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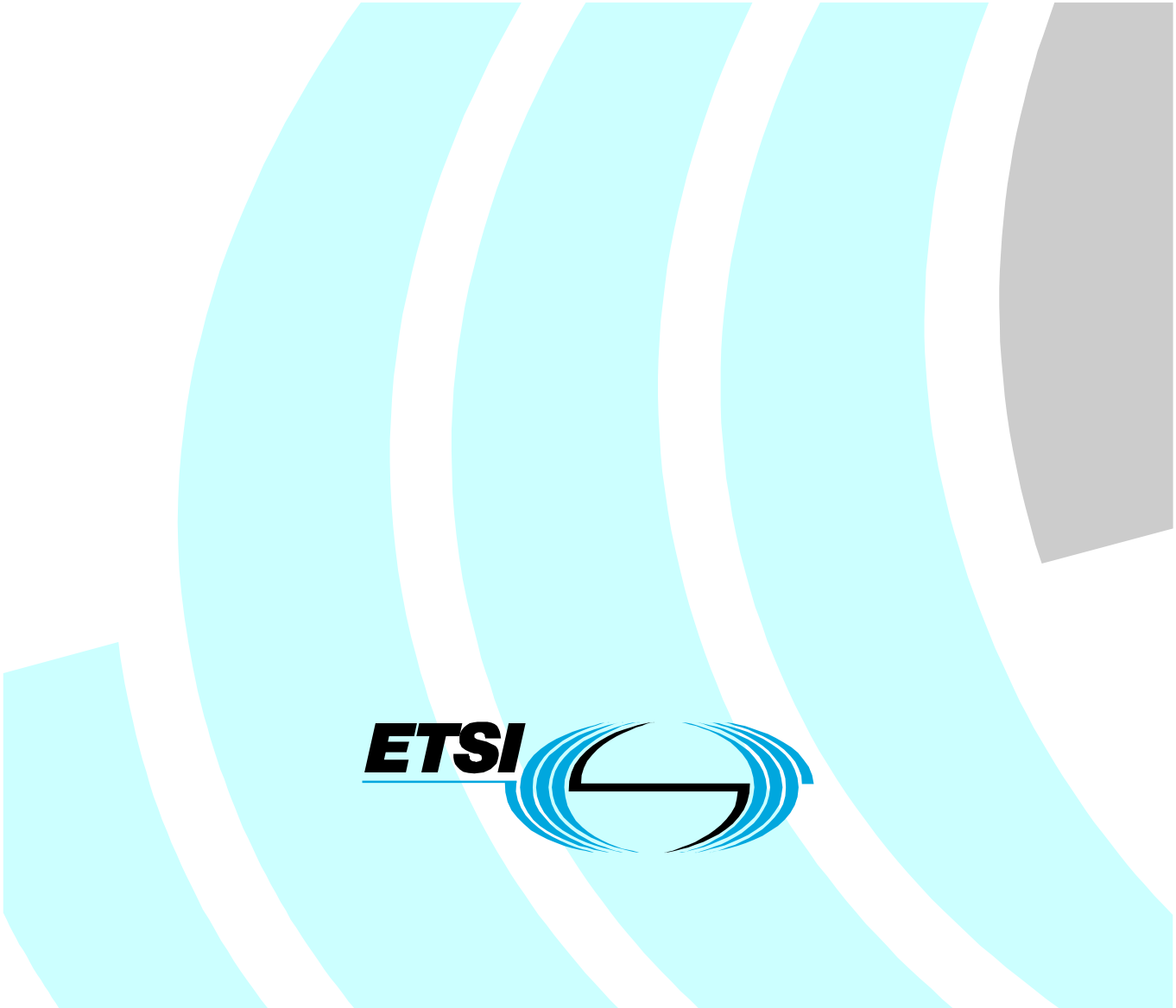

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Environmental Engineering (EE).

