BS ISO 20816-3:2022

BSI Standards Publication

Mechanical vibration — Measurement and evaluation of machine vibration

Part 3: Industrial machinery with a power rating above 15 kW and operating speeds between 120 r/min and 30 000 r/min

Documents
Document Sharing Hub

Full document details: BS ISO 20816-3:2022

National foreword

This British Standard is the UK implementation of ISO 20816-3:2022.

The UK participation in its preparation was entrusted to Technical Committee GME/21/5, Vibration of machines, vehicles and structures.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2022
Published by BSI Standards Limited 2022

ISBN 978 0 539 14476 5

ICS 17.160

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 October 2022.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS ISO 20816-3:2022

INTERNATIONAL STANDARD

ISO 20816-3

First edition
2022-10

Mechanical vibration — Measurement and evaluation of machine vibration

Part 3: Industrial machinery with a power rating above 15 kW and operating speeds between 120 r/min and 30 000 r/min

Vibrations mécaniques — Mesurage et évaluation des vibrations de machines —

Partie 3: Machines industrielles avec une puissance nominale supérieure à 15 kW et une vitesse de fonctionnement comprise entre 120 r/min et 30 000 r/min

Reference number
ISO 20816-3:2022(E)

Documents
Document Sharing Hub

© ISO 2022

Full document details: BS ISO 20816-3:2022

COPYRIGHT PROTECTED DOCUMENT

© ISO 2022

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO 20816-3:2022

Contents

Page

Foreword ... **iv**

Introduction ... **v**

1 Scope ... **1**

2 Normative references ... **2**

3 Terms and definitions ... **3**

4 Measurement procedures ... **3**
- 4.1 General ... 3
- 4.2 Measurement location ... 3
- 4.3 Measurement equipment ... 6
- 4.4 Continuous and non-continuous monitoring ... 7
- 4.5 Operational conditions ... 7
- 4.6 Background vibration ... 8
- 4.7 Choice of measurement type ... 8

5 Machine classification ... **9**
- 5.1 General ... 9
- 5.2 Classification according to machine type, rated power or shaft height ... 9
- 5.3 Classification according to support flexibility ... 9

6 Evaluation criteria ... **10**
- 6.1 General ... 10
- 6.2 Criterion I: Vibration magnitude ... 10
  - 6.2.1 General ... 10
  - 6.2.2 Evaluation zones ... 11
  - 6.2.3 Acceptance criteria ... 11
  - 6.2.4 Evaluation zone limits ... 11
- 6.3 Criterion II: Change in vibration magnitude ... 11
- 6.4 Evaluation during transient operation ... 12
- 6.5 Operational limits ... 12
  - 6.5.1 General ... 12
  - 6.5.2 Setting ALARM values ... 13
  - 6.5.3 Setting TRIP values ... 13
- 6.6 Supplementary procedures/criteria ... 13
- 6.7 Evaluation based on changes in vibration amplitude of specified frequency components and vibration vector information ... 13

Annex A (normative) **Evaluation criteria for vibration measured on non-rotating parts of coupled industrial machines under specified operating conditions** ... **15**

Annex B (normative) **Evaluation criteria for shaft relative vibration of coupled industrial machines under specified operating conditions** ... **17**

Annex C (informative) **Guidelines for considering the bearing clearance for the specification of evaluation criteria for shaft relative vibration of coupled industrial machines under specified operating conditions** ... **21**

Annex D (informative) **Cautionary notes about the use of vibration velocity criteria at low rotational speeds** ... **22**

Bibliography ... **24**

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO 20816-3:2022

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 specified 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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, 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 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 first edition of ISO 20816-3 cancels and replaces ISO 7919-3:2009, ISO 7919-3:2009/Amd 1:2017, ISO 10816-3:2009 and ISO 10816-3:2009/Amd 1:2017, which have been merged and editorially revised. A list of all parts in the ISO 20816 series can be found on the ISO website.

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.

© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 20816-3:2022

Introduction

This document provides specific guidance for assessing

a) the severity of vibration measured on bearings, bearing pedestals, or housings of industrial machines when measurements are made in-situ, and

b) the severity of radial shaft vibration on coupled industrial machines.

Evaluation criteria, based on previous experience, are given for use as guidelines for assessing the vibratory conditions of such machines. One criterion considers the magnitude of the observed broad-band vibration; the second considers the changes in the magnitude of the observed broad-band vibration. It should be recognized, however, that these criteria do not form the only basis for judging the severity of vibration.

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 20816-3:2022

Documents
Document Sharing Hub

Mechanical vibration — Measurement and evaluation of machine vibration —

Part 3: Industrial machinery with a power rating above 15 kW and operating speeds between 120 r/min and 30 000 r/min

1 Scope

This document specifies the general requirements for evaluating the vibration of various coupled industrial machine types with a power above 15 kW and operating speeds between 120 r/min and 30 000 r/min when measurements are made in-situ. Guidelines for applying evaluation criteria are provided for measurements taken on non-rotating and rotating parts under normal operating conditions. The guidelines are presented in terms of both steady running vibration values and in terms of changes to vibration magnitude, which can occur in these steady values. The numerical values presented are intended to serve as guidelines based on worldwide machine experience, but shall be applied with due regard to specific machine features which can cause these values to be inappropriate. In general, the condition of a machine is assessed by consideration of both the shaft vibration and the associated structural vibration, as well as specific frequency components, which do not always relate to the broadband severity values presented.

