

# Monthly report

## Railway Field Laboratory

January 2025

**Client:** Swiss confederation; Federal Offices for the Environment (FOEN) and Transport (FOT), CH-3003 Bern  
The FOEN and the FOT are offices of the Federal Department of the Environment, Transport, Energy and Communications (DETEC).

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**Version:** V1

**Date:** 6.5.2025

## 1. Status railway field laboratory

Construction work on the tracks:

- none

Downtimes of the measurement systems:

- MQ 11: 9.1. 17:37 – 22:37

Downtimes of the sensors:

- MQ 21: a-mq21-5-lx/y/z and a-mq21-5-ux/y/z (as of 11.9.2024 cable probably cut during mowing work)

Maintenance and sensor exchange:

- none

Modifications to the data, database, or analysis:

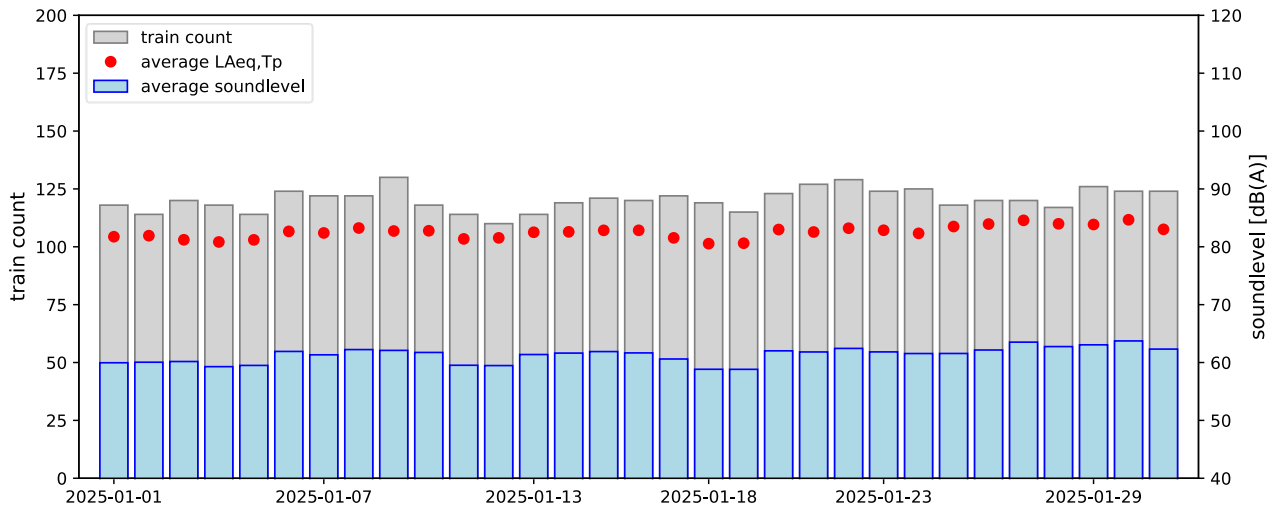
- none

Monthly data volume collected:

