EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50483-6

January 2009

ICS 29.240.20

English version

Test requirements for low voltage aerial bundled cable accessories - Part 6: Environmental testing

Prescriptions relatives aux essais
des accessoires pour réseaux aériens
basse tension torsadés -
Partie 6: Essais d’environnement

Prüfanforderungen für Bauteile für isolierte
Niederspannungsfreileitungen -
Teil 6: Umweltprüfungen

This European Standard was approved by CENELEC on 2008-12-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: avenue Marnix 17, B - 1000 Brussels

Ref. No. EN 50483-6:2009 E

Foreword

This European Standard was prepared by a sub-group of WG 11 of the Technical Committee CENELEC TC 20, Electric cables.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50483-6 on 2008-12-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2009-12-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2011-12-01

This is Part 6 of CENELEC standard EN 50483 "*Test requirements for low voltage aerial bundled cable accessories*", which has six parts:

- Part 1: Generalities;
- Part 2: Tension and suspension clamps for self supporting system;
- Part 3: Tension and suspension clamps for neutral messenger system;
- Part 4: Connectors;
- Part 5: Electrical ageing test;
- Part 6: Environmental testing.

Contents

Figures

Tables

1 Scope

EN 50483 series applies to overhead line fittings for tensioning, supporting and connecting aerial bundled cables (ABC) of rated voltage U_0/U (U_m): 0,6/1 (1,2) kV.

The objective is to provide a method of testing the suitability of accessories when used under normal operating conditions with low voltage aerial bundled cables complying with HD 626.

This Part 6 defines the environmental tests in particular the climatic and corrosion ageing tests. The objective of these tests is to predict the behaviour of ABC accessories when subjected to sun radiation, to weather conditions (humidity, spraying water, heat, cold) and pollution. EN 50483-1, EN 50483-2, EN 50483-3 and EN 50483-4 specify which type tests included in this part of the standard are needed.

Climate differs across Europe and in order to meet the differing geographic climatic conditions it is necessary to provide a range of tests to meet these variations. A range of optional, additional tests is provided to meet the varying climatic needs and these should be agreed between the customer and the supplier (see Annex C).

NOTE This European Standard does not invalidate existing approvals of products achieved on the basis of national standards and specifications and/or the demonstration of satisfactory service performance. However, products approved according to such national standards or specifications cannot directly claim approval to this European Standard. It may be possible, subject to agreement between supplier and purchaser, and/or the relevant conformity assessment body, to demonstrate that conformity to the earlier standard can be used to claim conformity to this standard, provided an assessment is made of any additional type testing that may need to be carried out. Any such additional testing that is part of a sequence of testing cannot be done separately.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50483 series, *Test requirements for low voltage aerial bundled cable accessories*

EN 60068-2-5, *Environmental testing – Part 2: Tests – Test Sa: Simulated solar radiation at ground level* (IEC 60068-2-5)

EN 60068-2-9:1999, *Environmental testing – Part 2: Tests – Guidance for solar radiation testing* (IEC 60068-2-9:1975 + A1:1984)

EN 60068-2-11:1999, *Environmental testing – Part 2: Tests – Test Ka: Salt mist* (IEC 60068-2-11:1981)

EN ISO 3231, *Paints and varnishes – Determination of resistance to humid atmospheres containing sulfur dioxide* (ISO 3231)

IEC 60050-461, *International Electrotechnical Vocabulary (IEV) – Part 461: Electric cables*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-461 and the following apply.

3.1

aerial bundled cable (ABC)
aerial cable consisting of a group of insulated conductors which are twisted together including, or not, a non insulated conductor
[IEV 461-08-02, modified]

NOTE The terms bundled conductors, bundled cables, bundled cores, conductor bundles and bundle could be used as equivalent to the term aerial bundled cable (ABC).

3.2
aerial-insulated-cable

insulated cable designed to be suspended overhead and outdoors
[IEV 461-08-01]

3.3
conductor (of a cable)

part of a cable which has the specific function of carrying current
[IEV 461-01-01]

3.4
core

assembly comprising conductor and its own insulation
[IEV 461-04-04, modified]

3.5
fixture (or fitting)

device for attaching ABC tension or/and suspension clamps to a pole or to a wall

3.6
insulation (of a cable)

insulating materials incorporated in a cable with the specific function of withstanding voltage
[IEV 461-02-01]

3.7
type test

test required to be made before supplying a type of material covered by this standard on a general commercial basis, in order to demonstrate satisfactory performance characteristics to meet the intended application

NOTE These tests are of such a nature that, after they have been made, they need not be repeated unless changes are made to the accessory materials, design or type of manufacturing process which might change the performance characteristics.

4 Symbols

λ_1 and λ_2	wavelength of UV light source
E_m	mean energy received by the samples
E	radiated energy of the lamp
n	number of cycles (defined in appropriate part of this standard)
θ	temperature measured by the black standard thermometer
θ_E	temperature of the chamber

5 Marking

See Clause 6 of EN 50483-1.

6 (Spare)

7 (Spare)

8 Type tests

8.1 Number of test samples and number of cycles

The number of samples and number of cycles for each of the following tests are included in each relevant part of EN 50483.

8.2 Requirements

The requirements for the following tests shall be as given in the relevant parts of this standard.

8.3 Cleaning

On completion of the environmental tests, and between different environmental tests when carried out as a sequence, the samples shall, unless otherwise specified, be cleaned using running tap water for 5 min to 10 min and then by using demineralised water for the same period. The temperature of the water shall not exceed 35 °C. The samples shall be dried either by shaking by hand or using air blast to remove droplets of water.

8.4 Corrosion ageing tests

These tests shall be carried out when the products contain metallic parts (or parts protected with a metallic coating), which are exposed to the atmosphere.

A justification of the tests is given in Annex A.

8.4.1 Salt mist test

8.4.1.1 Principle

This test exposes samples to a neutral salt spray (concentration of NaCl: 5 %).

8.4.1.2 Test equipment

The test equipment is defined in Clause 3 of EN 60068-2-11:1999.

8.4.1.3 Test arrangement

The preparation and use of the salt solution is defined in Clause 4 of EN 60068-2-11:1999.

8.4.1.4 Procedure

The test procedure is defined in Clause 7 of EN 60068-2-11:1999.

The connectors or accessories shall be installed as defined in the relevant parts of EN 50483.

