SURFACE VEHICLE RECOMMENDED PRACTICE	J3006	OCT2014
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Low-duty Inertia Dynamometer Hydraulic Brake Wear Test Procedures for Vehicles Above 4536 kg (10 000 lb) of GVWR

RATIONALE

Certain vehicle applications (like flat-bed recovery vehicles) have driving patterns which are considered light-duty with (a) friction material temperatures remaining under 232.0 °C (450 °F) 2.03 to 2.54 mm (0.08 to 0.1 inch) below the braking surface for at least 90% of the time, and (b) brake applications which require 2690 kPa (390 lbf/in²) or less of hydraulic pressure. This Recommended Practice provides two inertia-dynamometer test procedures, which are repeatable and cost-effective to assess, screen, benchmark, troubleshoot, or fingerprint a given foundation brake regarding low-duty brake wear. The first procedure (or Method A) is a wear versus temperature test from 93.0 to 427.0 °C (200 to 800 °F) to determine if there are potential wear rate issues under low temperature conditions and a low-duty driving cycle. If deemed required after the initial wear versus temperature test (Method A), or upon direct customer request, the second procedure (or Method B) provides an extensive wear test at a constant temperature of 79.0 °C (175 °F) to determine the wear rates and behavior of the friction couple. Data from this Recommended Practice may be combined with other brake system and vehicle characteristics for a comprehensive product characterization program.

Since other wear test procedures cover a different (higher) range of operating temperatures, kinetic energies, and levels, the accelerated wear rate behavior of certain friction materials under low-duty regimes is not properly determined or estimated using test conditions which can affect the transfer layer behavior. The wear test method implemented in this Recommended Practice was derived from prior field testing and correlation investigation. Hence, careful attention was given to not alter the sequence and test conditions which have demonstrated correspondence to the vehicle behavior.

The SAE Truck and Bus Hydraulic Brake Committee considers laboratory test procedures useful in supporting harmonization to improve the overall performance, durability, and safety of motor vehicle braking systems using relevant and cost-effective protocols.

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1. SCOPE

This Recommended Practice is derived from OEM and tier-1 laboratory tests and applies to two-axle multipurpose passenger vehicles, or trucks with a GVWR above 4536 kg (10 000 pounds) equipped with hydraulic disc or drum service brakes. Before conducting testing for a specific brake sizes or under specific test conditions, review, agree upon, and document with the test requestor any deviations from the test procedure. Also, the applicable criteria for the final test results and wear rates deemed as significantly different require definition, assessment, and proper documentation; especially as this will determine whether or not Method B testing is needed.

This Recommended Practice does not evaluate or quantify other brake system characteristics such as performance, noise, judder, ABS performance, or braking under extreme temperatures or speeds. Minimum performance requirements are not part of this recommended practice. Consistency and margin of pass/fail of the minimum requirements related to wear rates and wear behavior can be assessed as part of the project in coordination with the test requestor.

NOTE: This Recommended Practice uses the unit conversion and rounding techniques from the NIST Special Publication 811. This to ensure the use of standard conversion factors and to determine the appropriate number of significant digits to ensure the Rounding Error (RE) of the converted unit is smaller than or similar to the RE of the original English or Imperial unit.

1.1 Purpose

The purpose of this procedure is to assess wear levels and wear rates at different brake temperatures or at fixed temperature with extended wear cycles during conditions that correspond to low-duty braking using single-ended inertia dynamometer tests.

2. REFERENCES

2.1 Related Publication

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

2.1.1 NIST Publications

Available from NIST, Gaithersburg, MD 20899, http://physics.nist.gov/cuu/pdf/sp811.pdf

NIST Special Publication 811; 2008 Edition - Guide for the Use of the International System of Units (SI)

Besides internal or proprietary information or requirements, no other publications constitute a required part of this document.

