INTERNATIONAL STANDARD

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Plain bearings — Bearing fatigue —

Part 1:
Plain bearings in test rigs and in applications under conditions of hydrodynamic lubrication

Paliers lisses — Fatigue des paliers —

Partie 1: Paliers dans les machines d'essai et dans les applications en lubrification hydrodynamique

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.

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.

International Standard ISO 7905-1 was prepared by Technical Committee ISO/TC 123, *Plain bearings*, Subcommittee SC 2, *Materials and lubricants, their properties, characteristics, test methods and testing conditions.*

ISO 7905 consists of the following parts, under the general title *Plain bearings — Bearing fatigue*:

— *Part 1: Plain bearings in test rigs and in applications under conditions of hydrodynamic lubrication*

— *Part 2: Test with a cylindrical specimen of a metallic bearing material*

— *Part 3: Test on plain strips of a metallic multilayer bearing material*

— *Part 4: Tests on half-bearings of a metallic multilayer bearing material*

Annex A forms an integral part of this part of ISO 7905. Annex B is for information only.

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Plain bearings — Bearing fatigue —

Part 1:
Plain bearings in test rigs and in applications under conditions of hydrodynamic lubrication

1 Scope

This part of ISO 7905 describes a method of improving test result comparability by evaluating the stresses in the bearing layers leading to fatigue (see annex A). A similar evaluation is required in practical applications. Because the stresses are the result of pressure build-up in the hydrodynamic film, it is essential to fully state the conditions of operation and lubrication. In addition to dynamic loading, dimensional and running characteristics, the inclusion of the following adequately defines the fatigue system:

a) under conditions of dynamic loading the minimum bearing oil film thickness as a function of time and location to ensure no excessive local overheating or shearing as a result of mixed lubrication when running in;

b) the distribution of pressure circumferentially and axially with time under dynamic loading;

c) from this the resulting stresses in the bearing layers as a function of time and location, especially the maximum alternating stress.

Furthermore, bearing fatigue may be affected by mixed lubrication, wear, dirt, tribochemical reactions and other effects encountered in use thus complicating the fatigue problem. This part of ISO 7905 is therefore restricted to fatigue under full hydrodynamic separation of the bearing surfaces by a lubricant film.

This part of ISO 7905 applies to oil-lubricated plain cylindrical bearings, in test rigs and application running in conditions of full hydrodynamic lubrication. It comprises dynamic loading in bi-metal and multilayer bearings.

NOTE 1 The number of practical applications with different requirements has led to the development of many bearing test rigs. If the conditions of lubrication employed on these test rigs are not defined in detail, test results from different rigs are generally neither comparable nor applicable in practice. Different test rigs may yield inconsistent ranking between equal materials.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 7905. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 7905 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 468:1982, *Surface roughness — Parameters, their values and general rules for specifying requirements.*

ISO 7902-1:—[1], *Hydrodynamic plain journal bearings under steady-state conditions — Circular cylindrical bearings — Part 1: Calculation procedure.*

ISO 7902-2:—[1], *Hydrodynamic plain journal bearings under steady-state conditions — Circular cylindrical*

1) To be published.

bearings — Part 2: Functions used in the calculation procedure.

ISO 7902-3:—[1], *Hydrodynamic plain journal bearings under steady-state conditions — Circular cylindrical bearings — Part 3: Permissible operational parameters.*

3 Objective of testing

In this part of ISO 7905 the objective of testing with plain bearing test rigs, operating in conditions of full hydrodynamic lubrication, is to measure the dynamic load-carrying capacity e.g. the fatigue indurance limit of the bearing layer material in terms of amplitude of stress and number of cycles. This may be presented as a σ_{el}-N curve (endurance limit stress plotted against number of cycles), or as the endurance limit stress for a specified number of cycles. Endurance limit is reached when cracks appear in the bearing surface.

In terms of current understanding, the restriction to full hydrodynamic lubrication is a necessary simplification of the fatigue problem. This implies that the essential running-in of the bearing under test shall be carefully controlled to avoid significant predamage from excessive temperature and frictional shear stress which may cause surface microcracks.

NOTE 2 It should be noted that fatigue testing of bearing materials may be conducted also by utilizing the more classic methods of testing. See parts 2 to 4 of ISO 7905.

4 Requirements

4.1 Test rigs

In order to define the operating and lubricating conditions, the test rig shall have the following characteristics:

a) simple and clear mechanical construction;

b) easy dismantling, preferably with an *in situ* bearing inspection capability;

c) bearing dimensional stability under test together with resistance to deformation of housing and shaft deflection;

d) adequate lubricant supply without impairing oil film pressure development;

e) be capable of exceeding the entire range of load/stress and temperature encountered in practice.

4.2 Test methods

The test methods shall have the following characteristics:

a) the ability to apply specialized measuring techniques for oil film thickness, lubricant temperature, pressure distribution and crack disintegration debris; such techniques for the latter aspect include continuous radio nuclide measurement of wear or X-ray fluorescent analysis of intermittently withdrawn lubricant samples;

b) well-defined, experimentally verified hydrodynamic conditions (e.g. the verification of effective viscosity indicative of hydrodynamic behaviour);

c) clear distinction between mixed lubrication during running-in and full hydrodynamic lubrication during fatigue testing;

d) the stress can traverse the bearing as uniformly as possible (rotating load) in order to detect irregularities in the bearing material;

e) simple, theoretically and experimentally reproducible hydrodynamic conditions (i.e. a rotating load produces a hydrodynamic film and pressure distribution equal to a static load).

5 Test methods

In order to assure the compatibility of test results from different test rigs and their putting into practice, all parameters controlling the hydrodynamic oil film shall be detailed, starting with test conditions, bearing dimensions, lubricant and other factors influencing hydrodynamic oil film. The following constitute the essential characteristic conditions and parameters for fatigue testing.

5.1 Characteristic conditions

5.1.1 Effective running-in procedure

This is designed in order to avoid excessive temperature and frictional shear stress due to heavy asperity contact. The progress of running in may be monitored by measurements of temperature, electrical resistance, impedance or continuous radio nuclide measurement. For guidance h_0 should initially be greater than $(R_{z,b} + R_{z,s})$, where h_0 equals the minimum oil film thickness determined by measurement or calculation in accordance with parts 1 to 3 of ISO 7902, and $R_{z,b}$ and $R_{z,s}$ are the height of the profile irregularities in ten points of the bearing and counter-