



**Environmental Engineering (EE);
Environmental conditions and environmental tests for
telecommunications equipment;
Part 2-8: Specification of environmental tests;
Stationary use at underground locations**

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

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Modal verbs terminology

In the present document **"shall"**, **"shall not"**, **"should"**, **"should not"**, **"may"**, **"need not"**, **"will"**, **"will not"**, **"can"** and **"cannot"** are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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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 at underground locations covering the environmental conditions stated in ETSI EN 300 019-1-8 [1].

2 References

2.1 Normative 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 referenced document (including any amendments) applies.

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The following referenced documents are necessary for the application of the present document.

- [1] ETSI EN 300 019-1-8 (04-2003): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-8: Classification of environmental conditions; Stationary use at underground locations".
- [2] IEC 60068-2-1 (03-2007): "Environmental testing - Part 2-1: Tests - Test A: Cold".
- [3] IEC 60068-2-17 (07-1994): "Basic environmental testing procedures - Part 2-17: Tests - Test Q: Sealing".
- [4] Void.
- [5] ATIS T1.0600329 (2014): "Network Equipment - Earthquake Resistance".
- [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 (04-2013): "Environmental testing - Part 2-57: Tests - Test Ff: Vibration - Time-history and sine-beat method".
- [14] Void.
- [15] Void.

- [16] IEC 60068-2-78 (10-2012): "Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state".
- [17] Void.

2.2 Informative 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 referenced document (including any amendments) applies.

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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 (08-1994): "Environmental testing - Part 2-68: Tests - Test L: Dust and sand".
- [i.3] IEC 60068-2 (all parts): "Environmental testing - Part 2: Tests".
- [i.4] ETSI EN 300 019-1-0: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-0: Classification of environmental conditions; Introduction".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 300 019-1-0 [i.4] apply.

3.2 Symbols

For the purposes of the present document, the symbols given in ETSI EN 300 019-1-0 [i.4] apply.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI EN 300 019-1-0 [i.4] apply.

4 Environmental test specifications

4.0 General

The equipment shall be tested in its operational state throughout the test conditions described in the present document. The detailed descriptions of the environmental conditions shall refer to clauses 4 and 5 of ETSI EN 300 019-1-8 [1].

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

4.1 Equipment setup and configuration

The equipment shall be tested in its operational state throughout the test conditions described in the present document unless otherwise stated. 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.

4.2 Performance criteria

The following performance criteria shall apply in the tests defined by the present document.

Performance criterion A:

The equipment shall function according to the manufacturer specifications before, during and after the tests. No degradation of performance or loss of function is allowed below the performance level specified by the manufacturer when the equipment is used as intended. If the minimum performance level is not specified by the manufacturer, then this may be deduced from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

Performance criterion B:

The equipment shall function according to the manufacturer specifications before and after the tests. During the test it is not required to monitor the equipment functionality. No degradation of performance or loss of function is allowed below the performance level specified by the manufacturer when the equipment is used as intended. If the minimum performance level is not specified by the manufacturer, then this may be deduced from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

Performance criterion C:

The equipment shall function according to the manufacturer specifications before and after the tests. No degradation of performance or loss of function is allowed below the performance level specified by the manufacturer when the equipment is used as intended. If the minimum performance level is not specified by the manufacturer, then this may be deduced from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

During the application of the test, temporary loss of function is allowed but after the test the equipment shall restore to the normal functionality without replacement of components, manual rebooting or human intervention.

The equipment shall sustain the test without permanent structural or mechanical damage.

Performance criterion D:

This performance criterion applies to the enclosure of the equipment. No corrosion traces (e.g. rust) or deterioration of the enclosure shall occur at the end of the test.

4.3 Specification T 8.1: Partly weatherprotected underground locations

The present document shall apply to underground enclosures in footway boxes, manholes and some tunnels etc. which are protected from direct weather influences. The location has no temperature or humidity control, but the variations in the temperature are limited due to the stabilizing influence of the surroundings. The equipment may be immersed in water during exceptional conditions.