3. DEFINITIONS

3.1 APPARENT FRICTION FOR DISC BRAKES

Per Equation 1:

$$\mu = \frac{k_1 \cdot T}{2 \cdot (p - p_{threshold}) \cdot A_p \cdot r_{eff} \cdot \eta} \qquad \text{(Eq. 1)}$$

where:

μ = apparent friction for disc brakes. [unitless]

3.2 DRUM BRAKE EFFECTIVENESS (C*)

Per Equation 2:

$$C^* = \frac{k_1 \cdot T}{(p - p_{threshold}) \cdot A_p \cdot R_{eff} \cdot \eta} \quad \text{(Eq. 2)}$$

where:

$C*$ = effectiveness for drum brakes. [unitless]

T = output torque. [N·m], [lb·ft]

p = brake pressure. [kPa], [lbf/in²]

$p_{Threshold}$ = minimum pressure required to start developing braking torque. [kPa], [lbf/in²]

A_p = total piston area acting on one side of the caliper for disc brakes; total wheel cylinder area for drum brakes [mm²], [in²]

R_{eff} = radial distance from centerline of the piston to the axis of rotation for disc brakes; internal drum diameter divided by 2 for drum brakes, unless other dimensions are provided by the requestor. [mm], [in]

η = Brake efficiency ÷ 100 [unitless]

k_1 = Unit conversion factor; k_1 = 1x10^6 for SI units; and k_1 = 12 for English units

3.3 BRAKE CORNER

Assembly of the foundation brake including friction material, caliper or wheel cylinder assembly with mounting hardware, brake rotor or drum, and wheel hub assembly excluding wheel and tire.

3.4 BRAKING FORCE DISTRIBUTION

Ratio between the braking force of each axle and the total braking force for the vehicle, expressed as a percentage for each axle (e.g. 50% front, 50% rear). For the decelerations of interest in this procedure, the total braking force distribution between the front and the rear axle is a function of the corresponding brake sizes, tire sizes, and the coefficient of friction (or brake effectiveness for drum brakes).

3.5 BREAKAWAY AND SUSTAINED ROTATIONAL TORQUE

Torque required to initiate brake rotation and measured for one complete revolution, measured 30 seconds after releasing any pressure acting on the brake.

3.6 DECELERATION-CONTROLLED BRAKE APPLICATION

Inertia-dynamometer control algorithm which adjusts brake pressure in real time to maintain a constant torque output calculated from the instantaneous deceleration specified in the test procedure.

3.7 PRESSURE-CONTROLLED BRAKE APPLICATION

Inertia-dynamometer control algorithm that maintains a constant input pressure to the brake irrespective of the torque output.

3.8 TORQUE-CONTROLLED BRAKE APPLICATION

Inertia-dynamometer control algorithm which adjusts brake pressure in real time to maintain a constant torque output independently from the instantaneous deceleration.

3.9 INITIAL BRAKE TEMPERATURE – IBT

Brake rotor (or drum) temperature at the start of the service brake application. [°C], [°F]

3.10 GROSS VEHICLE WEIGHT RATING – GVWR

Maximum vehicle weight declared by the vehicle manufacturer. [kgf], [lbf]

3.11 GROSS AXLE WEIGHT RATING – GAWR

Maximum axle sprung weight declared by the manufacturer. When multiple axle component ratings are available instead of a unique value for the axle, use the lowest rating declared. [kgf], [lbf]

3.12 LIGHTLY LOADED VEHICLE WEIGHT – LLVW

Unloaded vehicle weight plus 227.0 kg (500 lbf) (including driver and test instrumentation). [kgf], [lbf]

3.13 TIRE DYNAMIC ROLLING RADIUS

Equivalent tire radius that generates for a specific tire size the revolutions-per-mile published by the tire manufacturer. Use Equation 3 for SI units and Equation 4 for English units. Use the tire dynamic rolling radius to calculate the dynamometer rotational speed for a given linear vehicle speed and the test inertia.

