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EUROPEAN STANDARD

**Environmental Engineering (EE);
Environmental conditions and environmental tests
for telecommunications equipment;
Part 2-3: Specification of environmental tests;
Stationary use at weatherprotected locations**

Reference

REN/EE-017003

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650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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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 3 of a multi-part deliverable. Full details of the entire series can be found in part 2, sub-part 0 [i.2].

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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 severities and methods for the verification of the required resistibility of equipment according to the relevant environmental class.

The tests in the present document apply to stationary use of equipment at weatherprotected locations covering the environmental conditions stated in ETSI EN 300 019-1-3 [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.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://docbox.etsi.org/Reference/>.

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

- [1] ETSI EN 300 019-1-3: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weatherprotected locations".
- [2] IEC 60068-2-1:2007: "Environmental testing - Part 2-1: Tests - Test A: Cold".
- [3] Void.
- [4] IEC 60721-3-3:2019: "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weatherprotected locations".
- [5] Void.
- [6] IEC 60068-2-2:2007: "Environmental testing - Part 2-2: Tests - Test B: Dry heat".
- [7] IEC 60068-2-14:2009: "Environmental testing - Part 2-14: Tests - Test N: Change of temperature".
- [8] IEC 60068-2-78:2012: "Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state".
- [9] IEC 60068-2-30:2005: "Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)".
- [10] IEC 60068-2-64:2008+AMD1:2019: "Environmental testing - Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance".
- [11] IEC 60068-2-27:2008: "Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock".
- [12] IEC 60068-2-6:2007: "Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)".
- [13] IEC 60068-2-57:2013: "Environmental testing - Part 2-57: Tests - Test Ff: Vibration - Time-history and sine-beat method".
- [14] IEC 60068-2-68:1994: "Environmental testing - Part 2-68: Tests - Test L: Dust and sand".

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.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

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 300 019-1-0: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-0: Classification of environmental conditions; Introduction".
- [i.2] 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".

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.1] apply.

3.2 Symbols

Void.

3.3 Abbreviations

Void.

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 are given in clauses 4 and 5 of ETSI EN 300 019-1-3 [1].

ETSI EN 300 019-2-0 [i.2] 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 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 Specifications T 3.1 and T 3.1E: Temperature-controlled locations

Specification T 3.1: Temperature-controlled locations - normal operating conditions.

The specification in table 1 and table 2 shall apply to permanently temperature-controlled enclosed locations where humidity is usually not controlled.

Table 1: Test specification T 3.1: Temperature-controlled locations - climatic tests

Environmental parameter			Environmental Class 3.1	Environmental test specification T 3.1: In-use, Temperature-controlled locations						
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes	
Air temperature	Low	(°C)	+5	+5	16 h	IEC 60068-2-1 [2]	Ab/Ad/Ae: Cold	A	1	
	High	(°C)	+40	+40 or +50	16 h	IEC 60068-2-2 [6]	Bb/Bd/Be: Dry heat	A	2	
	Change	(°C) (°C/min)	0,5	+25 to+40 0,5	half cycle t ₁ = 3 h	IEC 60068-2-14 [7]	Nb: Change of temperature	A	3	
Humidity	Relative	low (%)	5	None					4	
		high (%)	85	85	4 d	IEC 60068-2-78 [8]	Cab: Damp heat steady state	A	5	
		condensation	no	None						
	Absolute	low (g/m ²)	1	None					4	
high (g/m ²)		25	None					7		
Air	Pressure	low (kPa)	70	None					8	
		high (kPa)	106	None					8	
	Speed	(m/s)	5,0	None					4	
Water	Rain	Intensity	no	None						
		low temperature	no	None						
	Other sources		no	None						
	Icing & frosting		no	None						
Radiation	Solar	(W/m ²)	700	None					9	
	Heat	(W/m ²)	600	None					10	
Chemically active substances	Sulphur	SO ₂ (mg/m ³)	0,3/1,0	None					11	
		H ₂ S (mg/m ³)	0,1/0,5	None					11	
	Chlorine	salt mist	sea and road salt		None					11
		Cl (mg/m ³)		0,1/0,3	None					11
		HCl (mg/m ³)		0,1/0,5	None					11
	Nitrogen	NO _x (mg/m ³)		0,5/1,0	None					11
		NH ₃ (mg/m ³)		1,0/3,0	None					11
Hydrogen fluoride HF	(mg/m ³)		0,01/0,03	None					11	

Environmental parameter			Environmental Class 3.1	Environmental test specification T 3.1: In-use, Temperature-controlled locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
	Ozone O ₃	(mg/m ³)	0,05/0,1	None					11
Mechanically active substances	Dust	sedimentation (mg/(m ² h))	1,5	None					12
		suspension (mg/m ³)	0,2	None					13
	Sand	(mg/m ³)	30	None					12
Flora and fauna	Micro organisms		negligible						
	Rodents, insects		negligible						
NOTE 1:	(Air temperature, low). The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If a cold start up test is performed, the characteristic severity should be used as a cold start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the cold start up test shall commence once low temperature stability is achieved.								
NOTE 2:	(Air temperature, high). The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If two test temperatures are given, the lower test temperature applies if the equipment is protected against solar and heat radiation or the equipment is ventilated (natural or forced). The higher test temperature includes the heating effects of solar and/or heat radiation. If a high temperature start up test is performed, the characteristic severity should be used as a high start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the high temperature start up test shall commence once high temperature stability is achieved.								
NOTE 3:	(Air temperature, change). The change of temperature test is normally used to check design tolerance. IEC 60068-2-14 [7] Test Nb shall be used. For change of temperature of 0,5 °C/min, the cooling gradient may be reduced to 0,2 °C/min where test chamber restrictions preclude a gradient of 0,5 °C/min.								
NOTE 4:	(Relative humidity, low). There is no IEC 60068-2 series test method for this parameter.								
NOTE 5:	(Humidity, relative, high). IEC 60068-2-78 [8] Test Cab shall be used with test values not higher than climatogram limits for this class.								
NOTE 6:	(Condensation). IEC 60068-2-30 [9] Test Db shall be used with test values not higher than climatogram limits for this class.								
NOTE 7:	(Humidity, absolute, high). This effect is considered to be partly included in the damp heat test IEC 60068-2-78 [8] Test Cab.								
NOTE 8:	(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 9:	(Radiation, solar). The higher test temperature as described in note 2 includes the heating effect of solar radiation. Photochemical tests can be made separately for components and materials.								
NOTE 10:	(Radiation, heat). The higher test temperature as described in note 2 includes the heating effect.								
NOTE 11:	(Chemically active substances). The characteristic severities are given as mean/maximum values. These severities should be considered when designing the equipment and when choosing components and materials. No test is recommended in the present document.								
NOTE 12:	(Mechanically active substances). The characteristic severities are much lower than lowest test severity in IEC 60068-2-68 [14] Test L and therefore no test is recommended. This condition should be considered when designing the equipment and when choosing components and materials.								

