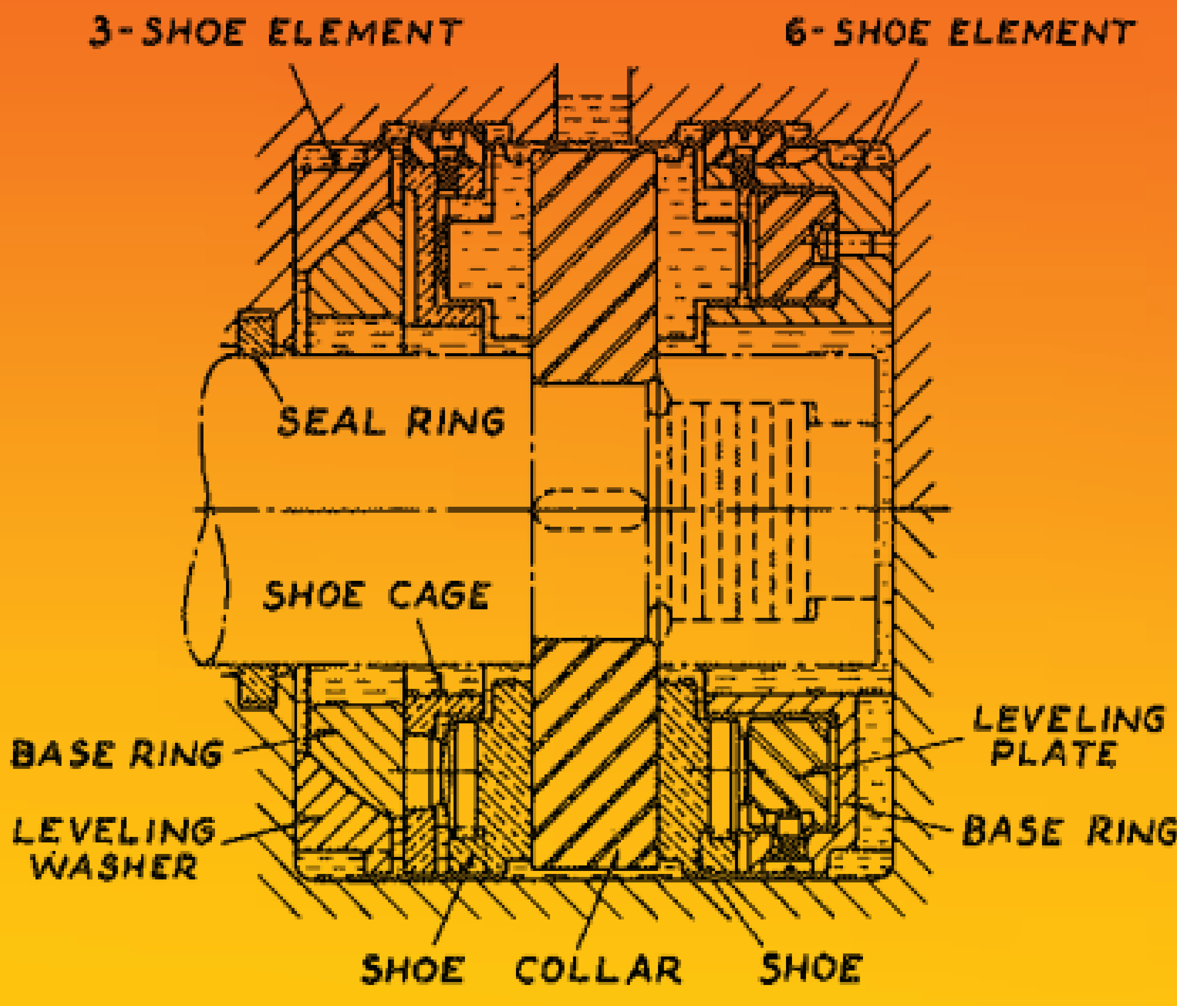
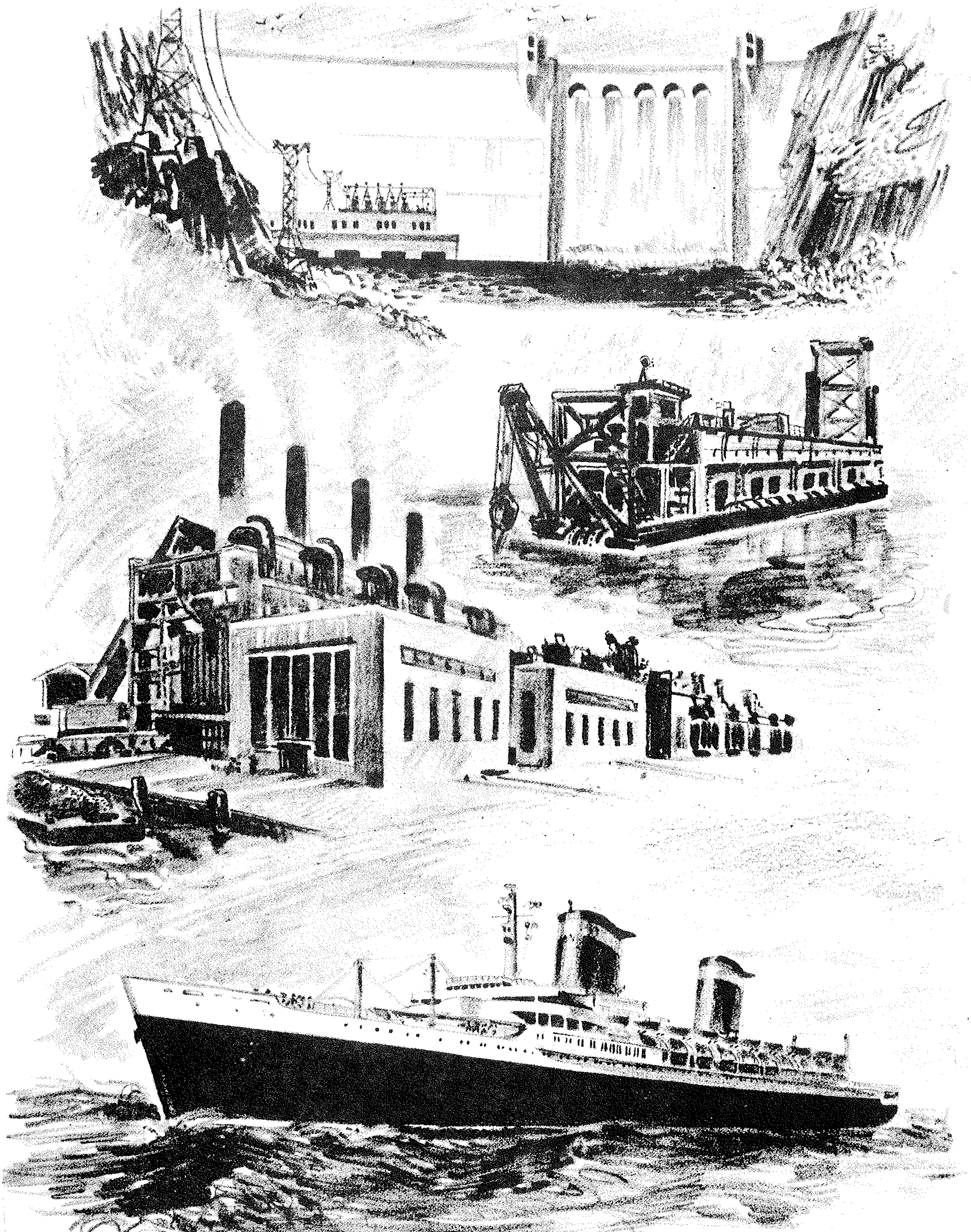
Equalizing Bearings

Three-Shoe and Six-Shoe Elements
HORIZONTAL & VERTICAL



Kingsbury, Inc.®



KINGSBURY

EQUALIZING BEARINGS

Three-Shoe and Six-Shoe elements

Horizontal and Vertical

DIMENSIONS
and
CAPACITIES

CATALOG EQ

KINGSBURY

KINGSBURY MACHINE WORKS, INC.
10385 DRUMMOND ROAD
PHILADELPHIA, PENNA. 19154

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FOREWORD

Kingsbury "Equalizing" Thrust Bearings are self-adjusting so that the thrust load is equally divided among all the shoes on either side of the thrust collar. They are to be distinguished from Kingsbury "Adjustable" Thrust Bearings, in which each shoe is backed by its own "jack screw," which must be separately adjusted. Since the oil films may be no more than one or two thousandths of an inch thick, automatic equalization of load and film thickness is a useful assurance that the bearing can be loaded to its theoretical capacity.

These "equalizing" bearings also compensate for slight misalignment or deflection of housings.

This Catalog covers only the standard sizes of three-shoe and six-shoe internal parts, which are by far most used. Those parts are intended to be incorporated by the machinery builder into housings of his own manufacture. They are applicable to both horizontal and vertical shafts, under a great variety of speed and load conditions, with proper provision for oil circulation and for cooling.

In certain small sizes, both three- and six-shoe bearings have been standardized with the addition of an "Oil Control Ring" for high-speed application to steam turbines and blowers. This feature controls the oil flow in such a way as to minimize power loss due to churning of the oil at turbine speeds.

Some more common applications of Kingsbury Thrust Bearings are mentioned on page 6: others are suggested. With the growing use of higher speeds and loads, Kingsburys offer performance scarcely attainable with other types of thrust bearings.

Because of the possibility of minor changes, or of changes to meet special conditions, the figures in the various Dimension Lists should be confirmed by us before starting actual construction.

Explanation of the basic Kingsbury principle of wedge-shaped oil films, automatically self-renewed and preventing metallic contact and wear, will be found in other booklets.

Typical Uses of Kingsbury Equalizing Thrust Bearings

Kingsbury Thrust Bearings are most used where loads are heavy and speeds are high, and where indefinitely long life is desired with minimum attention and freedom from repairs. Those characteristics follow naturally from the Kingsbury principle of "floating" the load on moving films of oil, by which the working surfaces are completely separated while running.

The following classes of service exemplify the above requirements. In each group, reference is made to the pages and tables wherein the particular "styles" of Kingsbury Bearings mentioned are shown.

Horizontal Shafts

Ship Propulsion

Most reduction-geared drives employ standard six-shoe bearings built into the forward end of the gear housing, as in Figures 23 and 24. See Style BHB, page 29; also, for smaller vessels, Style JHJ in sizes up to 17 inches diameter of thrust collar,* page 28. Occasionally the thrust bearing parts are located in the after end of the gear housing, or sometimes separately, in a specially-built housing on the line shaft. In these latter cases, the shaft size often requires using eight large-bore shoes instead of six standard shoes. Eight-shoe bearings are special, and are not listed here. We should be consulted.

The two-shoe "adjustable" bearings often used in smaller vessels are not included here: they are to be found in other literature.

Horizontal Centrifugal Pumps and Water Turbines

For boiler feed and similar pumps we usually supply complete self-lubricating bearings, including housings, for attachment to the customer's pump body. These are described in other literature.

However, we can furnish standard internal parts with six or three shoes to be built into the customer's housings and lubricated from an outside source. See Styles JHJ, JHN, and NHN, pages 9 and 11.

Horizontal Steam Turbines, Gas Turbines, Compressors and Blowers

Equalizing three- and six-shoe bearings for these high-speed applications are equipped with Oil Control Rings to minimize the power loss from oil churning at high rotative speeds. See page 13.

Vertical Shafts

Vertical Electric Motors

These include motors for deep-well pumps, drydock unwatering pumps, hot-well pumps, and miscellaneous pumps for water works and sewerage; also electrical condensers. The standard three- and six-shoe equalizing elements, in sizes 5 inches to 17 inches for vertical loads from 1000 to about 70,000 lbs., are suitable for most pump drives. See Styles NV, LV, JV and KV, pages 10 and 27 to 28. Style KV, page 10, is most often used. Hydroelectric machinery and large pump motors often use the larger six-shoe bearings, Style KBV. See page 29.

Vertical Hydroelectric Generators

Equalizing six-shoe bearings, Styles KBV and BV (page 29) are standardized up to 45 inches size. Larger sizes are often used: we shall be glad to make suitable recommendations.

Vertical Steam Turbines and Blowers

These use Style NV or JV internal parts (pages 9 and 10) in connection with special grooving in the housing to perform the function of an Oil Control Ring. The housing designs are special: we should be consulted.

Other Uses

In addition to the "typical" uses named above, Kingsbury equalizing bearings are employed in a great variety of miscellaneous and special uses, some of which are named on page 7. We are always glad to discuss new and unusual applications, including non-standard details if needed.

Atlantic Refining Company Tanker "Atlantic Prestige". Kingsbury Main Thrust Bearing size 45-inch, similar to Figure 27.

Bearings for Special Uses

Aside from the standard equalizing bearings here listed, others have been developed for special uses, on which information will be given on request. They are not listed in this Catalog. Among them are:

Small two-shoe bearings for light loads, usually at high speeds. They are equalizing and self-aligning, and may be used in combination with six shoes on the loaded side.

Large two-shoe bearings for the unloaded side of dredge pump thrusts, with six shoes on the loaded side. They are equalizing and self-aligning.

Large eight-shoe bearings, similar to the six-shoe bearings but so proportioned as to be suitable for shafts whose diameter is more than half the collar or runner size. Sometimes used abaft the drive in marine propulsion; also in large vertical hydroelectric generators.

Counting both standard and special designs, Kingsbury equalizing bearings are made in sizes from about 3 inches diameter of thrust collar for small steam and gas turbines and high-speed blowers, to over 100 inches for large hydroelectric generators. Loads run from a few hundred pounds to 3,000,000 pounds or more. We have found no commercial limits to the speed.

Basic Kingsbury Elements

The basic elements of all Kingsbury Bearings are:

(1) The stationary pivoted ***Shoes***.

(2) The ***Thrust Collar*** which rotates with the shaft, and applies the load to the shoes. (Called ***Runner*** in vertical bearings.)

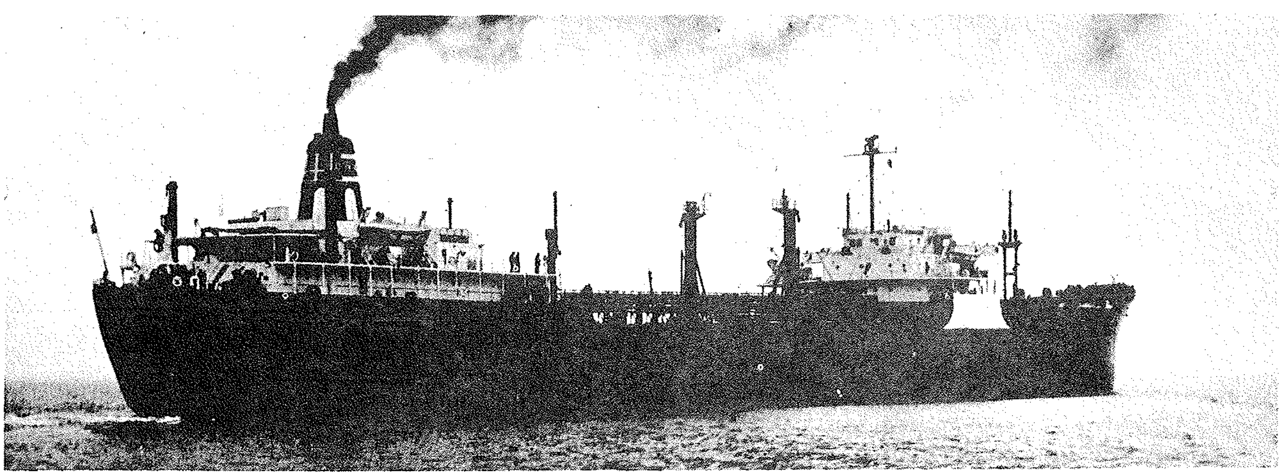
(3) The ***Base Ring***, or other means of supporting the shoes and equalizing the shoe loads.

(4) The ***Housing*** or mounting, which contains and supports the internal bearing elements.

(5) The ***Lubricating System***, which continuously floods the collar and shoes with oil.

(6) The ***Cooling System*** for removing the heat due to oil film shear.

Every thrust bearing installation involves all these elements in one form or another. Designs may be classified as horizontal or vertical; as having "equalizing" or "adjustable" thrust elements; and also according to the number of shoes. Some designs are furnished as complete units including housings. This Catalog EQ is, however, concerned only with the standard "equalizing" elements, which have either three or six shoes, and are contained in housings furnished by the machinery builder.



Atlantic Refining Company Tanker "Atlantic Prestige." Kingsbury Main Thrust Bearing size 45-inch, similar to Figure 27.

Standard Three-shoe and Six-shoe Bearing Parts

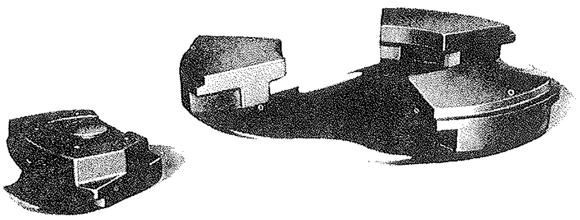


Figure 1
Three pivoted shoes (a fourth is inverted to show the hardened steel "shoe support" set into its base).

Shoes: Every Kingsbury shoe has a hardened insert in the back, which allows the shoe to tilt slightly. This permits the oil films between shoes and collar to take the natural taper which is characteristic of all Kingsbury Bearings. Typical shoes are shown in Figure 1.

Runners and Collars: The "*runner*" for a vertical shaft differs in shape from the "*collar*" for a horizontal shaft. As shown in the chart on page 12, the letter "V" indicates that the bearing referred to includes a separate *runner* for vertical service: "H" indicates a separate *collar* for horizontal service.

The runner takes its load from a massive *thrust block* secured to the shaft. The thrust block is identified in Figures 30 and 33, and is shown (sometimes dotted) in several other line drawings. It is commonly furnished by the customer.

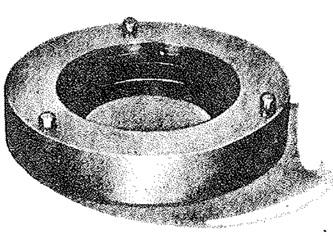


Figure 2
Standard runner for bearings with vertical shaft.

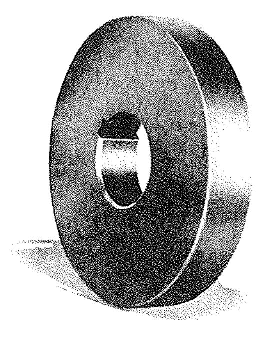


Figure 3
Standard collar for bearings with horizontal shaft.

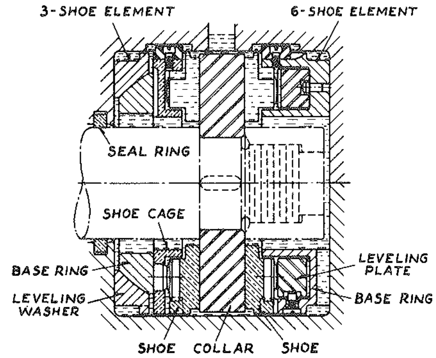


Figure 4
Three-shoe and six-shoe double horizontal thrust bearing elements.

Equalizing Means: *Three-shoe* bearings are equalized by the spherical-seated *leveling washer* and *base ring* shown on the left side in Figure 4. A *shoe cage* between the base ring and the shoes holds the shoes against rotation.

Six-shoe bearings are equalized by the interlocking *leveling plates* shown in Figures 5 and 6. These are held in place by the *base ring*, which also holds the shoes against rotation.

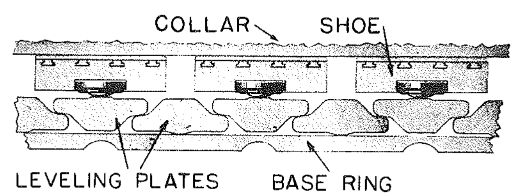


Figure 5
Developed diagram showing principle of equalized support of shoes by use of leveling plates.