Table 1: Test specification T 8.1: Partly weatherprotected underground 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	Performance criterion	Notes
Air temperature	Low	(°C)	-10	-10	16 h	IEC 60068-2-1 [2]	Ab/Ad/Ae: Cold	A	
	High	(°C)	+40	+40	16 h	IEC 60068-2-2 [7]	Bb/Bd/Be: Dry heat	A	
	Change	(°C) (°C/min)	5	-10 to +40 0,5	2 cycles t ₁ = 3 h	IEC 60068-2-14 [8]	Nb: Change of temperature with specified rate of change	A	1
Humidity	Relative	Low (%)	5	None					2
		High (%)	100	93 +30	21 d	IEC 60068-2-78 [16]	Cb: Damp heat Steady state	A	3
		Condensation (%)	Yes	90 to 100 +40	2 cycles	IEC 60068-2-30 [9]	Db: Damp heat, cyclic Variant 1	A	4
	Absolute	Low (g/m ³)	0,5	None					2
		High (g/m ³)	23	None					5
Air	Pressure	Low (kPa)	70	None					6
		High (kPa)	106	None					6
	Speed	(m/s)	1	None					2
Water	Rain	Intensity	None						
		Low temperature (°C)	None						
	Other sources	(m) (kPa)	dripping water condensed water immersion to soil water	2 19,6	1h	IEC 60068-2-17 [3]	Qf: Immersion	A	7
	Icing & frosting		Yes	None					2
Radiation	Solar	(W/m ²)	None	None					
	Heat	(W/m ²)	Yes	None					8
Chemically active substances	Sulphur	SO ₂ (mg/m ³)	0,3 to 1,0	None					9
		H ₂ S (mg/m ³)	0,1 to 0,5	None					9
	Chlorine	Salt mist	Sea and road salt	None					9
		Cl (mg/m ³)	0,1 to 0,3	None					9
		HCl (mg/m ³)	0,1 to 0,5	None					9
		NO _x (mg/m ³)	0,5 to 1,0	None					9
	Nitrogen	NH ₃ (mg/m ³)	1,0 to 3,0	None					9
		Hydrogen fluoride HF (mg/m ³)	0,01 to 0,03	None					9
	Ozone O ₃	(mg/m ³)	0,05 to 0,1	None					9

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	Performance criterion	Notes
Mechanically active substances	Dust	Sedimentation (mg/(m ² h))	15	None					10
		Suspension (mg/m ³)	0,4	None					10
	Sand	(mg/m ³)	300	None					10
Flora and fauna	Micro organisms	Mould, fungus, etc.	None						11
	Rodents, insects	Rodents, etc.	None						
<p>NOTE 1: (Air temperature, change). IEC 60068 2-1 [2] Test Na is recommended with value not specified in IEC 60068 2-1 [2]. The test may be subdivided in two tests as follows: -10/+5 °C and +5/+40 °C.</p> <p>NOTE 2: There is no IEC 60068-2 [i.3] series test for this parameter.</p> <p>NOTE 3: (Humidity, relative high). IEC 60068-2-78 [16] Test Cb shall be used with test severities not higher than climatogram limits for this class.</p> <p>NOTE 4: (Condensation). IEC 60068-2-30 [9] Test Db shall be used with test severities not higher than climatogram limits for this class.</p> <p>NOTE 5: (Humidity, absolute, high). This effect is considered to be partly included in the damp heat test IEC 60068-2-30 [9] Test Db.</p> <p>NOTE 6: (Air pressure, low and high). No test is required for normal applications, because the effect of air pressure is evaluated at the component level.</p> <p>NOTE 7: (Water, other sources). IEC 60068-2-17 [3] Test Qf: Immersion is recommended. The effect of dripping and condensed water is also covered by this test.</p> <p>NOTE 8: (Radiation, heat). The heating effect of all sources is included in the high temperature test.</p> <p>NOTE 9: (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 required in the present document.</p> <p>NOTE 10: (Mechanically active substances). The immersion test will normally ensure compliance with the dust and sand requirement. The characteristic severities are much lower than lowest severities in IEC 60068-2-68 [i.2] Test L and therefore no test is required. This condition should be considered when designing the equipment and choosing components and materials.</p> <p>NOTE 11: (Flora and fauna). The characteristic severities should be considered when choosing components and materials.</p>									

Table 2: Test specification T 8.1: Partly weatherprotected underground locations - 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	Performance criterion	Notes
Vibration Severity class 1	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 [12]	Fc: Vibration (sinusoidal)	A	1; 2
		ASD (m ² /s ³) (dB/oct) Frequency range (Hz) Axes of vibration	No	0,04 +12 -12 5-10 10-50 50-100 3	3 x 30 minutes	IEC 60068-2-64 [10]	Fh: Vibration, broad-band (digital control)	A	1; 3
Shocks Severity class 1	Shocks	Shock spectrum Duration (ms) Acceleration (m/s ²) Number of shocks Directions of shocks	Type II 6 250	Half sine 11 50 6	100 in each direction	IEC 60068-2-27 [11]	Eb: Bump	A	1; 4
Vibration Severity class 2	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 [12]	Fc: Vibration (sinusoidal)	A	1; 2
		ASD (m ² /s ³) (dB/oct) Frequency range (Hz) Axes of vibration	None	0,02 +12 -12 5-10 10-50 50-100 3	3 x 30 minutes	IEC 60068-2-64 [10]	Fh: Vibration, broad-band (digital control)	A	1; 3
Shocks Severity class 2	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 [11]	Ea: Shock	A	1; 4

NOTE 1: In this table two tests severity classes are given. Test severity class 2 may be chosen for equipment that, according to the product manufacturer specifications, are intended 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 the test severity class 1 shall be applied.

