LEG Bearings

THRUST AND JOURNAL

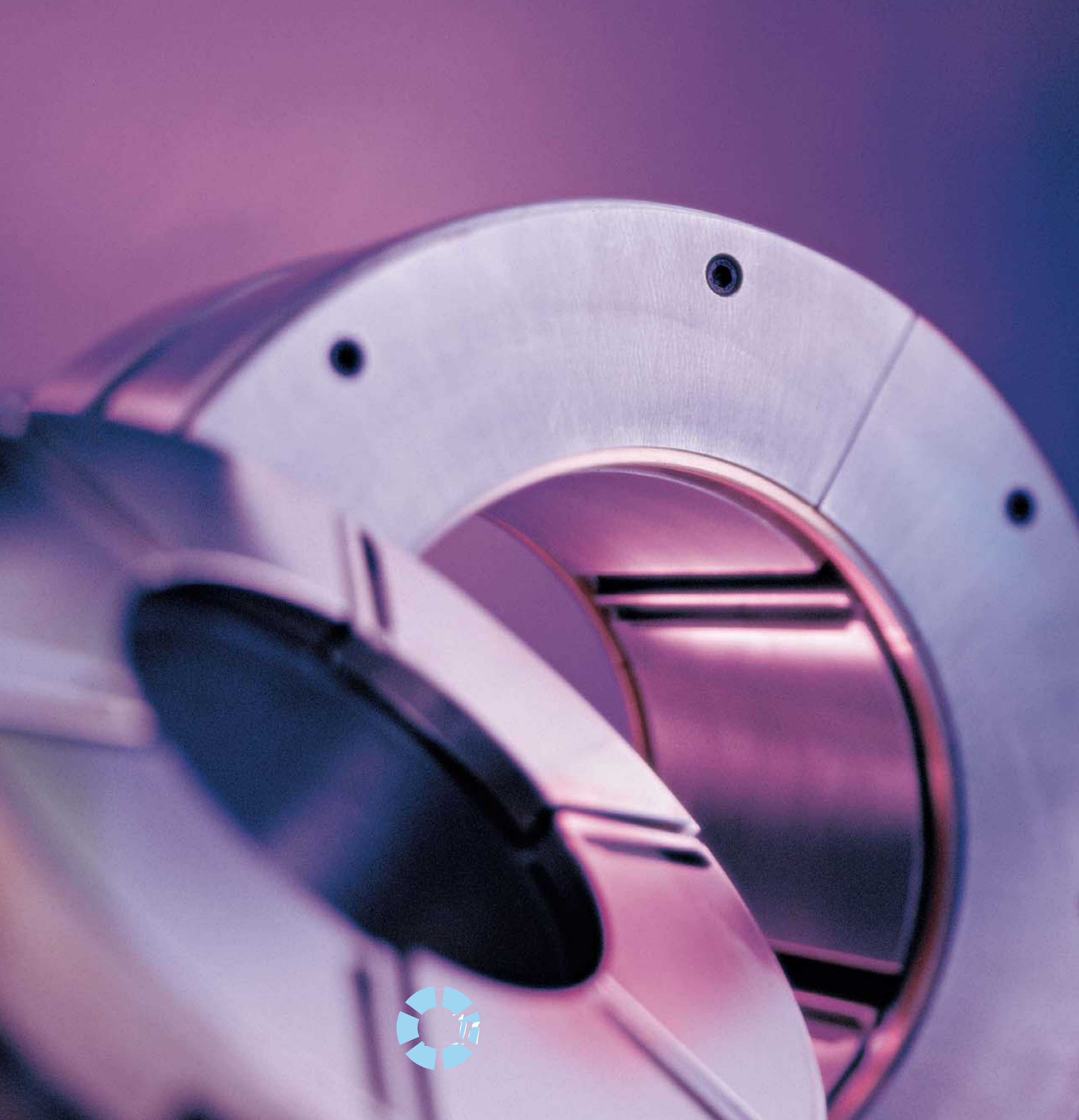


TABLE OF CONTENTS

INTRODUCTION

Kingsbury's patented Leading Edge Groove (LEG) thrust and journal bearings can significantly improve a machine's performance, reliability, and efficiency. Applications have proven that advanced design LEG bearings can, compared to already reliable standard Kingsbury bearings:

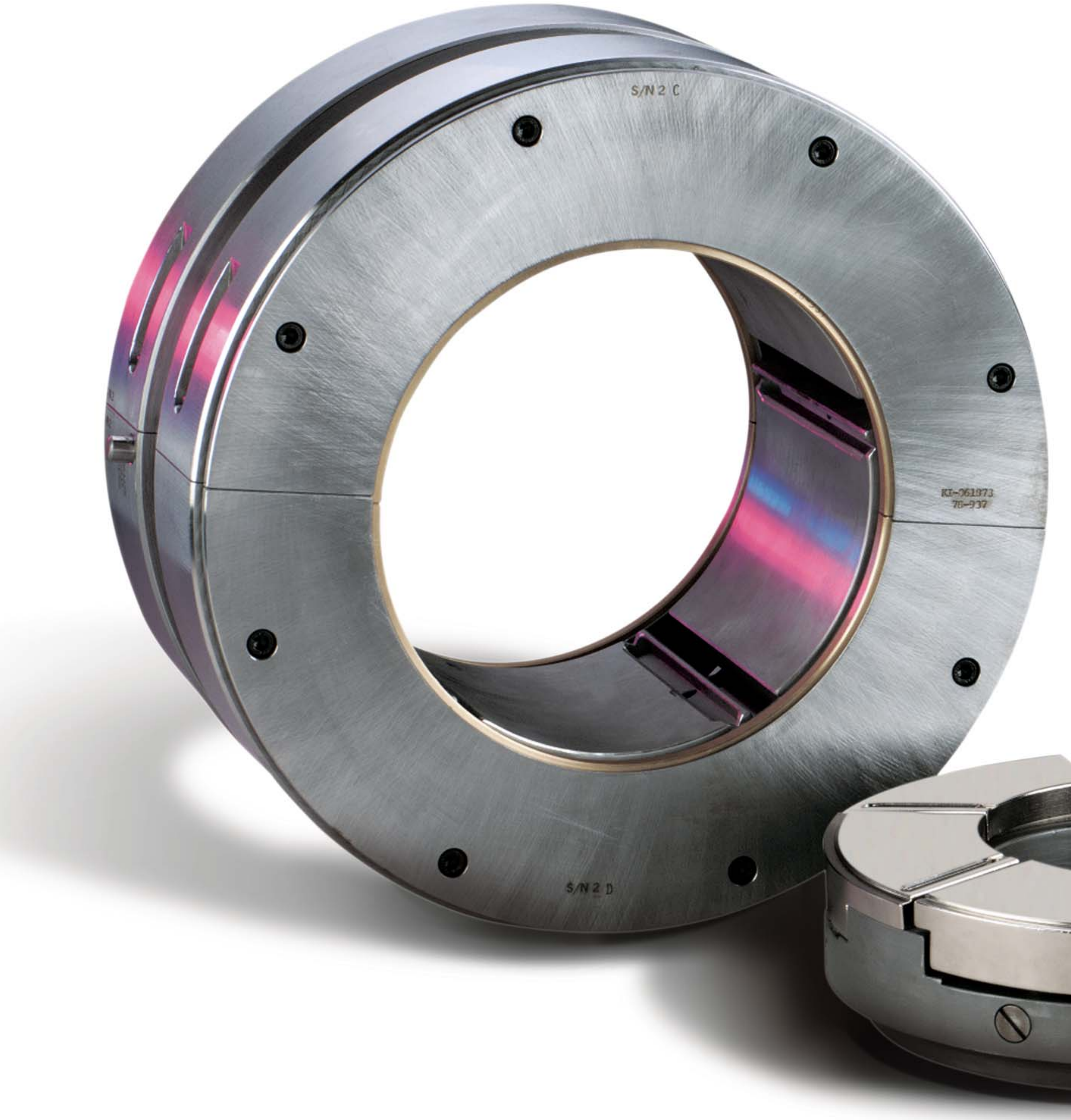
- Reliably operate with lower oil flow requirements.
- Substantially reduce bearing power losses.
- Significantly reduce operating temperatures.
- Dramatically increase load capacity.

Our LEG bearing design has been refined through exhaustive testing and represents the ultimate in directed lubrication technology. Yet the design is simple. The bearings are constructed so that cool inlet oil flows directly over the leading edge of the bearing shoe into the oil film which insulates the babbitt face from hot oil carryover.

Oil flow and power loss benefits are obtained by the efficient application of cool oil to the film. The LEG method of lubrication also allows operation in a non-flooded environment which eliminates parasitic (non-film) losses without risk of starving the oil film. Shoe temperature is lowered by protecting against the effects of hot oil carry-over and by reducing parasitic losses between shoes that would add heat to the oil film. The lower shoe temperatures increase the bearing's load capacity.

Kingsbury has used LEG lubrication in field applications since 1985. The applications and data demonstrate that LEG technology is a cost effective and reliable method of lubrication that improves efficiency, lowers capital costs, and adds value to machinery.

QUALITY STANDARDS:
KINGSBURY, INC.
ISO 9001/94 Registered


S/N 2 C
S/N 2 D

ADVANTAGES OF LEG TECHNOLOGY

LEG bearings use Kingsbury's original features to ensure optimum load distribution and trouble free operation, and also take advantage of other features such as offset pivots to achieve the best possible performance. Key features make the LEG bearing superior to other directed lubrication bearings in use today:

- Oil feed tubes connecting to the shoes ensures that cool oil does not bypass the film.
- The LEG feature is an integral part of the shoes.
- Large oil flow passages eliminate small-hole clogging.
- No oil seal rings are required, lowering power loss and simplifying design and installation.
- The LEG does not require (but can use) special, higher pressure lube systems typically needed for spray lubrication.

These optimum design and key features are standard on the LEG which contribute to the performance advantages. The LEG bearing's advantages extend beyond performance improvements. Since most of all the fresh oil flows into the oil wedge, the significant reduction in flow and power loss allows use of smaller lubrication oil systems, cutting capital costs.

LEG bearings are perfect for retrofit applications and can be used to economically increase bearing performance in existing installations. Retrofitting LEG bearings is the perfect solution if field experience has proven a bearing installation to be marginal or if upgrades or changes in operating conditions have caused an increase in load. LEG bearings can be installed quickly, without modifications to the bearing housing or shaft. Lubricating oil enters and exits the LEG bearing in the same manner as a standard bearing so no alterations need be made to the oil delivery system. Merely replacing standard bearings with LEG retrofits will immediately provide flow, power loss and shoe temperature advantages. Furthermore, with minor modifications to existing housing parts and flow paths, optimum benefits can be obtained.

For new applications as well as for retrofits, LEG thrust and journal bearings provide the following benefits:

- Lower friction power loss for increased overall machine efficiency.
- Lower operating temperature and increased load capacity.
- Lower oil flow requirements for smaller lubricating oil systems and lower capital costs.
- Ability to optimize for maximum load capacity or to minimize power loss.

LEG **Thrust**

Shoes

Kingsbury LEG bearing shoes are designed with offset pivots, 60% of the effective length of the shoe. (See "Optimized Offset," page 51, for further discussion.)

Standard materials of construction of shoe body are low carbon steel with high tin content babbitt. Material selection can be engineered to meet unusual applications.

Kingsbury utilizes a distinctive raised spherical support on the back of the shoe to allow full 360° pivot, rather than a raised strip which only allows shoe tilt in one direction. Shoe supports are made of carbon tool steel, heat treated to 52 to 57 Rockwell C to ensure no flattening of the sphere. Kingsbury tests indicate that this feature allows self-aligning of the shoe which lowers the difference between shoe temperatures.

Base Ring

Made of structural steel plate or forged steel, the base ring holds the shoes and leveling plates in their operating positions. An oil inlet annulus, at the back of the base ring, distributes oil to axial holes through the base ring outer wall and into the oil feed tube.

Oil Feed Tube

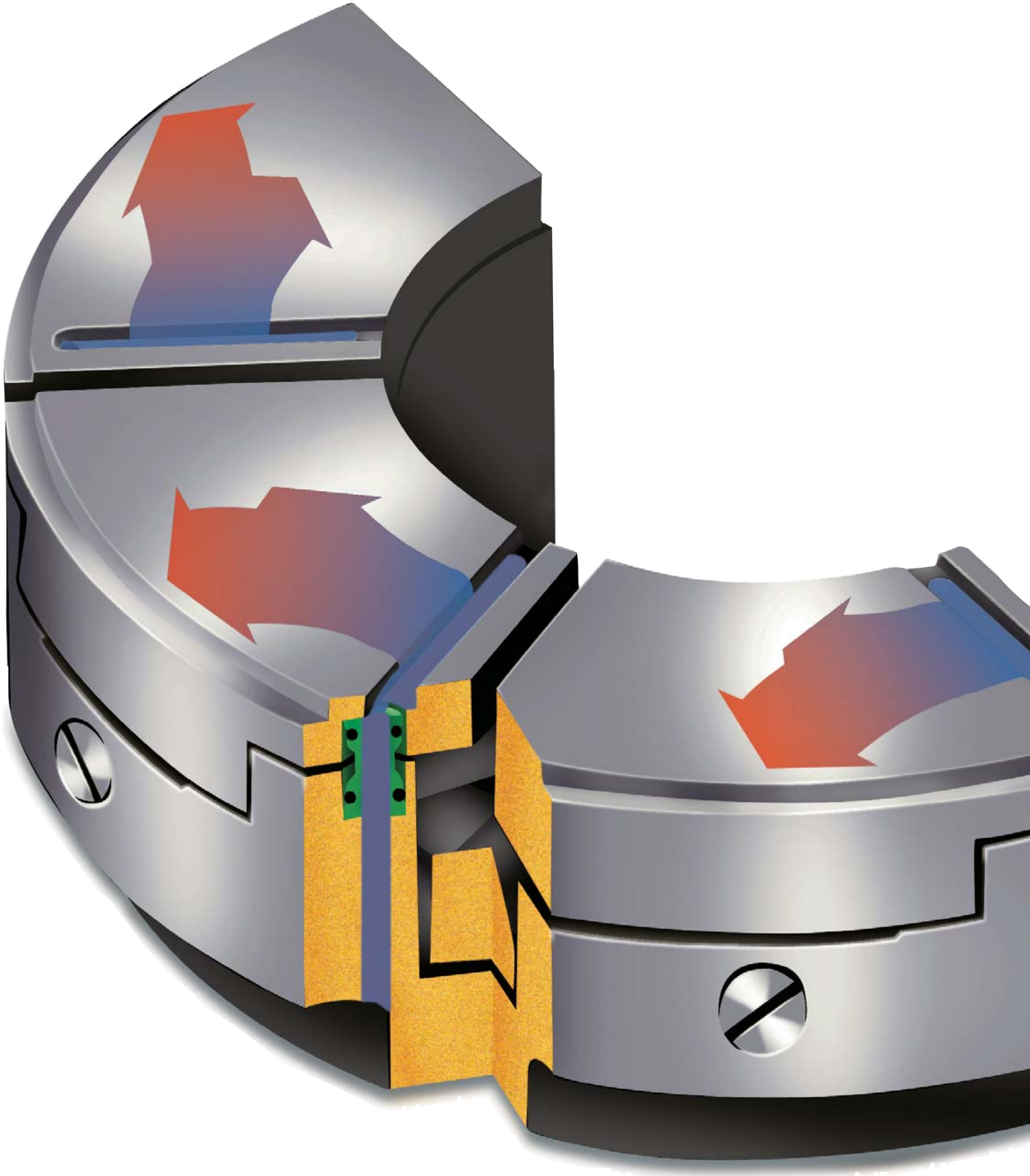
The oil feed tube, connecting the base ring and shoe, is uniquely designed so that the shoe is free to pivot. This allows freedom of movement in the shoe and ensures that oil is fed directly to the shoe face.

Leveling Plate Assembly

The equalizing feature of the Kingsbury thrust bearing allows each shoe to carry an equal amount of the total thrust load. That is, the leveling plate feature reduces the chance of one shoe being more highly loaded than another shoe. The leveling plates working with the spherical shoe supports ensure that the thrust bearing face becomes perfectly aligned with the rotating thrust collar.

Shoe Retention

Shoes are retained to facilitate assembly. See page 29 for further details.



LEG BEARINGS OUTPERFORM FLOODED AND OTHER DIRECTED LUBE TYPES

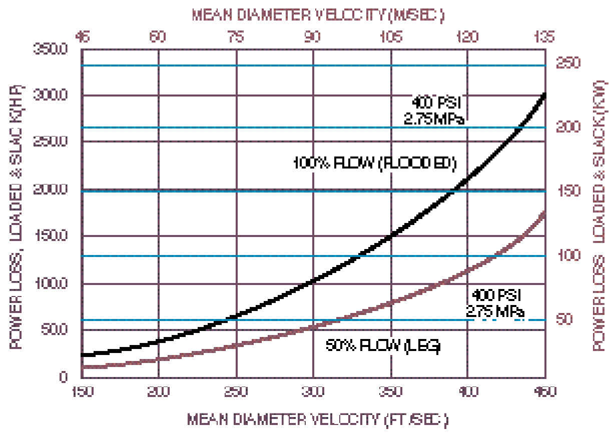
Kingsbury's LEG bearing design has proven itself through exhaustive testing and years of trouble-free operation to represent the ultimate in directed lubrication technology. Yet the design concept is remarkably simple.

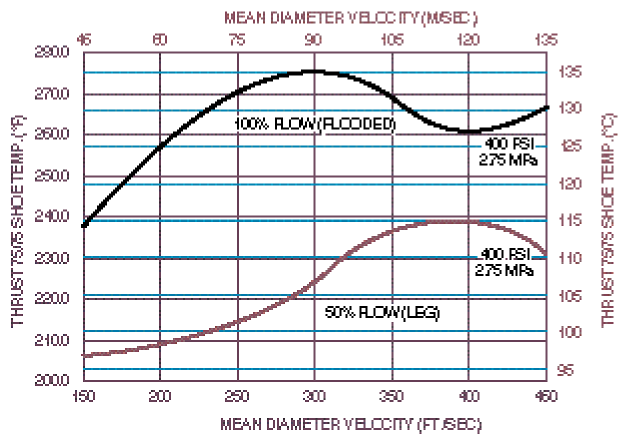
The bearing shoes and base ring are constructed so that cool undiluted inlet oil flows from the leading edge groove in the bearing shoe directly into the oil film. The cool oil in the oil film wedge insulates the babbitt face from the hot oil carryover that adheres to the rotating collar.

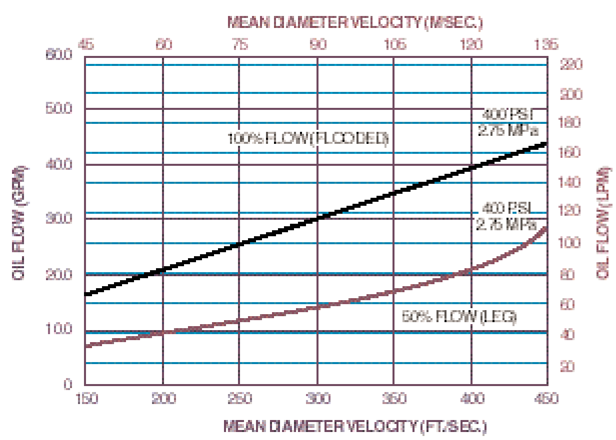
Because of these features, LEG thrust bearings can:

- Reduce operating temperatures at the 75/75 location by 8 to 28°C, depending on load and shaft speed.
- Provide a load capacity increase of 15 to 35%.
- Operate at oil flow rates as much as 60% lower, with an accompanying reduction in power losses of 45%.

