DESIGN PARAMETERS FOR OILUBE BEARINGS

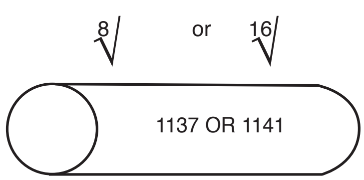
The following information will aid you in the proper selection of bearings to meet your needs. The sample problems will illustrate the design criteria which must be established in order to select the proper bearing. Should any questions arise, our staff is ready to assist you.

> **Sample Problem:** Design a bearing for 180 pound load at a speed of 1100 RPM

SHAFT SELECTION

Size Shaft size will be determined by the size and construction of the unit being designed. Refer to our PV Chart (page 5) in order to determine approximate criteria.

> **Example:** A 1.000 shaft is chosen. The PV chart shows that a 1.000 shaft operating at 1100 RPM will carry 175 pounds per sq. inch load.



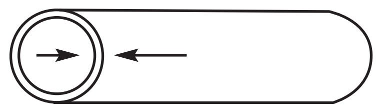
Materials Steels containing approximately 0.4% carbon are recommended, and any steels with a lower content should be avoided. The 1137-1141 series, for example, are effective grades for shaft material. In addition, drill rod and hardened and ground steels can be used.

Hard chromium plated materials are recommended when corrosion resistance is required. The performance of stainless steel materials does not equal that of straight carbon-alloy steels. If stainless steel must be used, the 300 series should be avoided. The 400 series is a good choice in stainless, and 416 stainless, heat-treated to maximum hardness, is the best.

Zinc or cadmium plating on shafts must be avoided as they are too soft and will ball up, resulting in a loss of bearing porosity, and lubrication.

Finishes Shaft finish is critical to long bearing life. Recommended finish is 16 RMS to 8 RMS. In some cases, a 32 RMS finish may be adequate if the application is not too precise.

BEARING WALL THICKNESS

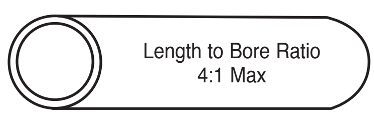


For bearings less than 1/4 inch ID, the minimum wall thickness is 11/32 inch. For bearings 1/4 inch ID and larger, use the following formula to determine wall thickness:

> **Example:**
> Wall thickness = .125 x Shaft dia.
> 1" shaft
> Wall thickness = .125 x 1000
> Wall thickness = .125

Larger bearings with extremely thin walls are more costly to produce and result in increased unit costs.

BEARING LENGTH



Maximum length is determined by using a ratio of length to bore, not to exceed 4:1. For diameters less than 1/4 inch, use a smaller ratio.

To determine proper bearing length, refer to the PV chart (page 5). It will give the unit load per square for a specific speed and shaft size. By dividing the unit load per square inch into the total load to be carried by the bearing, the minimum length is found. In addition we recommend that a safety margin be used. By adding extra length, the bearing avoids operating at extreme limits.

> **Example:** 180 lb. load
> 1100 RPM
> 1.000 Bearing ID
>
> PV chart indicates
> 175 PSI UNIT LOAD
>
> 180 ÷ 175 = 1.029 Minimum length
>
> 1.029 (Minimum Length)
> .221 (Safety margin)
> 1.250 Suggested length

LOADS AND SPEEDS

Load and speed limitations must be ascertained in order to insure proper bearing design. If design limits are exceeded, the bearing life will decrease and could result in premature failure. To determine the capacity of a bearing, use the following PV formula:

(P = The load per square inch of (Projected area
V = Shaft velocity in feet per minute
(P = $\frac{\text{load}}{\text{I.D. x Length}}$
V = R.P.M. x shaft diameter x .262
(PV = (P X V

1. The maximum P is 2000 P.S.I.
2. The maximum V is 1200 S.F.M.
3. The maximum PV for Oilube is 50,000

> **Example:** 180 lb. load
> 1100 RPM
> 1.000 I.D. x 1.250
>
> (P = $\frac{180}{1.000 \times 1.250}$
> (P = 144 WITHIN LIMIT
> V = 1100 x 1.00 x .262
> V = 288 SFM WITHIN LIMIT
> (PV = 144 X 288
> (PV = 41472 WITHIN LIMIT

Loads and Speeds

The normal load carrying capacity of OILUBE bearings is expressed as a PV factor (Pressure x Surface Velocity) where —

P = the load in psi on the projected bearing area (Bearing ID x Length).

