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Environmental testing - Part 2: Test methods - Test Sa: Simulated solar radiation at ground level and guidance for solar radiation testing

环境试验 第 2 部分：试验方法 试验 Sa：模拟地面上的太阳辐射及其试验导则

(IEC 60068-2-5:2010, Environmental testing - Part 2-5: Tests - Test Sa: Simulated solar radiation at ground level and guidance for solar radiation testing, IDT)

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Table of Contents

Environmental testing - Part 2: Test methods - Test Sa: Simulated solar radiation at ground level and guidance for solar radiation testing

1 Scope

This part of GB/T 2423 provides guidance for testing equipment or components, under solar radiation conditions.

The purpose of the test is to check the extent to which equipment or components are affected by solar radiation.

The comprehensive test method can detect changes in electrical, mechanical or other physical properties.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

IEC 60068-1 Environmental testing - Part 1: General and guidance

IEC 60068-2-1 Environmental testing - Part 2-1: Tests - Test A: Cold

IEC 60068-2-2 Environmental testing - Part 2-2: Tests - Test B: Dry heat

IEC 60068-2-78 Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state

CIE 85:1989[1)] Solar spectral irradiance

3 Terms and definitions

The terms and definitions as defined in IEC 60068-1, as well as the following terms and definitions, apply to this document.

[1] The original text of IEC is "CIE 85:1985", which is wrong in the year. It is corrected here to "CIE 85:1989".

If required, the recommended value of IEC 60068-2-78 shall be used first.

The relevant specifications shall specify the humidity during the following test AND whether it needs to be maintained:

a) Only during the irradiation period;

b) Only in the dark period;

c) The entire test duration.

5.4 Ozone and other polluting gases

The ozone, which is produced by the short-wave ultraviolet rays in the test radiation source, is usually discharged out of the test box, by a filter that corrects the spectral energy distribution. Because ozone and other polluting gases will significantly affect the degradation process of certain materials, it is important to exhaust these gases from the test box, unless otherwise required by relevant specifications.

5.5 Surface contamination

Dust and other surface contaminants can significantly change the absorption characteristics of the irradiated surface. Unless otherwise required, the test sample should be tested, under clean conditions. However, if the impact of surface contaminants is to be evaluated, relevant specifications should include necessary information such as surface preparation.

5.6 Installation of test sample

The test sample shall be installed on a raised support, turntable or a special base, which has known thermal conductivity and heat capacity, in the test box, according to the relevant specifications. There shall be sufficient spacing between test samples, to avoid the radiation from the light source OR secondary radiant heat. The temperature sensor should be attached to the test sample, as required.

5.7 Test facility

The optical parts, lamps, reflectors, filters of the test equipment shall be kept clean.

The irradiance on the specified measurement plane shall be measured, before each test.

Any specified auxiliary environmental conditions, such as ambient temperature, humidity, air flow rate or other parameters, shall be continuously monitored, throughout the test period.

5.8 Test equipment

The test box for the test shall be able to provide a light source, which meets the spectral distribution, which is specified in Table 1. Its irradiance on the specified radiation measurement plane is 1120 × (1 ± 10%) W/m^2. The irradiance value shall include any radiation, which is reflected from the test box AND received by the test sample; however, it shall not include the long-wave infrared radiation, which is emitted by the test box.

The test box shall be equipped with a device, which is capable of maintaining the specified temperature, air velocity, humidity conditions.

The temperature measurement in the test box shall be carried out, at one or several positions on a horizontal plane, 0 ~ 50 mm lower than the prescribed radiation measurement plane. The temperature measuring device shall be sufficiently shielded, to prevent radiant heat. At the same time, this (these) measurement position is at half the distance, between the test sample and the test box wall, OR 1 m away from the test sample, whichever is the smaller of these two positions.

6 Initial inspection

The test samples shall be subject to the visual inspection, size and function inspection, as required by relevant specifications.

7 Test

7.1 Overview

During the exposure period, the temperature inside the box shall be raised or lowered at a rate of less than 1 K/min [4)] AND maintained at a value recommended by IEC 60068-2-1 or IEC 60068-2-2, OR a value specified by relevant specifications.

In program A, the temperature in the test box shall start to rise, 2 h before the start of the irradiation period.

During the dark period of programs A and B, the temperature in the test box shall be lowered at a rate of less than 1 K/min [5)] AND kept at 25 °C. If the required temperature is lower than 25 °C, then the temperature shall be maintained at the required temperature value.

The requirements for the relationship between irradiance, temperature, time are

[4)] The original IEC "rate of 1 K/min" is changed to "rate of less than 1 K/min", for the same reason as footnote 3).
[5)] Same as 4).

Appendix A

(Informative)

Interpretation of test results

A.1 Compliance with specifications

The relevant specifications should specify the allowable external conditions and/or performance changes, after the test sample is exposed to the required irradiance level, for a specified duration. In addition to these requirements, the following explanations can be considered.

A.2 Short-term effects

The main concern is the thermal effect. The short-term effects to be understood are mainly the nature of local overheating.