Power loss is lower than both flooded and spray feed bearings due to the elimination of parasitic losses. The flow of cool oil over the leading edge lowers shoe surface temperatures, increasing the LEG bearing's capacity. The resulting performance improvements are shown in these graphs.







HOW TO SELECT AN LEG THRUST BEARING

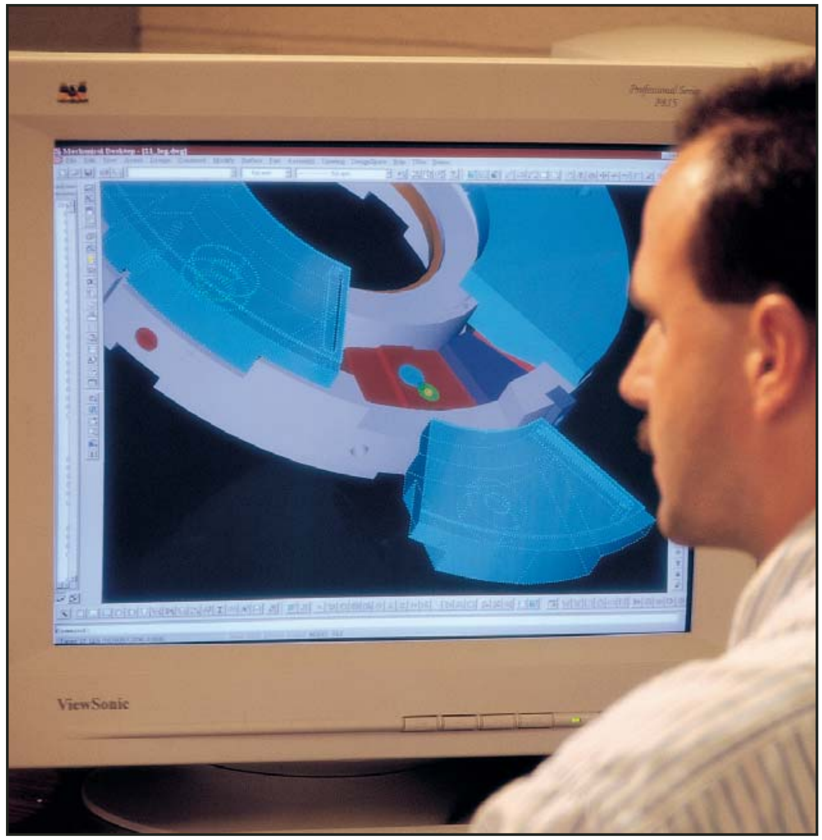
Thrust load, shaft RPM, oil viscosity and shaft diameter will determine the bearing size selected.

Size the bearing for normal load and speed when transient load and speed are within 20% of normal conditions. If transients exceed 120% of normal, please consult our engineering department for specific recommendations.

The selection curves for load capacity, friction power loss, and oil flow requirements in this catalog are divided into English and Metric groupings and are based on an oil viscosity of 150 SSU @ 100° F (ISO VG32), with an inlet oil temperature of 120° F (50° C). We recommend ISO VG32 oil viscosity for moderate and high speed applications. For other oil viscosities consult our engineering department for assistance in bearing selection.

Step-by-Step Sizing

1. Enter the load capacity curves, with the required bearing rated load and move horizontally along the corresponding rated load line until it intersects the vertical line representing the shaft RPM. The bearing size curve immediately above the intersection is the selected bearing size.



2. Next, find the selected bearing dimensions. Check to see if your shaft diameter is smaller than the maximum shaft diameter listed for the selected bearing.

3. Enter the power loss and oil flow curves, with the selected bearing size and the normal RPM to determine the power loss and oil flow.

4. Using the shoe temperature curves, determine that shoe temperatures are within acceptable limits.

If you need help selecting a bearing, contact Kingsbury's engineering department.

LUBRICATION REQUIREMENTS

LEG bearings, like other Kingsbury bearings, are designed to operate with a continuous supply of oil to the bearing shoe faces. An orifice is required before the bearing to properly regulate flow and pressure (See page 50, "Pressure and Flow Orifice"). The oil supplied to the bearing should be cooled and filtered to a normal of 25 microns.

BEARING HOUSING REQUIREMENTS

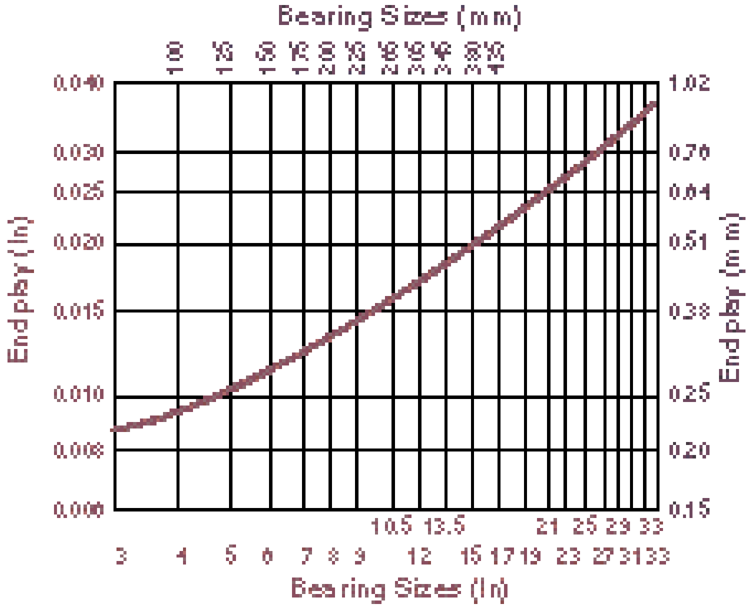
The bearing housing requirements for the LEG thrust bearing are similar to those of standard thrust bearings. No oil seal rings are required since the inlet oil is confined to passages within the base ring assembly. Fresh oil enters the bearing through an annulus located at the bottom of the base ring. The discharge space should be large enough to minimize contact between the discharged oil and the rotating collar. The discharge oil outlet should be amply sized so that oil can flow freely from the bearing cavity.

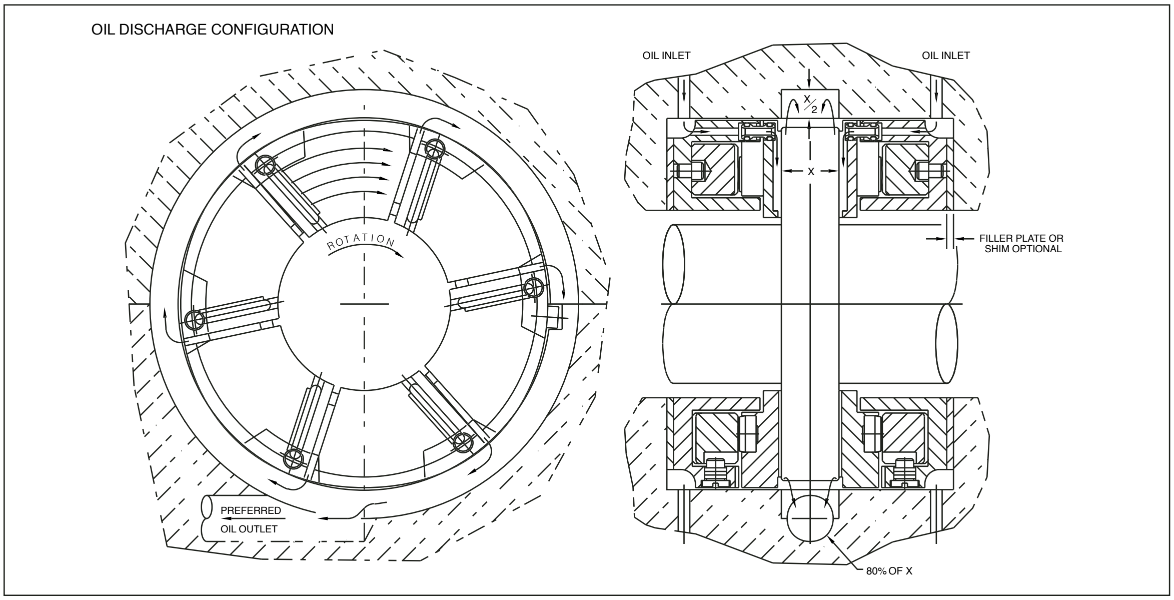
The typical bearing housing shown here provides our recommendations for sizing the discharge annulus. Kingsbury recommends a tangential discharge opening, equal to 80% of the collar thickness. If possible the discharge outlet should be located in the bottom half of the bearing housing.

BEARING CLEARANCE (ENDPLAY)

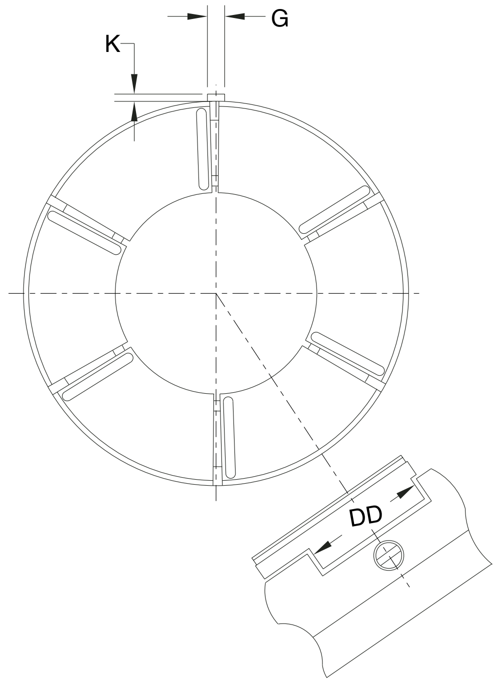
A certain amount of clearance is required for proper bearing operation. Clearance is typically adjusted by use of filler plates and/or shims during installation. The accompanying graph provides recommended values.

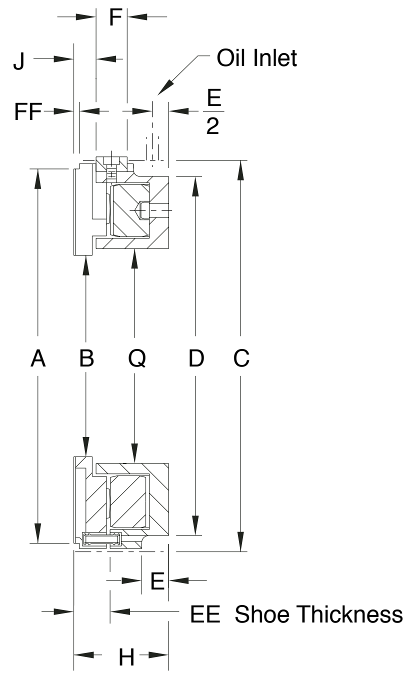
RECOMMENDED NOMINAL ENDPLAY

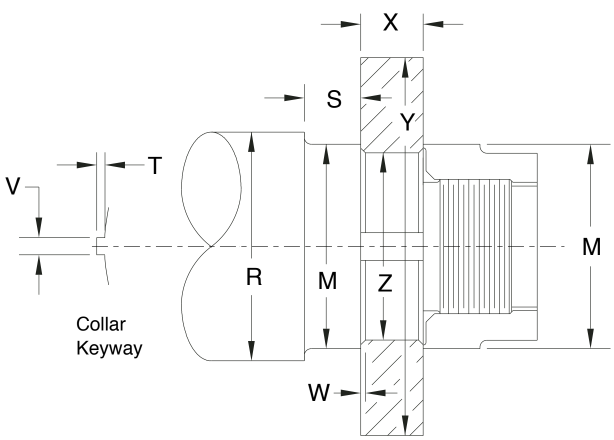


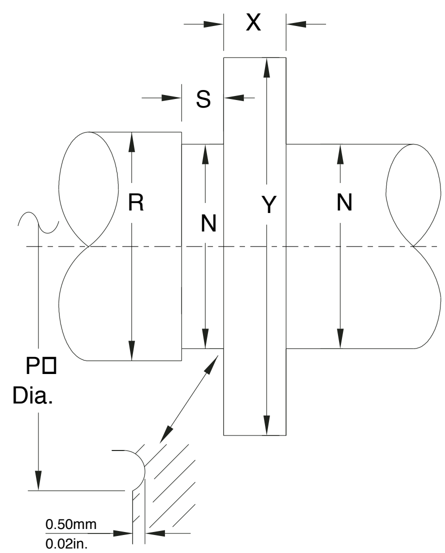


J-STYLE LEG BEARINGS (ENGLISH)

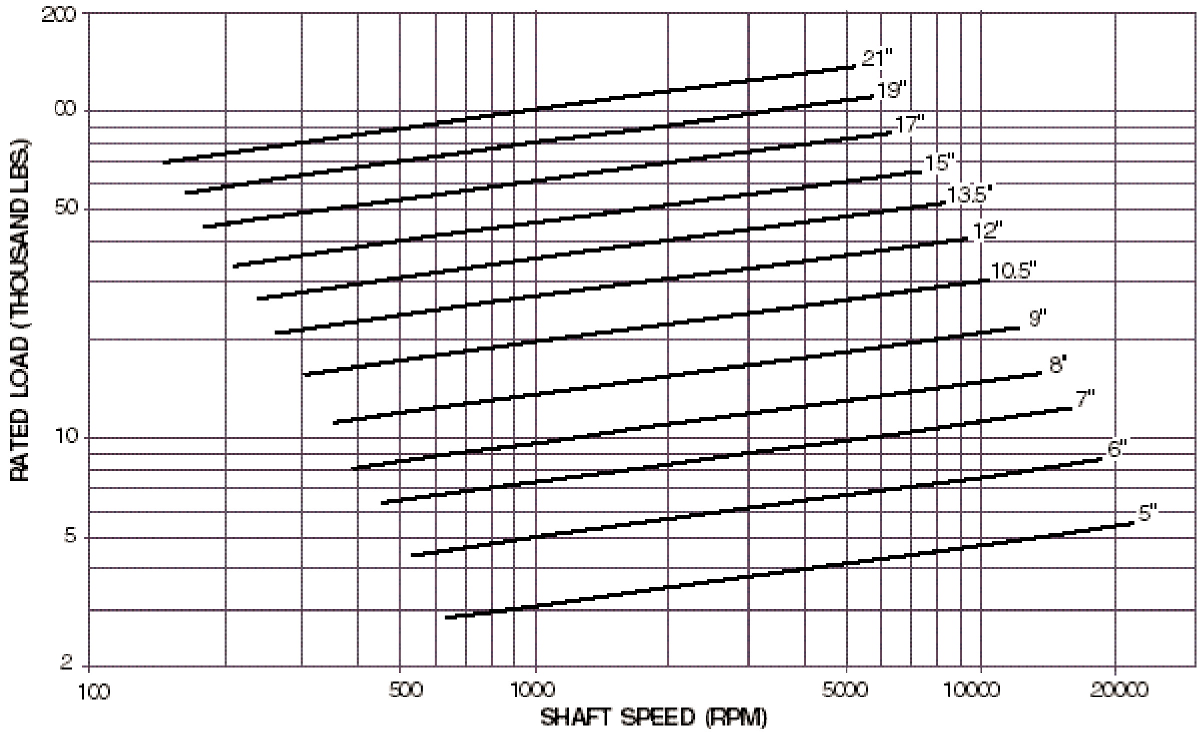








RATED LOAD FOR J-STYLE LEG THRUST BEARINGS

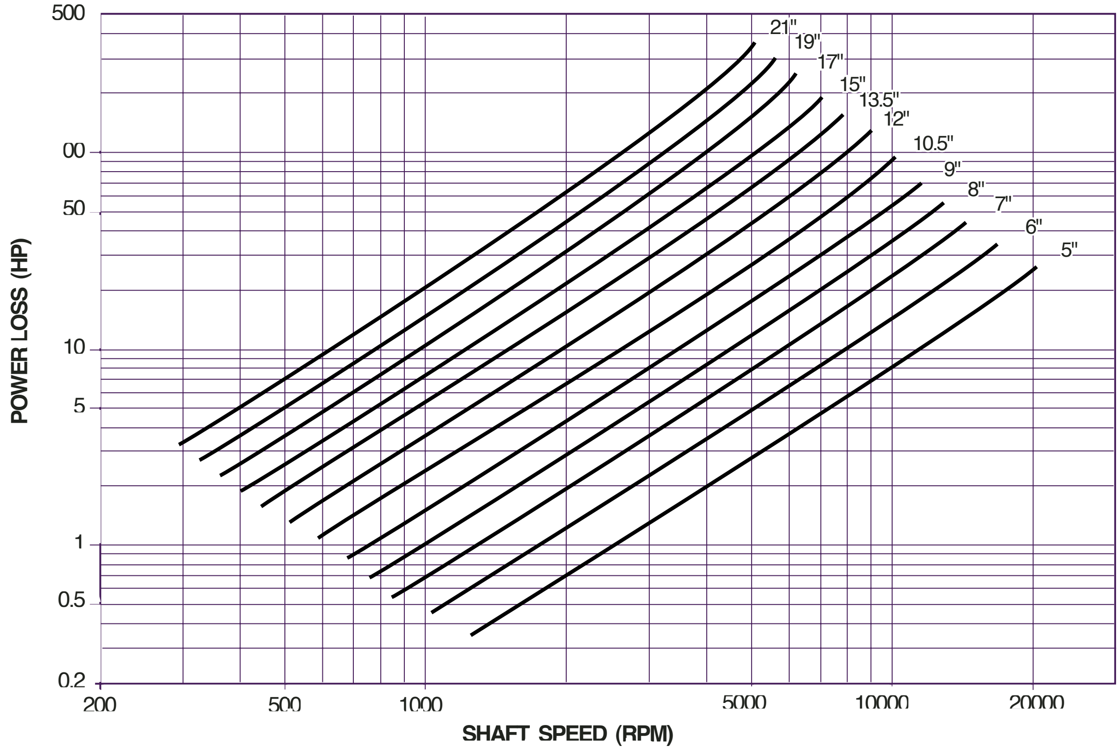


Based on ISO VG 32 supplied at 120° F

ENGLISH SIZES (Inches)

