
Železniške naprave - Klimatske naprave v železniških vozilih za mestni, primestni in regionalni promet - Parametri za določanje udobja in preskusi tipa

Railway applications - Air conditioning for urban, suburban and regional rolling stock : Comfort parameters and type tests

Bahnanwendungen - Luftbehandlung in Schienenfahrzeugen des städtischen-, Vorort- und Regionalverkehrs - Behaglichkeitsparameter und Typprüfungen

Applications ferroviaires - Conditionnement de l'air pour matériel roulant urbain, de banlieue et régional : Paramètres de confort et essais de type

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Bahnanwendungen - Luftbehandlung in
Schienenfahrzeugen des städtischen-, Vorort- und
Regionalverkehrs - Behaglichkeitsparameter und
Typrüfungen

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European foreword

This document (EN 14750:2024) 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of an identical text or by endorsement, at the latest by June 2025, and conflicting national standards shall be withdrawn at the latest by June 2025.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 14750-1:2006 and EN 14750-2:2006.

In comparison with the previous edition, the following technical modifications have been made:

- Creation of 3 vehicle categories (Urban, Suburban and Regional) to define the corresponding performances;
- Definition of normal and extended ranges of exterior temperatures with corresponding performances;
- Usage of an index Comfort Level (CL) to provide a global view of the climatic comfort;
- Improvement of the validation process with new regulation tests. The purpose is to assess the quality of the regulation of the system;
- Introduction of the process of validation of the climatic comfort parameters by simulations.

This document has been prepared under a Standardization Request addressed to CEN by the European Commission.

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Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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

EN 14750:2024 (E)**1 Scope**

This document establishes thermal comfort parameters for areas accessible to passengers and staff on railway vehicles.

This document also specifies conditions, performance values and the comfort parameter validation methods.

This document is applicable to urban (metro, tramway), suburban and/or regional vehicles equipped with cooling and/or heating/ventilation systems. This document does not apply to main line vehicles and driver's cabs which are considered in separate Standards.

2 Normative references

The following documents are referred to in the text in such a way that some or all their content constitutes requirements 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 ISO 7726:2001, *Ergonomics of the thermal environment — Instruments for measuring physical quantities (ISO 7726:1998)*

EN ISO 19659-1:2023, *Railway applications — Heating, ventilation and air conditioning systems for rolling stock — Part 1: Terms and definitions (ISO 19659-1:2017)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 19659-1:2023 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

NOTE Refer to informative Annex R for more information on abbreviations.

**3.1
air conditioning installation**

all equipment of Heating Ventilation Air Conditioning (HVAC) system involved to reach the thermal comfort

Note 1 to entry: Refer to EN ISO 19659-1:2023.

**3.2
interior temperature setpoint**

T_{ic}
target value for interior air temperature

**3.3
normal interior temperature setpoint**

$T_{ic,0}$
target value for interior air temperature according to regulation curve

Note 1 to entry: Refer to 9.2 and normative Annex B.

3.4 interior temperature setpoint offset

$T_{ic,off}$

adjustment of the interior temperature setpoint

Note 1 to entry: Refer to 9.2.

3.5 mean interior temperature

T_{im}

arithmetic mean of the interior temperatures of one comfort zone and measured 1,10 m above the floor as specified in the procedure described in normative Annex K

3.6 mean exterior temperature

T_{em}

arithmetic mean of the exterior temperatures measured according to the procedure described in normative Annex M

3.7 comfort envelope

areas designed for occupation by passengers, excluding local annexes

Note 1 to entry: If a gangway is designed for passengers to dwell inside, it is part of comfort envelope.

3.8 comfort zone

subset of the comfort envelope on one vehicle limited by steps or ramp with a total floor height difference of at least 0,3 m, partition wall, vestibule, interior door or gangway

Note 1 to entry: Tram is considered as one comfort zone.

Note 2 to entry: The comfort zone is divided in subzones to define the position of the measuring points (refer to normative Annex K especially Figure K.1 for the description of the subzones).

