

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



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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Equipment Engineering (EE), and is now submitted for the ETSI standards One-step Approval Procedure.

The present document consists of 2 parts as follows:

Part 1: "Classification of environmental conditions";

NOTE 1: Specifies different standardized environmental classes covering climatic and biological conditions, chemically and mechanically active substances and mechanical conditions during storage, transportation and in use.

Part 2: "Specification of environmental tests".

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

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

This sub-part 2-3 deals with stationary use at weatherprotected locations.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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 Part 2-3 of this multi-part EN apply to stationary use of equipment at weatherprotected locations covering the environmental conditions stated in ETS 300 019-1-3 [1].

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

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

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

3 Environmental test specifications

The detailed descriptions of the environmental conditions are in Clauses 4 and 5 of ETS 300 019-1-3 [1].

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

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

3.1 Specifications T 3.1 and T 3.1 E: Temperature-controlled locations

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

This specification applies to permanently temperature-controlled enclosed locations where humidity is usually not controlled. See tables 1 and 2.

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

Environmental parameter			Environmental Class 3.1	Environmental test specification T3.1: In-use, Temperature-controlled locations				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Air temperature	low	(°C)	+5	+5	16 h	IEC 60068-2-1	Ab/Ad: Cold	1, 21
	high	(°C)	+40	+40 or +50	16 h	IEC 60068-2-2	Bb/Bd: Dry heat	2, 21
	change	(°C) (°C/min)	0,5	+25/+40 0,5	half cycle t ₁ = 3 h	IEC 60068-2-14	Nb: Change of temperature	3, 21
Humidity	relative	low (%)	5	none				4, 21
		high (%) (°C)	85	85 +30	4 d	IEC 60068-2-56	Cb: Damp heat steady state	5, 21
	absolute	condensation	no					
		low (g/m ³)	1	none				4, 21
		high (g/m ³)	25					7, 21
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 icing & frosting		no					
Radiation	solar	(W/m ²)	700					10
	heat	(W/m ²)	600					11

Environmental parameter			Environmental Class 3.1	Environmental test specification T3.1: In-use, Temperature-controlled locations				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Chemically active substances	sulphur	SO ₂ (mg/m ³)	0,3/1,0	none				12
		H ₂ S (mg/m ³)	0,1/0,5	none				12
	chlorine	salt mist	sea and road salt	none				12
		Cl ₂ (mg/m ³)	0,1/0,3	none				12
		HCl (mg/m ³)	0,1/0,5	none				12
	nitrogen	NOx (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))	1,5	none				12
		suspension (mg/m ³)	0,2	none				13
	sand	(mg/m ³)	30	none				13
Flora and fauna	micro organisms		negligible					
	rodents, insects		negligible					
NOTE 1: no = this condition does not occur in this class.								
NOTE 2: none = verification is required only in special cases.								
NOTE 3: n = number of note, see clause 5.								

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	Notes
Vibration	sinusoidal	displacement (mm) acceleration (m/s ²) frequency range (Hz) axes of vibration	0,3 1,0 2-99-200	none				15
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	Ea: Shock	18
NOTE 1: none = verification is required only in special cases								
NOTE 2: n = number of note, see clause 5.								

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

This specification applies to permanently temperature-controlled locations where humidity is usually not controlled. The reference class is the same as for T 3.1, but the test specification relates to reduced performance requirements. See table 3.

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

Environmental parameter			Environmental Class 3.1E	Environmental test specification T3.1E: In-use, Temperature-controlled locations - Exceptional.				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Air temperature	low	(°C)	-5	-5	16 h	IEC 60068-2-1	Ab/Ad: Cold	1; 21
	high	(°C)	+45	+45 or +55	16 h	IEC 60068-2-2	Bb/Bd: Dry heat	2; 21
	change	(°C) (°C/min)	0,5	+25/+45 0,5	half cycle t ₁ = 3 h	IEC 60068-2-14	Nb: Change of temperature	3; 21
Humidity	relative	low(%)	5	none				4, 21
		high (%) (°C)	90	93 +30	4 d	IEC 60068-2-56	Cb: Damp heat steady state	5; 21
		condensation	no					
	absolute	low(g/m ³)	1	none				4, 21
		high (g/m ³)	25					7, 21
Radiation	solar	(W/m ²)	700					10
	heat	(W/m ²)	600					11
NOTE 1: no = this condition does not occur in this class. NOTE 2: none = verification is required only in special cases. NOTE 3: n = number of note, see clause 5.								

3.2 Specification T 3.2: Partly temperature-controlled locations

This specification applies to enclosed locations having neither temperature nor humidity control, but where heating may be used to avoid low temperatures. The building construction avoids extremely high temperatures. See tables 4 and 5.

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

Environmental parameter			Environmental Class 3.2	Environmental test specification T3.2: In-use, Partly temperature-controlled locations				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Air temperature	low	(°C)	-5	-5	16 h	IEC 60068-2-1	Ab/Ad: Cold	1, 22
	high	(°C)	+45	+45 or +55	16 h	IEC 60068-2-2	Bb/Bd: Dry heat	2, 22
	change	temp range (°C)		+25/+55 or +25/+45	half cycle t ₁ = 3 h	IEC 60068-2-14	Nb: Change of temperature	3, 22
		rate (°C/min)	0,5	0,5				
Humidity	relative	low (%)	5	none				4, 22
		high (%)	95	93	4 d steady state	IEC 60068-2-56	Cb: Damp heat	5, 22
		condensation (°C)	yes	+30°	1 cycle	IEC 60068-2-30	Db: Damp heat cyclic Variant 1	6, 22
	absolute	low (g/m ³)	1	none				4, 22
		high (g/m ³)	29					7, 22
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					10
	heat	(W/m ²)	600					11

Environmental parameter			Environmental Class 3.2	Environmental test specification T3.2: In-use, Partly temperature-controlled locations				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Chemically active substances	sulphur	SO ₂ (mg/m ³)	0,3/1,0	none				12
		H ₂ S (mg/m ³)	0,1/0,5	none				12
	chlorine	salt mist	sea and road salt	none				12
		Cl ₂ (mg/m ³)	0,1/0,3	none				12
		HCl (mg/m ³)	0,1/0,5	none				12
	nitrogen	NO _x (mg/m ³)	0,5/5,0	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					13
		suspension (mg/m ³)	0,4					13
	sand	(mg/m ³)	300					13
Flora and fauna	micro organisms		mould, fungus, etc.	none				14
	rodents, insects		rodents, etc.	none				14
NOTE 1: no = this condition does not occur in this class.								
NOTE 2: none = verification is required only in special cases.								
NOTE 3: n = number of note, see clause 5.								

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	Notes
Vibration	sinusoidal	velocity (mm/s) displacement (mm) acceleration (m/s ²) frequency range (Hz) axes of vibration	1,5 5 2-99-200	5 2 5-62 62-200 3	3 x 5 sweep cycles	IEC 60068-2-6	Fc: Vibration (sinusoidal)	16
	random	ASD (m ² /s ³) (dB/oct) frequency range (Hz) axes of vibration		0,02 +12 -12 5-10 10-50 50-100 3	3 x 30 minutes	IEC 60068-2-64	Fh: Vibration, broad-band random (digital control)	17
Shocks	shocks	shock spectrum duration (ms) acceleration (m/s ²) number of shocks directions of shocks	Type L 22 40	half sine 11 30 6	3 in each direction	IEC 60068-2-27	Ea: Shock	18
NOTE: n = number of note, see clause 5.								

3.3 Specification T 3.3: Not temperature-controlled locations

This specification applies to weatherprotected or partially weatherprotected locations having neither temperature nor humidity control. See tables 6 and 7.