- 592 GB

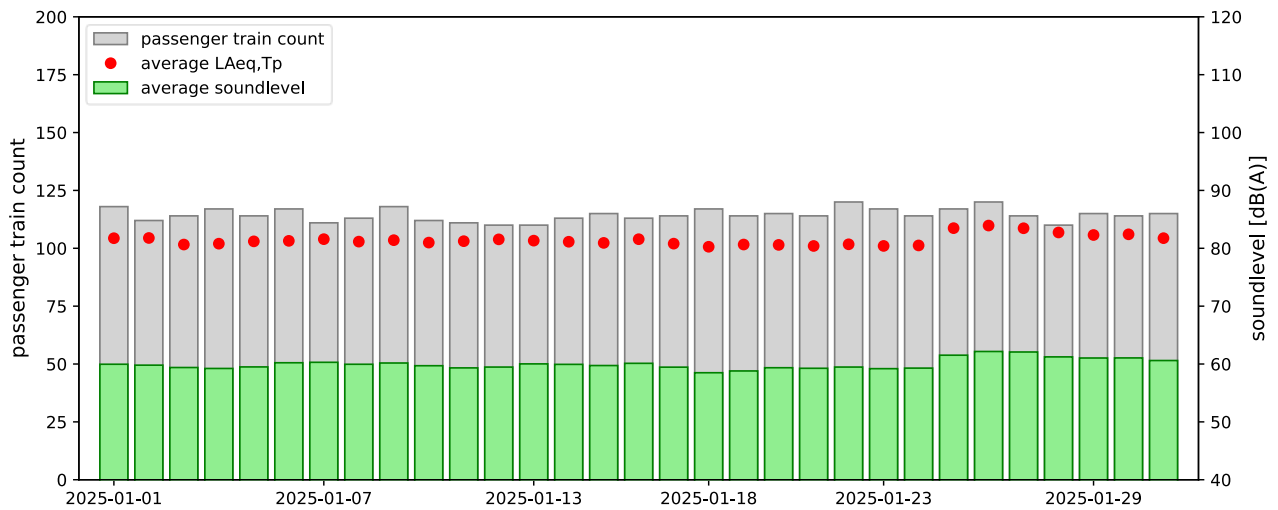
## 2. Measurement data

Daytime averages (24h) for all train passages at reference section (REF)



