

ANSI/ABMA 26.2

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ANSI/ABMA
Std. 26.2 - 1994

AMERICAN NATIONAL STANDARD
ABMA STANDARD

THIN SECTION BALL BEARINGS
INCH DESIGN

Sponsored by

American Bearing Manufacturers Association

Approved May 23, 1994

American National Standards Institute

AMERICAN NATIONAL STANDARD

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FOREWORD

(This foreword is not a part of American National Standard for Thin Section Ball Bearings - Inch Design, ANSI/ABMA Standard 26.2.)

This Standard covers inch design thin section ball bearings with a fixed cross section in series and types which have been in general use in the U.S.A. in recent years, as well as recommended extra width series which may be necessary to accommodate closures. These bearings are unique in that, within a given series, the bearing cross-section remains constant irrespective of the bore diameter. Ball bearings of single row, radial contact; single row, angular contact; and single row, four-point angular contact are covered.

The dimensions and tolerances stated in this standard are based on U.S.A. customary (inch-pound) units. A soft conversion to metric units for the various tables in this standard is provided in Annex A for the convenience of the user.

Suggestions for the improvement of this standard gained through experience with its use will be welcomed. These should be sent to the American National Standards Institute, Inc., 11 West 42nd Street, 13th Floor, New York, NY 10036.

The officers of Accredited Standards Committee B3 of the American National Standards Institute and the organizations represented at the time this standard was submitted are as follows:

W. G. Looft, Chairman
G. T. Satterfield, Secretary

American Bearing Manufacturers Association
Hydraulic Institute
Association for Manufacturing Technology
Society of Tribologists and Lubrication Engineers
U. S. Department of Defense, DISC
U. S. Department of the Navy

ABMA (formerly AFBMA) Standards for Ball and Roller Bearings

- 1 - Terminology for Anti-Friction Ball and Roller Bearings and Parts
- 4 - Tolerance Definitions and Gauging Practices for Ball and Roller Bearings
- 7 - Shaft and Housing Fits for Metric Radial Ball and Roller Bearings (Except Tapered Roller Bearings)
Conforming to Basic Boundary Plans
- 8.1 - Mounting Accessories, Metric Design
- 8.2 - Mounting Accessories, Inch Design
- 9 - Load Ratings and Fatigue Life for Ball Bearings
- 10 - Metal Balls
- 11 - Load Ratings and Fatigue Life for Roller Bearings
- 12.1 - Instrument Ball Bearings, Metric Design
- 12.2 - Instrument Ball Bearings, Inch Design
- 13 - Rolling Bearing Vibration and Noise (Methods of Measuring)
- 14 - Housings for Bearings with Spherical Outside Surfaces
- 15 - Ball Bearings with Spherical Outside Surfaces and Extended Inner Ring Width (Includes Eccentric
Locking Collars)
- 16.1 - Airframe Ball, Roller, and Needle Roller Bearings, Metric Design
- 16.2 - Airframe Ball, Roller, and Needle Roller Bearings, Inch Design
- 17 - Needle Rollers, Metric Design
- 18.1 - Needle Roller Bearings, Radial, Metric Design
- 18.2 - Needle Roller Bearings, Radial, Inch Design
- 19.1 - Tapered Roller Bearings, Radial, Metric Design
- 19.2 - Tapered Roller Bearings, Radial, Inch Design
- 20 - Radial Bearings of Ball, Cylindrical Roller and Spherical Roller Types, Metric Design
- 21.1 - Thrust Needle Roller and Cage Assemblies and Thrust Washers, Metric Design
- 21.2 - Thrust Needle Roller and Cage Assemblies and Thrust Washers, Inch Design
- 22.1 - Spherical Plain Radial Bearings, Joint Type - Metric Design
- 22.2 - Spherical Plain Radial Bearings, Joint Type - Inch Design
- 23.2 - Thrust Bearings of Tapered Roller Type - Inch Design
- 24.1 - Thrust Bearings of Ball, Cylindrical Roller and Spherical Roller Types - Metric Design
- 24.2 - Thrust Bearings of Ball and Cylindrical Roller Types - Inch Design
- 25.2 - Rolling Bearings, Linear Motion, Recirculating Ball, Sleeve Type - Inch Series
- 26.2 - Thin Section Ball Bearings - Inch Design

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THIN SECTION BEARINGS INCH DESIGN

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THIN SECTION BALL BEARINGS INCH DESIGN

1 Scope

This standard specifies the boundary dimensions and the tolerances for boundary dimensions, running accuracies and internal clearances for thin section ball bearings of single row radial contact, angular contact and four-point angular contact types.

2 References

ANSI/ABMA Standard 1, Terminology for Anti-Friction Ball and Roller Bearings and Parts.

ANSI/ABMA Standard 4, Tolerance Definitions and Gauging Practices for Ball and Roller Bearings.

ANSI/ABMA Standard 7, Shaft and Housing Fits for Metric Radial Ball and Roller Bearings (except Tapered Roller Bearings) Conforming to Basic Boundary Plans.

ANSI/ABMA Standard 9, Load Ratings and Fatigue Life for Ball Bearings.

