INTERNATIONAL STANDARD

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Mechanical vibration and shock — Analytical methods of assessing shock resistance of mechanical systems — Information exchange between suppliers and users of analyses

Vibrations et chocs mécaniques — Méthodes analytiques de l'évaluation de la résistance aux chocs des systèmes mécaniques — Échange d'informations entre les fournisseurs et les utilisateurs d'analyses

Reference number
ISO 9688:1990(E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9688 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock*.

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Introduction

This International Standard specifies the elements of the essential technical dialogue that must be established between a customer (who needs an analytical assessment of shock resistance) and the supplier (the person carrying out the analysis). It is intended to be a guide on what information should be exchanged between a customer and a supplier of an assessment of the shock resistance of a mechanical system (a product or human subject) where the assessment is based on computational analysis.

Normally, and where practicable, the shock resistance of the equipment or structural components should be verified by shock tests. Test procedures and test performance are already covered in some fields by International Standards, such as

IEC 68-2-27:1987, *Environmental testing — Part 2: Tests — Test Ea and Guidance: Shock.*

ISO 8568:1989, *Mechanical shock — Testing machines — Characteristics and performance.*

Through hands-on experience, a shock test can provide engineers with insight into the mechanical response of a machine, vehicle, structure or human subject to which an impact load has been applied. Such tests enable an engineer to determine the mechanical and functional reliability of a product and of a human subject more accurately than by computation. A product subjected to a physical test to assess its resistance to shock usually shows greater resistance than is indicated by an assessment of its resistance based on a mathematical analysis. However, there is an increasing reliance on assessments based on numerical results obtained using computational methods, primarily because of improvements in the methods by which computational analyses are accomplished and because their relationship with the real world is now understood better than before.

Analytical methods are preferred over shock tests when shock tests are not considered possible or practical, for example in cases where

— the structure or equipment for which an assessment is required is excessively large or expensive;

— an assessment of shock resistance is required as part of the design process and/or for the purpose of testing and improving the model used by the designer;

— the designer needs analytical support in deciding whether and how to test the product for which an assessment is required;

— the designer is seeking a basis for generalizing the results of shock tests performed on a product or class of products; or

— the shock resistance can be assessed adequately by using simple mathematical models (for example, in shock isolation design or the layout of fastenings for shock-resistant installations).

Depending upon the mechanical behaviour and complexity of the product, its functional importance relative to other parts of the system in which it will be used, and the safety requirements imposed on the product or the system of which it is a part, the analytical approach selected to assess appropriately the product's shock resistance may be relatively simple or sophisticated. It may be as simple as

— an equivalent-static-load (g-load) analysis, or

— an analysis of simple models using the elastic and/or plastic deformation-energy capability of the model as a measure of the model's capability to accept without failure the energy associated with a shock-pulse input.

It may be as sophisticated as computational methods that make use of

— time history,

— finite elements, and

— analytical modal analysis.

In order to avoid misunderstandings between the customer and the supplier of an analytical assessment, many details need to be discussed and established concerning

a) the mechanical properties of the product and its environment (i.e. size, weight, material, method of construction or manufacture, operating conditions, safety, shock-sensitive components, pipe connections, fasteners, etc.);

b) the specification of the shock-input parameters, tolerance-limit requirements or other acceptance criteria;

c) the appropriate mathematical model, the adequacy of which can be measured by the model's capability for characterizing the mechanical properties of the product in terms of the least number of parameters required to yield useful results. These include the kind of force-deflection constraints (linear or non-linear, elastic or plastic, singly or in combination), the type of system or modal damping, the manner in which energy is propagated through the system, and the form and number of degrees of freedom of the model (lumped-parameter and finite, or continuous and infinite);

d) an appropriate method of analysis, frequency range of interest, and the purpose and limits of the investigation;

e) the method and style of presenting the results.

Sometimes the supplier is handicapped in applying his background knowledge properly because sufficient technical information is not or cannot be furnished by the customer; however, the customer should be aware of what he can expect from an analytical assessment.

Mechanical vibration and shock — Analytical methods of assessing shock resistance of mechanical systems — Information exchange between suppliers and users of analyses

1 Scope

This International Standard establishes the procedures for specifying the analytical methods which can be used to assess the shock resistance of mechanical systems (products or human subjects). It provides a protocol for conducting and documenting a shock analysis and identifies the requirements of the protocol.

It applies to any product or human subject for which an analytical assessment of its shock resistance is required.

NOTE 1 In this International Standard, unless noted otherwise, the term "product" is used to designate an engineering artifact (for example, equipment, component, machine, vehicle or structure).

NOTE 2 Neither the parameters characterizing the shock environments of concern nor acceptable levels of performance are associated with specific numerical values in this International Standard. When evaluating the shock resistance of a specific product to specific shock environments and/or levels of performance, it is necessary that appropriate numerical values be assigned to these parameters; this International Standard only establishes how such an evaluation can be carried out and does not specify the numerical values that could or should be assigned in any specific instance.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2041:1990, *Vibration and shock — Vocabulary*.

3 Definitions

For the purposes of this International Standard, the following definitions apply. Definitions taken from ISO 2041 are cited as quotations.

3.1 mechanical system

(1) In the field of mechanical shock, the mechanical configuration of a product, including all constraints and interactive parts of its environment which must be present or accounted for in order to describe adequately the mechanical behaviour of the mounted product and its components.

(2) "An aggregate of matter comprising a defined configuration of mass, stiffness and damping."

[ISO 2041:1990, 1.22]

3.2 shock resistance: The ability of a system to withstand shock excitation, given in terms of a specified shock pulse, where the system responses do not exceed specified acceptable limits.

NOTE 3 In quantitative terms, the shock resistance of a system is stated as the shock input values the system can accept without the responses of the system exceeding defined (quantified) acceptable limits.