BRITISH STANDARD

BS EN
14813-1:2006

Railway applications — Air conditioning for driving cabs —

Part 1: Comfort parameters

The European Standard EN 14813-1:2006 has the status of a British Standard

ICS 45.060.10

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 14813-1:2006.

The UK participation in its preparation was entrusted by Technical Committee RAE/1, Railway applications, to Subcommittee RAE/1/-/6, Air conditioning, heating and ventilation, 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 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.

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Summary of pages

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Railway applications - Air conditioning for driving cabs - Part 1: Comfort parameters

Applications ferroviaires - Conditionnement de l'air pour cabines de conduite - Partie 1: Paramètres de bien-être

Bahnanwendungen - Luftbehandlung in Führerräumen - Teil 1: Behaglichkeitsparameter

This European Standard was approved by CEN on 26 June 2006.

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Contents

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Foreword

This document (EN 14813-1:2006) has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2007, and conflicting national standards shall be withdrawn at the latest by February 2007.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 96/48/EC.[1)]

For relationship with the EU Directive, see informative Annex ZA, which is an integral part of this document.

This series of European Standard includes the following parts:

— EN 14813-1, *Railway applications — Air conditioning for driving cabs — Part 1: Comfort parameters*

— EN 14813-2, *Railway applications — Air conditioning for driving cabs — Part 2: Type tests*

In the context of this series, there are two further series on air conditioning in rolling stock:

— EN 13129-1, *Railway applications — Air conditioning for main line rolling stock — Part 1: Comfort parameters*

— EN 13129-2, *Railway applications — Air conditioning for main line rolling stock — Part 2: Type tests*

— EN 14750-1, *Railway applications — Air conditioning for urban and suburban rolling stock — Part 1: Comfort parameters*

— EN 14750-2, *Railway applications — Air conditioning for urban and suburban rolling stock — Part 2: Type tests*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1) Official Journal No L 235 of 17.9.1996. Amended by Directive 2004/50/EC of the European Parliament and of the Council of 29 April 2004, Official Journal No L 164 of 30.4.2004.

Introduction

The object of this European Standard is to establish common comfort parameters for the European railways. It also specifies the performance of the air-conditioning installations.

If necessary, the revised requirements due to the operating constraints of the vehicle will be detailed in the contractual specification. This European Standard applies if there is no particular clause in the contractual specification.

1 Scope

This European Standard is applicable to railway vehicle driving cabs which are air-conditioned or heated/ventilated. These include:

— locomotives;

— mainline, suburban and regional vehicles;

— urban vehicles such as metros and trams.

This European Standard does not consider the special operational requirements of shunt locomotives.

This European Standard specifies the comfort parameters for the driving cab to ensure driver comfort which helps safe operation.

The conditions under which the physical parameters mentioned in this European Standard shall be measured are defined in EN 14813-2.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 779:2002, *Particulate air filters for general ventilation — Determination of the filtration performance*

EN 14813-2:2006, *Railway applications — Air conditioning for driving cabs — Part 2: Type tests*

EN 50126, *Railway applications — The specification and demonstration of reliability, availability, maintainability and safety (RAMS)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
comfort
agreeable sensation perceived by a person concerning his climatic environment

3.2
air conditioning installations
equipment intended for ventilation and/or heating and/or cooling and/or filtration

3.3
forced air ventilation
air circulation generated by a mechanical action

3.4
natural ventilation
air circulation generated without mechanical action

3.5
preheating
process which enables the interior temperature to be raised without the presence of occupants

3.6
precooling
process which enables the interior temperature to be lowered without the presence of occupants

