

Rail Noise Impact On People



Understanding and resolving noise discomfort in modern day rail transport



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Introduction: addressing noise in rail transport

As population pressure on capital cities mounts, high-capacity mass transit rail systems have become a critical element of an economical and environmentally sustainable transport solution.

Capable of moving 50,000 passengers per hour compared to a highway capacity of 2500, rail infrastructure has the ability to substantially reduce road congestion and create vital links between cities and increasingly sprawling outer suburbs¹.

The commercial viability of the rail network and relief of road congestion relies on maximising patronage, a crucial factor being high standards in comfort and safety. Passengers consider low vibration and noise as the most important elements of a comfortable trip, above cleanliness and air conditioning². This preference for quiet is illustrated by the introduction of 'silent carriages' on metro trains.



With mass transit a necessity as communities move ever further from city centres, the comfort and safety of passengers and residents is a priority.

Typically, trains produce five times less greenhouse emission than vehicles¹, yet the environmental impact of rail noise pollution is a consideration which requires strategic solutions.

New rail networks through suburban developments are generally viewed as an advantage, however particularly disruptive vibration and noise can result in negative sentiment and lower property values³.

Of particular note is the important safety element of the prolonged noise emissions associated with rail services, which, if unaddressed, can pose significant harm to residents, passengers and rail staff.

This white paper aims to investigate the main sources of noise transmission and the effect on communities and passengers, as well as propose effective mitigation methods.

Rolling Stock Variations

Rail soundproofing is not one-size-fits-all. Noise transmission from light rail, metro trains and freight rolling stock must be considered in combination with their route and track condition.

Mitigation methods can be applied both within the housing of the train carriage and on external structures to deflect noise or absorb reverberation. For optimal results, sound absorbing products and application techniques should be customised in line with decibel testing outcomes to provide a solution for individual train requirements.

Airborne noise sources

The principal source of low frequency noise is track vibration. The volume of the noise is largely determined by the speed of the rolling stock; a metro train which travels in excess of 100 km/h will produce higher track excitation levels than a tram or light rail, which travel between 45 and 80 km/h respectively. High speed trains can easily exceed 200 km/h, requiring solutions to reduce low frequency noise spreading and mitigate carriage vibration caused by increased air resistance.

Other sources of unwanted airborne noise include brake or curve-induced squealing and flanging, and external noise from construction, road traffic and the reverberation of airborne sound between carriage and walls when passing through concrete tunnels.

Structural noise sources

The vibration within the train shell is created by air resistance and air pressure during transit.

This is of particular concern because of the effects of whole-body vibration (WBV). Not only is high-level vibration of immediate physical discomfort, WBV over long periods (time frames experienced by regular long-haul commuters and on-board rail staff) can cause long-term health issues including bone damage⁴.

These externally transferred sounds and the ambient noise of passengers and HVAC systems reverberate between the hard surfaces of the train interior. While WHS Regulations state that a safe working environment is 85 dB for an eight-hour time frame, to ensure optimal communication and concentration, volumes should be kept below 50 dB⁵. This is significant for conductors in control rooms, which are subject to high noise transmission. Loudspeaker announcements to notify of next stops or relay vital emergency instructions can also be concerningly difficult for passengers to discern.

Rail-induced noise solutions

Studies have shown that the best way to tackle acoustic vibration annoyance for passengers and the surrounding urban environments is at the source⁴. An effective and economical solution is to adhere sound and vibration damping, absorbing and reflective products to highly resonant construction materials across a variety of mitigation methods. Ideally to create a more comfortable, quiet and safe trip for passengers.

Pyrotek®, global innovators in soundproofing technology for over 40 years, have designed a complete range of acoustic insulation products for light rail, metro, commuter and regional trains, as well as intercity and high-speed rail locomotives.

With over 80 locations in 35 countries, Pyrotek® acoustic insulation products continually evolve to anticipate the changing needs of a broad range of industries, across the lifetime of the application, without compromising on design or adding undue weight or bulk.

