TATA STEEL

TATA

# Targeted noise reduction using rail dampers

## Rail Technology Conference – 17-19 November 2015, Paris

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## Agenda

| | |
|---|---|
| 1 | Introduction |
| 2 | Rail noise reduction principals |
| 3 | SilentTrack® test programme |
| 4 | Results and Conclusions |
| 5 | Questions |

## Tata Group is one of the world's fastest-growing and most reputable corporations


- Tata businesses span 7 major industry sectors
- India's largest private sector employer, with 425,000 employees worldwide
- Operations in more than 80 countries
- Largest companies
  - Tata Steel
  - Tata Motors
  - Tata Consultancy Services
  - Tata Power
  - Tata Chemicals
  - Tata Global Beverages
  - Tata Communications
  - Indian Hotels

## Key markets we serve

Automotive

Construction

Energy & Power

Lifting & Excavating

Packaging

Rail

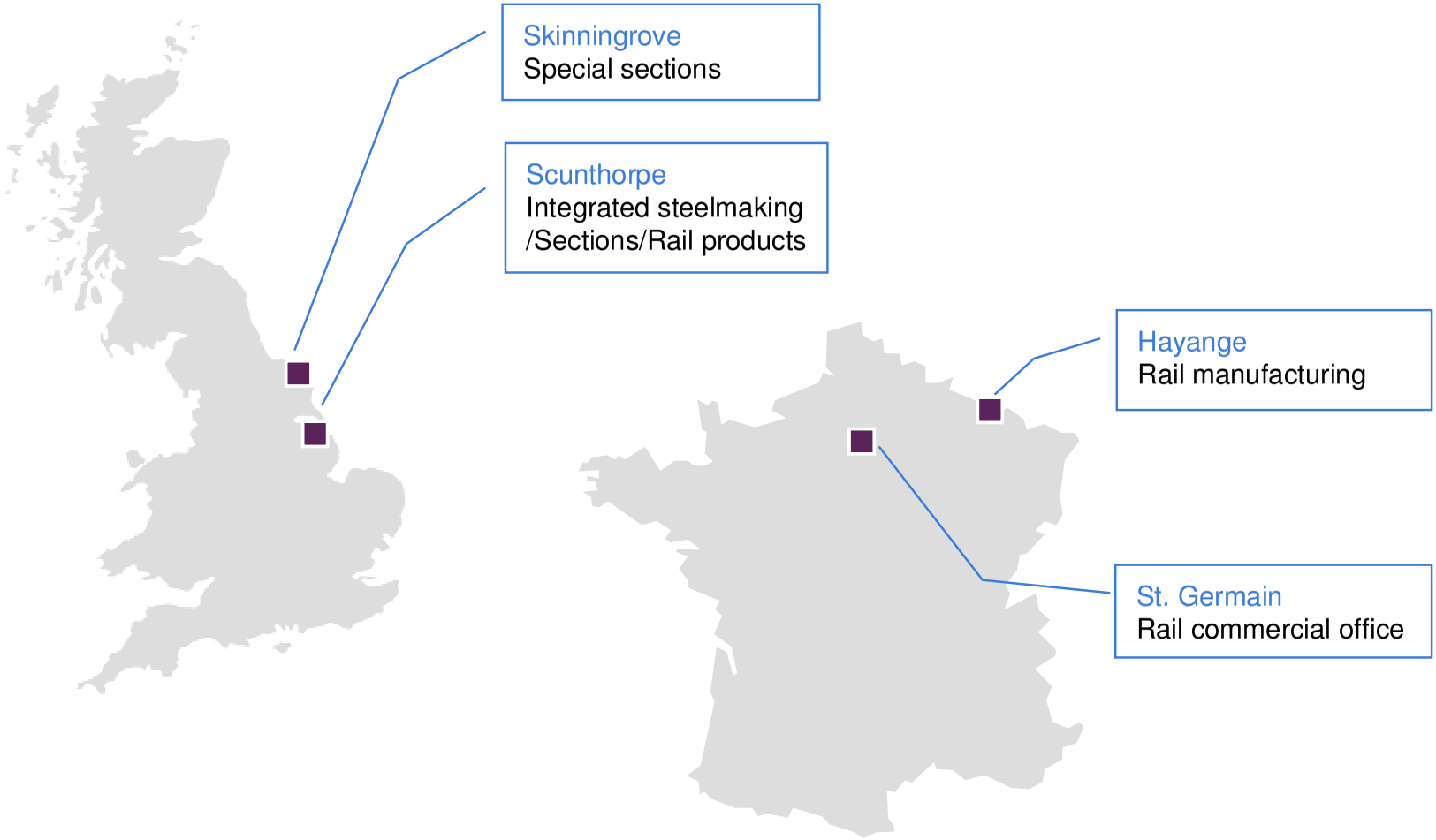
Aerospace

Consumer Goods

Defence & Security

## Our manufacturing and service locations – UK and France

**100+ profiles, 600kt output and rolling/heat-treating rail up to 120m long**



## Tata Steel in rail

### Investing for our customers

Since 2000, we have invested more than €210m in our advanced rail manufacturing facilities at Scunthorpe, UK and Hayange, France.

