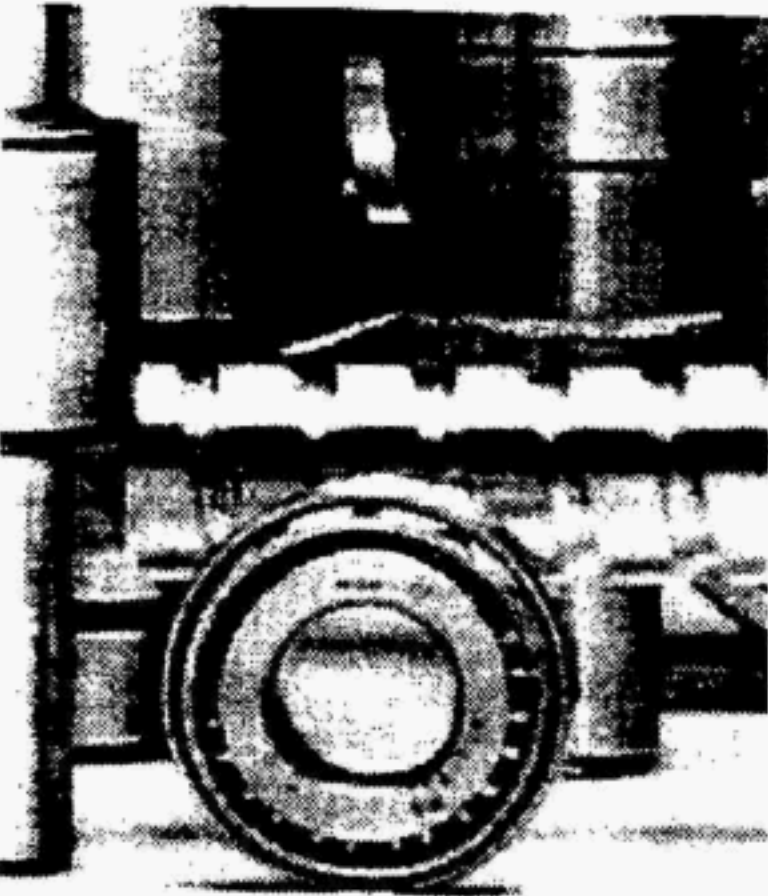
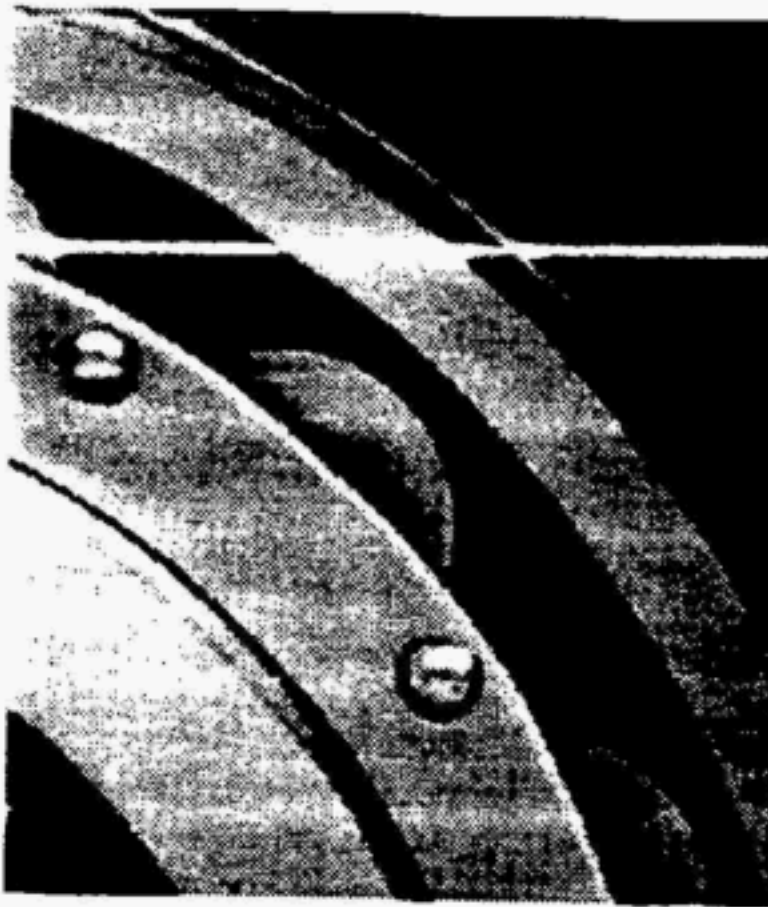


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ANSI/ABMA/ISO 14190:1997

# AMERICAN NATIONAL STANDARD

**ABMA Standard**

**ISO Standard**

## Aerospace – Airframe rolling bearings: ball and spherical roller bearings – Technical Specification

Secretariat  
American Bearing Manufacturers Association

Approved July 20, 1999



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Published by

American Bearing Manufacturers Association  
1200 19th Street, NW, Washington, DC 20036-2422

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Printed in the United States of America



Aerospace –  
Airframe rolling  
bearings: ball  
and spherical  
roller bearings –  
Technical Specification

Secretariat  
**American Bearing Manufacturers Association**

Approved July 20, 1999  
**American National Standards Institute, Inc.**

# Foreword (This foreword is not part of ANSI/ABMA/ISO 14190:1997.)

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

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

International Standard 14190 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee 15, *Airframe bearings*.

This standard was processed and approved for submittal to ANSI by Accredited Standards Committee B3 on Ball and Roller Bearings. Committee approval of this standard does not necessarily imply that all committee members voted for its approval.

Suggestions for the improvement of this standard gained through experience with its use will be welcomed. These should be sent to: American Bearing Manufacturers Association Secretariat, ANSI ASC B3, 1200 19th Street, NW, Suite 300, Washington DC 20036-2422.

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Printed in Switzerland

## Introduction

In 1986, ISO TC 4, *Rolling bearings*, approved a new work item to revise the International Standard on airframe bearings, ISO 1002:1983, *Rolling bearings — Airframe bearings — Characteristics, boundary dimensions, tolerances, static load ratings*. The work item was assigned to ISO TC 4, *Rolling bearings* and TC 20, *Aircraft and space vehicles*, Joint Working Group on airframe bearings.

Later that same year, ISO TC 4/TC 20 JWG on airframe bearings agreed that a technical specification for the procurement of airframe bearings should be prepared as part of the revision process.

The work item was subsequently transferred to ISO TC 20/SC 15, *Airframe bearings*.

As a result, this International Standard has been developed for the procurement of airframe ball and roller bearings and is supplemented with International Standards for each bearing type.



# Aerospace — Airframe rolling bearings: ball and spherical roller bearings — Technical specification

## 1 Scope

This International Standard specifies the required characteristics, inspections and tests, quality assurance and conditions for qualification, permissible static loads, acceptance and delivery conditions for rigid and self-aligning airframe ball and spherical roller bearings. These bearings are designed to withstand, under load, slow rotations and small oscillations only.

It is applicable to all airframe ball and spherical roller bearings in the referenced International Standards or in a design specification.

The fact that a rolling bearing is not included in this International Standard does not preclude its use in airframe applications.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard 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 1132:1980, *Rolling bearings — Tolerances — Definitions*.

ISO 2859-1:—<sup>1)</sup>, *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection*.

ISO 4288:1996, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*.

ISO 5593:1997, *Rolling bearings — Vocabulary*.

ISO 6507-1:1997, *Metallic materials — Vickers hardness test — Part 1: Test Method*.

ISO 6508-1:—<sup>2)</sup>, *Metallic materials — Rockwell hardness test (scales A, B, C, D, E, F, G, H, K, N, T) — Part 1: Test method*.

ISO 9001:1994, *Quality systems — Model for quality assurance in design, development, production, installation and servicing*.

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1) To be published. (Revision of ISO 2859-1:1989)

2) To be published. (Revision of ISO 6508:1986 and ISO 1024:1989)



ISO 9002:1994, *Quality systems — Model for quality assurance in production, installation and servicing.*

ISO 9003:1994, *Quality systems — Model for quality assurance in final inspection and test.*

ISO 14191:1998, *Aerospace — Airframe spherical roller bearings, single-row, self-aligning, diameter series 3 and 4 — Metric series.*

ISO 14192:1998, *Aerospace — Airframe spherical roller bearings, single-row, self-aligning, shielded, intermediate duty — Metric series.*

ISO 14193:1998, *Aerospace — Airframe spherical roller bearings, single-row, self-aligning, sealed, extended inner ring, intermediate duty — Inch series.*

ISO 14194:1998, *Aerospace — Airframe spherical roller bearings, double-row, self-aligning, sealed, extended inner ring, heavy duty — Inch series.*

ISO 14195:1998, *Aerospace — Airframe spherical roller bearings, double-row, self-aligning, sealed, torque tube design, light duty — Inch series.*

ISO 14196:1998, *Aerospace — Airframe spherical roller bearings, double-row, self-aligning, sealed, plain inner ring, heavy duty — Inch series.*

ISO 14197:1998, *Aerospace — Airframe spherical roller bearings, single-row, self-aligning, sealed, intermediate duty — Inch series.*

ISO 14201:1998, *Aerospace — Airframe ball bearings, double-row, self-aligning, diameter series 2 — Metric series.*

ISO 14202:1998, *Aerospace — Airframe ball bearings, single-row, rigid, diameter series 0 and 2 — Metric series.*

ISO 14203:1998, *Aerospace — Airframe ball bearings, single-row, rigid, diameter series 8 and 9 — Metric series.*

ISO 14204:1998, *Aerospace — Airframe ball bearings, double-row, rigid, diameter series 0 — Metric series.*

ISO 14206:1998, *Aerospace — Airframe ball bearings, single-row, rigid, sealed, light duty — Inch series.*

ISO 14207:1998, *Aerospace — Airframe ball bearings, single-row, rigid, precision, sealed, light duty — Inch series.*

ISO 14208:1998, *Aerospace — Airframe ball bearings, single-row, rigid, sealed, intermediate duty — Inch series.*

ISO 14209:1998, *Aerospace — Airframe ball bearings, single-row, rigid, precision, sealed, intermediate duty — Inch series.*

ISO 14210:1998, *Aerospace — Airframe ball bearings, single-row, rigid, sealed, torque tube design, light duty — Inch series.*

ISO 14211:1998, *Aerospace — Airframe ball bearings, single-row, rigid, precision, sealed, torque tube design, light duty — Inch series.*

ISO 14212:1998, *Aerospace — Airframe ball bearings, single-row, rigid, sealed, torque tube design, extra-light duty — Inch series.*

ISO 14213:1998, *Aerospace — Airframe ball bearings, single-row, rigid, precision, sealed, torque tube design, extra-light duty — Inch series.*

ISO 14214:1998, *Aerospace — Airframe ball bearings, double-row, rigid, sealed, heavy duty — Inch series.*

ISO 14215:1998, *Aerospace — Airframe ball bearings, double-row, rigid, precision, sealed, heavy duty — Inch series.*

ISO 14216:1998, *Aerospace — Airframe ball bearings, double-row, self-aligning, sealed, heavy duty — Inch series.*

ISO 14217:1998, *Aerospace — Airframe ball bearings, double-row, self-aligning, precision, sealed, heavy duty — Inch series.*

ISO 14218:1998, *Aerospace — Airframe ball bearings, single-row, self-aligning, sealed, heavy duty — Inch series.*

ISO 14219:1998, *Aerospace — Airframe ball bearings, single-row, self-aligning, precision, sealed, heavy duty — Inch series.*

ISO 14220:1998, *Aerospace — Airframe ball bearings, single-row, self-aligning, sealed, light duty — Inch series.*

ISO 14221:1998, *Aerospace — Airframe ball bearing, single-row, self-aligning, precision, sealed, light duty — Inch series.*

### 3 Definitions

For the purposes of this International Standard, the definitions given in ISO 5593, ISO 1132, and the following apply.

