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Part 1-5: Classification of environmental conditions  
Ground vehicle installations**

**ETSI**

European Telecommunications Standards Institute

**ETSI Secretariat**

**Postal address:** F-06921 Sophia Antipolis CEDEX - FRANCE

**Office address:** 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE

**X.400:** c=fr, a=atlas, p=etsi, s=secretariat - **Internet:** secretariat@etsi.fr

Tel.: +33 92 94 42 00 - Fax: +33 93 65 47 16

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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 1-5, deals with ground vehicle installations.

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 in ground vehicles. 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 when in use and permanently or temporarily installed in ground vehicles.

## 2 Normative references

This ETS contains, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications 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 721-3-5: "Ground vehicle installations".
- [3] IEC Publication 721-2-1: "Temperature and humidity".
- [4] IEC Publication 68-2-27: "Test Ea : Shock".

## 3 Definitions

In this sub-part the following definitions apply:

**Internally mounted:** The equipment is mounted internally in the vehicle in a compartment which affords some protection from the environment. The protection ranges from complete isolation from external influences to protection only from precipitation when the vehicle is not moving.

**Externally mounted:** The equipment is mounted on the outside of the vehicle. It is not protected from any external influences.

**Weatherprotected location:** A location at which the vehicle is protected from direct weather influences. The locality is assumed to be reasonably ventilated (at least natural flow).

## 4 Environmental classes

The classes shown in parentheses, e.g. (5S1), may be selected for special applications.

### 4.1 Class 5.1: Protected installation

This class is a combination of classes 5K2/5B2/5C2(5C3)/5F1(5F2)/5S2(5S1)/5M2 or 5M3 in IEC Publication 721-3-5 [2].

This class applies to equipment in vehicles used at weatherprotected and heated locations covered by world-wide open-air climates excluding extremely warm dry climates.

At non-weatherprotected locations this class applies to equipment in ventilated compartments and in the engine compartments of vehicles powered by electric motors in climatic conditions with normal rain intensities but excluding extremely cold, cold, cold temperate and extremely warm dry climates.

NOTE 1: For some environmental parameters (low air temperature, high air temperature) this class also covers externally mounted equipment.

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

This class applies to:

- equipment subjected to heat from heating elements and solar radiation through windows. The vehicle may be moved between cold, non-weatherprotected and warm, weatherprotected conditions. The equipment may also be subjected to dripping water and conditions of wet mounting surfaces. Engine compartments may be subjected to the ingress of water and snow;
- areas and conditions where mould growth and attacks by animals, except termites, may occur;
- equipment internally mounted in partly open compartments and in engine compartments which may be subjected to the ingress of road salts;
- locations with normal levels of contaminants experienced in urban areas with industrial activities scattered over the whole area and/or with heavy traffic;

NOTE 3: In areas with industrial sources emitting high quantities of chemical pollutants either special precautions must be taken or the special IEC chemical class 5C3 must be chosen.

- compartments where contaminating fluids are not expected;

NOTE 4: If the equipment is exposed to contaminating fluids either the special precautions must be taken or the special IEC class 5F2 must be chosen.

- equipment not protected from sand and dust on vehicles not used in desert areas;

NOTE 5: In a vehicle cab which is mainly protected from sand the special IEC class 5S1 may be chosen.

Class 5.1 also includes one of the following mechanical conditions as appropriate:

- Class 5M2: All types of road vehicles used in areas with well-developed road systems except tracked vehicles, motorcycles, scooters and other vehicles with low mass. The equipment can be mounted on surfaces which may be subjected to flying stones. The equipment may be mounted on passenger car instrument panels to which high frequency vibrations from the engine, or from other parts connected to the engine, may be transmitted. This class also applies to fork lift trucks and to trains with soft suspension and shock reducing buffers;
- Class 5M3: All types of road vehicles in areas without well-developed road system; tracked vehicles, self-propelled machines, overland vehicles, motorcycles, scooters and other vehicles with low mass. The equipment may be mounted on instrument panels to which high frequency vibrations from the engine, or from other parts connected to the engine, may be transmitted. This class also applies to trains with hard suspension. Externally mounted equipment may be directly hit by flying stones.

NOTE 6: The proper IEC class, 5M2 or 5M3, shall be chosen according to the expected installation and use of the equipment.

## 4.2 Class 5.2: Partly protected installation

This class is a combination of classes 5K3/5B2/5C2(5C3)/5F1(5F2)/5S2(5S1)/5M2 or 5M3 in IEC Publication 721-3-5 [2].

In addition to conditions in class 5.1, class 5.2 applies to equipment in vehicles used at non-weatherprotected locations in climatic conditions with normal rain intensities but excluding extremely cold, cold and extremely warm dry climates. This class also applies to internally mounted equipment in heated



compartments, after a warm-up period, and to equipment in engine compartments of vehicles powered by electric motors in general open-air climates.

