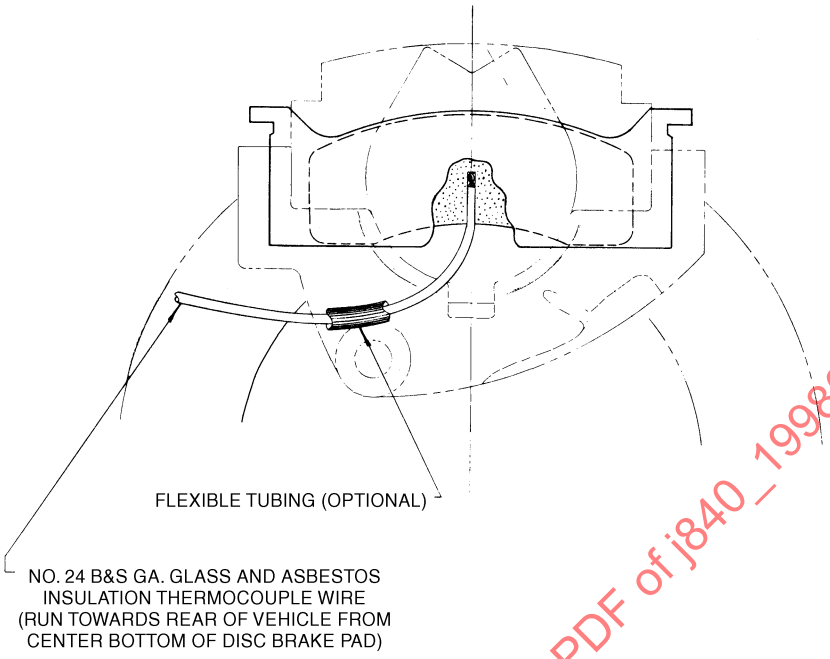

FIGURE 3B—DRAWING OF THERMOCOUPLE LOCATION—DISC BRAKE

This test is performed primarily to ensure proper cure of the adhesive. If the sample is exposed to excessive time at 205 °C (400 °F), the adhesive may be cured by the test procedure, giving invalid results.

3.4.3 REPORT, STANDARD METHOD OF REPORTING BOND FRACTURE—Figure 4 shows the 5 planes of fracture between the brake lining and the brake shoe. Each of these planes has been assigned a number form 1 to 5. The report should include the type or types of fractures encountered by indicating the appropriate number from 1 to 5, together with the relative areas of each fracture type expressed as a percentage of the total area in decreasing order (example: 60 No. 3, 30 no. 4, 10 no. 5—Note that the percent mark is not used.)

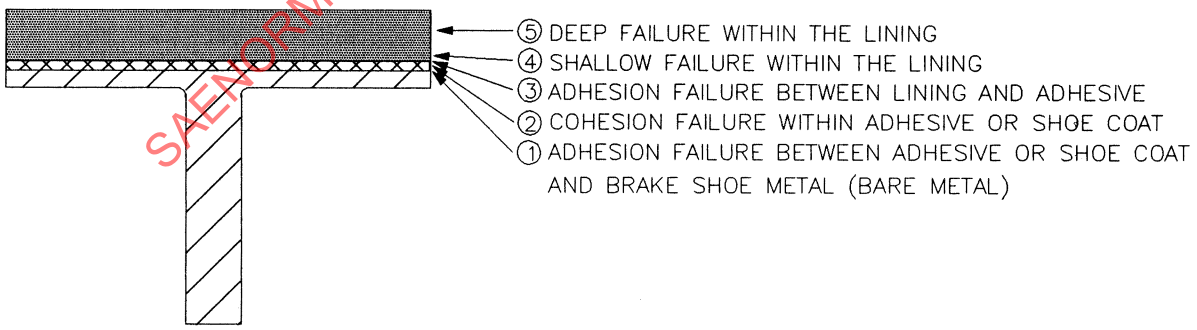

FIGURE 4—STANDARD METHODS OF BOND FRACTURE

3.5 Integrally Molded Shear Test Procedure

3.5.1 AMBIENT DESTRUCTIVE TEST PROCEDURE—The brake shoe and lining assembly shall be placed in the shear test fixture and the load shall be applied at a constant rate of 10 mm ± 1 mm (0.50 in ± 0.04 in) per minute after the ram is in contact with the lining edge. Loading shall be continued until failure has occurred. Failure is defined as observable lining movement or complete shear from the shoe. If partial shear occurs, check the fixture alignment and rerun the test.

The maximum load (e.g., Newtons or lbf) attained and the shear pattern (3.4.3) shall be recorded.

