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**Environmental 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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**Reference**

REN/EE-01049

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## Foreword

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

The present document is part 2, sub-part 4 of a multi-part deliverable. Full details of the entire series can be found in part 2, sub-part 0 [i.1].

<b>National transposition dates</b>	
Date of adoption of this EN:	23 August 2013
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# 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 the present document apply to stationary use of equipment at non-weatherprotected locations covering the environmental conditions stated in EN 300 019-1-4 [1].

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## 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.

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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 300 019-1-4: "Environmental 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 60068-2-1 (03-2007): "Environmental testing, Part 2-1: Tests - Test A: Cold".
- [3] Void.
- [4] 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".
- [5] ANSI T1.0600329 (2008): "Network Equipment - Earthquake Resistance Standard".
- [6] Void.
- [7] IEC 60068-2-2 (07-2007): "Environmental testing, Part 2-2: Tests - Test B: Dry heat".
- [8] IEC 60068-2-14 (01-2009): "Environmental testing - Part 2-14: Tests - Test N: Change of temperature".
- [9] IEC 60068-2-30 (08-2005): "Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)".
- [10] IEC 60068-2-64 (04-2008): "Environmental testing - Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance".
- [11] IEC 60068-2-27 (02-2008): "Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock".
- [12] IEC 60068-2-6 (12-2007): "Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)".
- [13] IEC 60068-2-57 (11-1999): "Environmental testing - Part 2-57: Tests - Test Ff: Vibration - Time-history method".
- [14] Void.

- [15] IEC 60068-2-18 (10-2000): "Environmental testing - Part 2-18: Tests - Test R and guidance: Water".
- [16] IEC 60068-2-78 (08-2001): "Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state".

## 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] ETSI EN 300 019-2-0: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-0: Specification of environmental tests; Introduction".
- [i.2] IEC 60068-2-68 (8-1994): "Environmental testing - Part 2: Tests - Test L: Dust and sand".

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## 3 Environmental test specifications

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

EN 300 019-2-0 [i.1] forms a general overview of part 2 of this multipart deliverable.

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, climatic tests

This specification applies to most of Europe as described in EN 300 019-1-4 [1] (see table 1).

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

Environmental parameter			Environmental Class 4.1	Environmental test specification T 4.1: 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 [2]	Ab/Ad: Cold	1
	High	(°C)	+40	+40 or +55	16 h	IEC 60068-2-2 [7]	Bb/Bd: Dry heat	2
	Change	(°C) (°C/min)	0,5	-10/+40 0,5	2 cycles t <sub>1</sub> = 3 h	IEC 60068-2-14 [8]	Nb: Change of temperature	3
Humidity	Relative	Low (%)	15	none				8
		high (%)	100	93	10 d	IEC 60068-2-78 [16]	Cab: Damp heat steady state	4
		condensation (°C)	yes	+30				
	Absolute	Low (g/m <sup>3</sup> )	0,26	90-100	2 cycles	IEC 60068-2-30 [9]	Db: Damp heat, cyclic Variant 1	
		high (g/m <sup>3</sup> )	25	+30				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 <sup>3</sup> /min 90 kPa	3 min/m <sup>2</sup> or 15 min	IEC 60068-2-18 [15]	Rb: Impacting water Method 1	9
		low temperature (°C)	+5	none				
	Other sources		splashing water					10
Radiation	Icing & frosting		yes	none				8
	Solar	(W/m <sup>2</sup> )	1 120					11
Heat	(W/m <sup>2</sup> )	negligible						

Environmental parameter			Environmental Class 4.1	Environmental test specification T 4.1: Stationary use, Non-weatherprotected locations				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Chemically active substances	Sulphur	SO <sub>2</sub> (mg/m <sup>3</sup> )	0,3/1,0	none				12
		H <sub>2</sub> S (mg/m <sup>3</sup> )	0,1/0,5	none				12
	Chlorine	salt mist	sea and road salt	none				12
		Cl (mg/m <sup>3</sup> )	0,1/0,3	none				12
		HCl (mg/m <sup>3</sup> )	0,1/0,5	none				12
	Nitrogen	NO <sub>x</sub> (mg/m <sup>3</sup> )	0,5/1,0	none				12
		NH <sub>3</sub> (mg/m <sup>3</sup> )	1,0/3,0	none				12
	Hydrogen fluoride HF	(mg/m <sup>3</sup> )	0,01/0,03	none				12
Ozone O <sub>3</sub>	(mg/m <sup>3</sup> )	0,05/0,1	none				12	
Mechanically active substances	Dust	sedimentation (mg/(m <sup>2</sup> h))	20					13
		suspension (mg/m <sup>3</sup> )	5					13
	Sand	(mg/m <sup>3</sup> )	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, climatic tests

This specification covers most of Europe as described in EN 300 019-1-4 [1] (see table 2).

