INTERNATIONAL STANDARD

ISO 3290

Second edition
1998-06-01

Rolling bearings — Balls — Dimensions and tolerances

Roulements — Billes — Dimensions et tolérances

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 3290 was prepared by Technical Committee ISO/TC 4, *Rolling bearings*.

This second edition cancels and replaces the first edition (ISO 3290:1975), clauses 2 and 3, the tables and annex B of which have been technically revised.

Annexes A and B form an integral part of this International Standard. Annex C is for information only.

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Rolling bearings — Balls — Dimensions and tolerances

1 Scope

This International Standard specifies requirements for finished steel balls for rolling bearings.

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

ISO 4291:1985, *Methods for the assessment of departure from roundness — Measurement of variations in radius*.

3 Definitions

For the purposes of this International Standard the following definitions apply.

3.1 nominal ball diameter, D_w: diameter value which is used for the general identification of a ball size.

3.2 single ball diameter, D_{ws}: distance between two parallel planes tangential to the actual surface of a ball.

3.3 mean ball diameter, D_{wm}: arithmetical mean of the largest and the smallest of the single diameters of a ball.

3.4 variation of ball diameter, V_{Dws}: difference between the largest and the smallest of the single diameters of a ball.

3.5 surface irregularities and form parameters: Various types of deviation from the perfect spherical ball surface, uniformly distributed and repeated around the ball surface.

NOTES

1 The deviations to which limits can be attributed are:

— deviation from spherical form;

— waviness;

— surface roughness.

2 Surface defects (and their limits) are not specified in this International Standard but may be defined as follows:

surface defect: Element, irregularity or group of elements and irregularities of the real surface, unintentionally or accidentally caused during manufacture, storage, handling or use of the surface. Such types of elements or irregularities differ considerably from those constituting the surface roughness and should not be considered during the measurement of the surface roughness, (see 4.2, note 2).

3.5.1 deviation from spherical form: Greatest radial distance, in any equatorial plane, between the smallest circumscribed sphere and the greatest inscribed sphere with their centre common to the least square sphere centre.

NOTE — Information about the measurement of this deviation is given in annex B.

3.5.2 waviness: Surface irregularities of random or periodical deviation from the ideal spherical form.

NOTE — It is recommended that waviness be evaluated as velocity amplitude. In practice, the waviness components are separated from the real surface by a waviness analyser (filters).

3.5.3 surface roughness: Surface irregularities with relatively small spacings, which usually include irregularities resulting from the method of manufacture being used and/or other influences.

NOTE — These irregularities are considered within the limits which are conventionally defined, for example, within the limits of the sampling length.

3.6 ball lot: definite quantity of balls manufactured under conditions presumed uniform and which is considered as an entity.

3.7 mean diameter of ball lot, D_{wmL}: arithmetical mean of the mean diameters of the largest ball and the smallest ball in a ball lot.

3.8 variation of ball lot diameter, V_{DwL}: difference between the mean diameters of the largest ball and the smallest ball in a ball lot.

3.9 ball grade, G: specific combination of dimensional, form, surface roughness and sorting tolerances for balls.

NOTE — Ball grade in identified by the letter G and a number.

3.10 ball gauge, S: amount by which the mean diameter of ball lot should differ from the nominal ball diameter, this amount being one of an established series.

NOTES

1 Each ball gauge is a whole multiple of the ball gauge interval established for the ball grade in question (see also annex A).

2 A ball gauge, in combination with the ball grade and nominal diameter, should be considered as the most exact ball size specification to be used by a customer for ordering purposes.

3.11 deviation of ball lot from ball gauge, Δ_S: difference between the mean diameter of ball lot and the sum of the nominal ball diameter and the ball gauge (see also table 3 and annex A).

$$\Delta_S = D_{wmL} - (D_w + S)$$

3.12 ball subgauge: amount of an established series of amounts, which is the nearest to the actual deviation from the ball gauge of a ball lot.

NOTES

1 Each ball subgauge is a whole multiple of the ball subgauge interval established for the ball grade in question (see table 3 and annex A).