3.9 local annex

place where passenger stays briefly or passes through

EXAMPLE 1 toilet compartment (WC)

EXAMPLE 2 baby change area

EXAMPLE 3 aisle

EXAMPLE 4 vestibule

Note 1 to entry: If a gangway is closed by two doors it is not considered as a local annex and no comfort criterion is applied.

Note 2 to entry: For multi-purpose areas, the classification as comfort zone or local annex have to be agreed.

EN 14750:2024 (E)**3.10****heat transfer coefficient** **k**

ratio between the thermal power per unit of surface area and the prevailing difference in temperature (T_{im}) and (T_{em}) across the relevant walls of the vehicles

Note 1 to entry: 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-airtightness of the vehicle in motion (doors, windows, various openings) and is applicable to all or part of the vehicle.

Note 2 to entry: This value is expressed in $W/(m^2 \cdot K)$.

3.11**equivalent solar irradiation**

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

3.12**stand by operation**

mode under which a predetermined interior temperature range is maintained when the vehicle is not in commercial service

3.13**design passenger load**

number of passengers used to size the air conditioning installation

3.14**free cooling**

provision of cooling using potential increase of fresh airflow and without use of refrigerant circuit

3.15**vestibule**

area with at least one exterior door separated from the comfort envelope by steps or ramp with a total floor height difference of at least $0,3 \text{ m}$, interior door(s), full partition wall(s) and without permanent seats

3.16**mean interior CO₂ concentration** **C_{im}**

arithmetic mean of the interior CO₂ concentration measured at the centre of each subzone of each comfort zone and at the height of $1,1 \text{ m}$

Note 1 to entry: Refer to normative Annex K.

3.17**climatic zone**

climatic conditions used to size the HVAC system

Note 1 to entry: Refer to 7.1, 7.2 and 7.3 for the definition of design and the extreme conditions.

3.18 mean interior absolute humidity

x_{im}

arithmetic mean of the absolute humidity calculated with the local relative humidity and corresponding temperature of the comfort zone measured at 1,1 m above the floor as specified in normative Annex K

3.19 mean interior relative humidity

RH_{im}

relative interior humidity calculated with the interior mean temperature (T_{im}) and absolute interior humidity (x_{im}) per comfort zone

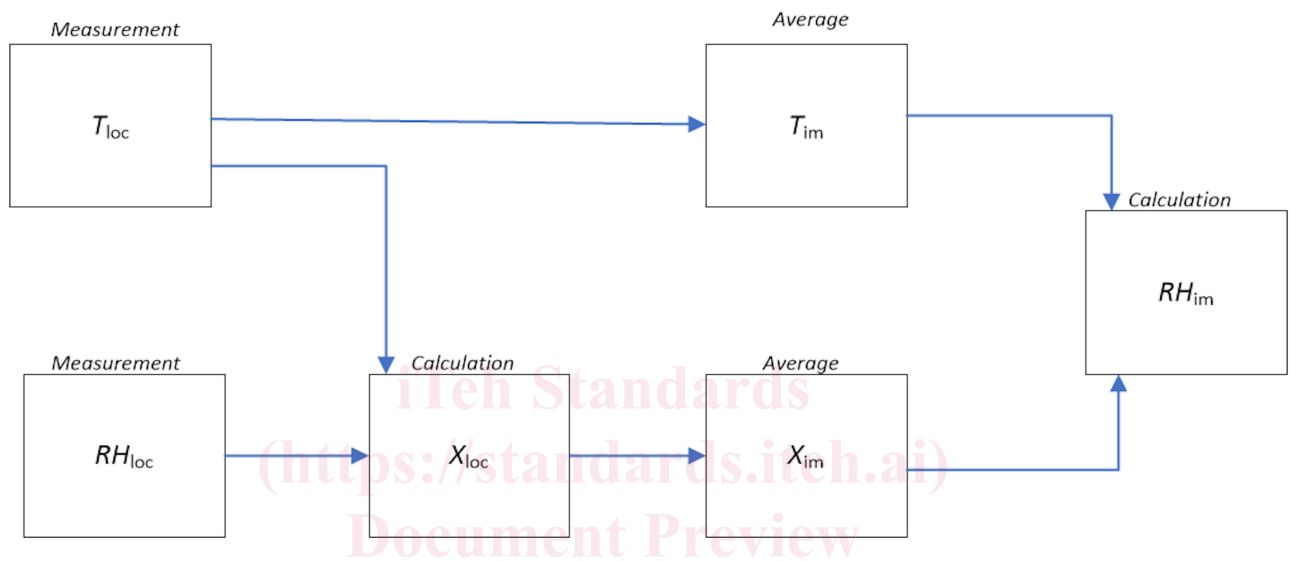


Figure 1 — Process to calculate RH_{im}

Note 1 to entry: The absolute humidity is given by Formula (1):