#### 3.1

##### **delivery batch**

quantity of rolling bearings shipped or to be shipped which have the same identity block, but may come from different production batches

#### 3.2

##### **sealed rolling bearings**

bearings in which the rolling elements and raceways are protected by contact seals (i.e., seals fitted to one ring and extending to the other ring with which they make sliding contact)

#### 3.3

##### **shielded rolling bearings**

bearings in which the rolling elements and raceways are protected by shields fitted to one ring and extending to the other ring with which they have a small clearance

#### 3.4

##### **surface discontinuities**

imperfections which include, but are not limited to, the following:

##### 3.4.1

##### **crack**

break in the material which may extend in any direction and which may be intercrystalline or transcrystalline in character

### 3.4.2

#### **open surface defect**

surface defect resulting from a tearing of the metal, such as a tool mark, score or scratch

### 3.4.3

#### **lap**

surface defect where particles of metal or sharp edges are folded over and then rolled or forged into the surface

### 3.4.4

#### **seam**

unwelded fold which appears as an open defect in the material

### 3.5

#### **starting torque without load**

maximum torque required to start rotation of a ring about the other

NOTE — Due regard should be given the fact that bearings without retainers or separators are not likely to have absolute freedom of rotation because of adjacent rolling elements rubbing each other.

### 3.6

#### **permissible static loads**

#### 3.6.1

##### **permissible static radial load**

maximum static radial load which can be applied to the bearing without impairing its subsequent operation

#### 3.6.2

##### **permissible static axial load**

maximum static axial load which can be applied to the bearing without impairing its subsequent operation

#### 3.6.3

##### **ultimate static radial load**

maximum static radial load which can be applied to the bearing without causing cracks or ruptures in any of the component parts

NOTE — The ultimate static radial load is a load equal to 1,5 times the permissible static radial load.

#### 3.6.4

##### **ultimate static axial load**

maximum static axial load which can be applied to the bearing without causing cracks or ruptures in any of the component parts

NOTE — The ultimate static axial load is a load equal to 1,5 times the permissible static axial load.

### 3.7

#### **diagonal internal clearance**

value of the total tilt of inner ring in relation to outer ring

## 4 Symbols

For the purposes of this International Standard, the symbols given in ISO 1132 and in the appropriate referenced International Standard apply.



## 5 Characteristics, requirements, inspections and test methods

Characteristics, requirements, inspections and test methods are given in table 1.

Table 1

| Sub-clause                                   | Characteristics                        | Requirements  | Inspection and test methods   | Q <sup>1)</sup> | A <sup>1)</sup> |
|--|--|---|---|-----------------|-----------------|
| 5.1  | Materials                              | Shall conform with product standards or design documentation.   | Chemical analysis or certificate of conformity issued by the manufacturer.  | X               | X               |
| 5.2  | Dimensions and tolerances              |   |   |                 |                 |
| 5.2.1  | At ambient temperature (20 °C ± 1 °C)  | Shall conform with product standards or design documentation.   | Suitable measuring instruments  | X               | X               |
| 5.2.2  | Dimensional stability                  | Permissible change 0,1 µm max. per 1 mm of diameter.  | See annex A   | X               |                 |
| 5.3  | Mass                                   | Shall conform with product standards or design documentation.   | Suitable methods  | X               |                 |
| 5.4  | Identification marking                 | Shall conform with product standards or design documentation.<br><br>Shall be legible and shall not damage the material or impair the performance of the bearing. | Visual examination  | X               | X               |
| 5.5  | Surface appearance <sup>2)</sup>       | Shall be free of surface discontinuities liable to distort their characteristics and lessen their endurance.  |   |                 |                 |
| 5.5.1  | Unassembled rings and rolling elements |   | Magnetic, dye penetrant or eddy current inspection.   | X               |                 |
| 5.5.2  | Assembled bearings                     |   | Visual inspection using suitable methods.   | X               | X               |
| 5.6  | Hardness <sup>2)</sup>                 | Shall conform with product standards or design documentation.   | Test in accordance with ISO 6508-1 or ISO 6507-1 <sup>3)</sup> . Inner ring, outer ring and three rolling elements shall be tested. The test shall be performed on the ground, polished cross-sectional area of the rings adjacent to the raceways. The test shall be performed on a ground, polished flat surface of the rolling elements. | X               | X               |
| Footnotes are given at the end of the table. |  |   |   |                 |                 |

| Sub-clause                                   | Characteristics  | Requirements  | Inspection and test methods  | Q <sup>1)</sup> | A <sup>1)</sup> |
|--|--|---|--|-----------------|-----------------|
| 5.7  | Surface roughness <sup>2)</sup>  | Shall conform with product standards or design documentation.   | Test in accordance with ISO 4288.  | X               | X               |
| 5.8  | Surface treatment  | Shall conform with product standards or design documentation.   | — Visual inspection<br>— In accordance with surface treatment standard           | X               | X               |
| 5.9  | Lubrication  | At least 80 % of the free space in the bearing shall be charged with the grease specified in the product standards or design documentation.   | Visual inspection after removal of seals or shields.                             | X               |                 |
|  |  |   | Visual inspection during manufacture   |                 | X               |
| 5.10   | Seals or shields   |   |  |                 |                 |
| 5.10.1                                       | Retention  | <b>All bearings:</b><br><br>Seals or shields shall be fitted correctly and shall not hinder the performance of the bearings.<br><br><b>Self-aligning bearings:</b><br><br>After the test, the seals or shields shall not have become loose or deformed. | Visual inspection<br><br><br><br>See annex B                                     | X               | X               |
| 5.10.2                                       | Sealing  | <b>Seals shall:</b><br>— retain grease.   | Visual inspection after the rings are manually turned in relation to each other. | X               | X               |
| 5.10.3                                       | Temperature test   | After this test, bearings shall conform with 5.10.1 and 5.13.1.   | See annex D  | X               |                 |
| 5.11   | Running accuracy:<br>— radial: $K_{ia}$ , $K_{ea}$<br>— axial: $S_{ia}$ , $S_{ea}$ | Shall conform with product standards or design documentation.   | See annex E  | X               | X               |
| 5.12   | Internal clearances:<br>— radial: $G_r$<br>— axial: $G_a$<br>— diagonal: $G_d$     | Shall conform with product standards or design documentation.   | See annex C  | X               | X               |
| Footnotes are given at the end of the table. |  |   |  |                 |                 |

| Sub-clause   | Characteristics   | Requirements  | Inspection and test methods                         | Q <sup>1)</sup> | A <sup>1)</sup> |
|--|---|---|---|-----------------|-----------------|
| 5.13   | Running behaviour   |   |   |                 |                 |
| 5.13.1   | At ambient temperature<br>(20 °C ± 1 °C)                                  | Shall be capable of rotating freely, without constraint, e.g. rolling elements catching in filling slots.   | See annex F, figures F.2 and F.4                    | X               | X               |
| 5.13.2   | At limit temperatures   | After this test, the mean starting torque without load shall not exceed 1,5 times the mean of the values recorded before the test.<br><br>Shall be capable of rotating freely, without constraint, e.g. rolling elements catching in filling slots. | See annex D<br><br>See annex F, figures F.2 and F.4 | X               |                 |
| 5.14   | Starting torque without load  | Shall conform with product standards or design documentation.   | See annex G   | X               | X               |
| 5.15   | Permissible static loads:<br><br>— radial: $C_s$<br>— axial: $F_{a \max}$ | Shall conform with product standards or design documentation.<br><br>After removing the loads, there shall be no permanent deformations impairing the rotational motion of the bearing.   | See annex F   | X               |                 |
| 5.16   | Ultimate static loads:<br>— radial<br>— axial                             | After removing the loads, there shall be no cracks or structural failure of the bearing.  | See annex F   | X               |                 |
| <p>1) Q = Qualification<br/>A = Acceptance tests</p> <p>2) This inspection is made in the absence of surface treatment which, for the purposes of qualification, may be removed by a chemical process.</p> <p>3) Conversion from Vickers hardness to Rockwell hardness readings shall be subject to agreement between customer and supplier.</p> |   |   |   |                 |                 |

## 6 Quality assurance

### 6.1 Approval of manufacturer

The manufacturer shall have a quality management system acceptable to the customer which meets the requirements of the appropriate ISO 9000 series quality management standard.



## 6.2 Product qualification

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Qualification shall be performed by bearing type and size. The manufacturer shall obtain qualification in accordance with tables 2 and 3.

However, qualification:

- for a plated bearing requires qualification of a non-plated bearing of the same dimensions, of the same type and made of the same material;
- is acquired for a bearing falling within the range of sizes available in the product standard, based on similarity, whereby qualification has been obtained previously for bearings of size, immediately before, and immediately after, the bearing in question.

To qualify a bearing of a given range, the manufacturer shall provide:

- nine bearings if this is the first qualification in this range;
- seven bearings for all other qualifications.

