



Component Multi-Axial Simulation Table Durability

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 durability characteristics of a subsystem or component when subjected to simulated road inputs. The table is typically used to simulate accelerations that will produce an inertial load in the specimen similar to that seen during customer usage. It can also be used to reproduce specific loads/strains on selected parts.

1.2 Applicability. This test is applicable to any vehicle subsystem or component that will generate inertial loads. The mass of the subsystem or component to be tested will be determined by the facility used, but will typically not exceed 30 kg. Some typical examples include:

- Engine Beauty Covers
- Air Induction Subsystems
- Engine Control Module (ECM) Brackets
- Battery Tray Subsystems
- Electric Park Brake Modules

1.3 Remarks. The Multi-Axial Simulation Table (MAST) provides controlled, multi-axial input in either (3 degrees of freedom) in the vertical, lateral, and fore-aft directions or (6 degrees of freedom) in the vertical, lateral, fore-aft, roll, pitch, and yaw directions.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14048 (ID)	GMW15242	GMW15244	GMW15268
GMW15235	GMW15243	GMW15245	GMW15269

(ID) = This standard is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

Note: This list of standards is for reference only. Not all will be required for all tests. Review entire procedure to determine needed references.

2.3 Additional References.

- Component Technical Specifications (CTS)
- Subsystem Technical Specifications (SSTS)
- Vehicle Technical Specifications (VTS)

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3 Resources

3.1 Facilities. A bedplate large enough for securing the test rig and capable of withstanding dynamic loading of the test rig/specimen is required. Also required is a hydraulic system capable of supplying oil at a rate consumed by a MAST. The test facilities and equipment shall be in good working order and all instrumentation shall have a valid calibration label.

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.

Note: The following list(s) include test rig, fixtures, transducers, instrumentation, and controllers typically used by the GMNA Structural Development Laboratory to perform this test. Other equipment may be substituted at the discretion of the local testing facility as long as it provides the same data and/or data record, with equivalent accuracy as specified herein or by the requestor.

3.2.1 Test Rig. A simulation table capable of controlling either three degrees of freedom, (vertical, lateral, and fore-aft) or 6 degrees of freedom (vertical, lateral, fore-aft, roll, pitch and yaw). See Figure B1 in Appendix B for an example of a typical test setup.

3.2.1.1 The simulation table surface area should be adequate to mount the test specimen and the appropriate fixtures. The hydraulic actuators should be sized appropriately to reproduce the acceleration experienced on the road.

3.2.1.2 Fixtures. Fixturing is required to support the test specimen in its in-vehicle position.

3.2.2 Transducers.

3.2.2.1 Specimen Transducers. GMW15268 defines the minimum transducer set required for Road Load Data Acquisition (RLDA) and the test development portion of the test procedure.

3.2.2.1.1 Accelerometer. Accelerometers are typically used to collect acceleration data at strategic locations during the RLDA and test development. The accelerometers will serve as the Remote Parameter Control (RPC) transducers in developing the simulation table drive signals. Remote parameter response coherent with the given direction for each actuator is required for each of the hydraulic actuators controlling the motion of the table. Acceleration responses collected on the body and/or frame side are required.

3.2.2.1.2 Loads/Strains. Loads and strains on the specimen can be used in a non-square matrix as additional control channels or for correlation.

3.2.2.1.3 Torque Wrench. A torque wrench is used to tighten all threaded fasteners to the specified torque.

3.2.3 Instrumentation.

3.2.3.1 Transducer Conditioner. The transducer conditioner is used to condition the inputs from the specimen transducers. It is used during the RLDA as well as for the test development on the test rig. A setup file is created at the start of the RLDA, which defines the gain, full scale, excitation, and sensitivity for each transducer. This information is saved and transferred to the test lab along with the RLDA transducers. This allows use of the same transducers/parameters during test development.

3.2.4 Controllers.

3.2.4.1 Test Site Controller (TSC). The TSC is used to play the test rig drive signals out to the test rig during test development and the durability portion of the test. It can also be used to collect responses from the test rig transducers for test monitoring.