SI units $$Rdyn = \frac{1\,609\,344}{2 \cdot \pi \cdot RevolutionsPerMile}$$ (Eq. 3)

English units $$Rdyn = \frac{63\,360}{2 \cdot \pi \cdot RevolutionsPerMile}$$ (Eq. 4)

where:

R_{dyn} = tire dynamic rolling radius. [mm] using Equation 3; [in] using Equation 4

Revolutions Per Mile = tire manufacturer specification for revolutions per mile. Typically shown for the tire size on the manufacturer's website

3.14 WHEEL LOAD

Portion of the total vehicle weight braked by the tested corner. Wheel load is a function of the vehicle load condition (LLVW or GVWR) and the brake force distribution per item 3.4. Unless otherwise specified, use 25% of the GVWR. [kg], [lb]

3.15 TEST INERTIA

Mechanical or simulated (electrical) inertia to replicate the rotational energy input as a function of the reflected wheel load braked by the corner and the tire dynamic rolling radius using Equation 5. [kg·m²], [lbf·ft²]

$$I = k_2 \cdot W \cdot {R_{dyn}}^2$$ (Eq. 5)

where:

I = test inertia. [kg·m²], [slug·ft²]

k_2 = unit conversion factor. k_2= 1 for SI units. k_2= 2.16 x 10^{-4} for English units

W = wheel load per item 3.14

R_{dyn} = tire dynamic rolling radius per item 3.13

3.16 SNUB

A service brake deceleration from a higher reference speed to a lower reference speed equal to or greater than 5 km/h (3.1 mph).

3.17 STOP

A service brake deceleration from a higher reference speed to a lower reference speed equal to or lower than 0.8 km/h (0.5 mph).

4. TEST CYCLE

4.1 Dynamic Brake Application

Figure 1 illustrates the main time-stamps used to characterize the brake application.

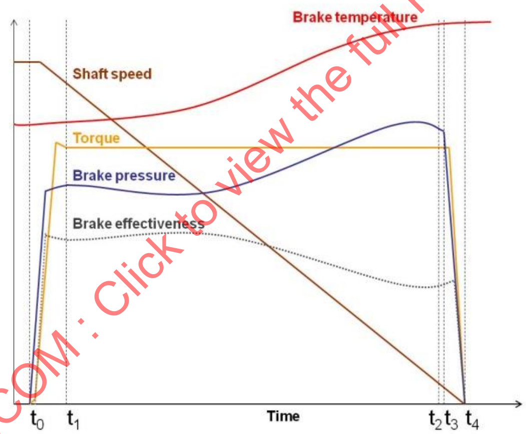


FIGURE 1 – TYPICAL BRAKE APPLICATION TIME STAMPS

4.2 Time t_0

Brake application initiation. At this time, the pressure starts to rise.

4.3 Time t_1

Time at level reached. At this time, the brake reaches its target level for deceleration, pressure, or torque control. At time t_1, the calculation of average-by-time and the average-by-distance begins.

4.4 Time t_2

Time at the end of the averages. At time t_2, the inertia-dynamometer data acquisition system terminates the calculation of average-by-time and average-by-distance. Time t_2 is the end of the stable portion of the brake application. t_2 is defined as the time at which speed is 0.5 km/h above the release speed (t_3).

4.5 Time t_3

Time at dynamometer release speed. At time t_3, the inertia-dynamometer servo controller releases the brake.

4.6 Time t_4

Time at brake pressure and torque lost and there is no measurable braking force. At time t_4, pressure and torque are below the minimum thresholds. The inertia-dynamometer considers the braking event complete and the foundation brake is fully released.

5. TEST EQUIPMENT

Single-ended brake inertia-dynamometer capable of performing deceleration-, pressure-, and torque-controlled brake applications, and capable to accelerate from zero to 450 revolutions per minute in 60 seconds or less.