**Table 2 — Non-destructive inspections and tests to be carried out for qualification**

| Types of inspections and tests <sup>1)</sup>  | Defined in subclause | Serial number of inspected samples |   |   |   |   |   |   |                 |                 |
|---|----------------------|------------------------------------|---|---|---|---|---|---|-----------------|-----------------|
|   |                      | 1                                  | 2 | 3 | 4 | 5 | 6 | 7 | 8 <sup>2)</sup> | 9 <sup>2)</sup> |
| Materials   | 5.1                  | X                                  | X | X | X | X | X | X | X               | X               |
| Dimensions and tolerances   | 5.2.1                | X                                  | X | X | X | X | X | X |                 |                 |
| Mass  | 5.3                  | X                                  | X | X | X | X | X | X |                 |                 |
| Identification marking  | 5.4                  | X                                  | X | X | X | X | X | X | X               | X               |
| Surface appearance  | 5.5.2                | X                                  | X | X | X | X | X | X | X               | X               |
| Surface treatment   | 5.8                  | X                                  | X | X | X | X | X | X | X               | X               |
| Retention of seals or shields   | 5.10.1               |                                    |   |   |   |   | X | X |                 |                 |
| Sealing (grease retention)  | 5.10.2               |                                    |   |   |   |   | X | X |                 |                 |
| Running accuracy ( $K_{ia}$ , $K_{ea}$ , $S_{ia}$ , $S_{ea}$ )  | 5.11                 | X                                  | X | X | X | X | X | X |                 |                 |
| Internal clearances ( $G_r$ , $G_a$ , $G_d$ )   | 5.12                 | X                                  | X | X | X | X | X |   |                 |                 |
| Running behaviour at ambient temperature  | 5.13.1               | X                                  | X | X | X | X | X | X | X               | X               |
| Starting torque without load  | 5.14                 | X                                  | X | X | X | X | X | X | X               | X               |
| 1) The order of testing is left to the discretion of the qualification authority.                                 |                      |                                    |   |   |   |   |   |   |                 |                 |
| 2) These tests are to be carried out only for the first bearing of a range submitted for qualification (see 6.2). |                      |                                    |   |   |   |   |   |   |                 |                 |

Table 3 — Destructive inspections and tests to be carried out for qualification

| Types of inspections and tests <sup>1)</sup>  | Defined in sub-clause                | Serial number of inspected samples |   |   |   |   |   |   |   |   |    |
|---|--------------------------------------|------------------------------------|---|---|---|---|---|---|---|---|----|
|   |                                      | 1                                  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Dimensional stability <sup>2)</sup>   | 5.2.2                                |                                    |   |   |   |   |   |   |   | X |    |
| Surface appearance  | 5.5.1                                |                                    |   |   |   |   | X | X |   |   |    |
| Hardness <sup>3)</sup>  | 5.6                                  |                                    |   |   |   |   |   | X |   |   |    |
| Surface roughness   | 5.7                                  |                                    |   |   |   |   | X | X |   |   |    |
| Lubrication   | 5.9                                  |                                    |   |   |   |   | X | X |   |   |    |
| Running behaviour and behaviour of bearings, seals or shields at extreme temperatures <sup>2)</sup> | 5.10.3<br>5.13.2                     |                                    |   |   |   |   |   |   |   | X |    |
| Test under static load  | radial — permissible ( $C_s$ )       | 5.15                               | X | X | X |   |   |   |   |   |    |
|   | radial — ultimate                    | 5.16                               | X | X | X |   |   |   |   |   |    |
|   | axial — permissible ( $F_{a \max}$ ) | 5.15                               |   |   |   | X | X |   |   |   |    |
|   | axial — ultimate                     | 5.16                               |   |   |   | X | X |   |   |   |    |

1) The order of testing is left to the discretion of the qualification authority.

2) These tests are to be carried out only if this is the first bearing of a range submitted for qualification (see 6.2).

3) A minimum of three rolling elements shall be inspected.

## 7 Acceptance conditions

### 7.1 Manufacturer's responsibility

The manufacturer shall have a quality management system acceptable to the customer which meets the requirements of the appropriate ISO 9000 series quality management standard.

The acceptance of a delivery batch shall be in accordance with table 4.

### 7.2 Customer quality control

**7.2.1** The customer may, on acceptance of a delivery batch, proceed to inspect it by using the tests and inspections specified in table 4, in full or in part, to ensure that the items conform to the required quality level and to determine whether the delivery batch is acceptable.

**7.2.2** This inspection can be carried out in the customer's factory or, by agreement, in the manufacturer's factory.



Table 4 — inspections and tests to be carried out for acceptance

| Types of inspections and tests <sup>1)</sup>                   | Defined in subclause | Sampling plan <sup>2), 3)</sup>   |
|--|----------------------|---|
| Materials  | 5.1                  | Chemical analysis or certificate of conformity issued by the semi-finished products manufacturer. |
| Dimensions and tolerances                                      | 5.2.1                | 0,65 AQL <sup>4), 5)</sup>  |
| Identification marking   | 5.4                  | 100 %   |
| Surface appearance   | 5.5.1                | 100 % (unassembled)   |
|  | 5.5.2                | 0,65 AQL <sup>4), 5)</sup>  |
| Hardness   | 5.6                  | five pieces per lot (unassembled components) <sup>4), 5)</sup>                                    |
| Surface roughness  | 5.7                  | five pieces per lot (unassembled components) <sup>4), 5)</sup>                                    |
| Surface treatment (if required)                                | 5.8                  | five pieces per lot (unassembled components) <sup>4), 5)</sup>                                    |
| Lubrication  | 5.9                  | 100 %   |
| Retention of seals or shields                                  | 5.10.1               | 0,65 AQL <sup>4), 5)</sup>  |
| Sealing (grease retention)                                     | 5.10.2               | 0,65 AQL <sup>4), 5)</sup>  |
| Running accuracy ( $K_{ia}$ , $K_{ea}$ , $S_{ia}$ , $S_{ea}$ ) | 5.11                 | 0,65 AQL <sup>4), 5)</sup>  |
| Internal clearances ( $G_r$ , $G_a$ , $G_d$ )                  | 5.12                 | 0,65 AQL <sup>4), 5)</sup>  |
| Running behaviour at ambient temperature                       | 5.13.1               | 100 %   |
| Starting torque without load                                   | 5.14                 | 0,65 AQL <sup>4), 5)</sup>  |

1) The order of testing is left to the discretion of the acceptance authority. These tests may be carried out at the time of manufacture.

2) For the manufacturer, when the sampling is not 100 %, any defect found in the course of an inspection or test requires this inspection to be extended to 100 %.

3) May vary with the approval of the user or authority responsible for acceptance.

4) Acceptance Quality Level (AQL) is based on inspection level II single sample plan in accordance with ISO 2859-1.

5) Minimum one piece.

## 8 Packaging

**8.1** Rolling bearings shall be packaged individually or in rolls to prevent possible damage during transportation.

**8.2** The packaging material in contact with the bearing shall be grease-resistant and shall protect against moisture, corrosion, dirt and other harmful substances.

**8.3** The following shall be the least amount of information to be affixed to each individual bearing package:

- manufacturer's name;
- quantity (in the case of rolls of bearings);
- identity block as defined by product standards or design documentation;
- lubrication date.



**8.4** The following information shall appear on collective packaging intended for transport:

- manufacturer's name and address;
- contract or order number;
- quantity;
- identity block as defined by product standards or design documentation.

## **9 Certificate of conformity**

**9.1** All bearings supplied in accordance with this International Standard shall be accompanied by a certificate of conformity issued by the manufacturer.

## **Annex A**

### **(normative)**

## **Dimensional stability test**

### **A.1 Apparatus**

A suitable installation for controlling the bearing test temperature is required.

### **A.2 Method**

#### **A.2.1 High temperature dimensional stability test**

**A.2.1.1** The test shall be conducted with grease B (synthetic hydrocarbon-type, see annex H) only.

**A.2.1.2** The external dimensions of the rolling bearing shall be determined before the test.

**A.2.1.3** Maintain the bearing at the temperature extreme of  $150\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  for 100 h, then allow it to return to room temperature.

**A.2.1.4** The external dimensions of the rolling bearing shall be determined after the test.

#### **A.2.2 Low temperature dimensional stability test**

**A.2.2.1** The external dimensions of the rolling bearing shall be determined before the test.

**A.2.2.2** Maintain the bearing at the temperature extreme of  $-54\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  for 4 h, then allow it to return to room temperature.

**A.2.2.3** The external dimensions of the rolling bearing shall be determined after the test.

## Annex B

(normative)

### Retention test for self-aligning bearing seals and shields

#### B.1 Apparatus

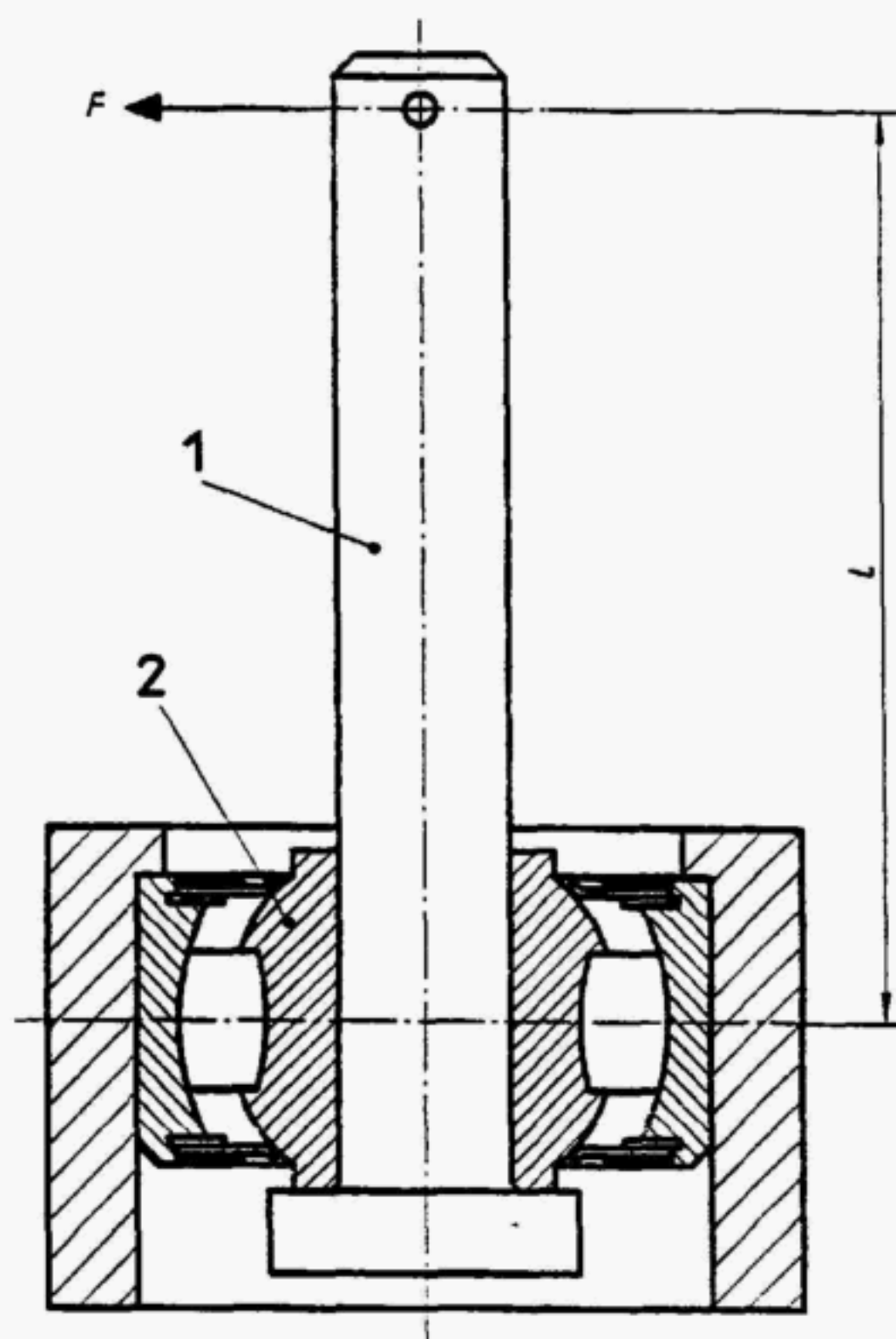
See figure B.1 as an example.

