



SWEDISH  
STANDARDS  
INSTITUTE

**SVENSK STANDARD**  
**SS-EN 14750-2:2006**

Fastställd 2006-06-09

Utgåva 1

**Järnvägar – Luftkonditionering för rullande  
materiel för lokaltrafik –  
Del 2: Typprovning**

**Railway applications – Air conditioning for  
urban and suburban rolling stock –  
Part 2: Type tests**

ICS 45.060.01

Språk: engelska

Publicerad: juni 2006

Europastandarden EN 14750-2:2006 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 14750-2:2006.

The European Standard EN 14750-2:2006 has the status of a Swedish Standard. This document contains the official English version of EN 14750-2:2006.

---

Uppllysningar om **sakinnehållet** i standarden lämnas av SIS, Swedish Standards Institute, telefon 08 - 555 520 00.

Standarder kan beställas hos SIS Förlag AB som även lämnar **allmänna uppllysningar** om svensk och utländsk standard.

*Postadress:* SIS Förlag AB, 118 80 STOCKHOLM  
*Telefon:* 08 - 555 523 10. *Telefax:* 08 - 555 523 11  
*E-post:* [sis.sales@sis.se](mailto:sis.sales@sis.se). *Internet:* [www.sis.se](http://www.sis.se)

EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 14750-2**

June 2006

ICS 45.060.01

English Version

## Railway applications - Air conditioning for urban and suburban rolling stock - Part 2: Type tests

Applications ferroviaires - Conditionnement de l'air pour matériel roulant urbain et banlieue - Partie 2: Essais de type

Bahnanwendungen - Luftbehandlung in Schienenfahrzeugen des innerstädtischen und regionalen Nahverkehrs - Teil 2: Typprüfungen

This European Standard was approved by CEN on 27 April 2006.

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, Romania, 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**

<b>Contents</b>	<b>Page</b>
Foreword.....	4
Introduction .....	5
1 Scope .....	6
2 Normative references .....	6
3 Terms and definitions .....	6
4 Test classification.....	6
5 Preliminary verifications .....	7
6 Comfort tests.....	7
6.1 Air movement.....	7
6.1.1 General remarks.....	7
6.1.2 Air flow rates .....	7
6.1.3 Pressure differentials (visualisation).....	7
6.2 Critical air speed.....	7
6.3 Measurement of air speeds .....	7
7 Climatic tests.....	8
7.1 General remarks.....	8
7.2 Preheating test.....	8
7.2.1 Test level TL1 .....	8
7.2.2 Test level TL2 .....	8
7.3 Pre-cooling test.....	8
7.3.1 Test level TL1 .....	8
7.3.2 Test level TL2 .....	8
7.4 Regulation tests.....	9
7.5 Tests with door open/closed .....	9
8 Tests at extreme exterior operating conditions .....	9
9 Complementary tests .....	9
9.1 Determination of the coefficient <i>k</i> .....	9
9.1.1 Purpose of the test .....	9
9.1.2 Definition .....	9
9.1.3 Procedure .....	10
9.2 Thermography.....	10
9.3 Noise emission.....	10
9.4 Vibration generation.....	10
10 Methods of measurement – Measuring instruments .....	10
10.1 General remarks.....	10
10.2 Temperatures .....	11
10.2.1 Air temperature .....	11
10.2.2 Surface temperatures.....	11
10.3 Relative humidity .....	11
10.4 Air speed.....	11
10.5 Airflow rate .....	11
10.6 Simulated speed of the vehicle .....	11
10.7 Equivalent solar load.....	11
10.8 Energy consumption and power rating.....	11
11 Characteristics of the test equipment .....	11
11.1 General remarks.....	11

