



Intermediate Shaft Stiffness/Hysteresis/Lash Test

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 determine the hysteresis, lash, on-center rate, and off center rate of passenger car and light duty truck collapsible intermediate shafts. This procedure may be used for development or validation. This test provides a constant torque applied to the intermediate shaft. Result of the test will be performance characterization of the intermediate shaft.

1.2 Applicability. This procedure applies to body on frame and body frame integral vehicles.

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): Defines the component level testing and reliability requirements of the component
- Gurley Precision Instruments, Troy, New York (www.gurley.com)
- MB Dynamics Technology, Test Processes and Engineering Services, Cleveland, Ohio (www.mbdynamics.com)

3 Resources

3.1 Facilities. A bedplate/slotted table approximately 1.2 m × 1.8 m (4.0 ft × 6 ft). The bedplate/slotted table must be isolated from outside influences that can affect the data collection portion of the test.

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.

Note: Sections 3.2.1 through 3.2.5 include test rig, fixtures, transducers, instrumentation, and controllers typically used by the General Motors North America (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 intermediate shaft Bill of Material (BOM) Family Owner (BFO).

3.2.1 Rotary Actuator. One (1) rotary actuator with low friction bearings. The actuator must have the ability to operate in torque control without noise or internal friction that may affect the response from the intermediate shaft. An example of an actuator with these characteristics is the MB Dynamics DS10.

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3.2.2 Rotary Encoders. High precision rotary encoders. The number of encoders necessary is equal to the number of joints on the intermediate shaft plus one. Examples of said joints are any cardan joints, sliding joints, isolators, etc. An example of an actuator with these characteristics is the shafted Gurley R158 encoder (maximum precision of 1 000 000 counts/revolution).

3.2.3 Fixtures. Fixtures necessary to support the intermediate shaft at the actuator end and the reaction end. The fixtures must simulate the interfacing parts of the intermediate shaft. The actual interfacing parts may be used as fixtures.

3.2.4 Miscellaneous Cabling. Cabling with appropriate end connectors will be required to connect the transducers to the instrumentation and controllers to the rotary actuator and instrumentation.

3.2.5 Data Acquisition System. A data acquisition system capable of recording the various displacement encoders as well as the torque response of the rotary actuator is required to evaluate the stiffness, hysteresis, and lash of an intermediate shaft. Data shall be collected at a minimum of 1000 samples/s.

3.3 Test Vehicle/Test Piece.

3.3.1 Sample quantity of the intermediate shaft as specified by the Design Engineer or Component Technical Specification (CTS). All test material should be certified prior to receipt to confirm that it is representative of design intent.

3.3.2 The intermediate shaft shall be in line with the actuator and extended to match the vehicle design position.

3.3.3 There must be a cardan joint at each end of the intermediate shaft. The intent is to prevent bending loads from being induced into the intermediate shaft. Vehicle joint angles are required.

3.4 Test Time.

Calendar time: 1 day

Test hours: 1 hours

Coordination hours: 2 hours

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

3.6 Personnel/Skills. Operator must be qualified and documented as capable to run this test as required by ISO 9001.

4 Procedure

4.1 Preparation.

4.1.1 Fix column end of intermediate shaft to rotary actuator. Fasten bolt to torque specification stated in the CTS.

4.1.2 Fix steering gear end of intermediate shaft to fixture which will later be grounded to supporting bed plate/slotted table. Fasten bolt to torque specification stated in the CTS.

4.1.3 Adjust shaft so that all angles are nominally representative of in vehicle geometry. See Appendix A, Figure A1.

4.1.4 Ground the fixture which the steering gear end of the intermediate shaft is attached to.

4.1.5 Encompass each joint on the intermediate shaft by two (2) rotary encoders so that the rotational displacement can be measured both upstream and downstream of the joint. See Appendix A, Figure A2.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

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 displacement vs. time responses. Data shall be collected at a minimum rate of 1000 samples/s.

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4.3.2 Test Parameters. Three (3) loading cycles shall be performed during each test. One cycle consists of loading the specimen to 6 N·m in both directions with a 0.5 s to 1 s pause in between each directional change. The load shall be applied at a rate of 5 N·m/s with an acceleration of 900 N·m/s². See Appendix A, Figure A3.

5 Data

5.1 Calculations.

5.1.1 Torsional Hysteresis. The amount of torsional hysteresis in the intermediate shaft is quantified as the difference in the shafts rotational position as the torsional load applied crosses through 0 N·m in both directions. See Appendix A, Figure A4.

5.1.2 Torsional Lash. The amount of torsional lash in the intermediate shaft is quantified as the net displacement of the shaft as the load on the shaft goes through zero (between +1 N·m and -1 N·m). See Appendix A, Figure A5.

5.1.3 On-Center Rate. The on-center rate of the intermediate shaft is quantified as the stiffness of the shaft as the load on the shaft goes through zero (between +1 N·m and -1 N·m). See Appendix A, Figure A6.

5.1.4 Off-Center Rate. The off-center rate of the intermediate shaft is quantified as the average stiffness of the shaft as it is loaded from 2 N·m to 4 N·m in both directions. See Appendix A, Figure A7.

5.2 Interpretation of Results. Pass/Fail criteria is specified in the CTS.

5.3 Test Documentation.

5.3.1 Any issues which occur during testing should be documented in an issue report.

5.3.2 The following information should be included in the final evaluation report.

- Sample Model Year/Model/System
- Test methodology
- Any deviations from procedure
- Photograph of setup
- Test instrumentation and calibration information
- Detailed description of results

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

7 Notes

7.1 Glossary.

7.2 Acronyms, Abbreviations, and Symbols.

BFO	BOM Family Owner
BOM	Bill of Materials
CTS	Component Technical Specification
GMNA	General Motors North America
GSSLT	Global Subsystem Leadership Team

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW17422

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