2 The ball subgauge, in combination with the nominal ball diameter and the ball gauge, is used by ball manufacturers to denote the mean diameter of ball lot and should not be used by customers for ordering purposes.

3.13 hardness: measure of resistance to penetration as determined by specific methods.

4 Requirements

4.1 Ball size

The preferred nominal ball diameters are given in table 1. The corresponding inch sizes are given for reference purposes only.

4.2 Quality of geometry and surface

Requirements for:

— variation of ball diameter, see table 2;

— deviation from spherical form, see table 2;

— waviness, see note 1;

— surface roughness, see table 2;

— surface appearance and defects, see note 2.

Measurement of surface roughness shall be made as described in ISO 4288.

NOTES

1 Limits and measuring methods for waviness should be agreed between customer and supplier.

2 Surface appearance characteristics, local defects, scratches and the like are subject to agreement between customer and supplier.

4.3 Sorting accuracy and ball gauges

Table 3 comprises the applicable values for:

— variation of ball lot diameter;

— gauge interval;

— preferred gauges;

— subgauge interval;

— subgauges.

4.4 Hardness

Hardness values and the measuring method shall be agreed upon between supplier and customer.

Table 1 — Preferred nominal ball diameters

Nominal ball diameter D_W mm	Corresponding inch size (reference) in	Nominal ball diameter D_W mm	Corresponding inch size (reference) in	Nominal ball diameter D_W mm	Corresponding inch size (reference) in
0,3		9,525	3/8	30,162	1 3/16
0,397	1/64	9,922	25/64	31,75	1 1/4
0,4		10		32	
0,5		10,319	13/32	33	
0,508	0,020	10,5		33,338	1 5/16
0,6		11		34	
0,635	0,025	11,112	7/16	34,925	1 3/8
0,68		11,5		35	
0,7		11,509	29/64	36	
0,794	1/32	11,906	15/32	36,512	1 7/16
0,8		12		38	
1		12,303	31/64	38,1	1 1/2
1,191	3/64	12,5		39,688	1 9/16
1,2		12,7	1/2	40	
1,5		13		41,275	1 5/8
1,588	1/16	13,494	17/32	42,862	1 11/16
1,984	5/64	14		44,45	1 3/4
2		14,288	9/16	45	
2,381	3/32	15		46,038	1 13/16
2,5		15,081	19/32	47,625	1 7/8
2,778	7/64	15,875	5/8	49,212	1 15/16
3		16		50	
3,175	1/8	16,669	21/32	50,8	2
3,5		17		53,975	2 1/8
3,572	9/64	17,462	11/16	55	
3,969	5/32	18		57,15	2 1/4
4		18,256	23/32	60	
4,366	11/64	19		60,325	2 3/8
4,5		19,05	3/4	63,5	2 1/2
4,762	3/16	19,844	25/32	65	
5		20		66,675	2 5/8
5,159	13/64	20,5		69,85	2 3/4
5,5		20,638	13/16	70	
5,556	7/32	21		73,025	2 7/8
5,953	15/64	21,431	27/32	75	
6		22		76,2	3
6,35	1/4	22,225	7/8	79,375	3 1/8
6,5		22,5		80	
6,747	17/64	23		82,55	3 1/4
7		23,019	29/32	85	
7,144	9/32	23,812	15/16	85,725	3 3/8
7,5		24		88,9	3 1/2
7,541	19/64	24,606	31/32	90	
7,938	5/16	25		92,075	3 5/8
8		25,4	1	95	
8,334	21/64	26		95,25	3 3/4
8,5		26,194	1 1/32	98,425	3 7/8
8,731	11/32	26,988	1 1/16	100	
9		28		101,6	4
9,128	23/64	28,575	1 1/8	104,775	4 1/8
9,5		30			

Table 2 — Form and surface roughness tolerances

µm

Grade	Variation of ball diameter V_{Dws} max.	Deviation from spherical form max.	Surface roughness R_a max.
	µm		
G 3	0,08	0,08	0,010
G 5	0,13	0,13	0,014
G 10	0,25	0,25	0,020
G 16	0,4	0,4	0,025
G 20	0,5	0,5	0,032
G 24	0,6	0,6	0,040
G 28	0,7	0,7	0,050
G 40	1	1	0,060
G 60	1,5	1,5	0,080
G 100	2,5	2,5	0,100
G 200	5	5	0,150

NOTE — The values given in this table do not take into account surface defects; hence measurement must be taken outside such defects.

