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Condition monitoring and diagnostics of machines — Vocabulary

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

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Introduction

This International Standard defines terms relating only to condition monitoring and diagnostics of machines. It does not include terms that are defined elsewhere, nor those specific to only one area of the field. It is considered a living document and will be amended or updated as additional terms arise.

Condition monitoring and diagnostics of machines — Vocabulary

Scope

This International Standard specifies definitions of terms used in condition monitoring and diagnostics of machines. It is intended to provide users and manufacturers of condition monitoring and diagnostics systems with a common vocabulary.

1 General terms

1.1
analysis
careful scrutiny of constituent parts of a **system** (1.17) in order to thoroughly understand the whole

1.2
breakdown maintenance
maintenance performed after a **machine** (1.10) has failed

1.3
catastrophic failure
sudden, unexpected **failure** (1.7) of a **machine** (1.10) resulting in considerable damage to the machine and/or associated machines or components

1.4
condition-based maintenance
maintenance performed as governed by condition monitoring programmes

1.5
condition monitoring
detection and collection of information and data that indicate the state of a **machine** (1.10)

NOTE The machine state deteriorates if **faults** (1.8) or **failures** (1.7) occur.

1.6
diagnostics
examination of **symptoms** (9.5) and **syndromes** (4.9) to determine the nature of **faults** (1.8) or **failures** (1.7) (kind, situation, extent)

1.7
failure
termination of the ability of an item to perform a required **function** (1.9)

NOTE Failure is an event as distinguished from **fault** (1.8), which is a state.

1.8
fault
condition of a component that occurs when one of its components or assemblies degrades or exhibits abnormal behaviour, which may lead to the **failure** (1.7) of the **machine** (1.10)

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

NOTE 2 Planned actions or lack of external resources are not a fault.

1.9
function
appropriate action of any **machine** (1.10) or part of a **system** (1.17)

NOTE The function is the action and activity assigned to, required of, or expected of a machine or system.

1.10
machine
mechanical system designed expressly to perform a specific task, such as the forming of material or the transference and transformation of motion, force or energy

NOTE This is also sometimes referred to as equipment.

1.11
machine characteristics
distinguishing attributes, qualities and properties of a **machine** (1.10) and its subsystems which, by their presence and the relative magnitudes of their effects, define the configuration, performance, behaviour and capabilities of the machine

1.12
machine system
machine train (deprecated)
mechanical system in which the principal subsystem is a specific **machine** (1.10) and whose other subsystems are components and auxiliaries whose individual functions are integrated to support the actions and work of the machine

1.13
predictive maintenance
maintenance emphasizing prediction of **failure** (1.7) and taking action based on the condition of the equipment to prevent failure or degradation

1.14
preventive maintenance
maintenance performed according to a fixed schedule, or according to a prescribed criterion that detects or prevents degradation of a functional structure, **system** (1.17) or component, in order to sustain or extend its useful life

1.15
proactive maintenance
type of maintenance emphasizing the routine detection and correction of **root cause** (8.11) conditions that would otherwise lead to **failure** (1.7)

EXAMPLES High lubricant contamination, misalignment and unbalance.

1.16
prognostics
analysis of the symptoms of **faults** (1.8) to predict future condition and remaining useful life

1.17
system
grouping of associated entities, which is characterized by a mental construct

NOTE One of the associated entities is the boundary of the system.

2 Machine characteristics

2.1
critical machinery
machinery which is required to accomplish a major part of an economic process

2.2
maintainability
ability of a machine or part of a system to be retained in, or restored to, a state in which it can perform the required **function(s)** (1.9)

2.3
performance
behaviour, characteristics and efficiency of a technological process, running in a **machine** (1.10)

2.4
reliability
probability that a **machine** (1.10) will perform its required **functions** (1.9) without **failure** (1.7) for a specified time period when used under specified conditions

3 Operation and maintenance

3.1
alignment
condition whereby the axes of **machine system** (1.12) components are either coincident, parallel or perpendicular, according to design criteria

3.2
reliability centred maintenance
RCM
disciplined logic used to identify those cost effective and technologically feasible maintenance tasks that realise the inherent **reliability** (2.4) of equipment at a minimum expenditure of resources over the life of the equipment

3.3
thermal growth
change in the dimensions of a system (1.17) component caused by expansion due to changes in temperature

4 Faults

4.1
abnormality
deviation from a standard condition

4.2
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** (4.3) and should be identified with a red indicator.

4.3
alert
operational signal or warning message designed to notify personnel when a selected anomaly, or a logical combination of anomalies, requiring heightened awareness is encountered

NOTE An alert is the first zone of an **anomaly** (4.4) and should be identified with a yellow indicator.

4.4
anomaly
irregularity or **abnormality** (4.1) in a **system** (1.17)

4.5
distortion
departure from normal shape or configuration

4.6
failure mode
effect by which a **failure** (1.7) is observed

[ISO/IEC 2382-14]

4.7
fault progression
characterization of the change in severity of a **fault** (1.8) over time

4.8
sign
characteristic parameter of a signal, which shows information about a state

cf. **symptom** (9.5)

4.9
syndrome
group of **signs** (4.8) or **symptoms** (9.5) that collectively indicate or characterize an abnormal condition

4.10
tribological wear
wear that occurs as a result of relative motion at the surface

5 Data collection (acquisition)

5.1
attenuation
decrease in strength of a signal, usually as a result of the distance a signal travels or the density of the medium through which it travels

5.2
background noise
unwanted noise present in a signal which cannot be attributed to a specific cause

5.3
dynamic range
ratio of the largest magnitude to the smallest magnitude that a transducer or analyser can detect

NOTE Dynamic range is generally expressed in decibels as 20 times the logarithm to the base 10 of the ratio of the largest magnitude to the smallest magnitude.

