Draft ETSI EN 300 019-2-2 V2.3.6 (2017-08)

Environmental Engineering (EE);
Environmental conditions and environmental tests for telecommunications equipment;
Part 2-2: Specification of environmental tests;
Transportation

Reference
REN/EE-0167

Keywords
environment, testing, transport

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Sous-Préfecture de Grasse (06) N° 7803/88

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Foreword

This draft European Standard (EN) has been produced by ETSI Technical Committee Environmental Engineering (EE), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI standards EN Approval Procedure.

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

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

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).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document specifies test severities and methods for verification of the required resistibility of equipment according to the relevant environmental class.

The tests defined in the present document apply to transportation of equipment covering the environmental conditions stated in ETSI EN 300 019-1-2 [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/.

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 necessary for the application of the present document.

[1] ETSI EN 300 019-1-2 (04-2014): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-2: Classification of environmental conditions; Transportation".

[2] IEC 60068-2-1 (03-2007): "Environmental testing, Part 2-1: Tests - Test A: Cold".

[3] ISO 4180:2009: "Packaging -- Complete, filled transport packages -- General rules for the compilation of performance test schedules".

[4] 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".

[5] IEC 60068-2-2 (07-2007): "Environmental testing, Part 2-2: Tests - Test B: Dry heat".

[6] IEC 60068-2-14 (01-2009): "Environmental testing - Part 2-14: Tests - Test N: Change of temperature".

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

[8] IEC 60068-2-30 (08-2005): "Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)".

[9] IEC 60068-2-64 (04-2008): "Environmental testing - Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance".

[10] IEC 60068-2-27 (02-2008): "Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock".

[11] IEC 60068-2-31 (05-2008): "Environmental testing - Part 2-31: Tests - Test Ec: Rough handling shocks, primarily for equipment-type specimens".

[12] IEC 60068-2-18 (03-2017): "Environmental testing - Part 2-18: Tests - Test R and guidance: Water".

[13] IEC 60068-2-68 (8-1994): "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".

3 Definitions

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

4 Environmental test specifications

4.0 General

The equipment shall be tested in the state in which it is normally transported where this is possible. The detailed descriptions of the environmental conditions are given in clauses 4 and 5 of ETSI EN 300 019-1-2 [1].

ETSI EN 300 019-2-0 [4] forms a general overview of this multi-part deliverable.

4.1 Equipment setup and configuration

The equipment shall be tested in the state in which it is normally transported where this is possible. If the equipment is normally transported in a packed state then it shall be tested in its packaging. If the equipment is transported both with and without its packaging it is necessary to perform tests for both configurations. For some tests and equipment, the test may be more severe for the packaged rather than the unpacked equipment.

4.2 Performance criteria

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

Performance criterion A:

- The equipment, or piece of equipment, shall be verified before and after the tests, The equipment shall function according to the manufacturer specifications before and after the test. No electrical or mechanical damages shall be allowed on the products due to the application of the tests. Packaging may be damaged after the application of the tests.

4.3 Specification T 2.1: Very careful transportation

The specification T 2.1 in tables 1 and 2 shall apply to transportation by air and by road on good quality road surfaces where special care has been taken with respect to low temperatures, handling and type of vehicle described in ETSI EN 300 019-1-2 [1].