The present document is part 1, sub-part 8 of a multi-part deliverable covering the classification of environmental conditions and environmental tests for telecommunications equipment, as identified below:

Part 1: "Classification of environmental conditions";

Sub-part 0: "Introduction";

Sub-part 1: "Storage";

Sub-part 2: "Transportation";

Sub-part 3: "Stationary use at weatherprotected locations";

Sub-part 4: "Stationary use at non-weatherprotected locations";

Sub-part 5: "Ground vehicle installations";

Sub-part 6: "Ship environments";

Sub-part 7: "Portable and non-stationary use";

Sub-part 8: "Stationary use at underground locations";

Part 2: "Specification of environmental tests".

Part 1 specifies different standardized environmental classes covering climatic and biological conditions, chemically and mechanically active substances and mechanical conditions during storage, transportation and in use.

Part 1-0 forms a general overview of part 1.

Part 2 specifies the recommended test severities and test methods for the different environmental classes.

National transposition dates	
Date of latest announcement of this EN (doa):	31 July 2003
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 January 2004
Date of withdrawal of any conflicting National Standard (dow):	31 January 2004

1 Scope

The present document defines the classes of environmental conditions and their severities to which telecommunications equipment may be exposed. The severities specified are those which will have a low probability of being exceeded; generally less than 1 %.

The present document applies to equipment installed for stationary use at underground locations during:

- normal operation;
- on site installation and lining up;
- repair, maintenance and restoration of functions failed.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

[1] ETSI ETR 035: "Equipment Engineering (EE); Environmental engineering Guidance and terminology".

[2] IEC 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".

[3] IEC 60068-2-27: "Environmental testing. Part 2: Tests. Test Ea and guidance: Shock".

[4] IEC 60721-2-6: "Classification of environmental conditions. Part 2: Environmental conditions appearing in nature. Earthquake vibration and shock".

[5] IEC 60068-3-3: "Environmental testing. Part 3: Guidance. Seismic test methods for equipment".

3 Definitions

For the purposes of the present document, the following terms and definitions apply:

absolute humidity: mass of water vapour in grammes which is associated with one cubic metre of dry air in an air/water vapour mixture

NOTE: It is not intended for portable use but short periods of handling during erection work, down time, maintenance and repair at the location are accepted.

relative humidity: ratio of the partial pressure of the water vapour in moist air at a given temperature, to the partial pressure of the water vapour in saturated air at the same temperature

stationary use: equipment permanently placed at a certain site

weatherprotected location: location at which the equipment is protected from direct weather influences

NOTE 1: Totally weatherprotected location: direct weather influences are totally excluded.

NOTE 2: Partly weatherprotected location: direct weather influences are not completely excluded.

4 Environmental class

4.1 Class 8.1: partly weatherprotected underground locations

At present no underground classes in IEC 60721 Publication series exist.

This class is a combination of classes 3Z7/3B2/3C2(3C3)/3S3/3M3(3M5) in IEC 60721-3-3 [2].

As no IEC 60721-3-3 [2] climatic class is applicable, climatic conditions are described in clause 4 based on measurements conducted at typical underground telecommunications locations.

Seismic environment: zone 4 as defined in IEC 60721-2-6 [4].

Option zone 4 (modified Mercalli scale $\geq$ 9): if earthquake conditions are specified by the customer, the conditions stated in clause 5.6 apply.

This class applies to partly weatherprotected underground locations. The location has no temperature or humidity control, but the variations in the temperature are limited due to the stabilizing influence of the surroundings.

The climatogram is shown in figure 1.

This class applies to locations:

- where the installed equipment is normally protected from direct weather influences;
- where the surrounding medium is normally air, but the equipment may be immersed in water during exceptional conditions;
- where mould growth or attacks by animals, except termites, may occur;
- with normal levels of contaminants experienced in urban areas with industrial activities scattered over the whole area and/or with heavy traffic;

NOTE 1: At locations in the immediate neighbourhood of industrial sources with chemical emissions either special precautions shall be taken or the special chemical class 3C3 shall be chosen.

- in close proximity to sources of sand and dust;
- with vibration and shock of low significance.

NOTE 2: At locations where the level of shock is high, e.g. in close vicinity of road traffic or adjacent to heavy machines, etc., either special precautions shall be taken or the special mechanical class 3M5 shall be chosen.

