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Environmental conditions and environmental tests for
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Part 2-2: Specification of environmental tests;
Transportation**



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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 Public Enquiry phase of the ETSI standards Two-step 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 | |
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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 EN 300 019-1-2 [1].

2 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 reference document (including any amendments) applies.

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2.1 Normative references

The following referenced documents are necessary for the application of the present document.

- [1] ETSI EN 300 019-1-2: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-2: Classification of environmental conditions; Transportation".
- [2] IEC 60068-2 (series): "Environmental testing - Part 2: Tests".
- [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".

2.2 Informative references

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 1-2: Classification of environmental conditions; Transportation".

3 Definitions

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

4 Environmental test specifications

The detailed descriptions of the environmental conditions are given in clauses 4 and 5 of EN 300 019-1-2 [1].

EN 300 019-2-0 [4] forms a general overview of of the present document.

If the equipment is normally transported in a packed state then it shall be tested in its packaging.

4.1 Specification T 2.1: Very careful transportation

Specification T 2.1 applies 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. See tables 1 and 2.

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

| Environmental parameter | | | Environmental Class 2.1 | Environmental test specification T2.1: Very careful transportation | | | | | |
|-------------------------|---------------|-------------------------------|-------------------------|--|----------|--------------------|----------------------------|--------------------------------|----|
| Type | Parameter | Detail parameter | Characteristic Severity | Test severity | Duration | Reference | Method | Notes | |
| Air temperature | low | (°C) | -25 | -25 | 6 h | IEC 60068-2-1 [2] | Ab: Cold | 1 | |
| | high | unventilated (°C) | +70 | +70 | 6 h | IEC 60068-2-2 [2] | Bb: Dry heat | | |
| | | ventilated or outdoors (°C) | +40 | None | | | | | |
| | change | air/air (°C) | -25/+30 | -25/+30 | 5 cycles | t1 = 3h | IEC 60068-2-14 [2] | Nb: Change of temperature | 3a |
| air/water (°C) | | +40/+5 | None | | 3b | | | | |
| Humidity | relative | slow temperature change (%) | 95 | 93 | 4 d | IEC 60068-2-78 [2] | Cb: Damp heat steady state | 4 | |
| | | rapid temperature change (%) | +40 | +30 | | | | | |
| | absolute | rapid temperature change (°C) | -25/+30 | 95 | 90-100 | 2 cycles | IEC 60068-2-30 [2] | Db: Damp heat cyclic Variant 1 | 5 |
| | | change (g/m ³) | +70/+15 | 60 | none | | | | |
| Air | pressure | low (kPa) | 70 | none | | | | 6 | |
| | | change | no | | | | | | |
| | speed | (m/s) | 20 | none | | | | 7 | |
| Water | rain | intensity (mm/min) | 6 | none | | | | 8 | |
| | | low temperature (°C) | no | | | | | | |
| | other sources | (m/s) | 1 | | | | | 7 | |
| | wetness | | wet surfaces | | | | | 9 | |
| Radiation | solar | (W/m ²) | 1 120 | | | | | 10 | |
| | heat | (W/m ²) | 600 | | | | | 10 | |

| Environmental parameter | | | Environmental Class 2.1 | Environmental test specification T2.1: Very careful transportation | | | | | |
|--------------------------------|----------------------|---------------------------------------|-------------------------|--|----------|-----------|--------|-------|----|
| Type | Parameter | Detail parameter | Characteristic Severity | Test severity | Duration | Reference | Method | Notes | |
| Chemically active substances | sulphur | SO ₂ (mg/m ³) | 1,0 | none | | | | 11 | |
| | | H ₂ S (mg/m ³) | 0,5 | none | | | | 11 | |
| | chlorine | salt | sea and road salt mist | | none | | | | 11 |
| | | Cl ₂ (mg/m ³) | no | | | | | | 11 |
| | | HCl (mg/m ³) | 0,5 | none | | | | | 11 |
| | nitrogen | NO _x (mg/m ³) | 1,0 | none | | | | | 11 |
| | | NH ₃ (mg/m ³) | 3,0 | none | | | | | 11 |
| | hydrogen fluoride HF | (mg/m ³) | 0,03 | none | | | | | 11 |
| ozone O ₃ | (mg/m ³) | 0,1 | none | | | | | 11 | |
| Mechanically active substances | dust | sedimentation (mg/(m ² h)) | 3,0 | none | | | | 12 | |
| | | suspension (mg/m ³) | no | | | | | | |
| | sand | (mg/m ³) | 100 | none | | | | 12 | |
| Flora and fauna | micro organisms | | mould, fungus, etc. | none | | | | 13 | |
| | rodents, insects | | rodents, etc. | none | | | | 13 | |

