



Steering Column Stiffness/Hysteresis/Lash Test 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 purpose of this test is to measure the stiffness and lash of a steering column. This test measures the horizontal and vertical displacement against applied force

1.2 Applicability. Any steering column.

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.

- Component Technical Specification (CTS) which defines the component level testing and reliability requirements of the component

3 Resources

3.1 Facilities. A bedplate that measures at least 1.2 m × 1.8 m (4 ft × 6 ft) with pneumatic (for air bearings) and electrical (for motor/controller) capacity. The bedplate and test equipment must be isolated from outside influences that can affect collected data.

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. Sections 3.2.1 through 3.2.6 include test rig, fixtures, transducers, instrumentation, and controllers typically used by the GMNA Global Steering Development Laboratory to perform this test. Other equipment may be substituted at the discretion of the local testing facility as long as it provides equivalent accuracy as specified herein or by the requestor. Any setup must be approved by the steering column Bill of Material (BOM) family owner (BFO).

3.2.1 Linear Actuator. A linear actuator is to be used to apply a load to the test specimen. The actuator in the GMNA test lab is capable of applying a constant 500 N force within a tolerance of ± 5 N.

3.2.2 Fixtures. Fixtures with adequate adjustability and appropriate mounting locations are required to mount the test specimens. The test specimen should be mounted using the in-vehicle mounting locations using similar bolts to the in-vehicle application. The stiffness of the mounting fixture shall be no less than ten (10) times as stiff as the test specimen requirement.

3.2.3 Load Cell. A load cell is to be placed between the linear actuator and the test specimen. The load cell shall be capable of measuring up to 500 N with a resolution of 1 N or smaller.

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3.2.4 Load Cell Linkages. Linkages are required to connect the load cell to the linear actuator and the test specimen. These linkages must be capable of transmitting the force from the linear actuator without bending or buckling.

3.2.5 Linear Encoder. A linear encoder is used to measure the displacement of the test specimen. The encoder must have a resolution ≤ 0.001 mm and must be capable of measuring at least ± 5 mm. Other non-encoder type measurement devices may be used in place of an encoder so long as resolution and range requirements are met.

3.2.6 Data Acquisition. Both the linear encoder and load cell data is to be recorded at a minimum rate of 1000 samples/s.

3.3 Test Vehicle/Test Piece. The test specimen mounting orientation shall be rotated about the vehicle coordinate system y-axis with respect to the in-vehicle position. The test specimen shall be rotated such that the column centerline is within ± 20 degrees of horizontal when at the center of rake/tilt. See Figure A1 (Appendix A) for an example. The load shall be applied to the end of the steering column that the steering wheel normally mounts. The displacement measurement shall also be taken as near to the load application point as possible.

3.4 Test Time.

Calendar time: 0.5 days

Test hours: 1 hour

Coordination hours: 2 hours

3.5 Test Required Information. The requesting engineer is responsible for providing the Component Technical Specification (CTS) which must include the performance objectives (sample size and failure criteria) for development and/or validation tests.

3.6 Personnel/Skills. A test engineer is required to run this test. The test engineer shall be capable of proficiently setting up and running the test, which involves aligning/clamping down fixtures and ensuring proper test bench function. The test engineer shall also be able to interpret the test results and create reports as appropriate, which includes the use and/or programming of software to process data.

4 Procedure

4.1 Preparation.

4.1.1 Place fixture on bedplate and mount the test specimen to the fixture.

4.1.2 Attach the load cell and linkages to the linear actuator and test specimen as described in 3.3.

4.1.3 Arrange the fixture and linear actuator on the bed plate such that the linear actuator is applying the load perpendicular to the centerline of the test specimen. Clamp/tighten the fixtures to the bed plate once the desired position has been achieved. See Figure A2 (Appendix A) for an example.

4.1.4 Position/attach the linear encoder as described in 3.2.5. The GMNA steering lab mounts the linear encoder to a magnetic base. The magnetic base is secured to the bedplate.

4.2 Conditions.

4.2.1 Environmental Conditions. Unless otherwise specified, tests are typically conducted at room temperature $22\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ with a Relative Humidity (RH) of $40\% \text{ RH} \pm 20\% \text{ RH}$.

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.

4.3 Instructions.

4.3.1 Data Collection Parameters. Unless otherwise specified, record the torque and all rotary encoder displacements vs. time responses. Data shall be collected at a minimum rate of 1000 samples/s.

4.3.2 Test Parameters. Unless otherwise specified, each test specimen shall be subjected to four (4) load cycles while measuring force and displacement. A load cycle is defined as:

- Start test at 0 N
- Apply +300 N at a rate of 50 N/s
- Apply -300 N at a rate of 50 N/s

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