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European Standard (Telecommunications series)

**Environmental Engineering (EE);
Environmental conditions and environmental tests
for telecommunications equipment;
Part 2-6: Specification of environmental tests;
Ship environments**



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Foreword

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

The present document is part 2, sub-part 6 of a multi-part deliverable covering environmental conditions and environmental tests for telecommunications equipment, as identified below:

Part 1: "Classification of environmental conditions";

Part 2: "Specification of environmental tests";

Sub-part 0: "Introduction";

Sub-part 1: "Storage";

Sub-part 2: "Transportation";

Sub-part 3: "Stationary use at weatherprotected locations";

Sub-part 4: "Stationary use at non-weatherprotected locations";

Sub-part 5: "Ground vehicle installations";

Sub-part 6: "Ship environments";

Sub-part 7: "Portable and non-stationary use";

Sub-part 8: "Stationary use at underground locations".

Part 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 specifies the recommended test severities and test methods for the different environmental classes.

Part 2-0 forms a general overview of part 2. The present document deals with ship environments.

National transposition dates	
Date of adoption of this EN:	29 November 2002
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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 defined in the present document apply to the use of telecommunication equipment installed permanently or temporarily in ships and cover the environments and the vessels stated in EN 300 019-1-6 [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 and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

- [1] ETSI EN 300 019-1-6: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-6: Classification of environmental conditions; Ship environments".
- [2] IEC 60068-2 (all parts): "Environmental testing - Part 2: Tests".
- [3] ETSI ETS 300 019-2-0: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-0: Specification of environmental tests; Introduction".

3 Environmental test specifications

The detailed descriptions of the environmental conditions are given in clauses 4 and 5 of EN 300 019-1-6 [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 Specification T 6.1: Totally weatherprotected locations

This specification applies to a totally weatherprotected use in ships excluding Warm Damp and Warm Damp Equable climates, see tables 1 and 4.

Table 1: Test specification T 6.1: Totally weatherprotected locations - climatic tests

Environmental parameter			Environmental Class 6.1	Environmental test specification T6.1: Ship, totally weatherprotected 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 [2]	Ab/Ad: Cold	1
	high	(°C)	+40	+40	16 h	IEC 60068-2-2 [2]	Bb/Bd: Dry heat	2
	change	air/water (°C)	no					
	surface	high (°C)	no					
Humidity	relative	low (%)	10	none				6
		high; slow temperature change (°C)	95	93	96 h	IEC 60068-2-56 [2]	Cb: Damp heat steady state	7
		high; rapid temperature change (°C)	no					
	absolute	high; rapid temperature change (°C)	no					
		high; rapid temperature change (°C)	no					
Air	speed	(m/s)	no					
Water	temperature	high (°C)	+30	none				6
		low (°C)	no					
	rain	intensity (mm/min)	no					
		volume (m ³ /min)	no					
	other sources	pressure (kPa)	no					
	velocity (m/s)	no						
	wetness		no					
Radiation	solar	(W/m ²)	no					
	heat	(W/m ²)	no					
Chemically active substances	sulphur	SO ₂ (mg/m ³)	0,1	none				15
		H ₂ S (mg/m ³)	0,01	none				15
	chlorine	sea salts	negligible					
		HCl (mg/m ³)	0,1	none				15
	nitrogen	NO _x (mg/m ³)	0,1	none				15
		NH ₃ (mg/m ³)	0,3	none				15
	hydrogen fluoride	HF (mg/m ³)	0,003	none				15
	ozone	O ₃ (mg/m ³)	0,01	none				15

Environmental parameter			Environmental Class 6.1	Environmental test specification T6.1: Ship, totally weatherprotected locations				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Mechanically active substances	dust	sedimentation	negligible					
	sand in air		no					
	soot deposit		no					
Flora and Fauna	micro organisms		negligible					
	rodents, insects		negligible					
no: This condition does not occur in this class.								
none: Verification is required only in special cases.								
NOTES: Number of note, see clause 4.2.								

3.2 Specification T 6.2: Partly weatherprotected locations

This specification applies to use in ships excluding Cold Climate and extreme weather conditions, see tables 2, 4 and 5.

