



Control Response

1 Scope

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 total vehicle understeer, steering sensitivity, roll gain, lateral acceleration and yaw velocity response times, and sideslip gain.

1.2 Foreword. This test procedure describes a method for measuring total vehicle understeer, steering sensitivity, roll gain, lateral acceleration and yaw velocity response times, and sideslip gain of a test vehicle.

1.3 Applicability. This test procedure applies to any two axle pneumatic rubber tired vehicle at all load conditions.

2 References

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

2.1 External Standards/Specifications.

ASTM E1136 ISO 9001

ASTM E1337-90

2.2 GM Standards/Specifications.

GMW14798

3 Resources

3.1 Facilities.

3.1.1 The test facilities and test equipment shall be in good working order and shall have a valid calibration record.

3.1.2 The test is run on a smooth, flat, dry surface with a high friction coefficient. Unless otherwise specified, the road test surface should produce a Peak Friction Coefficient (PFC) of 0.9 or greater when measured using ASTM E1136 standard reference test tire, and in accordance with ASTM E1337-90, at a speed of 64.4 km/h (40 mph), without water delivery.

3.1.3 The test surface has a consistent slope between level and 2.5%. The test should be conducted along the slope to ensure the same loading when turning both left and right.

3.2 Equipment.

3.2.1 Data Acquisition System (DAS).

3.2.2 Control response steering wheel with stops and steer angle measurement.

3.2.3 Motion package containing yaw rate sensor, lateral accelerometer and fore-aft accelerometer.

3.2.4 Speed and sideslip transducer.

3.2.5 Roll transducer.

3.2.6 Speed null meter (optional).

3.2.7 Appropriate cabling.

3.3 Test Vehicle/Test Piece. This test procedure applies to any vehicle with two axles and pneumatic rubber tires. It is applicable for all load conditions.

3.4 Test Time.

Calendar time: 1 to 2 days

Test hours: 3 hours

Coordination hours: 2 hours

3.5 Test Required Information.

3.5.1 Channels and Full Scale Values.

- Steering Wheel Angle: 300 degrees
- Vehicle Speed: 150 km/h
- Yaw Velocity (Rate): 50 degrees/s
- Roll: 10 degrees
- Lateral Acceleration: 10 m/s²
- Sideslip: 15 degrees

3.5.2 Additional Channels may be used as required.

3.5.3 Sample Rate is 100 Hz.

3.5.4 Filter Frequency is 25 Hz.

3.6 Personnel/Skills. Operator must be qualified and documented as capable to run this test as required by ISO 9001.

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May 2012

Originating Department: North American Engineering Standards

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4 Procedure

4.1 Preparation.

4.1.1 Vehicle Preparation.

4.1.1.1 The test vehicle should be inspected to ensure that the proper tires and suspension components are installed and that all chassis components are in serviceable condition.

4.1.1.2 Vehicles with an obvious high center of gravity should be reviewed by the responsible engineer for roll stability, and appropriate limitations established.

4.1.1.3 Heavy vehicles (greater than 3500 kg) may require a longer timing sequence and more space or reduced speed. Consult with the requesting engineer.

4.1.1.4 Ballast the vehicle to the requested weight and weight distribution.

Note: All equipment and ballast inside the passenger compartment of the vehicle must be securely held in place. External ballast must be contained in a ballast box, and a metal retaining screen installed between the cargo compartment and the passenger cab.

4.1.1.5 The fuel tank should be topped off, and the vehicle test weights determined.

4.1.1.6 Document the Condition of the Tires. New tires should be broken in with several moderate lateral acceleration events (0.5G) and several hard braking events (without locking the wheels). Worn tires should be checked and the condition noted on the Test Vehicle Description Sheet (TVD). See Appendix A for a sample TVD sheet.

4.1.1.7 A steering ratio test (see GMW14798) must be run on the vehicle before or after the control response test. The results of the steering ratio test are required for data processing.

4.1.2 Operator Precautions.

4.1.2.1 The test operator must use all available passenger restraints at all times. It is recommended that helmets be used at all times. Helmet usage is required when testing vehicles at Gross Vehicle Mass (GVM) condition or above 0.5G lateral acceleration.

4.1.2.2 The test operator must obtain clearance and instructions from the test site coordinator before initiating operations on the test site.

4.1.3 Installation.

4.1.3.1 The motion package is to be installed in the front passenger seat footwell in a level position. Leveling is accomplished using the attached

leveling screws and bubble levels. Record fore-aft location of the motion package on TVD sheet.

4.1.3.2 Check operation of motion package and DAS by recording a plus/minus ($\pm$) calibration and visually inspecting the system performance on the screen.

4.2 Conditions.

Note: The test is to be performed on a suitable test surface.

4.2.1 Environmental Conditions.

4.2.1.1 Wind speed should be less than 24 km/h (16 km/h for vehicles with large side area, such as vans).

4.2.1.2 The road surface should be smooth and dry.

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 Turn on instrumentation and data acquisition packages. Allow 5 minutes for equipment to warm up.

4.3.2 Enter dataset header information.

4.3.3 Maintaining 100 km/h speed, determine zero steer position by driving straight path across the test surface. Set this position on the steering wheel stop system.

4.3.4 With the vehicle stopped and wheels straight-ahead balance the DAS (if appropriate).

4.3.5 Set initial steer angle for 5 degrees. Initial turn direction is usually right, but can be left, depending on test facility traffic conditions and test surface coordinator instructions.

4.3.6 Accelerate to 100 km/h and stabilize speed and direction as you enter the test surface.

4.3.7 Steer the vehicle to the zero position previously determined and allow vehicle to stabilize.

4.3.8 When speed and steer are set for the straight path, begin data acquisition. Maintain speed to keep the null meter centered.

4.3.9 When the beeper sounds, steer the steering wheel against the previously set stop as quickly as possible. Maintain speed with smooth throttle application. Do not use cruise control at high steer angles; manual throttle control is necessary to maintain speed.

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