The conditions of this class may be found in:

- footway boxes;
- manholes;
- some tunnels;
- etc.

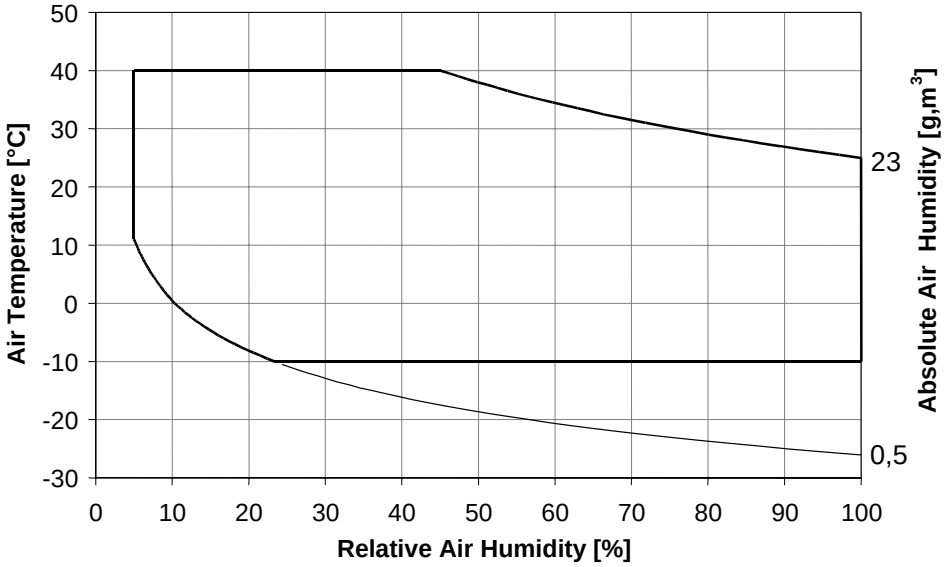

Figure 1: Climatogram for class 8.1: partly weatherprotected underground locations

5 Environmental conditions

5.1 Climatic conditions

Table 1: Climate parameters for environmental class 8.1

	Environmental parameter	Unit	Class 8.1
a)	Low air temperature	°C	-10
b)	High air temperature	°C	+40 (see note 1)
c)	Low relative humidity	%	5
d)	High relative humidity	%	100
e)	Low absolute humidity	g/m^3	0,5
f)	High absolute humidity	g/m^3	23
g)	Rate of change of temperature (see note 2)	°C/min	5 (see note 3)
h)	Low air pressure	kPa	70
i)	High air pressure (see note 4)	kPa	106
j)	Solar radiation	W/m^2	no
k)	Heat radiation	W/m^2	yes (see note 5)
l)	Movement of surrounding air	m/s	1
m)	Conditions of condensation	none	yes
n)	Conditions of wind-driven rain, snow, hail, etc.	none	no
o)	Conditions of water from sources other than rain	none	dripping water, condensed water soil water
p)	Conditions of icing	none	yes

NOTE 1: Includes any temperature rise due to heat dissipation of equipment and any secondary effect of the solar radiation to the cover.
NOTE 2: Averaged over a period of 5 minutes.
NOTE 3: This change of temperature may be experienced temporarily during maintenance or due to the immersion of water.
NOTE 4: Conditions in mines are not considered.
NOTE 5: Some radiation from the cover.

5.2 Biological conditions

Table 2: Biological conditions for environmental class 8.1

Environmental parameter		Unit	Class 8.1
a)	Flora	none	presence of mould, fungus etc.
b)	Fauna	none	presence of rodents or other animals harmful to products but excluding termites (see note)
NOTE: Micro-organisms living in the soil may be present.			

5.3 Chemically active substances

The parameters and their severities for airborne contaminants are given by table 3.

