SEMPERIT

TECHNICAL REPORT

Verification of temperature effects on railpad damping performance by analysis of the Track Decay Rate (EN 15461)

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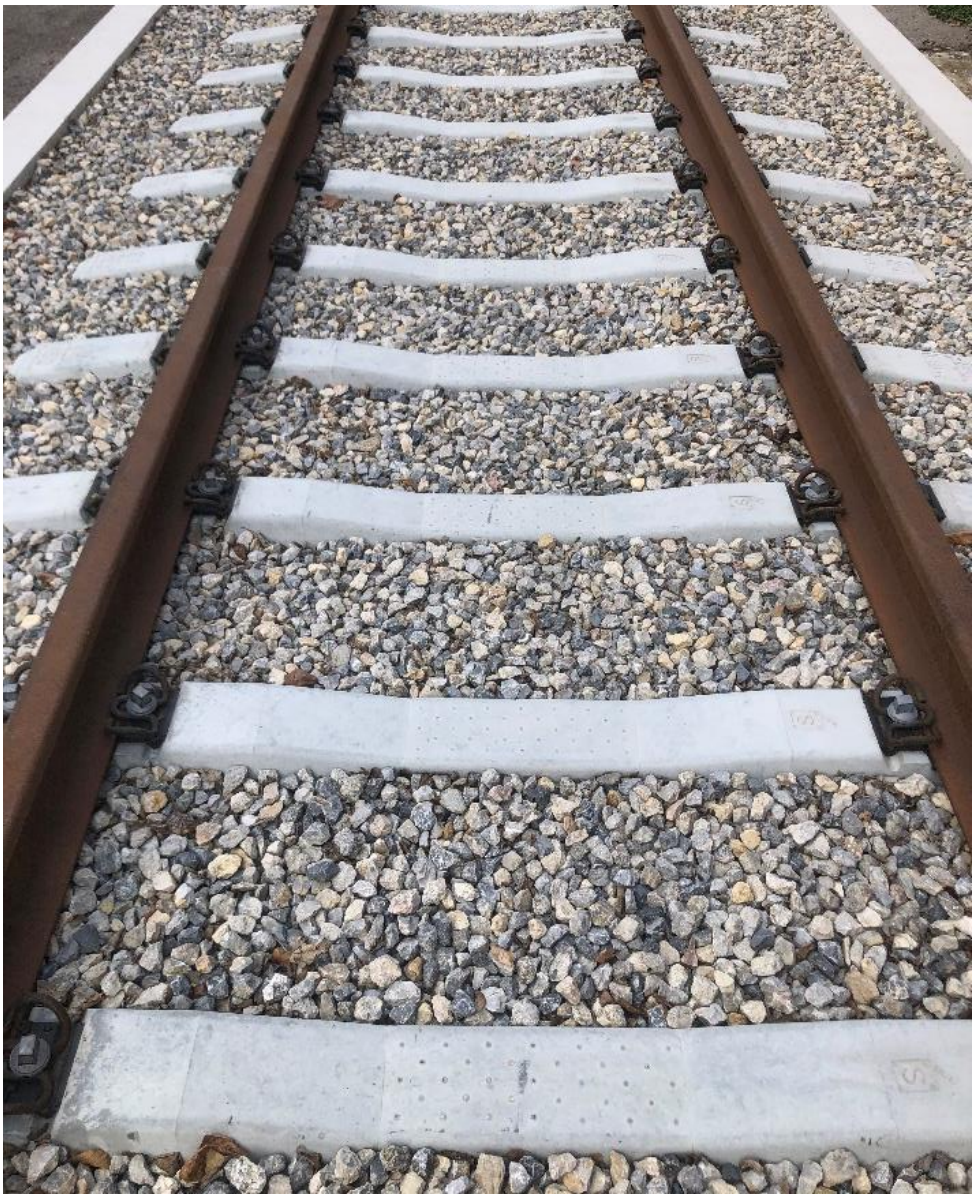


1. Project description

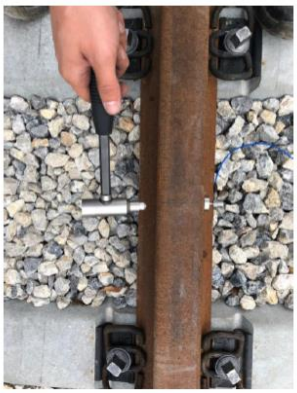
Pass-by noise of trains is influenced mainly by the combined wheel/rail roughness, the excitation of the wheel/rail system, and by amount of damping of the rail vibrations. Knowing the damping, and understanding the effect of the temperature on it, is crucial in the design of a rail pad.

