Antilock Brake System, ABS, Transition Response Time

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 objectively determine the Antilock Brake System (ABS) transition response time of a vehicle undergoing an abrupt change in the surface coefficient of friction.

1.2 Applicability. This procedure applies to all passenger cars and light trucks equipped with ABS.

1.3 Remarks. None.

2 References

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

2.1 External Standards/Specifications.

FMVSS 135

2.2 GM Standards/Specifications.

None

2.3 Additional References. None.

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 Laboratory for test vehicle build and instrumentation installation.

3.1.4 Surface area must be of sufficient size to accommodate test maneuvers without vehicle leaving surface.

3.1.5 Vehicle weigh station capable of measuring vehicle weight at each corner.

3.2 Equipment.

3.2.1 Speed Measurement Device and Readout. The speed transducer must be capable of reading velocity in excess of the vehicle test speed, a minimum of 150 km/h is recommended. The transducer accuracy must be within 0.5 km/h over the speed range of 5 km/h to 150 km/h.

3.2.2 Accelerometer oriented to measure longitudinal acceleration at vehicle's center of gravity. The accelerometer must be capable of measuring a minimum of 1.2g, with an accuracy of 0.01g.

3.2.3 Pressure transducers for measuring brake pressure at each wheel (optional).

3.2.4 Wheel speed measurement device for measuring angular velocity of each wheel.

3.2.5 Thermocouple and readout for front brake pads.

3.2.6 Pedal force transducer.

3.2.7 Optical transmitter and reflector.

3.2.8 Pedal travel transducer (optional).

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3.2.9 Booster vacuum transducer (optional).

3.2.10 Torque wheels for measuring brake torque output at each wheel (optional).

3.2.11 Appropriate signal conditioning equipment and cabling.

3.2.12 Digital Data Acquisition System (DAS) set to a 100 Hz scan rate.

3.2.13 All instrumentation is to be calibrated as required. Instrumentation identification numbers and calibration dates shall be recorded and stored with test information.

3.3 Test Vehicle/Test Piece.

3.3.1 The vehicle to be tested must be in safe operating condition.

3.3.2 Brake components should be replaced and burnished according to FMVSS 135 procedures unless otherwise specified by the test engineer.

3.3.3 Tires should be new unless otherwise specified by test engineer.

3.4 Test Time.

Calendar time:	2 d to 3 d
Test time:	Dependent on Test Request
Coordination time:	4 h to 8 h

3.5 Test Required Information. This test may be run as part of a series of burnished brake tests using a single vehicle build. This test should be run before any fade or abuse tests. This test should also be run near the end of the series due to the aggressive stopping.

3.6 Personnel/Skills. An experienced brake test technician qualified to set up the vehicle and to perform the test instructions in Section 4 is required.

4 Procedure

4.1 Preparation.

4.1.1 Thermocouple front brake friction material. Rear brake friction material may also be thermocoupled, if requested.

4.1.2 Install optical transmitter on the side of the vehicle over the center line of front axle.

4.1.3 Install instrumentation and data acquisition equipment according to departmental procedures.

4.1.4 Calibrate instrumentation as required.

4.1.5 Ballast vehicle to achieve loading desired. All ballast must be properly secured. Lightly loaded vehicle loading condition is recommended.

4.1.6 Inflate tires to manufacturer's recommended pressure or per test engineer's instructions.

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.1.1 Wind speed should be < 16 km/h.

4.2.1.2 Measure the Low Co Surface Friction Coefficient. The low co surface friction coefficient is to be between 0.1 and 0.2 and should be measured by taking the average deceleration of two (2) opposite direction 20 km/h straight line locked wheel brake stop test runs.

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.

4.3 Instructions.

4.3.1 Low to High Transition Test.

4.3.1.1 Determine the deceleration reference values using an ABS stop conducted on the low coefficient surface and the high coefficient surface.

4.3.1.1.1 Establish an Initial Brake Temperature (IBT) of 66 °C to 77 °C on the front axle or the warmest axle if both front and rear thermocouples are installed.

