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European Standard (Telecommunications series)

**Equipment Engineering (EE);
Environmental conditions and environmental tests for
telecommunications equipment;
Part 2-4: Specification of environmental tests;
Stationary use at non-weatherprotected locations**



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Contents

Intellectual Property Rights	4
Foreword	4
1 Scope.....	5
2 References	5
3 Environmental test specifications	5
3.1 Specification T 4.1: Non-weatherprotected locations	6
3.2 Specification T 4.1E: Non-weatherprotected locations - extended	8
4 Earthquake test specification	11
4.1 Vibration response investigation.....	11
4.2 Test conditioning	11
5 Notes to tables	13
5.1 General note.....	13
5.2 Notes to tables 1 to 4	13
Bibliography	16
History.....	17

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Foreword

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

The present document consists of 2 parts as follows:

Part 1: "Classification of environmental conditions".

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.

Part 2: "Specification of environmental tests".

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

Each part of the standard is divided into sub-parts. Sub-part 2-0 forms a general overview of Part 2.

This sub-part 2-4 deals with stationary use at non-weatherprotected locations.

National transposition dates	
Date of adoption of this EN:	3 September 1999
Date of latest announcement of this EN (doa):	31 December 1999
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	30 June 2000
Date of withdrawal of any conflicting National Standard (dow):	30 June 2000

1 Scope

The present document specifies test methods and severities for verification of the required resistibility of equipment according to the relevant environmental class.

The tests defined in Part 2-4 of this multi-part standard apply to stationary use of equipment at non-weatherprotected locations covering the environmental conditions stated in ETS 300 019-1-4 [1].

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, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

- [1] ETS 300 019-1-4: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions; Stationary use at non-weatherprotected locations".
- [2] IEC 60068-2: "Environmental testing - Part 2: Tests".
- [3] ETS 300 019-2-0: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-0: Specification of environmental tests; Introduction".
- [4] Void.
- [5] Void.
- [6] IEC 60721-3-4: "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 4: Stationary use at non-weatherprotected locations".

3 Environmental test specifications

The detailed descriptions of the environmental conditions are given in clauses 4 and 5 of ETS 300 019-1-4 [1].

ETS 300 019-2-0 [3] forms a general overview of Part 2 of the present document.

The equipment under test is assumed to be in its operational state throughout the test conditions described in the present document unless otherwise stated. The required performance before, during and after the test need to be specified in the product specification. Input and load conditions of the equipment shall be chosen to obtain full utilization of the equipment under test. The heat dissipation shall be maximized, except for the steady state, low temperature test, where it shall be minimized.

3.1 Specification T 4.1: Non-weatherprotected locations

This specification applies to many member countries of ETSI. See tables 1 and 3.

Table 1: Test specification T 4.1: Stationary use at non-weatherprotected locations-climatic tests

Environmental parameter			Environmental Class 4.1	Environmental test specification T4.1: Stationary use, Non-weatherprotected locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes	
Air temperature	low	(°C)	-33	-33 or -45	16 h	IEC 60068-2-1	Ab/Ad: Cold	1	
	high	(°C)	+40	+40 or +55	16 h	IEC 60068-2-2	Bb/Bd: Dry heat	2	
	change	(°C) (°C/min)	0,5	-10 / +40 0,5	2 cycles t ₁ = 3 h	IEC 60068-2-14	Nb: Change of temperature	3	
Humidity	relative	low	(%)	15	none			8	
		high	(%) (°C)	100	93 +30	21 d	IEC 60068-2-56	Cb: Damp heat steady state	4
		condensation	(%) (°C)	yes	90-100 +30	6 cycles	IEC 60068-2-30	Db: Damp heat, cyclic Variant 1	5
	absolute	low	(g/m ³)	0,26	none				
		high	(g/m ³)	25				6	
Air	pressure	low	(kPa)	70	none			7	
		high	(kPa)	106	none			7	
	speed	(m/s)	50	none				8	
Water	rain	intensity		6 mm/min	0,01 m ³ /min 90	3 min/m ² or 15 min	IEC 60068-2-18	Rb: Impacting water Method 2.2	9
		low temperature	(°C)	+5	none				
	other sources icing & frosting			splashing water yes	none			10 8	
Radiation	solar	(W/m ²)	1 120					11	
	heat	(W/m ²)	negligible						