Table 1: Test specification T 2.1: Very careful transportation - climatic tests

Environmental parameter			Environmental Class 2.1		Environmental test specification T 2.1: Very careful transportation				
Type	**Parameter**	**Detail parameter**	**Characteristic Severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criteria**	**Notes**
Air temperature	low	(°C)	-25	-25	6 h	IEC 60068-2-1 [2]	Ab: Cold	A	
	high	unventilated (°C)	+70	+70	6 h	IEC 60068-2-2 [5]	Bb: Dry heat	A	
		ventilated or outdoors (°C)	+40	None					
	change	air/air (°C) (°C/min)	-25/+30	-25/+30 1,0	5 cycles t1 = 3h	IEC 60068-2-14 [6]	Nb: Change of temperature	A	1a
		air/water (°C)	+40/+5	None					1b
Humidity	relative	slow temperature (%) change (°C)	95 +40	93 +30	4 d	IEC 60068-2-78 [7]	Cab: Damp heat steady state	A	2
		rapid temperature (%) change (°C)	95 -25/+30	90 - 100 +40	2 cycles	IEC 60068-2-30 [8]	Db: Damp heat cyclic Variant 1	A	3
	absolute	rapid temperature (°C) change (g/m^3)	+70/+15 60	None					
Air	pressure	low (kPa)	70	None					4
		change	No						
	speed	(m/s)	20	None					5
Water	rain	intensity (mm/min)	6	None					6
		low temperature (°C)	No						
	other sources	(m/s)	1	None					5
	wetness		wet surfaces	None					7
Radiation	solar	(W/m^2)	1 120	None					8
	heat	(W/m^2)	600	None					8

Environmental parameter			Environmental Class 2.1		Environmental test specification T 2.1: Very careful transportation				
Type	**Parameter**	**Detail parameter**	**Characteristic Severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criteria**	**Notes**
Chemically active substances	sulphur	SO_2 (mg/m^3)	1,0	None					9
		H_2S (mg/m^3)	0,5	None					9
	chlorine	salt	sea and road salt mist	None					9
		Cl_2 (mg/m^3)	No						9
		HCl (mg/m^3)	0,5	None					9
	nitrogen	NO_x (mg/m^3)	1,0	None					9
		NH_3 (mg/m^3)	3,0	None					9
	hydrogen fluoride HF	(mg/m^3)	0,03	None					9
	ozone O_3	(mg/m^3)	0,1	None					9
Mechanically	dust	sedimentation ($mg/(m^2h)$)	3,0	None					10
active		suspension (mg/m^3)	No						
substances	sand	(mg/m^3)	100	None					10
Flora and	micro organisms		mould, fungus, etc.	None					11
fauna	rodents, insects		rodents, etc.	None					11
Legenda: no = this condition does not occur in this class.									

Environmental parameter			Environmental Class 2.1		Environmental test specification T 2.1: Very careful transportation				
Type	**Parameter**	**Detail parameter**	**Characteristic Severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criteria**	**Notes**

NOTE 1: (Air temperature, change)
- 1a) (air/air)
  The change of temperature test is normally used to check design tolerance and the range is not important. However in this class condensation may occur. The lowest recommended test values of IEC 60068-2-14 [6] Test Nb have been chosen. For unpacked equipment with a mass < 5 kg test Na is applied.
- 1b) (air/water)
  The effect of rapid temperature change experienced by the equipment when it rains on a warm day is considered to be less severe than those experienced during the change of temperature (air/air; Test Nb) and therefore no additional test is needed.

NOTE 2: (Humidity, relative, slow temperature change) Test required for unpacked equipment only.
NOTE 3: (Humidity, absolute, rapid temperature change) Condensation is included in IEC 60068-2-30 [8] Test Db and temperature change is partly included in IEC60068-2-14 [6] Test Nb.
NOTE 4: (Air pressure, low) The effect of air pressure is evaluated at the component level therefore no test is required for transportation.
NOTE 5: No test is defined because there is no IEC standard for test of this parameter.
NOTE 6: (Water, rain) The water test may be omitted in tables 1 and 3 of test specifications T 2.1 and T 2.2 because in these classes the equipment will be exposed to rain only for short duration.
IEC 60068-2-18 [12] Test Rb method 1.2 "Spray nozzle" has been chosen even if it does not represent the normal rain. It is a simple hand held shower test, easy to perform and suitable to demonstrate that the specimen design is adequately designed to survive this condition.
NOTE 7: (Water, other sources, wet surfaces) If the equipment is in contact with wet surface the corrosion effect and degeneration effect has to be considered.
NOTE 8: (Radiation, solar, heat) The effect of direct sun radiation is included in the higher test value in IEC 60068-2-2 [5] Test Bb, as described in note 2. Photochemical tests can be made separately for components and materials.
NOTE 9: (Chemically active substances) For chemically active substances the characteristic severity should be considered when choosing components and materials. No test is required in the present document. Characteristic severities of chemically active substances are maximum values.
NOTE 10: (Mechanically active substances) For mechanical substances the packaging is supposed to protect the equipment against dust and sand, therefore no test is required. The levels of dust, both sedimentation and suspension, are far lower than the lowest severity defined in IEC 60068-2-68 [13] Test Lb.
NOTE 11: (Flora, fauna) The characteristic severity should be considered when choosing component and materials. No tests are required in the present document.