5.4
thermography
use of infrared imagers, whereby the temperatures of a wide variety of targets can be measured remotely and without contact by measuring the infrared energy radiating from the surface of the target and converting this measurement to an equivalent surface temperature

5.5
time window
time required for a digital analyser to take the number of samples required to accurately reconstruct the input signal

5.6
triboelectric noise
noise generated into a shielded cable, caused by bending or motion of the cable

6 Data characteristics

6.1
asynchronous
non-synchronous (deprecated)
vibration components that are not related to rotating speed

6.2
descriptor
feature
data item derived from raw or processed parameters or external observation

6.3
noise floor
level of noise present in a **system** (1.17) with no exciting signal present

6.4
off line
⟨in condition monitoring and diagnostics⟩ periodic or intermittent collection of data

6.5
on line
⟨in condition monitoring and diagnostics⟩ continuous collection of data

6.6
signal-to-noise ratio
ratio of the peak magnitude of a wave to that of the **noise floor** (6.3) of the wave

NOTE Signal-to-noise ratio is generally expressed in decibels (dB).

6.7
subsynchronous components
⟨on a spectrum of a vibration signal⟩ frequency components that occur at less than one times the shaft rotational speed

6.8
synchronous components
phased-locked components
⟨on a spectrum of a vibration signal⟩ frequency components that occur at integer multiples of the shaft rotation speed

6.9
thermal vector
vibratory force brought about as a result of uneven thermal distribution in a system

6.10
vibration signature
measure of all frequencies comprising the vibratory movement of a **system** (1.17)

7 Data (signal) processing

7.1
electrical current analysis
ECA
technique which uses the line current of an electrical **machine** (1.10) to extract information about the health of the electrical machine

7.2
frequency domain
display of frequencies present in a sample of a waveform

7.3
time domain
display of the behaviour of a **system** (1.17) during a specific period of time

7.4
waterfall
three-dimensional multiple spectra display versus time or revolutions per minute

8 Analysis

8.1
cost effectiveness
term giving the cost of equipment, cost of replacement and/or the cost of lost production versus the cost of accomplishing specific maintenance activities

NOTE The cost effectiveness in any situation is defined by the machine owner.

8.2
critical speed map
rectangular plot of the natural frequency of a **system** (1.17) (y-axis) versus the bearing or support stiffness (x-axis)

8.3
cross-channel analysis
use of an analyser with two or more input channels to calculate such functions as phase, coherence and transfer function

8.4
failure modes and effects analysis
FMEA
structured procedure to determine equipment functions and functional failures, with each **failure** (1.7) being assessed as to the cause of the failure and the effects of the failure on the **system** (1.17)

NOTE The technique may be applied to a new system based on analysis or an existing system based on historical data.

8.5
failure mode effects and criticality analysis
FMECA
FMEA with a classification process based on the severity of the **faults** (1.8)

NOTE This is in comparison with the criticality thresholds.

8.6
failure rate
number of **failures** (1.7) within a population divided by the number of life units used by that population

NOTE Failure rate is always measured during an interval under stated conditions.

8.7
fault frequency
frequency generated by a specific **fault** (1.8)

8.8
frequency analysis
machine analysis performed by examining a **frequency domain** (7.2) display

NOTE The frequencies that are present are used to determine the forcing functions.

8.9
Pareto analysis
simple method for separating the major causes (“vital few”) of a problem from the minor ones (“trivial many”)

8.10
risk assessment
process of balancing risk with cost, schedule and other management considerations

NOTE It consists of identifying risks, assessing those risks, determining a course of action and tracking the effectiveness of the decision.

8.11
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** (4.6)

8.12
root cause failure analysis
RCFA
after a failure, the logical systematic examination of an item, its construction, application and documentation in order to identify the **failure mode** (4.6) and determine the failure mechanism and its basic cause

NOTE Root cause failure analysis is often used to provide a solution to chronic problems.

9 Diagnostics

9.1
baseline
descriptor or group of descriptors which provides a criterion of the normal behaviour of a **machine** (1.10) under various process states

NOTE The baseline should be decided under steady-state condition parameters of the machine. The machine behaviour may change because some condition parameters, such as temperature, are changing even if the process states are steady.

9.2
confidence level
estimate of the likelihood that a calculated **reliability** (2.4) 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.

9.3
diagnosis
result of the diagnostics process

NOTE This gives more detailed information about the kind, situation and extent of a monitored **fault** (1.8) or **failure** (1.7).

9.4
parameter
measurable variable

9.5
symptom
perception, made by means of human observations and measurements (descriptors), which may indicate the presence of one or more **faults** (1.8) with a certain probability

10 Prognostics

10.1
availability
probability that a **machine** (1.10) will, when used under specified conditions, operate satisfactorily and effectively

10.2
prognosis
result of the prognostics process