INTERNATIONAL STANDARD

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Plain bearings — Testing of the tribological behaviour of bearing materials —

Part 1:
Testing of bearing metals

Paliers lisses — Essai de comportement tribologique des matériaux antifriction —

Partie 1: Essai des matériaux métalliques

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 7148 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 7148-1 was prepared by Technical Committee ISO/TC 123, *Plain bearings*, Subcommittee SC 2, *Materials and lubricants, their properties, characteristics, test methods and testing conditions.*

This second edition cancels and replaces the first edition (ISO 7148-1:1985) which has been technically revised.

ISO 7148 consists of the following parts under the general title *Plain bearings — Testing of the tribological behaviour of bearing materials*:

— *Part 1: Testing of bearing metals*

— *Part 2: Testing of polymer-based bearing materials*

Annex A of this part of ISO 7148 is for information only.

Plain bearings — Testing of the tribological behaviour of bearing materials —

Part 1:
Testing of bearing metals

1 Scope

This part of ISO 7148 specifies tribological tests of metallic bearing materials for plain bearings under conditions of boundary lubrication.

The test procedures, described in this part of ISO 7148 enable the friction and wear behaviour of bearing material/mating/lubricant combinations to be compared with that of other combinations, thus facilitating the selection of a bearing material for running repeatedly or for long periods under conditions of boundary lubrication, low speed and continuous sliding. Owing to differences in test conditions, measured friction and wear values can be expected to vary from one test facility to another.

The test results give useful information for practical application only if all parameters of influence are identical. The more the test conditions deviate from the actual application the greater will be the uncertainty of the applicability of the results.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this part of ISO 7148. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 7148 are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 4385, *Plain bearings — Compression testing of metallic bearing materials.*

3 Symbols and units

See Table 1.

Table 1 — Symbols and units

Symbol	Term	Unit
A, B	Test method	–
a	Sliding distance	km
A_5	Elongation at fracture	%
f	Coefficient of friction; ratio between friction force and normal force, i.e: $f = \frac{F_f}{F_n}$	–
F_f	Friction force	N
F_n	Normal force	N
K_A	Overlap ratio (area of contact divided by area of wear track)	–
K_w	Coefficient of wear, volumetric wear rate related to the normal force, i.e.: $K_w = \frac{V_w}{F_n \times a} = \frac{w_v}{F_n}$	$mm^3/(N \cdot km)$
l_w	Linear wear as measured by change in distance	mm
me	Metallic bearing material	–
m_w	Mass of material removed by wear	g
Ra	Surface roughness	µm
$R_{d0,2}$	Compression limit 0,2 %	N/mm^2
R_m	Tensile strength	N/mm^2
$R_{p0,2}$	0,2 % Proof stress	N/mm^2
T	Specimen's temperature near the sliding surface during testing under steady-state conditions	°C
T_{amb}	Ambient temperature	°C
T_L	Lubricant temperature	°C
t_{Ch}	Test duration	h
U	Sliding velocity	m/s
V_w	Material removed by wear as measured by change in volume	mm^3
w_l	Linear wear rate, i.e.: $w_l = \frac{l_w}{a}$	mm/km
w_v	Volumetric wear rate, i.e.: $w_v = \frac{V_w}{a}$	mm^3/km
η	Lubricant viscosity	mPa·s

4 Special features for the tribological testing of metallic bearing materials

Plain bearings made of metallic materials usually require lubrication (e.g. oil or grease) to ensure a low rate of friction and wear.

If possible, lubricated plain bearings should be designed to run under hydrodynamic conditions, where the sliding surfaces of the journal and the plain bearing are always fully separated by a film of lubricant. Under such conditions friction depends on the rheological properties of the lubricant and wear normally does not occur.

