INTERNATIONAL STANDARD

ISO 4386-3

Second edition
2018-07

Plain bearings — Metallic multilayer plain bearings —

Part 3: Non-destructive penetrant testing

Paliers lisses — Paliers lisses métalliques multicouches —

Partie 3: Contrôle non destructif par ressuage

Reference number
ISO 4386-3:2018(E)

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

Published in Switzerland

Contents

Page

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 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 123, *Plain bearings*, Subcommittee SC 2, *Materials and lubricants, their properties, characteristics, test methods and testing conditions*.

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.

This second edition cancels and replaces the first edition (ISO 4386-3:1992), which has been technically revised. The main changes compared to the previous edition are as follows:

— The Scope has been changed.

— Normative references have been updated.

— A new Clause 3 *Terms and definitions* has been added.

— The document has been restructured.

— All clauses have been technically revised.

— The figures in Annex A have been updated.

— The Bibliography has been deleted.

A list of all the parts in the ISO 4386 series can be found on the ISO website.

Plain bearings — Metallic multilayer plain bearings —

Part 3:
Non-destructive penetrant testing

1 Scope

This document specifies a non-destructive penetrant testing for determining bond defects and discontinuities in the sliding surface of the bearing.

The penetration method is used to detect

a) bond defects in the transitional area between the bearing backing/bearing material on the end faces and joint faces of multilayer plain bearings which cannot be detected by the ultrasonic testing method specified in ISO 4386-1, and

b) discontinuities in the sliding surface of the bearing.

The penetration method is applicable, in principle, to finished multilayer plain bearings.

The bond test is usually carried out on cast multilayer plain bearings, with a backing consisting of steel, cast steel or cast bronze. It can also be used as a non-production method to aid detection of manufacturing process defects with other bearing material types. Bearing backings which cannot be tin-plated, or only with difficulty, such as perlitic cast iron, rust-resistant steel and cast aluminium, cannot be tested since no bond is possible between the bearing material and bearing backing.

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 4386-1, *Plain bearings — Metallic multilayer plain bearings — Part 1: Non-destructive ultrasonic testing of bond of thickness greater than or equal to 0,5 mm*

ASTM-E 1417, *Standard Practice for Liquid Penetrant Testing*

3 Terms and definitions

No terms and definitions are listed in this document.

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/

4 Safety precautions

As penetrant inspection techniques often require the use of dangerous, flammable and/or volatile materials, the relevant measures shall be taken regarding accident prevention, handling of dangerous substances and environmental protection. Therefore the test should be carried out by trained personnel.

5 Preparation of test surface

5.1 General

The surfaces to be tested shall be free from residual matter to allow the penetrant to ingress in any discontinuity. Adherent metal splinters and chips caused by machining shall be removed mechanically, and adherent oil and grease removed chemically. Finally, the surface shall be thoroughly dried, at a maximum temperature of 55 °C.

The test surface shall have a surface roughness of $R_a \leq 5$ µm.

5.2 Mechanical pre-cleaning

Rust, etc. shall be removed by brushing, by grinding using an abrasive blasting process, or by similar methods. Care shall be taken to ensure that the defects are not sealed by the pre-cleaning process. If necessary, etching is recommended after the use of any mechanical method. The surface shall then be thoroughly rinsed and dried.

5.3 Chemical pre-cleaning

Residual matter shall be removed by means of suitable cleaning materials, e.g. by degreasing solvents, etchants or paint strippers. After use, all traces of cleaning materials shall be removed completely from the test surface and from the discontinuities, e.g. by rinsing the test surface.

5.4 Drying

At the end of the pre-cleaning process, the surfaces to be examined shall be dried so that no water or cleaning material remains in the discontinuities.

6 Application of penetrant

6.1 A penetrant that is removable by water or solvent shall be used for the test. The test temperature, i.e. the temperature of the test surface, shall be between 10 °C and 50 °C.

NOTE A very viscous penetrant increases the safety of the interim cleaning.

6.2 The penetrant shall be applied by immersing the bearing, or by means of a brush or by spraying. The penetration time shall be 10 min to 20 min. With very viscous penetrants, it shall be at least 20 min. The surface to be examined shall be wetted continuously during this time.

7 Removal of excess penetrant

The water based penetrant shall be removed from the surface by rinsing or spraying with water (without detergents) using a hand spray with hydrostatic pressure of less than 2 bar, and the solvent based penetrant shall be cleaned by wiping with a cloth lightly moistened with a solvent appropriate to the penetrant system. Excess washing is to be avoided by following the instructions of the test manufacturer. However, complete removal of penetrant shall be ensured with no traces of penetrant left sticking to the surface, particularly in grooves, slots and corners. The water or solvent used to remove the penetrant shall have a maximum temperature of 50 °C.

