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Part 1-4: Classification of environmental conditions;
Stationary use at non-weatherprotected locations

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Contents

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Foreword

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

The present document is part 1, sub part 4 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": (see note 1)

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" (see note 2).

NOTE 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. Sub-part 1-0 forms a general overview of part 1.

NOTE 2: Specifies the recommended test severities and test methods for the different environmental classes.

National transposition dates	
Date of adoption of this EN:	21 April 2014
Date of latest announcement of this EN (doa):	31 July 2014
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 January 2015
Date of withdrawal of any conflicting National Standard (dow):	31 January 2015

1 Scope

The purpose of the present document is to define a class of environmental conditions and their severities to which equipment may be exposed. Only severe conditions, which may be harmful to the equipment, are included. The severities specified are those which will have a low probability of being exceeded; generally less than 1 %.

The present document applies to equipment mounted for stationary use including periods of erection work, down time, maintenance and repair at non-weatherprotected locations defined in clause 5.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] ETSI EN 300 019-1-3 (2009): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weatherprotected locations".

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] Void.

[i.2] IEC 60721-3-4:1995: "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 4: Stationary use at non-weatherprotected locations".

[i.3] IEC 60721-2-4:2002: "Classification of environmental conditions - Part 2: Environmental conditions appearing in nature. Solar radiation and temperature".

[i.4] IEC 60068-2-27:2008: "Environmental testing. Part 2: Tests. Test Ea and guidance: Shock".

[i.5] IEC 60721-2-6:1990: "Classification of environmental conditions. Part 2: Environmental conditions appearing in nature - Earthquake vibration and shock".

[i.6] IEC 60068-3-3:1991: "Environmental testing - Part 3: Guidance. Seismic test methods for equipment".

[i.7] ETSI EN 300 019-2-4 (2013): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-4: Specification of environmental tests; Stationary use at non-weatherprotected locations".

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

non-weatherprotected location: location at which the equipment is not protected from direct weather influences

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: use of the equipment mounted firmly on the structure, or on mounting devices, or it is permanently placed at a certain site

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

4 Environmental classes

The classes shown in parentheses, e.g. (4C3), may be selected for special applications.

These classes shall apply to a non-weatherprotected location.

These classes shall apply to locations:

- which are directly exposed to an open-air climate, including solar radiation, movement of the surrounding air, precipitation and water jets; splashing water;
- where mould growth, or attacks by animals but excluding 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. It also applies to coastal areas;

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

- in areas with sand or dust sources, including urban areas;

NOTE 2: At locations in geographical areas with wind-driven sand or dust in air special precautions should be taken or a special class for mechanically active substances should be chosen.

- where transmitted vibrations are experienced from machines or passing vehicles. Higher level shocks may be experienced e.g. from adjacent machines.

NOTE 3: More severe mechanical conditions are to be expected for equipment intended for public use. Special requirements should be stated for such equipment, e.g. protection against vandalism.

If earthquake conditions can be expected, the conditions stated in clause 5.6 apply.

Two groups of classes are considered:

- Classes 4.1 and 4.1E apply to general climatic conditions - applies to climatic conditions in most of Europe.
- Classes 4.2L and 4.2H apply to extreme climatic conditions. These classes should be considered only in locations with extreme climates - applies to extremely cold or warm climatic conditions world-wide.

4.1 Class 4.1: Non-weatherprotected locations

Class 4.1 applies to most of Europe. For Class 4.1E see note in clause 4.2.

Class 4.1 is a combination of classes 4K2/4Z5/4Z7/4B1/4C2(4C3)/4S2/4M5 in IEC 60721-3-4 [i.2] and the environmental conditions are given in clause 5. It ranges from mild warm dry to cold temperate.

The climatogram is shown in figure 1.

