



Steering Column To-Ground Lateral and Vertical Static Stiffness Evaluation 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. To determine the steering column to-ground lateral and vertical static stiffness.

1.2 Applicability. Steering columns from GM and competitive vehicles.

1.3 Remarks. Steering column static stiffness metrics are included in the Chassis SSTS Template. These requirements are important for improving the vibration performance of 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.

GMW14172

2.3 Additional References.

Subsystem Technical Specification (SSTS)

3 Resources

3.1 Facilities. A bedplate.

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 Test Equipment.

3.2.1.1 Displacement transducer (i.e., digital dial indicator) with 0.005 mm resolution.

3.2.1.2 Force transducer with minimum range of 500 N static load and 5 N resolution, and associated power supplies and readouts, see GMW14172.

3.2.2 Test Fixtures.

3.2.2.1 Rigid stand for mounting the column to ground, and associated tie-down hardware, see Appendix A, Figure A1.

3.2.2.2 Spacer blocks for constraining the steering column via its fastener locations to the rigid stand.

3.2.2.3 Wedge block for providing level surface at dial indicator tip.

3.2.2.4 Appropriate adapter for load application 12 mm forward of steering column shaft end, see Appendix B, Figure B1.

GM Confidential

© Copyright 2016 General Motors Company All Rights Reserved

September 2016

Page 1 of 8

3.2.2.5 Elephant's foot, or similar, to mount the load application device to the bedplate, see Appendix C, Figure C1.

3.2.2.6 Spherical bearing (Heim Joints).

3.2.2.7 Threaded Rod/Washers/Nuts.

3.2.3 Spreadsheet program capable of performing linear regression and stiffness calculations (i.e., MS Excel).

3.3 Test Vehicle/Test Piece. A steering column. The steering column should be qualified to ensure that it represents design intent. Deviations should be corrected or noted. The requester should fully describe the condition of the steering column to be tested if it is non-standard.

3.4 Test Time.

Calendar time: 2 days

Test time: 2 hours

Coordination time: 14 hours

3.5 Test Required Information. Will require fabrication for adapting column fastener locations to the rigid stand.

3.6 Personnel/Skills. To complete these tests, one (1) technician and/or one (1) engineer skilled in static stiffness data acquisition and analysis is required.

4 Procedure

4.1 Preparation.

4.1.1 Rigid Stand (Appendix A, Figure A1). The rigid stand itself shall be bolted to the bedplate. Torque all constraint bolts to approximately 300 Nm. The steering column shall be bolted to the approved rigid stand. The production intent fasteners and torques shall be used to mount the column to the fixture. Fabrication may be required to weld spacer blocks to the stand for the column fastener locations.

4.1.2 Force Application (Appendix B, Figure B1). Force is applied to the steering column shaft, 12 mm forward of the end, either in the lateral or vertical direction. A heim joint (rod end bearing) is attached to the reacting body (usually an elephant's foot, see Appendix C, Figure C1). A force transducer is then orthogonally attached to the test object. The force transducer is bolted (via an adapter, see Appendix B, Figure B1) to the steering column shaft. A single threaded rod with two (2) nuts and one (1) washer is passed through the reacting bodies of the heim joint and then attached to the other end of the force transducer. One of the nuts is used to tighten the threaded rod to the force transducer and the other is used with the washer to apply the force to the test object.

4.1.3 Spherical Bearing (Heim Joint). When installing, make sure the bearing is oriented orthogonal to the direction of the load. Center the threaded rod within the bearing, see Appendix C, Figure C1.

4.1.4 Wedge Block (Appendix C, Figure C1). A wedge block is used to obtain a flat, smooth, horizontal surface for the dial indicator to measure from. Often a standard flat washer can be used. Install the block onto the steering column shaft surface with hot glue, in line with the load, 12 mm forward from the end of shaft.

4.1.5 Digital Dial Displacement Indicator (Appendix C, Figure C1). Mount the base of the dial indicator to the rigid stand. Align the measurement tip perpendicular to the steering column shaft, 12 mm forward of the shaft end, utilizing a wedge block.

4.1.6 Force Transducer (Appendix C, Figure C1). Align the transducer perpendicular to the test object. When using a threaded rod in combination with the force transducer, make sure that nuts are placed on either side of the force transducer to prevent independent motion.

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.

GM Confidential

© Copyright 2016 General Motors Company All Rights Reserved

September 2016

Page 2 of 8

Documents
Document Sharing Hub

4.3 Instructions.

4.3.1 Remove any hysteresis in the steering column by applying the maximum load case at 200 N and maintaining for 30 minutes. Release the load.

4.3.2 Set all dial indicators to zero (0).

4.3.3 Apply the first load at a 50 N increment and record the displacement. Continue in 50 N increments, up to 200 N, recording the displacement at each load increment.

4.3.4 Reduce the load in 50 N increments, recording the displacement at each load, until the steering column is no longer under load.

4.3.5 Repeat 4.3.2 thru 4.3.4 for a total of three (3) times to check repeatability.

5 Data

5.1 Calculations. Plot the applied force versus the measured displacement for each load case.

5.2 Interpretation of Results. Observe the quality of data in a graph (Appendix D, Table D1). A least squares fit of the data points should produce a straight line with a correlation coefficient of at least 0.92. The slope of the line generated is the steering column to-ground (lateral or vertical) static stiffness (N/mm).

5.3 Test Documentation. The single number for steering column to-ground lateral or vertical static stiffness (N/mm) should be presented with existing values for other steering columns, and compared to the SSTS requirement.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

7 Notes

7.1 Glossary.

Applied Force: Static load that is applied to the steering column shaft, in either the lateral or vertical direction.

Hysteresis: A retardation of an effect when the forces acting upon a body are changed (as if from viscosity or internal friction).

Static Stiffness: The slope of the force versus deflection curve for the steering column when it is subjected to a given static load case while constrained by specified boundary conditions.

7.2 Acronyms, Abbreviations, and Symbols.

IDSR Integration Driven Subsystem Requirements

N&V Noise and Vibration

VPO Vehicle Performance Owner

8 Coding System

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

Test to GMW14216

GM Confidential

© Copyright 2016 General Motors Company All Rights Reserved

September 2016

Page 3 of 8

AVA Documents
Document Sharing Hub