Environmental parameter			Environmental Class 3.1	Environmental test specification T 3.1: In-use, Temperature-controlled locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
NOTE 13: (Mechanically active substances). The characteristic severities are much lower than the lowest test severity in IEC 60068-2-68 [14] Test Lb and therefore no test is required. This condition should be considered when designing the equipment and choosing components and materials. One possible test to evaluate the impact of corrosion due to dust can be found in Annex A.									

Table 2: Test specification T 3.1: Temperature-controlled locations - mechanical tests

Environmental parameter			Environmental Class 3.1	Environmental test specification T 3.1: In-use, Temperature-controlled locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
Vibration	Sinusoidal	displacement (mm) acceleration (m/s ²) frequency range (Hz) axes of vibration	0,3 1,0 2-9 9-200	none					1
Shocks	Shocks	shock spectrum duration (ms) acceleration (m/s ²) number of shocks direction of shocks	Type L 22 40	half sine 11 30 6	3 in each direction	IEC 60068-2-27 [11]	Ea: Shock	A	2
NOTE 1: (Vibration, sinusoidal). No test is recommended as the characteristic severities represent insignificant levels of vibration. The severities are given as peak values.									
NOTE 2: (Shocks). The values for test severity are not specified in IEC 60068-2 series. 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.									

Specification T 3.1E: Temperature-controlled locations - exceptional operating conditions.

The specification in table 3 shall apply to permanently temperature-controlled locations where humidity is usually not controlled. The reference class is the same as for T 3.1, but with extended temperature and humidity ranges.

Table 3: Test specification T 3.1E: Temperature-controlled locations, exceptional operating conditions - climatic tests

Environmental parameter			Environmental Condition 3.1E	Environmental test specification T 3.1E: In-use, Temperature-controlled locations - Exceptional					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
Air temperature	Low	(°C)	-5	-5	16 h	IEC 60068-2-1 [2]	Ab/Ad/Ae: Cold	A	1
	High	(°C)	+45	+45 or +55	16 h	IEC 60068-2-2 [6]	Bb/Bd/Be: Dry heat	A	2
	Change	(°C) (°C/min)	0,5	+25 to+45 0,5	half cycle t ₁ = 3 h	IEC 60068-2-14 [7]	Nb: Change of temperature	A	3
Humidity	Relative	low (%)	5	none					4
		high (%)	90	93	4 d	IEC 60068-2-78 [8]	Cab: Damp heat steady state	A	5
		condensation	no						
	Absolute	low (g/m ³)	1	none					4
high (g/m ³)		25						6	
Radiation	Solar	(W/m ²)	700						7
	Heat	(W/m ²)	600						8
<p>NOTE 1: (Air temperature, low). The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If a cold start up test is performed, the characteristic severity should be used as a cold start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the cold start up test shall commence once low temperature stability is achieved.</p> <p>NOTE 2: (Air temperature, high). The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If two test temperatures are given, the lower test temperature applies if the equipment is protected against solar and heat radiation or the equipment is ventilated (natural or forced). The higher test temperature includes the heating effects of solar and/or heat radiation. If a high temperature start up test is performed, the characteristic severity should be used as a high start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the high temperature start up test shall commence once high temperature stability is achieved.</p> <p>NOTE 3: (Air temperature, change). The change of temperature test is normally used to check design tolerance. IEC 60068-2-14 [7] Test Nb shall be used. For change of temperature of 0,5 °C/min, the cooling gradient may be reduced to 0,2 °C/min where test chamber restrictions preclude a gradient of 0,5 °C/min.</p> <p>NOTE 4: (Relative humidity, low). There is no IEC 60068-2 series test method for this parameter.</p> <p>NOTE 5: (Humidity, relative, high). IEC 60068-2-78 [8] Test Cab shall be used with test values not higher than climatogram limits for this class.</p> <p>NOTE 6: (Humidity, absolute, high). This effect is considered to be partly included in the damp heat test IEC 60068-2-78 [8] Test Cab.</p> <p>NOTE 7: (Radiation, solar). The higher test temperature as described in note 2 includes the heating effect of solar radiation. Photochemical tests can be made separately for components and materials.</p> <p>NOTE 8: (Radiation, heat). The higher test temperature as described in note 2 includes the heating effect.</p>									

4.4 Specification T 3.2: Partly temperature-controlled locations

The specification in table 4 and table 5 shall apply to weather-protected locations having neither temperature nor humidity control, but where heating may be used to avoid low temperatures. The building construction avoids extremely high temperatures.

Table 4: Test specification T 3.2: Partly temperature-controlled locations - climatic tests

Environmental parameter			Environmental Class 3.2	Environmental test specification T 3.2: In-use, Partly temperature-controlled locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
Air temperature	Low	(°C)	-5	-5	16 h	IEC 60068-2-1 [2]	Ab/Ad/Ae: Cold	A	1
	High	(°C)	+45	+45 or +55	16 h	IEC 60068-2-2 [6]	Bb/Bd/Be: Dry heat	A	2
	Change	(°C) (°C/min)	0,5	+25 to+55 or +25 to+45 0,5	half cycle t ₁ = 3 h	IEC 60068-2-14 [7]	Nb: Change of temperature	A	3
Humidity	Relative	low (%)	5	none	4 d steady state	IEC 60068-2-78 [8]	Cab: Damp heat	A	4
		high (%)	95	93					5
		condensation (°C) (%)	yes	+30° 90-100	1 cycle	IEC 60068-2-30 [9]	Db: Damp heat cyclic Variant 1	A	6
	Absolute	low (g/m ³)	1	none					4
		high (g/m ³)	29						7
Air	Pressure	low (kPa)	70	none					8
		high (kPa)	106	none					8
	Speed	(m/s)	5,0	none					4
Water	Rain	intensity	no						
		low temperature	no						
	Other sources		no						
	Icing & frosting		yes						4
Radiation	Solar	(W/m ²)	700						9
	Heat	(W/m ²)	600						10

