



Single Bump Recognition Antilock Brake System Stopping Distance and Deceleration Uniformity

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 procedure is to measure the stopping distance ratio of Antilock Brake System (ABS) stops on a uniform surface vs. ABS stops over a single 38 mm Trapezoidal Bump. The procedure provides for subjective evaluations of ABS performance, deceleration uniformity including no 'sail-on' effect while braking over a single bump.

1.2 Applicability. This test procedure is applicable for vehicles with ABS.

1.3 Remarks. This procedure is designed to quantify and compare the stopping distance ratio of ABS stops on a uniform surface vs. ABS stops over a single 38 mm Trapezoidal Bump.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

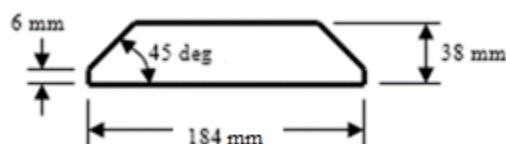
GMW14264

2.3 Additional References. None.

3 Resources

3.1 Facilities. Laboratory for test vehicle build and instrumentation installation. Recommended test surfaces are located at the Fenn Holden area at Milford Proving Ground (MPG) or comparable road, having Trapezoidal bumps as shown in Figure 1. Facilities to include a vehicle weigh station capable of measuring vehicle weight at each corner.

Figure 1: Trapezoidal Bump Configuration



Note: deg = degrees

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.

GM Confidential

© Copyright 2015 General Motors Company All Rights Reserved

December 2015

Page 1 of 7

3.2 Equipment.

3.2.1. Brake pressure sensors located at each corner and at master cylinder.

3.2.2 Vehicle steering wheel angle sensor.

3.2.3 Longitudinal accelerometer at vehicle's center of gravity ($\pm 1.25g$).

3.2.4 Wheel speed sensors at each corner.

3.2.5 Transition marker pickup device mounted at the front wheel axis and a transition marker positioned at the leading edge of the single bump.

3.2.6 Brake switch.

3.2.7 Brake pedal force transducer.

3.2.8 Brake pad temperature measuring equipment at each corner.

3.2.9 Speed measurement device with capability to capture initial speed and distance. 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. The transducer accuracy shall measure distance within $\pm 0.2\%$.

3.2.10 Sample rate is 10 ms (100 Hz).

3.2.11 Marker Cone.

3.3 Test Vehicle/Test Piece. Refer to Section 4.

3.4 Test Time.

Calendar time: 1 day

Test time: 1 hour

Coordination time: 2 hours

Instrumentation time: 3 days

3.5 Test Required Information. Refer to Section 4.

3.6 Personnel/Skills.

3.6.1 Experienced chassis test technician for vehicle instrumentation.

3.6.2 Chassis test driver certified for handling tests.

4 Procedure

4.1 Preparation.

4.1.1 The vehicle to be tested must be in safe operating condition for maneuvering levels approaching the limit of vehicle performance. Condition of tire, brake and suspension components should be inspected carefully. All vehicle safety equipment must be in proper operating condition.

4.1.2 Information about the vehicle and the brake system should be stored with the test data.

4.1.3 The requesting engineer shall specify tires and tire condition. New tires are recommended. The requesting engineer shall specify the brakes and brake condition.

4.1.4 **Instrumentation Installation.** Instrumentation is only required if test procedure has been previously run and an issue with "sail-on" was observed. However, it is suggested that this test procedure be run at the same time of conducting other ABS testing so that vehicle already has instrumentation installed. All instrumentation must be securely fastened to the vehicle due to the nature of test maneuver. Instrumentation should be located on the passenger or rear seats to avoid excessive ballast in the rear of the vehicle.

Install transducers, data acquisition, driver readouts, and steering control equipment. Accelerometers should be mounted as near the center of gravity as possible. If the speed measurement device is vehicle mounted, attach device as close to the vehicle centerline as possible.

4.1.5 Load vehicle to test configuration. Curb plus driver plus instrumentation plus full fuel load plus any required safety equipment loading is recommended. The requesting engineer may specify other loading conditions. All ballast must be properly secured. Record vehicle test weight.

GM Confidential

© Copyright 2015 General Motors Company All Rights Reserved

December 2015

Page 2 of 7

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

4.2 Conditions.

4.2.1 Environmental Conditions. Wind speed should be less than 24 km/h.

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 Test surfaces should be free of debris.

4.2.2.2 Test speed is 100 km/h $\pm$ 5 km/h. Other speeds may be specified by the requestor to suit the vehicle configuration depending on facility, vehicle or safety constraints.

4.3 Instructions.

4.3.1 Verify that all instrumentation is functioning properly. Calibrate instrumentation as necessary.

4.3.2 Place the transition marker at the leading edge of the single bump.

4.3.3 Place a marker cone 5 m prior to the leading edge of the single bump.

4.3.4 Perform Spike Brake Apply. Spike brake pedal, inducing ABS at 100 km/h $\pm$ 5 km/h on the smooth surface adjacent to the Single Bump at Fenn Holden (or equivalent). Maintain brake apply such that ABS control is maintained until vehicle speed is 0 km/h.

4.3.5. Perform Spike Brake Apply. Spike brake pedal, inducing ABS at 100 km/h $\pm$ 5 km/h, 5 m before the Single Bump. Maintain brake apply such that ABS control is maintained until vehicle speed is 0 km/h.

4.3.6 Repeat 4.3.4 and 4.3.5 two (2) times for a total of four (4) runs at 100 km/h.

4.3.7 Subjective Evaluations. Subjective evaluations of deceleration uniformity and sail-on will be performed over the Single Bump with varying deceleration rates up to threshold braking and varying vehicle speeds. The test will be performed to initiate the deceleration 3 m before the Single Bump. It will be necessary to begin the deceleration at a speed greater than the test speed such that the single bump is contacted at the test speed of 5 km/h.

4.3.8 Utilize the forms in Appendix A, Data Sheets A1 and A2 to document the Subjective Evaluations. Record the test speed, the subjective scale rating (per GMW14624) of the deceleration uniformity, any comments and the data file if applicable.

5 Data

5.1 Calculations.

5.1.1 Deceleration Ratio Metrics.

5.1.1.1 Stopping Distance Ratio. The stopping distance ratio is the ABS active stopping distance runs over the Single Bump at Fenn Holden (or equivalent) divided by the average of the ABS active stopping distance runs on the smooth surface adjacent to the Single Bump at Fenn Holden (or equivalent).

5.2 Interpretation of Results. Data is to be reviewed by engineer to resolve any issues surfacing during vehicle evaluation. Results may be compared to technical specifications and/or to results from tests on other vehicles.

5.3 Test Documentation. Publish test information and results according to departmental protocol. Test request and report if data is to be taken in addition to subjective evaluations.

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

In general, a risk assessment needs to be performed for every driving instruction prior to executing this standard. (**Note:** National law needs to be considered while performing a risk assessment.) The required rating of risk by exposure probability and possible violation will be done in a separate document. Every identified risk must be named inside the risk assessment for the relevant driving instruction in order to announce that risk to employees. Within the risk assessment, the vehicle equipment and different vehicle build stages have to be considered. After performing a risk assessment, non-acceptable risk needs to be mitigated by appropriate countermeasures. Here

GM Confidential

© Copyright 2015 General Motors Company All Rights Reserved

December 2015

Page 3 of 7



Documents
Document Sharing Hub