NOTE 1: no = this condition does not occur in this class.
NOTE 2: none = verification is required only in special cases.
NOTE 3: n = number of note, see clause 4.4.

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 | Notes |
| Vibration | sinusoidal | displacement (mm) | 3,5 10 15 | none | | | | 14 |
| | | acceleration (m/s ²) | 2 to 9 - 9 to 200 - | | | | | |
| | | frequency range (Hz) | 200 to 500 | | | | | |
| | random | ASD (m ² /s ³) | 1 0,3 | 1,0 | 3 x 30 minutes | IEC 60068-2-64 [2] | Fh: Vibration, broad-band random (digital control) | 15 |
| | | frequency range (Hz) | 10-200 200 to 2 000 | 5 to 20 20 to 200 | | | | |
| | | axes of vibration | 3 | | | | | |
| Shocks | shocks | shock spectrum | | no | | | | |
| | | duration (ms) | | | | | | |
| | | acceleration (m/s ²) | | | | | | |
| | | mass (kg) | | | | | | |
| | | number of bumps | | | | | | |
| | | direction of bumps | | | | | | |

| 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 | Notes |
| Fall | free fall | height (mm) mass (kg) attitude | no | | | | | |
| | toppling around | mass (kg) edges | no | | | | | |
| Acceleration | steady state | (m/s ²) | 20 | none | | | | 19 |
| Load | static load | (kPa) | 5 | none | | | | 20 |
| Miscellaneous | rolling and pitching | angle (deg) period (s) | no | | | | | |

NOTE 1: no = this condition does not occur in this class.
NOTE 2: none = verification is required only in special cases.
NOTE 3: n = number of note, see clause 4.4.

4.2 Specification T 2.2: Careful transportation

Specification T 2.2 applies 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. See tables 3 and 4.

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

| Environmental parameter | | | Environmental Class 2.2 | Environmental test specification T2.2: Careful transportation | | | | | |
|-------------------------|-----------|--|-------------------------|---|----------|---------------------|----------------------------|--------------------------------|----|
| Type | Parameter | Detail parameter | Characteristic severity | Test severity | Duration | Reference | Method | Notes | |
| Air temperature | low | (°C) | -25 | -25 | 72 h | IEC 60068-2-1 [2] | Ab: Cold | 1 | |
| | high | unventilated (°C) | +70 | +70 | 72 h | IEC 60068-2-2 [2] | Bb: Dry heat | | |
| | | 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 [2] | Nb: Change of temperature | 3a |
| air/water (°C) | | +40/+5 | none | | | | | 3b | |
| Humidity | relative | slow temperature change (%) | 95 | 93 | 4 d | IEC 60068-2-78 [2] | Cb: Damp heat steady state | 4 | |
| | | rapid temperature change (°C) | +40 | +40 | | | | | |
| | absolute | rapid temperature change (%) | 95 | 90-100 | +40 | 2 cycles | IEC 60068-2-30 [2] | Db: Damp heat cyclic Variant 1 | |
| | | rapid temperature change (°C) (g/m ³) | -25/+30 | none | | | | | 5 |