The cycle duration prescribed, in accordance with EN 60068-2-11:1999, 7.6 shall be 7 days.

No cleaning of the samples shall be carried out between cycles.

8.4.1.5 Test reports

The test report shall include the duration of exposure and the concentration and pH of the salt solution.

8.4.2 Gas atmosphere tests

NOTE 1 Two methods of testing are provided to meet the requirements of the gas atmosphere test. The first, Method 1, is based on the test procedure that has been used for many years in some countries. These countries have gained experience of both the procedures and outcomes of the test. The second, Method 2 is provided as an alternative as it requires a less complicated test environment and is based on ASTM G85.

NOTE 2 This test may be necessary for accessories that are used in areas subjected to heavy industrial pollution.

8.4.2.1 Gas atmosphere test (Method 1)

A justification of the tests is given in Annex A.

8.4.2.1.1 Principle

This test exposes samples to a humidity-saturated atmosphere rich with sulphur dioxide (initial concentration SO_2: 0,066 7 % (667 parts per million by volume)) with defined conditions of temperature and pressure.

8.4.2.1.2 Test equipment

The samples and supports shall be installed in a hermetic test chamber, with a humidity-saturated atmosphere in the presence of sulphur dioxide.

This test chamber shall be made of inert material. The test shall be made in accordance with EN ISO 3231.

8.4.2.1.3 Preparation of SO_2 atmosphere

After closing the chamber, sulphur dioxide (concentration = 0,066 7 %) shall be introduced from either a gas bottle or using a specific reaction in the chamber as described in Annex B.

8.4.2.1.4 Procedure

Each period, or basic module, shall comprise a weekly sequence.

7 cycles of 24 h (168 h total), each cycle includes an 8 h exposure with saturated humidity and high sulphur dioxide atmosphere (a total exposure of 56 h), and a 16 h exposure at the laboratory atmosphere (a total exposure of 112 h).

NOTE Exposure to laboratory atmosphere may be achieved by opening the chamber door. It is the intention of this phase to allow clean air to circulate around the test samples.

During the 8 h period, the temperature is raised to (40 ± 3) °C. During the 16 h period the chamber remains at ambient temperature and finally the water and sulphur dioxide atmosphere is renewed to the concentration as specified in 8.4.2.1.3.

8.4.2.1.5 Cleaning

When the specimens are exposed successively to a neutral salt spray and then to a humidity saturated atmosphere with sulphur dioxide, the procedure shall be

- 7 cycles of 24 h in salt,
- no cleaning,
- 7 cycles of 24 h in sulphur dioxide,
- cleaning in accordance with 8.3.

8.4.2.2 Gas atmosphere test (Method 2)

8.4.2.2.1 Procedure

The test samples shall be subjected to a cyclic corrosion test consisting of 1 h period of drying and 1 h period of fog. The test shall consist of 500 cycles (1 000 h). The fog period shall be at ambient temperature, while the drying time shall be at a higher temperature.

NOTE Experience indicates that longer cycle times may produce slower degradation.

8.4.2.2.2 Test equipment

The apparatus for salt spray (fog) testing consists of a fog chamber, a salt solution reservoir, a supply of suitable conditioned compressed air, one or more atomising nozzles, specimen supports, provision for heating the chamber, and necessary means of control. The size and detailed construction of the cabinet are optional, provided the conditions obtained meet the requirements of this standard. The material of construction shall be such that it will not be affected by the corrosiveness of the fog. The chamber shall be designed so that drops of solution that accumulate on the ceiling or cover of the chamber do not fall on the specimen being tested. The nozzle or nozzles shall be directed so that none of the spray can impinge directly on the test specimen.

The solution shall not be recycled.

8.4.2.2.3 Atomisation and quantity of fog

At least two clean fog collectors shall be placed within the exposure zone so that drops of solution from the test specimen or any other source are not collected. The collectors shall be positioned in the proximity of the specimens, one near to a nozzle and the other, as far as possible from all nozzles. It shall be secured so that, for each 80 cm² of horizontal collecting area, fog accumulates in each collector at a rate between 1,0 ml to 2,0 ml of solution per hour, based on an average run of at least 16 h continuous spray.

NOTE Suitable collecting devices are glass funnels with the stems inserted through stoppers into graduated cylinders or crystallising dishes. Funnels and dishes with a diameter of 100 mm have an area of about 80 cm².

8.4.2.2.4 Salt solution

The salt solution shall consist of 0,05 % sodium chloride (NaCl) and 0,35 % ammonium sulphate $(NH_4)_2(SO_4)$ by mass. The water shall be distilled or de-ionised water. The sodium chloride shall be substantially free of nickel and copper and shall contain, on the dry basis, not more than 0,1 % of sodium iodide and not more than 0,3 % of total impurities. The ammonium sulphate shall contain not more than 0,3 % total impurities. Some salts contain additives that may act as corrosion inhibitors; careful attention shall be given to the chemical content of the salt.

The pH of the collected solution shall be between 5,0 and 5,4.

8.4.2.2.5 Air supply

The compressed air supply to the nozzle or nozzles, for atomising the salt solution, shall be free of oil and dirt and maintain the air supply between 70 kPa and 170 kPa.

8.4.2.2.6 Procedure

The test shall consist of cycles of a 1 h drying period and a 1 h fog period. The electrolyte shall be a solution of sodium chloride and ammonium sulphate. The fog period shall be performed at ambient temperature, while the drying-off shall be at higher temperature. The solution atomising air shall not be saturated with water.

During the fog period, no heating shall be applied to the cabinet. The fog exposure shall be at (24 ± 3) °C.

During the drying-off period the temperature throughout the exposure zone shall reach and remain at (35 ± 2) °C within 45 min of switching from the fog period to the dry period. The drying-off shall be achieved by purging the chamber with fresh air so that within 45 min all visible moisture shall be dried off the specimen. Humidified air shall not be used for drying.

NOTE As the specimen cycles from wet to dry it is subjected to a range of solution concentration varying from dilute during the fog period to very concentrated just before the water dries off completely.

8.4.2.2.7 Cleaning

There shall be no cleaning of the test samples between the test cycles.

At completion of the test the samples shall be cleaned in accordance with 8.3.

