BS ISO 16079-2:2020

BSI Standards Publication

Condition monitoring and diagnostics of wind turbines

Part 2: Monitoring the drivetrain

Documents
Document Sharing Hub

Full document details: BS ISO 16079-2:2020

National foreword

This British Standard is the UK implementation of ISO 16079-2:2020.

The UK participation in its preparation was entrusted to Technical Committee GME/21/7, Mechanical vibration, shock and condition monitoring - Condition monitoring.

A list of organizations represented on this committee can be obtained on request to its committee manager.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2020
Published by BSI Standards Limited 2020

ISBN 978 0 580 51640 5

ICS 27.180

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 September 2020.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS ISO 16079-2:2020

INTERNATIONAL STANDARD

ISO 16079-2

First edition
2020-09

Condition monitoring and diagnostics of wind turbines —

Part 2: Monitoring the drivetrain

Surveillance et diagnostic des éoliennes de production d'électricité — Partie 2: Surveillance de la transmission

Reference number
ISO 16079-2:2020(E)

Documents
Document Sharing Hub

© ISO 2020

Full document details: BS ISO 16079-2:2020

COPYRIGHT PROTECTED DOCUMENT

© ISO 2020

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO 2020 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO 16079-2:2020

Contents

Page

Foreword ..... **v**
Introduction ..... **vi**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Abbreviated terms **2**
5 Failure mode and symptoms analysis (FMSA) **2**
5.1 General 2
5.2 The process of the FMSA analysis 2
6 Descriptors for fault detection **3**
6.1 General 3
6.2 Descriptor types 4
6.3 Descriptors based on process parameters — Operational values 5
6.3.1 General 5
6.3.2 Measurement of process parameter descriptors 6
6.4 Measurement of rotational speed and descriptors based on rotational speed 6
6.4.1 General 6
6.4.2 Measurement of rotational speed 7
6.5 Descriptors based on vibration 7
6.5.1 References to other standards 7
6.5.2 General 7
6.5.3 Measurement of vibration 8
6.5.4 Transducers for vibration measurements 8
6.5.5 Vibration transducer mounting 9
6.6 Descriptors based on stress wave measurements 10
6.6.1 General 10
6.6.2 Measurement of stress waves 10
6.6.3 Transducers for stress wave measurement 11
6.6.4 Mounting of stress wave sensors 11
6.7 Descriptors based on oil debris in lubricant oil 11
6.7.1 General 11
6.7.2 Oil debris descriptors 12
6.7.3 Oil debris sensors 12
7 Descriptor monitoring interval **13**
7.1 Reference to other standards 13
7.2 Factors influencing the monitoring interval 13
8 Descriptor notification criteria **14**
8.1 Reference to other standards 14
8.2 General 14
8.3 Establishing descriptor alarm and alert limits for a new turbine 15
8.4 Establishing alarm and alert limits for a turbine in normal operating condition 15
8.5 Establishing alert limits upon component change 15
9 Handling changes in operating conditions — The operational state bin concept **16**
9.1 General 16
9.2 Example of how to use active power as an operational state 16
10 Transducer locations **17**
10.1 Reference to other standards and guidelines 17
10.2 Location of vibration transducers 17
10.3 Location of stress wave transducers 19
10.4 Location of oil debris sensors 19

AVA Documents
Document Sharing Hub

© ISO 2020 – All rights reserved

Full document details: BS ISO 16079-2:2020

10.5 Example of naming conventions and transducer locations ... 19

11 Baseline — Initial recording of data for diagnosis at commissioning time ... 20
11.1 General ... 20
11.2 Duration of time waveforms for baseline recording ... 20
11.3 Repeatability and stability of time waveform recordings ... 21
11.4 Sampling rate of time waveform for baseline recording ... 21
11.5 Initial check of the baseline data — Recommendations ... 21

12 Diagnosis of faults and their causes ... 22
12.1 Reference to other standards ... 22
12.2 General ... 22
12.3 Component data ... 22
12.4 Raw-data time waveforms for detailed diagnosis ... 22
12.5 Regular recording ... 22
12.6 Recording on request ... 23

13 Prognosis ... 23
13.1 Reference to other standards ... 23
13.2 General ... 23
13.3 Type I — Failure data-based prognostics — Statistically based ... 24
13.4 Type II — Stress based prognostics — Model based ... 25
13.5 Type III — Data-driven method — Condition based ... 25

