

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Environmental testing – **STANDARD PREVIEW**
Part 2-11: Tests – Test Ka: Salt mist
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Essais d'environnement –
Partie 2-11: Essais – Essai Ka: Brouillard salin
IEC 60068-2-11:2021
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ENVIRONMENTAL TESTING –

Part 2-11: Tests – Test Ka: Salt mist

FOREWORD

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IEC 60068-2-11 has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 1981. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the preparation of the salt solution has been modified;
- b) the temperature of the solution for measuring pH has been modified;
- c) the atomizing pressure and water temperature of the saturation tower have been added and are given in Table 1;
- d) test report details have been modified;
- e) examples of typical test apparatus have been added and are given in Annex A;

- f) a method for evaluating corrosivity of the apparatus has been added and is given in Annex B;
- g) a bibliography has been added.

The text of this International Standard is based on the following documents:

Draft	Report on voting
104/888/FDIS	104/892/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 60068 series, published under the general title *Environmental testing*, can be found on the IEC website.

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- replaced by a revised edition, or
- amended.

INTRODUCTION

The object of the test specified in this document is to compare the resistance of electrotechnical equipment to deterioration from salt mist.

It is useful for evaluating the quality and uniformity of protective coatings.

The relationship between the deterioration provided by this test and long-term exposure of electrotechnical equipment to salt laden atmospheres cannot be readily determined. Consequently, the test cannot be reliably used to quantify the long-term aging of electrotechnical equipment. However, as the test commonly accelerates deterioration from salt mist, it does provide a useful means of comparing resistance of electrotechnical equipment to deterioration from salt laden atmospheres.

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ENVIRONMENTAL TESTING –

Part 2-11: Tests – Test Ka: Salt mist

1 Scope

This part of IEC 60068 specifies a test method for assessing the corrosion resistance of electrotechnical products components, equipment and materials in a salt mist environment. Its objective is to verify that the comparative quality of a metallic material, with or without corrosion protection, is maintained when exposed to salt mist.

This test method is useful for evaluating the quality and the uniformity of coatings applied to protect metals against corrosion. It is particularly useful for detecting discontinuities, such as pores and other defects, in certain metallic, organic, anodic oxide and conversion coatings.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

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3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

4 General

WARNING – This document can involve hazardous materials, operations and equipment. This document does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

For equipment and components, Test Kb (IEC 60068-2-52) is considered to provide more realistic conditions and to provide means of assessment of individual items. If, however, for particular circumstances, the relevant specification requires this test (Ka) to be applied to individual specimens for qualification purposes, then the specimens should be tested as part of the overall assembly or equipment in which they are to be used and be completed with any protection devices (cases, covers, shields, etc.), as in practice.

NOTE 1 "Salt mist" is also called "salt spray".

NOTE 2 The test specimen(s) is typically not energized during the test.

5 Salt solution

5.1 Preparation of salt solution

Dissolve a sufficient mass of sodium chloride in distilled or deionized water with a conductivity not higher than $20 \mu\text{S}/\text{cm}$ at $25 \text{ }^\circ\text{C} \pm 2 \text{ K}$ to produce a concentration of $50 \text{ g/l} \pm 5 \text{ g/l}$. The sodium chloride concentration of the sprayed solution collected shall be $50 \text{ g/l} \pm 5 \text{ g/l}$. The specific gravity range for a $50 \text{ g/l} \pm 5 \text{ g/l}$ solution is 1,029 to 1,036 at $25 \text{ }^\circ\text{C}$.

The sodium chloride shall not contain a mass fraction of the heavy metals copper (Cu), nickel (Ni) and lead (Pb) in total more than 0,005 %. It shall not contain a mass fraction of sodium iodide more than 0,1 % and a mass fraction of total impurities more than 0,5 %, calculated for dry salt.

NOTE Sodium chloride with anti-caking agents can act as corrosion inhibitors or accelerators. A useful sodium chloride salt grade is a grade named Ph. Eur/USP or JIS, ACS.

5.2 pH adjustment

If necessary, adjust the pH of the salt solution so that the pH of the sprayed solution collected within the test chamber is 6,5 to 7,2 at $25 \text{ }^\circ\text{C} \pm 2 \text{ K}$. Check the pH using electrometric measurement. Measurements of pH shall be done using electrodes suitable for measuring in weakly buffered sodium chloride solution in deionized water.

