

Railway applications — Air conditioning for main line rolling stock —

Part 2: Type tests

The European Standard EN 13129-2:2004 has the status of a
British Standard

ICS 45.060.20

Confirmed September 2011

National foreword

This British Standard is the official English language version of EN 13129-2:2004.

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 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.

Additional information

The UK as a member of CEN is obliged to publish EN 13129-2:2004 as a British Standard. However, attention is drawn to the fact that during the development of this European Standard, the UK voted against its approval as a European Standard at the adoption stage.

The reason for this disapproval is that during discussion of this standard by BSI Technical Committee RAE/1, which mirrors the work of CEN Committee TC 256 and Panel RAE/1/-/6, the UK committee and panel expressed the opinion that because several details relevant to the flow of equivalent solar energy are missing or not clearly identified, special attention should be given to the application of Figure B.1 to ensure that the correct equivalent solar energy value is used in air conditioning for main line rolling stock type tests.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 36, an inside back cover and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 7 December 2004

© BSI 7 December 2004

ISBN 0 580 45007 4

English version

Railway applications - Air conditioning for main line rolling stock - Part 2 : Type tests

Applications ferroviaires - Conditionnement de l'air pour
matériel roulant grandes lignes - Partie 2 : Essais de type

Bahnanwendungen - Luftbehandlung in
Schienenfahrzeugen des Fernverkehrs - Teil 2 :
Typprüfungen

This European Standard was approved by CEN on 16 January 2004.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN 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 CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Contents

Foreword.....	4
Introduction	5
1 Scope	6
2 Normative references	6
3 Terms and definitions	6
4 Preliminary verifications	6
5 Air movement tests.....	6
5.1 Static air movement tests	6
5.1.1 Test conditions	6
5.1.2 Air flow rates	7
5.1.3 Pressure differentials (Visualisation)	7
5.2 Dynamic air movement tests	7
5.3 Comfort tests.....	7
5.3.1 Critical air speed	7
5.3.2 Measurement of air speeds	7
6 Climatic tests.....	8
6.1 General remarks.....	8
6.2 Preheating test.....	8
6.3 Precooling test.....	8
6.4 Regulation tests	8
6.4.1 Procedure	8
6.4.2 Tests in heating mode	8
6.4.3 Tests in cooling mode	9
6.4.4 Tests with variable mean exterior temperature (Tem)	9
7 Tests at extreme exterior operating conditions	10
8 Complementary tests	10
8.1 Verification of the anti-freeze protection.....	10
8.1.1 General remarks.....	10
8.1.2 Aim of the tests	10
8.1.3 Test procedure	10
8.2 Determination of the coefficient k	10
8.2.1 Purpose of the test	10
8.2.2 Definition	10
8.2.3 Procedure	11
8.3 Thermography.....	11
8.4 Noise and vibration.....	11
9 Methods of measurement – Measuring instruments	11
9.1 General remarks.....	11
9.2 Temperatures	11
9.2.1 Air temperature	11
9.2.2 Surface temperatures	12
9.3 Relative humidity	12
9.4 Air speed.....	12
9.5 Airflow rate	12
9.6 Simulated speed of the vehicle	12
9.7 Equivalent solar energy	12
9.8 Energy consumption and power rating	12
10 Characteristics of the test equipment	12
10.1 General remarks.....	12