Table 3 — Sorting tolerances and gauges

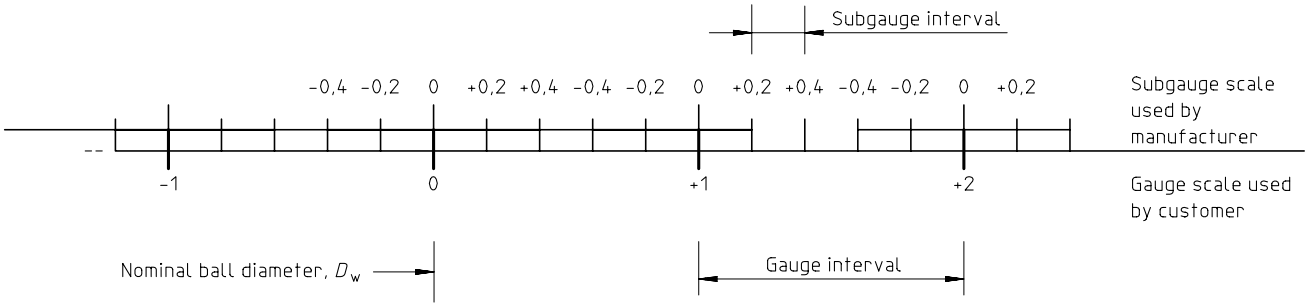
Grade	Variation of ball lot diameter V_{DwL} max	Gauge interval	Preferred gauges		Subgauge interval	Subgauges	
	µm						
G 3	0,13	0,5	– 5, .. – 0,5,	0, + 0,5, ... + 5	0,1	– 0,2, – 0,1	0, + 0,1, + 0,2
G 5	0,25	1	– 5, .. – 1,	0, + 1, ... + 5	0,2	– 0,4, – 0,2,	0, + 0,2, + 0,4
G 10	0,5	1	– 9, .. – 1,	0, + 1, ... + 9	0,2	– 0,4, – 0,2,	0, + 0,2, + 0,4
G 16	0,8	2	– 10, .. – 2,	0, + 2, ... + 10	0,4	– 0,8, – 0,4,	0, + 0,4, + 0,8
G 20	1	2	– 10, .. – 2,	0, + 2, ... + 10	0,4	– 0,8, – 0,4,	0, + 0,4, + 0,8
G 24	1,2	2	– 12, .. – 2,	0, + 2, ... + 12	0,4	– 0,8, – 0,4,	0, + 0,4, + 0,8
G 28	1,4	2	– 12, .. – 2,	0, + 2, ... + 12	0,4	– 0,8, – 0,4,	0, + 0,4, + 0,8
G 40	2	4	– 16, .. – 4,	0, + 4, ... + 16	0,8	– 1,6, – 0,8,	0, + 0,8, + 1,6
G 60	3	6	– 18, .. – 6,	0, + 6, ... + 18	1,2	– 2,4, – 1,2,	0, + 1,2, + 2,4
G 100	5	10	– 40, .. – 10,	0, + 10, ... + 40	2	– 4, – 2,	0, + 2, + 4

Annex A
(normative)