V = surface velocity of the shaft in feet per minute (sfm)

$$PV = \frac{W}{LD} \times \frac{\pi DN}{12} = \frac{3.14\ WN}{12L}$$

W = total load on bearing (pound)

L = bearing length (inches)

D = ID of bearing (inches)

N = shaft speed (rpm)

Normal Upper Limits of OILUBE Bearing Material

PV	Static (psi)	Dynamic (psi)	Velocity (sfm)
50,000	8000	2000	1,200

Normal Limits of Bearing Length

Material	Length to ID Ratio	Length to Wall Thickness Ratio
Oilube Bronze	4 to 1	24 to 1

For ratios greater than those shown above please contact us.

OILUBE BRONZE METRIC TOLERANCES

Nominal Sizes (mm)		Tolerances (IN 0.001mm)	
Over	To	I.D.	O.D.
3	6	+20 +0	+40 +19
6	10	+30 +05	+40 +19
10	18	+30 +05	+50 +28
18	30	+30 +05	+60 +35
30	50	+40 +09	+70 +40
50	65	+40 +10	+83 +50

Overall Length

Up	to	40mm	+/– 0.12mm
40mm	to	55mm	+/– 0.19mm
55mm	to	76mm	+/– 0.25mm

Flange Outside Diameter

Up	to	30mm	+/– 0.12mm
30mm	to	70mm	+/– 0.25mm

Flange Thickness

Up	to	3mm	+/– 0.07mm
3mm	to	5mm	+/– 0.13mm

Concentricity

Up	to	40mm	0.07mm
40mm	to	65mm	0.10mm
65mm	to	100mm	0.13mm
OVER		100mm	0.18mm

These manufacturing tolerances are the result of a compromise between ASTM-B438-73, and common ISO tolerances for G7-s7. Consider housing bores H7, assembly arbors n6, and shafts f7.

OILUBE MATERIAL SPECIFICATIONS

Composition %	Density (gm/cc)	Porosity (% by Vol.)	K Strength Constant	Tensile Strength	Elongation (in 1"%)	Yield Strength PSI	Comparable Designations
Copper 87.5-90.5 Tin 9.5-10.5 Iron 1.0 max. Carbon 1.75 Other Elements 0.5	6.4-6.8	19 min.	26500	14000	1	11000	ASTM B-438-70 GR1 Type II MPIF CT-1000-K26 Mil-B-5687C Type I, Comp. A SAE-841

*Other sizes, tolerances, lubricants and materials are available on special orders.

ISOSTATIC INDUSTRIES INC., CHICAGO, IL 800-621-5500

EXAMPLE AND WORKSHEET FOR CALCULATING BEARING DIMENSIONS

Fill in the blanks (. . . . . . .)

Housing Bore (Min.)	1.2495		1.2505	Housing Bore (Max.)
	....		....	
			+ .0015	Press Fit (Min.) See Page 7
			....	
Bearing O.D. (Max.)	1.253	+ .001	1.252	Bearing O.D. (Min.)
	....	O.D. Tol. Spread See Page 5	....	
Housing Bore (Min.)	1.2495			
	....			
Press Fit (Max.) See Page 7	.0035		.0015	Press Fit (Min.)
	....		....	
Percent Close-in See Page 7	× 80%		× %80	Percent Close-in
Close-in (Max.) (Pressfit (Max.) × percent close-in)	.003		.001	Close-in (Min.) Press Fit (Min.) × percent close-in
	....		....	
Shaft Diameter (Max.)	1.000			
	....			
Min. Shaft Clearance See Page 7	+ .0005			
	....			
Assembled Bearing I.D. (Min.)	1.0005			
	....			
Close-in (Max.)	+ .003			
	....			
Bearing I.D. Before Assembly (Min.)	1.0035	+ .001	1.0045	Bearing I.D. Before Assembly (Max.)
	....	I.D. Tol. Spread See Page 5	....	
			− .001	Close-in (Min.)
			....	
Assembled Bearing I.D. (Min.)	1.0005		1.0035	Assembled Bearing I.D. (Max.)
	....		....	
Shaft Diameter (Max.)	− 1.000		.9995	Shaft Diameter (Min.)
	....		....	
Clearance (Min.)	.0005		.0040	Clearance (Max.)
	....		....	

Check for Stock Size Usage (see page 7)

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CHECK FOR STOCK SIZE USAGE

From the calculations on the work sheet we have determined that the ideal dimensions should be

1.0035 / 1.0045 × 1.252 / 1.253 × 1-1/4

The stock list shows a size of

1.004 / 1.005 × 1.2515 / 1.2525 × 1-1/4 (AA1204-2)