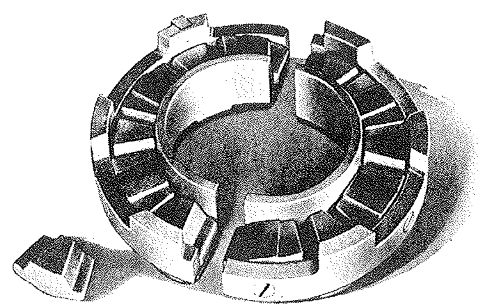
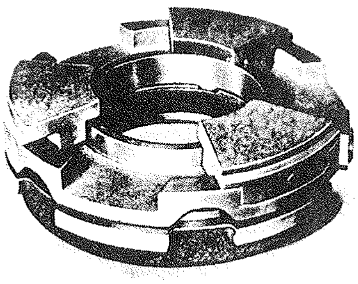


Figure 6
Split base ring and leveling plates of small (Style J) six-shoe bearing. A "lower" leveling plate is shown separately.

Standard Assemblies: Three-shoe and Six-shoe



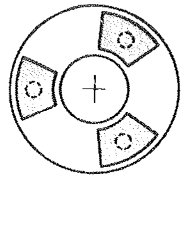


Figure 7
Three-shoe bearing, Style N. For vertical or horizontal shaft.

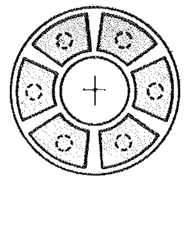
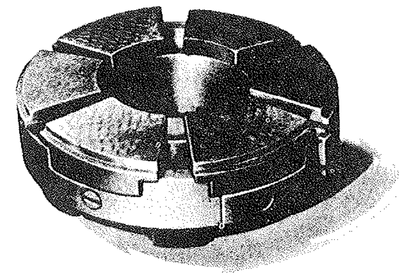


Figure 8
Style J bearing assembly. For vertical or horizontal shaft.



Below are described various details of the standard three-shoe and six-shoe bearing parts. Some of these details require consideration when selecting a bearing; others when designing the housing to contain it.

For the standard elements, the various symbols are listed in the chart on page 12. Bearings may be ordered either with or without the runner or collar.

The page numbers in the section-heads below refer to the dimension lists.

In all bearing symbols, the numeral denoting *size* may come either after or before the letters denoting *style*. Thus, "JHJ-15" means the same as "15″-JHJ."

Horizontal Bearings (Pages 20 to 26)

Three-Shoe Horizontal Bearings: These are made in sizes up to 17 inches. All forms are identified by the letter "N": e.g., N or NN if without separate collar; or NH or NHN, if collar is included. The shoes, shoe cage, spherical-seated base ring and leveling washer are described on pages 8 and 9. See also the left section in Figure 4.

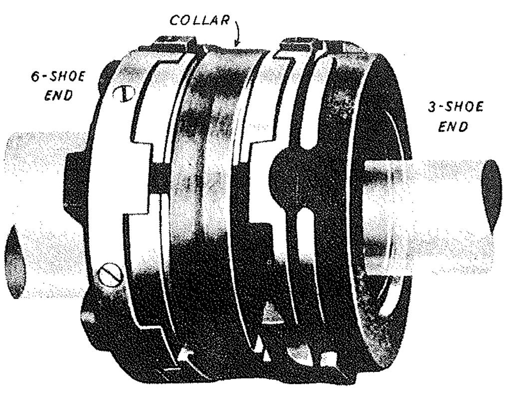


Figure 9
Style JHN double thrust bearing for horizontal shaft.

Oil enters the recesses in the bottom of the shoe cage, as shown by arrows in the photograph, Figure 10, and flows radially inward to the shaft and then to the shoes. Thence it passes outward between the shoes. The bearing enclosure must provide for these oil movements.

The shoe cage holds the shoes against rotation with the shaft, but not against outward displacement. It is keyed, either at the top center or at the housing joint. The various base elements are solid rings and must be assembled over the end of the shaft.

Six-Shoe Horizontal Bearings: These are made in two series: the "J" series for sizes up to 17 inches; the "B" series for sizes from 19 to 45 inches, and also for smaller sizes when so ordered. They differ only in that the "B" base rings are relatively thinner and hence better suited to large sizes. In both, oil from outside enters the annular passage around the base ring and flows radially inward by channels provided. Reaching the shaft, it turns outward between the shoes and escapes at the top above the collar rim. See white arrows, Figure 14.

In the smaller bearings up to size 17 (Style J), the base rings are regularly split for radial assembling as shown in Figure 6. In sizes 19 and larger (Style B), solid base rings can sometimes be furnished.

The base rings are keyed against rotation; usually at top center as shown in the dimension drawings, but at the housing joint if preferred.

Styles JN and BH are single-thrust bearings of Styles J and B, with separate collar added for a horizontal shaft. Interchangeable groups, "6 x 6" and "6 x 3," are noted on page 11.

In horizontal mountings, when running, the entire bearing is flooded with oil, the flow being maintained either by an external pump or by the "oil circulator" forming part of our self-contained bearings. An exception to this is the Oil Control Ring Bearing (page 13) used with steam turbines and other high speed machines.

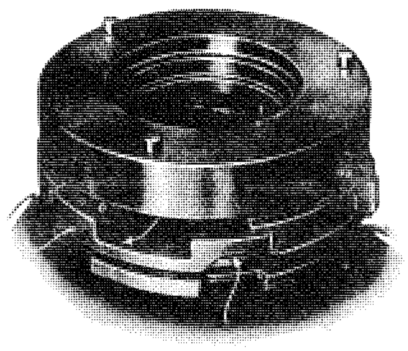


Figure 10
Style NV for vertical shaft. (Style N with runner added). Arrows show direction of oil flow.

Vertical Bearings (Pages 27 to 29)

Three-Shoe Vertical Bearings: These are made only in sizes up to 17 inches. When runners are included, the letter "V" forms part of the symbol, as in "NV," Figure 10.

Style NV bearings require that the customer's construction be such as to retain the shoes. See dotted lines in the dimension drawing, page 28. Openings for the entry of oil are essential, and we should be consulted about them. See Figures 32 and 33. The shoe cage is keyed against rotation. These bearings are useful where the space is limited, as when the housing is just large enough to receive the runner and shoes.

In Style LV the leveling washer has a raised flange, which retains the shoes radially. This is the most generally useful type of vertical three-shoe bearing. Holes for the entry of oil are drilled in the rim, and must not be covered by any surrounding structure. See Figure 11.

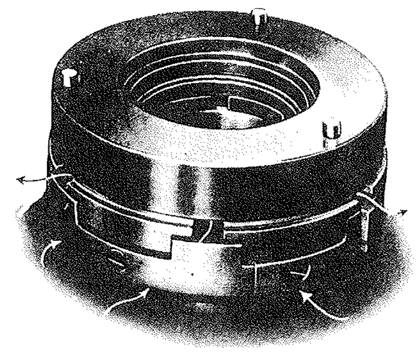
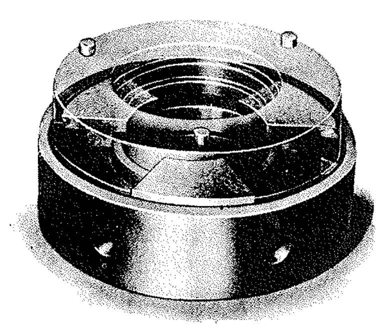


Figure 12
With vertical runner added, Style J becomes Style JV. The arrows show direction of oil flow.

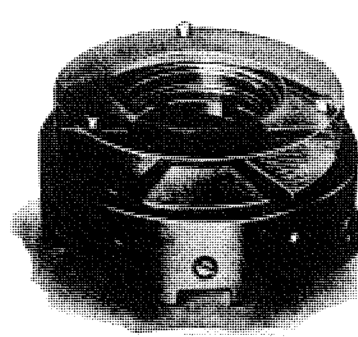
Six-Shoe Vertical Bearings: In six-shoe bearings the leveling plates are contained in the base ring, and the latter has raised lugs or pins which hold the shoes against rotation. See Figures 6, 20. The oil enters radial holes or slots in the base rings (see Figure 12), and thence follows the paths already described. The oil passages must be kept open.

In Style KV the base ring has a raised integral rim to retain the shoes. This is furnished only in sizes up to 17 inches. See Figure 12. The base ring is not split. Where split construction is not required for assembling, Style KV is the most convenient vertical six-shoe bearing within its size range.

Styles JV and BV must be contained in a cylindrical bore in the customer's construction, as shown by dotted lines, pages 27, 29, for holding the shoes in place radially. Oil holes must be provided, leading to the oil passage around the base ring, and the base ring must be keyed



Left—Figure 11
Style LV (3-shoe) thrust bearing for vertical shaft. Runner is shown in phantom. For vertical uses this is often the most convenient form of three-shoe bearing, as it does not require a separate shoe-retaining flange.



Right—Figure 13
Style KV (6-shoe) thrust bearing for vertical shaft. Runner is shown in phantom. The base ring is in one piece and has a raised shoe-retaining flange. Styles LV and KV have interchangeable dimensions.

against rotation. Styles JV and BV are regularly split, but Style BV can sometimes be furnished solid.

Style JV is made in sizes up to 17 inches. From 19 inches upward Style BV replaces it. The two are similar except that, since the base ring in Style B is more shallow, the oil passages in it must be supplemented by matching oil slots in the customer's construction. See dotted lines marked Oil Slots, in the dimension drawings for Styles KBV and BV, page 29.

Style KBV is roughly equivalent to KV in sizes 19 inch and larger. It has a split shoe-retaining band clamped around the upper part of the base ring; hence the base ring requires locating by dowels. The base ring is made in halves, with bolted joints.

Other Details

End Play: End play in horizontal bearings is always fixed by filler pieces or shims at one or both ends of the bearing cavity behind the base rings or leveling washers. Since the working surfaces do not wear in normal service, the end play rarely needs to be taken up.

Bearings Without Collars: Without "runner" or "collar," the three-shoe bearing is designated simply N, and the six-shoe bearing simply J or B. They are employed with integral thrust collars, and may be mounted either vertically or horizontally. Double bearings, for use with an integral collar, are designated Style NN, JJ or BB. In all cases our recommendations regarding oil passages, keying, and so on, must be carefully followed.

Interchangeability: In sizes 5 to 17, the six-shoe (but not Style B) and three-shoe groups of elements are interchangeable. Thus, Styles J and N are interchangeable; likewise JV and NV; JJ and NN; also JHJ, NHN and JHN.

Fits: There are no press or shrink fits on any dimensions listed. Collars on shafts, and keys in same, should be easy sliding fits, with the collar held square by the shaft shoulder and a large nut driven very tight. Thrust blocks must be a free fit in bore B of the vertical runner. Six-shoe and three-shoe base rings, and three-shoe leveling washers, are loose fits in the casing bore.

Shaft Sizes: The Dimension Tables, pages 20–29, are based on standard shaft sizes. These sizes are smaller than the shoe bore, which in standard bearings is one-half F (nominal size), but enough larger than the standard collar bore B to give an adequate shoulder for the collar. However, it is permissible on special order to have the collar bore smaller, for a smaller shaft, or larger for a larger shaft. In the latter case, however, the shoes must be bored larger than standard, which reduces their thrust capacity. See tables of standard shaft sizes, pages 32–33.

With collar integral, there must be clearance between shoes and shaft for the fillets.

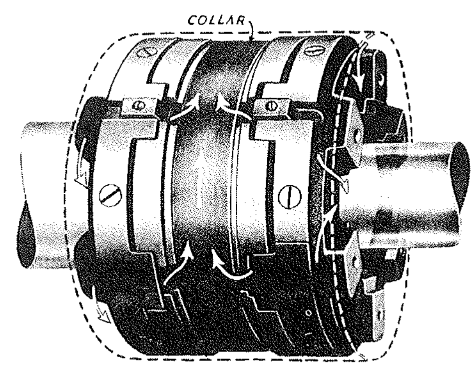


Figure 14
Small double six-shoe thrust bearing removed from housing. When installed, the end walls and bore of the housing constrain the oil to follow the paths shown by the arrows.

For vertical bearings, the clearances between shaft and runner must be enough to accommodate easily the stationary oil-retaining tube (Figures 28, 30, etc.). For the higher running speeds, additional clearance is essential between oil retainer and runner to avoid foaming, with possible loss of oil down the shaft.

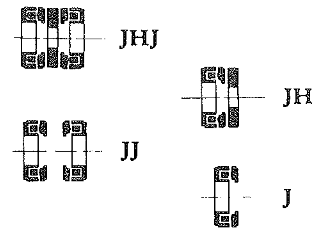
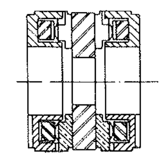
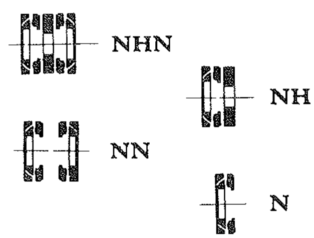
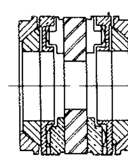
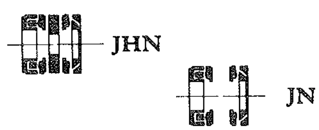
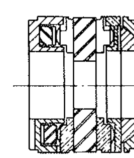
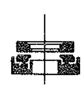
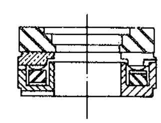
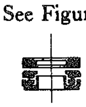
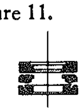
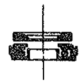
We should always be consulted.

Electrically Insulated Thrust Bearings: In vertical electrical machinery, especially for high speeds and heavy loads, it is frequently necessary to insulate the bearings to protect them from injury by stray electric current. Bearings with insulated sub-bases are furnished when specially ordered. See Figure 35, page 40. The extra heights required by such bases for the larger bearings should be allowed for in the design.

Symbols for Standard Assemblies

Horizontal and Vertical

NOTE: "H" as part of symbol means that separate collar (Figure 3) is furnished by us. "6" or "3" means shoes on one side only of collar. "6 x 6," etc., means shoes on both sides. Style J and B base rings are usually split: Style N base rings are always solid.

Bearing Symbol (*See Note*)	Horiz. or Vert. Shaft	No. of Shoes (*See Note*)	Usual Size Range	Description
JHJ	H	6 x 6	5-17	  JHJ Elements (See Fig. 14, page 11)
JH	H	6	5-17	
JJ	H	6 x 6	5-17	
J	H	6	5-17	
BHB	H	6 x 6	5-45	B base is same as for J series except thinner.
BH	H	6	5-45	
BB	H	6 x 6	5-45	
B	H	6	5-45	
NHN	H	3 x 3	5-17	  NHN Elements (Compare JHN)
NH	H	3	5-17	
NN	H	3 x 3	5-17	
N	H	3	5-17	
JHN	H	6 x 3	5-17	  JHN Elements (See Fig. 9, page 9)
JN	H	6 x 3	5-17	
BHN	H	6 x 3	5-17	B base is same as for J series except thinner.
BN	H	6 x 3	5-17	
KV	V	6	5-17	 KV See Figure 13.  JV Elements
JV	V	6	5-17	JV See Figure 12. 
LV	V	3	5-17	 LV See Figure 11.
NV	V	3	5-17	NV See Figure 10, page 10. 
BV	V	6	5-45	BV is like JV but thinner base ring.
KBV	V	6	19-45	 KBV Compare drawing, page 29.

High Speed Bearings for Turbines and Blowers

Horizontal and Vertical

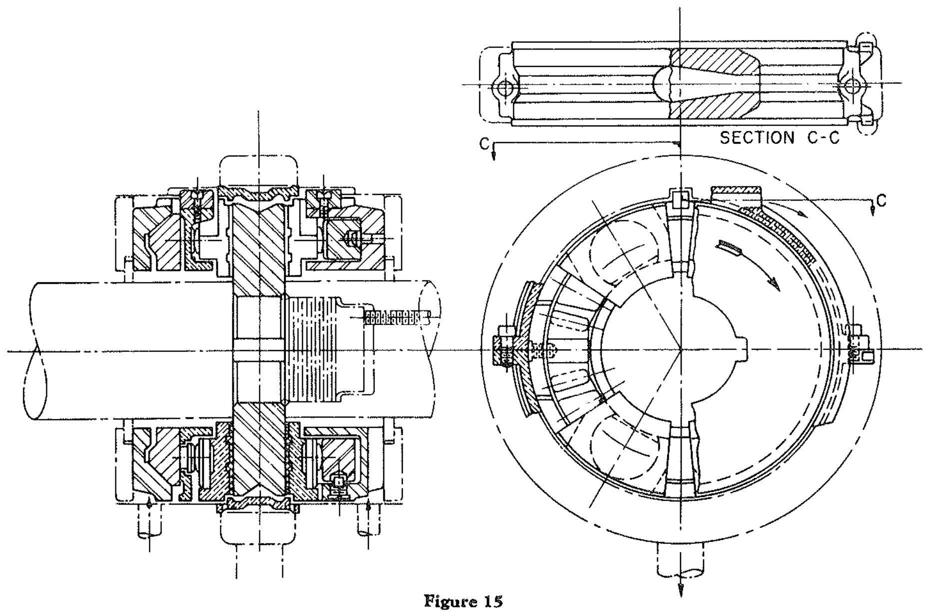


Figure 15
Oil Control Ring Bearing, horizontal (vertical bearings differ in some details).

For the running speeds of steam and gas turbines, and some gas blowers, the Oil Control Ring type of bearing, Figure 15, is recommended to minimize the power loss due to churning of the oil at high speeds.

The Oil Control Ring is a stationary bronze ring (split or solid) which loosely surrounds the thrust collar. The collar rim has a shallow groove, leaving in effect two low flanges. Other internal parts (three-shoe or six-shoe) are standard.

Oil reaches both sides of the collar in the usual manner between the shoes. On reaching the collar rim it is thrown off into grooves in the Control Ring, and then issues horizontally at the top, like the discharge from a centrifugal pump, into a fairly large drain passage in the housing surrounding the Oil Control Ring and leading to the sump. The flow is controlled at the inlet to an amount just sufficient to absorb the heat generated by oil shear, and the discharge is completely free. Thus there is no definite oil level when running, and no recirculation before the oil is expelled: the oil merely wets the collar on its way through the bearing.

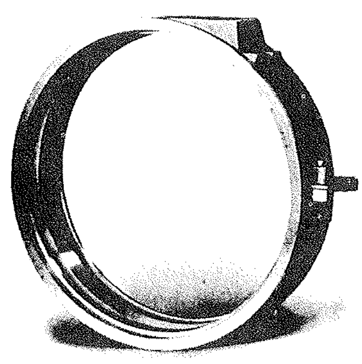


Figure 16
Oil Control Ring. Note discharge nozzle at top.

A thermometer is usually placed in or next to the discharge nozzle.

The housing may be arranged to retain oil during a shut-down up to any convenient level, preferably below the shaft to avoid leakage at the seals. Any surplus oil will be immediately expelled on starting. Unless oil is thus retained, the oil flow must always be started before the shaft starts.

The Oil Control Ring is held against turning with the collar by lugs on one side entering a recess in the housing at the joint.

In the dimension list, page 30, some non-standard sizes are indicated for which patterns are available.

For vertical shafts, arrangements similar in principle can be worked out. We should be consulted.

Lubrication, Cooling and Housing Design

Although the Kingsbury principle involves continual self-renewal of the oil films between shoes and collar, the thickness of those films (and hence the safety of the bearing) depends on the operating conditions. These conditions include load per square inch of shoe area (which can be greater with large shoes than with small ones), and viscosity of the oil at running temperature. Temperature depends on speed and on the cooling means. At high speeds (turbines and blowers) there is also the possibility of power loss due to churning. This is minimized by using the Oil Control Ring, page 13.

Though the heating due to oil shear is small, it is a definite quantity which may be calculated. The cooling agent may be an attached external cooler. Or the bearing may be tied into a general lubricating system with central cooling. For low speeds, air radiation may be sufficient: see last paragraphs below. With vertical bearings, there may be a copper coil in the oil bath, through which cooling water flows.