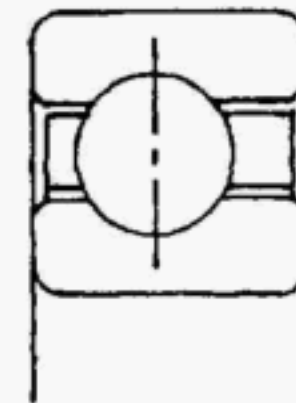
3 Terminology

3.1 Types of bearings

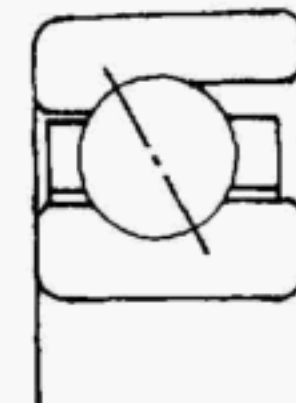
3.1.1 Thin section ball bearing, radial contact (Type C). A deep groove ball bearing, or filling slot ball bearing, designed to support primarily radial load.

3.1.2 Thin section ball bearing, angular contact (Type A). A non-separable angular contact ball bearing with a counter-bored outer ring and a nominal 30° axial contact angle.

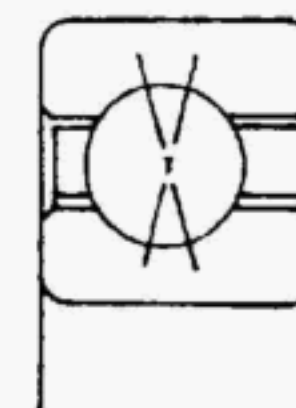
3.1.3 Thin section ball bearing, four-point contact (Type X). A four point contact ball bearing with a nominal 30° radial contact angle.



Type C



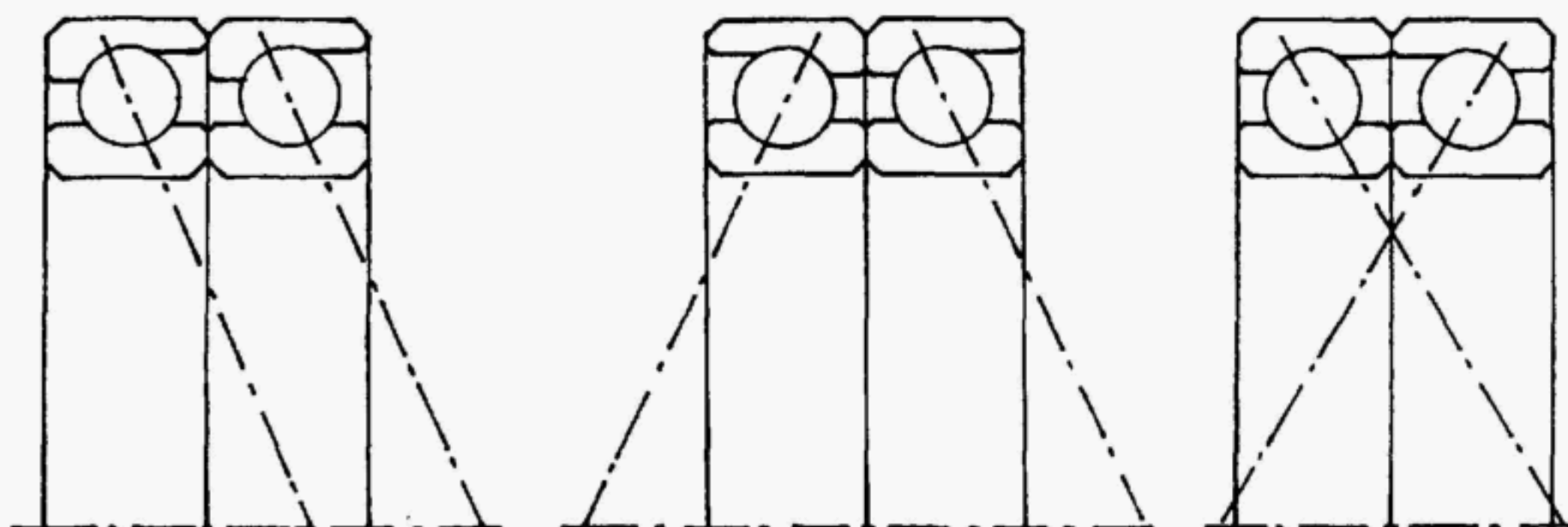
Type A



Type X

Figure 1 - Types of thin section bearings

3.1.4 Thin section ball bearing with closures. Any one of the preceding three design types with a contact seal or grease shield fitted on one or both sides.



Tandem Arrangement

Back-to-Back Arrangement

Face-to-Face Arrangement

Figure 2 - Duplex bearing arrangements

3.1.5 Thin section ball bearing, duplex. Two angular contact (Type A) bearings modified by the manufacturer for side-by-side mounting in a face-to-face, back-to-back, or tandem arrangement.

4 Definitions

4.1 General dimension and tolerance definitions are given in ANSI/ABMA Standard 4, Tolerance Definitions and Gauging Practices for Ball and Roller Bearings. Tolerance definitions specific to this standard and not included in ANSI/ABMA Standard 4 are defined in the following clauses:

4.2 Single plane average bore diameter (or outside diameter), d_{ap} (D_{ap}): Arithmetic average of the largest, smallest and many other measured single bore diameters (or outside diameters) in a single radial plane.