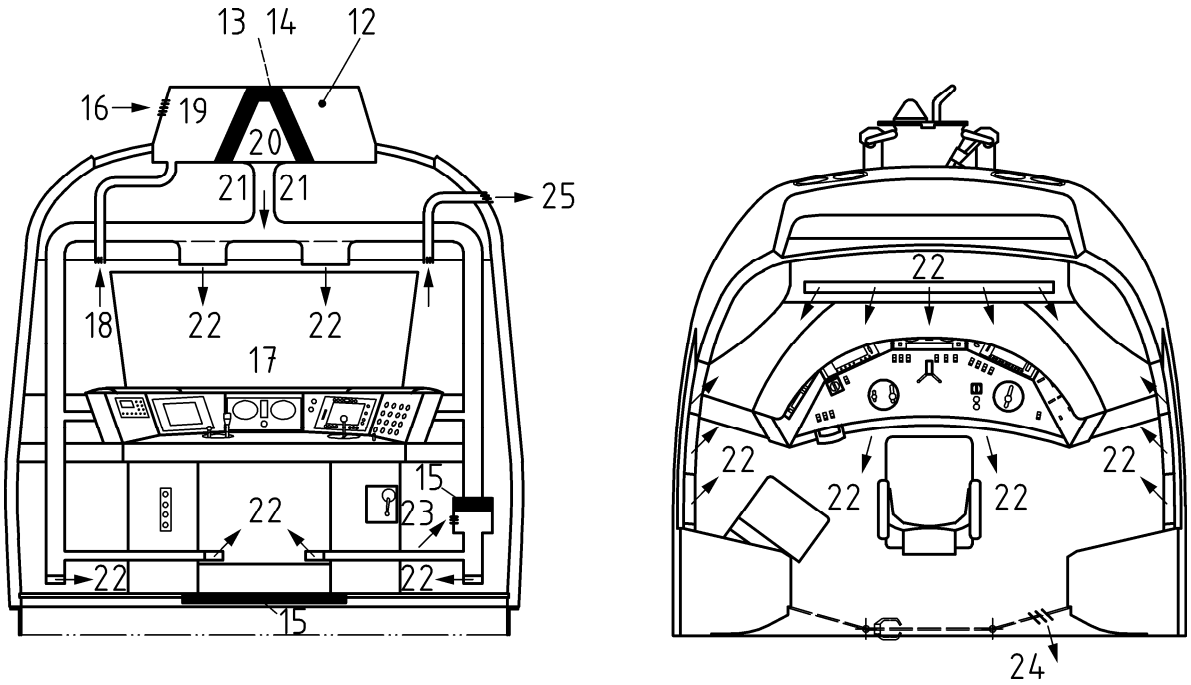
3.7
heating
process which enables the interior temperature to be raised or maintained

3.8
cooling
process which enables the interior temperature to be lowered or maintained

3.9
dehumidification
process which reduces the content of water in the interior air

3.10
air conditioning
system which includes ventilation, heating, cooling and/or dehumidification

3.11
heating and ventilation
system which includes ventilation and heating



NOTE 1 The representation is only given as an example and does not prejudice the design of the installation.

NOTE 2 Items 13 and 14 can be "and/or".

Figure 1 — Diagram explaining certain railway terms

3.12
air handling unit
group of components designed to move, filter and/or mix, heat and/or cool the air (see Figure 1, No 12)

3.13
cooling unit
system that carries out the cooling function in a centralised and/or de-centralised manner (see Figure 1, No 13)

3.14
principal heating unit
system that carries out the heating function in a centralised and/or de-centralised manner with the use of heating elements associated or not with the forced air ventilation (see Figure 1, No 14)

3.15
auxiliary heating unit
de-centralised heating element(s) for adding heat locally (see Figure 1, No 15)

3.16
outside air or fresh air
air taken from outside (see Figure 1, No 16)

3.17
room air
air contained in a specified space (see Figure 1, No 17)

3.18
re-circulated air
air taken from the interior of a specified space and re-used (see Figure 1, No 18)

3.19
mixed air
combination of fresh air and re-circulated air (see Figure 1, No 19)

3.20
treated (or conditioned) air
air that may have been and/or had energy exchanged as it passed through the air handling unit (see Figure 1, No 20)

3.21
primary air
quantity of treated air entering the ducts (see Figure 1, No 21)

3.22
supply air
treated air, that may be combined with some induced air, supplied to a specified space (see Figure 1, No 22)

3.23
induced air
room air that is taken and re-used locally (see Figure 1, No 23)

3.24
transfer air
air leaving a specified area (see Figure 1, No 24), for example air transferring to the saloon area

3.25
exhaust air
air rejected outside the vehicle (see Figure 1, No 25)

3.26
interior temperature setting (Tic)
theoretical control temperature to be achieved by the room air

3.27
interior temperature setting offset (ΔTic)
temperature offset selected by the driver

3.28
interior temperature (Tim)
interior temperature measured 0,74 m and/or 0,855 m above the seat reference point as specified in the procedure described in EN 14813-2:2006, Annex D

NOTE In the case where two seats within the cab are normally occupied, the mean of the temperatures at the two seats may be considered.