5.1 Automatic data acquisition system capable of recording digitally the following channels at 200 Hz minimum:

5.1.1 Brake equivalent linear speed. [km/h], [mph]

5.1.2 Brake input pressure. [kPa], [lbf/in^2]

5.1.3 Brake output torque. [N·m], [lbf·ft]

5.1.4 Brake fluid displacement, if available. [mm^3], [in^3]

5.2 Automatic data collection system capable of recording digitally the following channels at 50 Hz minimum:

5.2.1 Brake rotor (or drum) temperature. [°C], [°F]

5.2.2 Brake pad(s) or brake shoe(s) temperature (optional). [°C], [°F]

5.2.3 Cooling air temperature (optional). [°C], [°F]

5.2.4 Cooling air relative humidity (optional). [%RH]

5.2.5 Cooling air speed or flow. [km/h], [ft/s], [m^3/min], [ft^3/min]

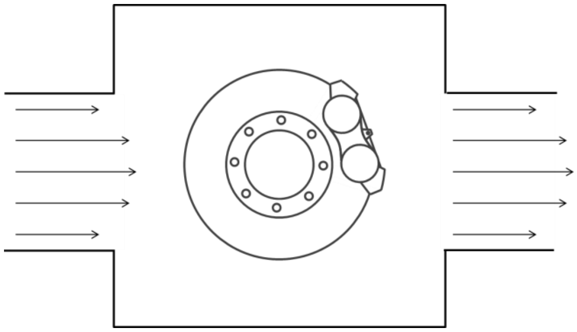
5.3 Global (continuous) data recording for the entire duration of the test (including brake-off operation) at 2 Hz.

6. TEST CONDITIONS

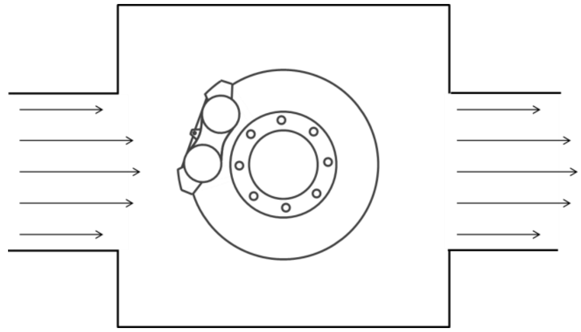
6.1 Use vehicle-specific hardware and components to fabricate the corresponding brake fixture. The fixture design and mounting on the inertia-dynamometer need to reflect as close as feasible in-service condition.

6.2 Unless otherwise specified, control cooling air temperature to 24.0 to 38.0 °C (75 to 100 °F) when a cooling air temperature control system is available.

6.3 Cooling air speed shall be 40 km/h ± 3.2 km/h (25 mph ± 2 mph) and directed uniformly and continuously over the brake assembly. Unless otherwise specified by the test requestor, direct the cooling air onto the rotor (opposite side of the caliper assembly) per Figure 2(a). Indicate on the test report the actual brake orientation relative to the incoming airflow used for the test. For drum brakes, there is no relative orientation required for the incoming cooling air.



(a) Airflow onto to the rotor (opposite to the caliper)



(b) Airflow onto the caliper

FIGURE 2 – COOLING AIR FLOW DIRECTION RELATIVE TO CALIPER POSITION

6.4 Control the initial brake temperature to within 3 °C (6 °F) of the target temperature for the brake application.

6.5 If the initial brake temperature is below the required temperature, conduct warm-up stops at 48 km/h (30 mph) at a deceleration rate of 1.2 m/s² (4 ft/s²), with cooling air speed below 5 km/h (3 mph). Count the warm-up stops as part of the main wear section so they do not add to the total stop count (nor towards brake kinetic energy or brake power) of the test. In case the target temperature is not achieved in 20 brake applications, interrupt the test and conduct a thorough inspection of the test setup, the data collection system, and the actual thermocouple installation.

6.6 Limit hydraulic pressure to whichever is lower, 15 860 kPa (2300 lbf/in²), or the value indicated by the test requestor or the foundation brake manufacturer.

6.7 Limit maximum torque to a deceleration level equivalent to 9.81 m/s² (32.2 ft/s²) based upon wheel load per item 3.12 and tire dynamic rolling radius per item 3.13.

6.8 Unless otherwise specified by the test requestor, control the hydraulic pressure ramp rate to (3450 kPa/s ± 170 kPa/s; (500 psi/s ± 25 psi/s).

6.9 For constant pressure applications are requested, control hydraulic pressure to within ±345 kPa (± 50 lbf/in²) or to within 10% of the target value, whichever is smaller.

