International Standard

ISO 20816-1

Mechanical vibration — Measurement and evaluation of machine vibration —

Part 1: General guidelines

Vibrations mécaniques — Mesurage et évaluation des vibrations de machines —

Partie 1: Lignes directrices générales

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

This second edition of ISO 20816-1 cancels and replaces the first edition (ISO 20816-1:2016), which has been technically revised.

The main changes are as follows:

— Introduction was shortened;

— wording in Clause 1 was aligned with ISO directives;

— references in Clause 2 were updated;

— terms in Clause 3 were added and definitions in 4.3.1 removed;

— Figure 5 and Figure 6 were updated;

— 4.8 and 4.9 were added with content from ISO/TR 19201;

— content of B.4 was deleted and merged with B.5;

— Figure C.1 was added;

— C.2 was removed;

— Annex E was added with content from ISO/TR 19201;

— wording in the document was aligned with ISO 20816-3;

— Bibliography was updated;

— document editorially revised;

A list of all parts in the ISO 10816 series and the ISO 20816 series can be found on the ISO website.

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Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document establishes general guidelines for the measurement and evaluation of mechanical machine vibration, as measured on rotating and on non-rotating parts of complete machines (e.g. shafts or bearing housings).

Recommendations for measurements and evaluation criteria pertaining to specific machine types are provided in additional parts of the ISO 20816 series as they become available as a replacement of parts of the ISO 10816 series.

For some machines, measurements made on non-rotating parts are sufficient to adequately characterize their running conditions with respect to trouble-free operation. There are also machine types (e.g. steam turbines, gas turbines and turbo compressors) which can have several modes of vibration in their operating speed range, for which measurements on the structure (e.g. bearing housings) do not always fully characterize the running condition of the machine, although such measurements are useful. Such machines generally contain flexible rotor shaft systems and changes in the vibration condition can be detected more effectively by measurements on the rotating elements. Machines having stiff and/or heavy housings in comparison to the rotor mass and/or stiffness are typical of those classes of machines for which shaft vibration measurements are often more appropriate.

Vibration measurements are used for purposes, ranging from routine operational monitoring and acceptance tests to advanced experimental testing as well as diagnostic and analytical investigations. These various measurement objectives lead to many differences in the methods of interpretation and evaluation used. To limit the number of these differences, this document is designed to provide guidelines primarily for use in operational monitoring and acceptance tests.

Three primary vibration quantities (displacement, velocity and acceleration) are defined and their advantages and disadvantages are given.

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Mechanical vibration — Measurement and evaluation of machine vibration —

Part 1: General guidelines

1 Scope

This document establishes general principles for the measurement and evaluation of vibration using measurements made on rotating or non-rotating parts of complete machines. It is applicable to vibration measurements on non-rotating parts and to both absolute and relative radial shaft vibration with regard to the monitoring of radial clearances, but does not apply to axial shaft vibration, unless otherwise stated. The evaluation criteria, which are presented in terms of both vibration magnitude and change in vibration, relate to both operational monitoring and acceptance tests. They have been provided primarily with regard to securing reliable, safe, long-term operation of the machine while minimizing any adverse effects on associated equipment. This document also gives guidance on setting operating limits.

NOTE 1 The evaluation criteria for different machine types are included in other parts of the ISO 10816 series and the ISO 20816 series.

NOTE 2 The term "shaft vibration" is used throughout the ISO 10816 series and the ISO 20816 series because, in most cases, vibration measurements are made on machine shafts. However, the ISO 10816 series and the ISO 20816 series are also applicable to measurements made on other rotating elements of the machine if such elements are found or known to be more suitable, provided that the guidelines set in this document are met.

The evaluation criteria are only applicable to the vibration produced by the machine itself and not the vibration transmitted to it from outside.

This document does not apply to torsional vibration.

NOTE 3 For information regarding the evaluation of torsional vibration, see e.g. ISO 3046-5, ISO 22266-1 or VDI 2039.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. 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 2954, *Mechanical vibration of rotating and reciprocating machinery — Requirements for instruments for measuring vibration severity*

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

ISO 10817-1, *Rotating shaft vibration measuring systems — Part 1: Relative and absolute sensing of radial vibration*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041 and the following apply.

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ISO and IEC maintain terminoly databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
shaft absolute vibration
absolute shaft vibration
vibration of rotating parts measured with respect to the absolute coordinate

3.2
shaft relative vibration
relative shaft vibration
vibration of rotating parts measured with respect to the transducer support

3.3
pedestal vibration
vibration measured on the pedestal bearing (a non-rotating part)

3.4
seismic vibration
vibration measured on a non- rotating part

3.5
dynamic stiffness of bearing
stiffness of the bearing part including damping and mass effects

3.6
dynamic stiffness of pedestal
stiffness of the bearing support structure including damping and mass effects

3.7
operational monitoring
measurements made during normal operation of a machine

4 Measurements

4.1 General

4.1.1 Overview

Clause 4 describes the measurements, procedures and operating conditions recommended for assessing machine vibration. The guidelines given enable the evaluation of vibration in accordance with the general criteria and principles given in Clause 6.

The ISO 10816 series and the ISO 20816 series enable the use of different measurement quantities and methods provided that they are well-defined and their advantages and disadvantages are set out so that the interpretation of the measurements is well-understood.

4.1.2 Vibration measurements

It is common practice to measure machine vibration on non-rotating parts or to measure shaft relative vibration, or both. The measurement type to be used for the protection system is usually based on the experience of the machine manufacturer.

4.1.3 Frequency range

Vibration measurement shall be broad-band such that the frequency spectrum of the machine is adequately covered.

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