- Improving the quality of our steel bloom feedstock for our rail mills
- Investments in Scunthorpe rail mill to improve length (36m to 120m) and transform manufacturing logistics. We also invested in world-class inspection systems
- €50m investment in Hayange rail mill to produce 108m heat-treated rail

## Introduction to Railway Noise

Railway authorities are being forced by legislation to reduce the noise generated by their activities, and are looking for cost effective ways of doing this.

Noise from rail traffic is generated in three principal ways :-

- from the wheel/rail interface.
- from structures carrying the railway.
- from rail vehicles themselves.

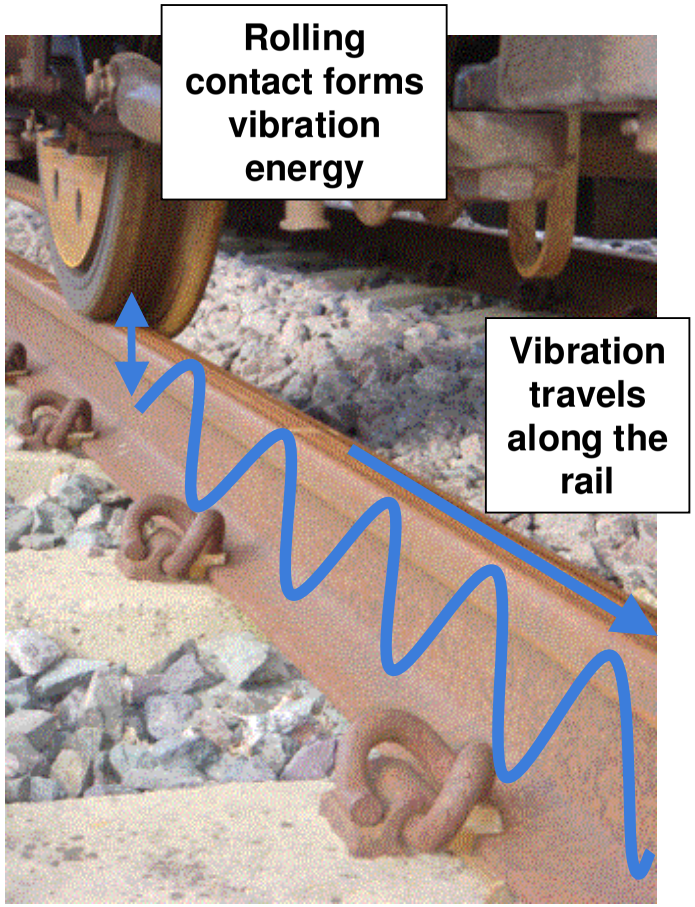
Noise can be prevented from reaching the public either by containing the noise (e.g with screens) or by reducing the noise being transmitted at source.

For “classic” railway traffic, the major source of railway noise is the track.

Tata Steel has developed a solution to railway noise called “SilentTrack®” which reduces rail noise at source.

## The Rail as a Noise Source

As multiple train wheels roll over a rail, the combined roughness of the rail and the wheel gives rise to vibration energy from rail / wheel contact.




In the mid to high frequency range, this vibration energy remains in the rail, where it is then transmitted into the surrounding air as noise.

The amount of noise generated depends on level of vibration that remains in the rail. The vibrations will diminish as they travel along the rail.

Modern railway tracks using elastic (“resilient”) rail fastenings have a low **decay rate** for vibration – ie the vibration travels further along the rail before diminishing, and thus more noise is generated.

Decay rate can be **increased** by the addition of rail damping.