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

Environmental parameter			Environmental Class 3.3	Environmental test specification T3.3: In-use, Not temperature-controlled locations				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Air temperature	low	(°C)	-25	-25	16 h	IEC 60068-2-1	Ab/Ad: Cold	1, 23
	high	(°C)	+55	+55 or +70	16 h	IEC 60068-2-2	Bb/Bd: Dry heat	2, 23
	change	(°C) (°C/min)	0,5	-5/+45 0,5	1 cycle t ₁ = 3 h	IEC 60068-2-14	Nb: Change of temperature	3, 23
Humidity	relative	low(%)	10	none				4, 23
		high (%) (°C)	100	93 +30	4 d	IEC 60068-2-56	Cb: Damp heat steady state	5, 23
		condensation (%) (°C)	yes	90-100 +30	2 cycles	IEC 60068-2-30	Db: Damp heat cyclic Variant 1	6, 23
	absolute	low(g/m ³)	0,5	none				4, 23
		high (g/m ³)	29					7, 23
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

Environmental parameter			Environmental Class 3.3	Environmental test specification T3.3: In-use, Not temperature-controlled locations				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Chemically active substances	sulphur	SO ₂ (mg/m ³)	0,3/1,0	none				12
		H ₂ S (mg/m ³)	0,1/0,5	none				12
	chlorine	salt mist	sea and road salt	none				12
		Cl ₂ (mg/m ³)	0,1/0,3	none				12
		HCl (mg/m ³)	0,1/0,5	none				12
	nitrogen	NO _x (mg/m ³)	0,5/1,0	none				12
		NH ₃ (mg/m ³)	1,0/3,0	none				12
	hydrogen fluoride HF	(mg/m ³)	0,01/0,03	none				12
	ozone O ₃	(mg/m ³)	0,05/0,1	none				12
Mechanically active substances	dust	sedimentation (mg/(m ² h))	15					13
		suspension (mg/m ³)	0,4					13
	sand	(mg/m ³)	300					13
Flora and fauna	micro organisms		mould, fungus, etc.	none				14
	rodents, insects		rodents, etc.	none				14
NOTE 1: no = this condition does not occur in this class.								
NOTE 2: none = verification is required only in special cases.								
NOTE 3: n = number of note, see clause 5.								

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	Notes
Vibration	sinusoidal	velocity (mm/s) displacement (mm) acceleration (m/s ²) frequency range (Hz) axes of vibration	1,5 5 2-99-200	5 2 5-62 62-200 3	3 x 5 sweep cycles	IEC 60068-2-6	Fc: Vibration (sinusoidal)	16
	random	ASD (m ² /s ³) (dB/oct) frequency range (Hz) axes of vibration		0,02 +12 -12 5-10 10-50 50-100 3	3 x 30 minutes	IEC 60068-2-64	Fh: Vibration, broad-band random (digital control)	17
Shocks	shocks	shock spectrum duration (ms) acceleration (m/s ²) number of shocks directions of shocks	Type L 22 40	half sine 11 30 6	3 in each direction	IEC 60068-2-27	Ea: Shock	18
NOTE: n = number of note, see clause 5.								

3.4 Specification T 3.4: Sites with heat-trap

This specification applies to weatherprotected or partially weatherprotected locations having neither temperature nor humidity control. Solar radiation and heat-trap conditions may cause high temperatures. See tables 8 and 9.

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

Environmental parameter			Environmental Class 3.4	Environmental test specification T3.4: In-use, Sites with heat trap				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Air temperature	low	(°C)	-40	-40	16 h	IEC 60068-2-1	Ab/Ad: Cold	1, 24
	high	(°C)	+70	+70 or +85	16 h	IEC 60068-2-2	Bb/Bd: Dry heat	2, 24
	change	(°C) (°C/min)	0,5	-5/+45 0,5	2 cycles t ₁ = 3 h	IEC 60068-2-14	Nb: Change of temperature	3, 24
Humidity	relative	low (%)	10	none				4, 24
		high (%)	100	93 +35	4 d	IEC 60068-2-56	Cb: Damp heat steady state	5, 24
		condensation (%)	yes	90-100 +30	2 cycles	IEC 60068-2-30	Db: Damp heat cyclic Variant 1	6, 24
	absolute	low (g/m ³)	0,1	none				4, 24
		high (g/m ³)	35					7, 24
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 T3.4: In-use, Sites with heat trap				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Chemically active substances	sulphur	SO ₂ (mg/m ³)	0,3/1,0	none				12
		H ₂ S (mg/m ³)	0,1/0,5	none				12
	chlorine	salt mist	sea and road salt	none				12
		Cl ₂ (mg/m ³)	0,1/0,3	none				12
		HCl (mg/m ³)	0,1/0,5	none				12
	nitrogen	NO _x (mg/m ³)	0,5/1,0	none				12
		NH ₃ (mg/m ³)	1,0/3,0	none				12
	hydrogen fluoride HF	(mg/m ³)	0,01/0,03	none				12
	ozone O ₃	(mg/m ³)	0,05/0,1	none				12
Chemically active substances	dust	sedimentation (mg/(m ² h))	15					13
		suspension (mg/m ³)	0,4					13
	sand	(mg/m ³)	300					13
Flora and fauna	micro organisms		mould, fungus, etc.	none				14
	rodents, insects		rodents, etc.	none				14
NOTE 1: no = this condition does not occur in this class.								
NOTE 2: none = verification is required only in special cases.								
NOTE 3: n = number of note, see clause 5.								

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	Notes
Vibration IEC 60721-3-3 Class 3M5	sinusoidal	displacement (mm) acceleration (m/s ²) frequency range (Hz) axes of vibration	3,0 10 2-99-200	1,2 4 5-99-200 3	3 x 5 sweep cycles	IEC 60068-2-6	Fc: Vibration (sinusoidal)	16, 19
	random	ASD (m ² /s ³) (dB/oct) frequency range (Hz) axes of vibration		0,04 +12 -12 5-10 10-50 50-100 3	3 x 30 minutes	IEC 60068-2-64	Fh: Vibration, broad-band random (digital control)	17, 19
Shocks IEC 60721-3-3 Class 3M5	shocks	shock spectrum duration (ms) acceleration (m/s ²) number of bumps directions of bumps	Type II 6 250	half sine 11 50 6	100 in each direction	IEC 60068-2-29	Eb: Bump	18, 19
Vibration IEC 60721-3-3 Class 3M3	sinusoidal	velocity (mm/s) displacement (mm) acceleration (m/s ²) frequency range (Hz) axes of vibration	1,5 5 2-99-200	5 2 5-62 62-200 3	3 x 5 sweep cycles	IEC 60068-2-6	Fc: Vibration (sinusoidal)	16, 19
	random	ASD (m ² /s ³) (dB/oct) frequency range (Hz) axes of vibration		0,02 +12 -12 5-10 10-50 50-100 3	3 x 30 minutes	IEC 60068-2-64	Fh: Vibration, broad-band random (digital control)	17, 19
Shocks IEC 60721-3-3 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 6	3 in each direction	IEC 60068-2-27	Ea: Shock	18, 19
NOTE: n = number of note, see clause 5.								

3.5 Specification T 3.5: Sheltered locations

This specification applies to sheltered locations where direct solar radiation and heat-trap conditions do not exist. See tables 10 and 11.

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	Notes
Air temperature	low	(°C)	-40	-40	16 h	IEC 60068-2-1	Ab/Ad: Cold	1, 25
	high	(°C)	+40	+40	16 h	IEC 60068-2-2	Bb/Bd: Dry heat	2, 25
	change	(°C) (°C/min)	1,0	-40/+40 1,0	2 cycles t ₁ = 3 h	IEC 60068-2-14	Nb: Change of temperature	3, 25
Humidity	relative	low (%)	10	none				4, 25
		high (%)	100	93 +35	4 d	IEC 60068-2-56	Cb: Damp heat steady state	5, 25
		condensation (%)	yes	90-100 +35	2 cycles	IEC 60068-2-30	Db: Damp heat cyclic Variant 1	6, 25
	absolute	low (g/m ³)	0,1	none				4, 25
		high (g/m ³)	35					7, 25
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	Notes
Chemically active substances	sulphur	SO ₂ (mg/m ³)	0,3/1,0	none				12
		H ₂ S (mg/m ³)	0,1/0,5	none				12
	chlorine	salt mist	sea and road salt	none				12
		Cl ₂ (mg/m ³)	0,1/0,3	none				12
		HCl (mg/m ³)	0,1/0,5	none				12
	nitrogen	NO _x (mg/m ³)	0,5/1,0	none				12
		NH ₃ (mg/m ³)	1,0/3,0	none				12
	hydrogen fluoride HF	(mg/m ³)	0,01/0,03	none				12
	ozone O ₃	(mg/m ³)	0,05/0,1	none				12
Mechanical active substances	dust	sedimentation (mg/(m ² h))	15					13
		suspension (mg/m ³)	0,4					13
	sand	(mg/m ³)	300					13
Flora and fauna	micro organisms		mould, fungus, etc.	none				14
	rodents, insects		rodents, etc.	none				14
NOTE 1: no = this condition does not occur in this class.								
NOTE 2: none = verification is required only in special cases.								
NOTE 3: n = number of note, see clause 5.								