**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 T 4.1E: 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 [2]	Ab/Ad: Cold	1
	High	(°C)	+45	+45 or +60	16 h	IEC 60068-2-2 [7]	Bb/Bd: Dry heat	2
	Change	(°C) (°C/min)	0,5	-10/+45 0,5	2 cycles t1 = 3 h	IEC 60068-2-14 [8]	Nb: Change of temperature	3
Humidity	Relative	low (%)	8	none				8
		high (%)	100	93	10 d	IEC 60068-2-78 [16]	Cab: Damp heat steady state	4
		condensation (°C)	yes	+30	2 cycles	IEC 60068-2-30 [9]	Db: Damp heat cyclic Variant 1	5
	Absolute	low (g/m <sup>3</sup> )	0,03	90–100 +30	none			6
		high (g/m <sup>3</sup> )	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 <sup>3</sup> /min 90 kPa	6 min/m <sup>2</sup> or 30 min	IEC 60068-2-18 [15]	Rb: Impacting water, method 1	9
		low temperature (°C)	+5	none				
	Other sources		splashing water					10
	Icing & frosting		yes	none				8
Radiation	Solar	(W/m <sup>2</sup> )	1 120					11
	Heat	(W/m <sup>2</sup> )	negligible					

Environmental parameter			Environmental Class 4.1E	Environmental test specification T 4.1E: Stationary use Non-weatherprotected locations – extended					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes	
Chemically active substances	Sulphur	SO <sub>2</sub> (mg/m <sup>3</sup> )	0,3/1,0	none				12	
		H <sub>2</sub> S (mg/m <sup>3</sup> )	0,1/0,5	none				12	
	Chlorine	salt mist	sea and road salt	none					12
		Cl (mg/m <sup>3</sup> )	0,1/0,3	none					12
		HCl (mg/m <sup>3</sup> )	0,1/0,5	none					12
	Nitrogen	NO <sub>x</sub> (mg/m <sup>3</sup> )	0,5/1,0	none					12
		NH <sub>3</sub> (mg/m <sup>3</sup> )	1,0/3,0	none					12
	Hydrogen fluoride HF	(mg/m <sup>3</sup> )	0,01/0,03	none					12
Ozone O <sub>3</sub>	(mg/m <sup>3</sup> )	0,05/0,1	none					12	
Mechanically active substances	Dust	sedimentation (mg/(m <sup>2</sup> h))	20						13
		suspension (mg/m <sup>3</sup> )	5						13
	Sand	(mg/m <sup>3</sup> )	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.

### 3.3 Specification T 4.2L: Non-weatherprotected locations – extremely cold, climatic tests

This specification covers world-wide conditions as described in EN 300 019-1-4 [1] (see table 3).

**Table 3: Test specification T 4.2L: Stationary use at non-weatherprotected locations, extremely cold - climatic tests**

Environmental parameter			Environmental Class 4.2L	Environmental test specification T 4.2L: Stationary use Non-weatherprotected locations – extremely cold				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Air temperature	Low	(°C)	-65	-65 or -75	16 h	IEC 60068-2-1 [2]	Ab/Ad: Cold	1
	High	(°C)	+35	+35 or +50	16 h	IEC 60068-2-2 [7]	Bb/Bd: Dry heat	2
	Change	(°C) (°C/min)	0,5	-10/+45 0,5	2 cycles t1 = 3 h	IEC 60068-2-14 [8]	Nb: Change of temperature	3
Humidity	Relative	low (%)	20	none				8
		high (%)	100	93	10 d	IEC 60068-2-78 [16]	Cab: Damp heat steady state	4
		condensation (°C)	yes	+30	2 cycles	IEC 60068-2-30 [9]	Db: Damp heat cyclic Variant 1	5
	Absolute	low (g/m <sup>3</sup> )	0,003	90 –100 +30				6
		high (g/m <sup>3</sup> )	22					
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 <sup>3</sup> /min 90 kPa	6 min/m <sup>2</sup> or 30 min	IEC 60068-2-18 [15]	Rb: Impacting water, method 1	9
		low temperature (°C)	+5	none				
	Other sources Icing & frosting		splashing water yes	none				10 8
Radiation	Solar	(W/m <sup>2</sup> )	1 120					11
	Heat	(W/m <sup>2</sup> )	negligible					

