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Vibration and shock — Isolators — Specifying characteristics for mechanical isolation (Guide for selecting and applying resilient devices)

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2017 was drawn up by Technical Committee ISO/TC 108, *Mechanical vibration and shock.*

It was approved in November 1970 by the Member Bodies of the following countries :

Australia	Greece	Sweden
Belgium	Israel	Switzerland
Brazil	Japan	Thailand
Czechoslovakia	Netherlands	United Kingdom
Denmark	New Zealand	U.S.A.
Egypt, Arab Rep. of	Norway	U.S.S.R.
France	South Africa, Rep. of	
Germany	Spain	

No Member Body expressed disapproval of the document.

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Vibration and shock — Isolators — Specifying characteristics for mechanical isolation (Guide for selecting and applying resilient devices)

0 INTRODUCTION

This International Standard is limited to consideration of resilient devices.

Some manufacturers of shock and vibration isolators (resilient mounts) have experience covering a wide variety of applications. The manufacturers, in most instances, are willing to use their background information for solving the users' isolation problems. However, it is frequently difficult for the manufacturer to provide this service, because the user has not furnished sufficient information to the manufacturer regarding the application.

On the other hand, the user is sometimes handicapped in applying isolators properly because sufficient technical information is not furnished by the manufacturer. Consequently, the user must conduct his own experimental evaluation of isolators and may unknowingly duplicate work already carried out by the manufacturer. The user must acquire proficiency in the art of applying resilient isolators, and needs appropriate technical information from the manufacturer. In some circumstances, the vibration or shock can be reduced at the source. This will be considered in other International Standards.

This International Standard is intended to serve as guide for the exchange of technical information between the user and supplier of resilient devices, as required for their proper application.

For the purposes of this International Standard, a resilient device is defined as a flexible element or system used between an equipment item and its supporting structure to attenuate the transmission of shock or vibration *from the equipment to the structure* or *from the structure to the equipment.*

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the subject matter and format for describing isolators (resilient mounts), the equipment to be isolated, supporting structure and environment so that there will be a clear understanding by both the user and the manufacturer. Since the intention of this International Standard is to encourage better communication between the manufacturer and the user, it is strongly recommended that its provisions be adhered to unless there are good reasons for departing from them.

2 REFERENCE

ISO 2041, *Vibration and shock — Terminology*. (At present at the stage of Draft.)

3 DEFINITIONS

NOTE — The basic terminology for vibration and shock contained in ISO 2041 is applicable to this document. Indicated below are some of the definitions concerned with isolators. Also indicated below are special definitions not included in ISO 2041.

3.1 isolator : A support, usually resilient, whose function is to attenuate the transmission of shock and/or vibration.

NOTE — An isolator may include collapsible parts, servomechanisms or other devices in lieu of, or in addition to, the resilient member.

3.2 vibration isolator : An isolator designed to attenuate the transmission of vibration in a frequency range.

3.3 shock isolator : An isolator designed to protect a system from a range of shock motions and/or forces.

3.4 isolation system : The items or support arrangements that secure an equipment to its supporting structure, and provide protection from shock and/or vibration.

NOTE — The characteristics of the system are influenced by the supported and supporting structures.

3.5 load range : The range of operation limited by the maximum and minimum continuous loads at which an isolator can perform its intended function.

3.6 shock limit : The severity of shock that an isolation system can withstand while still retaining its specified isolation characteristics.

3.7 static stiffness : The ratio of change in force to change in displacement under slowly applied increasing and decreasing loads. This information is normally presented in the form of a load-deflection curve.

NOTE — The static stiffness may be dependent upon temperature or other conditions.

3.8 dynamic stiffness :

a) The ratio of change of force to change of displacement under dynamic conditions.

b) The complex ratio of force to displacement during simple harmonic motion.

NOTE — The dynamic stiffness may be dependent upon strain, strain-rate, temperature, or other conditions.

3.9 transmissibility : The non-dimensional ratio of the response amplitude of a system in steady-state forced vibration to the excitation amplitude. The ratio may be one of forces, displacements, velocities, or accelerations.

3.10 centre of gravity (of a body) : That location in the body through which passes the resultant of the weights of its component particles for all orientations of the body with respect to a gravitational field.

3.11 random vibration : A vibration whose magnitude cannot be precisely predicted for any given instant of time.

NOTE — The probability that the magnitude of a random vibration is within a given range can be specified by a probability distribution function.

