

# Acoustic Solutions Can Improve Railcar Environment for Passengers and Crew

Rail transportation is a growing market globally, increasing in freight, passenger and urban segments since 2005. According to an SCI report, "Passenger rail performance is expected to continue growing dynamically, with an average growth rate of 3.2–3.3 percent per annum up to 2025. Growth is forecasted for all world regions, with Africa/Middle East showing the highest relative development, totalling 50 percent growth between 2015 and 2025" (Rail Transport Markets, 2017).

In 2015, the passenger transport systems in 39 countries logged 243 billion journeys, up 18 percent from 2000.

The USA rail market is USD\$73 billion and employs nearly 160,000 people, another report says. "In 2014, ridership across all public transport modes in the United States reached 10.8 billion, the highest level for 58 years. Rail ridership was up 3.3%, while passenger numbers for light rail climbed 3.6% with a 2.9% increase in commuter rail usage" (Melaniphy, 2016). Municipalities and others are investing in a number of passenger rail projects across the USA as populations within cities rise, and recent proposed regulations will allow faster trains.

As new train cars are built to meet the demand, the safety and comfort of passengers and crew should be considered.

Pyrotek offers a variety of solutions to control vibration and noise in rail applications.

## Effects of Interior Train Noise

Occupational hearing loss is one of the most common work-related illnesses in the USA. About 22 million workers are exposed to hazardous noise levels at work each year, the U.S. Occupational Safety and Health Administration (OSHA) says. Locomotive drivers, for example, can be exposed to hazardous noise from the diesel engine, which can also affect communication.

Train passengers also can be exposed to high noise levels, which can cause hearing loss and other health



issues. "The causal association between chronic exposure to excessive noise and permanent, irreversible, noise-induced hearing loss (NIHL) is well known, as are the adverse social, psychological, and occupational effects associated with the condition" (Basner et. al., 2014). Other adverse health effects from excessive noise exposure might include hypertension, ischemic heart disease, disruptions in stress hormones and sleep disorders.

OSHA requires companies to maintain a hearing conservation program in cases where workers are exposed to an average of 85 decibels (dBA) during an 8-hour workday. U.S. Title 49 transportation regulations state that railroads shall provide appropriate protection for its employees who are exposed to noise that exceeds safe limits. Companies also are required to measure and document noise sources, as well as administer a hearing conservation program. Exposure to continuous noise shall not exceed 115 dBA, except in certain cases.

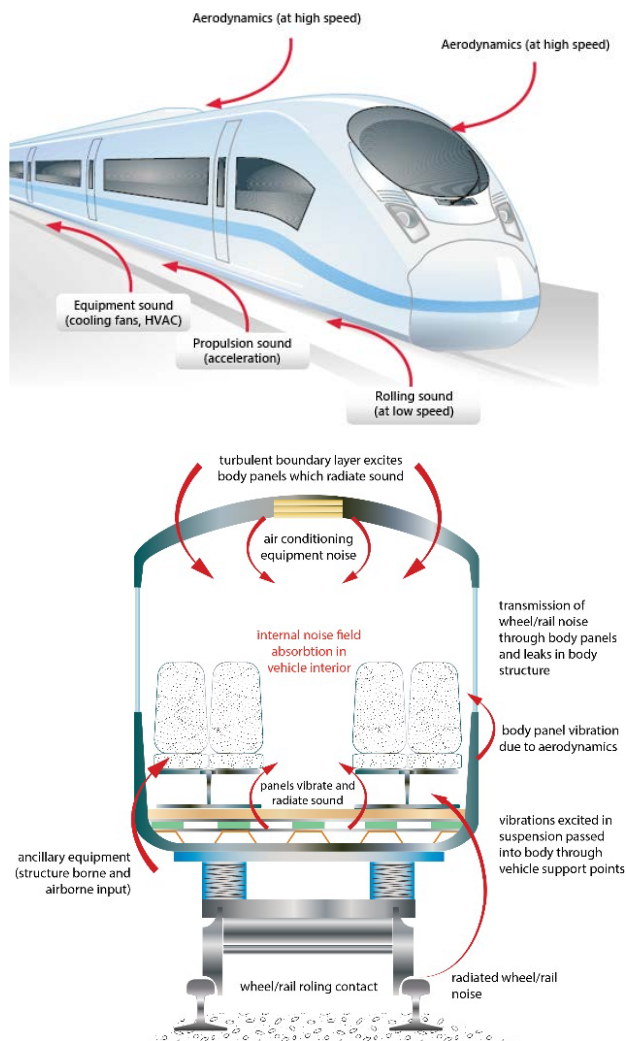
"Mass transit noise exposure has the potential to exceed limits recommended by the World Health Organization and the U.S. Environmental Protection Agency and thus cause noise-induced hearing loss among riders of all forms of mass transit given sufficient exposure durations. Environmental noise-control efforts in mass transit and, in cases in which controls are infeasible, the use of personal hearing protection would benefit the ridership's hearing health" (Neitzel, et. al., 2009).