The machine types covered by this document include:

a) steam turbines and generators with outputs less than or equal to 40 MW (see Note 1 and Note 2);

b) steam turbines and generators with outputs greater than 40 MW which normally operate at speeds other than 1 500 r/min, 1 800 r/min, 3 000 r/min or 3 600 r/min (although generators seldom fall into this category) (see Note 1);

c) rotary compressors;

d) industrial gas turbines with outputs less than or equal to 3 MW (see Note 2);

e) turbofans;

f) electric motors of any type, if the coupling is flexible. When a motor is rigidly coupled to a machine type covered by any other part of ISO 20816, the motor may be assessed either against that other part or against ISO 20816-3;

g) rolls and mills;

h) conveyors;

i) variable speed couplings; and

j) blowers or fans (see Note 3).

NOTE 1 Land based steam turbines, gas turbines and generators of greater than 40 MW capacity, which run at 1 500 r/min, 1 800 r/min, 3 000 r/min or 3 600 r/min are covered by the requirements of ISO 20816-2. Generators in hydro-electric plants are covered by ISO 20816-5.

NOTE 2 Gas turbines of power greater than 3 MW are covered by ISO 20816-4.

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 20816-3:2022

NOTE 3 The vibration criteria presented in this document are generally only applicable to fans with power ratings greater than 300 kW or fans which are not flexibly supported. As and when circumstances permit, recommendations for other types of fans, including those of lightweight sheet-metal construction, will be prepared. Until these recommendations are available, classifications can be agreed between the manufacturer and the customer; using results of previous operational experience (see also ISO 14694).

Machinery including a geared stage can fall under the scope of this document. For performing acceptance tests of gearboxes please refer to ISO 20816-9.

The following types of industrial machine are not covered by this document:

k) land-based gas turbines, steam turbines and generators with power outputs greater than 40 MW and speeds of 1 500 r/min, 1 800 r/min, 3 000 r/min or 3 600 r/min (see ISO 20816-2);

l) gas turbine sets with power outputs greater than 3 MW (see ISO 20816-4);

m) machine sets in hydraulic power generating and pumping plants (see ISO 20816-5);

n) reciprocating machines and machines solidly coupled to reciprocating machines (see ISO 10816-6);

o) rotordynamic pumps and any integrated or solidly coupled electric motors where the impeller is mounted directly on the motor shaft or is rigidly attached to it (see ISO 10816-7);

p) reciprocating compressor systems (see ISO 20816-8);

q) rotary positive displacement compressors (e. g. screw compressors);

r) submerged motor-pumps; and

s) wind turbines (see ISO 10816-21).

The requirements of this document apply to in-situ broad-band vibration measurements taken on the shafts, bearings, bearing pedestals, or housings of machines under steady-state operating conditions within their nominal operating speed range. The requirements relate to both acceptance testing and operational monitoring. The evaluation criteria included in this document can be applied to both continuous and non-continuous monitoring situations.

The requirements of this document cover machines which can have gears or rolling element bearings, but do not address the diagnostic evaluation of the condition of those gears or bearings.

The requirements in this document are applicable only for the vibration produced by the machine set itself and not for vibration that is transmitted to the machine set from external sources.

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

ISO 20816-1, *Mechanical vibration — Measurement and evaluation of machine vibration — Part 1: General guidelines*

© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 20816-3:2022

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041 apply. It provides a range of vocabulary and definitions specific to mechanical vibration, shock and condition monitoring used in this document.

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

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

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

4 Measurement procedures

4.1 General

The measurement procedures to be followed and the instrumentation which shall be used are specified in ISO 20816-1, subject to the recommendations given in this clause.

Care shall be taken to ensure that the measuring system is not influenced by environmental factors such as:

a) temperature variations;

b) magnetic fields, including magnetisation of the shaft;

c) sound fields;

d) power source variations;

e) transducer cable length (some designs of shaft vibration probe require matched cable lengths);

f) transducer cable faults;

g) transducer orientation.

Particular attention shall be paid to ensure that the vibration transducers are correctly mounted and that such mountings do not degrade the accuracy of the measurements taken.

4.2 Measurement location

It is common practice to measure vibration on non-rotating parts, or rotating parts (shaft relative vibration), or both. Unless stated otherwise, this document refers to shaft relative vibration when referring to displacement measurements taken on rotating parts. On rotating parts, measurement methods using non-contacting transducers are most commonly used and are preferred. The transducers are usually mounted as an orthogonal pair so that an orbit can be visualised. In some machines it is not possible to access the shaft directly adjacent to the bearing. Ensure that measurements reasonably represent the shaft vibration at the bearing and do not include any amplification due to local resonances of the supporting bracket, or due to a non-homogeneous shaft surface. See ISO 10817-1 for further details of instrumentation for radial vibration measurement on rotating parts.

Measurements taken on non-rotating parts shall be taken on the bearings, bearing support housing or other structural parts which significantly respond to the dynamic forces transmitted from the rotating elements at the bearing locations and characterize the overall vibration of the machine. In some machines it is not possible to access the bearing housings directly. In such cases, care shall be taken to ensure that measurements reasonably represent the vibration of the bearing housing and do not include any local resonances or amplification. Thin or otherwise flexible surfaces, such as fan covers or cowlings, should be avoided. It can be necessary to confirm the repeatability and validity of such measurement locations (e.g. by taking measurements at several locations and comparing the results).

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 20816-3:2022