BRITISH STANDARD

BS EN 50125-3:2003

Railway applications — Environmental conditions for equipment —

Part 3: Equipment for signalling and telecommunications

The European Standard EN 50125-3:2003 has the status of a British Standard

ICS 29.280

British Standards

National foreword

This British Standard is the official English language version of EN 50125-3:2003.

The UK participation in its preparation was entrusted by Technical Committee GEL/9, Railway applications, to Subcommittee GEL/9/1, Signalling and communications, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

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EUROPEAN STANDARD **EN 50125-3**

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English version

Railway applications - Environmental conditions for equipment Part 3: Equipment for signalling and telecommunications

Applications ferroviaires -
Conditions d'environnement
pour le matériel
Partie 3: Equipement pour la signalisation
et les télécommunications

Bahnanwendungen -
Umweltbedingungen für Betriebsmittel
Teil 3: Umweltbedingungen für Signal- und Telekommunikationseinrichtungen

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 50125-3:2003 E

Foreword

This European Standard was prepared by SC 9XA, Communication, signalling and processing systems, of Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50125-3 on 2002-12-01.

This European Standard was prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and supports the essential requirements of Directive 96/48/EC.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2003-12-01
- latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2005-12-01

Annexes designated « normative » are part of the body of the standard.
Annexes designated « informative » are given for information only.
In this European Standard, Annexes A and C are normative and Annexes B and D are informative.

Contents

1 Scope

This European Standard specifies the environmental conditions encountered within Europe. It can also be applied elsewhere by agreement between the supplier and the customer.

The scope of this European Standard covers the design and the use of equipment and any portable equipment for signalling and telecommunications systems (including test, measure, monitoring equipment, etc.).

The portable equipment must comply with the sections of this European Standard relevant to their use.

This European Standard does not specify the test requirements for equipment.

In particular the standard intends to define

- interface conditions between the equipment and its environment,
- parameters to be used by designers when calculating R.A.M.S. and life time with respect to environmental condition effects.

In this respect it gives general guidance in order to allow consistent assessments of contract documentation for European projects.

The defined environmental conditions are considered as normal in service.

Microclimates surrounding components may need special requirements to be defined by the product standard.

The effects of any signalling and telecommunications equipment (in either or failure mode of operation) on the overall signalling system safety are not within the scope of this European Standard. This European Standard does not provide the designer with information to enable him to determine the safety risk associated with environmental conditions. The safety of persons in the vicinity of (or working on) the signalling and telecommunications equipment is also out of the scope of this European Standard. The effects of vandalism on the equipment are not considered in this European Standard.

This European Standard applies to all signalling and telecommunications systems except those used for cranes, mining vehicles and cable cars. It does not define the specifications for train-borne signalling and telecommunications systems.

The train-borne signalling and telecommunications systems must comply with rolling stock environmental conditions specifications (EN 50125-1).

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 50121-1	Railway applications – Electromagnetic compatibility – Part 1: General
EN 50121-2	Railway applications – Electromagnetic compatibility – Part 2: Emission of the whole railway system to the outside world
EN 50121-4	Railway applications – Electromagnetic compatibility – Part 4: Emission and immunity of the signalling and telecommunications apparatus

EN 50124-2		Railway applications – Insulation coordination – Part 2: Overvoltages and related protection
EN 50125-1	1999	Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock
EN 60529	1991	Degrees of protection provided by enclosures (IP code) *(IEC 60529:1989)*
EN 60721-3-3	1995	Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weather protected locations *(IEC 60721-3-3:1994)*
EN 60721-3-4	1995	Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 4: Stationary use at non-weather protected locations *(IEC 60721-3-4:1995)*
HD 478.2.1 S1	1989	Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Temperature and humidity *(IEC 60721-2-1:1982 + A1:1987)*
HD 478.2.3 S1	1990	Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Air pressure *(IEC 60721-2-3:1987)*
ISO 4354		Wind actions on structures

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1
environmental conditions
range of physical, chemical, electrical and biological conditions external to the equipment to which it is subjected in service

3.2
equipment housing
case, or other protective housing, provided by the manufacturer to mount his equipment and protect it from accidental damage, and occasionally from EMC or environmental effects. It may offer protection to personnel e.g. from electric shock.

Where the equipment housing provides the full required environmental protection, then it is treated as a cubicle to define the relevant environmental parameters.

The housing normally contains only the single suppliers' equipment, and is only a part of a signalling or telecommunications system

3.3
cubicle
housing for apparatus which normally is used to co-locate various parts of the signalling or telecommunications system equipment, on occasion from different suppliers. It may contain various equipment housings installed within the cubicle and offers further environmental protection.

A cubicle is normally only used to install apparatus and is in general not sufficiently large to afford protection from weather to staff working on the apparatus.

No climatic or temperature control is provided on cubicles but ventilation or occasionally fan assisted ventilation is required.

Large housings which allow access to personnel but do not have the thermal properties of shelters, should be treated as cubicles

3.4
shelter/container
shelters/containers are normally provided when a larger volume of equipment is to be co-located at a single point or temperature/humidity sensitive equipment is to be installed.

Shelters/containers normally have double walls with insulation material (or an air gap) between them. Shelters/containers also normally have limited facilities for personnel.

Shelters/containers may also be provided with temperature control, especially where temperature sensitive apparatus is installed.

Where shelters/containers are fitted with climatic control (temperature and humidity control), they shall be treated as buildings with climatic control (buildings C.C.)

3.5
building
permanent construction provided with main services (e.g. water, electricity, gas,...) designed to protect equipment against the action of environmental conditions. A building may or may not be provided with climatic control

4 Environmental conditions

4.1 General

In the text, normal environmental conditions for Europe are classified with a suffix 1, 2, and special conditions with a suffix X.

The customer shall specify clearly in his technical specification the required class for each environmental parameter. If no class is specified, the class with suffix 1 shall be assumed.

The severities specified are those which will have a low probability of being exceeded. All specified values are maximum or limit values. These values may be reached, but do not occur permanently. Depending on the situation there may be different frequencies of occurrence related to a certain period of time. Such frequencies of occurrence have not been included in this European Standard, but should be considered for any environmental parameter.

They should additionally be specified if applicable.

4.2 Pressure

4.2.1 Altitude

Table 1 gives the different classes of altitude relative to sea level at which the equipment shall perform as specified.

Table 1 - Altitude relative to sea level

Classes	Altitude range relative to sea level m
A1	up to 1 400
A2	up to 1 000
AX	more than 1 400

Using AX class, the maximum altitude shall be specified by the customer.

Altitude is relevant, in particular for the air pressure level and its consequence on cooling systems. The air pressure shall be considered according to HD 478.2.3.

4.2.2 Pulse pressure

Particular local air pressure conditions may exist due to the effects of trains running through a tunnel.

The typical variation of pressure caused by train entering tunnel is:

$\Delta P = \pm 5$ kPa

The associated rate of change of pressure is:

$\Delta P/\Delta t = 0,5$ to 1 kPa/s

4.3 Temperature

Table 2 shows the overall system air temperature parameters.

Table 2 - Temperature ranges at different sites

Climatic classes	External ambient	In cubicle [a b]	In shelter [a b]		In building [a b]	
			N.T.C. [c]	T.C. [d]	N.C.C. [c]	C.C. [e]
T1	(-25 +40) °C	(-25 +70) °C	(-5 +55) °C	(+15 +30) °C	(0 +45) °C	(+18 +27) °C
T2	(-40 +35) °C	(-40 +65) °C	(-20 +50) °C	(+15 +30) °C	(-5 +40) °C	(+18 +27) °C
TX	(-55 +40) °C	(-55 +70) °C	(-35 +55) °C	(+15 +30) °C	(-5 +45) °C	(+18 +27) °C

[a] The temperatures inside cubicle, shelter or building are values measured in free air not directly adjacent to heat emitting elements.

