INTERNATIONAL STANDARD

ISO 10129

Second edition
2017-03

Plain bearings — Testing of bearing metals — Resistance to corrosion by lubricants under static conditions

Paliers lisses — Essai des matériaux antifriction — Résistance à la corrosion par des lubrifiants dans des conditions statiques

Reference number
ISO 10129:2017(E)

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Foreword

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This document 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 10129:2006), which has been technically revised.

Introduction

It is essential that certain properties of bearing materials combined within the tribological system remain unchanged or change only within a permissible range over a long period of time. It is on account of these properties that the materials are regarded as being especially suitable for the tribological system. As to the tribological system “plain bearing”, the compatibility between the bearing materials and lubricant is of special interest and is dependent on chemical and mechanical actions.

The test established in this document determines the behaviour of plain bearing materials with respect to corrosion by lubricants (lubricating oils) under static conditions, i.e. without any mechanical action taking place simultaneously.

In order for such corrosion tests to be evaluated and compared, it is necessary that they be carried out in accordance with the conditions laid down in this document. Other conditions are to be indicated in detail.

Plain bearings — Testing of bearing metals — Resistance to corrosion by lubricants under static conditions

1 Scope

This document establishes a test of the corrosion-resistance of bearing materials to lubricants. It also specifies the most important general principles for carrying out such corrosion testing.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

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

3.1
corrosion
reaction of a bearing material to its environment, causing a measurable change in the material and which can result in corrosion damage

Note 1 to entry: In most cases, this reaction is of a chemical nature. It can, however, also involve chemical or mechanical processes. Material changes solely caused by or found only in combination with mechanical influences are not dealt with in this document. For a detailed explanation of the various causes of damage to plain bearings, see ISO 7146-1.

4 Health and safety

Resources, test pieces, test materials, test equipment and test procedures shall comply with the current health and safety regulations/laws of the country in which the test is carried out. Where equipment, materials and/or reagents that may be hazardous to health are specified, appropriate precautions in conformity with local regulations/laws shall be taken.

5 General principles

5.1 In general, corrosion tests are carried out as comparison tests, i.e. several materials and lubricants are compared with one another. However, it is also possible to include already known behaviour in the test reference materials or reference lubricants.

5.2 The duration of the test shall be chosen, and, if necessary, extended, so that at the end of the test, definite information on the corrosion behaviour of the material tested and, possibly, of the reference material can be obtained under the specified test conditions.

5.3 A value for a single material test is less informative, owing to a greater dispersion of the results, which often occurs when determining an increase or decrease in mass.

Therefore, each result shall be given as a mean value from at least three tests.

6 Lubricants

The quantity of lubricant used shall be at least 10 ml/cm^2 of bearing material surface.

Specifications indicating the type and performance level of the oils are used to characterize the lubricants used for the tests.

However, in order to be able to draw conclusions concerning, for example, the additives used and their effect, it is recommended that the precise chemical and physical data be given, as follows:

— density at 15 °C, in grams per millilitre;

— flash point, in degree Celsius;

— neutralization value;

— saponification value;

— base number;

— kinematic viscosity at 40 °C, in square millimetres per second;

— kinematic viscosity at 100 °C, in square millimetres per second;

— sulfate ash yield, as a percentage by mass;

— zinc content, as a percentage by mass;

— phosphorus content, as a percentage by mass;

— barium content, as a percentage by mass;

— calcium content, as a percentage by mass;

— content of sulfur in corrosive forms, as a percentage by mass.

7 Apparatus

7.1 Beaker(s), of sufficient capacity to allow each test sample to be fully immersed.

7.2 Heating bath, preferably an oil bath, capable of maintaining the required temperature to within ±2 °C.

The heating bath shall be large enough to allow the beaker to be immersed up to three quarters of its height to prevent overspill of heating bath fluid into the test beaker.

8 Preparation of test samples

8.1 The preferred test sample shall be a complete bearing. Where this is not possible, a test sample of bearing material shall be cut out from parts sufficiently large that any influences of strong mechanical cold-working and of high temperature rise at the edges of the cut are eliminated. Burrs shall be removed.

8.2 The surface of the bearing material shall not be less than 25 cm^2 in order to eliminate as far as possible the influence of irregularities. If one bearing surface area is less than 25 cm^2, consider using more than one in the test vessel and combine the result.

