



Steering Gear Performance Test: Input Shaft Driven, Rack Free, Near Stop

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 is to measure the input shaft rotating torque with the rack unattached and the gear power on and off, with the input shaft driven to within 30 degrees of the stops. The output includes the near-center and near-stop torque ranges for clockwise and counterclockwise rotations, and once-per-revolution input shaft torque variation attributable to an eccentric pinion.

1.2 Applicability. This test procedure is applicable to any automotive rack and pinion steering gear whether manual or electrically or hydraulically assisted.

1.3 Remarks. The mesh of the rack and pinion steering gear causes torque fluctuations at the input shaft that depend on the gear-set quality, the preload strategy and the gear tuning. The test boundary conditions are that the gear is powered or unpowered, the rack is free of any attachments (except for an optional position encoder) and the input shaft is driven in both directions to within 30 degrees of the end of travel.

2 References

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

2.1 External Standards/Specifications.

ISO 17025

2.2 GM Standards/Specifications.

GMW16794

2.3 Additional References. None.

3 Resources

3.1 Facilities. A steering gear test bench, capable of 50 Nm input shaft moment, and an appropriate steering gear power supply (hydraulic or electric) are necessary to conduct this set of steering gear tests.

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 Data Acquisition System (DAS).

3.2.2 Position Transducers. There should be direct measurements of the input shaft rotational position with respect to the ground, an encoder is preferred.

3.2.3 Force Transducers. There should be a direct measurement of the input shaft torque.

3.3 Test Vehicle/Test Piece. This test procedure applies to any passenger vehicle, power rack and pinion steering gear.

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May 2016

Page 1 of 5

3.4 Test Time.

Calendar time: < 1 day
Test time: 0.5 hours
Coordination time: 0.5 hours

3.5 Test Required Information.

3.5.1 Channel. Name, Minimum Resolution and Minimum Full Scale Value.

- Input Shaft Angle, 0.025 degrees, 720 degrees
- Input Shaft Torque, 0.005 Nm, 50 Nm

3.5.2 Sample Rate. Fifty samples per second (50 Hz).

3.5.3 Anti-Aliasing Filter Frequency. 25 Hz.

3.6 Personnel/Skills. Operator must be qualified and documented as capable to run this test as required by ISO 17025.

4 Procedure

4.1 Preparation.

4.1.1 Installation.

4.1.1.1 Mount the gear housing to the fixture as it is mounted to the vehicle sprung mass. For example, if the housing mounts are compliant, those same mounts should be used in the test fixture.

4.1.1.2 The tie rod to housing boots should be removed.

4.1.1.3 All the tie rod joints should lie on the rack axis as much as possible. The effects of radial loads on the inner tie rod end are the subject of other investigations.

4.1.1.4 If the gear is hydraulic, after mounting in the fixture, the cylinder ports should be as near the top as possible to reduce the amount of trapped air.

4.1.1.5 Align and connect the steer actuator to the steering gear input shaft through an intermediate line shaft or, in the case of a column electric power steering (EPS) system, a properly mounted steering column and an intermediate shaft with vehicle-representative joint angles.

4.1.2 Test Specimen Preparation.

4.1.2.1 Unless requested, do not test the gear if it has loose and/or worn inner tie rod ends, a disturbed preload adjuster plug or dirt/corrosion inside the housing.

4.1.2.2 Center the steering gear based on the rack position where half the stop-to-stop travel is defined as center. The steering gear centering procedure is detailed in GMW16794.

4.2 Conditions.

4.2.1 Environmental Conditions.

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.

4.2.3 Hydraulically Assisted Gears.

4.2.3.1 Power Steering (P/S) pump flow at 100 km/h must be determined to supply the proper flow rate to the gear during the test. Most pumps will be in flow control at this vehicle speed. Pump flow rate vs. pump speed plots will help determine this value. The engine speed may be required which will depend on the transmission type and gear ratios. To establish engine speed, automatic transmissions should be in drive and manual transmissions should be in the highest gear capable of sustaining 100 km/h.

4.2.3.2 P/S fluid temperature should be maintained at 77 °C for the duration of the test.

4.2.3.3 For variable effort steering systems, power is supplied to the gear and current set to an appropriate level that matches the vehicle calibration value at 100 km/h.

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May 2016

Page 2 of 5

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