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	Notes
Vibration IEC 60721-3-3 Class 3M5	sinusoidal	displacement (mm) acceleration (m/s^2) frequency range (Hz) axes of vibration	3,0 10 2-99-200	1,2 4 5-99-200 3	3 x 5 sweep cycles	IEC 60068-2-6	Fc: Vibration (sinusoidal)	16, 19
	random	ASD (m^2/s^3) (dB/oct) frequency range (Hz) axes of vibration		0,04 +12 -12 5-10 10-50 50-100 3	3 x 30 minutes	IEC 60068-2-64	Fh: Vibration, broad-band random (digital control)	17, 19
Shocks IEC 60721-3-3 Class 3M5	shocks	shock spectrum duration (ms) acceleration (m/s^2) number of bumps directions of bumps	Type II 6 250	half sine 11 50 6	100 in each direction	IEC 60068-2-29	Eb: Bump	18, 19
Vibration IEC 60721-3-3 Class 3M3	sinusoidal	velocity (mm/s) displacement (mm) acceleration (m/s^2) frequency range (Hz) axes of vibration	1,5 5 2-99-200	5 2 5-62 62-200 3	3 x 5 sweep cycles	IEC 60068-2-6	Fc: Vibration (sinusoidal)	16, 19
	random	ASD (m^2/s^3) (dB/oct) frequency range (Hz) axes of vibration		0,02 +12 -12 5-10 10-50 50-100 3	3 x 30 minutes	IEC 60068-2-64	Fh: Vibration, broad-band random (digital control)	17, 19
Shocks IEC 60721-3-3 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 6	3 in each direction	IEC 60068-2-27	Ea: Shock	18, 19
NOTE: n = number of note, see clause 5.								

4 Earthquake test specification

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

The test specification is applicable to classes 3.1 to 3.5.

4.1 Vibration response investigation

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

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

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

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

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

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

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

NOTE: 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 12 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 ETS 300 019-1-3 [1].

4.2 Test conditioning

See table 12.

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 12: Test specification T 3.1 to T 3.5: 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	Notes
Earthquake	time-history	RRS	see part 1-3	fig.1, tab.13	30 s	IEC 60068-2-57	Ff: time-history method	20
		frequency range (Hz)	0,3 - 50	1-35				
		ZPA (m/s ²)	15	15				
		axes	3					
		damping ratio (%)	2					
				NOTE: n= number of note, see clause 5.				

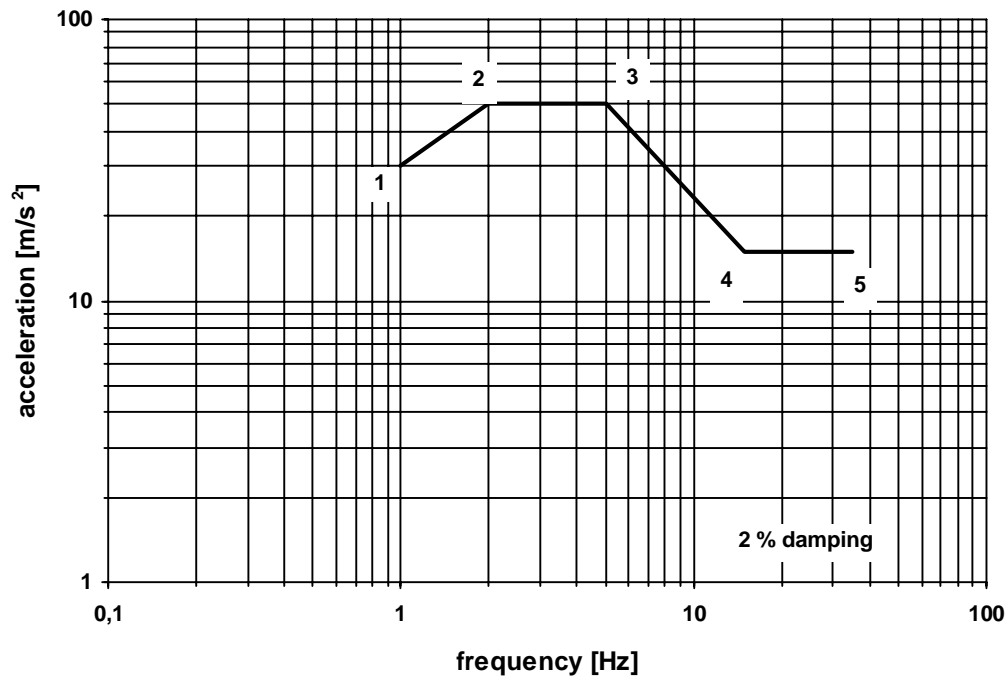


Figure 1: Earthquake Required Response Spectrum

Table 13: Acceleration co-ordinates for the Required Response Spectrum in Figure 1

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

5 Notes to tables

5.1 General note

The present document applies to the use of stationary equipment at weather protected locations covered by the environmental conditions stated in ETS 300 019-1-3 [1].

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

5.2 Notes to Tables 1 to 12

NOTE 1: (Air temperature, low)

The characteristic severity can be used as a cold start up temperature, but it may be modified by the product specification. The equipment under test shall remain operational throughout this test, except for the cold start up test which shall commence once low temperature stability is achieved.

NOTE 2: (Air temperature, high)

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. The characteristic severity can be used as a high start up temperature, but it may be modified by the product specification. The equipment under test shall remain operational throughout this test, except for the high temperature start up test which shall commence once high temperature stability is achieved.

NOTE 3: (Air temperature, change)

The change of temperature test is normally used to check design tolerancing. IEC 60068-2-14 [2] Test Nb is recommended. 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:

There is no IEC 60068-2 [2] test method for this parameter.

NOTE 5: (Humidity, relative, high)

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

NOTE 6: (Condensation)

IEC 60068-2-30 [2] Test Db is recommended 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 60068-2-56 [2] Test Cb.

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 [2] 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 this standard.

NOTE 13: (Mechanically active substances)

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

NOTE 14: (Flora, fauna)

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

NOTE 15: (Vibration, sinusoidal)

No test is recommended as the characteristic severities represent insignificant levels of vibration. The severities are given as peak values.

NOTE 16: (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 not specified in IEC 60068-2 [2]. Equipment under test shall be mounted in the "in-use" position. The equipment function shall be monitored throughout the test.

NOTE 17: (Vibration, random)

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

	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

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

NOTE 18: (Shocks)

The values for test severity are not specified in IEC 60068-2 [2]. The severities are given as peak values. The energy content and the SRS of the shock given as test severity have been considered more appropriate than that given by the characteristic severity.

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

NOTE 19: (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.

NOTE 20: (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.

NOTE 21: (Alternative climatic tests)

The alternative test method given in annex A may be used.

NOTE 22: (Alternative climatic tests)

The alternative test method given in annex B may be used.

NOTE 23: (Alternative climatic tests)

The alternative test method given in annex C may be used.

NOTE 24: (Alternative climatic tests)

The alternative test method given in annex D may be used.

NOTE 25: (Alternative climatic tests)

The alternative test method given in annex E may be used.