Optimal noise levels to facilitate normal speech are 60–63 decibels, one study found. For passengers, “good acoustics are crucial to reducing stress levels, a factor that is particularly relevant to high speed trains where the high velocity can raise background noise and vibration in the carriages. Designs need to address external and internal noise levels, particularly important is any effort spent on dampening the noise of conversations between passengers, and most especially those using mobile phones” (Firman and Hastings, 2017).

### Sources of Noise

Rail noise is generated from multiple sources, including the engine, wheels, and wind. There are a “large number of potential sources, including airborne sources generated by wheel/rail rolling contact, structure-borne sources propagated through the suspension, turbulent boundary layer noise around the moving train, and vibration from ancillary equipment or motive power plants” (Noh, 2017).

### Sources of Noise in Passenger Cars



### Controlling Noise

One study on the effect of hazardous noise on locomotive drivers suggests noise control procedures and solutions be implemented, including technical solutions can include insulation and soundproofing treatments to control noise at the source and noise pathways (Platon and Tudor, 2014).

Solutions can include:

- Vibration damping—Reduce the transfer of noise and energy generated by vibration.
- Noise barriers—Shield and deflect noise from entering critical areas, as well as composites for specialist applications.
- Sound absorbers—Absorb noise energy within spaces reducing noise levels caused by reflected noise energy.
- Condensation coatings—Reduce condensation build up.
- Fire protection—Control hot or cold transfer and provide fire protection and safety.

### Pyrotek Solutions

Pyrotek’s solutions for controlling noise and vibration on railcars include noise barriers, sound absorbers, vibration damping products, anti-condensation coatings and fire-protection materials. Custom kits are offered.