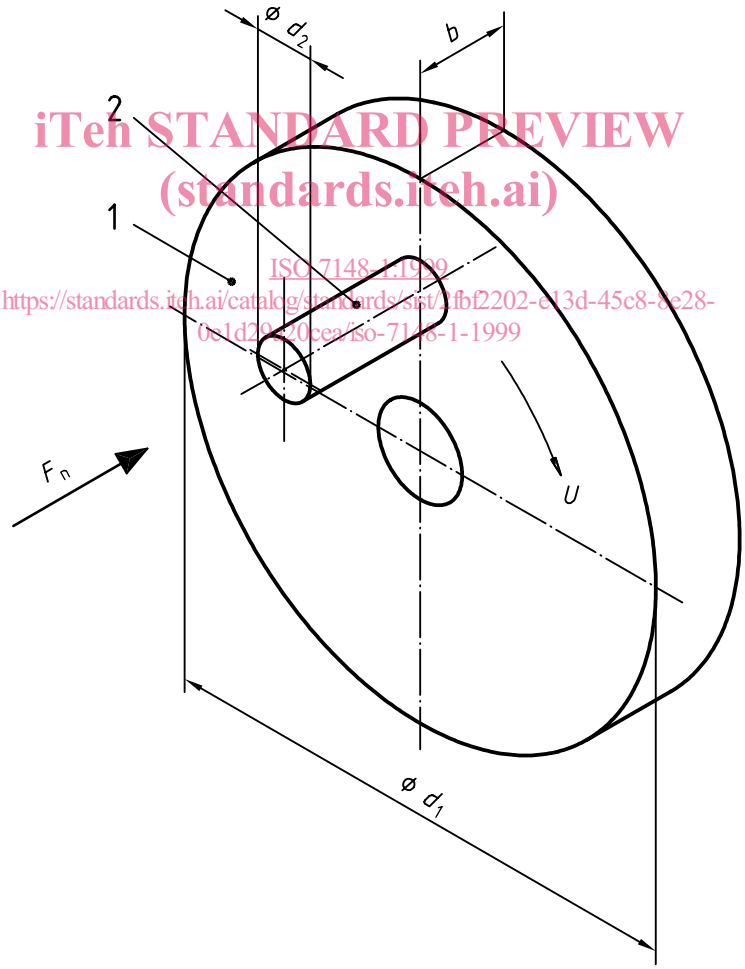
If hydrodynamic operation cannot be ensured, boundary lubrication prevails and wear of the bearing and mating material is likely. This may be during the starting or running down phase of a hydrodynamic plain bearing or when high loads, low sliding velocities, poor lubrication or oscillating movements prevent hydrodynamic action.

5 Test methods

Figures 1 and 2 show schematic drawings of the two possible specimen assemblies.

5.1 Test method A: pin-on-disc

See Figure 1.