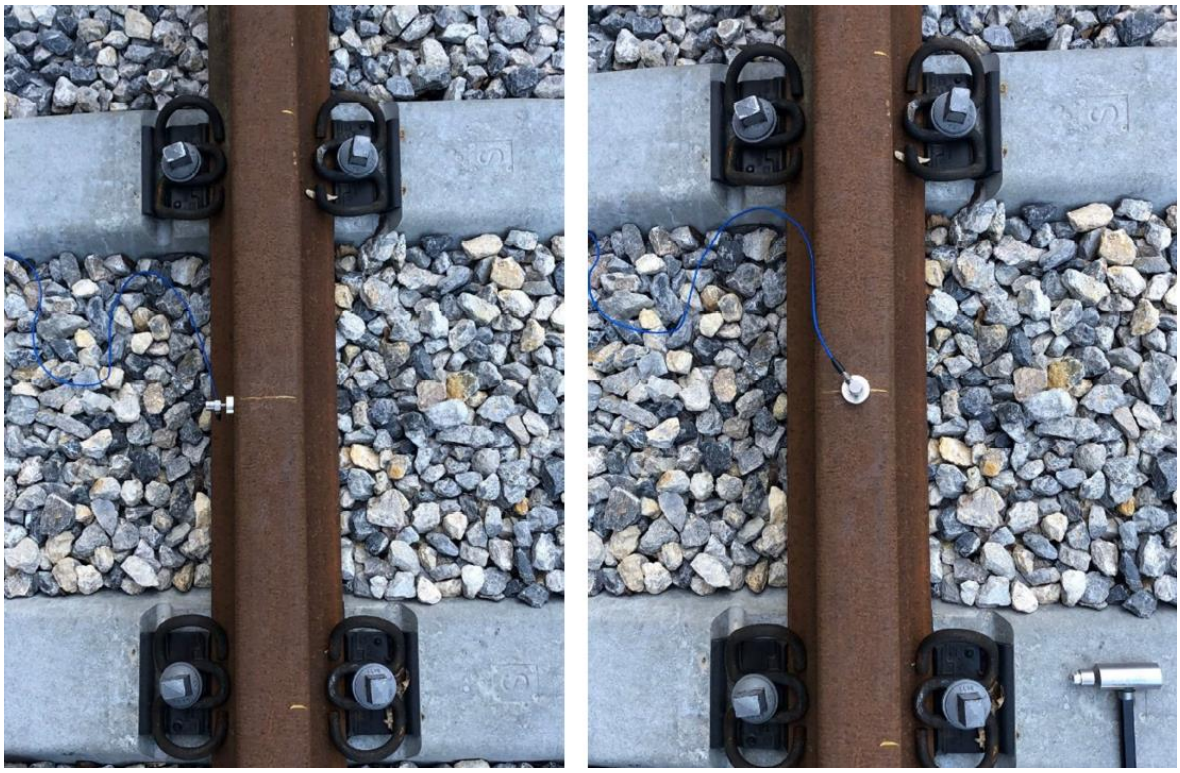
The rail vibration damping, also called the Track Decay Rate or TDR, can be measured by applying the norm **EN 15461**: **Railway applications–Noise emission–Characterisation of the dynamic properties of track sections for pass by noise measurements.**

The Semperit test track, equipped with 320kg mono-block sleepers, UIC60 rail en SKL14 fixations is used to measure the TDR following to EN 15461 at different rail temperatures. Temperatures are measured at the bottom side in the middle of the rail feet with a contact device thermocouple during 5 seconds. The average temperature of 3 points, spaced 5meter is calculated.

