INTERNATIONAL STANDARD

ISO 14964

First edition
2000-09-01

Mechanical vibration and shock — Vibration of stationary structures — Specific requirements for quality management in measurement and evaluation of vibration

Vibrations et chocs mécaniques — Vibrations des structures fixes — Exigences spécifiques pour le management de la qualité dans le mesurage et l'évaluation des vibrations

Reference number
ISO 14964:2000(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14964 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock*, Subcommittee SC 2, *Measurement and evaluation of mechanical vibration and shock as applied to machines, vehicles and structures*.

Annex A of this International Standard is for information only.

Introduction

In order to accomplish its objective, a body which has the charge of measurement and evaluation of vibration in structures should organize itself in such a way that the technical and human factors affecting the quality of its service will be under control. The aim of such control is primarily to foresee and detect all error sources and nonconformity during different stages of the process (choice of operating method and equipment, monitoring, data processing, definition and determination of parameters).

A quality system should be developed in order to achieve optimum effectiveness and to satisfy customer expectations.

An objectively defined quality management has the following purposes:

— customer confidence;

— company development in the market place;

— accreditation;

— criteria for public authorities when designating bodies for regulatory purposes;

— selection of expert witness.

Quality standards like the ISO 9000 family of standards describe the organizational structure, responsibilities, procedures and resources that are used for implementing a quality management system.

Technical standards like ISO 2631-2 and ISO 4866 define the basic requirements and the methods to be applied in order to accomplish a successful evaluation of vibration. This may range from simple monitoring at a given position and time to research and diagnostic studies.

This International Standard is complementary to the quality standards of the ISO 9000 series. It gives guidelines for specific requirements of these series when applied to Measuring and Evaluation Bodies of stationary-structure vibration. This International Standard therefore is an interface between the technical standard ISO 4866 and quality management standards.

Specific aspects of measurement and evaluation of vibration and shock in stationary structures are as follows.

a) Measurement and evaluation of vibration in structures can be defined as a service according to ISO 8402 and ISO 9004-2, but often requires advanced expertise and, in some cases, research work.

b) The contract reviews and the relationships between the Measuring and Evaluation Body and the customer are different from those of ordinary service. In most cases the Measuring and Evaluation Body is the consultant to the customer and the contract contains only a demand for a solution without any detailed task specification.

c) If the purpose of the measurements is to evaluate the maximum responses in a complicated structure, some flexibility in the investigation procedure may be needed and allowed for in any contracted arrangement.

d) For some vibration events, the information captured cannot be formally verified as in ISO 10012-1 by a true replication (for example, explosion, demolition and some other kinds of random motion).

e) It is recognized that, within many organizations, the Measuring and Evaluation Body is composed of few persons, sometimes of only one or two, so that formal management structures and reviews may be difficult to apply.

Mechanical vibration and shock — Vibration of stationary structures — Specific requirements for quality management in measurement and evaluation of vibration

1 Scope

This International Standard gives guidelines on specific requirements of the ISO 9000 family of standards when applied to Measuring and Evaluation Bodies of stationary-structure vibration. This International Standard therefore is complementary to the quality standards of the ISO 9000 series and acts as an interface between the technical standard ISO 4866 and quality management standards.

The measurement and evaluation of vibration in structures is an important task on which may depend structure serviceability and man's comfort and/or safety. The different stages up to the final report are related to one another. In order to give confidence to the final results, it is necessary to assure the quality of execution of each stage.

This International Standard is applicable in contractual situations when certain capabilities to measure and evaluate vibration effects on structures have to be demonstrated.

This International Standard is applicable to different stages in the evaluation of vibration, as follows:

— the contract review;

— the choice of the method of investigation;

— the choice of the measuring location;

— the selection of the measuring equipment;

— the data-processing procedure;

— the elements for diagnosis.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

ISO 9000 (all parts), *Quality management and quality assurance standards.*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply. For information, terms and definitions related to quality assurance are given in annex A.