[b] The maximum temperatures inside a cubicle, a shelter N.T.C. and a building N.C.C. are higher than max. ambient temperatures because of the effects of solar radiation and power dissipation of installed equipment

[c] The higher values of lowest temperatures compared to those for external ambient are due to heat emitting equipment.

[d] 3K2 of EN60721-3-3

[e] 3K1 of EN60721-3-3

C.C. : with climatic control.	T.C. : with temperature control.
N.C.C. : without climatic control	N.T.C. : without temperature control

The above table was derived from HD 478.2.1 where open air temperatures are measured 2 m above ground. All classes have been extended at the lower temperatures to allow for installation of signalling and telecommunications equipment at ground level.

The effects of rapid temperature changes shall be considered. Changes of 0,5 °C/min over a range of 20 °C may be assumed for open air changes.

The designer(s) must consider such factors as equipment power dissipation, surface exposed to solar radiation, ventilation including forced ventilation, use of thermostatic controlled heaters, heat dissipation coefficients of walls.

To enable the customer to verify the supplier compliance with the temperature levels specified in Table 2 and to verify good temperature design of all installed equipment, the relevant data shall be exchanged between customer and supplier, such as:

- geometrical characteristics of sub-assemblies,
- localisation of the main heat emitting elements and their heat dissipation,
- thermal parameters (resistance, capacity, …),
- characteristics of the cooling system.

The effect of the climatic or temperature control operating outside its specified parameters, should be considered for each individual installation.

All signalling and telecommunications system shall operate within the relevant limits of Table 2.

The yearly average temperature of each type of site (for R.A.M.S. calculation) to be used are the following:

- +40 °C for equipment housing, cubicle;
- +30 °C for shelter N.T.C.;
- +25 °C for shelter T.C. and building (N.C.C. and C.C.).

R.A.M.S. calculations shall take into account the real yearly average temperature of each equipment part or sub assembly.

For deviations from the temperatures shown in Table 2, the customer shall specify the temperature levels required.

4.4 Humidity

The equipment shall be designed to withstand the humidity levels in the complete range of the air temperature as defined in 4.3 above and as shown in the climatograms of Figures A.1 to A.6 of Annex A which gives the relationship between humidity and temperature variations for the different climatic classes.

Table 3 below gives the min. and max. values of relative and absolute humidity for the different climatic classes.

Table 3 - Humidity ranges at different sites

Climatic classes	Humidity	External ambient		In cubicle		In shelter				In building			
						N.C.C.		C.C. [a]		N.C.C.		C.C. [b]	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
T1	R %	15	100	5	100	5	100	10	75	5	95	20	75
	A g/m³	0,55	25 [c]	0,55	25 [c]	0,55	25 [c]	2	22	0,55	25 [c]	4	15
T2	R %	20	100	5	100	5	100	10	75	5	95	20	75
	A g/m³	0,12	22 [c]	0,12	22 [c]	0,12	22 [c]	2	22	0,12	22 [c]	4	15
TX	R %	15	100	5	100	5	100	10	75	5	95	20	75
	A g/m³	0,02	25 [c]	0,02	25 [c]	0,02	25 [c]	2	22	0,02	25 [c]	4	15

[a] 3K2 of EN 60721-3-3

[b] 3K1 of EN 60721-3-3

[c] 30 g/m³ for tunnel

C.C. : with climatic control.

N.C.C. : without climatic control.

R : Relative humidity.

A: Absolute humidity.

NOTE Table 3 has been derived from HD 478.2.1 for calculations, from EN 60721-3-3 and EN 60721-3-4 for values.

On cold surfaces, 100 % relative humidity may occur causing condensation on parts of equipment.

Sudden changes of the air temperature may cause localised condensation of water on parts of equipment.

The yearly average humidity level of the external ambient is 75 % of relative humidity.

On 30 days in the year, continuously, the level of the external ambient relative humidity can be in the range of 75 % to 95 %.

4.5 Wind

Equipment exposed to air movement shall be designed to withstand the stress generated. The stress caused by air movement can be generated by two sources.

1) Natural wind

The force (F_w) produced by natural wind shall be calculated as below:

$$F_w = q \times c \times A$$

where

F_w is the force (N);
q is the pressure head (N/m²);
c is the form factor (without dimension);
A is the equipment surface perpendicular to the direction of the wind (m²).

The formula shown above has been simplified for general signalling and telecommunications applications. For complex installations (e.g. buildings) please refer to ISO 4354.

The pressure head (q) shall be calculated by:

$$q = \delta/2 \times v^2$$

where

δ is the density of air (kg/m³);
v is the speed of air (m/s).

The maximum speed of wind is conventionally taken as 35 m/s. In this case we have the following values:

$$q = 1{,}25/2 \times 35 \times 35 = 0{,}76 \text{ kN/m}^2$$

$$F_{wMax} = 0{,}76 \times c \times A$$

If the customer requires a higher wind speed to be used in this calculation, then the relevant value must be specified to the supplier.

2) Air movement produced in the area of the track by the passing of the train

The air movement surrounding a moving train is extremely complex and it is not possible to derive a single value in this European Standard.

The customer shall advise the designer of the value of q to be used to calculate air movement pressure caused by trains.

Annex B shows some examples of q and c factors which may be used for guidance.

4.6 Rain

Equipment exposed to rain shall be designed to withstand a rain rate of 6 mm/min for classes T1 and T2 and a rain rate of 15 mm/min for class TX.

The designer shall also consider the combined effect of rain and wind.

The customer should consider whether more severe water protection is required (e.g. flooding) and specify his requirement to the supplier in accordance with EN 60529 IP code.

4.7 Snow and hail

Consideration shall be given to the effect of snow and/or hail. The maximum diameter of the hailstones is conventionally taken as 15 mm, larger diameter may occur exceptionally.

Consideration shall be given to all forms of snow which may occur.

The effects of snow driven by wind or passing vehicles shall be considered.

4.8 Ice

Equipment exposed to the effects of ice forming or falling shall be designed to operate in that environment.

In such conditions the performance of equipment shall be specified either in the product standard or by the customer.

4.9 Solar radiation

Equipment exposed to the effects of solar radiation shall be designed to ensure that it continues to operate and comply with the parameters of the design specifications.

The maximum level of solar radiation is 1 120 W/m² for equipment directly exposed according to EN 60721-3-4.

Care shall be taken to minimize the effects of UV radiation on the equipment exposed to solar radiation.

For equipment in other situations (e.g. inside, behind a window, etc.), the designer must choose other values and justify his choice to the customer.

4.10 Lightning

Consideration shall be given to the effects of lightning on the equipment.

For protection of the equipment against lightning refer to EN 50124-2.

4.11 Pollution

The effects of pollution shall be considered in the design of equipment and components.

The micro-environmental conditions and the effects of pollution in combination with humidity are described in EN 50124-1.

The severity of pollution will depend upon the location of the equipment.

The effects of pollution may be reduced by the use of appropriate protection. In this case the protection against water and solid objects shall be specified using the protection degree definition of EN 60529.

The effects of the following kinds of pollution shall be considered:

- chemical active substances:
  - salinity,
  - H_2S,
  - weedkiller (product to specify by the customer),
  - organic elements,
  - other chemical substances;
- biological active substances;
- mechanically active substances:
  - dust: due to presence of carbon or metallic powder, the dust may become electrically conductive with the presence of humidity,
  - stones coming from the ballast,
  - sand, if specified for the application.

Table 4 below gives the levels of pollution for "External Ambient" areas.

The external ambient pollution levels defined below are those normally found on equipment housings located in open air.

Table 4 - External ambient pollution levels

Pollution levels	Pollution type		
	Chemical active substances	**Biological active substances**	**Mechanical active substances**
Low	4 C 1	4 B 1	4 S 1
Medium	4 C 2 *	4 B 1	4 S 2
High	4 C 3 *	4 B 1	4 S 3
* Coastal areas are excluded from these classes. The customer must specify to the designer where protection from salt mist is required, in which case protection to a minimum 4 C 2 should be provided.			

