Draft ETSI EN 300 019-2-5 V3.0.7 (2021-06)

Environmental Engineering (EE);
Environmental conditions and environmental tests for telecommunications equipment;
Part 2: Specification of environmental tests;
Sub-part 5: Ground vehicle installations

Reference
REN/EE-017009

Keywords
environment, equipment practice, mobile,
terrestrial, testing

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Sous-Préfecture de Grasse (06) N° w061004871

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

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
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Modal verbs terminology

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

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

1 Scope

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

The tests defined in the present document apply to the use of equipment installed permanently or temporarily in ground vehicles and cover the vehicles and the environmental conditions stated in ETSI EN 300 019-1-5 [1].

The tests cover installations in vehicles powered by electric motors and combustion engines. Applications in combustion engine compartments are excluded.

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 300 019-1-5 (04-2003): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-5: Classification of environmental conditions; Ground vehicle installations".

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

[3] Void.

[4] Void.

[5] Void.

[6] Void.

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

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

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

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

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

[12] Void.

[13] Void.

[14] Void.

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

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

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

[i.2] IEC 60068-2 (all parts): "Environmental testing - Part 2: Tests".

[i.3] ETSI EN 300 019-1-0: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-0: Classification of environmental conditions; Introduction".

[i.4] IEC 60068-2-68 (08-1994): "Environmental testing - Part 2: Tests - Test L: Dust and sand".

[i.5] IEC 60721-3-5 (03-1997): "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 5: Ground vehicle installations".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 300 019-1-0 [i.3] apply.

3.2 Symbols

For the purposes of the present document, the symbols given in ETSI EN 300 019-1-0 [i.3] apply.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI EN 300 019-1-0 [i.3] apply.

4 Environmental test specifications

4.0 General

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

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

4.1 Equipment setup and configuration

The equipment shall be tested in its operational state throughout the test conditions described in the present document unless otherwise stated. Input and load conditions of the equipment shall be chosen to obtain full utilization of the equipment under test. The heat dissipation shall be maximized, except for the steady state, low temperature test, where it shall be minimized.

4.2 Performance criteria

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

Performance criterion A:

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

Performance criterion B:

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

Performance criterion C:

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

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

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

Performance criterion D:

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

4.3 Specification T 5.1: Protected installations

The tests specifications T 5.1 of the present document shall apply to equipment intended for use in weather protected heated locations in vehicles which are used in areas with or without well-developed road systems depending on the selected IEC mechanical class. See tables 1, 2 and 2a.

4.4 Specification T 5.2: Partly protected installations

The tests specifications T 5.2 of the present document shall apply to equipment intended for use in vehicles, excluding only non-weather protected use in unheated vehicles at extremely low temperature conditions. This test specification applies to equipment intended for use in vehicles in areas with or without developed road systems, depending on the selected IEC mechanical class, see tables 2 and 3.

4.5 Specification T 5.1: protected installation, climatic tests

The specification in table 1 shall apply to protected installation described in ETSI EN 300 019-1-5 [1].