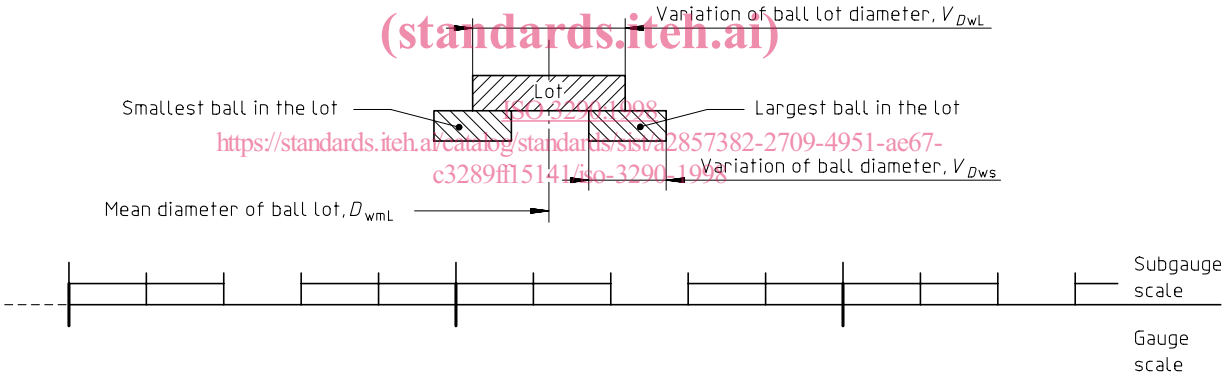
Illustration of gauges and sorting principles

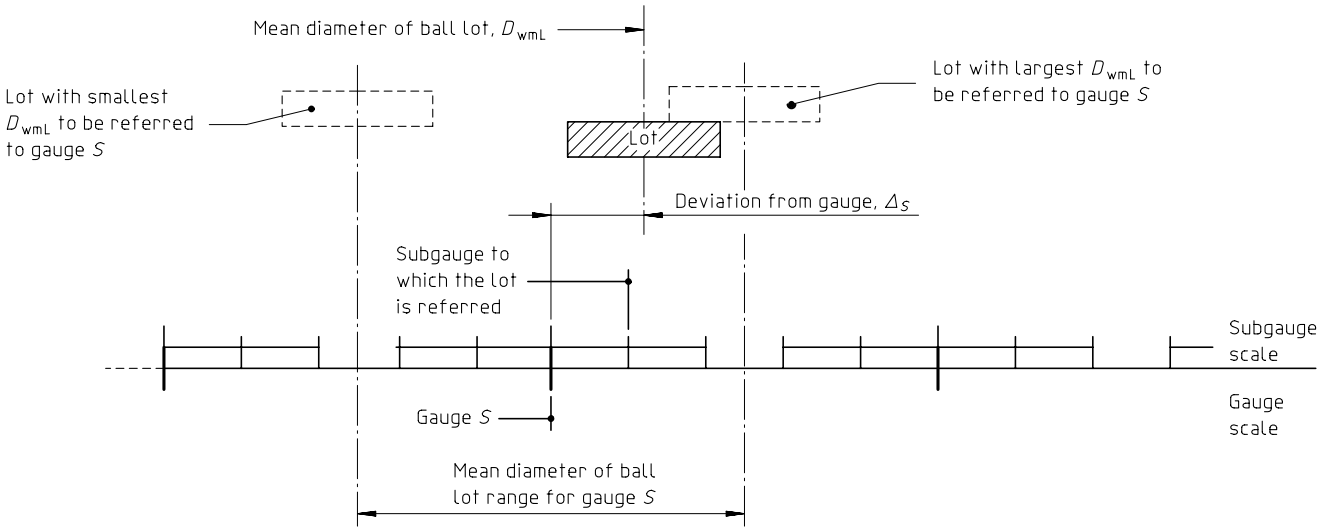
A.1 Gauge and subgauge

EXAMPLE: Grade G5, values in micrometers



A.2 Lot and gauge deviation





Annex B
(normative)

Method for the assessment of deviation from spherical form — Measurement of variations in radius

The measurement of deviation from spherical form of balls shall be carried out by measurement of roundness deviation in a required number of single equatorial planes.

The evaluation of roundness in a single equatorial plane may be carried out by calculation from the least square centre.

The greatest radial distance in any single equatorial plane is assumed to be the deviation from spherical form.

Roundness deviation is measured in three equatorial planes 90° to each other. For a detailed description of methods for the assessment of deviation from roundness see ISO 4291.