Annex A (normative): Alternative climatic test method for class 3.1

A.1 Description

This test method is an alternative to IEC 60068-2 [2] temperature and most humidity tests. It can also contain the cold start test given in the present document. The test uses a sequence which scans the characteristic conditions of the climatogram which is constructed from test severities specified in the present document. It may be applied to all equipment being tested for climatic conformance with class 3.1 in ETS 300 019-1-3 [1].

A.2 Objectives

To provide a standard test method for determining the functionality of an equipment when it is tested in a variable climatic environment consisting of a simultaneous change in combined values of temperature and humidity.

The climatogram test takes into account the boundary climatic conditions which can affect equipment throughout Europe up to an altitude of 3 000 metres. The objective of the test is the evaluation of equipment resistibility performance and no attempt is made to assess its reliability. This is why repairs are authorized during tests, provided that failures observed do not systematically recur in the same climatic conditions.

A.3 Test apparatus

The test apparatus shall consist of a single test chamber that is able to reproduce the conditions described in this annex.

The dimensions of the chamber shall be in accordance with the criteria described in IEC 60068-2-56 [2].

NOTE: When climatic stabilization is specified, the time required will vary depending on the thermal mass of the equipment under test, its heat dissipation and the relative size of the test chamber.

For naturally ventilated equipment it is important that the air flow in the test chamber is controlled (less than 1 m/s) near the equipment under test in order to prevent undue influence on its ventilation system. This will allow components inside the equipment to reach their working temperature in relation to the ambient conditions of the chamber.

The test chamber is required to control the rate of change of temperature to a maximum of 0,5°C per minute and the rate of change of relative humidity to a maximum of 10 % per hour with the equipment in its operational state.

A.4 Methodology

The traditional method used for climatic testing of equipment in order to demonstrate its resistibility is to use the IEC 60068-2 [2] tests (i.e. cold, dry heat, change of temperature and steady state damp heat). The severities of the tests are chosen to simulate the effects of the extreme climatic conditions of the class.

This annex describes an alternative test method which uses a sequence test following the characteristic conditions of the climatogram figure A.1.

A.5 Pre-conditioning

Pre-conditioning is required for a minimum period of one hour after temperature stabilization within the equipment under the initial condition 23°C / 50 % R.H. (i.e. point S on the climatogram of figure A.1).

A.6 Testing

A.6.1 Equipment operation

The equipment under test shall be in its operational state throughout the tests. Input and load conditions of the equipment shall be chosen to obtain full utilization of the equipment under test. The dissipation shall be maximized, except for the low temperature test, where it shall be minimized.

A.6.2 Equipment failures

If a failure occurs, the whole test cycle shall be started again, after the failure has been recorded and rectified.

A.6.3 Test severities

Table A.1: Test severities for class 3.1

Protected from solar and heat radiation or equipment is ventilated						Exposed to solar and heat radiation and equipment is not ventilated					
Exceptional operating conditions (8)			Normal operating conditions			Exceptional operating conditions (8)			Normal operating conditions		
Point	Temp (°C)	RH (%)	Point	Temp (°C)	RH (%)	Point	Temp (°C)	RH (%)	Point	Temp (°C)	RH (%)
S	+23 (3)	50 (6)	S	+23 (3)	50 (6)	S	+23 (3)	50 (6)	S	+23 (3)	50 (6)
A _e	+45 (3)	37 (6)	A via S	+40 (3)	47 (6)	A _e	+55 (3)	23 (6)	A via S	+50 (3)	30 (6)
B _e	+45 (3)	5 (5)	B	+40 (3)	5 (5)	B _e	+55 (3)	5 (5)	B	+50 (3)	5 (5)
C	+23 (3)	5 (5)	C	+23 (3)	5 (5)	C	+23 (3)	5 (5)	C	+23 (3)	5 (5)-
D	+5 (2)	15 (5)	D	+5 (2)	15 (5)	D	+5 (2)	15 (5)	D	+5 (2)	15 (5)
E _e	-5 (2), (7)	Any (1)	E	+5 (2), (7)	Any (1)	E _e	-5 (2), (7)	Any (1)	E	+5 (2), (7)	Any (1)
F _e	+5 (2)	90 (6)	F	+5 (2)	85 (6)	F _e	+5 (2)	90 (6)	F	+5 (2)	85 (6)
G _e	+28 (3)	90 (4)	G	+29 (3)	85 (4)	G _e	+28 (3)	90 (4)	G	+29 (3)	85 (4)
A	+40 (3)	47 (6)	A	+40 (3)	47 (6)	A	+50 (3)	30 (6)	A	+50 (3)	30 (6)
S	+23 (3)	50 (6)	S	+23 (3)	50 (6)	S	+23 (3)	50 (6)	S	+23 (3)	50 (6)

NOTE 1: It is acceptable to perform tests without controlling the humidity when testing below 5°C (as detailed in IEC 60068-2-1 Test Ad).

NOTE 2: ±3°C according to IEC 60068-2-1.

NOTE 3: ±2°C according to IEC 60068-2-2 and IEC 60068-2-56.
±3°C is acceptable for certain chamber sizes, as indicated in IEC 60068-2-2.

NOTE 4: ±3 % RH according to IEC 60068-2-56.

NOTE 5: Low relative humidity to be ±5 %.

NOTE 6: ±3 % RH.

NOTE 7: If the cold start test is required in the product specification, when arriving at the point E the equipment shall be switched off; after temperature stabilization is reached within the equipment, it shall be switched on and the test continued.

NOTE 8: Exceptional operating conditions relate to reduced performance requirements.

A.6.4 Scanning the climatogram

The sequence of scanning the climatogram is shown in figure A.1. Scanning begins at point S and ends at point S.

The various points of the climatogram correspond with test severities specified in table A.1.

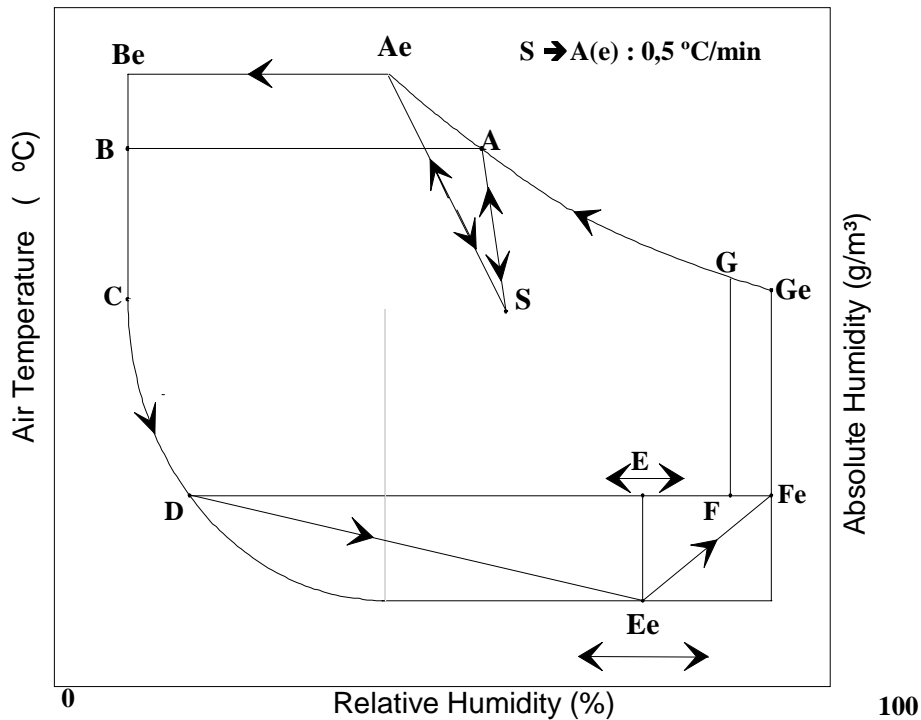


Figure A.1: Climatogram showing scanning sequence

A.6.5 Rates of change

The rates of change for temperature and humidity are:

- a) 5°C/h during constant relative or absolute humidity;
- b) 10 % RH/h during constant temperature;
- c) 0,5°C/min between point S to point A and Ae. This step is used to verify the performance of the equipment under maximum rate of change of temperature.

