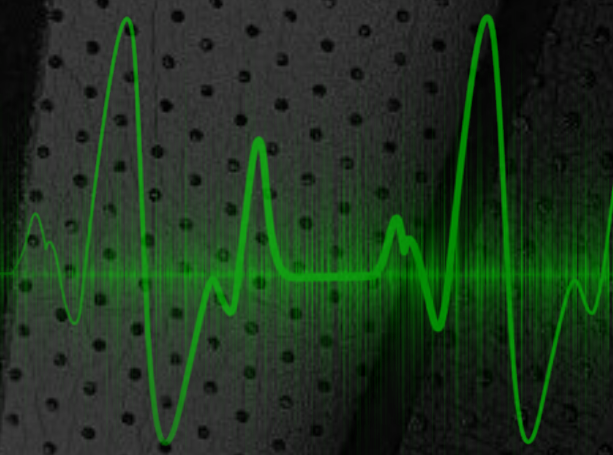
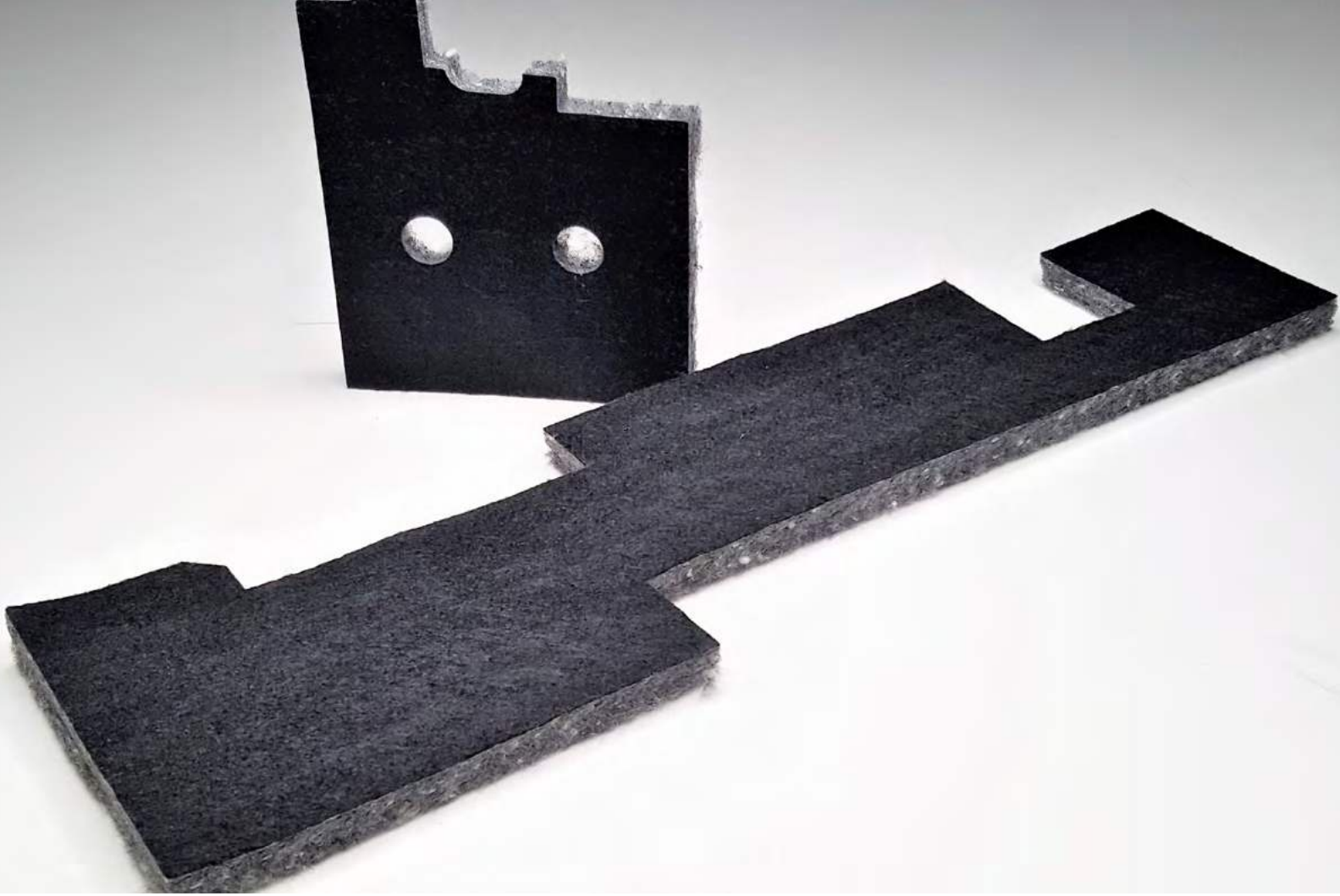