10.2	Occupation	12
10.3	Temperature of the climatic chamber (Tem) and uniformity of the temperature of the wind tunnel	13
10.4	Relative humidity	13
10.5	Simulation of speed (wind).....	13
10.6	Equivalent solar energy	13
11	Distribution of measuring points	13
11.1	Distribution of sensors in the vehicle	13
11.1.1	Comfort envelope temperature measurement points.....	13
11.1.2	Surface temperature measurement points	13
11.1.3	Supply air outlet temperature measurement points	14
11.1.4	Comfort envelope air speed measurement points	14
11.1.5	Comfort envelope relative humidity measurement points	14
11.2	Climatic chamber sensor distribution	14
Annex A (normative)	Tests for verification of comfort parameters	15
Annex B (normative)	Equivalent solar energy – (Simulation of solar exposure).....	27
Annex C (normative)	Location of the measuring points used for the determination of the mean interior temperature in the comfort envelope (Tim) and the measurement point location in the local annexes	28
Annex D (normative)	Location of the measuring points used for the determination of the range of internal temperature extremes and relative humidity across the comfort envelope	30
Annex E (normative)	Location of the measuring points used for the determination of the variation of internal temperatures within the comfort envelope	32
Annex F (normative)	Location of the measuring points used for the determination of surface temperatures	34
Annex G (normative)	Location of the measuring points used for the determination of air speeds in the comfort envelope.....	35
Annex H (normative)	Location of the sensors in the climatic chamber	36

Foreword

This document EN 13129-2:2004 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 January 2005, and conflicting national standards shall be withdrawn at the latest by January 2005.

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 the following EU Directives:

- Council Directive 96/48/EEC of 23 July 1996 on the interoperability of the trans-European high-speed rail system¹⁾
- Council Directive 93/38/EEC of 14 June 1993 coordinating the procurement procedures of entities operating in the water, energy, transport and telecommunications sectors²⁾

This entire document is applicable, so that no correspondence table is necessary.

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, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

These series of European Standard "Railway application – Air conditioning" includes the following parts:

- 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
- prEN 14750-1 Railway applications – Air conditioning for urban and suburban rolling stock – Part 1: Comfort parameters
- prEN 14750-2 Railway applications – Air conditioning for urban and suburban rolling stock – Part 2: Type tests
- prEN 14813-1 Railway applications – Air conditioning for driving cabs – Part 1: Comfort parameters
- prEN 14813-2 Railway applications – Air conditioning for driving cabs – Part 2: Type tests

¹⁾ Official Journal of the European Communities No L 235 of 17.9.96

²⁾ Official Journal of the European Communities No L 199 of 9.8.93

Introduction

The object of this document is to establish the programme and test methods to verify the air conditioning installations as described in EN 13129-1.

1 Scope

This document is applicable to main line railway vehicles that carry passengers, but excludes suburban, metro, tramway vehicles and driving cabs.

This document specifies the comfort parameter measurement methods for compartments or saloons (double-decker or not).

The comfort parameters and their tolerances referred to in this document are defined in EN 13129-1.

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 13129-1:2002, *Railway applications - Air conditioning for main line rolling stock – Part 1: Comfort parameters*.

EN ISO 7726:2001, *Ergonomics of the thermal environment - Instruments for measuring physical quantities (ISO 7726:1998)*.

CIE 85, *Solar spectral irradiance*³⁾.

UIC 563:1990-01, *Fittings provided in coaches in the interests of hygiene and cleanliness*.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13129-1:2002 apply.

4 Preliminary verifications

It is advised that preliminary tests are carried out to verify the electrical and electronic assemblies, the functional logic of the control system, the air tightness of the air distribution system and the thermal capacity of the air conditioning equipment.

5 Air movement tests

5.1 Static air movement tests

5.1.1 Test conditions

The tests shall be carried out under the following conditions:

- vehicle stationary and protected from bad weather,
- altitude < 1 000 m above sea level,

3) To be purchased from: International Commission of Illumination, CIE Central Bureau, Kegelgasse 27, A-1030 Wien

- exterior air speed between 0 m/s and 4 m/s,
- exterior temperature between + 15 °C and + 30 °C.

5.1.2 Air flow rates

The flow rates below shall be measured in accordance with 9.4:

- outside air (or fresh air),
- exhaust air (if appropriate),
- recirculated air and/or conditioned air and/or mixed air.

5.1.3 Pressure differentials (Visualisation)

If appropriate, this can be shown up by the movement of smoke between the two relative areas.

