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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 2423.65-2024

**Environmental testing - Part 2: Test methods - Combined salt
mist, temperature, humidity and solar radiation test**

环境试验 第2部分：试验方法 试验：盐雾/温度/湿度/太阳辐射综合

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Table of Contents

1	Scope
2	Normative references
3	Terms and definitions
4	General description of tests
4.2	Test phase Z
4.3	Test stage Z
4.4	Test phase Z
5	Test equipment
5.2	Equipment installation
6	Salt solution...
7	Specimens
8	Initial testing
9	Pretreatment
10	Specimen installation
11	Tests...
12	Intermediate testing
13	Recovery
14	Final testing
15	Information to be provided regarding the specifications

1 Scope

China's national combined environmental test applying salt mist, temperature, humidity and solar radiation together. It is part of the GB/T 2423 series and specifies the apparatus, the severities, the procedure and the evaluation for a test in which these four stresses are applied in combination rather than in sequence. The GB/T 2423 series is largely a catalogue of single-stress tests - a salt mist test, a damp heat test, a solar radiation test, each applied alone - and the reason for a combined test is that the real environment does not work that way and the damage it causes is not the sum of the parts. A coastal environment applies salt, heat, humidity and sunlight simultaneously and cyclically, and the interactions are what destroy equipment. Ultraviolet radiation degrades a polymer and opens the surface, which lets moisture and chloride reach the substrate that the intact coating would have protected. Solar heating drives a diurnal cycle that pumps moist salt air in and out of an enclosure through its breathing, depositing salt inside where no external

salt spray would reach. The heat accelerates the corrosion the salt starts, and the wet-dry cycling concentrates the electrolyte far beyond what a continuous salt spray produces - which is why a continuous salt spray test is known to correlate poorly with real coastal service. So the standard specifies a cycle rather than a condition: the sequence and duration of the salt application, the temperature and humidity phases and the irradiation, the severities available, the chamber and its instrumentation, and the evaluation of the specimen. It is aimed at equipment that lives outdoors near the sea. Issued on 23 August 2024 and in force since 1 March 2025.

This document describes a comprehensive testing method for electrical and electronic equipment, components, and materials under the effects of salt spray, temperature, humidity, and solar radiation, including information on testing equipment, conditions, and methods. This document is applicable to evaluate the environmental adaptability of electrical and electronic equipment, components, and materials used in humid and hot marine atmospheric environments under the combined effects of salt spray, temperature, humidity, and solar radiation.

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.

GB/T 2423.17, Environmental testing - Part

3 Terms and definitions

There are no terms or definitions that need to be defined in this document.

4 General description of tests

4.1 Overview This test is a comprehensive test that includes salt spray, dry heat, humid heat, and solar radiation. Each test cycle of the comprehensive test consists of three stages. The test phase Z1 is composed of humid heat (high temperature, high humidity), salt spray, and solar radiation. The test phase Z2 is composed of dry heat (high temperature, low humidity) and solar radiation. The test phase Z3 consists of humid heat (high temperature, high humidity) and salt spray. Carry out Z1, Z2, and Z3 in sequence to form the basic cycle of the comprehensive test.

4.2 Test phase Z

1.Damp heat, salt spray, and solar radiation conditions Under humid and hot conditions, salt spray, and solar radiation, firstly, the metal part of the specimen undergoes electrochemical or complex chemical reactions and corrosion during the contact process of settling salt

droplets. Secondly, the parts of the specimen affected by solar radiation have different abilities to absorb and release light and heat due to material, color, and other characteristics. The process of settling salt solution drying up on the surface of the specimen presents a sequential order, thus reflecting the differences in corrosion effects. At the same time, the solar radiation heat effect can cause deformation between the specimen components, leading to problems such as increased gaps in the original sealed position, which increases the probability of salt spray entering the interior of the specimen in subsequent stages. Finally, a humid and hot environment will maintain the existing humidity in the parts of the specimen surface that are not affected by solar radiation, thereby increasing the penetration time of the electrolyte liquid film into the protective coating of the specimen. The higher ambient temperature also accelerates the corrosion of metal surfaces.

4.3 Test stage Z

2.Dry heat and solar radiation conditions Under dry heat and solar radiation conditions, as the relative humidity decreases, the residual moisture on the surface of the specimen evaporates, and all salt crystals precipitate from the solution and adhere to the surface of the specimen. During this process, the concentration of the liquid film increases and accelerates the chemical reaction, accelerating the corrosion process. At the same time, the thermal effects of solar radiation have directionality and generate thermal gradients, causing different materials and components to expand or contract at different rates, resulting in failure behaviors such as coating blistering and delamination, reduced strength at welding or adhesive sites, seal integrity damage, and softening of encapsulated compounds. In addition, solar radiation can also cause accelerated aging of the protective coating on the surface of the specimen. The photochemical effect can promote the occurrence of loss of light, fading, discoloration, cracking, pulverization or microcracks, thereby accelerating the penetration of salt solution in the Z3 stage.

4.4 Test phase Z

3.Damp heat and salt spray conditions Under humid and hot conditions, as the relative humidity increases, salt crystals attached to the interior or surface of the specimen absorb water vapor and form a salt solution. At the same time, under salt spray conditions, the salt solution is replenished, ultimately forming an electrolyte membrane on the surface of the specimen to further promote corrosion and penetration. Simultaneously wet the surface of the specimen for the next Z1 stage.

5 Test equipment

5.1 General requirements for test equipment The materials used for devices directly exposed to salt spray inside the equipment shall not affect the corrosion effect of salt spray. They shall have good sealing performance and corrosion resistance. The materials used for

devices directly exposed to solar radiation inside the equipment shall not affect the photothermal aging effect of solar radiation. They shall have good anti-aging performance. Annex B provides examples of test equipment.

5.2 Equipment installation

5.2.1 Test chamber The structure of the test chamber and the method of providing salt spray may vary, but the following conditions shall be met.

- a) The operating conditions inside the test chamber are within the specified limits (see Chapter 11).
- b) The determination method of salt spray concentration shall be carried out in accordance with GB/T 10593.2. At least two testing points shall be arranged on the same horizontal plane in the workspace during each test to measure and record salt spray concentration. The deviation of salt spray concentration is within $\pm 30\%$.
- c) The airflow velocity inside the test chamber is controlled below 0.5 m/s. The measurement position is consistent with the irradiation reference plane, facing the direction of the airflow inlet.
- d) The temperature measurement inside the test chamber meets the requirements of GB/T 2423.24-2022. Other requirements for the test chamber are specified in GB/T 2423 (all parts).

7 Specimens

The type, quantity, shape, and size of the specimen shall be selected according to the relevant specifications of the tested material or product. If there is no standard, for material specimens, it is advisable to expose at least 3 parallel specimens of each type for statistical evaluation of the results. For equipment and component specimens, both parties can negotiate and determine.

8 Initial testing

Visual, dimensional, and functional inspections shall be conducted on the specimens. If necessary, electrical and mechanical performance testing shall be conducted in accordance with the requirements of relevant specifications.

9 Pretreatment

The specimen shall be pretreated according to relevant specifications and regulations. The relevant specifications shall specify the cleaning procedure to be used on the specimen before the test. They shall also specify whether the protective coating needs to be removed. The cleaning method used shall not affect the corrosion effect of salt spray on the