

ETSI EN 300 019-2-5 V3.1.1 (2021-09)



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

ReferenceREN/EE-017009

Keywordsenvironment, equipment practice, mobile,
terrestrial, testing

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Foreword

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

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

| National transposition dates | |
|--|-------------------|
| Date of adoption of this EN: | 13 September 2021 |
| Date of latest announcement of this EN (doa): | 31 December 2021 |
| Date of latest publication of new National Standard or endorsement of this EN (dop/e): | 30 June 2022 |
| Date of withdrawal of any conflicting National Standard (dow): | 30 June 2022 |

Modal verbs terminology

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

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1 Scope

The present document specifies test 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/>.

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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 2-68: 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 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 | |
| Air temperature | Low | (°C) | -25 | -25 | 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 | |
| | | (°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 | | | | A | 3a |
| | | gradual | (°C) | -25 to +30 | -25/+30 | 5 cycles $t_1 = 3$ h | IEC 60068-2-14 [8] | Na: Change of temperature | A | 3b |
| | | | (°C/min) | 5 | | | | | | |
| | | (°C/min) | -25 to +60 | 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 change | (%) | 95 | 90-100 | 2 cycles | IEC 60068-2-30 [9] | Db: Damp heat, cyclic, Variant 2 | A | 6a |
| | | | (°C) | -25 to +30 not d) | +40 | 2 cycles | IEC 60068-2-30 [9] | | A | 6b |
| | | (%) | 95 | 90-100 | 2 cycles | IEC 60068-2-30 [9] | Db: Damp heat, cyclic, Variant 2 | A | 6b | |
| | (°C) | +10 to +70 d) | +55 | | | | | | 8 | |
| | low | (%) (°C) | 10 +30 | None | | | | | 7 | |
| Air | absolute | rapid temperature change | (g/m ³) (°C) | 60 +70 to +15 | None | | | | | |
| | 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 ₂ S (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 ² h)) | 3,0 | None | | | | | 15 |
| | | cabin only (mg/(m ² h)) | 1,0 | | | | | | 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 | | None | | | | | 17 |
| | | transformer | | None | | | | | 17 |
| | Fluid | brake | Electrical engine compartment only | | 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 15 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 11 100 Type II 6 300 | 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 11 6 | 100 in each direction | IEC 60068-2-27 [11] | Eb: Bump | A | 4 |
| <p>NOTE 1: (Vibration, sinusoidal). Random vibration is considered to be a more realistic test for this condition, therefore no sinusoidal test is required.</p> <p>NOTE 2: (Vibration, random). For information, this characteristics severity corresponds to IEC 60721-3-5 [i.5] class M2.</p> <p>NOTE 3: (Shock). The severities are given as peak values.</p> <p>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.</p> | | | | | | | | | |

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 50 2 to 8 8 to 200 200 to 500 | None | | | | | 1 |
| | random | ASD (m ² /s ³) frequency range (dB/oct) axes of vibration (Hz) | 3 1 10 to 200 200 to 500 | 2 -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 of shocks | Type I 11 300 Type II 6 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 |
| <p>NOTE 1: (Vibration, sinusoidal). Random vibration is considered to be a more realistic test for this condition, therefore no sinusoidal test is required.</p> <p>NOTE 2: (Vibration, random). For information, this characteristics severity corresponds to IEC 60721-3-5 [i.5] class M3.</p> <p>NOTE 3: (Shock). The severities are given as peak values.</p> <p>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.</p> | | | | | | | | | |

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 temperature | | (°C) | +70 | +70 or +85 | 16 h | IEC 60068-2-2 [7] | Bb/Bd/Be: Dry heat | A | 2 | |
| | | rapid | (°C) | -40 to +30 | | | | | 3a | |
| | change | gradual | (°C) | -40 to +30 | 5 cycles $t_1 = 3$ h | IEC 60068-2-14 [8] | Na: Change of temperature | A | 3b | |
| | | (°C/min) | 5 | | | | | | 3c | |
| | | (°C/min) | -40 to +70 10 | | | | | | | |
| | | air/water | (°C) | -40/+5 | | | | | 4a | |
| Temperature | change | air/water | (°C) | +70/+5 | | | | | 4b | |
| | | air/ snow | (°C) | +70/-5 | | | | | 4b | |
| | | slow temperature change | (%) (°C) | 95 +45 | 93 +40 | 96 h | IEC 60068-2-78 [16] | Cb: Damp heat, steady state | A | 5 |
| | relative | rapid temperature change | (%) (°C) | 95 -45 to +30 | 90 to 100 +40 | 2 cycles | IEC 60068-2-30 [9] | Db: Damp heat, cyclic, variant 2 | A | 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 ₂ S (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 ² h)) cabin only (mg/(m ² h)) | 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 Fauna | micro organisms | | mould, fungus, etc. | none | None | | | | 16 |
| | rodents, insects | | rodents, etc. | none | None | | | | 16 |
| | oil | motor gearbox | No No | Not Applicable Not Applicable | | | | | |
| | | hydraulic | | None | | | | | 17 |
| Contaminating | | transformer | | None | | | | | 17 |
| Fluids | fluid | brake cooling | Electrical engine compartment only | None None | | | | | 17 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 B (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 |
| V3.1.1 | September 2021 | Publication |