4.3 Single plane average bore diameter (or outside diameter) deviation, Δd_{ap} (ΔD_{ap}): Difference between a single plane average bore diameter (or outside diameter) and the nominal bore diameter (or outside diameter).

5 Symbols and nomenclature

d	= nominal bore diameter
d_{ap}	= single plane average bore diameter
Δd_{ap}	= single plane average bore diameter deviation
D	= nominal outside diameter
D_{ap}	= single plane average outside diameter
ΔD_{ap}	= single plane average outside diameter deviation
B	= nominal inner ring width
B_s	= single inner ring width
ΔB_s	= deviation of a single inner ring width
C	= nominal outer ring width
C_s	= single outer ring width
ΔC_s	= deviation of a single outer ring width
K_i	= inner ring raceway to bore thickness variation
K_e	= outer ring raceway to outside surface thickness variation
S_i	= raceway parallelism with inner ring face
S_e	= raceway parallelism with outer ring face
$r_{s \min}$	= smallest single chamfer dimension
$r_{s \max}$	= largest single chamfer dimension
$r_{as \max}$	= largest permissible single shaft and housing fillet radius.
G_r	= radial internal clearance

6 Boundary dimensions

The bearings covered in Table 1 include those in general use. The seven ball bearing Diameter Series (AA, A, B, C, D, F, and G) are unique in that the bearing cross-section in each series remains constant irrespective of the bore diameter. The three Width Series for each Diameter Series provide an extra width which may be necessary to accommodate an integral seal or shield on one or both sides of a bearing.

These bearing designs are based on inch standards and a soft-conversion to metric units is provided in Annex A. The sizes shown in the table are selected to limit the number of bearing and component sizes, as much as possible, to promote economic production and yet provide a sufficient number of sizes and proportions to satisfy present and future needs of bearing users. These tables do not contain any indication as to availability of bearings.

7 Tolerances

7.1 General. The tolerance limits shown in Tables 2 through 9 are based on long established practice. They include tolerances for boundary dimensions and limits for runouts and normal radial internal clearance. See Clause 4 for tolerance definitions.

The radial internal clearance limits are valid for bearings which are not mounted, and with zero measuring load.

The unique proportions of these thin section bearings make some of the usual measuring and/or gauging practices impractical and unreliable. See Clause 8.

7.2 Special internal clearance and preload. Certain applications may require a specific control of bearing operating or starting torque, or axial or radial load deflection. In such cases, the manufacturer should be consulted in order to determine, based on the application conditions and requirements, the optimal limits for radial internal clearance or preload for Type

C or Type X bearings; or axial internal clearance or preload for Type A duplex mounting arrangements.

8 Inspection

Because of their very thin radial section, measurement of diameters, runouts and radial internal clearances is impractical or inaccurate using the recommended gauging practice described in ANSI/ABMA Standard 4.

Even a very light gauge pressure in two-point diameter measurement may cause unacceptable radial deflection. Non-contacting gauging with the bearing axis preferably in a vertical position must be used for the measurement of inner ring bore diameters and outer ring outside diameters. Bearing rings may be out-of-round in the free state in excess of the ANSI/ABMA Standard 20 limits for the equivalent size; but this condition has proven to be acceptable since the rings readily conform to their shaft and housing seats. Diameter size for the thin section bearings is expressed in terms of an average which requires the averaging of diameter measurements taken at many angular positions, i.e., using the mean of a single minimum and a single maximum diameter is not sufficient. Tolerances for inner ring bore diameter and outer ring outside diameter do not apply to bearings supplied by the manufacturer with internal preload.

Radial runout and face runout with raceway of assembled bearings is not specified for these bearings since accurate measurement is not possible. Instead tolerance limits apply to individual inner and outer rings by applying the K_i , K_e , S_i and S_e values in the tolerance tables.

Internal radial clearance is generally controlled by the manufacturer by selective assembly of rings and balls using measurements of raceway diameters and ball size. Because of free-state out-of-round and measurement deflection of the rings, accurate measurement of assembled bearing radial internal clearance, either directly or with special measuring equipment, is difficult. Clearance measurement methods must

be coordinated with the manufacturer.

Similarly, axial internal clearance or preload of duplex angular contact bearings is generally controlled by the manufacturer by selective assembly or ring face grinding to result in the desired amount of axial looseness or interference when the two bearings are clamped side-by-side in either a face-to-face or back-to-back arrangement. Measuring methods for these features must also be coordinated with the manufacturer.

bearings is largely dependent on the amount of support provided by the shaft and housing, bearing performance may vary from application to application. The user is, therefore, cautioned to establish appropriate safety factors and the degree of the functional interchangeability of his selected bearings in consultation with the bearing manufacturer(s).

9 Shaft and housing fits

The very thin radial section of these bearing rings require accurately finished shaft and housing seatings for satisfactory performance. Errors of form of the seating will be transmitted to the raceways since the rings will conform to a large extent to the shaft or housing profile when installed.