3.12 power spectral density; mean square spectral density; spectral density : The power spectral density $G(f)$ of a quantity $\epsilon(t)$ is the mean square value of that part of the quantity passed by a narrow-band filter of centre frequency f, per unit bandwidth, in the limit as the bandwidth approaches zero and the averaging time approaches infinity.

3.13 nominal bandwidth (of a filter); **bandwidth :** The difference between the nominal upper and lower cut-off frequencies. The difference may be expressed :

a) in hertz (cycles per second); or

b) as a percentage of the pass-band centre frequency; or

c) as the interval between the upper and lower nominal cut-offs in octaves.

3.14 shock response spectrum; response spectrum :

a) The presentation of the responses to an applied shock of a series of systems of a specified type as a function of their natural frequencies.

b) As used in the field of mechanical shock, an approximate expression of the maximum responses (displacement, velocity, or acceleration) to an applied shock of an assembly of linear single-degree-of-freedom systems, as a function of their natural frequencies.

3.15 snubber : A device used to increase the stiffness of an elastic system (usually by a large factor) whenever the displacement becomes larger than a specified amount.

3.16 damper : In vibration applications, a device used for reducing the magnitude of a shock or vibration by energy dissipation methods.

4 SPECIFICATIONS

4.1 Information supplied by the user

For the selection of a design of an isolation system, the following information, as applicable, is necessary :

4.1.1 *General description of the isolation problem*

A brief description of the information required for a complete understanding of the technical details of the proposed system shall be provided. This information shall include :

a) the type of equipment to be isolated;

b) the type of structure in which the equipment is to be mounted (ship, steel building, concrete building, power plant, etc.);

c) the location in the structure (engine room, main deck, roof, etc.);

d) the isolation efficiency — user's criteria for acceptance.

4.1.2 *Data on item or items to be mounted*

4.1.2.1 Allowable vibration and shock

The allowable vibration and shock that the equipment can withstand without malfunction and/or the level of vibration and shock generated by this equipment shall be specified if known, otherwise it must be estimated; in this case, a description of the exciting source must be given.

4.1.2.2 Equipment drawing

A drawing shall be furnished giving :

a) the outline and installation of the equipment;

b) the overall dimensions;

c) the location of the centre of gravity; the method of obtaining the centre of gravity shall be given i.e. estimate, calculation, or test);

d) specifications of bolt sizes and special connectors, for securing the equipment; locations of attachments, tapped holes, tolerances and any special material considerations shall be indicated on the drawing;

e) identification of the three mutually perpendicular axes with origin at the centre of gravity of the unit to be isolated under conditions of preferred orientation; orientation of the axes with respect to the equipment shall be given by dimensions;

f) the normal equipment orientation with respect to the vertical. The direction of major shock or vibration shall be indicated. Special or unusual orientations, such as changes in attitude, shall be indicated. Feasible

structural attachment points shall be given. These points frequently determine the isolation system in relation to attitude, centre of gravity, etc.

4.1.2.3 Isolator load characteristics

a) The maximum and minimum weights[1] (expressed in newtons) under operating conditions of the equipment shall be given.

b) The maximum permissible weight[1] of the isolator shall be indicated, where applicable.

c) The method of obtaining the total weight[1] shall be indicated (i.e. estimate, calculation, or test).

4.1.2.4 Moments of inertia and products of inertia

The moments of inertia and the products of inertia about the three axes defined in 4.1.2.2 and the method of obtaining the moments and products shall be given (i.e. estimate, calculation, or test). Inertia effects of attachments such as piping, cables, or attached accessories shall be included.

4.1.2.5 Natural frequencies

The natural frequencies and/or resonance frequencies of major or fragile parts of the equipment and any known information on the primary resonant modes of the equipment shall be given.

4.1.2.6 Equipment description

A statement shall be made describing the equipment. Fragile parts, extremely heavy parts, special tubes, etc., shall be called to the attention of the isolator manufacturer.

4.1.2.7 Special requirements

Special features peculiar to the equipment shall be covered in the equipment description and by drawings. Among such special features are :

a) electrical connectors, tubing, or piping which might modify the mechanical response of the mounting system (type, size, stiffness, etc. shall be indicated);

b) externally applied forces and moments;

c) required access areas;

d) minimum clearance required for cooling air flow; any temperature gradients which might adversely affect isolator operation shall be shown on the drawing, and the probable temperature range given;

e) maximum clearance between equipment and foundation, where applicable;

f) applicable stress data.

1) The indication of "weight" is usable for normal earth applications. In the case of zero-gravity or other special applications, the indication of "mass" may be preferable.

