



Measurement of Torsional Stiffness

1 Scope

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. This procedure will determine the global static torsional stiffness of a vehicle structure. Procedure can be used as a basis for alterations such as clockwise twist load or additional indicators. Deviations must be documented. The resultant data is used for benchmarking and diagnostics.

1.2 Foreword. There are two options to apply load to structure. (1) Twist Beam (2) Vertical Column. This test procedure can used to measure the torsional stiffness of a full vehicle or a Body in White (BIW).

1.3 Applicability. This standard applies to all Body Frame Integral (BFI) passenger 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.

- Body Structures Subsystem Technical Specifications (SSTS)
- CG190 GM Evaluation Report

3 Resources

3.1 Facilities.

3.2 Equipment.

3.2.1 Test plate (clamping plate 5 m x 3 m).

3.2.2 Minimum of twenty six (26) dial gauge indicators with a resolution of 0.01 mm; range 30 cm to 250 cm.

3.2.3 I-beam for supporting the vehicle across the front wheel wells or shock caps – pivot on centerline of vehicle.

3.2.4 Twist beam for applying the load above shock tower.

3.2.5 Load Applied to the Vehicle. If the Twist Beam method is used, 1100 N of total load divided into smaller amounts. If the Vertical Columns method is used, hydraulic loads with loads transducer.

3.2.6 Approximately 250 kg to 1600 kg in total ballast distributed into smaller amounts.

3.2.7 Two (2) machined shock cap adaptor plates.

3.2.8 Two (2) machined rings to fit around the spring pocket.

3.2.9 Two (2) lubricated bearings for rear spring supports (see Appendix A).

3.2.10 Testing with the vertical columns will require the following equipment: A center pivoted I-beam with a ball joint connection at each side. Two tubes (columns) with a machined adaptor for the strut top. A spindle drive with a shaft joint (or other devices to apply vertical forces) at each end of the I-beam. A load cell for each side and a measuring amplifier.

3.3 Test Vehicle/Test Piece. This procedure can be performed on a fully built vehicle or BIW, see 7.1. It is recommended that pictures and documentation carefully identifies all content of tested property, particularly BIW (i.e., glass, cradle, instrument panel (IP), etc.) For vehicles, partial removal of some suspension will be required. Refer to the Body Structures SSTs for the appropriate vehicle build if this testing will be done for validation.

3.4 Test Time. Not applicable.

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Not applicable.

4 Procedure

4.1 Preparation.

4.1.1 Inspection.

4.1.1.1 Equipment. Inspect test equipment for calibration and proper operation.

4.1.1.2 Test Vehicle. Visually inspect entire body and doors, with special attention to the roof structure, windshield, test side frame and front door structure. Structural damage in these areas is typically not acceptable.

4.1.2 Prepare Test Property.

4.1.2.1 Constraints and Loads Overview.

Front Constraints and Loading: There are two approaches depending on architecture or available equipment. One option is to load shock tower from the top supporting the structure on the rails or cradle (Twist Beam). The second Option is to support the structure on the shock caps and load the structure through the supports (Vertical columns). See Section 4.1.2.3 for detailed information.

Rear Constraints: The Rear Constraint method is the same regardless of which option is used for the front constraints and loading. See Section 4.1.2.2 for more information.

4.1.2.2 Rear Constraints. The objective in setting up the rear constraints is to **not** add fixture stiffness to the vehicle. To accomplish this there must be no lateral constraint on the side of the vehicle opposite the twist load (this location should be free to float up and down before ballast is added). Also, lubricated bearings are used at each spring seat to assure that a moment into the rail is not possible. See Appendix A for details on the lubricated bearings.

4.1.2.2.1 Rear Constraint on the Opposite Side of the Vehicle as the Twist Load.

- There should be a vertical constraint (Z as shown in Figure 2).
- Vertical (Z) Constraint - The vertical constraint needs to prevent lifting of this corner of the vehicle. The rear spring perch shall not lift. Ballast may be placed in passenger compartment seating area or in trunk of vehicle over rails. A minimum amount of ballast should be used to prevent the rear corner of the vehicle from lifting (approximately 250 kg). This will vary depending on the loading area of the mass.