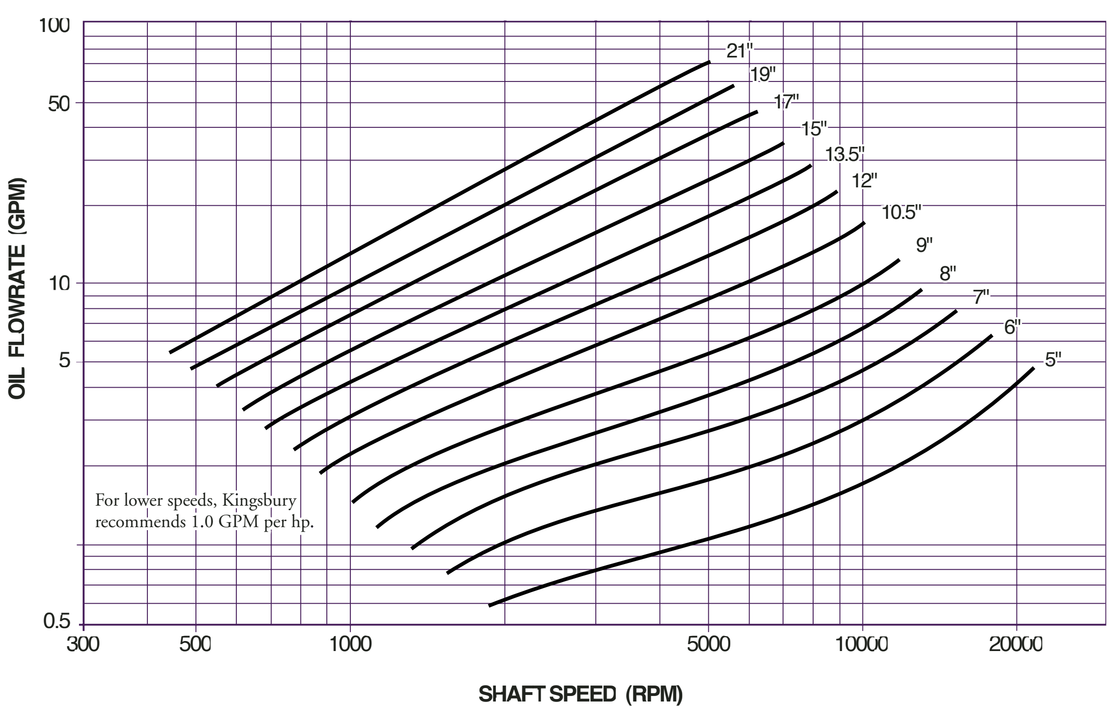
Brg. Size	5	6	7	8	9	10.5	12	13.5	15	17	19	21
No. of Shoes	6	6	6	6	6	6	6	6	6	6	6	6
Area (in^2)	12.5	18.0	24.5	31.4	40.5	55.1	72	91.1	112.5	144.5	180.5	220.5
A - Babbitt O.D.	5.00	6.00	7.00	8.00	9.00	10.50	12.00	13.50	15.00	17.00	19.00	21.00
B - Babbitt I.D.	2.50	3.00	3.50	4.12	4.50	5.25	6.00	6.75	7.50	8.50	9.50	10.5
H - Bearing Height (J)	1.75	2.06	2.38	2.69	3.00	3.38	3.75	4.25	4.62	5.25	5.25	5.25
H - Bearing Height (B)	1.62	1.88	2.12	2.38	2.69	2.94	3.25	3.56	3.88	4.38	4.75	5.25
C - Bearing O.D.	5.375	6.375	7.375	8.375	9.375	11.000	12.500	14.000	15.500	17.625	20.250	22.250
Q - Base ring I.D.	2.75	3.25	3.75	4.31	4.88	5.69	6.50	7.31	8.12	9.19	10.62	11.75
D - Oil annulus dia.	4.94	5.94	6.75	7.62	8.62	10.00	11.56	13.00	14.50	16.50	18.5	20.25
E - Oil annulus depth, min.	0.38	0.38	0.44	0.50	0.56	0.56	0.69	0.75	0.62	0.94	0.88	1.00
F - Bearing key, length	0.56	0.66	0.81	0.94	0.94	1.12	1.19	1.38	1.50	1.62	1.75	1.75
G - Bearing key, width	0.31	0.38	0.38	0.44	0.44	0.50	0.56	0.62	0.69	0.75	0.88	1.00
J - Collar to key	0.31	0.38	0.47	0.50	0.56	0.62	0.69	0.75	0.81	0.94	1.00	1.12
K - Key projection	0.16	0.19	0.19	0.19	0.19	0.22	0.22	0.25	0.31	0.31	0.34	0.38
M - Separate shaft dia.	2.25	2.75	3.25	3.75	4.25	4.88	5.62	6.38	7.00	8.00	8.88	9.88
N - Intergral shaft dia.	2.12	2.62	3.12	3.62	4.12	4.75	5.50	6.25	6.88	7.88	8.75	9.75
P - Max dia. over fillet	2.41	2.92	3.42	3.91	4.42	5.12	5.87	6.62	7.32	8.32	9.27	10.27
R - Dia. through base ring	2.50	3.00	3.50	4.00	4.50	5.25	6.00	6.75	7.50	8.50	9.75	10.75
S - Shaft lgth @ shoe I.D.	0.62	0.75	0.88	1.00	1.12	1.25	1.38	1.50	1.62	1.75	2.00	2.25
X - Collar thickness	0.88	1.00	1.25	1.38	1.50	1.75	2.00	2.25	2.50	2.88	3.25	3.62
Y - Collar dia.	5.12	6.12	7.12	8.12	9.12	10.69	12.19	13.69	15.19	17.25	19.25	21.25
Z - Collar bore	1.750	2.125	2.500	3.000	3.500	4.125	4.750	5.375	6.000	6.625	7.500	8.500
T - Collar key depth	0.19	0.19	0.25	0.31	0.31	0.38	0.38	0.44	0.50	0.50	0.56	0.62
V - Collar key width	0.38	0.38	0.50	0.63	0.63	0.75	0.75	0.88	1.00	1.00	1.13	1.25
W - Collar chamfer	0.06	0.06	0.06	0.06	0.06	0.09	0.09	0.09	0.09	0.12	0.12	0.12
DD - Straddle mill	1.59	1.97	2.34	2.72	3.03	3.19	3.97	4.22	5.09	5.72	5.97	6.97
EE - Shoe thickness	0.625	0.750	0.875	1.000	1.125	1.250	1.375	1.500	1.625	1.812	2.000	2.188
FF - Shoe relief	0.16	0.16	0.19	0.22	0.31	0.28	0.34	0.38	0.12	0.12	0.38	0.50
Weight (Lbs) Bearing	5.6	9.0	14.8	20.9	30.5	44.9	64.4	90.9	123.7	176.0	237.0	312.0
Weight (Lbs) Collar	4.5	7.3	12.3	17.4	23.6	37.8	56.0	79.2	108.1	162.2	226.8	304.8
Weight (Lbs) Spare shoes	2.1	3.5	5.5	7.8	11.2	18.0	25.0	34.5	47.0	68.0	100.0	132.0

POWER LOSS: DOUBLE ELEMENT J-STYLE LEG BEARINGS



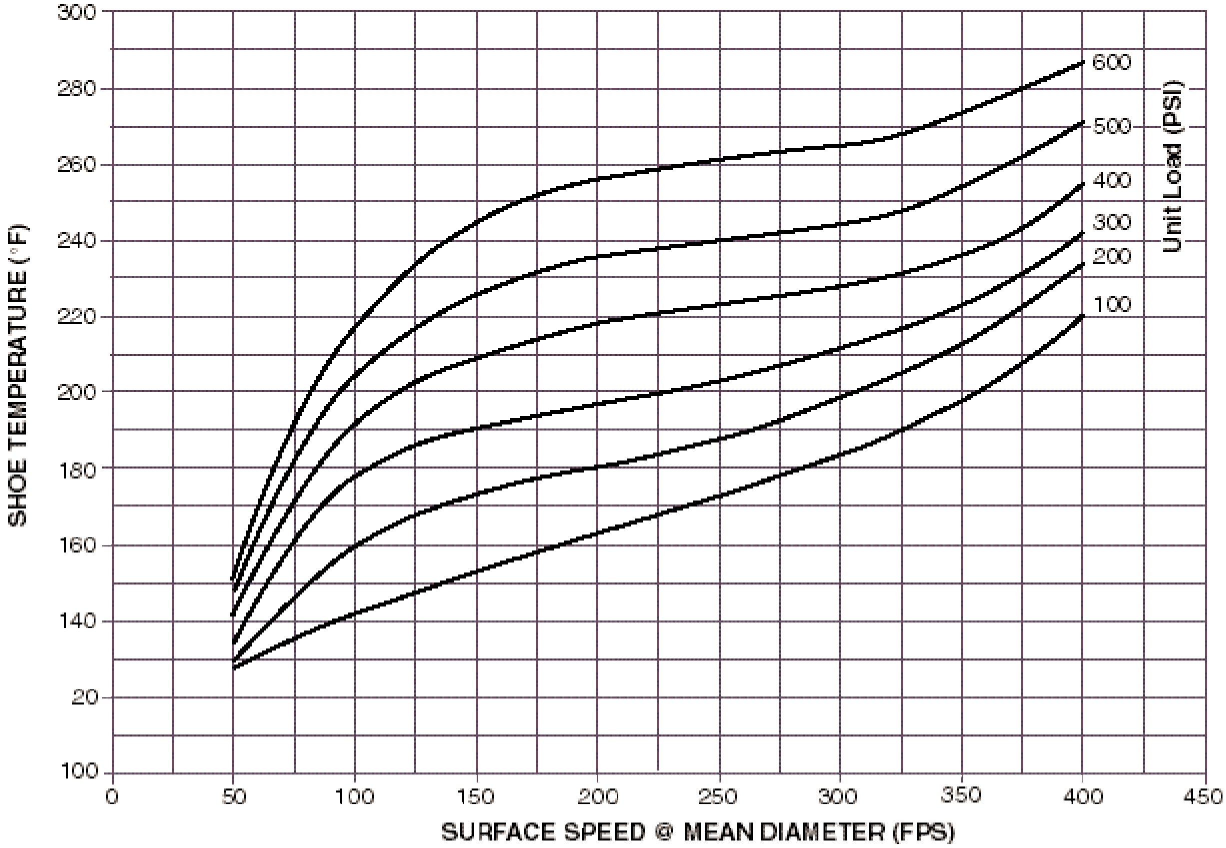
Based on 20% Slack Flow & ISO VG 32 supplied at 120° F.
Power loss is based on rated load, recommended oil flow, and Kingsbury's recommended discharge configuration.
If any of these is changed the power loss will also change.

OIL SUPPLY FOR J-STYLE LEG BEARINGS

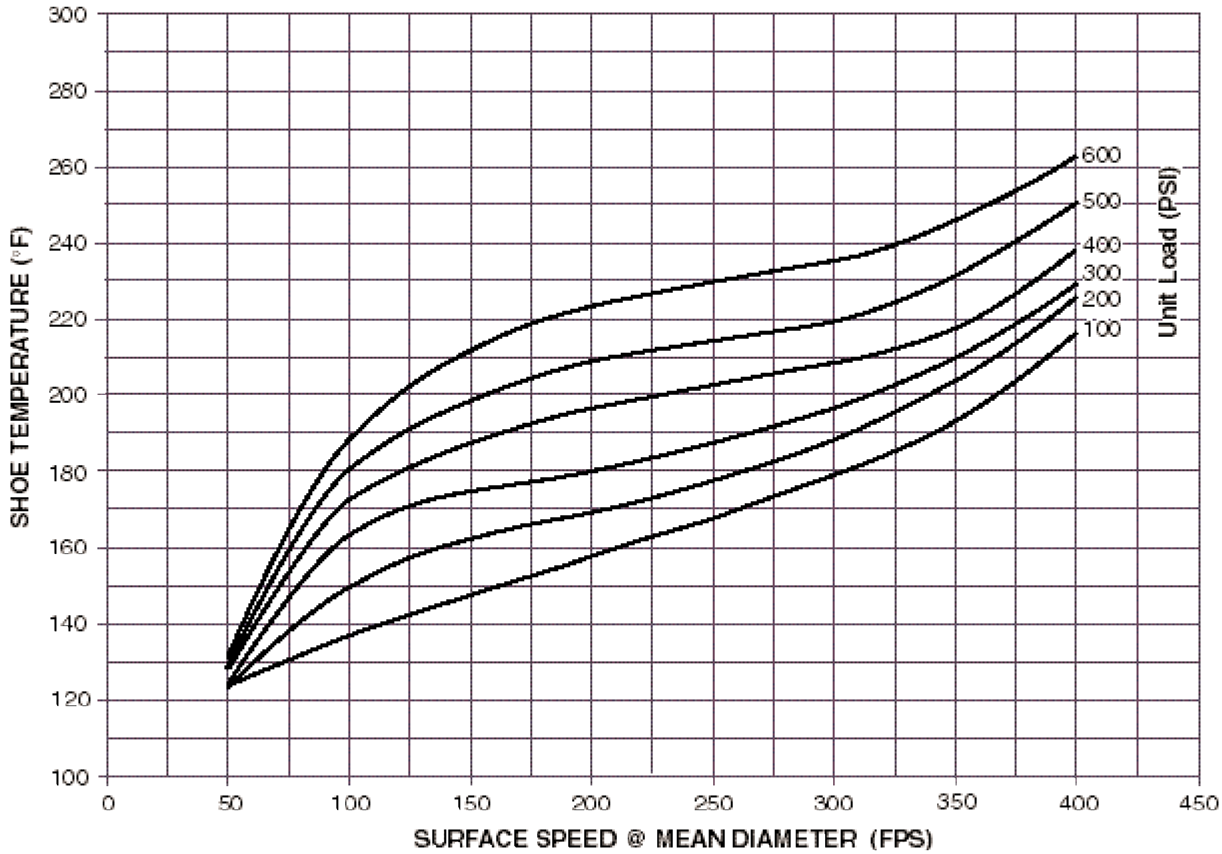


Based on ISO VG 32 supplied at 120°F.
This chart gives loaded side, single element flowrates for rated load. For double element bearings, supply an additional 20% to the inactive side. In machines where load may reverse and apply rated values to either side, provide equal flow to each side (a total of two times the chart value).

75/75 SHOE TEMPERATURE (STEEL)

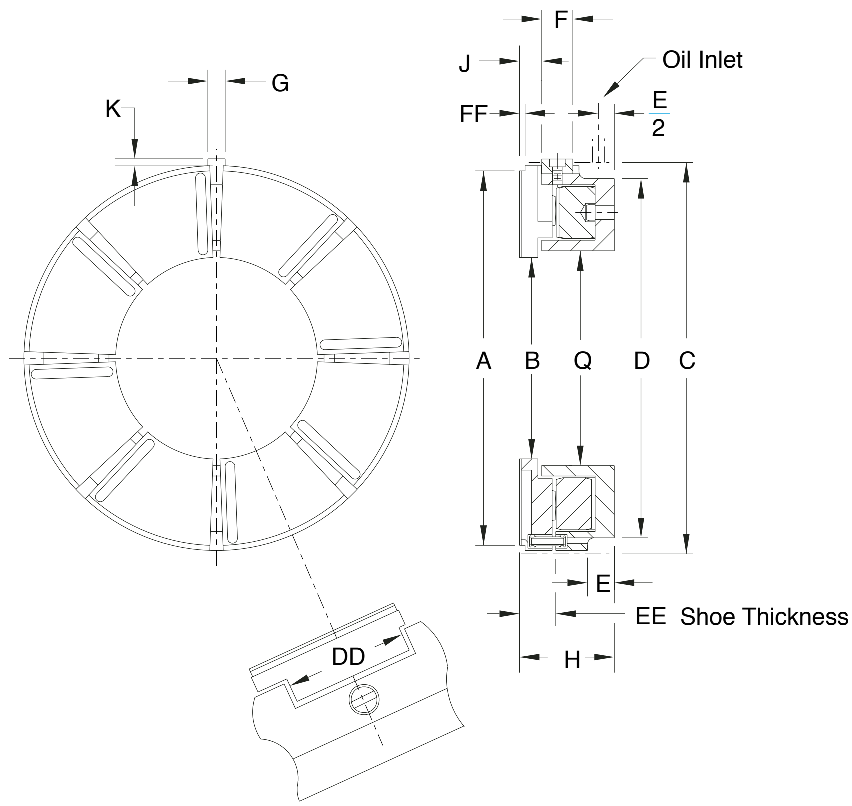


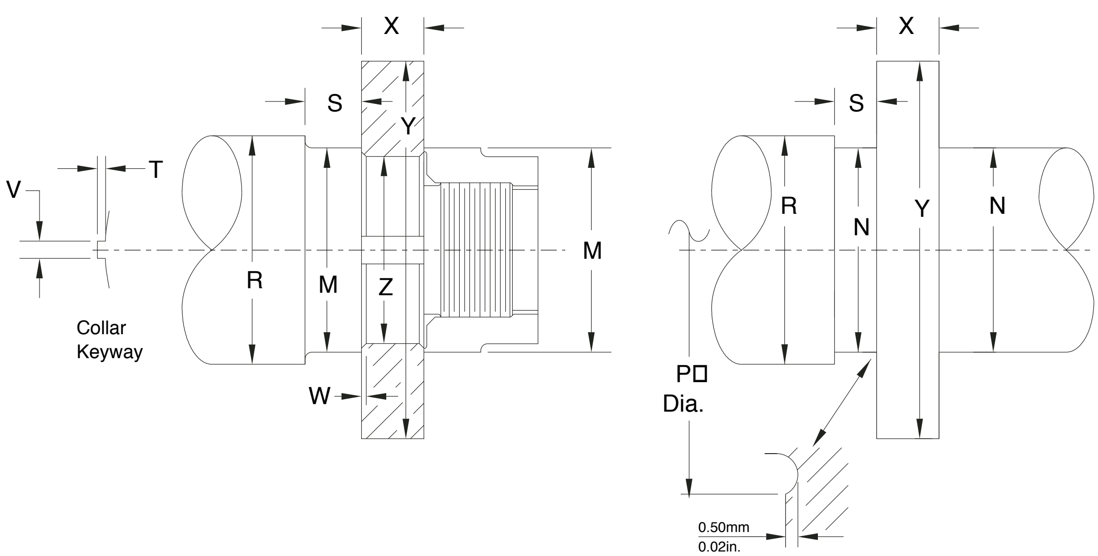
75/75 SHOE TEMPERATURE (CR-CU)



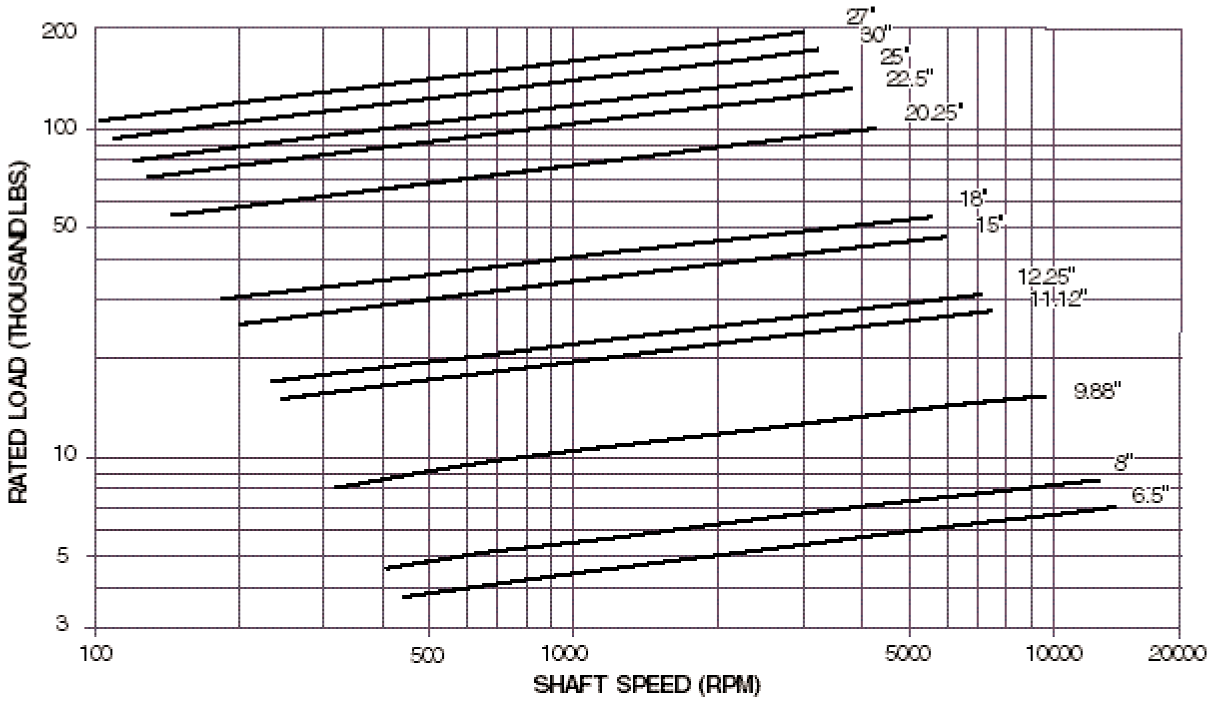
Temperatures are based on recommended oil, flow, and supply temperatures.
Unit load is load divided by bearing area.