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

This class applies to:

- equipment in compartments with wet surfaces and subjected to solar radiation. The equipment may also be subjected to direct solar radiation and rain;
- areas and conditions where mould growth, attacks by animals but except termites, may occur;
- equipment either externally mounted or internally mounted in partly-open compartments. The equipment may be subjected to the ingress of road salt or splashing water;
- locations with normal levels of contaminants experienced in urban areas with industrial activities scattered over the whole area and/or with heavy traffic;

NOTE 2: In areas with industrial sources emitting high quantities of chemical pollutants either special precautions shall be taken or the special IEC class 5C3 shall be chosen.

- compartments where contaminating fluids are not expected;

NOTE 3: If the equipment is exposed to contaminating fluids either special precautions shall be taken or the special IEC class 5F2 shall be chosen.

- equipment is not protected from sand and dust on vehicles not used in desert areas.

NOTE 4: In a vehicle cab which is mainly protected from sand the special IEC class 5S1 may be chosen.

Class 5.2 also includes one of the following mechanical conditions as appropriate:

- Class 5M2: All types of road vehicles used in areas with a well-developed road system, except tracked vehicles, motorcycles, scooters and other vehicles with low mass. The equipment can be mounted on surfaces which may be subjected to flying stones. The equipment may be mounted on passenger car instrument panels to which high frequency vibrations from the engine, or from other parts connected to the engine, may be transmitted. This class also applies to fork lift trucks and trains with soft suspension and shock reducing buffers;
- Class 5M3: All types of road vehicles in areas without a well-developed road system, tracked vehicles and self-propelled machines, overland vehicles, motorcycles, scooters and other vehicles with low mass. The equipment may be mounted on instrument panels to which high-frequency vibrations from the engine, or from other parts connected to the engine, may be transmitted. This class also applies to trains with hard suspension. Externally mounted equipment may be directly hit by flying stones.

NOTE 5: The proper mechanical IEC class, 5M2 or 5M3, shall be chosen according to the expected installation and use of the equipment.

## 5 Environmental conditions

### 5.1 Climatic conditions

**Table 1: Climatic conditions for environmental classes 5.1 and 5.2**

Environmental parameter	Unit	Class	
		5.1	5.2
a) Low temperature, air	°C	- 25	-40
b) High temperature, air, in ventilated compartments (except engine compartments) or outdoor (NOTE 1)	°C	+40	+40
c) High temperature, air, in unventilated compartments, except engine compartments (NOTE 2)	°C	+70	+70
d) High temperature, air, in engine compartments	°C	+70	+70
e) Change of temperature, air/air (NOTE 3)	°C	-25/+30	-40/+30
f) Gradual change of temperature, air/air, except in engine compartments	°C °C/minute	-25/+30 5	-40/+30 5
g) Gradual change of temperature, air/air, in engine compartments	°C °C	-25/+60 10	-40/+70 10
h) Change of temperature, air/water, except in engine compartments (NOTES 3,4)	°C	no	+40/+5
i) Change of temperature, air/water, in engine compartments (NOTES 3,4)	°C	+60/+5	+70/+5
j) Change of temperature, air/snow, in engine compartments only	°C	+60/-5	+70/-5
k) Relative humidity, not combined with rapid temperature changes except in engine compartments of vehicles powered by internal combustion engines	% °C	95 +40	95 +45
l) Relative humidity, not combined with rapid temperature changes, in engine compartments of vehicles powered by internal combustion engines	% °C	no no	95 +70
m) Relative humidity, combined with rapid temperature changes, air/air, at high relative humidities. Not in close proximity to refrigerated air conditioning systems	% °C	95 -25/+30	95 -40/+30
n) Relative humidity combined with rapid temperature changes, air/air, at high relative humidities. In close proximity to refrigerated air conditioning systems	% °C	95 +10/+70	95 +10/+70
o) Absolute humidity combined with rapid temperature changes, air/air, at high water content (NOTE 5)	g/m <sup>3</sup> of air °C/°C	60 +70/+15	60 + 70/+15
p) Low relative humidity	% RH °C	10 30	10 30
q) Low air pressure	kPa	70	70
r) Movement of the surrounding air	m/s	20	20

continued

**Table 1(concluded): Climatic conditions for environmental classes 5.1 and 5.2**

Environmental parameter	Unit	Class	
		5.1	5.2
s) Precipitation, rain	mm/min	no	6
t) Solar radiation	W/m <sup>2</sup>	700	1120
u) Heat radiation, not in engine compartments	W/m <sup>2</sup>	600	600
v) Heat radiation, in engine compartments	W/m <sup>2</sup>	600	1200
w) Water from sources other than rain (NOTE 6)	m/s	0,3	1
x) Wetness	none	conditions of wet surfaces	

NOTE 1: The high temperature of the surface of the equipment may be influenced by the surrounding air temperature given here and the solar radiation defined in t).