Table 1: Test specification T 5.1: protected installation - climatic tests

Environmental parameter			Environmental Class 5.1		Environmental test specification T5.1: Vehicle, protected installation				
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criterion**	**Notes**
	Low	(°C)	-25	-25	16 h	IEC 60068-2-1 [2]	Ab/Ad/Ae: Cold	A	1
Air temperature	High	(°C)	+40	+40 or +55	16 h	IEC 60068-2-2 [7]	Bb/Bd/Be: Dry heat	A	2
		(°C)	+70	+70 or +85	16 h	IEC 60068-2-2 [7]	Bb/Bd/Be: Dry heat	A	2
	Change	rapid (°C)	-25 to +30	None					3a
		(°C) gradual (°C/min)	-25 to +30 5	-25/+30	5 cycles t_1 = 3 h	IEC 60068-2-14 [8]	Na: Change of temperature	A	3b
		(°C) (°C/min)	-25 to +60 10	None					3c
Temperature	Change	air/water (°C)	+60/+5	None					4
		air/snow (°C)	+60/-5	None					4
Humidity	Relative	slow temperature (%) change (°C)	95 +40	93 +40	96 h	IEC 60068-2-78 [16]	Cb: Damp heat, steady state	A	5
		(%) rapid temperature (°C)	95 -25 to +30 not d)	90-100 +40	2 cycles	IEC 60068-2-30 [9]	Db: Damp heat, cyclic, Variant 2	A	6a
		change (%) (°C)	95 +10 to +70 d)	90-100 +55	2 cycles	IEC 60068-2-30 [9]	Db: Damp heat, cyclic, Variant 2	A	6b
		low (%) (°C)	10 +30	None					8
	absolute	rapid temperature (g/m^3) change (°C)	60 +70 to +15	None					7
Air	pressure	low (kPa)	70	None					9
	Speed	(m/s)	20	None					8
Water	Rain	Intensity (mm/min)	No	Not Applicable					
	other sources	velocity (m/s)	0,3	None					8
	wetness		wet surfaces	None					8,12
Radiation	Solar	(W/m^2)	700	None					13
	Heat	(W/m^2)	600	None					13

Environmental parameter			Environmental Class 5.1		Environmental test specification T5.1: Vehicle, protected installation				
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criterion**	**Notes**
Chemically active substance	Sulphur	SO_2 (mg/m^3)	0,3 to 1,0	None					14
		H_2S (mg/m^3)	0,1 to 0,5	None					14
	Chlorine	sea salts	salt mist	None					14
		road salts	solid salt, salt water	None					14
		HCl (mg/m^3)	0,1 to 0,5	None					14
	Nitrogen	NO_x (mg/m^3)	0,5 to 1,0	None					14
		NH_3 (mg/m^3)	1,0 to 3,0	None					14
	hydrogen fluoride	HF (mg/m^3)	0,01 to 0,03	None					14
	ozone	O_3 (mg/m^3)	0,05 to 0,1	None					14
Mechanically active substances	dust (Sedimentation)	other than cabin ($mg/(m^2h)$) cabin only ($mg/(m^2h)$)	3,0 1,0	None					15 15
	sand	(mg/m^3)	0,1	None					15
Flora and Fauna	micro organism		mould, fungus, etc.	None					16
	rodents, insects		rodents, etc.	None					16
Contaminating fluids	Oil	motor	No	Not Applicable					
		gearbox	No	Not Applicable					
		hydraulic	Electrical engine compartment only	None					17
		transformer		None					17
	Fluid	brake		None					17
		cooling		None					17
	Grease			None					17
	battery electrolyte			None					17
	Fuel		No	Not Applicable					

NOTE 1: (Air temperature, low). The characteristic severity can be used as a cold start up temperature. Other cold start temperature can be used as defined in the product specification.

NOTE 2: (Air temperature, high).

In ventilated compartment and outdoor air conditions, the lower test temperature is equal to the characteristic severity and refers to equipment to be protected against solar and heat radiation. The higher test temperature includes solar radiation.

In unventilated and engine compartment conditions, the higher test temperature is equal to the characteristic severity and refers to equipment to be protected against solar and heat radiation. The higher test temperature includes heat trap effect of direct solar radiation.

NOTE 3: (Air temperature, change).

3a) (rapid)

No test is required at equipment level. The rapid change of temperature test is normally used to check design tolerancing. This effect is included in IEC 60068-2-14 [8] Test Na.

3b) (gradual)

The IEC 60068-2-14 [8] Test Na has been chosen since the rapid temperature change is considered to be more severe than gradual temperature change. For engine compartment the test temperature change near upper limit is considered to be less severe and this effect is covered by test Bb. This test is not applicable to engine compartment.

3c) (gradual)

This characteristic severity refers to the engine compartment. No tests are required.

