
**Mechanical vibration — Measurement
and evaluation of machine
vibration —**

Part 8:
Reciprocating compressor systems

*Vibrations mécaniques — Mesurage et évaluation des vibrations des
machines —*

Partie 8: Systèmes de compresseurs alternatifs



This document is a preview generated by EMS



COPYRIGHT PROTECTED DOCUMENT

© ISO 2018

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
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Measurements	3
4.1 Measurement procedure.....	3
4.2 Measuring instrumentation and measured quantities.....	3
4.3 Locations and direction of measurements.....	4
4.3.1 Locations.....	4
4.3.2 Direction of measurements.....	9
4.4 Operating conditions.....	10
4.5 Record of measured results.....	10
5 Vibration criteria	10
5.1 Measuring quantities.....	10
5.2 Evaluation zones.....	10
5.2.1 General.....	10
5.2.2 Acceptance criteria.....	11
5.3 Guidance values for acceptable overall vibration values (2 Hz to 1 000 Hz).....	12
5.3.1 Guidance value tables for displacement, velocity and acceleration.....	12
5.3.2 Vibration values and the effect of mountings and foundations.....	13
5.3.3 Vibration values for horizontal compressors.....	13
5.3.4 Vibration values for vertical compressors.....	13
Annex A (normative) Measurement information requirements	14
Annex B (informative) Curves with overall limits of vibration velocity values	17
Annex C (informative) Measurement of vibration values on the crosshead guide	23
Annex D (informative) Root-mean-square value, peak value and crest factor	26
Annex E (normative) Small bore connections (SBC)	28
Bibliography	34

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).

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

For an explanation on 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 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*, in collaboration with ISO/TC 118, *Compressors and pneumatic tools, machines and equipment*.

This first edition of ISO 20816-8 cancels and replaces ISO 10816-8:2014, which has been technically revised. The main change is the addition of an annex dealing with vibration of small bore connections.

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.

Introduction

ISO 20816-1 gives general guidelines for the evaluation of machine vibration by measurements on both non-rotating parts and rotating shafts. The present document, however, establishes special procedures and guidelines for the measurement and classification of mechanical vibration of reciprocating compressors. Since, in general, it is not common to measure shaft vibration, this document refers to vibration of the main structure of the compressor, including the foundation, pulsation dampers and attached pipe system. The guidance values given for these vibrations are defined primarily to classify the vibration and to avoid problems with auxiliary equipment mounted on these structures. Recommendations for measurements and evaluation criteria are provided in this document.

Typical features of reciprocating compressors are the oscillating masses, the cyclically varying torques, cylinder stretch and the pulsating forces in the cylinders, pulsation dampers and the pipe system. All these features cause alternating loads on the main supports and vibration of the compressor system. The vibration values of reciprocating compressor systems are generally larger than for rotating compressors but, since they are largely determined by the design features of the compressor, they tend to remain more constant over the life of the system than for rotating machinery.

In the case of reciprocating compressor systems, the vibration measured on the main structure of the compressor (including the foundation, pulsation dampers and piping) and quantified according to this document can only give a rough idea of the vibratory states of the components within the machine itself.

The damage which can occur when exceeding the guidance values based on experience with similar compressor systems is sustained predominantly by machine-mounted components (e.g. instrumentation, heat exchangers, filters, pumps), connecting elements of the compressor with its peripheral parts (e.g. pipelines) or monitoring instruments (e.g. pressure gauges, thermometers). The question as above which vibration values damage is to be expected largely depends on the design of these components and their fastenings. In some cases, special measurements on certain compressor system components can be required to ascertain that the vibration values do not cause damage. It also happens that, even if measured values are within the guidance values of this document, problems occur owing to the great variety of components which can be attached.

Local vibration problems as described above can be rectified by specific “local measures” (e.g. by elimination of resonances). Experience has shown, however, that it is possible in the majority of cases to state measurable quantities characterizing the vibratory state and to give guidance values for these. This shows that the measurable variables and the guidance values for acceptable vibration in most cases permit a reliable evaluation.