Definitions of classes for chemical, biological and mechanical active substances are given in the relevant standard EN 60721-3-4.

The customer must specify a pollution level (L, M, H) for each pollution type shown in Table 4 which is applicable where the equipment is to be used.

For more severe conditions the customer must specify the pollution level which is required.

4.12 Fire protection

The level of fire protection should be stated in the relevant product standard specifications.

4.13 Vibrations and shocks

4.13.1 Vibrations

In Europe, the interaction between the track side equipment and the rolling stock varies considerably between each country.

The specification of vibrations is very complex and depends on a multitude of variables such as:

- track design and maintenance,
- proximity to rail discontinuities (e.g. block joints, crossings),
- axle loads,
- bogie design,
- wheel flat,
- speed.

Vibrations, energy levels and their distributions across the frequency range are thus variable.

The system designer should ensure, wherever possible, that equipment is situated in a position such as to minimise the shocks and vibrations experienced by the equipment.

In order to determine a standard for all countries, the shapes shown in Annex C apply for each application and have been estimated from a number of measurements taken at various sites.

These values shall be used for all equipment unless more stringent requirements are specified by the customer.

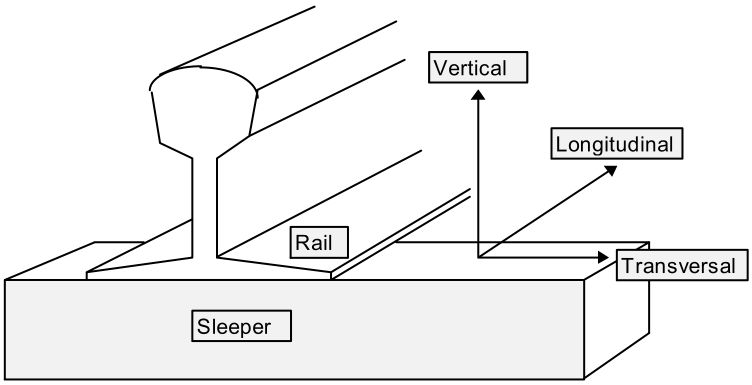
The P.S.D. curves are shown in Annex C and the r.m.s. acceleration values of these curves calculated between 5 Hz and 2 000 Hz are shown in Table 5 below.

Table 5 - Acceleration at track side positions

Position	**r.m.s. Vertical acceleration** m/s²	**r.m.s. Transversal acceleration** m/s²	**r.m.s. Longitudinal acceleration** m/s²	**Figure (Annex C)**
On rail	280	140	50	C.1
On sleeper	130	50	90	C.2
On ballast	10	10	10	C.3
Outside the track (from 1 m to 3 m from the rail)	2,3	2,3	2,3	C.4

Beyond 3 m the level of vibrations coming from the track is negligible.

The vibration curves of Annex C are shown with the three following axis:



4.13.2 Shocks

The values of shocks (vertical axis) are shown in Table 6. These values have been derived from ORE A 118 Rp 4.

Table 6 - Shocks at different track side positions (vertical axis)

Position	**Acceleration** (in m/s²) / **Duration** (in ms)	
	Mean	**Peak**
On rail	420 / 6	2 500 / 1
On sleeper	300 / 8	800 / 2
On ballast	50 / 11	100 / 8
Into a box upon post, outside the track (from 1 m to 3 m from the rail)	20 / 11	20 / 11

For railways systems not utilising steel wheels running upon steel rails (e.g. pneumatic tyre METRO systems), the customer must specify vibration and shock requirements in the technical specifications to the supplier.

4.14 Electromagnetic compatibility

The electromagnetic conditions encountered by apparatus are complex, and many are of a transient nature. It is not possible therefore to define a comprehensive set of EMC parameters (see EN 50121-1 and EN 50121-2 for generic details). EN 50121-4 defines a set of test conditions which represents current best practice for EMC.

4.15 Power supplies

The customer must specify the complete system power supply requirements to ensure that all equipment and systems will operate safely and reliably, particularly when equipment is supplied from a variety of different suppliers.

The specifications must include, for example, nominal voltages, expected variations and disturbances, nominal frequencies and variations, permitted ripple. European Standards dealing with a.c. or d.c. power supply like EN 61000-2-4, HD 472 S1, EN 60870-2-1, should be applied where possible.

Annex A
(normative)