3.1
organization
company, corporation, firm, enterprise, association or consultants, whether incorporated or not, publicly or privately owned

3.2
work cycle
description and the duration of a production operation producing vibration, used in series to manufacture a product

3.3
Measuring and Evaluation Body
(M&E Body)
organization undertaking the vibration measurement and evaluation

3.4
measuring equipment
all instruments used for measuring vibration, including transducers, amplifiers, filters and data-acquisition units

3.5
measurement
set of operations having the objective of determining the magnitude of one or more parameters of vibration

3.6
analysis
spectrum of activities from measurement, processing, ordering, characterization rating and presentation of data in a form fit for the purpose intended, together with assessment

3.7
evaluation
comparison with other related data or other authorized evaluation values which may, depending upon the type of survey (see ISO 4866), progress to diagnostics and severity judgements and review whether or not the measurement was carried out under appropriate conditions

3.8
accreditation
formal recognition of the Measuring and Evaluation Body that it is competent to carry out the relevant type of measurement and evaluation of vibration

3.9
accreditation criteria
set of requirements that are used by an accreditation body, to be fulfilled by a Measuring and Evaluation Body in order to be accredited

3.10
vibration source
simple or multiple solid, liquid or gaseous body causing vibration in its environment

NOTE This covers sources such as machinery, traffic, explosions, wave loading and wind loading.

3.11
vibration receiver
all structures or elements of structures responding to vibration energy emitted by an internal or external source

4 Requirements for a quality system

4.1 General

In order to diagnose and find a solution for a vibration problem, a vibration-evaluation project becomes a task that needs the cooperation of different parties: a designer and constructor of buildings, machines or sensitive equipment; a manufacturer of isolation systems; those responsible for industrial plants; and specialized laboratories for vibration measurement and evaluation.

A vibration measurement and evaluation project may include the following:

a) a study of effects of the vibration on existing structures; this vibration may originate from an industrial plant, quarry activities, rail and road traffic, or construction activities;

b) a study and characterization of the dominant vibration in an area in order to qualify it before any engagement for a future project;

c) a study and characterization of the dominant vibration in order to provide recommendations for improvement of the vibration source;

d) a study of the vibration in order to design the isolation of the vibration source (e.g. machines, railway tracks) or the receiver (e.g. buildings, sensitive equipment) or counter measures in the vibration propagation path;

e) identification of the characteristics and performances of vibration-isolation systems;

f) an analysis of the building vibration and associated phenomena produced by it in order to assess human complaints;

g) the planning and design of systematic measurements for research programmes.

The M&E Body shall operate a quality system according to appropriate quality standards for the phases of work performed. The elements of this system shall be documented in a quality manual which is available for use by the personnel. The establishment of this quality system shall take into consideration the requirements given in 4.2 to 4.9.

4.2 Legal identity

The M&E Body shall be legally identifiable. This shall be declared or noted on relevant documentation.

4.3 Impartiality, independence and integrity

The vibration M&E Body and its personnel shall be free from any commercial, financial or other pressure which might influence their technical judgement.

The M&E Body shall not be engaged in any activity that may compromise its independence of judgement and integrity in relation to its activities.

Where vibration arises from a company's activities and is measured and evaluated by an internal body, such a body may not be regarded as independent unless the work is endorsed by an independent assessor.

The remuneration of the M&E personnel engaged in tests shall not depend on the outcome of the investigation.

4.4 Contract review

Quality planning shall take into account the following realities.

a) If the client knows that there is a vibration problem, he asks for the necessary analysis in order to find a solution; it is frequently not possible to define a contractual measurement programme in the client's order.

b) In many cases (e.g. vibration of industrial plants) the M&E Body needs the assistance of those responsible for the source to appreciate the work system and work cycle while elaborating the investigation programmes.

c) For many sources whose time of occurrence may not be predictable, the time and duration of measurement cannot be specified in advance in any contract or brief and may have to be established on site.

d) In the case of a full investigation, the number and location of vibration measuring points may be modified according to observations and may not be specified in any contract.

e) The M&E Body shall provide indications of the level of confidence it has in its measurements and results.