4.1.2.8 Electrical features

Provisions for grounding and applicable specifications shall be indicated on the drawing, by an attached note.

4.1.2.9 Special requirements for mechanical stability

Special requirements shall be given. For example, special care is needed where equipment with a high or variable centre of gravity is supported by isolators located below the centre of gravity, or where uncompensated side thrusts exist.

4.1.3 *Data on supporting structure*

4.1.3.1 Nature of the supporting structure

A description of the supporting structure, and a general description, shall be given both from static and dynamic points of view.

4.1.3.2 Space envelope

The preferred space envelope showing the available space for displacement of the isolated equipment shall be shown by a drawing. Allowable forces at points of attachment, of cables, piping, etc., where applicable, shall be given.

4.1.4 *Environmental data*

All available detailed information concerning the vibration and shock environment and/or applicable test specification shall be given. For example, it would be sufficient if the user could supply complete and accurate data on the vibration at the point of attachment. In case such complete information cannot be supplied, the user shall indicate the source of excitation, such as : reciprocating engines, turbines and compressors, motors and generators, ship's propeller, etc.

4.1.4.1 Vibration

The vibration shall be described by the frequency and, with respect to the three axes of 4.1.2.2 e) above, by the amplitude (displacement, velocity, acceleration or force), or, for random vibrations, in terms of power spectral density, bandwidth or other descriptive parameters, and the duration over which this will occur.

4.1.4.2 Shock

The shock shall be described in terms of a shock spectrum or shock pulse shape including peak value, duration, and whether repetitive.

4.1.4.3 Constant accelerations

The magnitude and direction of any constant accelerations shall be given together with the duration. Special considerations such as zero-gravity shall be included.

4.1.4.4 Climatic environment

The user shall supply, as applicable, the following information on the climatic environment during transportation, storage and use :

a) the upper and lower temperature limits;

b) altitude;

c) humidity, presence of sand and dust, salt spray, ozone, oils, solvents, radiation, etc. .

4.1.4.5 Supplementary information

The user shall supply, as applicable, supplementary information concerning transportation, storage, and use.

4.2 Information supplied by the manufacturer

The manufacturer shall supply the following information as applicable to ensure proper use of the isolators :

4.2.1 *Physical data*

4.2.1.1 Drawing

A drawing shall be furnished by the manufacturer showing the following characteristics of his isolator as applicable :

a) overall dimensions;

b) location and size of mounting holes and studs;

c) loading displacements including installation clearance for

1) minimum load,

2) maximum load,

3) overload,

4) zero load;

d) materials in isolators;

e) weight [1] of isolator;

f) direction of loading and restrictions on loading;

g) recommended load range (minimum, maximum);

h) levelling features;

i) recommended arrangement position in typical installations.

4.2.1.2 Special features

The manufacturer shall describe special features of the isolators. The following shall be included :

a) snubbers (auxiliary devices or alternative designs);

b) dampers (auxiliary devices or alternative designs);

c) recommended blocking for transport;

d) recommended field of use : aircraft, satellites, shipboard, cross-country vehicles, machine tools, buildings, etc.;

e) special adaptations (designed to meet certain requirements such as extreme temperatures, nuclear radiation, corrosive fluids, sound isolation features, etc.).

4.2.1.3 Designation

The manufacturer shall describe his method of designating and specifying his isolators, (i.e. annotate any system used for model, type, and part numbers).

4.2.2 *Performance data*

4.2.2.1 Static stiffness

The manufacturer shall describe the translational and rotational static stiffness characteristics of his isolators in three principal directions as applicable. The environmental conditions under which the load-deflection data were obtained shall be described and tolerance limits given. (See also 4.2.3.)

4.2.2.2 Dynamic behaviour

The manufacturer shall describe the translational and rotational dynamic behaviour of his isolator in terms of dynamic stiffness. However, where necessary, as an alternative, the manufacturer may describe dynamic behaviour by transmissibility characteristics measured in a testing system which is fully described. Dynamic behaviour may be related to variations in the following input parameters :

a) frequency (frequency range);

NOTE – For shock, the rate of load application or removal.

b) amplitude;

c) load;

d) temperature.

4.2.2.3 Damping

The manufacturer shall describe the damping characteristics of his isolators in three principal directions, indicating applicable frequencies.

4.2.2.4 Durability

The manufacturer shall present such information on durability as :

a) endurance limit associated with repeated deflections and shocks;

1) See Note, page 3.