The "internal" resistance to flow of oil through the bearing assembly itself is slight. The piping and the oil passages in the bearing should be designed to carry the required flow easily. If the oil pump develops high pressure, it may be necessary to restrict the flow to avert needless loss of power. Three to five pounds per square inch at the inlet is usually sufficient.

With oil cooling, the flow must be sufficient to carry off the heat generated by oil shear between shoes and collar. The operating instructions usually specify the viscosity and oil flow recommended. When the correct pressure and restrictions have been established, it is best to have the restrictions take the form of suitable drilled plugs in the oil line at inlet or outlet or both, so that they cannot be inadvertently changed. (See, however, the reference to Oil Control Ring bearings, below.)

For large vertical bearings, a thermometer or temperature indicator is frequently installed, usually in the shoes of the loaded side.

Horizontal Bearings

Horizontal bearings usually run in sealed cavities through which oil flows and escapes at the top above the thrust collar. The housing must be designed with reference to the entry and discharge of the oil stream. For horizontal shafts the points of entry (on each side of the collar) are usually in the lower housing, and are so placed as to lead directly to oil passages in the six-shoe base ring or three-shoe leveling washer, described under "Standard Three-Shoe and Six-Shoe Elements."

It is important that no air enter at the end seals. Since most of these bearings discharge oil at the top (in order to ensure that the bearing cavity shall always be full while running), it is advisable to apply enough restriction at the outlet to cause a slight escape at the seals.

Means should be provided for inspecting the shoes occasionally. This is best done by turning the base ring or shoe cage and lifting out one or

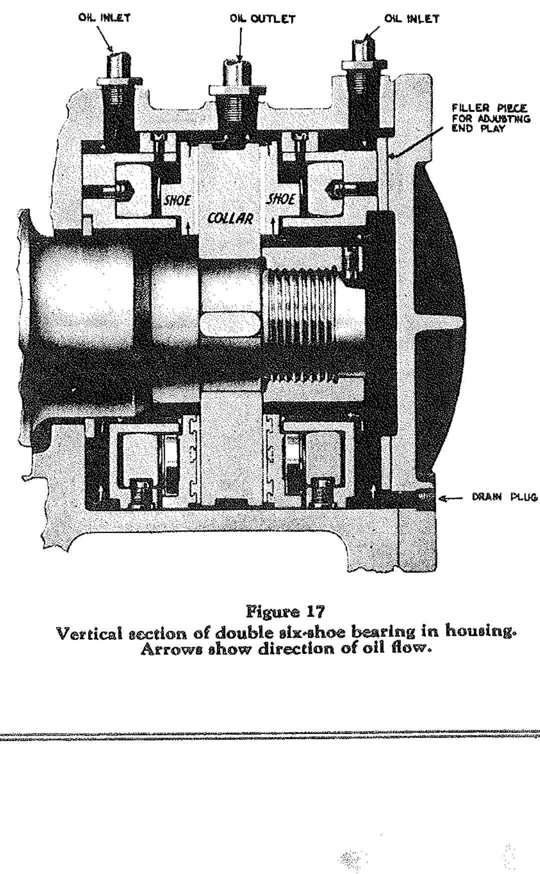


Figure 17
Vertical section of double six-shoe bearing in housing. Arrows show direction of oil flow.

more shoes. For large bearings, an access cover is desirable for that purpose.

Sometimes the bearing cavity is so designed that no oil is retained when not running. Thus, there may be an oil leakoff at the bottom, aimed to prevent trapping sediment, or to minimize corrosion during a long shutdown. Or the oil may be introduced at such a point or in such a manner that it can drain back through the inlet upon stopping. For such conditions, oil circulation must always be started before the shaft starts to turn.

When an Oil Control Ring is used, only the inlet is restricted, the outlet being left wholly free. The top discharge is then tangential, like that from a centrifugal pump, into a large drain passage. See "High Speed Bearings for Turbines and Blowers," page 13.

Vertical Bearings

Most vertical bearings run in a bath of oil, which is kept from the shaft by a fixed oil-retaining tube secured to the housing at its base with an oil-tight joint. The tube rises above the highest level of the oil in the bath. The runner is bored to clear the tube by a space sufficient to avoid objectionable oil foaming at the intended speed. Usually the *thrust block*, which joins the runner to the shaft, must be bored above the runner to clear the top of the oil-retaining tube.

Where only downward loads and ordinary speeds are expected (such as in pumps and generators), very simple arrangements are sufficient, as in Figures 18 and 28. For such bearings in medium to large sizes, the usual cooling means is a water coil submerged in a large oil pot surrounding the bearing. Baffles should be used to ensure oil movement across the coil. An alternative is to circulate the oil in and out, and cool it outside, where any leak in the cooler can more readily be seen and repaired. Where the oil is to be cooled outside the housing, the required flow is specified in the instructions which accompany each order.

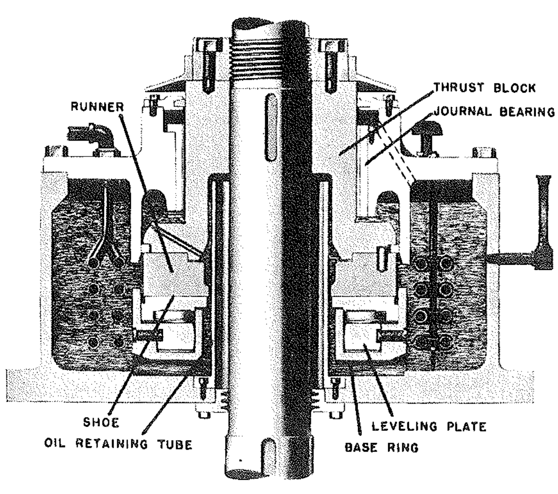


Figure 18
Vertical equalizing thrust bearing, using Style KV elements in housing with guide bearing and cooling coil.

For high-speed vertical bearings (as for vertical turbine-driven auxiliaries on shipboard), arrangements similar to the Oil Control Ring should be worked out. As they are somewhat special, we should be consulted.

If air cooling is employed, the size, design and location of the housing will affect the heat dispersal. A nearby moving part, such as a flywheel or armature, may give sufficient air movement; or a fan may be mounted on the shaft.

Table IV on page 17 shows speed limits permissible for air-cooled bearings (usually vertical) under average conditions, using plain mountings (not ribbed). It is based on a room temperature of 80 degrees F. and oil having a viscosity of 300 to 400 Saybolt at 100 degrees F., with free circulation of the air. For higher speeds the oil may be cooled by pumping it through an external coil placed in the path of moving air.

Small bearings, running at speeds considerably too high for ordinary air cooling, can sometimes be cooled by generous internal and external fins and a strong air current. We should be consulted regarding such arrangements.

Thrust Capacity

The safe load for a Kingsbury Bearing depends chiefly upon three factors: bearing size, shaft speed and oil viscosity. An increase in any of these factors increases the permissible load without changing the thickness of the oil film. Kingsbury Bearings carry heavier loads at high than at low speeds. The coefficient of friction is least when the bearing is well loaded.

Tables I, II and III show rated capacities of 6-shoe and 3-shoe standard Kingsbury Bearings respectively at various speeds. These tables apply to both vertical and horizontal bearings.

They are based on a viscosity of 150 seconds Saybolt at the inlet or oil bath temperature. The true criterion is the minimum film thickness, but for convenience the ratings are expressed as total loads. The ratings are conservative, and may be increased by 10 per cent in case of need, or even 25 per cent provided the oil viscosity be increased in the same proportion.

Consult us freely about special conditions, such as loads, speeds, and bearing proportions outside the range given, also substantial overloads that may seem necessary.

Table I Rated Thrust Capacities: Sizes 5 to 17 inches

(In Pounds)

SIX-SHOE BEARINGS

Size	Area Sq. In.	REVOLUTIONS PER MINUTE								
		100	200	400	800	1200	2000	4000	6000	10000
5	12.5	.....	.....	2,370	2,650	2,850	3,100	3,500	3,700	4,040
6	18.0	.....	.....	3,850	4,300	4,600	5,000	5,600	6,000	6,550
7	24.5	.....	.....	5,700	6,400	6,850	7,450	8,400	9,000	9,700
8	32.0	.....	7,100	8,000	9,000	9,600	10,500	11,800	12,500	13,600
9	40.5	.....	9,600	10,800	12,000	13,000	14,000	15,800	17,000	18,400
10½	55.1	.....	14,000	15,800	17,800	19,000	20,700	23,500	25,000	.....
12	72.0	17,500	19,500	22,000	24,700	26,500	29,000	32,500	34,500	.....
13½	91.1	23,500	26,500	29,500	33,000	35,500	38,500	43,500	46,500	.....
15	112.5	30,500	34,000	38,500	43,000	46,000	50,000	56,000	.....	.....
17	144.5	41,500	46,500	52,000	58,500	62,500	68,000	76,000	.....	.....

Table II Rated Thrust Capacities: Sizes 19 to 45 inches

(In Pounds)

SIX-SHOE BEARINGS

Size	Area Sq. In.	REVOLUTIONS PER MINUTE								
		60	100	150	200	300	500	800	1200	2000
19	180	.....	54,000	58,000	61,000	66,000	71,000	77,000	82,000	89,000
21	220	.....	69,500	74,000	79,000	84,000	91,000	98,000	105,000	115,000
23	264	.....	86,500	92,500	97,000	105,000	113,000	122,000	130,000	.....
25	312	98,500	107,000	115,000	120,000	130,000	140,000	152,000	162,000	.....
27	364	118,000	128,000	137,000	143,000	155,000	168,000	180,000	.....	.....
29	420	140,000	152,000	163,000	170,000	185,000	200,000	215,000	.....	.....
31	480	165,000	179,000	192,000	200,000	217,000	234,000	254,000	.....	.....
33	544	192,000	209,000	224,000	234,000	253,000	273,000	295,000	.....	.....
37	684	253,000	275,000	295,000	310,000	335,000	360,000	.....	.....	.....
41	840	325,000	355,000	380,000	395,000	430,000	460,000	.....	.....	.....
45	1012	405,000	440,000	470,000	495,000	535,000	575,000	.....	.....	.....

Rated Thrust Capacities: Sizes 5 to 17 inches Table III

(In Pounds)

THREE-SHOE BEARINGS

Size	Area Sq. In.	REVOLUTIONS PER MINUTE 100	200	400	800	1200	2000	4000	6000	10000
5	6.2	.....	.....	1,185	1,325	1,425	1,550	1,750	1,850	2,020
6	9.0	.....	.....	1,925	2,150	2,300	2,500	2,800	3,000	3,275
7	12.2	.....	.....	2,850	3,200	3,425	3,725	4,200	4,500	4,850
8	16.0	.....	3,500	4,000	4,500	4,800	5,250	5,900	6,250	6,800
9	20.2	.....	4,800	5,400	6,000	6,500	7,000	7,900	8,500	9,200
10½	27.5	.....	7,000	7,900	8,900	9,500	10,350	11,750	12,500	....
12	36.0	8,750	9,750	11,000	12,350	13,250	14,500	16,250	17,250	....
13½	45.5	11,750	13,250	14,750	16,500	17,750	19,250	21,750	23,250	....
15	56.2	15,250	17,000	19,250	21,500	23,000	25,000	28,000	.....	....
17	72.2	20,750	23,250	26,000	29,250	31,250	34,000	38,000	.....	....

Maximum Speeds for Air-Cooled Operation Table IV

Average Air Conditions (*See Notes Below*)

Thrust Load (Lbs.)	REVOLUTIONS PER MINUTE							
	6-Shoe Bearings for Vertical or Horizontal Service				3-Shoe Bearings for Vertical or Horizontal Service			
	Single		Double		Single		Double	
	A	B	A	B	A	B	A	B
2,000	450	320	385	295	565	330	485	305
4,000	360	265	310	240	455	275	390	255
8,000	285	220	245	195	360	230	310	210
12,000	250	195	215	170	315	205	270	190
20,000	210	165	180	145	265	180	230	165
30,000	180	145	155	130	...	...	...	...
40,000	165	135	140	120	...	...	...	...
60,000	145	120	125	105	...	...	...	...
80,000	130	110	115	98	...	...	...	...
120,000	115	96	99	86	...	...	...	...
200,000	97	84	84	75	...	...	...	...

Assumptions: Surrounding air can pass freely over vertical walls of mounting. Maximum air temperature about 80 degrees F. Viscosity of oil about 400 Saybolt at 100 degrees F.

Vertical Service: Use column A when radial bearing is omitted, or when it is placed below the thrust and cooled by machine frame. Use column B when radial bearing is above the thrust bearing.

Horizontal Service: Use Column A when thrust mounting contains no radial bearing or when mounting is enlarged proportionately because of the addition of a radial bearing.

Use Column B for very compact mountings with a radial bearing. For compact mountings containing two radial bearings use 90 per cent of speed in Column B.

Friction Losses and Oil Requirements

For every bearing there is a calculable power loss due principally to shearing of the oil films: turbulence and kinetic losses in the oil stream are other factors.

These losses vary greatly with the size and area of the bearing, the speed, the thrust load, the grade of oil used, the rate of oil supply, and (in "double" bearings) the end-play or clearance. In high-speed bearings, viscous losses at the thrust collar periphery depend largely on whether or not the Oil Control Ring construction is employed.

Power loss calculations involving so many variables present a rather difficult problem. On request, for any specific application, we will calculate the power loss and recommend a rate of oil flow where applicable. For this, we need the speed, the thrust load, the grade of oil used and the supply temperature.

The chart, Figure 19, permits quick estimates of power losses, where accuracy is not important. To simplify matters, the following standard assumptions have been made:

Six shoes, of standard proportions, per face.

Thrust load equal to normal rated capacity, Tables I and II. (Losses decrease rather slowly with decreasing loads, particularly in double bearings.)

Oil used, about 250 to 300 Saybolt Universal viscosity at 100 degrees F., with inlet or oil bath temperature of about 125 degrees F. (Losses decrease rather slowly, with lighter oils.)

Rate of oil flow, for high-speed bearings, one-half gallon per minute per horsepower of friction loss. For low-speed bearings, one gallon. (Increasing the flow increases the loss.)

End play (total axial clearance) for double bearings, .001 inch per inch of collar diameter; a little more for smaller sizes. (Losses increase noticeably with decreasing end-play.)

For three-shoe bearings, at moderate to low speeds, the losses are about 50 per cent of those shown by the chart. (The thrust loads are also assumed reduced 50 per cent: see Table III.)

In high-speed service, unless the Oil Control Ring construction is used, the losses will be greater than those shown by the chart. The difference may range up to about 50 per cent for the highest surface speeds, measured at the collar periphery.

When in doubt, or whenever conditions seem to be unusual, consult us about power losses and oil requirements.

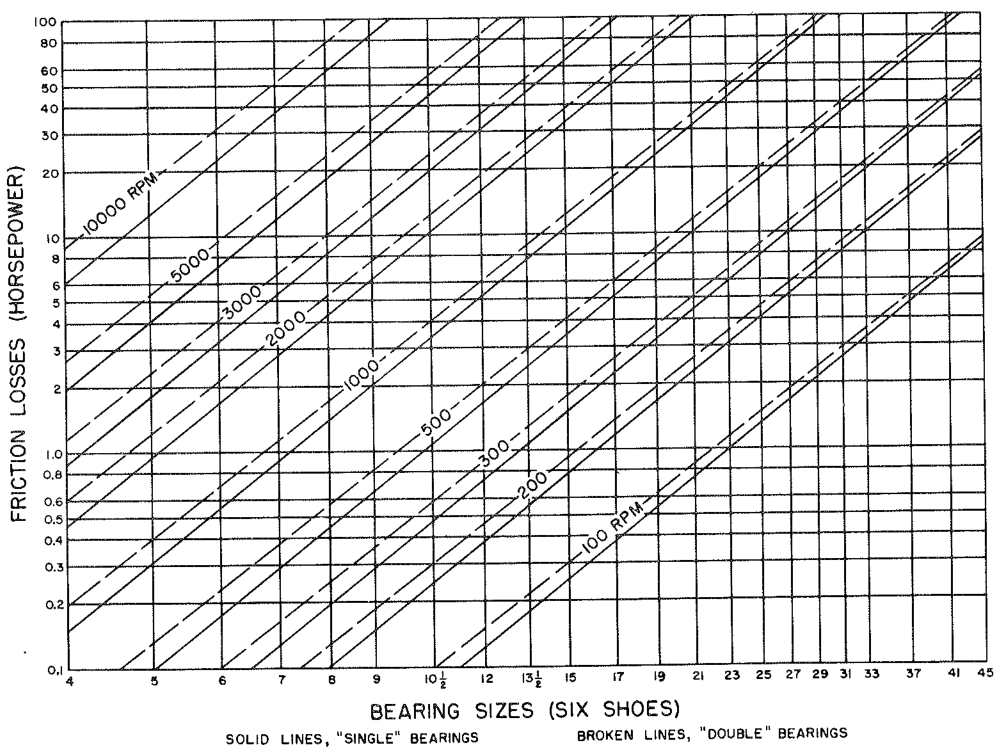


Figure 19
Friction Power Losses
Single six-shoe bearings (chiefly vertical): solid lines.
Double six-shoe bearings (if equipped with Oil Control Rings for high-speed service): broken lines.

Choosing the Style and Size

The standard three- and six-shoe Thrust Bearings here listed are suitable for a great variety of uses, afloat and ashore and from small to large. Thus, a towboat with turbine or electric drive would be likely to use a 6 x 6 JHJ main thrust; a tanker, cargo ship or liner a 6 x 6 BHB; the two styles differing only in size and in relative thickness of the base rings. A medium-size hydroelectric generator or large vertical pump might use a six-shoe KBV, a smaller pump a JV or KV. Both would have shoes and base rings like the BHB and JHJ respectively, but a "runner" instead of a "collar."

For ordinary uses, therefore, once the load, speed, shaft size and shaft position (horizontal or vertical) are known, the normal choice can readily be made by referring to the Dimension and Capacity Tables. Other matters, such as space available, accessibility and cooling arrangement, will still need to be considered. See page 41 for information which should accompany the inquiry or order for new applications. See pages 36 to 40 for examples of good mounting practice.

At steam and gas turbine speeds, avoidance of needless churning becomes important. For such cases, with horizontal shafts, the Oil Control Ring, page 13, is recommended. This calls for radically different treatment of oil flow. Figure 15 is typical, but details may be modified. For vertical shafts, similar but less standardized arrangements are available. We should always be consulted regarding new applications.

Selecting the Bearing

In choosing the thrust bearing for a given use, one starts with the shaft position (horizontal or vertical) and size. Six shoes carry maximum loads: three shoes carry half the load, but with smaller power loss. See the Tables of Dimensions and Capacity. Oil Control Rings are best for turbine speeds.

The size chosen must carry the load at the designed speed and with oil of appropriate viscosity. For ordinary commercial speeds (not turbine speeds) a safe preliminary assumption is that the oil should have a viscosity of 150 Saybolt seconds at the actual inlet or oil bath temperature. For heavy loads and slower speed, the viscosity may be higher.

For light loads, the smallest available bearing is likely to be determined by the shaft size, as the shoes must always clear the shaft by a substantial margin. Sometimes the shoes can be bored slightly oversize. A light oil is indicated.

For very light loads where the shaft dictates the bearing size, two-shoe equalizing bearings can be furnished. They are not, however, standard.

Where it is feasible to do so, we recommend the same oil as used elsewhere in the machine.

The chart on page 18 shows the friction loss for various loads and speeds, also oil flow where applicable. For special conditions, particularly high speed, we should always be consulted.

Air cooling is permissible with low speeds. The speeds shown in Table IV may be somewhat increased by use of internal and external fins. However, we should be consulted in all such cases, since cooling requirements rise rapidly with speed.