Table 2: Test specification T 6.2: Partly weatherprotected locations - climatic tests

Environmental parameter			Environmental Class 6.2	Environmental test specification T6.2: Ship, partly weatherprotected 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 [2]	Ab/Ad: Cold	1	
	high	(°C)	+70	+70 or +85	16 h	IEC 60068-2-2 [2]	Bb/Bd: Dry heat	2	
	change	gradual (°C) (°C/min)	-25/+40 3	-25/+40 3	5 cycles t ₁ = 3 h	IEC 60068-2-14 [2]	Nb: Change of temperature	3	
	change	air/water (°C)	+40/+5	none				4	
	surface	high (°C)	+70	none				5	
Humidity	relative	low (%)	10	none				6	
		high; slow temperature change (°C)	95 +45	93 +40	96 h	IEC 60068-2-56 [2]	Cb: Damp heat steady state	7	
		high; rapid temperature change (°C)	95 -25/+35	none				8	
		absolute	high; rapid temperature change (g/m ³) (°C)	60 +70/+15	90-100 +55	6 cycles	IEC 60068-2-30 [2]	Db: Damp heat cyclic, variant 2	9
	Air	speed (m/s)	30	none					6
Water	temperature	high (°C)	+35	none				6	
		low (°C)	freezing point	none				10	
	rain	intensity (mm/min)	6						11
		volume pressure (m ³ /min) (kPa)			0,01 90	1 min/m ² or 5 min	IEC 60068-2-18 [2]	Rb: Impacting water method 1.2	
	other sources	velocity (m/s)	3	none				12	
wetness		wet surfaces	none					13	

Environmental parameter			Environmental Class 6.2	Environmental test specification T6.2: Ship, partly weatherprotected locations					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes	
Radiation	solar	(W/m ²)	1 120	none				14	
	heat	(W/m ²)	1 200	none				14	
Chemically active substances	sulphur	SO ₂	(mg/m ³) 1,0	none				15	
		H ₂ S	(mg/m ³) 0,5	none				15	
	chlorine	salts mist		yes	none				15
		sea salts	(kg/m ³) 30		none				15
		HCl	(mg/m ³) 0,5		none				15
	nitrogen	NO _x	(mg/m ³) 1,0		none				15
		NH ₃	(mg/m ³) 3,0		none				15
	hydrogen fluoride	HF	(mg/m ³) 0,03		none				15
ozone	O ₃	(mg/m ³) 0,1		none				15	
Mechanically active substances	dust	sedimentation (mg/(m ² h))	3,0	none				16	
	sand in air	(mg/m ³)	0,1	none				16	
	soot deposit		yes	none				16	
Flora and Fauna	micro organisms		mould, fungus etc.	none				17	
	rodents, insects		rodents, etc.	none				17	
no:	This condition does not occur in this class.								
none:	Verification is required only in special cases.								
NOTES:	Number of note, see clause 4.2.								

3.3 Specification T 6.3: Non-weatherprotected locations

This specification applies to normal unlimited use in ships, see tables 3, 4 and 5.

Table 3: Test specification T 6.3: Non weatherprotected locations - climatic tests

Environmental parameter			Environmental Class 6.3	Environmental test specification T6.3: Ship, non weatherprotected 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 [2]	Ab/Ad: Cold	1	
	high	(°C)	+70	+70 or +85	16 h	IEC 60068-2-2 [2]	Bb/Bd: Dry heat	2	
	change	gradual	(°C) (°C/min)	-25/+40 3	-25/+40 3	5 cycles $t_1 = 3$ h	IEC 60068-2-14 [2]	Nb: Change of temperature	3
		air/water	(°C)	+40/+5	none				4
	surface	high	(°C)	+70	none				5
Humidity	relative	low	(%)	10	none			6	
		high; slow temperature change	(%) (°C)	95 +45	93 +40	21 days	IEC 60068-2-56 [2]	Cb: Damp heat steady state	7
		high; rapid temperature change	(%) (°C)	95 -25/+35	none				8
	absolute	high;	(g/m ³)	60					9
		rapid temperature change	(°C)	+70/+15	90-100 +55	6 cycles	IEC 60068-2-30 [2]	Db: Damp heat cyclic, variant 2	
Air	speed	m/s	50	none				6	
Water	temperature	high	(°C)	+35	none			6	
		low	(°C)	freezing point	none			10	
	rain	intensity	(mm/min)	15					11
		volume pressure	(m ³ /min) (kPa)		0,01 90	1 min/m ² or 5 min	IEC 60068-2-18 [2]	Rb: Impacting water method 1.2	
	other sources	velocity	(m/s)	10	none			12	
wetness			wet surfaces	none			13		
Radiation	solar	(W/m ²)	1 120	none				14	
	heat	(W/m ²)	1 200	none				14	
Chemically active substances	sulphur	SO ₂	(mg/m ³)	1,0	none			15	
		H ₂ S	(mg/m ³)	0,5	none			15	
	chlorine	salts mist		yes	none			15	
		sea salts	(kg/m ³)	30	none			15	
		HCl	(mg/m ³)	0,5	none			15	
	nitrogen	NO _x	(mg/m ³)	1,0	none			15	
		NH ₃	(mg/m ³)	3,0	none			15	
	hydrogen fluoride	HF	(mg/m ³)	0,03	none			15	
ozone	O ₃	(mg/m ³)	0,1	none			15		

Environmental parameter			Environmental Class 6.3	Environmental test specification T6.3: Ship, non weatherprotected locations				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Mechanically active substances	dust	sedimentation (mg/(m ² h))	3,0	none				16
	sand in air	(mg/m ³)	0,1	none				16
	soot deposit		yes	none				16
Flora and Fauna	micro organisms		mould, fungus, etc.	none				17
	rodents, insects		rodents, etc.	none				17
no: This condition does not occur in this class.								
none: Verification is required only in special cases.								
NOTES: Number of note, see clause 4.2.								

