



Front and Rear Brake Corner/Knuckle Fatigue Under Braking Loads

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. The purpose of this test is to determine the fatigue life characteristics of passenger car and light-duty truck front and/or rear knuckle and brake components when subjected to repeated forward and reverse braking loads.

1.2 Applicability. This test procedure applies to passenger cars and light duty trucks.

1.3 Remarks. Criteria for brake reaction fatigue performance is suggested. The actual requirements for validation should be stated in the Subsystem Technical Specification (SSTS) or Component Technical Specification (CTS) for each model year by program.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- CG583 Development/Validation Test and Vehicle Review Form
- Component Technical Specification (CTS)
- Subsystem Technical Specification (SSTS)

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.1.3 Front Brake Test. Bedplate approximately 3.1 m × 3.1 m (10 ft × 10 ft) with hydraulic capacity.

3.1.4 Rear Brake Test. Bedplate large enough to accommodate the largest rear axle on test. Bedplate should also have hydraulic capacity.

Note: This may apply to truck only.

3.2 Equipment.

3.2.1 One (1) actuator capable of applying the required force for vertical loading.

3.2.2 One (1) actuator capable of applying the required force for fore/aft brake loading.

3.2.3 Two (2) load cells.

3.2.4 Two (2) channel load readout devices.

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3.2.5 Hydraulic brake apply system with master cylinder.

3.2.6 Fixturing to hold the brake corner/knuckle assembly/rear axle in position. This may include angle stands, heim joints, and other fasteners to complete the setup.

3.2.6.1 Load arm to simulate the rolling radius of the largest wheel and tire assembly released for the vehicle being tested. The load arm is constructed such that the braking force is applied at the tire patch and the vertical load is applied along the wheel centerline.

3.2.6.2 Design representative wheel bearings, control arms/links, knuckles, brake calipers and pads. These shall be replaced with each test sample.

3.2.6.3 A simulated rotor and simulated brake pads may be used in place of design-intent parts. A walking beam pin (see Figure 1 and Appendix A, Figures A5 and A6) should be inserted through a spherical bearing in the rotor, and nested into mating sockets in the pads on both sides. This allows for equal load transfer from both pads to the caliper mounting bracket.

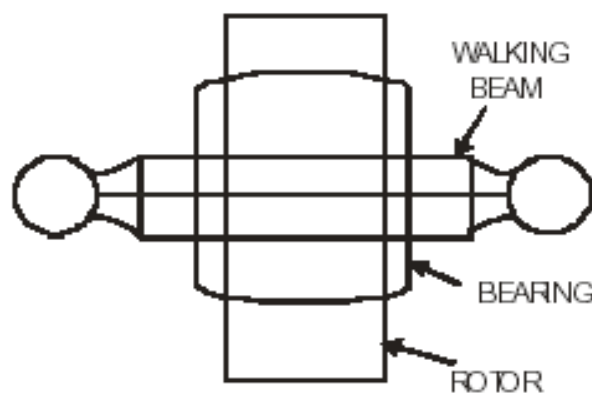


Figure 1: Walking Beam Pin

3.3 Test Vehicle/Test Piece. Sample quantity of the knuckle and/or brake caliper shall be three (3) left-hand and three (3) right-hand.

3.4 Test Time.

Calendar time: 40 days to 105 days

Test time: 240 hours to 720 hours

Coordination time: 80 hours to 120 hours

3.5 Test Required Information. Gross Vehicle Weight (GVW), Front/Rear Gross Axle Weight Rating (GAWR), Center of Gravity (CG) height, and wheelbase are needed to determine the test loads. Static Loaded Radius (SLR), wheel offset, and suspension hardpoint coordinates are needed for test setup.

3.6 Personnel/Skills. The test technician should be familiar with the test machine and the instrumentation required to obtain test data.

4 Procedure

4.1 Preparation. Test load calculations for front knuckle or brake corner.

Note: The vertical loads are always applied upward relative to the vehicle.

4.1.1 Front Axle.

4.1.1.1 Vertical Load (V) for one (1) front wheel:

For forward braking (**Note:** A = 1.0 for Phase I, A = 0.8 for Phase II):

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$$V_F = \frac{\text{Front GAWR}}{2} + \frac{GVW \times A \times H}{2 \times L}$$

For reverse braking:

$$V_F' = \frac{\text{Front GAWR}}{2}$$

Where:

A = Deceleration ratio (Deceleration rate (a)/(9.8 m/s²))

H = The height of the center of gravity of the vehicle above the ground

L = Vehicle Wheelbase

4.1.1.2 Forward Braking Load (F) for one (1) front wheel:

$$F_F = V_F \times A$$

4.1.1.3 Reverse Braking Load (R) for one front wheel:

$$R_F = 0.66 \times F_F \text{ (for Phase I)}$$

$$R_F = F_F \text{ (for Phase II)}$$

4.1.2 Rear Axle.

4.1.2.1 Vertical Load (V) for one (1) rear wheel:

For forward braking (Note: A = 0.8):

$$V_R = \frac{\text{Rear GAWR}}{2} - \frac{GVW \times A \times H}{2 \times L}$$

For reverse braking (Note: A = 0.5):

$$V_R' = \frac{\text{Rear GAWR}}{2} + \frac{GVW \times A \times H}{2 \times L}$$

4.1.2.2 Forward Braking Load (F) for one rear wheel:

$$F_R = V_R \times A$$

4.1.2.3 Reverse Braking Load (R) for one rear wheel:

$$R_R = V_R' \times A$$

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.2.2.1 These requirements shall also be documented on the CG583 Development/Validation Test and Vehicle Review form, including photographs and/layouts of the test setup.

4.3 Instructions.

4.3.1 Pretest. All samples should be magnetic particle inspected prior to test, or dye penetrate inspected in the case of aluminum. If any cracks or indications are found, notify the Design Responsible Engineer. X-rays of the castings should be taken to document the level of porosity that is being validated.

4.3.2 Setup for Front and Rear Independent Suspensions.

4.3.2.1 For knuckles incorporating an integral spindle (Gen0 wheel bearing), install hub and wheel bolt assembly with bearings. Pack inner and outer bearings with wheel bearing grease. Tighten the spindle nut to minimum specified torque. If required to install a cotter pin, tighten with minimal additional nut rotation.

4.3.2.2 For knuckles incorporating a Gen1 wheel bearing, install the spindle assembly with appropriate bearing and spacing components. Tighten the spindle nut to the minimum specified torque.

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