GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW14230

Rear Frame Torsional 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 rear frame torsional static stiffness of the frame from a full-frame vehicle.

1.2 Applicability. Frames from GM and competitive full-frame vehicles.

1.3 Remarks. The torsional stiffness of the rear frame is an important factor in the level of on-road shake experienced by the occupants of a full-frame vehicle. High torsional stiffness in this area also provides a solid foundation for the rear suspension, which simplifies the suspension tuning. Frame static stiffness metrics are intended as an improvement over the previous practice of specifying free-free frame mode frequencies, which have not been shown to relate to full vehicle performance.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14336

2.3 Additional References.

Subsystem Technical Specification (SSTS)

3 Resources

3.1 Facilities. A large 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 Spherical bearings.

3.2.2 Elephant's feet.

3.2.3 Force ring transducers.

3.2.4 Dial indicators.

3.2.5 Wedge blocks.

3.2.6 Threaded rod/nuts.

3.3 Test Vehicle/Test Piece. A Frame including bolt-on hardware (e.g., bumpers and cross members).

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3.4 Test Time.

Calendar time:	1 day
Test time:	3 hours
Coordination time:	5 hours

3.5 Test Required Information. May require fabrication for load application interface.

3.6 Personnel/Skills. One (1) engineer and one (1) technician skilled in calibration and data acquisition using force transducers and dial indicators.

4 Procedure

The Frame Static Stiffness Master Procedure GMW14336 shall be followed with the only deviations being those described in the following Rear Frame Torsional Static Stiffness Validation Procedure.

4.1 Preparation.

4.1.1 Calibrate force ring transducers.

4.1.2 Boundary Conditions. Constrain the frame at the Nol. 1 and No. 3 body mount brackets on both sides. See Appendix A Figure A1.

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 Force Input Locations. Applied vertically through the rear suspension damper (shock absorber) brackets, opposite directions.

4.3.2 Displacement Measurements. On the damper brackets as close as practical to the force input on both sides. Also, on the reference bar on both sides. See Appendix A, Figure A1.

4.3.3 Reverse the input force orientations and repeat.

5 Data

5.1 Calculations.

5.1.1 Geometry.

Where:

Y_{Load}	Distance Between Applied Forces (mm)
$Y_{Disp.}$	Distance Between Displacement Transducers Near Load (mm)
$Y_{Ref.}$	Distance Between Displacement Transducers on Reference Bar (mm)

5.1.2 Measurements (for each load case).

Where:

F	Applied Force (N)
Z_L	Measured Vertical Displacement on Shock Tower, Near Applied Load, Left (mm)
Z_R	Measured Vertical Displacement on Shock Tower, Near Applied Load, Right (mm)
Z_{RefL}	Measured Vertical Displacement on Reference Bar, Left (mm)
Z_{RefR}	Measured Vertical Displacement on Reference Bar, Right (mm)

See Appendix A, Figure A2.

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5.1.3 Equations.

5.1.3.1 Moment Due to Force Couple (N-m).

$$M = F * Y_{Load}$$

5.1.3.2 Angle of Frame Torsion at Moment (rad).

$$\theta_{Load} = \frac{Z_L - Z_R}{Y_{Displacement}}$$

5.1.3.3 Angle of Frame Torsion at Reference Bar (rad).

$$\theta_{Reference} = \frac{Z_{RefL} - Z_{RefR}}{Y_{Reference}}$$

5.1.3.4 Rear Frame Torsional Static Stiffness (kN-m/rad).

$$K_{Rear\ Frame\ Torsion} = \frac{M}{\theta_{Load} - \theta_{Reference}}$$

Note: Use the generated data to plot the Moment vs. Angle (@Load - @Reference) for all load cases.

5.2 Interpretation of Results. Observe the quality of data in graphs (see Appendix B, Figure B1). A least-squares fit of the data points (see Appendix B, Table B1) should produce a straight line with a correlation coefficient of at least 0.95. The slope of the line generated is the rear frame torsional static stiffness (kN-m/rad).

5.3 Test Documentation. The single number for rear frame torsional static stiffness (kN-m/rad) should be presented with existing values for other frames, and compared to the Subsystem Technical Specifications (SSTS).

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.

Applied Forces: Static loads that are induced onto the frame at specific locations (e.g., front shock attachments).

Boundary Condition: Constraining forces applied to the frame that prevent frame gross motion during applied forces.

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

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