Environmental parameter			Environmental Class 3.2	Environmental test specification T 3.2: In-use, Partly temperature-controlled locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
Chemically active substances	Sulphur	SO ₂ (mg/m ³)	0,3/1,0	none					11
		H ₂ S (mg/m ³)	0,1/0,5	none					11
	Chlorine	salt mist	sea and road salt	none					11
		Cl (mg/m ³)	0,1/0,3	none					11
		HCl (mg/m ³)	0,1/0,5	none					11
	Nitrogen	NO _x (mg/m ³)	0,5/5,0	none					11
		NH ₃ (mg/m ³)	1,0/3,0	none					11
	Hydrogen fluoride HF	(mg/m ³)	0,01/0,03	none					11
Ozone O ₃	(mg/m ³)	0,05/0,1	none					11	
Mechanically active substances	Dust	sedimentation (mg/(m ² h))	15	none					12
		suspension (mg/m ³)	0,4	none					13
	Sand	(mg/m ³)	300	none					12
Flora and fauna	Micro organisms	mould, fungus, etc.	none						14
	Rodents, insects	rodents, etc.	none						14
NOTE 1:	(Air temperature, low). The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If a cold start up test is performed, the characteristic severity should be used as a cold start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the cold start up test shall commence once low temperature stability is achieved.								
NOTE 2:	(Air temperature, high). The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If two test temperatures are given, the lower test temperature applies if the equipment is protected against solar and heat radiation or the equipment is ventilated (natural or forced). The higher test temperature includes the heating effects of solar and/or heat radiation. If a high temperature start up test is performed, the characteristic severity should be used as a high start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the high temperature start up test shall commence once high temperature stability is achieved.								
NOTE 3:	(Air temperature, change). The change of temperature test is normally used to check design tolerance. IEC 60068-2-14 [7] Test Nb shall be used. For change of temperature of 0,5 °C/min, the cooling gradient may be reduced to 0,2 °C/min where test chamber restrictions preclude a gradient of 0,5 °C/min.								
NOTE 4:	(Relative humidity, low). There is no IEC 60068-2 series test method for this parameter.								
NOTE 5:	(Humidity, relative, high). IEC 60068-2-78 [8] Test Cab shall be used with test values not higher than climatogram limits for this class.								
NOTE 6:	(Condensation). IEC 60068-2-30 [9] Test Db shall be used with test values not higher than climatogram limits for this class.								
NOTE 7:	(Humidity, absolute, high). This effect is considered to be partly included in the damp heat test IEC 60068-2-78 [8] Test Cab.								

Environmental parameter			Environmental Class 3.2	Environmental test specification T 3.2: In-use, Partly temperature-controlled locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
NOTE 8:	(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 9:	(Radiation, solar).	The higher test temperature as described in note 2 includes the heating effect of solar radiation. Photochemical tests can be made separately for components and materials.							
NOTE 10:	(Radiation, heat).	The higher test temperature as described in note 2 includes the heating effect.							
NOTE 11:	(Chemically active substances).	The characteristic severities are given as mean/maximum values. These severities should be considered when designing the equipment and when choosing components and materials. No test is recommended in the present document.							
NOTE 12:	(Mechanically active substances).	The characteristic severities are much lower than lowest test severity in IEC 60068-2-68 [14] Test L and therefore no test is recommended. This condition should be considered when designing the equipment and when choosing components and materials.							
NOTE 13:	(Mechanically active substances).	The characteristic severities are much lower than the lowest test severity in IEC 60068-2-68 [14] Test Lb and therefore no test is required. This condition should be considered when designing the equipment and choosing components and materials. One possible test to evaluate the impact of corrosion due to dust can be found in Annex A.							
NOTE 14:	(Flora, fauna).	The characteristic severity should be considered when choosing components and materials.							

Table 5: Test specification T 3.2: Partly temperature-controlled locations - mechanical tests

Environmental parameter			Environmental Class 3.2	Environmental test specification T 3.2: In-use, Partly temperature-controlled locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
Vibration	Sinusoidal	velocity (mm/s)	1,5	5	3 x 5 sweep cycles	IEC 60068-2-6 [12]	Fc: Vibration (sinusoidal)	A	1
		displacement (mm)							
		acceleration (m/s ²)	5	2					
		frequency range (Hz)	2-9	9-200	5-62	62-200			
		axes of vibration		3					
	Random	ASD (m ² /s ³) (dB/oct)	no	0,02	3 x 30 minutes	IEC 60068-2-64 [10]	Fh: Vibration, broad-band random (digital control)	A	2
		frequency range (Hz)							
		axes of vibration							
Shocks	Shocks	shock spectrum	Type L	half sine	3 in each direction	IEC 60068-2-27 [11]	Ea: Shock	A	3
		duration (ms)	22	11					
		acceleration (m/s ²)	40	30					
		number of shocks		6					
		directions of shocks							

Environmental parameter			Environmental Class 3.2	Environmental test specification T 3.2: In-use, Partly temperature-controlled locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
NOTE 1: (Vibration, sinusoidal). The severities are given as peak values. The characteristic severity given is considered to be too severe for this class. Test severity values are not specified in IEC 60068-2 series. Equipment under test shall be mounted in the "in use" position. The equipment function shall be monitored throughout the test.									
NOTE 2: (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.									
			Classes: 3.2/3.3/3.4 (3M3)/3.5 (3M3)			Classes: 3.4 (3M5)/3.5 (3M5)			
Acceleration RMS (for information only)			1,06 m/s ²			1,5 m/s ²			
NOTE 3: (Shocks). Equipment under test shall be mounted in the "in-use" position. The equipment function shall be monitored throughout the test. The values for test severity are not specified in IEC 60068-2 series. 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.									

4.5 Specification T 3.3: Not temperature-controlled locations

The specification in table 6 and table 7 shall apply to weatherprotected or partially weatherprotected locations having neither temperature nor humidity control.

Table 6: Test specification T 3.3: Not temperature-controlled locations - climatic tests

Environmental parameter			Environmental Class 3.3	Environmental test specification T 3.3: In-use, Not temperature-controlled locations						
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes	
Air temperature	Low	(°C)	-25	-25	16 h	IEC 60068-2-1 [2]	Ab/Ad/Ae: Cold	A	1	
	High	(°C)	+55	+55 or +70	16 h	IEC 60068-2-2 [6]	Bb/Bd/Be: Dry heat	A	2	
	Change	(°C) (°C/min)	0,5	-5 to+45 0,5	1 cycle t ₁ = 3 h	IEC 60068-2-14 [7]	Nb: Change of temperature	A	3	
Humidity	Relative	low	(%)	10	none				4	
		high	(%)	100	93	4 d	IEC 60068-2-78 [8]	Cab: Damp heat steady state	A	5
		condensation	(°C)	yes	+30					
		(%) (°C)		90-100 +30	2 cycles	IEC 60068-2-30 [9]	Db: Damp heat cyclic Variant 1	A	6	
Absolute	low	(g/m ³)	0,5	none					4	

Environmental parameter			Environmental Class 3.3	Environmental test specification T 3.3: In-use, Not temperature-controlled locations						
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes	
		high (g/m ³)	29						7	
Air	Pressure	low (kPa)	70	none					8	
		high (kPa)	106	none					8	
	Speed	(m/s)	5,0	none					4	
Water	Rain	intensity	wind driven						9	
		low temperature	no							
	Other sources		dripping water						4	
	Icing & frosting		yes						4	
Radiation	Solar	(W/m ²)	1 200						10	
	Heat	(W/m ²)	600						11	
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 (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))	15	none					14	
		suspension (mg/m ³)	0,4	none					13	
	Sand	(mg/m ³)	300	none					14	
Flora and fauna	Micro organisms		mould, fungus, etc.	none					15	
	Rodents, insects		rodents, etc.	none					15	