NOTE: The cooling gradient may be reduced to 0,2°C/min where test chamber restrictions preclude a gradient of 0,5°C/min.

A.6.6 Functional requirements and verification

Where practicable, the performance of the equipment should be monitored throughout the test. The parameters shall be fully described in the relevant test specification.

At the beginning and the end of scanning (Point "S" on the test climatogram, figure A.1) the equipment shall be visually examined and functional checks shall be made as prescribed by the test specification.

Functional checks shall also be performed at relevant points on figure A.1 as described in subclauses A.6.3 and A.6.4, after a minimum period of one hour has elapsed since temperature stabilization within the equipment. The test specification shall detail which functions are to be checked at each point on the test climatogram.

Annex B (normative): Alternative climatic test method for class 3.2

B.1 Description

This test method is an alternative to IEC 60068-2 [2] temperature and most humidity tests. It can also contain the cold start test given in the present document. The test uses a sequence which scans the characteristic conditions of the climatogram which is constructed from test severities specified in the present document. It may be applied to all equipment being tested for climatic conformance with class 3.2 in ETS 300 019-1-3 [1].

NOTE: This test method is made complete with the condensation test (see table 4: Test specification T 3.2 - Test Db) and should be carried out on the same test specimen.

B.2 Objectives

To provide a standard test method for determining the functionality of an equipment when it is tested in a variable climatic environment consisting of a simultaneous change in combined values of temperature and humidity.

The climatogram test takes into account the boundary climatic conditions which can affect equipment throughout Europe up to an altitude of 3 000 metres. The objective of the test is the evaluation of equipment resistibility performance and no attempt is made to assess its reliability. This is why repairs are authorized during tests, provided that failures observed do not systematically recur in the same climatic conditions.

B.3 Test apparatus

The test apparatus shall consist of a single test chamber that is able to reproduce the conditions described in this annex.

The dimensions of the chamber shall be in accordance with the criteria described in IEC 60068-2-56 [2].

NOTE: When climatic stabilization is specified, the time required will vary depending on the thermal mass of the equipment under test, its heat dissipation and the relative size of the test chamber.

For naturally ventilated equipment it is important that the air flow in the test chamber is controlled (less than 1 m/s) near the equipment under test in order to prevent undue influence on its ventilation system. This will allow components inside the equipment to reach their working temperature in relation to the ambient conditions of the chamber.

The test chamber is required to control the rate of change of temperature to a maximum of 0,5°C per minute and the rate of change of relative humidity to a maximum of 10 % per hour with the equipment in its operational state.

B.4 Methodology

The traditional method used for climatic testing of equipment in order to demonstrate its resistibility is to use the IEC 60068-2 [2] tests (i.e. cold, dry heat, change of temperature and steady state damp heat). The severities of the tests are chosen to simulate the effects of the extreme climatic conditions of the class.

This annex describes an alternative test method which uses a sequence test following the characteristic conditions of the climatogram figure B.1.

B.5 Pre-conditioning

Pre-conditioning is required for a minimum period of one hour after temperature stabilization within the equipment under the initial condition 23°C / 50 % R.H. (i.e. point S on the climatogram of figure B.1).

B.6 Testing

B.6.1 Equipment operation

The equipment under test shall be in its operational state throughout the tests.

Input and load conditions of the equipment shall be chosen to obtain full utilization of the equipment under test. The dissipation shall be maximized, except for the low temperature test, where it shall be minimized.

B.6.2 Equipment failures

If a failure occurs, the whole test cycle shall be started again, after the failure has been recorded and rectified.

B.6.3 Test severities

Table B.1: Test severities for class 3.2

Protected from solar and heat radiation or equipment is ventilated			Exposed to solar and heat radiation and equipment is not ventilated		
Climatic limits			Climatic limits		
Point	Temp (°C)	RH (%)	Point	Temp (°C)	RH (%)
S	+23 (3)	50 (6)	S	+23 (3)	50 (6)
A	+45 (3)	45 (6)	A	+55 (3)	28 (6)
B	+45 (3)	5 (5)	B	+55 (3)	5 (5)
C	+23 (3)	5 (5)	C	+23 (3)	5 (5)
D	+5 (2)	15 (5)	D	+5 (2)	15 (5)
E	-5 (2), (7)	Any (1)	E	-5 (2), (7)	Any (1)
F	+5 (2)	95 (6)	F	+5 (2)	95 (6)
G	+30 (3)	95 (4)	G	+30 (3)	95 (4)
A	+45 (3)	45 (6)	A	+55 (3)	45 (6)
S	+23 (3)	50 (6)	S	+23 (3)	50 (6)
NOTE 1: It is acceptable to perform tests without controlling the humidity when testing below 5°C (as detailed in IEC 60068-2-1 Test Ad). NOTE 2: $\pm 3^{\circ}\text{C}$ according to IEC 60068-2-1. NOTE 3: $\pm 2^{\circ}\text{C}$ according to IEC 60068-2-2 and IEC 60068-2-56. $\pm 3^{\circ}\text{C}$ is acceptable for certain chamber sizes, as indicated in IEC 60068-2-2. NOTE 4: $\pm 3\%$ RH according to IEC 60068-2-56. NOTE 5: Low relative humidity to be $\pm 5\%$. NOTE 6: $\pm 3\%$ RH. NOTE 7: If the cold start test is required in the product specification, when arriving at the point E the equipment shall be switched off; after temperature stabilization is reached within the equipment, it shall be switched on and the test continued.					

B.6.4 Scanning the climatogram

The sequence of scanning the climatogram is shown in figure B.1. Scanning begins at point S and ends at point S.

The various points of the climatogram correspond with test severities specified in table B.1.

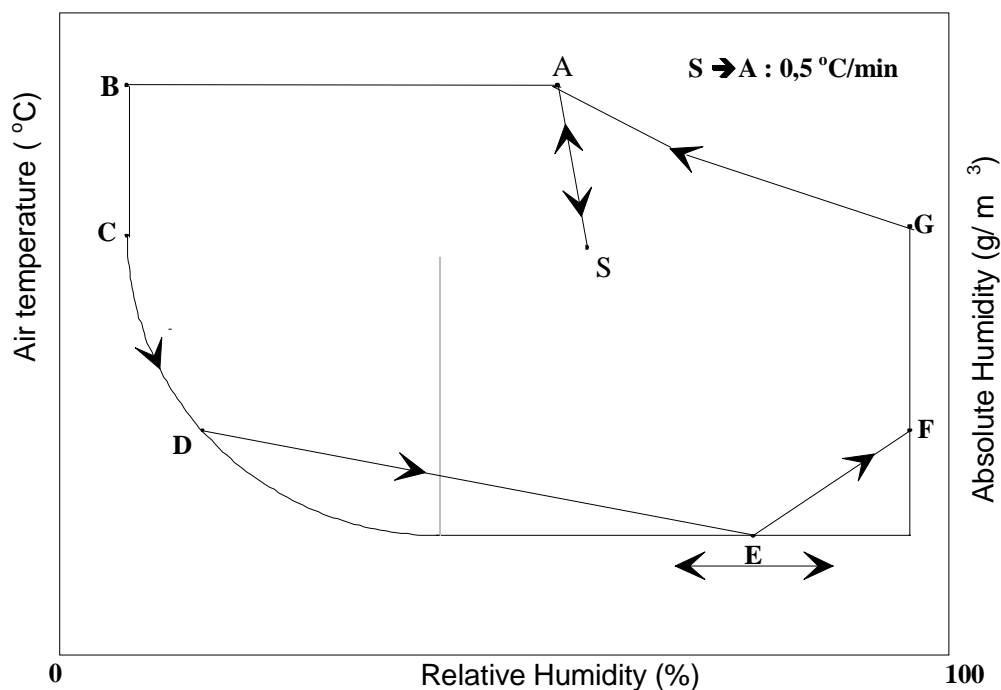


Figure B.1: Climatogram showing scanning sequence

B.6.5 Rates of change

The rates of change for temperature and humidity are:

- 5°C/h during constant relative or absolute humidity;
- 10 % RH/h during constant temperature;
- 0,5°C/min between point S to point A. This step is used to verify the performance of the equipment under maximum rate of change of temperature.

