



Vehicle Road Simulation for S&R

Effective, Lower-Cost & Quieter Excitation of Squeaks & Rattles

Squeaks & rattles (S&Rs) are annoying noises that cause customer dissatisfaction, produce high warranty costs, and expose poor quality. The J.D. Power Initial Quality StudySM (IQS) surveys owner-reported problems in the first 90 days of new-vehicle ownership. **Body & Interior Quality - Mechanical** scores issues including poor interior fit & finish and squeaks & rattles. IQS findings command worldwide attention. Media inform consumers when OEMs fall short: "We get downgraded because of little things like a squeak or a loose part." OEMs and suppliers welcome technology to help them design & build S&R-free vehicles.

MB Dynamics delivers effective, low-cost, and quiet excitation technology to root source S&Rs in vehicles, trimmed bodies, subsystems and components. MB's patented Direct Body Excitation (DBE) Road Simulator and Dynamic Vehicle Twist (DVT) technologies help detect vehicle S&Rs during development, launch, and production. Electrodynamic and pneumatic excitations under PC control replace hydraulics.

- ❖ **Patented Direct Body Excitation (DBE) into body at 2 stiff locations, 1 @ front & 1 @ rear**
- ❖ **Since excitation is not thru tire & suspension, forces & displacements are << 4-posters**
- ❖ **PC control of vibration response to road-measured drive-files at door hinge or A-pillar or shock tower or trunk, under MIMO control**
- ❖ **10 years experience at different OEMs: BMW, GM, Mercedes Benz, Ford, Hyundai**
- ❖ **High correlation to road tests & 4-posters**
- ❖ **Patented stiff suspensions in electro-dynamic Energizers, and stingers, protect Energizers from failure during vehicle response**



- ❖ **Dynamic body twist or torsion, simulates twist ditch circuit and low-speed curb impacts (DVT)**
- ❖ **Excites suspension & mount noises, rubber & seal itches, and body creaks**
- ❖ **Air spring actuators provide up to 150mm peak of up-stroke under each wheel**
- ❖ **MIMO control of each of 4 wheels, controls displacement amplitude, shape and phase**
- ❖ **Programmable speeds up to 8 km/hr (2 Hz)**
- ❖ **Wheel pans support vehicle during DBE**
- ❖ **Front wheel pans move for various wheelbases**

CUSTOMER TESTIMONIAL: "Your team has done an excellent job in putting together a viable S&R assessment/root cause determination tool. We have the potential to significantly reduce the root cause/source determination of squeaks and rattles. This will result in a better quality product and higher levels of customer satisfaction. I can see significant improvements concerning (1) redundant S&R road testing, (2) time required for rapid and accurate S&R assessments and corrective action determination and validation, and (3) enhanced end-of-the-line throughput to name but a few."

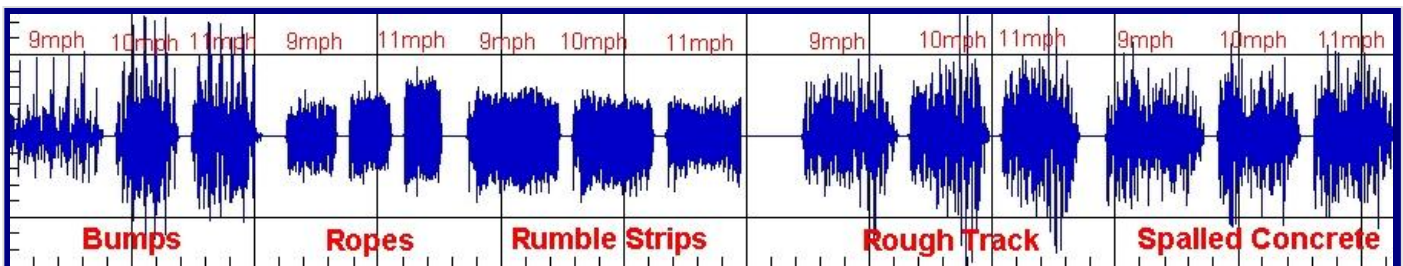
Features & Benefits:

- ❖ **S&R detection effectiveness: comparable to S&Rs produced and heard during road tests & with 4-poster**
- ❖ **DBE system cost is 35% - 40% of hydraulic 4-poster**
- ❖ **Requires no seismic mass; no special foundation; minimal disruption to facility; minimal facility cost**
- ❖ **Safe: no 215 bar oil pressure; no disposal of used oil**
- ❖ **Safe: get in & out during test or even get under vehicle**
- ❖ **Low maintenance; simple to operate by plants or labs**
- ❖ **Higher frequency energy (up to 200 Hz) excites S&Rs not found with road simulators (< 50 - 70 Hz)**
- ❖ **Quiet compared to 4-poster: no wheel pan slap; no servo-valve hiss; no equipment noise to mask S&Rs**
- ❖ **Quiet compared to rolling road: no tire clunk on bumps**
- ❖ **Realism: physically feels like, audibly sounds like, road**
- ❖ **Used for automated in-line end-of-line systems, audits on sampled production, S&R aging simulation tests, and technical center design / development tests**
- ❖ **Used in factory, quiet room, or chamber: -40°C to 50°C**
- ❖ **One system for vehicles, trimmed bodies & subsystems**
- ❖ **Used with pit or no pit – user preference**
- ❖ **Used on body-on-frame vehicles weighing 3,800 kg**
- ❖ **Facility: 220 VAC, 50 Amp; 7 - 8 bar air at 2,000 l/min; smooth factory floors with no extra reinforcement**



Controllability and Road Simulation

- ❖ Replicate real driving conditions using proving ground surfaces, assembly plant tracks, and local S&R roads
- ❖ Control to acceleration time histories, PSD random spectra, speed sweeps from 0–25 mph/kph, sine vibration
- ❖ Reproduce random-like vibration, chuckhole-type transient events, periodic inputs, & speed-dependent inputs
- ❖ Use remote control mouse from inside the vehicle to repeat road surfaces over & over to identify root cause (s)
- ❖ Vary amplitudes from 25% to 150% of recorded accelerations to find/fix amplitude-dependent S&Rs
- ❖ Sequence, then link, different roads into corporate test procedures or vehicle-specific excitation conditions



CUSTOMER TESTIMONIAL: "The new interface, which allows the plants to select any portion of the test that they wish to run, or the entire test, is a big time saver and provides really good results. The 9, 10 and 11 mile variations was surprisingly impressive. Giving the plants the ability to adjust the amplitude to > than 100% was another nice bonus that will also help in root cause analysis. All told, I think we definitely have a solid piece of equipment that will help us improve the quality of our vehicles."