SURFACE VEHICLE RECOMMENDED PRACTICE

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Superseding J1802 DEC2008

Brake Block Effectiveness Rating

RATIONALE

J1802 has been reaffirmed to comply with the SAE five-year review policy.

FOREWORD

The brake block test methodologies in this SAE Recommended Practice provide the techniques and procedures required to determine brake effectiveness for the entire range of brake blocks, whether asbestos-based, nonasbestos organic, semimetallic, or full metallic in composition. Brake effectiveness is the nondimensional measurement of braking performance. This document is intended to supersede that of SAE J661 for brake blocks. An inertia dynamometer with one reference brake assembly is utilized to determine brake effectiveness under both normal temperature and high temperature conditions. This full-sized reference brake assembly is used to characterize the effectiveness performance of complete brake assemblies, thereby eliminating the shortcomings and uncertainties inherent in the use of small brake lining specimens.

1. SCOPE

This SAE Recommended Practice provides the test procedure and methods to calculate the effectiveness of brake blocks, using an inertia dynamometer. To minimize testing variability, and to optimize standardization and correlation, a single, high volume size of brake block is specified (FMSI No. 4515E) and evaluated in a reference S-cam brake assembly of 419 mm x 178 mm (16.5 in x 7.0 in) size, using a specified brake drum.

1.1 Purpose

The purpose of this document is to establish a uniform procedure for the determination and classification of brake effectiveness for commercial vehicle brake blocks. This document will permit comparison of basic frictional properties for brake blocks. Service usage classification ratings and applicable axle load ratings are not included in this document.

2. REFERENCES

2.1 Applicable Publications

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

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
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2.1.1 SAE Publication

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

SAE J1802-1 Test Component Specification

2.1.2 FMSI Publication

Available from Friction Materials Standards Institute, 23 Woodland Road, Suite B-3, Madison, CT 06443, Tel: 203-245-8425, www.fmsi.org.

FMSI No. 4515E Drawing of 16.5 Brake Block

3. TEST PROCEDURE

This test procedure applies to a reference air brake assembly of 419 mm x 178 mm (16.5 in x 7.0 in) size that utilizes S-cam actuation, with cam rotation same as brake drum rotation. Reference Appendix A and Figure A1.

Specifications for this brake assembly and the associated component parts, including installation/assembly requirements and maintenance procedures, are specified in Appendices B and C.

Dimensional, chemical, metallurgical, and surface finish specifications and requirements for the reference brake drums are included in Appendix D.

Brake lining block grinding requirements are shown in Appendix E.

Installation and mounting requirements for the brake assembly to the dynamometer stub axle fixture can be found in SAE J1802-1. SAE J1802-1 can be obtained from SAE.

A complete parts list, which includes all components of the reference brake assembly, can be found in SAE J1802-1. SAE J1802-1 can be obtained from SAE.

3.1 Dynamometer Test Conditions

3.1.1 The dynamometer inertia is to be 1134 kg-m^2 (837 slug-ft^2).

3.1.1.1 Reference

Nominal wheel load - 4536 kg (10 000 lb)
Effective radius - 0.5 m (19.7 in)

3.1.2 Ambient temperature for the dynamometer cooling air is to be between 25 °C and 40 °C (77 °F and 104 °F).

3.1.3 Air at ambient temperature is to be directed uniformly and continuously over the brake drum during the test procedures at a velocity that when cooled from 250 °C (482 °F) and rotating at a uniform 60 rpm ± 5 rpm with no brake drag, the cooling time from 200 °C (392 °F) to 100 °C (212 °F) will be 10.0 min ± 1.0 min 30 s. If cooling characteristics are not achieved, abort test.

3.1.4 The brake drum temperature is to be measured with one thermocouple, installed at the center of the braking surface. The thermocouple hole is to be positioned within 3 to 4 mm (0.12 to 0.16 in) of the rubbing surface. Installation is per Appendix F.

3.1.5 Brake temperatures are to be within ±5 °C (±9 °F) of those temperatures as specified.

3.1.6 Brake apply pressures are to be maintained within -0 to + 15 kPa (-0 to +2.0 psi) of those pressures as specified.

3.1.7 Chamber air pressure rise rate is to be 1.50 mPa/s ± 0.3 mPa/s (220 psi/s ± 45 psi/s).

3.1.8 The maximum air pressure in the chamber is not to exceed 700 kPa (100 psi). If a specified deceleration requires pressures above the pressure limit, continue at the limit pressure and resulting deceleration until the deceleration returns or the test section is completed.