Environmental parameter			Environmental Class 4.1	Environmental test specification T4.1: Stationary use, Non-weatherprotected locations				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Chemically active substances	sulphur	SO ₂ (mg/m ³)	0,3/1,0	none				12
		H ₂ S (mg/m ³)	0,1/0,5	none				12
	chlorine	salt mist	sea and road salt	none				12
		Cl ₂ (mg/m ³)	0,1/0,3	none				12
		HCl (mg/m ³)	0,1/0,5	none				12
	nitrogen	NO _x (mg/m ³)	0,5/1,0	none				12
		NH ₃ (mg/m ³)	1,0/3,0	none				12
	hydrogen fluoride HF	(mg/m ³)	0,01/0,03	none				12
ozone O ₃	(mg/m ³)	0,05/0,1	none				12	
Mechanically active substances	dust	sedimentation (mg/(m ² h))	20					13
		suspension (mg/m ³)	5					13
	sand (mg/m ³)	300					13	
Flora and fauna	micro organisms	mould, fungus, etc.	none					14
	rodents, insects	rodents, etc.	none					14

NOTE 1: none = verification is required only in special cases.
NOTE 2: n = number of note, see clause 5.

3.2 Specification T 4.1E: Non-weatherprotected locations - extended

This specification applies to all member countries of ETSI. See tables 2 and 3.

Table 2: Test specification T 4.1E: Stationary use at non-weatherprotected locations, extended - climatic tests

Environmental parameter			Environmental Class 4.1E	Environmental test specification T4.1E: Stationary use Non-weatherprotected locations - extended					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes	
Air temperature	low	(°C)	-45	-45 or -55	16 h	IEC 60068-2-1	Ab/Ad: Cold	1	
	high	(°C)	+45	+45 or +60	16 h	IEC 60068-2-2	Bb/Bd: Dry heat	2	
	change	(°C) (°C/min)	0,5	-10/+45 0,5	2 cycles t1 = 3 h	IEC 60068-2-14	Nb: Change of temperature	3	
Humidity	relative	low	(%)	8	none			8	
		high	(%)	100	93	21 d	IEC 60068-2-56	Cb: Damp heat steady state	4
		condensation	(°C)	yes	+30°C / 90 -100 %	6 cycles	IEC 60068-2-30	Db: Damp heat cyclic Variant 1	5
	absolute	low	(g/m ³)	0,03	none			6	
	high	(g/m ³)	30						
Air	pressure	low	(kPa)	70	none			7	
		high	(kPa)	106	none			7	
	speed	(m/s)	50	none				8	
Water	rain	intensity		15 mm/min	0,01 m ³ /min 90 kPa	6 min/m ² or 30 min	IEC 60068-2-18	Rb: Impacting water Method 2.2	9
		low temperature	(°C)	+5	none				
	other sources icing & frosting			splashing water	yes				10
Radiation	solar	(W/m ²)	1 120					11	
	heat	(W/m ²)	negligible						

Environmental parameter			Environmental Class 4.1E			Environmental test specification T4.1E: Stationary use Non-weatherprotected locations - extended		
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Chemically active substances	sulphur	SO ₂ (mg/m ³)	0,3/1,0	none				12
		H ₂ S (mg/m ³)	0,1/0,5	none				12
	chlorine	salt mist	sea and road salt	none				12
		Cl ₂ (mg/m ³)	0,1/0,3	none				12
		HCl (mg/m ³)	0,1/0,5	none				12
	nitrogen	NO _x (mg/m ³)	0,5/1,0	none				12
		NH ₃ (mg/m ³)	1,0/3,0	none				12
hydrogen fluoride HF	(mg/m ³)	0,01/0,03	none				12	
ozone O ₃	(mg/m ³)	0,05/0,1	none				12	
Mechanically active substances	dust	sedimentation (mg/(m ² h))	20					13
		suspension (mg/m ³)	5					13
	sand	(mg/m ³)	300					13
Flora and fauna	micro organisms		mould, fungus, etc.	none				14
	rodents, insects		rodents, etc.	none				14

NOTE 1: none = verification is required only in special cases.
NOTE 2: n = number of note, see clause 5.

