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BSI Standards Publication

Mechanical vibration and shock — Resilient mounting systems

Part 3: Technical information to be exchanged for application of vibration isolation to new buildings

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National foreword

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Part 3: Technical information to be exchanged for application of vibration isolation to new buildings

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 108, *Mechanical vibration, shock and condition monitoring*.

ISO 2017 consists of the following parts, under the general title *Mechanical vibration and shock — Resilient mounting systems*:

— *Part 1: Technical information to be exchanged for the application of isolation systems*

— *Part 2: Technical information to be exchanged for the application of vibration isolation associated with railway systems*

— *Part 3: Technical information to be exchanged for application of vibration isolation to new buildings*

Introduction

Some suppliers of shock and vibration isolators (resilient mounts) have experience covering a wide variety of applications. In most instances, they are willing to use their background information for solving the user's isolation problems. However, it is frequently difficult for the supplier to provide this service, because the customer, the user, or the producer of vibration source or receiver has not furnished sufficient information regarding the application.

On the other hand, the user (architect and construction operator) is sometimes handicapped in applying isolators properly because sufficient technical information is not furnished by the supplier. Consequently, the user will often conduct his own experimental evaluation of the isolator and may unknowingly duplicate work already carried out by the supplier.

This part of ISO 2017 is intended to serve as guide for the exchange of technical information regarding the application for vibrations and shocks isolation of buildings, between the customer and the supplier of resilient devices as required for their proper application.

For the purposes of this part of ISO 2017, a resilient device is defined as a flexible element or system used between the building and its supporting structure to attenuate the transmission of shock or vibration from the surrounding sources to the building.

INTERNATIONAL STANDARD **ISO 2017-3:2015(E)**

Mechanical vibration and shock — Resilient mounting systems —

Part 3: Technical information to be exchanged for application of vibration isolation to new buildings

1 Scope

This part of ISO 2017 establishes requirements to ensure appropriate exchange of information regarding the application of isolation of buildings from vibrations and shocks generated by man-made sources.

This part of ISO 2017 is applicable only during the design and construction of new buildings in areas affected by important vibrations which can be generated by single or multiple sources (railways, traffic, industrial activity, etc.) The isolation of these buildings serves to ensure the integrity of the structure and equipment inside (including sensitive equipment) and human comfort.

This part of ISO 2017 specifies the information to be exchanged between building owner, customer, and vibration isolation supplier. It gives appropriate responses to questions highlighted by the producer and user (why, what, when, and how to isolate mechanical systems).

This part of ISO 2017 does not include earthquake and wind-generated forces.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 2631-2, *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 2: Vibration in buildings (1 Hz to 80 Hz)*

ISO 4866, *Mechanical vibration and shock — Vibration of fixed structures — Guidelines for the measurement of vibrations and evaluation of their effects on structures*

ISO 7626-1, *Vibration and shock — Experimental determination of mechanical mobility — Part 1: Basic terms and definitions and transducer specification*

ISO 9688, *Mechanical vibration and shock — Analytical methods of assessing shock resistance of mechanical systems — Information exchange between suppliers and users of analyses*

ISO 10815, *Mechanical vibration — Measurement of vibration generated internally in railway tunnels by the passage of trains*

ISO 10846-1, *Acoustics and vibration — Laboratory measurement of vibro-acoustic transfer properties of resilient elements — Part 1: Principles and guidelines*

ISO 14837-1, *Mechanical vibration — Ground-borne noise and vibration arising from rail systems — Part 1: General guidance*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041, ISO 7626-1, ISO 9688, ISO 10846-1, and ISO 14837-1 and the following apply.

3.1
vibration receiver
all structures or elements of structures responding to vibration energy emitted by an external source

[SOURCE: ISO 2017-1:2005, 3.3]

3.2
customer
user or purchaser of a product (building)

[SOURCE: ISO 2017-1:2005, 3.4, modified]

3.3
producer
party constructing the product that needs to be isolated from vibrations and which the *customer* (3.2) agrees to purchase

[SOURCE: ISO 2017-2:2007, 3.4, modified]

3.4
isolation supplier
party responsible for providing and installing an isolation system that will meet the requirements to reduce vibration as agreed upon with the *customer* (3.2) who agrees to purchase

Note 1 to entry: In certain cases, the producer and the supplier may be the same party.

Note 2 to entry: The customer, the producer, or the supplier may each mandate subcontractors to execute the work or to purchase elements.

