Gogan Hardness of Brake Lining – SAE J379a

SAE Recommended Practice
Last Revised May 1972

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PREPRINT

GOGAN HARDNESS OF BRAKE LINING—SAE J379a SAE Recommended Practice

Report of Brake Committee and Automotive Safety Committee approved January 1969 and last revised May 1972.

1. Purpose—To establish a uniform procedure for determining the Gogan hardness of brake lining.

2. Scope—Gogan hardness, a nondestructive (a penetrator causes shallow surface deformation) method of measuring compressibility, is used as a quality control check of the consistency of formulation and processing of brake lining. Gogan hardness alone shows nothing about a lining's ability to develop friction or to resist fade when used as a friction element in brakes. Gogan hardness varies with formulation, contour, and thickness of the lining.

The Gogan hardness and the range of Gogan hardness are peculiar to each formulation, thickness, and contour and, therefore, the acceptable values or range must be established for each formulation and part configuration by the manufacturer.

2.1 The hardness of sintered powder metal lining is usually determined with Rockwell Superficial hardness equipment. Reference ASTM B 347[1] (latest revision), Standard Method of Test for Hardness of Sintered Metal Friction Materials.

3. Equipment—A commercially available Gogan Model 911 (or equivalent) direct reading hardness testing machine is required. In this machine the flat end of a cylindrical penetrator is forced against the lining supported by a matching anvil. The Gogan hardness number is the distance, in units of 0.00025 in. (0.0064 mm) the penetrator advances into the lining, while the force on the penetrator increases from the initial or minor load to the final or major load. Two systems are used: 1500 kg or 3000 kg (14.71 or 29.42 kN) major loads with nominal 500 kg and 1500 kg (4.90 and 14.71 kN) minor loads, respectively.

3.1 The test cycle is initiated by closing an electric switch, causing the penetrator to approach and contact the lining sample and start to apply the test load. When the minor load is reached, the hardness indicator is engaged to the penetrator and the two timers that control the actual test cycle are activated. At 0.75 s (ET_1), the hardness indicator is disengaged and arrested. The major load is reached prior to the ET_1 setting, the time depending upon the hardness of the lining penetrator travel, and the force buildup in the hydraulic system. At 1.75 s (ET_2), the cycle is terminated and the machine returns to its idle position and is reset for the next test. The 1 s interval between ET_1 and ET_2 provides sufficient dwell for the operator to read the Gogan hardness dial indicator. Four test combinations are possible utilizing 1 or 0.75 in. (25.39 or 19.05 mm) diameter penetrators with either 1500 or 3000 kg (14.71 or 29.43 kN) major loads. This requires that Gogan hardness numbers be prefixed with a scale symbol representing the load and penetrator as listed in Table 1. The combination of the load and penetrator is selected to provide the greatest sensitivity with the least damage to the lining. Usually, this is accomplished when the Gogan readings fall within the ranges shown, although the desirable range will differ with formulation and the configuration of the lining, particularly its thickness and curvature.

4. Test Machine Specifications

4.1 Minor load—Nominal 500 or 1500 kg (4.90 or 14.71 kN).

4.2 Major load—1500 or 3000 kg (14.71 or 29.42 kN).

4.3 Penetrator diameter—1 or 0.75 in. (25.39 or 19.05 mm).

4.4 Split penetrator—For grooved lining, has a flat end face consisting of two semicircles, either 1 or 0.75 in. (25.39 or 19.05 mm) in diameter, spaced apart a minimum of the groove width plus 0.25 in. (6.4 mm) as shown in Fig. 1.

4.5 Timers—Reference, Gogan Machine Co., Wiring Diagram XE-1473. ET_1—0.75 s, ET_2—1.75 s.

4.6 Anvil for curved lining—Curved to minimum inside radius specified for lining. Cord length, 2 in. (50.8 mm); minimum width, 2 in. (50.8 mm).

Anvil for flat lining—Minimum 1¾ in. (44.4 mm) diameter flat.