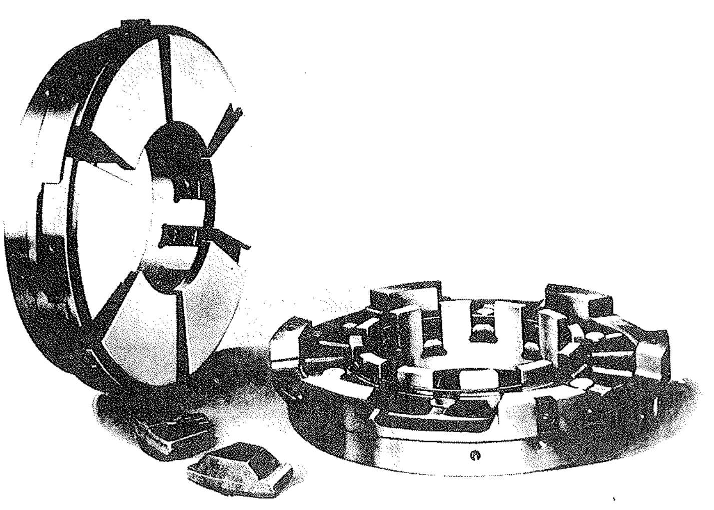
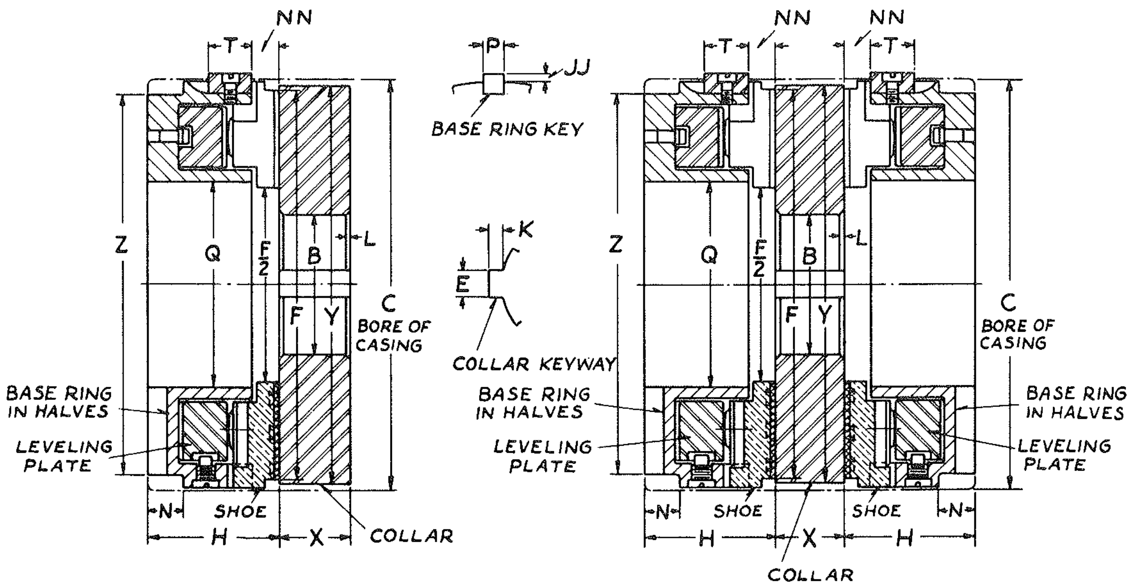


Figure 20
Large six-shoe bearing, without collar. Solid base ring and leveling plates are shown at right. Two leveling plates (upper and lower) shown separately.

Six-Shoe Self-Aligning Equalizing



STYLE JH
(Single, Split)

STYLE JHJ
(Double, Split)

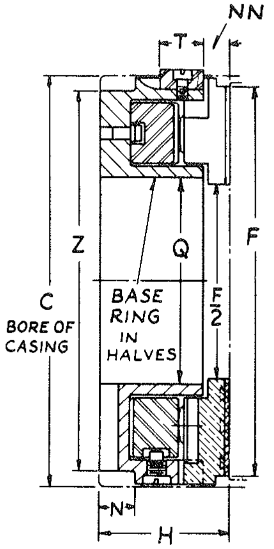
Base rings may be keyed at the housing joint if preferred.

Caution: Before actual construction, these dimensions should be confirmed by a certified print.

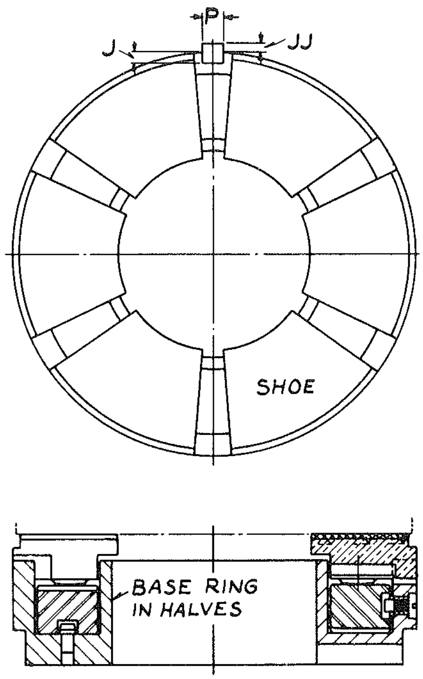
Bearing Number	**JH-5 JHJ-5**	**JH-6 JHJ-6**	**JH-7 JHJ-7**	**JH-8 JHJ-8**	**JH-9 JHJ-9**	**JH-10 1/2 JHJ-10 1/2**	**JH-12 JHJ-12**	**JH-13 1/2 JHJ-13 1/2**	**JH-15 JHJ-15**	**JH-17 JHJ-17**
Area (Net Sq. In.)	12.5	18.0	24.5	32.0	40.5	55.1	72.0	91.1	112.5	144.5
Weights (Lbs. Net) **JH Bearing,** complete	11	18	30	41	56	88	140	175	240	366
JHJ Bearing, complete	17	29	47	64	88	138	223	270	372	569
Spare Collar	4 1/2	7 1/2	12 1/2	17 1/2	24	38	57	80	108	163
6 Spare Shoes	2	3 1/2	6	9	12	20	26	35	45	62
ALL DIMENSIONS ARE IN INCHES										
B (Bore)*	1.750	2.125	2.500	3.000	3.500	4.125	4.750	5.375	6.000	6.625
C	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
E	3/8	3/8	1/2	5/8	5/8	3/4	3/4	7/8	1	1
F (Nominal Size)	5	6	7	8	9	10 1/2	12	13 1/2	15	17
H	1 3/4	2 1/16	2 3/8	2 11/16	3	3 3/8	3 3/4	4 1/4	4 5/8	5 1/4
JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	1/4	5/16	5/16
K	3/16	3/16	1/4	5/16	5/16	3/8	3/8	7/16	1/2	1/2
L (Chamfer)	1/16	1/16	1/16	1/16	1/16	3/32	3/32	3/32	3/32	1/8
N	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
NN	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	15/16
P	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
Q	2 3/4	3 1/4	3 3/4	4 5/16	4 7/8	5 11/16	6 1/2	7 5/16	8 1/8	9 3/16
T	9/16	11/16	13/16	15/16	1	1 1/8	1 3/16	1 3/8	1 1/2	1 5/8
X	7/8	1	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 7/8
Y	5 1/8	6 1/8	7 1/8	8 1/8	9 1/8	10 11/16	12 3/16	13 11/16	15 3/16	17 1/4
Z	5 1/16	6	6 7/8	7 3/4	8 3/4	10 1/4	11 9/16	13	14 1/2	16 1/2

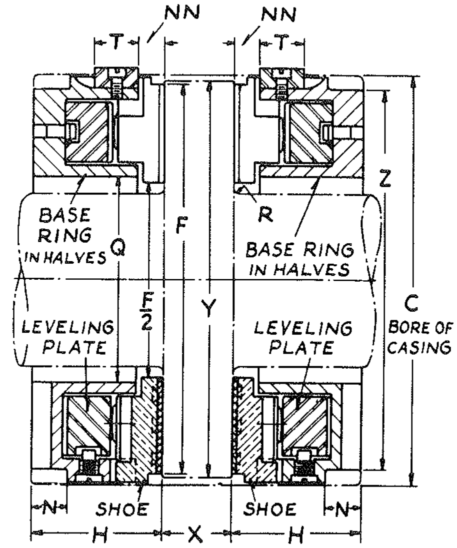
*NOTE: Shaft must be easy sliding fit in bore "B".

Six-Shoe Self-Aligning Equalizing



STYLE J
(Single, Split)
Vertical or Horizontal





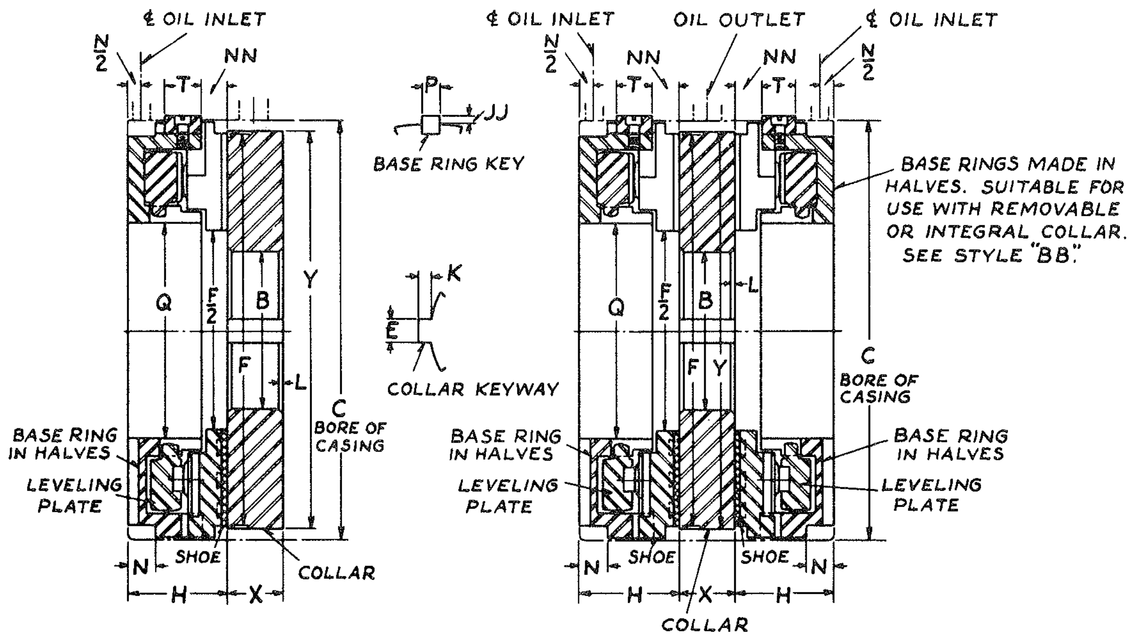
STYLE JJ
(Double, Split)
Vertical or Horizontal

Base rings may be keyed at the housing joint if preferred.

Caution: Before actual construction, these dimensions should be confirmed by a certified print.

Bearing Number	J-5 JJ-5	J-6 JJ-6	J-7 JJ-7	J-8 JJ-8	J-9 JJ-9	J-10½ JJ-10½	J-12 JJ-12	J-13½ JJ-13½	J-15 JJ-15	J-17 JJ-17
Area (Net Sq. In.)	12.5	18.0	24.5	32.0	40.5	55.1	72.0	91.1	112.5	144.5
Weights (Lbs. Net) J Bearing, complete	6	10½	17	23	32	50	83	95	132	203
Weights (Lbs. Net) JJ Bearing, complete	12	21	34	46	64	100	166	190	264	406
Weights (Lbs. Net) 6 Spare Shoes	2	3½	6	9	12	20	26	35	45	62
ALL DIMENSIONS ARE IN INCHES										
C	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
F (Nominal Size)	5	6	7	8	9	10½	12	13½	15	17
H	1¾	2 1/16	2⅜	2 11/16	3	3⅜	3¾	4¼	4⅝	5¼
J	5/32	3/16	¼	5/16	5/16	11/32	13/32	½	9/16	9/16
JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	¼	5/16	5/16
N	½	9/16	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½
NN	5/16	⅜	7/16	½	9/16	⅝	11/16	¾	13/16	15/16
P	5/16	⅜	⅜	7/16	7/16	½	9/16	⅝	11/16	¾
Q	2¾	3¼	3¾	4 5/16	4⅞	5 11/16	6½	7 5/16	8⅛	9 3/16
R (Rad. See page 32)	3/32	3/32	3/32	3/32	3/32	⅛	⅛	⅛	5/32	5/32
T	9/16	11/16	13/16	15/16	1	1⅛	1 3/16	1⅜	1½	1⅝
X	⅞	1	1¼	1⅜	1½	1¾	2	2¼	2½	2⅞
Y	5⅛	6⅛	7⅛	8⅛	9⅛	10 11/16	12 3/16	13 11/16	15 3/16	17¼
Z	5 1/16	6	6⅞	7¾	8¾	10¼	11 9/16	13	14½	16½

Six-Shoe Self-Aligning Equalizing



STYLE BH
(Single, Split)

STYLE BHB
(Double, Split)

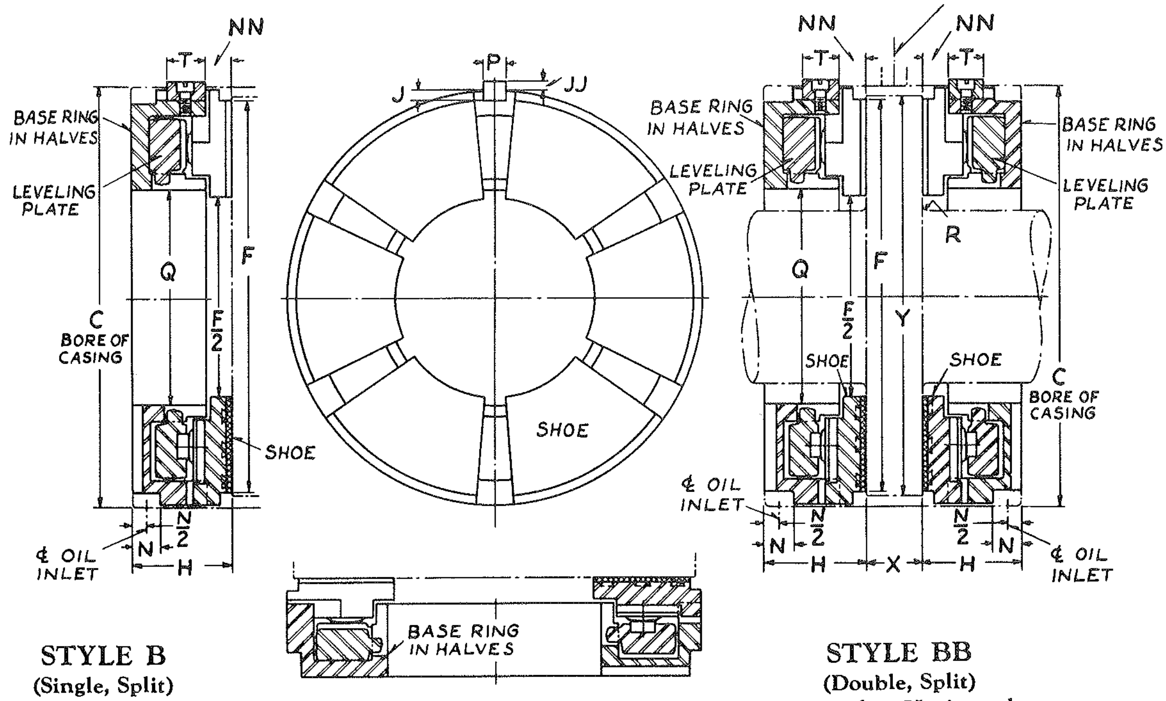
Base rings may be keyed at the housing joint if preferred.

Caution: Before actual construction, these dimensions should be confirmed by a certified print.

Bearing Number	BH-19 BHB-19	BH-21 BHB-21	BH-23 BHB-23	BH-25 BHB-25	BH-27 BHB-27	BH-29 BHB-29	BH-31 BHB-31	BH-33 BHB-33	BH-37 BHB-37	BH-41 BHB-41	BH-45 BHB-45
Area (Net Sq. In.)	180	220	264	312	364	420	480	545	684	840	1012
Weights (Lbs. Net): BH Bearing, complete	465	620	800	1,020	1,288	1,590	1,935	2,450	3,350	4,475	5,970
Weights (Lbs. Net): BHB Bearing, complete	700	930	1,210	1,525	1,931	2,360	2,905	3,625	5,010	6,685	8,970
Weights (Lbs. Net): Spare Collar	228	308	394	514	645	813	975	1,200	1,687	2,265	2,960
Weights (Lbs. Net): 6 Spare Shoes	91	122	165	227	242	305	388	550	666	818	1,150
ALL DIMENSIONS ARE IN INCHES											
B (Bore)*	7.500	8.500	9.375	10.000	11.000	11.750	12.500	13.375	15.000	16.750	18.500
C	20.250	22.250	24.500	26.500	28.750	30.750	33.000	35.000	38.500	43.750	48.000
E	1 1/8	1 1/4	1 1/4	1 1/2	1 1/2	1 3/4	1 3/4	2	2 1/4	2 1/4	2 1/2
F (Nominal Size)	19	21	23	25	27	29	31	33	37	41	45
H	4 3/4	5 1/4	5 11/16	6 3/16	6 11/16	7 1/8	7 5/8	8 1/8	9	10	11
JJ	11/32	3/8	3/8	1/2	1/2	1/2	9/16	9/16	9/16	5/8	3/4
K	9/16	5/8	5/8	3/4	3/4	7/8	7/8	1	1 1/8	1 1/8	1 1/4
L (Chamfer)	1/8	1/8	5/32	5/32	5/32	3/16	3/16	3/16	1/4	1/4	1/4
N	7/8	1	1	1 1/8	1 3/16	1 1/4	1 3/8	1 7/16	1 9/16	1 3/4	1 15/16
NN	1	1 1/8	1 5/16	1 3/8	1 7/16	1 1/2	1 5/8	1 3/4	1 15/16	2 1/8	2 5/16
P	7/8	1	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	1 3/4	2
Q	10 5/8	11 3/4	12 3/4	14	15	16 1/4	17 1/4	18 1/2	20 3/4	23	25
T	1 3/4	1 3/4	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	3	3 1/4	3 9/16
X	3 1/4	3 5/8	3 7/8	4 1/4	4 5/8	5	5 1/4	5 5/8	6 3/8	7	7 5/8
Y	19 1/4	21 1/4	23 1/4	25 1/4	27 1/4	29 3/8	31 3/8	33 3/8	37 1/2	41 1/2	45 1/2

*NOTE: Shaft must be easy sliding fit in bore "B".

Six-Shoe Self-Aligning Equalizing



STYLE B
(Single, Split)
Vertical or Horizontal

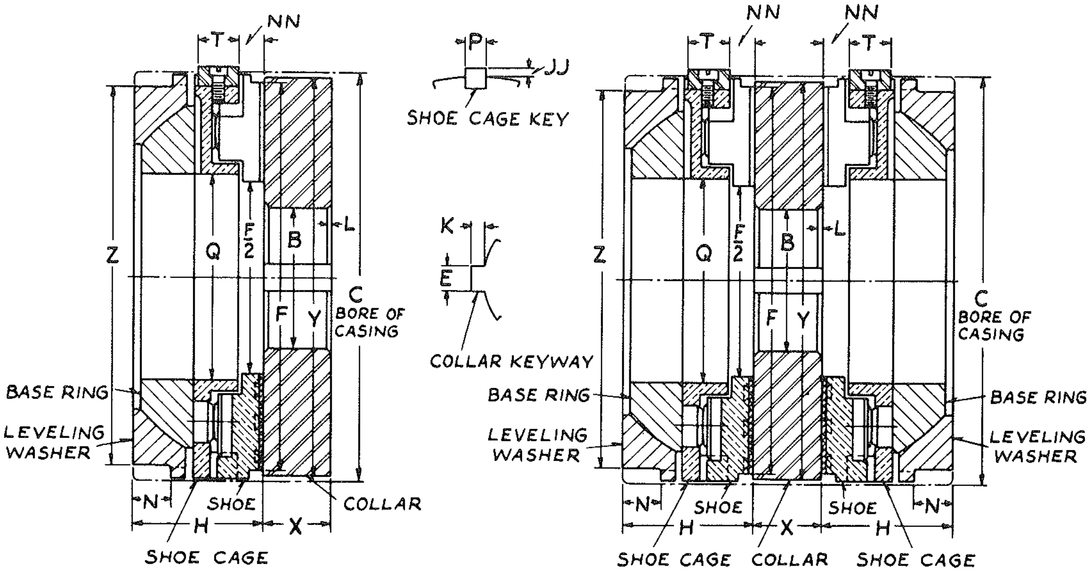
STYLE BB
(Double, Split)
Vertical or Horizontal

Base rings may be keyed at the housing joint if preferred.