Climatograms

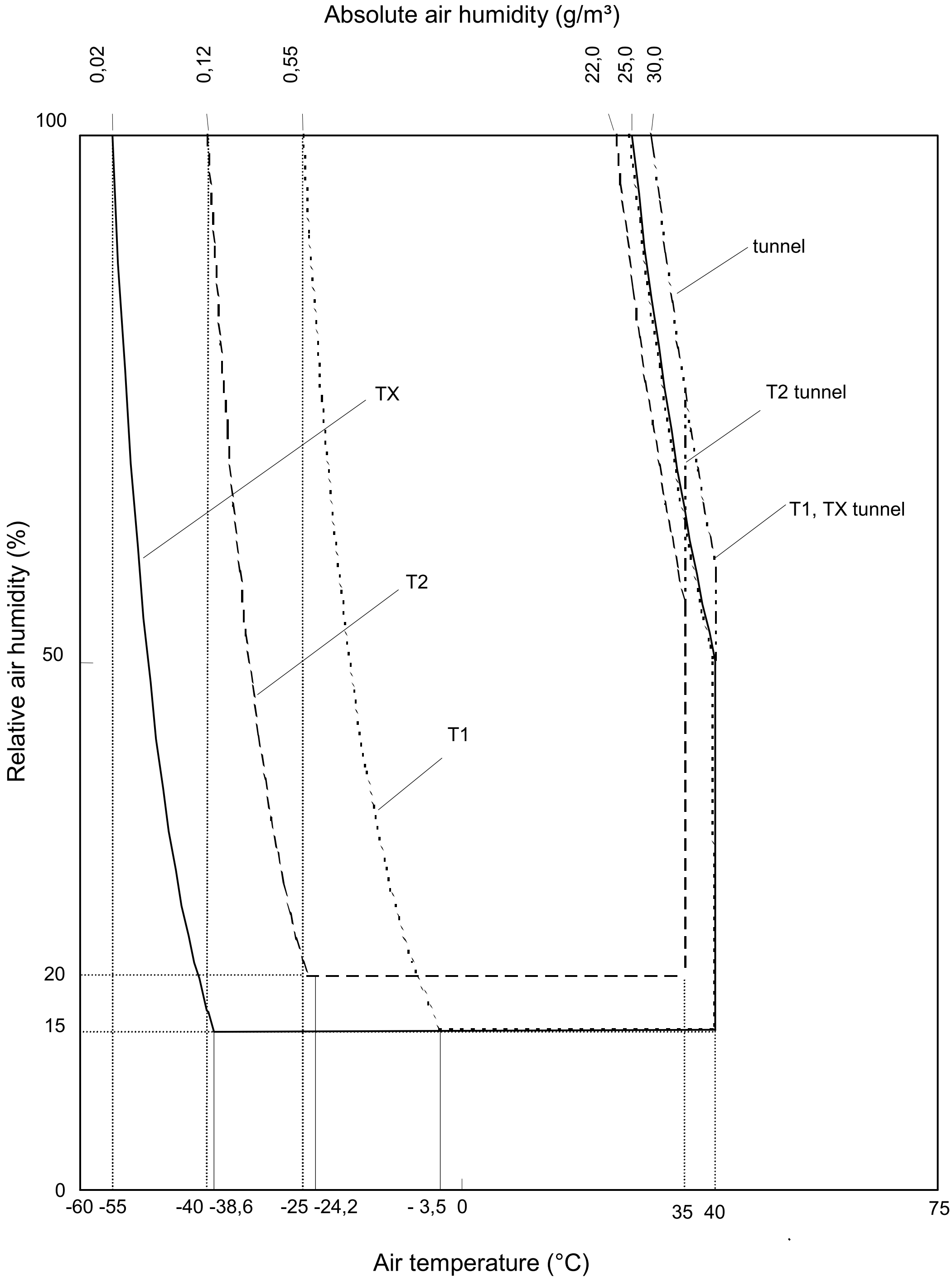
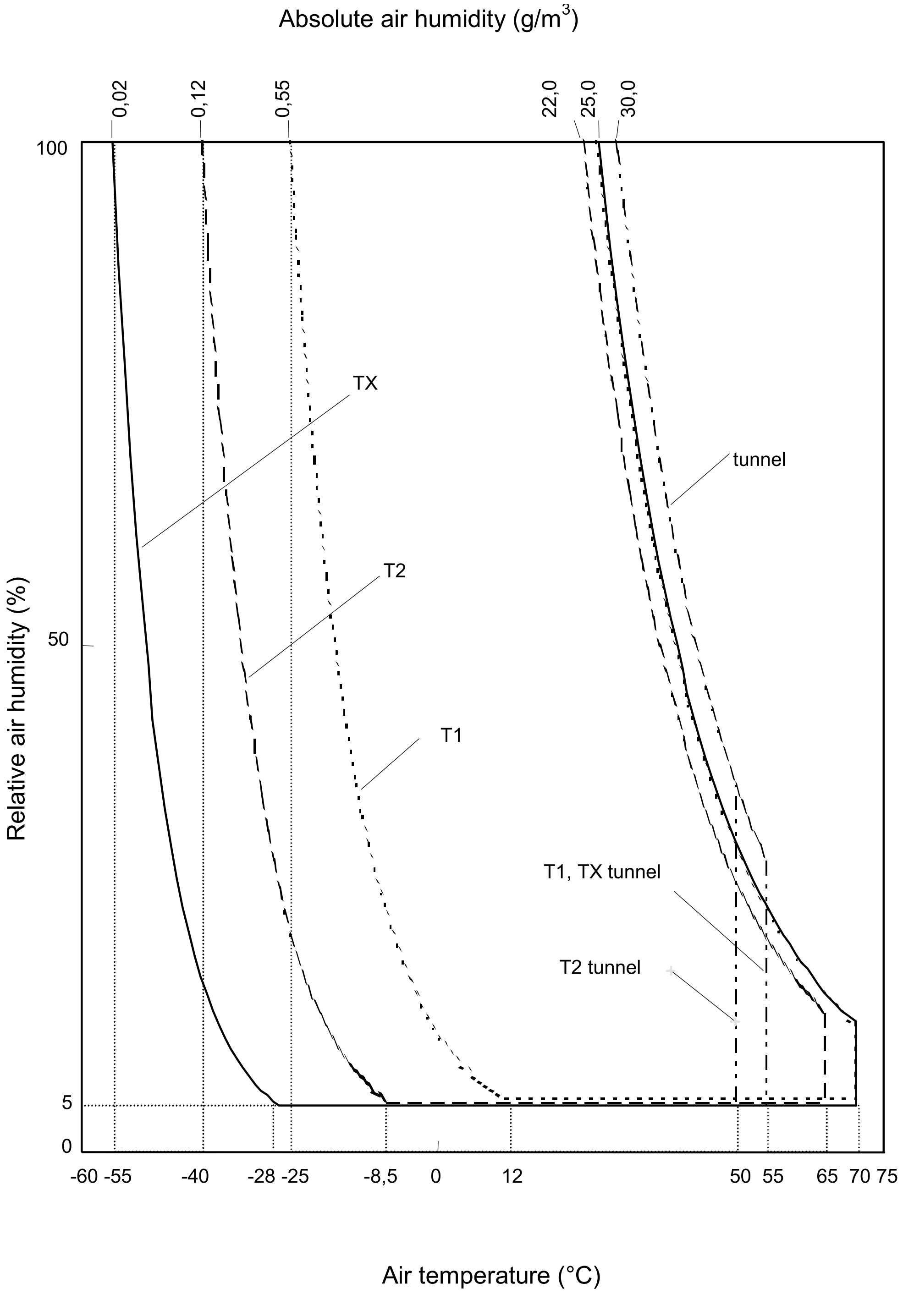
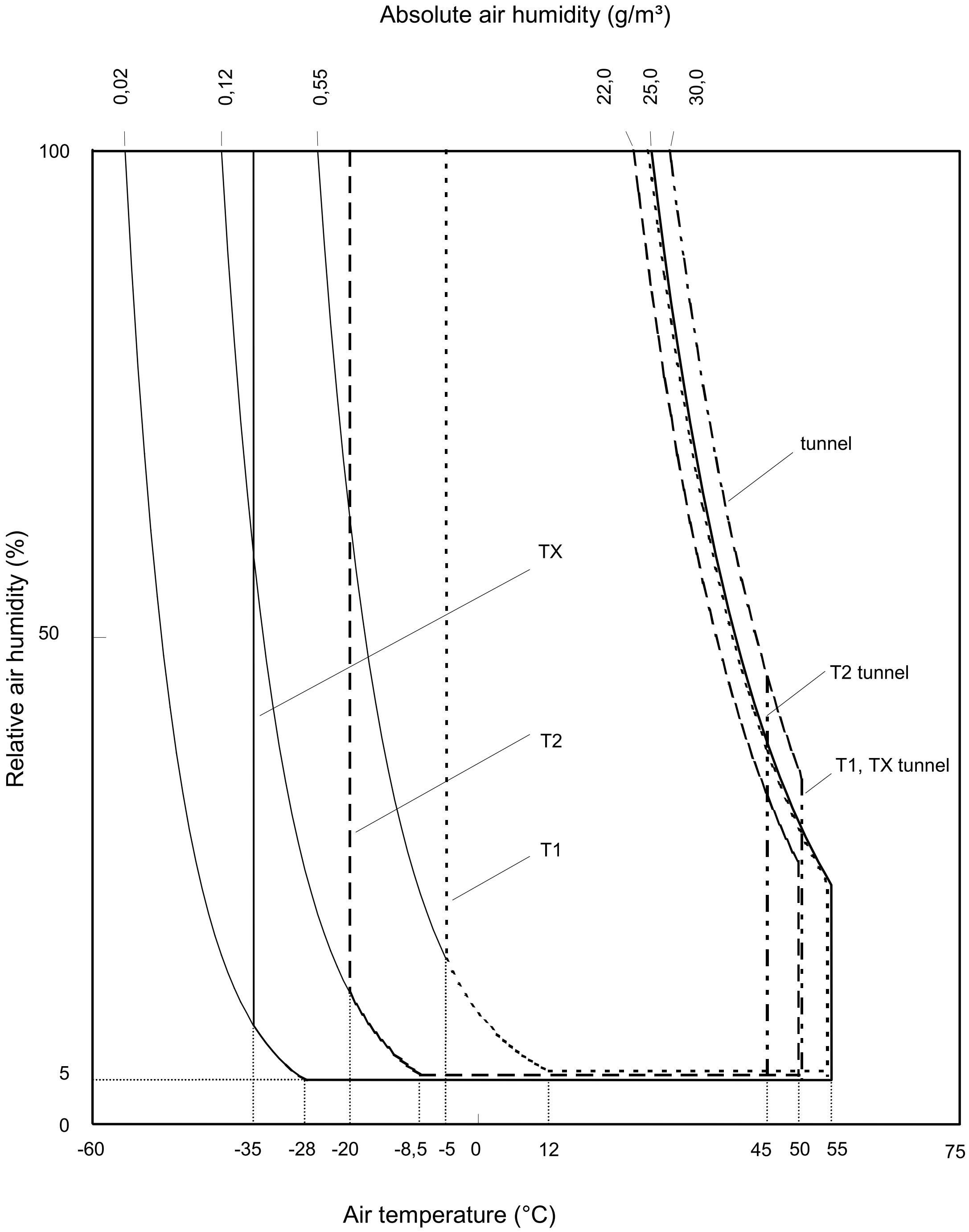


Figure A.1 - Temperature and humidity in external ambient Climatograms for external ambient for climatic classes T1, T2 and TX with extension for tunnel conditions



NOTE Upper temperatures are lower for all classes in tunnels due to the lack of solar radiations.

