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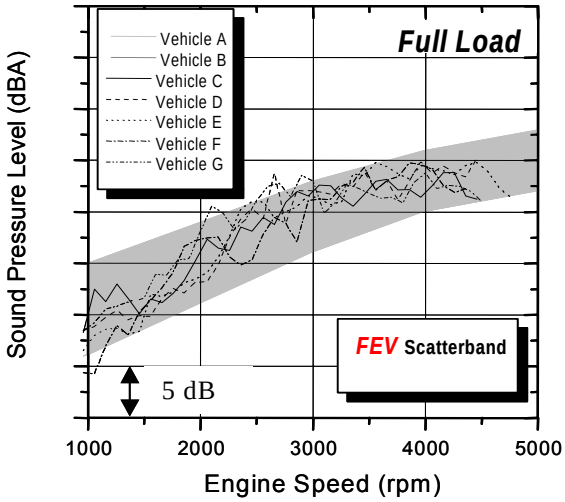
Vehicle NVH Development
Benchmarking

In order to support the development of high quality vehicles, it is critical to have a good understanding of the state-of-the-art. In support of vehicle NVH development, FEV routinely benchmarks new vehicles from various manufacturers every year for their NVH behavior.

All benchmarking tests are conducted in controlled acoustic environments such as semi-anechoic chassis roll dynamometers. Benchmarking tests span a variety of engine speed and load conditions.

NVH measurements include sound and vibration data collected at various locations on the powertrain, vehicle, and exhaust system as well as customer interface points in the vehicle interior. The measured data are processed to yield various metrics that are stored in a proprietary **vehicle NVH database** as scatterbands, an example of which is shown in the figure below. The interior sound measurements are also processed as psychoacoustic or sound quality metrics.



Extensive effort is dedicated towards documenting NVH relevant design features of the benchmarked vehicles and correlation of such features to measured data.

Such a database provides invaluable information towards vehicle level and component level **target setting** on development programs. Typically, vehicle development programs have significant carryover content from previous or similar models. FEV uses the database to identify weaknesses in the current content and provide direction for improvements so that the desired vehicle level NVH characteristics can be realized.

- **Vehicle NVH Benchmarking Database**
  - Interior Noise and Vibration
  - Engine Mount Vibration
  - Exhaust Hanger Vibration
  - Induction/Exhaust Orifice Noise
  - Sound Quality Metrics
    - Articulation Index
    - Loudness
    - Sharpness
- **NVH Relevant Design Feature Documentation and Correlation to Vehicle NVH Characteristics**
- **NVH Target Setting**

In addition, specialized tests such as those simulating hot/cold weather conditions are conducted in an environmentally controlled chassis roll dynamometer facility.

Such tests are used, for instance, to quantify the cold start behavior and piston slap characteristics of engines and their influence on interior vehicle NVH characteristics. The following picture shows an example of a test used to quantify the influence of induction orifice noise on the interior vehicle sound.

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