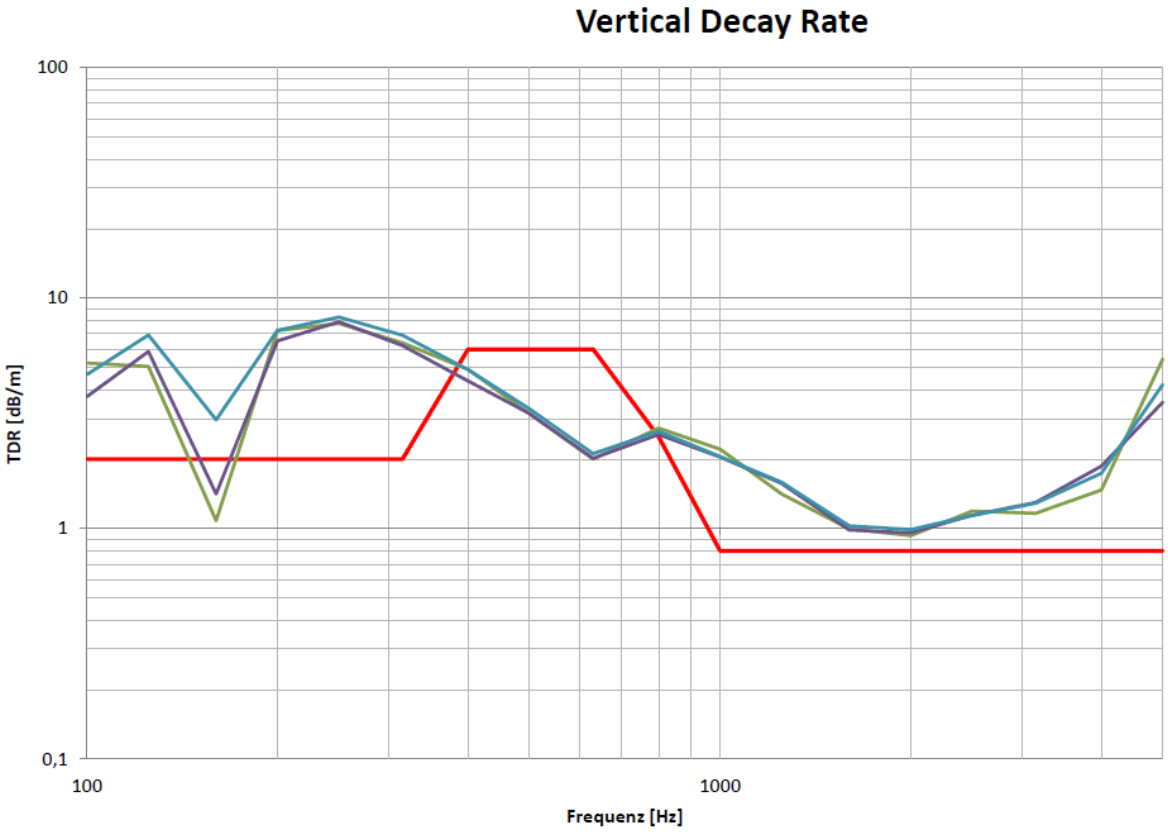
2. Setup and equipment

All equipment, data processing and analysis is as requested by the EN 15461. Pictures below show the measurement test-setup, response accelerometers and impulse hammer.
A verification of the measurement procedure was done by comparing measurement results and calculations with similar measurements and setups performed by external partners.
A detailed study on the performance of the test track by means of a tuned finite element model, acceleration measurement versus calculation, comparison with real railway tracks in use etc. is done in order to verify and approved the performance of the test track. This study is not public.



