108

INTERNATIONAL STANDARD

ISO 8569

First edition
1989-12-01

Mechanical vibration — Shock-and-vibration-sensitive electronic equipment — Methods of measurement and reporting data of shock and vibration effects in buildings

Vibrations mécaniques — Équipements électroniques sensibles aux chocs et aux vibrations — Méthodes de mesurage et de présentation de données relatives aux effets des chocs et des vibrations dans les bâtiments

Reference number
ISO 8569 : 1989 (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 approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8569 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock.*

Annexes A to D of this International Standard are for information only.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Printed in Switzerland

Introduction

This International Standard is intended to give provisional guidelines for the measurement and evaluation of shock and vibration affecting shock-and-vibration-sensitive electronic equipment.

To facilitate the comparison of data (for example the comparison of shock and vibration levels measured in different countries on equipment from different manufacturers) a database reporting system is considered. The reporting system presented will aid in the establishment of limit levels for specific equipment.

Further information regarding the methods of measurement and evaluation is given in annexes A, B and C.

Mechanical vibration — Shock-and-vibration-sensitive electronic equipment — Methods of measurement and reporting data of shock and vibration effects in buildings

1 Scope

1.1 This International Standard defines methods of measuring and reporting shock and vibration data for shock-and-vibration-sensitive electronic equipment (in the operating and non-operating modes) in buildings. The shock and vibration data obtained may then be used to establish a database.

Electronic components are not dealt with in this International Standard.

The types of shock and vibration considered are those transmitted from floors, tables, walls or ceilings into an equipment unit. The vibration and shock of individual mechanical or electronic parts inside the unit are not considered.

1.2 The database established using the methods described in this International Standard should serve as a guide for constructors, users, suppliers and manufacturers of shock-and-vibration-sensitive electronic equipment. The types of equipment envisaged include

a) commercial stationary computer systems (including the peripherals);

b) commercial stationary telecommunication equipment;

c) commercial stationary laboratory electronic instruments, such as electron microscopes, mass spectrometers, gas chromatographs, lasers, X-ray apparatus and electronic apparatus of general character.

Whenever possible it is recommended that the vibration and shock is measured with the sensitive equipment in both the operating and the non-operating mode in order to distinguish between the various possible sources. The types of shock and vibration considered herein can be generated by:

a) external sources, for example traffic or building and construction activities such as blasting, piling and vibratory compaction (sonic booms and acoustic excitations are also included);

b) equipment for indoor use, such as punch presses, forging hammers, rotary equipment (air compressors, air conditioners, pumps, etc.) and heavy equipment transported or operated inside a building;

c) natural sources, such as earthquakes, water and wind;

d) human activities in connection with the service or operation of equipment.

The frequency range of interest is 0,1 Hz to 1 000 Hz. (The frequency range of interest for earthquake-induced vibrations is 0,1 Hz to 35 Hz.)

The vibration levels of interest, expressed in terms of acceleration values, are in the range from 0,01 m/s^2 to 250 m/s^2. The upper limit may be produced by high-frequency vibrations or shocks. Limits for low-frequency vibrations are normally expressed in terms of displacement. The durations considered for shocks are in the range 0,5 ms to 25 ms.

Blasting induces a complex vibration wave-form. The response of buildings to such a vibration is in the frequency range from about 5 Hz to 300 Hz.

The vibration levels of interest for transient vibration from blasting are given for information in annex A.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were 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 editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4866 : —[1)], *Mechanical vibration and shock — Measurement and evaluation of vibration effects on buildings — Guidelines for the use of basic standard methods.*

ISO 5348 : 1987, *Mechanical vibration and shock — Mechanical mounting of accelerometers.*

3 Methods of measurement

3.1 Preliminary assessment

Situations may arise where an assessment of shock and vibration problems has to be made by desk study alone, i.e. usually before field measurements are carried out. Empirical methods can be used to estimate the response, given data on the source parameters and building and/or equipment response characteristics such as fundamental frequency and damping.

1) To be published.

3.2 Field survey

A field survey should be made in order to assess the vibration severity, often in comparison with coded or regulatory values. The minimum requirement for measurement is that the shock or vibration is characterized by a continuous registration of the peak particle velocity values and/or the peak acceleration values with the assumption that the base frequency content can be estimated fairly precisely. Frequency information should be provided whenever possible to aid in the analysis.

Measurements should be of an accuracy compatible with the uncertainties implicit in the shock and vibration indices and empirical relationship used.