Table 2: Test specification T 2.1: Very careful transportation - mechanical tests

Environmental parameter			Environmental Class 2.1	Environmental test specification T 2.1: Very careful transportation					
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	3,5 10 15 2 - 9 9 - 200 200 - 500	None					1
	random	ASD (m^2/s^3) (dB/oct) frequency range (Hz) axes of vibration	1 0,3 10 - 200 200 - 2 000	1,0 -3 5 - 20 20 - 200 3	3 x 30 minutes	IEC 60068-2-64 [9]	Fh: Vibration, broad-band random (digital control)	A	2
Shocks	shocks	shock spectrum duration (ms) acceleration (m/s^2) mass (kg) number of shocks direction of shocks	No						
Fall	free fall	height (mm) mass (kg) attitude	No						
	toppling around	mass (kg) edges	No						
Acceleration	steady state	(m/s^2)	20	None					3
Load	static load	(kPa)	5	None					4
Miscellaneous	rolling and pitching	angle (deg) period (s)	No						

Legenda: no = this condition does not occur in this class.

NOTE 1: (Vibration, sinusoidal) Random vibration is considered to be a more realistic test for this condition, therefore no sinusoidal test is recommended. The characteristic severities are given as peak values.

NOTE 2: (Vibration, random) The most energy is in low frequencies and therefore the most realistic test has been described with a -3 dB/oct slope from 20 Hz to 200 Hz. ASD (Acceleration Spectral Density) vibrations are of greatest significance in the vertical direction. If normal attitude during transportation is specified, then the severity for the horizontal axes ASD is reduced by a factor 10.

Acceleration RMS (for information only):

- 7,83 m/s^2.
- 2,47 m/s^2, when the test severity is reduced by a factor 10.

NOTE 3: (Acceleration, steady state) This characteristic severity is considered to be insignificant and therefore no test is required.

NOTE 4: (Load) Packaging and/or equipment should be designed taking into account this requirement but no tests are required.

4.4 Specification T 2.2: Careful transportation

The specification T 2.2 in tables 3, 4 and 7 shall apply to transportation by air, by road on good quality road surfaces, by ship and by train with specially designed shock-reducing buffers and where special care has been taken with respect to low temperatures and handling described in ETSI EN 300 019-1-2 [1].

