Controlling Noise

Soundproofing 101

Text and Photography by Steve Warner

Many rock 'n' roll groups sing about it, we listen to it all the time, and we constantly wish to rid our lives of it. What is it, you ask? Quite simply, it is noise. Moreover, while it may be nearly impossible to eliminate it from your house, knowing how to get rid of it from your personal vehicle is another thing. This is a lesson in soundproofing science.

When it comes to soundproofing trucks and SUVs, the challenges are many. You want to take advantage of all the good sounds and eliminate or at least mask the unwanted sounds. Most competent audio installation shops can effectively do this because they are often trained in improving interior acoustical environments. However, this story is not aimed at the pro audio shops. It is meant to be an easy lesson in sound absorption so that when you decide to upgrade the audio components in your ride, you will have a basic understanding of what separates good sound vibrations from unwanted sound vibrations.

Want to take advantage of those new, extremely large subwoofers you just installed? Unless you do not want to completely vibrate your windows or seriously distort the exterior sheetmetal, you will need to apply some sort of sound-deadening or absorption material to maximize your listening environment.

While you may not realize it, many typical spray-in bedliners can actually prove quite beneficial when it comes time to sound-deaden the inside of your sport truck or SUV. If there is a drawback to the spray-in style of sound insulation, it would be the expense of having a professional spray or apply the polyurethane coating and the necessary trouble of having to completely strip your interior of its, well, interior.

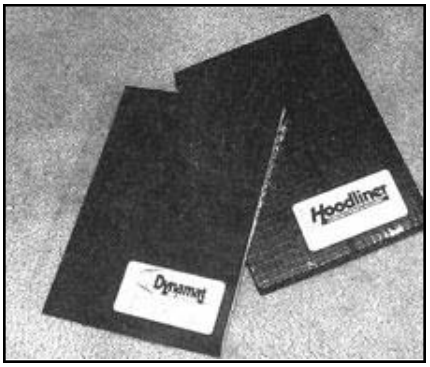
THE BASICS

Let us start with the most basic lesson — sound. Simply put, sound is a fluctuation in air pressure by which particles are displaced. Sound frequency is the particular number of oscillations a particle undergoes, and a cycle is one complete displacement. To the automotive world, sound is produced when the air is disturbed by a vibrating object; in this case, the movement of the speaker cone. The wavelength is the distance a soundwave travels in each complete vibration cycle. This can be put more easily into a mathematical equation:

$$\text{Wavelength} = \frac{\text{Speed of sound}}{\text{Frequency}}$$

This formula is very important to the audio world because sound occurs in space. For instance, the wavelength of a 20-Hertz sound is about 56 feet. The typical human hearing range is about 20 to 20,000 Hz, which is why those monster 15-inch subwoofers will sound better at a distance in a compact car than in a sport truck or an SUV. However, once the vehicle gets closer, the sound quality drastically diminishes. This is one acoustical advantage trucks and SUVs offer over cars. Because trucks and SUVs offer more room for low-frequency wavelengths to develop, sound quality will be much better in the long run. Another consideration is that low frequencies mask high frequencies better than high frequencies mask low frequencies, and the effect increases as the sounds get louder.

For example: Imagine going to see



Dynamat comes in a variety of thicknesses for many different uses. Besides being able to apply it to the doors and the floorboards, you can also use varying thicknesses under the truck's hood as sound deadener against unwanted engine noise. Installation of Dynamat is very easy, and the material is quite flexible. However, prior to any installation, you may want to let the sheets lie in the sun to absorb some heat. Not only will the material become more flexible and easier to use, but the double-sided tape that is used to install most Dynamat products will adhere to the metal surfaces better.

your favorite band at a club, and all you can hear are the drums and bass, not the lead singer's vocals. The drums and the bass are low frequency and the vocals are high frequency, so the vocals become masked as the volume increases — something all bands try to accomplish. Who can play louder?

To better help visualize how sound travels, try this. Drop a rock into the water. As the waves ripple from the initial hit of the rock, the waves radiate outward until they are completely dissipated or until another solid object encounters the water. Sound is the same thing. A noise is heard initially, but fades out over time until another object makes contact to produce another sound. The underlying challenge in auto sound is to eliminate as many unwanted waves from vehicle and road noise as possible.

BASIC APPLICATION

In automotive applications, the only way to eliminate as many sound waves as possible is to either mask them or to block them out entirely from the vehicle. We often hear catch phrases such as structural resonance control that improves the vibro-acoustic environment. Automotively speaking, there are several well-known aftermarket companies offering products that will do just this. These include Dynamic Control which offers Dynamat and Scosche Industries, whose Accumat products come in different sizes and thicknesses to control this structural resonance control. Each company is able to do this by producing materials that act specifically as a barrier of sound or an absorber of sound. Specifically, the barrier method involves keeping as much sound out of the interior as possible. Most barrier materials usually come in 0.25-inch thickness and have a two-layer construction to block noise. Key areas where the barrier method for sound would be warranted include truck and SUV floorpans and transmission tunnels. These barrier method sheets also offer heat resistance. The absorption of sound strives to trap unwanted noise near its source. The common placement of absorber material is under the hood (a 0.75-inch-thick mat) and as a headliner (a 0.5-inch-thick mat).

