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

**Part 1:
Vocabulary**

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

Partie 1: Vocabulaire

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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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).

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For an explanation on 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 the following URL: 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*.

This second edition cancels and replaces the first edition (ISO 14839-1:2002), which has been technically revised. It also incorporates the Amendment ISO 14839-1:2002/Amd. 1:2010.

The main change compared to the previous edition is as follows:

- the terms have been updated and revised to reflect how they are used in practice.

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.

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

Part 1: Vocabulary

1 Scope

This document defines terms relating to rotating machinery equipped with active magnetic bearings.

NOTE General terms and definitions of mechanical vibration are given in ISO 2041; those relating to balancing are given in ISO 21940-2; those relating to geometric characteristics such as coaxiality, concentricity and runout are explained in ISO 1101.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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 General terms

3.1.1

levitation

maintaining the position of a rotor by attractive or repulsive magnetic forces without mechanical contact

3.1.2

magnetic bearing

bearing which utilizes either attractive or repulsive magnetic forces for the *levitation* (3.1.1) and dynamic stabilization of a rotor

3.1.3

active magnetic bearing

AMB

means of supporting a rotor, without mechanical contact, using only attractive magnetic forces based upon servo feedback technology which normally consists of transducers, electromagnets, *power amplifiers* (3.5.3), power supplies and controllers

Note 1 to entry: For rotating machinery equipped with active magnetic bearings, the graphical symbols for bearings are shown in [Figure 1](#).

Note 2 to entry: The principle of an active magnetic bearing is shown in [Figure 2](#).