Environmental parameter			Environmental Class 3.3	Environmental test specification T 3.3: In-use, Not temperature-controlled locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
NOTE 1:	(Air temperature, low).								The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If a cold start up test is performed, the characteristic severity should be used as a cold start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the cold start up test shall commence once low temperature stability is achieved.
NOTE 2:	(Air temperature, high).								The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If two test temperatures are given, the lower test temperature applies if the equipment is protected against solar and heat radiation or the equipment is ventilated (natural or forced). The higher test temperature includes the heating effects of solar and/or heat radiation. If a high temperature start up test is performed, the characteristic severity should be used as a high start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the high temperature start up test shall commence once high temperature stability is achieved.
NOTE 3:	(Air temperature, change).								The change of temperature test is normally used to check design tolerance. IEC 60068-2-14 [7] Test Nb shall be used. For change of temperature of 0,5° C/min, the cooling gradient may be reduced to 0,2 °C/min where test chamber restrictions preclude a gradient of 0,5 °C/min.
NOTE 4:	(Relative humidity, low).								There is no IEC 60068-2 series test method for this parameter.
NOTE 5:	(Humidity, relative, high).								IEC 60068-2-78 [8] Test Cab shall be used with test values not higher than climatogram limits for this class.
NOTE 6:	(Condensation).								IEC 60068-2-30 [9] Test Db shall be used with test values not higher than climatogram limits for this class.
NOTE 7:	(Humidity, absolute, high).								This effect is considered to be partly included in the damp heat test IEC 60068-2-78 [8] Test Cab.
NOTE 8:	(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 9:	(Water, rain).								The effect of wind driven rain outside to the equipment in the weatherprotected or partly weatherprotected locations is included in IEC 60068-2-30 [9] Test Db. No test is recommended.
NOTE 10:	(Radiation, solar).								The higher test temperature as described in note 2 includes the heating effect of solar radiation. Photochemical tests can be made separately for components and materials.
NOTE 11:	(Radiation, heat).								The higher test temperature as described in note 2 includes the heating effect.
NOTE 12:	(Chemically active substances).								The characteristic severities are given as mean/maximum values. These 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 [14] Test Lb and therefore no test is required. This condition should be considered when designing the equipment and choosing components and materials. One possible test to evaluate the impact of corrosion due to dust can be found in Annex A.
NOTE 14:	(Mechanically active substances).								The characteristic severities are much lower than lowest test severity in IEC 60068-2-68 [14] Test L and therefore no test is recommended. This condition should be considered when designing the equipment and when choosing components and materials.
NOTE 15:	(Flora, fauna).								The characteristic severity should be considered when choosing components and materials.

Table 7: Test specification T 3.3: Not temperature-controlled locations - mechanical tests

Environmental parameter			Environmental Class 3.3	Environmental test specification T 3.3: In-use, Not temperature-controlled locations						
Type	Parameter	Detail parameter	Characteristic severity	Test severity		Duration	Reference	Method	Performance criteria	Notes
Vibration	Sinusoidal	velocity (mm/s)	1,5	5	5	2	IEC 60068-2-6 [12]	Fc: Vibration (sinusoidal)	A	1
		displacement (mm)								
Vibration	Random	acceleration (m/s ²)	no	0,02	+12	-	IEC 60068-2-64 [10]	Fh: Vibration, broad-band random (digital control)	A	2
		frequency range (Hz)								
Shocks	Shocks	axes of vibration	Type L	half sine	22	11	IEC 60068-2-27 [11]	Ea: Shock	A	3
		shock spectrum								
Shocks	Shocks	duration (ms)	22	11	30	6	3 in each direction	Ea: Shock	A	3
		acceleration (m/s ²)								
Shocks	Shocks	number of shocks	22	11	30	6	3 in each direction	Ea: Shock	A	3
		directions of shocks								

NOTE 1: (Vibration, sinusoidal).

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

NOTE 2: (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.

	Classes: 3.2/3.3/3.4 (3M3)/3.5 (3M3)	Classes: 3.4 (3M5)/3.5 (3M5)
Acceleration RMS (for information only)	1,06 m/s ²	1,5 m/s ²

NOTE 3: (Shocks). Equipment under test shall be mounted in the "in-use" position. The equipment function shall be monitored throughout the test.

The values for test severity are not specified in IEC 60068-2 series. 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.

4.6 Specification T 3.4: Sites with heat-trap

The specification in table 8 and table 9 shall apply to weatherprotected or partially weatherprotected locations having neither temperature nor humidity control. Solar radiation and heat-trap conditions may cause high temperatures.

Table 8: Test specification T 3.4: Sites with heat-trap - climatic tests

Environmental parameter			Environmental Class 3.4	Environmental test specification T 3.4: In-use, Sites with heat trap						
Type	Parameter	Detail parameter		Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
Air temperature	Low	(°C)	-40	-40	16 h	IEC 60068-2-1 [2]	Ab/Ad/Ae: Cold	A	1	
	High	(°C)	+70	+70 or +85	16 h	IEC 60068-2-2 [6]	Bb/Bd/Be: Dry heat	A	2	
	Change	(°C) (°C/min)	0,5	-5 to +45 0,5	2 cycles t ₁ = 3 h	IEC 60068-2-14 [7]	Nb: Change of temperature	A	3	
Humidity	Relative	low (%)	10	none					4	
		high (%)	100	93	4 d	IEC 60068-2-78 [8]	Cab: Damp heat steady state	A	5	
		condensation (°C)	yes	+35					A	6
	Absolute	low (g/m ³)	0,1	90-100	2 cycles	IEC 60068-2-30 [9]	Db: Damp heat cyclic Variant 1			4
		high (g/m ³)	35	+30						7
Air	Pressure	low (kPa)	70	none					8	
		high (kPa)	106	none					8	
	Speed	(m/s)	5,0	none					4	
Water	Rain	intensity	wind driven						9	
		low temperature	no							
	Other sources		dripping and spraying water						4	
	Icing & frosting		yes						4	
Radiation	Solar	(W/m ²)	1 200						10	
	Heat	(W/m ²)	600						11	