NOTE 2: The high temperature of the surface of the equipment may be influenced by the surrounding air temperature given here and the solar radiation through a window or other opening.

NOTE 3: A direct transfer of the equipment between the two temperatures is presumed.

NOTE 4: The lower temperature is equivalent to the temperature of tap water.

NOTE 5: The equipment 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 6: The figure indicates the velocity of water and not the height of water accumulation.

## 5.2 Biological conditions

**Table 2: Biological conditions for environmental classes 5.1 and 5.2.**

Environmental parameters	Unit	Classes 5.1 and 5.2
a) Flora	--	Presence of mould, fungus etc.
a) Fauna	--	Presence of rodents and other animals harmful to products, excluding termites.

## 5.3 Chemical active substances

**Table 3: Chemically active substances for environmental classes 5.1 and 5.2.**

Environmental parameter	Unit	Classes			
		5.1, 5.2 mean values	max. values (NOTE 1)	Special (5C3) mean values	(NOTE 2) max. values (NOTE 1)
a) Sea salt	--	Conditions of salt mist			
b) Road salts	--	Conditions of solid salt and salt water			
c) Sulphur dioxide	mg/m <sup>3</sup>	0,3	1,0	5,0	10
d) Hydrogen sulphide	mg/m <sup>3</sup>	0,1	0,5	3,0	10
e) Nitrogen oxides	mg/m <sup>3</sup>	0,5	1,0	3,0	10
f) Ozone	mg/m <sup>3</sup>	0,05	0,1	0,1	0,3
g) Hydrogen chloride	mg/m <sup>3</sup>	0,1	0,5	1,0	5,0
h) Hydrogen fluoride	mg/m <sup>3</sup>	0,01	0,03	0,1	2,0
i) Ammonia	mg/m <sup>3</sup>	1,0	3,0	10	35
<p>NOTE 1: The figures given are maximum values, occurring over a 30 minute period per day.</p> <p>NOTE 2: It is not mandatory to consider the special class as a requirement for the combined effect of all parameters stated. Where applicable, values of single parameters from the special class may be selected. In such instances the severities of classes 5.1 and 5.2 are valid for all remaining parameters.</p>					

#### 5.4 Contaminating fluids

**Table 4: Contaminating fluids for environmental classes 5.1 and 5.2.**

Environmental parameter	Class	
	5.1, 5.2	5F2 (Engine compartment)
a) Motor oil	no	no
b) Gearbox oil	no	no
c) Hydraulic oil	no	yes
d) Transformer oil	no	yes
e) Brake fluid	no	yes
f) Cooling fluids	no	yes
g) Grease	no	yes
h) Fuel	no	no
i) Battery electrolyte	no	yes

#### 5.5 Mechanically active substances

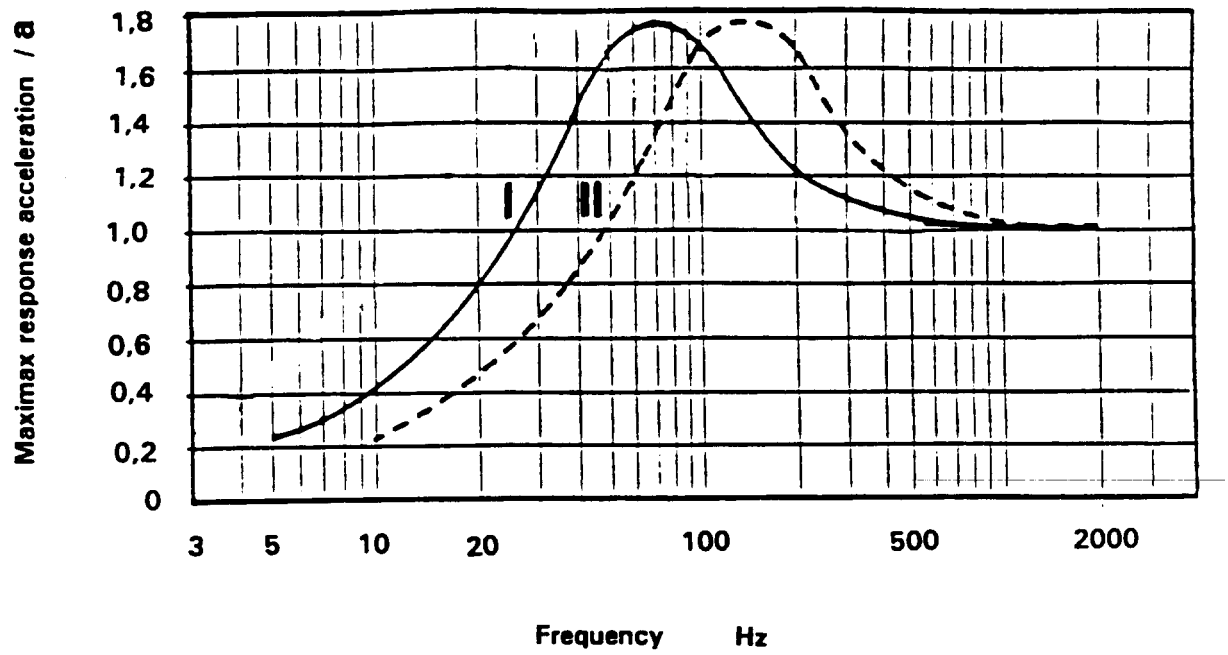
**Table 5: Mechanically active substances for environmental classes 5.1 and 5.2.**