8.3 The surface condition of test samples during the tests shall agree as far as possible with the surface condition of the bearing material in practice. The test sample shall be thoroughly cleaned and degreased. Suitable organic solvents (e.g. white spirit or methanol) should be used.

8.4 Test samples shall be clearly identified or could be marked. Marking methods which harm the mechanical strength of the bearing (e.g. electromechanical methods) shall be avoided.

9 Test procedure

Perform the following test procedure before testing.

a) Record the mass, dimensions and roughness of the test samples.

b) Place the bearing material test samples in the beakers (7.1) in such a way that they are completely covered by the lubricant in order to avoid the influence at the phase limit air/lubricant. Protect the beakers against dirt by means of a cover.

c) In principle, test only samples of the same bearing material in one beaker in order to avoid any interaction. The atmosphere should be free from any substance which could interfere with the test.

d) During the test, maintain the beakers at the specified test temperature to within ±2 °C. Recommended test temperatures are 80 °C, 100 °C, 120 °C, 150 °C and 180 °C.

The duration of the test shall be 20 days at least; it may be extended if necessary (see 5.2). Intermediate assessments shall be made after one week and after two weeks. Test temperatures and test times should be chosen to reflect operating conditions in the intended bearing application.

e) For the purpose of the intermediate and final assessments, clean the test samples by spraying using an appropriate solvent as one of the means. Dry them in a hot-air cabinet until a constant mass is attained. Record the mass, dimensions and roughness.

10 Expression of results

10.1 Mass change

Data concerning the mass changes of the samples are only really informative when the surface of the test samples is uniformly attacked.

The mass change of the samples (mass loss or increase in mass) shall be given as the mean value from at least three samples.

10.2 Changes in dimensions

Data concerning the dimensional changes of the samples are only really informative when the surface of the test samples is uniformly attacked.

The dimensional change of the samples (decrease or increase in dimensions) shall be given as the mean value from at least three samples.

10.3 Surface changes

During the intermediate and final assessments, check the surfaces of the test samples with regard to the frequency, extension and distribution of single corrosion points, as well as discolouration.

Record the macro and micro surface condition by means of photographs. Optical and electron microscopy methods may be used to characterize the surface changes. Depth measurements may be taken by using a scanning electron microscope or surface finish scans.

10.4 Microstructural changes

Metallographical structure tests are necessary if, for example, a constituent or the grain boundary is especially attacked during the corrosion process. Use an appropriate drawing or a photograph to record the positions of the sections and, if necessary, the places from where the test samples were taken.

10.5 Type and nature of the corrosion products

Indicate the colour and nature of the corrosion products in the test report. For basic tests, it can be useful to determine the chemical composition and structure of the corrosion products, for example, by X-ray photoelectron spectroscopy or Auger electron spectroscopy analysis techniques.

10.6 Change of lubricant

The chemical composition or the physical properties of the lubricant can change on reaction with the bearing material. The recording of this change can help considerably when evaluating the compatibility test. The list given in Clause 6 may serve as a basis for the data to be determined.

11 Test report

As well as the presentation of results, the test report shall contain at least the following information:

a) a reference to this document, i.e. ISO 10129:2017;

b) chemical composition of the bearing material samples, and their designation if necessary;

c) condition of the material, e.g. cast, hot-rolled, cold-rolled or method of heat treatment;

d) type of sample, e.g. test sample cut out of solid or multilayer material (e.g. steel/AlSn6Cu) or prefabricated part (bearing liner or bush);

e) method of sampling, e.g. longitudinal direction or at right angles to this;

f) dimensions of the test sample before and after testing;

g) surface roughness of the test sample before and after testing;

h) method of cleaning;

i) microsection before and after testing, to determine the structure, e.g. grain size, distribution of lead or tin in the case of heterogeneous alloys;

j) test duration and test temperature;

k) type and nature of the corrosion products;

l) date and place of testing and name of tester;

m) photographs, sample micro and macro appearance before and after testing.

Bibliography

[1] ISO 7146-1, *Plain bearings — Appearance and characterization of damage to metallic hydrodynamic bearings — Part 1: General*

ICS 21.100.10

Price based on 5 pages