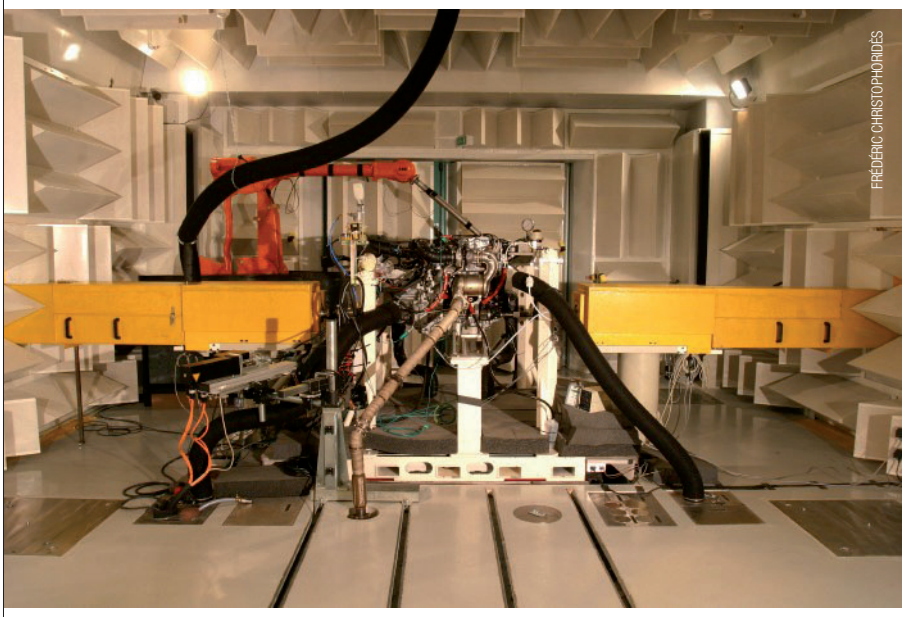
“NVH” UNIT

NOISE VIBRATION HARSHNESS

Although a car’s acoustic comfort involves reducing the level of noise produced by the powertrain, there are other contributory factors, too. Some noises, even though they may not be very loud, can be irritating and tiring. On the other hand, some sounds assert a vehicle’s temperament. **Determining this acoustic identity** also brings subjective factors into play. It is a subtle mix and it is “NVH” unit’s job to make it the right mix.



- Safety
- Environment
- Life on board
- Mobility
- Competitiveness

BASIC FACTS

When an engine converts its pistons’ up-down motion into rotational movement it generates vibration and acyclism. And because of its high rev speed a turbocharger can produce whistling if the turbine’s vanes are unbalanced. Gearboxes and drivetrains can also be noisy. What is more, all mechanical parts have their own resonant frequencies. At a given frequency a part behaves similarly to a tuning fork, amplifying its frequency by combining with other parts in the powertrain environment.

The vibration and noise produced by a car’s moving parts can be transmitted to the cabin either through the car’s physical structure (e.g. engine suspension/body, drivetrain/steering column/steering wheel) or through the air (vents, cablesheaths, window and door sealing joints). What’s more, in addition to passengers’ acoustic comfort, the powertrain’s acoustic dispersion, i.e. the external noises it makes, must also be controlled.

IN SHORT

THE “NVH” UNIT’S PURPOSE IS TO DETERMINE THE ACOUSTIC IDENTITY OF A POWERTRAIN BY FACTORING IN NOT JUST LOWNOISE PARAMETERS, BUT ALSO MORE ONE IN ORDER TO ENSURE THAT THERE IS A MATCH BETWEEN THE QUALITY OF SOUND A CAR MAKES AND ITS CHARACTER.

In September 2005, to address powertrain noise and vibration problems, Renault created a Noise, Vibration, Harshness (NVH) Unit. The prime purpose of the research and measurements NVH carries out is to identify the source of any noise and vibration and to implement solutions to reduce its intensity. The fact that "harshness" features in the unit's name shows that subjective parameters are also factored into consideration when adjusting the "acoustic temperament" of a powertrain and finding its "acoustic identity".

In other words, a hatchback should not "sound like" a sports car, or vice versa. The noise generated by a powertrain must be in accordance with the kind of car it powers for its character to blossom.

Finally, acoustic comfort is not all about decibels and noise levels. There are some low intensity noises that can be irritating or tiring, while others are reassuring, even flattering, for a car.

HOW DOES IT WORK?

To carry out measurements NVH has six sound chambers, including a suite of semi-anechoic chambers – i.e. chambers whose walls are soundproofed. They are also soundproofed against noises from the outside.

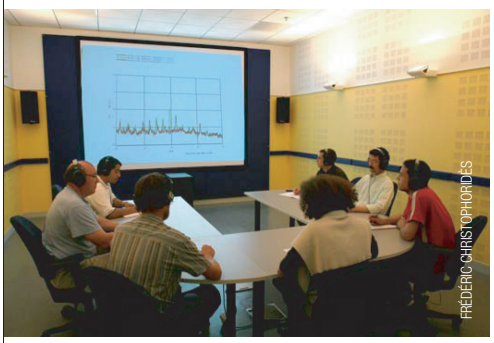
Two vibration test benches are dedicated to the study of lowand medium-frequency vibration emitted by powertrains and the exhaust lines. Three frequency ranges come in for special attention. Humming from 0 to 200Hz, rumbling from 200 to 350Hz, engine sound from 350 to 700Hz. The bench's data acquisition system enables engine to be fitted with up to 150 sensors (accelerometers, pressure gauges, laser systems, etc.). Two electric devices duplicate road loads (rolling and turning resistance) so that the engine operates in conditions identical to those it will encounter in real life.

A modal room tracks resonant frequencies specific to each mechanical part. In addition to the noise interference they can emit, they can also be caused by malfunctions and premature wear. Resonant frequencies are detected using vibrating bowls or hammers that are vibrated like glasses.

The test bench for driveline acyclisms focuses on irregular engine torque rotational speed, i.e. acyclism, which can be the source of noise and vibration. In spite of the presence of the inertia flywheel and the filtering it performs, the alternating pattern of compression and combustion leads to engine torque fluctuations. They can spread to the entire driveline (clutch, gearbox, transmission) and cause humming, growling, and idle gear rattle. A 260kW electric motor reproduces the behaviour of 2- to 6-cylinder engines and simulates rev speeds of up to 6000rpm.

The semi-anechoic powertrain bench has been specially soundproofed, giving it a relatively low cutoff frequency of 125Hz and an off-load background noise of 40dB and 67dB at 120kW. These features make it possible to work on all powertrain noises. For safety reasons acoustic intensity measurements at over 1500rpm are conducted by a robot that records point by point the noise levels emitted by the powertrain. The result is a veritable acoustic "hologram" of the powertrain environment. The semi-anechoic vehicle bench is dedicated to the acoustic analysis of an entire vehicle. It is a cost-effective alternative to track testing for analysing sounds like whistling from a turbocharger, intake valve and engine belt noises, etc. Four 1.9-metre wide rollers simulate the road. The bench thus simulates real-life conditions up to speeds of 200kph thanks to a system of ventilation that includes sound traps to filter out interference from extractor motors and fans.

The audio room is intended for subjective listening. More like an auditorium than a measurement room, it is equipped with high quality audio systems. Sound engineers and acoustics experts listen to recordings of different noises produced by powertrains. As they listen they can view curves and parameters displayed on a large screen.



The audio room, intended for subjective listening.

RENAULT