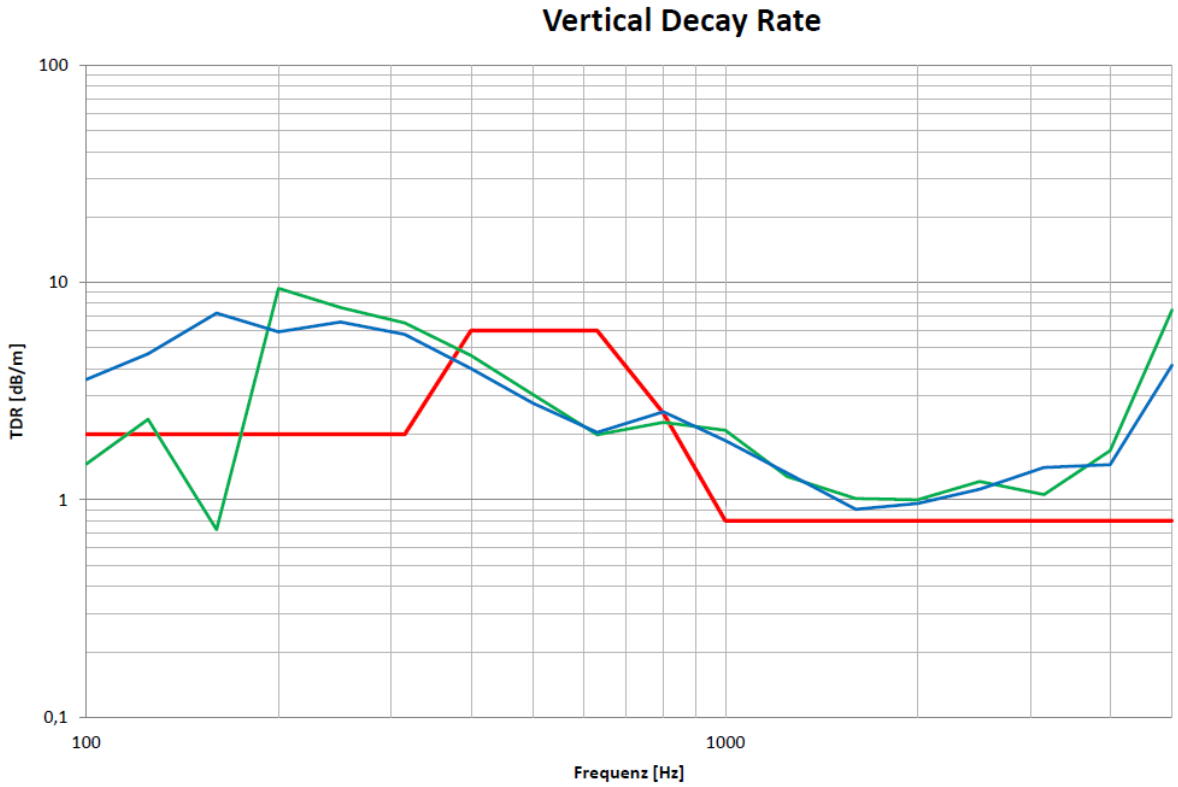


Care is taken to use the same SKL14 bold mounting torque at each pad installation in order to have a good repeatability of the measurements. Measurements and analysis are discribed in a strict procedure and are always performed by the same person using the same equipment.



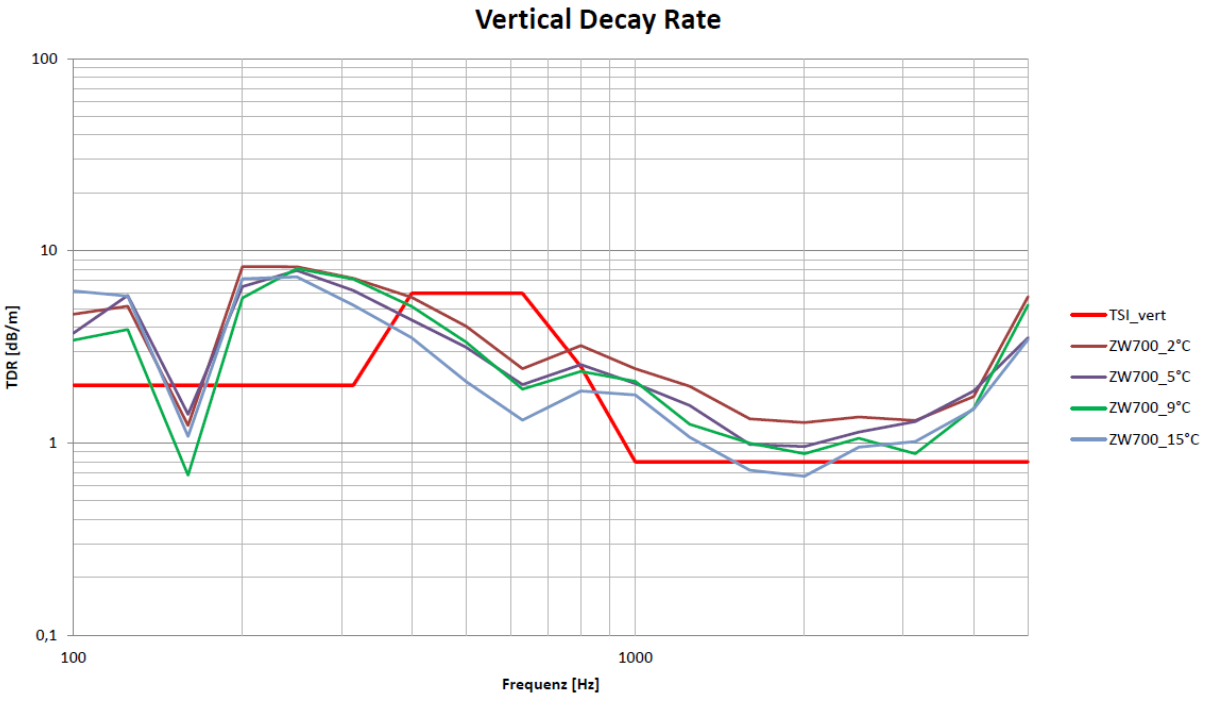
Vertical track decay rate standard elastic rail pad 7mm: measured 3 times

In the frequency range of interest 500 Hz tot 2.5 kHz, measurement, and analysis, also performed with a broad range of rail pads show very similar results.



