

# Quest for a Quieter Car

Between now and the year 2020, the limit imposed by European legislation on the level of external noise from automotive vehicles may be reduced to 71dB, which implies a reduction of half in the acoustic energy emitted from vehicles. This article looks at the response being made by the two major French car manufacturers Peugeot and Renault

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**T**here are four sources of noise and vibration from automotive vehicles: noise from the road, whose irregularities cause the tyres to vibrate, noise created by the air inlets in the engine compartment and by the exhaust at the tail pipe, the noise of the airflow around the vehicle which becomes turbulent at motorway speeds, and finally the noise generated by the power unit, which is the source of the noise connected with combustion and which generates vibrations due to the oscillating motions of the pistons connecting rods-crankshaft assembly.

## Peugeot

The PSA Peugeot Citroen group is today the third largest European automotive manufacturer. It has for several years been carrying out a large amount of work in the field of acoustics and vibration in automotive vehicles. Significant progress has been accomplished with vehicles such as the Peugeot 406, and also the Citroen Xantia with its HDI diesel engine whose acoustic performance approaches that of a petrol engine.

Over the past five years, more than FFr100 million francs have been spent at the group's research facilities on upgrading or acquiring new test equipment, such as:

- anechoic power unit test beds with automated measuring equipment,
- semi-anechoic chambers with roller test beds,
- bodywork test beds,
- gear test beds,
- a subject listening studio, currently being designed.

In addition, a methodology called PAVAC has been created, in order to apply the advances in scientific computing to vibroacoustics fields. This method aims to break down the vehicle into subassemblies, calculate the results when they are subjected to particular stresses and, from the resulting data, to extrapolate the overall performance of the planned vehicle, without having to produce prototypes for any of the parts. With this methodology it is possible to reduce costs and design delays significantly and ensure the projected acoustic and vibration quality of the future vehicle.

The subjective listening studio entered service in 1999. It is now possible to quantify the qualitative expectations of customers and convert them into physical criteria for incorporation in the project.

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## Renault

The battle against noise has been a constant preoccupation at Renault. There are 300 people working in the acoustics field with a total annual budget of FFr100 million in. For the Laguna project, Renault devoted a budget of FFr39 million and some 100,000 development hours.

With the help of the Mega CAD software, Renault's engineers, heat transfer engineers, designers and acoustics engineers can discuss together a virtual but very realistic representation of an engine, which also shows the noise and performance curves resulting from the calculations. This acoustic standard duct simulation software meets the following two requirements: assistance in the design of vehicles for exterior noise and help in the drawing up of preliminary specifications sheets, including technology/cost optimisation.

Noise from the air inlets and exhaust are the subject of calculations to design the ducts upstream and downstream of the engine; these calculations are based on the theory of resonances of columns of air and are based on the principle of Helmholtz resonators which enable attenuation of the acoustic pressure created by the alternating motion of the valves. "This leads", according to Hubert de Fraguier, acoustical synthesis manager in the Engineering and Design Department, "to the "installation" of a combination of volumes and ducts assembled in series or in parallel appropriately "attached" to minimise noise levels, frequency by frequency. The volumes, lengths and crosssections of the various components can then be adjusted. Some multiple solutions exist, making it possible to optimise the design while taking into account other necessary factors, such as the operation of the engine, temperature distribution, accessibility, etc."

To limit the acoustic radiation from the various silencer volumes, it is sufficient to excite them principally by vibrations from the engine; the solution therefore consists of introducing after the exhaust manifold a device for filtering the vibrations (known as "Flexible"). Finally, one can limit the acoustic radiation from the volume walls by modifying the design of the walls, such as the introduction of internal stiffeners of appropriate shape.

Studies are being undertaken to reduce the noise radiated by the power unit so as to reduce the excitation at the base. The noise generated by the shocks in the various mechanical elements of the engine is being studied; specification sheets are produced and act as input data for the vibration calculations, which can lead to innovative designs such as stiffening beams for the bearing caps or cap casings.

Reducing the noise from the engine and the exhaust brings to attention other noises that were previously inaudible. Gradually, the sources of noise previously considered to be secondary (transmission shaft, gearbox, etc) are being made the subject of constant attention. Today, acoustic engineers are opening up new fields of investigation, such the aerodynamic excitation of the vehicle, vibrations from the road wheels, or fan noise.

The development of a "silent design" approach is today widely adopted. Renault is also exploring the possibilities opened up by other ways of improving the acoustic quality of its vehicles. Alternative fuels also have a big future in urban applications: for example, the Agora bus which runs on compressed natural gas has just won the 1998 Golden Decibel Trophy for its low noise emissions.

### For more Information

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## POLICE DOGS

A police dog handler is suing his force for damages because he believes the constant barking of dogs has damaged his hearing. Pc Alan Ross, 47 claims that working with noisy Alsatians for the past 14 years has left him suffering from industrial deafness. In the first case of its kind, he is taking Chief Constable Andrew Brown, of Grampian Police to court seeking £15,000 compensation for his loss of hearing.

## SNORING

When asked to describe her husband's snoring, a West Los Angeles woman likened it to the anguished roars of animals being killed. The woman's therapist advised her to sleep in another room. She got sleep, but found that sleeping separately had a negative affect on "our general intimacy." About 40% of the adult population snores, with 4% experiencing brief episodes of breathing cessation called apnea, said Dr. Richard Millman, director of the Sleep Disorders Center of Lifespan Hospitals in Rhode Island. Snoring is caused by the partial obstruction of the airway during sleep, the noises arising from a vibration of soft pliable tissues in the throat. Snoring increases with age and weight. And twice as many men as women snore. But snoring, which has been described in all its variations as sounding like a jackhammer, a goat, a revving motorcycle, a peeved bear and the earth shattering, causes more than sleep deprivation and marital discord. Snoring can sound a death knell for intimacy "Patients sometimes fall asleep during sex," reports Millman, who adds that sleep is interrupted up to 60 times a night. "Often they are so tired that they just aren't interested in sex. The snorer may have personality changes due to irritability. A couple of patients have problems with rage attacks. Patients have told me We broke up because of my snoring."