INTERNATIONAL STANDARD

ISO 4386-3

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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 4386-3:1992(E)

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 4386-3 was prepared by Technical Committee ISO/TC 123, *Plain bearings*, Sub-Committee SC 2, *Materials and lubricants, their properties, characteristics, test methods and testing conditions.*

ISO 4386 consists of the following parts, under the general title *Plain bearings — Metallic multilayer plain bearings*:

— *Part 1: Non-destructive ultrasonic testing of bond*

— *Part 2: Destructive testing of bond for bearing metal layer thicknesses greater than or equal to 2 mm*

— *Part 3: Non-destructive penetrant testing*

Annex A forms an integral part of this part of ISO 4386. Annex B is for information only.

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Plain bearings — Metallic multilayer plain bearings —

Part 3:
Non-destructive penetrant testing

1 Scope

This part of ISO 4386 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;

b) discontinuities in the sliding surface of the bearing.

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

The bond test can be carried out only on cast multilayer plain bearings, with a backing consisting of steel, cast steel or cast bronze. 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 reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 4386. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 4386 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4386-1:1992, *Plain bearings — Metallic multilayer plain bearings — Part 1: Non-destructive ultrasonic testing of bond.*

3 Safety precautions

As penetrant inspection techniques often require the use of dangerous, flammable and/or volatile materials, the relevant accident prevention, handling of dangerous substances and environmental protection regulations shall be observed.

4 Preparation of test surface

4.1 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 $R_a \leqslant 5$ µm.

4.2 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.

4.3 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.

4.4 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.

5 Application of penetrant

5.1 A penetrant which 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 1 A very viscous penetrant increases the safety of the interim cleaning.

5.2 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 60 min. With very viscous penetrants it shall be at least 20 min. The surfaces to be examined shall be wetted continuously during this time.

6 Removal of excess penetrant

The penetrant shall be removed from the surface by rinsing or spraying with water (without detergents) using a handspray with hydrostatic pressure of less than 2 bar, or by wiping with a cloth lightly moistened with a solvent appropriate to the penetrant system. Excess washing is to be avoided by prechecking the procedure on a standard test sample. The water or solvent used to remove the penetrant shall have a maximum temperature of 50 °C.

7 Application of the developer

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 less than 25 µm.

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 60 min. A slight uniform discoloration is permissible.

8 Inspection

8.1 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.

8.2 Sliding surface

Surface discontinuities such as deep tool marks or the breaking out of large crystals may leave marks which 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.

9 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.

10 Test report

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

a) reference to this part of ISO 4386;

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)

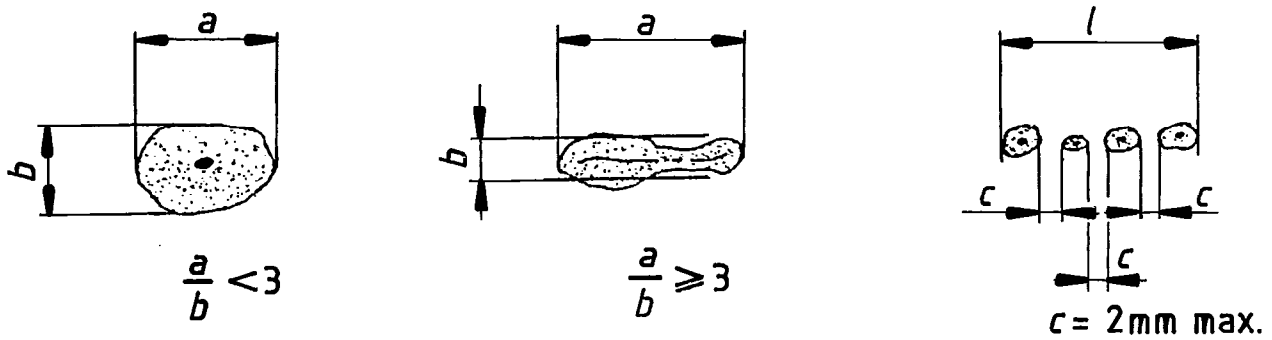
Designation classes and acceptance criteria

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.



a) Round mark

b) Linear mark

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.