Caution: Before actual construction, these dimensions should be confirmed by a certified print.

Bearing Number	B-19 BB-19	B-21 BB-21	B-23 BB-23	B-25 BB-25	B-27 BB-27	B-29 BB-29	B-31 BB-31	B-33 BB-33	B-37 BB-37	B-41 BB-41	B-45 BB-45
Area (Net Sq. In.)	180	220	264	312	364	420	480	545	684	840	1012
Weights (Lbs. Net) B Bearing, complete	237	312	406	506	643	777	960	1,250	1,663	2,210	3,010
Weights (Lbs. Net) BB Bearing, complete	474	624	812	1,012	1,286	1,554	1,920	2,425	3,326	4,420	6,020
Weights (Lbs. Net) 6 Spare Shoes	91	122	165	227	242	305	388	550	666	818	1,150
ALL DIMENSIONS ARE IN INCHES											
C	20.250	22.250	24.500	26.500	28.750	30.750	33.000	35.000	38.500	43.750	48.000
F (Nominal Size)	19	21	23	25	27	29	31	33	37	41	45
H	4 3/4	5 1/4	5 11/16	6 3/16	6 11/16	7 1/8	7 5/8	8 1/8	9	10	11
J	17/32	1/2	1/2	3/4	3/4	3/4	15/16	15/16	1 3/16	1 1/8	1 1/4
JJ	11/32	3/8	3/8	1/2	1/2	1/2	9/16	9/16	9/16	5/8	3/4
N	7/8	1	1	1 1/8	1 3/16	1 1/4	1 3/8	1 7/16	1 9/16	1 3/4	1 15/16
NN	1	1 1/8	1 5/16	1 3/8	1 7/16	1 1/2	1 5/8	1 3/4	1 15/16	2 1/8	2 5/16
P	7/8	1	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	1 3/4	2
Q	10 5/8	11 3/4	12 3/4	14	15	16 1/4	17 1/4	18 1/2	20 3/4	23	25
R (Rad. See page 32)	3/16	3/16	1/4	1/4	5/16	3/8	3/8	7/16	1/2	9/16	5/8
T	1 3/4	1 3/4	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	3	3 1/4	3 9/16
X	3 1/4	3 5/8	3 7/8	4 1/4	4 5/8	5	5 1/4	5 5/8	6 3/8	7	7 5/8
Y	19 1/4	21 1/4	23 1/4	25 1/4	27 1/4	29 3/8	31 3/8	33 3/8	37 1/2	41 1/2	45 1/2

Three-Shoe Self-Aligning Equalizing



STYLE NH
(Single, Solid)

STYLE NHN
(Double, Solid)

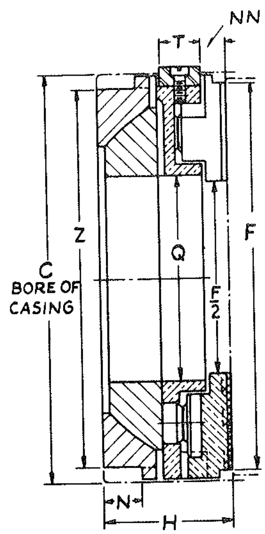
Shoe cages may be keyed at the housing joint if preferred.

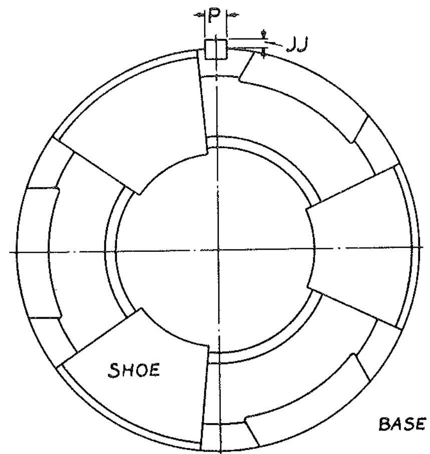
Caution: Before actual construction, these dimensions should be confirmed by a certified print.

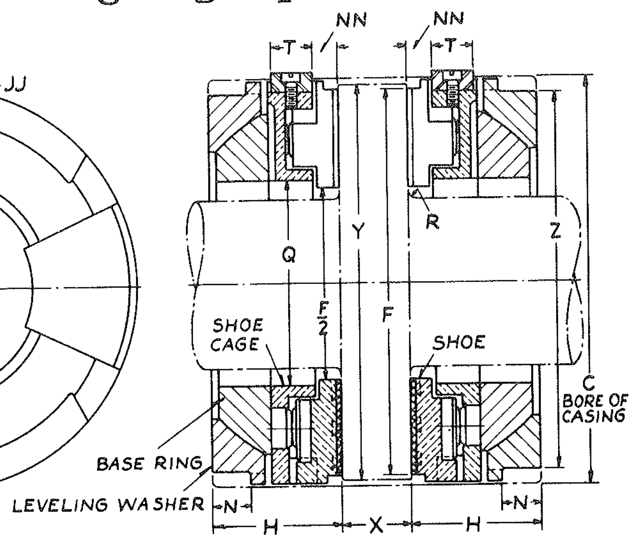
Bearing Number	NH-5 NHN-5	NH-6 NHN-6	NH-7 NHN-7	NH-8 NHN-8	NH-9 NHN-9	NH-10 1/2 NHN-10 1/2	NH-12 NHN-12	NH-13 1/2 NHN-13 1/2	NH-15 NHN-15	NH-17 NHN-17
Area (Net Sq. In.)	6.3	9.0	12.3	16.0	20.3	27.6	36.0	45.6	56.3	72.3
Weights (Lbs. Net): NH Bearing, complete	9	16	25	35	50	77	112	169	212	316
Weights (Lbs. Net): NHN Bearing, complete	14	24 1/2	39	52	76	116	167	248	316	469
Weights (Lbs. Net): Spare Collar	4 1/2	7 1/2	12 1/2	17 1/2	24	38	57	80	108	163
Weights (Lbs. Net): 3 Spare Shoes	1	1 3/4	3	4 1/2	6	10	13	17 1/2	22 1/2	31
ALL DIMENSIONS ARE IN INCHES										
B (Bore)*	1.750	2.125	2.500	3.000	3.500	4.125	4.750	5.375	6.000	6.625
C	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
E	3/8	3/8	1/2	5/8	5/8	3/4	3/4	7/8	1	1
F (Nominal Size)	5	6	7	8	9	10 1/2	12	13 1/2	15	17
H	1 3/4	2 1/16	2 3/8	2 11/16	3	3 3/8	3 3/4	4 1/4	4 5/8	5 1/4
JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	1/4	5/16	5/16
K	3/16	3/16	1/4	5/16	5/16	3/8	3/8	7/16	1/2	1/2
L (Chamfer)	1/16	1/16	1/16	1/16	1/16	3/32	3/32	3/32	3/32	1/8
N	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
NN	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	15/16
P	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
Q	2 3/4	3 1/4	3 3/4	4 5/16	4 7/8	5 11/16	6 1/2	7 5/16	8 1/8	9 3/16
T	9/16	11/16	13/16	15/16	1	1 1/8	1 3/16	1 3/8	1 1/2	1 5/8
X	7/8	1	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 7/8
Y	5 1/8	6 1/8	7 1/8	8 1/8	9 1/8	10 11/16	12 3/16	13 11/16	15 3/16	17 1/4
Z	5 1/16	6	6 7/8	7 3/4	8 3/4	10 1/4	11 9/16	13	14 1/2	16 1/2

*NOTE: Shaft must be easy sliding fit in bore "B".

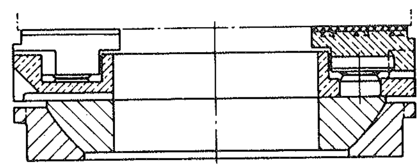
Three-Shoe Self-Aligning Equalizing







STYLE N
(Single, Solid)
Vertical or Horizontal



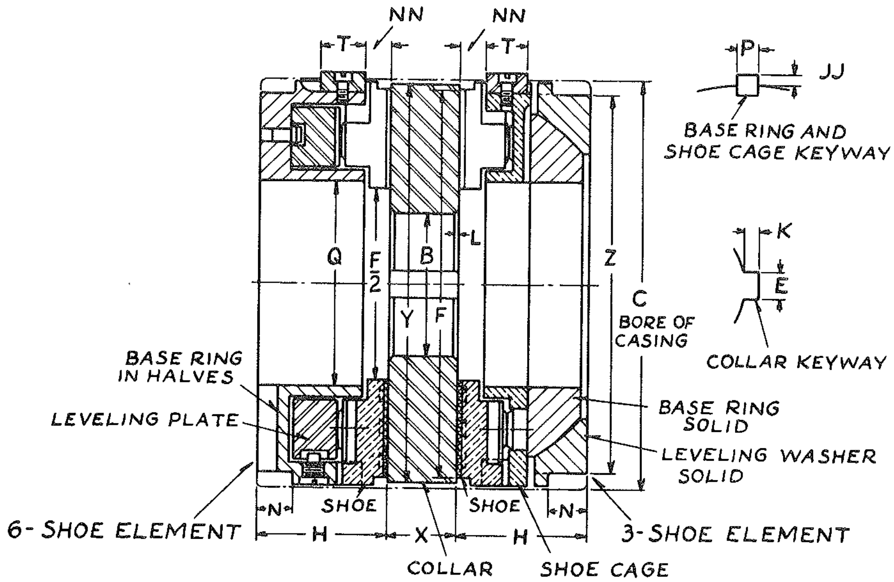
STYLE NN
(Double, Solid)
Vertical or Horizontal

Shoe cages may be keyed at the housing joint if preferred.

Caution: Before actual construction, these dimensions should be confirmed by a certified print.

Bearing Number	N-5 NN-5	N-6 NN-6	N-7 NN-7	N-8 NN-8	N-9 NN-9	N-10 1/2 NN-10 1/2	N-12 NN-12	N-13 1/2 NN-13 1/2	N-15 NN-15	N-17 NN-17
Area (Net Sq. In.)	6.3	9.0	12.3	16.0	20.3	27.6	36.0	45.6	56.3	72.3
Weights (Lbs. Net): N Bearing, complete	4 3/4	8 1/2	13	17	26	39	55	79	104	153
Weights (Lbs. Net): NN Bearing, complete	9 1/2	17	26	34	52	78	110	158	208	306
Weights (Lbs. Net): 3 Spare Shoes	1	1 3/4	3	4 1/2	6	10	13	17 1/2	22 1/2	31
ALL DIMENSIONS ARE IN INCHES										
C	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
F (Nominal Size)	5	6	7	8	9	10 1/2	12	13 1/2	15	17
H	1 3/4	2 1/16	2 3/8	2 11/16	3	3 3/8	3 3/4	4 1/4	4 5/8	5 1/4
JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	1/4	5/16	5/16
N	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
NN	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	15/16
P	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
Q	2 3/4	3 1/4	3 3/4	4 5/16	4 7/8	5 11/16	6 1/2	7 5/16	8 1/8	9 3/16
R (Rad. See page 32)	3/32	3/32	3/32	3/32	3/32	1/8	1/8	1/8	5/32	5/32
T	9/16	11/16	13/16	15/16	1	1 1/8	1 3/16	1 3/8	1 1/2	1 5/8
X	7/8	1	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 7/8
Y	5 1/8	6 1/8	7 1/8	8 1/8	9 1/8	10 11/16	12 3/16	13 11/16	15 3/16	17 1/4
Z	5 1/16	6	6 7/8	7 3/4	8 3/4	10 1/4	11 9/16	13	14 1/2	16 1/2

6 and 3-Shoe Self-Aligning Equalizing



STYLE JHN ("J" Split, "N" Solid)

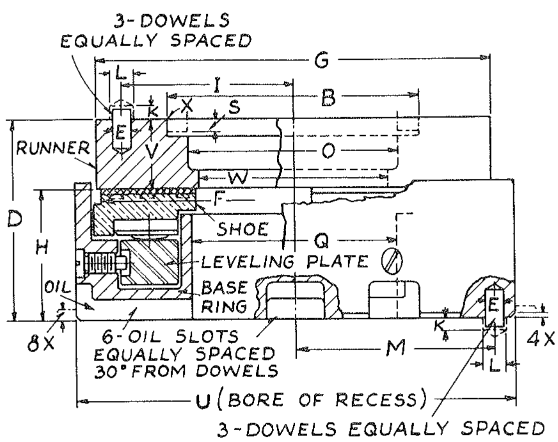
Keys may be located at the housing joint if preferred.

Caution: Before actual construction, these dimensions should be confirmed by a certified print.

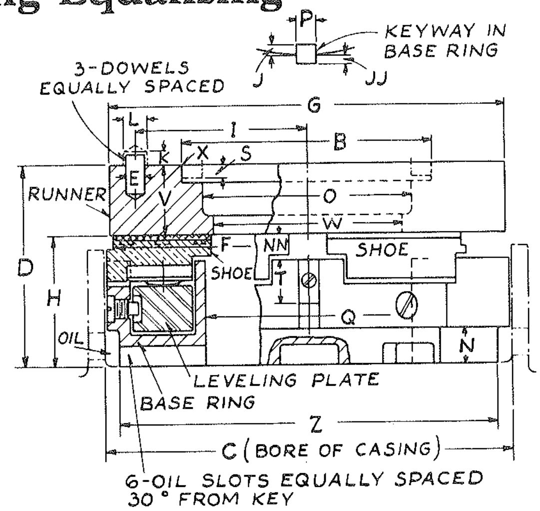
	Bearing Number	JHN-5	JHN-6	JHN-7	JHN-8	JHN-9	JHN-10½	JHN-12	JHN-13½	JHN-15	JHN-17
	3-Shoe Element Area (Net Sq. In.)	6.3	9.0	12.3	16.0	20.3	27.6	36.0	45.6	56.3	72.3
	6-Shoe Element Area (Net Sq. In.)	12.5	18.0	24.5	32.0	40.5	55.1	72.0	91.1	112.5	144.5
Weights (Lbs. Net)	**JHN Bearing, complete**	16	27	43	58	82	127	195	254	344	519
	Spare Collar	4½	7½	12½	17½	24	38	57	80	108	163
	6 Spare Shoes	2	3½	6	9	12	20	26	35	45	62
	ALL DIMENSIONS ARE IN INCHES										
	B (Bore)*	1.750	2.125	2.500	3.000	3.500	4.125	4.750	5.375	6.000	6.625
	C (Bore Casing)	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
	E	3/8	3/8	1/2	5/8	5/8	3/4	3/4	7/8	1	1
	F (Nominal Size)	5	6	7	8	9	10½	12	13½	15	17
	H	1¾	2 1/16	2⅜	2 11/16	3	3⅜	3¾	4¼	4⅝	5¼
	JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	1/4	5/16	5/16
	K	3/16	3/16	1/4	5/16	5/16	3/8	3/8	7/16	1/2	1/2
	L (Chamfer)	1/16	1/16	1/16	1/16	1/16	3/32	3/32	3/32	3/32	1/8
	N	1/2	9/16	5/8	3/4	7/8	1	1⅛	1¼	1⅜	1½
	NN	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	15/16
	P	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
	Q	2¾	3¼	3¾	4 5/16	4⅞	5 11/16	6½	7 5/16	8⅛	9 3/16
	T	9/16	11/16	13/16	15/16	1	1⅛	1 3/16	1⅜	1½	1⅝
	X	7/8	1	1¼	1⅜	1½	1¾	2	2¼	2½	2⅞
	Y	5⅛	6⅛	7⅛	8⅛	9⅛	10 11/16	12 3/16	13 11/16	15 3/16	17¼
	Z	5 1/16	6	6⅞	7¾	8¾	10¼	11 9/16	13	14½	16½

***NOTE: Shaft must be easy sliding fit in bore "B".**

Six-Shoe Self-Aligning Equalizing



STYLE KV (Solid)



STYLE JV (Split)

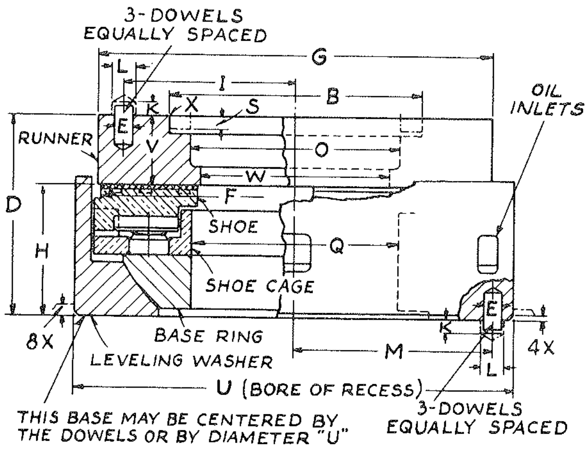
Openings for oil entry must not be covered.

Caution: Before actual construction, these dimensions should be confirmed by a certified print.

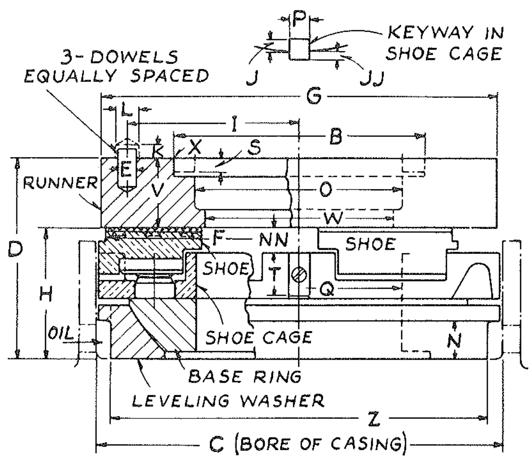
Bearing Number	KV-5 JV-5	KV-6 JV-6	KV-7 JV-7	KV-8 JV-8	KV-9 JV-9	KV-10½ JV-10½	KV-12 JV-12	KV-13½ JV-13½	KV-15 JV-15	KV-17 JV-17
Area (Net Sq. In.)	12.5	18.0	24.5	32.0	40.5	55.1	72.0	91.1	112.5	144.5
Weights (Lbs. Net) KV Bearing, complete	13	21	31	44	60	93	134	185	252	380
Weights (Lbs. Net) JV Bearing, complete	9½	16	25	35	48	76	126	156	213	220
Weights (Lbs. Net) Spare Runner	3¼	5½	8	12	16	26	43	61	81	117
Weights (Lbs. Net) 6 Spare Shoes	2	3½	6	9	12	20	26	35	45	62
ALL DIMENSIONS ARE IN INCHES										
B (Bore)*	3.375	4.000	4.625	5.250	6.000	7.000	8.000	9.000	10.000	11.250
C	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
D	2 5/8	3 1/16	3 5/8	4 1/16	4 1/2	5 1/8	5 3/4	6 1/2	7 1/8	8
E	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
F (Nominal Size)	5	6	7	8	9	10 1/2	12	13 1/2	15	17
G	5 1/8	6 1/8	7 1/8	8 1/8	9 1/8	10 11/16	12 3/16	13 11/16	15 3/16	17 1/4
H	1 3/4	2 1/16	2 3/8	2 11/16	3	3 3/8	3 3/4	4 1/4	4 5/8	5 1/4
I	2 3/16	2 5/8	3 1/8	3 9/16	4 1/16	4 3/4	5 7/16	6 1/8	6 13/16	7 3/4
J	5/32	3/16	1/4	5/16	5/16	11/32	13/32	1/2	9/16	9/16
JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	1/4	5/16	5/16
K	1/4	1/4	1/4	9/32	9/32	5/16	11/32	7/16	15/32	1/2
L	3/8	7/16	7/16	1/2	1/2	9/16	5/8	3/4	13/16	7/8
M	2 11/16	3 1/8	3 5/8	4 1/16	4 9/16	5 5/16	6	6 3/4	7 9/16	8 1/2
N	1/2	1/2	5/8	3/4	7/8	1	1 3/16	1 3/8	1 1/2	1 3/4
NN	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	15/16
O	2 11/16	3 3/16	3 3/4	4 1/4	4 7/8	5 9/16	6 7/16	7 1/4	8	9
P	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
Q	2.750	3.250	3.750	4.313	4.875	5.688	6.500	7.313	8.125	9.188
S	7/32	1/4	1/4	9/32	9/32	5/16	11/32	7/16	15/32	1/2
T	9/16	11/16	13/16	15/16	1	1 1/8	1 3/16	1 3/8	1 1/2	1 5/8
U (Bore of Recess)	6.000	7.000	8.000	9.125	10.125	11.750	13.375	14.875	16.500	18.625
V	7/8	1	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4
W	2 3/8	2 7/8	3 3/8	3 7/8	4 3/8	5 1/16	5 13/16	6 9/16	7 5/16	8 1/4
X (Chamfer)	1/32	1/32	1/32	1/32	1/32	3/64	3/64	3/64	3/64	1/16
Z	5 1/16	6	6 7/8	7 3/4	8 3/4	10 1/4	11 9/16	13	14 1/2	16 1/2

*NOTE: Thrust block should be a free fit in bore "B" of runner.

