



Ramp Steer Maximum Lateral Acceleration Determination Procedure

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 propose of this procedure is to determine a vehicle's maximum lateral acceleration value and corresponding steering wheel value for testing using a ramped steering input. These values will be used in another requested test.

1.2 Applicability. Chassis Controls testing includes Accelerating In a Turn (AIT), Braking In a Turn (BIT), Steering While Braking (SWB), Electronic Stability Control (ESC).

1.3 Remarks. Considerations when running this procedure are vehicle setup, test surface, driver skill, and instrumentation accuracy.

The factors that contribute to successful maximum lateral acceleration determination are vehicle dynamic response; tire characteristics, surface characteristics, driver input, and instrumentation accuracy. The object of maximum lateral acceleration determination is to slowly and smoothly approach and exceed the point where the vehicle becomes non-linear. In other words the point where lateral capability of the tire to road surface becomes saturated or where the vehicle begins to lose its ability to maintain the drivers intended path. It will vary from vehicle to vehicle.

1.3.1 Performing the Ramp Steer. The Traction Control System (TCS) and ESC systems must be off. The maximum lateral (maximum lateral acceleration) determination speed will be run at the test speed called out in the test to be run. The driver will accelerate to a speed slightly above the test speed and stabilize the vehicle at that speed prior to steering wheel input. The result of Steering Wheel Angle (SWA) input will slow the vehicle slightly. The driver will adjust the initial speed such that the maximum lateral acceleration is achieved at the required test speed ± 5 km/h. The driver must be able to maintain neutral throttle throughout the entire maneuver to eliminate any fore/aft wheel slip. If throttle position changes during the maneuver, it may change the torque at the wheels and result in inconsistent vehicle response. The gear selector must be chosen so that the vehicle does not upshift or downshift during the maneuver. Manual vehicles will utilize a normal driving gear for the test speed. The appropriate selected gear will be maintained throughout the maneuver.

The driver must be able to input a steady smooth consistent rate of steering wheel input so that the ramp is linear when viewed on the data acquisition trace. The driver must be able to drive the vehicle smoothly and consistently such that the vehicle generates increasing lateral acceleration until it saturates the capability of the tire to hold the test surface. In other words, up to and beyond the point where the vehicle begins to lose its ability to maintain the driver's intended path. The driver must be able to evaluate the vehicle response such that it generates the maximum lateral acceleration attainable on the test surface without excessive loss of directional control. The evaluator needs to be aware of the values that are reasonable for the vehicle and the surface. For example, a maximum lateral acceleration of 1.00g is probably not reasonable for a large utility vehicle. The requestor will provide a reasonable range of maximum lateral acceleration values for the test vehicle.

Table 1 should be used as a guide for steering wheel angle rates.

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Table 1: Steering Wheel Angle (SWA)

Surface	SWA Rate (in Degrees/s)
Ice	≤ 10
Ceramic	≤ 10
Snow	≤ 15
Basalt	≤ 15
Gravel	≤ 15
Wet Asphalt	≤ 15
Asphalt	≤ 25
Concrete	≤ 25

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.

- CG190 Evaluation Report Template
- Subsystem Technical Specification (SSTS)
- Vehicle Technical Specification (VTS)

3 Resources

3.1 Facilities.

- Laboratory for test vehicle build and instrumentation installation.
- Surface area must be of sufficient size to accommodate test maneuvers without vehicle leaving surface.

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.

3.2 Equipment.

3.2.1 Vehicle steering wheel angle sensor.

3.2.2 Yaw rate sensor rigidly mounted as close as possible to vehicle's center of gravity, capable of measuring ± 75 degrees/s.

3.2.3 Lateral accelerometer rigidly mounted as close as possible to vehicle's center of gravity, capable of measuring $\pm 1.25g$.

3.2.4 Vehicle speed sensor capable of measuring $V(x)$ longitudinal velocity to ± 160 km/h and $V(y)$ lateral velocity to ± 50 km/h, with 0.1 km/h resolution.

3.2.5 Accelerator pedal input.

3.2.6 Sample rate is 10 ms.

3.3 Test Vehicle/Test Piece. Not applicable.

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3.4 Test Time.

Test hours: 2 h to 4 h
Coordination hours: Up to 1 h
Instrumentation: 3 d

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 these test maneuvers. Instrumentation should be located on the passenger or rear seats to avoid excessive ballast in the rear of the vehicle.

The yaw and lateral acceleration sensors will be mounted rigidly as close as possible to vehicle's center of gravity.

4.1.2 Vehicle Preparation. Ballast vehicle to curb weight before installation of instrumentation. After installation of instrumentation, the vehicle must be within suspension alignment specifications with a full tank of gas. Tire pressures should be set to nominal pressures. 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.

4.1.3 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. The vehicle air bags 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.

4.2 Conditions.

4.2.1 Environmental Conditions. As stated in requested test procedure. (AIT, SWB, or BIT).

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 the Vehicle Technical Specification (VTS) and/or Subsystem Technical Specification (SSTS) and/or test procedure for test surface selection. The surface friction coefficient, μ , (μ) is to be between 0.1 and 0.2 for Ice and Wet Ceramic Tile, and between 0.2 and 0.35 for Packed Snow and Wet Basalt. μ (μ) is measured on surfaces by taking the average deceleration of two (2) straight locked wheel stops in opposite directions at 32 km/h. μ (μ) checks are not required on high μ , wet high μ , basalt tile, or ceramic tile surfaces.

4.3 Instructions.

4.3.1 TCS and ESC Must be OFF. Turn off the TCS and the ESC system by utilizing the switch, or by a means determined by the requestor.

4.3.2 Gear Selection. Select a gear that will not result in any shifting during the maneuver. Manual transmission vehicles should utilize a normal driving gear.

4.3.3 Surface μ Check. A total of two (2) μ checks will be performed, one (1) prior to maximum lateral determination and one (1) after maximum lateral determination. μ (μ) checks are not required on high μ , wet high μ , basalt tile, or ceramic tile surfaces.

4.3.3.1 Perform a locked wheel stop from 32 km/h.

4.3.3.2 Record the average deceleration.

4.3.3.3 Repeat steps 4.3.3.1 through 4.3.3.2, μ check, after determination of maximum lateral.

4.3.4 Maximum Lateral Determination.

4.3.4.1 Accelerate straight ahead to a speed slightly above test speed with steering wheel angle at 0 degrees. When the vehicle has stabilized at a speed slightly over the test speed, hold the throttle steady. Do not use cruise control. Maintain throttle position; do not increase throttle position to maintain vehicle speed.

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