Environmental parameter			Environmental Class 3.4	Environmental test specification T 3.4: In-use, Sites with heat trap					
Type	Parameter	Detail parameter		Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria
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 (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	
Chemically active substances	Dust	sedimentation (mg/(m ² h))	15						14
		suspension (mg/m ³)	0,4	none					13
	Sand	(mg/m ³)	300						14
Flora and fauna	Micro organisms		mould, fungus, etc.	none					15
	Rodents, insects		rodents, etc.	none					15
NOTE 1:	(Air temperature, low). The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If a cold start up test is performed, the characteristic severity should be used as a cold start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the cold start up test shall commence once low temperature stability is achieved.								
NOTE 2:	(Air temperature, high). The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If two test temperatures are given, the lower test temperature applies if the equipment is protected against solar and heat radiation or the equipment is ventilated (natural or forced). The higher test temperature includes the heating effects of solar and/or heat radiation. If a high temperature start up test is performed, the characteristic severity should be used as a high start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the high temperature start up test shall commence once high temperature stability is achieved.								
NOTE 3:	(Air temperature, change). The change of temperature test is normally used to check design tolerance. IEC 60068-2-14 [7] Test Nb shall be used. For change of temperature of 0,5 °C/min, the cooling gradient may be reduced to 0,2 °C/min where test chamber restrictions preclude a gradient of 0,5 °C/min.								
NOTE 4:	(Relative humidity, low). There is no IEC 60068-2 series test method for this parameter.								
NOTE 5:	(Humidity, relative, high). IEC 60068-2-78 [8] Test Cab shall be used with test values not higher than climatogram limits for this class.								
NOTE 6:	(Condensation). IEC 60068-2-30 [9] Test Db shall be used with test values not higher than climatogram limits for this class.								

Environmental parameter			Environmental Class 3.4	Environmental test specification T 3.4: In-use, Sites with heat trap					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
NOTE 7:	(Humidity, absolute, high).								
	This effect is considered to be partly included in the damp heat test IEC 60068-2-78 [8] Test Cab.								
NOTE 8:	(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 9:	(Water, rain).								
	The effect of wind driven rain outside to the equipment in the weatherprotected or partly weatherprotected locations is included in IEC 60068-2-30 [9] Test Db. No test is recommended.								
NOTE 10:	(Radiation, solar).								
	The higher test temperature as described in note 2 includes the heating effect of solar radiation. Photochemical tests can be made separately for components and materials.								
NOTE 11:	(Radiation, heat).								
	The higher test temperature as described in note 2 includes the heating effect.								
NOTE 12:	(Chemically active substances).								
	The characteristic severities are given as mean/maximum values. These 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 [14] Test Lb and therefore no test is required. This condition should be considered when designing the equipment and choosing components and materials. One possible test to evaluate the impact of corrosion due to dust can be found in Annex A.								
NOTE 14:	(Mechanically active substances).								
	The characteristic severities are much lower than lowest test severity in IEC 60068-2-68 [14] Test L and therefore no test is recommended. This condition should be considered when designing the equipment and when choosing components and materials.								
NOTE 15:	(Flora, fauna).								
	The characteristic severity should be considered when choosing components and materials.								

Table 9: Test specification T 3.4: Sites with heat-trap - mechanical tests

Environmental parameter			Environmental Class 3.4	Environmental test specification T 3.4: Stationary use, Sites with heat-trap					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
Vibration IEC 60721-3-3 [4] Class 3M5	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 9-2003		IEC 60068-2-6 [12]	Fc: Vibration (sinusoidal)	A	1, 4
	Random	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 random (digital control)	A	2, 4

Environmental parameter			Environmental Class 3.4	Environmental test specification T 3.4: Stationary use, Sites with heat-trap						
Type	Parameter	Detail parameter	Characteristic severity	Test severity		Duration	Reference	Method	Performance criteria	Notes
Shocks IEC 60721-3-3 [4] Class 3M5	Shocks	shock spectrum duration (ms) acceleration (m/s ²) number of shocks directions of shocks	Type II 6 250	half sine 11 50		100 in each direction	IEC 60068-2-27 [11]	Ea: Shocks	A	3, 4
Vibration IEC 60721-3-3 [4] Class 3M3	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 62-200		3 x 5 sweep cycles	IEC 60068-2-6 [12]	Fc: Vibration (sinusoidal)	A	1, 4
	Random	ASD (m ² /s ³) (dB/oct) frequency range (Hz) axes of vibration	no	0,02 +12 -12 5-10 10-50 50-100 3		3 x 30 minutes	IEC 60068-2-64 [10]	Fh: Vibration, broad-band random (digital control)	A	2, 4
Shocks IEC 60721-3-3 [4] Class 3M3	Shocks	shock spectrum duration (ms) acceleration (m/s ²) number of shocks directions of shocks	Type L 22 70	half sine 11 30		3 in each direction	IEC 60068-2-27 [11]	Ea: Shock	A	3, 4

NOTE 1: (Vibration, sinusoidal).

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

NOTE 2: (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.

	Classes: 3.2/3.3/3.4 (3M3)/3.5 (3M3)	Classes: 3.4 (3M5)/3.5 (3M5)
Acceleration RMS (for information only)	1,06 m/s ²	1,5 m/s ²

NOTE 3: (Shocks).
Equipment under test shall be mounted in the "in-use" position. The equipment function shall be monitored throughout the test.

The values for test severity are not specified in IEC 60068-2 series. 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 4: (Environmental parameter).

In this table two IEC 60721-3-3 [4] classes are given, Class 3M3 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 60721-3-3 [4] class 3M5 should be used.

4.7 Specification T 3.5: Sheltered locations

The specification in table 10 and table 11 shall apply to sheltered locations where direct solar radiation and heat-trap conditions do not exist.

Table 10: Test specification T 3.5: Sheltered locations - climatic tests

Environmental parameter			Environmental Class 3.5	Environmental test specification T3.5: In-use, Sheltered locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
Air temperature	Low	(°C)	-40	-40	16 h	IEC 60068-2-1 [2]	Ab/Ad/Ae: Cold	A	1
	High	(°C)	+40	+40	16 h	IEC 60068-2-2 [6]	Bb/Bd/B3: Dry heat	A	2
	Change	(°C) (°C/min)	1,0	-40 to +40 1,0	2 cycles t ₁ = 3 h	IEC 60068-2-14 [7]	Nb: Change of temperature	A	3
Humidity	Relative	low (%)	10	none					4
		high (%) (°C)	100	93 +35	4 d	IEC 60068-2-78 [8]	Cab: Damp heat steady state	A	5
		condensation (%) (°C)	yes	90-100 +35	2 cycles	IEC 60068-2-30 [9]	Db: Damp heat cyclic Variant 1	A	6
	Absolute	low (g/m ³)	0,1	none					4
		high (g/m ³)	35						7
Air	Pressure	low (kPa)	70	none					8
		high (kPa)	106	none					8
	Speed	(m/s)	30	none					4
Water	Rain	intensity	wind driven						9
		low temperature	no						
	Other sources		dripping and spraying water						9
	Icing & frosting		yes						4
Radiation	Solar	(W/m ²)	no						
	Heat	(W/m ²)	600	none					