4.7 Penetrator travel to upper surface of lining—½ ± ⅛ in. (13 ± 3 mm).

5. Operating Procedure

5.1 Position anvil in socket of anvil, adjusting screw after making sure seating surfaces are clean.

5.2 Position brake lining on anvil. Adjust backstop so that penetrator is no closer than ⅛ in. (3 mm) to edge of lining.

NOTE: The penetrator must be completely supported by brake lining with a minimum of ⅛ in. (3 mm) to any edge of the lining or groove for a valid Gogan hardness test.

A split penetrator will be used when the dimensions of the lining grooves on either side of the braking or shoe surface make it impossible to provide ⅛ in. (3 mm) clearance between the OD of the penetrator and the edge of the lining or groove.

In positioning grooved brake lining on the anvil, adjust the back stop so the groove in the lining is centered with the penetrator and rotate the anvil so the groove in the lining and the groove in the penetrator are parallel. Gogan hardness numbers taken on grooved lining with a split penetrator are prefixed with an additional symbol, "S," as in Table 1; thus, GAS, GBS, GCS, and GDS.

5.3 With square bar gage, adjust space between penetrator and top of lining to ½ ± ⅛ in. (13 ± 3 mm). Tighten adjusting screw clamping nut.

5.4 Start machine pump. Allow 2 min minimum warmup. Operate machine a few times to seat anvil and eliminate backlash of anvil screw.

5.5 Test the lining at the desired locations and note the Gogan hardness from the dial indicator.

6. Calibration Procedure

6.1 Calibrate the Gogan hardness tester in accordance with the following:

(a) Timers set as follows: ET_1—0.75 s, ET_2—1.75 s.

(b) Penetrator size—10 mm ball. Anvil size—8 in. (203.2 mm) spherical radius.

(c) Check hardness tester with standard Brinell test block.

1500 kg (14.71 kN) load:	
2.50–2.55* test block	25.1–25.5 hardness reading
2.55–2.60* test block	25.5–26.2 hardness reading
3000 kg (29.42 kN) load:	
3.20–3.25* test block	32.0–32.5 hardness reading

*Brinell indentation diameter.

6.2 Major calibration and resetting of Gogan hardness tester:

(a) If machine is out of calibration, check the major load with either a load cell or proving ring, or by Brinelling a polished steel block of known hardness and reading the impression diameter with an accurate glass. Adjust major load pressure regulating valve to obtain correct load.

(b) If major load is correct and calibration is off, adjust minor load pressure switch until indicator shows correct Gogan reading for standard Brinell test block.

TABLE 1—GOGAN HARDNESS SCALES

Scale Symbol	Major Load		Nominal Minor Load		Penetrator Diameter		Recommended Range of Gogan (G) Numbers
	kg	kN	kg	kN	in	mm	
A	1500	14.71	500	4.90	1	25.39	GA10-GA80
B	3000	29.42	1500	14.71	1	25.39	GB10-GB80
C	1500	14.71	500	4.90	3/4	19.05	GC10-GC80
D	3000	29.42	1500	14.71	3/4	19.05	GD10-GD80

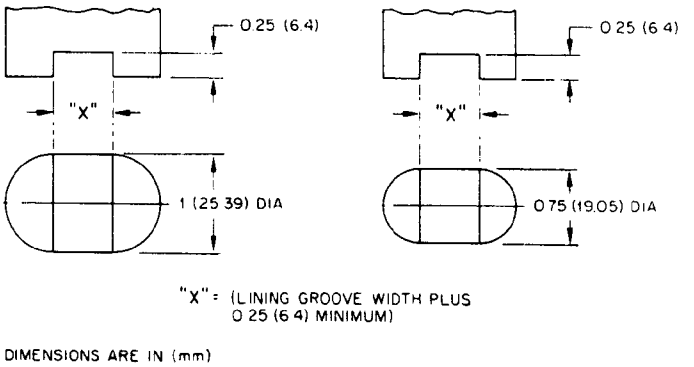

FIG. 1—SPLIT PENETRATOR END

[1]Published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.