



Engine Drag Control Instantaneous Accelerator Pedal Release in a Turn

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 standard is to test the vehicle's response to an instantaneous accelerator pedal release at a defined vehicle speed, transmission gear, and engine rpm while the vehicle is turning at the specified percent of maximum attainable lateral acceleration on the test surface.

1.2 Foreword. Not applicable.

1.3 Applicability. Vehicles equipped with Electronic Stability Control (ESC) and/or Engine Drag Control (EDC) are candidates to use this test procedure.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References.

Subsystem Technical Specifications (SSTS)

Vehicle Technical Specification (VTS)

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 Vehicle test surfaces of various surface friction coefficients (μ) as specified in Table A1 (Appendix A) of this procedure. 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 Brake pressure sensors located at each corner and at master cylinder.

3.2.2 Vehicle Steering Wheel Angle (SWA) sensor.

3.2.3 Yaw rate sensor at the vehicle's center of gravity, capable of measuring ± 75 degrees/s.

3.2.4 Lateral accelerometer at the vehicle's center of gravity, capable of measuring ± 1.25 g.

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3.2.5 Longitudinal accelerometer at the vehicle's center of gravity, capable of measuring ± 1.25 g.

3.2.6 Vehicle side slip sensor at the vehicle's center of gravity, capable of measuring speed accuracy to 0.05 km/h and with a slip angle to an accuracy of no less than 0.15° in its highest accuracy product/mode.

3.2.7 Wheel speed sensors at each corner.

3.2.8 Brake switch.

3.2.9 Accelerator pedal position.

3.2.10 Throttle position.

3.2.11 Sample rate is 10 ms.

3.2.12 If the approved Inertial and Global Positioning System (GPS) sensor is not used then a longitudinal and lateral velocity sensor can be used ($V(x) \pm 200$ km/h with 0.1 km/h resolution, $V(y) \pm 50$ km/h with 0.01 km/h resolution).

3.3 Test Vehicle/Test Piece. See Section 4.

3.4 Test Time.

Calendar time: Not applicable

Test hours: 4 hours

Coordination hours: Not applicable

3.5 Test Required Information. See Section 4.

3.6 Personnel/Skills. Experienced chassis test technician for vehicle instrumentation. Chassis test driver certified for handling tests.

4 Procedure

4.1 Preparation.

4.1.1 Instrumentation Installation. All instrumentation must be securely fastened to the vehicle due to the nature of test maneuver. Instrumentation should be located on the passenger seat or a rear seat to avoid excessive ballast in the rear of the vehicle. For velocity sensors that are mounted outside the vehicle, they should be mounted on the front of the vehicle with protective shielding to protect sensor from potential damage due to snow banks. The distance from the sensor to the centreline of the front axle must be measured in meters for use in post processing data in order to determine the vehicle's slip angle.

4.1.2 Vehicle Preparation. The vehicle must be within suspension alignment specifications (toe) and the cross corner vehicle weights must be within 68 kg (150 lb) with a full tank of gas. Tire pressures must be set to design intent cold pressure. Tires should be broken in but must not have excessive wear. Brake system operation must not have excessive compliance due to worn brake pads or air in the hydraulic system. A roll cage should be considered for any vehicle with a high center of gravity.

4.2 Conditions.

4.2.1 Environmental Conditions. Wind speed should be <16 km/h (10 mph).

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.

Review VTS and SSTs for test surface selection. The surface friction coefficient is to be between 0.1 and 0.2 for ice or wet ceramic tile. The surface friction coefficient is to be between 0.2 and 0.35 for packed snow or wet basalt. See 4.3.3 for measuring μ .

4.2.3 Operator Precautions. All instrumentation must be securely fastened due to the nature of vehicle dynamics testing. The vehicle operator must use the vehicle restraint system at all times. Helmet usage is mandatory for testing on high coefficient surface. The vehicle's air bag should be disarmed due to the steering wheel angle sensor installation. Vehicle dynamic testing must be done in the middle of a test surface to avoid leaving the boundaries of the test surface.