S-STYLE LEG BEARINGS (ENGLISH)





RATED LOAD FOR S-STYLE LEG THRUST BEARINGS

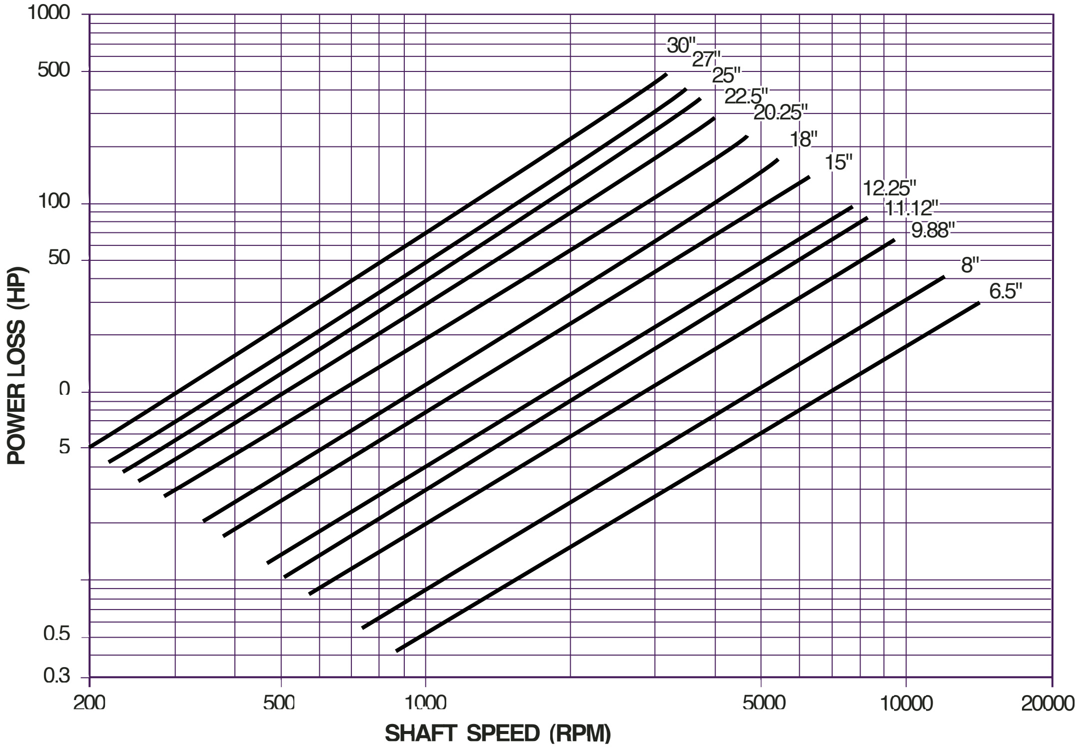


Based on ISO VG 32 supplied at 120°F.

ENGLISH SIZES (Inches)

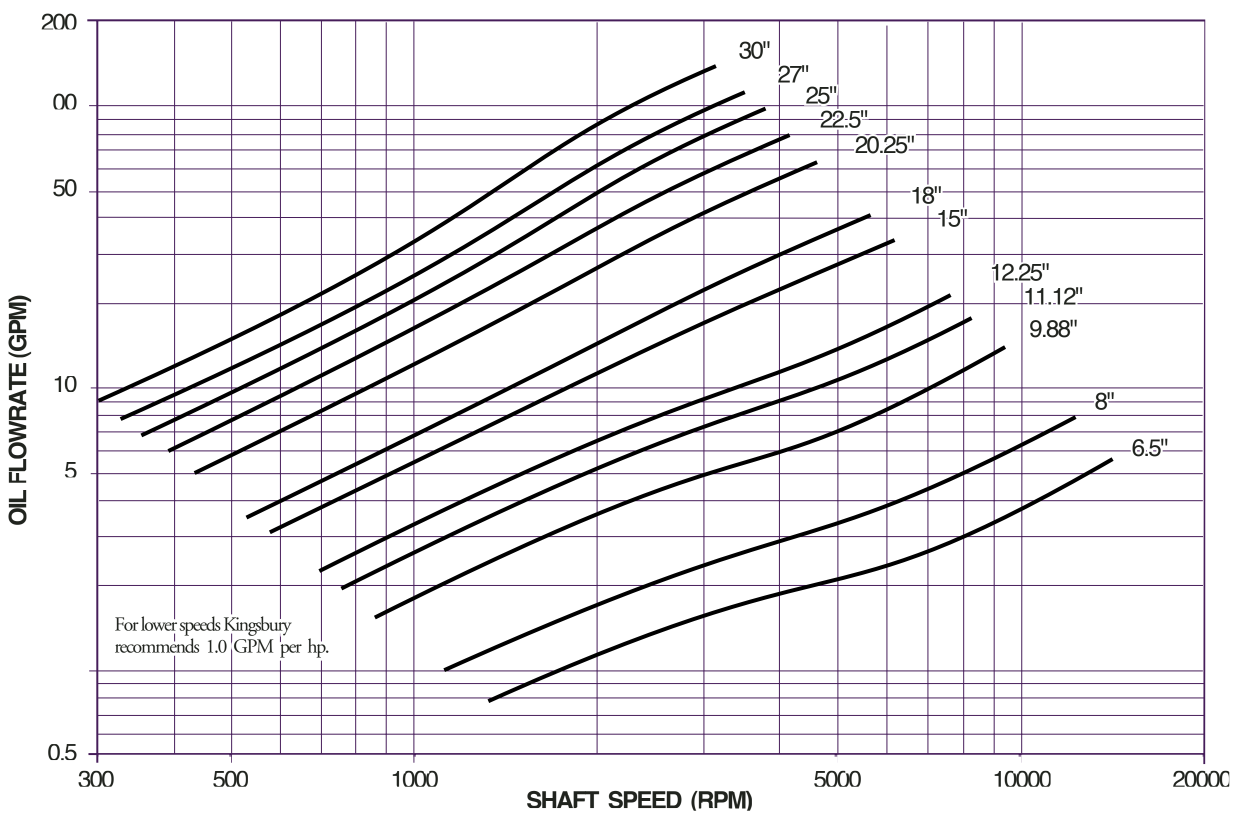
Brg. Size	6.5	8	9.88	11.12	12.25	15	18	20.25	22.5	25	27	30
No. of Shoes	8	8	12	8	8	10	8	8	8	8	8	12
Area (in²)	15.3	19.2	30.6	54.1	60.6	82.4	89.0	172.0	217.0	259.0	292.0	271.0
A - Babbitt O.D.	6.50	8.00	9.88	11.12	12.25	15.00	18.00	20.25	22.50	25.00	27.00	30.00
B - Babbitt I.D.	4.06	5.50	7.00	6.50	7.50	9.75	12.25	12.00	13.00	15.00	15.50	20.88
H - Bearing Height	1.56	1.94	1.88	2.75	2.31	2.88	3.50	4.50	5.00	5.50	5.75	5.00
C - Bearing O.D.	6.750	8.375	10.125	11.500	12.625	15.500	18.750	21.000	23.125	26.500	28.000	31.187
Q - Base ring I.D.	4.06	5.50	7.00	6.75	7.62	10.25	12.75	12.75	14.00	15.62	17.25	20.88
D - Oil annulus dia.	6.12	7.81	9.50	10.62	11.56	14.25	17.50	19.50	21.50	24.00	25.25	28.94
E - Oil annulus depth	0.31	0.53	0.50	0.62	0.44	0.69	0.88	1.00	1.25	1.19	1.25	1.58
F - Bearing key, length	0.56	0.75	0.66	0.94	0.50 dia	0.50 dia	1.19	1.38	1.62	2.50	2.12	1.00 dia
G - Bearing key, width	0.31	0.50	0.31	0.44	0.50 dia	0.50 dia	0.56	0.62	0.75	1.12	1.25	1.00 dia
J - Collar to key	0.37	0.44	0.41	0.59	1.06	0.88	0.75	0.93	1.12	1.12	1.31	1.50
K - Key projection	0.16	0.19	0.19	0.19	0.19	0.19	0.22	0.25	0.38	0.50	0.50	0.50
M - Separate shaft dia.	3.88	5.25	6.62	6.12	7.12	9.38	11.88	11.50	12.50	14.50	14.75	20.00
N - Intergral shaft dia.	3.62	5.00	6.38	5.88	6.88	9.00	11.50	11.00	12.00	14.00	14.25	19.50
P - Max dia. over fillet	3.88	5.31	6.81	6.31	7.31	9.56	12.00	11.75	12.62	14.62	15.00	20.38
R - Dia. through base ring	3.88	5.25	6.62	6.38	7.25	9.88	12.38	12.25	13.50	15.12	16.50	20.00
S - Shaft lgth @ shoe I.D.	0.62	0.62	0.75	1.00	1.00	1.00	1.50	1.50	1.75	1.75	2.00	2.00
X - Collar thickness	1.00	1.38	1.50	1.75	2.00	2.00	2.50	3.00	3.25	4.25	4.50	3.75
Y - Collar dia.	6.62	8.12	10.00	11.25	12.38	15.12	18.25	20.50	22.75	25.25	27.25	30.25
Z - Collar bore	3.250	4.500	6.000	5.500	6.500	8.250	10.500	10.250	11.250	13.000	13.500	18.500
T - Collar key depth	0.19	0.31	0.19	0.31	0.38	0.38	0.50	0.50	0.62	0.75	0.75	0.75
V - Collar key width	0.38	0.62	0.38	0.62	0.75	0.75	1.00	1.00	1.25	1.50	1.50	1.50
W - Collar chamfer	0.02	0.06	0.06	0.09	0.09	0.09	0.12	0.12	0.16	0.16	0.16	0.16
DD - Straddle mill	1.47	1.63	1.66	2.78	2.88	2.91	3.56	4.50	4.97	6.22	5.62	4.00
EE - Shoe thickness	0.593	0.687	0.781	1.125	1.125	1.250	1.438	1.750	1.937	2.125	2.375	2.000
FF - Shoe relief	0.06	0.06	0.06	0.06	0.08	0.08	0.06	0.12	0.12	0.19	0.19	0.19
Weight (Lbs) Bearing	9.0	16.0	20.0	48.0	48.0	80.0	130.0	250.0	340.0	500.0	560.0	540.0
Weight (Lbs) Collar	7.5	14.0	21.0	37.0	50.0	71.0	125.0	210.0	285.0	440.0	560.0	480.0
Weight (Lbs) Spare shoes	3.0	4.0	6.0	14.0	16.0	25.0	40.0	75.0	100.0	145.0	180.0	215.0

POWER LOSS: DOUBLE ELEMENT S-STYLE LEG BEARINGS



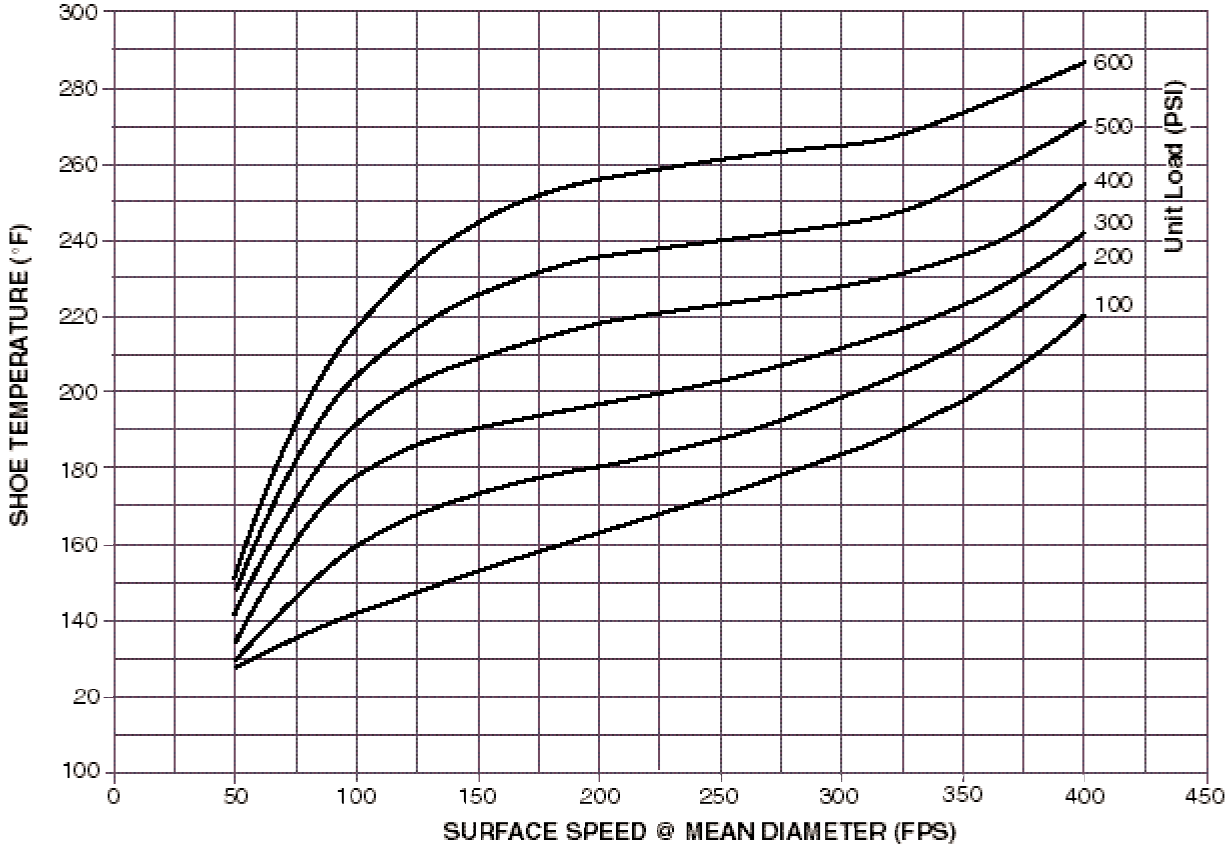
Based on 20% Slack Flow & ISO VG 32 supplied at 120°F.
Power loss is based on rated load, recommended oil flow, and Kingsbury's recommended discharge configuration.
If any of these is changed the power loss will also change.

OIL SUPPLY FOR S-STYLE LEG BEARINGS

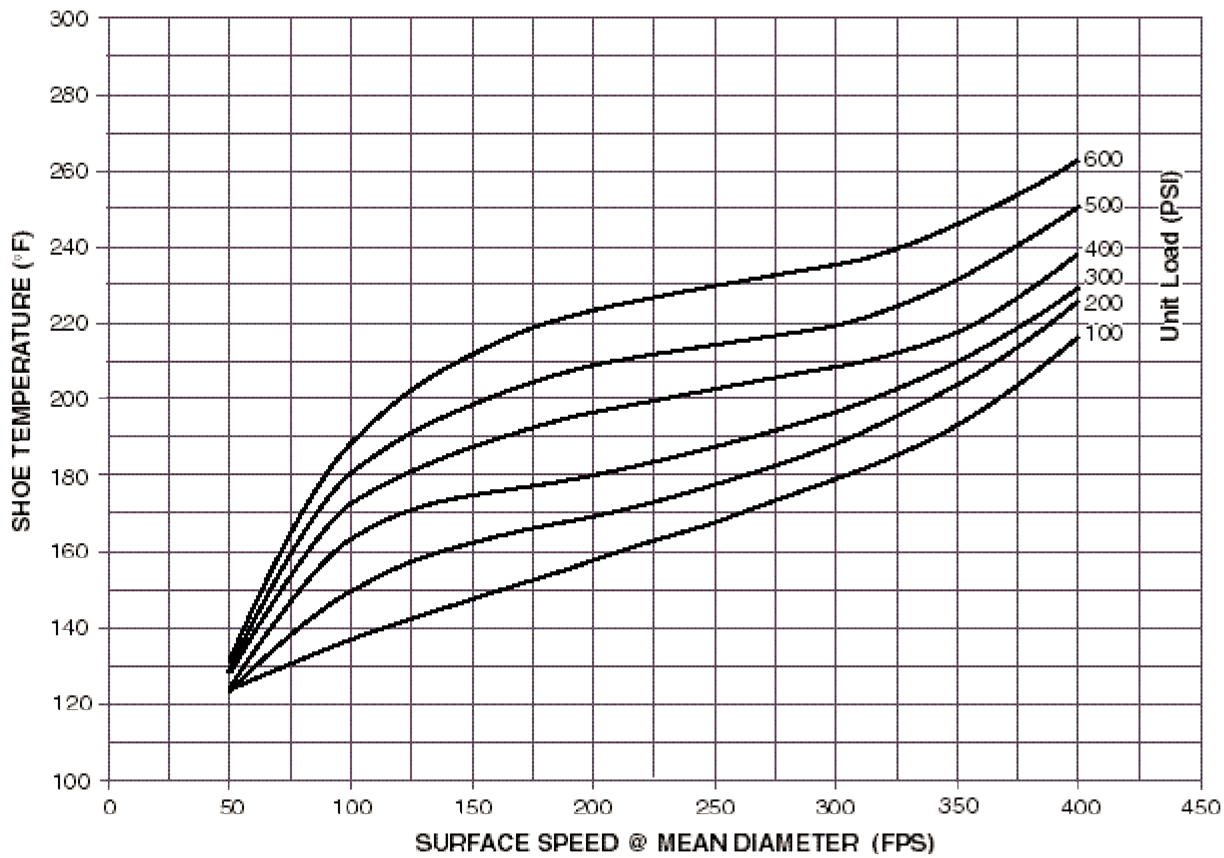


Based On 20% Slack Flow & ISO VG 32 supplied at 120°F.
This chart gives loaded side, single element flowrates for rated load. For double element bearings, supply an additional 20% to the inactive side. In machines where load may reverse and apply rated values to either side, provide equal flow to each side (a total of two times the chart value).