3.1.9 The brake drum temperature is increased to a specified level by conducting one or more stops from 320 rpm at a deceleration of 3.0 m/s^2 ± 0.15 m/s^2 (9.8 ft/s^2 ± 0.5 ft/s^2) and an interval of not less than 60 s, unless otherwise specified.

3.1.10 The brake drum temperature is decreased to a specified level by rotating the drum at a constant 240 rpm. Air flow rates are not to be varied during the test sequence, except during periods of measurement and inspection.

3.1.11 Adjustment

With brake fully released and the brake drum temperature less than 70 °C (158 °F), set clevis position such that the center of the pin to chamber mounting face is 69.85 mm ± 3.18 mm (2.75 in ± 0.125 in) with the brake drum temperature less then 70 °C (158 °F) adjust slack adjuster to 12.7 to 25.4 mm (0.50 to 1.0 in) of air chamber stroke at 70 kPa (10 psi), with peak brake drag less than 11.3 N·m (100 in-lb) with the brake released.

3.1.12 Brake Assembly Geometry Check

With brake, drum, and stub axle assembled, actuate brake with 35 kPa (5 psi) chamber pressure; using a 0.025 mm (0.001 in) feeler gage, confirm shoe to drum contact near shoe centers. This check is to be performed after the brake lining blocks have been ground per Appendix E.

3.1.13 All rotation speeds referenced are to be within ±10 rpm.

3.2 Brake Burnish Procedure

3.2.1 Brakes are Burnished Before Testing as Follows

Place the reference brake assembly, with new test linings (ground per the requirements of Appendix E) and a new drum on the inertia dynamometer and set up the brake as specified in Appendix A and 3.1. Make 200 stops from 320 rpm at a deceleration rate of 3.0 m/s^2 ± 0.15 m/s^2 (9.8 ft/s^2 ± 0.5 ft/s^2) with an initial brake drum temperature on each stop of 200 °C (392 °F).

3.2.2 Normal Temperature Test for Brake Effectiveness

3.2.2.1 With an initial brake drum temperature of 100 °C (212 °F), conduct a stop from 400 rpm maintaining brake chamber air pressure at a constant 70 kPa (10 psi). Record the brake output torque, and air pressure and stroke or chamber force exerted by the brake from the time the specified air pressure is reached until the brake stops. Perform this procedure at 70 kPa (10 psi), 103 kPa (15 psi), 138 kPa (20 psi), 172 kPa (25 psi), 207 kPa (30 psi), 241 kPa (35 psi), 276 kPa (40 psi), 310 kPa (45 psi), up to a maximum of 345 kPa (50 psi).

3.2.2.2 Normal Temperature Inspection

For the test to be acceptable, 90% minimum lining contact is required on all four lining blocks. If specified contact pattern is not achieved, the test is invalid.

3.2.3 Warm the brake by conducting stops from 320 rpm, at a deceleration of 3.0 m/s^2 ± 0.15 m/s^2 (9.8 ft/s^2 ± 0.5 ft/s^2), at 45 s intervals until the drum reaches 315 °C (599 °F).

3.2.4 Make 200 additional stops from 320 rpm at a deceleration of 3.0 m/s^2 ± 0.15 m/s^2 (9.8 ft/s^2 ± 0.5 ft/s^2) with an initial brake drum temperature on each stop of 300 °C (572 °F).

3.2.5 Evaluate brake drum cooling characteristics, as specified in 3.1.3, ±1 min 30 s at the completion of the burnish procedure. If cooling time from 200 °C (392 °F) to 100 °C (212 °F) is not 10 min ± 1 min 30 s, the test is to be aborted.

3.3 Hot Temperature Test for Brake Effectiveness

3.3.1 Brake Adjustment

Cool brake to a drum temperature below 70 °C (158 °F). Adjust the brake as specified in 3.1.11.

3.3.2 Warm the brake by conducting stops from 320 rpm, at a deceleration of 3.0 m/s^2 ± 0.15 m/s^2 (9.8 ft/s^2 ± 0.5 ft/s^2), at 45 s intervals until the drum reaches 315 °C (599 °F); make five additional stops from 300 °C (572 °F) initial brake temperature at 320 rpm and 3.0 m/s^2 ± 0.15 m/s^2 (9.8 ft/s^2 ± 0.5 ft/s^2) deceleration.

3.3.3 With an initial brake drum temperature of 300 °C (572 °F), conduct a stop from 400 rpm, maintaining brake chamber air pressure at a constant 70 kPa (10 psi). Record the brake output torque, brake chamber air pressure, and stroke or chamber force exerted by the brake chamber from the time the specified air pressure is reached until the brake stops.