Table 3: Test specification T 2.2: Careful transportation - climatic tests

Environmental parameter			Environmental Class 2.2	Environmental test specification T 2.2: Careful transportation					
Type	**Parameter**	**Detail parameter**	**Characteristic Severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criteria**	**Notes**
Air temperature	Low	(°C)	-25	-25	72 h	IEC 60068-2-1 [2]	Ab: Cold	A	
	High	unventilated (°C)	+70	+70	72 h	IEC 60068-2-2 [5]	Bb: Dry heat	A	
		ventilated or outdoors (°C)	+40	None					
	change	air/air (°C) (°C/min)	-25/+30	-25/+30 1,0	5 cycles t1 = 3h	IEC 60068-2-14 [6]	Nb: Change of temperature	A	1a
		air/water (°C)	+40/+5	none					1b
Humidity	relative	slow temperature (%) change (°C)	95 +40	93 +40	4 d	IEC 60068-2-78 [7]	Cab: Damp heat steady state	A	2
		rapid temperature (%) change (°C)	95 -25/+30	90-100 +40	2 cycles	IEC 60068-2-30 [8]	Db: Damp heat cyclic Variant 1	A	
	absolute	rapid temperature (°C) change (g/m^3)	+70/+15 60	None					3
Air	pressure	low (kPa)	70	None					4
		change	no						
	speed	(m/s)	20	None					5
Water	Rain	intensity (mm/min)	6	None					6
		low temperature (°C)	no						
	other sources	(m/s)	1	None					5
	wetness		wet surfaces	None					7
Radiation	Solar	(W/m^2)	1 120	None					8
	Heat	(W/m^2)	600	None					8
Chemically active substances	sulphur	SO_2 (mg/m^3)	1,0	None					9
		H_2S (mg/m^3)	0,5	None					9
	chlorine	Salts	sea and road salt mist	None					9
		Cl_2 (mg/m^3)	no						
		HCl (mg/m^3)	0,5	None					9
	nitrogen	NO_x (mg/m^3)	1,0	None					9
		NH_3 (mg/m^3)	3,0	None					9

Environmental parameter			Environmental Class 2.2	Environmental test specification T 2.2: Careful transportation					
Type	**Parameter**	**Detail parameter**	**Characteristic Severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criteria**	**Notes**
	hydrogen fluoride HF	(mg/m^3)	0,03	None					9
	ozone O_3	(mg/m^3)	0,1	None					9
Mechanically active substances	Dust	sedimentation ($mg/(m^2h)$)	3,0	None					10
		suspension (mg/m^3)	no						
	Sand	(mg/m^3)	100	None					10
Flora and Fauna	micro organisms		mould, fungus, etc.	None					11
	rodents, insects		rodents, etc.	None					11

Legenda: no = this condition does not occur in this class.

NOTE 1: (Air temperature, change)
- 1a) (air/air)
  The change of temperature test is normally used to check design tolerance and the range is not important. However in this class condensation may occur. The lowest recommended test values of IEC 60068-2-14 [6] Test Nb have been chosen. For unpacked equipment with a mass < 5 kg test Na is applied.
- 1b) (air/water)
  The effect of rapid temperature change experienced by the equipment when it rains on a warm day is considered to be less severe than those experienced during the change of temperature (air/air; Test Nb) and therefore no additional test is needed.

NOTE 2: (Humidity, relative, slow temperature change) Test required for unpacked equipment only.

NOTE 3: (Humidity, absolute, rapid temperature change) Condensation is included in IEC 60068-2-30 [8] Test Db and temperature change is partly included in IEC 60068-2-14 [6] Test Nb.

NOTE 4: (Air pressure, low) The effect of air pressure is evaluated at the component level therefore no test is required for transportation

NOTE 5: No test is defined because there is no IEC standard for test of this parameter.

NOTE 6: (Water, rain) The water test may be omitted in tables 1 and 3 of test specifications T 2.1 and T 2.2 because in these classes the equipment will be exposed to rain only for short duration.
IEC 60068-2-18 [12] Test Rb method 1.2 "Spray nozzle" has been chosen even if it does not represent the normal rain. It is a simple hand held shower test, easy to perform and suitable to demonstrate that the specimen design is adequately designed to survive this condition.

NOTE 7: (Water, other sources, wet surfaces) If the equipment is in contact with wet surface the corrosion effect and degeneration effect has to be considered.

NOTE 8: (Radiation, solar, heat) The effect of direct sun radiation is included in the higher test value in IEC 60068-2-2 [5] Test Bb, as described in note 2. Photochemical tests can be made separately for components and materials.