#### B.2 Method

B.2.1 Carry out the test at ambient temperature.

B.2.2 Apply a force  $F$  to the end of a lever arm  $L$ . This force shall produce the torque specified in table B.1.

B.2.3 Carry out the test in two directions,  $90^\circ$  from each other.



#### Key

1 Shaft

2 Self-aligning bearing

Figure B.1



| Nominal<br>bore<br>diameter | Torque minimum<br>N·m |              |              | Nominal<br>bore<br>diameter<br><br>mm | Torque minimum<br>N·m |              |              |              |              |              |              |
|-----------------------------|-----------------------|--------------|--------------|---------------------------------------|-----------------------|--------------|--------------|--------------|--------------|--------------|--------------|
|                             | Metric series         |              |              |                                       | Inch series           |              |              |              |              |              |              |
|                             | ISO<br>14192          | ISO<br>14191 | ISO<br>14201 |                                       | ISO<br>14193          | ISO<br>14216 | ISO<br>14217 | ISO<br>14218 | ISO<br>14219 | ISO<br>14220 | ISO<br>14221 |
| 5                           | —                     | —            | 0,4          | 4,326                                 | —                     | 0,9          | 0,9          | 0,68         | 0,68         | 0,45         | 0,45         |
| 6                           | 1,5                   | —            | 0,4          | 6,35                                  | 1,5                   | 1,35         | 1,35         | 0,56         | 0,56         | 0,68         | 0,68         |
| 8                           | 2                     | 1,5          | 0,5          | 7,938                                 | 2                     | 3,15         | 3,15         | 1,81         | 1,81         | 1,13         | 1,13         |
| 10                          | 2,5                   | 2,5          | 0,7          | 9,525                                 | 2,5                   | 5,1          | 5,1          | 2,03         | 2,03         | 0,9          | 0,9          |
| 12                          | 3,5                   | 3            | 0,8          | 11,113                                | —                     | —            | —            | —            | —            | —            | —            |
| 15                          | 4                     | 3,7          | 1            | 12,7                                  | 3,3                   | 6,8          | 6,8          | 2,26         | 2,26         | —            | —            |
| 17                          | 4,5                   | 4            | 1,2          | 14,288                                | —                     | —            | —            | —            | —            | —            | —            |
| 20                          | —                     | 4,5          | 1,4          | 15,875                                | 4,2                   | 8,8          | 8,8          | 2,82         | 2,82         | —            | —            |
| 25                          | —                     | 5,5          | —            | 19,05                                 | 5                     | —            | —            | —            | —            | —            | —            |
| 30                          | —                     | 6            | —            |                                       |                       |              |              |              |              |              |              |

## **Verification of internal clearances of assembled bearing**

### **C.1 Radial internal clearance ( $G_r$ )**

#### **C.1.1 Apparatus**

See figure C.1 as an example.

#### **C.1.2 Method**

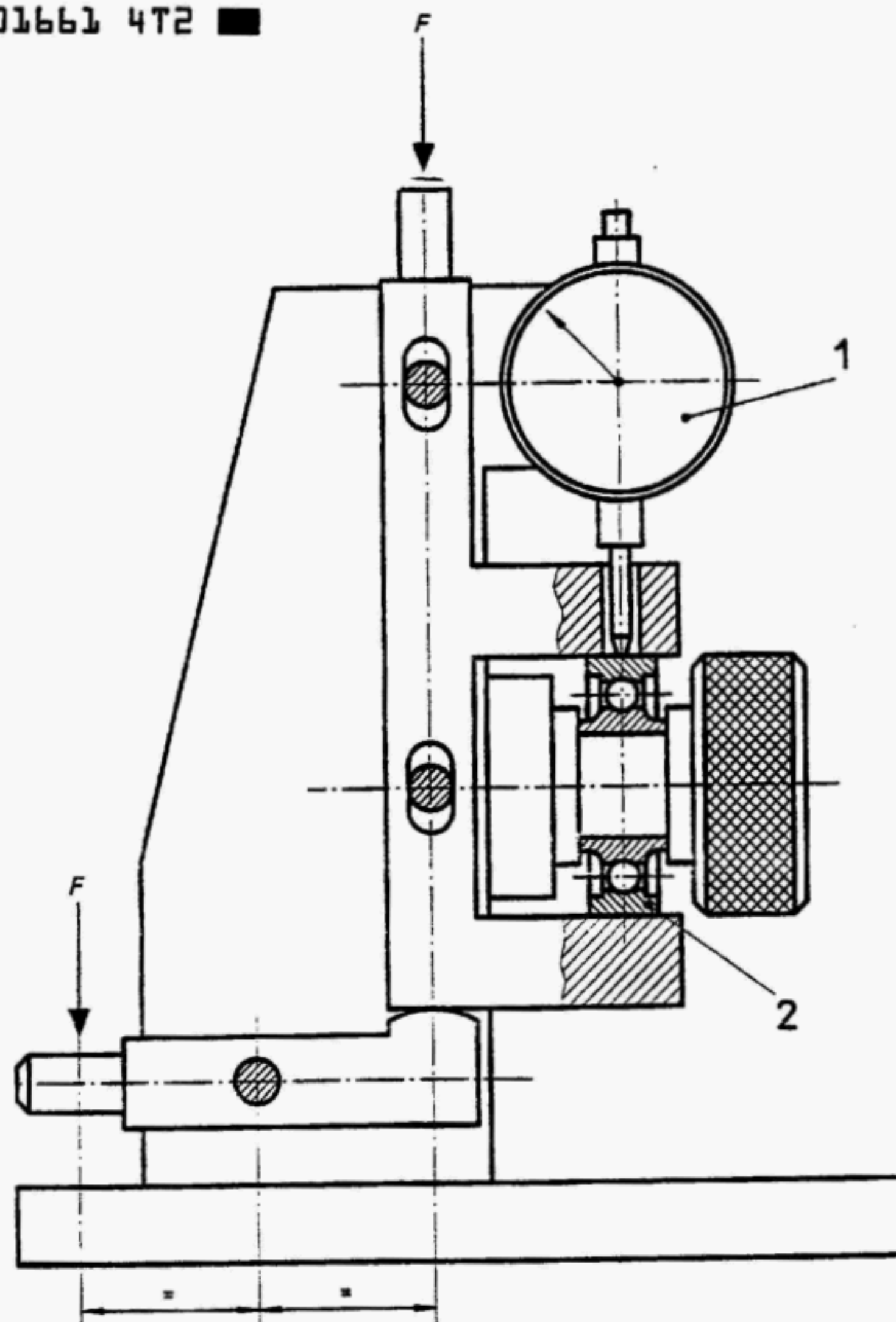
**C.1.2.1** Mount the bearing vertically and immobilize the inner ring.

**C.1.2.2** Place a dial gauge in the radial plane of the bearing.

**C.1.2.3** Apply the load  $F$  (see table C.1), first in the direction of the dial gauge, and then in the opposite direction.

**C.1.2.4** Record the difference,  $G_r$ , between the maximum and minimum readings on the dial gauge.

**C.1.2.5** Repeat this measurement in various angular positions by rotating one ring in relation to the other.



**Key**

- 1 Dial gauge
- 2 Bearing

**Figure C.1**



| Nominal<br>bore<br>diameter<br><br>mm | Load<br><br>$F$<br><br>max.<br><br>N<br><br>$\pm 10\%^{1)}$ |              |              |              |                               | Nominal<br>bore<br>diameter<br><br>mm | Load<br><br>$F$<br><br>max.<br><br>N<br><br>$\pm 10\%^{1)}$ |                              |                              |
|---------------------------------------|---|--------------|--------------|--------------|-------------------------------|---------------------------------------|---|------------------------------|------------------------------|
|                                       | Metric series   |              |              |              |                               |                                       | Inch series   |                              |                              |
|                                       | ISO<br>14191  | ISO<br>14192 | ISO<br>14201 | ISO<br>14202 | ISO 14203<br>and<br>ISO 14204 |                                       | ISO<br>14193  | ISO 14194<br>to<br>ISO 14197 | ISO 14206<br>to<br>ISO 14221 |
| $\leq 8$                              | 25  | 25           | 25           | 25           | 25                            | All sizes                             | 25  | 100                          | 25                           |
| $> 8$                                 | 50  | 50           | 50           |              | 50                            |                                       |   |                              |                              |

1) Relative tolerance

## C.2 Axial internal clearance ( $G_a$ )

### C.2.1 Apparatus

See figure C.2 as an example.