3.2.4.2 Servo Hydraulic Controller. The servo controller provides closed loop control to the servo hydraulic loops on the test rig. Test rig drive signals (command) are played into the servo controller from the TSC. The servo hydraulic controller also provides shutdown limits that can be tailored by the user for a specific test. These limits can prevent unsafe operation of the test rig when system control is interrupted.

Many modern controls systems include both the servo controller and TSC in a single box.

Note: Test rig tuning should be confirmed after the specimen has been installed on the table and adjusted as required. Index fasteners with a paint pen, torque seal or equivalent, to enable visual inspection of fastener movement from initial position.

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3.2.5 Test Sample. Typically, multiple samples are tested to multiple lives of simulated severe customer usage to demonstrate customer reliability. For example, a sample size of three tested to three times life will confirm 97% reliability with 50% confidence, assuming a Weibull slope of 2. A sample size that produces a lower reliability target should be agreed upon by the test requestor unless specifically called out in the VTS, SSTS, or CTS.

3.2.5.1 RLDA Hardware. A duplicate set of hardware must be provided by the RLDA requester if the hardware used in performing the RLDA will not be made available for developing the test in the lab; or any RLDA hardware removed and provided to the lab will have to be replaced on the RLDA vehicle. A request to the RLDA group, to duplicate the hardware with the specific modifications, should be made at the time of the RLDA request.

3.3 Test Vehicle/Test Piece. Not applicable.

3.4 Test Time. The following is an estimate of the amount of time (work hours) needed to perform this procedure.

Note: These time estimates are approximate averages. Actual times vary considerably depending on early component failures (and subsequent availability of replacement parts), testing to varying multiples of cycle lives, scheduling problems for test facilities, test equipment malfunctions, scheduling of overtime and/or multiple shifts, actual readiness of test samples upon receipt, unique or additional requests for detailed test information, running multiple samples (times shown are for one sample), etc.

The reported times consider preparation and other downtime, actual test, and analysis of data in capturing a total calendar time. They are estimated ranges for a typical durability test and will vary based upon the chosen durability schedule. Report writing, approval, processing, etc., are not part of the reported times.

Calendar time:	3 d to 10 d
Test time:	70 h to 250 h
Coordination time:	40 h to 80 h

3.5 Test Required Information. The requesting engineer is responsible for identifying the durability schedule to be simulated and provide test specifications, SSTS or CTS paragraph numbers, appropriate to the component/subsystem being tested.

Testing worst-case scenarios may uncover some potential problems. Discuss with the requesting engineer if testing should include some worst-case scenarios. Certain components may be considered worst case for a particular variant. Components not evaluated by the test may be validated by analysis. Also, consider if any of the following may apply: tolerance stack-ups, build variations, misalignment, minimum/maximum fastener torque(s), environmental extremes, symmetry (Left Hand vs. Right Hand), mold or die source, etc.

The following specifications or information are required to run this test:

3.5.1 RLDA Report. An RLDA report should be available that describes the RLDA property, road segments collected, channel lists, instrumentation, etc.

3.5.2 Time History Data. RLDA data should be provided to the test lab in RPCIII format. File names must adhere to the local standard naming convention. Modifications to the provided data should be documented in the RLDA report.

3.5.3 Durability Part Information. Part numbers, design level, Uniform Part Classification (UPC) codes, Functional Name Address (FNA) codes, etc., must be provided for the production intent material to be evaluated during the test. Fastener torque specifications must be provided along with assembly sequences that may apply to properly assemble the test specimen.

3.5.4 Test Inspections. The minimum lab practice is to inspect the test specimen 2 times per 8 h shift during durability testing. Any increase in inspection frequency should be specified by the requester at the start of durability testing.

3.6 Personnel/Skills. Prior experience/training in setting up and running similar tests and experience/training in the use of the referenced test equipment are required for a successful evaluation. This experience is also critical to achieving the estimated times shown in 3.4, Test Time.

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