4.3 Instructions.

4.3.1 Determine Engine rpm to km/h Ratio. Determine the ratio of engine rpm to kilometer per hour (km/h) of vehicle speed for each transmission gear.

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4.3.2 Determine Test Transmission Gears. Determine the lowest three (3) transmission gears to achieve the test specified vehicle speed range without exceeding an engine rpm level of 1000 rpm below “redline”. Vehicle speed shall be biased towards the upper range of test specification if the maximum allowed engine rpm is not exceeded. Vehicle speed shall be biased towards the lower range of test specification if the nominal test speed exceeds the maximum allowed engine rpm but the low end of the vehicle speed range does not.

4.3.3 Measure μ . The surface friction coefficient should be measured by taking the average deceleration of two (2) opposite direction 20 km/h straight line locked wheel brake stop test runs. See Test Conditions for acceptable μ values for each surface type.

4.3.4 Select the appropriate transmission gear for test.

4.3.5 Determine Maximum Lateral Acceleration on Test Surface. Determine the maximum achievable lateral acceleration of the test surface for both left and right hand turns.

4.3.6 Zero Instrumentation. Zero steering wheel angle sensor (0 ± 1) degree, yaw rate sensor (0 ± 0.5) degrees/s, brake pressure transducers (0 ± 69) kPa (0 ± 10) psi, accelerometers (0 ± 0.02)g, and the velocity sensor (0 ± 0.05) km/h if applicable while driving vehicle straight ahead.

4.3.7 Determine Test Open Loop SWA Input. Determine the SWA input needed to achieve 50% of the maximum achievable lateral acceleration (90% for dry asphalt) for both left and right hand turns.

4.3.8 Set SWA Sensor Stops. Set steering wheel sensor lock to the steering wheel angle input determined in the previous step.

4.3.9 Attain Steady State Test Speed. Drive vehicle on high μ surface (asphalt or concrete) to the appropriate vehicle speed and maintain straight ahead steering input.

4.3.10 Perform Test. Drive vehicle onto test surface and turn steering wheel angle until reaching the stop. Pause at least 2 s and then instantaneously release the accelerator pedal. No corrective steering wheel angle inputs are allowed for at least 2 s.

5 Data

5.1 Calculations.

5.1.1 The 1 s yaw velocity ratio is calculated as the average yaw rate from 0.9 s to 1.1 s after accelerator pedal transitions through 50% of the initial pedal input divided by the average yaw rate for the period of 0.25 s to 1 s before releasing the accelerator pedal.

5.1.2 The 2 s yaw velocity ratio is calculated as the average yaw rate from 1.9 s to 2.1 s after accelerator pedal transitions through 50% of the initial pedal input divided by the average yaw rate for the period of 0.25 s to 1 s before releasing the accelerator pedal.

5.1.3 The vehicle deceleration is calculated as the average of the longitudinal acceleration from 0.5 s to 1 s after the accelerator pedal transitions through 50% of the initial pedal input. To avoid vehicle pitch influence on accelerations read from an accelerometer located above the center of gravity and/or located forward or behind the center of gravity, the deceleration may be calculated using a linear regression on the vehicle speed during the period of 0.5 s to 1 s after the accelerator pedal transitions through 50% of the initial pedal input.

5.1.4 If using an approved Inertial and GPS sensor. The time delay of the Inertial and GPS sensor should be understood and correct offset applied to the data channels. If using other sensors the longitudinal and lateral velocity signals must be shifted forward the correct amount of time in the time domain to offset the lag in the sensor's output.

5.1.5 If measuring V_x and V_y the vehicle slip angle shall be calculated using the following formula (this will calculate vehicle slip angle at the vehicle's center of gravity):

$$\text{Beta} = \text{ARCTAN} \{ [V(y) + (YR \times 0.0628 \times Q)] / V(x) \} \times (180/\pi)$$

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