

Reducing vehicle noise by 50%?

Trelleborg Novibra, Volvo Penta and the Institute of Technology in Karlskrona-Ronneby, Sweden are jointly developing a system for active noise reduction, initially in one of Volvo's speed boats. Part of the system involves microphones which register and analyze sound waves with the help of a computer.

Ships and aircraft are becoming increasingly sophisticated in terms of the technology they use. More powerful engines and lighter designs are producing very fast machines. However, this combination does not have an equally favourable effect on noise. Trelleborg Novibra, in cooperation with Volvo Penta and the Institute of Technology in Karlskrona-Ronneby are now jointly focusing on the development of a system for active noise reduction. Noise is a growing environmental problem, even at sea. Engine noise and vibration levels in pleasure-craft and commercial vessels are frequently excessive.

At the end of 1996, a research project, initiated by the Swedish Coast

Guard Service, was started at the Institute of Technology in Karlskrona-Ronneby. By joining forces with Trelleborg Novibra and Volvo Penta, the Institute hopes that a solution will be found that will reduce vibrations and thus cut the noise level in half. "Measurements made on board the Swedish Coast Guards' vessels showed that the noise level was highest at the place where personnel spend most of their time – by the instrument panel," says doctoral student Mathias Winberg, whose research focuses on signal processing and who is responsible for the project. "This results in a very strenuous work environment. The vibrations also give rise to unnecessary wear damage to the machines. At the same time, Government authorities are imposing ever stricter restrictions on noise levels, both in and around vessels. In other words, this is a research area of the utmost current interest."

Noise control is also important in several other areas, such as the automotive industry, which has already achieved excellent results. Automakers are currently concentrating on finding the "right" sound. It is already theoretically possible to create silence completely but this is not desirable – some engine noise is an absolute necessity.

Cooperation opens opportunities

The research project was made possible by the fact that Volvo Penta contributed a Storebro 36 vessel equipped with two Volvo engines, which are being used as the test equipment. Trelleborg Novibra is



A Novibra RAEM B00 damper was used in the project

participating by providing passive dampers and considerable expertise in vibration reduction.

“We have been working on the development of passive vibration dampers for quite some time,” explains Rune Bengtsson, who is responsible for the project for Trelleborg. “Thanks to this project, we are also positioned at the leading edge of development in the field of active vibration dampers. The project is also interesting from the view-point of our increasing focus on marine applications.

Interesting combination

When the engine and propeller are in operation, powerful vibrations are produced. These vibrations then spread to the hull and further out into the vessel, resulting in a high noise level in the cabin area. As designs become lighter, the level of vibration and noise also increase.

“The system we are working on is based on a combination of passive and active vibration reduction,” explains Mathias Winberg. “Active damping methods are already used in Saab’s turbo-prop aircraft, so the technology is not new. What is interesting is the combination of active and passive dampers, because active noise insulation generally works better at high frequencies, while passive dampers are more efficient at low frequencies.

Controlled by microphones

Quite simply, the passive damper is a rubber component installed between

the engine and the base in order to muffle part of the vibration effect. In this case, the passive damper is a Novibra RAEM 800 from Trelleborg Novibra. It is supplemented by an actuator, the active part of the system, which functions as a layer between the passive damper and the engine.

The actuator is mounted on a spring and can be controlled in such a manner that it functions in counter-phase to the engine, whereby the vibrations offset each other and thus reduce the noise level. The movements of the actuator are controlled by microphones mounted on the cabin of the vessel and which register and analyze sound waves with the help of a computer.

Noise level reduced by half

“It is probably reasonable to believe that we’ll be able to halve the perceived noise level using this technique,” says Mathias Winberg. “But a great deal of work is still required to make the technology commercially viable. And initially, this silencing method will probably only be used in commercial and luxury vessels, since the technology is expensive.

“In the long run, this project will give Trelleborg Novibra an opportunity to develop a new product, a complete system of dampers and actuators,” according to Rune Bengtsson. “In addition, the cooperation with the Institute of Technology and other companies provides us with an opportunity to exchange experiences and test new ideas.”

Vibration damping

Vibration reduction, in this context, is based on insulating the machine causing vibrations from its base. This is achieved by mounting the machine on springs with special properties. These are normally produced in some form of rubber, a so-called polymer material, or steel.

Polymer materials have the ability to efficiently dampen vibration, and they are also highly elastic. Rubber, for example, can be stretched up to 1,000 percent without becoming permanently deformed. Another strength is rubber’s sound-insulation properties. The inherent ability to suppress noise means that the rubber absorbs most of the sound that would otherwise be transmitted to the floor and structure as a result of the machine’s vibrations.

Springs constructed of steel have the advantage of being able to withstand very heavy loads but its poor suppression properties are a disadvantage. Another difference between steel and rubber is that when exposed to damp air and acids, steel can easily rust, which can weaken the springs.

Rubber has much greater resistance to damp and acid. On the other hand, certain types of rubber, for example, natural rubber are unable to withstand oil and high temperatures to the same extent as steel.

Boeing sonic cruiser

Plans for a successor to Concorde which would be three times cheaper to fly are being drawn up by the American manufacturer Boeing. The company said it had been asked by airlines to revise its designs for a “Sonic Cruiser” to produce an aircraft capable of flying at 1.8 times the speed of sound, roughly 1,200mph. Decreasing the impact of the sonic boom would open the possibility of supersonic flight over land.

noise notes