### Vibration Damping & Isolation

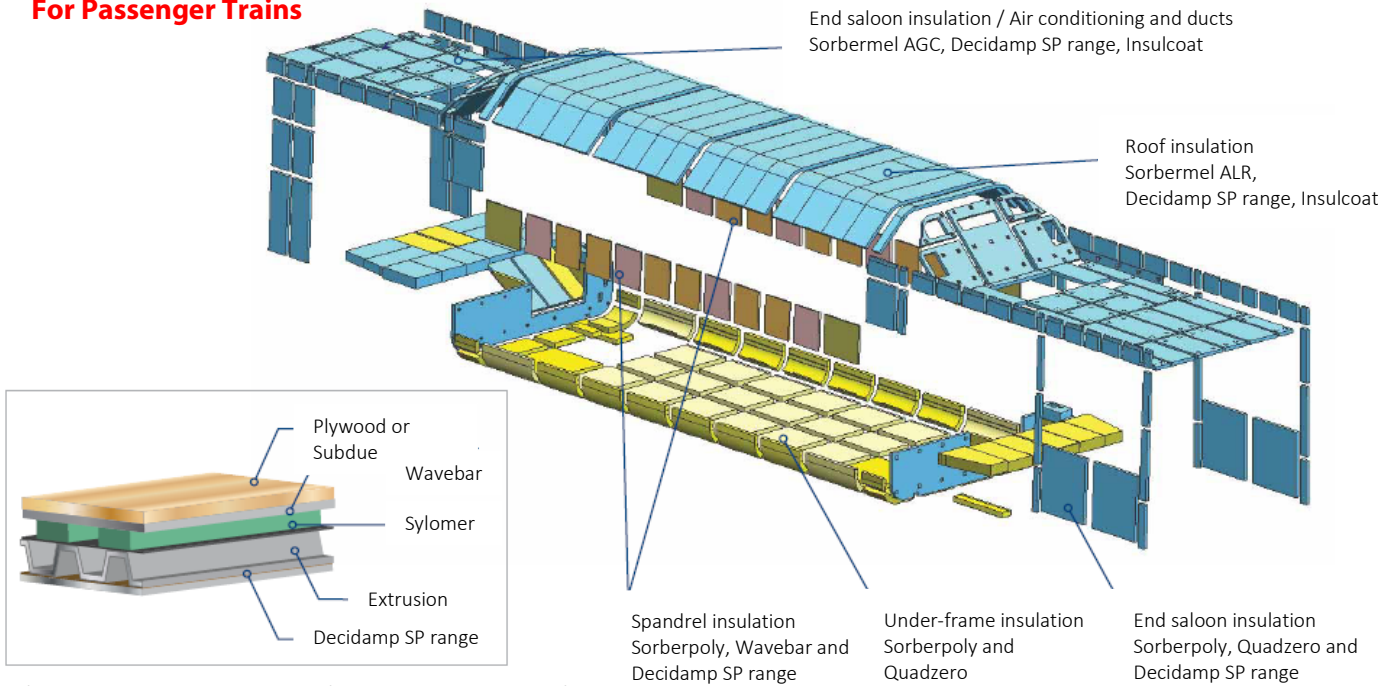
Structures made from materials such as steel, fibreglass and alloys have minimal internal damping properties. If not effectively damped, the vibration will radiate as airborne sound. Pyrotek products help reduce body noise, provide moisture control, lessen vibration and airborne noise and reduce metal fatigue and cracking.

- Decidamp SP450—A water-based, viscoelastic vibration damping compound designed to improve acoustic quality of rail carriages
- Decidamp SP500—A water-based, non-sagging coating designed for protecting the underbody of rail and tram cars and luggage compartments

### Sound Absorbers

Sound absorbers maximize noise energy reduction through converting motion into thermal energy, which is due to friction within the fibrous cellular materials. Pyrotek’s sound absorbers offer excellent

**Pyrotek Solutions  
For Passenger Trains**



*Floor construction using a noise barrier or composite and isolation*

thermal properties, are lightweight, have low thermal conductivity and meet global rail standards for smoke, fire and toxicity.

- Sorberpoly 3D AGC—A lightweight high-performance polyester sound absorber with aluminium foil glass cloth facing
- Sorbermel—A flexible, open-cell foam made from melamine resin that is self-supporting and suited to weight-sensitive applications

**Noise Barriers**

Noise barriers are used to reduce noise transfer and flanking paths between acoustically sensitive areas and to increase performance of existing structures by wrapping or hanging as a shield or cover.

Pyrotek’s Quadzero dBX is a mass-loaded vinyl barrier made from recycled polymers that are halogen-free, laminated with an aluminium foil-covered glass cloth facing for a flame-retardant surface. It reduces noise from tracks and brakes when used in locomotive floor systems. It is also suited for use in rail carriages as underfloor insulation, on walls and on ceilings. They have a high noise reduction-to-weight ratio, meet global rail standards for smoke,

fire and toxicity, are easily cut and fitted and are suitable for walls, floors and partitions.

**Condensation Control**

Corrosion on metal components is caused when surfaces are exposed to heat, light, condensation, chemicals and salts. It occurs on surfaces when there is temperature differential on either side of the substrate and when there is heat transfer through the material.