The general principles and considerations for the selection of shaft and housing fits can be found in ANSI/ABMA Standard 7. However, since interference fitting greatly reduces internal clearance of thin section bearings, prospective users should consult the manufacturer to make certain the bearing design and its fitting are correctly specified to satisfy all mounting and operational conditions and requirements. The shaft and housing recommendations in Tables 1 and 3 of ANSI/ABMA Standard 7 are not normally applicable for thin section bearing fit selection.

10 Load ratings and fatigue life

The general criterion and definitions of static and dynamic load ratings and bearing life can be found in ANSI/ABMA Standard 9. However, since this standard does not specify bearing internal construction, i.e., ball size, number of balls, raceway cross-section radii, etc., bearing performance may vary from manufacturer to manufacturer. Further, since the internal load distribution for thin section

Table 1 - Basic plan for boundary dimensions of thin section bearings ²⁾

Bore d		Diameter Series AA										Diameter Series A										Diameter Series B										Diameter Series C																											
		O.D. D					Chamfer ¹⁾					Width Series					O.D. D					Chamfer ¹⁾					Width Series					O.D. D					Chamfer ¹⁾					Width Series																	
							r _s min					KAA										PAA					RAA										r _s min					KB					PB					RB							
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r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min					K					P					R					r _s min					K					P					R					r _s min					K					P					R				
r _s min																																																											

¹⁾ "r_s min" does not necessarily apply to the corner on the non-thrust face of Type A angular contact bearing rings or bearings with closures. See Table 7 for tolerances on chamfer dimensions.
²⁾ Popular sizes are shown in half-tone.

Table 1 - Basic plan for boundary dimensions of thin section bearings ²⁾(continued)

Diameter Series D										Diameter Series F										Diameter Series G									
Bore d	O.D.		Chamfer ¹⁾		Width Series				O.D.	Chamfer ¹⁾		Width Series				O.D.	Chamfer ¹⁾		Width Series										
	D	RD	KD	PD	P	R	KF	PF		RF	D	r _s min	K	P	R		KG	PG	RG										
Width - B or C										Width - B or C										Width - B or C									
4	5	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	5.5	0.08	0.75	0.875	1	6	0.08	1	1.1875	1.375										
4.25	5.25	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	5.75	0.08	0.75	0.875	1	6.25	0.08	1	1.1875	1.375										
4.5	5.5	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	6	0.08	0.75	0.875	1	6.5	0.08	1	1.1875	1.375										
4.75	5.75	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	6.25	0.08	0.75	0.875	1	6.75	0.08	1	1.1875	1.375										
5	6	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	6.5	0.08	0.75	0.875	1	7	0.08	1	1.1875	1.375										
5.5	6.5	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	7	0.08	0.75	0.875	1	7.5	0.08	1	1.1875	1.375										
6	7	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	7.5	0.08	0.75	0.875	1	8	0.08	1	1.1875	1.375										
6.5	7.5	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	8	0.08	0.75	0.875	1	8.5	0.08	1	1.1875	1.375										
7	8	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	8.5	0.08	0.75	0.875	1	9	0.08	1	1.1875	1.375										
7.5	8.5	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	9	0.08	0.75	0.875	1	9.5	0.08	1	1.1875	1.375										
8	9	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	9.5	0.08	0.75	0.875	1	10	0.08	1	1.1875	1.375										
9	10	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	10.5	0.08	0.75	0.875	1	11	0.08	1	1.1875	1.375										
10	11	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	11.5	0.08	0.75	0.875	1	12	0.08	1	1.1875	1.375										
11	12	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	12.5	0.08	0.75	0.875	1	13	0.08	1	1.1875	1.375										
12	13	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	13.5	0.08	0.75	0.875	1	14	0.08	1	1.1875	1.375										
14	15	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	15.5	0.08	0.75	0.875	1	16	0.08	1	1.1875	1.375										
16	17	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	17.5	0.08	0.75	0.875	1	18	0.08	1	1.1875	1.375										
18	19	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	19.5	0.08	0.75	0.875	1	20	0.08	1	1.1875	1.375										
20	21	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	21.5	0.08	0.75	0.875	1	22	0.08	1	1.1875	1.375										
25	26	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	26.5	0.08	0.75	0.875	1	27	0.08	1	1.1875	1.375										
30	31	0.6563	0.5781	0.5	0.06	0.6563	0.5781	0.5	0.06	31.5	0.08	0.75	0.875	1	32	0.08	1	1.1875	1.375										
35	-	-	-	-	-	-	-	-	-	36.5	0.08	0.75	0.875	1	37	0.08	1	1.1875	1.375										
40	-	-	-	-	-	-	-	-	-	41.5	0.08	0.75	0.875	1	42	0.08	1	1.1875	1.375										

¹⁾ "r_{s min}" does not necessarily apply to the corner of the non-thrust face of Type A angular contact bearing rings or bearings with closures. See Table 7 for tolerances on chamfer dimensions.
²⁾ Popular sizes are shown in half-tone.