75/75 SHOE TEMPERATURE (STEEL)

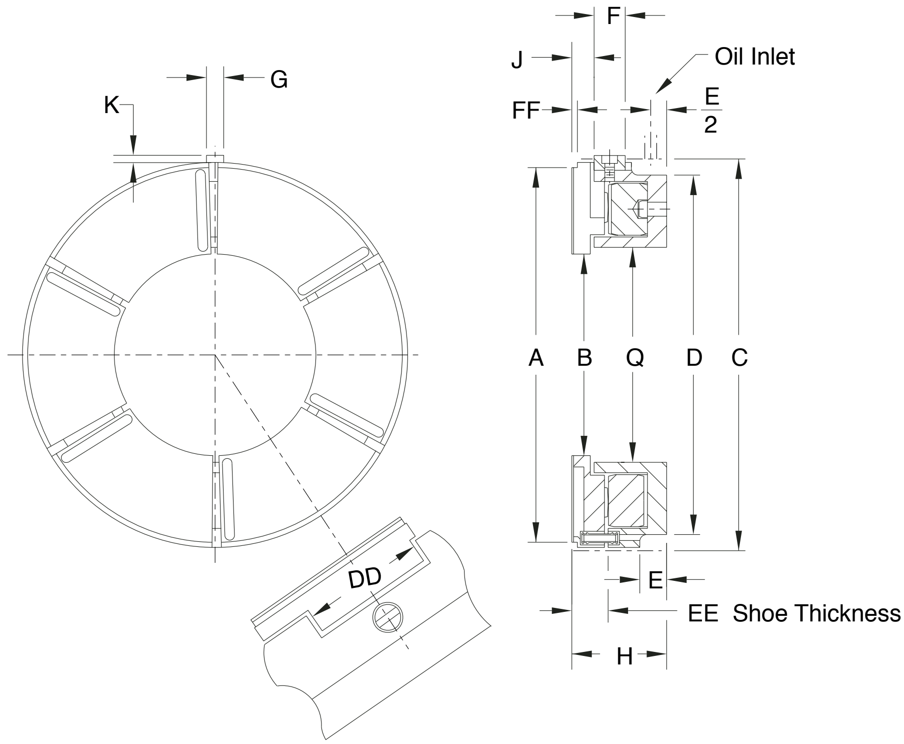


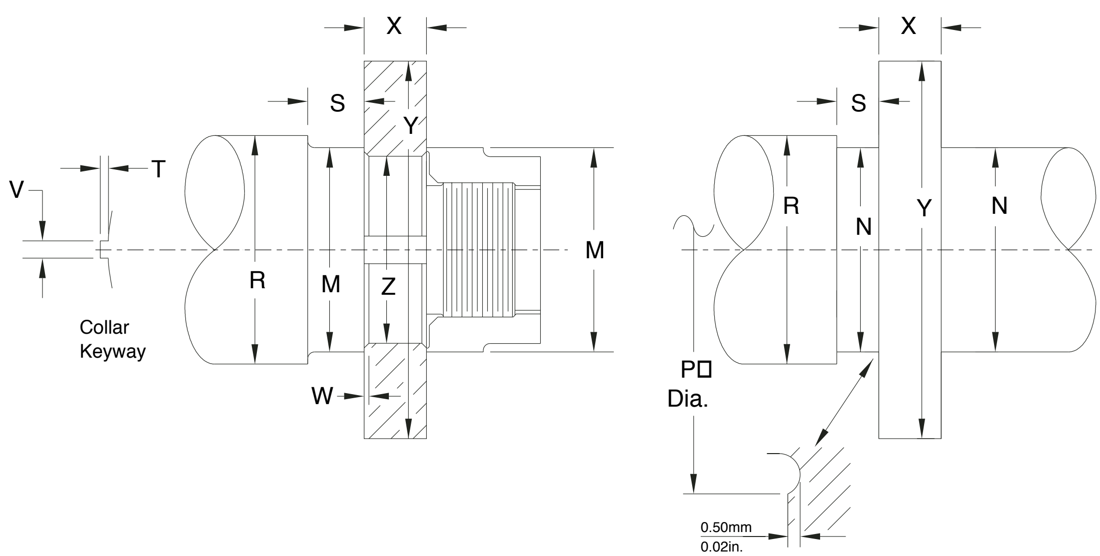
75/75 SHOE TEMPERATURE (CR-CU)



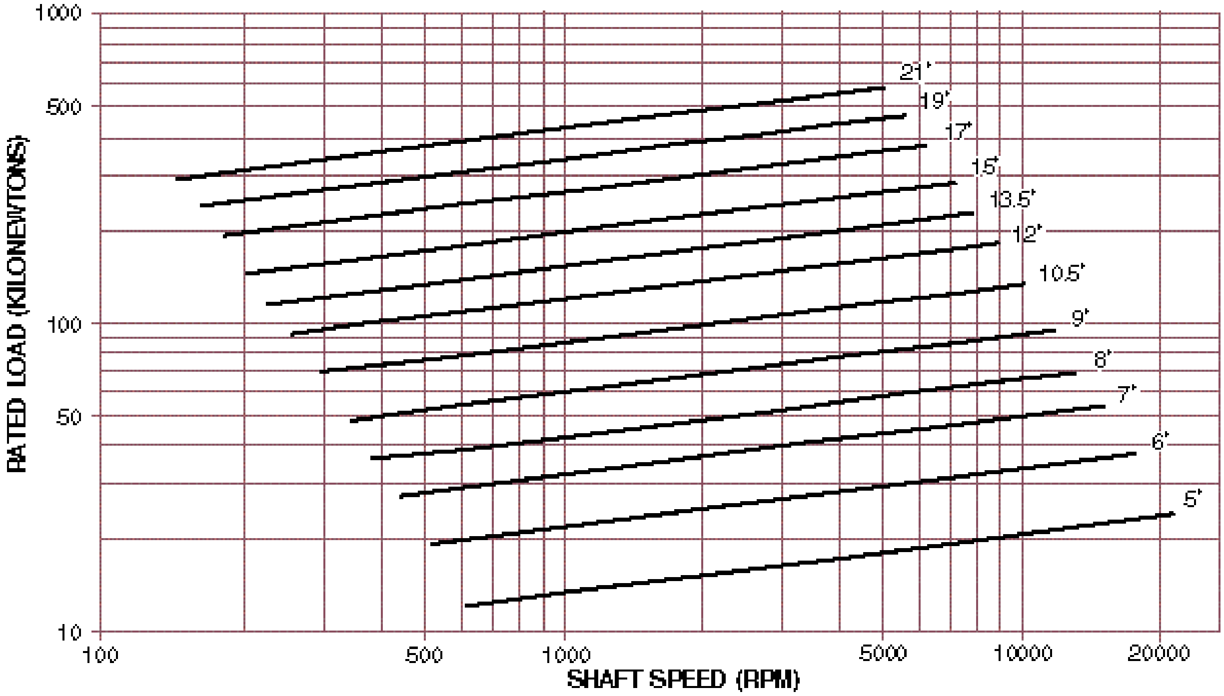
Temperatures are based on recommended oil, flow, and supply temperatures.
Unit load is load divided by bearing area.

J-STYLE BEARINGS (METRIC)





RATED LOAD FOR J-STYLE LEG THRUST BEARINGS

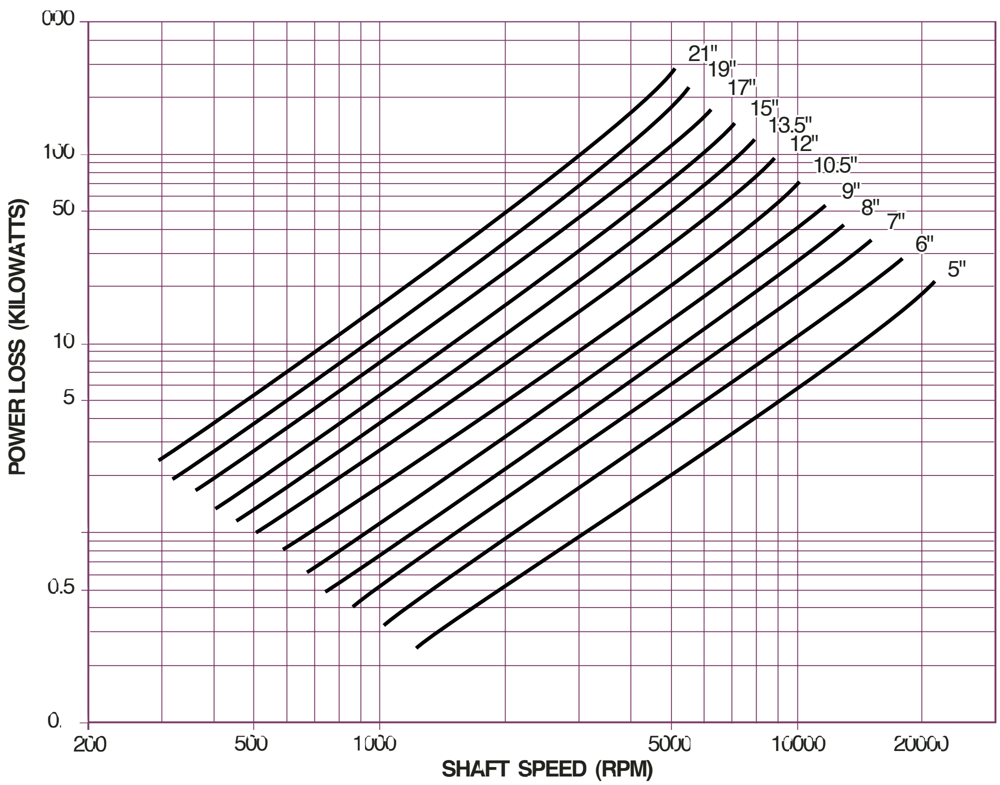


Based on ISO VG 32 supplied at 50°C

METRIC SIZES (mm)

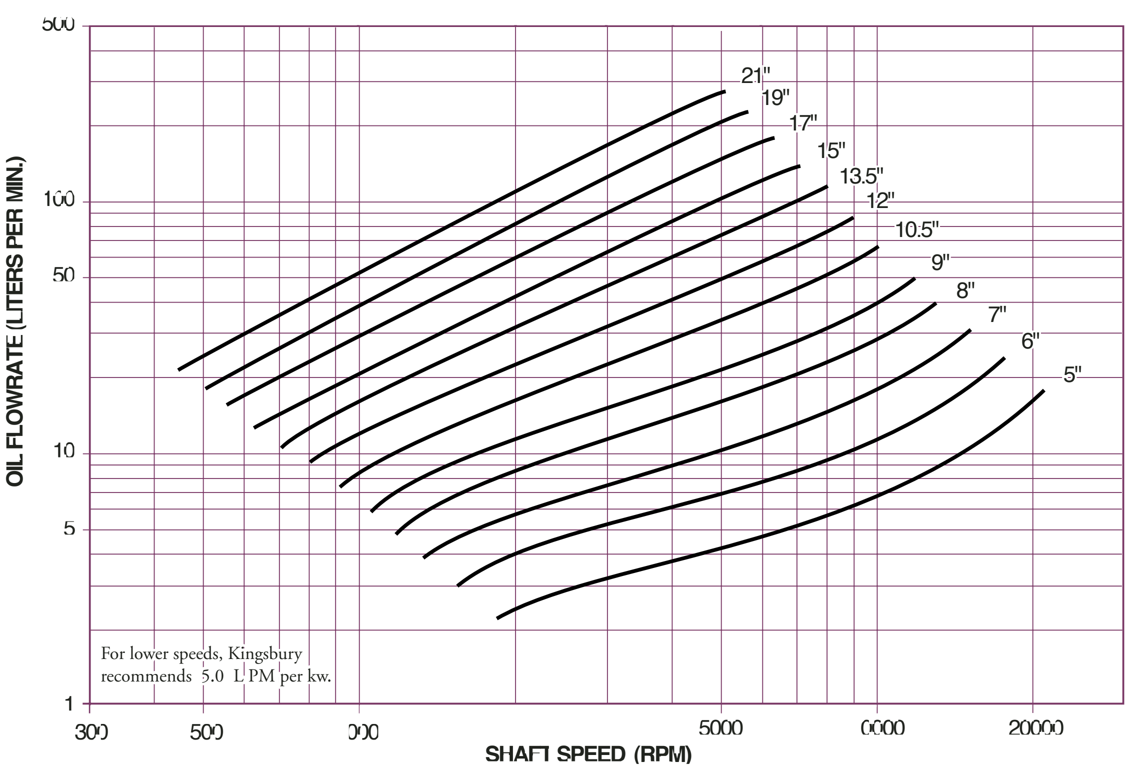
Brg. Size	5	6	7	8	9	10.5	12	13.5	15	17	19	21
No. of Shoes	6	6	6	6	6	6	6	6	6	6	6	6
Area (mm²)	8065	11613	15806	20258	26129	35548	46452	58774	72581	93226	116451	142258
A - Babbitt O.D.	127.0	152.4	177.8	203.2	228.6	266.7	304.8	342.9	381.0	431.8	482.6	533.4
B - Babbitt I.D.	63.5	76.2	88.9	104.6	114.3	133.4	152.4	171.5	190.5	215.9	241.3	266.7
H - Bearing Height (J)	44.5	52.3	60.5	68.3	76.2	85.9	95.3	108.0	117.4	133.4	133.4	133.4
H - Bearing Height (B)	41.1	47.8	53.8	60.5	68.3	74.7	82.6	90.4	98.6	111.3	120.7	133.4
C - Bearing O.D.	136.53	161.93	187.33	212.73	238.13	279.40	317.50	355.60	393.70	447.68	514.35	565.15
Q - Base ring I.D.	69.9	82.6	95.3	109.5	124.0	144.5	165.1	185.7	206.2	233.4	269.7	298.5
D - Oil annulus dia.	125.5	150.9	171.5	193.5	218.9	254.0	293.6	330.2	368.3	419.1	469.9	514.4
E - Oil annulus depth, min.	9.7	9.7	11.2	12.7	14.2	14.2	17.5	19.1	15.7	23.9	22.4	25.4
F - Bearing key, length	14.2	16.8	20.6	23.9	23.9	28.4	30.2	35.1	38.1	41.1	44.5	44.5
G - Bearing key, width	7.9	9.7	9.7	11.2	11.2	12.7	14.2	15.7	17.5	19.1	22.4	25.4
J - Collar to key	7.9	9.7	11.9	12.7	14.2	15.7	17.5	19.1	20.6	23.9	25.4	28.4
K - Key projection	4.1	4.8	4.8	4.8	4.8	5.6	5.6	6.4	7.9	7.9	8.6	9.7
M - Separate shaft dia.	57.2	69.9	82.6	95.3	108.0	124.0	142.7	162.1	177.8	203.2	225.6	251.0
N - Intergral shaft dia.	53.8	66.5	79.2	91.9	104.6	120.7	139.7	158.8	174.8	200.2	222.3	247.7
P - Max dia. over fillet	61.2	74.2	86.9	99.3	112.3	130.0	149.1	168.1	185.9	211.3	235.5	260.9
R - Dia. through base ring	63.5	76.2	88.9	101.6	114.3	133.4	152.4	171.5	190.5	215.9	247.7	273.1
S - Shaft lgth @ shoe I.D.	15.7	19.1	22.4	25.4	28.4	31.8	35.1	38.1	41.1	44.5	50.8	57.2
X - Collar thickness	22.4	25.4	31.8	35.1	38.1	44.5	50.8	57.2	63.5	73.2	82.6	91.9
Y - Collar dia.	130.0	155.4	180.8	206.2	231.6	271.5	309.6	347.7	385.8	438.2	489.0	539.8
Z - Collar bore	44.45	53.98	63.50	76.20	88.90	104.78	120.65	136.53	152.40	168.28	190.50	215.90
T - Collar key depth	4.8	4.8	6.4	7.9	7.9	9.7	9.7	11.2	12.7	12.7	14.2	15.7
V - Collar key width	9.7	9.7	12.7	16.0	16.0	19.1	19.1	22.4	25.4	25.4	28.7	31.8
W - Collar chamfer	1.5	1.5	1.5	1.5	1.5	2.3	2.3	2.3	2.3	3.0	3.0	3.0
DD - Straddle mill	40.4	50.0	59.4	69.1	77.0	81.0	100.8	107.2	129.3	145.3	151.6	177.0
EE - Shoe thickness	15.88	19.05	22.23	25.40	28.58	31.75	34.93	38.10	41.28	46.02	50.80	55.58
FF - Shoe relief	4.1	4.1	4.8	5.6	7.9	7.1	8.6	9.7	3.0	3.0	9.7	12.7
Weight (kG) Bearing	2.5	4.1	6.7	9.5	13.8	20.4	29.2	41.2	56.1	79.8	107.5	141.5
Weight (kG) Collar	2.0	3.3	5.6	7.9	10.7	17.1	25.4	35.9	49.0	73.6	102.9	138.3
Weight (kG) Spare shoes	1.0	1.6	2.5	3.5	5.1	8.2	11.3	15.6	21.3	30.8	45.4	59.9

POWER LOSS: DOUBLE ELEMENT J-STYLE LEG BEARINGS



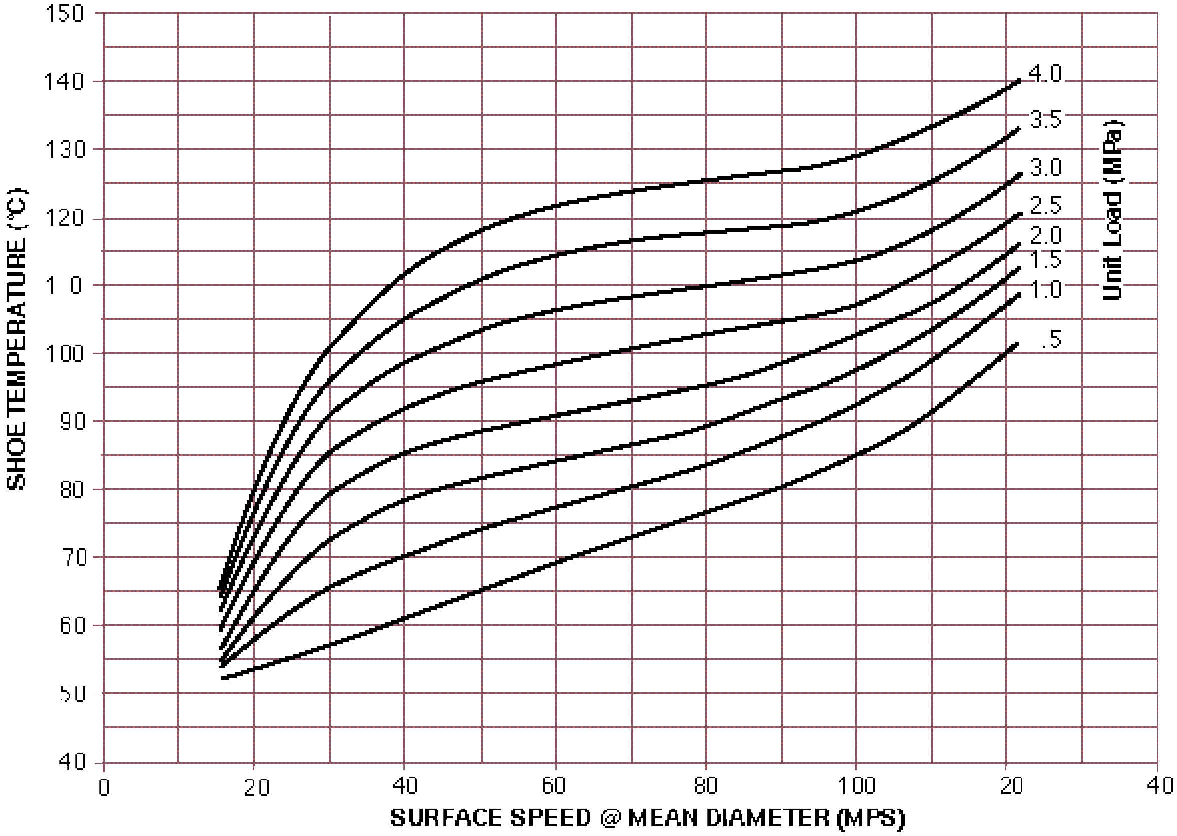
Based on 20% Slack Flow & ISO VG 32 supplied at 50°C
Power loss is based on rated load, recommended oil flow, and Kingsbury's recommended discharge configuration. If any of these is changed the power loss will also change.

