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**Railway applications — Heating,
ventilation and air conditioning
systems for rolling stock —**

**Part 2:
Thermal comfort**

*Applications ferroviaires — Systèmes de chauffage, ventilation et
climatisation pour le matériel roulant —*

Partie 2: Confort thermique

Reference number
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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Contents

	Page
Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Category of passenger railway vehicles	1
4.1 General	1
4.2 Category 1 (e.g. main line, intercity, long-distance, high speed)	1
4.3 Category 2 (e.g. suburban, commuter, regional)	2
4.4 Category 3 (e.g. urban, LRV, tram, metro/subway)	2
5 Design conditions	2
5.1 General	2
5.2 Exterior design conditions	2
5.2.1 Parameters	2
5.2.2 Temperature and corresponding relative humidity	2
5.2.3 Solar radiation	4
5.2.4 Altitude	4
5.2.5 Train speed	4
5.3 Extreme exterior conditions	5
5.4 Interior design conditions	5
5.4.1 Internal heat gains	5
5.4.2 Temperature and corresponding relative humidity	5
6 Interior temperature setting (T_{ic})	6
7 Thermal comfort parameters	9
7.1 General	9
7.2 Interior air temperature in the comfort zone	10
7.2.1 Mean interior temperature range (difference between T_{im} and T_{ic})	10
7.2.2 Horizontal temperature range (ΔT_h)	10
7.2.3 Vertical temperature range (ΔT_v)	10
7.3 Relative humidity in the comfort zone	10
7.4 Surface temperature on the comfort envelope	11
7.5 Air velocity in the comfort zone	11
7.6 Interior temperature in the local annexes	12
7.7 Air quality	12
7.7.1 Fresh air volume flow rate into the comfort zone	12
7.7.2 Particulate filtration of the air	13
7.7.3 Air transfer between interior zones	13
8 Air movement tests	13
8.1 General	13
8.2 Air volume flow rate	13
8.3 Air velocity	14
8.4 Air transfer between interior zones	14
9 Climatic tests	14
9.1 General	14
9.2 Type of tests	15
9.2.1 General	15
9.2.2 Design conditions test	15
9.2.3 Extreme conditions test	15
9.2.4 Regulation test	15
9.2.5 Door open/close cycling test	16
9.3 Test programme	16

10	Characteristics of the test facility and equipment	18
10.1	General	18
10.2	Exterior temperature	18
10.3	Relative humidity	18
10.4	Occupation	19
10.5	Wind speed (if required)	19
10.6	Equivalent solar load	19
11	Recording and measuring instruments	19
11.1	General	19
11.2	Recording	19
11.3	Temperature	19
11.4	Relative humidity	20
11.5	Air velocity	20
11.6	Air volume flow rate	20
11.7	Wind speed (if required)	20
11.8	Equivalent solar load (if required)	20
11.9	Energy consumption and power rating	20
12	Position of measuring points	20
12.1	General	20
12.2	Position of sensors in the passenger railway vehicle	20
12.2.1	General	20
12.2.2	Interior air temperature	21
12.2.3	Relative humidity	21
12.2.4	Surface temperature	21
12.2.5	Air velocity	21
12.2.6	Interior temperature in the local annex	21
12.3	Position of sensors in the test facility	21
12.3.1	General	21
12.3.2	Exterior air temperature	21
12.3.3	Relative humidity	21
12.3.4	Wind speed (if required)	21
12.3.5	Equivalent solar load (if required)	22
12.4	Position of sensors for testing where no test facility exists	22
12.4.1	General	22
12.4.2	Exterior air temperature	22
12.4.3	Relative humidity	22
12.4.4	Wind speed	22
12.4.5	Solar load (if required)	22
Annex A (informative) Example of exterior design temperature and corresponding relative humidity	23	
Annex B (informative) PMV calculation results per each vehicle category	25	
Annex C (informative) Method to calculate the recommended air velocity range	30	
Bibliography	31	

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 269, *Railway applications*, Subcommittee SC 2, *Rolling Stock*.

