Designation: B 438/B 438M – 05

Standard Specification for Bronze Powder Metallurgy (P/M) Bearings (Oil-Impregnated)[1]

This standard is issued under the fixed designation B 438/B 438M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers sintered bronze, oil-impregnated bearings made primarily from elemental copper, tin, lead, and graphite powders. The manufacturer may, at his discretion, use prealloyed bronze powder in the mixed powder.

1.2 This specification covers the following variables:

1.2.1 *Grades*—Available in three bronze base compositions identifiable by different graphite contents and one leaded bronze grade.

1.2.2 *Type*—Grades 1 and 2 are available in four types described by specific density ranges. Grade 3 is available in two types and Grade 4 is available in one type.

1.3 Bearings ordered to this specification will normally be sized after sintering and will be impregnated with a lubricating oil unless otherwise specified by the print.

1.4 The values stated in either inch-pound or SI units are to be regarded separately as standard. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with this specification.

1.5 The following safety hazards caveat pertains only to the test methods described in this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

B 328 Test Method for Density, Oil Content, and Interconnected Porosity of Sintered Metal Structural Parts and Oil-Impregnated Bearings

B 939 Test Method for Radial Crushing Strength, K, of Powder Metallurgy (P/M), Bearings and Structural Materials

E 9 Test Methods of Compression Testing of Metallic Materials at Room Temperature

2.2 *Government Standards:*[3]

MIL-PRF-6085 Lubricating Oil: Instrument, Aircraft, Low Volatility

MIL-PRF-17331 Lubrication Oil: Steam Turbine and Gear, Moderate Service

FED-STD-151 Metals Test Method

2.3 *MPIF Standard:*[4]

MPIF Standard 35 Materials Standards for P/M Self-Lubricating Bearings

3. Ordering Information

3.1 Orders for bearings under this specification shall include the following information:

3.1.1 Dimensions and tolerances (Section 9),

3.1.2 Grade and type (see Tables 1-5),

3.1.3 Wet density specification (Table 2 and Table 3), and

3.1.4 Oil type.

4. Materials and Manufacture

4.1 Sintered bronze bearings shall be made by molding or briquetting metal powder mixtures to the proper density. The green bearing shall be sintered at a time–temperature relationship to produce a microstructure that is essentially alpha bronze and contains no tin-rich phases visible at 300×. Sintered bronze bearings are normally sized after sintering to maintain the dimensional characteristics required of the bearing. After sizing and inspection, they are impregnated with a lubricating oil unless otherwise specified.

[1] This specification is under the jurisdiction of ASTM Committee B09 on Metal Powders and Metal Powder Products and is the direct responsibility of Subcommittee B09.04 on Bearings.

Current edition approved Nov. 1, 2005. Published November 2005. Originally approved in 1966. Last previous edition approved in 2004 as B 438/B 438M – 04.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111–5094, Attn: NPODS.

[4] Available from Metal Powders Industries Federation (MPIF), 105 College Road East, Princeton, NJ 08540–6692, USA.

TABLE 1 Chemical Requirements (Composition, %)

Element	Grade 1	Grade 2	Grade 3	Grade 4
Copper	87.2–90.5	85.7–90.0	82.8–88.3	80.9–88.0
Tin	9.5–10.5	9.5–10.5	9.2–10.2	9.5–10.5
Graphite	0–0.3	0.5–1.8	2.5–5.0	0.50–1.75
Iron, max	1.0	1.0	1.0	1.0
Total other elements by difference, max	1.0	1.0	1.0	0.5
Lead				2.0–4.0
Zinc, max				0.75
Nickel, max				0.35
Antimony, max				0.25

NOTE—Grade 4 to be used for special government needs.

TABLE 2 Density Requirements (Oil Impregnated)

	Type	Density, g/cm^3
Grades 1 and 2	1	5.8–6.2[A]
Grades 1, 2, and 4	2	6.4–6.8
Grades 1 and 2	3	6.8–7.2
Grades 1 and 2	4	7.2–7.6

[A] Maximum density limit of 6.2 g/cm^3 has been established on Type 1 to ensure meeting an oil content of 27 % minimum. Satisfactory bearings can also be produced between Type 1 and Type 2. These bearings have slightly higher strength constants and slightly lower oil content.