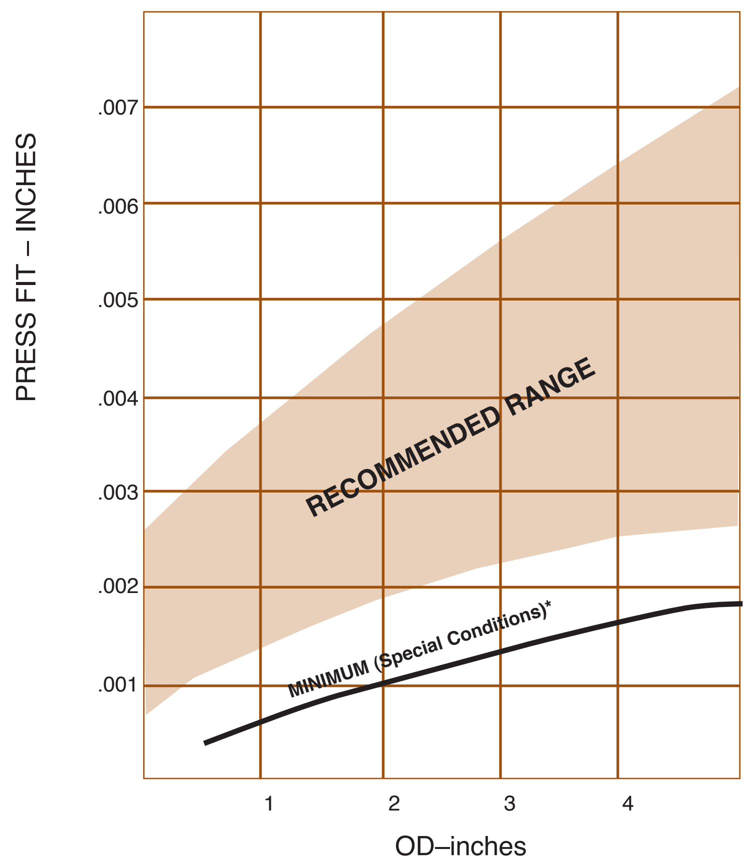
A check can be made to see if this standard size can be used.

Bearing O.D.	1.2525	1.2515
Housing Bore	– 1.2495	– 1.2505
Press Fits	.0030	.0010
Close in factor	× .8	× .8
Close in (to nearest .0005)	.0025	.0010*
Bearing I.D.	1.0050	1.0040
Close-in	– .0010	– .0025
I.D. after assembly	1.0040	1.0015
Shaft diameter	– .9995	– 1.0000
Bearing Clearance	.0045	.0015

*Press fit deviation of .0005 is acceptable.

By using a standard size, tool costs are reduced and parts are in ready supply.

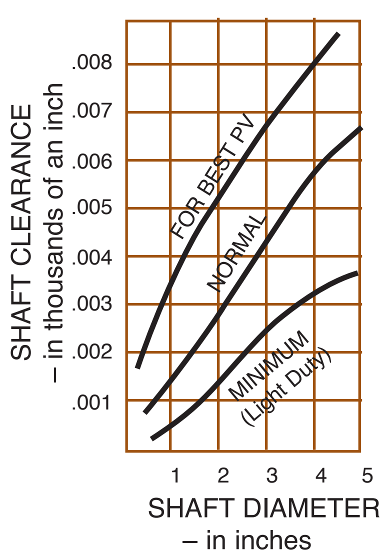
OILUBE PRESS FIT VALVES



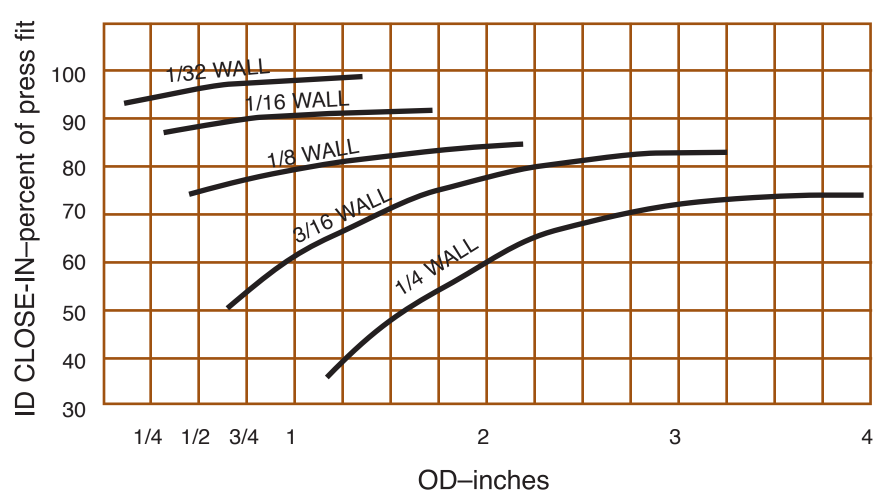
Considerable force is required to seat large bearing when press fit approaches the top of the recommended range.

*Less than normal press fit proves satisfactory,
(1) if the bearing is long and the wall is not exceptionally thin, and
(2) if the bearing is also carrying a moderate load exerted only in one direction.