OIL SUPPLY FOR J-STYLE LEG BEARINGS

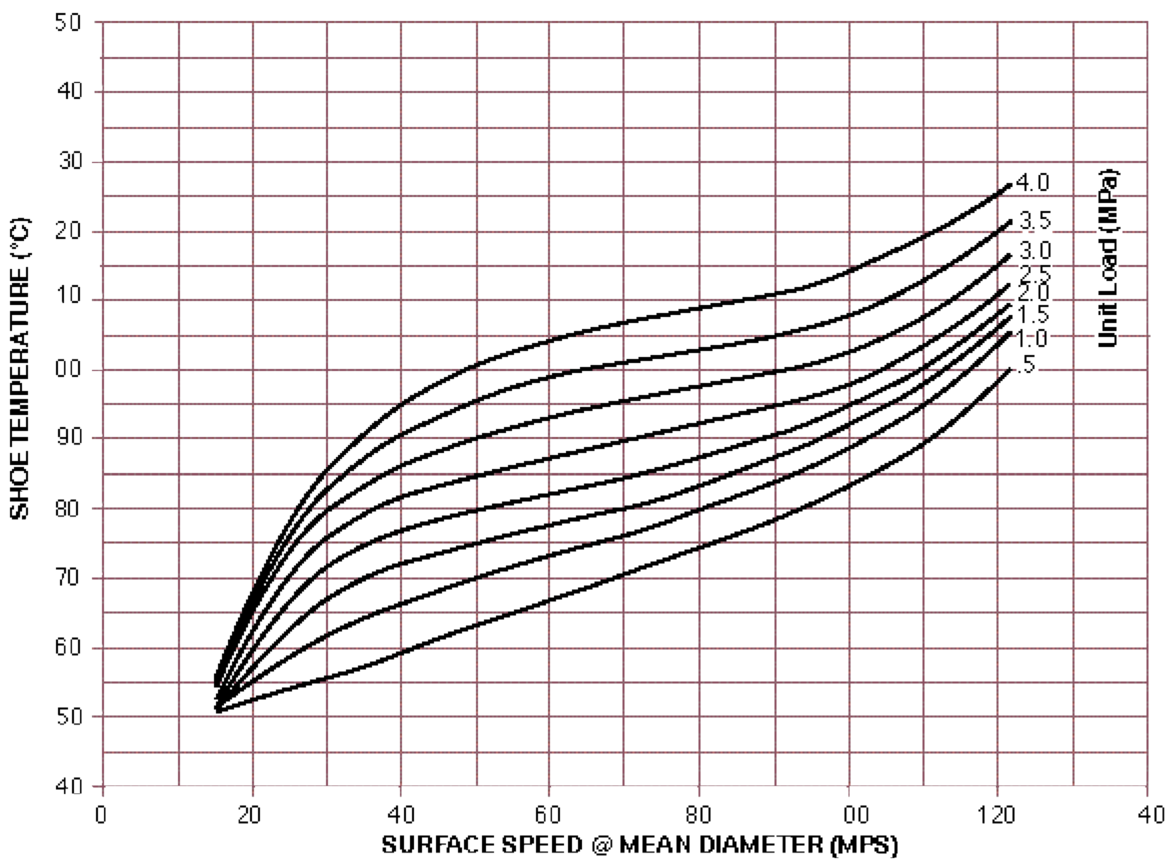


Based on ISO VG 32 supplied at 50°C
This chart gives loaded side, single element flowrates for rated load. For double element bearings, supply an additional 20% to the inactive side. In machines where load may reverse and apply rated values to either side, provide equal flow to each side (a total of two times the chart value).

75/75 SHOE TEMPERATURE (STEEL)

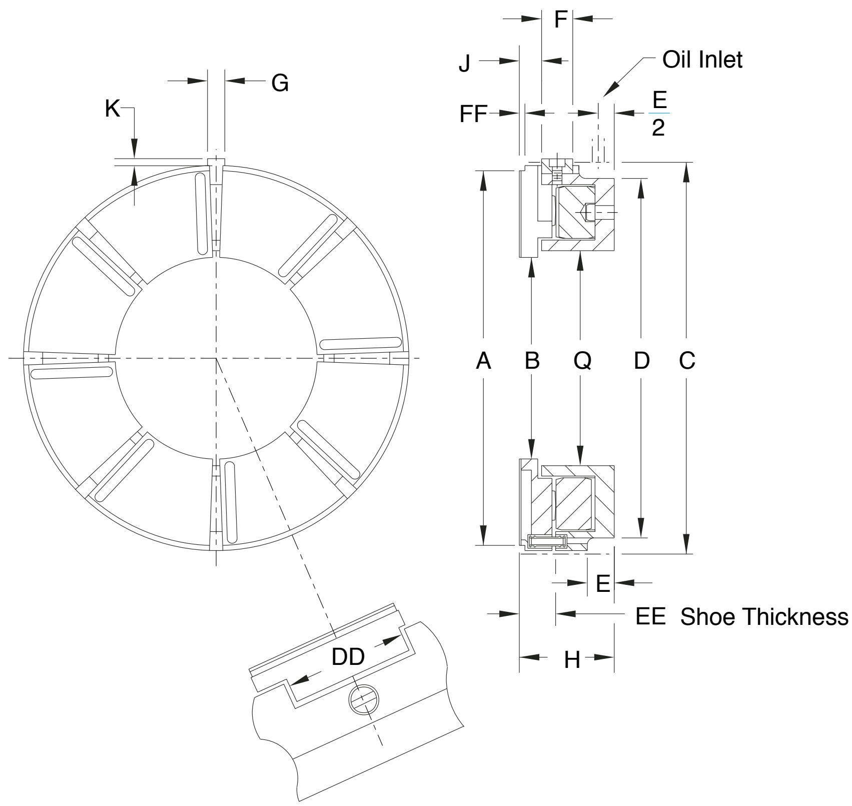


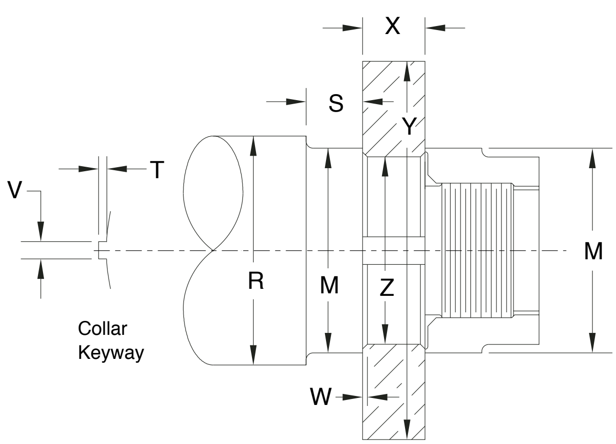
75/75 SHOE TEMPERATURE (CR-CU)

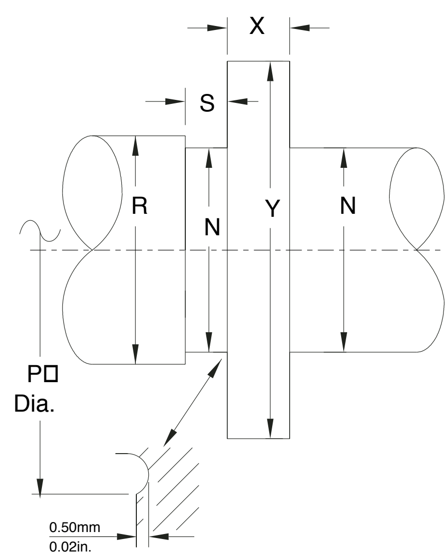


Temperatures are based on recommended oil, flow, and supply temperatures.
Unit load is load divided by bearing area.

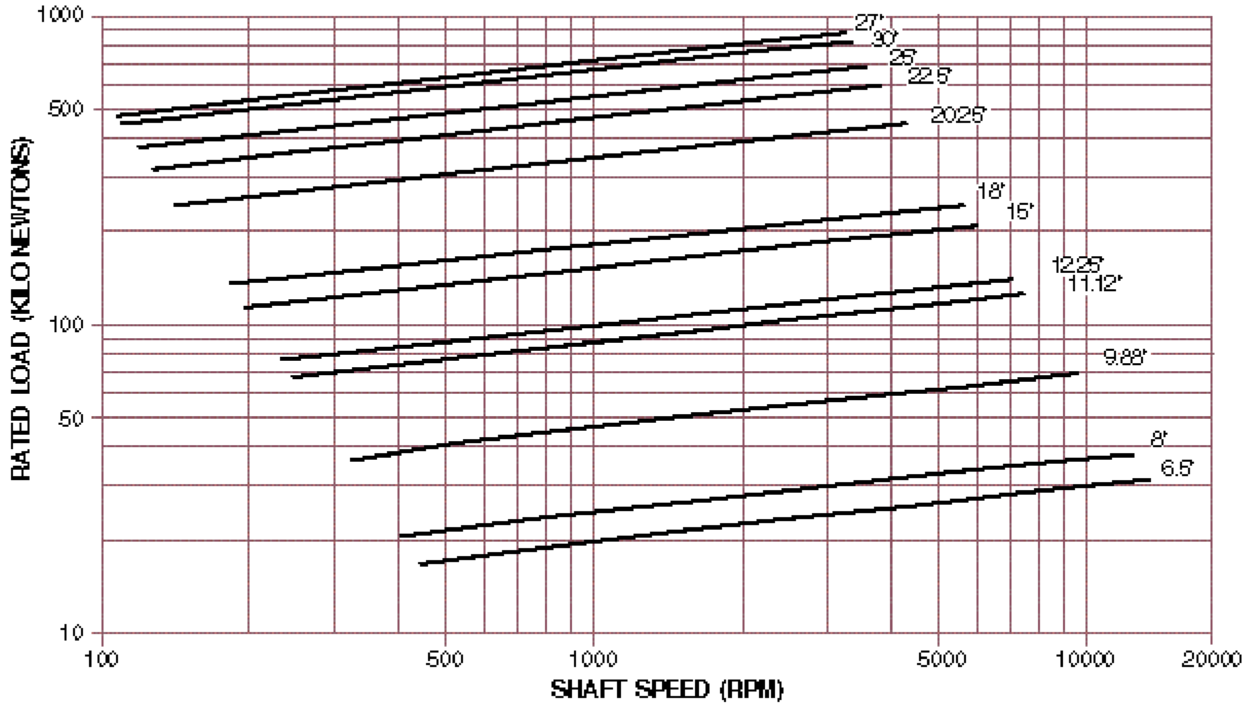
S-STYLE LEG BEARINGS (METRIC)







RATED LOAD FOR S-STYLE LEG THRUST BEARINGS

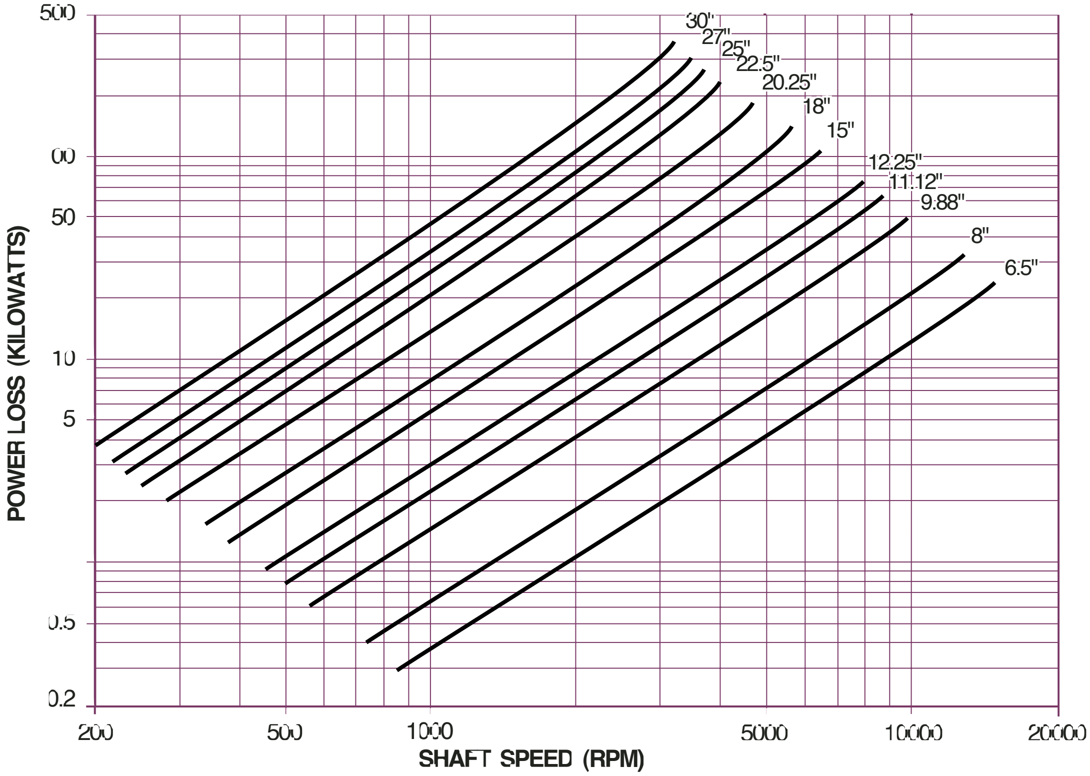


Based on ISO VG 32, 50°C Inlet Temperature.

METRIC SIZES (mm)

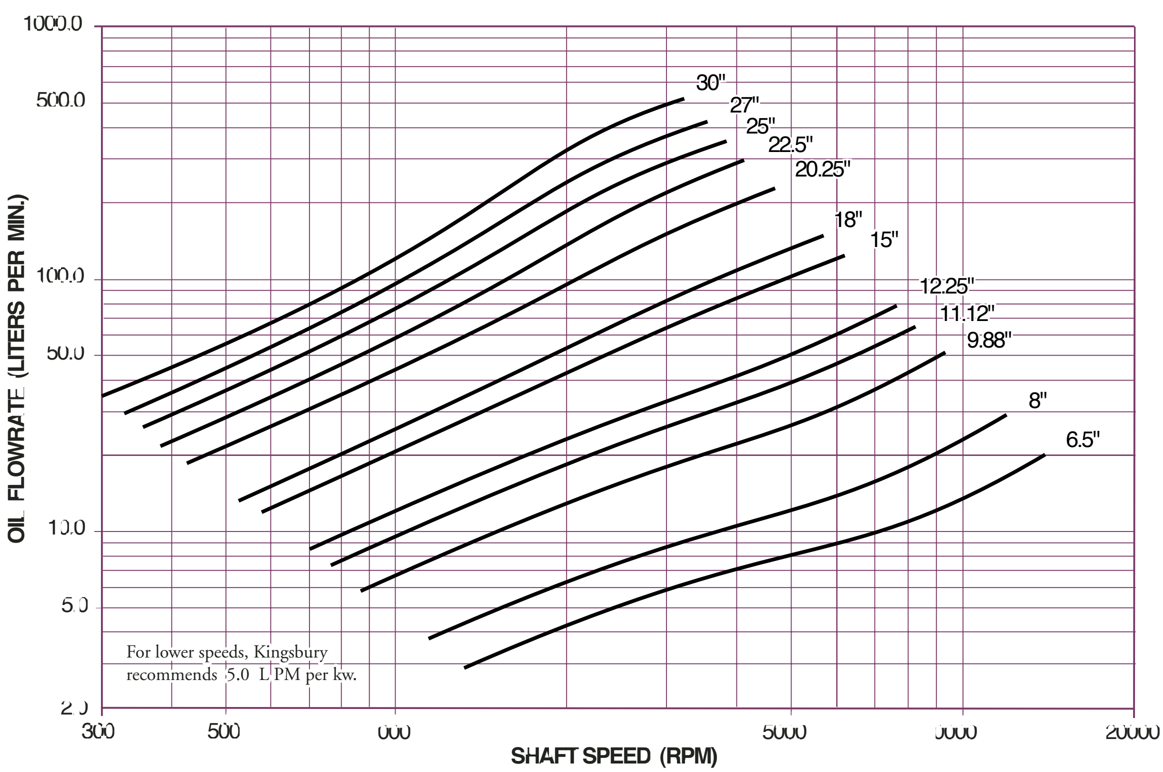
Brg. Size	6.5	8	9.88	11.12	12.25	15	18	20.25	22.5	25	27	30
No. of Shoes	8	8	12	8	8	10	8	8	8	8	8	12
Area (mm²)	9871	12387	19742	34903	39097	53161	57419	110968	140000	167096	188387	174838
A - Babbitt O.D.	165.1	203.2	251.0	282.4	311.2	381.0	457.2	514.4	571.5	635.0	685.8	762.0
B - Babbitt I.D.	103.1	139.7	177.8	165.1	190.5	247.7	311.2	304.8	330.2	381.0	393.7	530.4
H - Bearing Height	39.6	49.3	47.8	69.9	58.7	73.2	88.9	114.3	127.0	139.7	146.1	127.0
C - Bearing O.D.	171.45	212.73	257.18	292.10	320.68	393.70	476.25	533.40	587.38	673.10	711.20	792.15
Q - Base ring I.D.	103.1	139.7	177.8	171.5	193.5	260.4	323.9	323.9	355.6	396.7	438.2	530.4
D - Oil annulus dia.	155.4	198.4	241.3	269.7	293.6	362.0	444.5	495.3	546.1	609.6	641.4	735.1
E - Oil annulus depth	7.9	13.5	12.7	15.7	11.2	17.5	22.4	25.4	31.8	30.2	31.8	40.1
F - Bearing key, length	14.2	19.1	16.8	23.9	12.7 Dia	12.7 Dia	30.2	35.1	41.1	63.5	53.8	25.4 Dia
G - Bearing key, width	7.9	12.7	7.9	11.2	12.7 Dia	12.7 Dia	14.2	15.7	19.1	28.4	31.8	25.4 Dia
J - Collar to key	9.4	11.2	10.4	15.0	26.9	22.4	19.1	23.6	28.4	28.4	33.3	38.1
K - Key projection	4.1	4.8	4.8	4.8	4.8	4.8	5.6	6.4	9.7	12.7	12.7	12.7
M - Separate shaft dia.	98.6	133.4	168.1	155.4	180.8	238.3	301.8	292.1	317.5	368.3	374.7	508.0
N - Intergral shaft dia.	91.9	127.0	162.1	149.4	174.8	228.6	292.1	279.4	304.8	355.6	362.0	495.3
P - Max dia. over fillet	98.6	134.9	173.0	160.3	185.7	242.8	304.8	298.5	320.5	371.3	381.0	517.7
R - Dia. through base ring	98.6	133.4	168.1	162.1	184.2	251.0	314.5	311.2	342.9	384.0	419.1	508.0
S - Shaft lgth @ shoe I.D.	15.7	15.7	19.1	25.4	25.4	25.4	38.1	38.1	44.5	44.5	50.8	50.8
X - Collar thickness	25.4	35.1	38.1	44.5	50.8	50.8	63.5	76.2	82.6	108.0	114.3	95.3
Y - Collar dia.	168.1	206.2	254.0	285.8	314.5	384.0	463.6	520.7	577.9	641.4	692.2	768.4
Z - Collar bore	82.55	114.30	152.40	139.70	165.10	209.55	266.70	260.35	285.75	330.20	342.90	469.90
T - Collar key depth	4.8	7.9	4.8	7.9	9.7	9.7	12.7	12.7	15.7	19.1	19.1	19.1
V - Collar key width	9.7	15.7	9.7	15.7	19.1	19.1	25.4	25.4	31.8	38.1	38.1	38.1
W - Collar chamfer	0.5	1.5	1.5	2.3	2.3	2.3	3.0	3.0	4.1	4.1	4.1	4.1
DD - Straddle mill	37.3	41.4	42.2	70.6	73.2	73.9	90.4	114.3	126.2	158.0	142.7	101.6
EE - Shoe thickness	15.06	17.45	19.84	28.58	28.58	31.75	36.53	44.53	49.20	53.98	60.33	50.80
FF - Shoe relief	1.5	1.5	1.5	1.5	2.0	2.0	1.5	3.0	3.0	4.8	4.8	4.8
Weight (kG) Bearing	4.1	7.3	9.1	21.8	21.8	36.3	59.0	113.4	154.2	226.8	254.0	244.9
Weight (kG) Collar	3.4	6.4	9.5	16.8	22.7	32.2	56.7	95.3	129.3	199.6	254.0	217.7
Weight (kG) Spare shoes	1.4	1.8	2.7	6.4	7.3	11.3	18.1	34.0	45.4	65.8	81.6	97.5