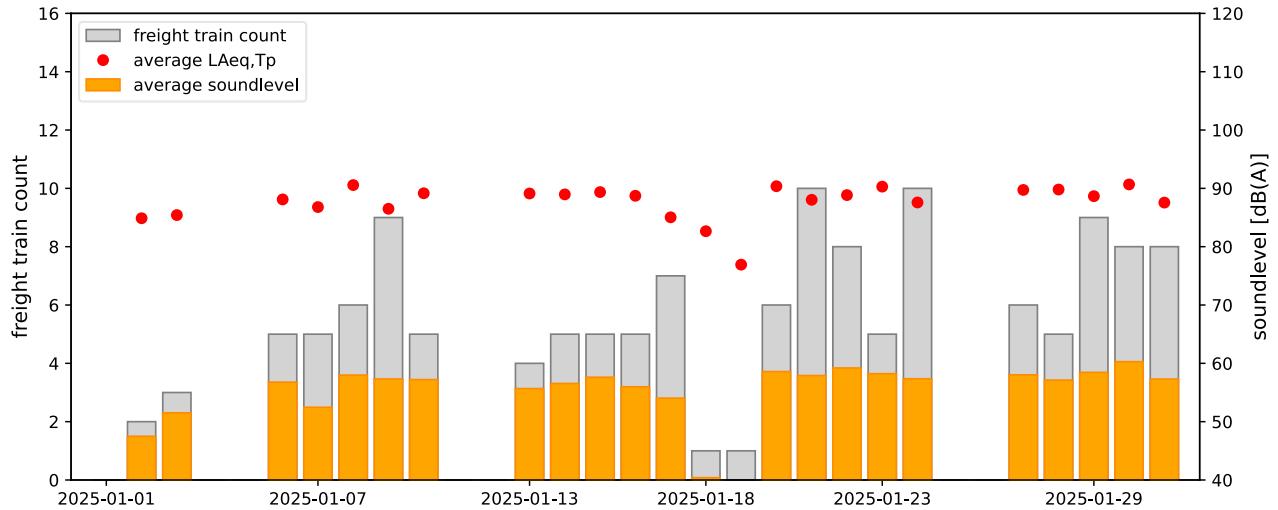
| date       | location | train count | passenger train count | freight train count | service train count | average LAeqTp | average soundlevel |
|------------|----------|-------------|-----------------------|---------------------|---------------------|----------------|--------------------|
| 01.01.2025 | REF      | 118         | 118                   | 0                   | 0                   | 81,7           | 60,0               |
| 02.01.2025 | REF      | 114         | 112                   | 2                   | 0                   | 81,9           | 60,1               |
| 03.01.2025 | REF      | 120         | 114                   | 3                   | 3                   | 81,2           | 60,2               |
| 04.01.2025 | REF      | 118         | 117                   | 0                   | 1                   | 80,8           | 59,3               |
| 05.01.2025 | REF      | 114         | 114                   | 0                   | 0                   | 81,2           | 59,5               |
| 06.01.2025 | REF      | 124         | 117                   | 5                   | 2                   | 82,7           | 61,9               |
| 07.01.2025 | REF      | 122         | 111                   | 5                   | 6                   | 82,4           | 61,3               |
| 08.01.2025 | REF      | 122         | 113                   | 6                   | 3                   | 83,2           | 62,2               |
| 09.01.2025 | REF      | 130         | 118                   | 9                   | 3                   | 82,7           | 62,1               |
| 10.01.2025 | REF      | 118         | 112                   | 5                   | 1                   | 82,8           | 61,7               |
| 11.01.2025 | REF      | 114         | 111                   | 0                   | 3                   | 81,4           | 59,5               |
| 12.01.2025 | REF      | 110         | 110                   | 0                   | 0                   | 81,5           | 59,5               |
| 13.01.2025 | REF      | 114         | 110                   | 4                   | 0                   | 82,5           | 61,4               |
| 14.01.2025 | REF      | 119         | 113                   | 5                   | 1                   | 82,6           | 61,6               |
| 15.01.2025 | REF      | 121         | 115                   | 5                   | 1                   | 82,8           | 61,9               |
| 16.01.2025 | REF      | 120         | 113                   | 5                   | 2                   | 82,8           | 61,7               |
| 17.01.2025 | REF      | 122         | 114                   | 7                   | 1                   | 81,5           | 60,6               |
| 18.01.2025 | REF      | 119         | 117                   | 1                   | 1                   | 80,5           | 58,8               |
| 19.01.2025 | REF      | 115         | 114                   | 1                   | 0                   | 80,6           | 58,8               |
| 20.01.2025 | REF      | 123         | 115                   | 6                   | 2                   | 83,0           | 62,0               |
| 21.01.2025 | REF      | 127         | 114                   | 10                  | 3                   | 82,6           | 61,8               |
| 22.01.2025 | REF      | 129         | 120                   | 8                   | 1                   | 83,2           | 62,4               |
| 23.01.2025 | REF      | 124         | 117                   | 5                   | 2                   | 82,9           | 61,8               |
| 24.01.2025 | REF      | 125         | 114                   | 10                  | 1                   | 82,3           | 61,6               |
| 25.01.2025 | REF      | 118         | 117                   | 0                   | 1                   | 83,5           | 61,6               |
| 26.01.2025 | REF      | 120         | 120                   | 0                   | 0                   | 83,9           | 62,2               |
| 27.01.2025 | REF      | 120         | 114                   | 6                   | 0                   | 84,6           | 63,5               |
| 28.01.2025 | REF      | 117         | 110                   | 5                   | 2                   | 84,0           | 62,8               |
| 29.01.2025 | REF      | 126         | 115                   | 9                   | 2                   | 83,8           | 63,1               |
| 30.01.2025 | REF      | 124         | 114                   | 8                   | 2                   | 84,7           | 63,7               |
| 31.01.2025 | REF      | 124         | 115                   | 8                   | 1                   | 83,0           | 62,3               |
| month      | REF      | 3731        | 3548                  | 138                 | 45                  | 82,7           | 61,5               |

Daytime averages (24h) for all passenger train passages at reference section (REF)