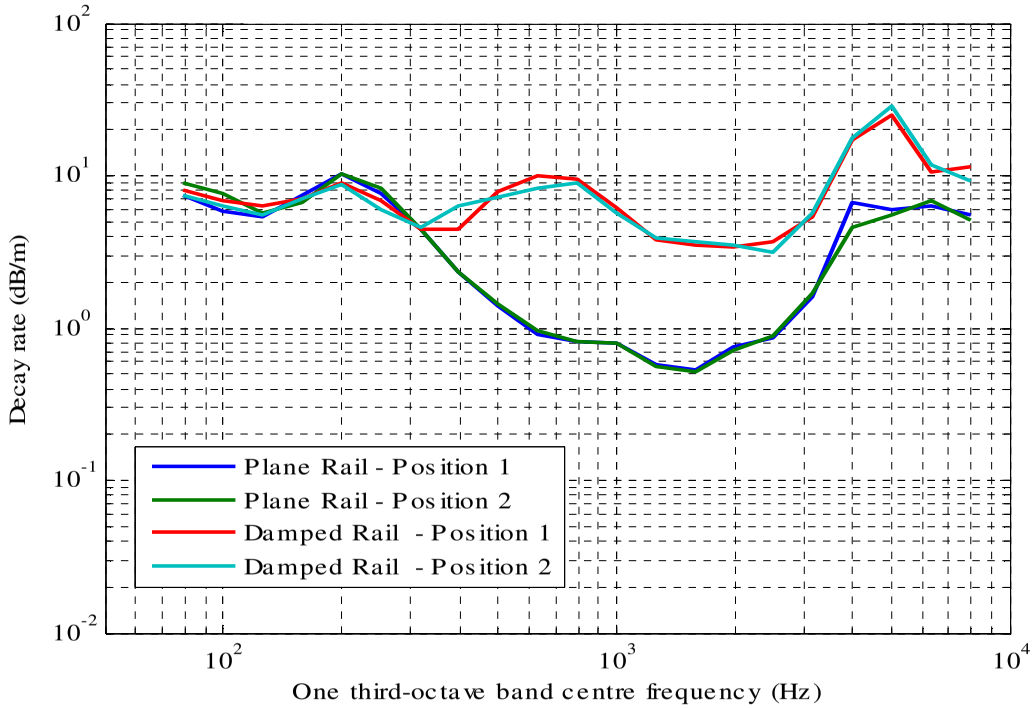
This **reduces** the vibration waves travelling along the rail, and therefore **reduces** the vibrating length of the rail, and hence the noise emitted.

## Effect of Tuned Rail Dampers on Decay Rate

The improvement in track decay rate is recognised by the Rail Industry as the key noise-reducing performance indicator of a rail damper.

The upper lines show the increased decay rate on a track with SilentTrack® tuned rail dampers, compared with the undamped track