4.1.2.2.2 Rear Constraint on the Same Side of the Vehicle as the Twist Load.

- There should be a horizontal, lateral, and a vertical constraint (X, Y, and Z as shown in Figure 2).
- A ring around the spring pocket, as shown in Figure 1, can be used for the X, Y, and Z constraint.
- A lubricated bearing shall be used to prevent the fixture from inducing a moment into the rail about the X, Y, or Z axis.



Figure 1: Rear Constraints - Example of Bearing to Prevent a Moment into the Rail

4.1.2.3 Front Constraints and Loading.

4.1.2.3.1 Option 1, Twist Beam.

4.1.2.3.1.1 Option 1, Twist Beam – Front Support. The Cradle or Rail is supported by a Pivoting I Beam. The load is applied using a twist beam above the shock towers to apply the torque to the structure, see Figure 2.

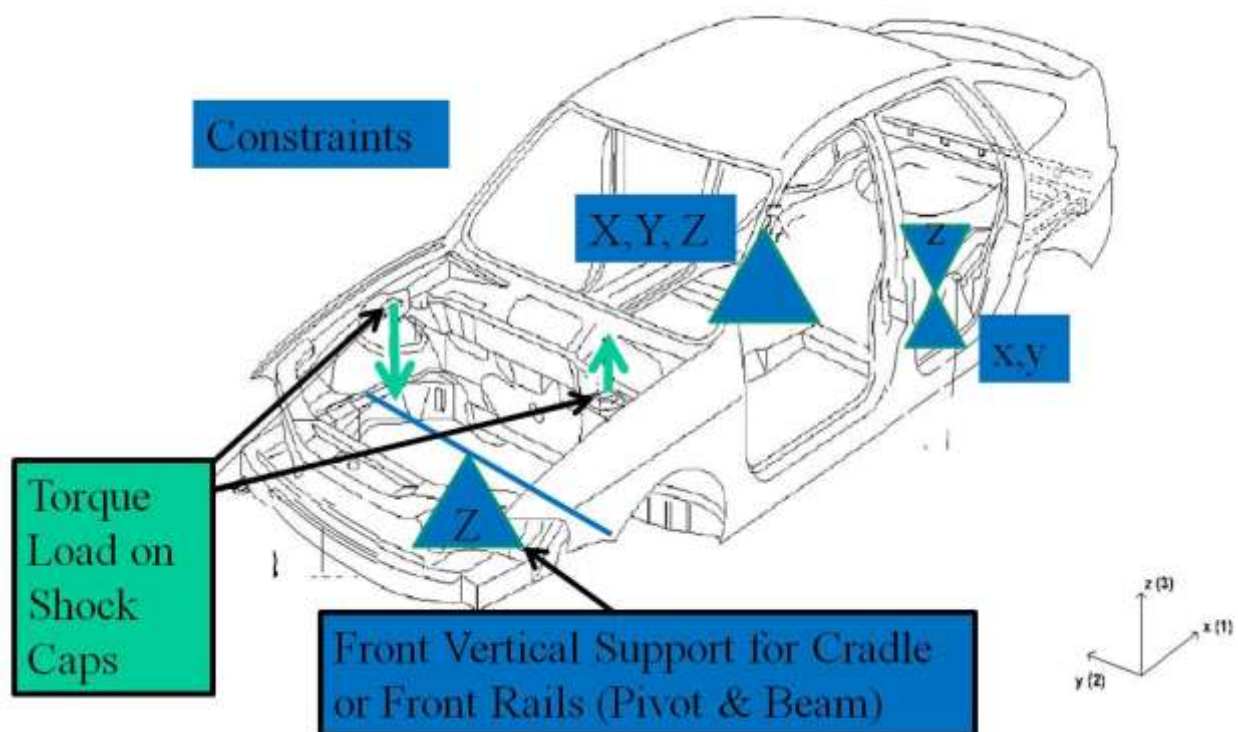


Figure 2: Overall Constraints and Loads Twist Beam Approach

The front of the car shall be supported by a pivot located at the centerline of the vehicle, see Figure 3. The I-beam shall be installed near the Fore/Aft (F/A) center of the front shock tower, see Figure 4. Care should be taken to support the surface of the cradle/rail so the flanges do not bend due to the I-beam.



