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**Part 1-2: Classification of environmental conditions**  
**Transportation**

**ETSI**

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## **Foreword**

This multi-part European Telecommunication Standard (ETS) has been produced by the Equipment Engineering (EE) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This standard is concerned with environmental conditions and environmental tests for telecommunications equipment and comprises two main parts, each with subdivisions:

- ETS 300 019-1: "Classification of environmental conditions".

This part of the standard, Part 1, specifies different standardised environmental classes covering climatic and biological conditions, chemically and mechanically active substances and mechanical conditions during storage, transportation and in use.

- ETS 300 019-2: "Specification of environmental tests".

This part of the standard will specify the test requirements for the different environmental classes.

Each part of the standard is divided into sub-parts. Sub-part 1-0 will form a general overview of Part 1. This sub-part, Sub-part 1-2, deals with transportation.

This part of the standard (Part 1) was submitted to Public Enquiry as prETS 300 019 Part B. The original Part A is to be published as ETSI Technical Report ETR 035 entitled: "Equipment Engineering (EE); Environmental engineering Guidance and terminology".

Annex A to this sub-part is normative.

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## 1 Scope

The purpose of this sub-part of this standard is to define the classes of environmental conditions and their severities to which equipment may be exposed when being transported. 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 %.

This sub-part applies to equipment being transported from one place to another after being made ready for dispatch from the manufacturer's works. The most commonly used methods of transportation have been taken into account, i.e. ground, water and air transport. Loading and unloading as well as temporary storage, have been included. Where the equipment is packaged the environmental conditions apply to the packaging protecting the equipment.

NOTE: Normal transportation time is considered to be 30 days or less. Where the total transportation time exceeds 30 days then additional storage or packaging precautions must be considered.

## 2 Normative references

This ETS incorporates by dated or 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 721-3-2: "Transportation".
- [3] IEC Publication 721-2-1: "Temperature and Humidity".
- [4] IEC Publication 68-2-27: "Test Ea: Shock".

## 3 Definitions

In this sub-part of this standard, the following definitions apply:

**Weatherprotected:** The equipment, packaged or unpackaged, is contained within an enclosure which affords some protection from the environment, ranging from a temperature controlled container to a waterproof cover placed over the equipment. Ventilation ranges from controlled air flow to the raising of part of a waterproof cover to allow for natural air flow.

**Non-weatherprotected:** The equipment, packaged or unpackaged, is not protected in any way from the environment.

## 4 Environmental classes

The classes shown in parentheses, e.g. (2M3) may be selected for special applications.

Three different environmental classes have been defined. Classes 2.1 and 2.2 are special classes relating to low temperature and less severe mechanical conditions. Class 2.3 is the normal class for transportation of equipment.

### 4.1 Class 2.1: Very careful transportation

This class is a combination of classes 2K3/2B2/2C2/2S2/2M1 (see Table 5 NOTE 8) in IEC Publication 721-3-2 [2].

This class applies to transportation where special care has been taken e.g. with respect to low temperature and handling.

The conditions covered include transportation in unventilated enclosures and in non-weatherprotected conditions with restrictions on the general open-air climates, excluding cold and cold temperate climates. transportation by air only covers equipment carried in heated, pressurised holds.

NOTE: A survey of applications in different climates is shown at Annex A. Climatic conditions for different areas are defined in IEC Publication 721-2-1 [3].

This class applies to transportation:

- where the equipment may be moved between cold, non-weatherprotected and warm, weatherprotected conditions. It may for short periods be exposed to direct solar radiation, precipitation and splashing water. The equipment may be placed on a wet floor and inside an enclosure which is subjected to sunshine and rain etc. Non-weatherprotected exposure does not include exposure to sea waves. The equipment may be placed close to heating elements;
- in areas and conditions where mould growth, attacks by animals, except termites, may occur;
- which is non-weatherprotected (but including transport by sea where the equipment is protected against sea waves) in areas with normal industrial activities excluding those where large quantities of chemical pollutants are emitted;
- which is non-weatherprotected, as well as weatherprotected and where sweeping of dusty floors is taken into account. Transportation in sand desert areas is not included;
- in aircraft, lorries and air-cushioned trucks and trailers in areas with well-developed road systems. Only mechanical loading and unloading is included. No risk of dropping is taken into account. The mechanical conditions given apply to equipment placed on the floor of the compartment in which it is transported.

### 4.2 Class 2.2: Careful transportation

This class is a combination of classes 2K3/2B2/2C2/2S2/2M1 in IEC Publication 721-3-2 [2].