Environmental parameter			Environmental Class 3.5	Environmental test specification T3.5: In-use, Sheltered locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	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 (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	
Mechanical active substances	Dust	sedimentation (mg/(m ² h))	15						14
		suspension (mg/m ³)	0,4	none					13
	Sand	(mg/m ³)	300						14
Flora and fauna	Micro organisms		mould, fungus, etc.	rodents, etc.					15
	Rodents, insects		rodents, etc.						15
NOTE 1:	(Air temperature, low). The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If a cold start up test is performed, the characteristic severity should be used as a cold start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the cold start up test shall commence once low temperature stability is achieved.								
NOTE 2:	(Air temperature, high). The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If two test temperatures are given, the lower test temperature applies if the equipment is protected against solar and heat radiation or the equipment is ventilated (natural or forced). The higher test temperature includes the heating effects of solar and/or heat radiation. If a high temperature start up test is performed, the characteristic severity should be used as a high start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the high temperature start up test shall commence once high temperature stability is achieved.								
NOTE 3:	(Air temperature, change). The change of temperature test is normally used to check design tolerance. IEC 60068-2-14 [7] Test Nb shall be used. For change of temperature of 0,5 °C/min, the cooling gradient may be reduced to 0,2 °C/min where test chamber restrictions preclude a gradient of 0,5 °C/min.								
NOTE 4:	(Relative humidity, low). There is no IEC 60068-2 series test method for this parameter.								
NOTE 5:	(Humidity, relative, high). IEC 60068-2-78 [8] Test Cab shall be used with test values not higher than climatogram limits for this class.								
NOTE 6:	(Condensation). IEC 60068-2-30 [9] Test Db shall be used with test values not higher than climatogram limits for this class.								
NOTE 7:	(Humidity, absolute, high). This effect is considered to be partly included in the damp heat test IEC 60068-2-78 [8] Test Cab.								
NOTE 8:	(Air pressure, low and high). No test is recommended for normal applications, because the effect of air pressure is evaluated at the component level.								

Environmental parameter			Environmental Class 3.5	Environmental test specification T3.5: In-use, Sheltered locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
NOTE 9:	(Water, rain).	The effect of wind driven rain outside to the equipment in the weatherprotected or partly weatherprotected locations is included in IEC 60068-2-30 [9] Test Db. No test is recommended.							
NOTE 10:	(Radiation, solar).	The higher test temperature as described in note 2 includes the heating effect of solar radiation. Photochemical tests can be made separately for components and materials.							
NOTE 11:	(Radiation, heat).	The higher test temperature as described in note 2 includes the heating effect.							
NOTE 12:	(Chemically active substances).	The characteristic severities are given as mean/maximum values. These 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 [14] Test Lb and therefore no test is required. This condition should be considered when designing the equipment and choosing components and materials. One possible test to evaluate the impact of corrosion due to dust can be found in Annex A.							
NOTE 14:	(Mechanically active substances).	The characteristic severities are much lower than lowest test severity in IEC 60068-2-68 [14] Test L and therefore no test is recommended. This condition should be considered when designing the equipment and when choosing components and materials.							
NOTE 15:	(Flora, fauna).	The characteristic severity should be considered when choosing components and materials.							

Table 11: Test specification T 3.5: Sheltered locations - mechanical tests

Environmental parameter			Environmental Class 3.5	Environmental test specification T 3.5: In-use, Sheltered locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
Vibration IEC 60721-3-3 [4] Class 3M5	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, 4
	Random	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 random (digital control)	A	2, 4
Shocks IEC 60721-3-3 [4] Class 3M5	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]	Ea: Shocks	A	3, 4

Environmental parameter			Environmental Class 3.5	Environmental test specification T 3.5: In-use, Sheltered locations						
Type	Parameter	Detail parameter	Characteristic severity	Test severity		Duration	Reference	Method	Performance criteria	Notes
Vibration IEC 60721-3-3 [4] Class 3M3	Sinusoidal	velocity (mm/s)	1,5	5	2	3 x 5 sweep cycles	IEC 60068-2-6 [12]	Fc: Vibration (sinusoidal)	A	1, 4
		displacement (mm)								
		acceleration (m/s ²)	2-9	9-200	5-62	62-200				
		frequency range (Hz)			3					
		axes of vibration								
	Random	ASD (m ² /s ³) (dB/oct)	no	0,02	+12	-12	IEC 60068-2-64 [10]	Fh: Vibration, broad-band random (digital control)	A	2, 4
		frequency range (Hz)								
		axes of vibration								
Shocks IEC 60721-3-3 [4] Class 3M3	Shocks	shock spectrum	Type L	half sine	11	30	IEC 60068-2-27 [11]	Ea: Shock	A	3, 4
		duration (ms)								
		acceleration (m/s ²)	70							
		number of shocks								
		directions of shocks								

NOTE 1: (Vibration, sinusoidal).

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

NOTE 2: (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.

	Classes: 3.2/3.3/3.4 (3M3)/3.5 (3M3)	Classes: 3.4 (3M5)/3.5 (3M5)
Acceleration RMS (for information only)	1,06 m/s ²	1,5 m/s ²

NOTE 3: (Shocks). Equipment under test shall be mounted in the "in-use" position. The equipment function shall be monitored throughout the test.

The values for test severity are not specified in IEC 60068-2 series. 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 4: (Environmental parameter).

In this table two IEC 60721-3-3 [4] classes are given, Class 3M3 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 60721-3-3 [4] class 3M5 should be used.

4.8 Specification T 3.6: Control room locations

Specification T 3.6: Control room locations - normal operating conditions.

The specification in table 12 and table 13 shall apply to permanently temperature-controlled enclosed locations where humidity is usually not controlled. See table 12.

Table 12: Test specification T 3.6: Control room locations - climatic tests

Environmental parameter			Environmental Class 3.6	Environmental test specification T3.6: In-use, Temperature-controlled locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
Air temperature	Low	(°C)	+15	+15	16 h	IEC 60068-2-1 [2]	Ab/Ad/Ae: Cold	A	1
	High	(°C)	+30	+30 or +40	16 h	IEC 60068-2-2 [6]	Bb/Bd/Be: Dry heat	A	2
	Change	(°C) (°C/min)	0,5	+25 to +30 0,5	half cycle $t_1 = 3$ h	IEC 60068-2-14 [7]	Nb: Change of temperature	A	3
Humidity	Relative	low (%)	10	none					4
		high (%)	75	85	4 d	IEC 60068-2-78 [8]	Cab: Damp heat steady state	A	5
		condensation (°C)	no						
	Absolute	low (g/m ³)	2	none					4
		high (g/m ³)	22						7
Air	Pressure	low (kPa)	70	none					8
		high (kPa)	106	none					8
	Speed	(m/s)	5,0	none					4
Water	Rain	intensity	no						
		low temperature	no						
	Other sources		no						
	Icing & frosting		no						
Radiation	Solar	(W/m ²)	700						9
	Heat	(W/m ²)	600						10