| Environmental parameter | | | Environmental Class 2.2 | Environmental test specification T2.2: Careful transportation | | | | |
|--------------------------------|---------------------------|---------------------------------------|-------------------------|---|----------|-----------|--------|-------|
| Type | Parameter | Detail parameter | Characteristic severity | Test severity | Duration | Reference | Method | Notes |
| Air | pressure change | low (kPa) | 70 | none | | | | 6 |
| | | speed (m/s) | 20 | none | | | | 7 |
| Water | rain | intensity (mm/min) | 6 | none | | | | 8 |
| | | low temperature (°C) | no | | | | | |
| | other sources (m/s) | 1 | | | | | | 7 |
| | wetness | | wet surfaces | | | | | 9 |
| Radiation | solar heat | (W/m ²) | 1 120 | | | | | 10 |
| | | (W/m ²) | 600 | | | | | 10 |
| Chemically active substances | sulphur | SO ₂ (mg/m ³) | 1,0 | none | | | | 11 |
| | | H ₂ S (mg/m ³) | 0,5 | none | | | | 11 |
| | chlorine | Salts | sea and road salt mist | none | | | | 11 |
| | | Cl ₂ (mg/m ³) | no | | | | | |
| | nitrogen | HCl (mg/m ³) | 0,5 | none | | | | 11 |
| | | NO _x (mg/m ³) | 1,0 | none | | | | 11 |
| | | NH ₃ (mg/m ³) | 3,0 | none | | | | 11 |
| hydrogen fluoride HF | (mg/m ³) | 0,03 | none | | | | 11 | |
| ozone O ₃ | (mg/m ³) | 0,1 | none | | | | 11 | |
| Mechanically active substances | dust | sedimentation (mg/(m ² h)) | 3,0 | none | | | | 12 |
| | | suspension (mg/m ³) | no | | | | | |
| | sand (mg/m ³) | 100 | none | | | | | 12 |
| Flora and Fauna | micro organisms | | mould, fungus, etc. | none | | | | 13 |
| | rodents, insects | | rodents, etc. | none | | | | 13 |

NOTE 1: no = this condition does not occur in this class.
NOTE 2: none = verification is required only in special cases.
NOTE 3: n = number of note, see clause 4.4.

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 | Notes |
| Vibration | sinusoidal | displacement (mm) | 3,5 | | | none | | | | 14 |
| | | acceleration (m/s ²) | 10 | 15 | | | | | | |
| | | frequency range (Hz) | 2 to 9 | 9 to 200 | 200 to 500 | | | | | |
| | | axes of vibration | | | | | | | | |
| | random | ASD (m ² /s ³) | 1,0 | | 0,3 | 1,0 | | IEC 60068-2-64 [2] | Fh: Vibration, broad-band random (digital control) | 15 |
| | | frequency range (Hz) | 10 to 200 | 200 to 2 000 | | | -3 | | | |
| | | axes of vibration | | | | 5 to 20 20 to 200 | | | | |
| Shocks | shocks | shock spectrum | Type I | | | half sine | | IEC 60068-2-27 [2] | Eb: Bump | 16 |
| | | duration (ms) | 11 | | | 6 11 | | | | |
| | | acceleration (m/s ²) | 100 | | | 100 50 | | | | |
| | | mass (kg) | | | | ≤ 50 > 50 | | | | |
| | | number of bumps | | | | | 100 in each direction | | | |
| | | direction of bumps | | | | 6 | | | | |
| Fall | free fall | height (m) | 0,25 | 0,25 | 0,1 | | | IEC 60068-2-31 [2] | Ed: Procedure 1 | 17 |
| | | mass (kg) | < 20 | 20 to 100 | > 100 | see table 7 | | | | |
| | toppling around | mass edges (kg) | < 20 | 20 to 100 | > 100 | none | | | | 18 |
| Acceleration | steady state | (m/s ²) | 20 | | | none | | | | 19 |
| Load | static load | (kPa) | 5 | | | none | | | | 20 |
| Miscellaneous | rolling and pitching | angle (deg) | no | | | | | | | |
| | | period (s) | | | | | | | | |

NOTE 1: no = this condition does not occur in this class.

