## Railway noise reduction measures

In describing railway noise, it is possible to distinguish the following main noise sources:

- rolling noise,
- traction and auxiliary noise,
- aerodynamic noise,
- impact noise,
- curve squeal, and
- braking noise.

For train speeds between about 100 km/h and 250 km/h, rolling noise is the dominant noise source. Rolling noise emanates from the roughness of the wheel and the rail. Wheels, rails, and sleepers vibrate and radiate noise. It is amplified significantly on steel bridges. Traction noise is generated by powered railway vehicles such as locomotives and passenger trainsets, and can be dominant below 60 km/h and at idling. Aerodynamic noise is important for high speed trains, and can be dominant above 300 km/h. Impact noise occurs on tracks with rail joints, at points and crossings and at infrastructure transitions (e.g. track-bridge), and occurs frequently at junctions and on light rail networks. Curve squeal occurs both in curves and on points, and is stronger on light rail due to the smaller curve radii. Braking noise occurs both at speed and at lower speeds often as brake screech, even on modern high-speed trains. Braking of long freight trains can produce very high noise levels locally. There are several noise reduction measures for railway noise (see Table 1), where the most effective one can reach up to 30 dB of noise reduction.

**Table 1:** Overview of railway noise reduction measures

| type of measure | specific measure | factors affecting the potential | potential noise reduction |
|---|---|---|---|
| Reduction at the source. Normal rolling noise. | Retrofitting railway rolling stock, in particular freight trains. | Retrofitting the European freight wagon fleet may take several decades. | 8-10 dB |
| | Impact noise at turnouts. | Local problem at turnouts. | 10 dB |
| | Tuned rail dampers. | | 1-3 dB<br>2-4 dB combined with wheel dampers |
| | Embedded rails for slab or steel track. | Requires absorbing embedding ground surface. | 3 – 4 dB |
| | Broadband rail dampers. | Combined with wheel dampers. | 5 – 7 dB (note this seems rather high). |
| | Steel bridges. | | 3-6 dB existing bridges<br>5-15 dB replacement |
| | Special rail profiles. | | 0 – 3 dB |
| | Anti corrugation systems. | Prevention for new track, grinding for existing track. | 10 dB<br>1-6 dB |
| | Anti squeal measures, including rail lubrication | Local problem. | depends on situation, potentially large reductions |
| | Brake noise measures. | Local problem. | depends on situation, potentially large reductions |
| Reduction at the source Curve noise; Braking | BREMEX ANNSYS technology | | up to 30 dB |

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|---|---|---|---|
| noise | CL-E1 technology<br>DRYproANNSYS technology | | up to 30 dB<br>up to 20 dB |
| Reduction at the source.<br>Excessive rolling noise. | Wheel truing.<br>Rail grinding. | These measures should be considered as maintenance. | 7 - 10 dB for smooth rails<br>2 - 5 dB for smooth wheels |
| Reduction at the source.<br>Traction noise. | Measures for cooling systems (fan noise), orifice noise (mufflers, active control). | | 5-15 dB |
| Reduction at the source.<br>Aerodynamic noise. | Low –noise design.<br>Low noise pantograph. | | depends on specific situation |
| Legal and operational restrictions. | Access restrictions for noisy trains.<br>Noise limits. | <br>Apply to new or upgraded rolling stock. | depends on specific situation<br>Will ensure 7-10 dB reduction for freight wagons<br>2 – 5 dB reduction foreseen for 2016-2018 |
| Operational measures. | Speed restrictions.<br>Rerouting of trains. | *Not* considered effective action plan options by UIC. | depends on specific situation |
| Sound transmission, immission at the receiver. | Noise barriers.<br><br><br><br>Tunnels.<br><br>Isolation of houses. | Noise reduction at the source should be investigated before considering noise barriers.<br><br>Applicable to new railway lines. | up to about 25 dB<br><br><br><br>more than 25 dB<br><br>up to about 20 dB |
| Land-use planning and management. | | | depends on specific situation |
| Socio-economic measures. | Rail access track charge differentiation.<br>Incentives for low noise vehicles. | | depends on specific situation<br>depends on specific situation |