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Environmental testing for electric and electronic products - Part 2: Test methods - Test: Combined temperature (cold and heat)/low air pressure/vibration (sinusoidal)

电工电子产品环境试验 第 2 部分：试验方法 试验：温度（低温、高温）/低气压/振动（正弦）综合

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Environmental testing for electric and electronic products - Part 2: Test methods - Test: Combined temperature (cold and heat)/low air pressure/vibration (sinusoidal)

1 Scope

This Part specifies the basic requirements, severity levels, test procedures, other technical details of the combined temperature (cold and heat)/low air pressure/vibration (sinusoidal).

This Part is applicable to determine the applicability of products, for storage, transportation, use under the combined effects of temperature (cold, hot), low air pressure, vibration (sinusoidal). Refer to this Part for combined tests with temperature changes.

2 Normative references

The provisions in following documents become the provisions of this Part through reference in this Part of GB/T 2423. For the dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Part; however, parties who reach an agreement based on this Part are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 2421-1999 Environmental testing for electric and electronic products-- Part 1: General and guidance (Idt IEC 60068-1:1988)

GB/T 2422-1995 Environmental testing for electric and electronic products - Terms and definitions (Idt IEC 60068-5-2:1990)

GB/T 2423.1-2001 Environmental testing - Part 2: Test methods - Tests A: Cold (IEC60068-2-1:1990, IDT)

GB/T 2423.2-2001 Environmental testing - Part 2: Test methods - Tests B: Dry heat (IEC60068-2-2:1974, IDT)

GB/T 2423.10-2008 Environmental testing for electric and electronic products - Part 2: Tests methods - Test Fc: Vibration (sinusoidal) (IEC 60068-2-6:1995, IDT)

GB/T 2423.21-1991 Basic environmental testing procedures for electric and electronic products - Test M: Low air pressure (neq IEC 60068-2-13:1991)

GB/T 2423.26-1992 Basic environmental testing procedures for electric and electronic products - Test Z/BM: combined heat/low air pressure tests (neq IEC 60068-241:1983)

3 Terms and definitions

The terms and definitions, which are defined in GB/T 2422-1995, GB/T 2423.1-2001, GB/T 2423.2-2001, GB/T 2423.10-2008, GB/T 2423.21-1991, GB/T 2423.26-1992, apply to this Part.

4 General description

This test is a combined test of test A (low temperature), test B (high temperature), test M (low air pressure), test Fc (vibration (sinusoidal)).

The test sample shall be subjected to the vibration test, temperature test, temperature/low air pressure combined test, in sequence, in accordance with the test procedure; finally superimposed with vibration (sinusoidal), to make the test sample withstand temperature (cold, hot)/low pressure/vibration (sinusoidal) combined test. When the test sample has passed a single vibration (sinusoidal) test, temperature test and temperature/low air pressure combined test, it may directly carry out the temperature (cold, hot)/low air pressure/vibration (sine) combined test.

Whether the test sample is in working condition, during the test, shall be stipulated by the relevant specifications.

5 Test equipment

5.1 General requirements for test equipment

The test equipment shall comply with the requirements for test equipment, in GB/T 2423.1-2001 (or GB/T 2423.2-2001), GB/T 2423.21-1991, GB/T 2423.10-2008, OR otherwise meet the requirements of this test.

Attention shall be paid, to avoid the mechanical coupling, between the vibration bench and the test box (chamber), as well as the air pollution in the test box (chamber), due to inhaled air, when the pressure returns to normal atmospheric pressure.

When developing test equipment by oneself, it shall properly handle the

problems, such as equipment devices and "interface" devices.

5.2 Equipment device

Unless otherwise specified in the relevant specifications, under normal circumstances, the vibration bench itself shall be installed, outside the test box (chamber); only the vibration bench surface is extended into the box (chamber). This configuration is more reasonable.

If the vibration bench is installed in the test box (chamber), it will not only make the vibration bench repeatedly suffer the comprehensive environment and affect the life of the vibration bench, but also the heat generated by the vibration bench will interfere with the temperature field in the box (chamber). It must also be noted that, the vibration transmission characteristics of the vibration bench's isolating device (such as rubber shock absorbers), under low temperature conditions, have undergone significant changes. At this time, there is a mechanical coupling, between the vibration bench and the test box (chamber), which produces excitation, which may damage the structure of the test box (chamber).

5.3 Interface device

When the vibration bench's body is outside the test box (chamber) BUT the vibration bench surface is deep into the test box (chamber), the problem of heat insulation and pressure-resistant sealing interface device, between the vibration bench and the test box (chamber), must be solved. In addition to meeting the basic requirements of thermal insulation and airtightness, the interface device shall also avoid mechanical coupling, between the vibration bench and the test box (chamber), the vibration bench's surface deviating from the equilibrium position (rising or deviating from the center), when the test box (chamber)'s air pressure drops, and other unfavorable factors.

6 Sample installation

The installation of the test sample shall simulate the actual installation state. It shall meet the installation requirements of GB/T 2423.1-2001 (or GB/T 2423.2-2001) and GB/T 2423.10-2008. For the test of heat dissipation test samples, the heat insulation pad, between the test sample and the vibration bench, shall have large rigidity and low thermal conductivity (thermal insulation).

7 Severity level

The severity of the test is determined jointly, by the temperature, air pressure, vibration frequency range, amplitude value, duration.

