



SURFACE VEHICLE RECOMMENDED PRACTICE

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Thermal Swell, Growth, and Hot Compressibility of Brake Friction Materials and Noise Insulators

RATIONALE

This revision recommends preconditioning per SAE J3281 to remove adsorbed moisture from the test specimen and specifies the procedure to measure hot compressibility for disc brake pads and noise insulators.

FOREWORD

The dimensional stability of friction materials when exposed to elevated temperatures is an important aspect of brake performance and an indication of the different formulation and manufacturing effects. The swell and/or growth of the friction material may create unintended contact with the rubbing surface with potential effects like brake drag, development of rotor thickness variation, or change in brake pedal feel.

1. SCOPE

This document specifies a universal method of measuring the thickness change of friction materials to determine the effects of temperature. The test applies to both disc and drum-type linings commonly used in hydraulic and air brake systems for automotive or commercial vehicle applications.

This document describes several methods for thermal swell and growth. Method A is where the friction material is in contact with a heated surface to simulate the heat input to the pad that occurs during actual usage. Method B uses an oven to heat the freestanding material and is an approximate procedure requiring less instrumentation. Method A is recommended for disc brake pad assemblies, noise insulators, or flat coupons, while Method B is recommended for curved drum brake linings.

This document also describes how to test the warmed-up disc brake pads and noise insulators for hot compressibility using Method A.

1.1 Purpose

This test procedure establishes common laboratory test methods to determine the thickness change of friction materials when exposed to elevated temperatures. The intent of this procedure is to characterize thermal swell, growth, and hot compressibility.

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2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J3079/1 Validation of Compressibility Test Systems for Friction Materials

SAE J3079/2 Low-preload Deflection Measurement for Brake Pads, Noise Shims, and Brake Pad Assemblies

SAE J3281 Desorption of Brake Friction Materials

2.1.2 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ISO 6313:1980 Road Vehicles - Brake Linings - Effects of Heat on Dimensions and Form of Disc Brake Pads - Test Procedure

2.1.3 JIS Publications

Available from Japanese Standards Association, 4-1-24, Akasaka Minato-ku, Tokyo 107-8440, Japan, Tel: +81-3-3583-8005, www.jsa.or.jp.

JIS D4416:1998 Test Procedure of Thermal Expansion for Brake Linings and Pads of Automobiles

JIS B7502:1994 Micrometer Calipers

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J2986 Brake Lining Thickness Measurement

3. DEFINITIONS

3.1 GREEN SWELL

Transient change in thickness of a friction material during the first brake heating event. The largest portion of green swell occurs when the friction material temperature is above the temperature used for curing in the manufacturing process. Green swell includes both swell and growth.

3.2 HOT COMPRESSIBILITY

The compressive deflection of friction materials, noise insulators, and disc brake pad assemblies when measured at elevated temperature.

3.3 THERMAL GROWTH

The permanent change in thickness of a friction material when returned to ambient after exposure to an elevated temperature cycle.

3.4 THERMAL SWELL

The temporary change in the thickness of a friction material due to exposure to elevated temperatures.

4. SYMBOLS

See Table 1.

Table 1 - Symbols

Symbols		Designation
z_i	z_f	Mean thickness of a test specimen, i-initial, f-final
y_i	y_f	Mean width of a test specimen, i-initial, f-final
x_i	x_f	Mean length of a test specimen, i-initial, f-final
d_i	d_f	Movement of upper platen, i-initial, f-final
t		Time

5. THERMAL SWELL, GROWTH, AND HOT COMPRESSIBILITY TEST METHOD A - HOT PLATE METHOD

5.1 Equipment (See Figure 1)

The test equipment consists of the following elements (refer to ISO 6313:1980, JIS D4416:1998, and SAE J3079/1 for additional loading systems that are allowed for this method):

5.1.1 Base and Fixtures

Includes fixtures to match the sample under test and to react to the applied forces without deformation.

5.1.2 Heating Platen

An electrically heated steel plate with facilities to mount fixtures to emulate the braking surface for each test sample.

5.1.3 Pad Assembly or Noise Insulator Locator (Not Shown in Figure 1)

Device used to ensure proper and repeatable alignment and positioning of the brake pad assembly (or noise insulator) with the piston(s) simulator, resembling the vehicle/caliper relative position of the piston(s) and the test item (brake pad assembly or noise insulator).

5.1.4 Loading System

A mechanism capable of maintaining a normal load on the test sample equivalent to $30 \text{ kPa} \pm 10 \text{ kPa}$ over the sample surface area in contact with the heating platen. For noise insulator testing, use the contact area for the intended brake pad assembly. For hot compressibility, the equipment needed to perform SAE J3079/2 is required.