Table 3: Test specification T 4.1: Non-weatherprotected locations - mechanical tests
Test specification T 4.1E: Non-weatherprotected locations, extended - mechanical tests

Environmental parameter			Environmental Class 4.1	Environmental test specification T 4.1 and 4.1E: Stationary use, Non-weatherprotected locations				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Vibration IEC 60721-3-4 Class 4M5	sinusoidal	displacement (mm) acceleration (m/s^2) frequency range (Hz) axes of vibration	3,0 10 2-9 9-200	1,2 4 5-9 9-200 3	3 x 5 sweep cycles	IEC 60068-2-6	Fc: Vibration (sinusoidal)	15;16
	random	ASD (m^2/s^3) (dB/oct) frequency range (Hz) axes of vibration		0,04 +12 -12 5-10 10-50 50-100 3	3 x 30 minutes	IEC 60068-2-64	Fh: Vibration, broad-band (digital control)	15;17
Shocks IEC 60721-3-4 Class 4M5	shocks	shock spectrum duration (ms) acceleration (m/s^2) number of bumps directions of bumps	Type II 6 250	half sine 11 50 6	100 in each direction	IEC 60068-2-29	Eb: Bump	15;18
Vibration IEC 60721-3-4 Class 4M3	sinusoidal	velocity (mm/s) displacement (mm) acceleration (m/s^2) frequency range (Hz) axes of vibration	1,5 5 2-9 9-200	5 2 5-62 62-200 3	3 x 5 sweep cycles	IEC 60068-2-6	Fc: Vibration (sinusoidal)	15;16
	random	ASD (m^2/s^3) (dB/oct) frequency range (Hz) axes of vibration		0,02 +12 -12 5-10 10-50 50-100 3	3 x 30 minutes	IEC 60068-2-64	Fh: Vibration, broad-band (digital control)	15;17
Shocks IEC 60721-3-4 Class 4M3	shocks	shock spectrum duration (ms) acceleration (m/s^2) number of shocks directions of shocks	Type L 22 70	half sine 11 30 6	3 in each direction	IEC 60068-2-27	Ea: Shock	15;18

NOTE: n = number of note, see clause 5

4 Earthquake test specification

If earthquake conditions are specified by the customer, the earthquake test requirements stated below shall be applied.

The test specification is applicable to class 4.1.

4.1 Vibration response investigation

A preliminary vibration response investigation shall be carried out to determine the lowest resonant frequency of the mounted test specimen.

The vibration response investigation can be carried out by means of *sine sweep testing* or *random testing*.

When using the *sine sweep testing*, the vibration response investigation shall be carried out in a manner based on that of IEC 60068-2-6 [2] (test Fc), with the following parameter severities:

Frequency range:	1 Hz to 35 Hz
Vibration amplitude:	2 m/s ²
Sweep rate:	≤ 1 octave/min

NOTE 1: The vibration amplitude may be reduced to 1 m/s² or less in case of sharp resonances.

If a *random test* is used this shall be performed in accordance with the requirements of IEC 60068-2-64 [2], using the following severities:

Frequency range:	1 Hz to 20 Hz	20 Hz to 35 Hz
ASD:	0,5 m ² /s ³	-3 dB/octave
Duration:	3 minutes	

NOTE 2: The Acceleration Spectral Density (ASD) value may be reduced to 0,3 m²/s³ or less in case of sharp resonances.

The time-history stated in table 4 can be omitted if, after the vibration response investigation, the equipment does not exhibit any resonance below 5 Hz and has passed the sinusoidal vibration test reported in table 3 for class 4M5. This test is sufficient to prove compliance with the earthquake conditions given in part 1 subpart 4 of ETS 300 019-1-4 [1].

4.2 Test conditioning

See table 4.

The extent to which the equipment under test has to function during tests or merely to survive conditions of test shall be stated in the product specification.

Table 4: Test specification T 4.1: Earthquake test

Environmental parameter			Environmental class 4.x	Environmental test specification T4.x: Earthquake test				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Earthquake	time-history	RRS	fig.1, tab.5	fig.1, tab.5		IEC 60068-2-57	Ff: time-history method	19
		frequency range (Hz)	0,3 - 50	1 - 35				
		ZPA (m/s ²)	5	5				
		axes		3	30 s			
		damping ratio (%)		2				
				NOTE: n = number of note, see clause 5.				