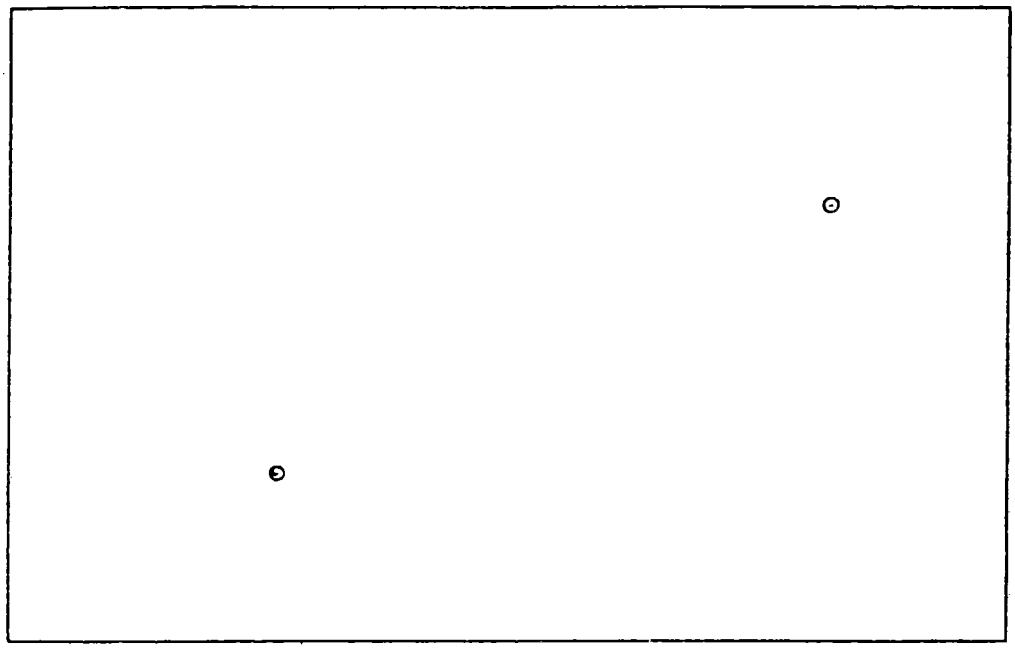


Figure A.2 — Shape and location of marks — Class A

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.

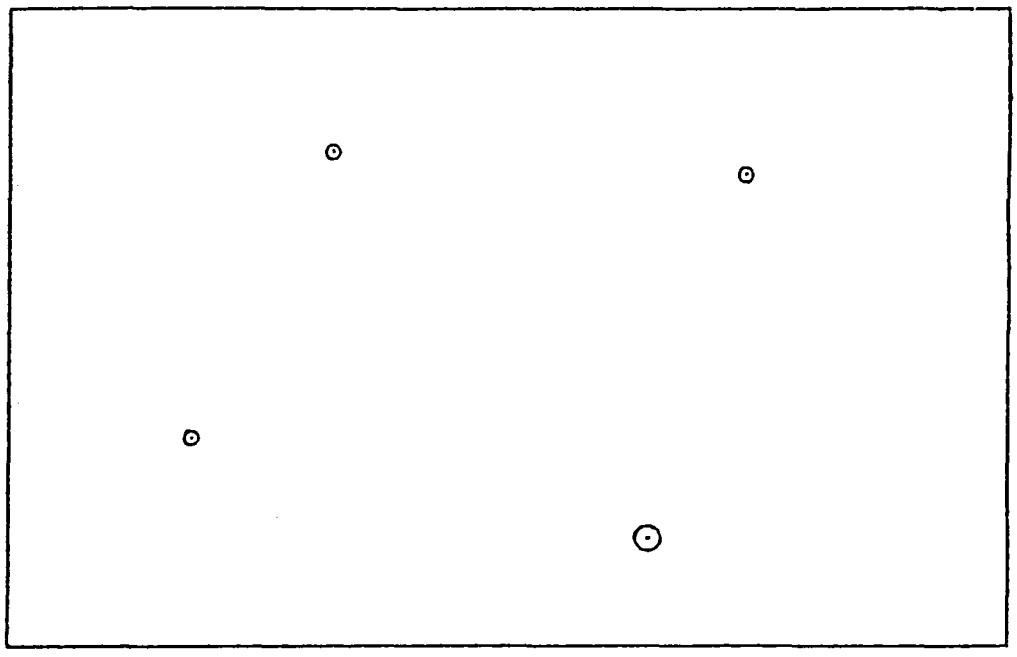


Figure A.3 — Shape and location of marks — Class B

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.

