BRITISH STANDARD

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Railway applications — Environmental conditions for equipment —

Part 2: Fixed electrical installations

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National foreword

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— aid enquirers to understand the text;

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Applications ferroviaires - Conditions d'environnement pour le matériel Partie 2: Installations électriques fixes

Bahnanwendungen - Umweltbedingungen für Betriebsmittel Teil 2: Ortsfeste elektrische Anlagen

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 50125-2:2002 E

Foreword

This European Standard was prepared by SC 9XC, Electric supply and earthing systems for public transport equipment and ancillary apparatus (fixed installations), of Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50125-2 on 2002-07-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2003-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2005-07-01

Annexes designated "informative" are given for information only.
In this standard, Annex A is informative.

Contents

1 Scope

This European Standard takes into account environmental conditions within Europe.

This European Standard deals with the environmental influences on fixed electrical installations for traction power supply and equipment essential to operate a railway

- in open air;
- in covered areas;
- in tunnels;
- within enclosures placed in above areas.

Escalators, lifts, fire protection, lighting in tunnels and on platforms, ticket machines, ventilation systems and non-essential functions are not included.

Such influences include altitude, temperature and humidity, air movement, rain, snow, hail, ice, sand, solar radiation, lightning, pollution, vibration, shocks and EMC.

This standard does not specify the test requirements for equipment.

In case of environmental conditions not covered by the standard the data to be adopted for a specific project should be clearly stipulated when preparing a specification.

This standard is not intended to apply to cranes, installations in underground mines, suspended cable cars and funicular railways.

Nuclear radiation is excluded.

Signalling and telecommunications systems are not considered in this standard.

Fixed installed signalling and telecommunication equipment shall comply with EN 50125-3.

2 Normative references

This European Standard incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate place in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the last edition of the publication referred to applies (including amendments).

EN 50121-5	Railway applications – Electromagnetic compatibility Part 5: Emission and immunity of fixed power supply installations and apparatus
EN 50124-1	Railway applications - Insulation coordination Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment
EN 50124-2	Railway applications - Insulation coordination Part 2: Overvoltages and related protection

EN 50125-3	Railway applications – Environmental conditions for equipment Part 3: Equipment for signalling and telecommunications
EN 60529	Degrees of protection provided by enclosures (IP code) (IEC 60529)
EN 60721-3-3	Classification of environmental conditions Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weatherprotected locations (IEC 60721-3-3)
EN 60721-3-4	Classification of environmental conditions Part 3: Classification of groups of environmental parameters and their severities – Section 4: Stationary use at non-weatherprotected locations (IEC 60721-3-4)
ENV 1991-2-4	Eurocode 1: Basis of design and actions on structures – Part 2-4: Actions on structures – Wind actions
HD 478.2.1	Classification of environmental conditions Part 2: Environmental conditions appearing in nature - Temperature and humidity (IEC 60721-2-1)
HD 478.2.2	Classification of environmental conditions Part 2: Environmental conditions appearing in nature - Precipitation and wind (IEC 60721-2-2)
HD 478.2.3	Classification of environmental conditions Part 2: Environmental conditions appearing in nature - Air pressure (IEC 60721-2-3)

3 Definitions

For the purpose of this standard the following definitions apply.

3.1
covered area
protected from precipitation, but open to the effects of humidity and wind

NOTE 1 Some constructions may be affected by solar radiation.

NOTE 2 Tunnels are excluded from this definition.

3.2
cubicle
closed space where the direct open air influences are excluded

3.3
environment
the surrounding objects, region or circumstances which may influence the behaviour of the system and/or may be influenced by the system

3.4
environmental conditions
conditions which are brought about because of the environment

3.5
environmental protection
provisions to avoid the interaction of the system with the environment

3.6
open air
not protected from direct environmental influences

3.7
tunnel
artificial underground passage through a hill or below the normal ground level or under sea level

4 Environmental conditions

4.1 General

The purchaser shall specify clearly in his specification the class to consider. Otherwise the class mentioned in the product standard shall apply where available. Where no other specifications are specified, the normal requirements in this standard shall be used. Installations shall function, or be capable of functioning, under all specified conditions.