Table 2 - Tolerances: ABEC 1F - Type C bearings

Tolerance values in 0.0001 inches

d in.		$\Delta d_{ap}^{1)}$		K_i S_i	ΔB_s		$\Delta D_{ap}^{1)}$		K_o S_o	ΔC_s	
over	incl.	high	low	max.	high	low	high	low	max.	high	low
-	1	0	-4	5	0	-50	0	-5	8	Identical to ΔB_s of inner ring of same bearing	
1	1.5	0	-5	6	0	-50	0	-5	8		
1.5	2.5	0	-6	8	0	-50	0	-5	10		
2.5	3	0	-6	8	0	-50	0	-6	10		
3	4	0	-8	10	0	-50	0	-6	12		
4	4.5	0	-8	10	0	-50	0	-8	14		
4.5	5	0	-10	12	0	-50	0	-8	14		
5	6.5	0	-10	12	0	-50	0	-10	16		
6.5	7	0	-10	12	0	-50	0	-10	16		
7	9	0	-12	16	0	-50	0	-12	18		
9	12	0	-14	18	0	-50	0	-14	20		
12	14	0	-16	18	0	-100	0	-16	20		
14	16	0	-18	18	0	-100	0	-18	20		
16	18	0	-18	20	0	-100	0	-18	20		
18	20	0	-20	20	0	-100	0	-20	20		
20	30	0	-30	20	0	-100	0	-30	20		
30	40	0	-40	20	0	-100	0	-40	20		

¹⁾ Does not apply to bearings supplied by the manufacturer with internal preload.

Table 3 - Tolerances: ABEC 1F - Types A and X bearings

Tolerance values in 0.0001 inches

d in.		$\Delta d_{ap}^{1)}$		K_i S_i	$\Delta B_s^{2)}$		$\Delta D_{ap}^{1)}$		K_o S_o	$\Delta C_s^{2)}$	
over	incl.	high	low	max.	high	low	high	low	max.	high	low
-	1	0	-4	3	0	-50	0	-5	4	Identical to ΔB_s of inner ring of same bearing	
1	1.5	0	-5	4	0	-50	0	-5	4		
1.5	2	0	-6	5	0	-50	0	-5	5		
2	2.5	0	-6	5	0	-50	0	-5	5		
2.5	3	0	-6	6	0	-50	0	-6	6		
3	4	0	-8	6	0	-50	0	-6	6		
4	4.5	0	-8	6	0	-50	0	-8	8		
4.5	5	0	-10	8	0	-50	0	-8	8		
5	6.5	0	-10	10	0	-50	0	-10	10		
6.5	7	0	-10	10	0	-50	0	-12	10		
7	9	0	-12	12	0	-50	0	-12	12		
9	12	0	-14	14	0	-50	0	-14	14		
12	14	0	-14	14	0	-100	0	-14	14		
14	18	0	-16	16	0	-100	0	-16	16		
18	30	0	-18	18	0	-100	0	-18	18		
30	40	0	-20	20	0	-100	0	-20	20		

¹⁾ Does not apply to bearings supplied by the manufacturer with internal preload.²⁾ See Table 7 for width tolerances for Type A bearings modified for duplex mounting.

Table 4 - Tolerances: ABEC 3F

Tolerance values in 0.0001 inches

d in.		$\Delta d_{ap}^{1)}$		K_i S_i	$\Delta B_s^{2)}$		$\Delta D_{ap}^{1)}$		K_e S_e	$\Delta C_s^{2)}$	
over	incl.	high	low	max.	high	low	high	low	max.	high	low
-	1	0	-2	3	0	-50	0	-3	4	Identical to ΔB_s of inner ring of same bearing	
1	1.5	0	-3	4	0	-50	0	-3	4		
1.5	2.5	0	-4	4	0	-50	0	-4	5		
2.5	3	0	-4	4	0	-50	0	-4	6		
3	4	0	-5	5	0	-50	0	-4	6		
4	4.5	0	-5	5	0	-50	0	-5	8		
4.5	5	0	-6	6	0	-50	0	-5	8		
5	6.5	0	-6	6	0	-50	0	-6	9		
6.5	7	0	-6	6	0	-50	0	-7	10		
7	9	0	-7	8	0	-50	0	-7	10		
9	11	0	-8	10	0	-50	0	-8	12		
11	12	0	-8	10	0	-50	0	-9	14		
12	14	0	-8	12	0	-100	0	-9	14		
14	18	0	-9	14	0	-100	0	-10	16		
18	20	0	-10	16	0	-100	0	-12	18		

¹⁾ Does not apply to bearings supplied by the manufacturer with internal preload.²⁾ See Table 7 for width tolerances for Type A bearings modified for duplex mounting.

Table 5 - Tolerances: ABEC 5F

Tolerance values in 0.0001 inches

d in.		$\Delta d_{ap}^{1)}$		K_i	S_i	$\Delta B_s^{2)}$		$\Delta D_{ap}^{1)}$		K_e	S_e	$\Delta C_s^{2)}$	
over	incl.	high	low	max.	max.	high	low	high	low	max.	max.	high	low
-	1.5	0	-2	2	3	0	-50	0	-2	2	3	Identical to ΔB_s of inner ring of same bearing	
1.5	2.5	0	-3	2	3	0	-50	0	-3	3	4		
2.5	3	0	-3	2	3	0	-50	0	-3	4	5		
3	4	0	-3	3	4	0	-50	0	-3	4	5		
4	4.5	0	-3	3	4	0	-50	0	-4	4	5		
4.5	5	0	-4	3	4	0	-50	0	-4	4	5		
5	7	0	-4	3	4	0	-50	0	-5	5	6		
7	9	0	-5	4	5	0	-50	0	-5	5	6		
9	11	0	-5	5	6	0	-50	0	-5	6	7		
11	12	0	-5	5	6	0	-50	0	-6	7	8		
12	14	0	-6	5	7	0	-100	0	-6	7	8		
14	18	0	-6	7	8	0	-100	0	-7	8	9		
18	20	0	-7	8	9	0	-100	0	-8	9	10		

¹⁾ Does not apply to bearings supplied by the manufacturer with internal preload.²⁾ See Table 7 for width tolerances for Type A bearings modified for duplex mounting.