Environmental parameter			Environmental Class 5.1		Environmental test specification T5.1: Vehicle, protected installation				
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criterion**	**Notes**

NOTE 4: (Temperature, change, air/water, air/snow).
Temperature change is partly included in IEC 60068-2-14 [8] Test Na. The characteristic severity does not cover the engine compartment and should be considered when designing the equipment and when choosing components and materials. This No test is required at equipment level.

NOTE 5: (Humidity, relative, slow temperature change).
These severities are the nearest preferred values in IEC 60068-2-78 [16] Test Cb and the minor differences in humidity condition is considered to be insignificant and within normal measurement tolerances.

NOTE 6: (Humidity, relative, rapid temperature change).
Variant 2 has been chosen rather than variant 1 due to the high temperature/absolute humidity involved and the difficulty in maintaining tolerances in most chambers with heat producing specimen.

6a) This characteristic severity does not apply to near refrigerated air conditioning.

6b) This characteristic severity applies to near refrigerated air conditioning.

NOTE 7: (Humidity, absolute, rapid temperature change).
This effect is partly included in IEC 60068-2-30 [9] Test Db. No additional tests are required.

NOTE 8: As there is no IEC 60068-2 [i.2] test method for this parameter, no tests are defined.

NOTE 9: (Air pressure, low).
No test is recommended for normal applications, because the effect of air pressure is evaluated at the component level.

NOTE 10: Void.

NOTE 11: Void.

NOTE 12: (Water, wetness).
If the equipment is in contact with wet surface, the corrosion effect and degeneration effect has to be considered.

NOTE 13: (Radiation, solar, heat).
Heating effect of all sources is included in high temperature test. Photochemical tests can be made separately for components and materials.

NOTE 14: (Chemically active substances).
For chemically active substances, the characteristic severity should be considered when choosing components and materials. No test is required at equipment level.
Characteristic severities of chemically active substances are mean/maximum values.

NOTE 15: (Mechanically active substances).
The characteristic severities are much lower than lowest test severity in IEC 60068-2-68 [i.4] Test Lb and therefore no test is required. This condition should be considered when designing the equipment and when choosing components and materials.

NOTE 16: (Flora, fauna).
The characteristic severity should be considered when designing the equipment and when choosing components and materials.

NOTE 17: (Contaminating fluids).
Appropriate for electrical engine compartment only. The characteristic severity should be considered when designing the equipment and when choosing components and materials.

4.6 Specification T 5.1 and T 5.2: protected and partly protected installation, mechanical tests

The specification in table 2 shall apply to protected (T 5.1) and partly protected (T 5.2) installation described in ETSI EN 300 019-1-5 [1]. Test specifications for random vibrations in Table 2 are based on characteristics severity of IEC 60721-3-5 [i.5] class M2.

Table 2: Test specification T5.1: protected installation
Test specification T5.2: partly protected installation

Environmental parameter			Environmental Class 5.1	Environmental test specification T5.1 and 5.2: Vehicle, protected and partly protected installations					
Type	**Parameter**	**Detail parameter**	**Characteristic Severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criterion**	**Notes**
Vibration	sinusoidal	displacement (mm) acceleration (m/s^2) frequency range (Hz)	3,3 3 2 to 9 9 to 200 200 to 500	None					1
	random	ASD (m^2/s^3) (dB/oct) frequency range (Hz) axes of vibration	1 0,3 10 to 200 200 to 500	1 -3 5 to 20 20 to 500 3	3 x 30 min	IEC 60068-2-64 [10]	Fh: Vibration, broad-band random (digital control)	A	2
Shocks	shocks	shock spectrum duration (ms) acceleration (m/s^2) number of shocks directions shocks	Type I Type II 11 6 100 300	half sine 6 300 6	3 in each direction	IEC 60068-2-27 [11]	Ea: Shock	A	3
	bump	acceleration (m/s^2) duration (ms) number of bumps directions of bumps	No	100 11 6	100 in each direction	IEC 60068-2-27 [11]	Eb: Bump	A	4