NOTE 9: (Chemically active substances) For chemically active substances the characteristic severity should be considered when choosing components and materials. No test is required in the present document. Characteristic severities of chemically active substances are maximum values.

NOTE 10: (Mechanically active substances) For mechanical substances the packaging is supposed to protect the equipment against dust and sand, therefore no test is required. The levels of dust, both sedimentation and suspension, are far lower than the lowest severity defined in IEC 60068-2-68 [13] Test Lb.

NOTE 11: (Flora, fauna) The characteristic severity should be considered when choosing component and materials. No tests are required in the present document.

Table 4: Test specification T 2.2: Careful transportation - mechanical tests

Environmental parameter			Environmental Class 2.2	Environmental test specification T 2.2: Careful transportation					
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	3,5 10 15 2 - 9 9 - 200 200 - 500	None					1
	random	ASD (m^2/s^3) (dB/oct) frequency range (Hz) axes of vibration	1,0 0,3 10 - 200 200 - 2 000	1,0 -3 5 - 20 20 - 200 3	3 x 30 minutes	IEC 60068-2-64 [9]	Fh: Vibration, broad-band random (digital control)	A	2
Shocks	shocks	shock spectrum duration (ms) acceleration (m/s^2) mass (kg) number of shocks direction of shocks	Type I 11 100	half sine 6 11 100 50 ≤ 50 > 50 6	100 in each Direction	IEC 60068-2-27 [10]	Ea: shocks	A	3
Fall	free fall	height (m) mass (kg) attitude	0,25 0,25 0,1 < 20 20 to 100 > 100	see table 7		IEC 60068-2-31 [11]	Ec: Procedure 1	A	4
	toppling around	mass (kg) edges	< 20 20 to 100 > 100 any no no	None					5
Acceleration	steady state	(m/s^2)	20	None					6
Load	static load	(kPa)	5	None					7
Miscellaneous	rolling and pitching	angle (deg) period (s)	no						

Environmental parameter			Environmental Class 2.2	Environmental test specification T 2.2: Careful transportation					
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criteria**	**Notes**
Legenda: no = this condition does not occur in this class. NOTE 1: (Vibration, sinusoidal) Random vibration is considered to be a more realistic test for this condition, therefore no sinusoidal test is recommended. The characteristic severities are given as peak values. NOTE 2: (Vibration, random) The most energy is in low frequencies and therefore the most realistic test has been described with a -3 dB/oct slope from 20 Hz to 200 Hz. ASD (Acceleration Spectral Density) vibrations are of greatest significance in the vertical direction. If normal attitude during transportation is specified, then the severity for the horizontal axes ASD is reduced by a factor 10. Acceleration RMS (for information only): – 7,83 m/s^2. – 2,47 m/s^2, when the test severity is reduced by a factor 10. NOTE 3: (Shocks) During transportation, the number of shocks is expected to be high, so the shock test is more adequate for testing. The characteristic severities are given as peak values. For masses > 500 Kg no shock test is required. These test severity values are not specified in IEC 60068-2-27 [10]. The specified test severities for m < 50 kg and m > 50 kg have been chosen to have the same energy per mass unit for both situations. Shocks are of greatest significance in the vertical direction. If normal attitude during transportation is specified, 100 shocks have to be applied along that direction only. NOTE 4: (Free Fall) ISO test severities are chosen because they are considered to be more realistic. NOTE 5: (Toppling around) No test is required because the effect is included in IEC 60068-2-31 [11] Test Ed, free fall. NOTE 6: (Acceleration, steady state) This characteristic severity is considered to be insignificant and therefore no test is required. NOTE 7: (Load) Packaging and/or equipment should be designed taking into account this requirement but no tests are required.									

4.5 Specification T 2.3: Public transportation

This specification T 2.3 in tables 5 to 7 shall apply to transportation by air, by road on all qualities of road surface, by ship and by train and where some care has been taken with respect to low temperatures described in ETSI EN 300 019-1-2 [1].