POWER LOSS: DOUBLE ELEMENT S-STYLE LEG BEARINGS



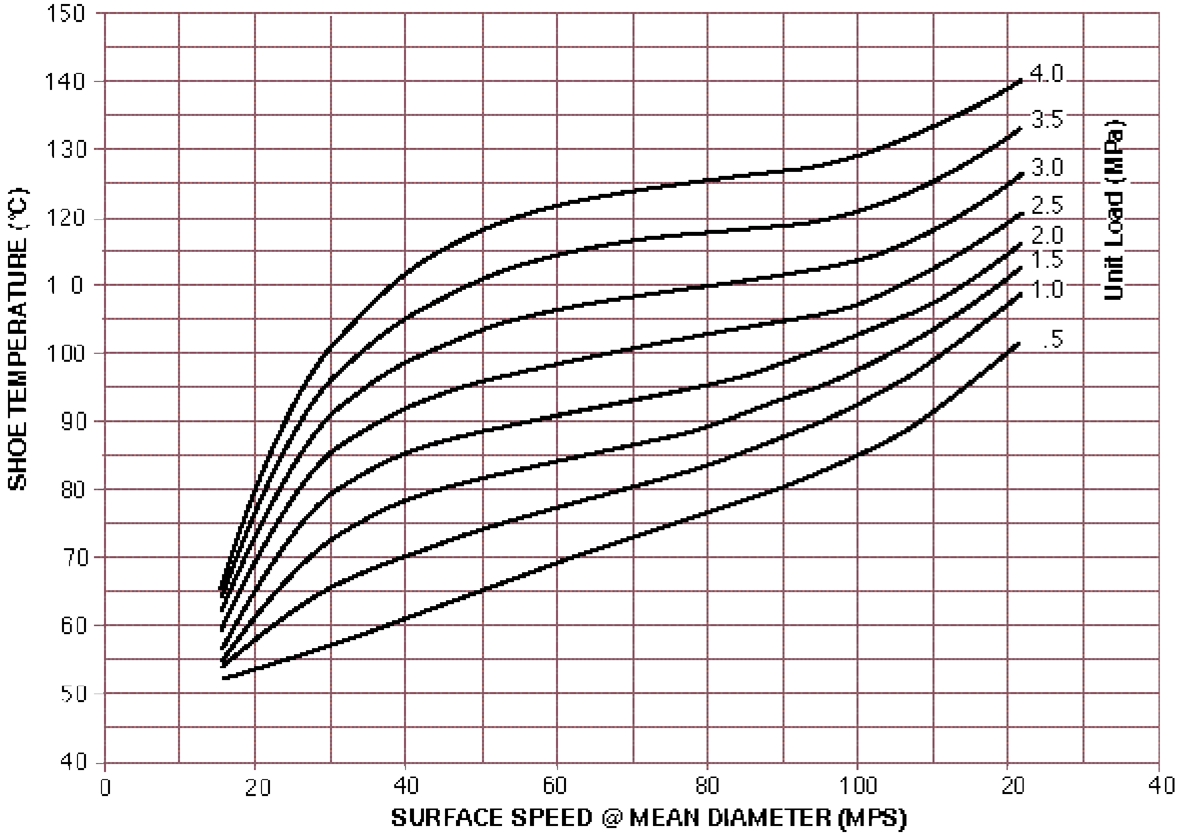
Based on 20% Slack Flow & ISO VG 32 supplied at 50°C.
Power loss is based on rated load, recommended oil flow, and Kingsbury's recommended discharge configuration. If any of these is changed the power loss will also change.

OIL SUPPLY FOR S-STYLE LEG BEARINGS

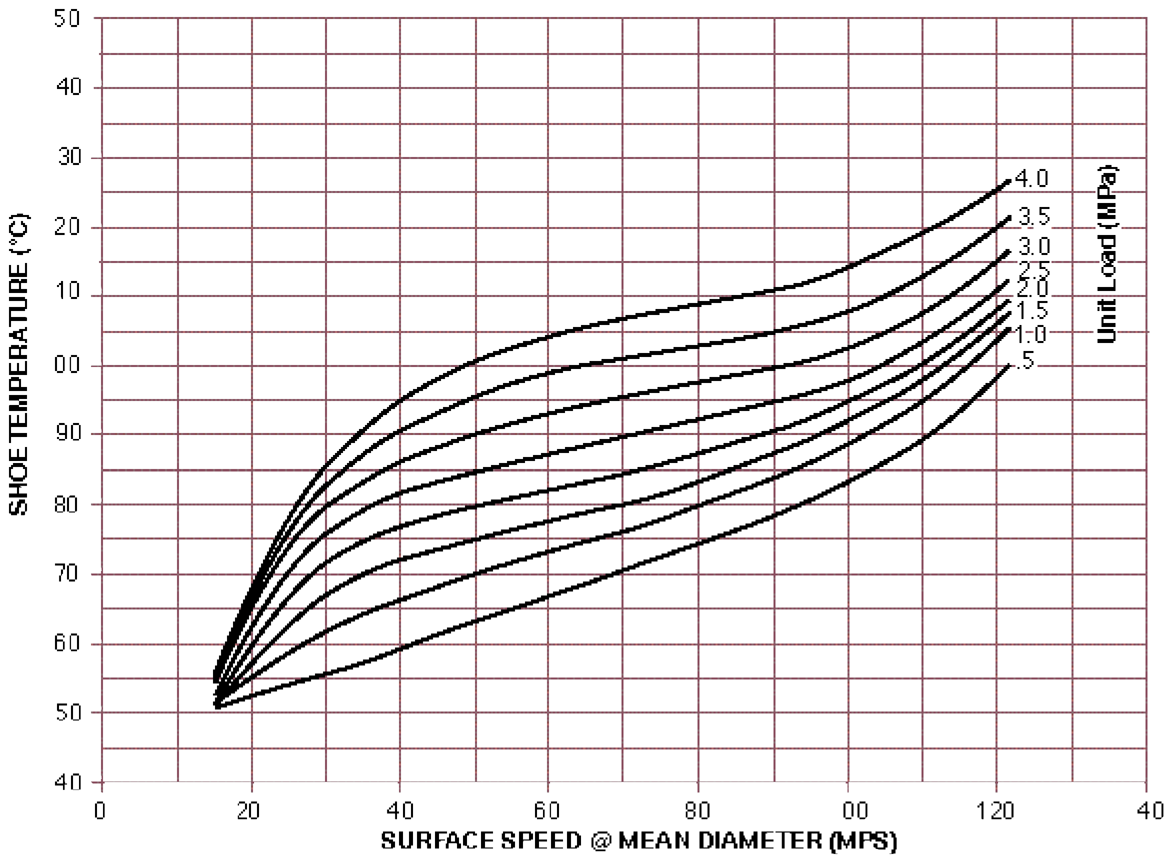


Based on ISO VG 32 supplied at 50°C
This chart gives loaded side, single element flowrates for rated load. For double element bearings, supply an additional 20% to the inactive side. In machines where load may reverse and apply rated values to either side, provide equal flow to each side (a total of two times the chart value).

75/75 SHOE TEMPERATURE (STEEL)



75/75 SHOE TEMPERATURE (CR-CU)



Temperatures are based on recommended oil, flow, and supply temperatures.
Unit load is load divided by bearing area.

INSTRUMENTATION

LEG thrust bearings can be instrumented in the same manner as standard thrust bearings.

Temperature Measurement

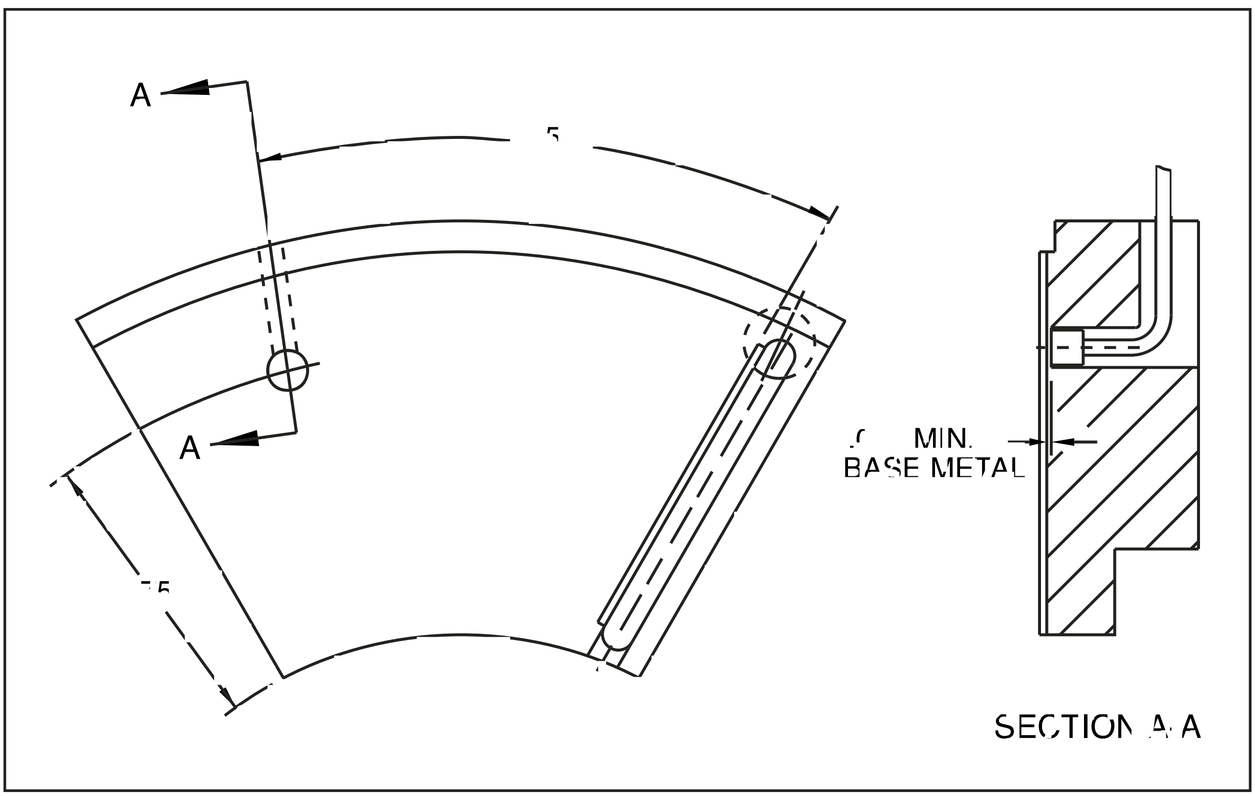
Changes in load, shaft speed, oil flow, oil inlet temperature, or bearing surface finish can affect bearing surface temperatures. At excessively high temperatures, the shoe babbitt metal is subject to wiping, which causes bearing failure. Consequently, for critical applications, we recommend using shoes with built-in temperature sensors so you can see actual metal temperatures under all operating conditions.

Either thermocouples or resistance temperature detectors (RTDs) can be installed in the shoe body near the shoe body/babbitt interface. See figure below for Kingsbury's recommended location. See page 50 "Temperature Detector Location" for further discussion.

Thrust Measurement

For bearings subject to critically high loads, continual thrust measurement can provide a vital indication of machine and bearing condition. To let you measure thrust, we can install a strain gauge load cell in one or more places in the bearing.

Load cells can be installed in LEG bearings in the upper leveling plate or in place of the shoe support. We can also provide complete measuring instrumentation and recorders.



NOTES ON SELECTING LEG THRUST BEARINGS

API Ratings

The thrust bearing ratings given in the charts comply with API specifications for thrust bearing selection, i.e., all loads listed are equal to or less than one half of the ultimate capacity.

Slack Side Load Capacity & Flow

Load capacity is related to shoe temperature which is influenced by oil flow. The rated loads listed in the charts are based on recommended flow values to the loaded bearing. In machines where load can reverse and apply full force on the normally slack bearing, an equal amount of oil flow is required to the "slack side."

Power loss varies with oil flow. The case of equal rated load capacity and flow to both bearing sides results in the highest power loss. If design loads are less than the bearing ratings, flow requirements can be lowered with a resulting reduction in power loss. To achieve the optimum reduction in power loss, loaded and slack flows can be sized proportionately for normal and reverse design loads.

Time is required for operating shoe temperatures to climb to steady state values. When the reverse load is of very short duration, or when there is little or no reverse load, slack side flows can be reduced to as low as 20% of rated values resulting in the lowest possible power loss and flow requirements.

Endplay

Endplay recommendations presented in this catalog are a generic guideline to cover a wide range of applications. Special cases such as very high speeds, extreme ambient conditions, external axial vibration, etc., may require special consideration and recommendations. Please contact your Kingsbury Sales Engineer for situations not addressed by this catalog.

Shoe Retention

Standard LEG thrust bearings are designed with features to hold the shoes in place so the bearings do not fall apart during handling and assembly. This feature is not the same as the housing design which is required to retain the shoes during operation as shown in the figure on page 11. If the housing does not serve this purpose, e.g., in the case of a retrofit application, it is important to consult Kingsbury so that a shoe retention design can be engineered which is suitable for your application.

Shock Loads

Thrust bearings contain several contact areas which allow shoe pivot, equalizing and misalignment features. These features are conservatively designed for the rated loads listed in this catalog as well as usual momentary or adverse conditions that may be encountered in most machine operation. Special designs and parts are available for more severe requirements such as shock loads or earthquake design criteria. Contact your Kingsbury Sales Engineer to discuss these applications.

LEG Journal

Shoes

Each standard LEG pivoted shoe journal bearing consists of five journal shoes supported in a precisely machined aligning ring. Smaller journal shoes are manufactured from heat-treated 4100 class alloy steel. Shoes larger than 10" incorporate heat-treated 4100 class alloy steel pivot inserts. The back of the journal shoe or pivot insert is contoured differently in both the circumferential and axial directions so the shoe can tilt and pivot to develop an optimum oil film and self-align to the journal.

Kingsbury LEG bearing shoes are designed with offset pivots, 60% of the effective length of the shoe. (See “Optimized Offset,” page 51, for further discussion.)

High-tin babbitt is centrifugally cast, metallurgically bonded, then precisely machined to create the bearing surface. Proprietary manufacturing processes provide a uniform babbitt thickness across each journal shoe, while tight design tolerances permit interchangeability of shoes, both within a single bearing and between different bearings of the same size.

The combination of hardened alloy steel and moderate Hertzian stresses allows Kingsbury pivoted shoe journal bearings to be used in high shock load or vibration applications without damaging the pivot contact areas.

Aligning Ring

The aligning ring, manufactured from heat treated 4100 class alloy steel, is axially split to allow easy assembly of the bearing around the shaft. Both halves are doweled for positive realignment and secured with socket head cap screws, while a hardened steel dowel on the cylindrical outside diameter prevents rotation of the bearing assembly in the housing.

An oil distribution annulus is machined into the outside of the aligning ring, and feed tubes direct cool oil from the annulus to the groove at the leading edge of each shoe.

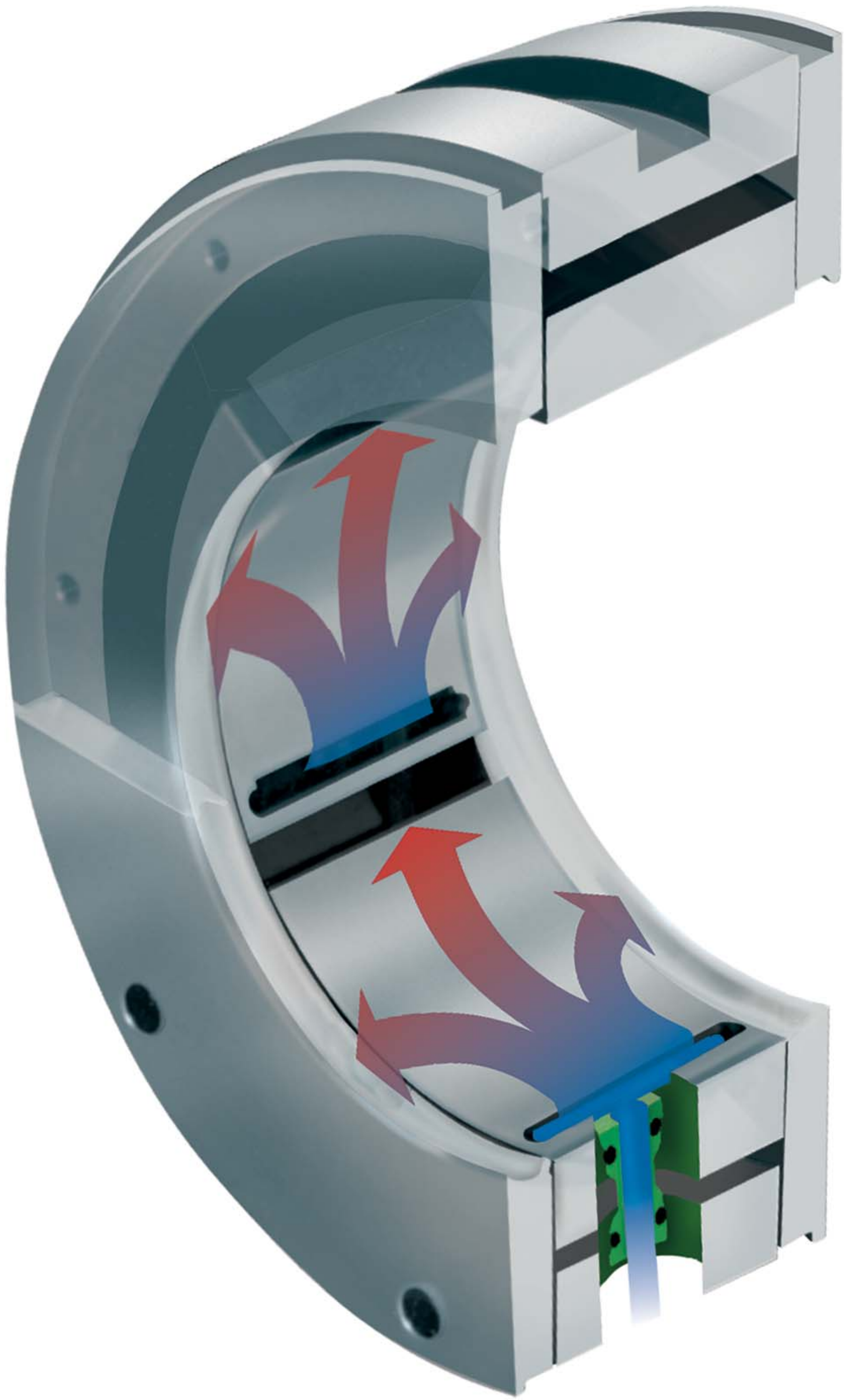
Shoe Retention

The shoe retaining plates are manufactured from tempered aluminum plate. They are axially split and precision bored to regulate oil discharge from the bearing assembly. Locating pins at the ends of each journal shoe match corresponding holes in the retaining plates to provide accurate circumferential positioning, and to retain shoes when the bearing assembly is split for installation or inspection.