NOTE 1: (Vibration, sinusoidal).
Random vibration is considered to be a more realistic test for this condition, therefore no sinusoidal test is required.
NOTE 2: (Vibration, random).
For information, this characteristics severity corresponds to IEC 60721-3-5 [i.5] class M2.
NOTE 3: (Shock).
The severities are given as peak values.
NOTE 4: (Bump).
The severities are given as peak values. Bump test is required in addition to shocks as the number of expected shocks is high. Bumps are of greatest significance in the vertical direction. If only one operational position is specified, 100 bumps have to be applied along that direction only.

The specification in table 2a shall apply to protected (T 5.1) and partly protected (T 5.2) installation described in ETSI EN 300 019-1-5 [1]. Test specifications for random vibrations in Table 2a are based on characteristics severity of IEC 60721-3-5 [i.5] class M3.

Table 2a: Test specification T5.1: Protected installation
Test specification T5.2: Partly protected installation

Environmental parameter			Environmental Class 5.1 & 5.2	Environmental test specification T5.1 and 5.2: Vehicle, protected and partly protected installations					
Type	**Parameter**	**Detail parameter**	**Characteristic Severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criterion**	**Notes**
Vibration	sinusoidal	displacement (mm) acceleration (m/s^2) frequency range (Hz)	7,5 20 2 to 8 Hz 8 to 200 Hz 50 200 to 500 Hz	None					1
	random	ASD (m^2/s^3) (dB/oct) frequency range (Hz) axes of vibration	3 1 10 to200 Hz 200 to 500 Hz	2 -3 5 to 20 Hz 20 to 500 Hz 3	3 × 30 min	IEC 60068-2-64 [10]	Fh: Vibration, broad-band random (digital control)	A	2
Shocks	shocks	shock spectrum duration (ms) acceleration (m/s^2) number of shocks directions of shocks	Type I Type II 11 6 300 1 000	half sine 6 1 000 6	3 in each direction	IEC 60068-2-27 [11]	Ea: Shock	A	3
	bump	acceleration (m/s^2) duration (ms) number of bumps directions of bumps	No	100 11 6	100 in each direction	IEC 60068-2-27 [11]	Eb: Bump	A	4

NOTE 1: (Vibration, sinusoidal).
Random vibration is considered to be a more realistic test for this condition, therefore no sinusoidal test is required.
NOTE 2: (Vibration, random).
For information, this characteristics severity corresponds to IEC 60721-3-5 [i.5] class M3.
NOTE 3: (Shock).
The severities are given as peak values.
NOTE 4: (Bump).
The severities are given as peak values. Bump test is required in addition to shocks as the number of expected shocks is high. Bumps are of greatest significance in the vertical direction. If only one operational position is specified, 100 bumps have to be applied along that direction only.

4.7 Specification T 5.2: partly protected installation, climatic tests

The specification in table 3 shall apply to partly protected installation described in ETSI EN 300 019-1-5 [1].

Table 3: Test specification T 5.2: partly protected installation - climatic tests