TABLE 3 Density Requirements (Oil Impregnated)

	Type	Density, g/cm^3
Grade 3	1	5.8–6.2
	2	6.2–6.6

TABLE 4 Oil Content (Oil Content, Volume %, Min)

Type	Grade 1	Grade 2	Grade 3	Grade 4
1	27	25	11[A]	...
2	19	17	...[B]	17
3	12	9	...	...
4	9	7	...	...

[A] At 3 % graphite, Type 1 will contain 14 % min oil content.
[B] At 3 % graphite, Type 2 will contain 8 % min oil content. At 5 % graphite, Type 2 will contain only a minimal amount of oil.

5. Chemical Composition

5.1 The material shall conform to the requirements as to the chemical composition prescribed in Table 1.

6. Physical Properties

6.1 *Density*—The density of bearings supplied impregnated with lubricant shall be within the limits prescribed in Table 2 and Table 3, when determined in accordance with Test Method B 328.

6.2 *Oil Content*—Oil content of bearings shall not be less than shown in Table 4 for each grade and type when determined in accordance with Test Method B 328.

7. Mechanical Properties

7.1 The manufacturer and purchaser shall agree on the number of sample bearings to be taken at random from each lot for quantitative determination of mechanical properties by destructive tests.

7.2 *Radial Crushing Strength*—Radial crushing strength in psi or Mpa is the mechanical property by which the strength of oil-impregnated P/M bearing material is characterized and evaluated. It is determined by breaking plain, thin-walled bearings or hollow cylindrical test specimens under diametrical loading, following the procedure described in Test Method B 939, and calculating the radial crushing strength according the material strength formula contained herein.

TABLE 5 Minimum Radial Crushing Strength for Bronze Bearings (Oil-Impregnated)

Grade	Type	Minimum Strength	
Bronze Composition	Wet Density g/cm^3	K psi	K MPa
Low Graphite Bronze			
1	1	15 000	100
1	2	26 000	180
1	3	37 000	260
1	4	40 000	280
Medium Graphite Bronze			
2	1	13 000	90
2	2	23 000	160
2	3	30 000	210
2	4	34 000	230
High Graphite Bronze			
3	1	10 000	70
3	2	15 000	100
Leaded Bronze			
4	2	23 000	160

7.2.1 Plain sleeve bearings and thrust bearings are tested in the oil-impregnated condition. For acceptance, the radial crushing strength, determined on the test bearings, shall not be less than the minimum strength specification value listed in Table 5 for the grade and type of bearing material.

7.2.2 Flanged oil-impregnated bearings shall be tested by cutting off the flange and crushing the body as a plain sleeve bearing. For acceptance, the radial crushing strength so determined shall meet the minimum material strength requirements prescribed in Table 5. The testing procedure and material strength requirements of the flange shall be a matter of agreement between manufacturer and purchaser.

7.2.3 To evaluate spherical bearings or those of other configuration, a number of sample parts from the lot shall first be machined to a right circular cylinder, measured, and then crushed to determine the radial crushing strength of the oil-impregnated bearing material. This value shall not be less than the minimum radial crushing strength specified in Table 5 for the grade and type of the material in the spherical bearing.

7.3 *Bearing Breaking Load*—If agreed to by the manufacturer and the purchaser, an acceptance specification for the minimum bearing breaking load, P_{min}, in lbf or N, may be established for any specific standard oil-impregnated bearing. This simplifies acceptance testing because the decision is now based solely upon reading the output of the testing machine without a need for further calculations. This acceptance procedure can be very useful when evaluating multiple or repeat shipments of the same bearing.

7.3.1 The minimum breaking load, P_{min}, required for acceptance of any specific plain sleeve or thrust bearing is calculated using the breaking load formula:

$$P_{min} = K \times L \times t^2/(D - t) \quad (1)$$

where:

P_{min} = minimum bearing breaking load, lbf or N,
K = radial crushing strength, psi or MPa,
L = length of bearing, in. or mm,
t = wall thickness (t = (D – d)/2), in. or mm,
D = outside diameter, in. or mm, and
d = inside diameter, in. or mm.

Use the minimum radial crushing strength value specified for the grade and type oil-impregnated bearing material from Table 5 for K, use the actual D, d, and L dimensions of the as-received bearing and solve for P_{min}. This calculated value will be the minimum acceptable breaking load for that specific plain bearing.