NOTE 2: none = verification is required only in special cases.

NOTE 3: n = number of note, see subclause 4.4.

4.3 Specification T 2.3: Public transportation

Specification T 2.3 applies 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. See tables 5 to 7.

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

| Environmental parameter | | | Environmental Class 2.3 | Environmental test specification T2.3: Public transportation | | | | |
|-------------------------|---------------|--|-------------------------|--|-----------------------------------|--------------------|------------------------------------|-------|
| Type | Parameter | Detail parameter | Characteristic severity | Test severity | Duration | Reference | Method | Notes |
| Air temperature | low | (°C) | -40 | -40 | 72 h | IEC 60068-2-1 [2] | Ab: Cold | 1 |
| | high | unventilated (°C) | +70 | +70 (and +85) | 72 h (6 h) | IEC 60068-2-2 [2] | Bb: Dry heat | 2 |
| | | 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 [2] | Nb: Change of temperature | 3a |
| air/water (°C) | | +40/+5 | none | | | | 3b | |
| Humidity | relative | slow temperature change (%) (°C) | 95 +45 | 93 +40 | 4 d | IEC 60068-2-78 [2] | Cb: Damp heat steady state | 4 |
| | | rapid temperature change (%) (°C) | 95 -40/+30 | 90-100 +40 | 2 cycles | IEC 60068-2-30 [2] | Db: Damp heat cyclic Variant 1 | |
| | absolute | rapid temperature change (°C) (g/m ³) | +70/+15 60 | none | | | | 5 |
| Air | pressure | low (kPa) | 70 | none | | | | 6 |
| | | Change | no | | | | | |
| | speed | (m/s) | 20 | none | | | | 7 |
| Water | rain | intensity | 6 mm/min | 0,01 m ³ /min, 90 kPa | 3 min/m ² or 15 min | IEC 60068-2-18 [2] | Rb: Impacting water, Method 2.2 | 8 |
| | | low temperature (°C) | no | | | | | |
| | other sources | (m/s) | 1 | | | | | 7 |
| | wetness | | wet surfaces | | | | | 9 |
| Radiation | solar | (W/m ²) | 1 120 | | | | | 10 |
| | heat | (W/m ²) | 600 | | | | | 10 |

| Environmental parameter | | | Environmental Class 2.3 | Environmental test specification T2.3: Public transportation | | | | |
|--------------------------------|----------------------|---------------------------------------|-------------------------|--|----------|-----------|--------|-------|
| Type | Parameter | Detail parameter | Characteristic severity | Test severity | Duration | Reference | Method | Notes |
| Chemically active substances | sulphur | SO ₂ (mg/m ³) | 1,0 | none | | | | 11 |
| | | H ₂ S (mg/m ³) | 0,5 | none | | | | 11 |
| | | salts | sea and road salt mist | none | | | | 11 |
| | chlorine | Cl ₂ (mg/m ³) | no | | | | | 11 |
| | | HCl (mg/m ³) | 0,5 | none | | | | 11 |
| | nitrogen | NO _x (mg/m ³) | 1,0 | none | | | | 11 |
| | | NH ₃ (mg/m ³) | 3,0 | none | | | | 11 |
| | hydrogen fluoride HF | (mg/m ³) | 0,03 | none | | | | 11 |
| ozone O ₃ | (mg/m ³) | 0,1 | none | | | | 11 | |
| Mechanically active substances | dust | sedimentation (mg/(m ² h)) | 3,0 | none | | | | 12 |
| | | suspension (mg/m ³) | no | | | | | |
| | sand | (mg/m ³) | 100 | none | | | | 12 |
| Flora and fauna | micro organisms | | mould, fungus, etc. | none | | | | 13 |
| | rodents, insects | | rodents, etc. | none | | | | 13 |

NOTE 1: no = this condition does not occur in this class.

NOTE 2: none = verification is required only in special cases.

NOTE 3: n = number of note, see clause 4.4.