Table 4: Test specification T 6.1 to T 6.3: Ship locations - mechanical tests (IEC Class 6M3)

Environmental parameter			Environmental Class 6.1 to 6.3	Environmental test specification T 6.1 to 6.3: Ship locations				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Vibration	sinusoidal	displacement (mm)	1,5	1,5		IEC 60068-2-6 [2]	Fc: vibration (sinusoidal)	18
		acceleration (m/s ²)	20	19,6				
		frequency range (Hz)	2-18	5-18	18-200			
		axes of vibration		3 axes				
	sinusoidal	displacement (mm)	1,5	1,0		IEC 60068-2-6 [2]	Fc: vibration (sinusoidal)	19
		acceleration (m/s ²)	20	7,0				
		frequency range (Hz)	2-18	5-13	13-80			
		axes of vibration		3 axes				
Shocks	shocks	shock spectrum type	I II III	half sine		IEC 60068-2-27 [2]	Ea: Shock	21
		duration (ms)	11 6 2, 3	6				
		acceleration (m/s ²)	100 300 500	300				
		mass (kg)		≥ 100				
		shocks						
		directions of shocks		6				
	bump	acceleration (m/s ²)	no	250		IEC 60068-2-29 [2]	Ed: Bump	20
		mass (kg)		< 100				
		duration (ms)		6				
		bumps						
		direction of bumps		6				
Acceleration, steady state		x-direction (surge) (m/s ²)	5	none				
		y-direction (sway) (m/s ²)	6	none				
		z-direction (heave) (m/s ²)	10	none				
Angular motion	static	rotation around x-axis (list) (deg)	15	none				
		rotation around y-axis (trim) (deg)	10	none				
	dynamic	rotation around x-axis (roll) (deg)	22,5	none				
		rotation around y-axis (pitch) (deg)	10	none				
		rotation around z-axis (yaw) (deg)	4	none				
		rotation around x-axis (roll) (Hz)	0,14					
		rotation around y-axis (pitch) (Hz)	0,2					
		rotation around z-axis (yaw) (Hz)	0,05					
no: This condition does not occur in this class.								
none: Verification is required only in special cases.								
NOTES: Number of note, see clause 4.2.								

Table 5: Mechanical tests - Alternative for Classes 6.2 and 6.3 (IEC Class 6M4)

Environmental parameter			Environmental Class 6.2 to 6.3	Environmental test specification T 6.2 and 6.3: Ship locations Alternative test (IEC Class 6M4)				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Vibration	sinusoidal	displacement (mm)	1,5	1,5		IEC 60068-2-6 [2]	Fc: vibration (sinusoidal)	18
		acceleration (m/s ²)	50	49				
		frequency range (Hz)	2-28	28-150	3 x 10 sweep cycles			
	random	ASD (m ² /s ³)	no	19,2		IEC 60068-2-64 [2]	Fh: Vibration, broad-band (digital control)	20
		frequency range (Hz)		-3				
		axes of vibration		5-28	28-150	3 x 30 min		
Shocks	shocks	shock spectrum type	I II III	half sine		IEC 60068-2-27 [2]	Ea: Shock	21
		duration (ms)	11 6 2,3	6				
		acceleration (m/s ²)	100 300 500	300				
		mass (kg)		≥ 100				
		shocks directions of shocks		6	3 shocks in each direction			
	bump	acceleration (m/s ²)		400		IEC 60068-2-29 [2]	Eb: Bump	21
		mass (kg)		< 100				
		duration (ms)		6				
		bumps direction of bumps		6	100 bumps in each direction			
Acceleration, steady state		x-direction (surge) (m/s ²)	5	none				
		y-direction (sway) (m/s ²)	6	none				
		z-direction (heave) (m/s ²)	10	none				
Angular motion	static	rotation around x-axis (list) (deg)	15	none				
		rotation around y-axis (trim) (deg)	10	none				
	dynamic	rotation around x-axis (roll) (deg)	22,5	none				
		rotation around y-axis (pitch) (Hz)	0,14	none				
		rotation around z-axis (yaw) (Hz)	0,05	none				

no: This condition does not occur in this class.
none: Verification is required only in special cases.
NOTES: Number of note, see clause 4.2.