6.10 For constant deceleration stops, during the stable part of the brake application, control deceleration within ±0.15 m/s² (±0.5 ft/s²) of the target value.

6.11 Control brake speed to within ±1.61 km/h (±1 mph).

6.12 Unless otherwise indicated on Tables 2 and 3, conduct brake stops with a release speed for all service brake applications is 0.8 km/h (0.5 mph).

7. TEST PARTS PREPARATION AND TEST SETUP

7.1 Thermocouples Installation for Disc Brakes

7.1.1 Install the control thermocouple for the IBT per item 3.9 on the centerline of the inner friction ring of the brake rotor, located 3.20 mm (0.125 inch) below the outside diameter per Figure 3.

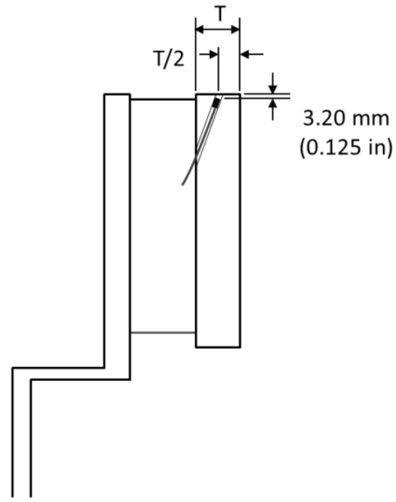


FIGURE 3 – PLUG-TYPE THERMOCOUPLE FOR BRAKE ROTOR

7.1.2 Install a thermocouple on the inner pad 2.3 mm (0.090 inch) below the friction surface. Locate the thermocouple along the centerline of the friction surface in the radial direction, and approximately in the mind-point between the centerline of the pad and the leading edge in the tangential direction.

7.1.3 Install a thermocouple on the outer pad 2.3 mm (0.090 inch) below the friction surface. Locate the thermocouple along the centerline of the friction surface in the radial direction, and approximately in the centerline of the pad in the tangential direction.

7.1.4 For center-grooved or split pads, locate the thermocouples following items 7.1.2 and 7.1.3 and 3.0 to 6.1 mm (0.12 to 0.24 inch) from the edge of the groove.

7.1.5 If a second thermocouple is requested, install on the inner pad a second thermocouple 4.0 mm (0.16 inch) below the ground surface at the beginning of the test and within 25.4 mm (1 inch) of the first thermocouple and at the same radial position. If requested, install additional thermocouples on the outer pad.

7.2 Thermocouples Installation for Drum Brakes

7.2.1 Install the control thermocouple for the IBT per item 3.9 on the mid-point of the braking surface 3.20 mm (0.125 inch) below the braking surface of the drum. For single web shoes, offset the thermocouples on the brake shoe by 12.7 mm (0.5 inch) from the web and on the inboard side of the drum.

7.2.2 Install one thermocouple on the most heavily loaded shoe, 2.3 mm (0.090 inch) below the ground surface.

7.2.3 If a second thermocouple is requested, install on the most heavily loaded shoe a second thermocouple 4.0 mm (0.16 inch) below the ground surface at the beginning of the test within 25.4 mm (1.0 inch) of the first thermocouple, along the same circle for drum brakes, and towards the wheel cylinder end of the shoe. If requested, install additional thermocouples on the trailing brake shoe per this item.

7.3 Unless otherwise specified by the test requestor, use new friction material and rotor (or drum) for each test.

7.4 Wear Measurement for Disk Brakes

7.4.1 Measure and record pad thickness at eight positions equally distributed along the periphery of the friction surface in contact with the rotor and approximately 6.4 mm (0.25 inch) from the edge per Figure 4. Use the nomenclature indicated for proper alignment of measurement positions among inner and outer pads.