3.29
mean exterior temperature (Tem)
arithmetic mean of the exterior temperatures measured according to the procedure described in EN 14813-2

3.30
comfort envelope
areas normally occupied by driver and co-driver

3.31
heat transfer coefficient (*k*)
ratio between the density to the heat flow rate per unit of surface area and the prevailing difference in temperature (Tim) and (Tem) across the relevant walls of the driving cab

NOTE 1 The coefficient *k* takes account of the efficiency of the insulation of the exterior walls and the effect of the infiltration of air caused by the non-air tightness of the driving cab in motion (doors, windows, various openings) and is applicable to all or part of the driving cab.

NOTE 2 This value is expressed in W/m^2K.

3.32
overall transmission factor of the windows
ratio between the overall energy flow transmitted to the interior of the vehicle through the windows including the wind screen and the incident solar flow, for thermal load calculation

3.33
equivalent solar load
total heat received by 1 m^2 surface perpendicular to the radiation emitted by a luminous source (solar equivalent) and this, when inclined at an angle of 30° to the horizontal

3.34
stabilised operation
operation obtained when Tim remains within the tolerance band defined in 9.1.1

3.35
stand by operation
mode under which a predetermined interior temperature different from the interior temperature setting (Tic) is maintained during non operational activity of the vehicle

3.36
pressure protection devices
equipment intended to protect against undue vehicle interior tympanic pressure variations

4 Driving cab classification

The operator shall detail in his contractual specification the driving cab classification.

For guidance, a driving cab classification is proposed in Table 1. The relevant comfort parameters vary with the applicable driving cab category.

Table 1 — Driving cab classification

	Category A	**Category B**
Cab interior volume	≥ 9 m^3	< 9 m^3
Typical duration of continuous driver presence in the cab	> 60 min	≤ 60 min

NOTE Driving cab for main line and suburban/regional trains are in general category A and other vehicles are category B. Where driving areas are not physically separated from the passenger areas they are considered as category B.

5 Comfort parameters

Outside the preconditioning periods, comfort is assessed:

— on the basis of environmental parameters such as:

  — air temperature;

  — air speed according to Annex A;

  — relative humidity according to Annex B;

  — temperature of the interior surfaces;

— as a function of thermal exchange between the environment and a seated person dressed normally according to Annex C;

— on the basis of the exterior climatic conditions which have an indirect effect.

6 Exterior conditions

6.1 Determination of climatic zones

For determination of the climatic zone where the vehicle will be operated, guidance is given in Annex E.

6.2 Normal exterior operating conditions

The comfort parameters shall be satisfied between the limits of exterior conditions given in Annex D, except where indicated otherwise in the contractual specifications (tunnel operation for example).

6.3 Extreme exterior operating conditions

The air conditioning installations shall be able to operate under extreme temperatures:

— 5 K below the minimum values and 5 K above the maximum values specified in Annex D;

— if they are placed under frame, 10 K above the maximum values specified in Annex D.

The interior conditions as defined in Clause 9 are not contractual for these extreme conditions.

7 Performance of the heating and cooling installations

7.1 Heating

At the minimum exterior temperature for all climatic zones (see Annex D) defined in the contractual specifications, at the maximum vehicle operational speed, without solar load, without occupation and with the minimum fresh air supply (see 9.6.1), the interior temperature (Tim) in the comfort envelope shall for all climatic zones be above + 18 °C for category A and category B.

7.2 Preheating

The preheating conditions and performance (electrical power consumption and voltage, interior temperature increase and time etc.) shall be defined in the contractual specifications.

In the absence of any detail as above, the preheating time depends on the performance defined in 7.1 and other operational restrictions.

7.3 Cooling

At the maximum exterior temperature of the climatic zone (see Annex D) defined in the contractual specifications with a stationary vehicle, with solar load (if contractual), with occupation (driver and co-driver if applicable) and minimum fresh air supply (see 9.6.1), the interior temperature (Tim) shall be less than or equal to the values in Table 2.

Table 2 — Maximum interior temperature at the design condition

Zone (summer)	Category A °C	Category B °C
I	+ 27	+ 30
II	+ 26	+ 28
III	+ 22	+ 24

The interior relative humidity shall be less than or equal to the relevant values as shown in Annex B.

7.4 Precooling

The precooling conditions and performance (electrical power consumption and voltage, interior temperature decrease and time etc.) shall be defined in the contractual specifications.

In the absence of any detail as above, the precooling time depends on the performance defined in 7.3 and other operational restrictions.

7.5 Stand by operation

If stand by operation is required, it shall be detailed in the contractual specifications.

