

Condition monitoring and diagnostics of machines — General guidelines on data interpretation and diagnostics techniques

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National foreword

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- 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 subcommittee can be obtained on request to its secretary.

Cross-references

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Summary of pages

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Condition monitoring and diagnostics of machines — General guidelines on data interpretation and diagnostics techniques

*Surveillance et diagnostic d'état des machines — Lignes directrices
générales sur l'interprétation des données et les techniques de
diagnostic*



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Foreword

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ISO 13379 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock*, Subcommittee SC 5, *Condition monitoring and diagnostics of machines*.

Introduction

This International Standard contains general procedures that can be used to determine the condition of a machine relative to a set of baseline parameters. Changes from the baseline values and comparison to alarm criteria are used to indicate anomalous behaviour and to generate alarms: this is usually designated as condition monitoring. Additionally, procedures that identify the cause(s) of the anomalous behaviour are given in order to assist in the determination of the proper corrective action: this is usually designated as diagnostics.

Condition monitoring and diagnostics of machines — General guidelines on data interpretation and diagnostics techniques

1 Scope

This International Standard gives guidance for data interpretation and diagnostics of machines. It is intended

- to allow the users and manufacturers of condition monitoring and diagnostics systems to share common concepts in the fields of machine diagnostics,
- to enable users to prepare the necessary technical characteristics that will be used for the further diagnosis of the condition of the machine, and
- to give an appropriate approach to achieve a diagnosis of machine faults.

Since it gives general guidelines, a list of the machine types addressed is not included. However, the machine sets covered by this International Standard will normally include industrial machines such as turbines, compressors, pumps, generators, electrical motors, blowers and fans.

2 Normative references

The following referenced documents are indispensable for the application 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, *Vibration and shock — Vocabulary*

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 2041, ISO 13372 and the following apply.

3.1 alarm

operational signal or message designed to notify personnel when a selected anomaly, or a logical combination of anomalies, requiring corrective actions is encountered

NOTE An alarm is a more severe anomaly zone than an alert and should be identified with a red indicator.

3.2 anomaly

irregularity or abnormality in a system

3.3
descriptor
condition monitoring descriptor

data item derived from raw or processed parameters or an external observation

NOTE Descriptors are used to express symptoms and anomalies. The descriptors used for diagnostics are generally those obtained from the condition monitoring systems. However, operational parameters, like any other measurement, can be considered as descriptors.

3.4
failure

⟨of a machine ⟩ termination of the ability of an item to perform a required function

NOTE Failure is an event as distinguished from fault, which is a state.

3.5
fault

⟨of a component of a machine, in a machine⟩ condition of a component that occurs when one of its components or assembly degrades or exhibits abnormal behaviour, which may lead to the failure of the machine

NOTE 1 Fault can be the result of a failure, but may exist without a failure.

NOTE 2 An event is not a fault if it is a result of planned actions or lack of external resources.

3.6
root cause

set of conditions and/or actions that occur at the beginning of a sequence of events that result in the initiation of a failure mode

3.7
symptom

⟨of a fault⟩ perception, made by means of human observations and measurements (descriptors), which may indicate the presence of one or more faults with a certain probability

3.8
syndrome

group of signs or symptoms that collectively indicate or characterize an abnormal condition

3.9
diagnosis confidence level

estimate of the likelihood that a calculated reliability will be achieved or bettered

NOTE 1 Reliability calculations are made on the basis of available evidence. The degree of trust that can be placed on the calculation is a function of the extent of the sample size.

NOTE 2 The diagnostic confidence level is a figure of merit that indicates the degree of certainty that the diagnosis is correct.

NOTE 3 The diagnostic confidence level is determined by the diagnostic confidence factor.

4 Condition monitoring set-up and diagnostics requirements

4.1 Role of diagnostics in operation and maintenance

Diagnostics has an essential role in decision making in operational and maintenance tasks. Hence, in order to be effective, diagnostics procedures should be set up according to the potential faults that may happen in the machine. Therefore, it is strongly recommended that a preliminary study be carried out when preparing the requirements for the condition monitoring and diagnostics system of a machine.

4.2 Establishing diagnostics needs

The principle of this study is shown in Figure 1. The “V” shape has been intentionally chosen to represent the high level concerns (maintenance: machine, risk assessment) and the “low level” ones (measurements: monitoring, periodical tests, data processing).

The right branch of the sketch corresponds to the condition monitoring and diagnostics activities that are normally undertaken after the machine has been commissioned. The left branch corresponds to the preliminary study which prepares, for a particular machine, the necessary data for condition monitoring and diagnostics. Each layer consists of a preparatory design phase (left) and a usage phase (right).

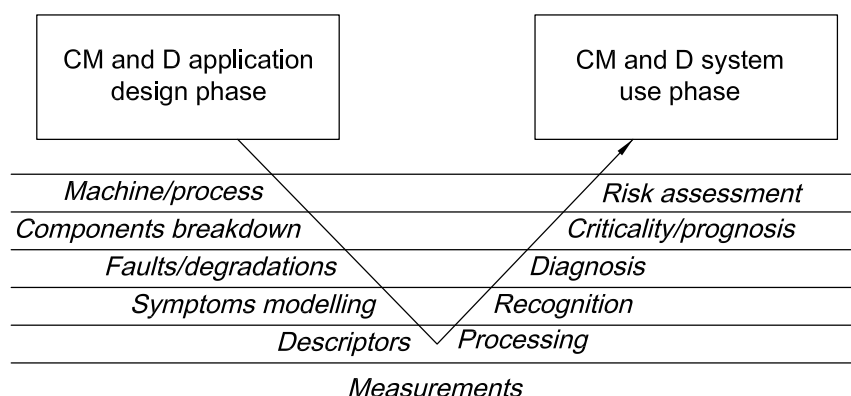


**Figure 1 — Condition monitoring and diagnostics (CM and D) cycle:
Design and use of the application on a machine**

The generic steps of the diagnostics study include the following:

- analyse the machine availability, maintainability and criticality with respect to the whole process;
- list the major components and their functions;
- analyse the failure modes and their causes as component faults;
- express the criticality, taking into account the gravity (safety, availability, maintenance costs, production quality) and the occurrence;
- decide accordingly which faults should be covered by diagnostics (“diagnosable”);
- analyse under which operating conditions the different faults can be best observed and define reference conditions;
- express the symptoms that can serve in assessing the condition of the machine, and that will be used for diagnostics;
- list the descriptors that will be used to evaluate (recognize) the different symptoms;
- identify the necessary measurements and transducers from which the descriptors will be derived or computed.

The steps given in a), b), c) and d) may be followed using maintenance optimization such as FMEA (Failure Modes and Effects Analysis), FMECA (Failure Modes, their Effects and Criticality Analysis). They may be also accomplished within a more general process of maintenance optimization like RCM (Reliability Centred Maintenance).

NOTE FMEA and FMECA procedures are outlined in BS 5760 and IEC 60812.