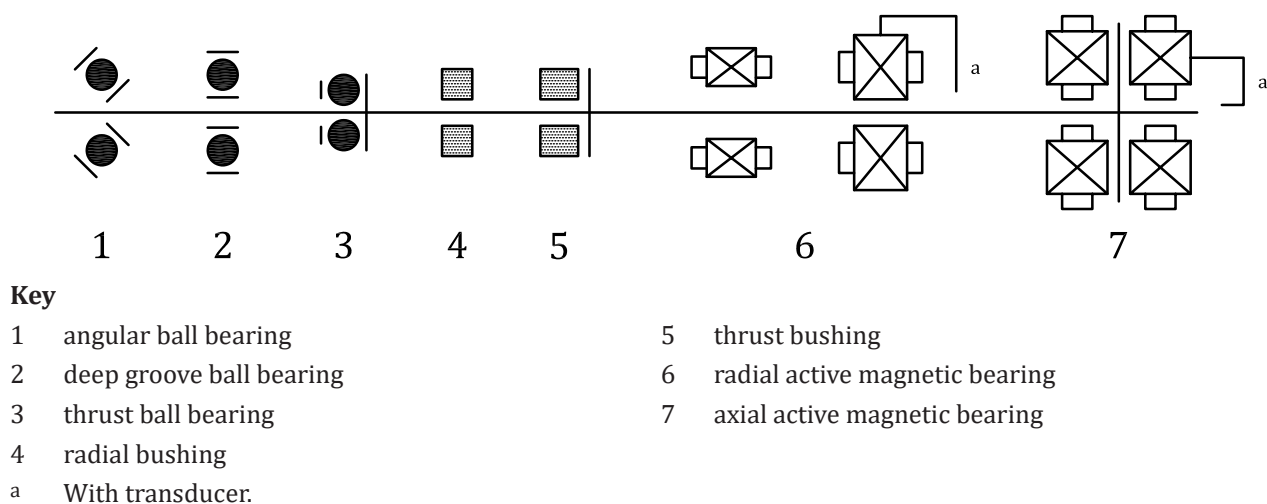


Figure 1 — Graphical symbols for bearings

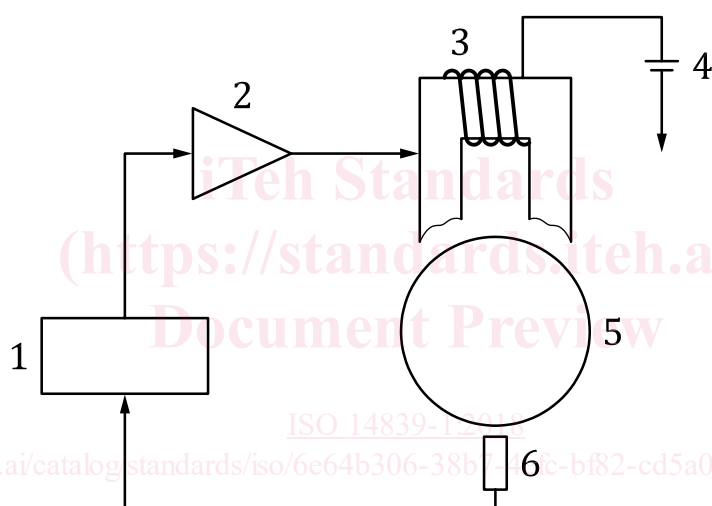


Figure 2 — Principle of active magnetic bearing

3.1.4

passive magnetic bearing

means of supporting a rotor, without mechanical contact, using magnetic forces without feedback control

EXAMPLE *Permanent magnetic bearing (3.1.5), super-conducting magnetic bearing (3.1.6).*

3.1.5

permanent magnetic bearing

PMB

passive magnetic bearing (3.1.4) using one or several pairs of permanent magnets without feedback control

3.1.6**super-conducting magnetic bearing
SMB**

passive magnetic bearing (3.1.4) using a pair of (high-temperature) super conductors and permanent magnets without feedback control, utilizing the so-called pinning force (attractive and repulsive forces)

3.1.7**hybrid magnetic bearing
HMB**

bearing consisting of any combination of an *active magnetic bearing* (3.1.3) and *passive magnetic bearing* (3.1.4)

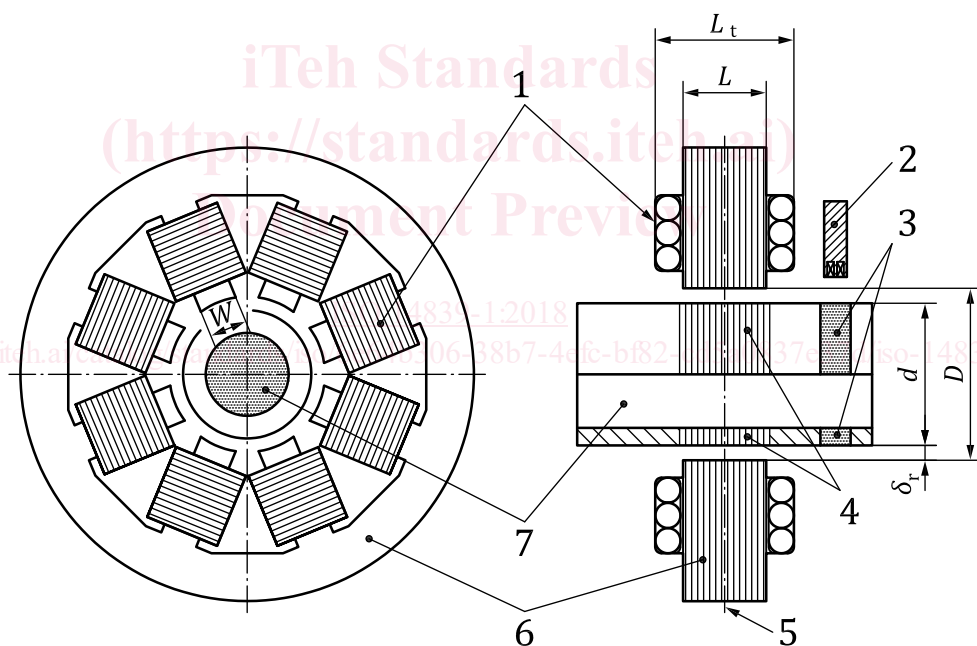
3.1.8**permanent-magnet-biased AMB**

active magnetic bearing (3.1.3) in which the nominal (non-zero) or bias magnetic fluxes are established by one or more permanent magnets

3.1.9**radial magnetic bearing**

magnetic bearing (3.1.2) which levitates a rotor in the radial direction and supports it against disturbances in the radial direction, such as unbalance forces, fluid forces or gravity

Note 1 to entry: See [Figure 3](#).