14 Review of the condition monitoring and diagnosis system design ... 25
14.1 Reference to other standards ... 25
14.2 General ... 26
14.3 Assessment of effectiveness of the condition monitoring system ... 26
14.4 Cost benefit analysis ... 27
14.4.1 General ... 27
14.4.2 Simple model ... 27
14.4.3 Advanced model ... 28

Annex A (informative) **Details on vibration-based descriptor types ... 31**

Annex B (informative) **FMSA analysis of the drivetrain ... 40**

Bibliography ... 43

© ISO 2020 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16079-2:2020

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 5, *Condition monitoring and diagnostics of machine systems*.

A list of all parts in the ISO 16079 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.

© ISO 2020 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16079-2:2020

Introduction

This document is the second step of the procedure for carrying out the CM and D application design phase according to the V-model of ISO 13379-1. In this step, the monitoring strategy for the drivetrain is defined, based upon the prioritized failure modes which were the outcome of the failure modes, effect and criticality analysis (FMECA) procedure performed according to ISO 16079-1 (see Figure 1).

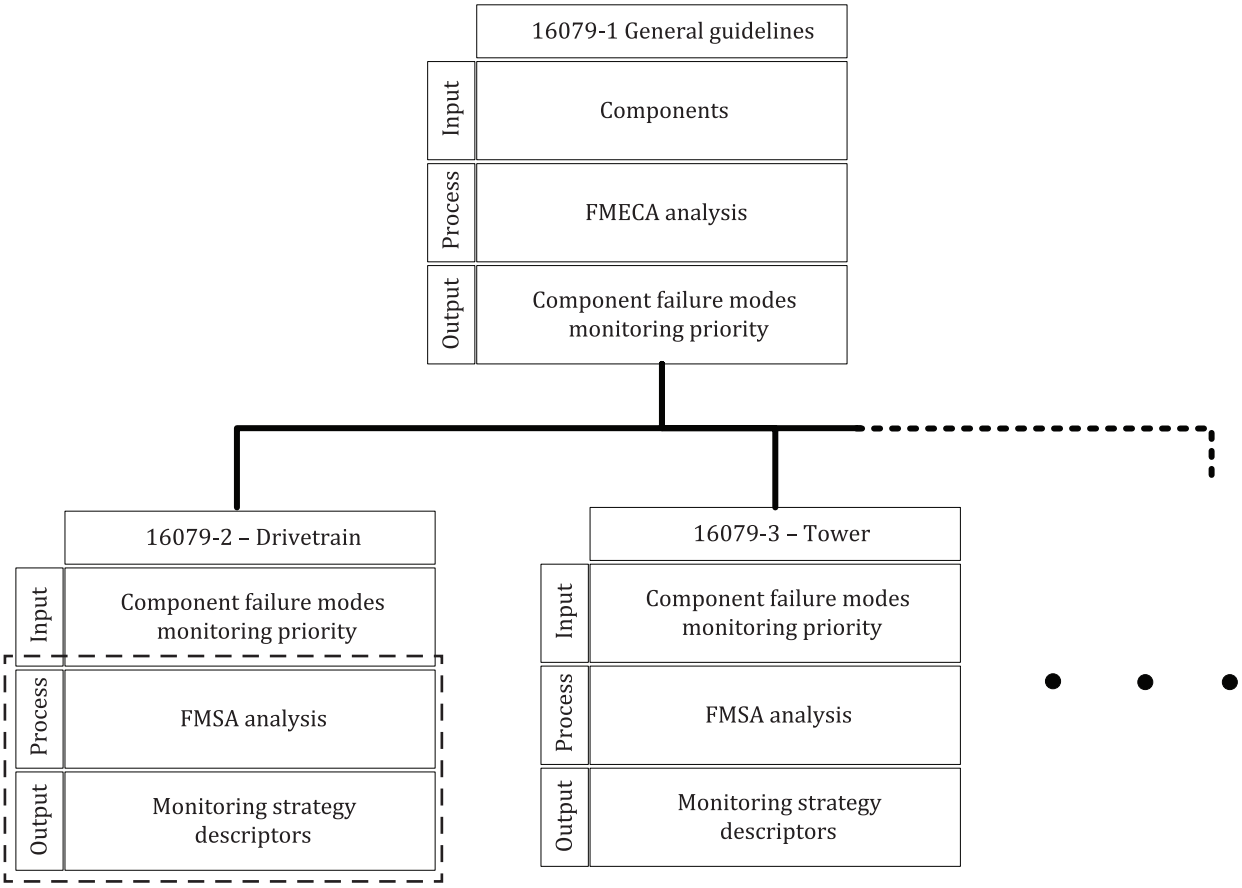
According to the V-Model of ISO 13379-1 and ISO 16079-1, the steps described in this document are as follows:

a) decide under which operating conditions the different faults can be best observed and specify the conditions under which the symptom is most likely to be observed;

b) identify the symptoms that can serve in assessing the condition of the machine, and that are used for diagnostics;

c) list the descriptors that are used to evaluate (recognize) the different symptoms;

d) identify the necessary measurements and transducers from which the descriptors are derived or computed.



Key

dotted line scope of this document

Figure 1 — The relationship between this document and ISO 16079-1

In relation to the V-model, this document describes the two last steps of the application design phase of the condition monitoring system. This process shall ensure that data are available to support an

© ISO 2020 – All rights reserved
AVA Documents Document Sharing Hub
Full document details: BS ISO 16079-2:2020

efficient process in the use phase of the condition monitoring system. The end goal of the "Use phase process" is minimizing wind turbine downtime through a risk assessment of a detected fault by means of remaining useful life (RUL) evaluation, and successive determination of maintenance timing. The criticality and risk assessment uses information from the FMECA analysis, but may also feed information back into an adjustment of the initial FMECA analysis (see Figure 2).

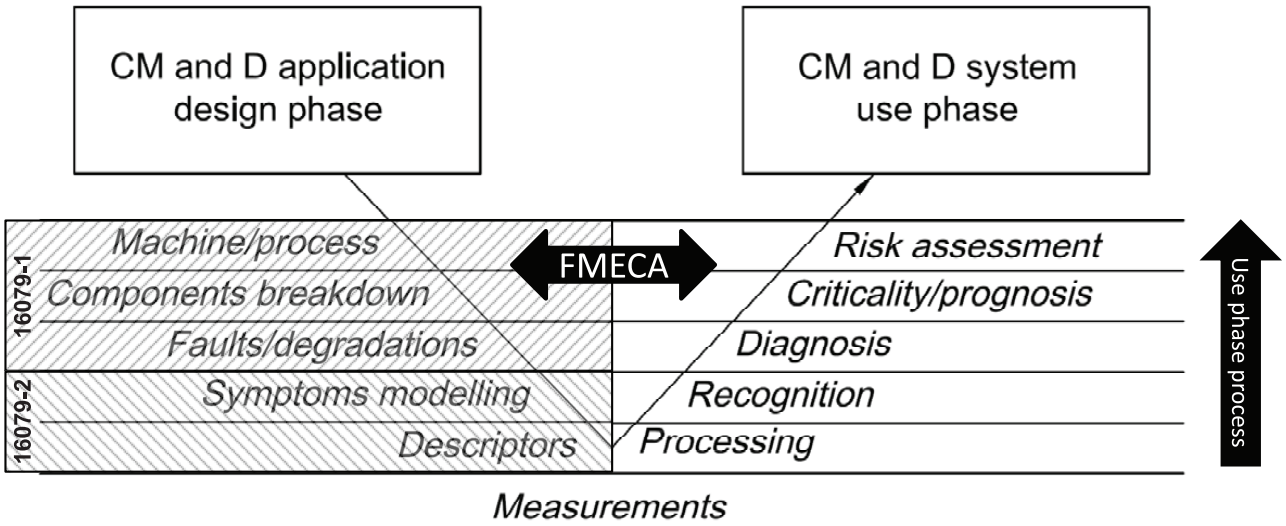


Figure 2 — Condition monitoring and diagnostics (CM and D) cycle: Design phase and use phase of the application on a machine

This document shows how to apply the results of an FMECA analysis made according to ISO 16079-1 by prescribing a methodology for making a failure mode symptoms analysis (FMSA) with the purpose of defining symptoms and related descriptors to detect a particular failure mode.