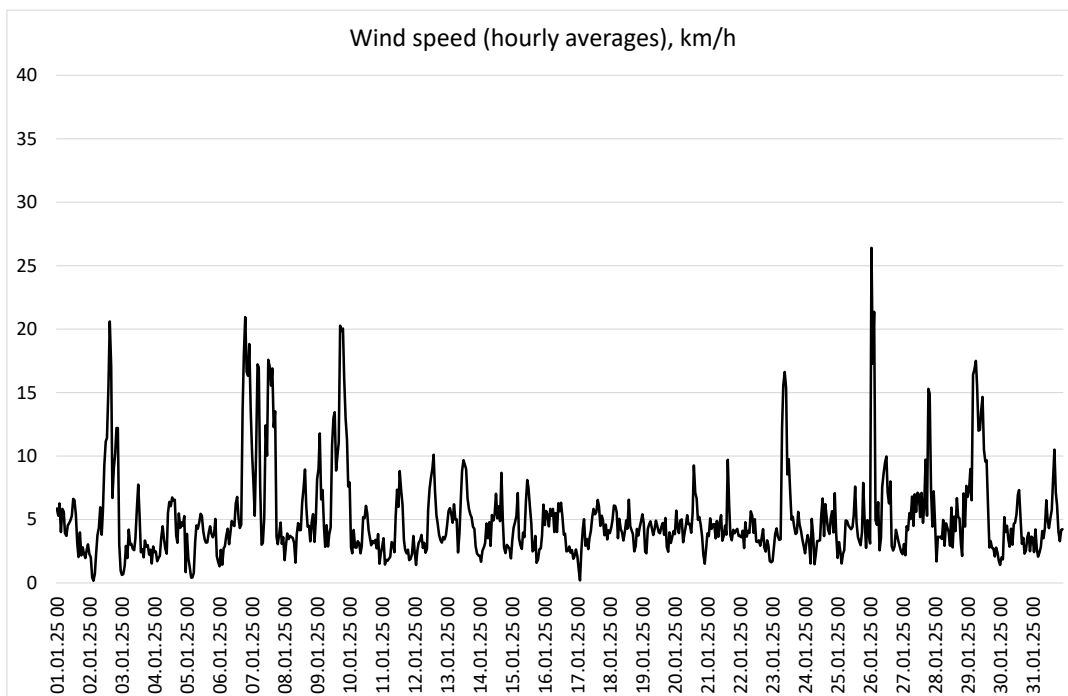
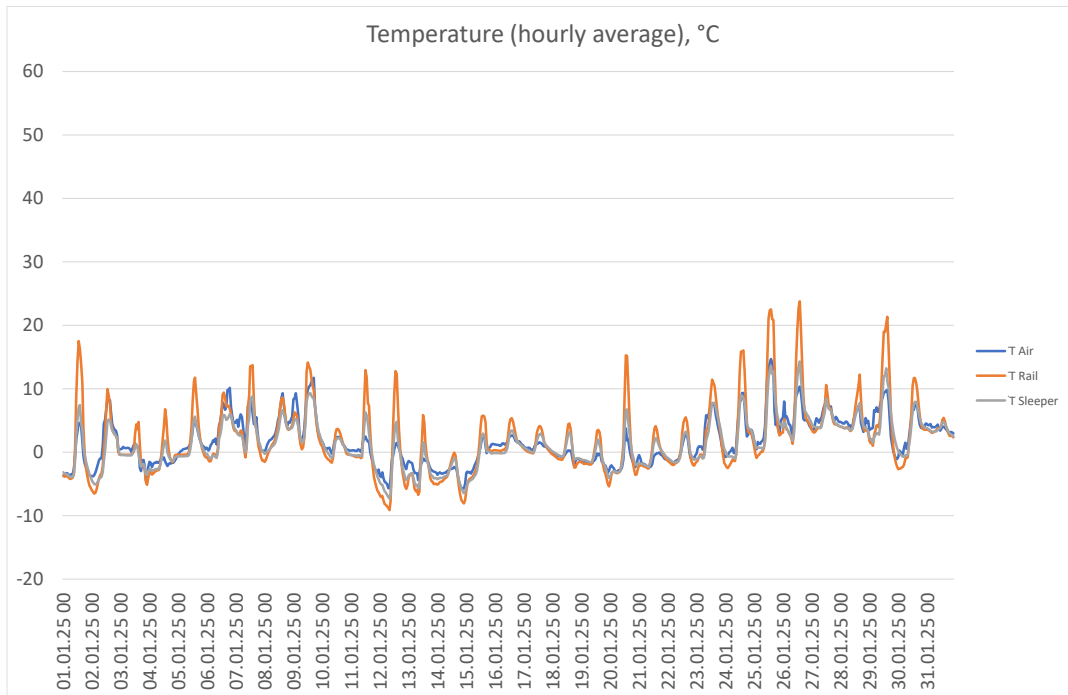
| date       | location | passenger train count | average speed | average length | average axlecount | average LAeqTp | average soundlevel |
|------------|----------|-----------------------|---------------|----------------|-------------------|----------------|--------------------|
| 01.01.2025 | REF      | 118                   | 111,1         | 136,6          | 20,2              | 81,7           | 60,0               |
| 02.01.2025 | REF      | 112                   | 112,0         | 137,8          | 20,4              | 81,8           | 59,8               |
| 03.01.2025 | REF      | 114                   | 112,4         | 159,5          | 23,4              | 80,6           | 59,4               |
| 04.01.2025 | REF      | 117                   | 111,8         | 144,9          | 21,2              | 80,8           | 59,2               |
| 05.01.2025 | REF      | 114                   | 110,8         | 141,1          | 21,0              | 81,2           | 59,5               |
| 06.01.2025 | REF      | 117                   | 112,7         | 164,2          | 24,3              | 81,3           | 60,2               |
| 07.01.2025 | REF      | 111                   | 111,7         | 163,5          | 24,2              | 81,6           | 60,3               |
| 08.01.2025 | REF      | 113                   | 112,1         | 164,8          | 24,5              | 81,2           | 60,0               |
| 09.01.2025 | REF      | 118                   | 114,0         | 159,6          | 23,7              | 81,4           | 60,2               |
| 10.01.2025 | REF      | 112                   | 114,4         | 167,6          | 24,7              | 81,0           | 59,7               |
| 11.01.2025 | REF      | 111                   | 111,9         | 140,6          | 20,8              | 81,2           | 59,3               |
| 12.01.2025 | REF      | 110                   | 111,1         | 136,6          | 20,2              | 81,5           | 59,5               |
| 13.01.2025 | REF      | 110                   | 112,7         | 168,0          | 24,6              | 81,3           | 60,0               |
| 14.01.2025 | REF      | 113                   | 112,7         | 166,7          | 24,6              | 81,1           | 59,9               |
| 15.01.2025 | REF      | 115                   | 112,7         | 163,8          | 24,2              | 80,9           | 59,7               |