Figure A.2 - Temperature and humidity in cubicle Climatograms for cubicles for climatic classes T1, T2 and TX with extension for tunnel conditions



NOTE 1 This climatogram assumes the worst case humidity conditions inside the shelter. If the shelter proposed by the designer has a superior performance then the variations from the ranges shown in the climatogram shall be demonstrated by the designer to the customer.

NOTE 2 Upper temperatures are lower for all classes in tunnels due to the lack of solar radiations.

Figure A.3 – Temperature and humidity in shelter N.T.C.
Climatograms for shelters for climatic classes T1, T2 and TX
with extension for tunnel conditions

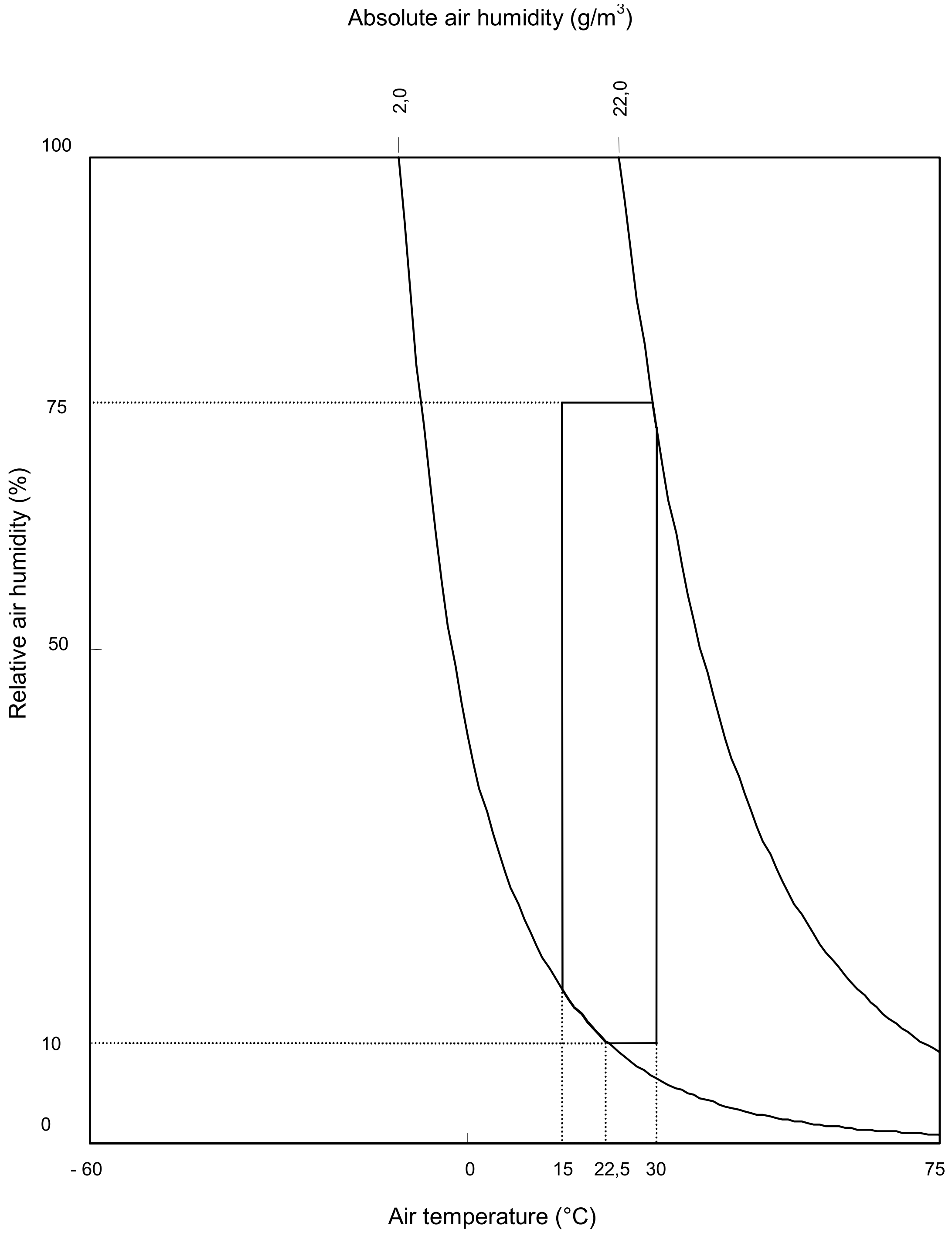
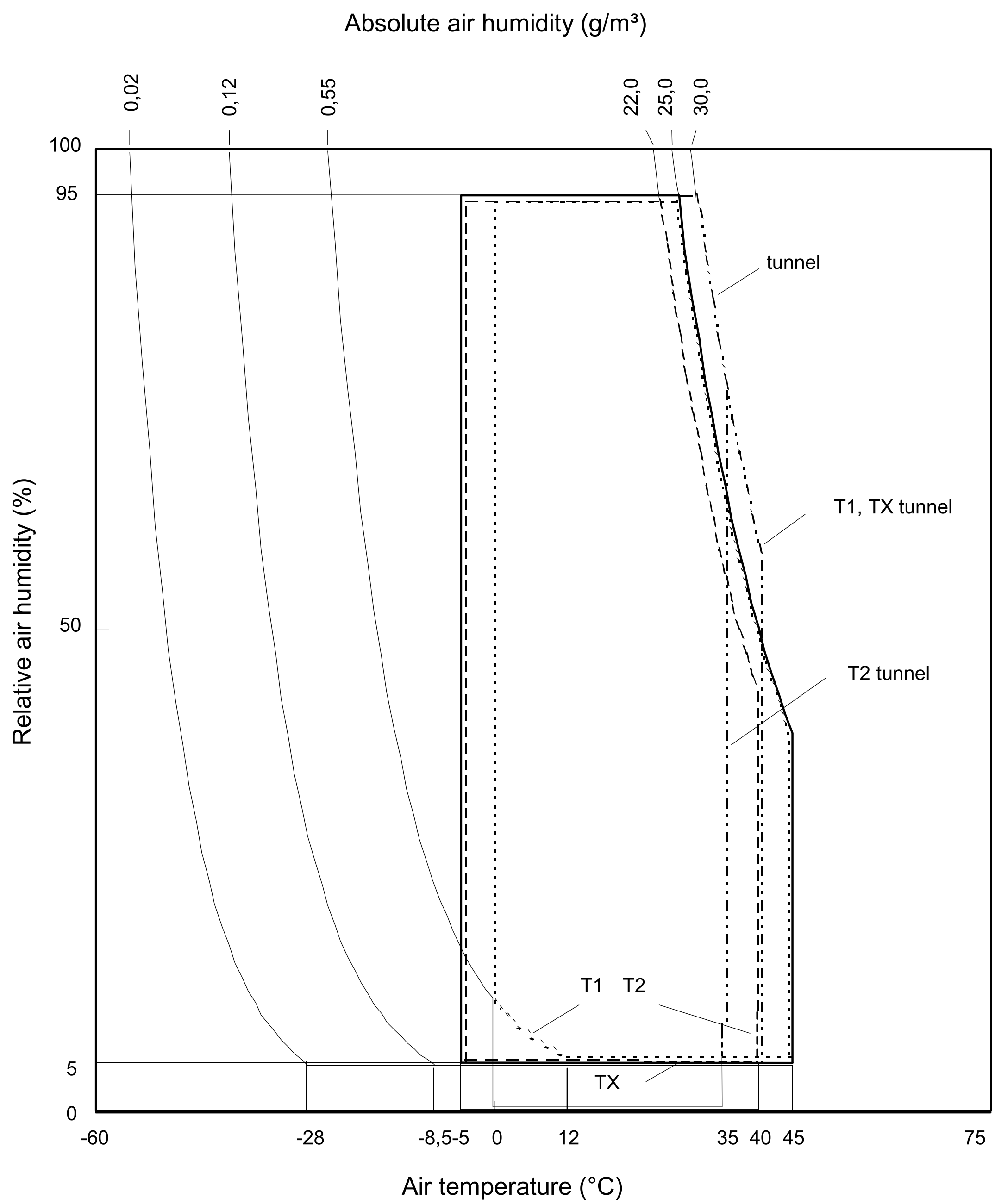


Figure A.4 - Temperature and humidity in shelter T.C.
Climatogram for shelters with temperature-control for climatic classes T1, T2 and TX



NOTE Upper temperatures are lower for all classes in tunnel due to lack of solar radiations.