8 Application of the developer

8.1 General

The developer shall be applied to the test surface immediately after the surface has been dried completely.

The developer is a powder in suspension in a liquid and shall therefore be carefully agitated or shaken before it is applied to the test surface. It may be applied by means of a spray gun or a spray can. It shall be applied in such a manner as to ensure a thin and uniform film. The coating thickness of the developer shall be in accordance with the instructions of the test manufacturer.

In the case of fluorescent penetrants, the powder may be applied in a dust-storm cabinet.

Since the penetrant diffuses rapidly in the developer, the test surface shall be observed immediately after the application of the developer for better interpretation of the indications as they develop. Comparison between the results and the acceptance criteria shall be carried out within 10 min to 20 min. A slight uniform discoloration is permissible.

8.2 Restriction

The penetrant and developer chemicals shall be in accordance with ASTM-E 1417 or equivalent, and should be used within the manufacturer's specified expiry date.

9 Inspection

9.1 Bond defects

Marks in the transitional area between the bearing backing/bearing material on the end faces or joint faces of multilayer plain bearings shall be evaluated in accordance with ISO 4386-1.

9.2 Sliding surface

Surface discontinuities such as deep tool marks or the breaking out of large crystals may leave marks that cannot be assessed. These surfaces shall be retested after they have been carefully machined again.

Isolated marks with dimensions not exceeding 1,5 mm shall be disregarded.

The results of the surface inspection shall be evaluated and classified by comparison with Figures A.2 to A.6. They specify five classes designated A to E, in decreasing order of quality (see Annex A).

The reference surface used in the comparison may be square or rectangular. It shall have an area of 1 dm^2.

10 Subsequent cleaning

After final inspection, subsequent cleaning of the component is necessary only in those cases where the penetrant residues could interfere with subsequent processing or service requirements.

11 Test report

The result shall be recorded in a test report, which shall include the following information:

a) reference to this document, i.e. ISO 4386-3:2018;

b) dimensions and material of the plain bearing;

c) designation of the testing media used, together with the name of the manufacturer, type of product and batch number;

d) result of the testing of the bond in the transitional area between the bearing backing/bearing material, and an indication of the permissible and found defect group;

e) test result of the sliding surface and indication of the permissible and found class;

f) place and date of inspection, and name of inspector.

Annex A
(normative)

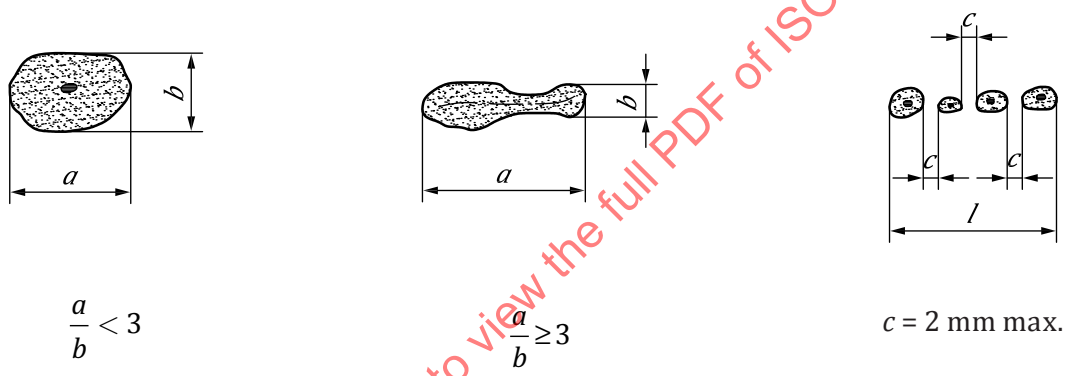
Designation classes and acceptance criteria

A.1 General

Figure A.1 shows types of mark.

The surface tested shall be compared with Figures A.2 to A.6, which each represent an area of 1 dm^2. The surface tested may be square or rectangular, with a maximum side length of 250 mm.

The surface compared shall be the worst-affected part of the area under examination.



$\frac{a}{b} < 3$

a) Round mark

$\frac{a}{b} \geq 3$

b) Linear mark

c = 2 mm max.

c) Linearly aligned marks

Figure A.1 — Marks

A.2 Class A acceptance criteria

a) No round mark with $a > 3$ mm.

b) No linear marks.

c) No linearly aligned marks.

d) No more than two marks, with a maximum total area of 6,3 mm^2.

e) Maximum total area of marks: 10 mm^2/dm^2.