Table 5: Test specification T 2.3: Public transportation - climatic tests

Environmental parameter			Environmental Class 2.3	Environmental test specification T 2.3: Public transportation					
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criteria**	**Notes**
Air Temperature	low	(°C)	-40	-40	72 h	IEC 60068-2-1 [2]	Ab: Cold	A	
	high	unventilated (°C)	+70	+70 (and +85)	72 h (6 h)	IEC 60068-2-2 [5]	Bb: Dry heat	A	1
		ventilated or outdoors(°C)	+40	none					
	change	air/air (°C) (°C/min)	-40/+30	-40/+30 1,0	5 cycles t1 = 3 h	IEC 60068-2-14 [6]	Nb: Change of temperature	A	2a
		air/water (°C)	+40/+5	None					2b
Humidity	relative	slow temperature (%) change (°C)	95 +45	93 +40	4 d	IEC 60068-2-78 [7]	Cab: Damp heat steady state	A	3
		rapid temperature (%) change (°C)	95 -40/+30	90 - 100 +40	2 cycles	IEC 60068-2-30 [8]	Db: Damp heat cyclic Variant 1	A	
	absolute	rapid temperature (°C) change (g/m^3)	+70/+15 60	None					4
Air	pressure	low (kPa)	70	None					5
		Change	No						
	speed	(m/s)	20	None					6
Water	rain	intensity	6 mm/min	0,01 m^3/min, 90 kPa	3 min/m^2 or 15 min	IEC 60068-2-18 [12]	Rb: Impacting water, Method 1.2 "spray nozzle"	A	8
		low temperature (°C)	no						
	other sources	(m/s)	1	None					6
	wetness		wet surfaces	None					8
Radiation	solar	(W/m^2)	1 120	None					9
	heat	(W/m^2)	600	None					9

Environmental parameter			Environmental Class 2.3	Environmental test specification T 2.3: Public transportation					
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criteria**	**Notes**
Chemically active substances	sulphur	SO_2 (mg/m^3)	1,0	None					10
		H_2S (mg/m^3)	0,5	None					10
		salts	sea and road salt mist	None					10
	chlorine	Cl_2 (mg/m^3)	no						10
		HCl (mg/m^3)	0,5	None					10
	nitrogen	NO_x (mg/m^3)	1,0	None					10
		NH_3 (mg/m^3)	3,0	None					10
	hydrogen fluoride HF	(mg/m^3)	0,03	None					10
	ozone O_3	(mg/m^3)	0,1	None					10
Mechanically active substances	dust	sedimentation ($mg/(m^2h)$)	3,0	None					11
		suspension (mg/m^3)	no						
	sand	(mg/m^3)	100	None					11
Flora and Fauna	micro organisms		mould, fungus, etc.	None					12
	rodents, insects		rodents, etc.	None					12
Legenda: no = this condition does not occur in this class.									

Environmental parameter			Environmental Class 2.3	Environmental test specification T 2.3: Public transportation					
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criteria**	**Notes**

NOTE 1: (Air temperature, high) An additional test at 85 °C for 6 h shall be conducted on unpacked equipment only. The additional test includes solar radiation effects.
NOTE 2: (Air temperature, change)
- 2a) (air/air)
  The change of temperature test is normally used to check design tolerance and the range is not important. However in this class condensation may occur. The lowest recommended test values of IEC 60068-2-14 [6] Test Nb have been chosen. For unpacked equipment with a mass < 5 kg test Na is applied.
- 2b) (air/water)
  The effect of rapid temperature change experienced by the equipment when it rains on a warm day is considered to be less severe than those experienced during the change of temperature (air/air; Test Nb) and therefore no additional test is needed.