Table 6 - Tolerances: ABEC 7F

Tolerance values in 0.0001 inches

d in.		$\Delta d_{ap}^{1)}$		K_i S_i	$\Delta B_s^{2)}$		$\Delta D_{ap}^{1)}$		K_o S_o	$\Delta C_s^{2)}$	
over	incl.	high	low	max.	high	low	high	low	max.	high	low
-	1	0	-1.5	1.5	0	-50	0	-2	2	Identical to ΔB_s of inner ring of same bearing	
1	2.5	0	-2	1.5	0	-50	0	-2	2		
2.5	3	0	-2	1.5	0	-50	0	-3	2		
3	4	0	-2.5	2	0	-50	0	-3	2		
4	4.5	0	-2.5	2	0	-50	0	-4	3		
4.5	6.5	0	-3	3	0	-50	0	-4	3		
6.5	7	0	-3	3	0	-50	0	-4	4		
7	9	0	-4	3	0	-50	0	-4	4		
9	11	0	-5	4	0	-50	0	-5	4		
11	12	0	-5	4	0	-50	0	-5	5		
12	14	0	-5	4	0	-100	0	-6	5		

¹⁾ Does not apply to bearings supplied by the manufacturer with internal preload.

²⁾ See Table 7 for width tolerances for Type A bearings modified for duplex mounting.

Table 7 - Width tolerances of modified Type A bearings

Tolerance values in 0.0001 inches

d in.		$\Delta B_s^{1)}$	
over	incl.	high	low
-	2	0	-200
2	5	0	-300
5	14	0	-400
14	40	0	-500

¹⁾ Applies to overall width deviation for a pair of Type A bearings modified for duplex mounting. The outer ring width deviation limit, ΔC_o , is identical to ΔB_s for the inner rings of the same bearing set.

Table 8 - Chamfer dimension limits

Dimensions in inches

r_s min	r_s max		r_{as} max
	radial	axial	
0.008	0.02	0.025	0.008
0.015	0.035	0.05	0.015
0.025	0.05	0.055	0.025
0.04	0.065	0.07	0.04
0.06	0.085	0.09	0.06
0.08	0.125	0.13	0.08

Note: The bearing chamfer dimension limits do not control the shape of the bearing chamfer. However, the smallest single bearing chamfer, $r_{s \text{ min}}$, must clear the largest permissible single shaft and housing fillet radius, $r_{as \text{ max}}$.

Table 9 - Normal radial internal clearance limits

Clearance limits in 0.0001 inches

d in.		G_r ¹⁾									
		Type C		Type X		Types C and X					
		ABEC 1F				ABEC 3F		ABEC 5F		ABEC 7F	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
-	1	10	16	10	15	7	11	5	9	4	8
1	1.5	12	18	12	17	8	12	5	9	5	9
1.5	2.5	12	24	12	22	8	18	5	9	5	10
2.5	3	12	24	12	22	8	18	6	12	6	12
3	4	16	28	16	26	10	20	6	12	6	12
4	4.5	16	28	16	26	10	20	8	14	8	14
4.5	5	20	34	20	30	12	22	8	14	8	14
5	6.5	20	34	20	30	12	22	10	16	8	14
6.5	7	20	34	20	30	14	24	10	16	8	14
7	9	24	42	24	34	14	24	10	16	8	14
9	11	28	48	28	38	16	26	10	16	10	16
11	12	28	48	28	38	18	28	12	18	10	16
12	14	32	52	28	38	18	28	12	18	12	18
14	18	36	56	32	42	20	30	14	20	-	-
18	20	40	60	36	46	24	34	14	22	-	-
20	30	60	80	36	46	-	-	-	-	-	-
30	40	80	100	40	50	-	-	-	-	-	-

¹⁾ Type A angular contact ball bearings are assembled with a radial internal clearance to provide a nominal 30° axial contact angle. Type A bearings are also available modified by the manufacturer for duplex mounting with axial internal clearance or axial preload when clamped together side-by-side.

ANNEX A (informative)

1. Introduction. This annex provides the SI (metric) unit information for values provided in the normative portion of this Standard.

2. Conversion. Metric values given in the tables in this annex are calculated from primary inch values given in the normative portion of this standard. Conversion has been carried out to yield equivalent values. For those tables for which conversions are presented, the metric value table is the same table number as in the normative portion of the standard.

