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Foreword

This multi-part draft European Telecommunication Standard (ETS) has been produced by the Equipment Engineering (EE) Technical Committee of the European Telecommunications Standards Institute (ETSI), and is now submitted for the Public Enquiry phase of the ETSI standards approval procedure.

This ETS consists of 2 parts as follows:

Part 1: "Classification of environmental conditions".

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 2 specifies the test requirements for the different environmental classes.

Each part of the standard is divided into sub-parts. Sub-part 1-0 forms a general overview of Part 1. This sub-part 1-8, deals with stationary use at underground locations.

Proposed transposition dates	
Date of latest announcement of this ETS (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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1 Scope

The purpose of this sub-part is to define the classes of environmental conditions and their severities to which equipment may be exposed at specified locations below ground level. The severities specified are those which will have a low probability of being exceeded; generally less than 1 %.

This sub-part 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 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places 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 ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

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

[2] IEC Publication 721-3-0: "Introduction".

[3] IEC Publication 721-3-3: "Stationary use at weather-protected locations".

[4] IEC Publication 68-2-27: "Test Ea: Shock".

[5] IEC Publication 721-2-6: "Earthquake vibration and shock".

[6] IEC Publication 68-3-3: "Guidance. Seismic test methods for equipment".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETS, the following definitions apply:

stationary use: The equipment is permanently placed at a certain site. 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.

totally weather-protected location: Direct weather influences are totally excluded.

partly weather-protected location: Direct weather influences are not completely excluded.

3.2 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

RS	Response Spectrum
ZPA	Zero Period Acceleration

4 Environmental class

4.1 Class 8.1: Partly weather-protected underground locations

At present no underground classes in IEC 721 Publication series exist.

This class is a combination of classes 3B2/3C2(3C3)/3S3/3M3 or 3M5 in IEC Publication 721-3-3 [3].

No IEC 721-3-3 [3] climatic class is applicable.

Seismic environment: zone 4 as defined in IEC 721-2-6 [5].

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

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

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;

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.

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.