In order to implement the results of the FMSA, sections with guidelines for condition monitoring of wind turbines are provided, covering:

1) guidelines for descriptor measurements;

2) adapting to changes in operating conditions;

3) selection of transducers and transducer technology;

4) selection of transducer locations;

5) naming convention for identifying transducer locations and related descriptors;

6) evaluation criteria for descriptor measurements;

7) requirements to data for diagnosis;

8) prognosis and/or criticality assessment; and

9) review of the CM & D design:

   a) assessment of effectiveness of the diagnostics system, and

   b) cost benefit analysis.

Figure 3 shows the relationship between the monitoring strategy, diagnostic strategy and maintenance strategy and how these important elements support the steps in the condition monitoring process. If the monitoring strategy, the diagnostic strategy, or both are based upon weak or missing data, it compromises the prognosis and the whole purpose of the condition monitoring process.

© ISO 2020 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16079-2:2020

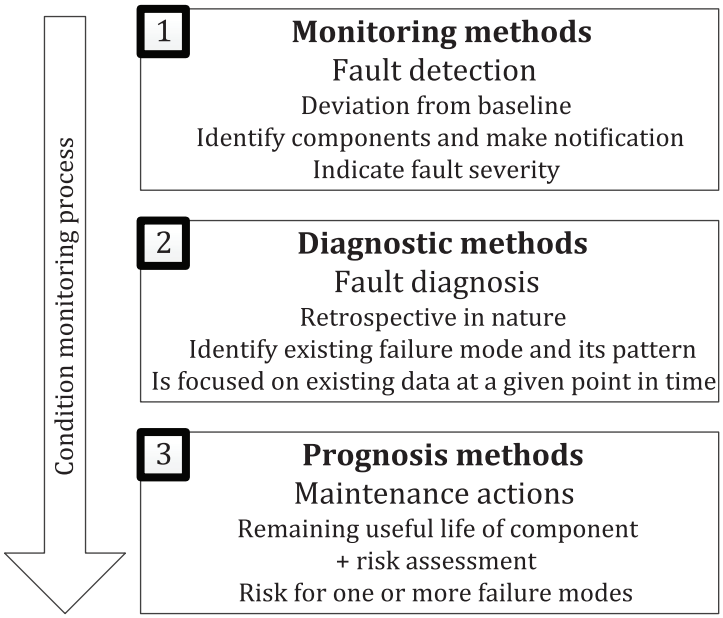


Figure 3 — Relationship between monitoring methods, diagnostic methods and prognosis methods

The selection of the monitoring method is to define where you measure, what you measure and how often you measure in order to provide data for:

— detecting the failure modes designated to be revealed by the condition monitoring system;

— assessing the severity of the present state of the fault;

— assessing the remaining useful lifetime of a certain component.

A weak point in the condition monitoring system setup (e.g. lack of transducers or bad transducer location, limitations in what can be measured, or too sparse data) affects the end goal of the condition monitoring process – the prognosis.

The choice of the diagnostic method is to provide enough data for:

— detailed analysis of a failure mode and identification of the root-cause;

— assessing the severity of the present state of the fault;

— assessing the remaining useful lifetime of a certain component.

The purpose of the prognosis is to make a prediction of remaining useful lifetime (RUL) of a component and assess the risk for related failure modes (secondary failure).

The maintenance action is based upon the data provided by the monitoring methods, the diagnostic methods and the prognosis methods, and on knowledge of maintenance history and alarm history. Therefore, it is very important that not only measured data are stored, but also information about earlier alarms, maintenance actions and identification of persons which have been involved with earlier alarm handling on the machine.

© ISO 2020 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 16079-2:2020

Condition monitoring and diagnostics of wind turbines —

Part 2: Monitoring the drivetrain

1 Scope

This document specifies the implementation of a condition monitoring system for wind turbines, with particular focus on monitoring of the drivetrain. Guidance for a practical implementation of the FMSA is provided, as well as guidance for specifying best practices and minimum recommendations regarding the condition monitoring system used for failure mode detection, diagnostics and prognostics of the direct drive and geared wind turbine drivetrain, including:

a) main bearing(s);

b) gearbox, if applicable; and

c) generator (mechanical aspects).

This also includes subcomponents such as coupling and the lubrication system.