4.3.1.1.2 Turn off all vehicle accessories.

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4.3.1.1.3 Accelerate the vehicle to test speed and stabilize. Use a test speed of 70 km/h ± 5 km/h.

4.3.1.1.4 Start the DAS.

4.3.1.1.5 Apply clutch if vehicle testing has a manual transmission.

4.3.1.1.6 Apply a spike brake input. Minimum pedal force of 667 N with a minimum average application of 6667 N/s. After spike brake input, apply the pedal force is held > 667 N to < 1779 N.

4.3.1.1.7 Stop DAS.

4.3.1.1.8 Repeat 4.3.1.1.1 through 4.3.1.1.7 for a total of two (2) stops on each surface. (Total of four (4) stops). Cool the brakes with cooling laps as necessary to reach the IBT before each stop.

4.3.1.2 Position the optical reflector stand at the surface transition point, such that the beam from the transmitter on the vehicle is reflected the moment the front axle is at the transition. Do this with the vehicle's front wheels parked directly over the transition point with the vehicle direction of travel being from the low coefficient surface to the high coefficient surface. See Appendix A, Figure A1 for further details.

4.3.1.3 Place a cone or other marking device to mark the position of the ABS brake applies. The cone or marking device is placed such that at the vehicle crosses the transition at 70 km/h ± 5 km/h and has achieved two (2) full ABS cycles prior to the transition. This will require a few trial runs to determine the cone placement and the initial test speed. Note this initial speed as it will be the required initial test speed for the transition test. To determine if a minimum of two (2) ABS cycles occur, view the pressure data on the data acquisition system (see Appendix A, Figure A2 for details).

4.3.1.4 Establish an IBT of 66 °C to 77 °C on the front axle or the warmest axle if both front and rear thermocouples are installed.

4.3.1.5 Accelerate vehicle to test speed, as determined in 4.3.1.2 and stabilize. The direction of travel of the vehicle must be perpendicular to the boundary between the low and high coefficient surfaces. The path should also be as close as possible to the optical reflector stand while still maintaining a safe distance.

4.3.1.6 Start DAS a minimum of 1 s prior to when the vehicle reaches the cone or marker.

4.3.1.7 Apply a spike brake input to the brake pedal when the vehicle front axle reaches the cone or marking device.

4.3.1.8 Maintain pedal force until vehicle comes to rest.

4.3.1.9 Stop DAS.

4.3.1.10 Repeat 4.3.1.4 through 4.3.1.9 for a total of four (4) low to high stops. Cool the linings between runs with cooling laps as needed.

4.3.2 High to Low Transition Test.

4.3.2.1 Determine the deceleration reference values for an ABS stop conducted on the low coefficient (Low Co) surface. If the low to high transition test is done on the same day as the high to low then the two (2) deceleration Low Co reference runs from 4.3.1.1.8 can be used. If the high to low test is performed on a different day then two (2) Low Co deceleration references must be run as directed in 4.3.2.

4.3.2.1.1 Establish an IBT of 66 °C to 77 °C on the front axle or the warmest axle if both front and rear thermocouples are installed.

4.3.2.1.2 Turn off all vehicle accessories.

4.3.2.1.3 Accelerate the vehicle to test speed and stabilize. Use a test speed of 70 km/h ± 5 km/h.

4.3.2.1.4 Start the DAS a minimum of 1 s before the brake apply.

4.3.2.1.5 Apply clutch if vehicle testing has a manual transmission.

4.3.2.1.6 Apply a spike brake input. Minimum pedal force of 667 N with a minimum average application of 6667 N/s. After spike brake input, apply the pedal force is held > 667 N to < 1779 N.

4.3.2.1.7 Stop DAS.

4.3.2.1.8 Repeat 4.3.2.1.1 through 4.3.2.1.7 for a total of two (2) stops on the Low Co surface. Cool the brakes with cooling laps as necessary to reach the IBT before each stop.

4.3.2.2 Position the optical reflector stand at the surface transition point, such that the beam from the transmitter on the vehicle is reflected the moment the front axle is at the transition. Do this with the vehicle's front wheels

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