7.3.2 The minimum acceptable breaking load for a specific flanged bearing shall be determined by first cutting off the flange and measuring the D, d, and L of the body. Then, using the minimum radial crushing strength for the grade and type of oil-impregnated bearing material from Table 5 for K in the breaking load formula and the measured dimensions of the body, a P_{min} value may be calculated. This will be the minimum bearing breaking load required for the body of that specific flanged bearing. The test procedure and breaking load requirements for the flange shall be a matter of agreement between purchaser and manufacturer.

7.3.3 For acceptance testing of whole spherical bearings, a minimum bearing breaking load specification, P_{min}, may be established on a specific oil-impregnated bearing. First, the radial crushing strength is determined on that specific spherical bearing machined to a right circular cylinder as in 7.2.3. Second, whole spherical bearings from the same lot are crushed, keeping their axes horizontal, to determine the breaking load of the whole bearing. Then, using the correlation formula, the specification for that whole spherical bearing is calculated as follows:

$$P_{min} = K \times P_a / K_a \quad (2)$$

where:

P_{min} = specification for the minimum bearing breaking load of a specific whole spherical bearing, lbf or N,
K_a = radial crushing strength of machined test spherical bearings according to 7.2.3, psi or MPa,
K = radial crushing strength for the grade and type of bearing material from Table 5, psi or MPa, and
P_a = breaking load of whole test spherical bearings, lbf or N.

8. Chemical Analysis

8.1 If required by purchase agreement, one sample for chemical analysis shall be taken from each lot. A representative sample of chips may be obtained by milling, drilling, filing, or crushing a bearing with clean dry tools without lubrication. To obtain oil-free chips, the parts selected for test shall have the oil extracted in accordance with Test Method B 328 if necessary.

8.2 The chemical analysis shall be made in accordance with the methods prescribed in Vol 03.05 of the *Annual Book of ASTM Standards* or by any other method agreed upon between the manufacturer and the purchaser.

9. Dimensions and Tolerances

9.1 Permissible variations in dimensions shall be within the limits specified on the drawings describing the bearings accompanying the order or shall be within the limits specified on the order.

10. Workmanship, Finish, and Appearance

10.1 Bearings shall be uniform in composition, clean, and conform to applicable drawings.

11. Sampling

11.1 *Lot*—Unless otherwise specified, a lot shall consist of parts of the same form and dimensions made from powders of the same composition, formed and sintered under the same conditions, and submitted for inspection at one time.

12. Inspection

12.1 Unless otherwise specified, inspection of parts supplied on contract shall be made by the purchaser at the destination.

13. Rejection

13.1 Parts that fail to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing.

14. Certification

14.1 When specified in the purchase order or contract, a producer's certification shall be furnished to the purchaser that the parts were manufactured, sampled, tested, and inspected in accordance with this specification and have been found to meet the requirements. When specified in the purchase order or contract, a report of the test results shall be furnished.

14.2 The purchase order must specify whether or not the certification includes chemistry.

14.3 Upon request of the purchaser in the contract or order, the certification of an independent third party indicating conformance to the requirements of this specification may be considered.

15. Supplementary Requirements

15.1 For some materials, supplementary requirements may be specified. Usually these apply only when specified by the purchaser in the inquiry, contract, or order. These supplementary requirements shall appear separately.

15.2 *Special Government Requirements*—Requirements that are special to government needs are listed in 15.2.1 through 15.2.9.

15.2.1 Materials shall conform to Table 1, Grade 4. Contractor shall furnish a percent composition analysis on an oil-free basis for each lot showing the percentage for each element as specified in Table 1. Bearing shall conform to this specification and supporting military specification as applicable.

15.2.2 High-grade non-gumming petroleum lubricants, such as MIL-PRF-6085, MIL-PRF-17331 (Military Symbol 2190–TEP), or as specified on referenced military standard specification sheets shall be used to impregnate the bearings.

15.2.3 When specified, a first-article inspection shall be performed on bearings. Four samples shall be made available for first-article inspection and tested for chemical requirements, density, porosity, radial crushing strength, oil excretion, and dimensional characteristics as specified herein, Test Method B 328, FED-STD-151, or in an otherwise specified document. Any defect or failure shall be cause for rejection of the lot. Waivers for minor defects may be addressed to the contracting officer.

15.2.4 When procured from a contractor versus the actual manufacturer, a certificate of quality conformance (COQC) supplied by the manufacturer of the bearing may be furnished in lieu of actual performance of such testing by the contractor, provided lot identity has been maintained and can be demonstrated to the Government. The certificate shall include the name of the contractor, contractor number, name of manufacturer, NSN, item identification, name of the component or material, lot number, lot size, dimensions, date of testing, test method, individual test results, and specification requirements.

