High Speed Stability 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 primary purpose of this procedure is to subjectively evaluate the vehicle's high speed directional stability relative to a benchmark vehicle.

1.2 Applicability. This test procedure applies to any two-axled pneumatic rubber tired vehicle at all load conditions.

1.3 Remarks. This test procedure describes a method for assessing vehicle direction control characteristics at speeds ≥ 160 km/h while remaining within the confines of a single lane and maintaining directional control. If the maximum speed of the vehicle is < 160 km/h, the evaluation is conducted at the maximum speed. The maneuver is primarily for subjective evaluation of vehicle directional stability described as a difference in subjective rating (as defined by GMW14264) relative to a reference or benchmark vehicle. These characteristics provide a very good indication of handling **"goodness"** at lower speeds. Three steering input types are used to perform the evaluation:

- In lane step steer.
- In lane pulse steer.
- Free control.

Instrumentation can optionally be installed to provide an objective assessment of these characteristics. This test is standard development work. It should be used to assess the vehicle throughout development.

2 References

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

2.1 External Standards/Specifications.

ISO 9001 SAE J670E
ISO 15037-1

2.2 GM Standards/Specifications.

GMW14264

2.3 Additional References.

Vehicle Technical Specification (VTS) Template

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

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3.1.4 The test shall be carried out on a smooth, clean, dry and uniform paved road surface. The test surface shall be maintained over a minimum recommended track width of 12 m for a length sufficient to permit at least 15 s running at the test speed. The peak coefficient of friction of the road surface should be between 0.8 and 1.0.

The roads in each region used for evaluating High Speed Stability are listed in Appendix A.

3.2 Equipment. As this procedure is primarily designed to subjectively assess vehicle direction stability characteristics at speeds ≥ 160 km/h (or maximum speed if maximum speed is < 160 km/h), no instrumentation is necessary other than a corrected vehicle speedometer.

3.2.1 In the event that instrumentation is used to gain additional insight to vehicle performance, the following instrumentation may be considered.

3.2.1.1 Data Acquisition System (DAS).

3.2.1.2 Instrumented steering wheel with steering wheel angle transducer.

3.2.1.3 Speed and Sideslip transducer.

3.2.1.4 Roll transducer.

3.2.1.5 Yaw velocity transducer.

3.2.1.6 Lateral acceleration transducer.

3.2.1.7 Longitudinal acceleration transducer.

3.2.1.8 Appropriate cabling.

3.3 Test Vehicle/Test Piece. This test procedure applies to any two-axled, pneumatic rubber-tired vehicle at all load conditions.

3.4 Test Time.

Calendar time:	0 days
Test hours:	1 day
Coordination hours:	1 day

3.5 Test Required Information.

3.5.1 (Optional) Channel Assignment and Full Scale Value:

- Steering Wheel Angle: 100 degrees.
- Vehicle Speed: 200 km/h.
- Vehicle Yaw Rate: 50 degrees.
- Vehicle Roll Rate: 10 degrees.
- Lateral Acceleration: 10 m/s².
- Longitudinal Acceleration: 10 m/s².
- Sideslip Angle: 15 degrees.

3.5.2 (Optional) Channels may be added as needed.

3.5.3 (Optional) If instrumentation is used, sample rate is 100 samples per second.

3.5.4 (Optional) If instrumentation is used, 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 “Requirements for Quality Management Systems”.

4 Procedure

4.1 Preparation.

4.1.1 Remove all loose equipment from the passenger compartment including tools, spare parts, extra transducers, and personal belongings.

4.1.2 (Optional) Instrumentation Installation.

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4.1.2.1 The yaw velocity and lateral acceleration transducers are to be installed in the front passenger seat footwell in a level position. Record the fore aft location of the motion package relative to the front wheel centerline on the vehicle, the lateral location relative to the vehicle centerline, and the vertical location relative to the ground in the Test Vehicle Description Sheet (TVD). Refer to Appendix B for a sample TVD.

4.1.2.2 The data acquisition computer must be fastened securely to the seat to prevent it from being dislodged in the event of unexpected loss of control.

4.1.3 Vehicle Preparation.

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

4.1.3.2 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.

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

4.1.4 Tire Preparation.

4.1.4.1 Tire pressures should be set to the manufacturer's recommended cold pressure unless otherwise stated on the test request.

4.1.4.2 Note the condition of the tires. New tires should be conditioned by driving 10 km at 100 km/h, including moderate cornering (0.5g) and several heavy brake stops (no locked wheels). Obviously worn tires should be noted and appropriate wear state checked on the TVD.

4.1.5 Operator Precautions.

4.1.5.1 Helmet and seat belts must be worn during the test in accordance with the regulations of the test facility.

4.1.5.2 The test operator must inform the testers using the facility of his presence using the mobile phone or radio system in accordance with the regulations of the test facility.

4.1.6 Additional information regarding industry standard Vehicle Dynamics test methods and terminology may be found in SAE J670E “Vehicle Dynamics Terminology” and ISO 15037-1 “Vehicle Dynamics Test Methods for Road Vehicles” respectively.

4.2 Conditions.

4.2.1 Environmental Conditions. The test is normally run on dry, clean asphalt surfaces that are clear of debris. Wet surfaces may be specified in special cases.

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.

4.2.2.1 During development, the vehicle can be tested under the conditions of interest. For Vehicle Technical Specifications (VTS) validation, the vehicle is to be tested at Driver + Equipment Load condition. An example of the High Speed Stability VTS Template is shown in Appendix C.

4.2.2.2 During development, the vehicle can be tested with and without Electronic Stability Control (ESC) activated. For VTS validation, the vehicle is to be tested with ESC active if the vehicle is equipped with ESC.

4.3 Instructions.

4.3.1 (Optional) Turn on instrumentation and data acquisition equipment. Allow five minutes for equipment to warm up.

4.3.2 (Optional) Stop the vehicle on the test road with the instrumentation and data acquisition running. With front wheels straight ahead and hands off steering wheel, balance the data acquisition system.

4.3.3 Bring the vehicle to the test speed.

4.3.4 Step Inputs Apply step steering inputs of an amplitude and duration that, with a counter steer input, allow the vehicle to remain within the traffic lane. Start with inputs that generate small vehicle responses and systematically increase amplitude and/or steering rate while maintaining directional control and remaining in the lane. Different amplitudes and steering rates may be applied to assess the sensitivity of the vehicle to these inputs.

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