



# Multi-Axis S&R Turnkey Solutions

## GMW14011 and GMW 7293TP

|  |  |                                       |          |
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|  | <b>WORLDWIDE ENGINEERING STANDARDS</b> | Test Procedure<br>Noise and Vibration | GMW14011 |
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Objective Subsystem/Component Squeak and Rattle Test

GM has worldwide test procedures GMW14011 and GMW 7293TP for performing Objective Subsystem/Component Squeak and Rattle Tests. The purpose of these procedures is to provide instructions for subjecting the subsystem or component to vibration profiles comparable to in-vehicle vibration and objectively measuring the Squeak and Rattle performance.

**GM explicitly recommends MB Dynamics' Energizer Series Shakers, Multi-directional Universal Test Fixtures and horizontal moving tables in these worldwide Test Procedures. MB delivered more than 100 turnkey squeak and rattle (S&R) solutions that meet GM's Background N10 Loudness level of 1.5 sones and that fully conform to GM Standards. MB provides engineering services, test process development, and training to fulfill such demanding S&R requirements.**

### Why Multi-Axis, Sequential Test Systems for Finding & Fixing S&Rs?

Road-induced vibration causes buzzes, squeaks & rattles (S&R) inside the vehicle's interior. Such annoying noises come from the cockpit (instrument panel), seats, door modules, console, headliner, sunroof, HVAC, steering columns and numerous components such as seat belt retractors, audio/entertainment/navigation systems, and cargo/sun shades. There are more than 1,000 contact points in these interior subsystems and components that could be the sources of friction-induced and impact-induced annoying noises. A systematic process is needed to troubleshoot and detect root causes of S&Rs, to identify their location, to understand the transmission path (s) (air-borne and/or structure-borne) from source to radiator to occupant, and to understand the physics of why they occur so that design, material, supplier or manufacturing process changes can be made to reduce if not eliminate them.

Multi-axis sequential vibration systems that excite these subsystems and components in their vertical, fore-aft (or longitudinal), and lateral directions one axis at a time have been proven to be effective means of diagnosing root causes, paths, etc. Oftentimes the physics of why such noises occur are so complicated and not intuitive that it is helpful to excite one direction at a time to diagnose root causes. Exciting with road-measured vibration levels separately in each direction helps in this process to detect and correct.

### What are some examples of multi-axis test systems?



## What are important specifications for the MB Multi-Axis S&R Test Systems?

| Parameter  | Specification   |
|--|---|
| Subsystems & Components Tested                               | Cockpits (instrument panel), seats, door modules, consoles, headliners, sunroofs, HVAC, steering columns, ¼ bucks, ½ bucks and numerous components such as seat belt retractors, audio/entertainment/navigation systems, cargo/sun shades, clusters, etc.   |
| Noise levels without payload                                 | 1.5 sones N10 Loudness running a typical S&R PSD profile  |
| Payload weights  | No practical limit; typical masses of above payloads; 150kg   |
| Payload sizes  | No practical limit with universal fixture tubes; attach above payloads to arrangement of universal fixture tubes, using brackets between payload's vehicle connect points and tubes   |
| Vibration excitation, each axis                              | Road-measured PSD random and time histories; sine   |
| Max. vibration amplitudes                                    | 0.75 gRMS and 3 g's peak instantaneous during PSD random or time history replication (typical S&R degradation levels are 100% higher); 1.0 g pk sine  |
| Number of Quiet Energizers with Force-Multiplying Lever Arms | 1 or 2 Energizer BLACKs or SILVERs, uncooled; 1 BLACK can perform above vibration amplitudes without forced air cooling for payloads less than 75kg; 2 Energizers are useful for heavier payloads or larger test items or with tests requiring higher S&R degradation amplitudes on heavier payloads  |
| Fixture-specific conditions                                  | No head expander because those large flat surfaces radiate noise and pump air causing higher Background Noise readings; universal fixture tubes have small surface areas; tubes are stiff but lightweight, having many inserts for bolting together any payload at its vehicle connect points   |
| Environmental conditioning                                   | All equipment can operate at -40 to + 80 C, with options  |
| Frequency range  | GM's S&R frequency range of 8 Hz - 100 Hz is easily attained  |
| Mobility and Positioning                                     | Energizers and universal fixture pedestals are mounted on base masses with air casters for moving over smooth lab floors for positioning for vertical, fore-aft and lateral excitation; can also be bolted to floor or T-slot table   |
| Turnkey System Deliverables                                  | Includes Energizer (s) with lever arms in 3-axis base (s) with Universal Fixture System having tubes and pedestals – configurable for vertical, fore-aft and lateral vibration; 19" cabinet; S&R Controller with rack-mount PC; brackets for 1 <sup>st</sup> test item; accelerometers, <i>S&amp;R Metrics</i> for measuring S&Rs; installation, training, start-up |

### What is *S&R Metrics*?

*S&R Metrics* is software and acoustic data acquisition hardware dedicated to measuring buzzes, squeaks and rattles. Sound quality packages are often used to quantify S&Rs, but contain extra and unneeded features, including: Sharpness, Tonality, Articulation, and Roughness. *S&R Metrics* is the **COST EFFECTIVE** S&R detection system. Easy to use modules make it suitable for any setting from R&D facilities to factory installations where technicians have little time for intricate setups and complex options. It includes Instationary Loudness, SPL, and other audio functions necessary for S&R.