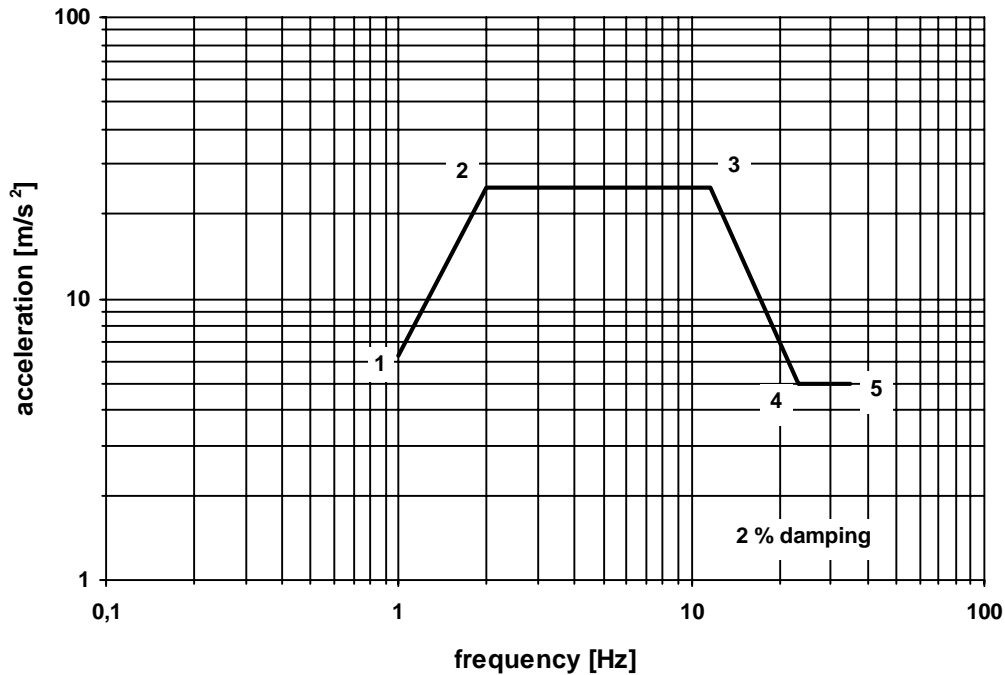


Figure 1: Earthquake Required Response Spectrum

Table 5: Acceleration co-ordinates for the Required Response Spectrum in figure 1

Co-ordinate point	Frequency [Hz]	Ground acceleration [m/s ²]
1	1,0	6,3
2	2,0	25
3	11,6	25
4	23,0	5
5	35,0	5

5 Notes to tables

5.1 General note

The present document applies to the use of stationary equipment at non weatherprotected locations covered by the environmental conditions stated in ETS 300 019-1-4 [1]. The notes have been added to explain the main reasons for recommended tests or to explain why no test has been recommended even if there is a characteristic severity given.

The relevant specification should specify, when during the environmental test programme, the equipment is in its operational state and which performance requirements should be measured before, during and after the test together with the fail criteria.

5.2 Notes to tables 1 to 4

NOTE 1: (Air temperature, low)

Two test temperatures are given, the higher test temperature applies if the equipment is protected against solar irradiation. The lower test temperature includes heat irradiation emitted from the equipment. The characteristic severity can be used as a cold start up temperature, but it may be modified by the product specification. The equipment under test shall remain operational throughout this test, except for the cold start up test, which shall commence once low temperature stability is achieved.

NOTE 2: (Air temperature, high)

Two test temperatures are given, the lower test temperature applies if the equipment is protected against solar radiation or the equipment is ventilated (natural or forced). The higher test temperature includes the heating effects of solar radiation. The characteristic severity can be used as a high start up temperature, but it may be modified by the product specification. The equipment under test shall remain operational throughout this test, except for the high temperature start up test, which shall commence once high temperature stability is achieved.

NOTE 3: (Air temperature, change)

This test is intended for specimen with large thermal time constant. For equipment where the rapid change of temperature of the surface has a significant effect on internal components, the values of the change of temperature up to 5°C/min can be applied (e.g. heat sinks).

NOTE 4: (Humidity, relative high)

IEC 60068-2-56 [2] Test Cb is recommended with test severities not higher than climatogram limits for this class.