The M&E Body shall provide expert advice based on measurements made by persons familiar with the methods and procedures, the objectives of the measurement and the assessment of the results. Only such persons may discuss the project with the client and define the vibration problem and make such modifications to the programme and procedure as are appropriate. All such modifications shall be documented and shall be disclosed to the client.

4.5 Choice of method of investigation

The methods of investigation depend upon the objectives of the investigation, the source, the receiver and the nature of the elements between them (the vibration path).

Technical parameters, like sampling rates, duration of recording, number of records, must be defined according to the type of investigation to assure the quality of the results.

The investigation of ground-borne vibration necessitates consideration of all relevant geotechnical aspects of the site.

The measurement at the source (e.g. beside railway tracks or in a tunnel) may contribute significally in understanding the vibration propagation and the transfer functions.

If the investigation concerns the protection of sensitive equipment near a vibration source, the investigation may start by establishing the vibration conditions under which the equipment has been operating prior to source actions, then comparing these magnitudes with the limit values given by the manufacturer of the sensitive equipment.

If the task is to determine the efficiency of an isolation system for a building, a machine or a piece of sensitive equipment, the method of investigation will be different. The investigation should establish that the response of other non-isolated elements does not interfere with the vibration of isolated elements.

In the case of preventative controls where temporary activities (e.g. vibration from piling) threaten a building, the investigation may require a real-time measuring and alarm system to avoid any damage to the structure or the installation.

A quality management system must take into account the capabilities of persons making measurements and responding to different aspects of the problem.

4.6 Choice of equipment

The basis of quality management is the recognition that there is no universal equipment that can be used in all vibration applications. The quality system must consider the responsibility for decisions about the measuring equipment according to the scope and nature of the investigation and the investigated structure. The elements of choice are the following.

a) Category of the transducer:

— the selection of a vibration transducer depends upon the frequency range and the amplitude to be measured, the nature of the support (bearer of the transducer) and the environment of the measuring locations (e.g. temperature, humidity);

— the sensitivity and resolution (lowest value) of the transducer shall be considered when investigating low-vibration effects, especially when they concern complaints from people;

— saturation (highest values) shall be considered when monitoring high vibration and shocks;

— vibration transducers should be adapted to provide a flat response (within ± 1 dB) over the frequency range of interest and to compensate for magnification at the natural frequency of the transducer; the effective frequency range and phase characteristics shall be addressed;

— if the chosen transducer gives an output simply related to the vibration parameter used in the evaluation, the quality procedures are simplified.

b) Choice of field recording system:

— the preferred measurement technique is one which records raw time histories from which any desired value can be determined later (see, for example, ISO 2631-2);

— the characteristics of anti-aliasing filters shall be stated;

— visual records are required for some one-time and some unusual events;

— in some cases automatic monitoring can be used to collect representative data or to prevent damage to the receiver; such a system needs to incorporate teletransmission and alarm capability and the choice of the vibration threshold is very important to avoid spurious alarms or loss of control;

— quality management can be enhanced if pre-processing of raw data is performed on site with the aim of checking data quality, but raw data shall also be recorded and stored.

4.7 Data-processing procedure

The staff or person in charge of processing should understand the purpose of the task. They shall not only be competent for the analysis, but are also required to have sufficient knowledge of the responses of the structure. The basis of quality management is to recognize that the processing procedure which belongs to the evaluation depends upon

— the data obtained, and

— the scope of the measuring and evaluation task.

This is the reason why the pre-processing on site is part of the quality procedure. No pre-processing should lead to any loss of information within the scope of the measuring and evaluation task.

4.8 Elements for diagnosis

Diagnosis can be confirmed by further measurements. The establishment of a diagnosis related to a measuring and evaluation task requires special capabilities and qualifications. The person in charge of the project often needs the assistance of the customer to exchange data relating to the source and the receiver of vibration.

4.9 Reporting

In addition to technical matters, the report should include:

— a statement on the limit of liability;

— identification of those parts which have called for the use of professional judgement.

Annex A
(informative)

Vocabulary used in quality assurance

NOTE These definitions are based on ISO 8402:1994.

