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# Mechanical vibration — Measurement and evaluation of machine vibration —

## Part 5: Machine sets in hydraulic power generating and pump-storage plants

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

*Partie 5: Groupes de machines équipant des centrales hydroélectriques et des stations de pompage et de stockage*



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## Contents

	Page
<b>Foreword</b> .....	<b>v</b>
<b>Introduction</b> .....	<b>vi</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>2</b>
<b>3 Terms and definitions</b> .....	<b>2</b>
<b>4 Machine arrangements</b> .....	<b>2</b>
<b>5 Measurement procedures and conditions</b> .....	<b>7</b>
5.1 General.....	7
5.1.1 Bearing housing vibration measurements.....	7
5.1.2 Shaft vibration measurements.....	7
5.2 Measurement types.....	7
5.2.1 Absolute bearing housing vibration.....	7
5.2.2 Radial shaft vibration.....	8
5.2.3 Bearing and shaft vibration in the axial direction.....	9
5.2.4 Detrimental influences.....	9
5.3 Measurement locations and directions.....	9
5.3.1 General.....	9
5.3.2 Measurement of relative shaft vibration.....	11
5.3.3 Measurement of the absolute bearing housing vibration.....	11
5.4 Measurement equipment.....	13
5.4.1 General.....	13
5.4.2 Absolute bearing housing vibration measurements.....	13
5.4.3 Shaft vibration measurement.....	15
5.4.4 Measurement of $S_{\max}$ or $S_{p-p}$ .....	15
5.5 Operational conditions.....	17
<b>6 Evaluation of vibration measurements</b> .....	<b>17</b>
6.1 General.....	17
6.1.1 Basis of the vibration values.....	17
6.1.2 Effect of turbine operating conditions on bearing housing vibration measurements.....	18
6.1.3 Effect of turbine operating conditions on shaft vibration.....	18
6.1.4 Pump operating conditions.....	18
6.1.5 Special operating conditions.....	18
6.2 Criterion I: Vibration magnitude.....	19
6.3 Criterion II: Change in vibration magnitude and phase.....	21
6.3.1 Assessment criteria.....	21
6.3.2 Monitoring prerequisites.....	21
6.3.3 Specific recommendation related to the generator.....	21
6.4 Operational limits.....	21
6.4.1 Alarms and trips.....	21
6.4.2 Setting of alarms.....	22
6.4.3 Setting of trips.....	22
6.4.4 Special operating conditions.....	22
6.5 Comparison of results for shaft vibration and bearing housing vibration.....	23
6.6 Evaluation based on vibration vector information.....	23
<b>Annex A (normative) Evaluation zone boundaries</b> .....	<b>24</b>
<b>Annex B (informative) Vibration monitoring — Prerequisite for trend analysis</b> .....	<b>32</b>
<b>Annex C (informative) Special features of bearing housing vibration and shaft vibration of hydraulic machine sets</b> .....	<b>37</b>
<b>Annex D (informative) Database, analysis procedure and statistical evaluation</b> .....	<b>40</b>

This is a preview of "ISO 20816-5:2018". [Click here to purchase the full version from the ANSI store.](#)

<b>Annex E (informative) Recommended practice for vibration data processing</b> .....	<b>45</b>
<b>Bibliography</b> .....	<b>50</b>

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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](http://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](http://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](http://www.iso.org/iso/foreword.html).

This document was prepared jointly 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*, and Technical Committee IEC/TC 4 *Hydraulic turbines*. The draft was circulated for voting to the national bodies of both ISO and IEC.

This first edition of ISO 20816-5 cancels and replaces ISO 7919-5:2005 and ISO 10816-5:2000, which have been technically revised. The main changes are:

- Vibrations of different type of machines and different shaft orientation are clearly identified.
- Demonstration that for each machine type, the vibration follows a similar statistical distribution profile (Burr distribution), which resulted in revised vibration values.
- A strong recommendation to look at both shaft vibration and the vibration of non-rotating parts together with physical parameters like bearing metal temperature and physical bearing clearances in order to obtain a complete assessment of the machine health.
- Recommendation of a collaborative approach between supplier and customer to investigate cases where vibration is larger than the statistical values instead of a rigid approach based only on vibration values.

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

## Introduction

ISO 20816-1 is the basic document which specifies the general requirements for evaluating vibration of various machine types. The present document provides specific guidance for the vibration of housings and shafts of machine sets installed in hydraulic power generating and pump-storage plants.

Two criteria are provided for assessing machine vibration:

- a) the first criterion considers the magnitude of the measured vibration;
- b) the second criterion considers changes in the magnitude and phase of the measured vibration.

This document covers the analysis of both shaft vibration and vibration of fixed, non-rotating parts.

Vibration criteria have been established for horizontal axis and vertical axis machines and have been developed for each type of turbine (Bulb, Francis, Pelton, Kaplan) when used for generating and also for pumping where appropriate. The vibration magnitudes criteria provided in this document are guidelines based on statistics; the magnitude values given should not be used as guarantees. It is recommended that the vibration assessment is performed by a vibration expert selected in common agreement by all parties. To identify the good behaviour of a hydraulic machine, it is essential to look at the following points together:

- the magnitude of the relative shaft vibration;
- the magnitude of the bearing housing vibration;
- the percentage of the guide bearings cold diametral clearance that is used;
- the operating temperature of the metal parts of the guide bearings;
- the operating regime (head and flow or head and power), to make sure the machine is operating within the normal operating range.

Recommended actions are given for those cases where the vibration magnitudes are above the action limits given in the tables in [Annex A](#) in order to establish if the machine is suitable for continued long-term operation without restriction.

Guidelines are presented both for the vibrations present when machines are operating and also for any changes in the amplitude or phase of those vibration values which can occur. The numerical values given in [Annex A](#) for vibration are intended to serve as the basis for the evaluation for the condition of the machine and, if required, further investigation. It is recommended in this document that the machine condition is assessed by considering both the bearing housing vibration and shaft vibration.