<b>11.2</b>	<b>Occupation</b> .....	<b>12</b>
<b>11.3</b>	<b>Equivalent solar load</b> .....	<b>12</b>
<b>11.3.1</b>	<b>Solar load calculation</b> .....	<b>12</b>
<b>11.3.2</b>	<b>Window area</b> .....	<b>12</b>
<b>11.3.3</b>	<b>Wall area</b> .....	<b>13</b>
<b>11.3.4</b>	<b>Roof area</b> .....	<b>13</b>
<b>12</b>	<b>Distribution of measuring points</b> .....	<b>13</b>
<b>12.1</b>	<b>General</b> .....	<b>13</b>
<b>12.2</b>	<b>Distribution of sensors in the vehicle</b> .....	<b>14</b>
<b>12.2.1</b>	<b>Comfort envelope temperature measurement points</b> .....	<b>14</b>
<b>12.2.2</b>	<b>Surface temperature measurement points</b> .....	<b>14</b>
<b>12.2.3</b>	<b>Supply air outlet temperature measurement points</b> .....	<b>14</b>
<b>12.2.4</b>	<b>Comfort envelope air speed measurement points</b> .....	<b>14</b>
<b>12.2.5</b>	<b>Comfort envelope relative humidity measurement points</b> .....	<b>14</b>
<b>12.3</b>	<b>Climatic chamber sensor distribution</b> .....	<b>14</b>
<b>Annex A</b>	<b>(normative) Test programme for TL1</b> .....	<b>15</b>
<b>Annex B</b>	<b>(normative) Test programme for TL2</b> .....	<b>17</b>
<b>Annex C</b>	<b>(normative) Equivalent solar load</b> .....	<b>22</b>
<b>Annex D</b>	<b>(normative) Location of the measuring points used for the determination of the mean interior temperature (T<sub>im</sub>), the determination of the range of extreme interior temperatures and the relative humidity in the comfort envelopes and local annexes</b> .....	<b>23</b>
<b>D.1</b>	<b>Vehicles without articulation</b> .....	<b>23</b>
<b>D.2</b>	<b>Vehicles with articulation</b> .....	<b>24</b>
<b>Annex E</b>	<b>(normative) Location of the measuring points used for the determination of surface temperatures</b> .....	<b>25</b>
<b>Annex F</b>	<b>(normative) Location of sensors</b> .....	<b>26</b>

## EN 14750-2:2006 (E)

### Foreword

This document (EN 14750-2:2006) 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 December 2006, and conflicting national standards shall be withdrawn at the latest by December 2006.

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 Directive 2004/17/EC of the European Parliament and of the Council of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services<sup>1)</sup>.

This series of European Standards includes the following parts:

- 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*.

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 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*.

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 134 of 30.4.2004.

## **Introduction**

The object of this European Standard is to establish programmes and test methods to verify the air conditioning installations as described in EN 14750-1.

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.

## EN 14750-2:2006 (E)

### 1 Scope

This European Standard is applicable to suburban and/or regional vehicles and also metro and tramway vehicles equipped with cooling and/or heating/ventilation systems. This European Standard excludes main line vehicles and driving cabs which are considered in separate European Standards.

This European Standard specifies the comfort parameter measurement methods for compartment or saloon (single level or double-decker).

The comfort parameters and their tolerances cited in this European Standard are defined in EN 14750-1.

### 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 14750-1:2006, *Railway applications — Air conditioning for urban and suburban rolling stock — Part 1: Comfort parameters*

EN ISO 3381, *Railway applications — Acoustics — Measurement of noise inside railbound vehicles (ISO 3381:2005)*

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

CIE 85, *Solar spectral irradiance*<sup>2)</sup>

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14750-1:2006 apply.

### 4 Test classification

Two levels of testing are detailed in this European Standard.

TL1 is a simplified level that gives principle information about the functionality of the system. It does not aim to verify the comfort parameters and performance of the system. It can be done in a workshop or at a yard.

TL2 is a full level test to verify the comfort parameters and the performance of the system. This test shall be performed in a climatic chamber or in appropriate environment.

The test classification shall be detailed in the contractual specification.

In the absence of any specified contractual detail, the full level of testing (TL2) shall apply. If not stated otherwise, the following requirements apply to both TL1 and TL2.

---

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



## 5 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, the water tightness of the vehicle and the thermal capacity of the air conditioning equipment. These verifications should be conducted before proceeding to the comfort test.

## 6 Comfort tests

### 6.1 Air movement

#### 6.1.1 General remarks

The tests shall be carried out under the following conditions:

- vehicle stationary and protected from bad weather;
- altitude < 1 000 m above sea level;
- exterior air speed between 0 km/h and 5 km/h;
- exterior temperature between + 15 °C and + 30 °C.

Where altitudes and exterior temperatures different to those stated above are used, corrections in relation to normal atmospheric conditions shall be made.

#### 6.1.2 Air flow rates

The flow rates of outside air (fresh air) shall be measured in accordance with 10.5.

#### 6.1.3 Pressure differentials (visualisation)

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

In particular, this visualisation shall be made for 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.