8.4.3 Immersion tests (optional)

NOTE Two test methods are provided to allow for the different climatic conditions encountered in service. Method 1 is provided to cater for severe salt pollution e.g. western coast of UK. Method 2 simulates a severely corrosive atmosphere e.g. near heavy industry.

8.4.3.1 Immersion test (Method 1)

8.4.3.1.1 Principle

For saline polluted areas an optional additional test shall be carried out when this is agreed between the customer and the supplier. In order to minimise testing, when agreed, this test shall be carried out during the mandatory heat cycle tests as provided in EN 50483-5.

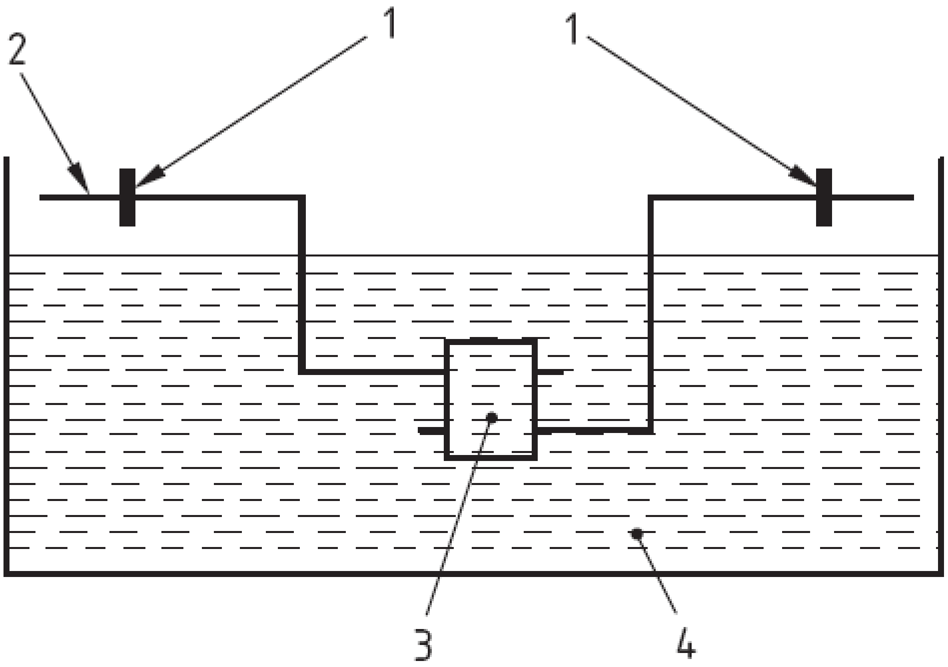
8.4.3.1.2 Test arrangement

This shall be, generally, in accordance with EN 50483-5, 5.2 but in particular the test circuit, as described in EN 50483-5, 5.2.1, shall be modified to allow the samples to be fully immersed in a saline solution during the heat cycle.

The saline solution shall be maintained at 29,22 g/l (approximately 3 % of mass) concentration of NaCl throughout the test.

NOTE 1 A practical arrangement is to place the test samples in a tank and pump the saline solution from a reservoir below. The tank can then be drained back into the reservoir after the required immersion period.

NOTE 2 The test loop may be arranged so that the samples, but not the measurement points, are immersed in the saline solution. Figure 1 shows a typical arrangement.



Key

1	potential points	3	connector
2	cable core	4	salt water

Figure 1 – Suggested arrangement for connections – Optional immersion test Method 1

8.4.3.1.3 Procedure

The procedure shall, generally, be in accordance with EN 50483-5, 5.2, 5.3, 5.4 and 5.5. However, in particular, the subsequent heat cycles defined in EN 50483-5, 5.5.2 shall be modified to include the immersion of the samples.

Immersion of the test samples shall occur on completion of period t_1 and they shall be fully immersed for a minimum period of 5 min. The time of immersion shall be considered part of the cooling period t_2. Periods, t_1 and t_2, are shown in EN 50483-5, Figure 3.

8.4.3.1.4 Assessment of results

The assessment, of the samples, shall be carried out in accordance with EN 50483-5, 5.5.4.

8.4.3.1.5 Requirements

The samples shall meet the requirements of EN 50483-5, 5.6.

8.4.3.2 Immersion test (Method 2)

8.4.3.2.1 Principle

This test reproduces the stresses on organic materials due to corrosive environments.

This test shall be carried out within the climatic ageing test (Method 1) of 8.5.1, after the completion of Period C and before Period D.

8.4.3.2.2 Test arrangement

The samples shall be those tested in Period C of climatic ageing tests.

The acid solution for the test shall contain H_2SO_4, HNO_3 and HCl dissolved in distilled water in order to obtain a pH value equal to 2. The following table reports the quantities of the above components.

Table 1 – Quantities for acid solution components

Acid [a]	**Quantity** [b] mg
H_2SO_4 at 98 %	245
HNO_3 at 90 %	315
HCl at 37 %	50

[a] % in mass.

[b] Mass per litre of distilled water.

The temperature of the acid solution shall be (45 ± 3) °C.

8.4.3.2.3 Procedure

The acidity of the solution shall be checked before the immersion of the samples.

The tests samples shall be completely immersed in the acid solution for a duration time of 23 h.

The solution shall be changed if the pH is greater than or equal to 2,5.

8.4.3.2.4 Requirements

This test has no specific requirements as it forms a part of climatic test Method 1, 8.5.1.

8.5 Climatic ageing test

Method 1 or Method 2 shall be used.

NOTE Two methods of testing are provided to meet the requirements of the climatic ageing test and provide for the use of available test equipment. The first, Method 1, is based on the test procedure, which has been used in some countries, for a number of years, and experience has been gained of both the procedures and outcomes of the test. This is based on a test method included in HD 626. The second, Method 2 has also been used in some countries with similarly successful experience and is provided as an alternative. It is based on EN 60068-2-5.

8.5.1 Method 1

8.5.1.1 Principle

The test subjects samples to a combined cycle of climatic constraints: ultraviolet radiation, humidity, water spray and temperature extremes.

Test conditions have been derived with the aim of reproducing normal service conditions.

This test shall be carried out in a single chamber or in separated chambers only for the climatic constraints at low temperature.

The test conditions and test equipment detailed in 8.5.1.2 and 8.5.1.3 are interdependent. Any modification of parameters could affect the consistency of the test results.