| 16.01.2025 | REF      | 113                   | 114,9         | 162,1          | 23,9              | 81,6           | 60,1               |
| 17.01.2025 | REF      | 114                   | 113,6         | 162,7          | 24,0              | 80,8           | 59,5               |
| 18.01.2025 | REF      | 117                   | 114,0         | 139,7          | 20,2              | 80,3           | 58,5               |
| 19.01.2025 | REF      | 114                   | 112,6         | 141,3          | 20,8              | 80,6           | 58,8               |
| 20.01.2025 | REF      | 115                   | 111,7         | 162,4          | 23,9              | 80,6           | 59,4               |
| 21.01.2025 | REF      | 114                   | 110,2         | 162,9          | 24,2              | 80,4           | 59,3               |
| 22.01.2025 | REF      | 120                   | 113,3         | 158,9          | 23,6              | 80,7           | 59,5               |
| 23.01.2025 | REF      | 117                   | 113,0         | 161,6          | 23,9              | 80,4           | 59,2               |
| 24.01.2025 | REF      | 114                   | 112,4         | 164,5          | 24,4              | 80,5           | 59,3               |
| 25.01.2025 | REF      | 117                   | 113,5         | 140,6          | 20,8              | 83,5           | 61,5               |
| 26.01.2025 | REF      | 120                   | 111,5         | 141,4          | 21,1              | 83,9           | 62,2               |
| 27.01.2025 | REF      | 114                   | 112,7         | 163,5          | 24,2              | 83,5           | 62,1               |
| 28.01.2025 | REF      | 110                   | 112,4         | 161,8          | 23,9              | 82,7           | 61,2               |
| 29.01.2025 | REF      | 115                   | 111,2         | 161,0          | 23,9              | 82,3           | 61,0               |
| 30.01.2025 | REF      | 114                   | 112,9         | 164,2          | 24,4              | 82,4           | 61,1               |
| 31.01.2025 | REF      | 115                   | 112,8         | 168,7          | 24,9              | 81,7           | 60,6               |
| month      | REF      | 3548                  | 112,5         | 155,8          | 23,0              | 81,5           | 60,1               |