15.2.5 When specified in the contract or purchase order, packaging and marking shall be completed in accordance with the provisions of the contract.

15.2.6 Oil excretion of the bearing shall be verified by placing the bearing in the chamber of a preheated oven. Oven temperature shall be nominally 300°F [149°C]. Exposure shall be 5 min. During the period, beads shall exude uniformly from the bearing surface. Lack of appreciable sweating of the lubricant on the bearing surface will be cause for rejection. Lubricant content may be verified using Test Method B 328.

15.2.7 Unless otherwise specified, the contractor is responsible for testing. The contractor may use their own or any other suitable facility for the performance of testing and inspection, unless an exception is stated. The Government reserves the right to perform an inspection set forth herein to assure supplies and sources conform to the prescribed requirements.

15.2.8 Records of examination and tests performed by or for the contractor shall be maintained and made available to the Government by the contractor for a period of three years after delivery of the products and associate material.

15.2.9 All requirements shall be as specified herein. Reference military standard specification sheets shall take precedence unless otherwise specified in the contract or purchase order.

16. Keywords

16.1 bearing breaking load; density; *K*, radial crushing strength, porous metallic bearings, strength constant; oil content; oil-impregnated bearings; P/M bearings; porosity

APPENDIXES

(Nonmandatory Information)

X1. EXPLANATORY INFORMATION

X1.1 Design Information

X1.1.1 In calculating permissible loads, the operating conditions, housing conditions, and construction should be considered. The maximum static bearing load should not exceed 8500 psi [60 MPa] of projected bearing area (length times inside diameter of bearing) for this material. This figure is 75 % of the value for the compression deformation limit [yield strength, permanent set of 0.001 in. [0.025 mm] for specimens 1⅛ in. [30 mm] in diameter and 1 in. [25 mm] in length] as determined in accordance with Test Methods E 9.

X1.2 Permissible Loads

X1.2.1 Permissible loads for various operating conditions are given in Table X1.1.

TABLE X1.1 Permissible Loads

Shaft Velocity, ft/min [m/s]	Permissible Loads, psi [MPa]			
	Grades 1, 2, 3, and 4			
	Type 1	Type 2	Type 3	Type 4
Slow and intermittent	3200 [22]	4000 [28]	4000 [28]	4000 [28]
25 [0.125]	2000 [14]	2000 [14]	2000 [14]	2000 [14]
50 to 100 [0.25–0.50], incl	500 [3.4]	550 [3.9]	550 [3.9]	550 [3.9]
Over 100 to 150 [0.50–0.75], incl	325 [2.2]	365 [2.5]	365 [2.5]	365 [2.5]
Over 150 to 200 [0.75–1.00], incl	250 [1.7]	280 [1.9]	280 [1.9]	280 [1.9]
Over 200 [1.00]	[A]	[A]	[A]	[A]

[A] For shaft velocities over 200 ft/min [1.00 m/s], the permissible loads may be calculated as follows:

$$P = 50\,000/V[1.75/V] \quad (1)$$

where:
P = safe load, psi [MPa] of projected area, and
V = shaft velocity, ft/min [m/s].

NOTE 1—With a shaft velocity of less than 50 ft/min [0.25 m/s] and a permissible load greater than 1000 psi [7 MPa], an extreme pressure lubricant should be used.

NOTE 2—With good heat dissipation and heat removal techniques, higher PV ratings can be obtained.

X1.3 Dimensional Tolerances

X1.3.1 Commercial dimensional tolerances are included in Table X1.2. Closer tolerances can be held with special tooling or processing, or both.

X1.3.2 The commercial tolerances listed in Table X1.2 are intended for bearings with a 4 to 1 maximum length to inside diameter ratio and a 24 to 1 maximum length to wall thickness ratio.

X1.3.3 Fig. X1.1, Fig. X1.2, and Fig. X1.3 illustrate standard sleeve, standard flange bearings, and standard thrust bearings, respectively. Their dimensions are referenced throughout the tolerance tables. Standard chamfer tolerances are also listed in Table X1.2.