Reduction of pass-by noise of 3.2 - 5.8dB(A) dependant on traffic was achieved

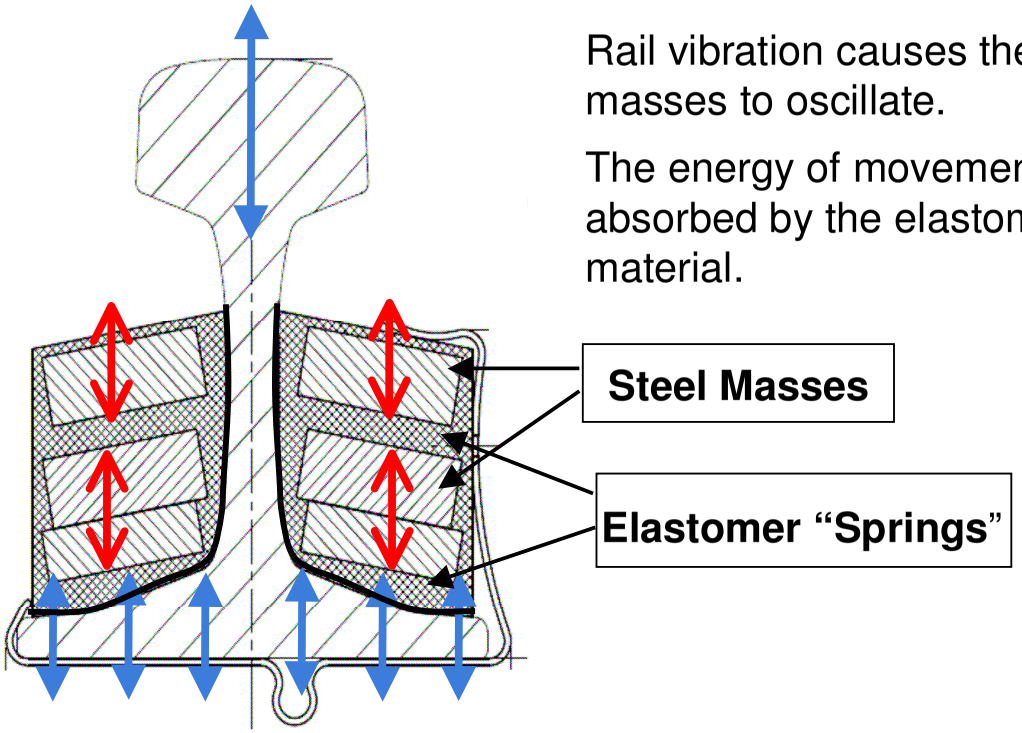


## SilentTrack® - How does it work?

As multiple train wheels roll over a rail, the combined roughness of the rail and the wheel gives rise to vibration energy from rail / wheel contact.

The SilentTrack® system efficiently absorbs the vibrations generated by the rail –wheel interface and prevents noise from being generated by the rail.

A **contact paste** is applied between the rail and the damper to ensure correct transference of vibrations.




Rail vibration causes the masses to oscillate.

The energy of movement is absorbed by the elastomer material.

We can investigate the effect of changing components in the laboratory to ensure we have a cost-effective solution, targeted at customers needs

## Testing Programme at Tata Steel R+D

Investigations focused on three areas

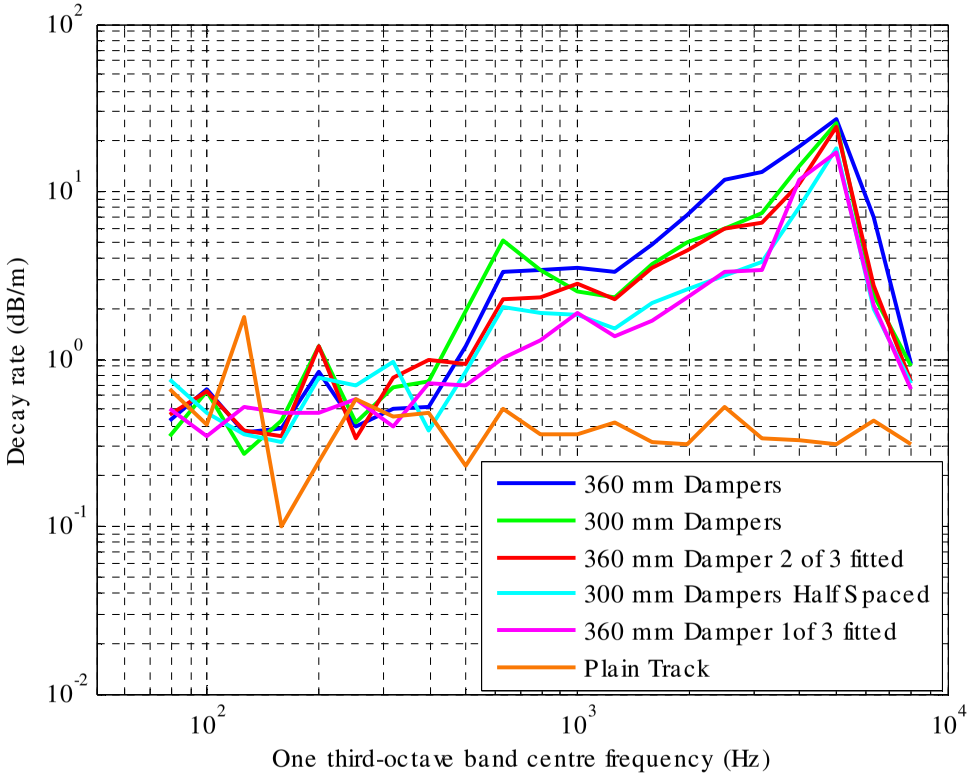
- Change to percentage of rail with dampers
- Alternative clip designs
- Revised polymer formulation

Measurement as STARDAMP method

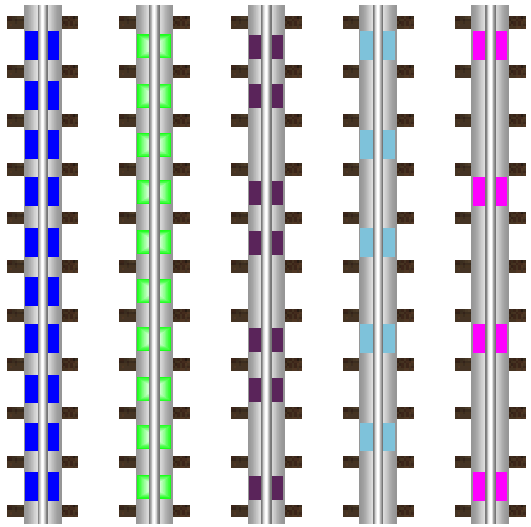
- Free rail, 6m length on soft supports
- Dampers positioned at 600mm intervals
- Vibration response measured at both ends of rail