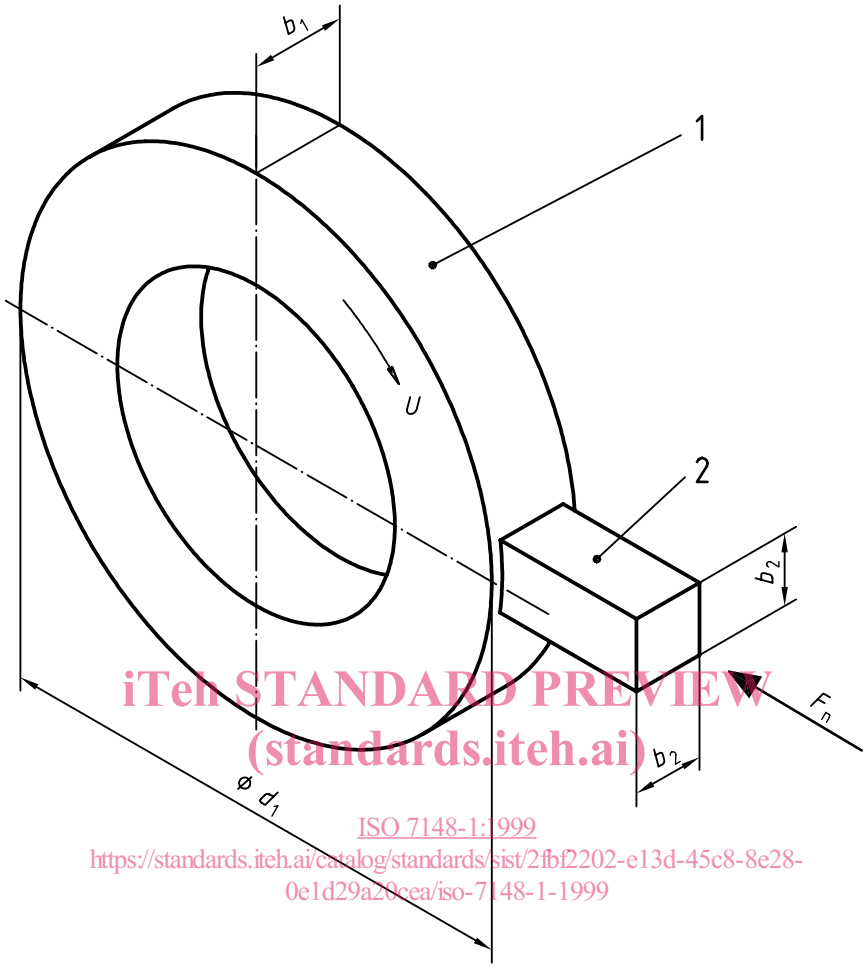
Key

1 Disc or ring
2 Pin or block

Figure 1 — Test method pin-on-disc

5.2 Test method B: block-on-ring

see Figure 2.



Key

1 Disc or ring

2 Pin or block

Figure 2 — Test method block-on-ring

6 Test specimens

6.1 Disc

The disc shall have the following preferred dimensions:

Diameter d_1:40 mm to 110 mm;

Width b: 8 mm to 12 mm.

The diameter of the sliding track shall be noted in the test report.

6.2 Ring

The ring shall have an outside diameter d_1 of 40 mm to 80 mm and the width b_1 of the ring shall exceed the width b_2 of the block.

6.3 Pin

The pin shall preferably have a diameter d_2 of 3 mm to 10 mm.

6.4 Block

The cross-section of the block shall be 5 mm to 10 mm high and 5 mm to 10 mm wide.

6.5 Preparation of the test specimens

After preparing the test surfaces with the same machining methods in order to obtain a suitable surface finish (similar to the application which is to be simulated), the specimens shall be thoroughly cleaned. An example of a cleaning method is:

— cleaning with alcohol, e.g., ultrasonic bath;

— drying in hot air;

— rinsing with hexane;

— drying in a drying stove at 110 °C.

7 Test methods and test equipment

In most cases the pin-on-disc method is preferred.

The pin or block, made of the bearing material is pressed with a known normal force F_n against the rotating specimen (disc or ring) made from the material of the mating component.

In practice, surfaces with cylindrical surface curvature (journal bearings) will also be tested. If they are multilayer materials, there are two alternatives:

a) adapt the radius of the ring to that of the block (see Figure 2);

b) begin testing with line contact (radius of the block to be larger than the radius of the ring).

The linear wear should not exceed the thickness of the surface bearing material layer. For thin layers test method A (pin-on-disc) is preferred.

If tests are performed under an other-than-normal atmosphere use shall be made of either a sufficiently airtight chamber or a high rate of gas flow.

Equipment for the continuous measurement of friction and wear shall be available.

If grease lubrication is to be used, the equipment shall be such that sufficient grease is continuously supplied to the sliding track.

Vibrations in the loading mechanism, which can cause undefined variations in the applied normal force, shall be avoided.

8 Lubrication

Oil or grease lubrication shall be used depending on the practical application. The contact surface between the pin or block and the disc or ring shall be completely filled with lubricant.

When oil lubrication is used, it is preferable for the specimens to be completely immersed in the oil. Spray lubrication may also be used assuming that the volume of the lubricant supplied is sufficient to ensure that the wear rate is not dependent upon the lubricant flow rate. The oil temperature shall be kept constant.

NOTE Test results can vary widely depending on the lubricant used.