Figure 3: Pivot at Centerline of Vehicle



Figure 4: I-beam Located on the Front Wheel Wells

4.1.2.3.1.2 Option 1, Twist Beam - Load Applied to Structure.

- The structure shall be twisted using a rigid beam connected to the front strut towers. The setup of the beam is shown in Figure 5. This beam is known as the twist beam.
- Care should be taken to minimize the local deflection of the shock caps. Stiffening the surface of the caps is necessary. Bolted on machined adapters shall be used for mounting both sides of the twist beam. The mounting scheme can be seen in Figures 6 thru 9.
- The driver side of the twist beam shall be bolted to the shock tower while the passenger side attachment shall be left loose. This setup prevents the twist beam from adding stiffness to the vehicle

© Copyright 2012 General Motors Company All Rights Reserved

July 2012

Page 4 of 16

structure. Machined adapters shall be used for mounting both sides of the beam. The mounting scheme for the twist beam can be seen in Figures 6 thru 9.

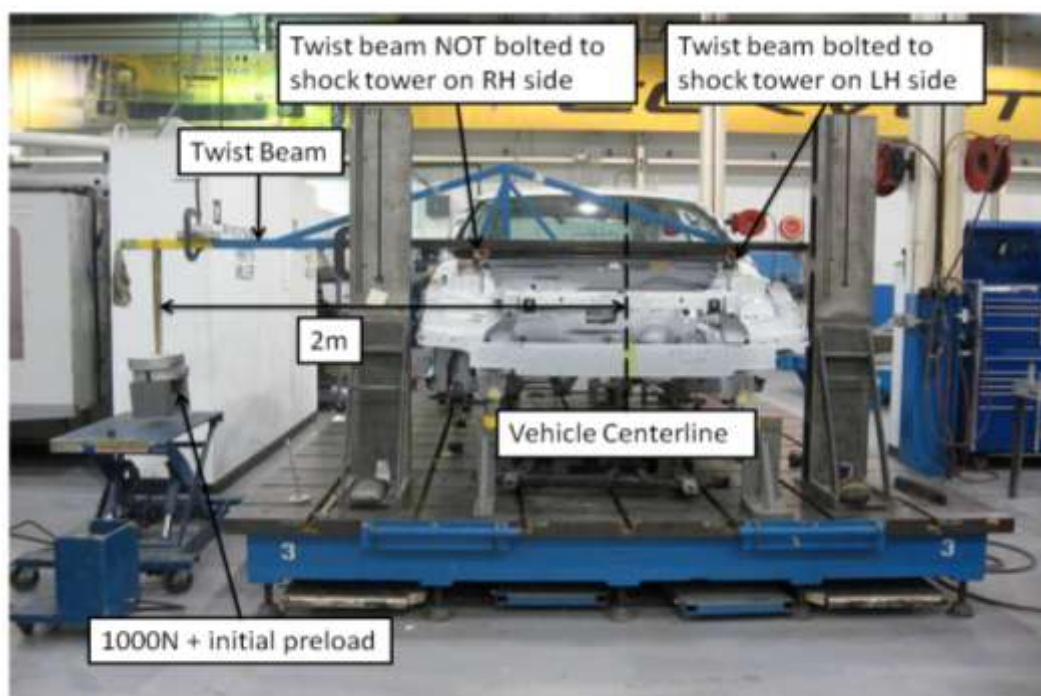


Figure 5: Setup of the Twist Beam Attached to the Body



Figure 6: Beam Mounting Scheme – Driver Side Upper Figure