This class applies to transportation where special care has been taken e.g. with respect to low temperature and handling.

Class 2.2 covers the conditions of class 2.1. In addition class 2.2 includes transportation in all types of lorries and trailers in areas with well-developed road systems. It also includes transportation by ship and by train with specially designed, shock-reducing buffers. Manual loading and unloading of up to 20 kg is included.

### 4.3 Class 2.3: Public transportation

This class is a combination of classes 2K4/2B2/2C2/2S2/2M2(2M3) in IEC Publication 721-3-2 [2].



This class applies to transportation, where no special precautions have been taken.

The conditions covered include transportation in unventilated enclosures and in non-weatherprotected conditions with restrictions on the general open-air climates, excluding cold climates. Transportation by air covers equipment carried in heated, pressurised holds.

NOTE: A survey of applications in different climates is shown in Annex A. Climatic conditions for different areas are defined in IEC Publication 721-2-1 [3].

Class 2.3 covers the conditions of classes 2.1 and 2.2. In addition class 2.3 has a lower cold-temperature limit. Continuous or repeated solar radiation, precipitation and splashing of water may occur. Class 2.3 also includes all types of transport in areas without well-developed road systems. Rough handling is included.

## 5 Environmental conditions

### 5.1 Climatic conditions

**Table 1: Climatic conditions for environmental classes 2.1 to 2.3**

Environmental parameter	Unit	2.1 and 2.2	2.3
a) low temperature air	°C	- 25	- 40
b) high temperature, air in unventilated enclosures (NOTE 1)	°C	+ 70	+ 70
c) high temperature, air, in ventilated enclosures or outdoor air (NOTE 2)	°C	+ 40	+ 40
d) change of temperature air/air (NOTE 3)	°C	- 25 / + 30	-40/+30
e) change of temperature, air/water (NOTE 3)	°C	+ 40 / + 5	+40/+5
f) relative humidity, not combined with rapid temperature changes	% °C	95 + 40	95 + 45
g) relative humidity, combined with rapid temperature changes air/air, at high relative humidity (NOTES 3, 6)	% °C	95 - 25 / + 30	95 -40/+30
h) absolute humidity, combined with rapid temperature changes: air/air, at high water content (NOTE 4)	g/m <sup>3</sup> °C	60 + 70 / + 15	60 +70/+15
i) low air pressure	kPa	70	70
j) change of air pressure	kPa/min	no	no
k) movement of the surrounding medium, air	m/s	20	20
l) precipitation, rain	mm/min	6 (NOTE 7)	6
m) radiation, solar	W/m <sup>2</sup>	1120	1120
n) radiation, heat	W/m <sup>2</sup>	600	600
o) water from sources other than rain (NOTE 5)	m/s	1 (NOTE 7)	1
p) wetness	none	conditions of wet surfaces	
NOTE 1:	The high temperature of the surface of a product may be influenced by both the surrounding air temperature, given here, and the solar radiation through a window or another opening.		
NOTE 2:	The high temperature of the surface of a product is influenced by the surrounding air temperature, given here, and the solar radiation defined below.		
NOTE 3:	A direct transfer of the product between the two given temperatures is presumed.		
NOTE 4:	The product is assumed to be subjected to a rapid decrease of temperature only (no rapid increase). The figures of water content apply to temperatures down to the dew-point; at lower temperatures the relative humidity is assumed to be approximately 100 %.		
NOTE 5:	The figure indicates the velocity of water and not the height of water accumulated.		
NOTE 6:	Occurrence of condensation.		
NOTE 7:	For short duration only.		

## 5.2 Biological conditions

**Table 2: Biological conditions for environmental classes 2.1 to 2.3**

Environmental parameter	Unit	Classes 2.1 to 2.3
a) Flora	none	Presence of mould, fungus, etc.
b) Fauna	none	Presence of rodents or other animals harmful to products but excluding termites

## 5.3 Chemically active substances

NOTE: Other chemically active substances may exist, e.g. motor oil and brake fluid.