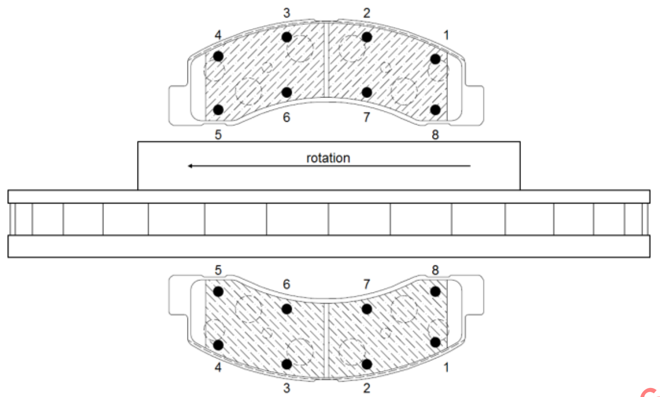


FIGURE 4 – WEAR MEASUREMENT POSITIONS FOR DISC PADS

7.4.2 Measure and record rotor thickness at three radial positions: 10.0 mm (0.4 inch) from the inner diameter of the braking surface, at the centerline of the braking surface, and 10 mm (0.4 inch) from the outer diameter. Measure at three positions equally distributed along the braking surface at 120 degrees ± 10 degrees intervals for a total of nine positions.

7.5 Wear Measurement for Drum Brakes

7.5.1 Measure the friction material thickness at 12 equally-distributed positions along the arc covered by the friction material, six on each side of the shoe and approximately 6.4 mm (0.25 inch) from the edge. Label the positions 1 to 12. Position 1 will be the first position on the inner side (chassis side or drum open side) of the brake and on the wheel cylinder end of the shoe; typically located at the 12 o'clock position. Position 12 will also be on the wheel cylinder end of the shoe on the outer side (wheel side or drum flange side) of the brake. See Figure 5.

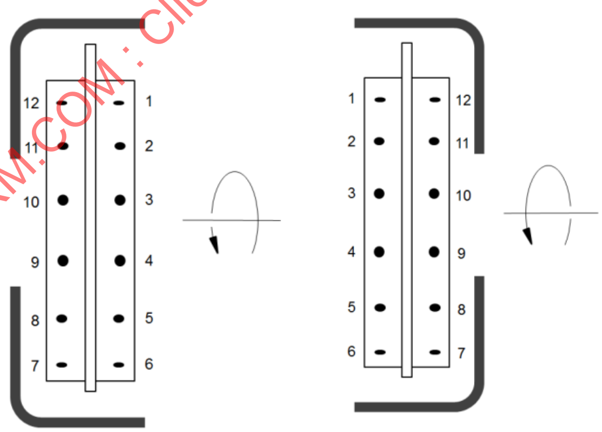


FIGURE 5 – WEAR MEASUREMENT POSITIONS FOR DRUM BRAKES
– (A) LEADING SHOE; (B) TRAILING SHOE

7.5.2 Measure and record drum thickness 25.4 mm (1 inch) from the inner edge of the drum at three positions equally distributed along the braking surface at 120 degree ± 10 degree intervals. Alternatively, measure the diameter of the drum at the same clock and axial positions locations.

7.6 Measurement of Surface Finish

7.6.1 Measure and record rotor surface finish on both sides and in the radial direction near the center positions per item 7.4.2. Take three readings at each position and report the average. Unless otherwise specified, use a stroke cutoff of 0.762 mm (0.03 inch) and a 5 µm single-skidded stylus. For coated rotors, use the appropriate solvent (like wheel cleaner) to remove the coating before taking the surface finish measurements.

7.6.2 Measure and record drum surface finish in the axial direction near the wear measurement positions per item 7.5.2. with a stylus per item 7.6.1.

NOTE: Unless allowed by the test requestor, do not use rotors or drums with a surface finish higher than 3.05 µm (0.12 mil) (Ra).

7.7 (Optional) Weigh to the nearest hundredth of a gram, and record to the nearest tenth of a gram each brake pad (or brake shoe) before every section and after the test completes. Use shop vacuum or alternatively blow clean the parts with low-pressure shop air using appropriate respiratory protection.

7.8 Weigh the rotor (or drum) before and after the test per item 7.9.

7.9 Unless otherwise requested, take digital pictures as follows:

7.9.1 A photograph of the initial setup should be acquired in such a manner so that the caliper size and type (or wheel cylinder size and configuration) can be readily identified.