Three-Shoe Self-Aligning Equalizing



STYLE LV (Solid)



STYLE NV (Solid)

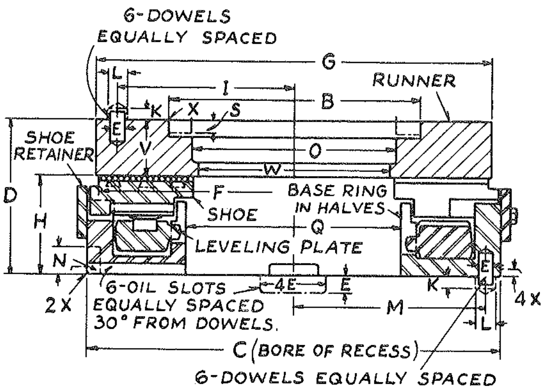
Openings for oil entry must not be covered.

Caution: Before actual construction, these dimensions should be confirmed by a certified print.

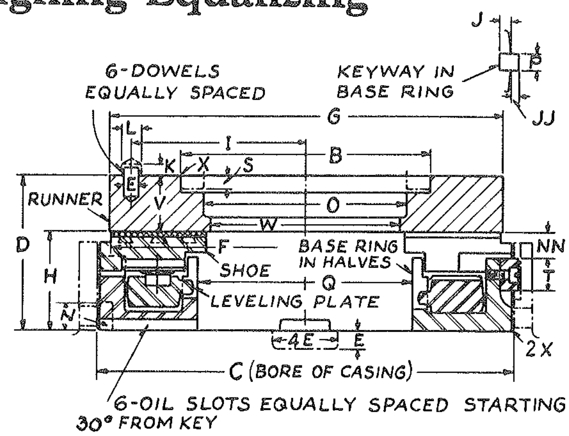
Bearing Number	LV-5 NV-5	LV-6 NV-6	LV-7 NV-7	LV-8 NV-8	LV-9 NV-9	LV-10½ NV-10½	LV-12 NV-12	LV-13½ NV-13½	LV-15 NV-15	LV-17 NV-17
Area (Net Sq. In.)	6.3	9.0	12.3	16.0	20.3	27.6	36.0	45.6	56.3	72.3
Weights (Lbs. Net) LV Bearing, complete	10	17	27	39	54	84	125	175	230	325
Weights (Lbs. Net) NV Bearing, complete	8	14	21	29	42	65	98	140	185	270
Weights (Lbs. Net) Spare Runner	3¼	5½	8	12	16	26	43	61	81	117
Weights (Lbs. Net) 3 Spare Shoes	1	1¾	3	4½	6	10	13	17½	22½	31
ALL DIMENSIONS ARE IN INCHES										
B (Bore)*	3.375	4.000	4.625	5.250	6.000	7.000	8.000	9.000	10.000	11.250
C	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625
D	2 5/8	3 1/16	3 5/8	4 1/16	4 1/2	5 1/8	5 3/4	6 1/2	7 1/8	8
E	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
F (Nominal Size)	5	6	7	8	9	10 1/2	12	13 1/2	15	17
G	5 1/8	6 1/8	7 1/8	8 1/8	9 1/8	10 11/16	12 3/16	13 11/16	15 3/16	17 1/4
H	1 3/4	2 1/16	2 3/8	2 11/16	3	3 3/8	3 3/4	4 1/4	4 5/8	5 1/4
I	2 3/16	2 5/8	3 1/8	3 9/16	4 1/16	4 3/4	5 7/16	6 1/8	6 13/16	7 3/4
J	5/32	3/16	1/4	5/16	5/16	11/32	13/32	1/2	9/16	9/16
JJ	5/32	3/16	3/16	3/16	3/16	7/32	7/32	1/4	5/16	5/16
K	1/4	1/4	1/4	9/32	9/32	5/16	11/32	7/16	15/32	1/2
L	3/8	7/16	7/16	1/2	1/2	9/16	5/8	3/4	13/16	7/8
M	2 11/16	3 1/8	3 5/8	4 1/16	4 9/16	5 5/16	6	6 3/4	7 9/16	8 1/2
N	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
NN	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	15/16
O	2 11/16	3 3/16	3 3/4	4 1/4	4 7/8	5 9/16	6 7/16	7 1/4	8	9
P	5/16	3/8	3/8	7/16	7/16	1/2	9/16	5/8	11/16	3/4
Q	2 3/4	3 1/4	3 3/4	4 5/16	4 7/8	5 11/16	6 1/2	7 5/16	8 1/8	9 3/16
S	7/32	1/4	1/4	9/32	9/32	5/16	11/32	7/16	15/32	1/2
T	9/16	11/16	13/16	15/16	1	1 1/8	1 3/16	1 3/8	1 1/2	1 5/8
U	6.000	7.000	8.000	9.125	10.125	11.750	13.375	14.875	16.500	18.625
V	7/8	1	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4
W	2 3/8	2 7/8	3 3/8	3 7/8	4 3/8	5 1/16	5 13/16	6 9/16	7 5/16	8 1/4
X (Chamfer)	1/32	1/32	1/32	1/32	1/32	3/64	3/64	3/64	3/64	1/16
Z	5 1/16	6	6 7/8	7 3/4	8 3/4	10 1/4	11 9/16	13	14 1/2	16 1/2

*NOTE: Thrust block should be a free fit in bore "B" of runner.

Six-Shoe Self-Aligning Equalizing



STYLE KBV (Split)



STYLE BV (Split)

Openings for oil entry must not be covered.

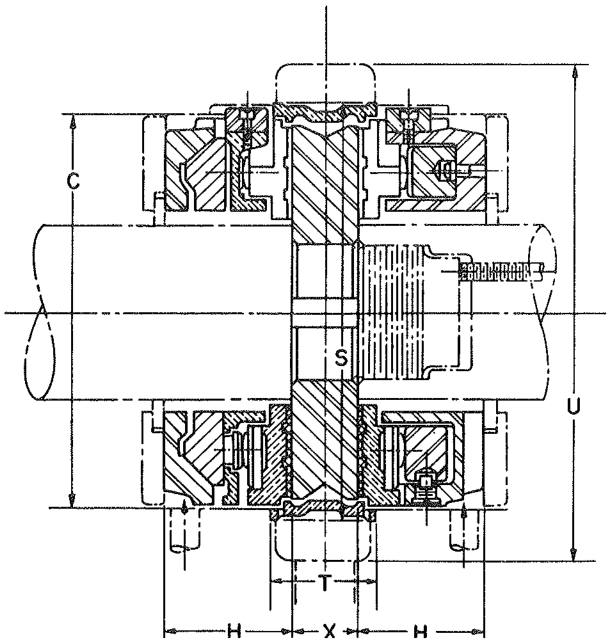
Caution: Before actual construction, these dimensions should be confirmed by a certified print.

Bearing Number	KBV-19 BV-19	KBV-21 BV-21	KBV-23 BV-23	KBV-25 BV-25	KBV-27 BV-27	KBV-29 BV-29	KBV-31 BV-31	KBV-33 BV-33	KBV-37	KBV-41	KBV-45
Area (Net Sq. In.)	180	220	264	312	364	420	480	545	684	840	1012
Weights (Lbs. Net): KBV Bearing, complete	399	512	635	826	1,020	1,218	1,475	1,875	2,478	3,260	4,310
Weights (Lbs. Net): BV Bearing, complete	396	507	629	818	1,007	1,203	1,457	1,850			
Weights (Lbs. Net): Spare Runner	159	195	223	312	364	426	497	600	795	1,027	1,275
Weights (Lbs. Net): 6 Spare Shoes	91	122	165	227	242	305	388	550	666	818	1,150
ALL DIMENSIONS ARE IN INCHES											
B (Bore)*	12.625	13.750	14.625	16.000	17.125	18.000	18.875	20.500	22.375	24.500	26.750
C	20.250	22.250	24.500	26.500	28.750	30.750	33.000	35.000	38.500	43.750	48.000
D**	7 3/4	8 1/4	8 11/16	9 9/16	10 1/16	10 1/2	11	11 7/8	12 3/4	14	15 1/8
E	7/8	1	1	1	1 1/4	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2
F (Nominal Size)	19	21	23	25	27	29	31	33	37	41	45
G	19 1/4	21 1/4	23 1/4	25 1/4	27 1/4	29 3/8	31 3/8	33 3/8	37 1/2	41 1/2	45 1/2
H	4 3/4	5 1/4	5 11/16	6 3/16	6 11/16	7 1/8	7 5/8	8 1/8	9	10	11
I	8 5/8	9 1/2	10 1/2	11 1/2	12 1/4	13 1/4	14 1/4	15 1/4	17	19	21
J (BV only)	17/32	1/2	1/2	3/4	3/4	3/4	15/16	15/16			
JJ (BV only)	11/32	3/8	3/8	1/2	1/2	1/2	9/16	9/16			
K	9/16	5/8	5/8	5/8	3/4	3/4	3/4	3/4	7/8	7/8	7/8
L	1	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8
M	9 1/4	10 3/16	11 5/16	12 5/16	13 5/16	14 1/8	15 1/8	16 1/8	18 1/4	20 1/8	22 1/16
N	7/8	1	1	1 1/8	1 3/16	1 1/4	1 3/8	1 7/16	1 9/16	1 3/4	1 15/16
NN (BV only)	1	1 1/8	1 5/16	1 3/8	1 7/16	1 1/2	1 5/8	1 3/4			
O	10 1/8	11 1/8	12 1/8	13 1/4	14 1/4	15 1/8	16 1/8	17 1/4	19 1/8	21 1/8	23 1/8
P (BV only)	7/8	1	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2			
Q	10 5/8	11 3/4	12 3/4	14	15	16 1/4	17 1/4	18 1/2	20 3/4	23	25
S	19/32	11/16	11/16	11/16	13/16	13/16	13/16	13/16	1	1	1
T (BV only)	1 3/4	1 3/4	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4			
V	3	3	3	3 3/8	3 3/8	3 3/8	3 3/8	3 3/4	3 3/4	4	4 1/8
W	9 1/4	10 1/4	11 1/4	12 1/4	13 1/4	14 1/8	15 1/8	16 1/8	18	20	22
X (Chamfer)	1/16	1/16	1/16	1/16	1/16	1/16	1/16	3/32	3/32	3/32	3/32

*NOTE: Thrust block should be a free fit in bore "B" of runner.

**Add to height D a suitable allowance for insulated sub-base if needed.

Standard Dimensions, Oil Control Ring Bearings



Standard Oil Control Ring Bearings consist of standard JHJ, JHN or NHN bearing elements with the bronze Oil Control Ring added.

In this table, dimensions *C*, *H*, and *X* are identical with the same dimensions in the other bearing tables. Dimensions *C*, *S*, and *T* are *housing* dimensions. The Control Ring itself is made with clearance enough for free movement.

The Control Ring is held against rotation by two lugs at the housing joint on the downward side of collar rotation. The recesses for these lugs may be either just below (as shown in Figure 15, page 13) or just above the joint.

For opposite rotation, these lugs and also the top horizontal discharge outlet must be on the other side of the shaft.

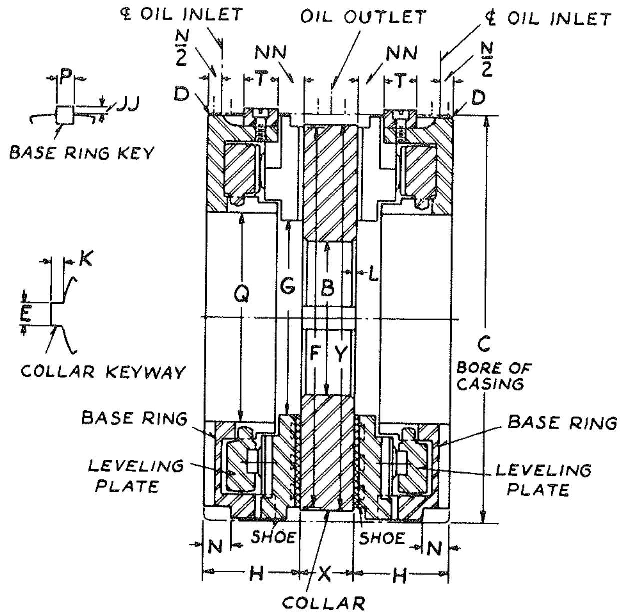
In this table, bearing sizes 4 and 4 7/16 are considered special. The same sizes are listed in the table of Special Bearings without the Control Ring, page 31.

ALL DIMENSIONS ARE IN INCHES

Caution: Before actual construction, these dimensions should be confirmed by a certified print.

Bearing Number	**4**	**4 7/16**	**5**	**6**	**7**	**8**	**9**	**10½**	**12**
Drawing Number	263554	462175	.....	.....	.....	.....	.....	.....	.....
C (Bore Housing)	4.875	5.500	5.375	6.375	7.375	8.375	9.375	11.000	12.500
H	1⅝	1 13/16	1¾	2 1/16	2⅜	2 11/16	3	3⅜	3¾
S (Bore Housing)	5.250	5.875	5.875	6.875	7.875	9.000	10.000	11.625	13.250
T (Housing)	1.375	2.250	1.375	1.625	2.000	2.250	2.500	2.875	3.250
U	7	7¼	7¾	8¾	9¾	10¾	12	13¾	15½
X	⅞	1	⅞	1	1¼	1⅜	1½	1¾	2

Special Horizontal Bearings



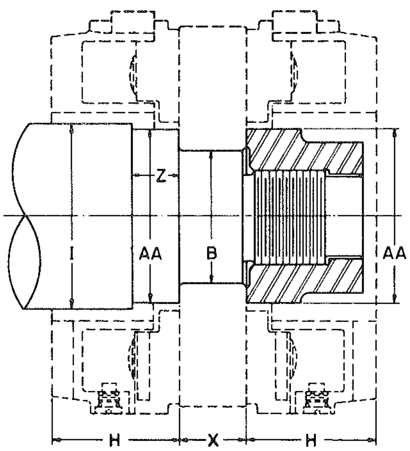
The table below gives the dimensions of frequently used non-standard sizes of equalizing bearings. See also "Special Two-Diameter Thrust Bearings," text and tables, page 34.

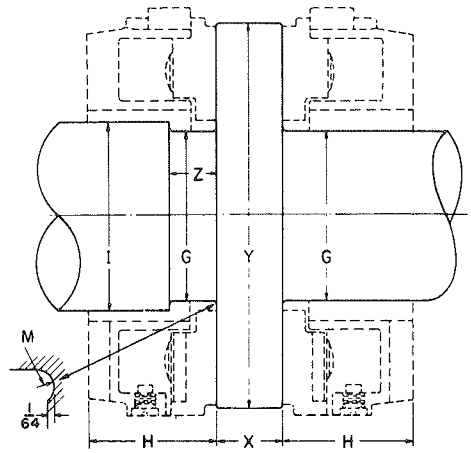
ALL DIMENSIONS ARE IN INCHES

Caution: Before actual construction, these dimensions should be confirmed by a certified print.

Bearing Number	4″ (4 x 4)	4 7/16″ (4 x 4)	18″ (8 x 8)	20″ (8 x 8)	BHBS 25 1/2	BHBS 28	BHBS 34	BHBS 34 1/2	BHBS 39	45″ (8 x 8)
Drawing Number	263554	462175	462634	463812	462067	462757	362743	362896	363408	463736
Area, Sq. Ins.	6.2	6.7	91	121	346	440	579	650	799	874
B (Bore)	1.125	1.375	Integral Collar	Integral Collar	9.000	9.000	13.750	11.750	13.750	Integral Collar
C (Bore of Hsg.)	4.875	5.500	18.750	20.750	26.500	28.750	36.250	36.500	41.250	46.500
E	5/16	3/8	.....	.....	1 1/2	1 1/2	2	2	2 1/4	....
F (Nominal Size)	4	4 7/16	18	20	25 1/2	28	34	34 1/2	39	45
G (Shoe Bore)	1 3/4	2 3/16	12 1/4	13 1/2	11 1/2	12	17	14 3/4	18	26 3/4
H	1 5/8	1 13/16	3 1/2	3 7/8	7 1/32	7 3/16	8 1/4	8 5/8	9	9
JJ	.....	3/16	7/32	7/32	1/2	1/2	1/2	3/4	5/8	Dowel
K	5/32	3/16	.....	.....	3/4	3/4	1	1	1 1/8	....
L (Chamfer)	1/16	1/16	.....	.....	5/32	5/32	3/16	3/16	1/4	....
N	7/16	7/16	7/8	1 1/16	.....	2 7/8	2 7/8	2 3/8	3 9/16	3 7/8
NN	19/32	23/32	3/4	7/8	1 5/8	1 7/16	1 13/16	2 5/8	1 15/16	1 1/16
P	Dowel	3/8	9/16	9/16	1 1/4	1 1/4	1 1/2	1 1/2	1 3/4	Dowel
Q (Min. Bore)	1 3/4	2 1/8	12 3/4	14	13 1/2	14 7/8	19	18 1/4	20 3/4	26 3/4
T	Dowel	21/32	1 3/16	1 3/16	2 1/4	2 3/8	3 1/2	3 1/2	3 1/4	Dowel
X	7/8	1	2	2 1/4	3 3/4	4 3/4	5 3/4	5 3/4	6 3/8	7 5/8
Y	4 1/8	4 9/16	18 1/4	20 1/4	25 3/4	28 1/4	34 3/8	34 7/8	39 1/2	45 1/2

Shaft Sizes for Standard Horizontal Equalizing Bearings





Maximum diameters of shaft and shaft nut are limited in order to allow free oil flow to the collar. Dimensions *H* and *X* are standard. Diameter *G*, with integral collars, is slightly smaller than *AA* to allow for the undercut fillet of radius *M*.

Dimension *Z* is somewhat optional, but should not be reduced below the figures stated.

If the shaft be reduced below diameter *AA*, diameter *B* must be reduced also, in order to give an adequate shoulder for the collar. This should be avoided if possible.

