



Brake Torque to Drive Axle Torque Balance

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 evaluate the ability of a vehicle to stop under 100% accelerator pedal input position. Tests are performed with the vehicle stationary and at highway speeds.

1.2 Applicability. This procedure is applicable to passenger cars, multi-purpose vehicles and light trucks.

1.3 Remarks. The Highway Speed Tests and High Speed Tests should be performed for passenger cars and trucks equipped with automatic and manual transmissions. The Stationary Vehicle Test should be run on vehicles with automatic transmissions.

2 References

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

2.1 External Standards/Specifications.

CMVSS 105

FMVSS 105

CMVSS 135

FMVSS 135

2.2 GM Standards/Specifications.

GMW15102

GMW15106

2.3 Additional References.

Fairchild Industrial Products Company, Winston-Salem, North Carolina (www.fairchildproducts.com)

Global Document Management (GDM) System (<https://documents.gm.com/gdm3/component/main>) (ID)

SimProc 0B-03-44, Analytical Guideline (ID)

(ID) = This website/document is limited to internal use within General Motors and shall not be accessed outside this company. Contact the GM Lead Engineer for further instructions.

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 Road tests require a level, asphalt or concrete test surface for straight line stops.

3.1.4 Tests with the vehicle stationary require a level surface that allows for forward, rearward, and lateral movement of the vehicle.

3.1.5 Vehicle scales capable of measuring at least the vehicle weight plus ballast at each axle.

3.2 Equipment.

3.2.1 Vacuum Transducer. For vehicles equipped with a vacuum power brake booster, installation of a vacuum transducer capable of measuring 0 kPa to 105 kPa on the booster side of the check valve is recommended to record booster vacuum. An adapter at the booster may be required.

GM Confidential

© Copyright 2016 General Motors Company All Rights Reserved

September 2016

Page 1 of 9

3.2.2 Pressure Regulator and Vacuum Gauge (Optional). For vehicles equipped with a vacuum power brake booster, installation of a pressure regulator and gauge is recommended if the test request includes testing with reduced booster vacuum. Install a Fairchild Model 16 vacuum regulator, or an equivalent regulator, in the vacuum line between the engine manifold and the brake booster check valve. Install a vacuum gauge with a range of 0 kPa to 105 kPa between the booster and the regulator to monitor the vacuum level when adjusting the regulator.

3.2.3 Remote, Normally-Closed, Direct Current Solenoid Valve. Install a normally closed Direct Current (DC) solenoid valve to allow manifold vacuum to be controlled to the booster during 4.3.6.

3.2.4 Fifth Wheel. Install a fifth wheel or equivalent device to measure and record vehicle speed and stopping distance.

3.2.5 Throttle Position Sensor. Instrumentation to detect and record the throttle position is required (usually available on the vehicle communication bus).

3.2.6 Accelerator Pedal Position Sensor. Instrumentation to detect and record the accelerator pedal position is required (usually available on the vehicle communication bus).

3.2.7 Pedal Force Transducer. Install a force transducer on the service brake pedal that is capable of recording and displaying pedal force data to the driver.

3.2.8 Accelerometer. Install an accelerometer within the vehicle in a level position as near the centerline of the vehicle as possible.

3.2.9 Data Acquisition System. The system must be capable of recording and displaying the test data to the driver at 100 Hz scan rate. An external trigger is recommended.

3.2.10 Thermocouple and Readout Device. Monitoring the initial brake temperature at the start of each stop is required. Use an imbedded thermocouple in the center of the brake pad per GMW15102 (Federal Motor Vehicle Safety Standard (FMVSS)/Canada Motor Vehicle Safety Standard (CMVSS) 135). Depending on the regional brake burnish schedule, additional thermocouples may be required.

3.3 Test Vehicle/Test Piece. Test vehicle must be equipped with the worst case (highest torque output) powertrain to be released with the brake system. The body control module, engine control module, and transmission control module calibrations shall be the latest released level and shall be documented in the test record/report. If more than one powertrain is released with the brake system, in addition to testing the worst case powertrain, each additional powertrain configuration should, at a minimum, be subjectively evaluated for proper Enhanced Electronic Pedal Override (EEPO) functionality.

3.4 Test Time.

Calendar time: 4 days to 5 days

Test hours: 12 hours to 16 hours

Coordination hours: 4 hours to 6 hours

3.5 Test Required Information. For 4.3.8, a specially made jumper harness must be available to partially disable the brake pedal position sensor so that the signal to the engine control module is disable, while the signal to the body control module is enabled. The home position of the dual brake pedal position sensor must be relearned after the jumper harness is installed. Alternate mechanizations other than dual pedal position sensors may require a different method.

3.6 Personnel/Skills. An experienced brake test technician or engineer is required to perform the instructions in this standard.

