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## SQUEAK & ITCH TEST SYSTEM FOR MATERIAL PAIR COMPATIBILITY TESTING

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*Instrument used for positioning & moving specimens  
plus for measuring friction & normal forces*

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*Squeak & Rattle technologies from MB have proven effective in many buzz, squeak and rattle test applications involving instrument panels and consoles, HVAC assemblies, seats, seat belt retractors, vent registers, airbag modules, clusters, steering column assemblies, radios and audio equipment, full vehicles, and material pairs.*

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### **Technologies for Vehicle Engineering**

The Squeak & Itch (S&I) Test System is designed to subject contacting pairs of automotive materials to precisely controlled interference and motion in order to acquire, monitor, analyze, and report acoustic and friction characteristics under in-vehicle environment conditions (*see terms defined below*).

This apparatus helps to better understand material compatibility and stick-slip behavior by obtaining test information to help guide the vehicle design process in order to prevent squeaks and itches. It helps to select mating materials, lubricants and coatings; modify resins by polymer blending; emboss or texture materials; specify tolerances and interferences between mating pairs; and provide design guidelines so that material pairs used are less susceptible to creating objectionable noises. While all materials will squeak or itch under certain conditions, the key is to find those combinations which best perform over a broad range of

conditions or in those applications considered crucial. Using the S&I Test System is superior to iterative trial-and-error methods of selecting material combinations that are installed and evaluated in vehicles. Such approaches are expensive in time and money, are at best empirical, and lengthen development schedules.

- ***Better understand material compatibility and behavior***
- ***Find material combinations that perform best over a broad range of conditions or those conditions considered crucial***
- ***Subject contacting pairs of materials to precisely controlled interference and motion to acquire, monitor, analyze, and report their acoustic and friction characteristics under in-vehicle environmental conditions***

## Turnkey S&I Test System

The system consists of: a friction and acoustic monitoring and control console running Windows NT with Squeak & Itch application software; an instrument for positioning and moving specimens plus for measuring friction and normal forces; a S&R Energizer, machine base, and power supply; acoustic and positioning instrumentation; temperature/humidity test chamber; system integration and installation.

The application software is coded using National Instruments' Lab Windows/CVI. National Instrument plug-in boards acquire friction and normal forces, moving specimen oscillations, interference, and temperature/humidity. A sound card with anti-aliasing filters captures acoustic data.



## S&I Test System Features

- ✓ Automatically measures and records in its database the following physical parameters:
  - Temperature and humidity inside chamber at test time
  - Interference (negative distance) between material pairs
  - Normal forces between material pairs
  - Friction forces between material pairs
  - Freq. of specimen moving table oscillations: 1-200 Hz
  - Amplitude of specimen moving table oscillations: units of displacement and/or velocity
  - Amplitude of specimen moving table oscillations: .001 - 1.0 inch p-p (0.025 - 25 mm) and/or 0.02 - 15.0 in. per sec. pk (0.5 - 380 mm/sec)
  - Acoustic time histories in pascals, or dB, exportable as WAV files, sampled at 44.1 kHz
  - dB and dBA, overall and as a function of time
  - Zwicker loudness, overall and as a function of time, in accordance with ISO 532B

✓ Provides post-processing plots of:

- Friction force and velocity vs. time
- Friction force vs. sliding velocity or stroke
- Pascals, dB and/or loudness vs. time or stroke
- Coefficient of friction vs. sliding velocity
- Stroke vs. time
- Normal force vs. time

✓ Includes an Instrument or moving apparatus which is noiseless, friction-less, without stiction and delivers no more than 10% cross-axis motion over the temperature, humidity and oscillation frequencies and amplitudes specified

✓ Allows testing of specimens and platens as well as actual pieces of car parts

✓ Provides custom reports that users can tailor to their needs

✓ Performs swept sine oscillations of the Instrument at constant amplitude (displacement or velocity) and a user-selectable constant linear or logarithmic sweep rate; or sine dwell oscillation at a user-selectable constant amplitude ramp rate; or single-direction, single-cycle, push/pull test; or random vibration (drive files)

✓ Measures normal and friction force amplitudes vs. time, at an A/D sampling rate  $\leq 6,000$  Hz per channel

✓ Provides test conditions from  $-35^{\circ}\text{F}$  to  $120^{\circ}\text{F}$  ( $-35^{\circ}\text{C}$  to  $50^{\circ}\text{C}$ ) with humidity at whatever Temperature/Humidity chambers can reasonably achieve at selected temperatures

## Definitions

1. "Precisely controlled interference" accurate static positioning during test set-up of the interference (negative gap) between mating pairs and exacting control to maintain this interference during dynamic tests, including precise measurement of friction and normal forces
2. "Precisely controlled motion" create and control periodic oscillatory movements (sinusoidal), single-direction push/pull tests, or randomly varying oscillations (random or drive files); create and control exact movements in the driven direction without stick-slip of the apparatus and with minimal cross-axis movements that contaminate acquired data
3. "Acquire" use PC-based data acquisition plug-in boards and software to process and stream-to-disk the digital signals collected from microphones, force transducers, temperature/humidity sensors, displacement/velocity sensors and/or accelerometers
4. "Acoustic and friction characteristics" noises (sound pressure, sound power, and loudness) resulting from the rubbing of these pairs and the associated friction and normal forces that cause the noises; view and analyze time-domain and frequency-domain signatures of such measurements