**Key**

- 1 radial coil
- 2 radial transducer
- 3 radial transducer target
- 4 radial rotor core
- 5 axial centre of radial AMB
- 6 radial stator core
- 7 shaft

- D inner diameter of radial stator core
- d outer diameter of radial rotor core
- δ_r nominal magnetic gap $(D - d)/2$
- L_t total bearing length (including coil windings)
- L effective length of radial bearing
- W width of a magnetic pole
- A_r area of magnetic pole ($A_r = WL$)

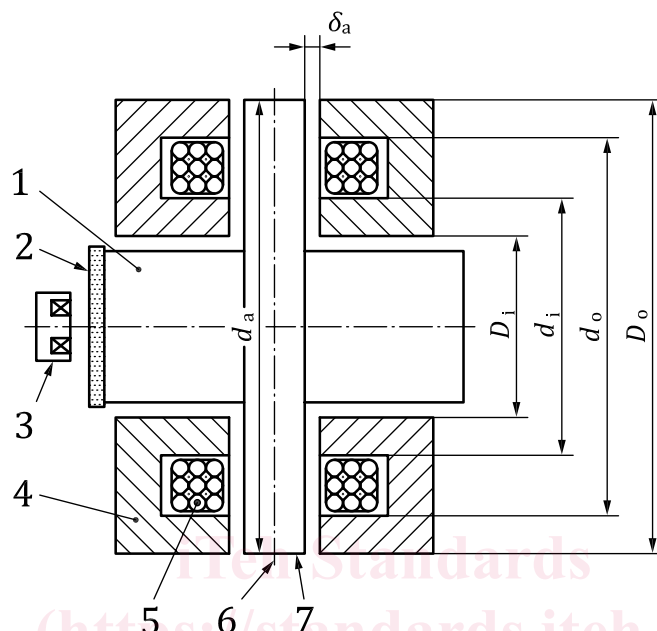
Figure 3 — Radial AMB assembly

3.1.10

axial magnetic bearing thrust magnetic bearing

magnetic bearing (3.1.2) which levitates a rotor in the axial direction and supports it against disturbances in the axial direction, such as fluid forces or gravity

Note 1 to entry: See Figure 4.



Key

- 1 rotor
- 2 axial transducer target
- 3 axial transducer
- 4 axial stator core
- 5 axial coil
- 6 (clearance) centre of axial AMB
- 7 axial rotor disc

- d_a outer diameter of axial rotor disc
- D_o outer diameter of outer pole of axial stator
- d_o inner diameter of outer pole of axial stator
- d_i outer diameter of inner pole of axial stator
- D_i inner diameter of inner pole of axial stator
- δ_a nominal magnetic gap
- A_a area of the magnetic pole pair

$$A_a = \frac{\pi}{4} (D_o^2 - d_o^2 + d_i^2 - D_i^2)$$

Figure 4 — Axial AMB assembly

3.1.11

nominal magnetic gap

distance between the magnetic materials of the rotor and the stator inside the AMB (3.1.3) when the journal centre of the rotor is located in the clearance centre of the bearing stator

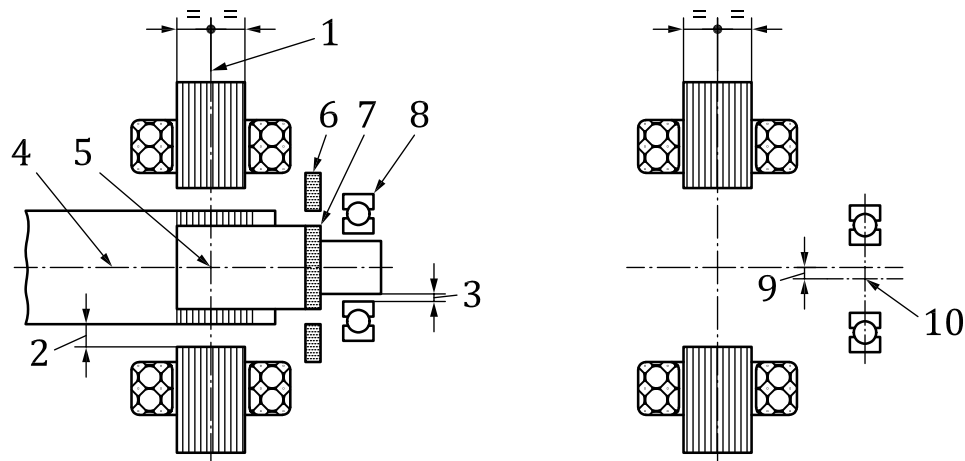
Note 1 to entry: See δ_r in Figure 3 for radial AMB, and δ_a in Figure 4 for axial AMB.

3.1.12

clearance centre of a radial AMB

geometric centre of a radial bearing stator

Note 1 to entry: See Figure 5.

