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Rolling bearings — Measuring and gauging principles and methods

Roulements — Principes et méthodes de mesurage et de vérification par calibres

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Contents

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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.

The main task of ISO technical committees is to prepare International Standards. In exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 9274, which is a Technical Report of type 3, was prepared by Technical Committee ISO/TC 4, *Rolling bearings,* Sub-Committee SC 4, *Tolerances*.

This Technical Report is issued for the guidance of those wishing to use the measuring and gauging methods described. The Technical Committee does not envisage that it will become an International Standard.

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Rolling bearings — Measuring and gauging principles and methods

1. Scope

This Technical Report establishes guidelines for measurement of dimensions, running accuracy and internal clearance of rolling bearings. The purpose is to outline the fundamentals of various measuring and gauging principles which may be used in order to comply with the definitions of ISO 1132 and ISO 5593.

The measuring and gauging methods described in this Technical Report do differ amongst themselves and do not provide for a unique interpretation of requirements of ISO 1132 and ISO 5593. It is recognized that there are other adequate measuring and gauging methods and that technical development may result in even more convenient methods. Therefore, this Technical Report does not imply any obligation to apply any particular method. However, the methods specified may be referred to in cases of dispute.

This Technical Report covers both radial and thrust rolling bearings.

2. References

ISO 1 - 1975 Reference temperature

ISO 1132 - 1980 Rolling Bearings - Tolerances - Definitions

ISO 5593 - 1984 Rolling Bearings - Vocabulary

3. Definitions

Measurement: A set of operations having the object of determining the dimension(s) or variation of a feature.

Gauging: An act of inspecting a size and/or form by means of a gauge.

Measuring and gauging principle: Fundamental geometrical basis for the measurement or gauging of the considered geometrical characteristic.

Measuring and gauging method: Practical application of the principle by the use of different equipment and operations.

Measuring equipment: Technical device necessary for a specific method (e.g. calibrated indicator).

Gauge: A device of defined geometric form and size used to assess the conformance of a feature of a workpiece to a dimensional specification. The device could give only "go" and/or "no go" information (e.g. plug gauge).

Measuring force: The force applied by the stylus of an indicator or a recorder to the feature being measured.

NOTE - Definitions of tolerance concepts applied in this Technical Report are given in ISO 1132.

Reference face: Face so designated by the manufacturer of bearings and which may be the datum for measurements.

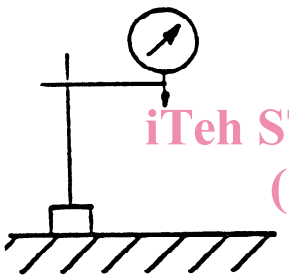
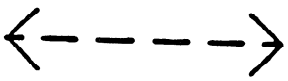
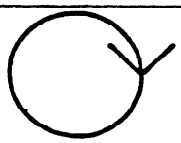
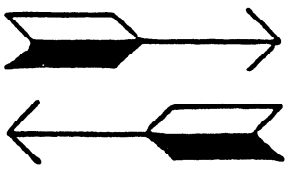
NOTE - The reference face for the measurement of a ring is generally taken as the unmarked face.
In case of symmetrical rings when it is not possible to identify the reference face, the tolerances are deemed to comply relative to either face.
The reference face of a shaft and housing washer of a thrust bearing, is that face intended to support axial load and is generally opposite the raceway face.
In the case of single row angular contact ball bearing rings and tapered roller bearing rings the reference face is the "back face" which is intended to support axial load.

4. Symbols

The tolerance symbols used in this Technical Report are in accordance with ISO 1132.

The symbols shown in Table 1 are applied throughout this Technical Report.

Table 1

	Symbol	Interpretation
1		Surface plate (measuring plane)
2		Fixed support
3		Indicator or recorder
4		Measuring stand with indicator or recorder. Symbols for measuring stands can be drawn in different ways in accordance with the measuring equipment used.
5		Centred arbor
6		Intermittent linear traverse
7		Intermittent turning
8		Rotation
9		Loading, direction of loading
10		Loading alternately in opposite directions

5. General Conditions

Measuring equipment

Measurements of the various dimensions and runouts can be performed on different kinds of measuring equipment and with different degrees of accuracy. In this Technical Report methods are described which are commonly used by bearing users and which, as a rule, provide an accuracy sufficient for practical purposes. It is recommended that the total measuring inaccuracy should not exceed 10% of the actual tolerance zone.

However, the measuring and gauging methods may not always fully check the indicated requirements. Whether or not such methods are sufficient and acceptable depends on the magnitude of the actual deviations from the ideal dimension and form and inspection circumstances.

Bearing manufacturers frequently use specially designed measuring equipment for individual components, as well as assemblies, to increase the speed and accuracy of measurement. Should the dimensional or geometrical errors appear to exceed those in the relative specifications, when using equipment as indicated in any of the principles in this Technical Report, the matter shall be referred to the bearing manufacturer.

Masters and indicators

Determination of dimensions is performed by comparing the actual part with appropriate gauge blocks or masters whose calibration is traceable to those used by National Standards Organizations. For such comparison an indicator, calibrated and of appropriate sensitivity, is used.

Arbors

In all cases when arbor methods of measuring of runout are used, the rotational accuracy of the arbor should be determined so that subsequent bearing measurements may be suitably corrected for any appreciable arbor inaccuracy.