**Table 3: Chemically active substances for environmental classes 2.1 to 2.3**

Environmental parameter	Unit (NOTE 1)	Classes 2.1 to 2.3 (NOTE 2)
a) Salts	none	Sea and road salt mist
b) Sulphur dioxide	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	1,0 0,37
c) Hydrogen sulphides	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	0,5 0,36
d) Nitrogen oxides (expressed as equivalent values of nitrogen dioxides)	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	1,0 0,52
e) Ozone	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	0,1 0,05
f) Hydrogen chloride	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	0,5 0,33
g) Hydrogen fluoride	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	0,03 0,036
h) Ammonia	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	3,0 4,2
NOTE 1: The values given in cm <sup>3</sup> /m <sup>3</sup> have been calculated from the values given in mg/m <sup>3</sup> and refer to 20 °C and 101,3 kPa. The table uses rounded values.		
NOTE 2: The figures given are limit or peak values, occurring over a period of time of not more than 30 minutes per day.		

## 5.4 Mechanically active substances

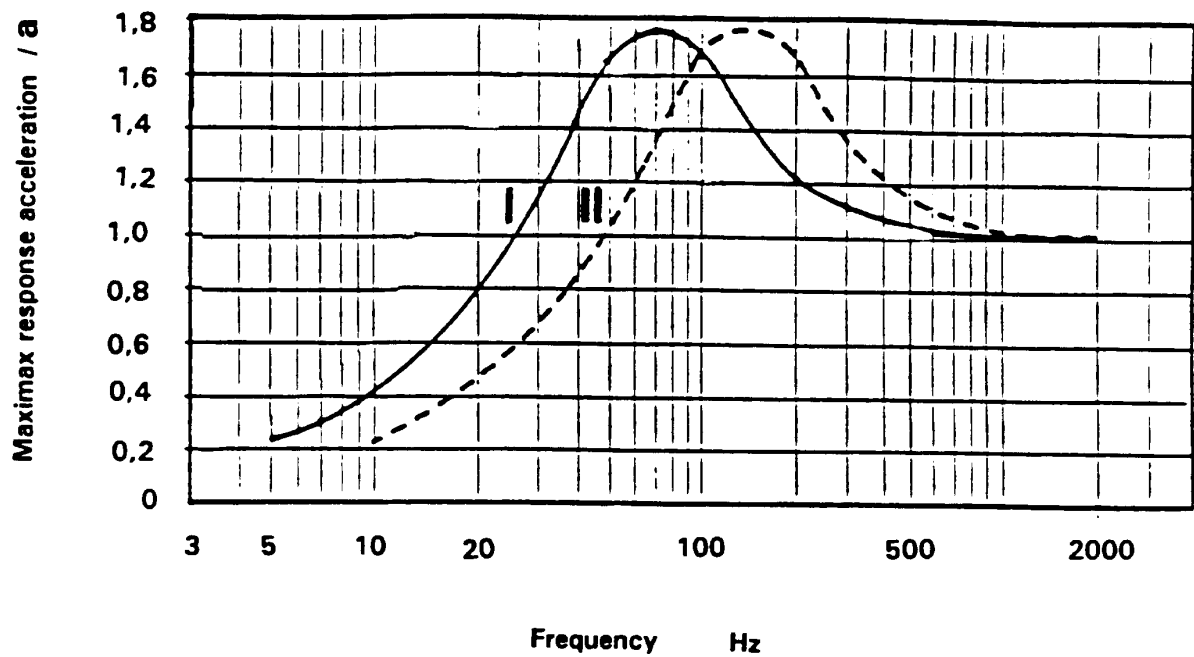
**Table 4: Mechanically active substances for environmental classes 2.1 to 2.3**

Environmental parameter	Unit	Classes 2.1 to 2.3
a) Sand in air	g/m <sup>3</sup>	0,1
b) Dust sedimentation	mg/(m <sup>2</sup> h)	3,0