Make any necessary corrections by adding hydrochloric acid, sodium hydroxide or sodium bicarbonate solution of analytical grade.

WARNING – Hydrochloric acid (CAS no. 7647-01-0) solution is toxic, corrosive, irritating and very toxic to aquatic life. Handling of hydrochloric acid solution shall be restricted to skilled personnel or conducted under their control. Care shall be taken in the disposal of this solution.

WARNING – Sodium hydroxide (CAS no. 1310-73-2) solution is toxic, corrosive and irritating. Handling of sodium hydroxide solution shall be restricted to skilled personnel or conducted under their control. Care shall be taken in the disposal of this solution.

NOTE Possible changes in pH can result from loss of carbon dioxide in the solution when it is sprayed. Such changes can be avoided by reducing the carbon dioxide content of the solution by, for example, heating it to a temperature above $35 \text{ }^\circ\text{C}$ before it is placed in the apparatus, or by making the solution using freshly boiled water.

The pH shall be measured when preparing each new batch of solution.

5.3 Filtration

If necessary, filter the solution before placing it in the reservoir of the apparatus, to remove any solid matter which might block the apertures of the spraying device.

5.4 Re-use

The sprayed solution shall not be re-used.

6 Test apparatus

6.1 Test chamber

The chamber for this test shall be constructed of such materials that will not influence the corrosive effects of the salt mist.

The detailed construction of the chamber, including the method of producing the mist, is provided as follows:

- a) The operating conditions in the chamber shall be within the limits specified (see Clause 11).
- b) The chamber shall have sufficient volume and performance that the introduction of test specimens will not detrimentally affect the control of the conditions.
- c) The solution shall not be sprayed directly onto test specimens but rather spread throughout the test chamber so that it falls naturally down to them.
- d) The upper parts of the chamber shall be designed so that drops of sprayed solution formed on its surface do not fall on the test specimens being tested.
- e) The chamber shall be properly vented to prevent pressure build-up and allow uniform distribution of salt mist. The discharge end of the vent shall be protected from strong air currents which can have a negative effect to the air flow.
- f) The test temperature shall be measured at least 100 mm from walls and radiant heat sources.

NOTE Examples of test apparatus are shown in Annex A (see Figure A.1 and Figure A.2).

6.2 Atomizer(s)

The atomizer(s) used shall be of such a design and construction as to produce a finely divided, wet, dense mist. The atomizer(s) shall be made of material that is non-reactive to the salt solution.

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6.3 Air supply

The compressed air entering the atomizer(s) shall be essentially free from all impurities, such as oil and dust.

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Means shall be provided to humidify and warm the compressed air as required to meet the operating conditions. The atomizing pressure shall be at an overpressure of 70 kPa to 170 kPa. The pressure is typically 98 kPa ± 10 kPa but can vary depending on the type of test chamber and atomizer used. The appropriate temperature depends on the pressure used and on the type of atomizer. Temperature, pressure or humidification, or a combination thereof, shall be adjusted so that the rate of collection of the spray in the chamber and the concentration of the collected spray are kept within the specified limits (see Clause 11). A commonly used humidifier is the saturation tower, where temperature and pressure are controllable. Table 1 gives suggested values on temperature and pressure combinations for the saturation tower. Distilled or deionized water with a conductivity not higher than 20 µS/cm at 25 °C ± 2 K shall be used for humidification of spray air.

Table 1 – Suggested values for the temperature of the hot water in the saturation tower

Atomizing overpressure kPa	Suggested values for the temperature of the hot water in the saturation tower when performing the salt mist test °C
70	45
84	46
98	48
112	49
126	50
140	52
160	53
170	54

6.4 Collecting devices

At least two collecting devices shall be used to check the homogeneity of the spraying of the chamber. A collecting device shall consist of a collecting funnel which has a diameter of $100 \text{ mm} \pm 2 \text{ mm}$, corresponding to a collecting area of approximately 80 cm^2 . The funnel should be made of chemically inert material and its stem inserted into a suitable measuring container.