8 Control

8.1 General

Each driving cab shall be fitted with a regulation system which shall enable the comfort parameters defined in this European Standard to be achieved.

8.2 Interior temperature setting (Tic)

8.2.1 General

Dependent on the operational requirements, one of the temperature control systems defined in 8.2.2 or 8.2.3 should apply.

8.2.2 Temperature control not related to exterior temperature

The driving cab shall have a temperature selection switch with which the interior temperature setting (Tic) can be selected in a range from + 18 °C to + 26 °C.

The interior temperature (Tim) shall follow the interior temperature setting (Tic) within the limits of performance defined in Clause 7. Outside these limits temperature deviation is allowed.

8.2.3 Temperature control related to exterior temperature

Depending on the temperature selection switch offset (ΔTic) and the mean exterior temperature (Tem), the interior temperature setting (Tic) shall be controlled according to the following equation if not specified otherwise:

$Tic = 20 + \Delta Tic + 0{,}4\ (Tem - 20)$ for $Tem \geq + 20$ °C;

$Tic = 20 + \Delta Tic$ for $Tem < + 20$ °C;

$\Delta Tic = [+ 4\ K; - 2\ K]$.

The interior temperature (Tim) shall follow the interior temperature setting (Tic) within the limits of performance defined in Clause 7. Outside these limits temperature deviation is allowed.

8.3 Fan speed control

It is recommended to have fan speed control under all operational modes.

If there is automatic fan speed control, a manual override shall be provided to ensure individual driver's comfort. It shall be possible to select a "high" or a "low" fan speed setting. Selection of "high" speed shall allow the air conditioning installation to continue to operate at its maximum capacity. Selection of "low" speed may limit the capacity of the air conditioning installation affecting its ability to achieve the desired interior temperature.

9 Comfort condition requirements

9.1 Temperatures in the comfort envelope

9.1.1 Range of the interior temperature (Tim) with respect to the interior temperature setting (Tic)

While the equipment functions under the nominal performance defined in Clause 7, this range shall not be greater than $\pm$ 1 K for category A driving cabs and $\pm$ 2 K for category B driving cabs.

9.1.2 Range of the interior air temperature in a vertical section of a seated driver

As defined in EN 14813-2, this range shall not be greater than 3 K for category A driving cabs and 6 K for category B driving cabs.

9.2 Relative humidity of air conditioned vehicles

Whatever the interior temperatures of comfort areas and within the limitations of the equipment performance defined in Clause 7 and Clause 8, the relative humidity shall be within the values in Annex B.

9.3 Surface temperatures inside and surrounding the comfort envelope

In comparison with the interior temperature (Tim), the range of the surface temperatures of the floor and ceiling excluding windows, walls and outer doors shall be not greater than 7 K for category A under all conditions and 12 K for category B under stationary conditions.

In comparison with the interior temperature (Tim), the range of the surface temperatures of the front windows, walls and outer doors shall be not greater than 12 K for category A under all conditions and 15 K for category B under stationary conditions.

All surfaces or equipment which are in frequent or permanent contact with the driver shall be manufactured from low thermal conductivity materials to avoid cold sensation or include surface heating as necessary.

The temperatures of heated surfaces in permanent direct contact with the driver (e.g. heated seat or foot rest) shall not be greater than + 35 °C.

The temperature of any accessible radiant heating panels which are not in permanent direct contact with the driver shall not be greater than + 60 °C.

9.4 Temperature at the supply air outlets

The temperature at any of the accessible supply air outlets shall not be greater than + 60 °C except during the preheating periods. The air diffused onto the seated driver shall not be greater than + 35 °C.

9.5 Air speed

The air speed in the comfort envelope shall be between the maximum and minimum values defined in Annex A.

In stabilised operation the fluctuation of the air speed at the supply air outlets shall be in a tolerance range of ± 20 % of the mean air velocity.

9.6 Air quantities

9.6.1 Outside air or fresh air

The total volume of fresh air added by forced ventilation to the comfort envelope shall be considered as follows:

— air conditioned driving cab: equal or above 30 m^3/h/person;

— heated/ventilated driving cab: equal or above 30 m^3/h/person in normal operation. However it shall be possible to increase the fresh air flow to at least 300 m³/h for ventilation only.

The position of the fresh air intake shall be optimised to provide the best quality air available.

The minimum fresh airflow rate of 30 m³/h/person is sufficient to keep the carbon monoxide and dioxide levels within the health and safety limits.