Vertical track decay rate standard elastic rail pad 7mm: Semperit and external partner

A first analysis of the rail foot temperature influence on TDR in the range between 2°C and 15°C was done on standard rail pads 7mm and shows clear the relation with the temperature. Even going from 2°C tot 5°C shows a shift in measured TDR values.



Vertical track decay rate standard elastic rail pad 7mm: different rail temperatures

3. Tested products

3.1 Rail pad 9mm standard: 90 MN/m @ 20 Hz

Table: TDR [db/m]

	Temperature		
Frequency [Hz]	0°C	10°C	20°C
100	5,1	3,6	2,9
125	6,4	4,7	4,7
160	3,5	7,2	2,8
200	8,4	5,9	3,8
250	9,9	6,6	5,9
315	9,8	5,8	4,2
400	7,8	4,0	2,5
500	5,8	2,8	1,7
630	3,6	2,0	1,2
800	4,3	2,5	1,7
1000	3,8	1,9	1,5
1250	2,0	1,3	0,8
1600	1,5	0,9	0,8
2000	1,4	1,0	0,5
2500	1,1	1,1	0,8
3150	1,2	1,4	0,8
4000	1,8	1,5	1,5
5000	12,9	4,2	4,8

Vertical track decay rate standard elastic rail pad 9mm: different rail temperatures 0°C / 10°C / 20°C

2.1 Rail pad 9mm acoustical optimzed: 280 MN/m @20 Hz

These rail pads are optimized for having a high and more stable TDR, staying above the reference curve at all temperatures, without having an extreme static stiffness and, still resulting in good distribution of the forces into the track, and giving a sufficient protection of the substructures (sleepers, ballast,etc.).

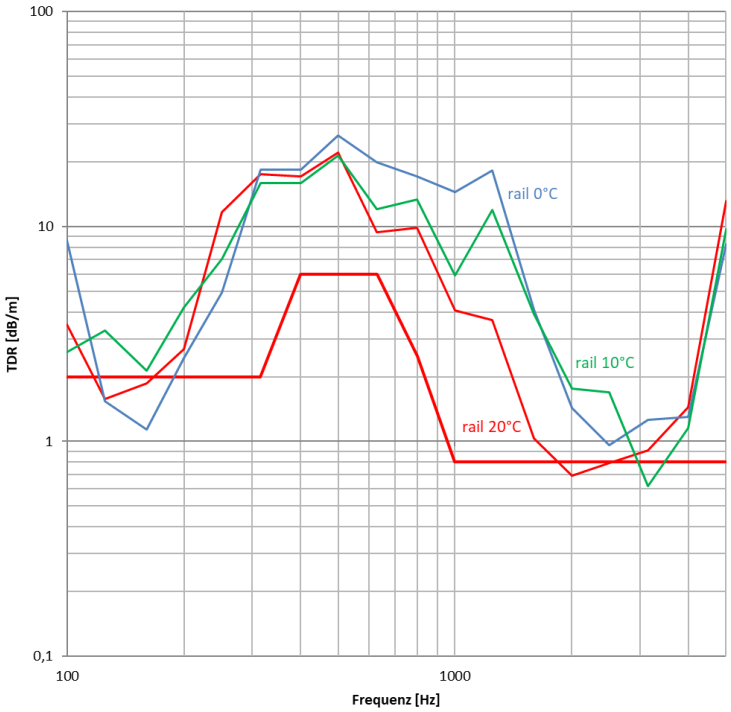


Table: TDR [db/m]

	Temperature		
Frequency [Hz]	0°C	10°C	20°C
100	8,6	2,6	3,5
125	1,5	3,3	1,6
160	1,1	2,1	1,9
200	2,4	4,2	2,7
250	4,9	7,0	11,7
315	18,3	16,0	17,6
400	18,3	16,0	17,1
500	26,5	21,4	22,0
630	19,9	12,0	9,4
800	17,1	13,4	9,9
1000	14,5	5,9	4,1
1250	18,2	11,9	3,7
1600	4,1	3,9	1,0
2000	1,4	1,8	0,7
2500	1,0	1,7	0,8
3150	1,3	0,6	0,9
4000	1,3	1,2	1,4
5000	8,3	9,7	13,2

Vertical track decay rate acoustical optimized elastic rail pad 9mm: different rail temperatures 0°C / 10°C / 20°C

4. Conclusion

Semperit Technische Produkte GmbH Austria, is a well-known company dealing with substructure components for rail track application. In the past it has successfully developed elastic rail pads for different railway organization according to their product specifications.
Since 2020, Semperit has been able to develop elastic rail pads based on track requirements as well as acoustic requirements. With the help of TDR measurements on your own test track, new products can be specifically developed and their acoustic potential for improvement can be predicted.