TABLE X1.2 Commercial Dimensional Tolerances

Inside Diameter, *d*, and Outside Diameter, *D*, in. [mm]		Total Diameter Tolerances, in. [mm]
Over	Through	
...	1 [25]	0.001 [0.025]
1 [25]	1.5 [40]	0.0015 [0.04]
1.5 [40]	2 [50]	0.002 [0.05]
2 [50]	2.5 [65]	0.0025 [0.064]
2.5 [65]	3 [75]	0.003 [0.076]

Length Tolerances, *L*, in. [mm]		
Over	Through	±
...	1.5 [40]	0.005 [0.13]
1.5 [40]	3 [75]	0.010 [0.25]
3 [75]	4.5 [115]	0.015 [0.38]

Outside Diameter, *D*, in. [mm]		Length, *L*, in. [mm]		Concentricity, ±in. [mm]
Over	Through	Over	Through	
...	1 [25]	0 [0]	0 [25]	0.003 [0.08]
...	1 [25]	1 [25]	1.5 [40]	0.004 [0.1]
...	1 [25]	1.5 [40]	2 [50]	0.004 [0.1]
...	1 [25]	2 [50]	2.5 [65]	0.005 [0.13]
...	1 [25]	2.5 [65]	3 [75]	0.005 [0.13]
1 [25]	2 [50]	0 [0]	1 [25]	0.004 [0.1]
1 [25]	2 [50]	1 [25]	1.5 [40]	0.005 [0.13]
1 [25]	2 [50]	1.5 [40]	2 [50]	0.005 [0.13]
1 [25]	2 [50]	2 [50]	2.5 [65]	0.006 [0.15]
1 [25]	2 [50]	2.5 [65]	3 [75]	0.006 [0.15]
2 [50]	3 [75]	0 [0]	1 [25]	0.005 [0.13]
2 [50]	3 [75]	1 [25]	1.5 [40]	0.006 [0.15]
2 [50]	3 [75]	1.5 [40]	2 [50]	0.006 [0.15]
2 [50]	3 [75]	2 [50]	2.5 [65]	0.007 [0.18]
2 [50]	3 [75]	2.5 [65]	3 [75]	0.007 [0.18]

Chamfer Tolerances		
Wall Thickness $(D-d)/2$		Chamfer, C. max, in. [mm]
in. Over	Through	
...	0.040 [1]	0.008 [0.2]
0.040 [1]	0.080 [2]	0.012 [0.3]
0.080 [2]	0.120 [3]	0.016 [0.4]
0.120 [3]	0.160 [4]	0.025 [0.6]
0.160 [4]	0.200 [5]	0.030 [0.8]
0.200 [5]	...	0.030 [0.8]

Angularity	Tolerance, ±
45° (from the face)	5°

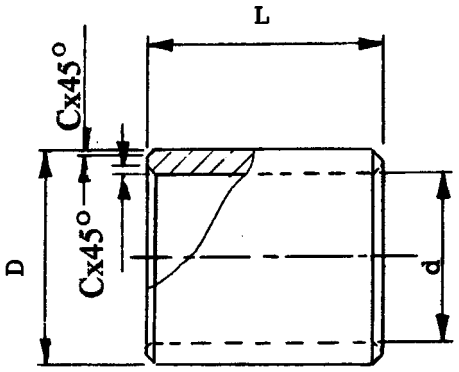

FIG. X1.1 Standard Sleeve Bearing

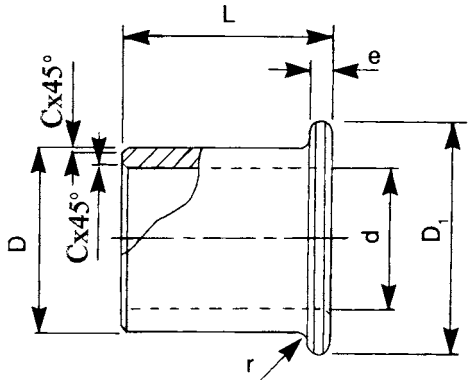

FIG. X1.2 Standard Flange Bearing

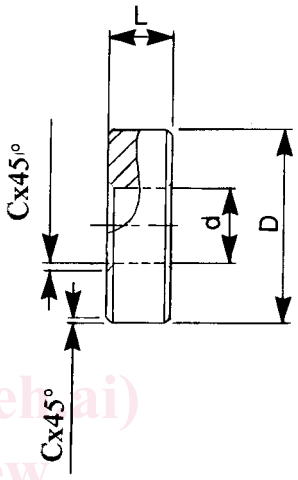

FIG. X1.3 Standard Thrust Bearing

X1.4 Press Fits

X1.4.1 Plain cylindrical journal bearings are commonly installed by press fitting the bearing into a housing with an insertion arbor. For housings rigid enough to withstand the press fit without appreciable distortion and for bearings with wall thickness approximately one eighth of the bearing outside diameter, the press fits shown in Table X1.3 are recommended.

