



Seat-to-Ground Natural Frequency Evaluation Procedure

1 Introduction

The Hand Held Force Input Frequency Response Function Acquisition, GMW14181, shall be referenced for more detailed information corresponding to the following procedure.

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. Define the process of determining the first fore/aft and lateral natural frequencies of a seat mounted to the ground. The product of this procedure will be a fore/aft and a lateral frequency value in Hertz (Hz).

1.2 Applicability. This test procedure is appropriate for use with all seats from passenger cars and light trucks.

1.3 Remarks. If a seat as mounted in-vehicle has a first resonant frequency at or near suspension frequencies (8 Hz to 16 Hz, depending on the vehicle), it could amplify energy from the road to the driver. The Seat Subsystem Technical Specification (SSTS) contains a requirement for seat as mounted to-ground natural frequencies (fore/aft and lateral). Typically, the frequency of these modes will drop 1 Hz to 3 Hz from the to-ground condition to in-vehicle, depending on the rigidity of the floor structure.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14181

2.3 Additional References.

- PCB Piezotronics, Inc., 3425 Walden Avenue, Depew, NY 14043-2495 USA
- Seat 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. Refer to GMW14181. For this test, a modally tuned impulse hammer (e.g., PCB-086D05 with PCB-084A51 Adaptor and hammer tips ranging from 084A50 to 086C05, the super soft tip (Grey 15.101, 1 in 10SS) is recommended and available from PCB Piezotronics, Inc.) shall be used.

3.2.2 Test Fixtures. Refer to GMW14181. For this test, rigid spacer blocks shall be used to mount the seat via its fasteners to ground (bedplate). The blocks shall be of sufficient footprint as to replicate the in-vehicle contact surface area at each of the seat/floor attachments (four (4) typical). The blocks shall be drilled and tapped to

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accommodate the fasteners. The spacer blocks should include rigid “ears” to facilitate clamping to the bedplate (ground). See Appendix A, Figure A4.

3.3 Test Vehicle/Test Piece. A complete seat assembly, including padding, cloth, trim, seat belt and hardware if All Belts To Seat (ABTS), power seat motors, headrest, seat track and mounting structure.

3.4 Test Time.

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

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Engineer and/or technician skilled in vibration data acquisition and analysis, and operation of the equipment.

4 Procedure

4.1 Preparation.

4.1.1 Boundary Conditions. Refer to GMW14181. For this test, the boundary conditions are to ground. The seat shall be secured via the design fasteners to the spacer blocks. The spacer blocks shall be clamped or otherwise secured to the bedplate (ground).

4.1.2 Component Preparation. Refer to GMW14181. For this test, the seat should be cycled through its full range of motion prior to data acquisition. For the data acquisition, the seat should be set to the center of its range of motion in the fore/aft direction. For a power seat, seat bottom vertical should be set to the center of its travel. The seat back to seat bottom angle should be adjusted to the seat design position. For benchmarking purpose, this angle should be considered 100 degrees. The headrest should be moved upwards enough to allow accelerometer placement and impact hammer hits.

4.2 Conditions. Wholly contained in GMW14181.

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 Setup for Measurement System.

- Frequency Range: 0 Hz to 128 Hz.
- Resolution: 0.25 Hz.
- Trigger Mode: Hammer Input channel.
- Time Windows: Uniform Window. If event cannot be completely observed, use Force/Exponential Windows.
- Trigger Level: 10% to 50% slope channel. Sign of the slope may vary depending on transducer type and Data Acquisition System (DAS).
- Trigger Delay: 1% (of time block) trigger delay (pre-trigger) for all channels.
- AC Coupled (1 Hz high pass filter) Enable overload detection.
- Measuring Function: Frequency Response Function (FRF) with force at reference.
- Number of Average: Five (5) minimum.
- Force Level Input: Select hammer tip to achieve an approximate 12 dB roll off 5 Hz to 100 Hz. Typical time domain input 40 N peak (approximately 1 N to 1.2 N Root Mean Square (RMS) from 5 Hz to 100 Hz). Check if it is necessary to add mass to impulse hammer to achieve the force level input.

4.3.2 Measurement Location. Mount the accelerometer to a rigid surface on the upper portion of the seat back with hot blue or other appropriate material. This surface ideally would be the metal seat back framework itself. This would require cutting the seat material, often impractical. Instead the plastic seat belt collar for an ABTS seat or the headrest post may be used. If no rigid location is available, bind the seat back with string or tape and attach the transducer at a firm location. In case of an issue with the supplier, the seat back frame shall be used.

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For the lateral direction, use the side of the seat at the upper crossmember. Initial transducer orientation will be in the fore/aft direction. See Appendix A, Figures A2 and A3.

4.3.3 Impacting the Structure. Refer to GMW14181. For this test, use the impact hammer as described in 3.2.1. Impact in the fore/aft direction, next to the accelerometer.

4.3.4 Data Acquisition. Refer to GMW14181. Acquire, verify and store a drive point FRF (fore/aft).

Change the accelerometer orientation to lateral, and impact the seat in the lateral direction. Acquire, verify and store a drive point FRF (lateral).

5 Data

Refer to GMW14181.

5.1 Calculations. The result of this test is the frequency at which the first high amplitude peak occurs in the imaginary position of the FRF.

5.2 Interpretation of Results. The seat-to-ground fore/aft and lateral frequencies should be compared to other previously measured seats and the SSTS requirements.

5.3 Test Documentation. Refer to GMW14181. The seat-to-ground fore/aft and lateral frequencies should be stored in the database. Examples are shown in Appendix A, Table A1 and Figure A1.

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.

All Belts To Seat (ABTS): A seat with an integral seat belt.

7.2 Acronyms, Abbreviations, and Symbols.

ABTS	All Belts To Seat
DAS	Data Acquisition System
FRF	Frequency Response Function
IDSR	Integration Driven Subsystem Requirements
IVER	Integration Vehicle Engineering Release
MST	Mid Size Truck
N&V	Noise and Vibration
RMS	Root Mean Square
VPO	Vehicle Performance Owner

8 Coding System

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

Test to GMW14206

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