

ACTIVE NOISE CANCELLATION SYSTEMS

Vehicle makers use many methods for reducing noise levels inside the passenger compartment. Thick carpeting, cotton padding, foam, and mastics are some of the more traditional items used for this purpose. These can add extra weight to a vehicle and require extra steps during vehicle assembly. Some vehicle makers use parts made from laminated steel for reducing interior noise. Cowl panels are sometimes made from this material to reduce noise from the engine compartment from entering the passenger compartment. More information on laminated steel can be found in the March 6, 2006 Advantage Online "Laminated Steel" article. In these cases, little or no extra materials are required for quieting the panel.

Active noise cancellation (ANC) is a relatively new option vehicle makers have for reducing annoying noises heard in the passenger compartment. It employs the same type of technology used for noise canceling headphones. Vehicle ANC systems are electronic systems that work by reproducing the same annoying noises through the vehicle sound system. The catch is that the noise is reproduced out of phase with the original. This results in the two noises canceling each other out. To better understand how this works, let's take a closer look at what sound is and how noise can be silenced with this process.

SOUND WAVES

Sound is basically a series of pressure waves, created by a vibrating object, that travel through air, water, steel, etc. Pressure waves act similar to waves created on the surface of water when a stone is

tossed in, except that they can't be seen. They are a series of positive and negative pressure fluctuations.

Sound pressure oscillations are identical to the vibration of the sound source. The frequency of sound is how many times the sound pressure waves oscillate during a certain period (see Figure 1), and is normally measured in hertz (Hz) or cycles per second. Musical instruments can be used to demonstrate the relationship between high-frequency and low-frequency sound waves. For example, air flowing through a flute (Figure 2) vibrates much more frequently than the vibrations of a bass guitar string (Figure 3).

Amplitude is the intensity of sound pressure waves or how loud a sound is. Sound wave amplitude is shown as the highest and lowest points of the illustrated sine waves.

ANC SYSTEMS

An ANC system works by using microphones to detect ambient sounds. The sounds are then converted to electronic information and sent to the ANC unit (computer). Depending on how the ANC unit is programmed, certain frequencies such as human voices may be ignored. Unwanted sound, or noise, is inverted 180° out of phase (see Figure 4) and sent to the system speakers to be reproduced at the same amplitude level.

How does this make it quieter? A basic analogy may help to explain how this works. Think of a spring-loaded door. It moves when you push on it, and returns to position when the force is removed.

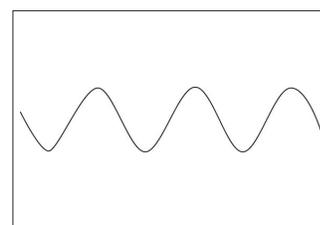


Figure 1 – Although sound is a series of pressure fluctuations, frequency can be represented with a sine wave.

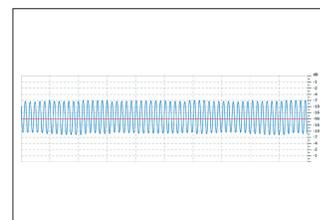


Figure 2 – This sine wave of a flute shows a frequency of about 700 Hz.

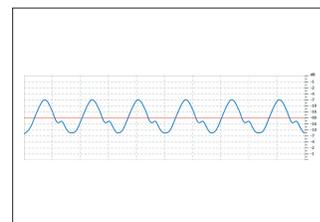


Figure 3 – This sine wave of a bass guitar shows a frequency of about 100 Hz.

Imagine pushing it in a short distance and allowing it to return several times a second. This represents sound waves. Now imagine someone on the other side of the door pushing with the same force and at the exact same times that you are. The door will remain mostly still. The person on the other side of the door represents the inverted sound waves, created by an ANC system, that negates the initial unwanted sound.

VEHICLE SYSTEMS

Honda is currently using an ANC system on some 2005-2007 Odyssey and Pilot vehicles with Variable Cylinder Management (VCM). A VCM system disables three of six cylinders during certain driving conditions for improved fuel efficiency. An ANC system is also used on the 2005-2007 Honda Accord Hybrid. The system helps reduce engine noises heard in the passenger compartment that may occur during certain cycles of the VCM. Other road noises may be suppressed as well. The reversed signals are amplified through the two front speakers of the vehicle sound system. The 2005-2007 Acura RL uses the Active Noise Cancellation™ system with the Acura/Bose® 10-SpeakerSurround Sound system. It is also used for reducing low-frequency engine noises. The reverse-phase audio signals in this system are amplified through the door speakers and the subwoofer. The systems remain active whether or not the vehicle sound system is on or off.

REPAIR

ANC system parts are typically located inside the passenger compartment, so the chance of collision damage is minimal. Microphones are generally located on the front and rear areas of the headliner and control units may be located in the center console behind the audio unit. However, the ANC unit in the 2005 Acura RL is located in the right side of the trunk and is more susceptible to damage. Damaged ANC parts typically require replacement.

A customer complaint of strange noises may be caused by an improper or non-functioning ANC system. Refer to vehicle specific service information for diagnosing problems that may be caused by the ANC system. Troubleshooting may include following a flowchart and checking the system circuits. This is done to

determine which parts of the system are not working and may require replacement. There is a technical service bulletin (TSB 06-005) for the ANC system on the 2005 Honda Accord Hybrid regarding a loud humming or booming noise from the front speakers. It provides a simple procedure for determining whether the ANC system is functioning properly. Replacement part numbers and where repair procedures can be located are also provided.

CONCLUSION

Vehicle makers now have another option for reducing unwanted noises in the passenger compartment. Rather than adding materials to body panels or using unique steels, this can be done electronically, through the vehicle sound system. It is important for collision repair technicians to be aware of such systems and ensure that they are working properly before returning the vehicle to the customer. A customer complaint of strange noises coming through the speakers may be caused by a non-functioning ANC system.

For comments or suggestions on the Advantage Online, please contact I-CAR Senior Instructional Designer Bob Jansen at bob.jansen@i-car.com.

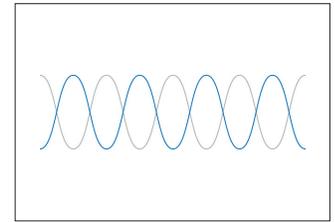


Figure 4 – The blue sine wave represents the frequency of the original sound. The red sine wave represents the reproduced sound, 180° out of phase.