### C.2.2 Method

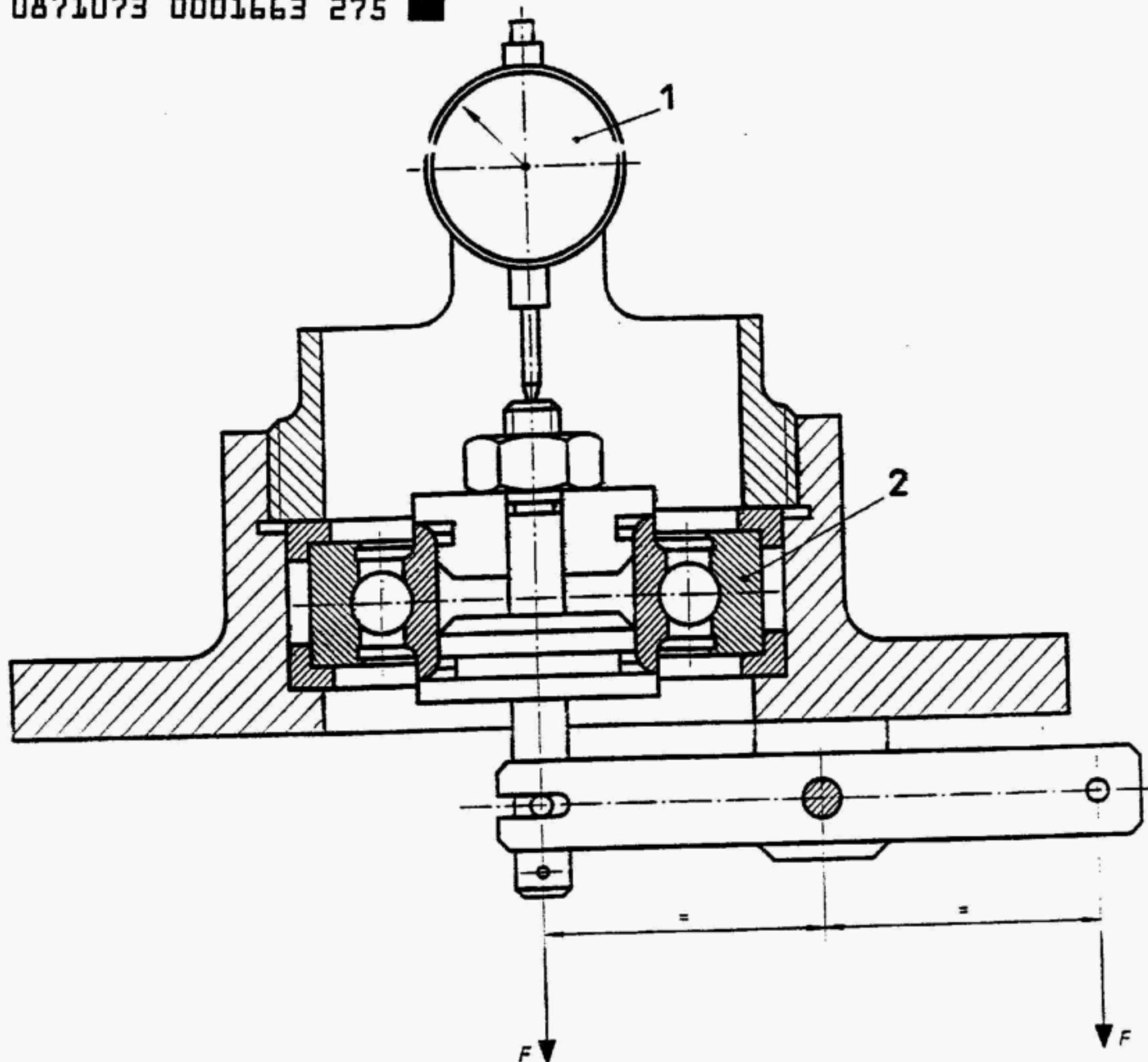
**C.2.2.1** Mount the bearing horizontally and immobilize the outer bearing.

**C.2.2.2** Place a dial gauge in the axis of the bearing.

**C.2.2.3** Apply the load  $F$  (see table C.2), first in the direction of the dial gauge, then in the opposite direction.

**C.2.2.4** Record the difference,  $G_a$ , between the maximum and minimum readings on the dial gauge.

**C.2.2.5** Repeat this measurement in different angular positions by rotating one ring in relation to the other.



# Key

- 1 Dial gauge
- 2 Bearing

Figure C.2

| Nominal<br>bore<br>diameter<br>mm | Load<br>$F$<br>$N$<br>$\pm 10 \%^{1)}$ |              |              |              |                               | Nominal<br>bore<br>diameter<br>mm | Load<br>$F$<br>$N$<br>$\pm 10 \%^{1)}$ |                              |                              |
|-----------------------------------|--|--------------|--------------|--------------|-------------------------------|-----------------------------------|--|------------------------------|------------------------------|
|                                   | Metric series                          |              |              |              |                               |                                   | Inch series                            |                              |                              |
|                                   | ISO<br>14191                           | ISO<br>14192 | ISO<br>14201 | ISO<br>14202 | ISO 14203<br>and<br>ISO 14204 |                                   | ISO<br>14193                           | ISO 14194<br>to<br>ISO 14197 | ISO 14206<br>to<br>ISO 14221 |
| $\leq 8$                          | 25                                     | 25           | 25           | 25           | 25                            | All sizes                         | 25                                     | 100                          | 25                           |
| $> 8$                             | 50                                     | 50           | 50           |              | 50                            |                                   |  |                              |                              |

1) Relative tolerance

### C.3 Diagonal internal clearance ( $G_d$ )

#### C.3.1 Apparatus

See figure C.3 as an example.

#### C.3.2 Method

**C.3.2.1** Mount the bearing horizontally and immobilize the outer ring.

**C.3.2.2** Fit a pin, unstressed, into the bore of the bearing (see figure C.3).

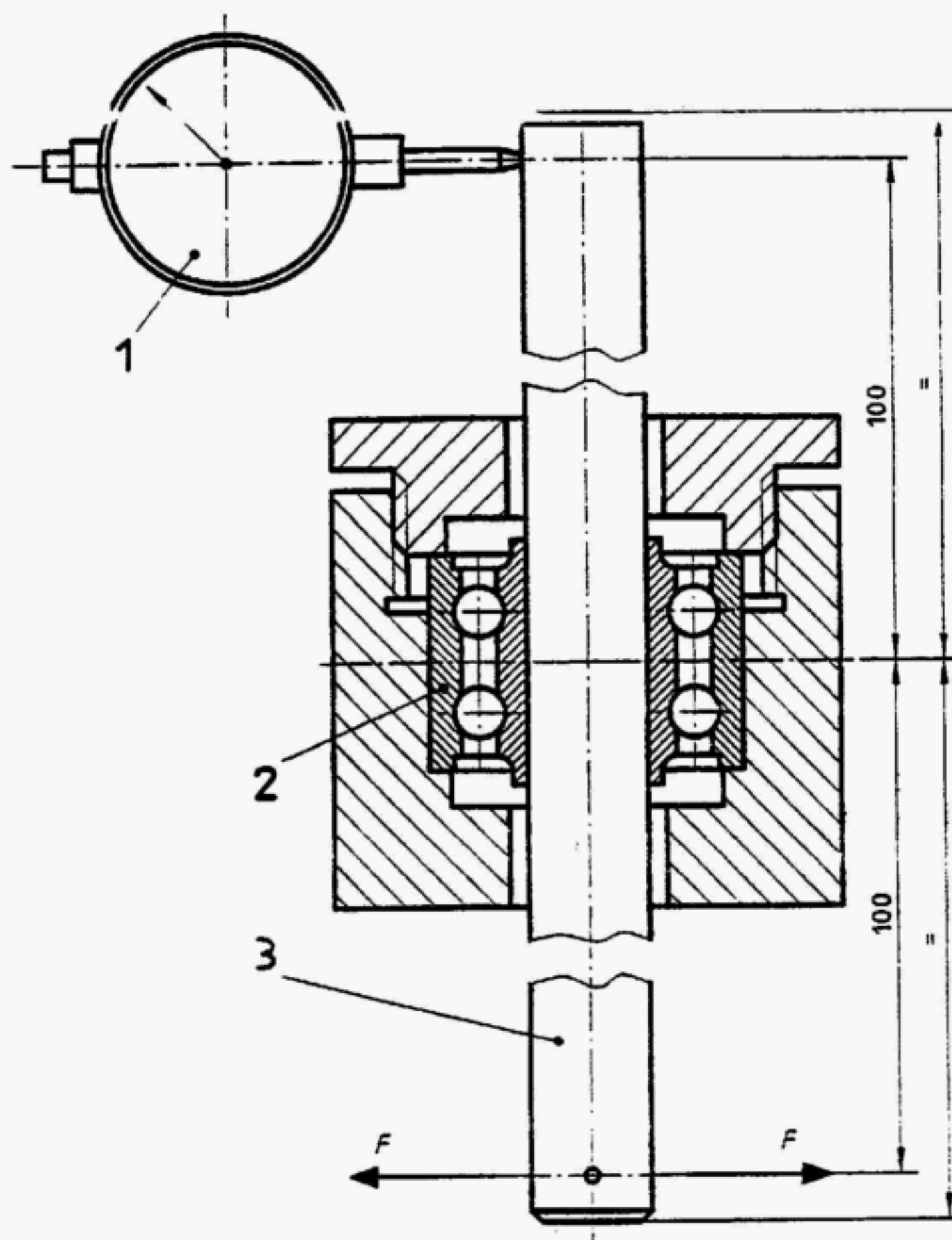
**C.3.2.3** Place a dial gauge on this pin (see figure C.3).

**C.3.2.4** Gradually apply the load  $F$  (see table C.3), as shown in figure C.3, on the side opposite the dial gauge, in the same direction as the dial gauge and then in the opposite direction.

**C.3.2.5** Record the difference,  $G_d$ , between the maximum and minimum readings on the dial gauge.

**C.3.2.6** Repeat this measurement in different angular positions by rotating one ring in relation to the other.





# Key

- 1 Dial gauge
- 2 Bearing
- 3 Pin

Figure C.3

Table C.3

| Nominal bore diameter<br>mm | Load<br>$F$<br>N<br>$\pm 10\%^{1)}$ |
|-----------------------------|-------------------------------------|
|                             | Metric series                       |
|                             | ISO 14204                           |
|                             | 10                                  |
| All diameters               |                                     |
| 1) Relative tolerance       |                                     |

## **Annex D**

(normative)

### **Test on the running behaviour of the bearings and on retention of seals and shields at the limit temperatures**

#### **D.1 Apparatus**

A suitable installation for torque measurement (see annex G, figure G.1) is required.

#### **D.2 Method**

**D.2.1** Carry out the test with grease B (synthetic hydrocarbon-type, see annex H) only.

**D.2.2** Measure the starting torque without load before the test (see annex G).

**D.2.3** Subject the bearing to a rotation rate of  $(3 \pm 1)$  r/min in a test chamber as follows:

- for 100 h at the minimum specified operating temperature, then
- for 100 h at the maximum specified operating temperature.

