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Condition monitoring and diagnostics of machine systems — Data interpretation and diagnostics techniques —

Part 1: General guidelines

Surveillance et diagnostic de l'état des systèmes de machines — Interprétation des données et techniques de diagnostic —

Partie 1: Lignes directrices générales

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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 document 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).

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This document was prepared by Technical Committee ISO/TC 108, *Mechanical vibration, shock and condition monitoring,* Subcommittee SC 5, *Condition monitoring and diagnostics of machine systems*.

This second edition of ISO 13379-1 cancels and replaces the first edition (ISO 13379-1:2012), which has been technically revised. The main changes are as follows:

— the Scope of the document has been extended by the addition of Clause 1 c);

— Clause 4 has been added to outline recommended steps to perform diagnostics;

— new methods for assessing the failure mode symptoms analysis have been added, see 5.3.4 and 5.3.5;

— new examples and descriptions of elements used for diagnostics have been added in Clause 6;

— information provided in 7.1, 7.3 and Annexes E and F has been updated to reflect the state of the art;

— descriptions of data-driven methods have been moved to (informative) Annex E;

A list of all parts in the ISO 13379 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.

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Introduction

Effective management of machine systems throughout their life cycles requires maintaining their performance, reliability and availability. One of the key strategies to support this objective is condition monitoring, which provides information on the state of the machine system.

Condition monitoring serves two principal roles:

a) to identify trends that indicate the remaining useful life of the machine system, deterioration of its performance or increased risk of failures; and

b) to detect nonconformities, referred to as anomalies in the context of condition monitoring, by identifying deviations from baseline values or expected operating conditions. Such deviations, when compared against predefined criteria, can result in alarms.

Once an anomaly has been detected, it is often needed to identify its cause(s). Identifying the cause(s) of the anomaly is referred to as diagnostics and supports the determination of appropriate corrective actions. Stakeholders typically expect a certain level of accuracy in diagnostics, as its output — a diagnosis — can directly influence machine system operation, maintenance planning and resource allocation. This document supports users in developing diagnostic procedures and models, and in evaluating their confidence level, applicability and limitations.

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Condition monitoring and diagnostics of machine systems — Data interpretation and diagnostics techniques —

Part 1: General guidelines

1 Scope

This document

a) establishes common concepts for condition monitoring and diagnostics of machine systems, simplifying communication between the users and manufacturers of condition monitoring and diagnostics systems;

b) establishes technical characteristics and describes principles for condition monitoring and diagnostics of machine systems;

c) gives guidance on developing condition monitoring and diagnostics systems; and

d) gives guidance on selecting an appropriate diagnostic approach in the particular application.

This document is applicable to any machine system whose state can be described by measuring or observing its operational parameters (or inputs) and responses (or outputs).

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

3 Terms and definitions

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

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

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

— IEC Electropedia: available at https://www.electropedia.org

3.1
confidence level
figure of merit, e.g. percentage, that indicates the degree of certainty that the diagnosis or prognosis is correct.

Note 1 to entry: This figure essentially represents the cumulative effect of error sources on the final certainty or confidence in the accuracy of the outcome. Such a figure can be determined algorithmically or via a weighted assessment system.

[SOURCE: ISO 13381-1:2025, 3.3, modified by adding ‘or’ and removing parentheses]

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3.2
diagnostic approach
methodology used to perform diagnostics, typically by analysing observed or simulated data (data-driven approach) or by explicitly representing fault or system behaviour (knowledge-based approach).

3.3
diagnostic model
mathematical or logical construct used to identify, analyse or interpret data and information for the purpose of supporting diagnostics

4 Diagnostics and its relation to condition monitoring

Condition monitoring involves continuous or scheduled measurement of machine system parameters, processing these measurements into data and information, and often the presentation and storage of the processed data and information. Diagnostics is generally triggered by detecting an anomaly during routine condition monitoring, routine analysis, random analysis or human perception. This detection is carried out by making a comparison between the present descriptors of a machine system and baseline (also called baseline values or reference sets) chosen from experience, from the manufacturer's specifications, from commissioning tests or computed from statistical information (e.g. long-term average for a particular operational state).

Diagnostics is a systematic approach used to identify the root cause of anomalies and plays an essential role in decision making for operation and maintenance tasks. It should include the following steps:

a) Anomaly validation: At the start of diagnostics, it should be ensured that the anomaly has not been caused by the malfunction of a transducer or any other part of the condition monitoring system.

b) Data and information collection: Next, relevant elements used for diagnostics should be gathered. These elements are described in Clause 6 and include measurements, descriptors derived from measurements, symptom and fault characteristics, records of the fault history, operation history and maintenance history, and specific information that describes machine system construction and operational parameters. ISO 17359 provides further guidelines for data and information collection.

c) Analysis: The gathered elements should be analysed to identify patterns, trends and deviations from the baseline. The particular analysis method shall depend on the selected diagnostic approach. The diagnostic approaches are described in Clause 7, together with guidelines for their selection.

d) Hypothesis formulation: Potential causes of the anomaly, also called hypothesis, should be reasoned using the information generated by the analysis. When formulating the hypotheses, consideration shall be given to the factors outlined in Clause 5. The hypothesis that no fault is present shall always be considered.

e) Hypothesis testing: Hypotheses should be tested for by taking additional actions, such as making targeted measurements or carrying out further tests, inspections or simulations. A hypothesis shall be rejected if the test results contradict it. If the test results do not contradict the hypothesis, it shall be considered not rejected. In cases where the test results provide a sufficiently high level of confidence, a hypothesis may be considered accepted for the purpose of diagnosis synthesis.

f) Diagnosis synthesis: The diagnosis should be formulated using hypotheses that were not rejected. If a higher confidence level is needed, only accepted hypotheses should be used. Further information on determining diagnosis confidence level is given in 7.4.

g) Recommendation: Recommendations for taking corrective actions shall be formulated based on diagnosis. The corrective actions can include maintenance tasks such as refurbishments, repairs and replacements, adjustments of operational parameters or further monitoring. To develop recommendations, the diagnostician should be aware of provisions given in Clause 5 and ISO 17359.

h) Follow-up: After implementing the recommended corrective actions, the machine system should be further monitored to assess whether the expected behaviour has been restored or additional actions

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