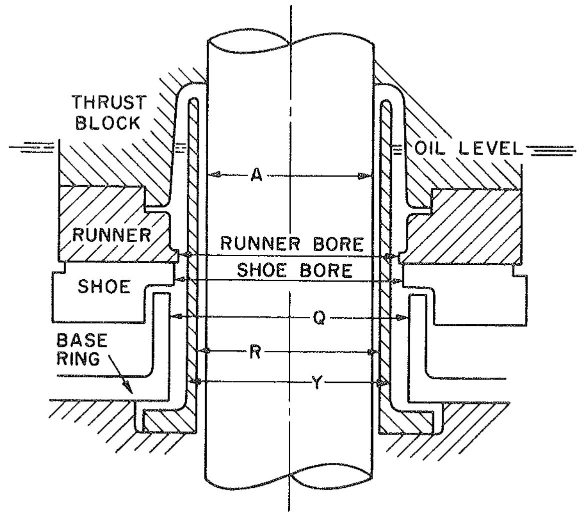
ALL DIMENSIONS ARE IN INCHES

Caution: Before actual construction, these dimensions should be confirmed by a certified print.

Bearing Size	5	6	7	8	9	10½	12	13½	15	17
AA (Standard)	2¼	2¾	3¼	3¾	4¼	4⅞	5⅝	6½	7	8
B (Standard Bore)	1.750	2.125	2.500	3.000	3.500	4.125	4.750	5.375	6.000	6.625
G (Maximum)	2⅛	2⅝	3⅛	3⅝	4⅛	4¾	5½	6¼	6⅞	7⅞
H	1¾	2 1/16	2⅜	2 11/16	3	3⅜	3¾	4¼	4⅝	5¼
I (Maximum)	2½	3	3½	4	4½	5¼	6	6¾	7½	8½
M (Fillet)	3/32	3/32	3/32	3/32	3/32	⅛	⅛	⅛	5/32	5/32
X	⅞	1	1¼	1⅜	1½	1¾	2	2¼	2½	2⅞
Y	5⅛	6⅛	7⅛	8⅛	9⅛	10 11/16	12 3/16	13 11/16	15 3/16	17¼
Z	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾

Bearing Size	19	21	23	25	27	29	31	33	37	41	45
AA (Standard)	8⅞	9⅞	10¾	11¾	12⅝	13⅝	14½	15½	17⅜	19¼	21⅛
B (Standard Bore)	7.500	8.500	9.375	10.000	11.000	11.750	12.500	13.375	15.000	16.750	18.500
G (Maximum)	8¾	9¾	10½	11½	12¼	13	14	14¾	16½	18¼	20
H	4¾	5¼	5 11/16	6 3/16	6 11/16	7⅛	7⅝	8⅛	9	10	11
I (Maximum)	9¾	10¾	11¾	12⅞	13⅞	15	16	17	19	21	23
M (Fillet)	3/16	3/16	¼	¼	5/16	⅜	⅜	7/16	½	9/16	⅝
X	3¼	3⅝	3⅞	4¼	4⅝	5	5¼	5⅝	6⅜	7	7⅝
Y	19¼	21¼	23¼	25¼	27¼	29⅜	31⅜	33⅜	37½	41½	45½
Z	2	2¼	2⅜	2½	2¾	3	3¼	3½	4	4¼	4½

Shaft and Oil Retainer Sizes for Vertical Equalizing Bearings



The drawings and tables, pages 20 to 29, show all dimensions of the bearings needed for installing. They do not, however, indicate diameters of the vertical shafts.

In the drawing above, the runner bore and shoe bore, also *Q*, are standard and are shown also in the other tables. The allowable diameters *A* and *Y*, of the shaft and oil retainer, and *R*, the retainer bore, will depend somewhat on the depth of submergence and on the running speed, being a little smallei than here listed for unusually high speeds.

Diameters *A*, *R* and *Y*, in the table below, are suitable maximums for usual electric motor speeds. For higher speeds we should be consulted.

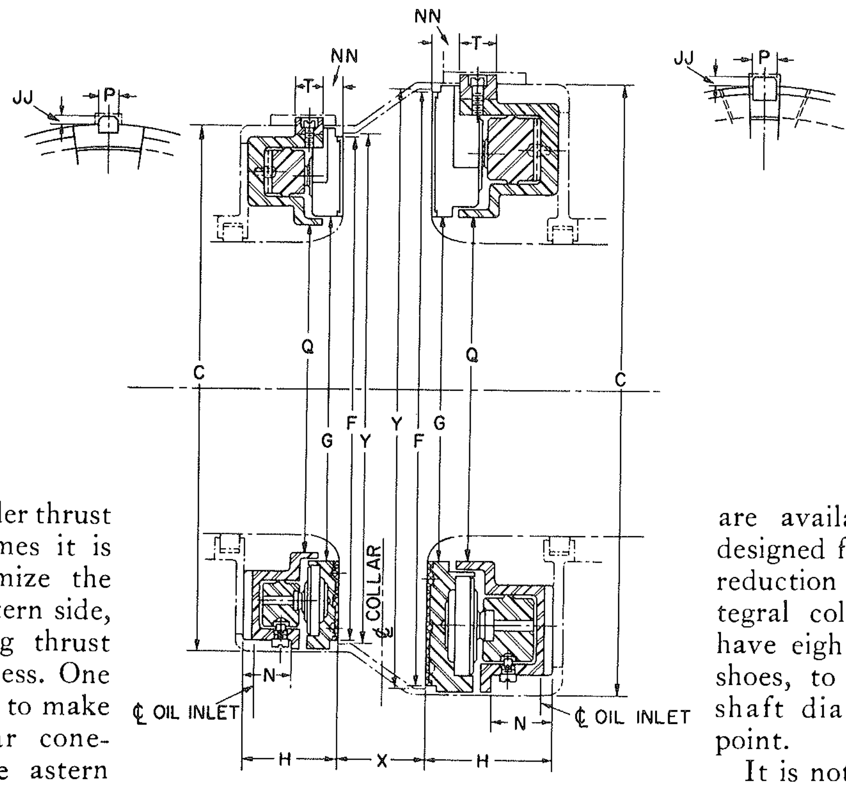
ALL DIMENSIONS ARE IN INCHES

Caution: Before actual construction, these dimensions should be confirmed by a certified print.

Bearing Number	5	6	7	8	9	10½	12	13½	15	17
A (Maximum)	1⅞	2 5/16	2 13/16	3¼	3 11/16	4 5/16	5	5⅝	6⅜	7 3/16
Shoe Bore (Standard)	2½	3	3½	4	4½	5¼	6	6¾	7½	8½
Q (Standard)	2¾	3¼	3¾	4 5/16	4⅞	5 11/16	6½	7 5/16	8⅛	9 3/16
R (Maximum)	2	2½	3	3½	3 15/16	4 9/16	5¼	5 15/16	6 11/16	7½
Runner Bore (Std.)	2⅜	2⅞	3⅜	3⅞	4⅜	5 1/16	5 13/16	6 9/16	7 5/16	8¼
Y (Maximum)	2 3/16	2⅝	3 3/16	3 11/16	4 3/16	4 13/16	5 9/16	6 5/16	7 1/16	7 15/16

Bearing Number	19	21	23	25	27	29	31	33	37	41	45
A (Maximum)	8 1/16	8½	9⅞	10¾	11⅝	12½	13⅜	14⅜	16⅛	18	19¾
Shoe Bore (Standard)	9½	10½	11½	12½	13½	14½	15½	16½	18½	20½	22½
Q (Standard)	10⅝	11¾	12¾	14	15	16¼	17¼	18½	20¾	23	25
R (Maximum)	8 7/16	9⅜	10 5/16	11¼	12⅛	13	14	14⅞	16¾	18½	20⅜
Runner Bore (Std.)	9¼	10¼	11¼	12¼	13¼	14⅛	15⅛	16⅛	18	20	22
Y (Maximum)	8⅞	9⅞	10 13/16	11¾	12⅝	13⅝	14½	15½	17⅛	19¼	21⅛

Special Two-Diameter Thrust Bearings



For ship propeller thrust bearings, sometimes it is desired to minimize the weight on the astern side, since the backing thrust is always much less. One way to do this is to make the thrust collar cone-shaped, with the astern shoes smaller. Those shoes can also be made of narrower width, to reduce their weight.

The accompanying table lists the dimensions of four such "Two-Diameter" bearings which we have supplied and for which patterns are available. All were designed for use aft of the reduction gears, with integral collars, and three have eight instead of six shoes, to suit the larger shaft diameter at that point.

It is not necessary that the sizes be combined just as shown. If the shaft size permits, for instance, a 31 x 25 combination might be used, or even a 35 x 26.

As all these are non-standard, details of their application should be discussed with us.

ALL DIMENSIONS ARE IN INCHES

Caution: Before actual construction, these dimensions should be confirmed by a certified print.

Bearing Number	22 x 19 6 x 6		29½ x 25 8 x 8		31 x 26 8 x 8		35 x 30 8 x 8	
Drawing Number	463685		463413		463606		463608	
	Ahead	Astern	Ahead	Astern	Ahead	Astern	Ahead	Astern
Area (Net Square Inches)	271	174	370	168	470	187	603	273
C (Bore Casing)	22.500	20.250	30.250	26.000	31.750	26.750	35.750	30.750
F (Nominal Size)	22	19	29½	25	31	26	35	30
G (Shoe Bore)	10	10	17	17	16½	17½	18½	19
H	5¼	4¾	6⅜	4¾	6⅜	4¾	6¾	5
JJ	3/16	3/16	½	7/16	½	7/16	½	7/16
N	1⅛	1	3⅛	2⅜	3⅛	2⅜	2⅞	1¾
NN	1⅛	1	1⅜	1	1⅜	1	1⅝	1⅛
P	⅞	⅞	1¼	1	1¼	1	1¼	1
Q (Minimum Bore)	10⅞	10⅝	17	16¼	17	16¾	19 5/16	19½
T	1	1	1⅞	1⅜	1⅞	1⅜	2¼	1⅝
X	3½		4½		4½		4¾	
Y	22¼	19¼	29¾	25¼	31¼	26¼	35¼	30¼

End Play

Some end play or clearance is always necessary. In horizontal bearings, it must be sufficient to permit formation of the wedge-shaped oil films on both sides of the collar, also to allow for expansion of the parts by heat.

Kingsbury thrust bearings are not easily damaged, even by considerable end play. For bearings used with centrifugal pumps, and with steam and gas turbines, the practical limit may be found in the rotor clearances rather than in the bearing elements.

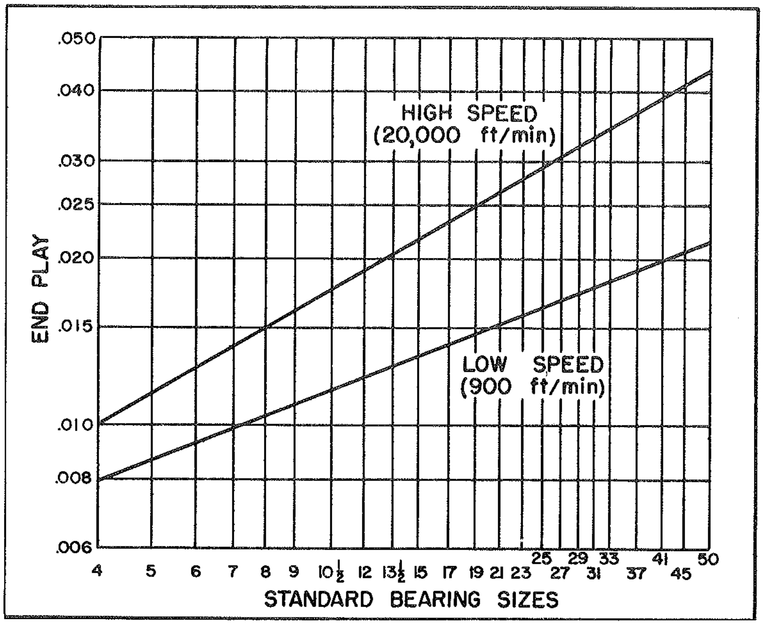


Figure 21
Recommended limits of end play for high and low speeds at rim of thrust collar.

For average installations, the end play allowance in a "double" bearing will be within the range of the chart, Figure 21. For low speeds, the end play can be quite small, if desired. Higher speeds call for a larger allowance, to minimize film shear losses.

Much time may be saved if it is realized that, for most installations, the amount of end play is not an exacting matter. Usually the nominal amount, plus or minus a few thousandths, is quite satisfactory.

In most cases, the end play is determined by filler pieces. These may be inside the housing bore, as in Figure 24 (where they also provide for endwise adjustment of the shaft), or under the flange of an end cover, as frequently in turbines. Usually their final thickness is given by grinding, after all parts have been assembled and the exact axial location for the shaft is known.

Both for installing and for later checking, the method of measuring end play for required filler thickness is illustrated in Figure 22. If the filler piece be under the flange of the end cover (right hand view), the matter is simple. Remove the filler (if it is in place) and draw up the end cover bolts. The required thickness *F* will equal the air gap *C* plus the specified end play *E*.

If the filler is in the housing bore (left-hand view), remove it and replace with a somewhat thicker dummy filler *B*, making an outside air gap *C*. Then the required filler thickness *A* will be the dummy filler thickness *B*, minus air gap *C*, minus the specified end play *E*.

For particular installations, it is common to specify a plus-or-minus range for the end play.

For new bearings, it is usual to aim at the lower limits of end play, in order to allow for the slight settling or brinelling of leveling plates which occurs in service.

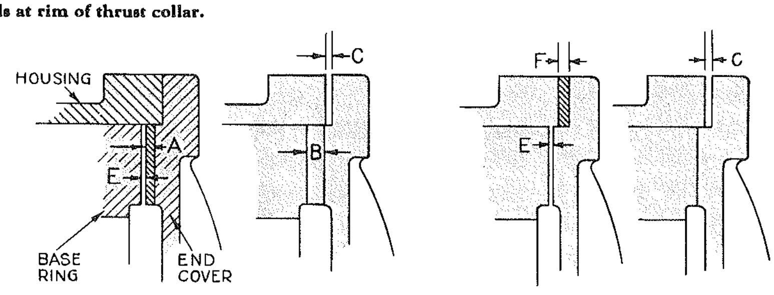


Figure 22
Measuring end play in six-shoe bearing. A, regular filler plate. B, dummy filler. C, air gap. E, end play. F, regular filler ring.
Left: A=B−C−E Right: F=C+E

Typical Mountings and Some Specials

Below are illustrated several typical mountings recommended for ordinary use with standard bearings, horizontal and vertical. In addition are shown in each category several variations from the standard arrangements, used to meet special conditions. Since vertical mountings are more apt to be special than horizontal, a variety of these are shown.

Horizontal Mountings

Figure 23, which is identical with Figure 17 and is here repeated for convenience, is a familiar application of a JHJ six-shoe bearing, as used, for example, at the forward end of marine reduction gearing. It departs from the strictly standard only in that the seal ring is set in a recess in the after base ring instead of in a recess in the housing. This drawing does not show a filler piece at that point, but one is often used, and is shown in Figures 24 and 27.

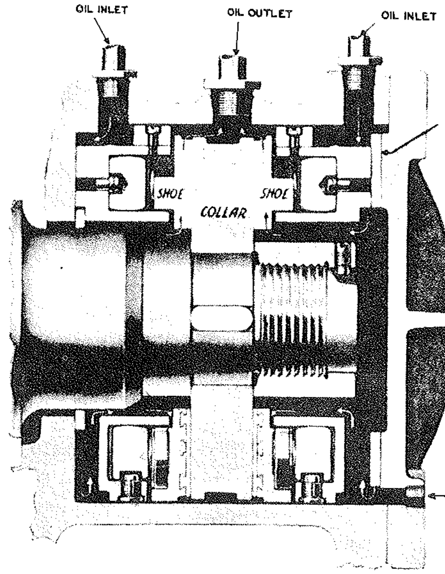


Figure 23
Vertical section of double six-shoe bearing in housing. Arrows show direction of oil flow.

The direction of oil flow is shown by the arrows: from outside into the channels surrounding both base rings, then radially inward to the shaft or shaft nut, then to the shoes, and outward to the space around the collar. The arrangement for three-shoe bearings is substantially similar, with the oil moving inward by radial channels in the backs of the shoe cages to meet the shoes.

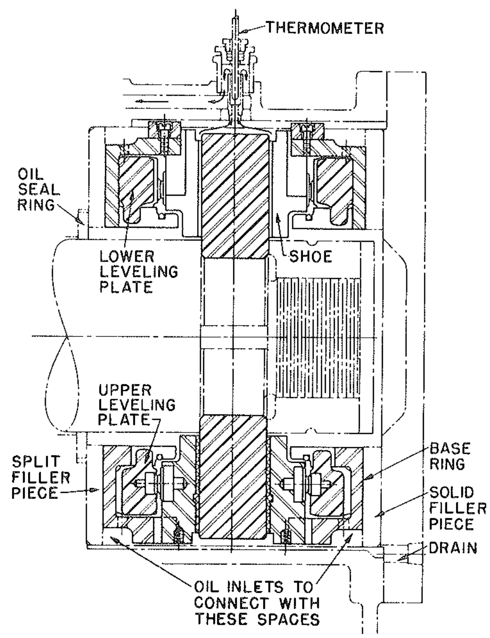


Figure 24
Typical arrangement of standard marine thrust bearing at forward end of gear housing.

All these bearings run with the thrust cavity full of oil: note the seal ring(s) in this and other illustrations. The one exception is the Oil Control Ring bearing described on page 13.

Figure 24 shows the same standard arrangement as Figure 23, but applied to a larger (Style BHB) bearing. The seal ring and after filler piece will be noticed. The thermometer at the top outlet is standard equipment in marine service.

Figure 25 shows a special application, using a double eight-shoe bearing directly aft of the reduction gears. It has been used extensively in sizes 18 and (with modified details) 20 inches, and is listed in those sizes in the dimension table of Special Horizontal Bearings, page 31. In the form shown here, the thrust collar and coupling flange are forged on a taper sleeve keyed on the shaft.

Figure 26 shows an eight-shoe bearing, this time designed to be mounted on the line shaft of a large ship. It likewise is dimensioned on

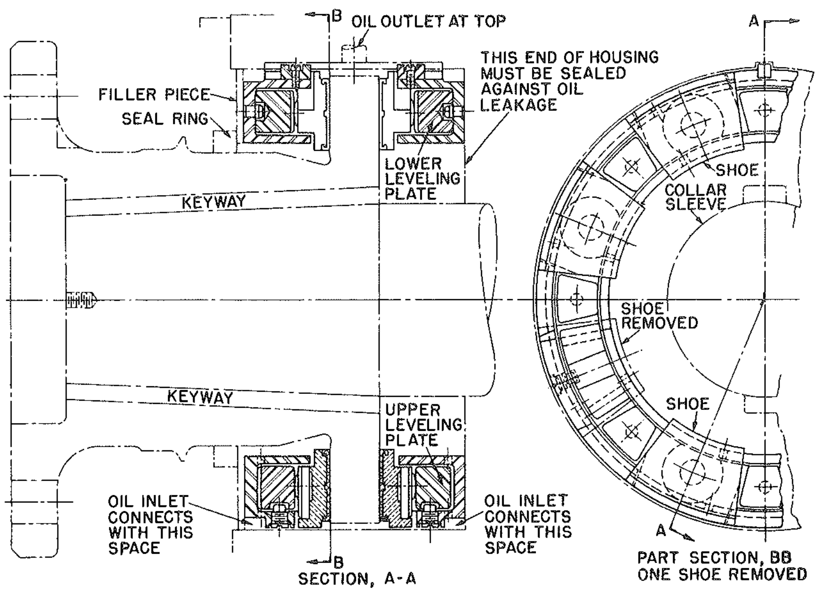


Figure 25
Special 8 x 8 thrust bearing, arranged for mounting at after end of the gear housing.

page 31. The special design of the leveling plates (see detail) is often used in large bearings.