The environmental conditions are considered for normal operation. More severe conditions may be specified for the equipment to withstand, when not operating, without suffering damage. An example of such a condition is wind velocity high enough to cause dewirements but not tearing down the overhead contact line.

Microclimates surrounding components may need special requirements which are covered by product standards.

Special conditions are classified with a suffix X.

The severities specified are those which have a low probability of being exceeded. All specified values are either maximum or minimum limits. These values can be reached, but do not occur permanently. Depending on the situation there are different frequencies of occurrence related to a certain period of time. Such frequencies of occurrence have not been included in this standard, but should be considered for any environmental parameter, if relevant. In this case they shall be specified.

4.2 Altitude

Altitude related to sea level is relevant for air pressure. Air pressure shall be considered in accordance with HD 478.2.3.

The different classes of altitude above sea level in open air at which the equipment shall perform as specified are given in Table 1.

Table 1 - Altitude relative to sea level

Class	Altitude range relative to sea level m
A 1	up to 1 400
A 2	up to 1 000
A X	above 1 400
NOTE In class A 2 installations under sea level are included.	

Using A X class, the maximum altitude shall be specified by the purchaser.

4.3 Air temperature and humidity

4.3.1 General

For air temperature and humidity in open air, the climates according to Table 2 of HD 478.2.1 shall be used, excluding the first and the last two climates.

These values are illustrated in Figure 2 to Figure 7 of HD 478.2.1.

For weather-protected areas, information is given in EN 60721-3-3.

Different values depending on national requirements are possible. These values are to be agreed separately between purchaser and supplier, as appropriate to the local conditions.

In principle, air temperatures are measured in the shade.

The values of humidity can be 100 %.

4.3.2 Special conditions

When considering the temperature of an object, the effects of thermal radiation from the ground, or due to the proximity of other large objects, has to be taken into account.

In open air

The temperatures in railway surroundings, e.g. during summer on large expanses of ballast such as are to be found in large stations, can be higher than outside the area itself.

In covered areas

Maximum temperatures in covered areas should be not less than those specified for open air.

Special attention should be given to installations under transparent roofs which are subject to solar radiation. Conditions depend on the cover material.

In cubicles

Depending on the cubicle, the maximum ambient temperature should be specified up to 30 K higher than those specified in open air .

Temperatures inside a cubicle shall be measured in free space away from the vicinity of the heat emitting elements. Cubicles in covered areas or with other screening above should have modified values. Temperature and humidity in cubicles are a function of the design of the enclosure and will depend on the ventilation arrangements.

If the equipment is to be installed in a controlled climatic environment and is required to operate only under these conditions, the temperature range shall be agreed between purchaser and supplier.

The effect of condensation and also temperature changes and extremes of temperature shall not lead to any malfunction or failure.

4.4 Air movement

Calculations of air movement and air pressure as used in special national standards.

4.4.1 Wind

Wind velocity is defined in metres per second (m/s) and should be referred either

- to a height of 10 m above ground, or
- to a height of 500 m above ground (gradient velocity).

The averaging period is 10 min and the reference values have a yearly probability of occurrence of 0,02 (equivalent to a return period of 50 years). For other probabilities the corresponding wind velocities can be taken from Figure 1 of ENV 1991-2-4.

Wind action on structures is greatly influenced by details of the local landscape, tall buildings and height above the ground. The greater the roughness of the ground surface, the more the wind action close to this surface is reduced; thus there may be considerable differences between wind near the ground surface and that at greater heights above the ground surface.

Wind action depending on the surface is classified into four categories. Relatively open terrain with trees and other obstacles is most frequently experienced in Central Europe and is recommended as the basis for reference wind velocities.

