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**Environmental testing for electric and electronic
products - Part 2: Test methods - Test: Inclinations
and swings**

电工电子产品环境试验 第2部分：试验方法 试验：倾斜和摇摆

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Environmental testing for electric and electronic products - Part 2: Test methods - Test: Inclinations and swings

1 Scope

This part is used to determine the working adaptability and/or structural integrity of components, equipment and other products, in the ship's inclination and swing environment.

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 (eqv IEC 60068-5-2:1990)

3 Terms and definitions

The terms and definitions, as established in GB/T 2422-1995, as well as the following terms and definitions, apply to this Part.

3.1

Inclination

There are two forms, namely longitudinal inclination and lateral inclination.

3.2

Swing

There are six forms, namely pitching, rolling, yawing, surging, swaying,

heaving. Among them, the pitching, rolling, yawing refers to the alternating angular displacement movement of the ship, around its 3 coordinate axes: longitudinal, transverse, vertical. The surging, swaying, heaving refers to the reciprocating translational movement of the ship, around its 3 coordinate axes: longitudinal, transverse, vertical.

4 General description

4.1 Sample status

The relevant specifications shall stipulate whether the test sample is in working status, during the test, according to the actual use situation.

4.2 Qualification requirement of test

The relevant specifications shall clearly stipulate the test qualification requirements of the test samples.

4.3 Selection of test equipment

The inclination test can be carried out on the swing test bench and/or platform. The swing test is generally to be carried out on a sine swing bench, which can simulate one or several types of ship swing.

5 Test requirements

5.1 Characteristics of the swing test bench

When the inclination test is carried out on the swing test bench, the test bench shall be able to be stably maintained at the specified position, under its maximum test load; there shall be no obvious shaking and drift.

The swing test bench shall be able to simulate at least one form of ship swing, which is usually rolling and/or pitching. In addition to meeting the requirements of 5.1.1 and 5.1.2 and Chapter 6, its swing amplitude and period shall also be arbitrarily adjustable.

When a swing rocking test bench cannot meet the test form, which is required by the relevant specifications, it is allowed to carry out the test, through rotating the installation direction, replacing the test bench, or use of method approved by the agreement, between the two parties to conduct the test.

5.1.1 Characteristics of the sine swing test bench

After the sine swing test bench is installed with the test sample, the swing waveform, which is generated, shall be a continuous and smooth sine wave.

The waveform distortion degree shall be less than 15%. The tolerance of swing amplitude of the test bench is not more than $\pm 10\%$; the cycle tolerance is not more than $\pm 5\%$.

5.1.2 Characteristics of random swing test bench

The characteristics of the random swing test bench shall be separately stipulated by the relevant specifications.

5.2 Measurement system

When performing a swing test, the swing amplitude and cycle, of the swing test bench, shall be monitored by direct-view or other instruments.

5.3 Installation

The test sample shall be installed on the test bench, directly or through a mounting frame, in a form sufficient to allow the test sample to withstand the specified test conditions, according to the actual installation position and method OR the provisions of the relevant specifications. Where there are several installation methods, it shall choose the one that can withstand the most severe conditions, OR several installation methods shall be tested. The rigidity of the mounting frame shall be sufficient to ensure that, during the process of applying the test conditions, the mounting frame will not be significantly deformed, due to the weight of the test sample AND the action of additional inertial force, which is formed by the swing.

The additional mass and constraints on the test sample, which are caused by the external connection, as necessary to ensure the test sample work or energize, during the testing, monitoring, test, shall be kept to a minimum OR as similar as possible to the actual installation.

In actual installation, equipment with shock absorbers shall generally be tested together with shock absorbers.

6 Severity level

The severity level of the inclination test is determined by two parameters: the inclination angle and the test duration.

The severity level of the sine swing test is determined by 3 parameters: swing angle (pitching, rolling, yawing) or linear acceleration amplitude (surging, swaying, heaving), swing cycle, test duration.

The severity level of the inclination test and the sine swing test shall generally be selected from Table 1 and Table 2. For special requirements, it can be

Appendix A

(Informative)

Guidelines

A.1 General description

Inclination and swing are a basic environment, for electrical and electronic products, which are installed on ships. Various products must withstand the effects of this environment. But in terms of product adaptability and structural reliability, according to past practices, not all electrical and electronic products, which are installed on ships, must undergo this environmental test.

The inclined environment, which is described in this Part, is generally caused by the impact of wind, unbalanced loading, manoeuvring, or marine accidents. The swing environment is generally caused by external forces, such as wind and waves.

The inclination test is mainly applicable to products, which must maintain normal or reliable operation, when the ship is inclined at a large angle, due to sea damage, manoeuvring, unbalanced loading, wind and other reasons, as well as products, which have a significant impact on their working performance in an inclined environment. Such impacts generally include:

- a) Cause the destruction of the original balance of forces in the product system;
- b) The change of bearing force condition;
- c) Deterioration of bearing lubrication conditions;
- d) The working malfunction as caused by the change of the position of the internal free liquid level;
- e) The leakage out of internal liquid.

The swing test is mainly applicable to products, which must maintain normal or reliable operation, during long-term swing, due to external forces, such as wind and waves, as well as products, which have a significant impact on their working performance, in the swing environment. Such impacts generally include:

- a) The additional inertial force, which is generated by the swing, may cause additional dynamic load, therefore causing the product to work abnormally OR causing structural damage;

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