NOTE: The cooling gradient may be reduced to 0,2°C/min where test chamber restrictions preclude a gradient of 0,5°C/min.

B.6.6 Functional requirements and verification

Where practicable, the equipment's performance should be monitored throughout the test. The parameters shall be fully described in the relevant test specification.

At the beginning and the end of scanning (Point S on the test climatogram, figure B.1), the equipment shall be visually examined, and functional checks shall be made as prescribed by the test specification.

Functional checks shall also be performed at relevant points on figure B.1, as described in subclause B.6.4, after a minimum period of one hour has elapsed since temperature stabilization within the equipment. The test specification shall detail which functions are to be checked at each point on the test climatogram.

Annex C (normative): Alternative climatic test method for class 3.3

C.1 Description

This test method is an alternative to IEC 60068-2 [2] temperature and most humidity tests. It can contain also the cold start test given in the present document. The test uses a sequence which scans the characteristic conditions of the climatogram which is constructed from test severities specified in the present document. It may be applied to all equipment being tested for climatic conformance with class 3.3 in ETS 300 019-1-3 [1].

NOTE: This test method is made complete with the condensation test (see table 6: Test specification T 3.3 - Test Db) and should be carried out on the same test specimen.

C.2 Objectives

To provide a standard test method for determining the functionality of an equipment when it is tested in a variable climatic environment consisting of a simultaneous change in combined values of temperature and humidity.

The climatogram test takes into account the boundary climatic conditions which can affect equipment throughout Europe up to an altitude of 3 000 metres. The objective of the test is the evaluation of equipment resistibility performance and no attempt is made to assess its reliability. This is why repairs are authorized during tests, provided that failures observed do not systematically recur in the same climatic conditions.

C.3 Test apparatus

The test apparatus shall consist of a single test chamber that is able to reproduce the conditions described in this annex.

The dimensions of the chamber shall be in accordance with the criteria described in IEC 60068-2-56 [2].

NOTE: When climatic stabilization is specified, the time required will vary depending on the thermal mass of the equipment under test, its heat dissipation and the relative size of the test chamber.

For naturally ventilated equipment it is important that the air flow in the test chamber is controlled (less than 1 m/s) near the equipment under test in order to prevent undue influence on its ventilation system. This will allow components inside the equipment to reach their working temperature in relation to the ambient conditions of the chamber.

The test chamber is required to control the rate of change of temperature to a maximum of 0,5°C per minute and the rate of change of relative humidity to a maximum of 10 % per hour with the equipment in its operational state.

C.4 Methodology

The traditional method used for climatic testing of equipment in order to demonstrate its resistibility is to use the IEC 60068-2 [2] tests (i.e. cold, dry heat, change of temperature and steady state damp heat). The severities of the tests are chosen to simulate the effects of the extreme climatic conditions of the class.

This annex describes an alternative test method which uses a sequence test following the characteristic conditions of the climatogram figure C.1.

C.5 Pre-conditioning

Pre-conditioning is required for a minimum period of one hour after temperature stabilization within the equipment under the initial condition 23°C / 50 % R.H. (i.e. point S on the climatogram of figure C.1).

C.6 Testing

C.6.1 Equipment operation

The equipment under test shall be in its operational state throughout the tests.

Input and load conditions of the equipment shall be chosen to obtain full utilization of the equipment under test. The dissipation shall be maximized, except for the low temperature test, where it shall be minimized.

C.6.2 Equipment failures

If a failure occurs, the whole test cycle shall be started again, after the failure has been recorded and rectified.

C.6.3 Test severities

Table C.1: Test severities for class 3.3

Protected from solar and heat radiation or equipment is ventilated			Exposed to solar and heat radiation and equipment is not ventilated		
Climatic limits			Climatic limits		
Point	Temp (°C)	RH (%)	Point	Temp (°C)	RH (%)
S	+23 (3)	50 (6)	S	+23 (3)	50 (6)
A	+55 (3)	28 (6)	A	+70 (3)	15 (6)
B	+55 (3)	10 (5)	B	+70 (3)	10 (5)
C,D	+5 (2)	10 (5)	C,D	+5 (2)	10 (5)
E	-25 (2), (7)	Any (1)	E	-25 (2), (7)	Any (1)
F	+5 (2)	100 (6)	F	+5 (2)	100 (6)
G	+29 (3)	100 (4)	G	+29 (3)	100 (4)
A	+55 (3)	28 (6)	A	+70 (3)	15 (6)
S	+23 (3)	50 (6)	S	+23 (3)	50 (6)
NOTE 1: It is acceptable to perform tests without controlling the humidity when testing below 5°C (as detailed in IEC 60068-2-1 Test Ad). NOTE 2: ±3°C according to IEC 60068-2-1. NOTE 3: ±2°C according to IEC 60068-2-2 and IEC 60068-2-56. ±3°C is acceptable for certain chamber sizes, as indicated in IEC 60068-2-2. NOTE 4 : ±3 % RH according to IEC 60068-2-56. NOTE 5: Low relative humidity to be ±5 %. NOTE 6: ±3 % RH. NOTE 7: If the cold start test is required in the product specification, when arriving at the point E the equipment shall be switched off; after temperature stabilization is reached within the equipment, it shall be switched on and the test continued.					

C.6.4 Scanning the climatogram

The sequence of scanning the climatogram is shown in figure C.1. Scanning begins at point S and ends at point S.

The various points of the climatogram correspond with test severities specified in table C.1.

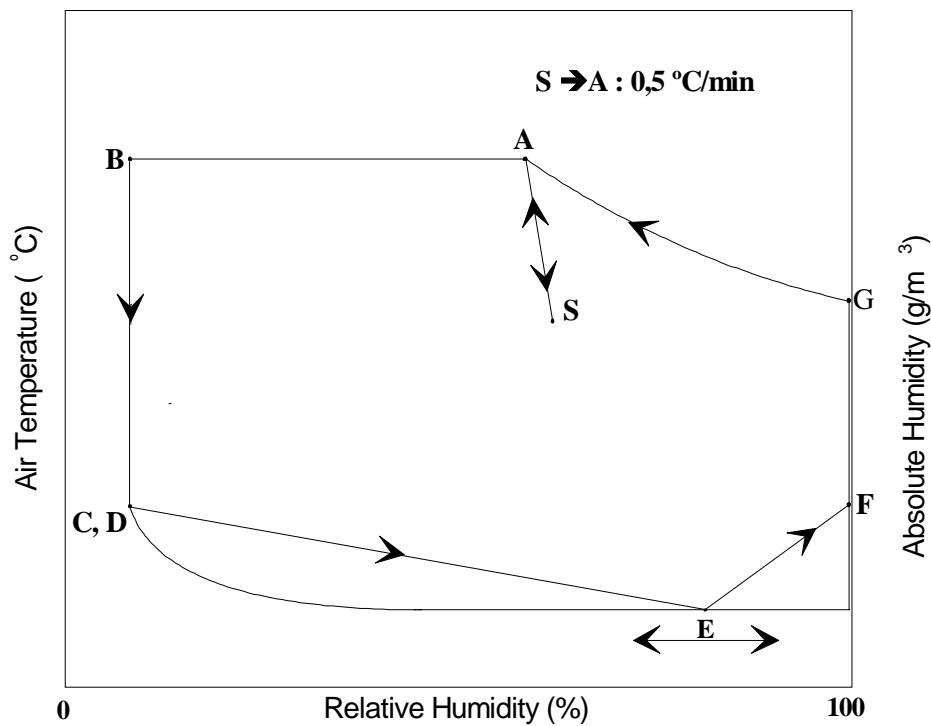


Figure C.1: Climatogram showing scanning sequence

C.6.5 Rates of change

The rates of change for temperature and humidity are:

- 5°C/h during constant relative or absolute humidity;
- 10 % RH/h during constant temperature;
- 0,5°C/min between point S to point A. This step is used to verify the performance of the equipment under maximum rate of change of temperature.