**D.2.4** Measure the starting torque without load of the bearing being tested (see annex G).

## **Verification of running accuracy of assembled bearing**

### **E.1 Radial running accuracy of inner ring ( $K_{ia}$ )**

#### **E.1.1 Apparatus**

See figure E.1 as an example.

#### **E.1.2 Method**

**E.1.2.1** Mount the bearing, unstressed, with its marked face pointing upwards, as shown in figure E.1.

**E.1.2.2** Immobilize the outer ring.

**E.1.2.3** Apply the load  $F$  (see table E.1), to the outer ring.

**E.1.2.4** Give the mandrel and inner ring under measuring load at least one turn.

**E.1.2.5** Record the difference,  $K_{ia}$ , between the maximum and minimum readings on the radial dial gauge.

### **E.2 Radial running accuracy of outer ring ( $K_{ea}$ )**

#### **E.2.1 Apparatus**

See figure E.1 as an example.

#### **E.2.2 Method**

**E.2.2.1** Mount the bearing, unstressed, with its marked face pointing upwards, as shown in figure E.1.

**E.2.2.2** Immobilize the inner ring.

**E.2.2.3** Apply the load  $F$  (see table E.1), to the outer ring.

**E.2.2.4** Give the outer ring under the measuring load at least one turn.

**E.2.2.5** Record the difference,  $K_{ea}$ , between the maximum and minimum readings on the radial dial gauge.

### **E.3 Axial running accuracy of outer ring ( $S_{ea}$ )**

#### **E.3.1 Apparatus**

See figure E.1 as an example.

#### **E.3.2 Method**

**E.3.2.1** Mount the bearing, unstressed, with its marked face pointing upwards, as shown in figure E.1.



**E.3.2.2** Immobilize the inner ring.

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**E.3.2.3** Apply the load  $F$  (see table E.1), to the outer ring.

**E.3.2.4** Give the outer ring under the measuring load at least one turn.

**E.3.2.5** Record the difference,  $S_{ea}$ , between the maximum and minimum readings on the axial dial gauge.

## **E.4 Axial running accuracy of inner ring ( $S_{ia}$ )**

### **E.4.1 Apparatus**

See figure E.2 as an example.

### **E.4.2 Method**

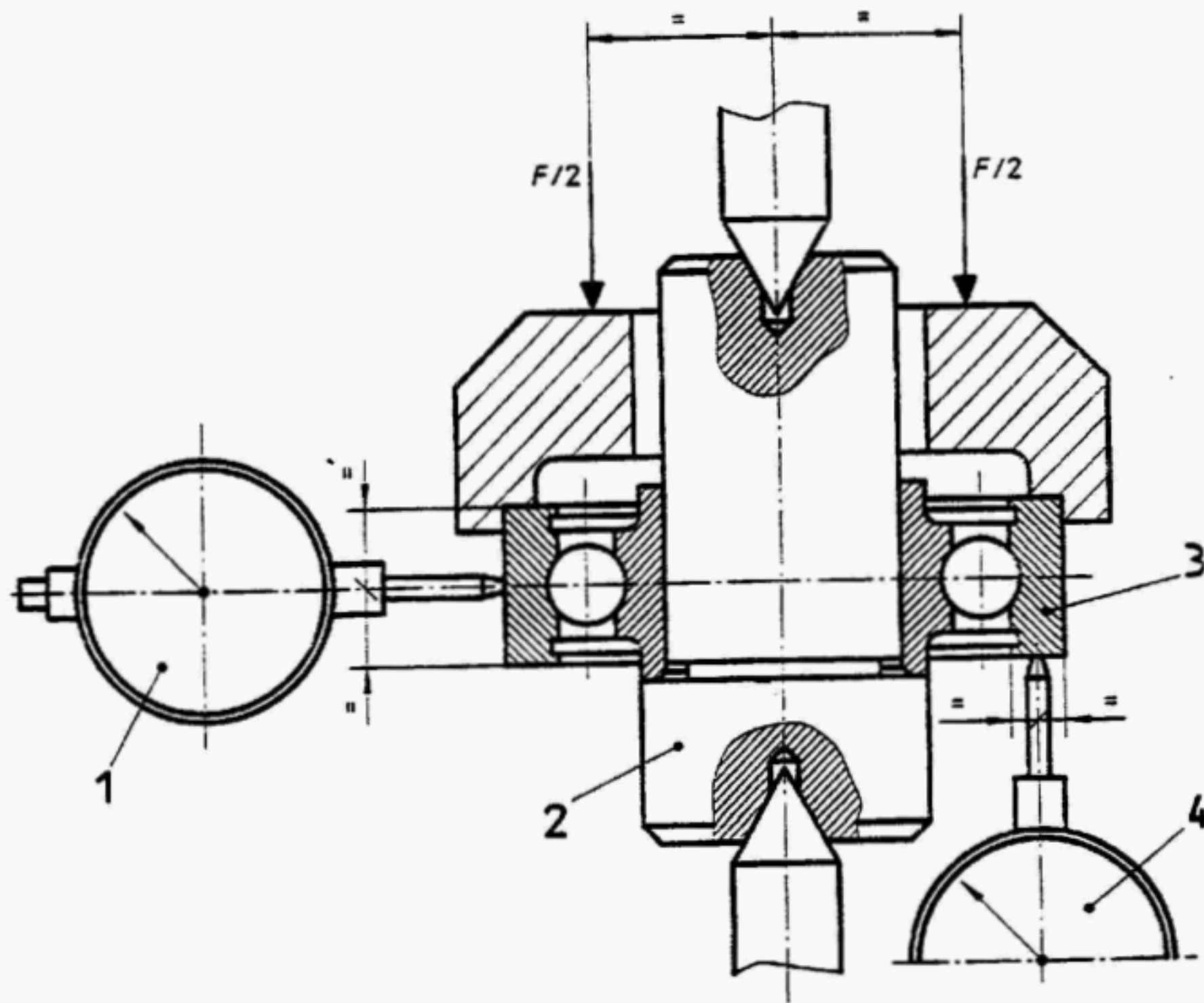
**E.4.2.1** Mount the bearing, unstressed, with its marked face pointing upwards, as shown in figure E.2.

**E.4.2.2** Immobilize the outer ring.

**E.4.2.3** Apply the load  $F$  (see table E.1) to the inner ring.

**E.4.2.4** Give the mandrel and inner ring under the measuring load at least one turn.

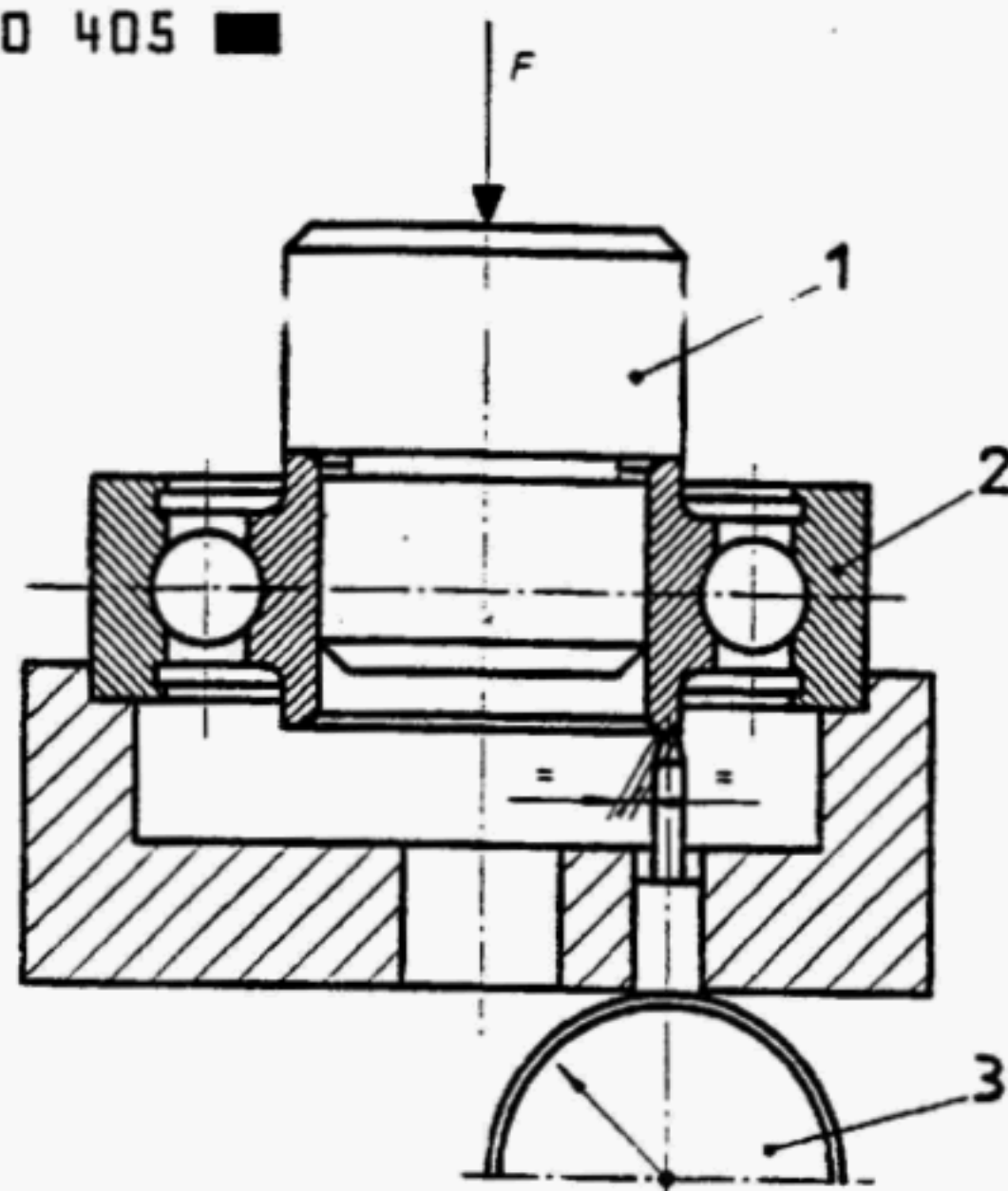
**E.4.2.5** Record the difference,  $S_{ia}$ , between the maximum and minimum readings on the axial dial gauge.