Daytime averages (24h) for all freight train passages at reference section (REF)



| date         | location   | freight train count | average speed | average length | average axle count | average LAeqTp | average soundlevel |
|--------------|------------|---------------------|---------------|----------------|--------------------|----------------|--------------------|
| 01.01.2025   | REF        |                     |               |                |                    |                |                    |
| 02.01.2025   | REF        | 2                   | 92,3          | 187,8          | 25,0               | 84,9           | 47,5               |
| 03.01.2025   | REF        | 3                   | 78,5          | 228,3          | 46,7               | 85,4           | 51,5               |
| 04.01.2025   | REF        |                     |               |                |                    |                |                    |
| 05.01.2025   | REF        |                     |               |                |                    |                |                    |
| 06.01.2025   | REF        | 5                   | 74,1          | 238,3          | 49,2               | 88,1           | 56,8               |
| 07.01.2025   | REF        | 5                   | 97,6          | 166,0          | 22,4               | 86,8           | 52,5               |
| 08.01.2025   | REF        | 6                   | 99,1          | 213,1          | 40,3               | 90,6           | 58,0               |
| 09.01.2025   | REF        | 9                   | 90,2          | 259,5          | 54,4               | 86,5           | 57,3               |
| 10.01.2025   | REF        | 5                   | 88,6          | 267,8          | 58,0               | 89,2           | 57,2               |
| 11.01.2025   | REF        |                     |               |                |                    |                |                    |
| 12.01.2025   | REF        |                     |               |                |                    |                |                    |
| 13.01.2025   | REF        | 4                   | 87,6          | 230,8          | 55,0               | 89,1           | 55,7               |
| 14.01.2025   | REF        | 5                   | 91,2          | 246,2          | 51,2               | 89,0           | 56,6               |
| 15.01.2025   | REF        | 5                   | 85,8          | 267,6          | 58,0               | 89,4           | 57,6               |
| 16.01.2025   | REF        | 5                   | 86,3          | 212,7          | 48,4               | 88,7           | 56,0               |
| 17.01.2025   | REF        | 7                   | 89,0          | 229,6          | 51,1               | 85,0           | 54,0               |
| 18.01.2025   | REF        | 1                   | 67,8          | 85,6           | 18,0               | 82,7           | 40,4               |
| 19.01.2025   | REF        | 1                   | 119,7         | 199,9          | 24,0               | 76,9           | 35,5               |
| 20.01.2025   | REF        | 6                   | 97,5          | 250,6          | 57,0               | 90,4           | 58,6               |
| 21.01.2025   | REF        | 10                  | 93,1          | 203,8          | 40,4               | 88,0           | 57,9               |
| 22.01.2025   | REF        | 8                   | 81,2          | 263,5          | 66,5               | 88,8           | 59,2               |
| 23.01.2025   | REF        | 5                   | 91,3          | 267,7          | 58,4               | 90,3           | 58,2               |
| 24.01.2025   | REF        | 10                  | 93,2          | 203,5          | 44,7               | 87,6           | 57,4               |
| 25.01.2025   | REF        |                     |               |                |                    |                |                    |
| 26.01.2025   | REF        |                     |               |                |                    |                |                    |
| 27.01.2025   | REF        | 6                   | 91,9          | 240,5          | 55,3               | 89,7           | 58,0               |
| 28.01.2025   | REF        | 5                   | 83,6          | 197,8          | 47,2               | 89,8           | 57,1               |
| 29.01.2025   | REF        | 9                   | 91,8          | 224,4          | 50,2               | 88,7           | 58,4               |
| 30.01.2025   | REF        | 8                   | 93,6          | 238,8          | 51,0               | 90,7           | 60,3               |
| 31.01.2025   | REF        | 8                   | 82,8          | 212,8          | 51,8               | 87,6           | 57,3               |
| <b>month</b> | <b>REF</b> | <b>138</b>          | <b>89,6</b>   | <b>228,8</b>   | <b>49,5</b>        | <b>88,7</b>    | <b>55,7</b>        |