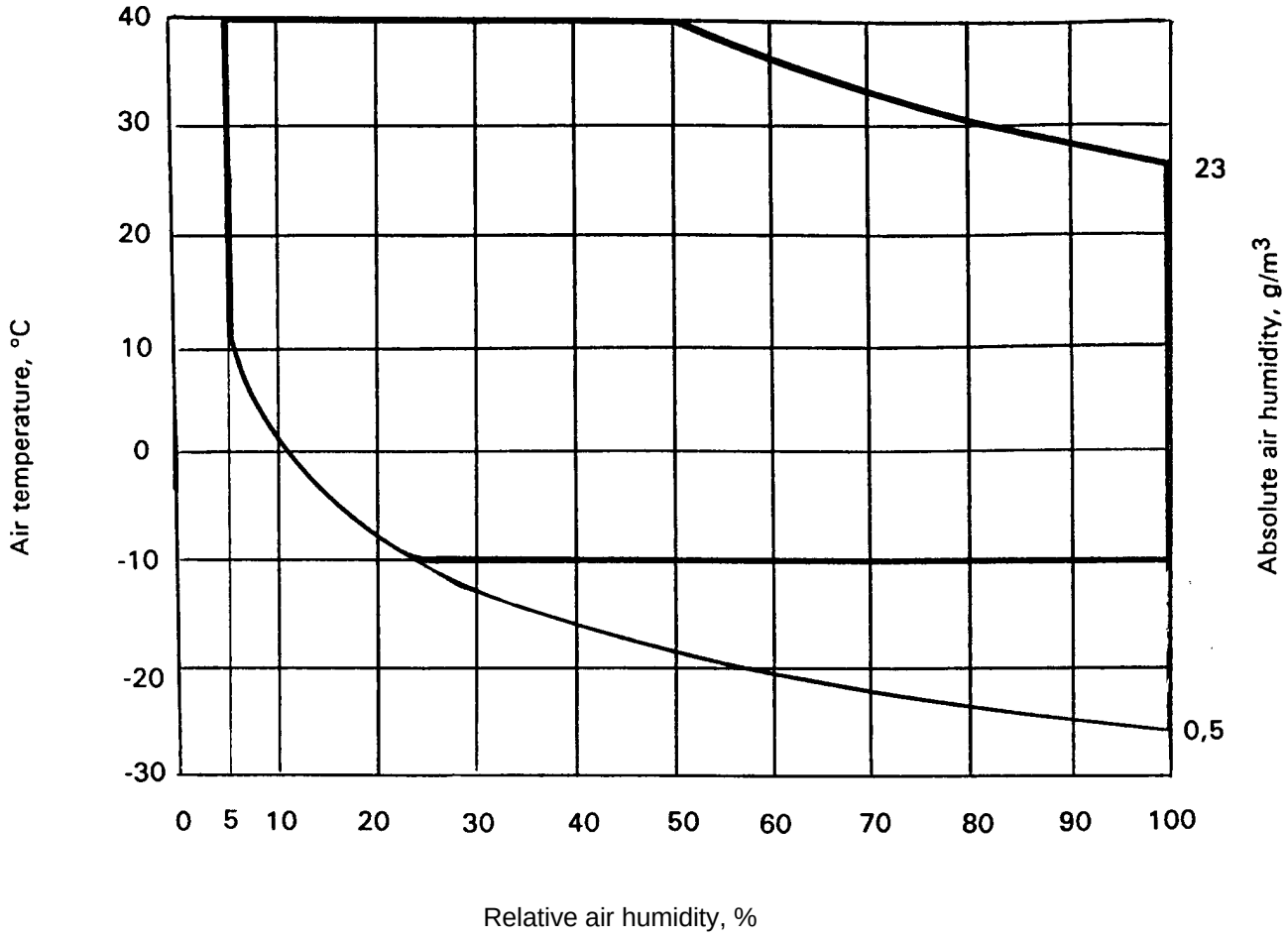


Figure 1: Climatogram for class 8.1: Partly weather-protected underground locations

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 (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 (note 2)	°C/min	5 (note 3)
h) low air pressure	kPa	70
i) high air pressure	kPa	106
j) solar radiation	W/m^2	no
k) heat radiation	W/m^2	yes (note 4)
l) movement of surrounding air	m/s	1
m) conditions of condensation	-	yes
n) conditions of wind-driven rain, snow, hail, etc.	-	no
o) conditions of water from sources other than rain	-	dripping water, condensed water soil water (note 5)
p) conditions of icing	-	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: Some radiation from the cover. NOTE 5: Not applicable if the location is waterproof or the ingress of soil water or flooding is not possible.		

5.2 Biological conditions

Table 2: Biological conditions for environmental class 8.1

Environmental parameter	Unit	Class 8.1
a) flora	-	presence of mould, fungus etc.
b) fauna	-	presence of rodents or other animals harmful to products but excluding termites (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)	
	(note 1)	mean (note 2)	maximum (note 3)	mean (note 2)	maximum (note 3)
a) salt mist	-	sea salts, road salts		sea salts, road salts	
b) sulphur dioxide	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	mg/m^3 cm^3/m^3	0,1 0,071	0,5 0,36	3,0 2,1	10 7,1
d) chlorine	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	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	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	mg/m^3 cm^3/m^3	1,0 1,4	3,0 4,2	10 14	35 49
h) ozone	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 (note 4)	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.

5.4 Mechanically active substances

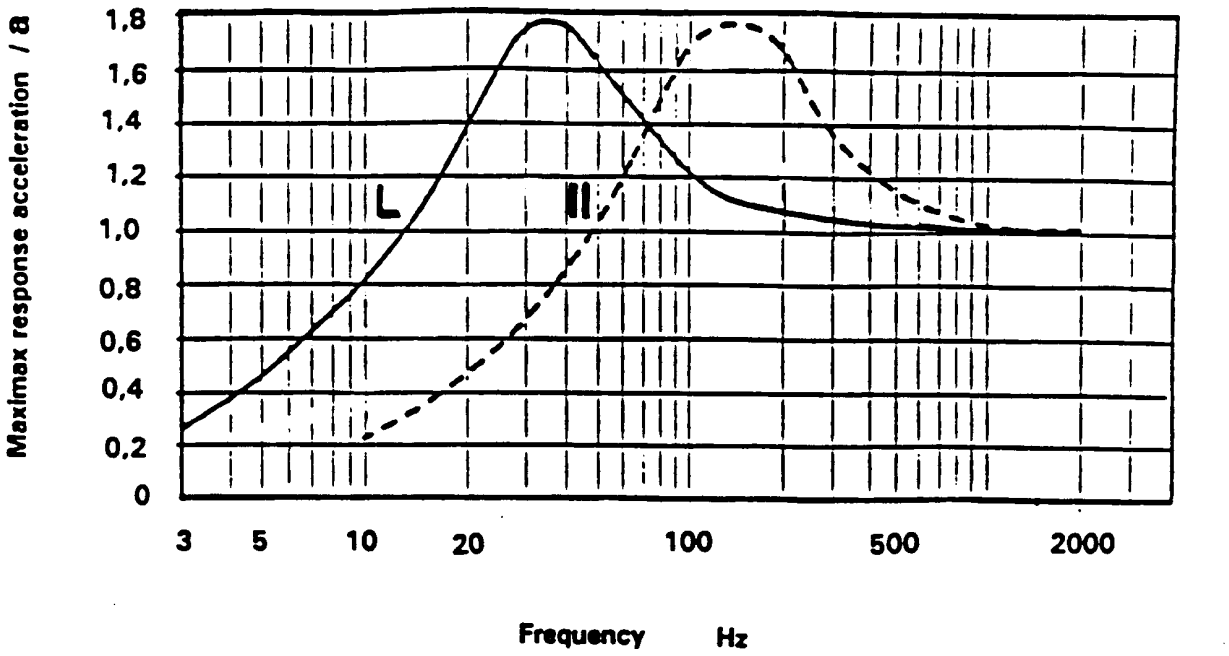
Table 4: Mechanically active substances for environmental class 8.1

