AEROACOUSTIC WIND TUNNEL (S2A)

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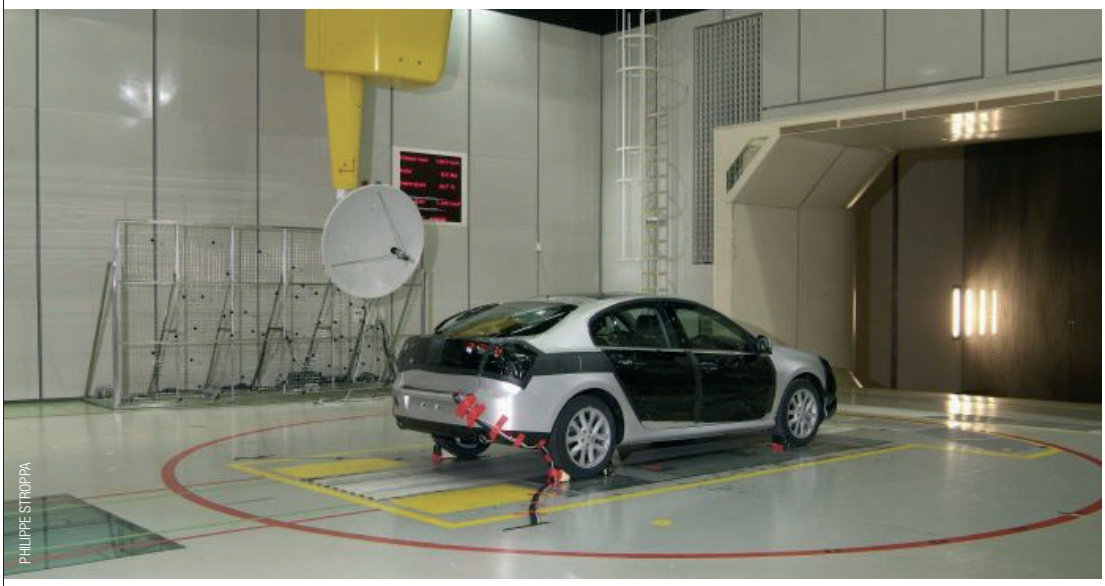
Able to drive perfectly uniform, steady air flows at 240kph into the plenum chamber, which is 6.5m wide by 3.7m high by 14m long, the S2A wind tunnel enables measurements to be made on life-size models and even on actual vehicles. In addition to conventional aerodynamic tests, the S2A's very low noise level is ideal for aerodynamic and acoustic engineers seeking to track down any irritant air noise.



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

IN SHORT

THE SHEER SIZE OF THE S2A WIND TUNNEL MAKES IT POSSIBLE TO PRACTICE MEASUREMENTS ON LIFE-SIZE VEHICLES WHILE SIMULATING DRIVING CONDITIONS WITH GREAT ACCURACY. AND THE FACT THAT IT IS SO QUIET IS A BOON FOR AERODYNAMICS AND ACOUSTICS ENGINEERS AS THEY SEARCH FOR WAYS OF REDUCING NOISES MADE BY THE AIR AND THE WIND.

BASIC FACTS

While digital modelling and computer-generated simulation help to rough out shapes created by designers so that they are aerodynamically satisfactory, finding the detail that makes the difference is an extremely delicate matter. Computing power and time are often wasted for only partial results. Ultimate optimization comes from the wind tunnel – an irreplaceable tool that both complements modelling and finetunes it through the high-precision measurements it affords. Located at Montigny le Bretonneux, on the outskirts of Paris, the S2A wind tunnel was born of a partnership between Renault, the Paris engineering university the Conservatoire National des Arts et Métiers, and the automaker PSA Peugeot Citroën. To this day it is still one of Europe's most powerful aerodynamics research tools.

If aerodynamics readings are to be reliable, it is indispensable that air flow generated by the wind tunnel must be of relatively much larger dimensions than the device or machine being tested. Otherwise, a "bottleneck" forms and produces misleading measurements. With its large plenum chamber the S2A wind tunnel can perform measurements on a real vehicle in strong facing winds.

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The high-performance capacities of the S2A wind tunnel do not stop at the powerful, large-dimensioned air flows that it generates. What makes it an outstanding tool for aerodynamics engineers is that it enables them to conduct high-precision, realistic measurements of the air flows generated by a moving vehicle. It reproduces the road beneath the vehicle, the rotation of the wheels, and incorporates many viewing devices and equipment for measuring air flows. Finally, the S2A wind tunnel stands out from others through its low operating noise levels. Because it is so quiet it can detect noises produced by the air flows at high speeds, both inside and outside the vehicle's cabin. It can also locate their sources and contribute to solutions – essential to meeting the demands of occupant comfort in today's vehicles.

HOW DOES IT WORK?

The wind tunnel's fan has a propeller that measures 8.3m in diameter and is composed of nine carbon fibber vanes, each 1.65m long. It is driven by an electric motor with an output of 3.8mW – the equivalent of a TGV power car. It delivers a flow rate of 1,600 cubic metres of air per second into a ring section. A nozzle with an operating surface of 24m^2 (6.5m x 3.7m) directs a flow of air into the plenum chamber, where measures are carried out. The air is captured at one extremity of the plenum chamber and redirected to the propeller. A cooling system upstream from the plenum chamber keeps the temperature stable. Otherwise the forces at play would soon produce air temperatures of over 60 °C in the test section, which would distort measurements as well as causing discomfort. Finally groups of auxiliary blades, located in bends in the section lined with a soundproof coating, direct the air flow along its route in order to minimize any interference caused by turbulence. This structure gives the wind tunnel a top noise level of merely 69dB – equivalent to street noise.

There is a moving belt in the plenum chamber's floor that can reach speeds of over 200kph to simulate the road driving. Similarly, auxiliary moving belts turn the car's wheels as they would in real life. They are equipped with sensors that can be mounted on the vehicle. Finally, to simulate a cross-wind, the entire assembly can tilt 30° in either direction about the wind tunnel's axis. In addition to the traditional Cd (drag coefficient), Cy (side force coefficient) and Cy (a vehicle's lift coefficient) are measured with high precision. In addition, an explorer probe measures all the speed and pressure parameters in the airflow.

For acoustic measurement two additional devices are used. One resembles a tennis racket and carries 64 microphones for recording noises inside a vehicle's cabin. By comparing the intensity and phase noise recorded by each microphone a computer builds an "acoustic picture" of the cabin, locating and measuring each noise with high precision. The other device is a mesh carrying 64 microphones. It maps the sources of outside noises. The two devices are supplemented by a third one – an acoustic antenna dish. Door mirrors, a windscreen sealing joint, and a door handle can all generate turbulence, and therefore noises, but none will escape detection.

DECEMBER 2008

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