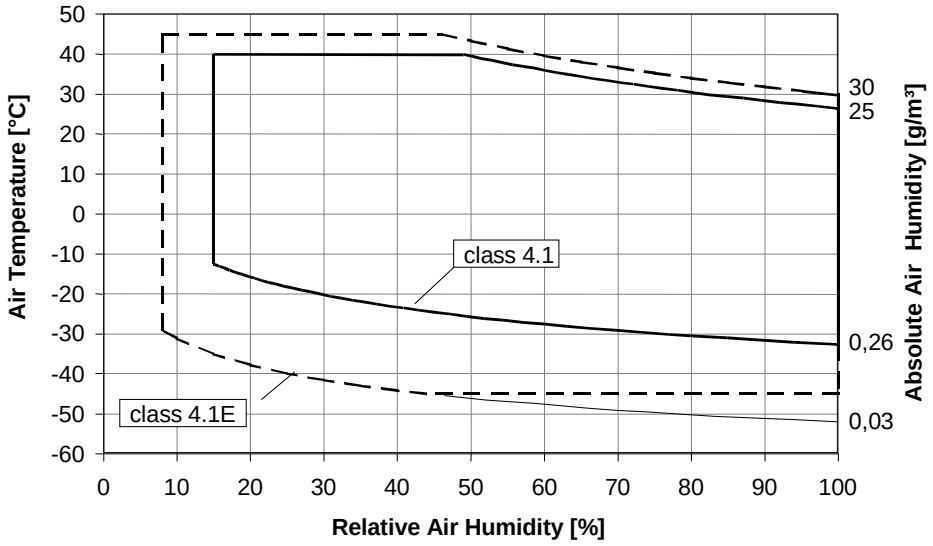


Figure 1: Climatogram for classes 4.1 and 4.1E: Non-weatherprotected locations

4.2 Class 4.1E: Non-weatherprotected locations - extended

Class 4.1E covers most of Europe.

Class 4.1E is a combination of classes 4Z5/4Z7/4B1/4C2(4C3)/4S2/4M5 in IEC 60721-3-4 [i.2] and the environmental conditions are given in clause 4. It ranges from mild warm dry to cold (see note).

NOTE: The climatic conditions in this class do not correspond to an IEC 60721-3-4 [i.2] class. In order to define a non-weatherprotected class covering European locations where the mean value of the annual extreme values -45 °C is chosen as the low temperature and +45 °C as the high temperature for the class 4.1E.

The climatogram is shown in figure 1.

4.3 Class 4.2L: Non-weatherprotected locations - extremely cold

Class 4.2L covers extremely cold climatic conditions world-wide.

Class 4.2L is a combination of classes 4K4L /4Z5/4Z7/4B1/4C2(4C3)/4S2/4M5 in IEC 60721-3-4 [i.2] and the environmental conditions are given in clause 5. It ranges from warm temperate to extremely cold.

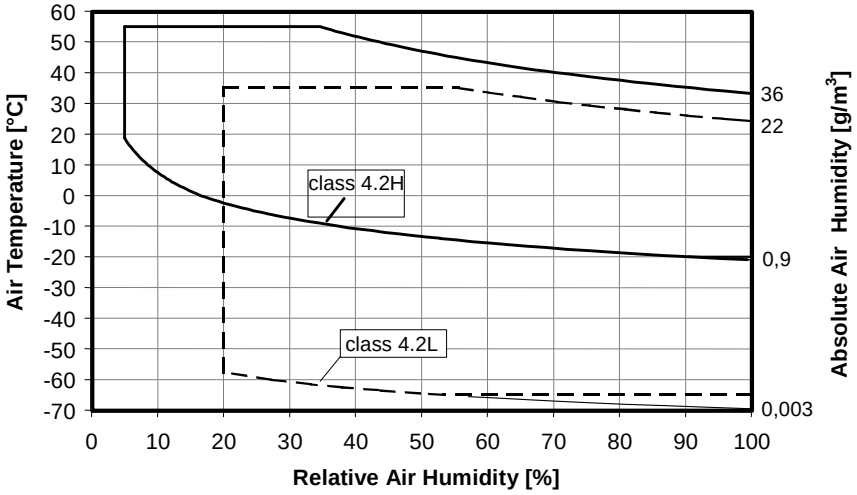
The climatogram is shown in figure 2.

4.4 Class 4.2H: Non-weatherprotected locations - extremely warm dry

Class 4.2H covers extremely warm dry climatic conditions world-wide.

Class 4.2H is a combination of classes 4K4H/4Z5/4Z7/4B1(4B2)/4C2(4C3)/4S2(4S3)/4M5 in IEC 60721-3-4 [i.2] and the environmental conditions are given in clause 4. It ranges from warm damp equable and extremely warm dry.

The climatogram is shown in figure 2.