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 | Notes |
| Vibration | sinusoidal | displacement (mm) | 3,5 | none | | | | 14 |
| | | acceleration (m/s ²) | 10 15 | | | | | |
| | | frequency range (Hz) | 2 to 9 9 to 200 200 to 500 | | | | | |
| | | axes of vibration | | | | | | |
| | random | ASD (m ² /s ³) | 1 0,3 | 1,0 | 3 x 30 minutes | IEC 60068-2-64 [2] | Fh: Vibration, broad-band random (digital control) | 15 |
| | | (dB/oct) | | -3 | | | | |
| | | frequency range (Hz) | 10-200200 to 2 000 | 5-20 20 to 200 | | | | |
| | | axes of vibration | | 3 | | | | |

| 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 | Notes |
| Shocks | shocks | shock spectrum | Type I | Type II | half sine | 100 in each direction | IEC 60068-2-27 [2] | Eb: Bump | 16 |
| | | duration (ms) | 11 | 6 | 6 | | | | |
| | | acceleration (m/s ²) | 100 | 300 | 180 | 100 | | | |
| | | mass (kg) | | | ≤ 50 | > 50 | | | |
| | | number of bumps | | | | | | | |
| | | direction of bumps | | | 6 | | | | |
| Fall | free fall | height (m) | 1,2 | 1,0 | 0,25 | see table 7 | IEC 60068-2-31 [2] | Ed: Procedure 1 | 17 |
| | | mass (kg) | < 20 | 20 to 100 | > 100 | | | | |
| | toppling around | mass (kg) | < 20 | 20 to 100 | > 100 | none | | | 18 |
| | | edges | any | any | any | | | | |
| Acceleration | steady state | (m/s ²) | 20 | | | none | | | 19 |
| Load | static load | (kPa) | 10 | | | none | | | 20 |
| Miscellaneous | rolling and pitching | angle (deg) | ±35 | | | none | | | |
| | | period (s) | 8 | | | | | | |

NOTE 1: none = verification is required only in special cases.
NOTE 2: n = number of note, see clause 4.4.

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

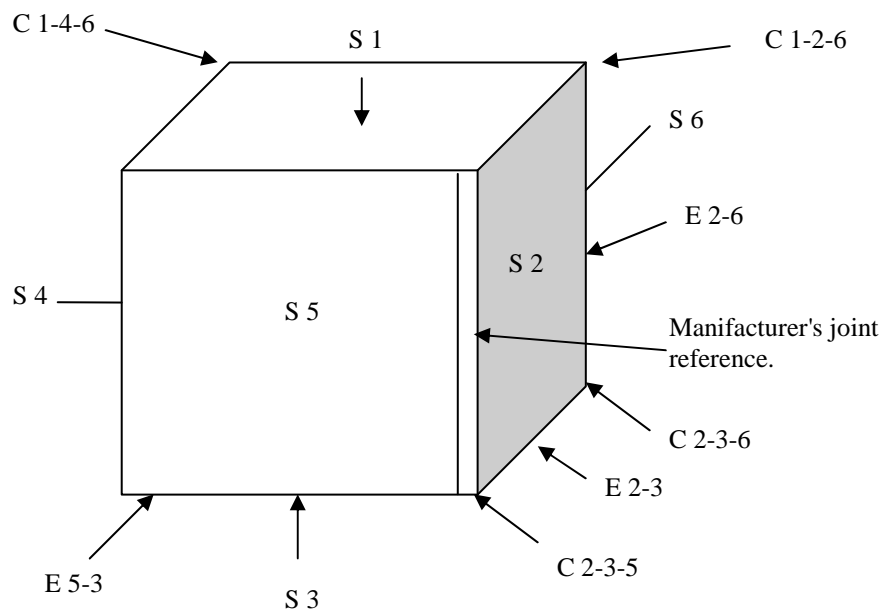
| Mass [kg] | Free fall test height [m] | |
|-----------|---------------------------|-------------|
| | Class T 2.2 | Class T 2.3 |
| < 10 | 0,8 | 1,0 |
| < 15 | 0,6 | 1,0 |
| < 20 | 0,6 | 0,8 |
| < 30 | 0,5 | 0,6 |
| < 40 | 0,4 | 0,5 |
| < 50 | 0,3 | 0,4 |
| < 100 | 0,2 | 0,3 |
| > 100 | 0,1 | 0,1 |

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, E2-6, E5-3.
- Corner C1-2-6, C1-4-6, C2-3-5, C2-3-6.

