Engine Drag Control Straight Line Instantaneous Accelerator Pedal Release

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 test procedure is to test the vehicle's response to an instantaneous accelerator pedal release at a defined vehicle speed, transmission gear, and engine revolutions per minute (rpm) while the vehicle is traveling in a straight line 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 Specification (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 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 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 ± 1.25g.

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

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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) ± 200 km/h with 0.1 km/h resolution, V(y) ± 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. Velocity sensors that are mounted outside the vehicle 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 centerline 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. μ is to be between 0.1 and 0.2 for ice or wet ceramic tile. μ 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 km/h of vehicle speed for each transmission gear.

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

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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. μ 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 4.2.2 for acceptable μ values for each surface type.

4.3.4 Select the appropriate transmission gear for test.

4.3.5 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.

4.3.6 Attain Steady State Test Speed. Drive vehicle on high μ surface to the appropriate test vehicle speed and maintain straight ahead steering input.

4.3.7 Perform Test. Drive vehicle onto test surface and instantaneously release accelerator pedal. No corrective steering inputs are allowed for at least 4 s.

5 Data

5.1 Calculations.

5.1.1 The peak vehicle yaw rate is measured using the yaw rate sensor located at the vehicle's center of gravity. The peak vehicle yaw rate is defined as the highest vehicle yaw rate measured within 3 s of the accelerator pedal travel transitioning through 50% of the initial accelerator pedal input. The yaw rate signal shall be filtered using a post process digital low pass Finite Impulse Response (FIR) filter with a corner frequency of 10 Hz and a Blackman window of 0.5 s.

5.1.2 The average vehicle yaw rate between 3 s and 4 s is defined as the average vehicle yaw rate between 3 s and 4 s after the accelerator pedal transitions through 50% pedal travel.

5.1.3 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

5.1.4 If measuring Vx and Vy the vehicle slip angle shall be calculated using the following formula: (This will calculate vehicle slip angle at the vehicle's center of gravity)

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

Where:

V(y)	=	lateral velocity from sensor in km/h
V(x)	=	longitudinal velocity from sensor in km/h
Q	=	-[distance to front axle + {wheelbase × (LR + RR)/(LF + RF + LR + RR)}]
Q	=	distance from velocity sensor to centerline of front axle (for external sensors only)
YR	=	yaw rate in degrees per second

LF, RF, LR, RR are corner vehicle weights (curb weight + instrumentation + 68 kg (150 lb) driver)

LF Left Front (Vehicle Corner Designation), **LR** Left Rear (Vehicle Corner Designation), **RF** Right Front (Vehicle Corner Designation), **RR** Right Rear (Vehicle Corner Designation)

5.1.5 The vehicle slip angle shall be filtered using a post process digital low pass Finite Impulse Response (FIR) filter with a corner frequency of 10 Hz and a Blackman window of 0.5 s.

5.2 Interpretation of Results. See Appendix A.

5.3 Test Documentation.

5.3.1 Example data collected on a 1999 Cadillac Catera with EDC and no ESC.

5.3.1.1 Example showing EDC Activation and Stabilization of Vehicle. See Figure 1.

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