# Key

- 1 Radial dial gauge for measuring  $K_{ia}$  and  $K_{ea}$
- 2 Mandrel
- 3 Bearing
- 4 Axial dial gauge for measuring  $S_{ea}$

Figure E.1



**Key**

- 1 Mandrel
- 2 Bearing
- 3 Axial dial gauge for measuring  $S_{ia}$

**Figure E.2**

**Table E.1**

| Nominal bore diameter | Load<br>$F$<br>max.<br>N<br>$\pm 10\%^{1)}$ |
|-----------------------|---|
| mm                    |   |
| $\leq 30$             | 6   |
| $> 30$                | 7,5   |
| 1) Relative tolerance |   |



## Annex F (normative)

### Verification of permissible and ultimate static loads

#### F.1 Permissible static radial load ( $C_s$ )

##### F.1.1 Apparatus

See figures F.1 and F.2 as examples.

##### F.1.2 Method

F.1.2.1 Mount the bearing as shown in figure F.1. It shall turn freely by hand.

F.1.2.2 Gradually apply a load  $C_s$  by increasing the load at a rate of 1 % per second.

F.1.2.3 Maintain the load for 1 min.

F.1.2.4 Remove the load.

F.1.2.5 Transfer and mount the bearing as shown in figure F.2.

F.1.2.6 Apply a minimum radial load  $F$  of 25 N.

F.1.2.7 Turn the bearing manually.

F.1.2.8 Check.

#### F.2 Ultimate static radial load

This test follows the test specified in clause F.1.

##### F.2.1 Apparatus

See figure F.1 as an example.

##### F.2.2 Method

F.2.2.1 Mount the bearing as shown in figure F.1. It shall turn freely by hand.

F.2.2.2 Gradually apply a load of 1,5  $C_s$  by increasing the load at a rate of 1 % per second.

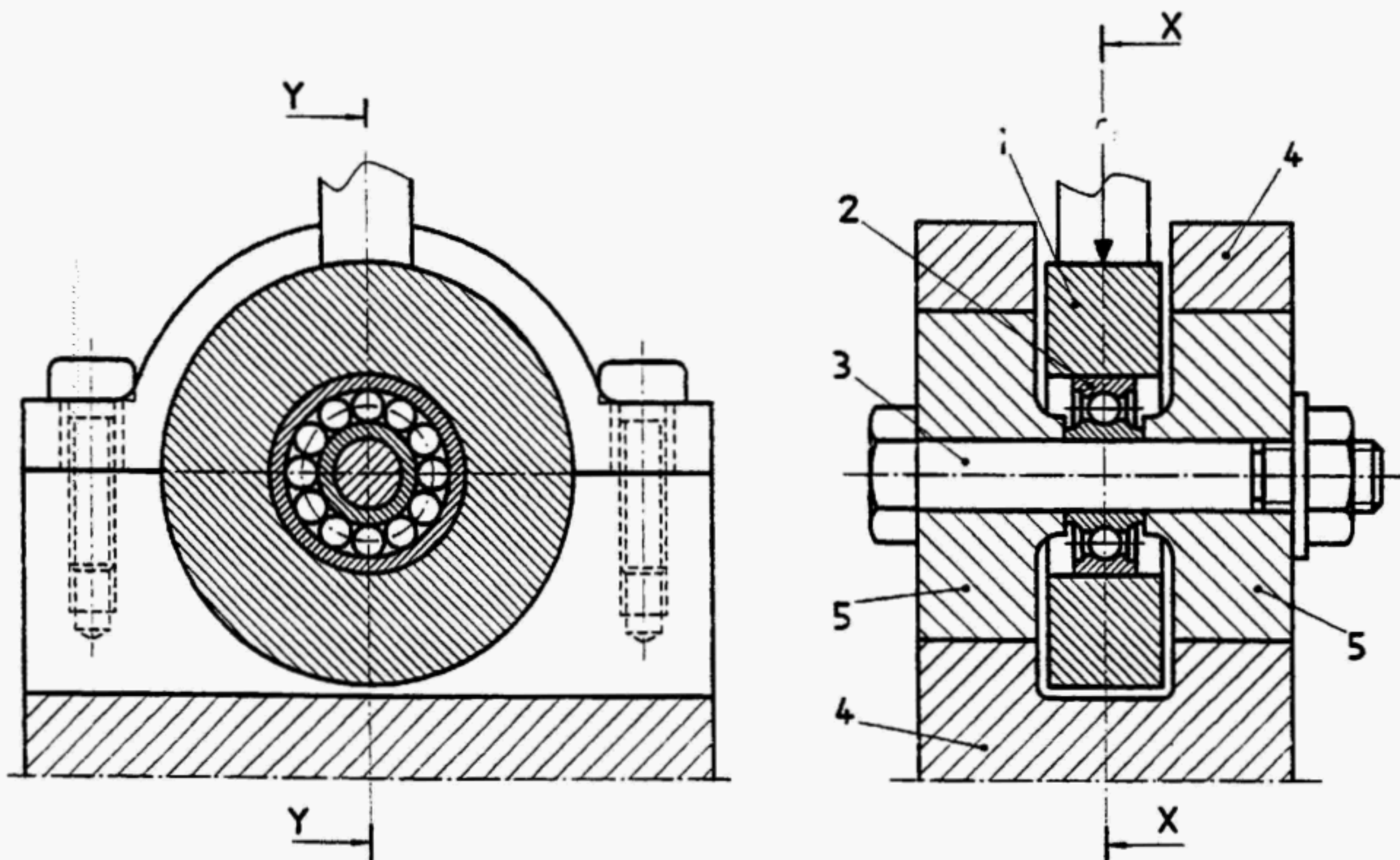
F.2.2.3 Maintain the load for 1 min.

F.2.2.4 Remove the load.

F.2.2.5 Check.

X-X

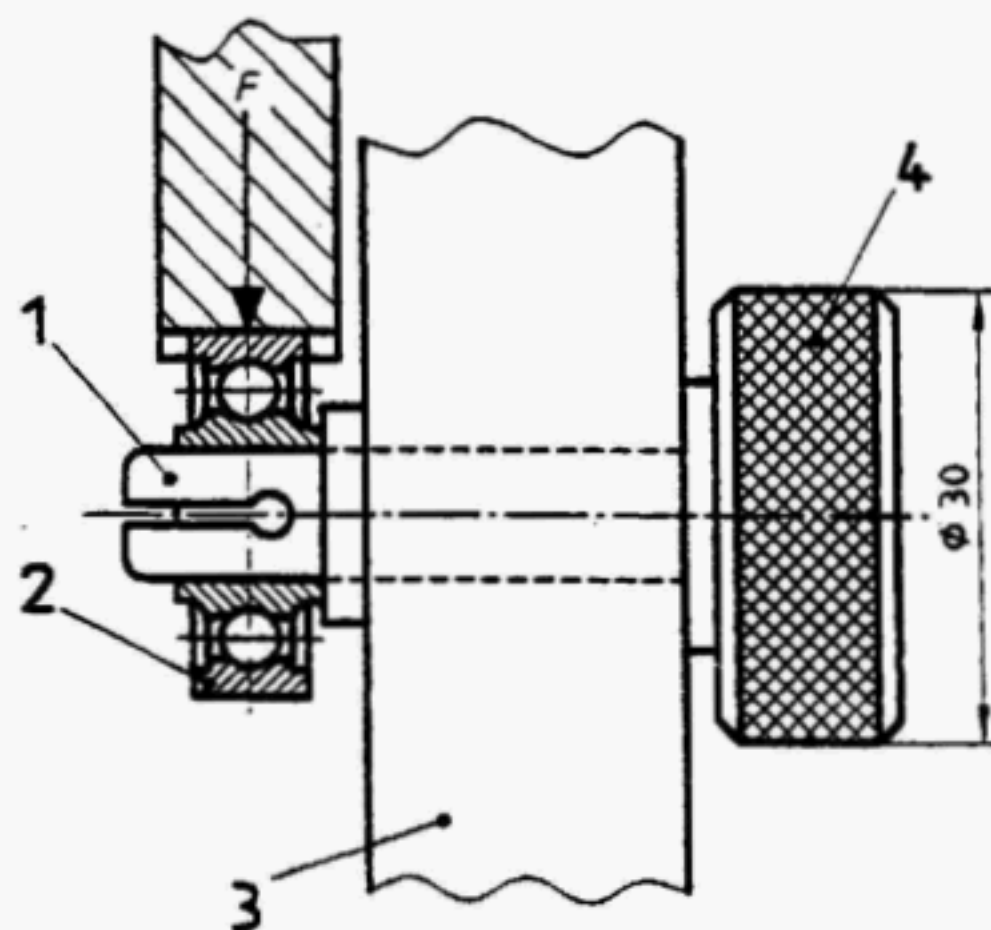
0871073 0001672 288 Y-Y

**Key**

- |                                     |                   |
|-------------------------------------|-------------------|
| 1 Circular piece in hardened steel  | 4 Clamping device |
| 2 Bearing                           | 5 Spacers         |
| 3 High tensile steel clamping shaft |                   |

**Figure F.1**

Dimensions in millimetres

**Key**

- |                |
|----------------|
| 1 Shaft        |
| 2 Bearing      |
| 3 Support      |
| 4 Knurled Knob |

**Figure F.2**

**F.3.1 Apparatus**

See figures F.3 and F.4 as examples.

**F.3.2 Method**

**F.3.2.1** Mount the bearing as shown in figure F.3. It shall turn freely by hand.

**F.3.2.2** Gradually apply a load  $F_{a \max}$  by increasing the load at a rate of 1 % per second.

**F.3.2.3** Maintain the load for 1 min.

**F.3.2.4** Remove the load.

**F.3.2.5** Transfer and mount the bearing as shown in figure F.4.

**F.3.2.6** Apply a minimum axial load  $F$  of 25 N.

**F.3.2.7** Rotate the bearing manually.

**F.3.2.8** Check.

**F.4 Ultimate static axial load**

This test follows the test specified in clause F.3.

**F.4.1 Apparatus**

See figure F.3 as an example.