A list of all parts in the ISO 19659 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Thermal comfort is the condition that expresses satisfaction with the thermal environment. This is mostly reached if the heat generated by the human metabolism is allowed to dissipate in every part of the human body in order to maintain thermal equilibrium with the surroundings. Since the heat generated by the human metabolism is individual, the satisfaction with the thermal comfort condition is also individual.

The main factors that influence thermal comfort locally at every part of the human body are physical activity, clothing insulation, air temperature, mean radiant temperature, air velocity and relative humidity. A satisfying thermal equilibrium can be reached in various combinations of the mentioned factors. Therefore, it is not possible to specify an independent optimum of a single factor, like air temperature, mean radiant temperature, air velocity or relative humidity.

ISO 7730 presents methods for predicting the general thermal sensation and degree of thermal satisfaction of people exposed to moderate thermal environments in buildings.

The thermal comfort sensation in railway vehicles is in addition strongly affected by temporary factors.

Passengers enter the vehicle coming from an environment with a different thermal condition and with an individual physical activity level. Thermal comfort sensation is then temporary depending on the thermal equilibrium and comfort sensation generated in the environment where they are coming from. In hot weather conditions, passengers who travel just for some minutes in an urban train typically prefer lower temperatures and higher air velocities than passengers who travel for some hours in a long-distance train. Further, whether passengers adapt their clothing during their stay in the vehicle is of additional influence.

The thermal comfort which can be offered is also affected by temporary factors. The interaction of the vehicle with the environment influences the thermal condition in the occupied areas in a dynamic way. Door openings in train stations, rapidly changing outside weather conditions, rapidly changing degree of occupation cannot be balanced promptly by the installed HVAC system.

The mentioned combinations of air temperature, mean radiant temperature, air velocity and relative humidity are furthermore limited by the high grade of occupation, high air volume exchange rate, short distance between passenger and surrounding surfaces and other technical constraints of a railway vehicle.

This document takes into account these special conditions in railway vehicles. It deals with the influence of the exterior climatic condition on the dimensioning of the HVAC system, the air quality, and the measurement methods in order to achieve adequate thermal comfort. This document also considers specific areas in railway vehicles, such as sanitary rooms, entrance areas and galleries.

This document describes the parameters and requirements in general which should be taken into account when designing and testing an HVAC system for railway vehicles. This document also describes guidelines to specify conditions, performance values and the comfort parameter measurement methods, but does not specify detailed pass and fail criteria for comfort requirements or any other technical property of the railway vehicles.

These specifications are designed to be considered together with the national/regional standards, which take into account different preferences, local weather and operational conditions.

Railway applications — Heating, ventilation and air conditioning systems for rolling stock —

Part 2: Thermal comfort

1 Scope

This document specifies a general approach for achieving thermal comfort for passenger compartments or saloons of railway vehicles (single level or double-decker) such as main line, regional/suburban and urban vehicles used in public transportation services.

This document also describes guidelines to specify conditions, performance values and the comfort parameter measurement methods for compartments, saloons and local annexes.

This document does not apply to the thermal comfort of the cab driver.

2 Normative references

The following documents are referred to in the text in such a way that some or all of 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.

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

3 Terms and definitions

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

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

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

4 Category of passenger railway vehicles

4.1 General

For the needs of this document, passenger railway vehicles are categorized into three types that consider average passenger travel time and average time between station stops next to each other. The following subclauses, [4.2](#), [4.3](#) and [4.4](#), are helpful for choosing the category.

NOTE The ability to achieve thermal comfort is influenced by the type of train. It is not practicable to take a level of thermal comfort of one vehicle category and apply it to a different vehicle category. For example, it is generally not feasible to provide the higher level of thermal comfort of a main line train in an urban train.

4.2 Category 1 (e.g. main line, intercity, long-distance, high speed)

Passenger railway vehicles are typically used in long-distance transit services between major cities and/or regions of a country and sometimes across several countries. They have toilets and often have