## Results – effect of damper spacing

The loss in performance (ie lower decay rate improvement) as the proportion of rail length that is damped can clearly be seen




**Damper lengths 300mm and 360mm**



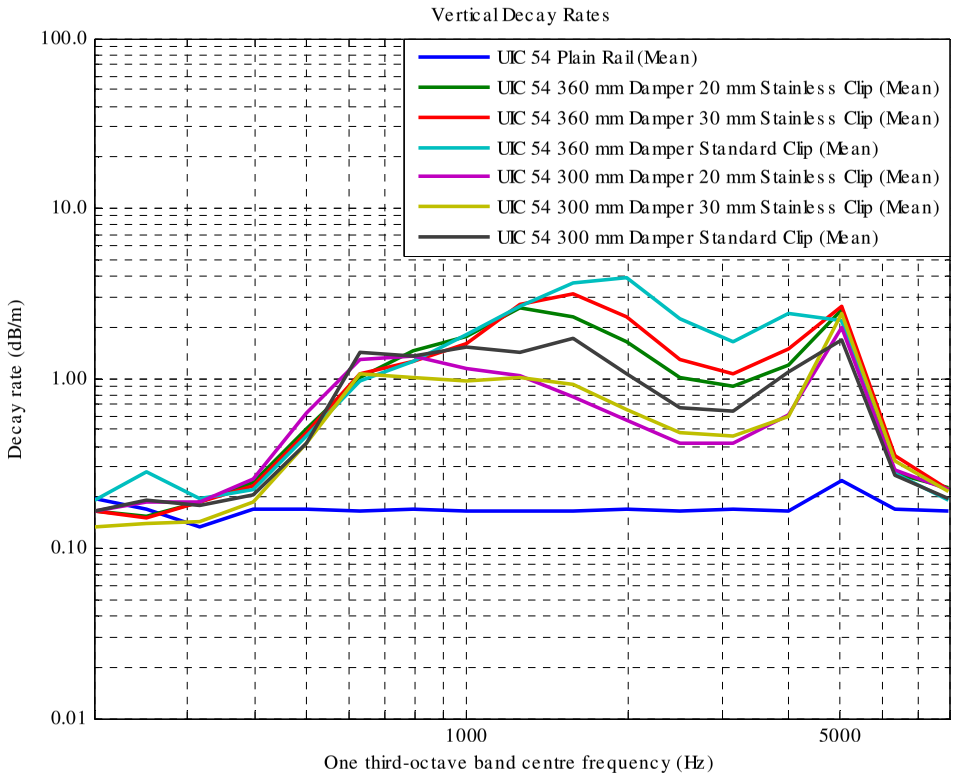
**100% 83% 66% 42% 33%**

**Dampers fitted as a percentage of maximum**

## Results – effect of different clip types

Three different types of clip were investigated, for the two damper lengths

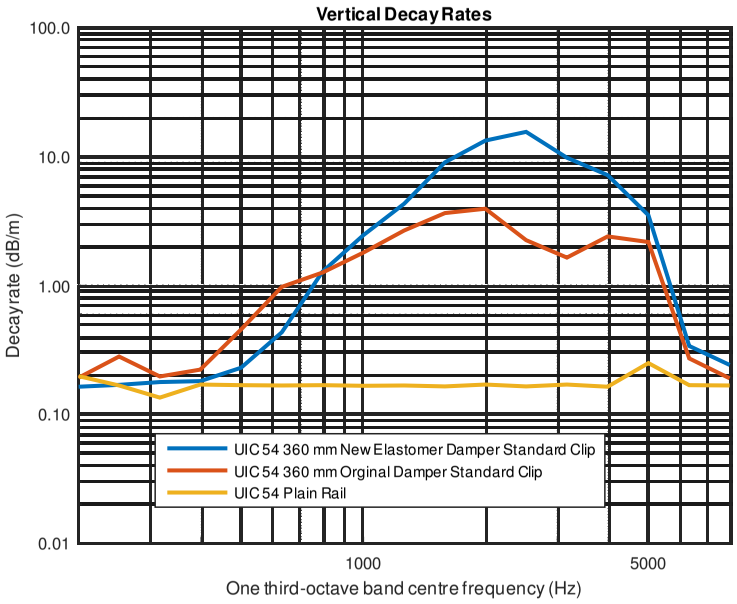
- Sprung steel, **40mm** wide
- Stainless steel **30mm** wide
- Stainless steel **20mm** wide