3.3 Engineering analysis

In order to determine the vibration and shock conditions to which equipment may be exposed, accurate and comprehensive measurements in the field shall be made. The time history shall be recorded for analysis. The measurement should be made with the shock-and-vibration-sensitive equipment, or with a dummy having the same mass and similar dynamic behaviour as those of the equipment under consideration, in place. The effective mass of the equipment on raised floors or tables may significantly change the input levels and frequencies. If the "dynamic mass" of the equipment is very small, for example as for a personal computer, it has no influence on the behaviour of the floor.

Also, the equipment itself may generate vibration which produces excitation in other units in the immediate area.

Annex B gives further information regarding the instrumentation and analysis methods required to obtain the data necessary to quantify adequately the vibration and shock conditions.

3.4 Position and mounting

The pick-ups should be mounted at a maximum distance of 0,05 m from the points of contact of the equipment with a floor or wall. If there is a soft covering (for example a rug) on the floor, the pick-up should be mounted on the floor under the covering whenever possible. When the floor is not rigid enough to transmit the frequency under consideration without significant attenuation, the mounting should be on the equipment itself (for example at the lower part of the frame, close to the caster or glide or other support).

Preliminary measurements should be made to determine the input variation among the supports between the equipment and the supporting surface. The data recorded and reported should show the worst case and the best case and whether there are significant variations. Portable r.m.s. or peak-reading accelerometers (see ISO 5348) or their equivalent may be used to carry out the preliminary measurements. The effect of the pick-up mounting system on the accuracy of the data should be evaluated and included with the reported data.

If an orthogonal system of pick-ups is used, the axes should coincide with the axes of the equipment unit being monitored.

The pick-ups and cables should be attached to the measuring point in such a way that accurate results are obtained over the total frequency range of interest. Epoxy cement or cyanoacrylate cement or studs are preferred means of attachment. Magnets, thin double-sided adhesive tape or beeswax may be used only if they transmit signals with an error of less than 10 % over the frequency range of interest (see B.5.4).

4 Database reporting system

For the various types of investigation, as described in 3.2 and 3.3, the reporting method should be as consistent as possible. For field surveys (3.2) it may be sufficient to record the peak velocity or acceleration values and information about the mounting method and mounting place together with the normal reporting method for the survey of buildings subjected to vibration and shock (see ISO 4866). For engineering analysis (3.3), it is desirable to collect and report data according to the method given in annex C. The proposed format for reporting data will aid in the establishment of future threshold levels for shock-and-vibration-sensitive equipment.

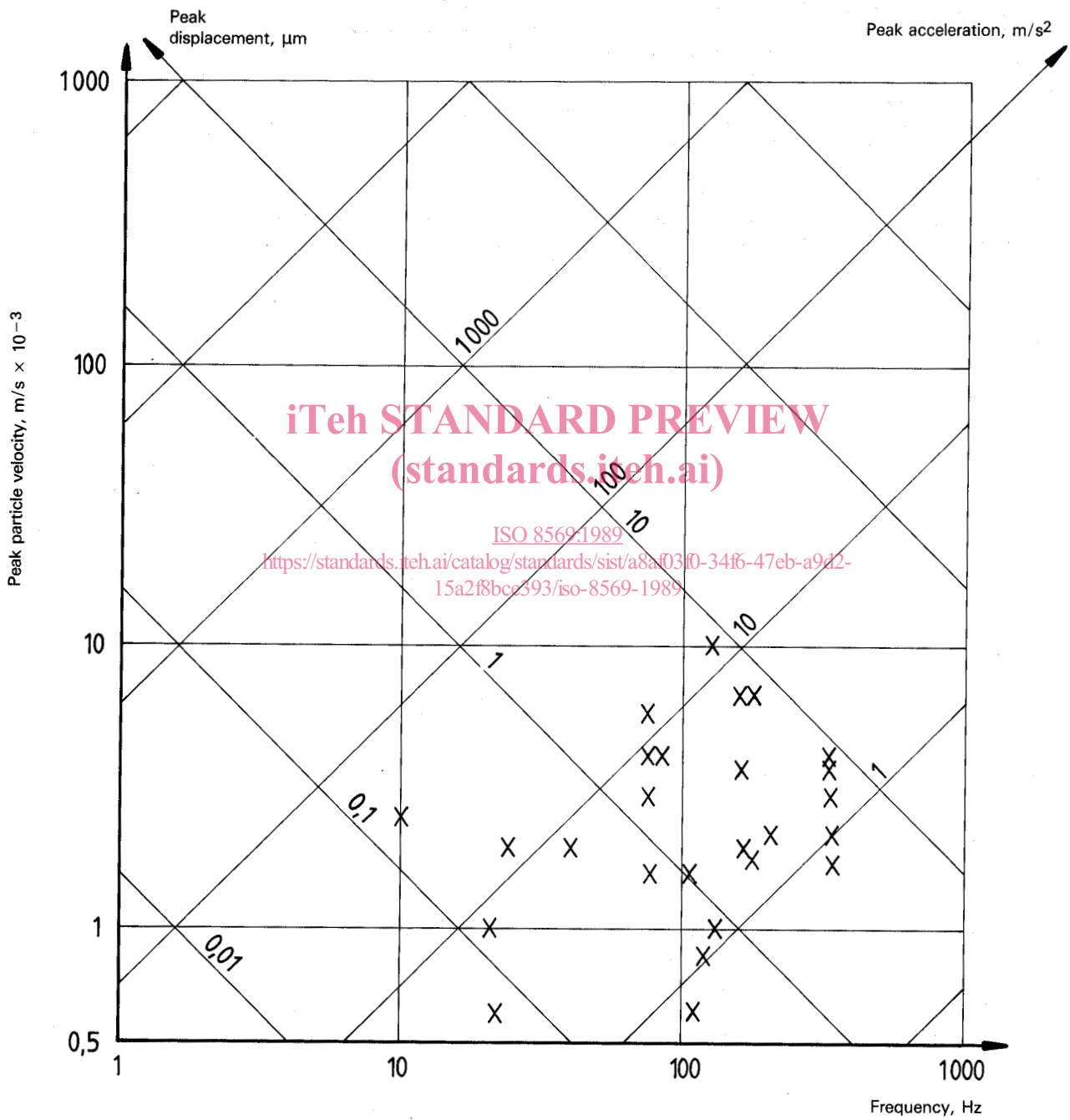
Annex A
(informative)

