
**Condition monitoring and diagnostics
of machines — Vibration condition
monitoring —**

**Part 7:
Diagnostic techniques for machine
sets in hydraulic power generating
and pump-storage plants**

Surveillance et diagnostic d'état des machines — Surveillance des vibrations —

Partie 7: Techniques de diagnostic pour machines équipant les centrales hydro-électriques et les stations de turbine-pompe



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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).

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*.

A list of all the parts in the ISO 13373 series can be found on the ISO website.

Introduction

This document is a guideline for procedures to be considered when carrying out vibration diagnostics of machine sets in hydraulic power generating and pump-storage plants, shortly named hydropower units. It is intended to be used by vibration practitioners, engineers and technicians, and it provides them with diagnostic tools. These tools include the use of diagnostic process tables and fault tables. The material contained herein presents the most basic, logical and intelligent steps that should be taken when diagnosing problems associated with these particular types of machines.

Acceptable vibration values for hydropower units, however, are contained in ISO 10816-5 (vibration of non-rotating parts) and ISO 7919-5 (vibration of rotating shafts), which are at present under revision and amalgamation to be published as ISO 20816-5.

ISO 13373-1 presents the basic procedures for narrow-band signal analysis of vibration. It includes description of the types of transducers to be used, their ranges and their recommended locations on various types of machines, online and periodic vibration systems, and potential machinery problems.

ISO 13373-2 leads to the diagnostics of machines. It includes descriptions of the signal conditioning equipment that is required, time and frequency domain techniques, and the waveforms and signatures that represent the most common machinery operating phenomena or machinery faults that are encountered when performing vibration signature analysis.

ISO 13373-3 provides some procedures to determine the causes of vibration problems common to all types of rotating machines. It includes systematic approaches to characterize vibration effects, the diagnostic tools available, tools needed for particular applications and recommendations on how the tools are to be applied to different machine types and components. However, this does not preclude the use of other diagnostic techniques.

It should be noted that ISO 17359 indicates that diagnostics can be

- started as a succeeding activity after detection of an anomaly during monitoring, or
- executed synchronously with monitoring from the beginning.

This document considers only the first case in which diagnostics is performed after an anomaly has been detected. Moreover, it focuses mainly on the use of process tables as diagnostic tools, as well as fault tables since it is felt that these are the tools that are most appropriate for use by practitioners, engineers and technicians in the field.

When approaching a machinery problem that manifests itself as a high or erratic vibration signal, the diagnosis of the problem should be carried out in a well-thought-out systematic manner. ISO 13373-3 and this document achieve that purpose by providing to the analyst guidance on the selection of the proper measuring tools, the analysis tools and their use, and the recommended step-by-step procedures for the diagnosis of problems associated with various types of machine sets in hydraulic power generating and pump-storage plants.

The diagnostic process table methodology presents a structured procedure for a person in the field to diagnose a fault and find its cause. The step-by-step procedure is able to guide the practitioner in the vibration diagnostics of the machine anomaly in order to detect the probable root cause.

The fault tables present a list of the most common faults in machinery, as well as their manifestations in the vibration data. The tables assist with the identification of machinery faults.

For some cases, it can be dangerous to start the machine again after a serious anomaly caused a trip. Then, the diagnosis to be performed may differ from the methods described in this document.

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Condition monitoring and diagnostics of machines — Vibration condition monitoring —

Part 7:

Diagnostic techniques for machine sets in hydraulic power generating and pump-storage plants

1 Scope

This document gives guidelines for specific procedures to be considered when carrying out vibration diagnostics of various types of machine sets in hydraulic power generating and pump-storage plants (hydropower units). It is intended to be used by condition monitoring practitioners, engineers and technicians and provides a practical step-by-step vibration-based approach to fault diagnosis. In addition, it includes a number of examples for a range of machine and component types and their associated fault symptoms.

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 13372, *Condition monitoring and diagnostics of machines — Vocabulary*

ISO 13373-1, *Condition monitoring and diagnostics of machines — Vibration condition monitoring — Part 1: General procedures*

ISO 13373-2, *Condition monitoring and diagnostics of machines — Vibration condition monitoring — Part 2: Processing, analysis and presentation of vibration data*

ISO 21940-2, *Mechanical vibration — Rotor balancing — Part 2: Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041, ISO 13372 and ISO 21940-2 apply.

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

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

4 Hydropower vibration

Vibration measurements mainly consist of quantifying the oscillation of the rotating shaft at the guide bearings relative to the bearing housing (shaft relative vibration) and the absolute vibration of the bearing housing itself (bearing housing vibration), which is representative for non-rotating parts.