NOTE Other arrangements that provide ultraviolet radiation, humidity, rain and temperature extremes that use developed testing technology may be agreed between customer and supplier.

8.5.1.2 Test equipment

NOTE Annex D (informative) provides a typical test equipment specification.

8.5.1.2.1 Source of light beam

The light source shall produce a spectrum that is as close as possible to the solar spectrum at ground level. This spectrum shall be consistent throughout the test and the energy absorbed, by the samples, shall be determined with a black standard thermometer, which shall measure the temperature rise created by the light source.

Temperature values shall be maintained between the values given in 8.5.1.3.4 by natural ventilation of the chamber.

Control and measurement shall be in accordance with 8.5.1.3.

8.5.1.2.2 Test chamber

The test chamber (see informative Figure D.1) shall contain a rotating sample rack. A system of ventilation shall produce air circulation around the samples in order to reduce the rise of surface temperature.

The distance between the samples and lamp shall be adapted to the power of this lamp. The arrangement shall be such so that the energy of lighting received by the samples does not vary by more than ± 15 % from the mean value E_m defined in 8.5.1.3.1.

To ensure consistent and equal exposure of the samples the rack shall be rotated around the lamp. The speed of rotation of the rack shall be between 1 turn/min and 5 turns/min. The orientation of the samples shall be such that the same face is maintained towards the light source throughout the rotation of the rack.

8.5.1.2.3 Black standard thermometer

A black standard thermometer shall be used to measure the temperature within the chamber. It shall be placed at the same distance from the lamp as the samples under test. Its orientation shall be such that the centre of the plate is vertically aligned with the centre of the lamp. The darkened metallic surface of the thermometer shall face the lamp.

8.5.1.2.4 Sprinkler device

Sprinkling shall be carried out by one or several rain injectors, allowing the spraying of the front face of every sample with approximately 50° angle of rain, the outflow of each sprinkler unit shall be between 15 l/h and 25 l/h. The sprinklers shall be assembled vertically above each other and shall be fed with water whose resistivity shall be greater than or equal to 0,1 MΩ.cm (conductivity less than or equal to 0,001 S/m). The period of spraying shall be for 3 min and the interval between spraying (dry period) shall be 17 min.

NOTE 1 The temperature of the spray water should be between 10 °C and 30 °C.

NOTE 2 The arrangement is shown in informative Figure D.1. The sprinkling system may incorporate recycling of the spray water. However if this method is employed it should ensure that the water does not become contaminated before it is reused for spraying.

8.5.1.3 Controls and measurements of the test parameters

8.5.1.3.1 Light beam source

The light beam shall be produced by a cylindrical lamp with a xenon arc and shall be modified by associated filters. The filters shall eliminate wavelengths lower than 270 nm, in order to provide, at ground level, a spectrum close to that of the solar spectrum, (typically with wavelengths above 290 nm). (Normally, there are two filters, one inner quartz filter and an outer borosilicate filter).

The characteristics of the optical filters will change with use, both because of ageing and accretion of deposits. In order to maintain the necessary luminous characteristics they shall be cleaned or replaced at convenient intervals.

The xenon lamps also undergo ageing which produces a reduction of the energy intensity in the ultraviolet domain. To minimise the effects of this ageing, it is necessary to increase the current supplying the lamp in order to maintain the energy flow, emitted in a band of the ultraviolet spectrum from 300 nm to 400 nm, at a constant level.

This increase of the current modifies the global energy emitted by the lamp and, consequently, the energy received at the surface of the samples. The temperature shall be controlled by a black-standard thermometer (see 8.5.1.2.3), placed in the enclosure and exposed to the light beam. The enclosure shall be adequately ventilated to ensure that this temperature remains between the values specified in 8.5.1.3.4 and that the lamp shall be replaced when the global energy, that it radiates, becomes too high.

The radiation energy of the lamp shall be controlled in a dry atmosphere (the relative humidity of air RH ≤ 50 %). Using a radiometer the radiation shall be checked before the start of each conditioning A period.

NOTE 1 It is recommended that measurements of radiation be made at least 30 s after the lamp is turned on.

The radiometer shall be used to adjust the electric power supply of the lamp. The radiometer, fitted with a diffuser, shall have a bandwidth of 300 nm < λ_1 < λ_2 < 400 nm where λ_1 and λ_2, are its limit values.

Energy control shall be carried out at an ambient temperature of (23 ± 3) °C.

The radiometer shall be placed at the same distance from the lamp as the test samples and shall be positioned so that its centre of the sensor is aligned with the centre of the lamp. For a given adjustment of the power of the lamp, the angular positioning of the radiometer shall be adjusted so that it gives the maximum reading of the value of radiated energy.

NOTE 2 These operations present some risks related to the operators' health, so safety procedures should be implemented to avoid any danger during testing and calibration.

The power supply of the lamp shall be adjusted in order to achieve an average value of radiation energy of 4,3 mW/cm^2 ± 15 %. This energy, E_m, shall be the total energy of radiation from the spectrum between 300 nm to 400 nm.

8.5.1.3.2 Calibration of the radiometers

The radiometers shall be calibrated so that they provide (if necessary by use of a conversion factor) the total radiation energy, across the spectrum, used in these tests.

Further information on the calibration of radiometers may be found in informative Annex D.

8.5.1.3.3 Relative humidity

The relative humidity (RH) of the air circulating in the test chamber shall be maintained within the limit of the values specified for each conditioning period and controlled by a suitable instrument protected from the radiation energy of the lamp.

8.5.1.3.4 Temperatures

The temperature (θ_E) of the chamber at the position of the samples shall be measured with a probe protected from the radiation energy of the lamp.

The temperature measured by the black standard thermometer (θ), (see informative Figure D.1), shall be between the two following limiting values:

$$\theta_E + 15\ \text{K} < \theta < \theta_E + 20\ \text{K}$$

wherever it is positioned along the sample rack.

The readings shall be made after sufficient time to allow the temperature of the plate to become stabilised. The arrangement can be seen in informative Figure D.1.

If the thermometer is positioned in a different location, the acceptable limiting values of temperature at the thermometer's position shall be determined by a preliminary calibration so that the ranges of temperatures comply with those indicated above. The surface quality of the black panel (absence of deposits, separation of painting and/or the probe) shall be checked once per week.