NOTE 3: (Humidity, relative, slow temperature change) Test required for unpacked equipment only.
NOTE 4: (Humidity, absolute, rapid temperature change) Condensation is included in IEC 60068-2-30 [8] Test Db and temperature change is partly included in IEC 60068-2-14 [6] Test Nb.
NOTE 5: (Air pressure, low) The effect of air pressure is evaluated at the component level therefore no test is required for transportation.
NOTE 6: No test is defined because there is no IEC standard for test of this parameter.
NOTE 7: (Water, rain) The water test may be omitted in tables 1 and 3 of test specifications T 2.1 and T 2.2 because in these classes the equipment will be exposed to rain only for short duration. IEC 60068-2-18 [12] Test Rb method 1.2 "Spray nozzle" has been chosen even if it does not represent the normal rain. It is a simple hand held shower test, easy to perform and suitable to demonstrate that the specimen design is adequately designed to survive this condition.
NOTE 8: (Water, other sources, wet surfaces) If the equipment is in contact with wet surface the corrosion effect and degeneration effect has to be considered.
NOTE 9: (Radiation, solar, heat) The effect of direct sun radiation is included in the higher test value in IEC 60068-2-2 [5] Test Bb, as described in note 2. Photochemical tests can be made separately for components and materials.
NOTE 10: (Chemically active substances) For chemically active substances the characteristic severity should be considered when choosing components and materials. No test is required in the present document. Characteristic severities of chemically active substances are maximum values.
NOTE 11: (Mechanically active substances) For mechanical substances the packaging is supposed to protect the equipment against dust and sand, therefore no test is required. The levels of dust, both sedimentation and suspension, are far lower than the lowest severity defined in IEC 60068-2-68 [13] Test Lb.
NOTE 12: (Flora, fauna) The characteristic severity should be considered when choosing component and materials. No tests are required in the present document.

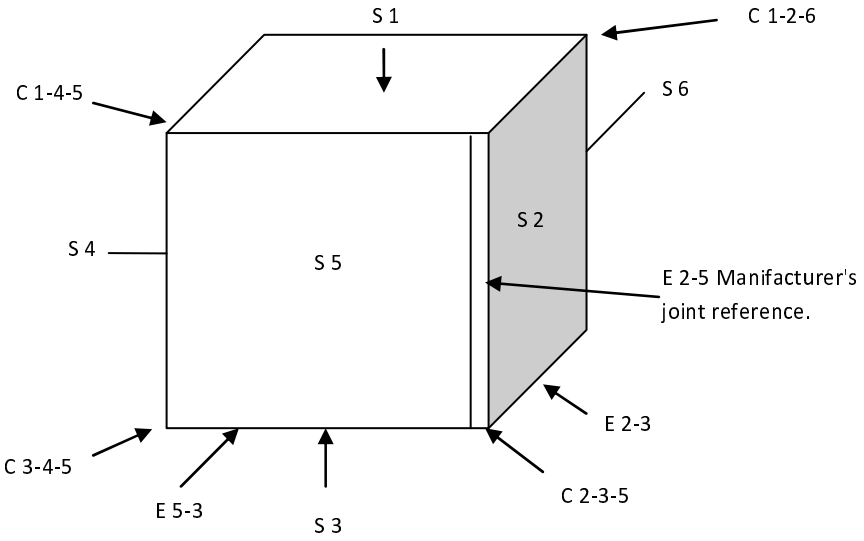
Table 6: Test specification T 2.3: Public transportation - mechanical tests