$$X_{Loc} = \frac{0,622 \times RH_{Loc} \times P_{Sat_Loc}}{100 \times P_{Atm} - RH_{Loc} \times P_{Sat_Loc}} \quad (1)$$

Where

X_{Loc}	Local absolute humidity in kilogram of water per kilogram of dry air [kg of water/kg dry air];
RH_{Loc}	Local relative hygrometry in percentage [% value from 0 to 100];
P_{Sat_Loc}	Local pressure of saturated steam calculated with T_{Loc} in pascals [Pa];
P_{Atm}	Local atmospheric pressure in pascals [Pa];
T_{Loc}	Local temperature in Celsius degrees [°C].

Note 2 to entry: The pressure of saturated steam is given by the Formula (2):

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$$P_{Sat_Loc} = 1000 \times e^{\left(16,6536 - \frac{4030,183}{T_{Loc} + 235}\right)} \quad (2)$$

Where

P_{Sat_Loc} Local pressure of saturated steam in pascals [Pa];

T_{Loc} Local temperature in Celsius degrees [°C].

EXAMPLE 1 At $T_{em} = 35^\circ\text{C}$ 50 % at atmospheric pressure of 101 325 Pa, $P_{Sat} = 5\,623,7$ Pa corresponds to $X = 0,017\,75$ kg of water/kg dry air or 17,75 g of water/kg dry air.

Note 3 to entry: The mean interior temperature is given by the Formula (3):

$$T_{im} = \frac{1}{N} \sum_{i=1}^N T_{Loc_i} \quad (3)$$

Where

T_{im} Mean interior temperature in Celsius degrees [°C];

N Number of local temperature involved in mean interior temperature calculation [number];

T_{Loc_i} Local temperature in Celsius degrees [°C].

Note 4 to entry: The mean interior absolute humidity is given by the Formula (4):

$$X_{im} = \frac{1}{N} \sum_{i=1}^N X_{Loc_i} \quad (4)$$

Where

X_{im} Mean interior absolute humidity in kilogram of water per kilogram of dry air [kg of water/kg dry air];

N Number of local absolute humidity involved in mean interior absolute humidity calculation [number];

X_{Loc_i} Local absolute humidity in kilogram of water per kilogram of dry air [kg of water/kg dry air].

Note 5 to entry: The mean relative hygrometry is given by the Formula (5):

$$RH_{im} = \frac{100 \times X_{im} \times P_{Atm}}{P_{Sat_im} \times (0,622 + X_{im})} \quad (5)$$

Where

RH_{im} Mean relative hygrometry in % [value from 0 to 100];

X_{im} Mean absolute humidity in kilogram per kilogram of dry air [kg of water/kg dry air];

P_{Atm} Local atmospheric pressure in pascals [Pa];

P_{Sat_im} Pressure of saturated steam calculate with the mean interior temperature in pascals [Pa].

EXAMPLE 2 In one comfort zone we have these measurements of temperature and relative humidity on 9 points (refer to Table 1). The atmospheric pressure is 101 325 Pa.