4 Notes to tables

4.1 General note

The present document applies the use of stationary equipment in ship environment covering the environmental conditions stated in EN 300 019-1-6 [1]. The notes have been added to explain the main reasons for recommended tests or to explain why no test has been recommended even if there is a characteristic severity given.

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

4.2 Notes to tables 1 to 5

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 temperatures are given, the higher test temperature includes heat trap effect of direct solar radiation on equipment. The equipment under test shall remain operational throughout this test, except for the start-up at high temperature, which shall commence once high temperature stability is achieved.

NOTE 3: (Air temperature, change, gradual).

IEC 60068-2-14 [2] Test Nb has been chosen with characteristic severity. The equipment function shall be monitored throughout the test.

NOTE 4: (Air temperature, change, air/water).

This condition is included in the test IEC 60068-2-14 [2] Test Nb.

NOTE 5: (Air temperature, surface, high).

There is no suitable IEC 60068-2 [2] test method for this parameter. This phenomenon should be taken into account when selecting materials.

NOTE 6: There is no suitable test method for this parameter in IEC 60068-2 [2].

NOTE 7: (Humidity, relative, high, slow temperature change).

These severities are the nearest preferred values in IEC 60068-2-56 [2] Test Cb. The minor differences both in temperature and in humidity conditions are considered to be insignificant.

NOTE 8: (Humidity, relative, high, rapid temperature change).

Rapid temperature change is a relevant parameter and therefore equipment should be designed with this requirement in mind. The wetting effect is included in IEC 60068-2-30 [2] Test Db.

NOTE 9: (Humidity, absolute, rapid temperature change).

For rapid change of temperature IEC 60068-2-30 [2] Test Db, Variant 2 is recommended.

NOTE 10: (Water, temperature, low).

The cooling effect of the low temperature of the rain is included in IEC 60068-2-14 [2] Test Nb.

NOTE 11:(Water, rain).

IEC 60068-2-18 [2] Test Rb method 1.2 has been chosen even though it does not imitate normal rain. It is a simple hand held shower test, which is easy to perform and can demonstrate that the specimen design is adequately tolerated to survive this condition. The greater of the two given durations should be used.

NOTE 12:(Water, other sources).

The effect of water is covered by IEC 60068-2-18 [2] Test Rb. This test does not demonstrate the mechanical shock caused by water waves. In IEC 60068-2 [2] series there is no a suitable test for this, but the effect has to be considered in the design of equipment. The corrosion effect of sea water should be considered when choosing materials and components. In particular, IEC 60068-2-52 [2] Test: Kb severity 1 is recommended.

NOTE 13:(Water, wetness).

If the equipment is in contact with wet surfaces the corrosion and degeneration effect has to be considered.

NOTE 14:(Radiation, solar, heat).

The effect of direct sun radiation is included in the higher test value in IEC 60068-2-2 [2] Test Bb/Bd as described in note 2. Photochemical tests can be made separately for components and materials.

NOTE 15:(Chemically active substances).

The characteristic severities are maximum values. For chemically active substances the characteristics severities should be considered when choosing components and materials. No test is recommended in the present document.

NOTE 16:(Mechanically active substances).

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

NOTE 17:(Flora, fauna).

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

NOTE 18:(Vibration, sinusoidal).

Test severity covers all types of vessels in any conditions.

The severities are given as peak values. Test severity values not specified in IEC 60068-2 [2]. The test severity is the same as the characteristic severity. In class 6M4 the maximum test frequency has been reduced because between 150 Hz and 200 Hz the contribution is insignificant. Equipment under test shall be mounted in the "in-use" position. The equipment function shall be monitored throughout the test.

A 30 minutes endurance test shall be carried out at any significant resonant frequencies.

NOTE 19:(Vibration, sinusoidal).

Test severity covers larger types of ship which do not navigate in ice.

The severities are given as peak values. Test severity values not specified in IEC 60068-2 [2]. The test severity is lower than the characteristic severity, which is considered to be too severe for this class. The maximum test frequency has been reduced because between 80 Hz and 200 Hz the contribution is insignificant. Equipment under test shall be mounted in the "in-use" position. The equipment function shall be monitored throughout the test.

A 30 minutes endurance test shall be carried out at any significant resonant frequencies.

NOTE 20:(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 150 Hz and 200 Hz the contribution is insignificant.

	IEC class 6M4
Acceleration RMS (for information only)	36,4 m/s ²

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

NOTE 21:(Shocks).

Shock to a hull is most likely to be perceived by the equipment as bump. A shock test is specified for equipment ≥ 100 kg as this is the most practical test.

The severities are given as peak values. Equipment under test shall be mounted in the "in-use" position. The equipment function shall be monitored throughout the test.

If the normal attitude is specified then the number of directions is reduced to 3.

Annex A (informative): Bibliography

- ETSI 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 300 019-2-6
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