# NVH

## Materials Guide





Noisy machinery is obtrusive and often dangerous for industrial workers, equipment operators, nearby population, and the overall environment. Noise, Vibration, and Harshness (NVH) refers to the study of noise and vibration for the purpose of modifying equipment for quieter, safer operation. Not only can noise be distracting or harmful to employees, but excess vibration can impact the function of equipment over the long-term by facilitating damage or misaligned components.

Early NVH studies originally focused on methods for reducing noise in automobiles. Newer NVH efforts have been aimed at noise and vibration control across a broad variety of commercial and industrial equipment.

NVH relies on three main principles of improvement:

- 1 Reducing source strength.** Most loud equipment noise originates from engines or motors. Devices such as silencers/mufflers and rotating mechanisms can help to reduce sound and vibration.
- 2 Interrupting the path of the noise/vibration.** Sound carries through vibrations working outward from the point of noise. If that path is disrupted, the sound waves bounce, and the noise will effectively be diffused. Barriers that block sound waves and isolators that stop parts from vibrating help interrupt this path.
- 3 Absorbing the noise and vibration.** Rather than bouncing energy away, some materials absorb the sound waves and vibrational energy. Foam noise absorbers and well-tuned vibration dampers absorb sound or vibrations to reduce the harmful effects on the surrounding area.

By combining all three of these principles as needed, NVH engineers can make machinery quieter and safer to be around.

## NVH Acoustical Treatments

Various solutions exist to support noise and vibration dampening in accordance with all three NVH principles.

### 1. Absorbers

Absorbers are designed to reduce airborne noise. They're composed of porous materials such as foam or blended fiber materials that can absorb sound waves and energy before it reaches operators or other bystanders in the area. Lining hard and sound-reflective surfaces within machinery with absorbers can greatly reduce ambient noise. Some of the most common materials for absorbers include:



- Polyester fiber
- Polyester foam
- Polyether foam

## 2. Barriers

Barriers don't stop noise or vibration from occurring—but they do stop it from spreading. Equipment manufacturers often use barriers to stop noise from affecting operators or the adjacent environment.

Acoustic barriers—commonly known as sound barriers—are usually constructed from Mass Loaded Vinyl (MLV), such as a flexible PVC vinyl. Acoustic barriers stop the transmission of noise, to varying degrees ranging from partial to nearly complete. These barriers can be mounted on a variety of surfaces, including:

- Enclosures
- Equipment housings
- Flooring
- Firewalls
- Vehicle cabs



## 3. Damping Materials

Vibrations often travel through materials. If vibrations occur near the material's natural frequency this can amplify the vibrations, making them louder, more jarring, or harsher. Damping materials change the resonant frequency of the substrate to which they are applied, greatly reducing the impact of the vibrations. Damping materials convert the mechanical energy of the vibrations into heat.





Viscoelastic materials such as PVC and constrained layer foam composites are typically used to make sound and vibration damping acoustic composites.



# NVH Methods

Using the right methods for designing and attaching NVH treatments will maximize the noise and vibration reducing effects of the treatments. These methods also need to fit within the system or machinery without impeding function.