[SOURCE: ISO 2017-1:2005, 3.6, modified]

3.5
base isolation
item or support arrangements that secure a structure to its supporting ground and provide protection from shock and/or vibration

[SOURCE: ISO 2017-2:2007, 3.6]

4 Purpose of vibration isolation (why isolate mechanical systems)

The purpose of vibration isolation is to reduce the vibrations and shocks felt by people, structures, and mechanical systems by taking action between the source and the receiver. In the case of high magnitude environmental vibrations, the purpose may include the assurance of the following:

a) structural integrity of new buildings;

b) comfort of people in temporary or permanent structures that may be subject to the vibration excitation;

c) functionality of sensitive equipment in these structures;

d) conformity with local, regional, and national requirements, if any.

5 What is to be isolated

Generally, it is desirable to isolate the vibration source. When it is impossible or if the results of such isolation are not satisfactory, then isolation is applied to the building (receiver), in most cases a new building. Sometimes, it is an economical compromise. It may concern new structures (bridges, towers, etc.) or elements of structures in the neighbourhood of a vibration source, which may include sensitive buildings (music halls, laboratories, or sensitive installations).

6 Applicability of vibration isolation (when to isolate structures or mechanical systems)

In urban areas, underground, over-ground or elevated railways, and industrial plants produce vibration and structure-borne noise that can cause problems, including the following:

a) effects of ground-borne vibration on the integrity of building structures;

b) perception of ground-borne vibration by human occupants;

c) perception of re-radiated noise (25 Hz to 500 Hz) by occupants;

d) interfering effects of re-radiated noise on the activity purpose of the building (cinema, music hall);

e) damaging effects of vibration on sensitive equipment inside a building.

When new structures or buildings are to be located near an existing source, structural isolation is necessary.

A vibration isolation system shall be used in addition to other design measures for reducing vibration.

7 Measurement and evaluation of vibration conditions (how to isolate)

In order to choose and design an adequate isolation mounting system, it is necessary to analyze the dynamic properties of the structure of the building to be constructed and to make prior measurements and evaluation of vibration (levels, frequency range, and duration) at the site of the construction.

Measurements and related analysis shall be made under the environmental conditions relevant for the location of the source and shall conform to the requirements given in ISO 4866. The measurements and analysis help in providing an understanding of the origin of the vibration problem and its parameters.

These measurements and related analysis shall be used for the estimation of the maximum vibration level at the future foundation emplacement when designing a new building to be constructed on the site. This estimation shall be made in accordance with an appropriate International Standard (ISO 2631-2, ISO 4866, or ISO 10815) and the standard shall be identified.

The measuring position can be defined in a contract. The mounting points of transducers and directions of measurements shall be reported. These measurements shall include time history monitoring for a sufficiently long period to cover activities to be considered as the source of vibration.

Analysis of frequency responses on the site will help to avoid coincidence between dominant frequencies of the source and the natural frequencies of a future structure or one of its elements.

8 Information for the choice of an isolation mounting system

Isolators for use in base isolation applications in buildings are commonly formed using steel coil springs or made from natural/synthetic rubber or other composites. The possibility of using other types cannot be excluded.

The location chosen for the isolators depends upon many factors such as areas to be isolated, other connection paths, the dynamic characteristics of the isolated building, and practicalities of providing access for inspection and replacement, where necessary.

In order to select appropriate isolators and to correctly fit the isolation, exchange of information is needed amongst the owner, the user, and the supplier of the isolator. Clauses 9 and 10 list the information required for an optimized isolation.

The choice of the isolation system shall take into consideration not only the static characteristics of the structure to be isolated but also its dynamic characteristics as described in 10.3. It will often be necessary for the supplier of a vibration isolation system to ask for more detailed information from the owner and user in order to provide the best possible solution.

Qualified professional acoustical and structural engineers should be consulted to obtain the necessary information. Close coordination is required amongst the following:

a) supplier of the isolation;

b) owners of structures and sensitive equipment;

c) project construction contractor;

d) acoustical and structural engineers.

9 Information to be supplied by the owner of the project

9.1 Building

The following information shall be provided by the owner, with the help of consultants and engineers:

a) site investigation reports that provide geology of the site (ground conditions, soil properties, depth and location of the underground water table and water sources);

b) a drawing of the structure, detailing the nature, (steel, concrete, combined), the depth, the dimensions and the position of the bearing elements (foundation or footings), the centre of gravity of the building;

c) the load-deflection data (uniform-non uniform), normal and or shearing loads, the distribution and load on the bearings of the building;

d) the position of the foundation in relation to the position of vibration sources (train tunnels, roads, or industrial plants);

e) function of the future building (offices, laboratories, habitation, manufacturing of particular equipment, or music hall);

f) maximum admissible vibration level for people, structural elements, and equipment;

g) a site plan indicating the applicable structures or buildings and vibration sources;

h) description of vibration measurements, including transducer locations, equipment used, description of sources measured, and results of measurements.