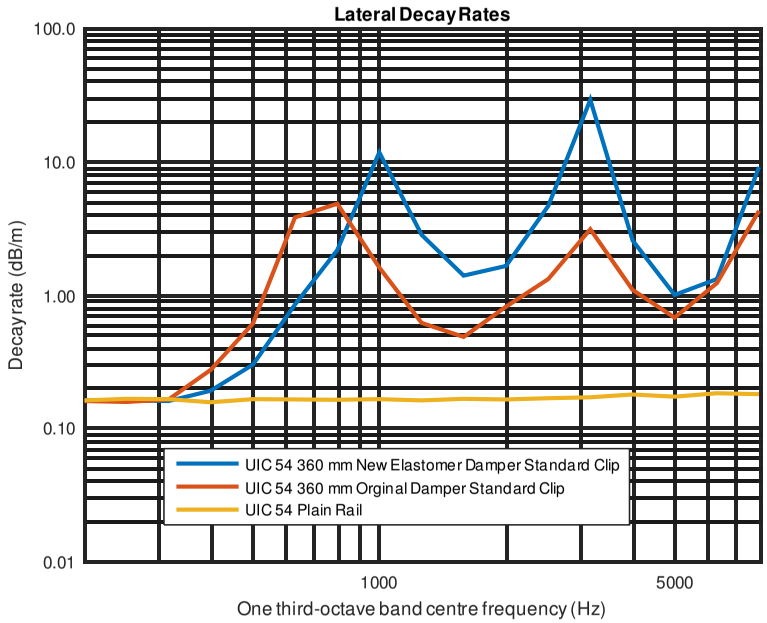


## Results – revised polymer formulations

The two polymers have difference performance characteristics:

- Original polymer is better for lower frequency (<800 Hz)
- Revised polymer is better for mid-high frequencies (1000 Hz – 5000 Hz)



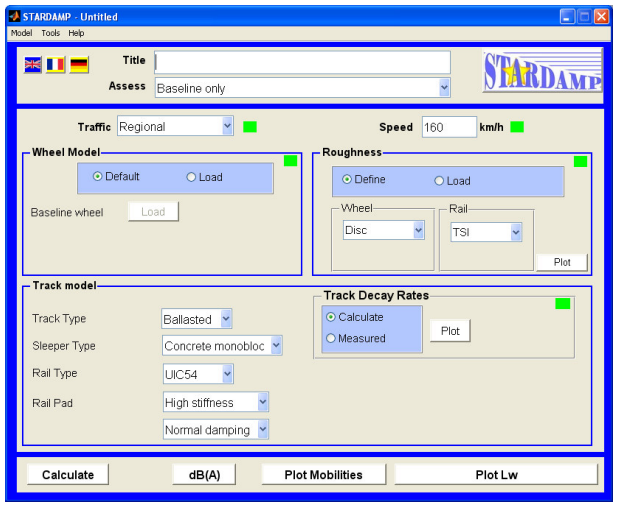



## Relative noise performance of polymer change using STARDAMP

Laboratory information can be used to compare the relative performance in reduction of rail noise of each configurations chosen.

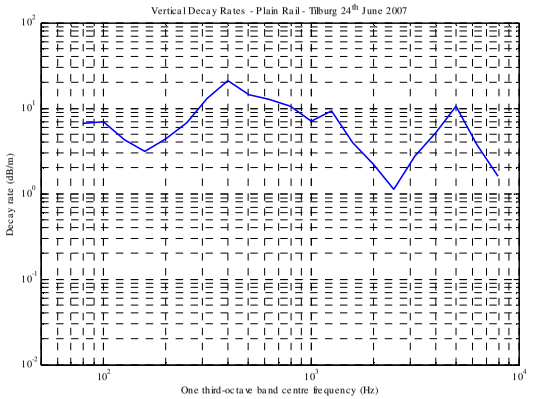
Input parameters for typical NS regional rolling stock