4 Procedure

4.1 Preparation.

4.1.1 Body Control Module, Engine Control Module and Transmission Control Module Calibrations. Confirm that body control module, engine control module and transmission control module calibrations are as requested in the test request. The engine control module calibration needs to include the EEPO Brake settings previously supplied by the brake development engineer. Reference analytical guideline SimProc 0B 03 44 for instructions for determining these EEPO brake settings.

GM Confidential

© Copyright 2016 General Motors Company All Rights Reserved

September 2016

Page 2 of 9

Documents
Document Sharing Hub

4.1.2 Brake System. Build brake system as requested in test request. For validation testing, the recommended brake condition is newly burnished brakes. The recommended brake burnish schedule is the brake burnish in the regional brake certification test applicable for the test vehicle. As a default, the GMW15102 brake burnish may be used. Install any required instrumentation to complete the specified brake burnish.

4.1.3 Instrumentation. Install the test equipment following standard procedures and the instructions in 3.2. The required data channels for each stop are throttle position, brake pedal force, vehicle speed, booster vacuum level, elapsed time, engine speed, accelerator pedal position, and distance required for the vehicle to come to a complete stop (except on ramp applies, 4.3.3). Recommended channels are gear selection, percent pedal position body control module, percent pedal position engine control module, and brake pressures.

4.2 Conditions.

4.2.1 Environmental Conditions. The ambient temperature shall be any temperature between -20 °C and 40 °C for vehicles, with a Gross Vehicle Weight Rating (GVWR) of 4536 kg or less per GMW15102 and GMW15106 (FMVSS/CMVSS 105).

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 Vehicle Accessories. During the testing, turn off the vehicle air conditioning, headlights, and any other accessories that could reduce the available powertrain torque output.

4.2.2.2 Vehicle Loading. The recommended vehicle loading condition for the testing is GVWR. The definitions of GVWR are in GMW15102. Other loading conditions may be specified. Load test vehicle following instructions in the test request.

4.2.3 Vehicle Test Descriptions.

4.2.3.1 Stationary Vehicle Test with 100% Accelerator Pedal Input Definition. The Stationary Vehicle Test is run with the vehicle starting out stationary, the transmission in Neutral, with the brakes applied to the target load of 400 N and the accelerator pedal applied to the 100% accelerator pedal input position. The transmission is then placed in the lowest forward gear. This test is also repeated with the transmission shifted to Reverse. This stationary vehicle test is only for vehicles with automatic transmissions. If the vehicle remains stationary during this test, the technician will slowly release the brake pedal while maintaining 100% accelerator pedal input position in order to determine at what point the vehicle begins to move.

4.2.3.2 Highway Speed Test Definition. The Highway Speed Test section consists of the tests listed in 4.2.3.2.1 through 4.2.3.2.7 completed at GVWR loading.

4.2.3.2.1 High Speed Effectiveness Test Definition (Baseline Stopping Distance) – Optional. The Baseline stopping distance is only needed for vehicles where stopping distance data for the FMVSS 135 high speed 160 ± 5 km/h section is not available.

4.2.3.2.2 Dynamic Test with Enhanced Electronic Pedal Override (EEPO) Enabled Ramp Apply and Release Definition. The Dynamic Test with EEPO Enabled Ramp Apply and Release consists of three (3) stops at GVWR. This section is performed to determine what pedal force the EEPO begins to reduce engine power. The target speed for this test is 50 km/h ± 5 km/h, but the exact speed is not critical. The ramp apply rate for this test should be between 50 N/s and 150 N/s to approximately 400 N pedal force.

4.2.3.2.3 High Speed Test with EEPO Enabled Definition. The High Speed Effectiveness Test consists of three (3) stops at GVWR loading. The target speed for the test is 160 km/h ± 5 km/h. The maximum brake apply force target is 500 N. A maximum pedal force of 667 N can be used for vehicles that must meet G requirements. However it is recommended that all vehicles be evaluated at the 500 N brake apply force maximum.

4.2.3.2.4 Highway Speed Test with EEPO Disabled Definition. The Highway Speed Test with EEPO Disabled consists of three (3) stops at GVWR loading. The target speed for the test is 100 km/h ± 5 km/h. The maximum brake apply force target is 500 N. A maximum pedal force of 667 N can be used for vehicles that must meet GMW15106 requirements. However it is recommended that all vehicles be evaluated at the 500 N brake apply force maximum.

4.2.3.2.5 Highway Speed Test with Reduced Initial Brake Booster Vacuum Definition. The Highway Speed Test with reduced initial brake booster vacuum consists of three (3) stops at GVWR loading. The target speed for the test is 100 km/h ± 5 km/h. The maximum brake apply force target is 400 N for all vehicles. If the optional disabled vacuum test (with all vacuum sources disabled) in 4.2.3.2.6 is performed and the vehicle meets the

GM Confidential

© Copyright 2016 General Motors Company All Rights Reserved