The temperature of the black standard thermometer shall be maintained in the range prescribed above by adjustment of the internal ventilation of the enclosure.

When the temperature (*θ*) exceeds the prescribed upper limit, the lamp shall be replaced.

8.5.1.4 Procedure

The whole test consists of a number, *n*, of identical weekly cycles, which are defined below. The number of cycles, *n*, shall be specified in the relevant part of this standard.

Every seven day cycle (see informative Figure 2), shall include four periods carried out in accordance with the procedures below and in the following order:

NOTE Important observations:

The control of the temperature of the black standard thermometer (see 8.5.1.2.3) placed in the chamber is necessary to avoid abnormal heating of the surface of samples in test.

During spraying, the temperature and relative humidity limits will not be achieved.

Seven-day cycle

Change from ambient temperature to 70 °C before the start of period A: time 1 h with exposure to radiation.

Period A - time 70 h

exposure to radiation

relative humidity RH ≤ 30 %, without spraying

temperature of chamber (θ_E), maintained at one of the following values:

- 70 °C ± 2 °C
- 55 °C ± 2 °C

The value of this temperature is specified in the relevant part of this standard or with agreement between customer and manufacturer.

Transition between Period A and Period B: time 1 h with exposure to radiation

Period B - time 23 h

exposure to radiation

humidity: 60 % RH ± 10 % RH with 69 cycles of sprinkling for 20 min, which consists of 17 min without sprinkling followed by 3 min of sprinkling

temperature of chamber θ_E = 55 °C ± 2 °C

Transition between Period B and Period C: time 1 h with exposure to radiation

Period C - time 23 h

exposure to radiation

relative humidity RH ≤ 30 % with 69 cycles of sprinkling of 20 min, which consists of 17 min without sprinkling followed by 3 min of sprinkling

NOTE In case of using 70 °C for Period C, humidity control is not needed but should be recorded for information.

temperature of chamber (θ_E), maintained at one of the values indicated for the Period A

Transition between Period C and Period D: time 1 h with exposure to radiation

Period D - time 46 h

exposure in wet heat, without radiation

humidity: 95 % RH ± 5 % RH, with cycles of sprinkling of 20 min, which consists of 17 min without sprinkling followed by 3 min of sprinkling when the chamber temperature is 55 °C

temperature of chamber θ_E = 55 °C ± 2 °C

During this period, there are 4 changes of temperature from 55 °C to θ_E = -25 °C ± 2 °C (see diagram in Figure 2):

maintaining at +55 °C ± 2 °C during 1 h with sprinkling cycles

transition +55 °C ± 2 °C → -25 °C ± 2 °C in 15 min; the transition shall be gradual and without sprinkling cycles

maintaining at -25 °C ± 2 °C for 1 h without sprinkling cycles

transition -25 °C ± 2 °C → +55 °C ± 2 °C in 1 h; the transition shall be gradual and without sprinkling cycles

maintaining at +55 °C ± 2 °C for 1 h with sprinkling cycles

transition +55 °C ± 2 °C → -25 °C ± 2 °C in 15 min; the transition shall be gradual and without sprinkling cycles

maintaining at -25 °C ± 2 °C for 1 h without sprinkling cycles

transition -25 °C ± 2 °C → +55 °C ± 2 °C in 1 h; the transition shall be gradual and without sprinkling cycles

maintaining at +55 °C ± 2 °C for 17 h 30 min with sprinkling cycles

transition +55 °C ± 2 °C → -25 °C ± 2 °C in 15 min; the transition shall be gradual and without sprinkling cycles

maintaining at -25 °C ± 2 °C for 1 h without sprinkling cycles

transition -25 °C ± 2 °C → +55 °C ± 2 °C in 1 h; the transition shall be gradual and without sprinkling cycles

maintaining at +55 °C ± 2 °C for 1 h with sprinkling cycles

transition +55 °C ± 2 °C → -25 °C ± 2 °C in 15 min; the transition shall be gradual and without sprinkling cycles

maintaining at -25 °C ± 2 °C for 1 h without sprinkling cycles

transition -25 °C ± 2 °C → +55 °C ± 2 °C in 1 h; the transition shall be gradual and without sprinkling cycles

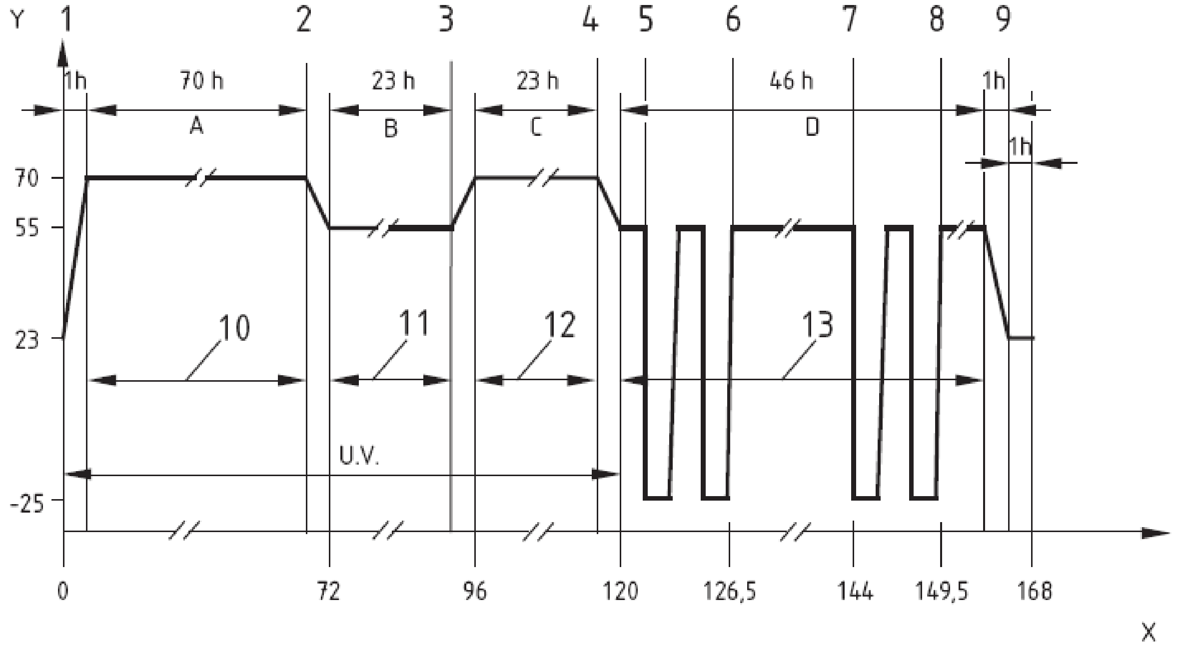
maintaining at +55 °C ± 2 °C for 16 h 30 min with sprinkling cycles

Transition from Period D to ambient temperature: time 1 h

Maintaining at ambient temperature: time 1 h

Information that is specified in the relevant parts of the standard:

a) location and orientation with respect to the lamp;
b) number of weekly cycles;
c) value of the temperature for the Periods A and C.