9.6.2 Recirculated air

A recirculated air system shall ensure operation (even in a degraded condition) if the design of the vehicle allows the fresh air intakes to be temporarily blocked.

In the case of combined air conditioning installations for the driving cab and a passenger area, the system shall not transfer air from the smoking to the non-smoking area. The smoking area shall be defined in the specification.

10 Complementary requirements

10.1 Heat transfer coefficient (k)

The coefficient k shall be measured on a stationary vehicle. The coefficient k of the driving cab shall be less than or at least equal to the values indicated in Table 3.

Table 3 — Coefficient k for the vehicle at standstill

Zone (winter)	Category A W/m^{2}K	Category B W/m^{2}K
I	2,3	3,5
II	1,9	3
III	1,6	2,5

10.2 Overall transmission factor of the windows

For vehicles which have mainly surface operation the overall transmission factor of the windows shall be less than or equal to 70 %.

10.3 Particle air filtration

Filter performance shall meet the requirements of EN 779, applicable to railway air conditioning installations. In the absence of any detail in the contractual specification, the filter grade G3 of EN 779:2002 is recommended.

10.4 Noise emission

For stationary vehicles, the sound pressure level generated in the comfort envelope by the air conditioning installation alone during any operating conditions (excluding vehicle preparation) shall not exceed the values in Table 4.

Table 4 — Maximum sound pressure level

Category A	Category B
62 dB(A)	65 dB(A)

10.5 Vibration generation

Air conditioning installations shall meet any specific requirements for vibration emission.

10.6 Safety devices

10.6.1 Heating

The heating equipment shall be fitted with a safety device to protect it from abnormal increases in air and equipment temperature. The heater shall be isolated in a reliable manner on activation of this safety device.

10.6.2 Cooling

The cooling equipment shall be fitted with a safety device to protect it against abnormal increases of pressure of the refrigerant fluid.

10.6.3 Emergency ventilation

If the flow of fresh air cannot be ensured by the air treatment unit, ventilation from the exterior shall be achieved by other means, e.g. window or roof hatch which can be manually opened.

10.7 Protection against pressure waves

When the contract specification requires it, the driving cab and its air conditioning unit shall be fitted in a manner that undue tympanic pressure variations do not occur.

Until a relevant European Standard will be published, details are to be agreed in the contractual specification.

10.8 Sealing against water, snow and dust

All precautions should be taken to avoid the infiltration and retention of water from condensation, rain and washing plants, as well as snow.

10.9 Reliability, maintainability

10.9.1 Reliability

The calculation of MTBF (Mean Time Between Failures) shall be carried out in accordance with the requirements of EN 50126.

Additional requirements shall be as detailed in the contractual specification.

10.9.2 Maintainability

The design of the vehicles and the air conditioning installations shall take into account the maintenance plan of the end-user.

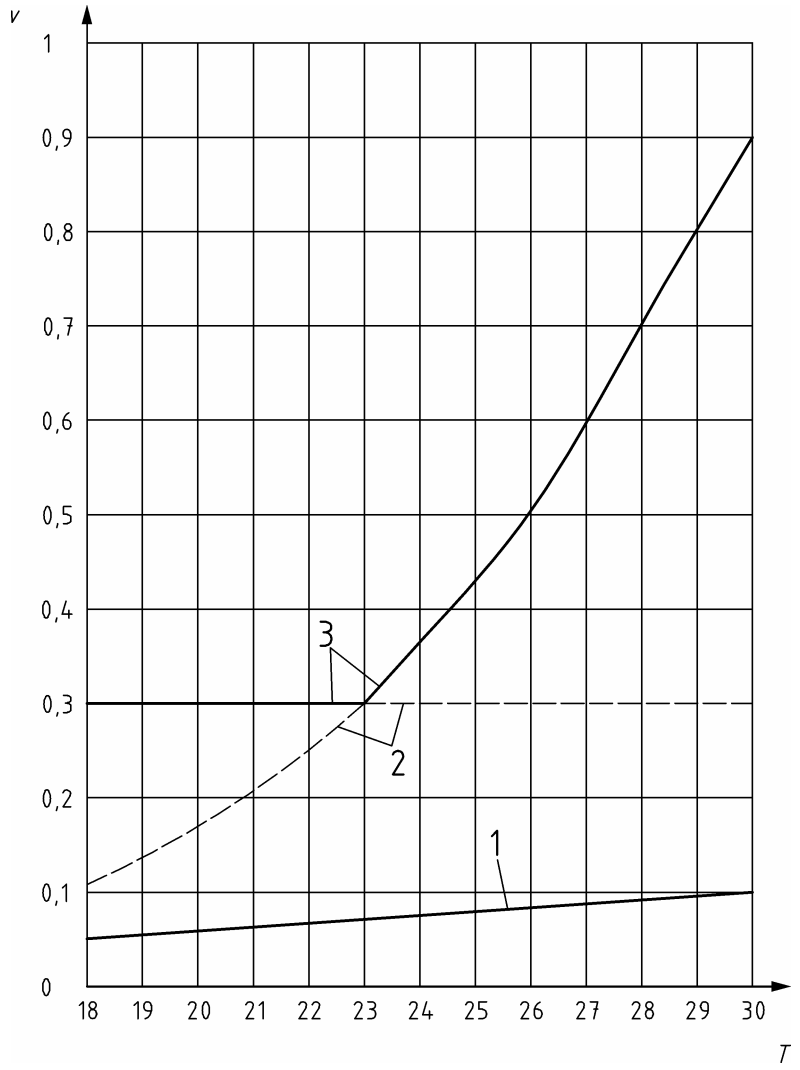
The periodic maintenance work shall be facilitated by easy access to and/or rapid dismantling of the items concerned.

