

Mechanical vibration of non-reciprocating machines — Measurements on rotating shafts and evaluation criteria

Part 5. Machine sets in hydraulic power generating and pumping plants

ICS 17.160; 29.160.40

National foreword

This British Standard reproduces verbatim ISO 7919-5 : 1997 and implements it as the UK national standard.

The UK participation in its preparation was entrusted to Technical Committee GME/21, Mechanical vibration and shock, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled 'International Standards Correspondence Index', or using the 'Find' facility of the BSI Standards Electronic Catalogue.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the ISO title page, page ii, pages 1 to 12, an inside back cover and a back cover.

Amendments issued since publication

Amd. No.	Date	Text affected

This British Standard, having been prepared under the direction of the Engineering Sector Board, was published under the authority of the Standards Board and comes into effect on 15 May 1997

© BSI 1997

ISBN 0 580 27520 5

INTERNATIONAL STANDARD

ISO
7919-5

First edition
1997-02-15

Mechanical vibration of non-reciprocating machines — Measurements on rotating shafts and evaluation criteria —

Part 5:

Machine sets in hydraulic power generating
and pumping plants

*Vibrations mécaniques des machines non alternatives — Mesurages sur
les arbres tournants et critères d'évaluation —*

*Partie 5: Machines équipant les centrales hydroélectriques et les stations
de pompage*



Reference number
ISO 7919-5:1997(E)

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.

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.

International Standard ISO 7919-5 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*.

ISO 7919 consists of the following parts, under the general title *Mechanical vibration of non-reciprocating machines — Measurements on rotating shafts and evaluation criteria*:

- *Part 1: General guidelines*
- *Part 2: Large land-based steam turbine generator sets*
- *Part 3: Coupled industrial machines*
- *Part 4: Gas turbine sets*
- *Part 5: Machine sets in hydraulic power generating and pumping plants*

Annex A forms an integral part of this part of ISO 7919. Annexes B and C are for information only.

Descriptors: vibration, rotating machines, generating sets, hydraulic turbomachinery, turbines, shafts (rotating), tests, vibration tests, measurement, vibration measurement.

Mechanical vibration of non-reciprocating machines — Measurements on rotating shafts and evaluation criteria —

Part 5:

Machine sets in hydraulic power generating and pumping plants

1 Scope

This part of ISO 7919 gives guidelines for applying shaft vibration evaluation criteria, under normal operating conditions, measured at or close to the bearings of machines or machine sets in hydraulic power generating and pumping plants. These guidelines are presented in terms of both steady-state running vibration and any amplitude changes which may occur in these steady values. The numerical values specified are not intended to serve as the only basis for vibration evaluation since, in general, the vibratory condition of a machine is assessed by consideration of both the shaft vibration and the associated structural vibration (see ISO 7919-1).

This part of ISO 7919 applies to machines or machine sets in hydraulic power generating and pumping plants where the hydraulic machines have speeds from 60 r/min to 1 800 r/min, shell- or shoe-type sleeve bearings, and main engine power of at least 1 MW. The position of the shaft line may be vertical, horizontal or at an arbitrary angle between these two directions.

Machine sets covered by this part of ISO 7919 may be a combination of

- hydraulic turbines and generators,
- pumps and electrical machines operating as motors,
- pump-turbines and motor-generators,

including auxiliary equipment (e.g. starting turbines or exciters lying in the shaft line).

This part of ISO 7919 is also applicable to turbines or pumps connected to generators or electrical motors via gears and/or radially flexible couplings. However, electrical machines with speeds between 1 000 r/min and 1 800 r/min should be evaluated according to the criteria specified in ISO 7919-3.

This part of ISO 7919 is not applicable to

- pumps in thermal power plants or industrial installations (for these machines, see ISO 7919-3),
- hydraulic machines or machine sets having rolling element bearings, or
- hydraulic machines having water-lubricated bearings.

Consistent with ISO 7919-1, shaft vibration of machines or machine sets in hydraulic power generating and pumping plants may be determined with regard to the following tasks:

- task A: changes in vibrational behaviour;
- task B: excessive kinetic load;
- task C: the monitoring of radial clearance.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 7919. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 7919 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7919-1:1996, *Mechanical vibration of non-reciprocating machines — Measurements on rotating shafts and evaluation criteria — Part 1: General guidelines*.

ISO 10817-1:—¹⁾, *Rotating shaft vibration measurement systems — Part 1: Relative and absolute signal sensing of radial vibration from rotating shafts*.

IEC 994:1991, *Guide for field measurement of vibrations and pulsations in hydraulic machines (turbines, storage pumps and pump-turbines)*.

3 Measurement procedures

The measurement procedures to be followed and the instrumentation used shall be as described in ISO 7919-1 and IEC 994.

3.1 Measurement type

Relative and absolute shaft vibration measurements are carried out on hydraulic machine sets using non-contacting transducers. Shaft-riding probes with seismic transducers cannot generally be used due to the very-low-frequency range of the measuring equipment required for low-speed hydraulic machinery.

For relative measurements, transducers should be mounted directly on the bearing shell or the bearing pad. If the transducers are installed on the bearing support structure or bearing housing, as it is common for vertical machines, care shall be taken that the relative motion between the bearing shell or pad and the transducer itself is small compared with the shaft motion. If this is not so, the measured signal cannot be said to be representative of the relative movement between the shaft and bearing shell or bearing pad, respectively. This requirement may be assessed by static analysis of the structure or additional measurement; the latter is usually difficult and expensive.

For absolute vibration measurements, non-contacting transducers shall be installed on rigid frameworks, fixed to the turbine or generator pit wall. Signals from these transducers can only be regarded as representative of the absolute shaft vibration when the absolute vibration of the supporting structure itself at the point of attachment of the transducer is less than 10 % of the measured peak-to-peak value, with 25 µm as an upper limit.

With regard to the transducer support structures, it is advisable that the lowest natural frequency of those vibration modes which create significant movements in the working direction of shaft displacement transducers should be greater than seven times the synchronous rotational frequency and should not be a direct multiple of the synchronous rotational frequency.

The absolute vibration of the support frame should always be measured using seismic transducers installed on the support frame as close as possible to the shaft movement transducer and in the same direction of action. The readings from the seismic transducers may be used after conversion into displacements to evaluate the absolute shaft displacement.

NOTE — Apart from the shaft vibration, the vibration of the bearing support is frequently monitored as well. The vibration measurement at the lower guide bearings of vertical machines may, however, be misinterpreted; the vibration value measured at the bearings and their supports which are rigidly embedded in the building is sometimes produced by hydraulic forces, directly transmitted from the hydraulic machine via the foundation, and is not produced by radial shaft vibration.

1) To be published.