3. List of Tables with Metric Unit Conversions

Table Description

- A2 ABEC 1F tolerances for Type C bearings
- A3 ABEC 1F tolerances for Types A and X bearings
- A4 ABEC 3F tolerances
- A5 ABEC 5F tolerances
- A6 ABEC 7F tolerances
- A7 Width tolerances for modified Type A bearings
- A8 Chamfer dimension limits
- A9 Normal radial internal clearance limits

Table A2 - Tolerances: ABEC 1F - Type C bearings

Tolerance values in micrometres

d in.		$\Delta d_{ap}^{1)}$		K_i S_i	ΔB_s		$\Delta D_{ap}^{1)}$		K_e S_e	ΔC_s	
over	incl.	high	low	max.	high	low	high	low	max.	high	low
-	1	0	-10	13	0	-127	0	-13	20	Identical to ΔB_s of inner ring of same bearing	
1	1.5	0	-13	15	0	-127	0	-13	20		
1.5	2.5	0	-15	20	0	-127	0	-13	25		
2.5	3	0	-15	20	0	-127	0	-15	25		
3	4	0	-20	25	0	-127	0	-15	30		
4	4.5	0	-20	25	0	-127	0	-20	36		
4.5	5	0	-25	30	0	-127	0	-20	36		
5	6.5	0	-25	30	0	-127	0	-25	41		
6.5	7	0	-25	30	0	-127	0	-25	41		
7	9	0	-30	41	0	-127	0	-30	46		
9	12	0	-36	46	0	-127	0	-36	51		
12	14	0	-41	46	0	-254	0	-41	51		
14	16	0	-46	46	0	-254	0	-46	51		
16	18	0	-46	51	0	-254	0	-46	51		
18	20	0	-51	51	0	-254	0	-51	51		
20	30	0	-76	51	0	-254	0	-76	51		
30	40	0	-102	51	0	-254	0	-102	51		

¹⁾ Does not apply to bearings supplied by the manufacturer with internal preload.

Table A3 - Tolerances: ABEC 1F - Types A and X bearings

Tolerance values in micrometres

d in.		$\Delta d_{ap}^{1)}$		K_i S_i	$\Delta B_s^{2)}$		$\Delta D_{ap}^{1)}$		K_e S_e	$\Delta C_s^{2)}$	
over	incl.	high	low	max.	high	low	high	low	max.	high	low
-	1	0	-10	8	0	-127	0	-13	10	Identical to ΔB_s of inner ring of same bearing	
1	1.5	0	-13	10	0	-127	0	-13	10		
1.5	2	0	-15	13	0	-127	0	-13	13		
2	2.5	0	-15	13	0	-127	0	-13	13		
2.5	3	0	-15	15	0	-127	0	-15	15		
3	4	0	-20	15	0	-127	0	-15	15		
4	4.5	0	-20	15	0	-127	0	-20	20		
4.5	5	0	-25	20	0	-127	0	-20	20		
5	6.5	0	-25	25	0	-127	0	-25	25		
6.5	7	0	-25	25	0	-127	0	-30	25		
7	9	0	-30	30	0	-127	0	-30	30		
9	12	0	-36	36	0	-127	0	-36	36		
12	14	0	-36	36	0	-254	0	-36	36		
14	18	0	-41	41	0	-254	0	-41	41		
18	30	0	-46	46	0	-254	0	-46	46		
30	40	0	-51	51	0	-254	0	-51	51		

¹⁾ Does not apply to bearings supplied by the manufacturer with internal preload.²⁾ See Table 7 for width tolerances for Type A bearings modified for duplex mounting.

Table A4 - Tolerances: ABEC 3F

Tolerance values in micrometres

d in.		$\Delta d_{ap}^{1)}$		K_i S_i	$\Delta B_s^{2)}$		$\Delta D_{ap}^{1)}$		K_e S_e	$\Delta C_s^{2)}$	
over	incl.	high	low	max.	high	low	high	low	max.	high	low
-	1	0	-5	8	0	-127	0	-8	10	Identical to ΔB_s of inner ring of same bearing	
1	1.5	0	-8	10	0	-127	0	-8	10		
1.5	2.5	0	-10	10	0	-127	0	-10	13		
2.5	3	0	-10	10	0	-127	0	-10	15		
3	4	0	-13	13	0	-127	0	-10	15		
4	4.5	0	-13	13	0	-127	0	-13	20		
4.5	5	0	-15	15	0	-127	0	-13	20		
5	6.5	0	-15	15	0	-127	0	-15	23		
6.5	7	0	-15	15	0	-127	0	-18	25		
7	9	0	-18	20	0	-127	0	-18	25		
9	11	0	-20	25	0	-127	0	-20	30		
11	12	0	-20	25	0	-127	0	-23	36		
12	14	0	-20	30	0	-254	0	-23	36		
14	18	0	-23	36	0	-254	0	-25	41		
18	20	0	-25	41	0	-254	0	-30	46		

¹⁾ Does not apply to bearings supplied by the manufacturer with internal preload.²⁾ See Table 7 for width tolerances for Type A bearings modified for duplex mounting.