6.5 Method for evaluating chamber corrosivity

To check the reproducibility of the test results, the corrosivity of the apparatus shall be verified at regular intervals. A suitable method for evaluating corrosivity of the apparatus by use of reference specimens is described in Annex B.

7 Test specimens

The number and type of test specimens, their shape and their dimensions shall be selected in accordance with the relevant specification. When not specified, these parameters shall be mutually agreed between the interested parties.

8 Initial measurements

The test specimens shall be visually examined and, if necessary, electrically and mechanically checked as required by the relevant specification.

NOTE Pre-test photographs of condition are useful when deciding if there has been degradation. Alternatively, retaining a second untested sample is useful for comparison purposes.

9 Pre-conditioning

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The relevant specification shall specify the cleaning method to be applied immediately before the test. It shall also state whether or not to remove any temporary protective coating.

The cleaning method used shall not interfere with the effect of the salt mist on the test specimen, nor introduce any secondary corrosion. Touching of the test surfaces by hand should be avoided as far as possible before the test.

10 Arrangement of the test specimens

10.1 The test specimens shall be tested in their normal operating positions in accordance with the relevant specification.

10.2 The angle at which the surface of the test specimen is exposed in the chamber is very important. The angle shall be mutually agreed between the interested parties.

Unless otherwise specified, specimens shall be mounted at an angle of $20^\circ \pm 5^\circ$ to the vertical, with the area of primary interest facing up. This is common practice for testing metallic specimens and are common measures to protect them from corrosion. When testing assemblies or enclosures, it can be preferable to mount the specimen at the same angle as in normal use.

10.3 The test specimens shall be arranged so that they do not come into contact with the chamber and so that surfaces to be tested are exposed to free circulation of spray. The test specimens may be placed at different levels within the chamber as long as the solution does not drip from the test specimens or their supports at one level onto other test specimens placed below. When practical, specimen repositioning at regular intervals during the test is recommended.

10.4 The supports for the test specimens shall be made of inert non-metallic material. If it is necessary to suspend test specimens, the material used shall not be metallic but shall be synthetic fibre, cotton thread or other inert insulating material.

11 Operating conditions

11.1 The operating conditions shall be as specified in Table 2.

Table 2 – Operating conditions

Condition	Specified value
Temperature	35 °C ± 2 K
Average collection rate for a horizontal collecting area of 80 cm ²	1,5 ml/h ± 0,5 ml/h
Concentration of sodium chloride (collected solution)	50 g/l ± 5 g/l
pH (collected solution)	6,5 to 7,2
The ± tolerances given are the allowable operational fluctuations, which are defined as the positive and negative deviations from the setting of the sensor at the operational control set point during equilibrium conditions. This does not mean that the set value may vary by plus/minus the amount indicated from the given value.	

11.2 Check the collection rate and other test conditions in the test chamber, filled to a similar extent as during the test. A completely filled chamber often exhibits different performance than the same chamber operated empty. The trial run for confirming the test conditions should be performed for a minimum of 24 h before starting a test. A trial run is not necessary when the time between tests is five day or less, if mutually agreed between the interested parties.

The measurements of test conditions shall be made immediately following the trial run and before exposing the test specimens to be tested. Care should be taken to only measure the solution that has not been subjected to significant evaporation. After it has been confirmed that the test conditions are within a specified range, stop spraying the salt solution, fill the test chamber with test specimens and start the test.

Evaporation of the collected solution inside the chamber and during measurement can have an effect on the concentration and pH.

11.3 Place at least two clean and dry collecting devices in the zone of the chamber where the test specimens are placed, one close to an inlet of spray and one remote from an inlet. Additional collecting devices may be used for more precise mapping of the spray homogeneity. The collecting devices shall be placed such that they are not shielded by the test specimens, and so that only mist, and not liquid falling from specimens or from parts of the chambers, is collected. Each collecting device shall collect sprayed solution in the amount of 1,5 ml/h ± 0,5 ml/h averaged over a minimum period of 24 h. In addition to performing a trial run prior to tests (11.2), daily monitoring of the collection rate is recommended during tests, when practical.

NOTE Additional collecting devices are placed in quantities proportional to the chamber exposure area. For optional daily monitoring, using a smaller quantity of collecting devices is common.