The non-heat-dissipating test sample shall adopt the test method of forced air circulation.

10.2 Conditional test

10.2.1 Vibration test

The combined test box (chamber) is at the laboratory temperature. The test sample is installed on the vibration bench, according to the specified axis, under the condition of not being packaged and not energized. Then the vibration test is carried out, according to the severity level, which is specified by the relevant specifications.

When it is necessary to determine the dangerous frequency of the test sample, a vibration response inspection of a sweep frequency cycle shall be carried out, within the specified frequency range.

When required by the relevant specifications, the test samples shall be subject to the performance test.

10.2.2 Temperature test

The test sample keeps the installation, during the vibration test.

The temperature, in the test box (chamber), shall be adjusted to the value, which is specified in the relevant specifications. Make the temperature of the test sample be stabilized.

The average rate of temperature change in the test box (chamber) is: 0.7 °C/min ~ 1 °C/min (calculate the average rate every 5 min).

When required by the relevant specifications, the test samples shall be subject to performance testing.

10.2.3 Combined temperature/low pressure test

After 10.2.2, the air pressure in the test box (chamber) drops to the value, which is specified by the relevant specifications. The rate of change of the air pressure shall not be greater than 10 kPa/min OR according to the relevant specifications.

After the temperature and air pressure have reached the specified values of the relevant specifications AND stabilized, when the relevant specifications require, the test sample shall be subject to performance testing.

10.2.4 Combined temperature (cold, hot)/low air pressure/vibration test

After the temperature and air pressure have reached the specified value AND stabilized, the vibration test shall be carried out, according to the severity level,

which is specified by the relevant specification. When it is necessary to carry out the vibration response inspection, for the purpose of determining the dangerous frequency of the test sample, the temperature and air pressure shall remain unchanged, for the specified duration, as shown in Figure 1 or Figure 2.

Stop the vibration at the end of the test. Power off or unload the test samples, which are running (or working) during the test.

11 Intermediate testing

Intermediate testing shall be completed, in the shortest possible time, before the end of the test.

Relevant specifications may specify loading and/or measurement, during or at the end of the test (the test sample is still in the test box). The measurement items and time shall be specified, when necessary. When measuring, the test sample shall not be taken out of the test box (chamber).

Note 1: During the test, the test sample shall not be taken out of the test box (chamber) for measurement, before recovery, AND then put into the test box (chamber) again.

Note 2: If it is necessary to know the performance of the test sample, at a specific time, before the end of the duration, an additional batch of test samples shall be added, for each specific time.

12 Recovery

The air pressure, in the test box (chamber), returns to normal atmospheric pressure, at a rate not greater than 10 kPa/min. During the pressurization period, temperature control is not necessary; the temperature in the test box (chamber) is restored to the normal laboratory climate state, at a rate not greater than 1 °C/min (average rate is calculated every 5 min). After that, the test samples are restored in the test box (chamber), according to the relevant specifications, as shown in Figure 2.

The test sample shall be restored, under standard atmospheric conditions. When the standard atmospheric conditions are not suitable for the test samples, the relevant specifications may specify other recovery conditions. When the test sample recovers, under standard atmospheric conditions, the recovery time shall be sufficient, to make it reach a stable temperature; the minimum time is 1 h. When several test samples are tested at the same time, whilst the recovery time of 1 h is not enough, THEN, the longest recovery time is 2 h, so the measurement must be completed before the end of this time.

If required by relevant specifications, energize or load the test sample, during

Appendix A

(Informative)

Guidelines

A.1 General description

A.1.1 Other applicable standards

The combined temperature (cold, hot)/low air pressure/vibration (sinusoidal) test method is established, based on the Test A (low temperature test method) in GB/T 2423.1-2001, or the Test B (high temperature test method) in GB/T 2423.2-2001, the Test Fc: vibration (sinusoidal) test method in GB /T 2423.10-2008, Test M: Low air pressure test method in GB/T 2423.21-1991. Therefore, the relevant test principles in the test guidelines of Cold and hot test, in GB/T 24224.1, AND in the test guidelines of the Vibration (sinusoidal), in GB/T 2424.7, are also applicable to this comprehensive test.

A.1.2 Test air pressure range

This combined test considers the range of air pressure, which is commonly used on the ground and aircraft. The air pressure, below 1 kPa, is not within the scope of this Part.

A.1.3 Selection of heat dissipation method

In the considered air pressure range, the surface temperature of the heat-dissipation test sample will be much lower than that, under the "free air" condition, under forced air circulation. Therefore, the "free air" condition shall be adopted, for the heat-dissipation test sample. However, considering the additional thermal interference, which is generated by the vibration bench, AND the equipment cannot meet the "free air" conditions, the forced air circulation test method, which has a wind speed of less than 0.5 m/s, is allowed, at this time.

A.1.4 Determination of the number of samples

Under low pressure conditions, due to the decrease in the efficiency of convection heat transfer AND the increase in the influence of heat radiation, the mutual thermal interaction, between the heat dissipation test samples, in the same test box (chamber), also increases. In order to avoid heat interference, which is caused by the radiation, between the heat-dissipation test samples, in this test, it is best to test only one test sample at a time. For the non-heat-dissipation test samples and those heat-dissipation test samples, which are known to have little mutual thermal interference (do not affect the reproducibility

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