The ease of dismantling of items shall take into account their reliability and maintenance period.

Annex A
(normative)

Acceptable air speed

The temperatures indicated on the abscissa correspond to the speed measurement points defined EN 14813-2.



Key

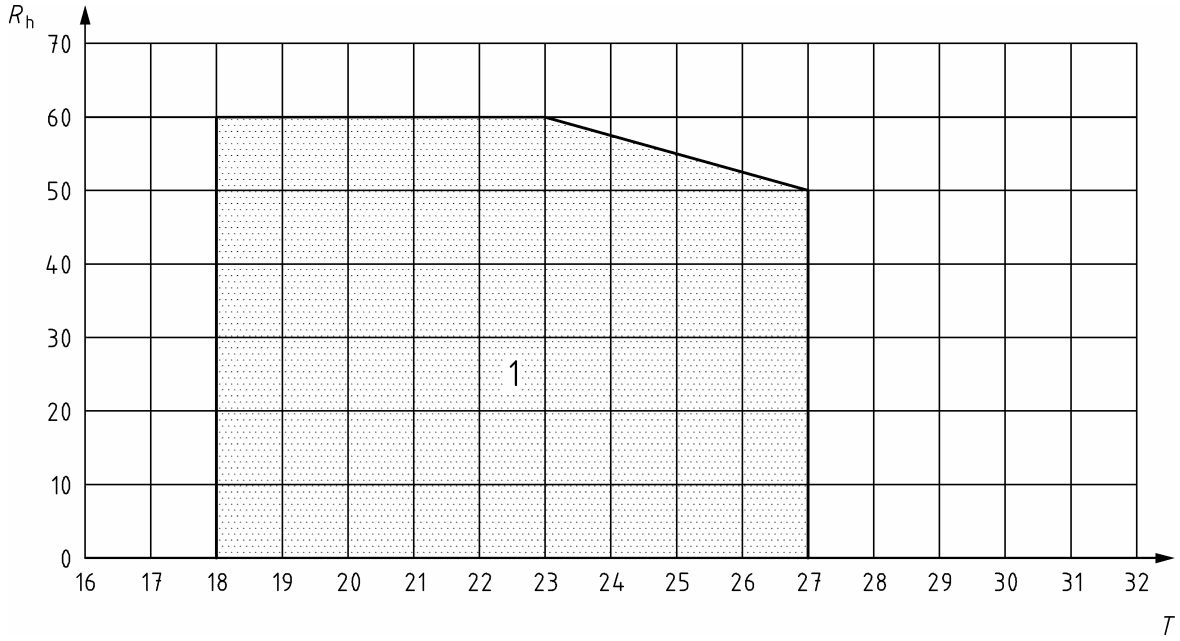
v air speed, in m/s
T temperature at the air speed measurement point, in °C
1 minimum air speed for category A and category B
2 maximum air speed for category A
3 maximum air speed for category B

Figure A.1 — Acceptable air speed

Annex B
(normative)

Relative humidity in the comfort envelope

The acceptable comfort condition for category A is situated in area 1 of the graph in Figure B.1.



