GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW14213

Frame Track Bar Bracket Lateral 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 track bar bracket lateral 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 track bar bracket lateral stiffness of the frame is an important factor in the level of on-road shake experienced by the occupants of a full-frame vehicle. High lateral stiffness in this area also provides a solid foundation for the suspension, which simplifies its 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.

None

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

4.1 Preparation.

4.1.1 Calibrate force ring transducers.

4.1.2 Boundary Conditions. Constrain the frame at the Front End Sheet Metal (FESM), No. 3 and No. 5 body mount brackets on both sides of the frame. 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 Location: Applied laterally through the rear suspension track bar bracket on one side of the frame.

4.3.2 Displacement Measurements. On the rear suspension track bar bracket as close as practical to the force input. Also, on the top outboard edge of the frame rail directly above the load. Also, on the center bolt of the No. 3 and No. 5 body mount constraints on the load side. See Appendix A, Figure A1.

5 Data

5.1 Calculations.

5.1.1 Geometry.

Where:

$X_{Forward}$	Fore/Aft Distance between Load and No. 3 Body Mount Constraint (mm)
$X_{Rearward}$	Fore/Aft Distance between Load and No. 5 Body Mount Constraint (mm)

5.1.2 Measurements (for each load case).

Where:

F	Applied Force (N)
D_{Load}	Measured Lateral Displacement on Track Bar Bracket, Near Applied Load (mm)
D_{Rail}	Measured Lateral Displacement on Frame Rail Upper Edge, Above Applied Load (mm)
$D_{\#3Const}$	Measured Lateral Displacement on No. 3 Body Mount Constraint on Load Side (mm)
$D_{\#5Const}$	Measured Lateral Displacement on No. 5 Body Mount Constraint on Load Side (mm)

See Appendix A, Figure A2.

5.1.3 Equations.

5.1.3.1 Frame Track Bar Bracket Regional Static Stiffness (N/mm).

$$K_{Regional} = \frac{F}{D_{Load} - D_{Rail}}$$

Note: The regional value includes the effect of any frame rail rotation between the constraints.

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5.1.3.2 Rigid Displacement Due to Imperfect Constraints (mm).

$$D_{Rigid} = \frac{X_{Forward}}{X_{Forward} + X_{Rearward}} * (D_{\#5Const} - D_{\#3Const}) + D_{\#3Const}$$

5.1.3.3 Frame Track Bar Bracket Semi-Global Static Stiffness (N/mm).

$$K_{Semi-Global} = \frac{F}{D_{Load} - D_{Rigid}}$$

Note: The semi-global value includes the effect of any frame rail rotation and frame rail bending between the constraints.

Plot both regional and semi-global static stiffness 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 frame track bar bracket lateral static stiffness, regional or semi-global Newtons/millimeters (N/mm).

5.3 Test Documentation. The single number for frame track bar bracket lateral static stiffness, both regional and semi-global (N/mm) 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.

7.2 Acronyms, Abbreviations, and Symbols.

FESM	Front End Sheet Metal
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 GMW14213

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