3.5.2 SHEAR STRENGTH DEGRADATION TEST—The brake shoe and lining assembly shall be placed in an oven that is preheated to the specified temperature and soaked for the specified time as listed in Tables 1 and 2. After the oven soak, remove linings and let them cool to ambient temperature before shear testing. When the shoe and linings have cooled to ambient, place in the shear fixture and shear test per 3.5.1.

TABLE 1—DRUM BRAKE

Soak Temperature	Soak Time
149 °C (300 °F)	24 h
204 °C (400 °F)	24 h
267 °C (500 °F)	12 h(1)
315 °C (600 °F)	2 h(1)

1. Optional for applications where high-operating temperatures are expected.

TABLE 2—DISC BRAKE

Soak Temperature	Soak Time
267 °C (500 °F)	24 h
315 °C (600 °F)	6 h
427 °C (800 °F)	2 h(1)
538 °C (1000 °F)	2 h(1)

1. Optional for applications where high-operating temperatures are expected.

NOTE—Soak temperatures should be selected based on the maximum temperatures expected at the lining/shoe interface during use. Low conductivity linings (organic or non-asbestos organic) typically experience lower bond line temperatures than high conductivity linings such as semi-metallics. This should be considered when selecting soak temperature for the strength degradation tests.

4. Cotton Tack Test

4.1 Purpose—This test is to determine by simple means the approximate state-of-cure of some adhesives on a fractured shoe and lining assembly. The adhesive vendor should be contacted for information on the specific solvent to use in this test. Due to the subjective nature of this test, it should be used for process control purposes but not for product qualification.

4.2 Equipment/Material—Long fiber absorbent cotton, an eye dropper, a suitable solvent, a chisel ½-in wide, a hammer, a vise, a rough cut file, a stiff wire brush, and fine emery paper.

4.3 Sample Preparation—The brake shoe and lining assembly is held in the vise and the lining removed in a lateral strip, approximately 25.4 mm (1 in) wide using the chisel. Using the file and wire brush, all traces of lining material must be removed from the area to be tested leaving the adhesive bonded to the shoe. Fine emery paper may be used to make a smooth surface of adhesive for testing. A rough adhesive surface may cause mechanical sticking of the cotton to the adhesive which will invalidate the test.

NOTE—As an alternative, the Bond Plane Shear Test (Section 3) may be used to remove the lining material from the shoe.

4.4 Procedure

4.4.1 Expose the adhesive layer as indicated in 4.3.

4.4.2 With the eye dropper, apply 2 or 3 drops of solvent.

4.4.3 While the solvent is evaporating, use a small wad of cotton to dab (not wipe) the moistened surface repeatedly at a rate of approximately 2 dabs per second, until the surface is completely dry.

4.4.4 Blow lightly on the surface to remove any stray cotton fibers which may have simply fallen onto the surface.

4.4.5 Examine the surface to determine whether any cotton remains stuck to the surface. Take care to determine if any cotton fibers remaining are stuck to the surface due to mechanical locking rather than tacky adhesive.

4.5 Report

4.5.1 If there are no cotton fibers stuck to the surface, report "no tack".

4.5.2 If there are cotton fibers stuck to the surface and it has been determined that this is not due to a rough surface, report "tack".

4.6 Interpretation of Results

4.6.1 Tack may be an indication that the adhesive is not completely cured and results should be verified by performing the State-of-Cure Test (Section 5).

NOTE—This test may not properly reflect the state-of-cure on all types of adhesive. The adhesive vendor should be contacted to determine the suitability of this test.

5. State-of-Cure Test

5.1 Purpose—This test is used to determine the state-of-cure of the adhesive of a bonded drum brake shoe and lining assembly.

5.2 Equipment—The equipment for performing this test consists of a vise, hacksaw, state-of-cure fixture shown in Figures 5 and 6, a small "C" clamp, a pyrometer with a thermocouple, and a gas burner or gas torch.

5.3 Procedure—The brake shoe shall be mounted in a vise and a 6.5 cm^2 (1 in^2) segment of lining is isolated along one edge with a hacksaw, making sure the saw reaches the bare metal of the shoe rim. Drill a hole for the thermocouple at the bondline adjacent to the saw cut. insert the thermocouple wire.

With the spring in the loaded position, the state-of-cure fixture is mounted on the shoe as illustrated in Figure 6. The sliding punch is brought to bear on the cut lining segment and secured by tightening the nuts. The fixture is then unclamped. This brings the spring load onto the edge of the lining segment.

The compressed spring length should be measured and agree with the previously calibrated length for 45.4 kg (100 lb). The "C" clamp is mounted on the spring side of the toggle clamp support and the shoe rim.