One of the key ingredients for sound absorption is the installation of a lay-in-style product. Dynamic Control offers Dynamat material, which comes in many styles, shapes, forms, and thicknesses. It is primarily intended to act as a barrier against vibration that is trying to get into or escape from the outside or interior compartment. Dynamat comes in several different styles and can be used just about anywhere that there is cause for some sort of vibration concern, such as on the floorboards, the headliners, the inner door panels, the transmission tunnels, and under the hood.

INTERIOR BASICS

For the purpose of this discussion, we will only speak of interior noise absorption. The two most common forms of absorbing interior sound are with spray-in or lay-in materi-

Sound Absorption Coefficients of Various Materials

	Frequency (Hz)					
Material	125	250	500	1000	2000	4000
Glass window	0.35	0.25	0.18	0.12	0.07	0.04
Plywood paneling	0.28	0.22	0.17	0.09	0.10	0.11
Carpet on pad	0.08	0.24	0.57	0.69	0.71	0.73
Person in upholstered seat	0.39	0.57	0.80	0.94	0.92	0.87
Well-upholstered seat only	0.19	0.37	0.56	0.67	0.61	0.59
Leather-upholstered seat	0.15	0.25	0.36	0.40	0.37	N/A

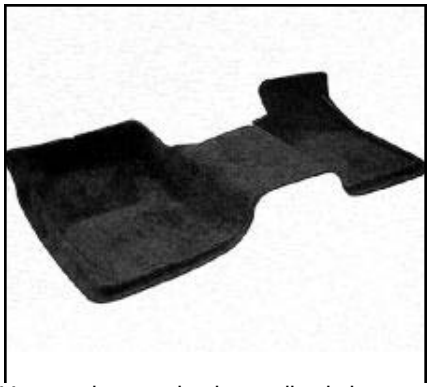
One common area for installing massive speakers on sport trucks is in the bed region. While this may seem like a logical space because the openness of the truck bed, vibration-wise it is a nightmare. One common cure prior to installing your arsenal of speakers is the installation of either a Dynamat or a Scosche Industries Accumat or a Wise Industries Bedrug. These products do not offer the same vibration-absorbing qualities as the aforementioned products, but do help to absorb some irritating road vibration.

als. Several companies offering spray-in absorption products include Line-X, Rhino Linings, Ultimate Linings, and ArmaThane Coatings, which are commonly used as bedliner materials to provide protection and skid resistance while preventing rust, but they also offer acoustical insulation. The only drawback to commercial spray-in methods is that each has to be applied professionally and can get quite expensive because they require a lot of preparation work when they are sprayed into an interior. Another drawback with spray-in acoustic material is that you have to completely strip the interior of everything that is interior-related. For the low-cost do-it-yourselfer, alternatives are aerosol-rubberized undercoating, hardware expandable foam, or applied processes such as Zolatone. Spray-in materials can also be incorporated with lay-in products such as Dynamat and Accumat, which have been specifically designed for various sound-damping duties. Using spray-in materials allows for penetration where lay-in materials cannot reach, such as small nooks and crannies that you could not reach with the lay-in material.

Two final ways to improve interior sound absorption are with seating and carpeting. Carpeting contributes to sound absorption in a number of ways. First, cut-pile carpeting provides more absorption than a loop-pile of similar thickness, and increased pile height and thickness further increase absorption. Also, the more permeable the backing, the higher the sound absorption. A foam rubber pad will absorb more than urethane foam. In general, name-brand aftermarket carpet kits have thicker jute padding than OEM floor coverings, so future carpet upgrades can include the new materials that are laid over the factory carpeting for even better sound absorption.

Upholstery is also a contributing factor in sound absorption. Yes, that old diamond-tuck velour will absorb sound better than your freshly covered vinyl or Italian leather seats; however, we will leave the aesthetical jokes of shag-carpeted dashboards and steering wheels for another debate. These ugly ’70s materials, however, do work better than the more pleasing leather.

Finally, people also help absorb sound as well. While we are not advocating running out and gaining 400 pounds, the more girth you and your passengers carry, the better your interior acoustics will be. However, you may give up on this assumption once the added fuel costs associated with weight have been factored in.



You maybe surprised to realize it, but carpeting also acts as a sound-deadener. Various styles work better than others, and the thicker the jute pad, the better. An old audio sound-deadening trick was to apply two layers of factory carpeting over the floorboards to further reduce vibration.

Because no two vehicles will ever sound the same, we have attempted to present a few acoustical laws and hint at how they relate to trucks and SUVs. For those individuals who want to create luxury, acoustically friendly interiors, it would be wise to consult local auto-sound pros that can determine the best approach for sound absorption through test equipment. Those who do not have access or the funds to visit the pros may want to consult mail-order audio specialist Crutchfield for various books outlining acoustical parameters. Now you have the main ingredients for controlling the noise. Since the professor has spoken, who is ready for the test?

The Source

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