



Strength and Durability Testing of Brackets and Supports for Powertrain Mounts

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. Determination of the static and dynamic durability of brackets and supports for powertrain mounts.

1.2 Applicability. Development tests, initial sample tests, and tests for quality monitoring of brackets and supports for powertrain mounts of the complete vehicle range.

2 References

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

2.1 External Standards/Specifications.

ISO 9000

2.2 GM Standards/Specifications.

GMW3425

GMW14116

GMW15011

GMW16285

GMW3428

GMW14676

2.3 Additional References.

Component Technical Specification (CTS)

Subsystem Technical Specification (SSTS)

3 Resources

3.1 Facilities. Supplier testing facilities shall be in accordance with the requirements of the responsible General Motors department. Technical data of the testing facilities (e.g., technical designs) shall be made available by the responsible GM department.

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. Servo-hydraulic testing device with appropriate regulating and control equipment for performance of the tests in accordance with 4.3.1 and 4.3.2.

3.3 Test Vehicle/Test Piece. Brackets and supports for powertrain mounts.

3.4 Test Time.

Calendar time: 5 days per sample (approximately)

Coordination hours: 8 hours

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. General automotive technician skills are required, with experience and training in the use of hydraulic testing equipment.

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4 Procedure

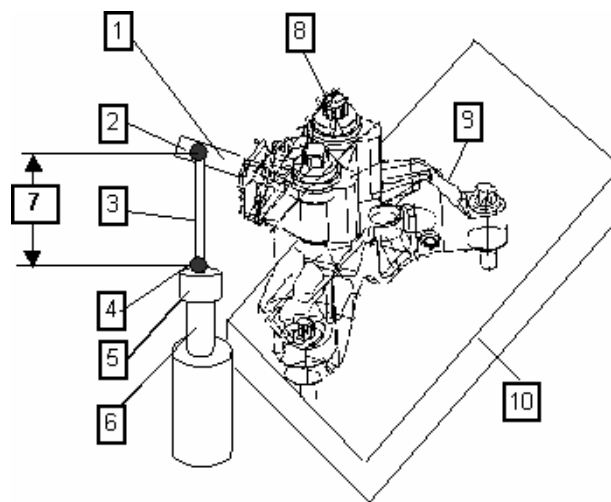
4.1 Preparation.

4.1.1 Clamping of Component Parts. The powertrain mounts and support brackets shall be fastened together in accordance with the applicable installation instructions. Components which are not to be tested may be replaced by a steel installation component. For this purpose, the geometry of the bracket contact surface shall correspond to that of the original mating component. The powertrain mount and support bracket assembly shall be mounted on a steel installation plate or on the original mating component (transmission housing, engine block, etc.) in vehicle installation position.

The original mounting geometry shall always be taken into account. This information is provided in math data files.

Both the steel installation plate as well as the original mating components (transmission housing, engine block, etc.) shall be mounted in such a way, that no change to the installation position occurs under operating load.

4.1.1.1 Ancillary Parts. If the bracket assembly includes other attaching or intermediate parts (e.g., brackets for guide rollers or brackets for air conditioning compressors), these shall be included either as original parts or as steel installation components. Refer to Figure 1 for illustration of test setup.



Where:

1. Installation component.
2. Upper joint point.
3. Joint rod for load application.
4. Lower joint point.
5. Force gauge.
6. Test cylinder.
7. Joint rod length: Static test > 500 mm, Dynamic test > 250 mm.
8. Test piece powertrain mounts.
9. Test piece support.
10. Clamping panel.

Figure 1: Test Setup for Static and Durability Tests

4.1.1.2 Installation of Component Parts. Test pieces shall be fastened using original bolts. The installation instructions are given in the relevant specification.

The bolts shall be tightened with the minimum torque specified. The nominal torque and the minimum angle may only be used for torque/torque angle assembly.

The test requestor shall provide nominal torque values.

All bolt-connection data (further torque), before and after the test, shall be recorded.

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4.1.1.3 Coordinate System. Dimensional references and load application directions shall follow the vehicle coordinate system as shown in Figure 2. These coordinates shall be used for construction purposes, references on part drawings, layout diagram coordinates, or for dimension sketches in the relevant drawings.

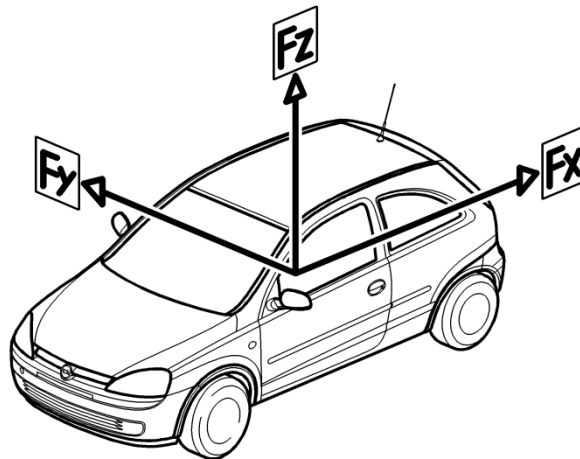


Figure 2: Coordinate System

4.2 Conditions.

4.2.1 Environmental Conditions.

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 Static Tests. The forces shall be applied in the specified coordinate directions, both in the compressive as well as in the tensile directions.