Environmental parameter			Environmental Class 3.6	Environmental test specification T3.6: In-use, Temperature-controlled locations						
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes	
Chemically active substances	Sulphur	SO ₂ (mg/m ³)	0,3/1,0	none					11	
		H ₂ S (mg/m ³)	0,1/0,5	none					11	
	Chlorine	salt mist	sea and road salt		none					11
		Cl (mg/m ³)	0,1/0,3		none					11
		HCl (mg/m ³)	0,1/0,5		none					11
	Nitrogen	NO _x (mg/m ³)	0,5/1,0		none					11
		NH ₃ (mg/m ³)	1,0/3,0		none					11
		Hydrogen fluoride HF (mg/m ³)	0,01/0,03		none					11
	Ozone O ₃ (mg/m ³)	0,05/0,1		none					11	
Mechanically active substances	Dust	sedimentation (mg/(m ² h))	1,5		none					12
		suspension (mg/m ³)	0,2		none					13
	Sand (mg/m ³)	30		none						12
Flora and fauna	Micro organisms		negligible							
	Rodents, insects		negligible							
NOTE 1:	(Air temperature, low). The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If a cold start up test is performed, the characteristic severity should be used as a cold start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the cold start up test shall commence once low temperature stability is achieved.									
NOTE 2:	(Air temperature, high). The equipment under test shall remain operational throughout this test (without any damage or deterioration of performance, according to product specification). If two test temperatures are given, the lower test temperature applies if the equipment is protected against solar and heat radiation or the equipment is ventilated (natural or forced). The higher test temperature includes the heating effects of solar and/or heat radiation. If a high temperature start up test is performed, the characteristic severity should be used as a high start up temperature, but it may be modified (within the class characteristic severity range) by the product specification. In this case, the high temperature start up test shall commence once high temperature stability is achieved.									
NOTE 3:	(Air temperature, change). The change of temperature test is normally used to check design tolerance. IEC 60068-2-14 [7] Test Nb shall be used. For change of temperature of 0,5 °C/min, the cooling gradient may be reduced to 0,2 °C/min where test chamber restrictions preclude a gradient of 0,5 °C/min.									
NOTE 4:	(Relative humidity, low). There is no IEC 60068-2 series test method for this parameter.									
NOTE 5:	(Humidity, relative, high). IEC 60068-2-78 [8] Test Cab shall be used with test values not higher than climatogram limits for this class.									
NOTE 6:	(Condensation). IEC 60068-2-30 [9] Test Db shall be used with test values not higher than climatogram limits for this class.									
NOTE 7:	(Humidity, absolute, high). This effect is considered to be partly included in the damp heat test IEC 60068-2-78 [8] Test Cab.									
NOTE 8:	(Air pressure, low and high). No test is recommended for normal applications, because the effect of air pressure is evaluated at the component level.									

Environmental parameter			Environmental Class 3.6	Environmental test specification T3.6: In-use, Temperature-controlled locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
NOTE 9:	(Radiation, solar). The higher test temperature as described in note 2 includes the heating effect of solar radiation. Photochemical tests can be made separately for components and materials.								
NOTE 10:	(Radiation, heat). The higher test temperature as described in note 2 includes the heating effect.								
NOTE 11:	(Chemically active substances). The characteristic severities are given as mean/maximum values. These severities should be considered when designing the equipment and when choosing components and materials. No test is recommended in the present document.								
NOTE 12:	(Mechanically active substances). The characteristic severities are much lower than lowest test severity in IEC 60068-2-68 [14] Test L and therefore no test is recommended. This condition should be considered when designing the equipment and when choosing components and materials.								
NOTE 13:	(Mechanically active substances). The characteristic severities are much lower than the lowest test severity in IEC 60068-2-68 [14] Test Lb and therefore no test is required. This condition should be considered when designing the equipment and choosing components and materials. One possible test to evaluate the impact of corrosion due to dust can be found in Annex A.								

Table 13: Test specification T 3.6: Control room locations - mechanical tests

Environmental parameter			Environmental Class 3.6	Environmental test specification T 3.6: In-use, Control room locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
Vibration	Sinusoidal	displacement (mm)	0,3	none					1
		acceleration (m/s ²)	1,0						
		frequency range (Hz)	2-9						
Shocks	Shocks	axes of vibration	9-200	half sine	3 in each direction	IEC 60068-2-27 [11]	Ea: Shock	A	2
		shock spectrum	Type L						
		duration (ms)	22						
		acceleration (m/s ²)	40						
		number of shocks	6						
direction of shocks									
NOTE 1:	(Vibration, sinusoidal). No test is recommended as the characteristic severities represent insignificant levels of vibration. The severities are given as peak values.								
NOTE 2:	(Shocks). The values for test severity are not specified in IEC 60068-2 series. 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.								

5 Earthquake test specification

5.0 General

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

The test specification is applicable to classes 3.1 to 3.6.

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 as specified in 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 14 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 9 (class 3.4) or in table 11 (class 3.5) for class 3M5. This test is sufficient to prove compliance with earthquake conditions given in ETSI EN 300 019-1-3 [1].

5.2 Test conditioning

See table 14.

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 14: Test specification T 3.1 to T 3.6: Earthquake test

Environmental parameter			Environmental class 3.x	Environmental test specification T3.x: Earthquake test					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Performance criteria	Notes
Earthquake	Time-history	RRS	see ETSI EN 300 019-1-3 [1]	figure 2, table 15		IEC 60068-2-57 [13]	Ff: time-history method	C	See note
		frequency range (Hz)	0,3 - 50	1 - 35					
		ZPA (m/s ²)	15	15					
		axes		3	30 s				
		damping ratio (%)			2				
<p>NOTE: (Earthquake). RRS (Required Response Spectrum). ZPA (Zero Period Acceleration). Equipment under test shall be 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.</p>									