### 3. Weather data



## Appendix: measurement quantities

### Transit Exposure Level *TEL*

A-weighted sound pressure level of a single train pass-by as energetic average over the entire exposure duration  $T$  and averaged over the pass-by duration  $T_p$ .

$$TEL = 10 \log \left( \frac{1}{T_p} \int_0^T \frac{p_A^2(t)}{p_0^2} dt \right) \quad (1)$$

Where

$p_A(t)$  = the A-weighted sound pressure, [Pa]

$p_0 = 20 \mu Pa$  (reference pressure), [Pa]

$T_p = T_2 - T_1$  = pass-by duration of the train, time interval during which a train is within the measurement cross-section and which starts with the entry time  $T_1$  into the measurement cross-section and ends with the exit time  $T_2$ , [s]

$T$  = time interval which starts when the smoothed sound pressure level (sound pressure level smoothed as a function of time with the frequency weighting A and a time weighting F („fast“) or averaging over a duration period of time, e.g. 100 ms) is for the last time 10 dB below that prevailing at the time of entering the measurement cross-section and which ends when the smoothed sound pressure level is for the first time 10 dB below the one at the time of leaving the measurement cross-section. [s]

### A-weighted equivalent sound pressure level of the train pass-by $L_{Aeq,Tp}$

The A-weighted equivalent sound pressure level equals the (energetic) average of the sound pressure level over the train pass-by time  $T_p$  according to the following equation:

$$L_{Aeq,Tp} = 10 \log \left( \frac{1}{T_p} \int_{T_1}^{T_2} \frac{p_A^2(t)}{p_0^2} dt \right) \quad (2)$$

where

$p_A(t)$  = the A-weighted sound pressure, [Pa]

$p_0 = 20 \mu Pa$  (reference sound pressure), [Pa]

$T_p = T_2 - T_1$  = pass-by duration of the train, [s]



### Sound Exposure Level *SEL*

The sound exposure level *SEL* references the acoustic energy of the entire pass-by event to one second. The *SEL* is used in calculating average sound level contributions from trains over longer periods of time (i.e. days/months/year). The *SEL* is related to the transit exposure level *TEL* through:

$$SEL = TEL - 10 \log (T_0 / T_p) \quad (3)$$

where

$$T_0 = 1 \text{ [s]}$$

$T_p$  = pass-by duration of the train, [s]

### Average sound level (period)

Average (energetic) A-weighted sound pressure level measured over a given period of time.

For the average sound level contributions from train pass-byes this equals the sum (energetic) of all sound exposure levels during the period for a given measurement position:

$$average \text{ soundlevel} = 10 \cdot \log_{10} \left( \sum 10^{\frac{SEL}{10}} \right) - A1 \quad (4)$$

where

$$A1 = 10 \cdot \log_{10}(n \cdot 24 \cdot 3600) \text{ for a 24-hour period}$$

*SEL* (see equation 3) taken from measurement data

$n$  = number of days being averaged over

### Average $L_{Aeq,Tp}$

Average (energetic) sound level of all the A-weighted sound pressure levels from the individual equivalent sound level of all train pass-byes in a given period of time (day/month/year).

Calculated per train category and per period day/night, month, year, etc. and per measurement location:

$$average L_{Aeq,Tp} = 10 \cdot \log_{10} \left( \sum T_p \cdot 10^{\frac{L_{Aeq,Tp}}{10}} \right) + 10 \cdot \log_{10} \left( \frac{1}{\sum T_p} \right) \quad (5)$$

where

$T_p$  = pass-by duration of the train [s]

$L_{Aeq,Tp}$  (see equation 2) is calculated directly from the measurement data