If the measured vibration values as given in this document do not exceed the guidance values, abnormal wear of internal compressor components caused by vibration is unlikely to occur.

The vibration values of reciprocating compressor systems are not only affected by the properties of the compressor itself but also, to a large degree, by the foundation. Since a reciprocating compressor can act as a vibration generator, vibration isolation between the compressor and its foundation can be necessary. The vibration response of the foundation and the vibration from adjacent equipment can have considerable effect on the vibration of the compressor system.

Mechanical vibration — Measurement and evaluation of machine vibration —

Part 8: Reciprocating compressor systems

1 Scope

This document establishes procedures and guidelines for the measurement and classification of mechanical vibration of reciprocating compressor systems. The vibration values are defined primarily to classify the vibration of the compressor system and to avoid fatigue problems with parts in the reciprocating compressor system, i.e. foundation, compressor, dampers, piping and auxiliary equipment mounted on the compressor system. Shaft vibration is not considered.

This document applies to reciprocating compressors mounted on rigid foundations with typical rotational speed ratings in the range 120 r/min up to and including 1 800 r/min. The general evaluation criteria which are presented relate to operational measurements. The criteria are also used to ensure that machine vibration does not adversely affect the equipment directly mounted on the machine, e.g. pulsation dampers and the pipe system.

NOTE The general guidelines presented in this document can also be applied to reciprocating compressors outside the specified speed range but different evaluation criteria might be appropriate in this case.

The machinery driving the reciprocating compressor, however, is evaluated in accordance with the appropriate part of ISO 10816, ISO 20816 or other relevant standards and classification for the intended duty. Drivers are not included in this document.

It is recognized that the evaluation criteria might only have limited application when considering the effects of internal machine components, e.g. problems associated with valves, pistons and piston rings might be unlikely to be detected in the measurements. Identification of such problems can require investigative diagnostic techniques which are outside the scope of this document.

Examples of reciprocating compressor systems covered by this document are

- horizontal, vertical, V-, W- and L-type compressor systems,
- constant and variable speed compressors,
- compressors driven by electric motors, gas and diesel engines, steam turbines, with or without a gearbox, flexible or rigid coupling, and
- dry running and lubricated reciprocating compressors.

This document does not apply to hyper compressors.

The guidelines are not intended for condition monitoring purposes. Noise is also outside the scope of this document.

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.

3 Terms and definitions

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 compressor system

machinery system comprising foundation, compressor (crankcase, crosshead guide, cylinders), pulsation dampers and piping

3.2 overall vibration value

single numeric representation of a feature or aggregate of features derived from a raw or processed time waveform or frequency spectrum of a vibration signal and often accompanied by descriptive text or indicators to specify methods used in its derivation

Note 1 to entry: The overall vibration value is measured in the frequency range from 2 Hz to 1 000 Hz.

3.3 corner frequency

frequency used to convert the vibration displacement to vibration velocity and vibration velocity to vibration acceleration for a sinusoidal signal

Note 1 to entry: The corner frequencies are 10 Hz and 200 Hz, respectively.

3.4 vendor

manufacturer or manufacturer's agent who supplies the compressor system

3.5 purchaser

agency that issues the order and specification to the vendor

3.6 mainline piping

piping of which the small bore connections are branched

Note 1 to entry: Mainline piping can also refer to stationary components of rotating machinery and pressure containing equipment like vessels or coolers.

Note 2 to entry: The definition of mainline piping diameter for non-cylindrical parts is given in Figure E.1.

3.7 small bore connection SBC

branch connection on mainline piping, vessels or equipment that has an actual outer diameter of 60,3 mm or smaller, or that has an actual outer diameter larger than 60,3 mm with a *branch ratio* (3.8) of less than or equal to 12 %

Note 1 to entry: All connections that have a branch ratio greater than 36 % are excluded.

Note 2 to entry: The small bore connection piping extends until the effect of the mainline piping vibration is negligible, which is typically the first support.

Note 3 to entry: Diameters of small bore connection are given in Table E.1.