Key

1	Day 1	10 am	9	Day 1	9 am
2	Day 4	9 am	10	RH ≤ 30 %	
3	Day 5	9 am	11	RH = 60 % sprinkling	
4	Day 6	9 am	12	RH ≤ 30 % sprinkling	
5	Day 6	11 am	13	RH = 95 % sprinkling	
6	Day 6	4.30 pm	*X*	elapsed time (h)	
7	Day 7	10 am	*Y*	cabinet temperature Θ_E (°C)	
8	Day 7	3.30 pm			

Figure 2 – Informative diagram of the conditioning cycle – Weekly cycle

Temperature of enclosure (70 °C or 55 °C) specified in the relevant part of the standard or other temperature chosen with agreement between customer and manufacturer.

The prescriptions of the relative humidity in % as well as those of the cycles of sprinkling are valid only for the +55 °C periods.

The given schedule is as an example.

8.5.2 Method 2 (to EN 60068-2-5)

NOTE Intending users of this test are directed to the health hazards associated with tests of this nature and should therefore read Clause 9 of EN 60068-2-9:1999.

8.5.2.1 Principle

To determine the effects (thermal, mechanical, chemical, electrical, etc.) produced on equipment and components as a result of exposure to solar radiation under the conditions experienced at the surface of the earth.

8.5.2.2 Test equipment

The enclosure in which the tests are to be carried out shall be provided with means for obtaining, over the prescribed irradiation measurement plane, an irradiance of 1,120 kW/m^2 ± 10 % with the spectral distribution given in Table 2. The value of 1,120 kW/m^2 shall include any radiation reflected from the test enclosure and received by the samples under test. It should not include long-wave infrared radiation emitted by the test enclosure*;* see EN 60068-2-9:1999, 6.1.

NOTE 1 Where only the thermal effects of solar radiation are of interest see EN 60068-2-9:1999, 2.2 and 2.3.

Means shall also be provided whereby the specified conditions of temperature, air flow and humidity can be maintained within the enclosure.

NOTE 2 Circulation of air may significantly reduce the temperature rise of sample¸ see EN 60068-2-9:1999, 4.5.

The temperature within the enclosure shall be measured (with adequate shielding from radiated heat) at a point or points in a horizontal plane 0 mm to 50 mm below the prescribed irradiation measurement plane, at half the distance between the sample under test and the wall of the enclosure, or at 1 m from the sample, whichever is the lesser.

8.5.2.3 Conditioning

The sample to be tested shall be placed either on raised supports or on a specified substrate of known thermal conductivity and thermal capacity within the enclosure and so spaced from other samples as to avoid shielding from source of radiation or re-radiated heat; see EN 60068-2-9:1999, 4.6.

During the entire test, the irradiation, the temperature within the enclosure, the humidity and any other specified environmental conditions shall be maintained at the level appropriate to the test procedure as called for in the relevant part of this standard.

The sample shall be exposed, for the duration called for in the relevant part of this standard, to the following test procedure (see Figure 3).

8.5.2.4 Procedure

The whole test consists of a number, *n*, of identical daily cycles, which are defined below. The number of cycles, *n*, shall be specified in the relevant part of this standard.

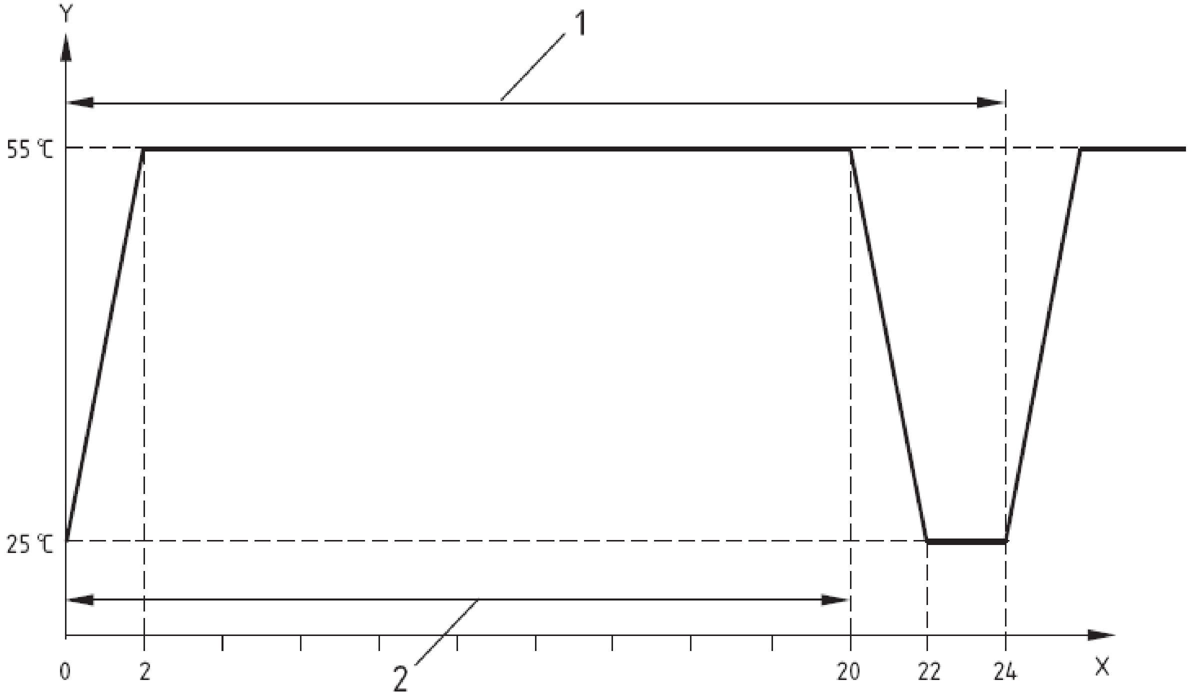
The duration of each cycle shall be 24 h, with 20 h irradiation and 4 h darkness, repeated as required (this gives a total irradiation of 22,4 kW/m^2 per daily cycle).