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

4.4 Notes to tables

4.4.1 General note

The present document applies to transportation of equipment covering environmental conditions stated in EN 300 019-1-2 [1]. The notes have been added to explain the main reasons for recommended tests or to explain why no test has been recommended even if there is a characteristic severity given.

The equipment should be tested in the state in which it is normally transported if possible. For example, if the equipment is in a packed state, then it should be tested in its packaging. If the equipment is transported both with and without its packaging it may be 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.

4.4.2 Notes to tables 1 to 6

NOTE 1: (Air temperature, low)

- If the equipment is tested without any package or if the equipment is small the duration may be decreased.

NOTE 2: (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 3: (Air temperature, change)

- **3a)** (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 [2] Test Nb have been chosen. For unpacked equipment with a mass < 5 kg test Na is applied.
- **3b)** (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 4: (Humidity, relative, slow temperature change)

- Test required for unpacked equipment only.

NOTE 5: (Humidity, absolute, rapid temperature change)

- Condensation is included in IEC 60068-2-30 [2] Test Db and temperature change is partly included in IEC 60068-2-14 [2] Test Nb.

NOTE 6: (Air pressure, low)

- For normal applications where the effect of air pressure is evaluated at the component level therefore no test is recommended.

NOTE 7: There is no IEC 60068-2 [2] test for this parameter.

NOTE 8: (Water, rain)

- The water test may be omitted in tables 2.1 and 2.2 because in these classes the equipment will be exposed to rain only for short duration. IEC 60068-2-18 [2] Test Rb method 2.2 has been chosen even if it does not imitate normal rain. It is a simple hand held shower test, easy to perform and can demonstrate that the specimen design is adequately tolerated to survive this condition.

NOTE 9: (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 10: (Radiation, solar, heat)

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

NOTE 11: (Chemically active substances)

- For chemically active substances the characteristic severity should be considered when choosing components and materials. No test is recommended in this standard. Characteristic severities of chemically active substances are max. values.

NOTE 12: (Mechanically active substances)

- For mechanical substances the packaging is supposed to protect the equipment against dust and sand, therefore no test is recommended. The Levels of dust both sedimentation and suspension are far lower than the lowest severity recommended in IEC 60068-2-68 [2] Test Lb.

NOTE 13: (Flora, fauna)

- The characteristic severity should be considered when choosing component and materials.

NOTE 14: (Vibration, sinusoidal)

- Random vibration is considered to be a more realistic test for this condition, therefore no sinusoidal test is recommended. The severities are given as peak values.

NOTE 15: (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):
 - 8,76 m/s².
 - 2,77 m/s², when the test severity is reduced by a factor 10.

NOTE 16: (Shocks)

- During transportation, the number of shocks is expected to be high, so the bump test is more adequate for testing. The severities are given as peak values. For masses > 500 Kg no bump test is required. Test severity values not specified in IEC 60068-2 [2].
- 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. Bumps are of greatest significance in the vertical direction. If normal attitude during transportation is specified, 100 bumps have to be applied along that direction only.

NOTE 17: (Free Fall)

- ISO severities are chosen because they are considered to be more realistic.

NOTE 18: (Toppling around)

- No test is required because the effect is included in IEC 60068-2-31 [2] Test Ed, free fall.

NOTE 19: (Acceleration, steady state)

- This characteristic severity is considered to be insignificant and therefore no test is recommended.

NOTE 20: (Load)

- This condition is for packaged equipment only. Packaging should be designed with this requirement in mind.

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 | | |
|-------------------------|----------------|--|
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