Environmental parameter			Environmental Class 4.2L	Environmental test specification T 4.2L: Stationary use Non-weatherprotected locations – extremely cold				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Chemically active substances	Sulphur	SO <sub>2</sub> (mg/m <sup>3</sup> )	0,3/1,0	none				12
		H <sub>2</sub> S (mg/m <sup>3</sup> )	0,1/0,5	none				12
	Chlorine	salt mist	sea and road salt	none				12
		Cl (mg/m <sup>3</sup> )	0,1/0,3	none				12
		HCl (mg/m <sup>3</sup> )	0,1/0,5	none				12
	Nitrogen	NO <sub>x</sub> (mg/m <sup>3</sup> )	0,5/1,0	none				12
		NH <sub>3</sub> (mg/m <sup>3</sup> )	1,0/3,0	none				12
	Hydrogen fluoride HF	(mg/m <sup>3</sup> )	0,01/0,03	none				12
Ozone O <sub>3</sub>	(mg/m <sup>3</sup> )	0,05/0,1	none				12	
Mechanically active substances	Dust	sedimentation (mg/(m <sup>2</sup> h))	20					13
		suspension (mg/m <sup>3</sup> )	5					13
	Sand	(mg/m <sup>3</sup> )	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.								

### 3.4 Specification T 4.2H: Non-weatherprotected locations – extremely warm dry, climatic tests

This specification covers world-wide conditions as described in EN 300 019-1-4 [1] (see table 4).

**Table 4: Test specification T 4.2H: Stationary use at non-weatherprotected locations, extremely warm dry - climatic tests**

Environmental parameter			Environmental Class 4.2H	Environmental test specification T 4.2H: Stationary use Non-weatherprotected locations – extremely warm dry				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Air temperature	Low	(°C)	-20	-20 or -30	16 h	IEC 60068-2-1 [2]	Ab/Ad: Cold	1
	High	(°C)	+55	+55 or +70	16 h	IEC 60068-2-2 [7]	Bb/Bd: Dry heat	2
	Change	(°C) (°C/min)	0,5	-10/+45 0,5	2 cycles t1 = 3 h	IEC 60068-2-14 [8]	Nb: Change of temperature	3
Humidity	Relative	low (%)	4	none				8
		high (%)	100	93	10 d	IEC 60068-2-78 [16]	Cab: Damp heat steady state	4
		condensation (°C)	yes	+40				
	Absolute	low (g/m <sup>3</sup> )	0,9	90–100	2 cycles	IEC 60068-2-30 [9]	Db: Damp heat cyclic Variant 1	5
		high (g/m <sup>3</sup> )	36	+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 <sup>3</sup> /min 90 kPa	6 min/m <sup>2</sup> or 30 min	IEC 60068-2-18 [15]	Rb: Impacting water, method 1	9
		low temperature (°C)	+5	none				
	Other sources		splashing water					10
	Icing & frosting		yes	none				8
Radiation	Solar	(W/m <sup>2</sup> )	1 120					11
	Heat	(W/m <sup>2</sup> )	negligible					

