



Transition 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. The purpose of this test procedure is to measure the steering feel properties of a vehicle during low lateral acceleration maneuvers appropriate for straight highway driving.

1.2 Applicability. This test procedure can be applied to all pneumatic rubber-tired highway vehicles with hand wheel steering control at any load condition.

1.3 Remarks. Steering feel properties are derived from steering wheel torque and steering sensitivity measurements during slow steering inputs from straight ahead.

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	ISO 13674-2

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- Norman, K.D., "Development of an On-Center Handling Test", CPE Engineering Report PG-40089, June 3, 1980.
- Norman, K.D., "Objective Evaluation of On-Center Handling Performance", SAE 840069, 1984.
- Norman, K.D., "Transition Test Development", GM Engineering Report PG075937, 2006.

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 This test is to be 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 an ASTM E1136 standard reference test tire, in accordance with ASTM Method E1337-90, at a speed of 64.4 km/h (40 mph), without water delivery.

3.1.4 This test procedure requires a test area approximately 30 m wide minimum by 400 m long with sufficient entrance track to enter the pad at 100 km/h.

3.1.5 ISO 13674-2 recommends that the lateral gradient of the test surface should not exceed 1%.

3.2 Equipment. Each test vehicle is to be equipped with sensors and a data acquisition system.

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March 2014

Page 1 of 9

Documents

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3.2.1 Steering wheel angle transducer.

3.2.2 Steering wheel torque transducer.

3.2.3 Vehicle Speed and Sideslip Sensor. Vehicle speed and sideslip are measured with an optical sensor or a Global Positioning System (GPS) based Inertial Measurement Unit (IMU).

3.2.4 Motion Package. This multi-axis inertial sensing system contains a yaw rate sensor, lateral accelerometer and fore-aft accelerometer.

3.2.5 Roll angle sensor.

3.2.6 Data Acquisition System (DAS). See 4.2.3 Data Collection for more information about the data acquisition method.

3.3 Test Vehicle/Test Piece. This test procedure can be applied to all pneumatic rubber tired highway vehicles with hand wheel steering control at any load condition.

3.4 Test Time.

Calendar time: 1 to 2 days

Test hours: 1 to 2 hours

Coordination hours: 1 to 2 hours

3.5 Test Required Information.

3.5.1 Parameters.

- Vehicle Speed.
- Vehicle Side Slip.
- Yaw Velocity.
- Steering Wheel Angle.
- Steering Wheel Torque.
- Lateral Acceleration.
- Roll Angle.

Note: See Appendix A, Table A1, for typical operating ranges.

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

4 Procedure

4.1 Preparation.

4.1.1 Installation.

4.1.1.1 The DAS must be well restrained inside the vehicle. The front passenger seat is a typical and acceptable location.

4.1.1.2 If an optical speed sensor is used, it should be mounted at the front or rear lateral center of the vehicle. If the sensor cannot be mounted at the precise lateral center of the vehicle, the magnitude and direction of offset from center should be documented and reported to the appropriate test engineer.

4.1.1.3 The motion package is to be installed in a level position as close to the total vehicle center of gravity as is practical. The front passenger seat footwell is a typical and acceptable location. The fore-aft location of the motion package should be recorded on the Vehicle Description Sheet.

4.1.2 Vehicle Preparation.

4.1.2.1 The test vehicle should be inspected to insure that the proper tires and suspension components are installed, and that all chassis components are in good mechanical condition.

4.1.2.2 The vehicle suspension should be aligned to nominal specifications.

4.1.2.3 With the fuel tank full, the vehicle test weights should be determined and recorded.

4.1.2.4 Vehicles equipped with a "tilt-wheel" steering column should be adjusted such that the position of the column is as straight as possible.

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March 2014

Page 2 of 9

4.1.3 Tire Preparation.

4.1.3.1 Tire pressures should be set to the requesting engineer's recommended cold pressure for each tire, unless otherwise stated on the test request.

4.1.3.2 Note 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.

4.1.4 Operator Precautions.

4.1.4.1 Seat belts must be worn during testing. Lock all doors and close all windows prior to testing.

4.1.4.2 The test operator (driver) must inform any others at the test site of his/her presence using the appropriate site-specific communications protocol.

4.2 Conditions. Deviations from the requirements of this test procedure must be agreed upon by Traffic Safety and Management. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.2.1 Environmental Conditions.

4.2.1.1 The test is run on a dry, clean asphalt surface that is clear from debris. A wet surface is acceptable, although there should be no standing water.

4.2.1.2 The wind speed component perpendicular to the direction of travel should be no more than 16 km/h (10 mph). If wind exceeds 5 km/h (3 mph), ideally the test should be run such that it is a tail wind.

4.2.1.3 Ambient air temperature should be above 0 °C (32 °F) and below 40 °C (104 °F).

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.

The test is generally conducted with automatic transmissions in drive. Manual transmissions are run in the highest gear capable of sustaining the desired test speed. The clutch is not disengaged during any test maneuver.

4.2.3 Data Collection. All data is to be sampled at 100 Hz. Typical filter frequency is 25 Hz.

Note: See Appendix A, Figures A1 thru A6, for sample data plots.

4.3 Instructions.

4.3.1 Turn on the instrumentation and data acquisition packages. Allow several minutes for equipment to warm up.

4.3.2 Establish the straight-ahead setting on the steering wheel by driving in a straight-ahead direction at 100 km/h. Mark the 12 o'clock position on the steering wheel with a piece of tape. Adjust the dash mounted pointer to provide a visual reference to the steering wheel straight ahead.

Note: Technicians learning the test may benefit from using a steering wheel protractor to reference steering wheel zero and steering amplitudes. Line up the steering wheel protractor zero degree mark with the pointer when the steering wheel is straight ahead.

4.3.3 With the vehicle at rest, the steering wheel straight ahead, and hands off the wheel, record the balance and calibration data.

4.3.4 Accelerate the vehicle to the test speed of 100 km/h (set cruise control if available). While moving straight ahead with hands off the steering wheel, begin recording data.

4.3.5 After 1 s gently grasp the steering wheel and input a steadily increasing steer angle at less than 2 degrees/s (preferably 1 degrees/s) until the yaw rate reaches 1.62 degrees/s (lateral acceleration of 0.08g). At this point, the DAS should emit a beep to alert the technician that the test is complete.

For test sites with adequate space, the test can be run up to a yaw rate of 2.43 degrees/s (lateral acceleration of 0.12g).

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March 2014

Page 3 of 9