### 6.2 Critical air speed

Air velocities shall be measured at a height of 1,10 m above the floor at all seat positions and at 1,70 m above the floor at the positions as defined in Annex D. The purpose of these measurements is to find the location with the highest air velocity in the comfort envelope. When the distribution or air flows are different in heating, cooling or ventilation mode, the location with the highest air velocity shall be found in each mode. These critical high air velocity locations shall be used for the detailed measurement of the air velocities and air temperature for validating the acceptable air velocity requirements in the comfort envelope.

### 6.3 Measurement of air speeds

These tests shall be carried out during the climatic tests without the simulation of the thermal and volumetric effects of occupation (the heating elements, humidification, and ventilation equipment necessary or passenger dummies can affect the measurement inside the comfort envelope).

## EN 14750-2:2006 (E)

### 7 Climatic tests

#### 7.1 General remarks

Annex A defines the test programme for test level TL1. The tests shall only be carried out on a stationary vehicle at an air speed as defined in Annex A.

Annex B defines the test programme for test level TL2 which enables the verification of comfort parameters defined in EN 14750-1. The order of the tests is not obligatory but shall be compatible with the physical conditions of the test and the means of measurement.

Throughout the tests, all the values at the measuring points defined in Clause 12 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 the doors, the toilet equipment, the power supply, the lighting etc. need to be tested, these tests shall not interfere in any way with the tests on the air conditioning systems.

#### 7.2 Preheating test

##### 7.2.1 Test level TL1

The test conditions for preheating are defined in Annex A.

The vehicle shall be placed in the test area at least 8 h prior to testing, with the heating installation switched off.

Before the start of the preheating test, the interior air and surface temperatures shall be stabilised for at least 15 min within  $\pm 2$  K of the exterior air temperature.

##### 7.2.2 Test level TL2

The test conditions for preheating are defined in Annex B.

Before the start of the preheating test, the interior air and surface temperatures shall be stabilised for at least 1 h within  $\pm 1$  K of the exterior air temperature.

#### 7.3 Pre-cooling test

##### 7.3.1 Test level TL1

The test conditions for pre-cooling are defined in Annex A.

The vehicle shall be placed in the test area at least 8 h prior to testing, with the air conditioning installations switched off.

Before the start of the pre-cooling test, the interior air and surface temperatures shall be stabilised for at least 15 min within  $\pm 2$  K of the exterior air temperature. At this time, before starting the pre-cooling test, the artificial sunlight equipment or equivalent heating power shall be switched on for 2 h, corresponding to the values given in Annex E of EN 14750-1:2006 with all doors and windows closed.

##### 7.3.2 Test level TL2

The test conditions for pre-cooling are defined in Annex B.

Before the start of the pre-cooling test, the interior air and surface temperatures shall be stabilised for at least 1 h within  $\pm 1$  K of the exterior air temperature. At this time, before starting the pre-cooling test, the artificial sunlight equipment or equivalent heating power shall be switched on for 2 h, corresponding to the values given in Annex E of EN 14750-1:2006 with all doors and windows closed.

#### 7.4 Regulation tests

The test conditions are defined in Annex A and Annex B.

Starting from stabilised operation (see 3.35 of EN 14750-1:2006), after a changing of a parameter (interior or exterior), wait 60 min or three similar consecutive control cycles, then the results obtained shall be in accordance with the requirements defined in EN 14750-1.

#### 7.5 Tests with door open/closed

The test conditions are defined in Annex A and Annex B.

Starting from stabilised operation (see 3.35 of EN 14750-1:2006), tests shall be performed according to 10.2 of EN 14750-1:2006.

### 8 Tests at extreme exterior operating conditions

The operation of the air conditioning equipment shall be checked at the extreme operating temperatures defined in 6.2 of EN 14750-1:2006.

At test level TL1, the tests could be carried out on the air conditioning equipment, prior to its installation onto the vehicle.

### 9 Complementary tests

#### 9.1 Determination of the coefficient $k$

##### 9.1.1 Purpose of the test

The coefficient  $k$  characterises the thermal quality of a vehicle (efficiency of the insulation). The test shall be carried out only at TL2. The test conditions are defined in Annex B.

##### 9.1.2 Definition

The global coefficient  $k$  is defined by the following equation:

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

- the surface  $A_c$  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;
- $P$  is the thermal power released inside the vehicle, necessary to maintain constantly the difference in absolute value between the mean interior temperature ( $T_{im}$ ) measured at 1,10 m, of all or part of the vehicle according to Annex D, and the mean exterior temperature ( $T_{em}$ ).