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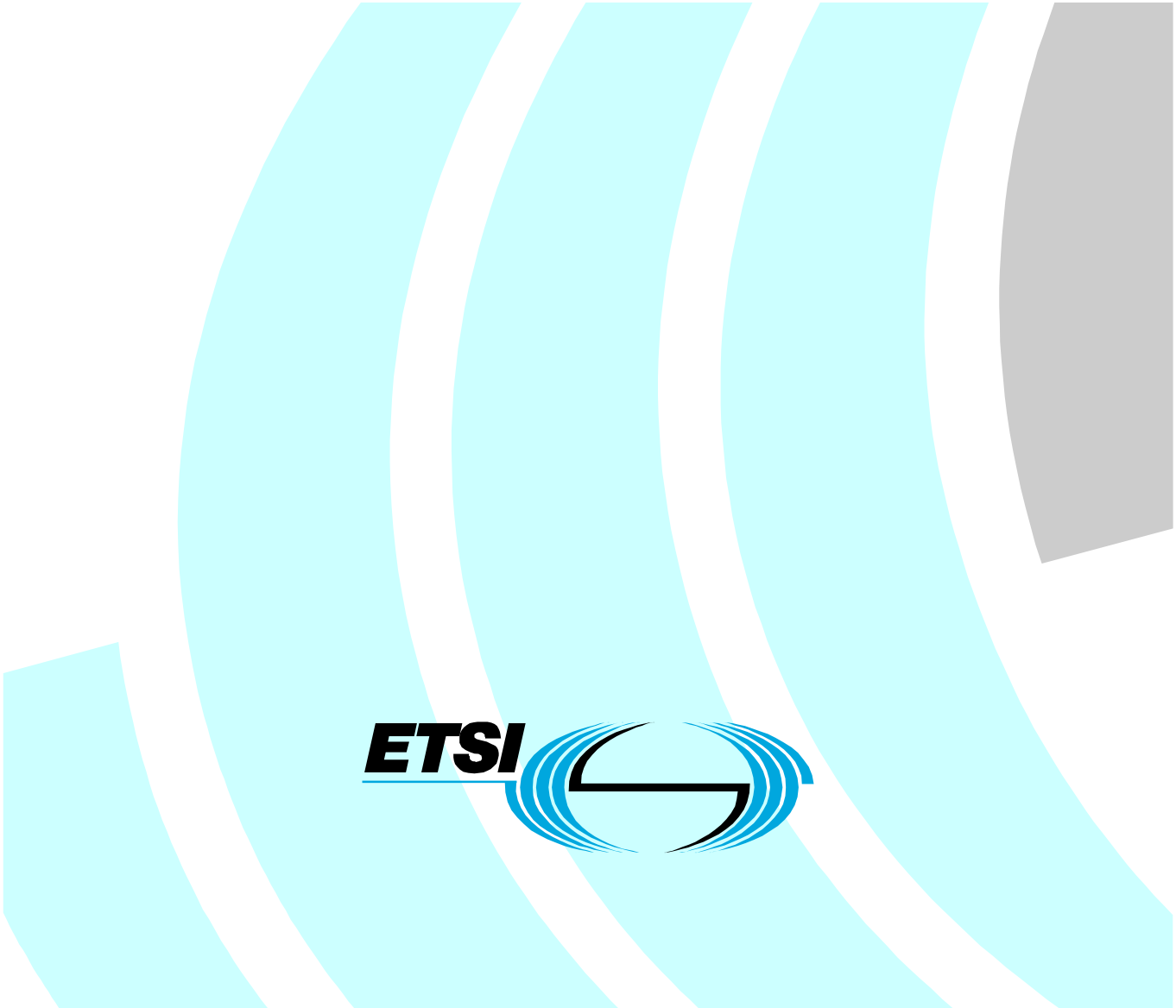
European Standard (Telecommunications series)

Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-5: Classification of environmental conditions; Ground vehicle installations



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Contents

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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 5 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
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Date of withdrawal of any conflicting National Standard (dow):	31 January 2004

Annex A to the present document is normative.

1 Scope

The present document defines 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 %.

The present document applies to equipment when in use and permanently or temporarily installed in ground vehicles.

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 60721-3-5: "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 5: Ground vehicle installations".

[3] IEC 60721-2-1: "Classification of environmental conditions. Part 2: Environmental conditions appearing in nature. Temperature and humidity".

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

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

externally mounted: equipment mounted on the outside of the vehicle, not protected from any external influences

internally mounted: equipment mounted internally in the vehicle in a compartment which affords some protection from the environment

NOTE: The protection ranges from complete isolation from external influences to protection only from precipitation when the vehicle is not moving.