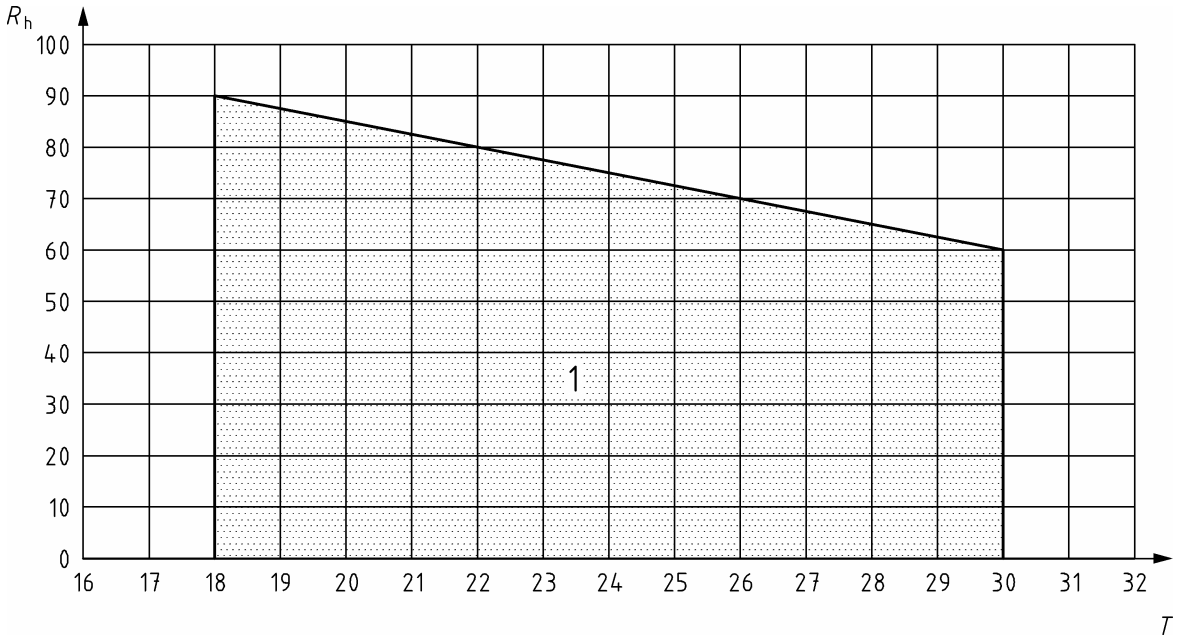
Key

R_h relative humidity, in %

T interior temperature Tim, in °C

Figure B.1 — Category A

The acceptable comfort condition for category B is situated in area 1 of the graph in Figure B.2.