Figure A.5 - Temperature and humidity in building N.C.C.
Climatograms for buildings for climatic classes T1, T2 and TX
with extension for tunnel conditions

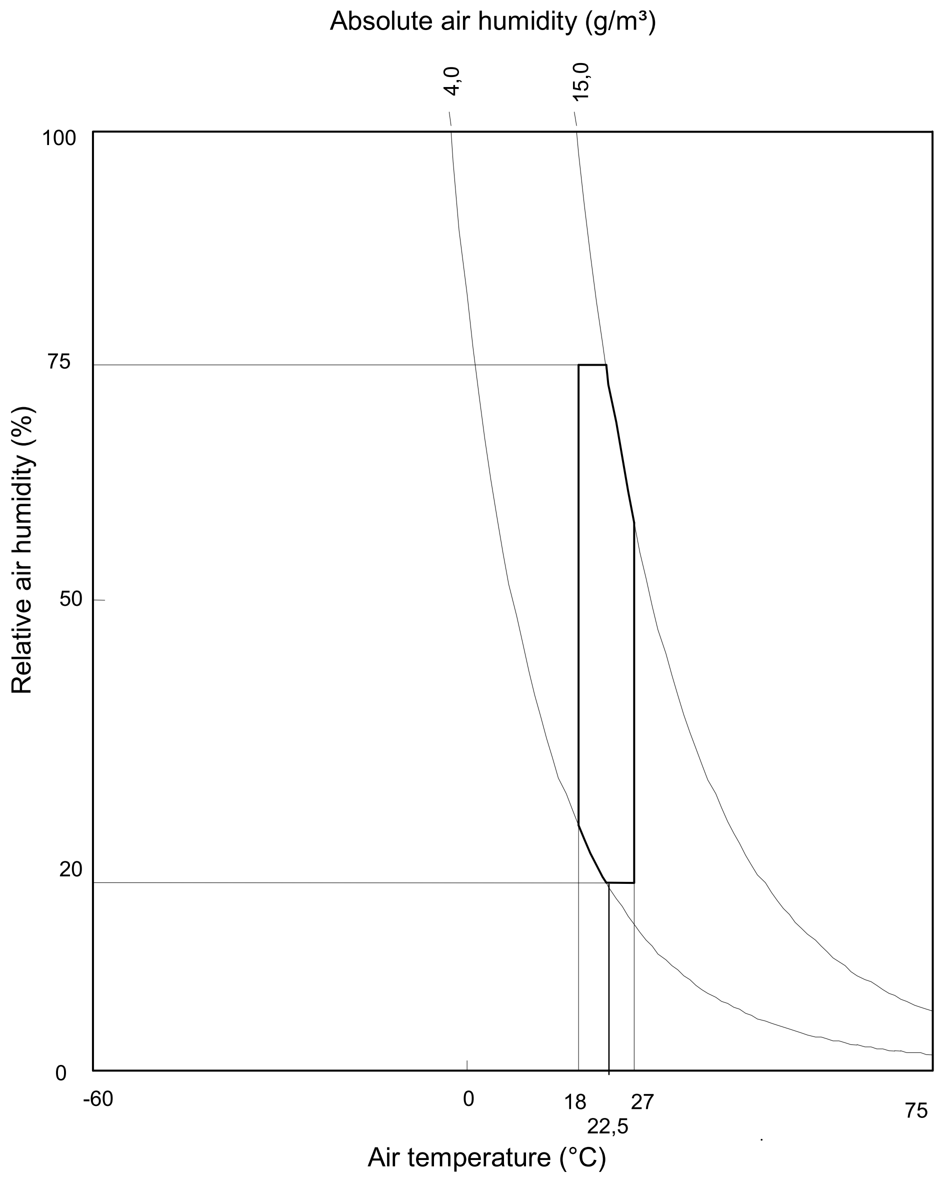


Figure A.6 - Temperature and humidity in building C.C.
Climatogram for buildings with climatic-control for climatic classes T1, T2 and TX

Annex B
(informative)

Examples of *q* and *c* factors

For more details, refer to ISO 4354 "Wind actions on structures".

As explained in 4.5 the pressure head (q) is calculated by:

$$q = \delta/2 \times v^2$$

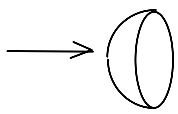
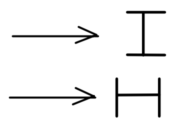
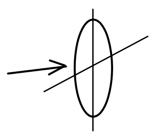
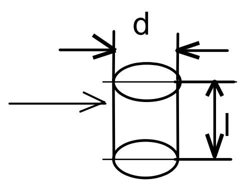
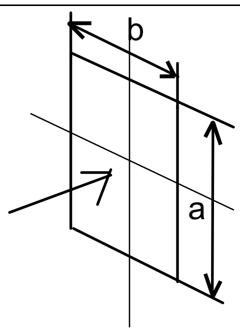
Some examples of pressure head in relation to air speed gives Table B.1:

Table B.1 - Pressure head in relation to air speed
With δ = 1,25 kg / m³ (density of air)

Pressure head N/m²	**Speed of air** m/s	**Speed of air** km/h
500	28,3	102
760	35	126
1 100	42	151
1 300	45,6	164

Typical values of form factors c are shown in Table B.2.

Table B.2 - Typical values of form factor c

<table>
<tr><th>Form</th><th>Form factor c</th><th>Form</th><th>Form factor c</th></tr>
<tr><td></td><td>0,34</td><td></td><td>2,04
0,86</td></tr>
<tr><td></td><td>1,11</td><td></td><td><table><tr><th>l/d</th><th>c</th></tr><tr><td>1</td><td>0,63</td></tr><tr><td>5</td><td>0,74</td></tr><tr><td>10</td><td>0,82</td></tr><tr><td>40</td><td>0,98</td></tr></table></td></tr>
<tr><td></td><td><table><tr><th>a/b</th><th>c</th></tr><tr><td>1</td><td>1,10</td></tr><tr><td>2</td><td>1,15</td></tr><tr><td>4</td><td>1,19</td></tr><tr><td>10</td><td>1,29</td></tr><tr><td>28</td><td>1,40</td></tr><tr><td>∞</td><td>2,01</td></tr></table></td><td></td><td></td></tr>
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Annex C
(normative)