## 5.5 Mechanical conditions

**Table 5: Mechanical conditions for environmental classes 2.1 to 2.3**

Environmental	Unit	Class		
		2.1	2.2	2.3 (NOTE 7)
a) Stationary vibration sinusoidal:				
displacement (NOTE 2) amplitude	mm	3,5	3,5	3,5
acceleration (NOTE 2) amplitude	m/s <sup>2</sup>	10 15	10 15	10 15
frequency range (NOTE 3)	Hz	(NOTE 4) 2-9 9-200 200-500	(NOTE 4) 2-9 9-200 200-500	(NOTE 4) 2-9 9-200 200-500
b) Stationary vibration random:				
acceleration spectral density	m <sup>2</sup> /s <sup>3</sup>	1 0,3	1 0,3	1 0,3
frequency range (NOTE 3)	Hz	10-200 200-2000	10-200 200-2000	10-200 200-2000
c) Non-stationary vibration				
shock response spectrum type I (NOTE 5) peak acceleration $\dot{a}$	m/s <sup>2</sup>	no	100	100
shock response spectrum type II (NOTE 5) peak acceleration $\dot{a}$	m/s <sup>2</sup>	no	no	300
d) Free fall:				
mass < 20 kg	m	no	0,25	1,2
mass 20 to 100 kg	m	no (NOTE 8)	0,25	1,0
mass > 100 kg	m	no	0,1	0,25
e) Toppling:				
mass < 20 kg	none	no	Toppling around any of the edges	
mass 20 to 100 kg	none	no	no	Toppling around any of the edges
mass > 100 kg	none	no	no	
f) Rolling, pitching: angle period	degree s	no no	no no	± 35 8 (NOTE 6)
g) Steady state acceleration	m/s <sup>2</sup>	20	20	20
h) Static load	kPa	5	5	10
<p>NOTE 1: The mechanical conditions given apply to items placed on the floor of the transport compartments.</p> <p>NOTE 2: Peak values.</p> <p>NOTE 3: The frequency range may be limited to 200 Hz for transportation on parts of the vehicle with high internal damping.</p> <p>NOTE 4: The cross-over frequency is a rounded value.</p> <p>NOTE 5: See figure 1.</p> <p>NOTE 6: An angle of 35° only occurs temporarily, but angles up to 22,5° can be reached for long periods of time.</p> <p>NOTE 7: For more severe conditions IEC Publication class 2M3 may be applied.</p> <p>NOTE 8: For class 2.1 the IEC conditions of free fall and shock have very low probability of occurrence and therefore are not applicable.</p>				



Spectrum type I: Duration: 11 ms.

Spectrum type II: Duration: 6 ms.

**Figure 1: Model Shock Response Spectra (First Order Maximax Shock Response Spectra, see IEC Publication 721-3-2 [2]). For definition of Maximax see IEC Publication 68-2-27 [4].**

## Annex A (normative): Summary of applications of classes 2.1, 2.2 and 2.3 in different climates

Table A.1

Application (NOTE 1)	Statistical Open-air climates								
	EC	C	CT	WT	WDr	MWDr	EWDr	WDa	WDaE
Weatherprotected location									
- ventilated									
- temperature controlled	2.1,2.3	2.1,2.3	2.1,2.3	2.1,2.3	2.1,2.3	2.1,2.3	2.1,2.3	2.1,2.3	2.1,2.3
- heated	2.1,2.3	2.1,2.3	2.1,2.3	2.1,2.3	2.1,2.3	2.1,2.3	2.1,2.3	2.1,2.3	2.1,2.3
- not heated	---,---	---,---	---,2.3	2.1,2.3	2.1,2.3	2.1,2.3	---,---	2.1,2.3	2.1,2.3
- not ventilated	(NOTE 2)		(NOTE 2)	(NOTE 2)	(NOTE 2)	(NOTE 2)		(NOTE 2)	(NOTE 2)
- heated	,2.3	,2.3	,2.3	,2.3	,2.3	,2.3	---,---	,2.3	,2.3
- not heated	---,---	---,---	---,2.3	(NOTE 2) ,2.3	(NOTE 2) ,2.3	(NOTE 2) ,2.3	---,---	(NOTE 2) ,2.3	(NOTE 2) ,2.3
non-weather protected location (NOTE 3)	---,---	---,---	---,2.3	2.1,2.3	2.1,2.3	2.1,2.3	---,---	2.1,2.3	2.1,2.3
NOTE 1: Classes 2.1 and 2.2 have the same climatic conditions. NOTE 2: Classes 2.1 and 2.2 do not apply in compartments with wet surfaces subjected to solar radiation. NOTE 3: Normal rain up to 6 mm/minute is included.									

### A.1 Statistical open-air climates

EC	Extremely Cold Climate (except the Central Arctic)
C	Cold Climate
CT	Cold Temperate Climate
WT	Warm Temperate Climate
WDr	Warm Dry Climate
MWDr	Mild Warm Dry Climate
EWDr	Extremely Warm Dry Climate
WDa	Warm Damp Climate
WDaE	Warm Damp Equable Climate

Climatic conditions for different areas are defined and the climatic map is presented in IEC Publication 721-2-1 [3].

### A.2 Grouping of statistical open-air climates

- Restricted Open-air Climates limited to WT.
- Moderate Open-air Climates including CT, WT, WDr and MWDr.
- General Open-air Climates including all except EC and EWDr.
- World-wide Open-air Climates including all climates.

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