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Vibration generating machines — Guidance for selection —

Part 4: Equipment for multi-axial environmental testing

Générateurs de vibrations — Lignes directrices pour la sélection — Partie 4: Équipement pour les essais environnementaux multi-axiaux

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Contents

Page

Foreword ..... **v**
Introduction ..... **vi**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Requirements for multi-axial environmental tests **2**
4.1 Multi-axial vibration test motivation 2
4.2 Test waveforms 3
4.3 Types of multi-axial environmental testing 3
4.3.1 General 3
4.3.2 Parallel thrust testing 3
4.3.3 Bi-axial vibration testing 3
4.3.4 Tri-axial vibration testing 4
4.3.5 Six-degrees-of-freedom vibration testing 4
4.3.6 Other multi-degrees-of -freedom testing 4
5 Multi-axial vibration test equipment **4**
5.1 Types of multi-axial vibration test equipment 4
5.1.1 General 4
5.1.2 Parallel thrust equipment 4
5.1.3 Bi-axial linear vibration equipment 4
5.1.4 Tri-axial linear vibration equipment 6
5.1.5 Six-degrees-of-freedom test equipment 6
5.1.6 Other multi-axial test equipment 8
5.2 Coordinate system 8
5.3 Typical configurations for multi-axial testing 8
6 Main components of multi-axial test equipment **10**
6.1 Exciter 10
6.2 Table 11
6.3 Connectors 12
6.3.1 General 12
6.3.2 Spherical connector 12
6.3.3 Planar connector 14
6.3.4 Orthogonal linear bearing set 15
6.3.5 Drive rod 16
6.3.6 Other connectors 17
6.4 Other components 17
7 System parameters **18**
7.1 General 18
7.2 Number of exciters 18
7.3 Number of total, linear and angular degrees of freedom 18
7.4 Maximum displacement 19
7.5 Maximum velocity 19
7.6 Maximum acceleration 19
7.7 Maximum angular displacement 19
7.8 Maximum angular velocity 20
7.9 Maximum angular acceleration 20
7.10 Frequency range 21
7.11 Parasitic motion 21
7.11.1 General 21
7.11.2 Harmonic distortion 21
7.11.3 Non-uniformity ratio 22
7.11.4 Transverse motion 22

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7.12 Maximum payload 23
7.13 Maximum torque 23
7.14 Table suspension stiffness 23

8 Selection procedures **23**
8.1 General 23
8.2 Determination of the exciter and connector numbers 24
8.3 Determination of exciter types 24
8.3.1 General 24
8.3.2 Test waveform 24
8.3.3 Frequency range 25
8.3.4 Maximum displacement, velocity, and acceleration 25
8.3.5 Maximum force 25
8.3.6 Validation of the proposed selection 26
8.3.7 Other factors to be considered 26

Annex A (informative) **Examples of selections** **27**

Bibliography **34**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 108, *Mechanical vibration, shock and condition monitoring*, Subcommittee SC 6, *Vibration and shock generating systems*.

A list of all parts in the ISO 10813 series can be found on the ISO website.

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Introduction

Selection of a suitable vibration generating system is an urgent problem as one needs to purchase new test equipment or to update the equipment already at one's disposal to perform a certain test or to choose from among the equipment proposed by a test laboratory or even a laboratory itself which offers its service to carry out such a test. A problem like this can be resolved only if a number of factors are considered simultaneously, as follows:

— type of test to be carried out (environmental testing, normal and/or accelerated, dynamic structural testing, diagnosis, calibration, etc.);

— requirements to be followed;

— test conditions (single or multiple excitation, one mode of vibration or combined vibration, single or combined test, for example, dynamic plus climatic, etc.);

— objects to be tested.

This document deals only with equipment to be used for multi-axial environmental testing, and procedures of the selection are predominant to meet the requirements of this testing.

Because the multi-axial environmental test system is composed of more than one exciter, ISO 10813-1 should be used along with this document to select the proper exciters. It is presumed in this document that the system to be selected will be able to drive the object under test up to a specified level. In order to generate an excitation without undesired motions, a suitable control system should be used, however selection of a control system lays beyond the scope of this document.

It should be emphasized that vibration generating systems are complex machines, so the correct selection always demands a certain degree of engineering judgement. As a consequence the purchaser, when selecting the vibration test equipment, may resort to the help of a third party. In such a case, this document can help the purchaser to ascertain if the solution proposed by the third party is acceptable or not. Designers and manufacturers can also use this document to assess the market environment.

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Vibration generating machines — Guidance for selection —

Part 4: Equipment for multi-axial environmental testing

1 Scope

This document gives guidance for the selection of vibration generating equipment for multi-axial environmental testing, depending on the test requirements.

Multi-axial environmental test equipment dealt with in this document refers to a vibration test system having controlled vibration of more than one degree of freedom, including linear vibration and angular vibration. In this document, one or more exciter per desired degree of freedom is supposed.

The guidance covers such aspects of selection as

— number, type and models of exciters,

— number, type and models of connectors,

— system configuration, and

— some components.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 2041, *Mechanical vibration, shock and condition monitoring — Vocabulary*

ISO 10813-1, *Vibration generating machines — Guidance for selection — Part 1: Equipment for environmental testing*

ISO 15261, *Vibration and shock generating systems — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041 and ISO 15261 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
exciter
vibration generator
excitation source where vibratory forces are generated

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3.2
table
platform on which specimens or fixtures are mounted

3.3
multi-exciter system
vibration generating system which includes two or more *exciters* (3.1) and a control system to coordinate the motion

3.4
connector
device used to transmit the excitation force from *exciters* (3.1) to the *table* (3.2) or specimens with the capability of decoupling the linear motions between *exciters* (3.1)

3.5
spherical connector
connector (3.4) with spherical joints

Note 1 to entry: Normally spherical connector has one or two spherical joints (see Figure 7).

3.6
planar connector
connector (3.4) having planar restriction which is capable of moving in two orthogonal axes in that plane

Note 1 to entry: Some planar connectors also have another single-degree-of-freedom (1-DOF) rotational motion in the plane.

3.7
drive rod
stinger
rod with a large length-diameter ratio, stiff in the longitudinal direction and flexible in the transverse direction

3.8
parasitic motion
undesired motion of the *table* (3.2) that occurs when multi-axial excitation is carried out over the *table* (3.2)

3.9
guidance system
mechanical device used to guide the *exciter* (3.1) to move in the axial direction, providing transverse motion restraint to the *exciter* (3.1)

4 Requirements for multi-axial environmental tests

4.1 Multi-axial vibration test motivation

In the real world, pure single axis vibration does not exist, meaning that the real vibration environment is multi-axial. However due to test equipment restrictions, multi-axial vibration testing is mainly conducted one axis after another sequentially, which has different impacts on the specimens than multi-axial simultaneous vibration tests. It is reported that some devices failed in the real multi-axial environment after single axis vibration testing was conducted with no abnormities observed. Therefore, to simulate the real vibration environment and help discover the product malfunction rationale due to multi-axial vibration, the need to conduct a real multi-axial vibration testing has been growing dramatically.

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