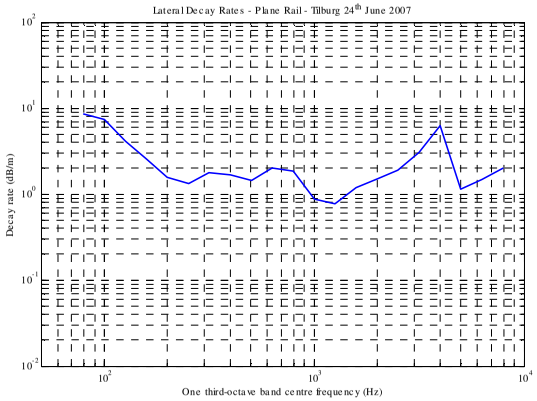
Un-damped track decay rate values from The Netherlands used as baseline




**STARDAMP Input Page**

| | |
|---|---|
| Traffic | Regional |
| Speed | 100 km/h |
| | 120 km/h |
| | 160 km/h |
| Wheel / Brake | Disc |
| Track type | Ballasted |
| Sleeper type | Concrete Mono-bloc |
| Rail profile | 54 E 1 |



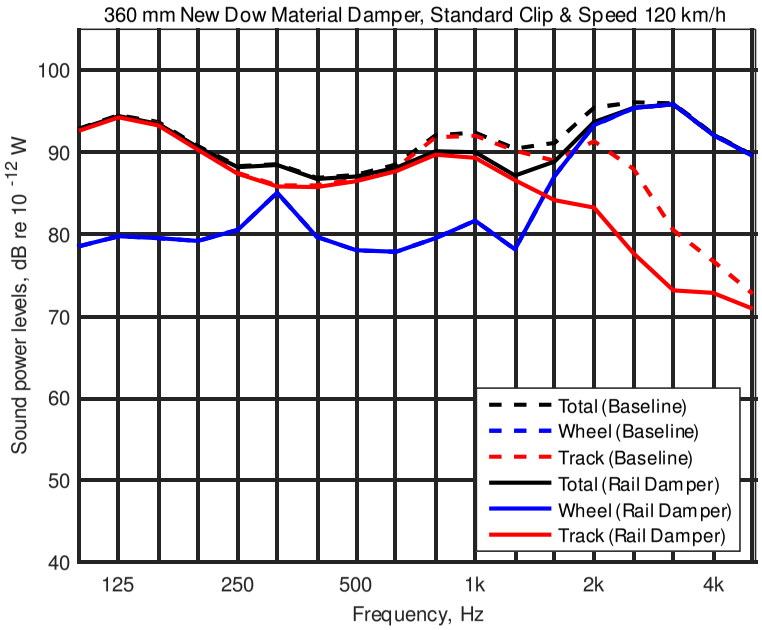



## Results – assessment of noise reduction

STARDAMP used to generate prediction of rail and wheel noise contributions for each test case

Comparison with existing case allows improvements to be quantified.

- Example of revised polymer shown below




| 360mm damper | Speed = 120km/h | | |
|---|---|---|---|
| Standard clip | Baseline noise | w. Rail Damper | Difference |
| **Existing** Polymer | 99.6 dB(A) | 97.2 dB(A) | -2.4dB(A) |
| **Revised** Polymer | 99.6 dB(A) | 96.1 dB(A) | -3.5 dB(A) |
| **Relative Improvement** | | | **+1.1 dB(A)** |

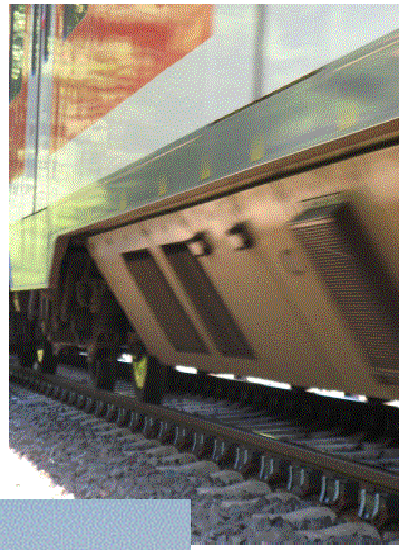
## Conclusions

- The test programme highlights the ease with which the STARDAMP methods can be used to assess rail damper performance as various components are changed
- The STARDAMP method avoids the need for multiple on-track trials
- The changes to performance can readily quantified, enabling product improvement and lower-cost solutions to be proposed with an increased degree of certainty.
- Improvements to product design will continue to ensure that noise reduction targets can be achieved through the use of rail dampers