NOTE: The cooling gradient may be reduced to 0,2°C/min where test chamber restrictions preclude a gradient of 0,5°C/min.

C.6.6 Functional requirements and verification

Where practicable, the performance of the equipment should be monitored throughout the test. The parameters shall be fully described in the relevant test specification.

At the beginning and the end of scanning (Point S on the test climatogram, figure C.1), the equipment shall be visually examined, and functional checks shall be made as prescribed by the test specification.

Functional checks shall also be performed at relevant points on figure C.1, as described in subclause C.6.4, after a minimum period of one hour has elapsed since temperature stabilization within the equipment. The test specification shall detail which functions are to be checked at each point on the test climatogram.

Annex D (normative): Alternative climatic test method for class 3.4

D.1 Description

This test method is an alternative to IEC 60068-2 [2] temperature and most humidity tests. It can also contain the cold start test given in the present document. The test uses a sequence which scans the characteristic conditions of the climatogram which is constructed from test severities specified in the present document. It may be applied to all equipment being tested for climatic conformance with class 3.4 in ETS 300 019-1-3 [1].

NOTE: This test method is made complete with the condensation test (see table 8 Test specification T 3.4 - Test Db) and should be carried out on the same test specimen.

D.2 Objectives

To provide a standard test method for determining the functionality of an equipment when it is tested in a variable climatic environment consisting of a simultaneous change in combined values of temperature and humidity.

The climatogram test takes into account the boundary climatic conditions which can affect equipment throughout Europe up to an altitude of 3 000 metres. The objective of the test is the evaluation of equipment resistibility performance and no attempt is made to assess its reliability. This is why repairs are authorized during tests, provided that failures observed do not systematically recur in the same climatic conditions.

D.3 Test apparatus

The test apparatus shall consist of a single test chamber that is able to reproduce the conditions described in this annex.

The dimensions of the chamber shall be in accordance with the criteria described in IEC 60068-2-56 [2].

NOTE: When climatic stabilization is specified, the time required will vary depending on the thermal mass of the equipment under test, its heat dissipation and the relative size of the test chamber.

For naturally ventilated equipment it is important that the air flow in the test chamber is controlled (less than 1m/s) near the equipment under test in order to prevent undue influence on its ventilation system. This will allow components inside the equipment to reach their working temperature in relation to the ambient conditions of the chamber.

The test chamber is required to control the rate of change of temperature to a maximum of 0,5°C per minute and the rate of change of relative humidity to a maximum of 10 % per hour with the equipment in its operational state.

D.4 Methodology

The traditional method used for climatic testing of equipment in order to demonstrate its resistibility is to use the IEC 60068-2 [2] tests (i.e. cold, dry heat, change of temperature and steady state damp heat). The severities of the tests are chosen to simulate the effects of the extreme climatic conditions of the class.

This annex describes an alternative test method which uses a sequence test following the characteristic conditions of the climatogram figure D.1.

D.5 Pre-conditioning

Pre-conditioning is required for a minimum period of one hour after temperature stabilization within the equipment under the initial condition 23°C / 50 % R.H. (i.e. point S on the climatogram of figure D.1).

D.6 Testing

D.6.1 Equipment operation

The equipment under test shall be in its operational state throughout the tests.

Input and load conditions of the equipment shall be chosen to obtain full utilization of the equipment under test. The dissipation shall be maximized, except for the low temperature test, where it shall be minimized.

D.6.2 Equipment failures

If a failure occurs, the whole test cycle shall be started again, after the failure has been recorded and rectified.

D.6.3 Test severities

Table D.1: Test severities for class 3.4

Protected from solar and heat radiation or equipment is ventilated		
Climatic limits		
Point	Temp (°C)	RH (%)
S	+23 (3)	50 (6)
A	+70 (3)	18 (6)
B	+70 (3)	10 (5)
C,D	+5 (2)	10 (5)
E	-40 (2), (7)	Any (1)
F	+5 (2)	100 (6)
G	+33 (3)	100 (4)
A	+70 (3)	28 (6)
S	+23 (3)	50 (6)
NOTE 1: It is acceptable to perform tests without controlling the humidity when testing below 5°C (as detailed in IEC 60068-2-1 Test Ad). NOTE 2: ±3°C according to IEC 60068-2-1. NOTE 3: ±2°C according to IEC 60068-2-2 and IEC 60068-2-56. ±3°C is acceptable for certain chamber sizes, as indicated in IEC 60068-2-2. NOTE 4: ±3 % RH according to IEC 60068-2-56. NOTE 5: Low relative humidity to be ±5 %. NOTE 6: ±3 % RH. NOTE 7: If the cold start test is required in the product specification, when arriving at the point E the equipment shall be switched off; after temperature stabilization is reached within the equipment, it shall be switched on and the test continued.		

D.6.4 Scanning the climatogram

The sequence of scanning the climatogram is shown in figure D.1. Scanning begins at point S and ends at point S.

The various points of the climatogram correspond with test severities specified in table D.1.

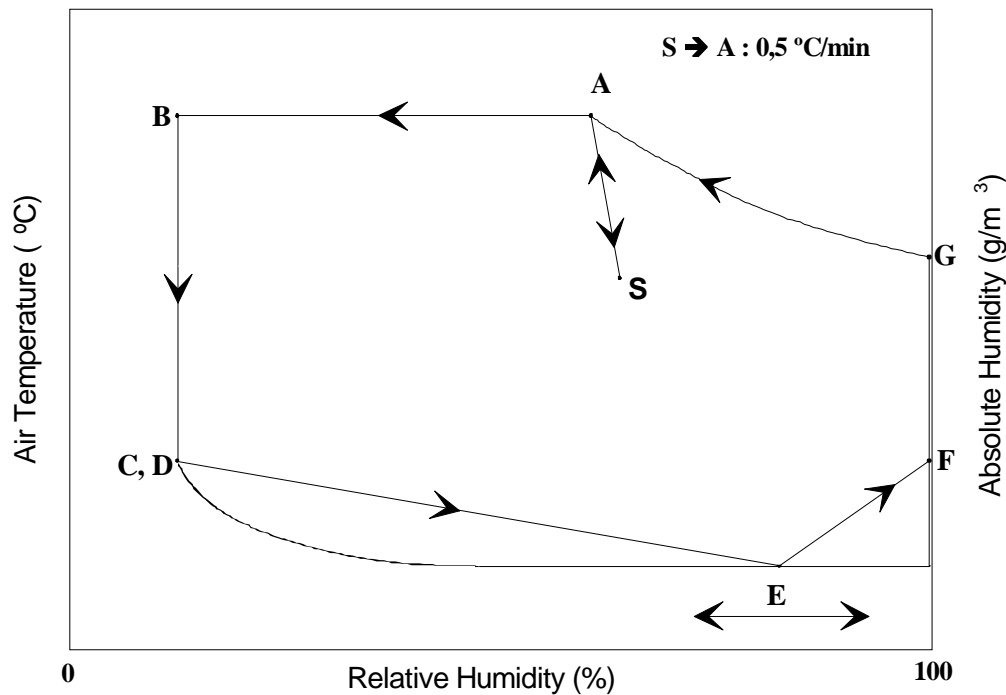


Figure D.1: Climatogram showing scanning sequence

D.6.5 Rates of change

The rates of change for temperature and humidity are:

- 5°C/h during constant relative or absolute humidity;
- 10 % RH/h during constant temperature;
- 0,5°C/min between point S to point A. This step is used to verify the performance of the equipment under maximum rate of change of temperature.

NOTE: The cooling gradient may be reduced to 0,2°C/min where test chamber restrictions preclude a gradient of 0,5°C/min.

D.6.6 Functional requirements and verification

Where practicable, the performance of the equipment should be monitored throughout the test. The parameters shall be fully described in the relevant test specification.

At the beginning and the end of scanning (Point S on the test climatogram, figure D.1), the equipment shall be visually examined, and functional checks shall be made as prescribed by the test program.