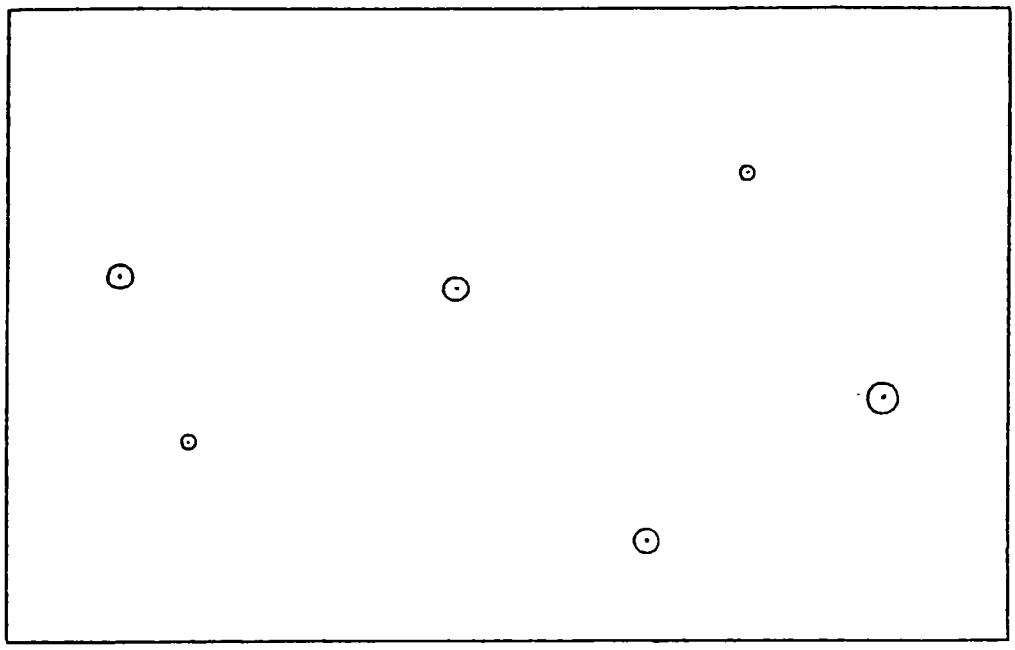


Figure A.4 — Shape and location of marks — Class C

A.5 Class D acceptance criteria

a) No round mark with $a > 6$ mm.

b) No linear marks.

c) No linearly aligned marks with $l > 10$ mm.

d) No more than 11 marks, with a maximum total area of 100 mm^2.

e) Maximum total area of marks: 125 mm^2/dm^2.