NOTE For further information, see EN 60068-2-9:1999, 3.1 and 3.2.

The temperature shall rise to (55 ± 2) °C within 2 h of the start of the irradiation period and shall be maintained at this temperature throughout the irradiation period. During the darkness period the temperature within the enclosure shall fall at an approximately linear rate within 2 h and then shall be maintained at (25 ± 2) °C.

Table 2 – Spectral energy distribution and permitted tolerances

Spectral region	**Ultra-violet B** [a]	**Ultra-violet A**	**Visible**			**Infra-red**
Bandwidth	0,28 µm - 0,32 µm	0,32 µm - 0,40 µm	0,40 µm - 0,52 µm	0,52 µm - 0,64 µm	0,64 µm - 0,78 µm	0,78 µm - 3,00 µm
Irradiance	5 W/m^2	63 W/m^2	200 W/m^2	186 W/m^2	174 W/m^2	492 W/m^2
Tolerance	± 35 %	± 25 %	± 10 %	± 10 %	± 10 %	± 10 %
[a] Radiation shorter than 0,30 µm reaching the earth's surface is insignificant.						



Key

1	1 cycle	3	*Y* = temperature axis
2	irradiation period (20 h)	4	*X* = time axis in hours

Figure 3 – Temperature – Radiation – Time relationships

Annex A
(informative)

Salt mist and gas atmosphere corrosion test justification

Equipment for aerial networks with bare or insulated cables is subjected to humid and corrosive atmospheres.

When a surface becomes, and remains wet, the two main factors involved in atmosphere corrosiveness are

- chloride ion, mainly in marine atmosphere,
- sulphur dioxide, mainly in industrial atmosphere.

Occasionally, both these factors apply at the same time when there is a mixed marine and industrial atmosphere.

Moreover, both factors are involved in test procedures defined in ISO standards (TC 156 - Alloys and metals corrosion) for natural atmosphere corrosiveness determination and classification:

- ISO 9223;
- ISO 9225;
- ISO 9226.

Equipment for aerial networks with bare or insulated cables may be used in various environments. It is therefore useful to submit accessories to laboratory tests involving these two factors. To simplify the laboratory test there are two methods. In Method 1 two successive sequences have been defined. The first is exposure to salt mist, the second is exposure to a humidity saturated, high sulphur dioxide content atmosphere. These sequences are moreover standardised by IEC and ISO. In Method 2 salt mist and sulphur dioxide are combined in the same cycle.

Annex B
(informative)

Example of specific reaction to obtain sulphur dioxide

It is possible to generate sulphur dioxide in the test apparatus by treating some sodium pyrosulfite ($Na_2S_2O_5$) by a relatively strong acid, sulfamic acid (HSO_3NH_2), which is the only solid mineral acid of easy conservation.

The procedure used consists of taking a light excess of sodium pyrosulfite that is dissolved in water (reaction [1] hereunder), then to add in the enclosure the stoichiometric quantity of sulfamic acid (reaction [2] hereunder).

$$Na_2S_2O_5 + H_2O \longrightarrow 2NaHSO_3 \qquad [1]$$

$$NaHSO_3 + HSO_3NH_2 \longrightarrow NaSO_3NH_2 + H_2O + SO_2\nearrow \qquad [2]$$

The global reaction is:

$$Na_2S_2O_5 + 2\ HSO_3NH_2 \longrightarrow 2NaSO_3NH_2 + H_2O + 2\ SO_2\nearrow$$

Therefore, to obtain one litre of SO_2 in normal conditions (t = 0 °C, p = 101,3 kPa), 4,24 g of sodium pyrosulfite + 4,33 g of sulfamic acid are needed.

Annex C
(informative)

Climatic areas

The climatic conditions differ across Europe; therefore the requirements of climatic testing are different for different areas.

This standard describes several climatic tests and these tests are extracted from different, current European or national standards.

The following table provides a selection of different climatic conditions with the appropriate tests.

Table C.1 – Climatic conditions – Appropriate tests

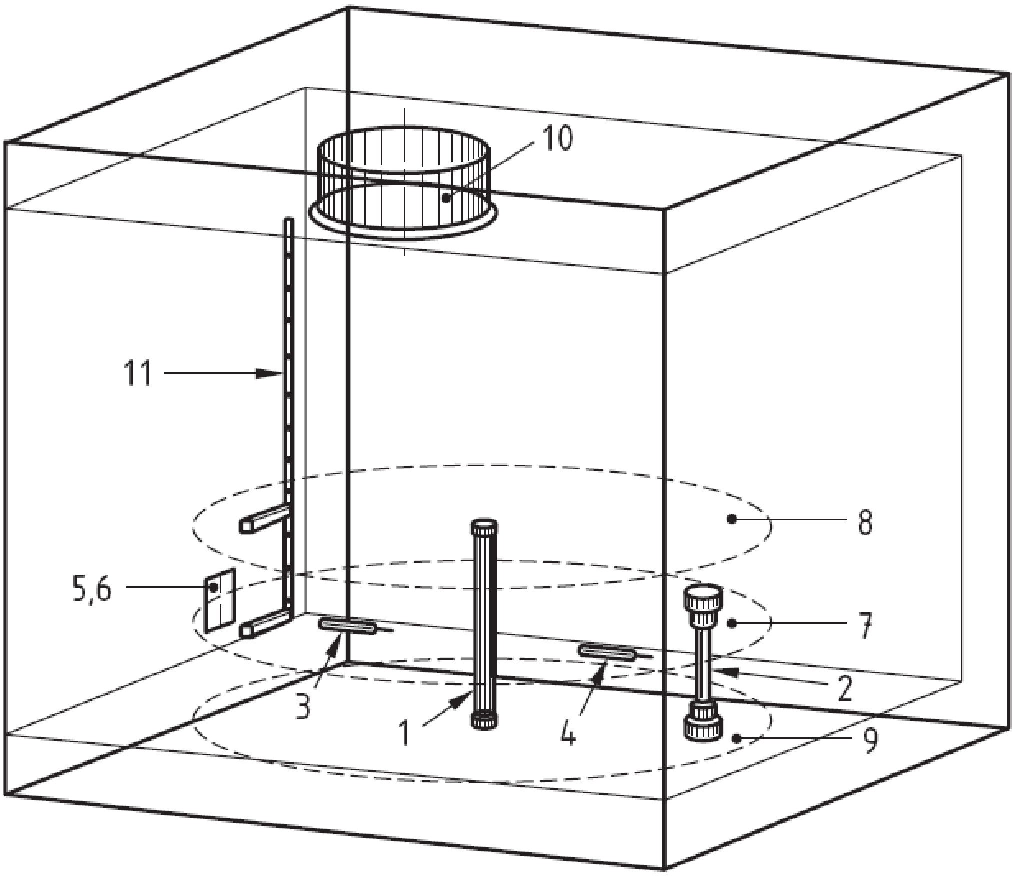
Weather conditions/area	Salt mist test (8.4.1)	Gas atmosphere test (8.4.2)	Immersion test (8.4.3)	Climatic ageing test (8.5)
Coastal area where there is salt pollution	**X**	**X**	**X**[a]	**X**
Coastal area where there is no salt pollution (e.g. Baltic coast)	**X**			**X**
Polluted industrial area	**X**	**X**		**X**
Polluted industrial and salt area	**X**	**X**	**X**[a]	**X**
Inland or unpolluted area	**X**			**X**
Sunny areas (UV radiation)	**X**			**X**
Arctic areas	**X**			**X**

