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**Železniške naprave – Klimatske naprave v železniških vozilih za daljinski promet –  
2. del: Preskusi**

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

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

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

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**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.

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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.

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COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

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## 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of an identical text or by endorsement, at the latest by January 2005, and conflicting national standards shall be withdrawn at the latest by January 2005.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 system<sup>1)</sup>
- Council Directive 93/38/EEC of 14 June 1993 coordinating the procurement procedures of entities operating in the water, energy, transport and telecommunications sectors<sup>2)</sup>

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

<sup>1)</sup> Official Journal of the European Communities No L 235 of 17.9.96

<sup>2)</sup> 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.

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## EN 13129-2:2004 (E)

## 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*<sup>3)</sup>.

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

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## 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,

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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.

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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.

## EN 13129-2:2004 (E)

## 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  $\pm 1$  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  $\pm 1$  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<br>0 °C<br>+ 10 °C | - 20 °C<br>- 10 °C<br>0 °C<br>+ 10 °C | - 40 °C<br>- 10 °C<br>0 °C<br>+ 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 <sup>2</sup>           | °C                   | % RH              | W/m <sup>2</sup>           | °C                   | % RH              | W/m <sup>2</sup>           |
| 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.

**EN 13129-2:2004 (E)**

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.