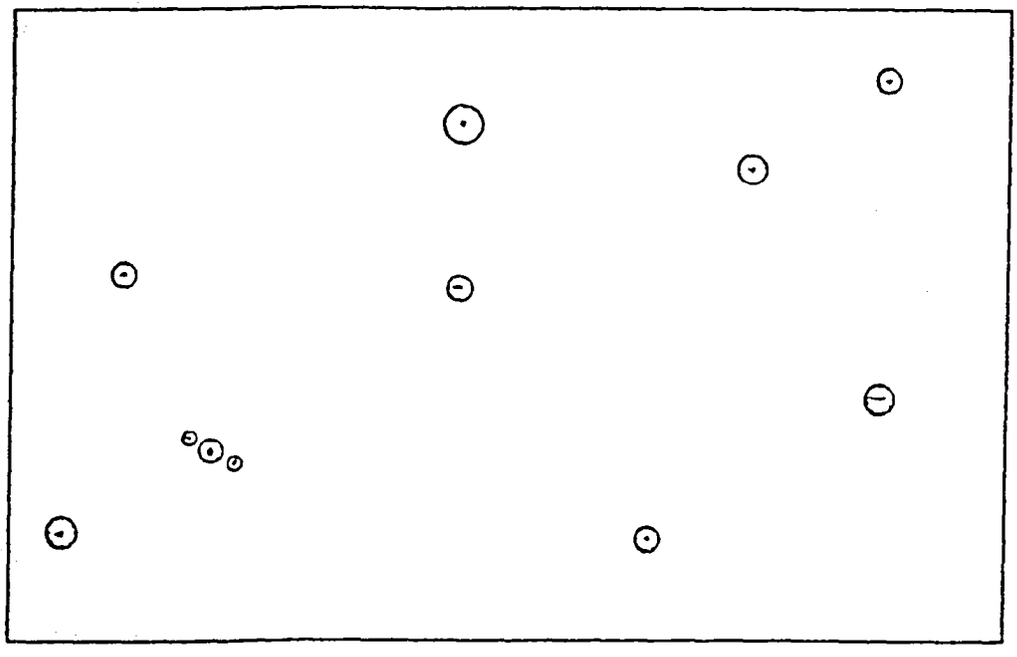


Figure A.5 — Shape and location of marks — Class D

A.6 Class E acceptance criteria

a) No round mark with $a > 8$ mm.

b) No linear mark with $a > 7$ mm.

c) No linearly aligned marks with $l > 16$ mm.

d) No more than 20 marks, with a maximum total area of 250 mm^2.

e) Maximum total area of marks: 250 mm^2/dm^2.

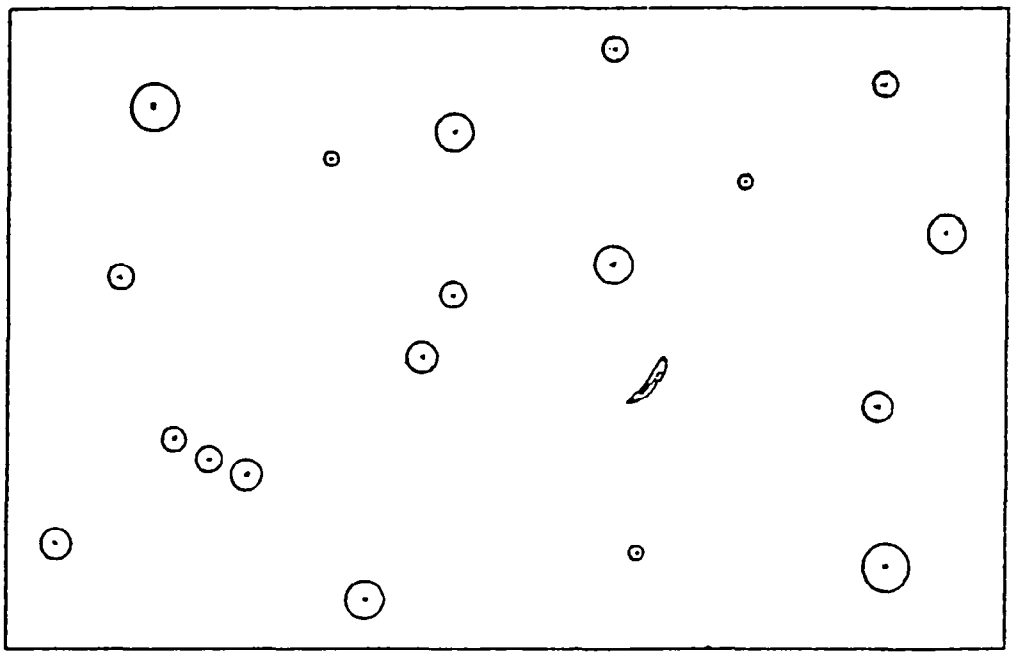


Figure A.6 — Shape and location of marks — Class E

Annex B
(informative)

Bibliography

[1] ISO 3452:1984, *Non-destructive testing — Penetrant inspection — General principles.*

[2] ISO 3453:1984, *Non-destructive testing — Liquid penetrant inspection — Means of verification.*

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