Four of the most common NVH methods include:

-  **1 (Multi-functional Layered Composites)**  
Acoustic materials can be made with absorbing, damping, and transmission loss layers. Materials may start with a viscoelastic damping material against the substrate followed by a decoupler, a transmission loss mass barrier in the center, and a porous outer material that absorbs sound. Different materials used at varying ratios can be combined to attenuate, isolate, and block different frequencies.
-  **2 Decoupling**  
Incorporating layers of air between layers of barriers (decoupling) can also help mitigate noise and vibration issues. When MLV barriers are separated from a substrate or enclosure wall, the combination of hard dense materials, MLV barriers, and air space absorbers act like multiple walls multiplying and enhancing their effectiveness across all frequencies. This is ideal for addressing NVH concerns without adding more mass to the substrates.
-  **3 Facings**  
NVH materials such as foams and fiber composites may be more susceptible to damage from the operating environment or have lower temperature ratings than surrounding machinery. Facings—materials that resist heat, flame, and chemical damage—can be added to the treatment to keep the machinery up to standards and enhance effectiveness by tuning the absorber materials to the problem frequencies.
-  **4 Adhesives**  
Most NVH solutions are assembled with self-adhesive backings for easier installation. This adhesive is designed for a specific substrate to provide a long lasting or permanent application. It's essential to use the right adhesive not just because of the substrate's surface material but because intense vibrations can quickly wear through the wrong adhesive.

Understanding your specific NVH challenges will help you identify the correct method or combination of methods to create a safer, quieter work environment.

## Sound and Vibration Control from Technicon Acoustics

Technicon Acoustics is a sound science company that designs, manufacturers, and delivers NVH solutions to a broad range of commercial and industrial clients. In our state-of-the-art facility, our team of engineers and manufacturing experts uses the latest technologies to develop better ways of mitigating sound and vibration.

At Technicon Acoustics, our objectives are as follows for NVH solutions:

- **Industry Leader:** We strive to lead the development of NVH solutions for greater safety and end-user comfort.
- **Delivering the Perfect Order Experience:** We work hard to ensure every customer receives high-quality, high-performance products that are shipped correctly and on time.

### Custom Cutting and Laminating

All of our NVH materials and solutions can be customized to fit your company's products and applications. Materials can be adjusted for size, weight, and thickness so they fit within pre-existing structures and equipment. Our production capabilities include:

- **Custom cutting.** We use a variety of CNC cutting and die cutting options to ensure we can meet any client need.
- **Flame lamination or thermal lamination.** Our products can be bi-laminated or tri-laminated to seal materials from 0.125-4.0" thick and up to 80" wide. These heat-based lamination techniques ensure a tight bond between the material layers.



## Viscous Compound Casting and Foam Embossing

We also specialize in viscous compound casting. This method produces customized NVH forms from vinyl. Casted solutions include:

- MLV sound barriers
- Extensional damping compounds and acoustical composite materials
- Vinyl floorboards that mitigate sound and vibration

Through our foam embossing process, we can compress the foam and increase the density of their cells for more low-frequency absorption. Embossing also creates a unique visual aesthetic for visible materials.



## Kitting a Complete NVH Solution for OEMs

Our facility includes die cutting and CNC cutting equipment for fast production of pre-cut materials. We can provide kitting solutions that facilitate faster receiving, assembly, and shipping at your facility. Ordering kits ahead of time gives your company the benefit of simpler inventory and ordering processing. Our value-added services include:

- Kitting
- Just-in-Time shipping
- Kanban inventory scheduling

For more information about our products and services, please don't hesitate to contact us or request a quote.

## Glossary of Acoustical Terms

### A-Weighting (dBA)

The filtering of sound that replicates the human hearing frequency response. The human ear is most sensitive to sound at mid frequencies (500 to 4,000 Hz) and is progressively less sensitive to sound at frequencies above and below this range. A-weighted sound level is the most commonly used descriptor to quantify the relative loudness of various types of sounds.