# And finally …….. SilentTrack® – a proven product!

| Contractor | City | Profile | Length (meter) |
|---|---|---|---|
| | | | |
| ProRail | Breda, Netherlands | UIC54 | 7,000 |
| ProRail | Veenendaal, Netherlands | UIC54 | 200 |
| ProRail | Breda 2, Netherlands | UIC54 | 4,000 |
| ProRail | Tilburg 1,2, Netherlands | UIC54 | 8,000 |
| Privat/ProRail | Helmond, Netherlands | UIC54 | 2,000 |
| HSL/ProRail | Rotterdam, Netherlands | UIC54 | 8,000 |
| Betuweroute | Barendrecht, Netherlands | UIC54 | 1,800 |
| ProRail | Almelo, Netherlands | UIC54 | 2,800 |
| ProRail | Baarn, Netherlands | UIC54 | 4,000 |
| ProRail | Holten, Netherlands | UIC54 | 200 |
| ProRail | Twello, Netherlands | UIC54 | 6,000 |
| ProRail | Houten, Netherlands | UIC54 | 4,000 |
| ProRail | Nijkerk, Netherlands | UIC54 | 1,200 |
| ProRail | Sloelijn, Netherlands | UIC54 | 2,000 |
| ProRail Regio Zuid | 16 towns - Netherlands South | UIC54 | 18,000 |
| ProRail Regio Midden | 25 towns - Netherlands Central | UIC54 | 17,800 |
| ProRail - Bridge Projects | 5 bridges | UIC54 | 950 |
| ProRail | Diemen | UIC54 | 1,300 |
| Deutsche Bahn AG | Hamburg Hausbruch, Germany | S49/S54 | 700 |
| Deutsche Bahn AG | St. Goarshausen, Germany | UIC60 | 7,200 |
| Deutsche Bahn AG | Bingen, Germany | UIC60 | 100 |
| Deutsche Bahn Systemtechnik | Gersthofen, Germany | UIC60 | 150 |
| Deutsche Bahn AG | Celle Hannover, Germany | UIC60 | 4,400 |
| Deutsche Bahn AG | Bonn, Germany | UIC60 | 3,600 |
| Deutsche Bahn AG | Osterspai, Germany | UIC60 | 3,600 |
| Deutsche Bahn AG | Bad Honneff, Germany | UIC60 | 600 |
| Deutsche Bahn AG | Emmerich, Germany | UIC60 | 14,400 |
| Deutsche Bahn AG | Elbtal, Germany | UIC60 + R65 | 1,510 |
| Deutsche Bahn AG | Rhine Valley Projects | UIC60 | 2,150 |
| Stuttgarter Strassenbahnen | Tunnel Stuttgart, Germany | S49 | 100 |
| SNCF | Pierre-Latte, France | UIC60 | 200 |
| SNCF | Maisons Alfort, Paris, France | UIC60 | 100 |
| RFF Rhone Alpe | Montuel, Lyon, France | UIC60 | 100 |
| ÖBB | Innsbruck, Austria | UIC60 | 100 |
| TIDC, Sydney | Sydney, Australia | AS60 | 17,000 |
| RHK | Kerava, Finland | UIC60 | 200 |
| Banverket | Tjönarp/Skövde, Sweden | UIC60 | 200 |
| Trafikverket | Kävlinge, Sweden | UIC60 | 100 |
| Kollektivtransportproduksjon | Oslo, Norway | S49 | 100 |
| Network Rail, Thameslink Project | Blackfriars, London, UK | 56 E 1 | 1400 |
| Network Rail, Thameslink Project | Blackfriars, London, UK | UIC60 | 60 |
| Bombardier | Leicester, UK | UIC60 | 50 |
| SZDC | Podebrady, Czech Republic | UIC60 | 200 |
| SSB / BLS | Kerzers, Switzerland | UIC60 | 80 |
| Espumlatex, Fenoco | Bosconia, Columbia | ARA 90 | 100 |
| Rail Procurement Agency | Dublin (LUAS), Ireland | S49 | 100 |
| SMRT | Singapore | UIC60 | 140 |
| TrenItalia | Depot access line, Milano, Italy | UIC60 | 150 |
| UudenBV | Oslo Metro | S49 | 725 |
| Silens | Bejing Metro | UIC60 | 100 |
| Gold Linq | Gold Coast Metro, Brisbane | S49 | 1670 |
| UudenBV | Arnhem, The Netherlands | UIC54 | 960 |
| Zeleznicne Stavby | Brno, Czech Republic | UIC60 | 952 |
| London Overground | Shoreditch, London | 56 E 1 | 600 |
| Network Rail, Thameslink Project | Borough Market | 56 E 1 | 430 |

170km of track worldwide now fitted with SilentTrack®



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