7.9.2 Take photographs of the friction material at the start and end of testing. They should be photographed in such a manner so that the friction face can be identified. Any anomalies during testing are to be photographed. Anomalies would include edge chipping, surface cracks, delaminating, banding, excessive wear imbalance or taper wear, etc.

7.9.3 Take photographs of the rotor (or drum) at the start and end of testing. Any anomalies found during the inspections should be photographed and documented for the condition and the test section. Anomalies might include bluing, heat checking or cracking, hot spots, excessive lining transfer, thermal banding, etc.

7.10 During all phases of the procedure document and report any operational anomalies such as noise, unusual odor, vibration, fire or smoke, etc. Take photographed if possible.

7.11 Additional Verification for Disc Brakes

7.11.1 Assure that disc mounted lateral run-out and rotor thickness variation are within specifications for the application.

7.11.2 The assembled lateral run-out (unless otherwise specified) shall not exceed 125 µm (0.005 inch) when measured 10 mm (0.4 inch) from the outside diameter on the outboard surface.

7.11.3 The maximum rotor thickness variation (unless otherwise specified) shall not exceed 50 µm (0.002 inch) when measured 10 mm (0.4 inch) from the outside diameter.

7.12 Assemble and adjust the brake corner (including torque plates or fasteners which ensure the structural integrity of the brake fixture) per the vehicle (or the brake manufacturer) recommended sequence, torque settings, lubrication, running clearances, etc.

7.13 Mark bolt head, pin flange, and caliper ear with torque seal (or other method) to identify bolt head-to-pin flange location, and pin-flange-to-caliper ear location before each cycle.

7.14 At the end of each section, record if any of the torque seals have been broken or the bolt or pin has rotated.

NOTE: Do not use pulse or impact tools to tighten caliper pin bolts

7.15 Lubricate brake hardware and tighten all fasteners to specifications per brake manufacturer or test requestor.

7.16 At each inspection, after measuring the brake drag and static fluid displacement per item 8, measure and record caliper pin bolt static breakaway torque in the loosening direction starting with the trailing bolt. Use the torque seal or other identifying mark to distinguish when the bolt first begins to rotate. Record the peak torque value during the initial rotation of the bolt.

7.17 All brake applications are stops per item 3.17.

7.18 Rotate the brake at 48 km/h (30 mph) between brake applications to reach the IBT for the next brake application in the sequence.

8. BRAKE DRAG, FLUID DISPLACEMENT, AND BRAKEAWAY TORQUES

With the brake fully assembled and ready to commence testing, and before each inspection or bolt torque evaluation, measure and record brake drag, breakaway torque, torque to maintain speed, and static fluid displacement (during brake pressure applications) as follows:

8.1 Conduct these measurements with the brake stationary at four pressure levels (0, 3450, 6890, 10 340) kPa; [(0, 500, 1000, 1500) lbf/in^2].

8.2 Except for the step at zero pressure, apply 3450 kPa/s (500 psi/s) and hold the target pressure for 5 seconds.

8.3 Wait 30 seconds after pressure release to allow for full seal retraction.

8.4 Measure the breakaway torque, and the torque required to sustain rotation with a suitable torque wrench or a precision torque sensor if available on the dynamometer.

8.5 Ensure the torque measurement does not include any dynamometer shaft losses or parasitic torque.

8.6 Measure after the brake is initially installed on the dynamometer and at each subsequent inspection before acquiring the bolt torque to loosen measurements per item 7.16.

9. TEST PROCEDURES

9.1 Low-Duty Wear versus Temperature Test – Method A

Table 1 indicates the test sequence for an initial evaluation of any potential low-duty wear issues of a given brake corner. The test procedure is comprised of a series of eight 250-stop sections at constant test conditions (with increasing and decreasing initial brake temperature) with inspections and wear measurements in-between.