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

5.5 Mechanical conditions

Table 5: Mechanical conditions for the environmental class 8.1

Environmental parameter	Unit	Class 8.1 (3M3)		Class 8.1 (3M5)	
a) Stationary vibration, sinusoidal:					
displacement amplitude	mm	1,5		3,0	
acceleration amplitude	m/s^2		5		10
frequency range	Hz	2-9	9-200	2-9	9-200
b) Non-stationary vibration including shock (see figure 2):					
shock response spectrum type L, peak acceleration â	m/s^2	70		-	
shock response spectrum type II, peak acceleration â	m/s^2	-		250	



Spectrum type L: Duration: 22 ms.
Spectrum type II: Duration: 6 ms.

Figure 2: Model shock response spectra (first order maximax shock response spectra, see IEC Publication 721-3-3 [3]). For definition of maximax see IEC Publication 68-2-27 [4]

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 68-3-3 [6]):

$ZPA = af = ag \times K \times D \times G$

where:

af floor acceleration;

ag 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 Publication 68-3-3 [6]).

Table 6: Earthquake parameters for the environmental class 8.1

Parameters	Description	Severity
earthquake intensity	strong to very strong earthquakes (Richter scale magnitude > 7, Modified Mercalli intensity scale > IX)	ag = 5 m/s^2
superelevation factor	mounting of equipment on rigid foundations or on structures of high rigidity	K = 1 (note 1)
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 1: 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 Publication 68-3-3 [6].		

The corresponding Response Spectrum, assuming a damping ratio of the single degree-of-freedom oscillators ζ = 2 %, is described in figure 3 and table 7.

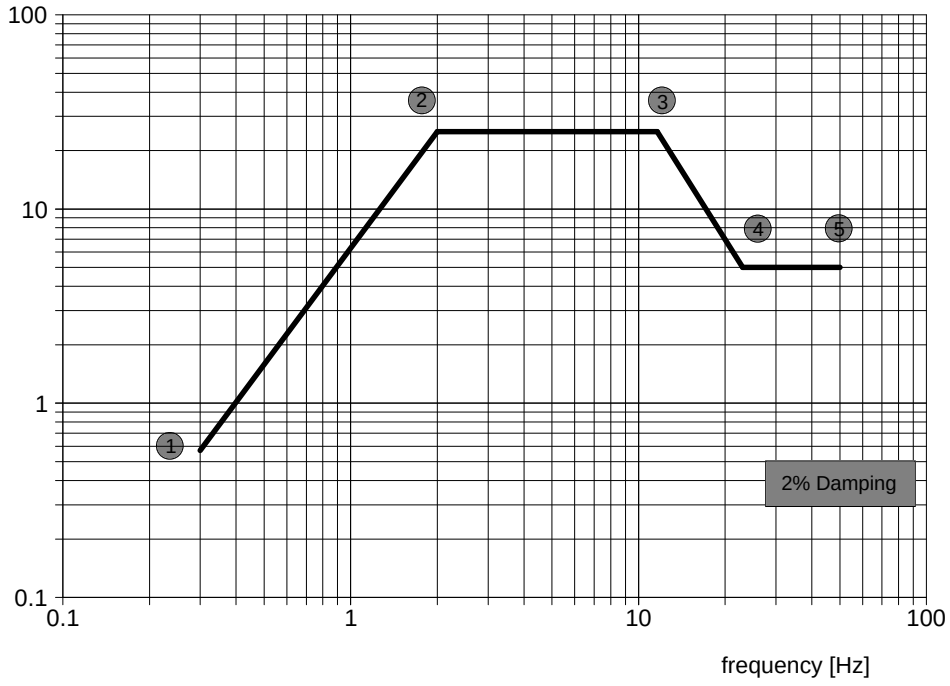


Figure 3: Earthquake Response Spectrum

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			
July 1996	Public Enquiry	PE 109:	1996-07-08 to 1996-11-01