In particular, this visualisation should be made for the catering service areas, the composite vehicles smoking/non-smoking, toilet/washrooms and the driving cab in order to verify that the air conditioning installation is well designed to avoid the propagation of odours.

5.2 Dynamic air movement tests

If appropriate, measurements of air speed and/or pressure shall be done during dynamic tests. These measurements shall be applied to the following air flows:

- fresh,
- exhaust,
- condenser.

These results shall be compared with measurements taken whilst using the same equipment on a stationary vehicle.

5.3 Comfort tests

5.3.1 Critical air speed

The purpose of these measurements is to find, as a minimum, the three seated positions which are the most unfavourable in the comfort envelope (see Annex G).

5.3.2 Measurement of air speeds

These measurements shall be carried out without the simulation of the thermal and volumetric effects of occupation (the heating elements, humidification equipment or dummies can affect the measurements inside the passenger space).

It is recommended, for information purpose only, to carry out further measurement:

- with a volumetric occupation of a compartment or a bay simulated with dummies,
- to continuously record the passenger space air speeds in accordance with 10.2 with the thermal output of occupation being simulated throughout the regulation tests.

6 Climatic tests

6.1 General remarks

Annex A defines a minimum schedule of tests which enables the verification of comfort parameters defined in EN 13129-1.

The order of the tests is not obligatory but shall be compatible with the physical characteristics of the climatic chamber and the means of measurement.

Throughout the tests, all the values at the measuring points defined in Clause 11 shall be recorded continuously, as well as the energy consumption and the power absorbed by the air conditioning installation itself, and the whole of the vehicle.

Should other equipment such as, for example, doors, toilet equipment, power supply, lighting, special equipment, etc, need to be tested, these tests should not interfere in any way with the tests on the air conditioning systems.

6.2 Preheating test

The test conditions for preheating are defined in Annex A.

Before the start of the pre-heating test, the interior temperatures of the air and the interior surfaces shall be the same as the exterior temperature and stabilised at ± 1 K for at least 1 h.

6.3 Precooling test

The test conditions for precooling are defined in Annex A.

Before the start of the precooling tests, the interior temperatures of the air and the interior surfaces shall be the same as the exterior temperature and stabilised at ± 1 K for at least 1 h. At this time, before starting the precooling test, the artificial sunlight equipment shall be switched on for 2 h, corresponding to the values given in Annex E of EN 13129-1:2002 with doors and windows closed.

6.4 Regulation tests

6.4.1 Procedure

Starting from stabilised operation (see 3.36 of EN 13129-1:2002),

- 1) one changes a parameter (interior or exterior)
- 2) after 90 minutes or three similar consecutive control cycles the results obtained shall be in accordance with the comfort conditions defined in EN 13129-1.

6.4.2 Tests in heating mode

6.4.2.1 The tests shall be carried out at the temperatures given in Table 1:

Table 1 — Mean exterior temperatures (T_{em}) for tests in heating mode

Zone I	Zone II	Zone III
Temperature	Temperature	Temperature
- 10 °C 0 °C + 10 °C	- 20 °C - 10 °C 0 °C + 10 °C	- 40 °C - 10 °C 0 °C + 10 °C

6.4.2.2 The requirements specified in Clause 7 of EN 13129-1:2002 shall be verified by changing the position of the temperature setting device from the normal setting to the maximum and minimum position.

6.4.2.3 In order to be able to check the behaviour of the regulation system and see how the temperatures in the particular compartments vary, it is recommended to set 20 % to 30 % of the compartments at maximum and the remainder to minimum. The same check shall be made with 70 % to 80 % of the temperature setting devices at maximum position and the remainder at minimum.

6.4.2.4 To check the effect of occupation, total or partial, on the regulation system, tests with a simulated occupation shall be carried out in accordance with 10.2.

6.4.2.5 The tests carried out in the presence of wind are intended to check the behaviour of the air conditioning installation and the tightness of the vehicle body, as well as the behaviour of the air extraction outlets.