This document provides an overview of the important aspects of condition monitoring of wind turbines and makes references to other standards where in-depth information on the subjects is available.

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041 and ISO 13372 and the following 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

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

3.1
time waveform
sampled vibration signal recorded from the transducer

Note 1 to entry: Time waveform recordings have a certain length in time and represent a parameter value at every instance during the recording of the time waveform.

© ISO 2020 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16079-2:2020

4 Abbreviated terms

Table 1 gives the explanations of abbreviated terms used in this document

Table 1 — Abbreviated terms and their explanations

Abbreviation	Explanation
ETTF	Estimated time to failure.
FFT	Fast Fourier Transform.
FMECA	Failure modes, their effect and criticality analysis.
FMSA	Failure mode symptoms analysis.
IEPE	Integrated electronics piezoelectric. An accelerometer type using constant current supply. The abbreviation CCS (constant current source) is also used for this type of accelerometer.
IIoT	Industrial Internet of Things. Refers to a subcategory of the broader Internet of Things (IoT). Both concepts have the same main character of availability of intelligent and connected devices. The only difference between the two is their general usages. While IoT is most commonly used for consumer usage, IIoT is used for industrial purposes, such as manufacturing, supply chain monitoring and management systems.
MEMS	Micro electromechanical system. Applies to any sensor manufactured using microelectronic fabrication techniques. These techniques create mechanical sensing structures of microscopic size, typically on silicon. When coupled with microelectronic circuits, MEMS sensors can be used to measure physical parameters, such as acceleration.
n_{MP}	Monitoring priority number.
OPC	Open platform protocol. The purpose of OPC is to define an open common interface that is written once per device and then reused by any SCADA, HMI, or custom software packages. The OPC Foundation maintains the OPC standard, which has been adopted by IEC as the IEC 62541 series.
RUL	Remaining useful lifetime.
TCP/IP	Transmission control protocol/Internet protocol. The suite of two protocols, TCP and IP, used to interconnect network devices on the Internet.

5 Failure mode and symptoms analysis (FMSA)

5.1 General

The FMSA process is essentially an extension of the FMECA process with a focus on the symptoms produced by the identified and ranked possible failure modes that were the outcome of the FMECA analysis.

The FMSA methodology is designed to assist with the selection of monitoring techniques and strategies that provide the greatest sensitivity to detection and rate of change of a given symptom, thus maximizing the confidence level in the diagnosis and prognosis of each of the failure modes identified for each of the components of the wind turbine drivetrain.

Where the confidence in a technique's sensitivity and resulting diagnosis/prognosis accuracy is questionable, then the use of additional techniques for further correlation is recommended.

Refer to ISO 16079-1 which gives guidance on applying FMECA analysis to wind turbines.

5.2 The process of the FMSA analysis

The FMSA analysis shall be a team effort with participation of condition monitoring experts as well as participation of staff with an in-depth knowledge of the machine under analysis.

© ISO 2020 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 16079-2:2020

The essential elements of the FMSA process are:

— listing the components involved;

— listing the possible failure modes for each component;

— listing the effects of each failure mode;

— listing the causes of each failure mode;

— listing the symptoms produced by each failure mode;

— listing the most appropriate primary and feasible monitoring technique;

— listing the estimated frequency of monitoring – monitoring interval;

— listing the most appropriate correlation techniques. Increased diagnosis and prognosis confidence can be gained by using "correlation techniques" when monitored at a given frequency.

The FMSA analysis shall be performed for each component/failure mode, which can be prioritized by using the monitoring priority number (n_{MP}) of the FMECA analysis.

A practical approach is to use copies of Table 2 to structure the FMSA process.

Refer to the example in Annex B which shows an FMSA analysis for the most common failure modes of the wind turbine drivetrain.

Table 2 — Template for implementation of the FMSA analysis

Component: <RDS-PP reference>	**<descriptive name from FMECA analysis>**	**<short name according to IEC 61400-25-6>**
Failure mode	<name of failure mode from FMECA analysis>	
Cause of failure mode	<What is the failure mode caused by>	
Effect of failure mode	<What is the effect of the failure mode. What happens>	
Monitoring priority number (n_{MP})	<monitoring priority number from the FMECA analysis>	
P-F Timescale	<Rough assessment>	
Symptom(s)	<describe the symptom(s) indicating the failure mode>	
Descriptors	<descriptor name>	<explanation>
	<descriptor name>	<explanation>
	…	…
Primary monitoring technique	<describe detection method>	
Monitoring interval	<interval between successive descriptor measurements>	
Operational state bin parameter	<descriptor name> if more than one correlation parameter, add more rows to the table.	