TABLE 1 – WEAR VERSUS TEMPERATURE TEST SEQUENCE – METHOD A

Section No.	Section Description	Number of Stops	Braking Speed km/h (mph)	Deceleration m/s² (ft/s²)	IBT or Cycle Control °C (°F)
5	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 8			
10	Instrument check stops	5	56 (35)	1.52 (5)	66.0 (150)
20	Burnish	100	56 (35)	1.52 (5)	93.0 (200)
21	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 8			
22	Wear Inspection	Conduct inspection, wear measurements, and take digital pictures per items 7.4, to 7.9			
30	First 93 °C (200 °F) wear section	250	56 (35)	1.52 (5)	93.0 (200)
31	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 8			
32	Wear Inspection	Conduct inspection, wear measurements, and take digital pictures per items 7.4, to 7.9			
40	176 °C (350 °F) wear section	250	56 (35)	1.52 (5)	177.0 (350)
41	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 8			
42	Wear Inspection	Conduct inspection, wear measurements, and take digital pictures per items 7.4, to 7.9			
50	218 °C (425 °F) wear section	250	56 (35)	1.52 (5)	218.0 (425)
51	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 8			
52	Wear Inspection	Conduct inspection, wear measurements, and take digital pictures per items 7.4, to 7.9			
60	260 °C (500 °F) wear section	250	56 (35)	1.52 (5)	260.0 (500)
61	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 7.16 and item 7.17			
62	Wear Inspection	Conduct inspection, wear measurements, and take digital pictures per items 7.4, to 7.9			
70	330 °C (625 °F) wear section. See note 1	250	56 (35)	1.52 (5)	329.0 (625)
71	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 8			
72	Wear Inspection	Conduct inspection, wear measurements, and take digital pictures per items 7.4, to 7.9			
70	370 °C (700 °F) wear section. See note 2	250	56 (35)	1.52 (5)	371.0 (700)
71	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 8			
72	Wear Inspection	Conduct inspection, wear measurements, and take digital pictures per items 7.4, to 7.9			

TABLE 1 – WEAR VERSUS TEMPERATURE TEST SEQUENCE – METHOD A (CONTINUED)

Section No.	Section Description	Number of Stops	Braking Speed km/h (mph)	Deceleration m/s² (ft/s²)	IBT or Cycle Control °C (°F)
80	Second 93 °C (200 °F) wear section	250	56 (35)	1.52 (5)	93.0 (200)
81	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 8			
82	Wear Inspection	Conduct inspection, wear measurements, and take digital pictures per items 7.4, to 7.9			
90	425 °C (800 °F) wear section. See note 3	250	56 (35)	1.52 (5)	427.0 (800)
91	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 8			
92	Final wear Inspection	Conduct inspection, wear measurements, and take digital pictures per items 7.4, to 7.9			

Note 1: use cooling air speed of 32 km/h (20 mph)

Note 2: use cooling air speed of 25 km/h (15 mph)

Note 3: use cooling air speed of 8 km/h (5 mph)

9.2 Low-Duty Wear at Fixed Temperature Test – Method B

Table 2 indicates the test sequence to evaluate low-duty wear rates at a fixed initial brake temperature. The test procedure is comprised of four 500-stop sections at constant test conditions with inspections and wear measurements in-between.

TABLE 2 - FIXED TEMPERATURE WEAR TEST SEQUENCE – METHOD B

Section No.	Section Description	Number of Stops	Braking Speed km/h (mph)	Deceleration m/s² (ft/s²)	IBT or Cycle Control °C (°F)
5	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 8			
10	Instrument check stops	5	56 (35)	1.52 (5)	66.0 (150)
20	First 500-stop wear section	500	48 (30)	1.2 (4)	93.0 (200)
21	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 8			
22	Wear Inspection	Conduct inspection, wear measurements, and take digital pictures per items 7.4, to 7.9			
30	Second 500-stop wear section	500	48 (30)	1.2 (4)	93.0 (200)
31	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 8			
32	Wear Inspection	Conduct inspection, wear measurements, and take digital pictures per items 7.4, to 7.9			
40	Third 500-stop wear section	500	48 (30)	1.2 (4)	93.0 (200)
41	Brake drag, fluid displacement, and breakaway torque	Conduct measurements per item 8			