NOTE 5: (Condensation)

IEC 60068-2-30 [2] Test Db is recommended with test severities not higher than climatogram limits for this class.

NOTE 6: (Humidity, absolute, high)

This effect is considered to be partly included in the damp heat test IEC 60068-2-56 [2] Test Cb.

NOTE 7: (Air pressure, low and high)

No test is recommended for normal applications, because the effect of air pressure is evaluated at the component level.

NOTE 8:

There is no IEC60068-2 [2] test for this parameter.

NOTE 9: (Water, rain)

IEC60068-2-18 [2] Test Rb method 2.2 has been chosen even if it does not imitate normal rain. It is a simple hand held shower test, easy to perform and can demonstrate that the specimen design is adequately tolerated to survive this condition. The cooling effect of the low temperature of the rain is included in IEC 60068-2-14 [2] Test Nb. Two durations are given, whichever is the greatest should be chosen.

NOTE 10: (Water, other sources)

No test is recommended because the effect is already included in IEC 60068-2-18 [2] Test Rb.

NOTE 11: (Radiation)

The heating effect of solar radiation is included in the higher test temperature in IEC 60068-2-2 [2] Test Bb as described in note 2. Photochemical tests can be made separately for component and materials.

NOTE 12: (Chemically active substances)

Characteristic severities are mean/maximum values. The characteristic severities should be considered when designing the equipment and when choosing components and materials. No test is recommended in this standard.

NOTE 13: (Mechanically active substances)

The characteristic severities are much lower than the lowest test severity in IEC 60068-2-68 [2] Test L and therefore no test is recommended. This condition should be considered when designing the equipment and choosing components and materials.

NOTE 14: (Flora and fauna)

The characteristic severities should be considered when choosing components and materials.

NOTE 15: (Environmental parameter)

In this table two IEC classes are given. IEC Class 4M3 may be chosen for equipment to be installed in locations where the mechanical conditions are equivalent to those given for partly- and not-temperature controlled locations or where the probability of high mechanical stresses are rare. In all other cases IEC class 4M5 should be used.

NOTE 16: (Vibration, sinusoidal)

The severities are given as peak values. Test severity values not specified in IEC 60068-2 [2]. The test severity is lower than the characteristic severity which is considered to be too severe for this class. Equipment under test shall be mounted in the "in-use" position. The equipment function shall be monitored throughout the test.

NOTE 17: (Vibration, random)

ASD (Acceleration Spectral Density) random vibration testing method may be used instead of the sinusoidal vibration test. The test severity values are not specified in IEC 60068-2 [2]. The maximum test frequency has been reduced because between 100 Hz and 200 Hz the contribution is insignificant.

	IEC class 4M3	IEC class 4M5
Acceleration RMS (for information only)	1,06 m/s ²	1,5 m/s ²

Equipment under test shall be mounted in the "in-use" position. The equipment function shall be monitored throughout the test.

NOTE 18: (Shocks)

The severities are given as peak values. The Energy content and the SRS of the shock given as test severity have been considered more appropriate than that given by the characteristic severity. Equipment under test shall be mounted in the "in-use" position. The equipment function shall be monitored throughout the test.

NOTE 19: (Earthquake)

RRS (Required Response Spectrum). ZPA (Zero Period Acceleration).

The equipment under test mounted in the "in use" position. The testing configuration shall be worst case in terms of weight and stiffness. The influence of connections, piping, cables, etc. shall be taken into account when mounting the specimen. The normal "in service" mounting structure of the specimen should be included in the test.

Single-axis excitation is recommended; simultaneous multi-axis excitation is also acceptable, but it is not recommended since, in general, multi-axis testing gives less reproducible test results.

The three testing axes can be reduced to two horizontal axes if the equipment, after the vibration response investigation in the vertical axis, does not exhibit any resonance below 20 Hz.

The strong part of the time-history should be at least 15 s. The duration of each time-history signal shall be 30 s. One time-history shall be applied along each axis.

Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

- ETR 035: "Equipment Engineering (EE); Environmental engineering; Guidance and terminology".
- IEC 60068-1: "Environmental testing - Part 1: General and guidance".

History

Document history		
Edition 1	May 1994	Publication as ETS 300 019-2-4
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