Coatings provide an advantage over alternate treatments because they help eliminate thermal bridging. Pyrotek’s Decicoat T35 is a water-based, sprayable thermal insulation coating, formulated to provide excellent anti-condensation and corrosion protection. It is lightweight and has excellent thermal resistance.

**Pyrotek Case Studies**

**High-speed Rail Project in China**

Pyrotek formed a connection with China’s high-speed rail industry in 2009. With the development of technology, high-speed rail noise standards need to catch up with international levels. Passengers



increasingly care about comfort, fire performance and environmental protection.

China has the longest High-Speed train line in the world. A high-speed classification means the train can travel over 200 kilometers per hour. CRH operates the fastest train in China, and there are restrictions on acceptable noise levels in control rooms. When running at full speed of 300 kilometers per hour, the noise in the control room must be lower than 75 dBA. There were a number of design requirements encountered during the building process, which restricted options available to CRH for reducing noise. For example, the body structure design could not be altered due to its aerodynamics.

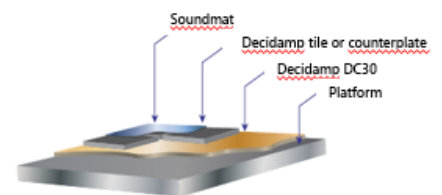
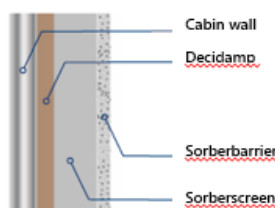
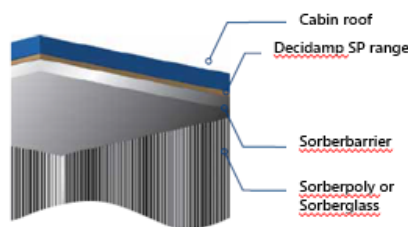
Pyrotek's acoustic team specified a solution that would be suitable for floor installation that was resistant to water, oil and adverse weather conditions, while also meeting local fire codes and giving some internal noise reduction. The company's laboratory then developed a variation of Pyrotek Wavebar barrier, Quadzero NL, to meet the CRH's requirements. The new product met the Chinese flame resistance standard of TB 3237 and DIN 5510-S4 class. At 11 kilograms per square metre, the barrier also was extremely effective in reducing noise levels.

### Diesel Locomotive in India

Diesel Locomotive Works (DLW) in Varanasi, India, wanted to reduce the noise of its WDP4D-4500HP passenger locomotive to below 90 dBA.

The dual-cab locomotive was a broad-gauge passenger traffic Co-Co diesel electric locomotive equipped with 16-cylinder, 4500-horsepower engine. The cabin noise in the locomotive was measured at 100–110 dBA, exceptionally high for worker safety.

### Pyrotek Solutions for Locomotives



To reduce cabin noise, Pyrotek installed 4-kilogram Wavebar noise barrier, Sorberpoly 2D fibre-based acoustic insulation, Decidamp damping compound and Sorberscreen, a micro-perforated metal sound absorber.

Decidamp was applied 1.5–2 millimetres thick on the metallic walls of the locomotive's cabin to deaden the sound coming from structural vibrations of the cabin. For the sound absorption and transmission issues, Wavebar and Sorberpoly 2D were adhered together and installed on top of the Decidamp compound. For a robust and long lasting finish, Sorberscreen Micro was applied to overcome the low frequency noise.

Post-installation measurements showed that noise levels had been reduced markedly to 87 dBA.

### About Pyrotek

Pyrotek® is a global engineering leader and innovator of performance-improving technical solutions, integrated systems design and consulting services for customers in the energy, metals, glass and other high-temperature materials industries.

The company's acoustic treatment and thermal insulation division started over 40 years ago in Australia and now serves transportation, marine, construction and industrial customers around the world. Pyrotek operates and continually invests in its facilities for acoustic and material property testing.

With global resources and dependable local support in more than 35 countries, Pyrotek products are in use around the world in automotive, aerospace, rail transportation and high-tech manufacturing.

[pyroteknc.com/industries/transport](http://pyroteknc.com/industries/transport)

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