Designation: B 439 – 00$^{\epsilon 1}$

Standard Specification for Iron-Base Sintered Bearings (Oil-Impregnated)[1]

This standard is issued under the fixed designation B 439; 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.

ε[1] NOTE—Section 9.2 was editorially corrected in May 2003.

[1] This specification is under the jurisdiction of ASTM Committee ~~B-9~~ B09 on Metal Powders and Metal Powder Products and is the direct responsibility of Subcommittee B09.04 on Bearings.

Current edition approved October 10, 2000. Published December 2000. Originally published as B 439–66 T to replace portions of B 202. Last previous edition B 439–95 (2000).

1. Scope

1.1 This specification covers sintered metal powder, oil-impregnated, bearings of four iron-base compositional grades:

Grades 1 and 2—iron-carbon

Grades 3 and 4—iron-copper

1.2 The values stated in inch-pound units are to be regarded as the standard. The metric equivalents of inch-pound units may be approximate.

2. Referenced Documents

2.1 *ASTM Standards:*

B 328 Test Method for Density, Oil Content, and Interconnected Porosity of Sintered Powder Metal Structural Parts and Oil-Impregnated Bearings[2]

E 9 Test Methods of Compression Testing of Metallic Materials at Room Temperature[3]

3. Ordering Information

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

3.1.1 Grade (Section 5),

3.1.2 Density (6.1),

3.1.3 Dimensions, and

3.1.4 Certification (12.1).

4. Manufacture

4.1 Bearings shall be made by briquetting and sintering metal powders, with or without sizing, so as to produce finished parts conforming to the requirements of this specification.

5. Chemical Requirements

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 fully impregnated with lubricant shall be within the limits prescribed in Table 2.

6.2 *Oil Content*— Oil content of bearings shall not be less than that shown in Table 2.

6.3 *Radial Crushing Strength*—Radial crushing strength shall not be less than the value calculated as follows:

$$P = KLT^2/(D - T) \quad (1)$$

[2] *Annual Book of ASTM Standards,* Vol 02.05.

[3] *Annual Book of ASTM Standards,* Vol 03.01.

TABLE 1 Chemical Requirements

Element	Composition, %			
	Grade 1	Grade 2	Grade 3	Grade 4
Copper	0–1.5	0–1.5	9.0–11.0	18.0–22.0
Iron	balance	balance	balance	balance
Total other elements by difference, max	2.0	2.0	2.0	2.0
Combined carbon[A](on basis of iron only)	0.3 max	0.3–0.6	0.3 max	0.3 max

[A]The combined carbon may be a metallographic estimate of the carbon in the iron.

TABLE 2 Density and Oil Content Requirements

Grade	Density, g/cm^3		Oil Content, Volume, % min
	min	max	
1 and 2	5.6	6.0	21
3 and 4	5.8	6.2	19

where:
P = radial crushing strength, lbf (or N);
D = outside diameter of bearing, in. (or mm);
T = wall thickness of bearing, in. (or mm);
K = strength constant as shown in Table 3 for grade specified, psi (MPa); and
L = length of bearing, in. (or mm).

7. Workmanship, Finish, and Appearance

7.1 Bearings shall be uniform in composition. When cut or fractured, the exposed surface shall be of uniform appearance. The parts shall be free from defects which would affect their serviceability.

8. Sampling

8.1 *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.

8.2 *Sample for Chemical Analysis* —At least one sample for chemical analysis shall be taken from each lot. A representative sample of chips may be obtained by milling, drilling, or crushing at least two pieces 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.

8.3 *Mechanical Tests*— The manufacturer and purchaser shall agree on a representative number of specimens for mechanical tests.

9. Test Methods

9.1 *Density and Oil Content*—Density and oil content shall be determined in accordance with Test Method B 328.

9.2 *Radial Crushing Strength*—Radial crushing strength shall be determined by compressing the test specimens between two flat surfaces at a "no-load" speed no greater than 0.2 in./min (5.0 mm/min), the direction of the load being normal to the longitudinal axis of the specimen. The point at which the load drops as a result of the first crack shall be considered the crushing strength. This test shall be applied to plain cylindrical bearings. Flanged bearings shall be tested by cutting off the flange and compressing the two sections separately. Each section shall meet the ~~maximum~~ minimum strength requirements prescribed in 6.3.

10. Inspection

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

11. Rejection

11.1 Rejection based on tests made in accordance with this specification shall be reported to the manufacturer within 30 days of receipt of shipment; however, the rejected parts should not be returned without authority from the producer.

TABLE 3 Strength Constants

Grade	K (Strength Constant), psi (MPa)
1	15 000 (105)
2	20 000 (140)
3	30 000 (205)
4	30 000 (205)

12. Certification

12.1 A certification based on the manufacturer's quality control that the material conforms to the requirements of this specification, shall be the basis of shipment of the material. A certificate covering the conformance of the material to these specifications shall be furnished by the manufacturer upon request of the purchaser.

13. Keywords

13.1 density; iron-base bearings; *K* strength constant; oil content; oil impregnated; porosity

APPENDIX

(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. In general, this material has less resistance to seizure and corrosion than copper-base material. The maximum static bearing load should not exceed 15 000 psi (105 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 1⅛in. (28.6 mm) in diameter and 1 in. (25.4 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.