The large eight-shoe bearing shown in Figure 27 is interesting in several respects: it is used aft of the gear housing on all the Maritime Administration high-speed cargo vessels of the "Mariner" class, built in 1952–53.

The high flanges of the housing, permitting it to be mounted on a long foundation, eliminate the overturning leverage due to thrust, which must be considered with the more usual pedestal mounting. The forward end of the housing is bolted to a short shaft cover extending to the reduction gear housing. The filler pieces permit exact adjustment of the fore-and-aft location of the shaft after the housing has been bolted down. A large circular inspection plate in the top of the housing permits the shoes to be lifted out one at a time for inspection. As usual, the thrust cavity runs full of oil, which is discharged at the top above the collar. The arrangement of the after end closure will be noticed: it makes an effective seal without depending on packing which might wear and leak.

Another quite special marine design, with reduced-size shoes and collar face on the after side, has been built in several sizes as listed in the Table on page 34. The purpose is to minimize the weight required for the smaller astern thrust. It is always located aft of the reduction gears, and usually—though not always—uses eight shoes on each side of the collar.

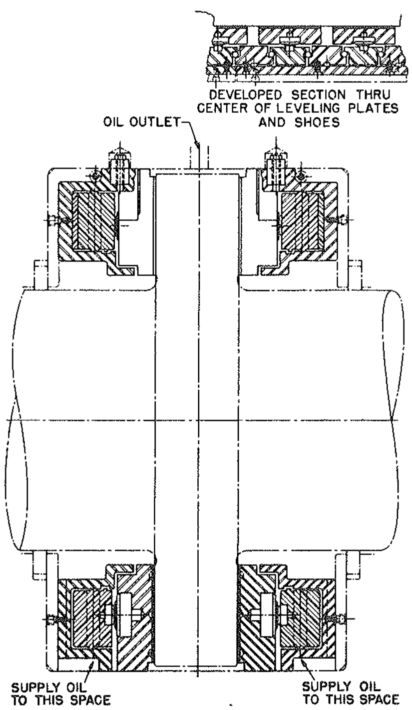


Figure 26
Large 8 x 8 thrust bearing on line shaft.

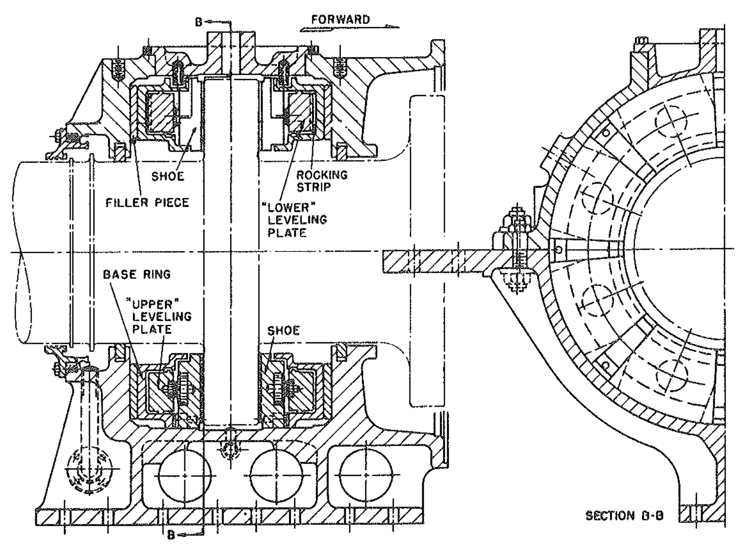


Figure 27
Large 8 x 8 thrust unit, with high-flange housing on line shaft.

Split or Solid Construction

In both horizontal and vertical six-shoe bearings, split base rings are so often needed for assembling that they are standard in all sizes up to 19-inch, and are regularly furnished—unless otherwise specified—in larger sizes.

In horizontal bearings, the most frequent exception is the forward half of a BHB unit, next to the end cover in a marine reduction gearset. The after half of the same set is always split, to permit assembling or removal without disturbing the collar.

With vertical generators, the determining factor is accessibility for assembling and repairs. In large vertical bearings, the runner is often split; and this is usually done with "umbrella" construction (thrust bearing under generator rotor).

Vertical Bearings

A typical mounting for small-to-medium three- and six-shoe vertical bearings is that shown in Figure 30, which is repeated from page 15. The thrust elements shown are Style KV, but Style LV (3 shoes) might be used. The thrust block is expanded at its lower end to the runner diameter, and a seal ring is recessed into it to insure a supply of oil for the journal bearing just above. Oil pumped by centrifugal action follows a groove in the babbitt to the top of the journal bearing and overflows (dotted lines) into the surrounding bath.

In Figure 30 the oil level is carried well

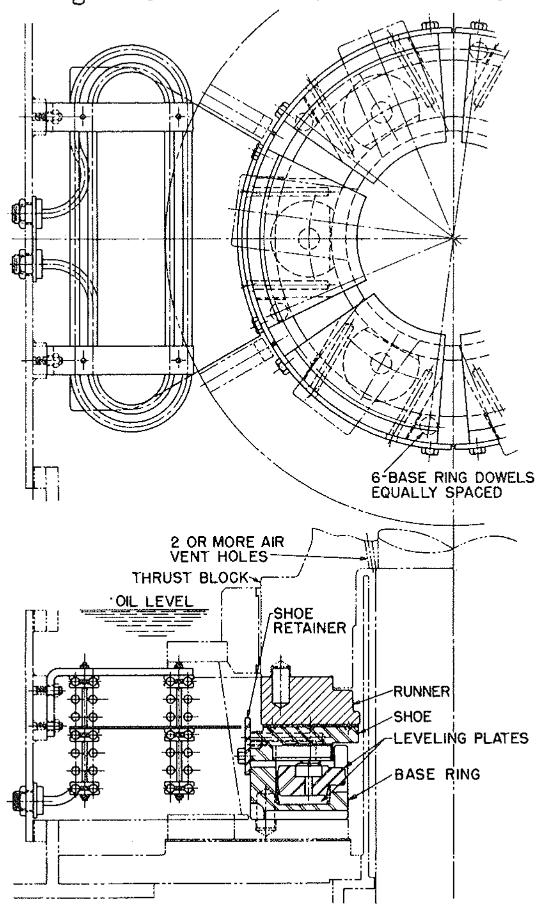


Figure 29
Style KBV thrust bearing with cooling coil. The thrust block acts also as a guide bearing.

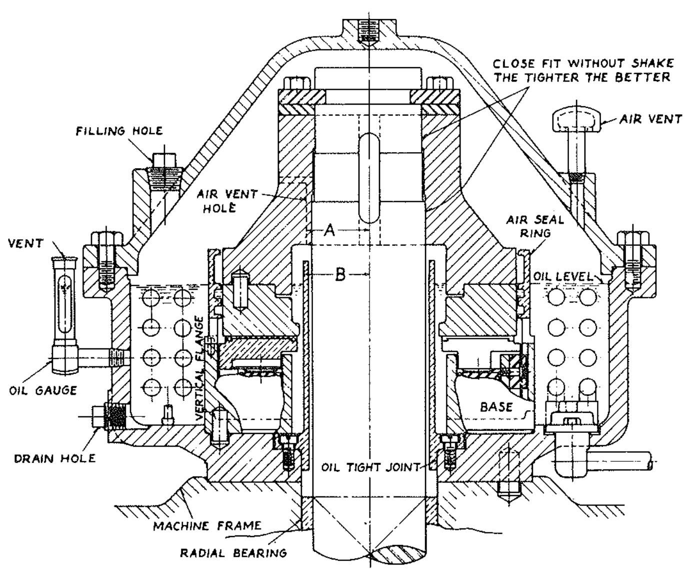


Figure 28
Simple vertical mounting with cooling coil and air seal ring. Thrust bearing may be Style LV or KV.

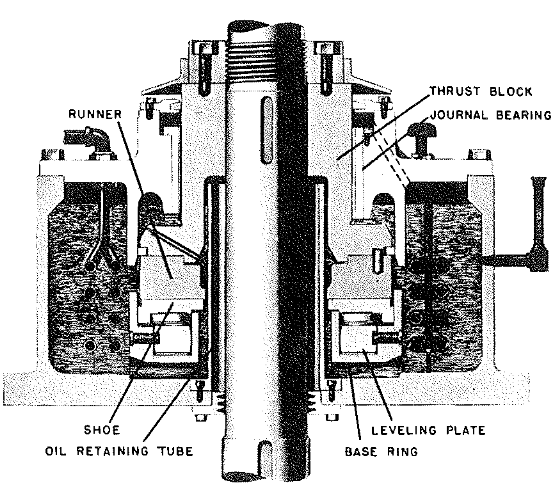


Figure 30
Vertical equalizing thrust bearing, using Style KV elements in housing with guide bearing and cooling coil.

above the level of the runner. There is therefore no foaming tendency and no need for an air seal ring to protect the shoes and runner.

Figure 28 shows an arrangement in which it was not feasible to carry the oil level so high as in Figure 30. With this arrangement there

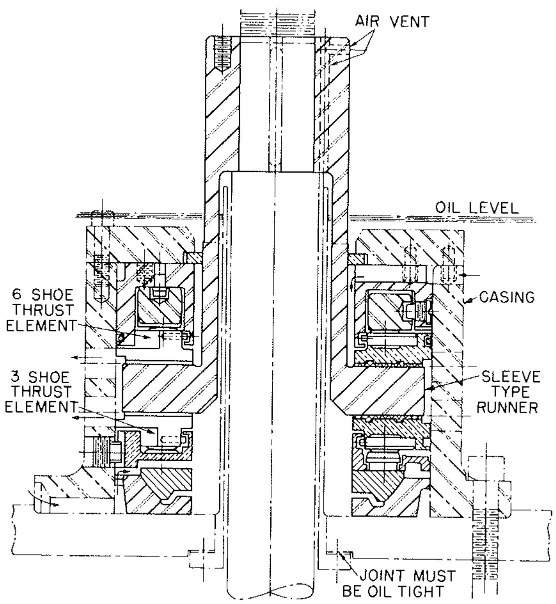


Figure 31
Styles J and N units arranged for upward principal thrust. Casing is drilled for in-and-out circulation.

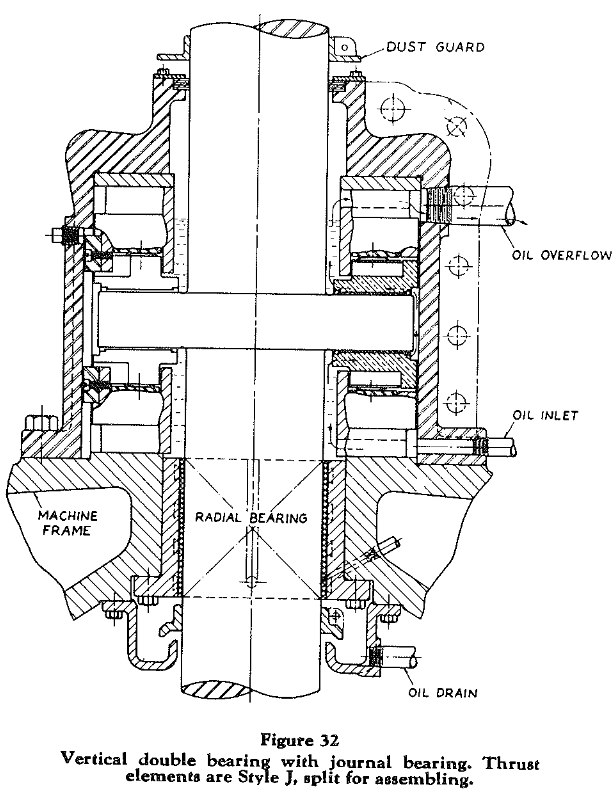


Figure 32
Vertical double bearing with journal bearing. Thrust elements are Style J, split for assembling.

would be some tendency at the higher running speeds to cause foam at the oil level, which might reach the shoes. To prevent that, the air seal ring is used. The thrust block must have a long close fit on the shaft, and its lower face must be exactly square with the shaft axis.

Air Seal Rings in various forms are used where the running speed is high and the oil level (as in this case) cannot be carried much above the runner.

Figure 29 shows a somewhat similar arrangement in which it was found practicable to carry the oil retaining sleeve (broken lines) higher into the thrust block, and therefore to carry the oil level well above the runner. Thus the need for an Air Seal Ring is avoided.

In this design the steady bearing takes the form of a babbitt-lined ring (or "shoes") around the larger diameter of the thrust block, which is polished to act as a journal.

The cooling coils are carried through, and mounted on, the side cover plates of the housing.

Figure 31 shows an arrangement designed for a vertical steam turbine in which the major thrust is upward. The six-shoe thrust element acts on the upper surface of the combined thrust block and runner. The entire bearing runs submerged in oil as indicated; and the thrust block has a long bore to give clearance to the unusually high oil retaining sleeve. Arrows show oil flow.

Figure 32 shows a combined vertical double thrust bearing and radial bearing. The housing above the journal bearing is separate, and split for convenient assembling. The cooling coil connections are in the stationary half. The housing must be strong enough to carry the upward thrust. If clearance permits it to be raised clear of the bearing, it may be made in one piece. If split, short keyways may be used instead of one long keyway. Lubrication and cooling are by circulation from an external pump. Internal oil circulation follows the course of the arrows. It must always be started before the shaft turns. When the overflow pipe is large enough to avoid accumulation of pressure in the housing, a felt washer or equivalent may be used at the top. Otherwise a seal ring with drain above it should be placed around the shaft just above the bearing.

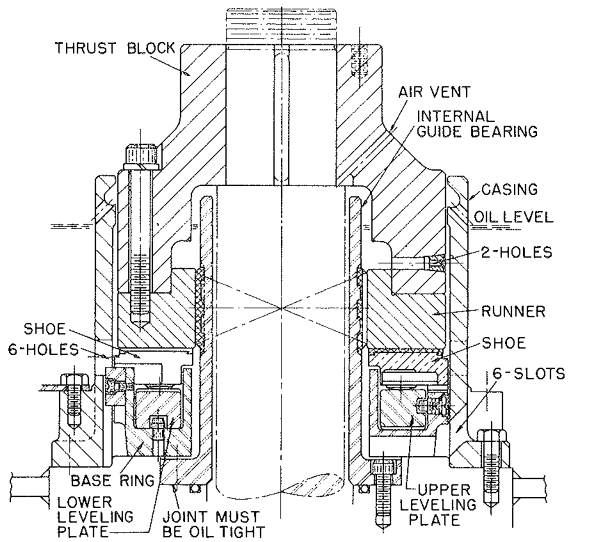


Figure 33
Vertical bearing in which the oil-retaining sleeve is adapted to function as a guide bearing.

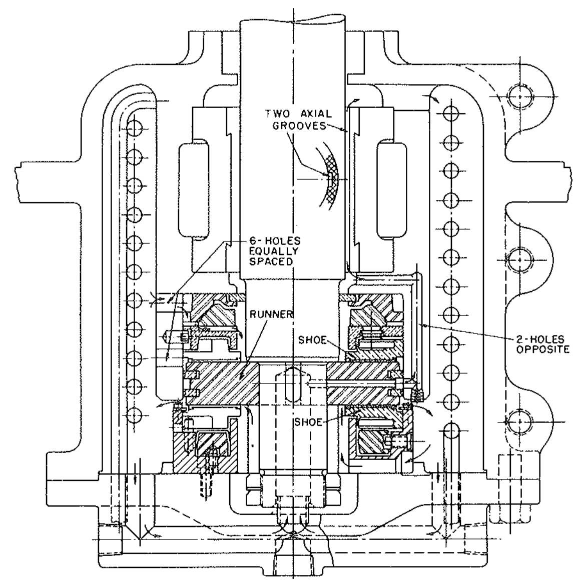


Figure 34
Step bearing with Styles N and KV thrust units. Arrows show circulation of oil cooled by water coil.

In Figure 33 the oil retaining sleeve is made massive enough to act as a stationary journal for the internal polished bore of the runner. The "journal" carries six babbitted pads, between which oil can freely rise to the radial holes in the thrust block. These holes constitute a centrifugal pump. Oil enters six slots at the bottom of the thrust elements and rises to the shoes. Part of it escapes radially at the shoe level: part rises past the journal bearing and finally escapes through the various outlets in the casing.

A step bearing for the bottom of a shaft is illustrated in Figure 34. A six-shoe bearing takes the principal (downward) load. Above the thrust bearing is a steady bearing.

The circulation is self-contained, and the entire housing is filled with oil. The thrust collar acts as a centrifugal pump. The bottom of the shaft is hollow: oil entering it passes to radial pumping holes in the collar, where it is discharged between the upper and lower seal rings into drilled passages leading upward to the bottom of the steady bearing. Oil grooves in that bearing lead to the top, where oil overflows and runs down over the cooling coil.

In addition, cool oil enters the slots in the six-shoe base ring, rises to the shoes, and is radially discharged as the arrows show. Similar circulation cools the three-shoe bearing above the collar.

Figure 35 shows a generator bearing having a sub-base with insulation above and below. Since the sub-base is completely insulated, its insulation can be checked by testing.

Sometimes the insulating bushings surrounding the dowels and bolts in the sub-base are considerably thickened radially, becoming virtual plugs, in order better to resist the tangential forces that might possibly occur. That feature, however, is not shown in this drawing.

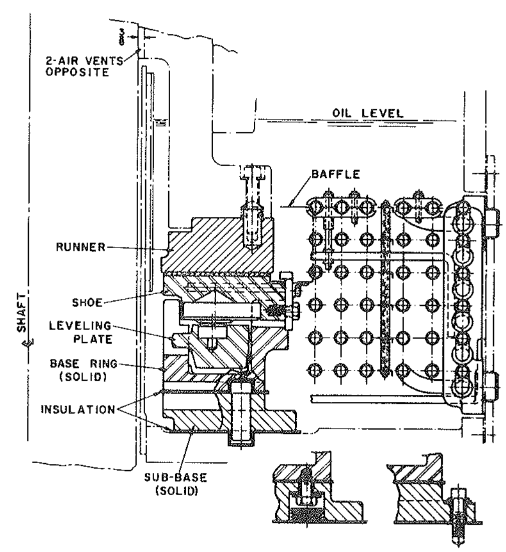


Figure 35
Style KBV bearing with complete insulation against stray currents.

Spare Parts

A Kingsbury Bearing correctly chosen, properly aligned and supplied with clean oil, is practically indestructible for the life of the ship. However, spare parts are customarily provided as a matter of insurance.

For marine machinery, American Bureau of Shipping rules will usually determine what spare parts are required. These regularly include thrust shoes, occasionally thrust collars, also journal bearing shells and cooler parts where fitted.

For other applications, it is usually sufficient to stock thrust shoes, and thrust collars or runners.

The other parts of the bearing practically never need replacement. Therefore, there is no need to carry *complete* bearings as spares.

Data Needed for Ordering

To make specific recommendations, we should have the fullest possible information on conditions to be met, as follows:

(A) Thrust load, maximum.

(B) Revolutions per minute, maximum.

(C) Shaft diameter (see pages 32 – 33).

(D) Will thrust collar be integral with shaft?

(E) Solid or split base rings? (Six-shoe only).

(F) Is cooling water available?

(G) Is external lubricating system available?

(H) Give space limitations, where applicable.

If, for any kind of application, the thrust load is not known, some sort of estimate must be made.

For propeller thrusts, we can make a sufficiently close estimate if given the following particulars:

Single, twin or multiple screws?

Maximum s.h.p. per shaft, and corresponding vessel speed, running free (not towing).

Propeller diameter, pitch and number of blades.

For dredge pump thrusts we should have also the impeller diameter, and the diameter of the suction opening or "eye" in the impeller.

Standard Guarantee

Any bearing or part furnished by us, which shall prove defective in design, material or workmanship, within one year after installation and test, will be replaced without charge f.o.b. Philadelphia, if returned to our factory. No allowance will be made for labor or other expense in connection therewith unless authorized in writing by an officer of the Company.

For oil coolers and cooling coils, in accordance with usual trade practice, there is no specific guarantee period.

KINGSBURY