A.1
quality assurance
all planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality

NOTE 1 Unless the given requirements fully reflect the needs of the user, quality assurance will not be complete.

NOTE 2 For effectiveness, quality assurance usually requires a continuing evaluation of factors that affect the adequacy of the design or specification for intended applications, as well as verifications and audits of production, installation and inspection operations. Providing confidence may involve producing evidence.

NOTE 3 Within an organization, quality assurance serves as a management tool. In contractual situations, quality assurance also serves to provide confidence in the supplier.

A.2
quality control
operational techniques and activities that are used to fulfil requirements for quality

NOTE 1 In order to avoid confusion, care should be taken to include a modifying term when referring to a sub-set of quality control such as "manufacturing quality control", or when referring to a broader concept, such as "company-wide quality control".

NOTE 2 Quality control involves operational techniques and activities aimed both at monitoring a process and at eliminating causes of unsatisfactory performance at relevant stages of the quality loop (quality spiral) in order to result in economic effectiveness.

A.3
quality loop
quality spiral
conceptual model of interacting activities that influence the quality of a product or service in the various stages, ranging from the identification of needs to the assessment of whether these needs have been satisfied

A.4
quality management
that aspect of the overall management function that determines and implements the quality policy

NOTE 1 The attainment of desired quality requires the commitment and participation of all members of the organization, whereas the responsibility for quality management belongs to top management.

NOTE 2 Quality management includes strategic planning, allocation of resources and other systematic activities for quality such as quality planning, operations and evaluations.

A.5
quality plan
document setting out the specific quality practices, resources and sequence of activities relevant to a particular product, service, contract or project

A.6
quality policy
overall quality intentions and direction of an organization as regards quality, as formally expressed by top management

NOTE The quality policy forms one element of the corporate policy and is authorized by top management.

A.7
quality system
organizational structure, responsibilities, procedures, processes and resources for implementing quality management

NOTE 1 The quality system should only be as comprehensive as needed to meet the quality objectives.

NOTE 2 For contractual, mandatory and assessment purposes, demonstration of the implementation of identified elements in the system may be required.

Bibliography

[1] 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)*.

[2] ISO 8041, *Human response to vibration — Measuring instrumentation*.

[3] ISO 8402:1994, *Quality management and quality assurance — Vocabulary*.[1)]

[4] ISO 9001, *Quality systems — Model for quality assurance in design, development, production, installation and servicing*.[1)]

[5] ISO 9002, *Quality systems — Model for quality assurance in production, installation and servicing*.[1)]

[6] ISO 9003, *Quality systems — Model for quality assurance in final inspection and test*.[1)]

[7] ISO 9004-2, *Quality management and quality system elements — Part 2: Guidelines for services*.

[8] ISO 10012-1, *Quality assurance requirements for measuring equipment — Part 1: Metrological confirmation system for measuring equipment*.

[9] ISO 10012-2, *Quality assurance for measuring equipment — Part 2: Guidelines for control of measurement processes*.

1) At the time of the publication of this International Standard, the current ISO 9000 family of Quality Management and Quality Assurance standards is being revised to form the core of the future year 2000 ISO 9000 family of standards. These revisions will include:

— the merging of ISO 9001:1994, ISO 9002:1994 and ISO 9003:1994 into a single standard ISO 9001:2000;

— the merging of ISO 8402 and part of the contents of ISO 9000-1 into a new standard ISO 9000:2000;

— the revision of ISO 9004-1 into a new standard ISO 9004:2000;

— the merger of ISO 10011 (parts 1, 2 and 3) with ISO 14010, ISO 14011 and ISO 14012 into a new guidelines standard for quality and environmental management system auditing (to be numbered ISO 19011).

The other 20 or so documents within the current ISO 9000 family of standards will also be formally reviewed by ISO Technical Committee ISO/TC 176 to determine whether they should be revised, amended or withdrawn from the ISO 9000 family in light of the above revisions.

ICS 03.120.10; 17.160.00

Price based on 8 pages