Variation of the 10 min mean values with height *h* can be calculated by

$$v_h = v_{10}\left(\frac{h}{10}\right)^{\alpha}$$

where

v_{10} wind velocity at 10 m height in m/s,

v_h wind velocity at height *h* in m/s at m,

α roughness parameter depending on the terrain category which is

- α = 0,28 for town centres,
- α = 0,20 for suburban districts and forest areas,
- α = 0,16 for open terrain with obstacles,
- α = 0,12 for flat land and coast.

The wind velocities which shall be taken into account when assessing operational aspects are listed in Table 2. The Class has to be selected according to the local conditions. The data apply to ”open terrain with obstacles” 10 m above ground.

Table 2 - Reference wind velocities ($v_{ref,0,02}$)

Class	Wind velocity m/s
W 1 (low)	24,0
W 2 (normal)	27,5
W 3 (heavy)	32,0
W 4 (special)	36,0

W 4 class: the maximum wind velocity shall be specified by the purchaser.

Values for wind velocities for all countries in Europe are given in ENV 1991-2-4.

Different values are possible and are to be agreed between purchaser and supplier.

As far as calculation of wind actions based on specified wind velocities is concerned, reference should be made to relevant design standards.

Data in Table 2 refer to a return period of 50 years corresponding to a yearly probability of 0,02.

The wind velocities for differing probabilities can be obtained of multiplying the data in Table 2 by the ratio $v_{ref,p}/v_{ref,0,02}$ taken from Figure 1.

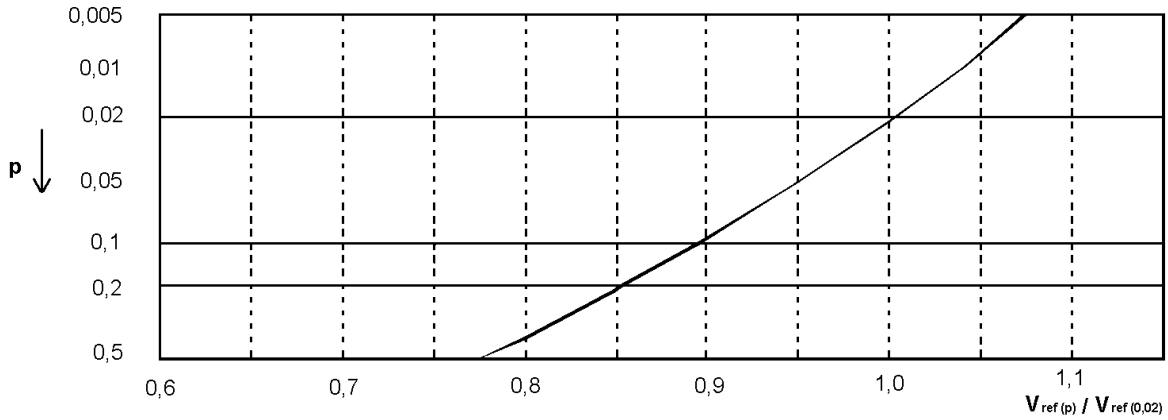

Figure 1 - Ratio of reference wind velocity corresponding to a yearly probability *p* to wind velocity with a probability of 0,02

NOTE 1 The wind velocity value for construction purposes is usually higher than the value for operation of the railway system.

NOTE 2 At wind velocity W 3 the equipment may be out of service but without suffering permanent damage.

4.4.2 Surrounding air

The relative movement of surrounding air shall be defined where necessary, e. g. for calculating the current capacity of an overhead contact line or cooling devices within cubicles.

For calculating the current capacity of an overhead contact line, three classes of wind velocity in Table 3 should be adopted.

Table 3 - Wind velocities

Class	Wind velocity m/s
SW 1 (low)	0,6
SW 2 (normal)	1,0
SW 3 (heavy)	2,0

Pressure pulses (e. g. due to passing trains) should be taken into account, where applicable.