NOTE—It is not clamped tightly and is used to prevent the fixture cocking from the shoe.

Heat is now applied to the assembly at a uniform rate to permit the bond line to reach the test temperature of 204.4 to 215.6 °C (400 to 420 °F) within 45 to 60 s. A dwell at the test temperature is required for 2 to 3 min, thereby assuring the entire area is at temperature.

5.4 **Results—**If no failure occurs, the adhesive is considered to be properly cured. Incomplete cure is evidenced by any movement of the lining with respect to the shoe rim, providing the cause can be established as an adhesive failure rather than a lining failure.

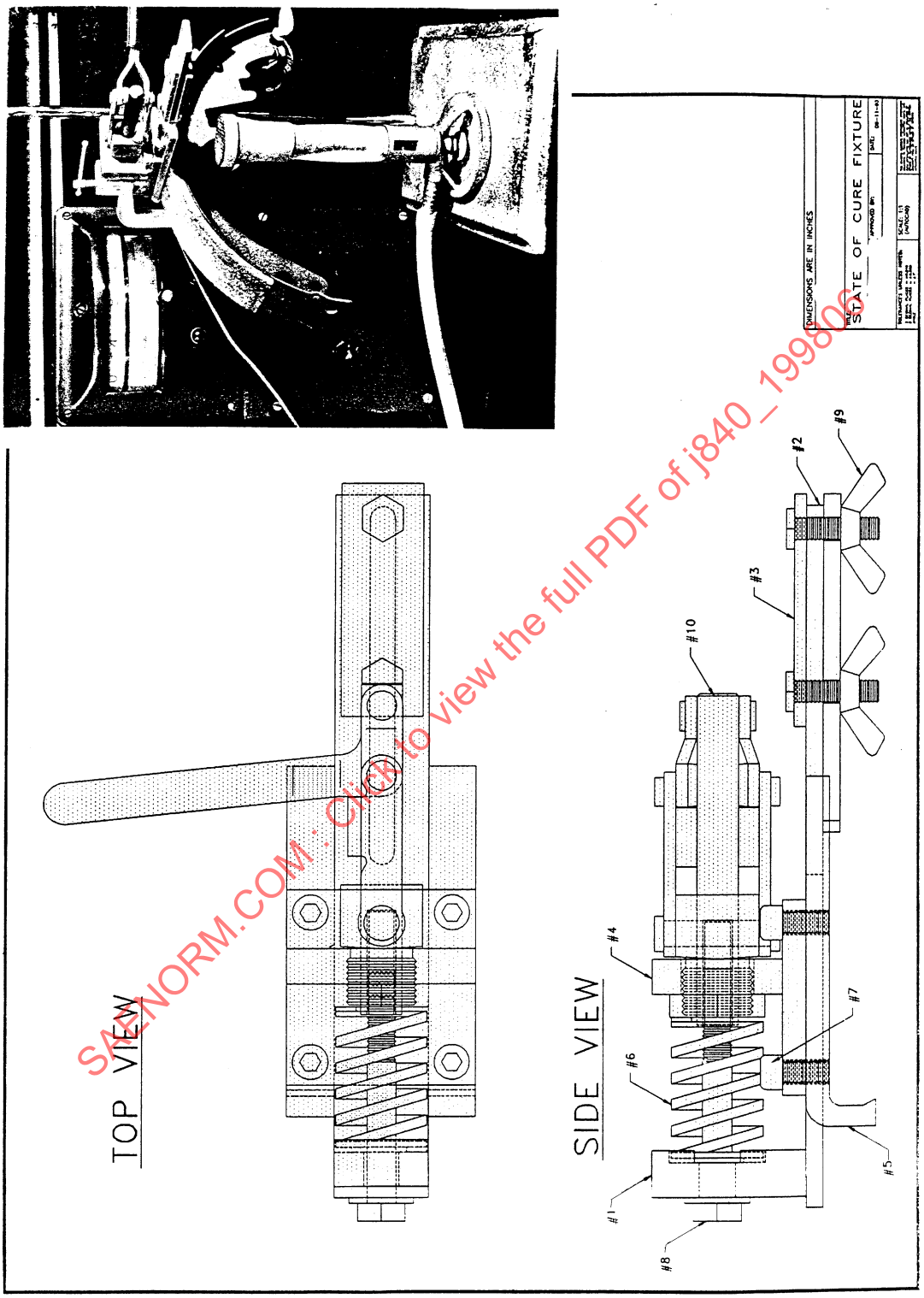

FIGURE 5—STATE-OF-CURE FIXTURE (TOP VIEW AND SIDE VIEW)