BEARING CLEARANCE OILUBE BEARINGS



BEARING CLEARANCE OILUBE BEARINGS



LUBRICATION

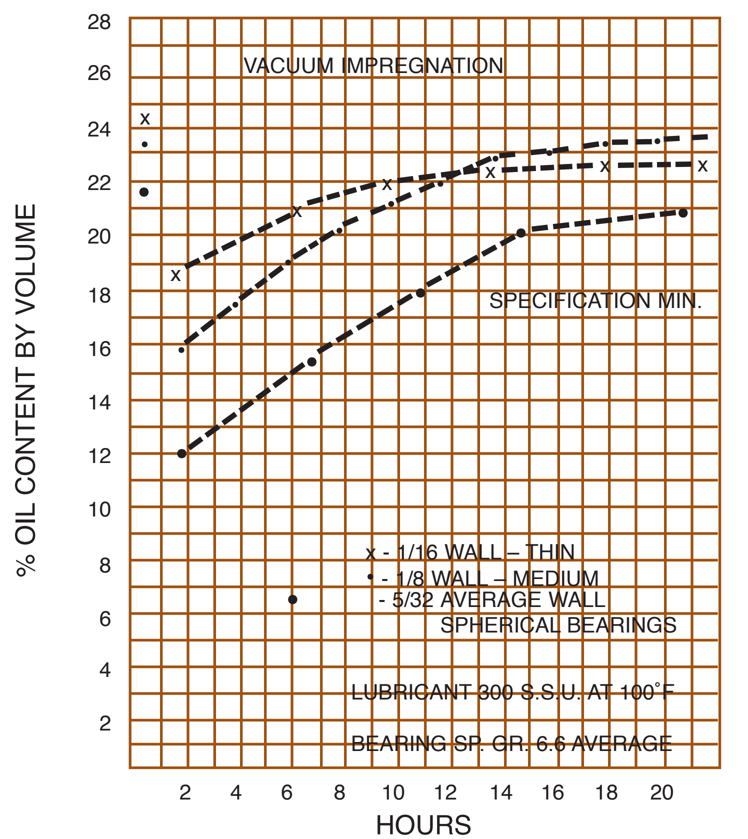
Proper lubrication is essential for the Oilube bearing, and we use the highest quality oils available. Our standard lubricant has an effective operating range from +10ºF to + 175 *F. Applications requiring extended or unusual operating ranges must be identified so that we can select a special lubricant to do the job. This impregnation process is available for a minimal charge.

Supplementary Lubrication Additional lubrication can be provided thru the use of oil soaked felts, wicks, etc., or by periodic oiling. A unique advantage of the Oilube bearing is that it does not require any grooving or holes to distribute the oil across the bearing surfaces. The Oilube bearing distributes oil evenly across the bearing face due to the microscopic pores in the material.

Storage of Bearings Oilube bearings must be stored in non-absorbing containers. Do not store in paper or cloth containers. Do not store in cardboard boxes! The best containers are made of plastic or metal.

De-Oiling *To* remove oil from a bearing, immerse it in a solvent for 12 hours. An aromatic solvent is recommended. Chlorinated solvents should be avoided, as they can initiate corrosion within the pores of the material. After soaking in solvent, the bearings should air dry until the absorbed solvent is evaporated.

Re-Oiling The most efficient method of impregnation is by the vacuum process. However, this process is typically available only to bearing manufacturers. Re-oiling can also be accomplished by immersing the bearings in oil heated to 150-175ºF. This method will result in a 90% saturation of the bearing material. The graph above indicates the length of time required to achieve maximum impregnation by both methods.



Immersion versus vacuum impregnation for bearing lubrication.

CUSTOM MADE BEARINGS

Custom bearings can be designed and manufactured according to customer specifications, including requirements for special dimensions and/or materials. Our inventory provides for a large supply of nearly all the powdered metal mixes used in bearing manufacture. Please give us a call and tell us about your special needs.

OILUBE MATERIAL SPECIFICATIONS

Composition %	Density (gm/cc)	Porosity (% by Vol.)	K Strength Constant	Tensile Strength	Elongation (in 1"%)	Yield Strength PSI	Comparable Designations
Copper 87.5-90.5 Tin 9.5-10.5 Iron 1.0 max. Carbon 1.75 Other Elements 0.5	6.4-6.8	19 min.	26500	14000	1	11000	ASTM B-438-70 GR1 Type II MPIF CT-0010-R SAE 841 Mil-B-5687C Type I. Comp. A

SUPER OILUBE MATERIAL SPECIFICATIONS

Copper 18.0-22.0 Iron Balance Other Elements 2.0	5.8-6.2	19 min.	40000	22000	1	22000	ASTM B-439-70 GR 4 SAE 863. Type 3 Mil-B-5687C Type II. Comp. B