X1.5 Running Clearance

X1.5.1 Proper running clearance for sintered bearings depends to a great extent on the particular application. Therefore, only minimum recommended clearances are listed in Table X1.4. The maximum running clearances will automatically be held within good design practice for average conditions. It is assumed that ground steel shafting having a recommended

TABLE X1.3 Recommended Press Fits

Outside Diameter of Bearing, in. [mm]		Press Fit	
Over	Through	min, in. [mm]	max, in. [mm]
0.000 [0.000]	0.760 [20]	0.001 [0.025]	0.003 [0.08]
0.760 [20]	1.510 [40]	0.0015 [0.04]	0.004 [0.10]
1.510 [40]	2.510 [63]	0.002 [0.05]	0.005 [0.13]
2.510 [63]	3.010 [75]	0.002 [0.05]	0.006 [0.15]
3.010 [75]	...	0.002 [0.05]	0.007 [0.18]

TABLE X1.4 Running Clearances

Shaft Size, in. [mm]		Clearance, min, in. [mm]
Over	Through	
0.000 [0.000]	0.250 [6]	0.0003 [0.008]
0.250 [6]	0.760 [20]	0.0005 [0.013]
0.760 [20]	1.510 [40]	0.0010 [0.025]
1.510 [40]	2.510 [60]	0.0015 [0.040]
2.510 [60]	... [...]	0.0020 [0.050]

finish of 4 to 16 root mean square (rms) will be used and all bearings will be oil impregnated.

X1.6 Flange and Thrust Bearing Specifications

X1.6.1 Diameter and thickness specifications for flange and thrust washers are shown in Table X1.5.

X1.7 Lubricating Oil-Impregnant

X1.7.1 It was found that the high-grade turbine oil containing rust and oxidation inhibitors and antifoam additives is the most desirable type of oil to be used. The viscosity should be specified by the user in accordance with the application.

TABLE X1.5 Flange and Thrust Bearings Diameter and Thickness Tolerances[A]

Flange Bearings, Flange Diameter Tolerances			
Diameter Range, in. [mm]		Standard (Tolerance), in. [mm]	Special (Tolerance), in. [mm]
Over	Through		
0 [0]	1½ [40]	±0.005 [±0.13]	±0.0025 [±0.06]
1½ [40]	3 [75]	±0.010 [±0.25]	±0.005 [±0.13]
3 [75]	6 [150]	±0.025 [±0.63]	±0.010 [±0.25]
Flange Bearings, Flange Thickness Tolerances			
Diameter Range, in. [mm]		Standard (Tolerance), in. [mm]	Special (Tolerance), in. [mm]
Over	Through		
0 [0]	1½ [40]	±0.005 [±0.13]	±0.0025 [±0.06]
1½ [40]	3 [75]	±0.010 [±0.25]	±0.007 [±0.20]
3 [75]	6 [150]	±0.015 [±0.40]	±0.010 [±0.25]

Flange Bearings, Radius, *r*, Tolerance		
Outside Diameter, *D*, in. [mm]		Radius, *r*, max, in. [mm]
Over	Through	
0 [0]	0.475 [12]	0.012 [0.3]
0.475 [12]	1.200 [30]	0.024 [0.6]
1.20 [30]	··· [···]	0.031 [0.8]

Thrust Bearings (¼-in. [6.35-mm] Thickness, max), Thickness Tolerances for All Diameters[B]	
Standard (Tolerance), in. [mm]	Special (Tolerance), in. [mm]
±0.005 [±0.13]	±0.0025 [±0.06]

Parallelism of Faces, max			
Diameter Range, in. [mm]		Standard (Tolerance), in. [mm]	Special (Tolerance), in. [mm]
Over	Through		
0 [0]	1½ [40]	0.003 [0.08]	0.002 [0.05]
1½ [40]	3 [75]	0.004 [0.10]	0.003 [0.08]
3 [75]	6 [150]	0.005 [0.13]	0.004 [0.10]

[A] Standard and special tolerances are specified for diameters, thickness, and parallelism. Special tolerances should not be specified unless required since they require additional or secondary operations and, therefore, are costlier.

[B] Outside diameter tolerances are the same as for flange bearings.