Perform this procedure at 70 kPa (10 psi), 103 kPa (15 psi), 138 kPa (20 psi), 172 kPa (25 psi), 207 kPa (30 psi), 241 kPa (35 psi), 276 kPa (40 psi), 310 kPa (45 psi), up to a maximum of 345 kPa (50 psi).

3.3.4 Final Inspection

For the effectiveness tests to be acceptable, 90% minimum lining contact is required on all four lining blocks. If specified contact pattern is not achieved, the tests are invalid.

3.4 Effectiveness Determination

3.4.1 The brake effectiveness for this document is the nondimensional value that is calculated from the measured average brake torque output and the average torque input, using a distance based averaging method. The average torque input is the product of average chamber force and nominal slack arm length—all incompatible measurement units.

Chamber force can be obtained by using chamber calibration curves with input pressure and stroke, or measured directly using force transducers.

3.4.2 Brake effectiveness is defined as the slope of the linear regression line which describes the relationship between average output torque, as determined by this procedure, and the input average torque.

To calculate brake effectiveness, the following equation is to be used:

$$\text{Brake Effectiveness} = \frac{\Sigma XY - \frac{\Sigma X \Sigma Y}{N}}{\Sigma X^2 - \frac{(\Sigma X)^2}{N}} \qquad \text{(Eq. 1)}$$

where:

X = Average Input Torque
Y = Average Output Torque
N = Number of Stops (9 for this procedure)

3.4.3 The same interval is to be used for measuring pressure, input torque, and output torque.

3.4.4 The start of the interval is defined as the point at which the air pressure measured at the input point to the air chamber reaches the specified value.

3.4.5 The end of the interval is defined as the point at which the brake is released or 0 rpm, whichever is higher. The speed at which the brake is released shall not exceed 10 rpm.

NOTE: Some “rockback” is to be expected during 3.3.

3.5 Normal Effectiveness

3.5.1 Normal effectiveness is determined from the data developed in 3.2.2.1 and the brake effectiveness formula defined in 3.4.2, using the average brake torque values and the corresponding effective input torques.

3.6 Hot Effectiveness

3.6.1 Hot effectiveness is determined from the data developed in 3.3.3 and the brake effectiveness formula defined in 3.4.2, using the average brake torque values and the corresponding effective input torques.

4. NOTES

4.1 Marginal Indicia

A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY THE SAE TRUCK AND BUS FOUNDATION BRAKE SUBCOMMITTEE
OF THE SAE TRUCK AND BUS BRAKE AND STABILITY CONTROL COMMITTEE