Environmental parameter				Environmental Class 5.2	Environmental test specification T 5.2: Vehicle, partly protected installations					
Type	**Parameter**	**Detail parameter**		**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criterion**	**Notes**
	Low		(°C)	-40	-40	16 h	IEC 60068-2-1 [2]	Ab/Ad/Ae: Cold	A	1
	High		(°C)	+40	+40 or +55	16 h	IEC 60068-2-2 [7]	Bb/Bd/Be: Dry heat	A	2
Air			(°C)	+70	+70 or +85	16 h	IEC 60068-2-2 [7]	Bb/Bd/Be: Dry heat	A	2
temperature		rapid	(°C)	-40 to +30	None					3a
	change		(°C)	-40 to +30	-40 to +30	5 cycles t_1 = 3 h	IEC 60068-2-14 [8]	Na: Change of temperature	A	3b
		gradual	(°C/min)	5						
			(°C)	-40 to +70						3c
			(°C/min)	10						
		air/water	(°C)	-40/+5	None					4a
Temperature	change	air/water	(°C)	+70/+5	None					4b
		air/ snow	(°C)	+70/-5	None					4b
		slow temperature change	(%) (°C)	95 +45	93 +40	96 h	IEC 60068-2-78 [16]	Cb: Damp heat, steady state	A	5
	relative		(%)	95	90 to 100	2 cycles	IEC 60068-2-30 [9]	Db: Damp heat, cyclic, variant 2	A	
		rapid temperature	(°C)	-45 to +30	+40					6
Humidity		change	(%) (°C)	95 +10 to +70	90 to 100 +55	2 cycles	IEC 60068-2-30 [9]	Db: Damp heat, cyclic, variant 2	A	6
		low	(%) (°C)	10 +30	None					8
	absolute	rapid temperature change	(g/m^3) (°C)	60 +70 to +15	None					7
Air	pressure	low	(kPa)	70	None					9
	speed		(m/s)	20	None					8
	rain	intensity	mm/min	6	0,01 m^3/min; 90 kPa	3 min/m^2 or 15 min	IEC 60068-2-18 [15]	Rb: Impacting water Method 1.2	A	10
Water	other sources	velocity	(m/s)	1	None					11
	wetness			wet surfaces	None					8,12

Environmental parameter			Environmental Class 5.2	Environmental test specification T 5.2: Vehicle, partly protected installations					
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criterion**	**Notes**
Radiation	solar	(W/m^2)	1 120	None					13
	heat	(W/m^2) (W/m^2)	600 not c) 1 120 c)	None					13
	sulphur	SO_2 (mg/m^3)	0,3 to 1,0	None					14
		H_2S (mg/m^3)	0,1 to 0,5	None					14
		sea salts	salt mist	None					14
Chemically	chlorine	road salts	solid salt salt water	None					14
Active		HCl (mg/m^3)	0,1 to 0,5	None					14
Substances	nitrogen	NO_x (mg/m^3)	0,5 to 1,0	None					14
		NH_3 (mg/m^3)	1,0 to 3,0	None					14
	hydrogen fluoride	HF (mg/m^3)	0,01 to 0,03	None					14
	ozone	O_3 (mg/m^3)	0,05 to 0,1	None					14
Mechanically	dust (Sedimentation)	other than cabin ($mg/(m^2h)$) cabin only ($mg/(m^2h)$)	3,0 1,0	None					15 15
active substances	sand	other than cabin (mg/m^3) cabin only	0,1 No	None Not Applicable					15 15
Flora and	micro organisms		mould, fungus, etc.	none	None				16
Fauna	rodents, insects		rodents, etc.	none	None				16
		motor	No	Not Applicable					
	oil	gearbox	No	Not Applicable					
		hydraulic	Electrical engine compartment only	None					17
Contaminating		transformer		None					17
Fluids	fluid	brake		None					17
		cooling		None					17
	grease			None					17
	battery electrolyte			None					17
	fuel		No	Not Applicable					

NOTE 1: (Air temperature, low). The characteristic severity can be used as a cold start up temperature. Other cold start temperature can be used as defined in the product specification.

NOTE 2: (Air temperature, high).

In ventilated compartment and outdoor air conditions, the lower test temperature is equal to the characteristic severity and refers to equipment to be protected against solar and heat radiation. The higher test temperature includes solar radiation.

In unventilated and engine compartment conditions, the higher test temperature is equal to the characteristic severity and refers to equipment to be protected against solar and heat radiation. The higher test temperature includes heat trap effect of direct solar radiation.

NOTE 3: (Air temperature, change).