Environmental parameter			Environmental Class 2.3	Environmental test specification T 2.3: Public transportation					
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	3,5 10 15 2 - 9 9 - 200 200 - 500	None					1
	random	ASD (m^2/s^3) (dB/oct) frequency range (Hz) axes of vibration	1 0,3 10 - 200 200 - 2 000	1,0 -3 5 - 20 20 - 200 3	3 x 30 minutes	IEC 60068-2-64 [9]	Fh: Vibration, broad-band random (digital control)	A	2
Shocks	shocks	shock spectrum duration (ms) acceleration (m/s^2) mass (kg) number of shocks direction of shocks	Type I Type II 11 6 100 300	half sine 6 11 180 100 ≤ 50 > 50 6	100 in each Direction	IEC 60068-2-27 [10]	Ea: shocks	A	3
Fall	free fall	height (m) mass (kg) attitude	1,2 1,0 0,25 < 20 20 to 100 > 100	see table 7		IEC 60068-2-31 [11]	Ec: Procedure 1	A	4
	toppling around	mass (kg) edges	< 20 20 to 100 > 100 any any any	None					5
Acceleration	steady state	(m/s^2)	20	None					6
Load	static load	(kPa)	10	None					7
Miscellaneous	rolling and pitching	angle (deg) period (s)	±35 8	None					

Environmental parameter			Environmental Class 2.3	Environmental test specification T 2.3: Public transportation					
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criteria**	**Notes**
NOTE 1: (Vibration, sinusoidal) Random vibration is considered to be a more realistic test for this condition, therefore no sinusoidal test is recommended. The characteristic severities are given as peak values. NOTE 2: (Vibration, random) The most energy is in low frequencies and therefore the most realistic test has been described with a -3 dB/oct slope from 20 Hz to 200 Hz. ASD (Acceleration Spectral Density) vibrations are of greatest significance in the vertical direction. If normal attitude during transportation is specified, then the severity for the horizontal axes ASD is reduced by a factor 10. Acceleration RMS (for information only): – 7,83 m/s^2. – 2,47 m/s^2, when the test severity is reduced by a factor 10. NOTE 3: (Shocks) During transportation, the number of shocks is expected to be high, so the shock test is more adequate for testing. The characteristic severities are given as peak values. For masses > 500 Kg no shock test is required. These test severity values are not specified in IEC 60068-2-27 [10]. The specified test severities for m < 50 kg and m > 50 kg have been chosen to have the same energy per mass unit for both situations. Shocks are of greatest significance in the vertical direction. If normal attitude during transportation is specified, 100 shocks have to be applied along that direction only. NOTE 4: (Free Fall) ISO test severities are chosen because they are considered to be more realistic. NOTE 5: (Toppling around) No test is required because the effect is included in IEC 60068-2-31 [11] Test Ed, free fall. NOTE 6: (Acceleration, steady state) This characteristic severity is considered to be insignificant and therefore no test is required. NOTE 7: (Load) Packaging and/or equipment should be designed taking into account this requirement but no tests are required.									

Table 7: Free fall test severities for test specifications T 2.2 and T 2.3

	Free fall test height [m]	
Mass [kg]	**Class T 2.2**	**Class T 2.3**
< 10	0,8	1,0
< 15	0,6	1,0
< 20	0,6	0,8
< 30	0,5	0,6
< 40	0,4	0,5
< 50	0,3	0,4
< 100	0,2	0,3
> 100	0,1	0,1
NOTE 1: Packaged equipment with mass < 100 kg and without pallet is subjects to free-fall drop tests on each of the following, see figure 1: – Surface S1, S2, S3, S4, S5, S6 (every surface). – Edge E2-3, E2-5, E5-3. – Corner C1-2-6, C1-4-5, C2-3-5, C3-4-5. Allow 1 minute between drops for the cushioning to recover its shape. Packaged equipment with mass ≥ 100 kg or with pallet the package is subjects to free-fall drop tests. Two drops shall be performed to the normal rest surface (e.g. side with the pallet). NOTE 2: Values specified in ISO 4180 [3].		



Legend:
C: Corner.
E: Edge.

Figure 1

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 ETSI ETS 300 019-2-2
V2.1.2	September 1999	Publication
V2.2.1	January 2012	Publication
V2.3.1	April 2013	Publication
V2.3.6	August 2017	EN Approval Procedure AP 20171126: 2017-08-28 to 2017-11-27