APPENDIX A - REFERENCE BRAKE ASSEMBLY

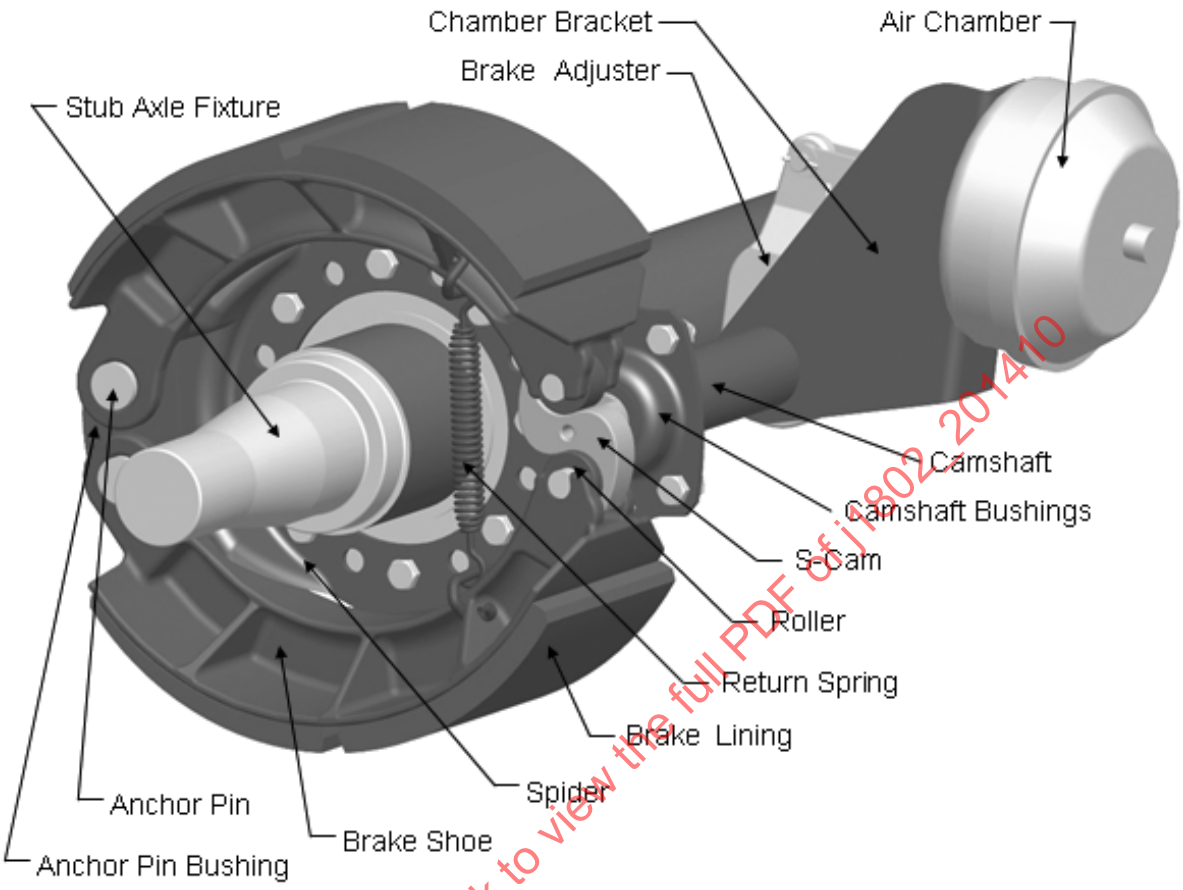

FIGURE A1 - REFERENCE BRAKE ASSEMBLY

APPENDIX B - BRAKE ASSEMBLY SPECIFICATIONS

B.1 DESIGN

Single sourced, dimensionally certified
Only certified components to be used
Test component identification must be recorded

B.2 SPIDER

Specified spindle alignment and axle mounting/assembly
Refer to Appendix A (SAE J1802/1)

B.3 CAMSHAFT

Prescribed rise rate
Hardened and ground surfaces
Minimal, restricted journal clearance
Hardnesses specified (surface, case, and core)
Strain gaging optional (for calibration checking purposes only)

B.4 AIR CHAMBER

Rotochamber type, calibrated

B.5 SHOES

Precision, pivot locations
Controlled shoe table dimensions
Bolted block attachment
Prescribed block grind as specified in Appendix E
Lining retention bolt torque: 9 to 11 N·m (80 to 100 in-lb)

B.6 SLACK ADJUSTER

137.50 mm (5.50 in) effective length
Manual design

B.7 CHAMBER BRACKET

68.75 mm (2.75 in) clevis pin to chamber mounting face

B.8 RETURN SPRINGS

Specified spring rate
Specified installed load

B.9 ANCHOR PINS

Hardened journals

B.10 ROLLERS

Hardened trunnions

APPENDIX C - MAINTENANCE GUIDELINES

C.1 CAMSHAFT AXIAL/RADIAL PLAY

C.1.1 Axial play of camshaft should be adjusted by adding/subtracting spacing washers between slack adjuster and snap ring. Maximum axial play: 0.75 mm (0.030 in).

C.1.2 Radial play of camshaft within the bushing should not exceed 0.37 mm (0.015 in) total reading. Replace and rebore bushings as necessary.

C.2 LUBRICATION

Lubricate camshaft bushings and roller ID prior to each test with an appropriate high temperature NGLI #1 grease. DO NOT apply excessive grease. Cam head and roller surface should not be lubricated. Grease shall not run onto lining during test.

C.3 BRAKE DRUM

Brake drum runout should not exceed 0.2 mm (0.008 in) total indicator reading 25.4 mm (1.0 in) from the open end of the brake drum.

C.4 LININGS

Use a new set of linings for each individual test. Linings must be ground on shoe as indicated in Appendix E.

C.5 ANCHOR PINS/ROLLERS

Check anchor pins and rollers for flat spots. Replace as necessary.

C.6 RETURN SPRING

Replace return spring if installed load is greater/less than 2.3 kg (5.0 lb) from that specified.

C.7 AIR CHAMBER

Check air chamber calibration every 12 tests. Replace if output force varies more than 1% from previous calibration.

C.8 SLACK ADJUSTER

Position slack so that clevis pin is located at 68.75 mm ± 1.55 mm (2.75 in ± 0.062 in) from air chamber mounting face. If clevis hole elongates, allowing greater than 1.50 mm (0.060 in) movement, replace components as necessary.