Table 1 — Parameters considered in the example

	Unit	1	2	3	4	5	6	7	8	9
TLoc	°C	25,1	25,2	24,7	24,8	25,5	24,1	24,5	26,1	25,3
RHLoc	%	50,8	55,6	57,3	54,8	56,9	59,2	56,1	48,1	48,9
PSat_Loc	Pa	3186,3	3205,3	3111,1	3129,8	3263,0	3001,3	3074,2	3381,1	3224,5
XLoc	kg of water/kg dry air	0,0101	0,0111	0,0111	0,0107	0,0116	0,0111	0,0108	0,0101	0,0098

Note 6 to entry: The calculated values are indicated in Table 2:

Table 2 — Calculated values in the example

	Unit	Value
T_{im}	°C	25,0
X_{im}	kg of water /kg dry air	0,0107
$P_{Sat_{im}}$	Pa	3173,7
RH_{im}	%	54,1

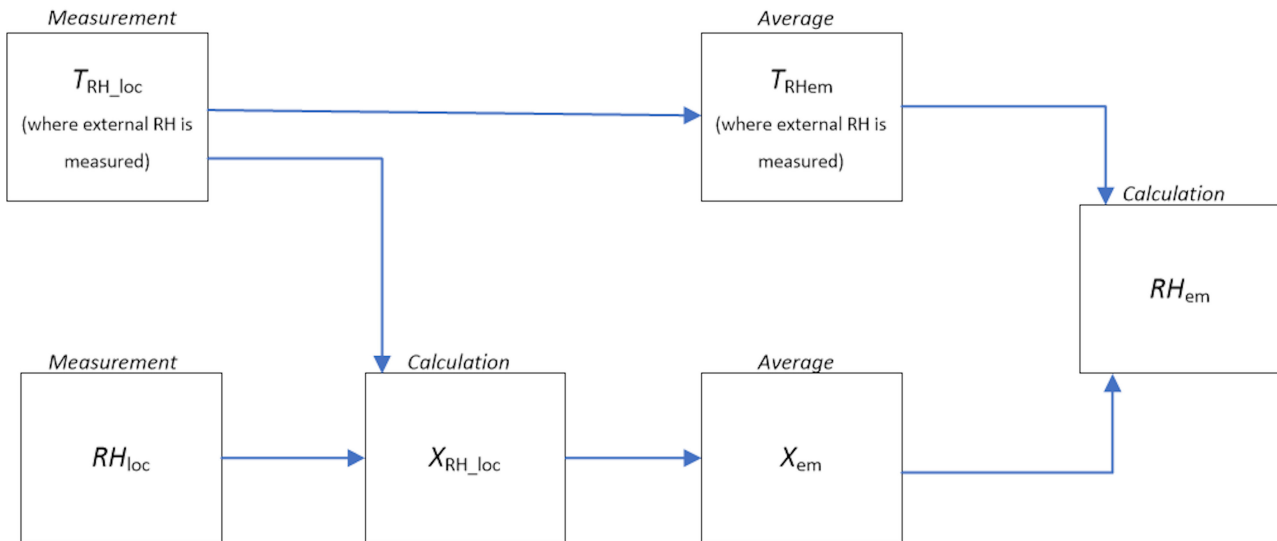
3.20**mean exterior absolute humidity** x_{em}

arithmetic mean of the absolute humidity calculated with the local relative humidity RH_{Loc} and corresponding temperature as specified in normative Annex M

3.21**mean exterior relative humidity** RH_{em}

relative exterior humidity calculated with the exterior mean temperature (T_{em}) and absolute exterior humidity (x_{em})

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Figure 2 — Process to calculate RH_{em}

3.22

subzone

portion of the comfort zone only used for the location of the test sensors

3.23

mean air speed of vehicle surrounding flow

arithmetic mean of the air speed measured at 6 points outside the vehicle at the distance of 0,1 m from the wall of the vehicle

Note 1 to entry: The mean air speed of vehicle surrounding flow is used for measurements at standstill.

Note 2 to entry: See normative Annex M for the position of the 6 measuring points.

3.24

mean air speed of interior flow

arithmetic mean of the air speed measured at 6 points inside the vehicle at the distance of 0,1 m from the wall of the vehicle

Note 1 to entry: See normative Annex M.

3.25

vehicle interior temperature

T_{iv}

arithmetic mean of all interior temperatures of all different comfort zones of the vehicle measured at 1,1 m above the floor as specified in the procedure described in normative Annex K

3.26

vehicle interior absolute humidity

X_{iv}

arithmetic mean of the absolute humidity calculated with the local relative humidity in all different comfort zones of the vehicle and corresponding temperature measured at 1,1 m above the floor as specified in normative Annex K