X1.3 Dimensional Tolerances

X1.3.1 Commercial dimensional tolerances are given in Table X1.2.

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. It is assumed that ground steel shafting will be used and that 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

TABLE X1.1 Permissible Loads

Shaft Velocity, ft/min (m/min)	Permissible Loads, psi (MPa)	
	Grade 1, 2	Grade 3, 4
Slow and intermittent	3600 (25)	8000 (55)
25 (7.6)	1800 (12)	3000 (20)
50 to 100 (15.2 to 30.4), incl	450 (3.1)	700 (4.8)
Over 100 to 150 (30.4 to 45.7), incl	300 (2.1)	400 (2.8)
Over 150 to 200 (45.7 to 61), incl	225 (1.6)	300 (2.1)
Over 200 (61)	[A]	[A]

[A] For shaft velocities over 200 ftt/min the permissible loads may be calculated as follows:

$$P = 50\,000/V$$

where:
P = safe load, psi of projected area and
V = shaft velocity, ft/min.

TABLE X1.2 Commercial Dimensional Tolerances

NOTE 1—This table is intended for bearings with a 3 to 1 maximum length to inside diameter ratio and a 20 to 1 maximum length to wall thickness ratio. Bearings having greater ratios than these are not covered by the table.

Inside Diameter and Outside Diameter		Total Diameter Tolerance[A]			
		Inside Diameter		Outside Diameter	
in.	mm	in.	mm	in.	mm
Up to 0.760	up to 19.31	0.001	0.025	0.001	0.025
0.761 to 1.510	19.32 to 38.36	0.0015	0.025	0.0015	0.04
1.511 to 2.510	38.37 to 63.76	0.002	0.05	0.002	0.05
2.511 to 3.010	63.77 to 76.46	0.003	0.08	0.002	0.08
3.011 to 4.010	76.47 to 101.86	0.004	0.10	0.004	0.10
4.011 to 5.010	101.87 to 127.26	0.005	0.13	0.005	0.13
5.011 to 6.010	127.27 to 152.65	0.006	0.15	0.006	0.15

Length		Total Length Tolerance[B]	
in.	mm	in.	mm
Up to 1.495	up to 37.97	0.010	0.25
1.496 to 1.990	37.98 to 50.54	0.015	0.38
1.991 to 2.990	50.55 to 75.96	0.020	0.51
2.991 to 4.985	75.97 to 126.61	0.030	0.76

Outside Diameter		Wall Thickness, max		Concentricity Tolerance[C]	
in.	mm	in.	mm	in.	mm
Up to 1.510	up to 38.36	up to 0.355	9.02	0.003	0.08
1.511 to 2.010	38.37 to 51.06	up to 0.505	12.83	0.004	0.10
2.011 to 4.010	51.07 to 101.86	up to 1.010	25.65	0.005	0.13
4.011 to 5.010	101.87 to 127.26	up to 1.510	38.35	0.006	0.15
5.011 to 6.010	127.27 to 152.65	up to 2.010	51.05	0.007	0.18

[A] Total tolerance on the inside diameter and outside diameter is a minus tolerance only.
[B] Total tolerance is split into plus and minus.
[C] Total indicator reading.

TABLE X1.3 Recommended Press Fits

Outside Diameter of Bearing		Press Fit			
		Min		Max	
in.	mm	in.	mm	in.	mm
Up to 0.760	up to 19.31	0.001	0.025	0.003	0.08
0.761 to 1.510	19.32 to 38.36	0.0015	0.04	0.004	0.10
15.11 to 2.510	38.37 to 63.76	0.002	0.05	0.005	0.13
2.511 to 3.010	3.77 to 76.45	0.002	0.05	0.006	0.15
Over 3.010	over 76.45	0.002	0.05	0.007	0.18

TABLE X1.4 Running Clearancse

Shaft Size		Clearance, min	
in.	mm	in.	mm
Up to 0.760	up to 19.31	0.0005	0.01
0.761 to 1.510	19.32 to 38.36	0.001	0.025
1.511 to 2.510	38.37 to 63.76	0.0015	0.04
Over 2.510	over 63.76	0.002	0.05

X1.7 Lubrication

X1.7.1 It was found that a circulating type oil containing rust and oxidation inhibitors 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		Standard		Special	
in.	mm	in.	mm	in.	mm
0 to 1½	0 to 38	±0.005	±0.13	±0.0025	±0.06
Over 1½ to 3	39 to 76	±0.010	±0.25	±0.005	±0.13
Over 3 to 6	77 to 152	±0.025	±0.64	±0.010	±0.25
Flange Bearings, Flange Thickness Tolerances					
Diameter Range		Standard		Special	
in.	mm	in.	mm	in.	mm
0 to 1½	0 to 38	±0.005	±0.13	±0.0025	±0.06
Over 1½ to 3	39 to 76	±0.010	±0.25	±0.007	±0.18
Over 3 to 6	77 to 152	±0.015	±0.38	±0.010	±0.25

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

Parallelism on Faces, max					
Diameter Range		Standard		Special	
in.	mm	in.	mm	in.	mm
0 to 1½	0 to 38	0.005	0.13	0.003	0.08
Over 1½ to 3	39 to 76	0.007	0.18	0.005	0.13
Over 3 to 6	77 to 152	0.010	0.25	0.007	0.18

[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 same as for flange bearings.