INTERNATIONAL STANDARD

ISO 13373-4

First edition
2021-11

Condition monitoring and diagnostics of machines — Vibration condition monitoring —

Part 4: Diagnostic techniques for gas and steam turbines with fluid-film bearings

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

Partie 4: Techniques de diagnostic pour turbines à gaz et turbines à vapeur à paliers à film fluide

Reference number
ISO 13373-4:2021(E)

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Published in Switzerland

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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 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.*

A list of all parts in the ISO 13373 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

This document provides guidelines for the procedures to be considered when carrying out vibration diagnostics of gas turbines and steam turbines on fluid-film bearings. It is intended to be used by vibration practitioners, engineers and technicians and it provides them with useful diagnostic tools. These tools include the use of diagnostic flowcharts, process tables, fault tables and symptom tables. The material contained in this document presents the most basic, logical, and intelligent steps that should be taken when diagnosing problems associated with these particular types of machines.

The ISO 20816 series of standards contains acceptable vibration magnitudes and zones for various types and sizes of machines, ranging from new and well-running machines to machines that are in danger of failing.

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

ISO 13373-2 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; which tools are 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 synchronous with monitoring from the beginning.

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

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

The fault tables present a list of the most common faults in machinery, as well as their manifestations in the machine and vibration data. The symptom tables contain the main distinguishing vibration features of the main faults. When used with the flowcharts, the tables assist with the identification of machinery faults.

When approaching a machinery problem that manifests itself as a high or erratic vibration signal, the diagnosis of the problem should be done in a well thought out, systematic manner. This document and ISO 13373-3 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 step-by-step recommended procedures for the diagnosis of problems associated with various types of gas and steam turbines with fluid-film bearings.

VDI 3839-4 provides typical vibration patterns in steam and gas turbines, and can be a useful reference.

Condition monitoring and diagnostics of machines — Vibration condition monitoring —

Part 4: Diagnostic techniques for gas and steam turbines with fluid-film bearings

1 Scope

This document sets out guidelines for the specific procedures to be considered when carrying out vibration diagnostics of various types of gas and steam turbines with fluid-film bearings.

This document 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 gives examples for a range of machine and component types and their associated fault symptoms.

The approach given in this document is based on established good practice, put together by experienced users, although it is acknowledged that other approaches can exist. Recommended actions for a particular diagnosis depend on individual circumstances, the degree of confidence in the fault diagnosis (e.g. has the same diagnosis been made correctly before for this machine), the experience of the practitioner, the fault type and severity as well as on safety and commercial considerations. It is neither possible nor the aim of this document to recommend actions for all circumstances.

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 13373-3:2015, *Condition monitoring and diagnostics of machines — Vibration condition monitoring — Part 3: Guidelines for vibration diagnosis*

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:

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