Environmental parameter	Unit	Class	
		5S1 (Vehicle cab only)	5.1, 5.2
a) Sand (including grit)	g/m <sup>3</sup> of air	no	0,1
b) Dust sedimentation	mg/(m <sup>2</sup> h)	1,0	3,0

#### 5.6 Mechanical conditions

**Table 6: Mechanical conditions for environmental classes 5.1 and 5.2.**

Environmental parameter	Unit	Class					
		5M2 (NOTE 1)			5M3 (NOTE 1)		
a) Stationary vibration, sinusoidal :							
displacement amplitude (NOTE 2)	mm	3,3			7,5		
acceleration amplitude (NOTE 2)	m/s <sup>2</sup>		10	15		20	40
frequency range	Hz	2-9 (NOTE 4)	9-200	200-500	2-8 (NOTE 4)	8-200	200-500
b) Stationary vibration, random:							
acceleration spectral density	m <sup>2</sup> /s <sup>3</sup>	1	0,3		3	1	
frequency range	Hz	10-200	200-500		10-200	200-500	
c) Non-stationary vibration, including shock:							
shock response spectrum type I peak acceleration (ä) (NOTE 3)	m/s <sup>2</sup>		100			300	
shock response spectrum type II peak acceleration (ä) (NOTE 3)	m/s <sup>2</sup>		300			1000	
d) Impact from foreign bodies, stones		under consideration					
NOTE 1: The choice of class 5M2 or 5M3 depends on installation and use.							
NOTE 2: Peak values.							
NOTE 3: See figure 1.							
NOTE 4: The cross-over frequency is a rounded value.							



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 -3-5 [2]). For definition of Maximax see IEC Publication 68-2-27 [4].**

**Table A.1**

## Annex A (normative): Summary of applications of classes 5.1 and 5.2 in different climates

Application	Statistical Open-air Climates								
	EC	C	CT	WT	WDr	MWDr	EWDr	WDa	WDaE
Weather protected ventilated location									
- temperature controlled	5.1,5.2	5.1,5.2	5.1,5.2	5.1,5.2	5.1,5.2	5.1,5.2	5.1,5.2	5.1,5.2	5.1,5.2
- heated	5.1,5.2	5.1,5.2	5.1,5.2	5.1,5.2	5.1,5.2	5.1,5.2	---	5.1,5.2	5.1,5.2
- not heated	---	---	---	5.1,5.2	5.1,5.2	5.1,5.2	---	5.1,5.2	5.1,5.2
Non-weather protected location (NOTE 1)									
internally mounted									
- ventilated compartment	---	---	---	5.1,5.2	5.1,5.2	5.1,5.2	---	5.1,5.2	5.1,5.2
- not ventilated compartment	---	---	---	(2), 5.2	(2), 5.2	(2), 5.2	---	(2), 5.2	(2), 5.2
- heated compartment before warm-up	---	---	---	5.1,5.2	5.1,5.2	5.1,5.2	---	5.1,5.2	5.1,5.2
- heated compartment after warm-up	5.1,5.2	5.1,5.2	5.1,5.2	5.1,5.2	5.1,5.2	5.1,5.2	---	5.1,5.2	5.1,5.2
externally mounted	---	---	---	(3), 5.2	(3), 5.2	(3), 5.2	---	(3), 5.2	(3), 5.2
NOTE 1: Normal rain up to 6 mm/minute is included.									
NOTE 2: Class 5.1 does not apply in compartments with wet surfaces subjected to solar radiation.									
NOTE 3: Class 5.1 covers only some climatic parameters (low air temperature, high air temperature).									

### 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].

### 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.

History

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