Key
—— : Climatic limits for class 4.2H
-------: Climatic limits for class 4.2L

Figure 2: Climatogram for classes 4.2L and 4.2H: Non-weatherprotected locations

5 Environmental conditions

5.1 Climatic conditions

Table 1: Climatic conditions for environmental classes 4.1, 4.1E, 4.2L and 4.2H

Environmental parameter	Unit	Class			
		4.1	**4.1E**	**4.2L**	**4.2H**
a) Low air temperature (see note 1)	°C	-33	-45	-65	-20
b) High air temperature	°C	+40	+45	+35	+55
c) Low relative humidity	%	15	8	20	4
d) High relative humidity	%	100	100	100	100
e) Low absolute humidity	g/m^3	0,26	0,03	0,003	0,9
f) High absolute humidity	g/m^3	25	30	22	36
g) Rain intensity	mm/min	6	15	15	15
h) Rate of change of temperature (see note 2)	°C/min	0,5	0,5	0,5	0,5
i) Low air pressure (see note 3)	kPa	70	70	70	70
j) High air pressure	kPa	106	106	106	106
k) Solar radiation	W/m^2	1 120	1 120	1 120	1 120
l) Heat radiation	W/m^2	negligible	negligible	negligible	negligible
m) Movement of surrounding air	m/s	50	50	50	50
n) Condensation	none	yes	yes	yes	yes
o) Precipitation (rain, snow, hail, etc)	none	yes	yes	yes	yes
p) Low rain temperature (see note 4)	°C	+5	+5	+5	+5
q) Water from sources other than rain	none	splashing water	splashing water	splashing water	splashing water
r) Icing and frosting ice and frost formation	none	yes	yes	yes	yes

NOTE 1: In cloudless nights an object exposed to atmospheric radiation will radiate more heat than it receives off the surface, compared to the ambient air temperature. In practice (under extreme conditions) the surface may come down to a temperature in the order of 10 °C to 20 °C below ambient air temperature, when the ambient temperature ranges from +20 °C to -30 °C.
(For further information see IEC 60721-2-4 [i.3]).
NOTE 2: Averaged over a period of 5 minutes.
NOTE 3: 70 kPa represent a limit value for open air use, normally at about 3 000 m.
NOTE 4: This rain temperature should be considered together with high air temperature b) and solar radiation k). The cooling effect of the rain has to be considered in connection with the surface temperature of the equipment.

5.2 Biological conditions

Table 2: Biological conditions for environmental classes 4.1, 4.1E, 4.2L and 4.2H

Environmental parameter	Unit	Class	
		4.1, 4.1E, 4.2L, 4.2H	**4.2H only Special (4B2)**
a) Flora	none	presence of mould, fungus, etc.	presence of mould, fungus, etc.
b) Fauna	none	presence of rodents and other animals harmful to products, excluding termites	presence of rodents and other animals harmful to products, including termites

5.3 Chemically active substances

Table 3: Chemically active substances for environmental classes 4.1, 4.1E, 4.2L and 4.2H (see note 1)

Environmental parameter	Unit (see note 2)	Class			
		4.1, 4.1E, 4.2L, 4.2H		Special (4C3) (see note 5)	
		mean value (see note 3)	max. value (see note 4)	mean value (see note 3)	max. value (see note 4)
a) Salt mist	none	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_2)	mg/m^3 cm^3/m^3	0,1 0,034	0,3 0,1	0,3 0,1	1,0 0,34
e) Hydrochloric acid (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) Hydrofluoric acid (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 oxides (NO_x) (see note 6)	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: This table shows the 99 % values.
NOTE 2: The values given in cm^3/m^3 have been calculated from the values given in mg/m^3 at 20 °C.
NOTE 3: Mean values are the average values (long term values) to be expected.
NOTE 4: Maximum values are limit or peak values, occurring over a period of not more than 30 minutes per day.
NOTE 5: It is not mandatory to consider the special class as a requirement for the combined effect of all parameters stated. If applicable, values of single parameters may be selected from these classes. In this case the severities of class 4.1 are valid for all parameters not especially named.
NOTE 6: Expressed in the equivalent values of nitrogen dioxide.

