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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 2424.10-2012

Replacing GB/T 2424.10-1993

Environmental testing - General guidance of accelerated testing for atmospheric corrosion

环境试验 大气腐蚀加速试验的通用导则

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Foreword Foreword

GB/T 2424, Environmental testing, is divided into a number of parts: GB/T 2424.1 Guidance for high temperature and low temperature tests; GB/T 2424.2 Guidance for damp heat tests; GB/T 2424.5 Confirmation of the performance of temperature test chambers; GB/T 2424.6 Confirmation of temperature chambers for tests A and B (with load); GB/T 2424.7 General guidance for accelerated atmospheric corrosion testing; GB/T 2424.10 Guidance for solar radiation testing; GB/T 2424.14 Guidance for combined temperature and low air pressure tests; GB/T 2424.15 Guidance for soldering tests; GB/T 2424.17 Guidance for environmental tests simulating the effects of storage; GB/T 2424.19 Guidance for tilting and swinging tests; GB/T 2424.20 Guidance for combined temperature (low temperature, high temperature) and vibration (sinusoidal) tests; GB/T 2424.22 Seismic test methods; GB/T 2424.25 Guidance for tests; GB/T 2424.26 Supporting documentation and guidance - Selection of vibration tests. This part is Part 10 of GB/T 2424.

This part is drafted according to the rules given in GB/T 1.1-2009. It replaces GB/T 2424.10-1993, Basic environmental testing procedures for electric and electronic products - Accelerated atmospheric corrosion testing - General guidance for accelerated atmospheric corrosion testing. Compared with GB/T 2424.10-1993 the main differences are: to bring the title into line with the titles of the current GB/T 2424 series, the title of the standard has been changed to Environmental testing - General guidance of accelerated testing for atmospheric corrosion; the expression this standard has been changed to this part; a table of contents and a foreword have been added; in item b) of 3.2.3 the wording accelerated velocity test has been changed to accelerated test; and the original Clause 9 has been merged into Clause 8 as 8.6, with its clause heading removed.

This part is proposed by, and under the jurisdiction of, the National Technical Committee on Environmental Conditions and Environmental Testing for Electric and Electronic Products of

Standardization Administration of China (SAC/TC 8).

Relationship to previous standards Relationship to previous standards

The foreword states that the previous editions of the standard replaced by this part were issued as GB/T 2424.10-1981 and GB/T 2424.10-1993.

1 Scope

This part of GB/T 2424 gives the applicability of the conditions and of the methods of accelerated atmospheric corrosion testing, and guidance on the application of the various accelerated tests.

This part applies to the drafting of standards and of test schedules for accelerated atmospheric corrosion test methods for electrical and electronic equipment and components, and is a guide for carrying out artificially accelerated corrosion tests; it is for reference when standards and codes for accelerated atmospheric corrosion tests are drafted and when artificially accelerated corrosion tests are carried out.

2 Normative references

The following document is indispensable for the application of this document. For dated references, only the edition cited applies to this document. For undated references, the latest edition (including all amendments) applies to this document.

GB/T 2423.17-2008 Environmental testing for electric and electronic products - Part 2: Test methods - Test Ka: Salt mist (IEC 60068-2-11:1981, IDT).

3 Tests for predicting the performance of the test specimen under use conditions

The ideal, general corrosion test method would give, within a short time - a few weeks or a few days, and preferably a few hours or even a few minutes - the performance that a material, a component or a piece of equipment would show after several years of operation under use conditions. No such corrosion test method exists at present, because: a) use conditions are not fixed and vary widely; b) when certain corrosion factors are intensified in order to accelerate the corrosion test, there is a risk that the corrosion mechanism and the corrosion products may change; c) different materials react very differently to the intensification of a corrosion factor.

3.1 Use conditions. The factors that influence corrosion under use conditions are: a) the climate, such as a marine, rural, urban, industrial or tropical climate, or a combined climate; b) the frequent variation of the climatic conditions, which is highly irregular, differing from

one place to another and also between different periods in the same place; c) the exposure conditions, such as indoors, under a shelter or in the open; d) atmospheric pollution, such as dust and corrosive gases in the atmosphere; e) the position in which the test specimen is placed, for instance horizontal, vertical or inclined, directly exposed to sunlight, washed by rain or sheltered from rain, so that even for the same material on the same piece of equipment the degree of corrosion may differ with the position. Since use conditions differ so much, it is impossible to use one general accelerated test to predict the performance of a component or of a piece of equipment under use conditions. One test may vary the number of test cycles to simulate different degrees of corrosion in actual use, so that a product used in a rural atmosphere is tested for one cycle while one used in a marine atmosphere is tested for four cycles; but the corrosion factors of these climates are not the same, and the real behaviour of the test specimen in the different climatic conditions still cannot be predicted. It is generally held that using different accelerated test methods for different climates may give a closer approximation, for example the salt mist test for a marine atmosphere and the damp heat test containing sulfur dioxide for an industrial atmosphere. It should be pointed out, however, that when the results obtained by these different accelerated test methods are interpreted, the variability of the use conditions makes them not fully reliable, and they may lead to many wrong conclusions.