9.2 Sensitive equipment

When sensitive equipment will be located in the building, the following information shall be provided:

a) the type of equipment;

b) the type of structure in which the equipment is mounted;

c) the location of the equipment in the structure;

d) data on the supporting structure (natural frequencies, etc.);

e) criteria for acceptance of isolation efficiency.

The producer of sensitive equipment shall supply the following information to help the user to choose the best location to set up the equipment:

a) the overall dimensions;

b) the total mass and the position of the centre of gravity;

c) feasible structure attachment points (three points frequently determine the isolation system);

d) acceptable vibration level measured at the base of the equipment;

e) particular natural frequency to be avoided at the equipment base.

10 Information to be provided by the supplier of the isolation system

10.1 Performance of isolation system

The contract established between the supplier and user of the isolation system shall specify the performance of the isolation system and the criteria for the output level measured after reduction of vibration by the isolation system. This shall be validated according to Clause 11.

10.2 Physical data of the isolation system

The supplier of the isolation system shall provide detailed information on the following characteristics of the isolation system:

a) type of isolation system;

b) materials of the isolation system including potential for degradation from exposure to the environment or contaminants;

c) mass of the isolation system;

d) levelling features;

e) static and dynamic stiffness of isolators;

f) maximum and minimum weight forces under operation conditions;

g) dimensions, structure, mass, location, and orientation of the isolation system (e.g. drawing), including any intermediate structure;

h) creep of isolators relative to load and time;

i) special requirements for air mounted systems;

j) fire behaviour, flammability and risk of dangerous gas generation.

10.3 Dynamic behaviour

The supplier shall describe the translational and rotational dynamic behaviour of the isolation system in terms of dynamic stiffness. The environmental conditions (temperature and humidity) and the frequency of dynamic stiffness under which the load-deflection data were obtained shall be described and tolerances shall be given. The supplier shall also confirm that the load deflections are in the normal direction and spatially uniform or describe the dynamic behaviour with frequency-dependent

transmissibility characteristics measured in temperature and frequency ranges in a testing set-up which is fully described. Dynamic behaviour can be related to variations in the following parameters:

a) frequency characteristics of transmissibility, including resonance, of the isolation system as a function of load;

b) magnitude of input vibration;

c) temperature and humidity;

d) damping: dynamic stiffness and linear damping coefficient for the direction (orientation and frequency range of interest; see ISO 10846-1).

The supplier shall describe the efficiency of isolation in the three principal directions, indicating applicable frequencies.

10.4 Durability

The supplier shall present the following information on durability (the change of the physical characteristics) as:

a) endurance limit associated with repeated deflections and shocks;

b) creep (permanent deformation) data, where applicable, and how the data have been obtained;

c) ageing effects due to storage in specified environments, including maximum and minimum temperatures;

d) maximum displacement permissible before restraint is required;

e) vibration isolation maintenance programme.

10.5 Environmental data

The supplier shall supply the following information on the isolators as necessary to ensure proper use:

a) the upper and lower temperature limits beyond or below which the isolator, under rated loads, will not properly perform its function or will undergo permanent changes in characteristics;

b) the ability of the isolator to withstand corrosion or deterioration caused by such factors as humidity, water, salt spray, fungus, ozone, oils and fuels, corrosive vapours, sunshine, etc.;

c) the ability to perform under adverse conditions, for example, in an atmosphere loaded with sand or dust;

d) the permissible storage environment.

10.6 Maintenance data

The supplier shall supply details of any maintenance, periodic inspection, and service requirements.

11 Validation of isolation performance

Normally, the supplier of isolating systems has a contractual or guarantee requirement to prove the performance of vibration isolation of the building. If required, this performance shall be evaluated by an experimental method, including the following:

a) prediction, measurement and the evaluation of vibration, in accordance with ISO 4866, by an independent specialist before installation;

b) definition of vibration limit values that were accepted contractually by the supplier;

c) establishing and reporting measurement positions, directions, and conditions;

d) after construction, vibration monitoring at reported positions;

e) comparing the measured values with the contractual limit values to validate the performance.

As in Clause 7, acceptable limit values should be defined contractually between the user and the supplier. After correction, measurements should be carried out as described in Clause 7. The results should be compared with the contractual values.

In more complex situations, more detailed measurements will be required.

Bibliography

[1] ISO 2017-1, *Mechanical vibration and shock — Resilient mounting systems — Part 1: Technical information to be exchanged for the application of isolation systems*

[2] ISO 2017-2, *Mechanical vibration and shock — Resilient mounting systems — Part 2:Technical information to be exchanged for the application of vibration isolation associated with railways*

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