Examples of typical vibration values due to blasting

The rapid introduction of shock-and-vibration-sensitive equipment and their accessories has become a problem for the building construction industry. Manufacturers of accessories prescribe very low maximum vibration values for their equipment. As a result, the building construction industry is often limited in its choice of methods for excavation and improvement of the ground for foundation work in areas near existing sensitive equipment.

An investigation[1] has been carried out to investigate the guidelines and shock and vibration criteria proposed by manufacturers, suppliers and users of shock-and-vibration-sensitive electronic equipment, such as computers, disc drives and telephone switches.

Figure A.1 shows some typical vibration values measured during construction work where blasting was taking place. The points of measurement were situated on a computer frame or on the floor close to a computer. The peak particle velocity (or acceleration) is plotted as a function of the dominant frequency.



NOTE — Measurements were made on the frame of or on the floor close to a computer

Figure A.1 — Typical vibration values caused by blasting

Annex B
(informative)

Guidelines for an engineering analysis type of investigation of vibration and shock conditions

B.1 Objective

The objective is to establish a common database for collecting, recording and analysing shock and vibration conditions due to construction activities and other events for shock-and-vibration-sensitive equipment.

B.2 Items to be considered

The following items should be considered:

a) the parameters to be measured;

b) the data and information to be recorded for analysis;

c) instrumentation and measurement techniques;

d) data analysis techniques;

e) database reporting format;

f) the responsibility for co-ordinating the database information.

B.3 Parameters to be measured

B.3.1 Shock

The time history (for all three axes) should be recorded and should include the following measurements:

a) acceleration or velocity variation, including

1) the maximum values,

2) the average values over their time of occurrence,

3) the distribution of the maximum and average values;

b) duration;

c) pulse shape;

d) repetition rate, if applicable.

B.3.2 Vibration

The time history (for all three axes) should be recorded and should include the following measurements:

a) acceleration or velocity variation, including

1) the maximum values,

2) the average values over their time of occurrence,

3) the distribution of the maximum and average values;

b) duration;

c) frequency analysis, including

1) the frequency range,

2) the characteristic frequencies.

B.4 Data and information to be recorded

The data and information to be recorded are as follows:

a) the parameters specified in clause B.3;

b) a description of the equipment installation, including

1) room size and layout, and site location,

2) building construction type and floor plan,

3) equipment make, machine type and age,

4) mounting of equipment (i.e. floor, table, wall; for telecommunication equipment, shimmed or not shimmed),

5) vibration isolators;

c) a definition of any equipment failures;

d) a description of the construction activity or other source of shock and vibration conditions;

e) a description of the shock-and-vibration-measuring instrumentation, including

1) instrument model and manufacturer, including calibration equipment, pick-ups, amplifiers, recorders and analysers,

2) pick-up location and directions of axes,

3) pick-up, including cable and mounting,

4) frequency response.