Table 3: Chemically active substances for environmental class 8.1

Environmental parameter		Unit	Class			
			8.1		Special (3C3) (see note 5)	
		(see note 1)	mean (see note 2)	maximum (see note 3)	mean (see note 2)	maximum (see note 3)
a)	Salt mist	none	sea salts, road salts		sea salts, road salts	
b)	Sulphur dioxide(SO_2)	mg/m^3 cm^3/m^3	0,3 0,11	1,0 0,37	5,0 1,85	10 3,7
c)	Hydrogen sulphide(H_2S)	mg/m^3 cm^3/m^3	0,1 0,071	0,5 0,36	3,0 2,1	10 7,1
d)	Chlorine(Cl)	mg/m^3 cm^3/m^3	0,1 0,034	0,3 0,1	0,3 0,1	1,0 0,34
e)	Hydrogen chloride(HCl)	mg/m^3 cm^3/m^3	0,1 0,066	0,5 0,33	1,0 0,66	5,0 3,3
f)	Hydrogen fluoride(HF)	mg/m^3 cm^3/m^3	0,01 0,012	0,03 0,036	0,1 0,12	2,0 2,4
g)	Ammonia(NH_3)	mg/m^3 cm^3/m^3	1,0 1,4	3,0 4,2	10 14	35 49
h)	Ozone(O_3)	mg/m^3 cm^3/m^3	0,05 0,025	0,1 0,05	0,1 0,05	0,3 0,15
i)	Nitrogen oxide (see note 4) (NO_X)	mg/m^3 cm^3/m^3	0,5 0,26	1,0 0,52	3,0 1,56	9,0 4,68

NOTE 1: The values given in cm^3/m^3 have been calculated from the values given in mg/m^3 and refer to a temperature of +20°C and a pressure of 101,3 kPa. The table uses rounded values.
NOTE 2: Mean values are the average values (long-term values) to be expected.
NOTE 3: Maximum values are limit or peak values occurring over a period of not more than 30 minutes per day.
NOTE 4: Expressed in the equivalent values of nitrogen dioxide.
NOTE 5: It is not mandatory to consider the special class 3C3 as a requirement for the combined effect of all parameters stated. If applicable, values of single parameters may be selected from this special class. In such instances the values given for the class 8.1 are valid for all parameters not especially named.

5.4 Mechanically active substances

Table 4: Mechanically active substances for environmental class 8.1

Environmental parameter		Unit	Class 8.1
a)	Sand	mg/m^3	300
b)	Dust (suspension)	mg/m^3	0,4
c)	Dust (sedimentation)	$mg/(m^2h)$	15

5.5 Mechanical conditions

Table 5: Mechanical conditions for the environmental class 8.1

			Class			
	Environmental parameter (see note 1)	**Unit**	**8.1**		**Special (3M5)**	
a)	Stationary vibration, sinusoidal:					
	displacement amplitude	mm	1,5		3,0	
	acceleration amplitude	m/s^2		5		10
	frequency range (see note 2)	Hz	2 to 9	9 to 200	2 to 9	9 to 200
b)	Non-stationary vibration including shock (see note)					
	shock response spectrum type L,					
	peak acceleration â	m/s^2	70			
	duration	ms	22			
	shock response spectrum type II,					
	peak acceleration â	m/s^2			250	
	duration	ms			6	

NOTE 1: Peak values For definition of Model Shock Response Spectra (First Order Maximax Shock Response Spectra) see IEC 60721-3-3 [2], and Maximax see IEC 60068-2-27 [3].
NOTE 2: Cross-over frequency is a rounded value.

5.6 Earthquake conditions

The dynamic environment which an equipment experiences during an earthquake depends on several parameters including the intensity of the ground motion and the characteristics of the structures used to support and/or house the equipment itself.

The conditions hereafter stated refer only to equipment mounted at underground locations using a structure of high rigidity.

The most common way to specify seismic conditions is through the definition of a Response Spectrum (RS).

An RS is the graphical representation of the maximum responses (i.e. acceleration), of an array of single degree-of-freedom oscillators as a function of oscillator frequency, in response to an applied transient base motion.

In other words the RS may be used to describe the motion that equipment is expected to experience at its mounting during a postulated seismic event.

To define an RS it is necessary to define the postulated base motion and the characteristics of the array of the single degree-of-freedom oscillators, including their damping ratio.