Temperature

Before measurement is made, the part to be measured, the measuring equipment and the master should be brought to the temperature of the room in which the measurements are to be made. Care should be used to avoid heat transfer to the part or assembled bearing during measurement. Recommended room temperature is + 20°C.

Measuring force and radius of measuring stylus

To avoid undue deflection of thin rings, measuring force should be minimized and if significant distortion is present, a load deflection factor shall be introduced to correct the measured value to the free unloaded value.

For measuring force and radius of measuring stylus see Table 2.

Table 2

Bearing feature	Nominal size range mm		Measuring force N	Radius of measuring stylus mm
	over	incl.	max.	min.
Bore diameter d	-	10	2	0.8
	10	30	2	2.5
	30	-	3.5	2.5
Outside diameter D	-	30	2	2.5
	30	-	2.5	2.5

Coaxial measuring load

To maintain the bearing parts in their proper relative positions the coaxial measuring load in tables 3 and 4 shall be applied for methods 8.2.1.1, 8.3.1.1, 8.4.1.1, and 8.5.1.1.

Table 3 - Coaxial measuring loads for groove type ball bearings

Nominal size range of the bearing outside diameter mm		Coaxial load on the bearing N
over	incl.	min.
-	30	5
30	50	7.5
50	80	15
80	120	35
120	180	70
180	-	140

Table 4 - Coaxial measuring loads for tapered roller bearings

Nominal size range of the bearing outside diameter mm		Coaxial load on the bearing N
over	incl.	min.
-	30	40
30	50	80
50	80	120
80	120	150
120	-	150

Measurement zone

The limits for deviations of a bore diameter or an outside diameter are not applicable to measurements in radial planes situated at a distance of less than 1.2 r_{smax} from the side faces of the bearing rings.

Preparation before measuring

Any grease or corrosion inhibitor adhering to the bearings shall be removed if it is likely to affect the measurement results. Before measuring, the bearings should be lubricated with a low viscosity oil.

NOTE - Immediately after completion of the measurements the bearings should be coated with a corrosion inhibitor.

6. Measuring and gauging principles and methods

For each characteristic to be measured or gauged one or more measuring or gauging principles are indicated in Clauses 7 and 8. For each principle one or more measuring or gauging methods are given.

The left hand columns entitled "Method" show:

- the number of the method
- a figure illustrating the method
- essential characteristics of the method
- the readings to be taken
- required repetitions

The right hand columns entitled "Comments" are used for supplementary information, for example:

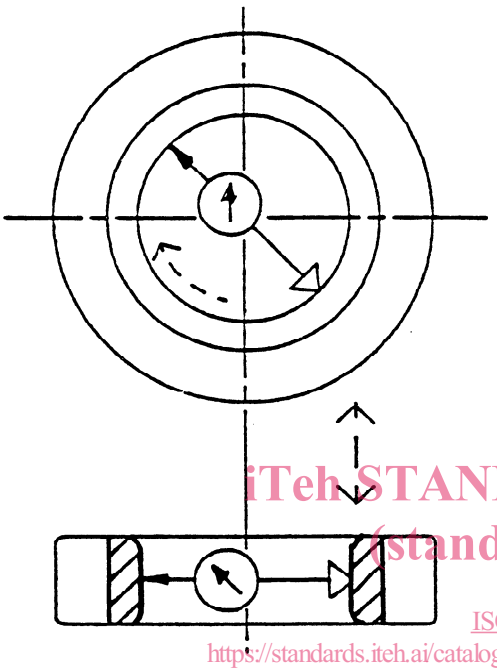
- a particular application
- any restrictions in application
- any particular sources of error
- any particular requirements as to equipment
- examples of equipment
- treatment of readings obtained.

It should be noted that consideration has neither been given to the influence of the accuracy and design of the measuring equipment, nor to the skill of the operator. These factors sometimes have a greater influence on the result of the measurement or gauging than the difference between the methods described.

The measuring and gauging principles and methods are not illustrated in detail and are not intended for application on end-product drawings.

The numbering of measuring and gauging principles and methods shall not be regarded as a classification of priority within the prescribed type of tolerances.

7. Inner and outer rings, shaft and housing washers.
7.1 Bore diameter - d.
7.1.1 Principle 1. Two-point measurement of bore diameter.

METHOD	COMMENTS
7.1.1.1  Use device arranged for two-point bore measurements. Measure single bore diameters in several angular directions and also in several radial planes. In this manner the smallest and the largest single diameter of the bore surface is obtained. Also, when required, the smallest and largest single diameter in each radial plane is determined, from which the diameter variation in a single radial plane, the mean diameter in each radial plane and the variation of the mean diameter from plane to plane are obtained.	If the size or section of the bearing inner ring is such that, with the bearing axis in a horizontal position, the bore measurement is influenced by gravity, the bearing should be placed with the axis in a vertical position and, if necessary, use a lower measuring force. $\Delta_{ds} = d_s - d$ Δ_{ds} = deviation of single bore diameter d = nominal bore diameter $\Delta_{dmp} = d_{mp} - d$ Δ_{dmp} = single plane mean bore diameter deviation. $d_{mp} = \frac{d_{smax} + d_{smin}}{2}$ NOTE - in a single radial plane $V_{dp} = d_{smax} - d_{smin}$ V_{dp} = bore diameter variation in a single radial plane $V_{dmp} = d_{mpmax} - d_{mpmin}$ V_{dmp} = mean bore diameter variation (applies only to basically cylindrical bore).