[a] Immersion test is provided for areas where salt pollution is high.

Annex D

(informative)

Test equipment



Key

1	xenon lamp
2	test sample
3	measurement of the humidity: dry probe
4	measurement of the humidity: wet probe
5	position of the radiometer or the black standard thermometer
6	measurement of the temperature of the chamber at the level of the test samples, protected from the radiation of the lamp
7	median plan of the lamp
8	plane A plane bounding the zone where the radiation of the lamp provides radiation energy within the specified tolerances
9	plane B plane bounding the zone where the radiation of the lamp provides radiation energy within the specified tolerances
10	fan
11	sprinkler

Figure D.1 – Typical test arrangement

D.1 Calibration of the radiometers

Some commercial radiometers do not integrate the received energy on the whole of the spectrum ranging from 300 nm up to 400 nm but control this quantity for a given wavelength accompanied with a bandwidth given defined by λ_1 and λ_2. When these radiometers are used they should be calibrated and certified in order to provide a conversion factor to convert their reading of radiation energy into the real total radiation energy across the spectrum used in the tests.

The radiometers should be calibrated with an apparatus comprising a filtered xenon arc lamp that uses a spectrum-characterised radiometer having traceability against national standards.

When an integrating radiometer is used, this measurement should be carried out when the sample rack is rotating at 2 revolutions per minute (rpm). During an integer number of turns equal or higher than four, the measurement of the surface quantity of radiant energy, expressed in mJ/cm^2, received by the radiometer should be made.

Where other radiometers are used, 8 measurements should be made on the periphery. The measurements should be taken at angular steps of approximately $\pi/4$. The duration of each measurement should be between 15 s and 20 s.

The radiometer should be periodically calibrated, in accordance with relevant standards, and compared to a standard radiometer apparatus calibrated by an accredited organisation.

D.2 Black standard thermometer

Black standard thermometers consist of a plane (flat) stainless steel plate with a thickness of about 0,5 mm and a typical length and width of about 70 mm by 40 mm.

The surface of this plate facing the light source should be coated with a black layer that has good resistance to ageing.

The coated black plate should absorb at least 90 % to 95 % of all incident flux to 2 500 nm.

A platinum resistance sensor should be attached in good thermal contact with the centre of the plate on the side opposite the radiation source.

The side of the metal plate should be attached to a 5 mm base plate made of unfilled poly vinylidene fluoride (PVDF).

A small space sufficient to hold the platinum resistance sensor should be machined in the PVDF base plate.

The distance between the sensor and this recess in the base plate should be about 1 mm.

The length and width of the PVDF plate should be sufficient so that no metal – metal thermal contact exists between the black-coated metal plate and the mounting holder into which it is fitted.

The metal mounts of the holder of the insulated black panel should be at least 4 mm from the edges of the metal plate.

Black standard thermometers which differ in construction are permitted as long as the temperature indicated by the alternative construction is within ± 1,0 °C of that of the specified construction at all steady state temperature and irradiance settings that the exposure device is capable of attaining.

In addition, the time needed for an alternative black standard thermometer to reach the steady state should be within 10 % of the time needed for the specified black standard thermometer to reach the steady state.

The difference between a black standard thermometer and a black panel thermometer is that the black plates have a thermal insulation. See EN ISO 4892-1 for full details.

Consequently, the temperatures indicated by the black standard thermometer correspond to those that exist on the exposed surface of samples made from materials of a dark colour that have a low heating conductibility.

The black standard thermometer is used to characterise the thermal conditions of the dark samples having a low heating conductibility. It is situated in the same plane as the test samples mounted in the sample rack during exposure to the energy lighting as shown in Figure D.1.

There is a difference in temperature between the black panel thermometer and the black standard thermometer. For practical reasons and when a laboratory is able to estimate this difference, then with customer / manufacturer agreement, a black panel thermometer may be used. In case of disagreement, the black standard thermometer should be used.

Bibliography

EN ISO 4892-1, *Plastics – Methods of exposure to laboratory light sources – Part 1: General guidance* (ISO 4892-1)

HD 626, *Overhead distribution cables of rated voltage* $U_o/U(U_m)$*: 0,6/1 (1,2) kV*

ISO 9223, *Corrosion of metals and alloys – Corrosivity of atmospheres – Classification*

ISO 9225, *Corrosion of metals and alloys – Corrosivity of atmospheres – Measurement of pollution*

ISO 9226, *Corrosion of metals and alloys – Corrosivity of atmospheres – Determination of corrosion rate of standard specimens for the evaluation of corrosivity*

ASTM Standard G 85, *“Standard Practice for Modified Salt Spray (Fog) Testing”*, ASTM International, West Conshohocken, PA www.astm.org