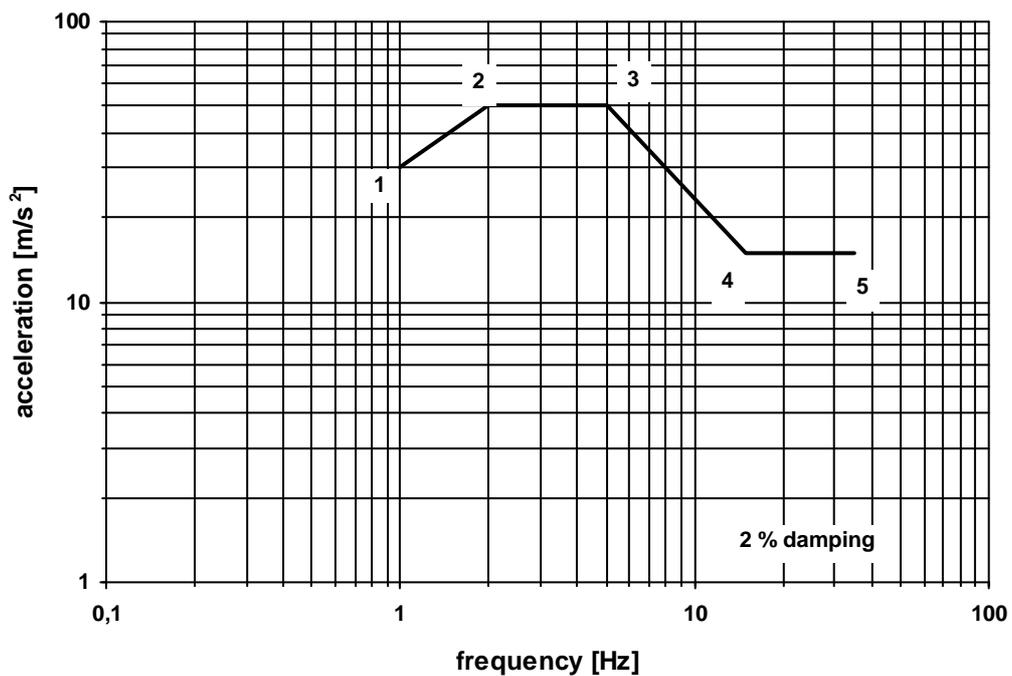


Figure 1: Earthquake Required Response Spectrum

Table 15: Acceleration co-ordinates for the Required Response Spectrum in figure 2

Co-ordinate point	Frequency [Hz]	Values for upper floor acceleration [m/s^2]
1	1	30
2	2	50
3	5	50
4	15	15
5	35	15

Annex A (informative): Impact of corrosion due to dust

A.0 General

It is recognized that the value reported in tables relating to environmental condition contains a value for the Mechanically Active substances (Dust) that is related to characteristic severities that are much lower than the lowest test severity in IEC 60068-2-68 [14] Test Lb and therefore no test is required.

Corrosion effects on the equipment may occur with a combination of dust and high humidity.

In this case a possible methodology of test is described in this annex.

To evaluate possible corrosion effect in PCB that can influence equipment performance, high relative humidity test is required to be executed after a suspension dust test.

A.1 Test condition

A.1.0 Introduction

The equipment need be positioned in a adequate test environment with the equipment in normal working conditions for test duration.

A.1.1 Dust test condition

Table A.1

Environmental test specification			
Duration	Reference	Method	Performance criteria
1d	IEC 60068-2-68 [14]	Lb	D

A.1.2 Corrosion test

After dust test on the equipment need be performed a test with the following conditions:

- Wind speed in the chamber should be less than 0,2 m/s.
- Dust density 30 mg/m³.
- Mixture of the Arizona Dust with diameter less than 75 µm.
- Soluble salt should be used, with salt percentage 16 % by weight.

The salt may be composed by NaCl and Na₂SO₄, while the weight percentage of NaCl in salt is 65 %:

- Test duration 1 day.

A.1.3 Pass criteria

After the test the part under test need respect its normal operation condition (performance criteria B); in addition maintenance activities should be in line with operating/maintenance instruction.

A possible recommended test facility to perform all the test in same test environment is described in clause A.2.

A.2 Schematic Diagram of Suspension Dust Test Chamber

The dust test facility (could be used as figure A.1 Comprehensive test facility for temperature, humidity and dust.

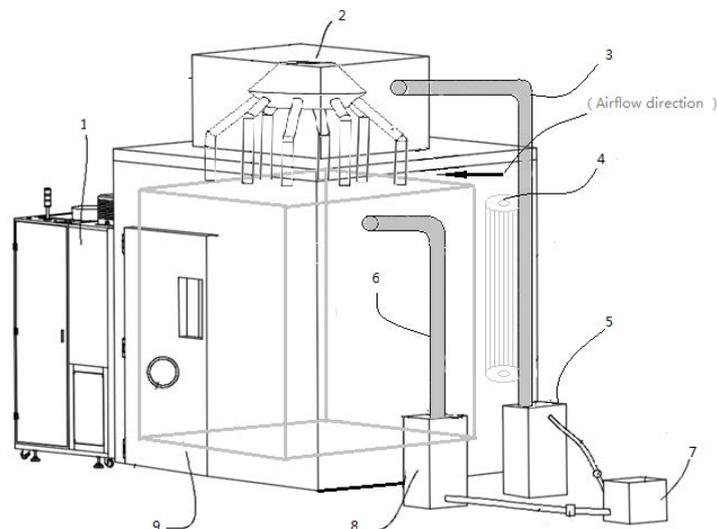


Figure A.1: Comprehensive test facility for temperature, humidity and dust

The comprehensive test device for temperature, humidity and dust facility consists of the following:

- 1) temperature, humidity, dust control unit and operation panel;
- 2) free fall dust distribution unit;
- 3) dust conveying pipeline;
- 4) the temperature control fan;
- 5) dust stirring unit and dust supplying device;
- 6) humidifying pipeline;
- 7) dry compressed air supply unit;
- 8) humidity supply unit;
- 9) double layer box for heat exchange.

Figure A.2 shows the cross section review of the chamber.

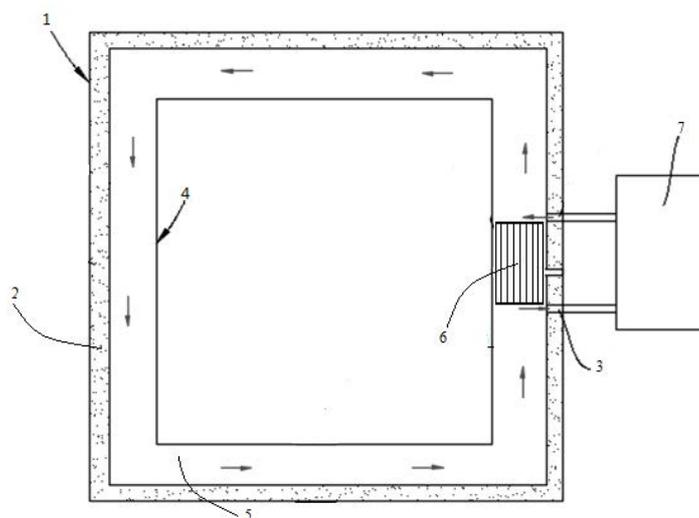


Figure A.2: Horizontal Cross Section Review of the Chamber

Double layer box for heat exchange:

- 1) double layer box for heat exchange;
- 2) the chamber outside wall;
- 3) refrigerant line;
- 4) the chamber inside wall;
- 5) circulating air duct;
- 6) heat exchanger;
- 7) heating refrigerating device.

In order to achieve the effect of uniform dust sedimentation, the inside chamber need keep wind speed less than 0,2 m/s, so take the double heat exchange box, through the air between the layers and air circulation, control the temperature of the inside chamber wall. The inner box air temperature is subjected to the conduction and radiation effect of the metal item to realize the temperature control of the inner box air.

Annex B (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	May 1994	Publication as ETSI ETS 300 019-2-3
Amendment 1	June 1997	Amendment 1 to 1 st Edition of ETSI ETS 300 019-2-3
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