**Key**

- | | |
|--|---|
| 1 axial centre of radial AMB | 7 radial transducer target |
| 2 magnetic gap of radial AMB | 8 touch-down bearing |
| 3 radial clearance of touch-down bearing | 9 radial centre offset between radial touch-down bearing and AMB centre |
| 4 journal (rotor) centreline of radial AMB | 10 radial centre of radial touch-down bearing |
| 5 clearance centreline of radial AMB | |
| 6 radial transducer | |

NOTE Similar consideration applies to a radial homopolar AMB.

Figure 5 — Centres and centrelines of radial heteropolar AMB

3.1.13**magnetic centre of a radial AMB**

position of a rotor in a radial AMB (3.1.3) at which the net radial attractive forces exerted on the rotor go to zero for nominal currents or fluxes, and without any magnetic excitation or compensation forces

3.1.14**axial centre of a radial AMB**

axial directional position of geometric centre of *stator core* (3.3.1)

Note 1 to entry: See Figure 5.

3.1.15**clearance centre of an axial AMB****clearance centre of a thrust AMB**

axial position of the geometric centre of an (axial) thrust AMB (3.1.3) stator

Note 1 to entry: See Figure 4.

3.1.16**axial magnetic centre of an axial AMB**

position of an *axial rotor disc* (3.2.2) in an axial AMB (3.1.3) at which the net axial attractive forces exerted on the rotor disc go to zero for nominal currents or fluxes, and without any magnetic excitation or compensation forces

3.1.17**clearance centreline of a radial AMB**

line between the clearance centres of two radial AMBs (3.1.3) specified by the bearing stator configuration

Note 1 to entry: See Figure 5.

3.1.18

journal centreline of a radial AMB

geometric centreline between the journal centres of a radial AMB (3.1.3) rotor

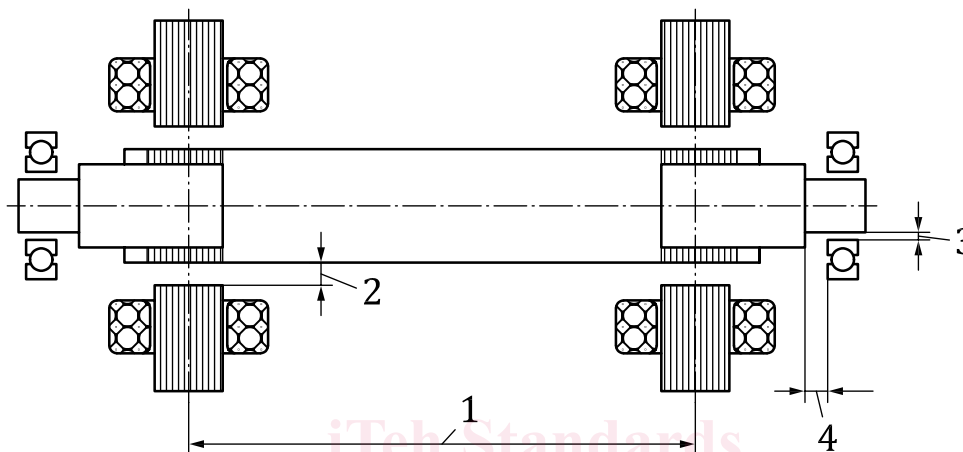
Note 1 to entry: See Figure 5.

3.1.19

bearing span between radial AMBs

axial distance between the axial centres of two radial AMBs (3.1.3)

Note 1 to entry: See Figure 6.



Key

- 1 bearing span between radial AMBs
- 2 magnetic radial clearance of radial AMB
- 3 radial clearance of touch-down bearing
- 4 axial clearance of touch-down bearing

Figure 6 — Heteropolar-type radial AMB

3.1.20

number of poles

sum of the south and north magnetic gap poles of an AMB (3.1.3)

Note 1 to entry: See Figure 7.

3.1.21

heteropolar-type radial AMB

radial AMB (3.1.3) in which the electromagnetic cross section has poles of different polarity, and the poles may have different polarity arrangements

Note 1 to entry: Polarity arrangements can be (N, S, N, S, ...), (N, S, S, N, ...), etc.

Note 2 to entry: See Figure 7 a).

3.1.22

homopolar-type radial AMB

radial AMB (3.1.3) whose electromagnet has more than one axial cross section, each having poles of a single polarity

Note 1 to entry: See Figure 7 b).