6 Descriptors for fault detection

6.1 General

The FMSA process provides a list of potential fault indicators – the descriptors; this clause describes how some of those descriptors may be derived.

NOTE In some literature, the term "characteristic value" is used instead of "descriptor".

The format of a descriptor is a single scalar value and a timestamp. This makes descriptors very suitable for long term trending against time. Changes in the measured value of descriptors are very easily detected and correlation between different descriptor values such as vibration-based values and

© ISO 2020 – All rights reserved

AVA Documents Document Sharing Hub
Full document details: BS ISO 16079-2:2020

process parameters is straightforward. Any database historian can store descriptor values due to the simple format.

Regardless of the technique, the capability of a condition monitoring system relies upon the following basic elements: the number of sensors, the type of sensors, and the associated signal processing and simplification methods utilized to extract important information in the form of descriptors from the various signals and observations.

A symptom indicating a fault is expressed by the behaviour of one or more descriptors with respect to:

— presence,

— absence,

— increase or decrease,

— rate of change,

— location(s) of the change of descriptor,

— operating conditions.

The more selective the descriptors are, the more selective the symptoms, and therefore, the easier the diagnosis. The descriptor selectively reduces the number of fault hypotheses when inferring from symptoms to fault.

The number of descriptors which are defined shall be considered very carefully. It shall be ensured that each descriptor provides value and redundancy shall be avoided. The resources for performing the condition monitoring increase with the number of descriptors, as a result of the increased number of potential alarms due to statistical outliers.

6.2 Descriptor types

The descriptors are chosen based on the FMSA, which has provided a range of characteristics of specific faults. The most common descriptor types utilized for fault detection on the wind turbine drivetrain can be grouped as follows and derived from:

— process parameters,

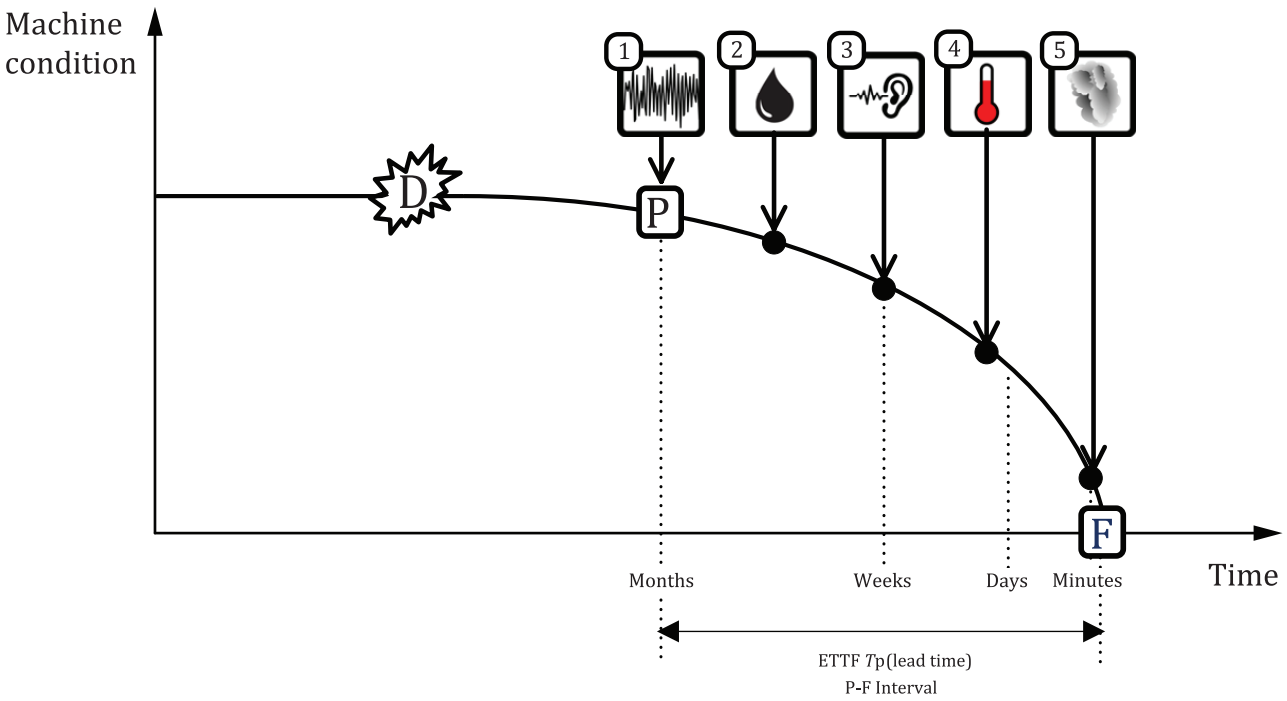
— rotational speed,

— vibration signals,

— on-line oil analysis.

The most common types are descriptors based upon vibration. Descriptors derived from process parameters such as rotational speed, wind speed and actual power are often used for compensating vibration-based measurements with respect to varying operating conditions. On-line oil debris measurements are used for detecting ferrous or non-ferrous particles in the oil. Figure 4 provides an example representation of the development of a mechanical failure.

© ISO 2020 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 16079-2:2020



Key

D fault starts to develop

P point where fault is detectable (potential failure)

F point where functional failure occurs

1 point where increase in vibrations can be detected by advanced descriptors

2 point where mechanical wear particles can be detected by oil analysis

3 point where audible noise can be detected

4 point where temperature increase can be detected by temperature sensors

5 point where smoke can be detected by smell or visually

NOTE The example in the figure represents how a bearing failure would develop in most cases. Some gear faults can be detected earlier by oil analysis. The sequence of detection depends very much on the capabilities of the vibration monitoring system.

Figure 4 — Example representation of the development of a mechanical failure

6.3 Descriptors based on process parameters — Operational values

6.3.1 General

a) Process parameters or operational values are most often values acquired from the wind turbine controller or by direct measurement using a transducer. It may be values such as temperature, pressure, load, voltage, wind speed, wind direction, pitch, active power and bearing temperatures.

b) Such parameters are self-contained, in that they can be trended against each other and/or against time with no further processing. For these parameters, the pattern of change in value on a millisecond basis does not provide additional information over the inherent longer-term value.

c) The value of the scalar measurement forms the descriptor. Process parameter descriptors can be used for the following:

— Trend versus time, e.g. to visualize changes in bearing temperature.

© ISO 2020 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16079-2:2020

— Correlation: trend vs. other descriptors to visualize any dependency between one or more descriptors.

— Operational state classification: for adapting the alarm evaluation of consecutive vibration measurements to the running conditions.

Examples of important process parameter descriptors include:

— **Active power**: this process parameter is important as it is proportional to the load on the wind turbine; in general, the stress on the components is higher when power production is high. Active power correlates also very well with the vibration level sensed on the components of the drivetrain. Active power is an important parameter for operational state classification.

— **Wind speed**: this process parameter also indicates the stress the wind turbine has been exposed to.

— **Temperature**: monitoring the temperature of a component is a very common condition monitoring method. Temperature monitoring is used to detect the presence of any potential failure related to temperature changes in the component. Temperature monitoring is used on components such as bearings, oil, and generator windings. Temperature monitoring provides information on the ongoing deterioration process in the component from excessive mechanical friction due to faulty bearings and gears, insufficient oil properties, and loose or bad electrical connections. However, temperature develops slowly and is not enough for early and precise fault detection. Furthermore, the measured temperature can also be influenced by the surroundings. Temperature is a valuable secondary source of information together with vibration monitoring.

6.3.2 Measurement of process parameter descriptors

Process parameters are usually provided by:

— 4-20 mA current loop signal: the 4-20 mA current loop is a common method of transmitting sensor information in many industrial process-monitoring applications. Transmitting sensor information via a current loop is particularly useful when the information must be sent to a remote location over long distances as the current loop is able to compensate for the voltage drop on the signal line. Many older wind turbine controllers can provide process parameters via a 4-20 mA output.

— Voltage: some controllers provide a voltage signal proportional to the process parameter. However, this is not as common as the 4-20 mA current loop and not suited for transmitting signals over long distances.