5.4 Mechanically active substances

Table 4: Mechanically active substances for environmental classes 4.1, 4.1E, 4.2L and 4.2H

Environmental parameters	Unit	Class	
		4.1, 4.1E, 4.2L, 4.2H	4.2H only Special (4S3)
a) Sand	mg/m^3	300	1 000
b) Dust (suspension)	mg/m^3	5,0	15
c) Dust (sedimentation)	$mg/(m^3h)$	20	40

5.5 Mechanical conditions

Table 5: Mechanical conditions for environmental classes 4.1, 4.1E, 4.2L and 4.2H

Environmental parameter	Unit	Class 4.1, 4.1E, 4.2L, 4.2H	
a) Stationary vibration, sinusoidal (see notes 1 and 3)			
displacement amplitude	mm	3,0	
acceleration amplitude	m/s^2		10
frequency range	Hz	2-9	9-200
b) Non-stationary vibration, including shock type II (see note 2)			
peak response acceleration	m/s^2	250	
duration	ms	6	

NOTE 1: Units are peak displacement amplitude (mm) and peak acceleration amplitude (m/s^2).
NOTE 2: For definition of Model Shock Response Spectra (First Order Maximax Shock Response Spectra) see IEC 60721-3-4 [i.2], and Maximax see IEC 60068-2-27 [i.4].
NOTE 3: Random vibration is often a more realistic vibration characteristic compared with sinusoidal. Test severities for random vibration are given in EN 300 019-2-4 [i.7] and these represent all types of vibration found in practice. It is therefore recommended to use random vibration as an environmental parameter unless significant sinusoidal vibration is known to be present in a particular application. IEC 60721-3-4 [i.2] presently has no data for random vibration levels experienced in practice.

5.6 Earthquake conditions

If earthquake conditions are likely to occur then the conditions detailed below are applicable.

The parameters have been derived from methods stated in IEC Publication 60068-3-3 [i.6] and environment zone 4 as defined in IEC 60721-2-6 [i.5].

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 ground level or on structures of high rigidity. Earthquake conditions for equipment mounted on pylons, poles and any other non-rigid structures can differ significantly. For equipment mounted on top of buildings using a structure of high rigidity, the conditions and tests stated in EN 300 019-1-3 [1] shall apply.

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

A 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 [i.6]):

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

where:

a_f *floor acceleration;*

a_g *ground acceleration* that depends on the intensity of the earthquake expressed as a peak value;

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

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

G *geometric factor*; 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.

Table 6: Earthquake parameters for class 4.1

Parameters	Description	Severity
Earthquake intensity	strong to very strong earthquakes (Richter scale magnitude > 7)	a_g = 5 m/s^2
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_{xyz} = 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, i.e. pylons, poles, etc., 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 [i.6].		

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

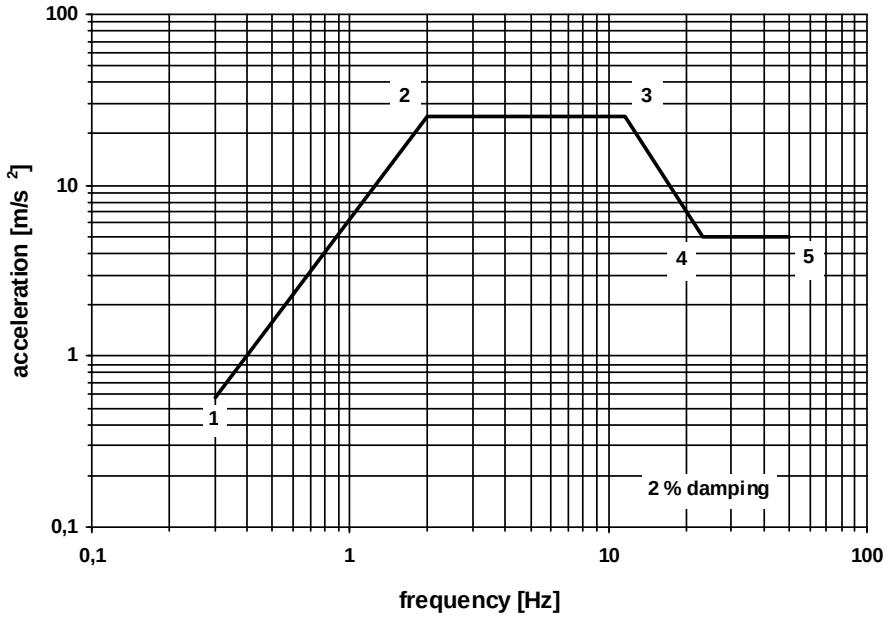


Figure 3: Earthquake Response Spectrum

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

Annex A (informative): Bibliography

ETSI TR 100 035 (2004): "Equipment Engineering (EE); Environmental engineering; Guidance and terminology".

History

Document history		
Edition 1	February 1992	Publication as ETS 300 019-1-4
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