Table A5 - Tolerances: ABEC 5F

Tolerance values in micrometres

d in.		$\Delta d_{ap}^{1)}$		K_i	S_i	$\Delta B_s^{2)}$		$\Delta D_{ap}^{1)}$		K_e	S_e	$\Delta C_s^{2)}$	
over	incl.	high	low	max.	max.	high	low	high	low	max.	max.	high	low
-	1.5	0	-5	5	8	0	-127	0	-5	5	8	Identical to ΔB_s of inner ring of same bearing	
1.5	2.5	0	-8	5	8	0	-127	0	-8	8	10		
2.5	3	0	-8	5	8	0	-127	0	-8	10	13		
3	4	0	-8	8	10	0	-127	0	-8	10	13		
4	4.5	0	-8	8	10	0	-127	0	-10	10	13		
4.5	5	0	-10	8	10	0	-127	0	-10	10	13		
5	7	0	-10	8	10	0	-127	0	-13	13	15		
7	9	0	-13	10	13	0	-127	0	-13	13	15		
9	11	0	-13	13	15	0	-127	0	-13	15	18		
11	12	0	-13	13	15	0	-127	0	-15	18	20		
12	14	0	-15	13	18	0	-254	0	-15	18	20		
14	18	0	-15	18	20	0	-254	0	-18	20	23		
18	20	0	-18	20	23	0	-254	0	-20	23	25		

¹⁾ Does not apply to bearings supplied by the manufacturer with internal preload.²⁾ See Table 7 for width tolerances for Type A bearings modified for duplex mounting.

Table A6 - Tolerances: ABEC 7F

Tolerance values in micrometres											
d in.		$\Delta d_{ap}^{1)}$		K_i S_i	$\Delta B_s^{2)}$		$\Delta D_{ap}^{1)}$		K_o S_o	$\Delta C_s^{2)}$	
over	incl.	high	low	max.	high	low	high	low	max.	high	low
-	1	0	-4	4	0	-127	0	-5	5	Identical to ΔB_s of inner ring of same bearing	
1	2.5	0	-5	4	0	-127	0	-5	5		
2.5	3	0	-5	4	0	-127	0	-8	5		
3	4	0	-6	5	0	-127	0	-8	5		
4	4.5	0	-6	5	0	-127	0	-10	8		
4.5	6.5	0	-8	8	0	-127	0	-10	8		
6.5	7	0	-8	8	0	-127	0	-10	10		
7	9	0	-10	8	0	-127	0	-10	10		
9	11	0	-13	10	0	-127	0	-13	10		
11	12	0	-13	10	0	-127	0	-13	13		
12	14	0	-13	10	0	-254	0	-15	13		

¹⁾ Does not apply to bearings supplied by the manufacturer with internal preload.

²⁾ See Table 7 for width tolerances for Type A bearings modified for duplex mounting.

Table A7 - Width tolerances of modified Type A bearings

Tolerance values in micrometres			
d in.		$\Delta B_s^{1)}$	
over	incl.	high	low
-	2	0	-508
2	5	0	-762
5	14	0	-1,016
14	40	0	-1,270

¹⁾ Applies to overall width deviation for a pair of Type A bearings modified for duplex mounting. The outer ring width deviation limit, ΔC_o , is identical to ΔB_s for the inner rings of the same bearing set.

Table A8 - Chamfer dimension limits

Maximum limit dimensions in millimetres				
$r_{s \min}$		$r_{s \max}$		$r_{as \max}$
in.	mm.	radial	axial	
0.008	0.2	0.5	0.6	0.4
0.015	0.4	0.9	1.3	
0.025	0.6	1.3	1.4	
0.04	1.0	1.7	1.8	1.0
0.06	1.5	2.2	2.3	1.5
0.08	2.0	3.2	3.3	2.0

Note: The bearing chamfer dimension limits do not control the shape of the bearing chamfer. However, the smallest single bearing chamfer, $r_{s \min}$, must clear the largest permissible single shaft and housing fillet radius, $r_{as \max}$.

Table A9 - Normal radial internal clearance limits

Clearance limits in micrometres

d in.		G _r ¹¹									
		Type C		Type X		Types C and X					
		ABEC 1F				ABEC 3F		ABEC 5F		ABEC 7F	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
-	1	25	41	25	38	18	28	13	23	10	20
1	1.5	30	46	30	43	20	30	13	23	13	23
1.5	2.5	30	61	30	56	20	46	13	23	13	25
2.5	3	30	61	30	56	20	46	15	30	15	30
3	4	41	71	41	66	25	51	15	30	15	30
4	4.5	41	71	41	66	25	51	20	36	20	36
4.5	5	51	86	51	76	30	56	20	36	20	36
5	6.5	51	86	51	76	30	56	25	41	20	36
6.5	7	51	86	51	76	36	61	25	41	20	36
7	9	61	107	61	86	36	61	25	41	20	36
9	11	71	122	71	97	41	66	25	41	25	41
11	12	71	122	71	97	46	71	30	46	25	41
12	14	81	132	71	97	46	71	30	46	30	46
14	18	91	142	81	107	51	76	36	51	-	-
18	20	102	152	91	117	61	86	36	56	-	-
20	30	152	203	91	117	-	-	-	-	-	-
30	40	203	254	102	127	-	-	-	-	-	-

¹¹ Type A angular contact ball bearings are assembled with a radial internal clearance to provide a nominal 30° axial contact angle. Type A bearings are also available modified by the manufacturer for duplex mounting with axial internal clearance or axial preload when clamped together side-by-side.