Environmental parameter			Environmental Class 4.2H	Environmental test specification T 4.2H: Stationary use Non-weatherprotected locations, extremely warm dry				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Chemically active substances	Sulphur	SO <sub>2</sub> (mg/m <sup>3</sup> )	0,3/1,0	none				12
		H <sub>2</sub> S (mg/m <sup>3</sup> )	0,1/0,5	none				12
	Chlorine	salt mist	sea and road salt	none				12
		Cl (mg/m <sup>3</sup> )	0,1/0,3	none				12
		HCl (mg/m <sup>3</sup> )	0,1/0,5	none				12
	Nitrogen	NO <sub>x</sub> (mg/m <sup>3</sup> )	0,5/1,0	none				12
		NH <sub>3</sub> (mg/m <sup>3</sup> )	1,0/3,0	none				12
	Hydrogen fluoride HF (mg/m <sup>3</sup> )	0,01/0,03	none				12	
	Ozone O <sub>3</sub> (mg/m <sup>3</sup> )	0,05/0,1	none				12	
Mechanically active substances	Dust	sedimentation (mg/(m <sup>2</sup> h))	20					13
		suspension (mg/m <sup>3</sup> )	5					13
	Sand (mg/m <sup>3</sup> )	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.								

### 3.5 Specification T 4.1, 4.1E, 4.2L and 4.2H: Non-weatherprotected locations - mechanical tests

**Table 5: Test specification T 4.1: Non-weatherprotected locations - mechanical tests**  
**Test specification T 4.1E: Non-weatherprotected locations, extended - mechanical tests**  
**Test specification T 4.2L: Non-weatherprotected locations, extremely cold - mechanical tests**  
**Test specification T 4.2H: Non-weatherprotected locations, extremely warm dry - mechanical tests**

Environmental parameter			Environmental Class 4.X	Environmental test specification T 4.X: Stationary use, Non-weatherprotected locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity		Duration	Reference	Method	Notes
Vibration IEC 60721-3-4 [4] Class 4M5 [5]	Sinusoidal	displacement (mm)	3,0	1,2			IEC 60068-2-6 [12]	Fc: Vibration (sinusoidal)	15;16
		acceleration (m/s <sup>2</sup> )	10	4					
		frequency range (Hz)	2-9	5-9	9-200	3 x 5 sweep cycles			
	Random	ASD (m <sup>2</sup> /s <sup>3</sup> )	no	0,04			IEC 60068-2-64 [10]	Fh: Vibration, broad-band (digital control)	15;17
		frequency range (Hz)		+12	-12				
		axes of vibration		5-10	10-50	50-100	3 x 30 minutes		
				3					
Shocks IEC 60721-3-4 Class 4M5 [4]	Shocks	shock spectrum	Type II	half sine			IEC 60068-2-27 [11]	Ea: Shock	15;18
		duration (ms)	6	11					
		acceleration (m/s <sup>2</sup> )	250	50					
		number of shocks		6		100 in each direction			
		directions of shocks							
Vibration IEC 60721-3-4 Class 4M3 [4]	Sinusoidal	velocity (mm/s)	1,5	5			IEC 60068-2-6 [12]	Fc: Vibration (sinusoidal)	15;16
		displacement (mm)		2					
		acceleration (m/s <sup>2</sup> )	2-9	5-62	62-200	3 x 5 sweep cycles			
		frequency range (Hz)		3					
	Random	ASD (m <sup>2</sup> /s <sup>3</sup> )	no	0,02			IEC 60068-2-64 [10]	Fh: Vibration, broad-band (digital control)	15;17
		frequency range (Hz)		+12	-12				
		axes of vibration		5-10	10-50	50-100	3 x 30 minutes		
				3					
Shocks IEC 60721-3-4 Class 4M3 [4]	Shocks	shock spectrum	Type L	half sine			IEC 60068-2-27 [11]	Ea: Shock	15;18
		duration (ms)	22	11					
		acceleration (m/s <sup>2</sup> )	70	30					
		number of shocks		6		3 in each direction			
		directions of shocks							

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 classes 4.1, 4.1E, 4.2L and 4.2H.

### 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 [12] (test Fc), with the following parameter severities:

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

NOTE 1: The vibration amplitude may be reduced to 1 m/s<sup>2</sup> 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 [10], using the following severities:

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

NOTE 2: The Acceleration Spectral Density (ASD) value may be reduced to 0,3 m<sup>2</sup>/s<sup>3</sup> or less in case of sharp resonances.

- The time-history stated in table 6 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 5 for class 4M5. This test is sufficient to prove compliance with the earthquake conditions given in EN 300 019-1-4 [1].

### 4.2 Test conditioning

See table 6.