Functional checks shall also be performed at relevant points on figure D.1, as described in subclause D.6.4, after a minimum period of one hour has elapsed since temperature stabilization within the equipment. The test specification shall detail which functions are to be checked at each point on the test climatogram.

Annex E (normative): Alternative climatic test method for class 3.5

E.1 Description

This test method is an alternative to IEC 60068-2 [2] temperature and most humidity tests. It can also contain the cold start test, given in the present document. The test uses a sequence test which scans the characteristic conditions of the climatogram which is constructed from test severities specified in the present document. It may be applied to all equipment being tested for climatic conformance with class 3.5 in ETS 300 019-1-3 [1].

NOTE: This test method is made complete with the condensation test (see table 10 Test specification T 3.5 - Test Db) and should be carried out on the same test specimen.

E.2 Objectives

To provide a standard test method for determining the functionality of an equipment when it is tested in a variable climatic environment consisting of a simultaneous change in combined values of temperature and humidity.

The climatogram test takes into account the boundary climatic conditions which can affect equipment throughout Europe up to an altitude of 3 000 metres. The objective of the test is the evaluation of equipment resistibility performance and no attempt is made to assess its reliability. This is why repairs are authorized during tests, provided that failures observed do not systematically recur in the same climatic conditions.

E.3 Test apparatus

The test apparatus shall consist of a single test chamber that is able to reproduce the conditions described in this annex.

The dimensions of the chamber shall be in accordance with the criteria described in IEC 60068-2-56 [2].

NOTE: When climatic stabilization is specified, the time required will vary depending on the thermal mass of the equipment under test, its heat dissipation and the relative size of the test chamber.

For naturally ventilated equipment it is important that the air flow in the test chamber is controlled (less than 1 m/s) near the equipment under test in order to prevent undue influence on its ventilation system. This will allow components inside the equipment to reach their working temperature in relation to the ambient conditions of the chamber.

The test chamber is required to control the rate of change of temperature to a maximum of 1,0°C per minute and the rate of change of relative humidity to a maximum of 10 % per hour with the equipment in its operational state.

E.4 Methodology

The traditional method used for climatic testing of equipment in order to demonstrate its resistibility is to use the IEC 60068-2 [2] tests (i.e. cold, dry heat, change of temperature and steady state damp heat). The severities of the tests are chosen to simulate the effects of the extreme climatic conditions of the class.

This annex describes an alternative test method which uses a sequence test following the characteristic conditions of the climatogram figure E.1.

E.5 Pre-conditioning

Pre-conditioning is required for a minimum period of one hour after temperature stabilization within the equipment under the initial condition 23°C / 50 % R.H. (i.e. point S on the climatogram of figure E.1).

E.6 Testing

E.6.1 Equipment operation

The equipment under test shall be in its operational state throughout the tests.

Input and load conditions of the equipment shall be chosen to obtain full utilization of the equipment under test. The dissipation shall be maximized, except for the low temperature test, where it shall be minimized.

E.6.2 Equipment failures

If a failure occurs, the whole test cycle shall be started again, after the failure has been recorded and rectified.

E.6.3 Test severities

Table E.1: Test severities for class 3.5

Protected from solar and heat radiation or equipment is ventilated		
Climatic limits		
Point	Temp (°C)	RH (%)
S	+23 (3)	50 (6)
A	+40 (3)	69 (6)
B	+40 (3)	10 (5)
C,D	+5 (2)	10 (5)
E	-40 (2), (7)	Any (1)
F	+5 (2)	100 (6)
G	+33 (3)	100 (4)
A	+40 (3)	69 (6)
S	+23 (3)	50 (6)
NOTE 1: It is acceptable to perform tests without controlling the humidity when testing below 5°C (as detailed in IEC 60068-2-1 test Ad). NOTE 2: ±3°C according to IEC 60068-2-1. NOTE 3: ±2°C according to IEC 60068-2-2 and IEC 60068-2-56. ±3°C is acceptable for certain chamber sizes, as indicated in IEC 60068-2-2. NOTE 4: ±3 % RH according to IEC 60068-2-56. NOTE 5: Low relative humidity to be ±5 %. NOTE 6: ±3 % RH. NOTE 7: If the cold start test is required in the product specification, when arriving at the point E the equipment shall be switched off; after temperature stabilization is reached within the equipment, it shall be switched on and the test continued.		

E.6.4 Scanning the climatogram

The sequence of scanning the climatogram is shown in figure E.1. Scanning begins at point S and ends at point S.

The various points of the climatogram correspond with test severities specified in table E.1.

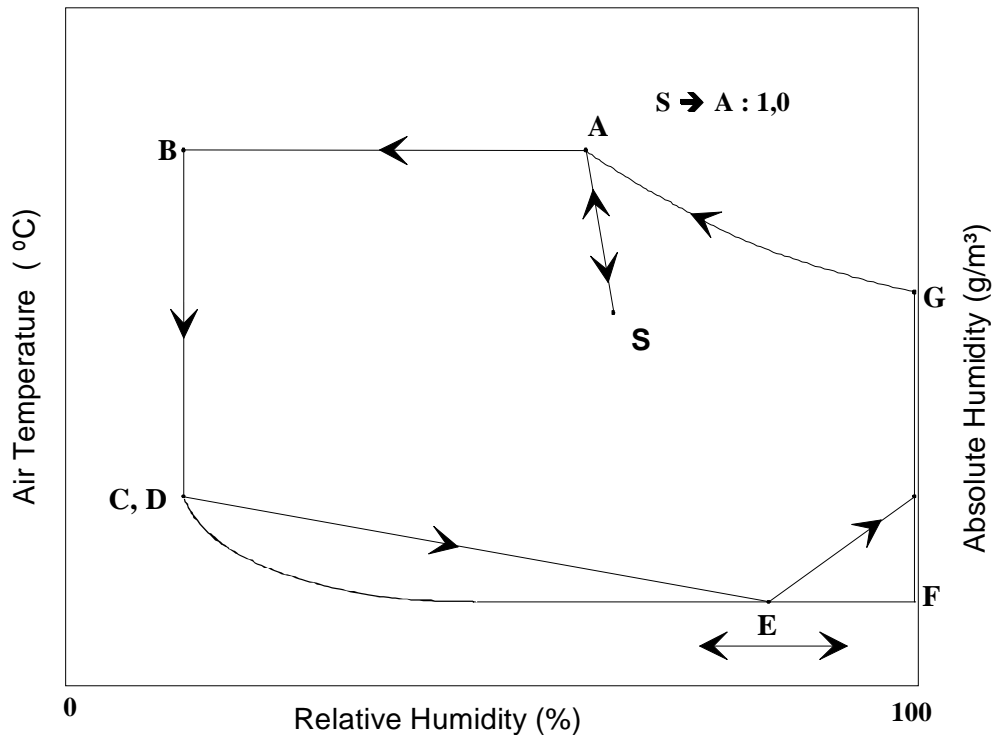


Figure E.1: Climatogram showing scanning sequence

E.6.5 Rates of change

The rates of change for temperature and humidity are:

- 5°C/h during constant relative or absolute humidity;
- 10 % RH/h during constant temperature;
- 1°C/min between point S to point A. This step is used to verify the performance of the equipment performance under maximum rate of change of temperature.

E.6.6 Functional requirements and verification

Where practicable, the performance of the equipment should be monitored throughout the test. The parameters shall be fully described in the relevant test specification.

At the beginning and the end of scanning (Point S on the test climatogram, figure E.1), the equipment shall be visually examined and functional checks shall be made as prescribed by the test specification.

Functional checks shall also be performed at relevant points on figure E.1, as described in subclause E.6.4, after a minimum period of one hour has elapsed since temperature stabilization within the equipment. The test specification shall detail which functions are to be checked at each point on the test climatogram.

Bibliography

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

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

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

History

Document history		
Edition 1	May 1994	Publication as ETS 300 019-2-3
V2.1.1	April 1999	One-step Approval Procedure OAP 9935: 1999-04-30 to 1999-08-27