3.2 Methods of accelerating the corrosion process. In order to obtain test results within a short time the corrosion process has to be accelerated; the methods commonly used are: a) raising the temperature; b) raising the relative humidity; c) increasing the degree of condensation; d) increasing the concentration of the corrosive medium; e) increasing, within the test cycle, the ratio of the time with corrosive medium to the time without corrosive medium, or lengthening the test time; f) applying voltage or current; g) applying mechanical stress; h) making the temperature vary cyclically. A note adds that if the sensitivity with which corrosion is assessed could be raised, results could be obtained more quickly, but this is at present difficult to achieve, so that acceleration is normally sought only in the corrosion process itself.

3.2.1 Temperature. Where raising the temperature does not cause or accelerate some other reaction, a temperature rise of 10 °C generally increases the chemical reaction by two to three times; many of the factors that influence the corrosion rate, however, change with the temperature. Examples are as follows: a) the solubility of gases in water usually falls as the temperature rises, and under particular condensation conditions this may instead lower the corrosion rate; b) if under normal use conditions the corrosion products form a protective layer on the metal surface, at high temperature such a layer may not form, so that the corrosion rate rises quickly and the corrosion behaviour changes completely; c) a metal that under normal conditions shows only slow general corrosion may at high temperature show very severe corrosion, for example cavitation corrosion and stress corrosion; d) when two metals are in contact, the metal with the lower electrode potential protects the metal with the higher electrode potential, but at high temperature the order of their potentials may

change: under normal use conditions zinc protects iron, but when the temperature is above 70 °C the potential of zinc may become higher than that of iron and it no longer protects it.

3.2.2 Relative humidity. Generally speaking, an increase in the relative humidity makes the corrosion rate faster.

3.2.3 Condensation. Periods of condensation occur in most climatic conditions, and only the time at which condensation appears and its degree differ. Generally speaking the corrosion rate with condensation is faster than without it, and increasing the degree of condensation can make corrosion faster, but the condensation conditions in use and in testing are complex: a) condensation is closely related to how clean and how smooth the surface of the test specimen is; on a smooth, clean surface condensation appears only when the relative humidity at the surface of the specimen reaches 100 %, whereas when substances able to absorb moisture settle on the surface of the specimen, or hygroscopic corrosion products form, such a surface absorbs moisture easily and condensation appears even when the relative humidity is below 100 %; b) if a component is inside an incompletely sealed enclosure, the enclosure gives some protection against moisture, because the relative humidity inside it varies less than the surrounding atmosphere, and a component used inside such an enclosure is not likely to show condensation; but when such a component is subjected to an accelerated test, damage caused by condensation appears within a very short time; c) when the temperature and the humidity change, condensation is related to the heat capacity of the equipment or of the component: as the temperature of the atmosphere rises, a test specimen with a large heat capacity warms up more slowly, stays below the dew point of the atmosphere and produces condensation, whereas a test specimen with a small heat capacity warms up faster, stays above the dew point of the atmosphere and produces no condensation. Clearly, obtaining acceleration only by increasing condensation is difficult, because excessive condensation during the test washes the test specimen and instead reduces the degree of corrosion, and heavier condensation also makes components inside incompletely sealed enclosures show degradation phenomena that do not occur in actual use.

3.2.4 Concentration of the corrosive substance. Various corrosive substances are present in the atmosphere, and the corrosive medium of an accelerated test should generally be a substance that occurs frequently in the atmosphere, such as sodium chloride in a marine atmosphere and sulfur dioxide in urban and industrial atmospheres. The concentration of the corrosive substance also has to be higher than under normal conditions in order to accelerate corrosion; but sometimes when the concentration is raised the corrosion rate becomes slower instead, because the solubility of other substances related to corrosion may fall: adding sodium chloride to a sodium chloride solution reduces the dissolution of oxygen, and this phenomenon is especially marked at high temperature. Increasing the concentration of the corrosive substance may also change the nature of the corrosion: at low concentration only slight corrosion appears, while at high concentration severe cavitation corrosion and stress corrosion may be produced. An incompletely sealed