### Absorption

The attenuation (or reduction) of sound level that results when sound is controlled by a sound absorptive material such as glass fiber or open-cell urethane foam. In the case of sound absorptive, attenuation of sound is produced by the conversion of molecular motion, into thermal energy due to friction of air molecules with fibrous or cellular materials.

### Absorption coefficient (<math>\alpha</math>)

The degree that sound is absorbed when struck by a sound wave. The scale goes from 0 to 1.0 being no absorption, 1 being perfect absorption. Absorption Coefficients may be reported per frequency or as a one-number average. See NRC or Noise Reduction Coefficient.

### Acoustics

- 1 Acoustics is the science of sound, including its production, transmission and effects.
- 2 The acoustics of a room are those qualities that together determine its character with respect to the perception of sound.

## Ambient Noise

Ambient noise encompasses all sound present in a given environment, being usually a composite of sounds from many sources near and far.

## Audiogram

The method of determining a person's threshold of hearing. The amount of hearing loss can be determined from an audiogram. The audiogram is typically the detection of a tone at its lowest perceivable level. The tones are at industry-designated frequencies.

## Barriers

An obstacle, such as a wall, that blocks the line-of-sight between a sound source and a receiver, thereby providing a barrier attenuation, i.e., a reduction of sound level at the receptor. Sound attenuation provided by barriers is principally related to the sound transmission loss through the barrier material.

## Decay Rate (dB/sec)

The rate at which sound will get quieter when the noise source is removed.

## Decibel (dB)

Unit for reporting level (magnitude) of sound. A change of 10 decibels is generally considered a doubling or a halving of the perceived loudness of a sound.

## Exchange Rate

The louder the sound, the lower the allowable exposure time to it. The exchange rate is the relationship between exposure time and noise level. The exchange rate halves the exposure time for every 5 dB increase in noise level.

## Flanking

The transmission of sound around the perimeter or through holes within partitions (or barriers) that reduce the sound isolation between areas. Examples of flanking paths within buildings are ceiling plena above partitions; ductwork, piping, and electrical conduit penetrations through partitions; back-to-back electrical boxes within partitions, window mullions, etc.

## Hearing Conservation Program

Monitoring of the workplace noise level and workers hearing sensitivity. When noise levels in the workplace exceed 85 dBA over an eight-hour period, a hearing conservation program is required.

## Hearing Protection

Also known as Personal Hearing Protection. Commonly used hearing protection is ear plugs and ear muffs. Hearing protection is required to be issued to workers in a work environment with a time weighted average noise level of 85 dB.

## Hertz (Hz)

Frequency measure in units of cycles per second. See frequency.

## Leq (Equivalent Noise Level)

Measure used to express the average sound level (typically expressed in dBA) over a given period of time.

## Ln Statistical Noise Levels

Sound levels (typically expressed in dBA) that is exceeded n percent of the time. Common statistical levels are L10 (level exceeded 10% of the time), L50 (level exceeded 50% of the time), and L90 (level exceeded 90% of the time).

## Octave Band

Groups of frequencies defined by standards where the upper frequency of each band is equal to twice the lower frequency of the next higher band. Octave bands are usually named by their center frequency.

The full complement of octave bands in the audible frequency range is as follows: 31.5, 63, 125, 250, 500, 1,000, 2,000, 4,000, 8,000 and 16,000 Hz.

## 1/3 Octave Band

Frequency band encompassing 1/3 of one octave. Three successive 1/3 octave bands make one full octave.

## Noise

A sound that typically does not carry any positive benefits and typically produces annoyance.

## Noise Criteria (NC)

A one-number rating for the quietness of a room. Typically associated with HVAC noise but includes all ambient noise present in room when measured.

Examples of typical NC ratings:

Below NC 15: Quiet studio

NC 15 - NC 25: Quiet library or classroom

NC 25 - NC 35 Typical Office

NC 35 - NC 45 Noisy Office

## Noise Induced Hearing Loss

Hearing loss caused by exposure to high noise levels, versus hearing loss due to aging or other means.

