



Suspension Knuckle Strength Test Under Panic 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 if there is yielding of the front and rear suspension knuckles under repeated panic braking loads.

1.2 Applicability. This test is applicable to passenger cars and light duty trucks.

1.3 Remarks. A criterion for the knuckle strength is suggested. The actual requirements for validation should be stated in the Subsystem 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.

- Appendix G2 of Statement of Requirements (SOR): Validation Sign-Off Form (CG583)

Note: The CG numbers in parentheses are provided primarily as a convenience to GM users of this standard to identify the templates used to create the referenced SOR appendices. The CG numbers may or may not be listed in the titles or printed on the documents in the appendices.

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 x 3.1 m (10 ft x 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.

3.1.5 All test facilities and equipment shall be in good working order and shall have a valid calibration label.

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.

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 apply a horizontal braking load at twice the Static Loaded Radius (SLR) through the hub. The SLR used shall be for the largest wheel and tire assembly released for the program, at Gross Vehicle Weight (GVW). The load arm also transmits the vertical load, at the wheel centerline, to the hub.

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.

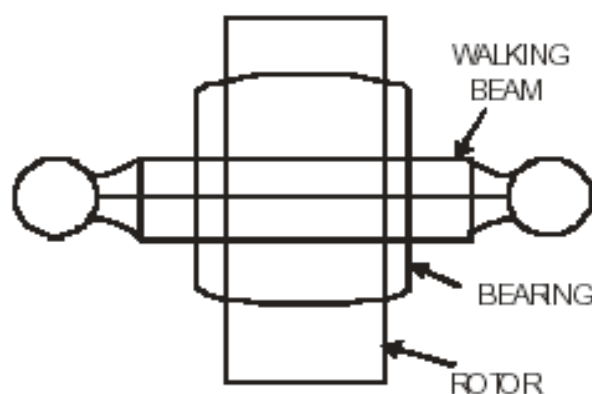


Figure 1: Walking Beam Pin

3.3 Test Vehicle/Test Piece.

3.3.1 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: 7 days to 10 days

Test time: 10 hours to 16 hours

Coordination time: 20 hours to 40 hours

3.5 Test Required Information. Gross Vehicle Weight (W), Front Gross Axle Weight Rating (W_F) and Rear Gross Axle Weight Rating (W_R), center of gravity height at GVW (H), and vehicle wheelbase (L) are needed to determine the test loads. Static Loaded Radius, 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. Calculate test loads for the knuckle or brake corner as prescribed in 4.1.1 thru 4.1.2 (see Appendix A, Figure A2 for Free Body Diagram).

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

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4.1.1 Front Axle.**4.1.1.1 Vertical Load for One Front Wheel.**

For forward braking (Acceleration Ratio (A) = 0.8 for forward braking):

$$V_F \text{ (Vertical Load-Forward Braking)} = \frac{W_F}{2} + \frac{W \times A \times H}{2 \times L}$$

For reverse braking (A = 0.5 for reverse braking):

$$V_F' \text{ (Vertical Load-Reverse Braking)} = \frac{W_F}{2} - \frac{W \times A \times H}{2 \times L}$$

4.1.1.2 Forward Braking Load (F_F) for one front wheel:

$$F_F = V_F \times A$$

Where:

V_F = Vertical load, front corner

V_F' = Vertical load, front corner (reverse braking)

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

$$R_F = V_F' \times A$$

4.1.2 Rear Axle.**4.1.2.1 Vertical Load for one rear wheel.**

For forward braking (A = 0.8 for forward braking):

$$V_R \text{ (Vertical Load-Forward Braking)} = \frac{W_R}{2} - \frac{W \times A \times H}{2 \times L}$$

For reverse braking (A = 0.5 for reverse braking):

$$V_R' \text{ (Vertical Load-Reverse Braking)} = \frac{W_R}{2} + \frac{W \times A \times H}{2 \times L}$$

4.1.2.2 Forward Braking Load (F_R) for one front wheel:

$$F_R = V_R \times A$$

4.1.2.3 Reverse Braking Load (R_R) for one front wheel:

$$R_R = V_R' \times A$$

Where:

V_R = Vertical load, rear corner

V_R' = Vertical load, rear corner (reverse braking)

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 Appendix G2 of SOR Validation Sign-Off Form, including photos and/layouts of the test setup (CG583).

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.

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