4.5 Rain

The normal rain rate to be taken into account shall be 6 mm/min.

If necessary other values can be selected from HD 478.2.2.

The effect of rain shall be considered depending on the equipment installation together with wind and other air movements and, if applicable, with negative temperatures of the surface hit by the rain (forming of ice shells).

4.6 Hail

Where applicable consideration shall be given to the effect of hail. The maximum diameter of the hail stones is taken as 15 mm.

4.7 Snow and ice

Where applicable snow and ice load shall be taken into account at temperatures up to +5 °C.

Ice loads on conductors should be specified as nominated in Table 4.

Table 4 - Ice loads

Class	Iceload N/m
I 0 (no ice)	0
I 1 (low)	3,5
I 2 (medium)	7
I 3 (heavy)	15

These values are valid for conductors in the usual diameters between 10 mm and 20 mm.

Snow depth shall be considered for the access to cubicle doors and the height of live parts above ground.

Equipment required to be operated mechanically with exposed moving parts under iced up conditions shall be tested in accordance with their own product standards for these conditions.

4.8 Solar radiation

The value for the thermal effect is valid for radiation perpendicular to the surface.

Equipment exposed to solar radiation shall remain unaffected.

Depending on the latitude and according to class 4K 3 of EN 60721-3-4, the thermal effect of solar radiation shall be taken as given in Table 5.

Table 5 -Solar radiation

Class	Solar radiation W/m²
R 1 (low)	700
R 2 (high)	1 120

In open air the effect of UV-radiation shall be considered, this applies especially for synthetic materials.

The maximum duration shall be taken as 10 hours per day, unless otherwise stated.

4.9 Vibrations and shocks

Vibrations and shocks have to be considered only when the equipment is situated so close to the track that it can be influenced by passing vehicles. Specification of vibrations and shocks should be agreed according to EN 60721-3-3 and EN 60721-3-4 between purchaser and supplier.

If necessary compare with 4.13 of EN 50125-3.

4.10 Pollution

The effects of pollution shall be considered in the design of equipment under the following aspects:

- decrease of the withstand voltage on the insulation. EN 50124-1 defines requirements on the effect of pollution on the insulation;
- corrosive effects of polluted air and rain;
- for the design of ventilation provisions.

The effects of the following kinds of pollution shall be considered:

- chemical active substances;
- biological active substances;
- mechanical active substances.

NOTE Stones coming from the ballast belong to mechanical substances.
Salt, sand and other contamination can occur due to adjacent roads.
Salt applied to city streets for ice problems may affect the track of inner city metros.
Salt problems at or close to level crossings and salt contamination of insulators in coastal areas may be considered.

Table 6 gives the level of pollution for outdoor areas.

Table 6 – Pollution type

Pollution levels	Chemical active substances	Biological active substances	Mechanical active substances
Low	4C1	4B1	4S1
Medium	4C2	4B1	4S2
High	4C3	4B1	4S3

Definitions of classes for chemical, biological and mechanical active substances are given in EN 60721-3-4.

4.11 Lightning

Consideration shall be given to the effects of lightning. See EN 50124-1 and EN 50124-2.

4.12 Electromagnetic compatibility

The electromagnetic conditions encountered by apparatus are complex and many are of a transient nature. It is not possible therefore to define a comprehensive set of EMC-parameters. For further information see EN 50121-5.

4.13 Fire protection

Two classes of fire protection are defined as follows:

- F 0 for non safety related equipment (not installed in tunnels, passenger stations, etc.) not capable of developing toxic gases;
- F 1 for fire restricted areas that have requirements of non toxicity and limited opacity of smoke, self extinguishing equipment, and poor energy contribution to external fires.

4.14 Environmental conditions in tunnels

Environmental conditions relating to tunnels are dealt with in Annex A.