A.3 Long-term effects

The purpose of the long-term test is to determine the degradation mode, which has the following two purposes: to observe whether there is an initial sharp change AND to evaluate the effective life of the test sample.

A.4 Thermal effect

The maximum surface temperature and internal temperature reached by the test sample or device depends on:

a) Ambient air temperature;

b) Irradiance;

c) Air velocity;

d) Duration of exposure;

e) The thermal properties of the object itself, such as surface reflectivity, size and shape, thermal conductivity, specific heat.

If the ambient temperature is as low as 35 °C ~ 40 °C, the temperature of the equipment, which is fully exposed to solar radiation, can exceed 80 °C. The reflectivity of the surface of an object greatly affects the temperature rise, due to its heating by the sun. For example, changing the coating from dark to bright white will reduce the temperature a lot. On the contrary, it can be expected that the fresh paint layer, which is used to lower the temperature, will gradually deteriorate, which will lead to an increase in temperature.

Most materials are selective reflectors, that is, their spectral reflectance varies with wavelength. For example, in general, although the paint layer may have high reflection efficiency in the visible light region, it has poor reflection ability in the infrared region. In addition, many materials have sharp changes in their spectral reflectance in the visible light (causing color perception in the human eye) and near-infrared regions. Therefore, it is very important to ensure that the spectral energy distribution of the radiation source, which is used in the simulation test, reproduces the spectral energy distribution of natural sunlight, as accurately as possible, OR adjust the irradiance appropriately to obtain the same heating effect.

A.5 Degradation of materials

The combined effects of solar radiation, atmospheric gases, temperature and humidity changes are often collectively referred to as "weathering", which leads to the aging and ultimate destruction of most organic materials (for example, plastics, rubber, coatings, wood, etc.).

Many materials are satisfactory for use, in temperate regions, BUT they are completely unsuitable for use in more unfavorable tropical regions. Typical defects are rapid deterioration and cracking of the coating, cracking and chipping of the cable cover, discoloration of the pigment.

The damage of materials under the effects of weathering is usually not caused by a single reaction, BUT by several different types of independent reactions, which occur at the same time; it is often accompanied by mutual influence. Although solar radiation (mainly ultraviolet light, leading to photodegradation) is often the main factor of weathering, in fact its influence can hardly be separated from the influence of other weathering factors. For example, the effect of ultraviolet radiation on polyvinyl chloride, wherein the effect of ultraviolet radiation alone is not obvious here, BUT the sensitivity of polyvinyl chloride to thermal damage (oxygen may play a major role) is significantly enhanced.

Artificial tests occasionally produce abnormal defects, which do not occur in natural weathering. It can usually be attributed into one or more of the following:

a) Many laboratory ultraviolet radiation sources and natural solar radiation have considerable differences, in the spectral energy distribution;

b) When the ultraviolet radiation intensity, temperature, humidity and other factors are strengthened, to obtain the acceleration effect, the speed of each independent reaction, which occurs under normal exposure conditions, may not increase to the same degree;

c) Generally, artificial tests do not simulate all natural weathering factors.

Appendix C

(Informative)

Measurement instrument

C.1 Overview

The test equipment, which is described in the ISO 4892 standard, shall be used for the tests, which are specified in this Part of GB/T 2423.[6)]

C.2 Irradiance measurement

The pyranometer is considered to be the most suitable instrument for monitoring irradiance. It is used to measure the total radiation of the sun and sky on the horizontal plane.

Two types of instruments are suitable for measuring the radiation of simulated solar light sources, each of which relies on thermopile to work.

It is recommended to use the measuring instrument, which is described in ISO 9370, to monitor the irradiance of the laboratory light source.

None of these measuring instruments can be significantly affected by the long-wave infrared radiation, which is emitted by the test sample or test box.

C.3 Measurement of spectral distribution

The total irradiance is easy to measure, BUT the detailed measurement of the spectral characteristics is more difficult. The main spectral changes can be checked, by cheap daily measurements with a pyranometer, in combined with the selected filter. But to check the detailed distribution characteristics of the equipment, it needs to use a sophisticated spectroradiometer to measure.

The spectral characteristics of lamps, reflectors, filters will change after a period of time, which may cause the spectral distribution to seriously exceed the tolerance range. Manufacturing tolerances mean that changing the lamp may cause an inadmissible change, in the irradiance level, as relative to the initial set value. Therefore, regular monitoring is necessary. However, when there are test samples for testing, it may not be feasible to monitor the detailed spectral distribution in the test box.

C.4 Temperature measurement

[6] According to the provisions of GB/T 1.1-2009, the informative appendix shall not give the requirements, BUT the IEC original text does so. In addition, the test equipment, which is described in the ISO 4892 standard includes xenon arc lamps, fluorescent ultraviolet lamps, carbon arc lamps and other light source exposure equipment. Except for xenon arc lamps, the spectral energy distribution of other light sources does not meet the requirements of Table 1. Hereby explain.

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