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# Mechanical vibration — Vibration of rotating machinery equipped with active magnetic bearings —

## Part 5: Touch-down bearings

*Vibrations mécaniques — Vibrations de machines rotatives équipées de paliers magnétiques actifs —*

*Partie 5: Paliers d'arrêt*

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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 14839 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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# Mechanical vibration — Vibration of rotating machinery equipped with active magnetic bearings —

# Part 5: Touch-down bearings

## 1 Scope

This document gives guidelines for identifying:

a) The typical architectures of touch-down bearing systems to show which components are likely to comprise such systems and which functions these components provide;

NOTE Touch-down bearings are also known as “backup bearings”, “auxiliary bearings”, “catcher bearings” or “landing bearings”. Within this document, the term “touch-down bearings” is used exclusively as defined in ISO 14839-1.

b) The functional requirements for touch-down bearing systems so that clear performance targets can be set;

c) Elements to be considered in the design of the dynamic system such that rotordynamic performance can be optimized, both for touch-down bearings and active magnetic bearings (AMBs);

d) The environmental factors that have significant impact on touch-down bearing system performance allowing optimization of overall machine design;

e) The AMB operational conditions that can give rise to contact within the touch-down bearing system so that such events can be considered as part of an overall machine design. It also considers failure modes within the AMB system that can give rise to a contact event. This ensures that the specification of the touch-down bearings covers all operational requirements;

f) The most commonly encountered touch-down bearing failure modes and typical mechanisms for managing these events;

g) Typical elements of a design process for touch-down bearing systems including the specification of load requirements, the sizing process, the analytical and simulation methods employed for design validation;

h) The parameters to be taken into account when designing a touch-down bearing system acceptance test programme including the test conditions to be specified and the associated instrumentation to be used to ensure successful test execution;

i) The condition monitoring and inspection methods that allow the status of in-service touch-down bearings to be evaluated and when necessary identifying the corrective actions to be taken;

j) The factors to be considered when designing the maintenance regime for a touch-down bearing system including the actions to be taken after specified events have occurred together with any actions to be performed on a regular basis;

k) The factors to be considered regarding other life cycle topics (e.g. obsolescence management, de-commissioning and disposal).

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## 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 14839-1, *Mechanical vibration — Vibration of rotating machinery equipped with active magnetic bearings — Part 1: Vocabulary*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041 and ISO 14839-1 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 https://www.electropedia.org/

## 4 General structure and components

Rotating machinery equipped with AMBs is typically also equipped with touch-down bearings. These touch-down bearings are intended to support the rotor when the AMB system is not activated or during a failure or overload of the AMB system. In these instances, the touch-down bearings are required to support the rotor until either levitation is recovered or the rotor is brought to zero rotational speed without damaging to other parts of the machine.

During normal operation of the machinery, the touch-down bearings have a clearance with the rotor and consequently do not apply force. The clearance at the touch-down bearings is typically the closest clearance within the rotating machine. This ensures in the event of a problem with the AMB, when the rotor moves away from its normal “centred” operating position, the first item to make contact between the rotor and stator is the touch-down bearing. Such an event occurring during rotation is referred to as a “touch-down event”, “landing event”, “contact event” or “drop event”. Such events have historically been categorized by some vendors as either “hard” landings, where a full de-levitation from high speed occurs or “soft” landings where either a partial de-levitation or a momentary contact occurs.

Touch-down bearings are required to constrain rotor movement in the degrees of freedom normally constrained by the AMB system. In the case of a rotor with two radial AMBs and one axial AMB, the touch-down bearings are required to constrain the associated five axes of movement. This is typically achieved by using:

a) two radial touch-down bearings with a separate axial touch-down bearing;

b) two radial touch-down bearings, each with a single acting thrust face; or

c) one radial touch-down bearing with a combined radial/axial touch-down bearing.

Touch-down bearings use a range of technologies, such as:

d) stator mounted rolling element bearings;

e) rotor mounted rolling element bearings;

f) dry lubricated plain bushings;

g) dry lubricated pad construction;

h) foil bearings;


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