Annex A
(informative)

Conditions relating to tunnels

A.1 General

Environmental conditions in tunnels regarding temperature, humidity, dynamic movements and pollution are different for each location depending on various parameters such as the number of tracks, tunnel design, gradient, train frequency, etc. Therefore it is necessary to define the conditions for each tunnel.

The various aspects discussed in A.2 to A.8 should be considered. Tunnels that are not close to the surface of the ground are generally designed to be a close fit to the dimensions of the swept gauge of the rolling stock. When the track is nearer to the surface it is often found to be more appropriate to use a cut and cover technique of construction that results in a rectangular section of tunnel. In such cases there is often more than one track per tunnel. Examples are urban mass transit systems with tunnels below streets and buildings, and main line services that also run below the street level in urban areas as well as through tunnels in high ground.

A.2 Temperature

Temperature is influenced by air movement due to the piston effect of the train and by forced ventilation, where it is necessary. The tunnel walls are likely to maintain a fairly constant temperature in the mid range of average ambient conditions for the region. The resulting temperatures in the tunnel are principally due to the frequency of trains, the number of passengers, as well as the forced ventilation system.

Cut and cover tunnels tend towards the range of ambient temperatures in the open air surrounding the tunnel, especially at the end of a tunnel. The effect of trains passing in opposite directions will cause a degree of turbulence and buffeting. Humidity also may be greater.

For tunnels less than 2 000 m long, as well as in the first and last 1 000 m sections of longer tunnels, the same assumptions should be made as in open air.

Within the middle section of long tunnels the minimum temperatures may be assumed to be 20 K higher than those in open air and the maximum temperature may be reduced by 5 K as well.

A.3 Humidity

Humidity will tend to be low unless the tunnel walls allow a significant amount of moisture to ingress. Nevertheless it is often impossible to maintain dry conditions and in some cases a degree of flooding can be expected. Cable ducts alongside and below tracks are especially vulnerable to flooding.

A.4 Dynamic movements

Special conditions for local air pressure, vibrations and shocks may exist due to the effect of wind, vehicle movement, fans, etc. In this case, the relevant data shall be exchanged between the appropriate interested parties engaged with the project.

A.5 Dust

Another important factor is dust that comes from various sources:

- dust containing metal particles and iron oxide is created by the effect of brake shoes on the surface of wheels and also by the wear of metal wheels on the rail. This type of dust can lead to an explosive mixture which could be a problem in the presence of arcing. Other forms of braking and careful driving, particularly by the use of automatic systems, can lead to a reduction of brake dust. Carbon and copper particles appear from the use of pantographs;

- dust will also arrive from the presence of small flakes sloughed off the surface of human skin;

- some freight systems use closed containers, but there are also open containers, or wagons, which may be a cause of dust;

- dust from construction sites provide a concrete dust which may influence electrical equipment in fixed installations;

- diesel traffic fumes can contaminate the surface of electrical insulation thereby enhancing the retention of dust.

A.6 Direct discharge toilets

Debris from direct discharge toilets can lead to contamination of insulation at track level.

A.7 Vermin

Debris such as particles of consumable can encourage the presence of vermin. This can lead to damage from building of nests and destruction of insulation materials.

A.8 Environmental protection

Taken together the factors in this annex may lead to significant IP ratings (refer to EN 60529) for the enclosures of equipment located in running tunnels or immediately adjacent.

Bibliography

EN 50119	Railway applications - Fixed installations - Electric traction overhead contact lines
EN 50123-1	Railway applications - Fixed installations - D.C. switchgear Part 1: General
EN 50123-4	Railway applications - Fixed installations - D.C. switchgear Part 4: Outdoor d.c. in-line switch-disconnectors, disconnectors and d.c. earthing switches
EN 50125-1	Railway applications – Environmental conditions for equipment Part 1: Equipment on board rolling stock
EN 60721-3-2	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities Section 2: Transportation (IEC 60721-3-2)

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