**F.4.2 Method**

**F.4.2.1** Mount the bearing as shown in figure F.3. It shall turn freely by hand.

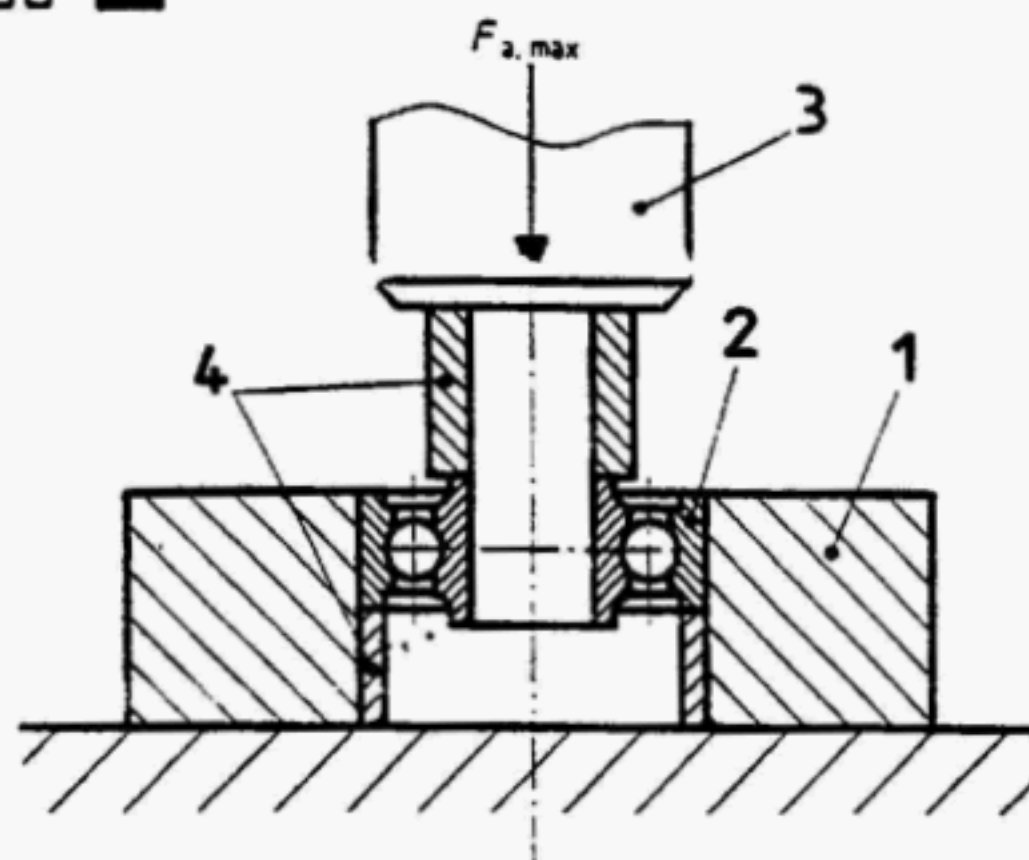
**F.4.2.2** Gradually apply a maximum axial load of  $1,5 F_{a \max}$  by increasing the load at a rate of 1 % per second.

**F.4.2.3** Maintain the load for 1 min.

**F.4.2.4** Remove the load.

**F.4.2.5** Check.



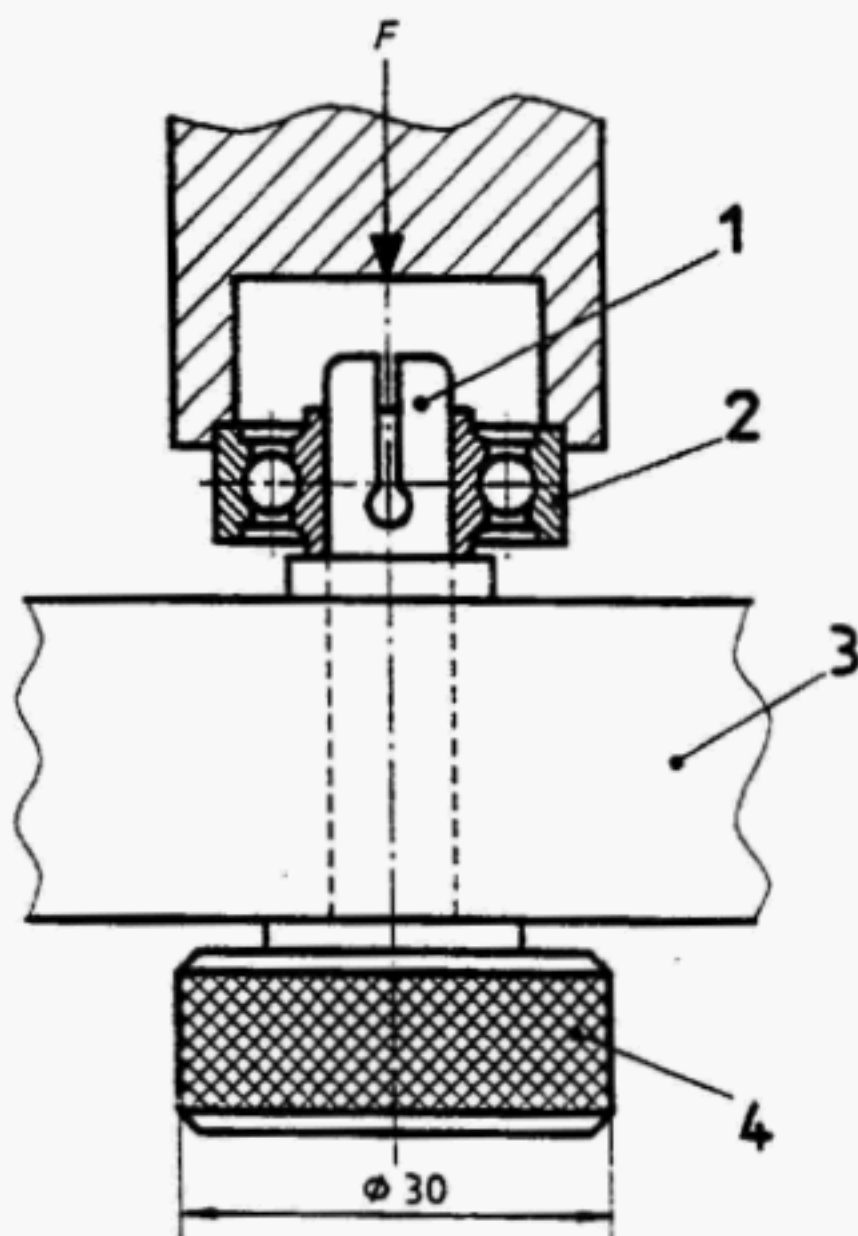


### Key

- 1 Circular piece in hardened steel
- 2 Bearing
- 3 Load shaft
- 4 Spacers

Figure F.3

Dimensions in millimetres



### Key

- 1 Shaft
- 2 Bearing
- 3 Support
- 4 Knurled knob

Figure F.4

## **Annex G**

### **(normative)**

# **Starting torque at zero load test**

## **G.1 Apparatus**

See figure G.1 as an example. Alternative methods of support which secure one bearing ring and permit the other ring to be rotated are equally acceptable.

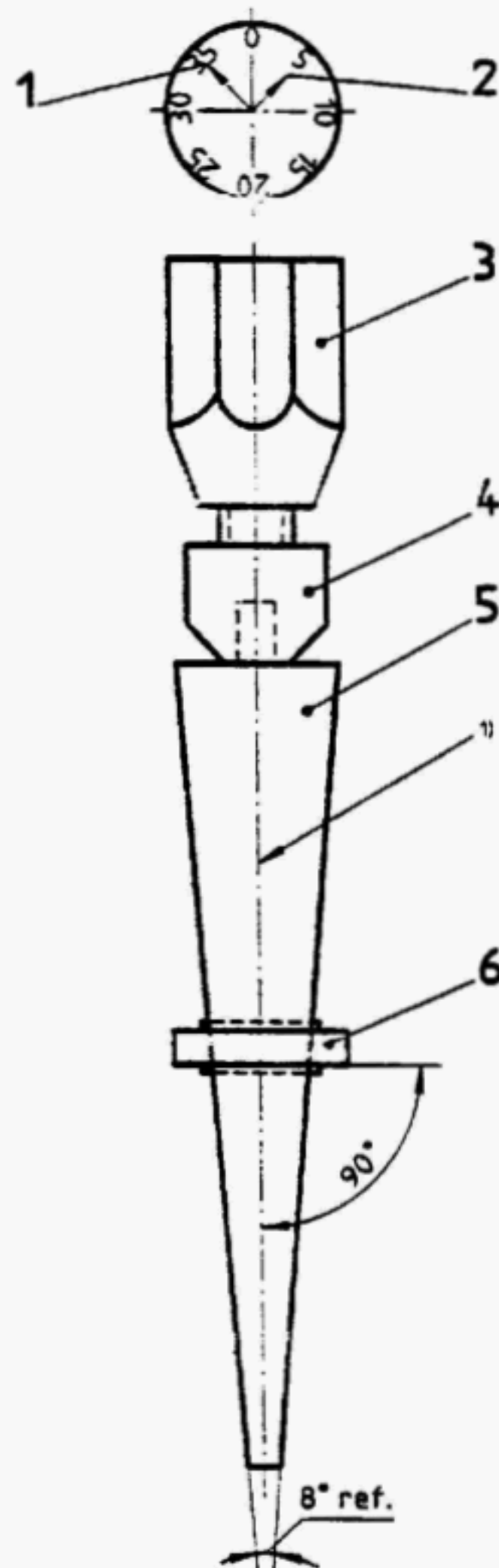
## **G.2 Method**

**G.2.1** Rotate one of the two bearing rings at least four revolutions in both directions to distribute the grease evenly.

**G.2.2** Align bearing ring faces perpendicularly to the bearing adapter's axis and push lightly onto the adapter until wedging action just holds the bearing on the adapter.

**G.2.3** With the bearing at ambient temperature ( $20\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ ), apply torque either using a power driven torque measuring device which gradually increases the torque from zero until rotation occurs, or manually using a torque gauge.

**G.2.4** Measure the torque five times in both rotational directions and record the highest value.



# Key

- |   |   |
|---|---|
| 1 Stop indicator                            | 4 Key chuck or similar                          |
| 2 Torque indicator                          | 5 Rubber or nylon wedge-type adapter or similar |
| 3 Torque watch                              | 6 Test bearing                                  |
| 1) Axis (vertical or horizontal acceptable) |   |

Figure G.1

## Annex H (normative)

### Greases for airframe bearings

#### H.1 Grease A

Ester-type extreme pressure grease having the following main properties shall be used.

- Nature: synthetic, with gelling agents and extreme pressure additives
- Dropping point: not lower than 163 °C
- Worked penetration: 270 mm to 310 mm
- Operating temperature: from – 73 °C to 121 °C

#### H.2 Grease B

Synthetic hydrocarbon-type grease having the following main properties shall be used.

- Nature: synthetic, with gelling agents and high melting point
- Dropping point: not lower than 232 °C
- Worked penetration: 265 mm to 320 mm
- Operating temperature: from – 54 °C to 177 °C



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## ICS 49.035

**Descriptors:** aircraft industry, rolling bearings, airframe bearings, ball bearings, roller bearings, spherical bearings, specifications, characteristics, delivery condition, tests, acceptance testing, inspection, quality assurance, qualification, packaging.

**Price based on 32 pages**

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