For more information, visit pyroteknc.com





A Note on Echo in Tunnels

Reverberation inside rail line tunnels can potentially raise dB readings inside carriages to uncomfortable noise levels. Fitting tunnel interiors with highly absorbent panels, such as Pyrotek's non-combustible Reapor and Viterolite panels can provide impressive results to reduce reverberation within the tunnel space. It has also been shown to reduce the radiation of sound at tunnel openings, lessening community impact⁶.

Tiles can be designed to be fitted between tracks and affixed onto tunnel walls.



The right combination of soundproofing products means stronger protection against vibration and low frequency noise in rail applications. Wall, floor and roof cavities can be treated with vibration and sound damping, soundproofing panels and thermal insulation for optimal results.

Vibration damping compounds

High quality damping compounds add light-weight mass to train housing, to absorb and dissipate resonant vibration and impact-generated noise at the source. Decidamp® SP450 and SP500 are fast drying, viscoelastic damping compounds that can be easily sprayed or trowelled onto a range of surfaces, including fibreglass, aluminium and steel.



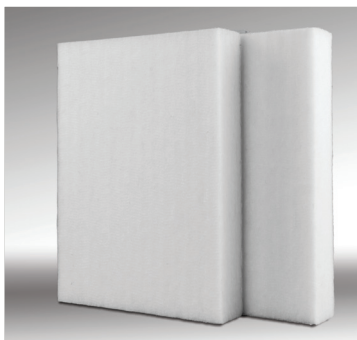
Decidamp® 500 is a high chip resistant structural damping material offering superior condensation and corrosion protection. Also included in the Decidamp® range are damping sheets and tiles.

With low combustibility, Decidamp SP500 effectively absorbs and dissipates vibrational energy from the flexural stress of the base making it an ideal choice for premium transport applications.

Acoustic insulation (sound absorbers)

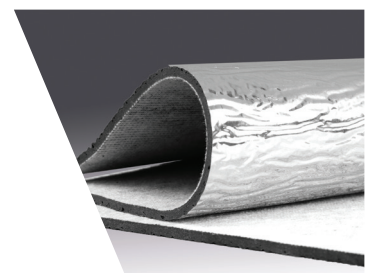
In wall, floor and ceiling cavities, sound absorbing and thermal insulating sheets can be layered on the damping compound. Made from ultra fine fibres of non-woven polyester, Sorberpoly™ is especially suited to rail vehicles for its resilience to high humidity and condensation, as well as being fuel, oil and grease resistant.

Sorberpoly™ has been engineered to provide superior thermal insulation with low thermal conductivity, and will never degrade. Combine with open cell decoupling layer to allow for drainage of condensation.



Noise barriers - including floors

Quadzero™ NL and dBX are foil-faced, mass-loaded vinyl acoustic barriers in Pyrotek's Wavebar® MLV range. Engineered to prevent coincidence dip resonance they are highly durable, and particularly effective when incorporated into flooring systems to address the primary source of noise emissions from the wheel/rail interaction. Dense, thin and lightweight, Quadzero™ NL and dBX have high tensile strength, are easily cut to size and thus are quickly installed. Certification has proven materials meet all fire regulation requirements.



Subdue, another specialised variation, provides effective structural flooring and acoustics in one product. Lightweight multi-layered panels feature two outer layers of dense plywood encapsulating various lightweight cork, with unique barrier interlayer composition.

Available in standard or custom designed modular sizes, according to project requirements.

Conclusion

Addressing noise in rail transport requires a considered, holistic approach with correctly engineered and long lasting materials. Providing a comfortable ride with reduced vibration and noise for the life of carriages will provide better usability and safety for those on board well into the future.

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About Pyrotek®

Pyrotek® provides innovative noise control products and tailored acoustic insulation solutions to global rail, infrastructure and architectural markets.

With an inhouse engineering team, Pyrotek® can create highly specialised products to designed specifications and performance requirements.

To find out more about Reapor®, Sorberpoly™, Decidamp®, Quadzero™, or other acoustic solutions visit pyroteknc.com

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