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

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

NOTE: 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 60721-3-5 [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 60721-2-1 [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 60721-3-5 [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 60721-2-1 [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 (see note 1)	°C	+40	+40
c)	High temperature, air, in unventilated compartments, except engine compartments (see note 2)	°C	+70	+70
d)	High temperature, air, in engine compartments	°C	+70	+70
e)	Change of temperature, air/air (see 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/minute	-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 (see note 5)	g/m^3 of air	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
s)	Precipitation, rain	mm/min	no	6
t)	Solar radiation	W/m^2	700	1 120
u)	Heat radiation, not in engine compartments	W/m^2	600	600
v)	Heat radiation, in engine compartments	W/m^2	600	1 200
w)	Water from sources other than rain (see 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 parameter		Unit	Class 5.1 and 5.2
a)	Flora	none	Presence of mould, fungus etc.
b)	Fauna	none	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	Class			
			5.1 and 5.2		Special (5C3) (see note 2)	
			Mean values	Max. values (see note 1)	Mean values	Max. values (see note 1)
a)	Sea salt	none	Conditions of salt mist			
b)	Road salts	none	Conditions of solid salt and salt water			
c)	Sulphur dioxide(SO_2)	mg/m^3	0,3	1,0	5,0	10
d)	Hydrogen sulphide (H_2S)	mg/m^3	0,1	0,5	3,0	10
e)	Nitrogen oxides(NO_X)	mg/m^3	0,5	1,0	3,0	10
f)	Ozone(O_3)	mg/m^3	0,05	0,1	0,1	0,3
g)	Hydrogen chloride (HCl)	mg/m^3	0,1	0,5	1,0	5,0
h)	Hydrogen fluoride(HF)	mg/m^3	0,01	0,03	0,1	2,0
i)	Ammonia(NH_3)	mg/m^3	1,0	3,0	10	35
NOTE 1: The figures given are maximum values, occurring over a 30 minute period per day. 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.						

5.4 Contaminating fluids

Table 4: Contaminating fluids for environmental classes 5.1 and 5.2

Environmental parameter		Class	
		5.1 and 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^3 of air	no	0,1
b)	Dust sedimentation	$mg/(m^2h)$	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 (see note 1)			5M3 (see note 1)		
a)	Stationary vibration, sinusoidal:							
	displacement amplitude (see note 2)	mm	3,3			7,5		
	acceleration amplitude (see note 2)	m/s^2		10	15		20	40
	frequency range (see note 4)	Hz	2 to 9	9 to 200	200 to 500	2 to 8	8 to 200	200 to 500
b)	Stationary vibration, random:							
	acceleration spectral density	m^2/s^3	1		0,3	3		1
	frequency range	Hz	10 to 200		200 to 500	10 to 200		200 to 500
c)	Non-stationary vibration, including shock: (see note 3)							
	shock response spectrum type I							
	peak acceleration (â)	m/s^2	100			300		
	duration	ms	11			11		
	shock response spectrum type II							
	peak acceleration (â)	m/s^2	300			1 000		
	duration	ms	6			6		
d)	Impact from foreign bodies, stones	Joule	5			20		

NOTE 1: The choice of class 5M2 or 5M3 depends on installation and use.
NOTE 2: Peak values.
NOTE 3: For definition of Model Shock Response Spectra (First Order Maximax Shock Response Spectra) see IEC 60721-3-5 [2], and Maximax see IEC 60068-2-27 [4].
NOTE 4: The cross-over frequency is a rounded value.

Annex A (normative): Summary of applications of classes 5.1 and 5.2 applied to the climatic conditions for different areas as defined in IEC 60721-2-1

Table A.1

IEC 60721-2-1 [3] Open-air climates									
Application	**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	----, ----	----, ----	----, 5.2	5.1, 5.2	5.1, 5.2	5.1, 5.2	----, ----	5.1, 5.2	5.1, 5.2
non-weather protected location (see note 1)									
internally mounted									
- ventilated compartment	----, ----	----, ----	----, 5.2	5.1, 5.2	5.1, 5.2	5.1, 5.2	----, ----	5.1, 5.2	5.1, 5.2
- not ventilated compartment	----, ----	----, ----	----, 5.2	note 2, 5.2	note 2, 5.2	note 2, 5.2	----, ----	note 2, 5.2	note 2, 5.2
- heated compartment before warm-up	----, ----	----, ----	----, 5.2	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	----, ----	----, ----	----, 5.2	note 3, 5.2	note 3, 5.2	note 3, 5.2	----, ----	note 3, 5.2	note 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.

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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