



Suspension Panic Brake Durability Test

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. To evaluate the durability of the front or rear suspension system, including the frame, when subjected to maximum braking forces.

1.2 Applicability. This procedure applies to front suspensions of rear wheel drive and rear suspensions of front wheel drive passenger cars and light trucks.

1.3 Remarks. This test differs from GMW15782 in that this test uses a load application fixture that is twice the length of the one used in the brake reaction test. This was done to double the wheel torque without changing the horizontal force on the suspension system. Past studies indicated that the rotational inertia of the tire/wheel system could double the normal brake reaction force.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15782

2.3 Additional References.

- Subsystem Technical Specification (STS)
- Vehicle Technical Specification (VTS)

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.

3.2 Equipment.

3.2.1 Bedplate. Bedplate area that is large enough to accommodate suspension system and/or half of vehicle buck and fixturing to support suspension.

3.2.2 Hydraulic Actuator/Controller. One (1) servo-hydraulic actuator capable of achieving a dynamic stroke of 250 mm and a dynamic load greater than that calculated as the braking force (reaction loads) in 5.1.

One (1) adequately sized load cell (per braking force (reaction loads) 5.1) and a controller capable of driving the actuator at a 0.5 Hz sine wave using a feedback load loop.

3.2.3 Upper Fixturing. If a vehicle buck is not used, depending on suspension configuration, fixturing may be necessary to support the upper strut mounts. This fixturing must properly locate the upper strut mounts in all

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three (3) axes and be capable of supporting strut loads when compressed at design height. (See Appendix A, Figure A1 and Figure A2.)

3.2.4 Angle Stands. Angle stands (usually four (4)) or the equivalent, capable of rigidly supporting the suspension system and/or half of the vehicle buck during testing. The suspension must be held high enough above the bedplate to allow the loading arms and loading beam to operate freely underneath. (See Appendix A, Figure A1 and Figure A2.)

3.2.5 Loading Arms. Two (2) loading arms (one for each side) that bolt to the test vehicle's wheel stud pattern and have a length equal to twice the vehicle's largest tire rolling radius and duplicate the correct wheel offset. (See Appendix A, Figure A1 and A2.)

3.2.6 Loading Beam. The loading beam must span the width between the loading arms. It attaches in the center to the actuator with a clevis and to the loading arms on both ends with a pin joint. (See Appendix A, Figure A1 and Figure A2.)

3.2.7 Modified Brakes. The test sample's brakes must be modified to apply a moment to the brake/steering knuckle. The brake pads and rotor can be bolted together or the wheel bearing halves can be welded together. If the wheel bearing is welded, then the brake interfaces to the knuckle and/or backing plate can no longer be evaluated in this test. (Appendix A, Figure A3 illustrates a means of locking the rotor to the knuckle by bolting the brake pads to the rotor.)

3.2.8 Steering Gear Lockout. One (1) steering gear lock out fixture (if testing a front suspension) to prevent rotation of the knuckles. (Appendix A, Figure A4 shows a fixture locking the steering input shaft to the gear housing.)

3.3 Test Vehicle/Test Piece. Each sample to be tested should consist of a complete suspension system and frame and/or body section as appropriate. Front suspension testing also requires the steering gear and linkage. The number of samples to be tested should be determined by the Subsystem Technical Specification (SSTS) reliability requirement.

3.4 Test Time.

Calendar time: 11 d

Test time: 24 h

Coordination time: 6 h to 8 h

3.5 Test Required Information. Not applicable.

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.

4.1.1 Stencil ink or equivalent should be used on all critical parts in order to observe crack initiation and propagation.

4.1.2 All fasteners should be tightened to their minimum torque specification and indexed such that possible relative motion during testing can be observed.

4.1.3 The suspension must be held in the correct vertical design position (Z-height or D-height), see Appendix A, Data Sheet A1.

4.1.4 Camber, caster, and toe angles must be within vehicle specifications. Record initial alignment settings.

4.2 Conditions.

4.2.1 Environmental Conditions. This test has traditionally been performed in an ambient laboratory environment with room temperatures and humidity. However, this test could be performed in an environmental chamber to simulate actual driving conditions.

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.

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4.3 Instructions.

4.3.1 The suspension system should be loaded at a frequency of 0.5 Hz.

4.3.2 Stop the test at predetermined inspection intervals and turn off the hydraulic controller. Inspect the test for wear, cracks, loss of fastener torque/clamp load, camber, caster, toe change, etc.

Measure and record the final caster, camber and toe values at end of test. The requesting engineer should establish functional requirements (e.g., maximum acceptable crack length).

4.3.3 The number of brake reaction cycles (forward and reverse) is determined by the vehicle platform or reliability department.

Note: A total of 30 forward and 10 reverse load applications (three (3) forward, one (1) reverse) has been used in the past.

Note: This test is frequently performed in conjunction with GMW15782. In this case, one (1) life of Panic Brake (PB) cycles is followed by two (2) lives of Brake Reaction (BR) cycles, which are followed by two (2) lives of PB cycles. Lastly, another life of BR cycles is performed. This test sequence minimizes fixturing adjustments that are necessary to alternate between the two (2) tests. It also reduces test time in the event that the suspension cannot withstand PB loads (incidents are discovered early). The same set of test material is retained throughout the test sequence described in Figure 1.

1PB	1BR	1BR	1PB	1PB	1BR
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Figure 1: Test Cycle Sequence

5 Data

5.1 Calculations.

5.1.1 Front Suspension Load Determination. If the front suspension is being tested, the test loads are calculated as follows:

5.1.1.1 Forward Reaction Load.

$$R_{FF} = a/g [F_F + a/g \times (WH/L)]$$

5.1.1.2 Reverse Reaction load.

$$R_{FR} = a/g [F_F - a/g \times (W \times H/L)]$$

5.1.2 Rear Suspension Load Determination. If the rear suspension is being tested, the test loads are calculated as follows:

5.1.2.1 Forward Reaction Load.

$$R_{RF} = a/g [F_R - a/g \times (W \times H/L)]$$

5.1.2.2 Reverse Reaction Load.

$$R_{RR} = a/g [F_R + a/g \times (W \times H/L)]$$

Where:

R_{FF} = Front suspension, Forward reaction load

R_{FR} = Front suspension, Reverse reaction load

R_{RF} = Rear suspension, Forward reaction load

R_{RR} = Rear suspension, Reverse reaction load

W = Gross Vehicle Weight Rating

F_F = Front axle weight rating

F_R = Rear axle weight rating

H = Height of vehicle center of gravity

L = Wheelbase of vehicle

a/g = Deceleration ratio, the recommended ratios are:

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