## Noise Reduction (NR)

The reduction of sound, expressed in dB, from one side of a barrier or material to the other.

## Noise Reduction Coefficient (NRC)

The average of the absorption coefficients ( $\alpha$ ) for the frequency bands 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz. Commonly used to describe the average absorption of acoustical materials such as ceiling tiles and wall panels.

## Reverberation

Reverberation is the persistence of sound in an enclosed space resulting from multiple reflections from space surfaces.

## Reverberation Time (RT60)

The reverberation time of a room is the time it takes for sound to decay by 60 dB once the source of sound has stopped. Reverberation time is inversely related to sound absorption and is a way to measure the amount of absorption in a room.

## Sabin

A unit of absorption having the dimensions of square feet or square meters, as appropriate. A quantity of the amount of absorption equal to the surface area (SA) of a material multiplied by its absorption coefficient ( $\alpha$ ).

## Signal

A sound carrying useful information or information of interest. The signal could be a test tone, speech, or music.

### Signal to Noise Ratio (SNR)

A measure of useful signal to unwanted noise. When computed using sound levels in units of dB, it is a subtraction and not a ratio.  $SNR = LS - LN$  where LS is the level of the signal and LN is the level of the noise.

### Sound Absorber

An apparatus or material that reduces the amount of sound reflected back into the environment once the incident sound wave hits it. The most common type of absorber are porous materials. Once the sound enters the porous material, its sound energy is dissipated as heat. Also see absorption.

### Sound Isolation

Ability of an object or material to inhibit sound from passing through it. Typically isolating material should be nonporous. Mass increases the isolation of materials.

### Sound Pressure Level, (SPL or L)

Measure of sound in units of decibels. 0 dB is considered to be the lower threshold of human hearing. Most often Sound Pressure Levels are expressed in A-weighted SPL (dBA). See also A-weighted.

### Sound Reinforcement

Electronically amplifying an acoustic sound source such as a talker. Sound reinforcement systems typically use microphones, amplifiers, and loudspeakers.

### Sound Transmission Class (STC)

Overall single number performance rating of transmission loss. See transmission loss.

### Spectrum - Spectra

Sound can be composed of a multitude of tones of different frequencies. The decomposition of the sound into its frequency components is the sound spectrum. The sound spectrum will show the levels within each frequency band. This allows one to determine what frequencies are problems to focus noise control efforts on.

### Speech Intelligibility

The ability to understand spoken words in a particular environment.

### Speech Transmission Index (STI)

Measure of the intelligibility of speech in an environment. Scale of 0 to 1. An STI of 0 is completely unintelligible. An STI of 1 would be perfectly intelligible. STI can be measured in the field or can also be calculated using computer models of architectural spaces.

### Speed of Sound

Sound travels at different speeds in different physical media. For air, the typical speed is 350 m/s (1100 ft/s).

### Threshold Shift

After exposure to noise of high levels over a period of time, the sensitivity of the ear is reduced. The threshold shift of hearing sensitivity can be temporary or permanent.

## Time Weighted Average

Because the noise level is not constant over time, a method of computing the entire equivalent noise dose is required. This is the time weighted average.

## Transmission Loss (TL)

Similar to Noise Reduction but removes influence of size of test sample and amount of sound absorption of test room. TL is reported, in decibels for individual octave or 1/3 octave frequency bands.

## Wavelength

The distance a wave travels in the time it takes to complete one cycle. Wavelength is inversely related to frequency. As frequency increases, wavelength decreases and vice versa.





# About Us

We are the leading producer of Acoustic and Thermal Solutions for Original Equipment Manufacturers throughout North America.

We design, develop, manufacture, and deliver parts and materials that absorb, block, and isolate sound and thermal energy. Our dedicated team of Engineering, Manufacturing, and Administrative Professionals utilize the latest systems, processes, and technologies in our state-of-the-art facility to meet and exceed your expectations.

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