3a) (rapid)

No test is required at equipment level. The rapid change of temperature test is normally used to check design tolerancing. This effect is included in IEC 60068-2-14 [8] Test Na.

3b) (gradual)

The IEC 60068-2-14 [8] Test Na has been chosen since the rapid temperature change is considered to be more severe than gradual temperature change. For engine compartment the test temperature change near upper limit is considered to be less severe and this effect is covered by test Bb. This test is not applicable to engine compartment.

Environmental parameter			Environmental Class 5.2	Environmental test specification T 5.2: Vehicle, partly protected installations					
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Performance criterion**	**Notes**

3c) (gradual)
This characteristic severity refers to the engine compartment. No tests are required.

NOTE 4: (Temperature, change; air/water, air/snow)
Temperature change is partly included in IEC 60068-2-14 [8] Test Na. The characteristic severity should be considered when designing the equipment and when choosing components and materials. This No test is required at equipment level.

4a)
The characteristic severity does not cover the engine compartment.

4b)
The characteristic severity covers the engine compartment.

NOTE 5: (Humidity, relative, slow temperature change).
These severities are the nearest preferred values in IEC 60068-2-78 [16] Test Cb and the minor differences in humidity condition is considered to be insignificant and within normal measurement tolerances.

NOTE 6: (Humidity, relative, rapid temperature change).
Variant 2 has been chosen rather than variant 1 due to the high temperature/absolute humidity involved and the difficulty in maintaining tolerances in most chambers with heat producing specimen.

6a) This characteristic severity does not apply to near refrigerated air conditioning.

6b) This characteristic severity applies to near refrigerated air conditioning.

NOTE 7: (Humidity, absolute, rapid temperature change).
This effect is partly included in IEC 60068-2-30 [9] Test Db. No additional tests are required.

NOTE 8: As there is no IEC 60068-2 [i.2] test method for this parameter, no tests are defined.

NOTE 9: (Air pressure, low).
No test is recommended for normal applications, because the effect of air pressure is evaluated at the component level.

NOTE 10: (Water, rain).
IEC 60068-2-18 [15] 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 adequate to survive this condition. The greater of the two given durations should be chosen.

NOTE 11: (Water, other sources).
No test is recommended because the effect is already included in IEC 60068-2-18 [15] Test Rb.

NOTE 12: (Water, wetness).
If the equipment is in contact with wet surface, the corrosion effect and degeneration effect has to be considered.

NOTE 13: (Radiation, solar, heat).

NOTE 14: (Chemically active substances).
For chemically active substances, the characteristic severity should be considered when choosing components and materials. No test is required at equipment level.
Characteristic severities of chemically active substances are mean/maximum values.

NOTE 15: (Mechanically active substances).
The characteristic severities are much lower than lowest test severity in IEC 60068-2-68 [i.4] Test Lb and therefore no test is required. This condition should be considered when designing the equipment and when choosing components and materials.

NOTE 16: (Flora, fauna).
The characteristic severity should be considered when designing the equipment and when choosing components and materials.

NOTE 17: (Contaminating fluids).
Appropriate for electrical engine compartment only. The characteristic severity should be considered when designing the equipment and when choosing components and materials.

Annex A (informative): Bibliography

- ETSI ETR 100 035: "Equipment Engineering (EE); Environmental engineering; Guidance and terminology".
- IEC 60068-1: "Environmental testing. Part 1: General and guidance".
- IEC 60721-3-3: "Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use at weatherprotected locations".

Annex (informative): Change History

Date	Version	Information about changes
10/2020	3.1.1	Changes made in respect to V.3.0.0 are the addition of performance criteria and the updates of reference standards and test methods

History

Document history		
Edition 1	May 1994	Publication as ETSI ETS 300 019-2-5
V2.1.2	September 2001	Publication
V3.0.0	December 2002	Publication
V3.0.7	June 2021	EN Approval Procedure AP 20210912: 2021-06-14 to 2021-09-13