6.4.3 Tests in cooling mode

6.4.3.1 The tests shall be carried out at the external climatic conditions given in Table 2:

Table 2 — External climatic conditions for tests in cooling mode

Zone I			Zone II			Zone III		
Dry bulb temperature	Relative humidity	Equivalent solar radiation	Dry bulb temperature	Relative humidity	Equivalent solar radiation	Dry bulb temperature	Relative humidity	Equivalent solar radiation
°C	% RH	W/m ²	°C	% RH	W/m ²	°C	% RH	W/m ²
40	40	800	35	50	700	28	45	600
28	70	600	28	70	600	22	80	500
22	80	500	22	80	500			

6.4.3.2 The requirements specified in Clause 7 of EN 13129-1:2002 shall be verified by changing the position of the temperature setting device from the normal position to the maximum and minimum position.

6.4.3.3 In order to be able to check the behaviour of the regulation and see how the temperatures in the particular compartments vary, it is recommended to set 20 % to 30 % of the compartments at the maximum and the remainder at the minimum. The same check shall be made with 70 % to 80 % of the temperature setting devices at the maximum position and the remainder at minimum.

6.4.3.4 To check the effect of occupation, total or partial, on the regulation system, tests with a simulated occupation shall be carried out in accordance with 10.2.

6.4.3.5 The tests carried out in the presence of wind are intended to check the behaviour of the air conditioning installation and the tightness of the vehicle body, as well as the behaviour of the exhaust air outlets.

6.4.3.6 In order to verify the effect of the solar gain on the control system, the first test shall be carried out with a solar exposure of at least 4 h; the balance of tests will then follow the procedure of 6.4.1.

6.4.4 Tests with variable mean exterior temperature (Tem)

The regulation tests carried out with a mean exterior temperature (Tem) that decreases or increases by 3 K/h are intended to check the behaviour of the air conditioning installation and its control system during the change over from the cooling mode to the heating mode and vice versa; with and without supplementary disturbance caused by occupation and solar radiation of the vehicle.

The tests are also intended to record the start conditions of the modes of heating and/or ventilation and/or cooling. To carry this out, the corresponding mean exterior temperature (T_{em}) shall be stabilised for 30 min.

7 Tests at extreme exterior operating conditions

It will be necessary to check the operation of the air conditioning equipment at the extreme operating temperatures specified for the zones defined in 5.2 of EN 13129-1:2002.

8 Complementary tests

8.1 Verification of the anti-freeze protection

8.1.1 General remarks

Not specific to the air condition comfort test, but is complementary to it, the verification of anti-freeze protection shall be carried out if there is a functional connection between the air conditioning system and the water installation.

8.1.2 Aim of the tests

The object of the tests is to verify that the on board equipment does not suffer from damage caused by freezing in accordance with 1.4 of the document UIC 563:1990.

8.1.3 Test procedure

- The water tanks are filled at least five hours before the start of the tests with water at a temperature below 15 °C: for each type of tank, one tank is 1/4 full, the other tanks are filled to 3/4 full.
- The control functions of the installation are performed in accordance with the test operation instruction.

Before the start of the tests in line with the document UIC 563, there is a need to stabilise for 5 h, the mean exterior and interior temperatures of the areas reserved for passengers.

- Minimum duration of cooling of the vehicle: see UIC 563.
- The control functions of the installation are performed in accordance with the operation instruction.

The temperature of the tanks, exhaust valves, pipes and other items exposed to a risk of freezing shall be recorded. The test shall be discontinued if there is a risk of icing-up.

8.2 Determination of the coefficient k

8.2.1 Purpose of the test

The coefficient k characterises the thermal quality of a vehicle (efficiency of the insulation and influence of air infiltration).

8.2.2 Definition

The global coefficient k is defined by the following formula:

$$k = \frac{P}{A_e \times (T_{im} - T_{em})}$$

- The surface A_e is the developed exterior surface of the assembly including walls, ceiling, floor and ends of the structure for all or part of the vehicle under consideration. This shall include windows, doors and openings.