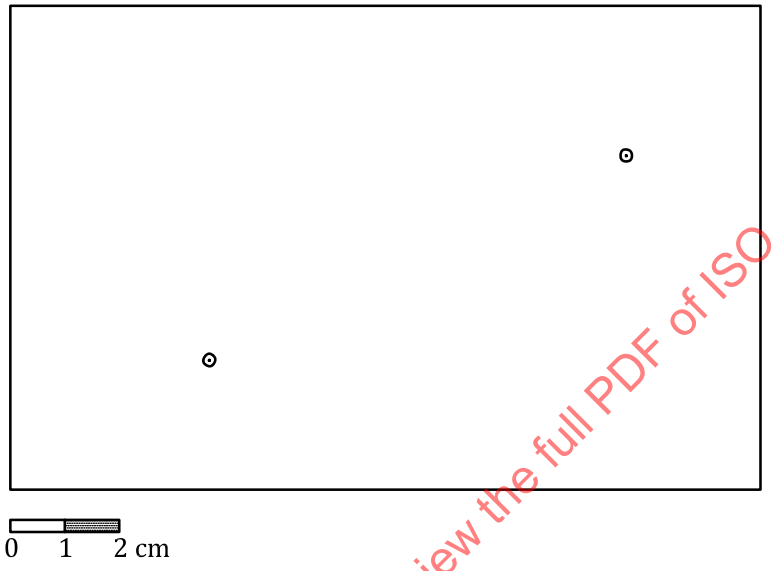


Figure A.2 — Shape and location of marks — Class A

A.3 Class B acceptance criteria

a) No round mark with $a > 4$ mm.

b) No linear marks.

c) No linearly aligned marks.

d) No more than four marks, with a maximum total area of 16 mm^2.

e) Maximum total area of marks: 20 mm^2/dm^2.

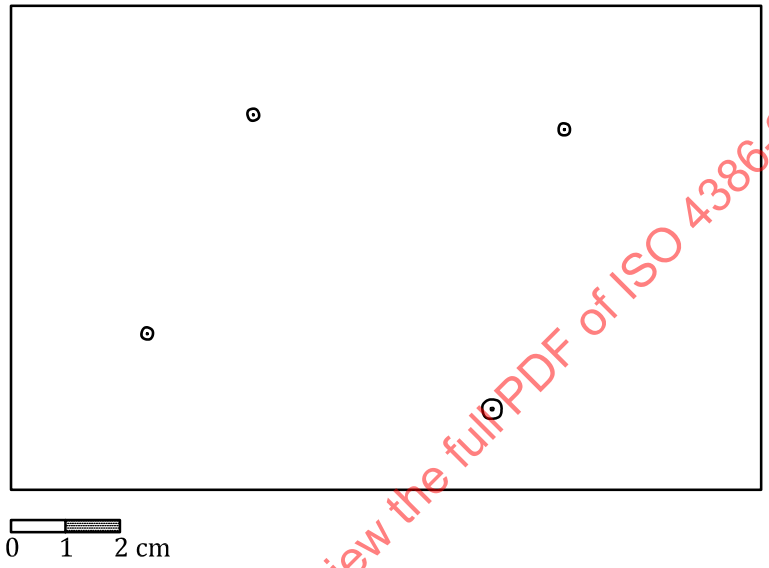


Figure A.3 — Shape and location of marks — Class B

A.4 Class C acceptance criteria

a) No round mark with $a > 5$ mm.

b) No linear marks.

c) No linearly aligned marks.

d) No more than six marks, with a maximum total area of 40 mm^2.

e) Maximum total area of marks: 50 mm^2/dm^2.

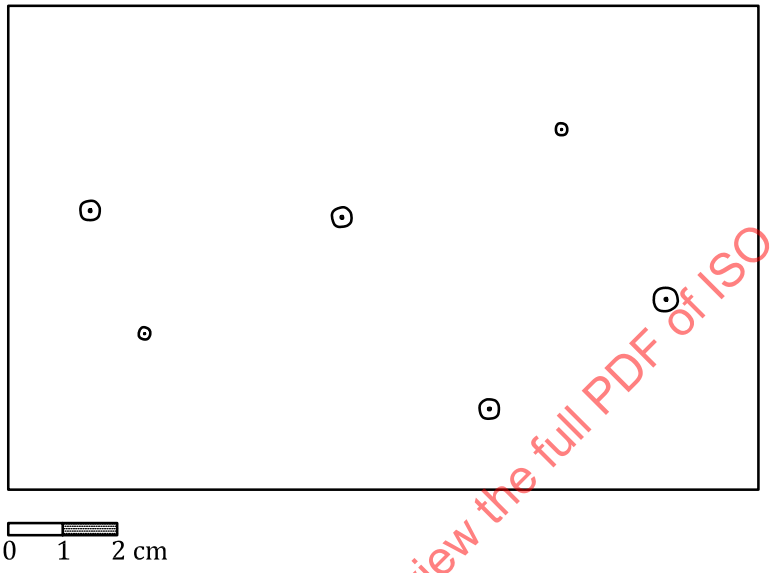


Figure A.4 — Shape and location of marks — Class C