NOTE 2: (Vibration, sinusoidal). The severities are given as peak values. These test severity values are not specified in IEC 60068-2 [i.3] 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.

NOTE 3: (Vibration, random). ASD (Acceleration Spectral Density) random vibration testing method may be used instead of the sinusoidal vibration test. These test severity values are not specified in IEC 60068-2 [i.3] 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. Equipment under test shall be mounted in the "in-use" position.

NOTE 4: (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.

5 Earthquake test specification

5.0 General

If the equipment is declared by the manufacturer to be designed to withstand earthquake conditions, the test requirements stated below shall be applied.

The test specification is applicable to classes 8.1.

5.1 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:

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 [10], 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 3 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 2 for the test severity class 1. This test is sufficient to prove compliance with the earthquake conditions given in ETSI EN 300 019-1-8 [1].

5.2 Test conditioning

The tests shall be performed according to the test conditions defined in table 3.

Table 3: Test specification T 8.1: 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	Performance criterion	Notes
Earthquake	Time-history	RRS	Figure 1, table 4	Figure 1, table 4		IEC 60068-2-57 [13]	Ff: time-history method	C	(see note)
		Frequency range (Hz)	0,3 - 50	1 - 35					
		ZPA (m/s ²)	5	5					
		Axes		3	30 s				
		Damping ratio (%)		2					
<p>NOTE: (Earthquake). Time history signal Verreq II specified in ATIS T1.0600329 [5] shall be used. Required Response Spectrum (RRS). Zero Period Acceleration (ZPA). 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 shall be included in the test. Single-axis excitation shall be used; 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.</p>									

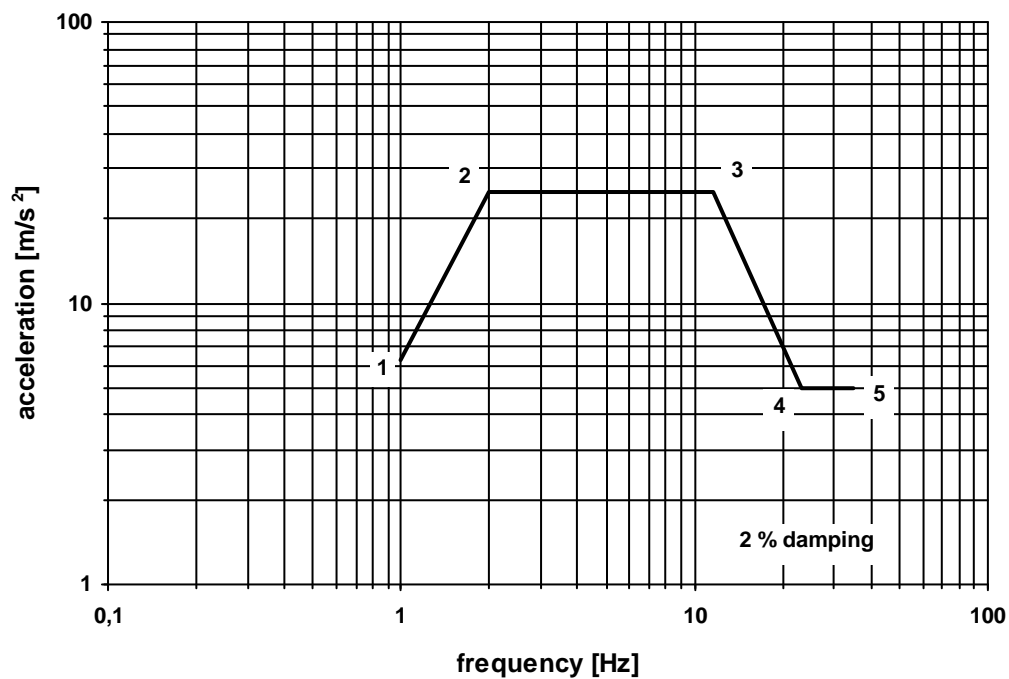


Figure 1: Earthquake Required Response Spectrum

Table 4: 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

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

Document history		
Edition 1	September 1997	Publication as ETSI ETS 300 019-2-8
V2.1.2	September 1999	Publication
V2.1.8	December 2019	EN Approval Procedure AP 20200309: 2019-12-10 to 2020-03-09
V2.2.1	March 2020	Publication