Vibrations

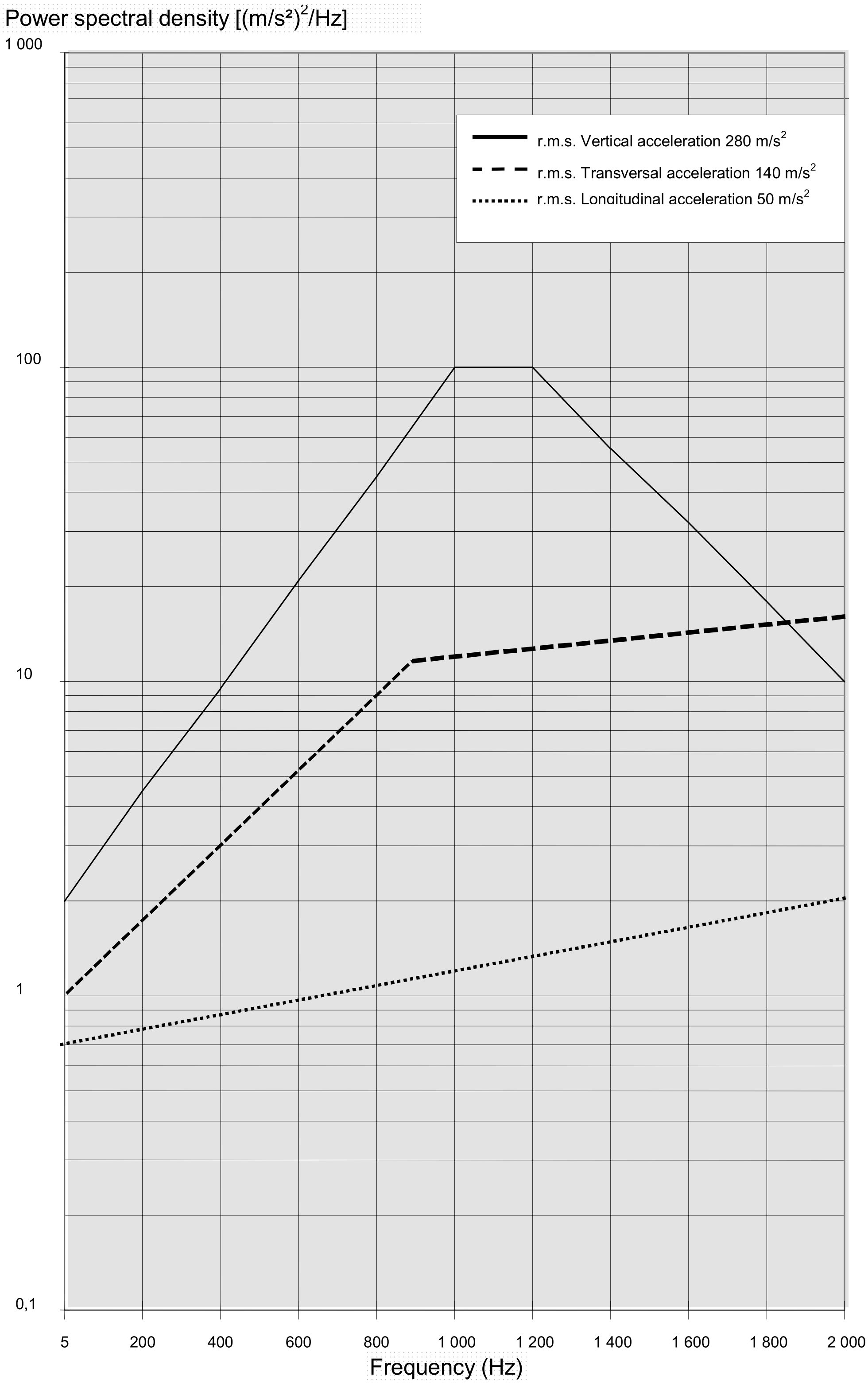

Figure C.1 - Power spectral density of vibrations on rail

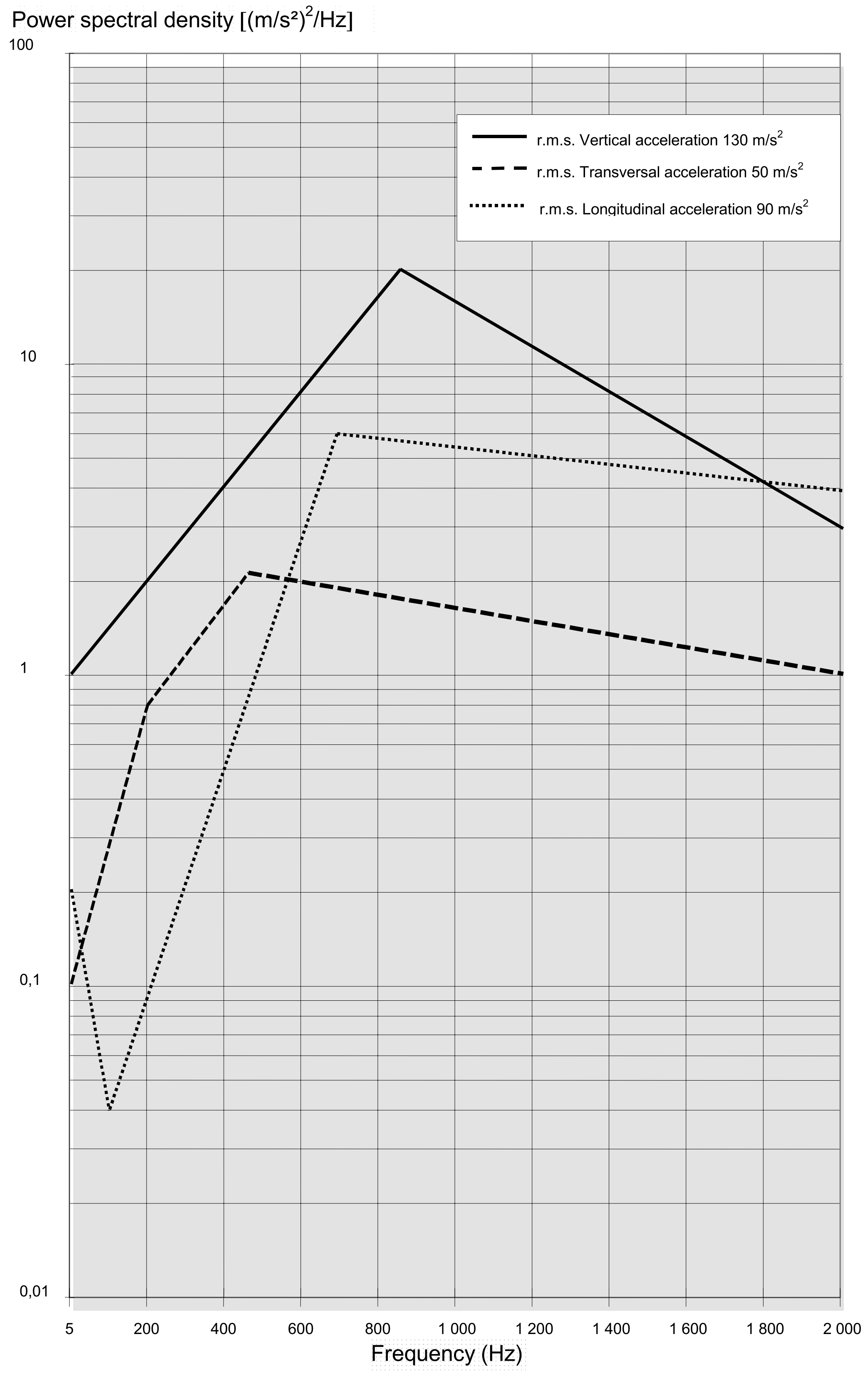

Figure C.2 - Power spectral density of vibrations on sleeper

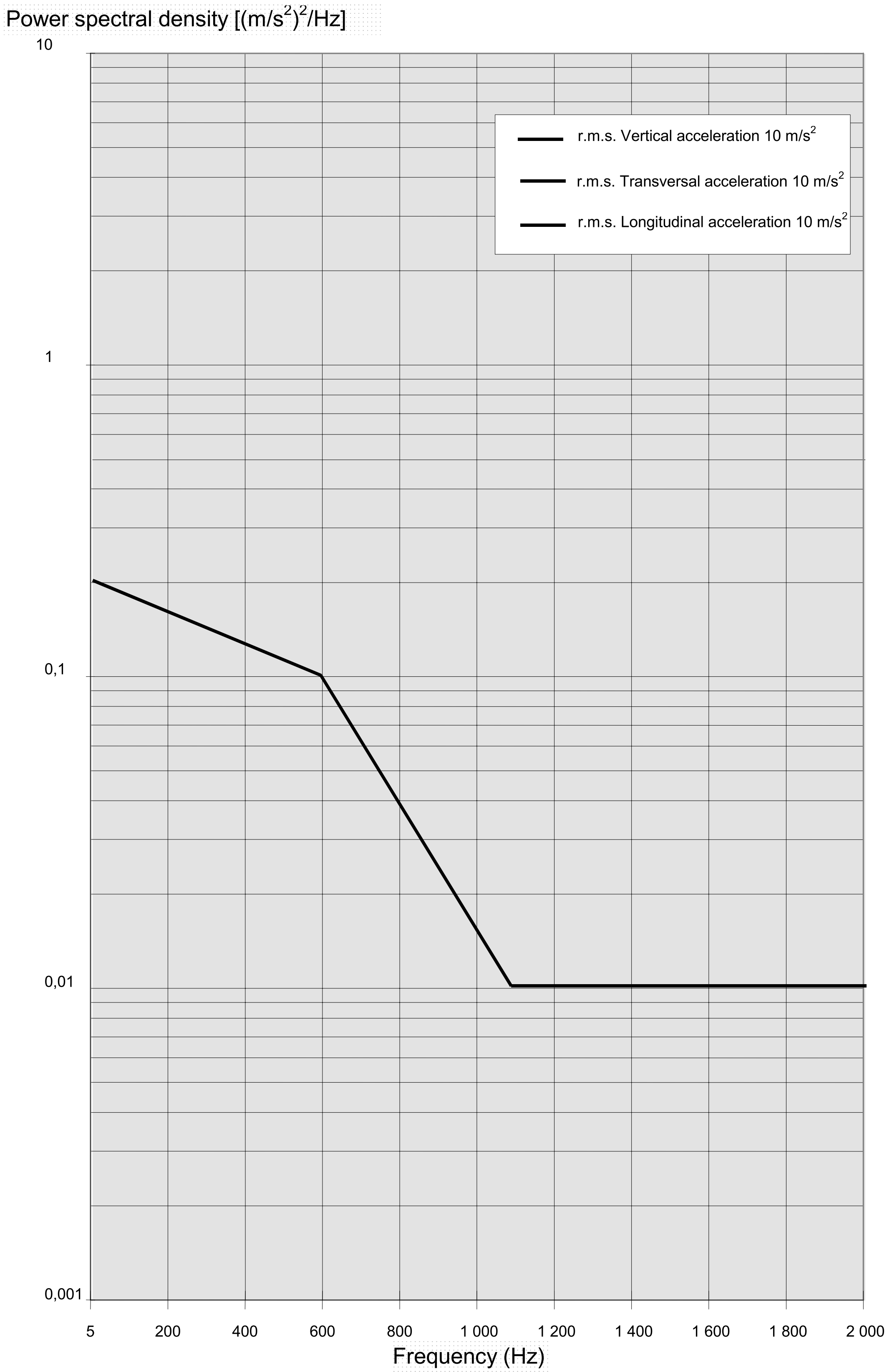

Figure C.3 - Power spectral density of vibrations on ballast

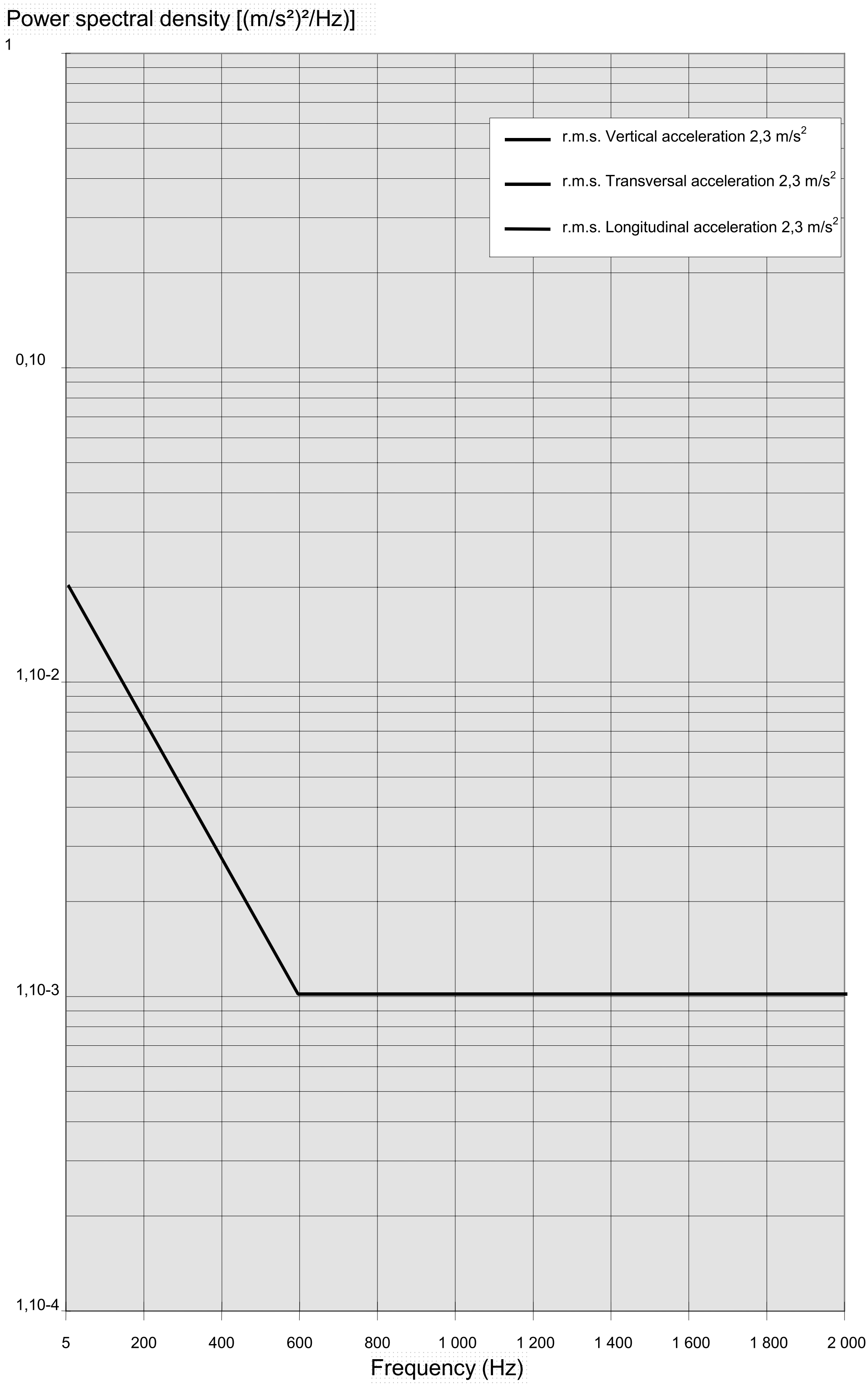

Figure C.4 - Power spectral density of vibrations outside the track (from 1 m to 3 m from the rail)

Annex D
(informative)

Example of European regions and theirs appropriate climatic classes

Class	Type of climate
T1	Warm temperate, warm dry, mild warm dry
T2	Cold temperate
TX	Cold
Types of climate as defined in HD 478.2.2. S1 (IEC 60721-2-1:1982 + A1:1987).	

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EN 60870-2-1		Telecontrol equipment and systems – Part 2: Operating conditions – Section 1: Power supply and electromagnetic compatibility (IEC 60870-2-1)
EN 61000-2-4	1994	Electromagnetic compatibility (EMC) – Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances (IEC 61000-2-4:1994 + corr. August 1994)
HD 472 S1		Nominal voltages for low-voltage public electricity supply systems (IEC 60038, mod.)
ERRI A 118 Rp 4		European Rail Research Institute (ERRI): Use of electronic components in signalling – Non-electrical environment in the case of electronic signalling systems

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