The high frequency asymptotic value of the acceleration of the response spectrum is normally called Zero Period Acceleration (ZPA) and represents the largest peak value of acceleration of the base motion.

In absence of a detailed knowledge of the possible seismic motion, the ZPA value can be obtained by the following formula (see IEC 60068-3-3 [5]):

$$ZPA = a_f = a_g \times K \times D \times G$$

where:

a_f *floor acceleration*;

a_g *ground acceleration* that depends on the intensity of the earthquake;

K *superelevation factor* that takes into account the amplification of the ground acceleration resulting from the vibrational behaviour of supporting structures;

D *direction factor* that takes into consideration possible intensity differences of the seismic motion among the horizontal and vertical axes;

G *geometric factor*; this is normally specified among testing parameters when single axis excitation is used for testing to take into account the interaction, due to installation location, along the different axes of the equipment of simultaneous multi-directional input vibrations.

The parameter severities that shall be used for class 8.1 are reported in table 6.

The severities have been chosen from those stated in IEC 60068-3-3 [5].

Table 6: Earthquake parameters for the environmental class 8.1

Parameters	Description	Severity
Superelevation factor	Mounting of equipment on rigid foundations or on structures of high rigidity	K = 1 (see note)
Direction factor	No intensity differences among axes	$D_{x,y,z}$ = 1
Geometric factor	Single-axis excitation with no interaction with the other axes	G = 1
NOTE: If the equipment is not mounted on structures of high rigidity, the structure should be included in the test, or a corrected Response Spectrum should be determined selecting the appropriate K value from those reported in IEC 60068-3-3 [5].		

The corresponding Response Spectrum, assuming a damping ratio of the single degree-of-freedom oscillators ζ = 2 %, is described in figure 2 and table 7.

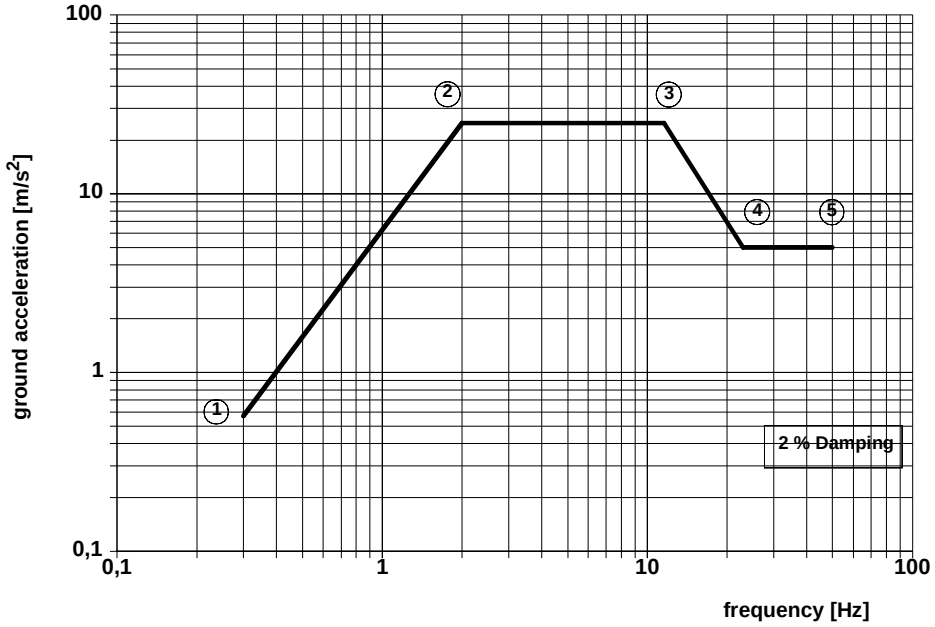

Figure 2: Earthquake Response Spectrum

Table 7: Acceleration co-ordinates for the Response Spectrum

Co-ordinate point	Frequency [Hz]	Ground acceleration [m/s^2]
1	0,3	0,57
2	2,0	25
3	11,6	25
4	23,0	5
5	50,0	5

History

Document history		
Edition 1	September 1997	Publication as ETS 300 019-1-8
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