Key

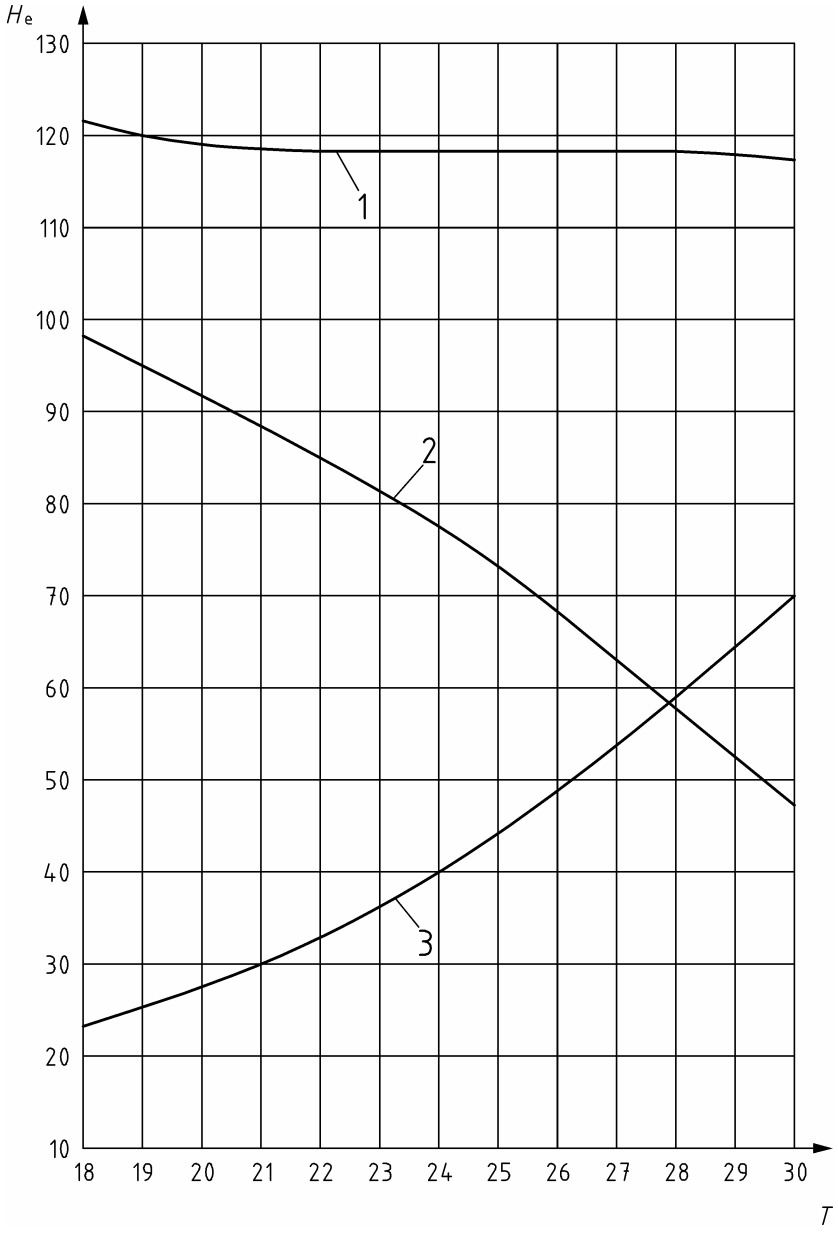
R_h relative humidity, in %

T interior temperature Tim, in °C

Figure B.2 — Category B

Annex C
(normative)

Heat emitted by a seated person normally dressed



Key

H_e heat emission, in W
T interior temperature Tim, in °C
1 total heat, in W
2 sensible heat, in W
3 latent heat, in W

Figure C.1 — Heat emitted by a seated person normally dressed

Annex D
(normative)

Definition of climatic zones

Table D.1 — Definition of climatic zones — Winter

Zone (winter)	Minimum exterior temperatures °C
I	- 10
II	- 20
III	- 40

Table D.2 — Definition of climatic zones — Summer

Zone (summer)	Maximum exterior temperatures °C	Relative humidity %	Equivalent solar load (E_n) W/m^2
I	+ 40	40	800
II	+ 35	50	700
III	+ 28	45	600

Annex E
(informative)

Grouping of countries in climatic zones

Country	Winter	Summer
Austria	Zone II	Zone II
Belgium	Zone II	Zone II
Bulgaria	Zone II	Zone II
Czech Republic	Zone II	Zone II
Croatia	Zone II	Zone II
Denmark	Zone II	Zone II
France	Zone II	Zone II
Finland	Zone III	Zone III
Greece	Zone I	Zone I
Germany	Zone II	Zone II
Hungary	Zone II	Zone II
Ireland	Zone I	Zone III
Italy	Zone II	Zone I
Luxembourg	Zone II	Zone II
Netherlands	Zone II	Zone II
Norway	Zone III	Zone III
Poland	Zone III	Zone II
Portugal	Zone I	Zone I
Romania	Zone II	Zone II
Serbia and Montenegro	Zone II	Zone II
Slovakia	Zone II	Zone II
Slovenia	Zone II	Zone II
Spain	Zone I	Zone I
Sweden	Zone III	Zone III
Switzerland	Zone II	Zone II
United Kingdom	Zone I	Zone III

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 96/48/EC as amended by Directive 2004/50/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the Directive 96/48/EC, as amended by Directive 2004/50 which is based on the principles of the New Approach, on the interoperability of the trans-european high speed rail system.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 96/48/EC

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ERs) of Directive 96/48/EC	Chapters/points of TSI Rolling Stock	Qualifying remarks/Notes
9.6 Air quantities 9.6.1 Outside air or fresh air	Annex III – Essential requirements 2 Requirements specific to each subsystem 2.4 Rolling stock 2.4.3 Technical compatibility	3.3.5 Technical compatibility: Essential requirement 2.4.3 Section 3: The characteristics of the rolling stock must be such as to allow it to travel on any line on which it is expected to operate. This essential requirement is covered by values of the basic parameters ... 4.1.11 Boundary characteristics linked to air conditioning (BP21) Driving cab: The ventilation of the driving cab shall be such as to ensure that carbon monoxide and dioxide levels remain under the level set by European health and safety legislation.	

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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