It is recommended that a test setup which enables the application of forces via the joint rod (Figure 1, Item 3) in the tensile direction be used.

The component parts shall be tested in the relevant loading directions until failure occurs.

Load velocity:

- a. ≤ 10 mm/minute
- b. ≤ 0.1 kN/s

4.3.1.1 Indication of F_{min} in Relevant Specifications. F_{min} values derived from the applicable CTS, SSTS, or component drawing shall be indicated in the relevant test specification (see Appendix A, Table A1) as specified by the responsible GM Department.

4.3.2 Constant Amplitude Tests (Durability Tests).

4.3.2.1 Load Specification. The vibration forces may be indicated in X, Y and Z directions, in accordance with the test piece type and function in the vehicle. Load shall be applied sinusoidally to the component. A test frequency of $f = 1/T$ shall also be specified, where T is the period of the sinusoidal signal in seconds. See Figure 3 for details. Alternately, Block Cycle Tests are also allowed; the Block Cycle schedule should be correlated for damage to service loads on the subsystem.

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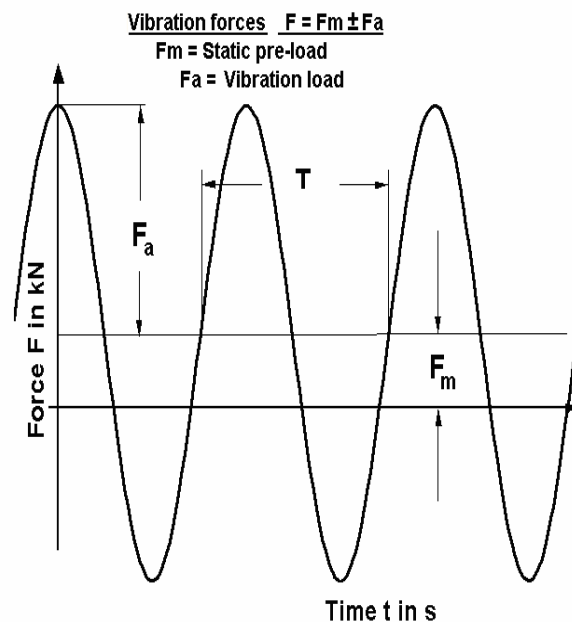


Figure 3: Vibration Forces Specification

4.3.2.2 Reliability Testing - First Test Level F_1 . $F_1 = F_m \pm F_{a1}$ is based on Road Load Data (RLD), GMW3425 or GMW3428 (program dependent). F_m (Engine/transmission load in the mount center) shall be applied as static preload and F_{a1} as vibration load, as shown in Figure 3. Block Cycle test to be developed using GMW16285.

One life is estimated with the F_1 force level and a fatigue damage factor < 0.3 (see Appendix C, Sections C1 and C2); typical loads from calculation should also be taken into the account.

In the case of no RLD (early project phase), the use of load data from comparable projects is allowed.

4.3.2.2.1 Procedure. Test four (4) samples according to 4.3.2.2. If no cracks occur up to three (3) lives on all four (4) samples, the procedure according to 4.3.2.3 shall be performed.

4.3.2.3 Failure Mode Testing - Test Level F_2 . The purpose of this test level is the determination of failure modes and effects. A test frequency of $f = 1/T$ shall be specified.

In Test Level F_2 , a force $F_2 = F_m \pm F_{a2}$ shall be determined, in which the first cracks occur.

Methodology to determine extended usage:

- $F_{a2} = 1.3 \times F_{a1}$
- Run test to failure on four (4) samples each in X, Y and Z directions
- The crack position and the associated crack period in cycles shall be recorded

4.3.2.4 Statistical Evaluations and Crack Criterion. Test failure criteria and reliability requirements are as specified in GMW14116.

4.3.2.5 Crack Inspection. The components shall be periodically checked so as to enable the detection of crack periods, which correspond to the crack lengths specified in 4.3.2.4.

4.3.2.6 Indication of Test Levels and Rated Cycles in Relevant Specifications. The required test levels as specified by the responsible GM Department shall be derived from the CTS, SSTs or component drawing requirements as applicable to the components being tested. (See also Appendix A, Table A1).

4.3.3 Additional Tests on Aluminum Parts.

4.3.3.1 Thread Pull-out Force Test according to GMW15011.

4.3.3.2 Compression Test according to GMW15011.

4.3.4 Damping Blocks with Steel Inner Sleeves. Test according to GMW14676 (Compression Test). Test values shall be specified on the drawing or in the CTS.

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