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 6: Test specification T 4.X: Earthquake test

Environmental parameter			Environmental Class 4.X	Environmental test specification T 4.X: Earthquake test				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Earthquake	Time-history	RRS	fig.1, tab.7	fig.1, tab.7		IEC 60068-2-57 [13]	Ff: time-history method	19
		frequency range (Hz)	0,3 - 50	1 - 35				
		ZPA (m/s <sup>2</sup> )	5	5				
		axes		3	30 s			
		damping ratio (%)		2				

NOTE: n = number of note, see clause 5.

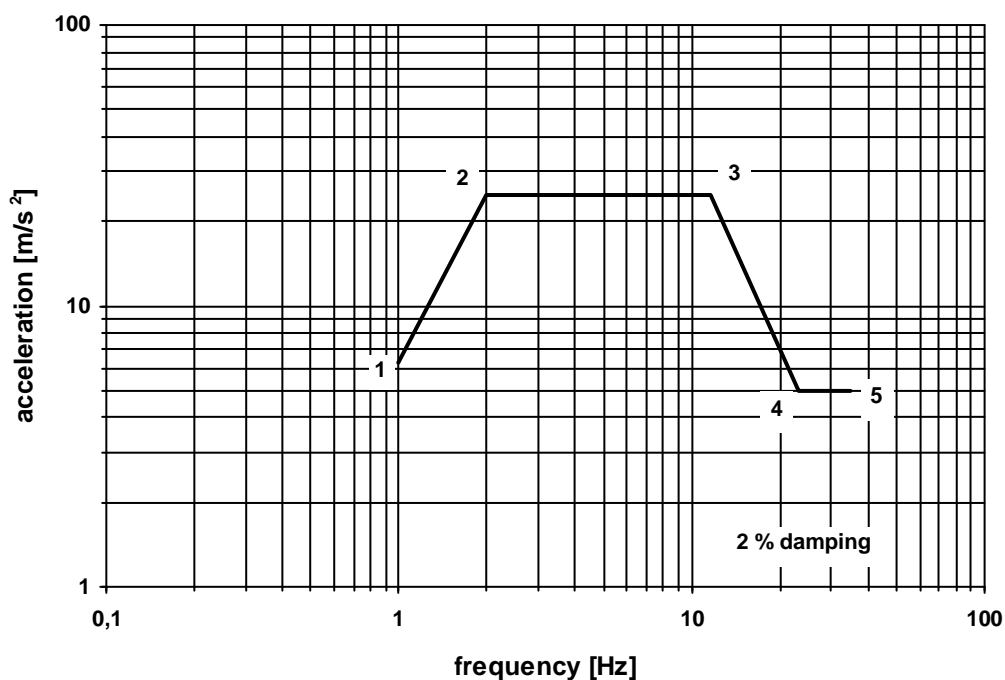


Figure 1: Earthquake Required Response Spectrum

Table 7: Acceleration co-ordinates for the Required Response Spectrum in figure 1

Co-ordinate point	Frequency [Hz]	Ground acceleration [m/s <sup>2</sup> ]
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 EN 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 6

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 60068-2-78 [16] Test Cab is recommended with test severities not higher than climatogram limits for this class.

NOTE 5: (Condensation).

IEC 60068-2-30 [9] 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 60068-2-78 [16] Test Cab.

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 IEC 60068-2 [2] series test for this parameter.

NOTE 9: (Water, rain).

IEC 60068-2-18 [15] Test Rb method 1 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 [8] 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 [15] Test Rb.

NOTE 11: (Radiation).

The heating effect of solar radiation is included in the higher test temperature in IEC 60068-2-2 [7] 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 the present document.

NOTE 13:(Mechanically active substances).

The characteristic severities are much lower than the lowest test severity in IEC 60068-2-68 [i.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 series. 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 series. The maximum test frequency has been reduced to 100 Hz because between 100 Hz and 200 Hz the contribution is insignificant. Also at low and high frequency ends the ASD is reduced by 12 dB/oct.

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

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).

Time history signal Verteq II specified in ANSI T1.0600329 [5] shall be used.

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.

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## Annex A (informative): Bibliography

IEC 60068-1: "Environmental testing - Part 1: General and guidance".

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

## History

<b>Document history</b>		
Edition 1	May 1994	Publication as ETS 300 019-2-4
Amendment 1	June 1997	Amendment 1 to 1 <sup>st</sup> Edition of ETS 300 019-2-4
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