— Via LAN: process parameters may be acquired directly from the controller, or from the SCADA system via network protocols. High level protocols such as Modbus TCP/IP or OPC are very common. Some vendors have their own proprietary network protocols.

6.4 Measurement of rotational speed and descriptors based on rotational speed

6.4.1 General

Measurement of the rotational speed is important for compensating other descriptors for variation in the rotational speed of the turbine. Many descriptors used for indicating failure modes on the drivetrain are speed dependent. This means that they are not measured at a certain fixed frequency but are measured at a frequency which is a certain ratio to the running speed. Gearbox descriptors such as the vibration level at the tooth meshing frequencies are typical examples of speed dependent descriptors.

The raw speed signal can be stored as a time waveform, or as time stamps related to trigger points related to shaft position. (1/rev or n/rev). This data can be used for further processing of rotational-speed-related descriptors and in detailed diagnostic investigations.

© ISO 2020 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 16079-2:2020

6.4.2 Measurement of rotational speed

It is important to select the correct sensor type and the correct number of sensors for the speed measurement.

1) Phase reference tachometer: usually inductive proximity switches or incremental encoders are used as a speed reference. In most cases (depending on the gear box transmission ratio), it is enough to only have one tachometer pulse per revolution at the high-speed shaft, as this facilitates both measuring the vibration magnitude and the phase of the vibration signal. Phase measurements are useful when it is needed to detect shaft related problems. For analysis of the low speed rotor, it is useful to have a separate phase reference on the low speed shaft for vibration vector analysis.

2) Incremental encoders, either on the high-speed shaft or input shaft, provide a phase and a more accurate speed measurement. If two incremental encoders are used, a torsional vibration measurement is possible.

3) Speed measurements from the turbine controller can only be used if the accuracy and resolution is sufficient. Insufficient resolution may lead to faults when doing speed dependent analysis.

6.5 Descriptors based on vibration

6.5.1 References to other standards

For more information on the content of this clause, refer to:

— ISO 5348,

— ISO 13373-1,

— ISO 13373-2,

— VDI 3832.

6.5.2 General

When using vibration data for condition monitoring, the raw signals from the vibration transducers contain a lot of information about the machine component. Unlike a traditional process parameter (e.g. a temperature), which is measured at a certain location, the raw signal from a vibration transducer can be further processed to extract several different descriptor types indicating the vibration level at the characteristic frequencies of the different machine components. Vibration is caused by the motion of the turbine components on either a macroscopic level (e.g. introduced by unbalance or misalignment) or a microscopic motion (e.g. introduced by impacting, fatiguing and friction).

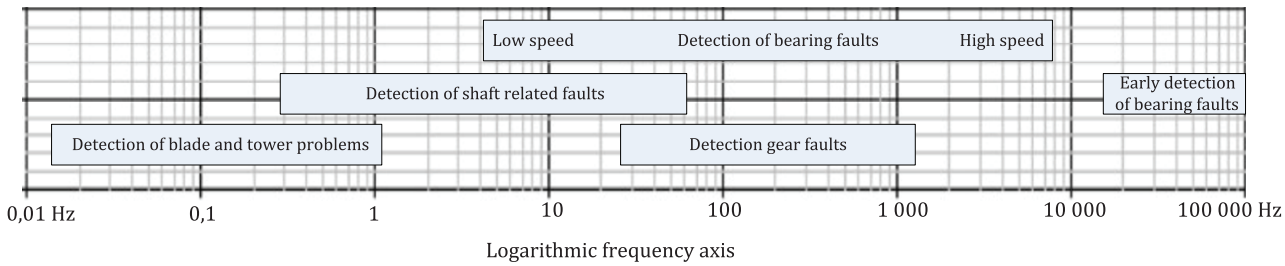


Figure 5 — Typical representation of frequency ranges for failure modes on a wind turbine

As an example, one descriptor can indicate if a bearing fault is present by measuring the vibration level at the outer ring of a certain bearing, another can indicate the vibration level at the shaft running speed and can indicate misalignment, unbalance or other shaft related faults. Figure 5 indicates the need for different descriptor types in a wide frequency range for detecting vibration related failure modes on a wind turbine.

© ISO 2020 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16079-2:2020