Oil Feed Tube

The oil feed tube, connecting the aligning ring and shoe, is uniquely designed so that the shoe is free to pivot. This allows freedom of movement in the shoe and ensures that oil is fed directly to the shoe face.


ROTATION
ROTATION
1.05750



LEG BEARINGS OUTPERFORM FLOODED AND OTHER DIRECTED LUBE TYPES.

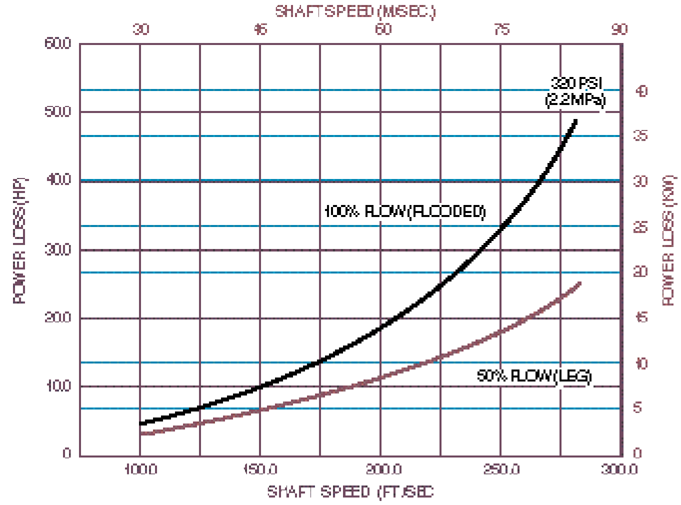
Kingsbury's LEG bearing design has proven itself through exhaustive testing and years of trouble-free operation to represent the ultimate in directed lubrication technology. Yet the design concept is remarkably simple.

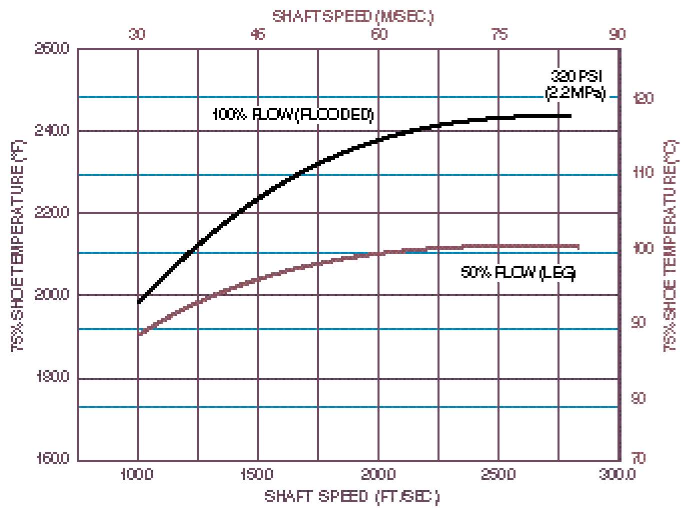
The bearing shoes and aligning ring are constructed so that cool undiluted inlet oil flows from the leading edge groove in the bearing shoe directly into the oil film. The cool oil in the oil film wedge insulates the babbitt face from the hot oil carryover that adheres to the shaft.

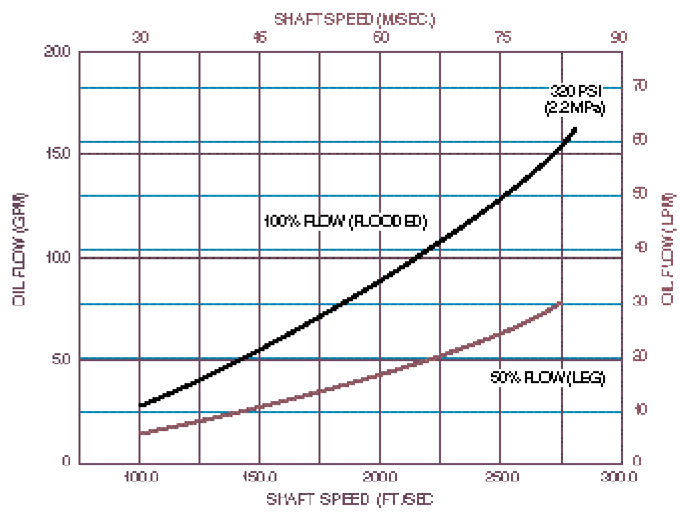
Because of these features, LEG journal bearings can:

- Reduce operating temperatures at the 75% location by 6 to 17°C, depending on load and speed.
- Provide a load capacity increase of 15 to 35%.
- Operate at 50% lower oil flow rates with an accompanying reduction in power losses of 30 to 50% depending on speed.

Power loss is lower than both flooded and spray feed bearings due to the elimination of parasitic losses. The flow of cool oil over the leading edge lowers shoe surface temperatures, increasing the LEG bearing's capacity. The resulting performance improvements are shown in these graphs.







Instrumentation

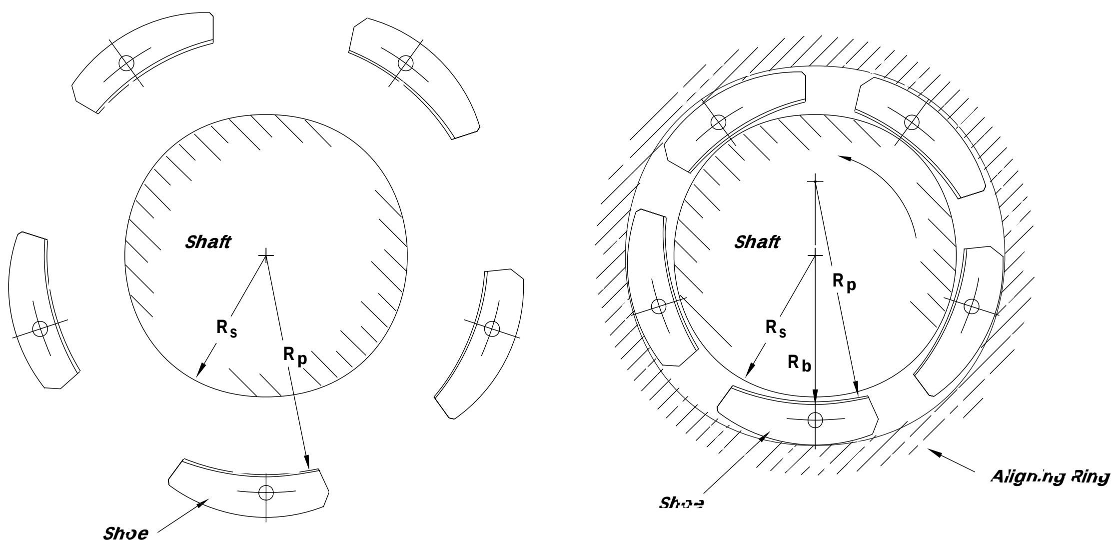
HOW TO SELECT LEG JOURNAL BEARINGS

The standard bearing configurations listed in this catalog were selected to provide good overall bearing operation and performance. Because bearing selection is also an integral part of the total system dynamics, variations from the standards are sometimes required. The following are design parameters that can be selected to optimize the bearing characteristics. Please contact us for more specific information on the application of these special designs.

Clearance And Preload

Bearing clearance and preload are defined by relations between the shaft, shoe and bearing radii. The assembled clearance allows space for thermal expansion, shoe tilt, and oil films. It also affects the quantity of oil flowing through the film, which removes heat generated by shear.

Both the assembled clearance and the preload affect the operating characteristics of the bearing, such as power loss, oil and shoe temperatures, film thickness, and dynamic stiffness and damping coefficients. This catalog provides data for bearing selection based on Kingsbury standard values of 0.25 preload and 0.0015 units per unit diameter clearance.



Pivoting Shoes As Machined

Pivoting Shoes As Assembled

R_s = SHAFT RADIUS

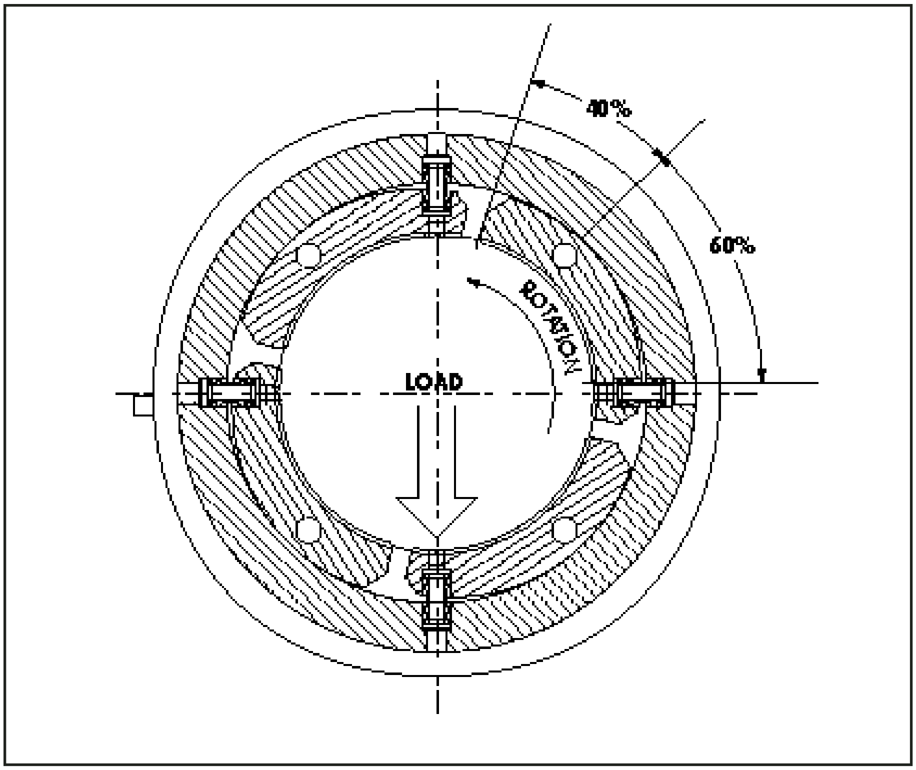
R_p = SHOE MACHINED CURVATURE

R_b = BEARING ASSEMBLED RADIUS

C_p = SHOE MACHINED CLEARANCE $R_p - R_s$

C_b = BEARING ASSEMBLED CLEARANCE $R_b - R_s$

$$\text{Preload } M = 1 - \frac{C_b}{C_p}$$



Typical Four-Shoe Journal Bearing

Number Of Shoes

The five-shoe bearing was selected as standard because of the wide range of applications suited to this design. Four shoe bearings are another popular design. The number of shoes is often selected to obtain required dynamic performance. If horizontal stiffness requirements are high, a pivoted four-shoe journal bearing with load between shoesprovides a horizontal stiffness equal to the vertical stiffness, not afforded by the asymmetrical five-shoe design.

Four-shoe bearings will virtually eliminate the potential of an elliptical orbit. Because four-shoe journal bearing shoes have a longer arc than those in the five-shoe bearing, they also generate a thicker oil film, which will improve bearing damping characteristics.

In certain cases, selection is based on shoe proportions. On units with short axial lengths, more than five shoes can be supplied.

Oil Grade

Bearing capacity and power loss values are based on oil grade ISO VG32, supplied at an inlet temperature of 120°F (50°C). The recommended oil flow is based on an oil outlet temperature of 162°F (73°C), and assumes standard Kingsbury preload and clearances.

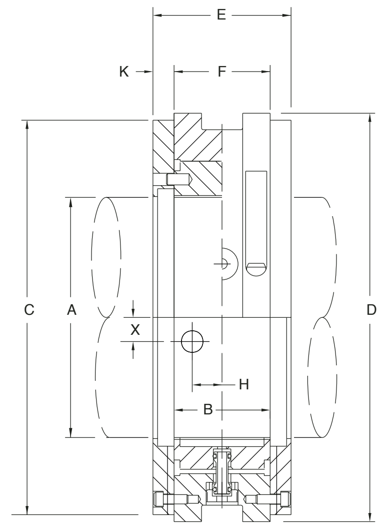
For power loss, oil flow, and bearing capacity using oil grades and operating temperatures other than those given above, or using preload and clearances different from standard, contact Kingsbury's Engineering Department.

Sizing An LEG Journal Bearing

The following section is divided into English and Metric groupings. Within each group, select the dimensions and load capacities using the B/A ratio best suited to your applications. Note that rated loads for two different orientations are incorporated into the dimensional tables.

After selecting journal length and load orientation, use the appropriate curves to determine power loss and required oil flow. Using the shoe temperature curves, determine that shoe temperatures are within acceptable limits.

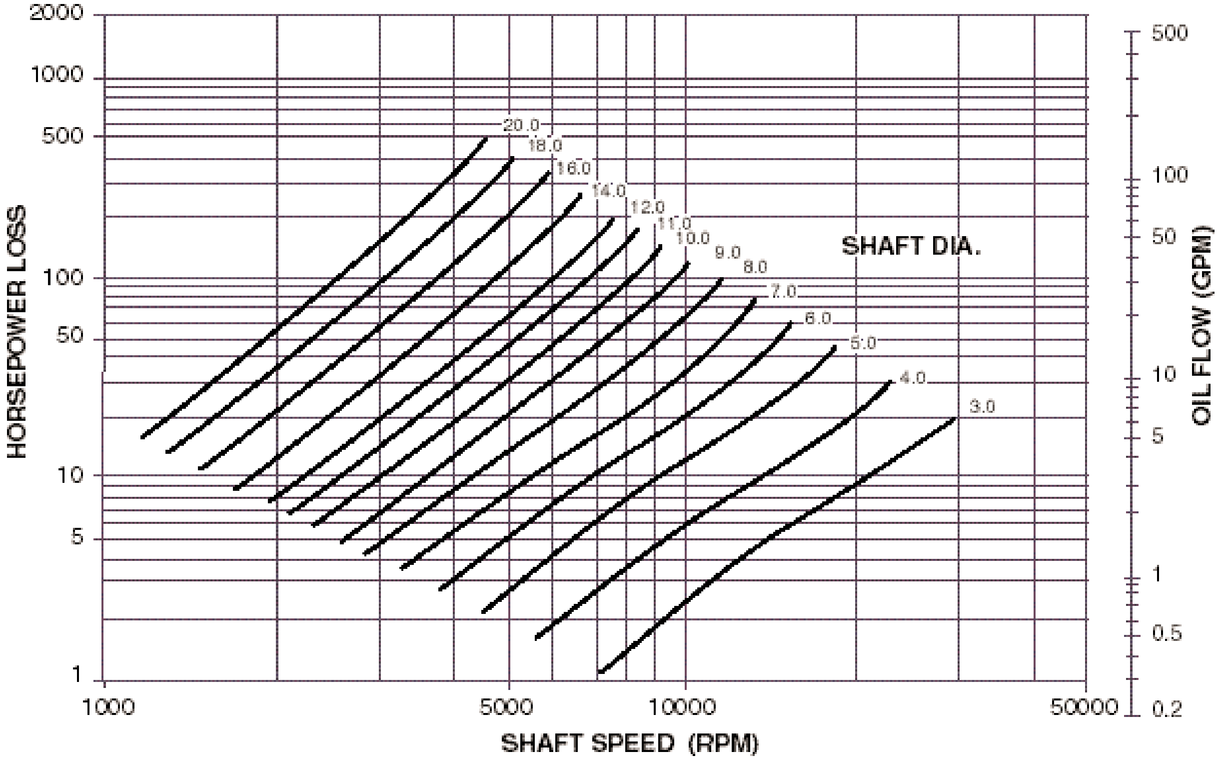
0.4 B/A BEARINGS (ENGLISH)



0.4 B/A English (Inches)

Shaft Diameter **A**	Shoe Width **B**	Housing Bore **D**	Endplate O.D. **C**	Overall Width **E**	Seat Width **F**	Locating Pin Diameter **G**	Locating Pin Location **H**	Locating Pin Projection **J**	Locating Pin Location **X**	Endplate Projection **K**	Rated Load (Lbs) Load on Shoe	Rated Load (Lbs) Load Betwn. Shoe
3.000	1.25	5.500	5.31	2.13	1.25	0.25	0.41	0.25	0.25	0.44	933	1509
3.500	1.50	6.125	5.88	2.50	1.50	0.25	0.50	0.25	0.25	0.50	1306	2113
4.000	1.63	7.000	6.56	2.75	1.63	0.31	0.53	0.31	0.31	0.56	1702	2753
4.500	1.81	7.500	7.19	2.94	1.81	0.31	0.62	0.31	0.31	0.56	2135	3454
5.000	2.00	8.500	7.88	3.25	2.00	0.38	0.69	0.38	0.38	0.63	2618	4236
5.500	2.25	9.000	8.63	3.50	2.25	0.38	0.75	0.38	0.38	0.63	3240	5242
6.000	2.44	10.000	9.50	3.81	2.44	0.50	0.81	0.50	0.50	0.69	6195	3829
7.000	2.81	11.750	11.00	4.19	2.81	0.50	0.94	0.50	0.50	0.69	5153	8338
8.000	3.25	13.250	12.75	4.75	3.25	0.63	1.06	0.63	0.63	0.75	6807	11014
9.000	3.75	14.750	14.00	5.75	3.75	0.63	1.25	0.63	0.63	1.00	8836	14297
10.000	4.00	16.000	15.31	6.00	4.00	0.75	1.31	0.75	0.75	1.00	10996	17791
11.000	4.50	17.750	16.75	6.75	4.50	0.75	1.50	0.75	0.75	1.13	13607	22017
12.000	5.00	19.000	18.25	7.25	5.00	0.75	1.63	0.75	0.75	1.13	16493	26687
13.000	5.25	20.750	19.75	7.75	5.25	0.75	1.75	0.75	0.75	1.25	18761	30356
14.000	5.63	22.500	21.25	8.13	5.63	1.00	1.88	1.00	1.00	1.25	21648	35027
15.000	6.00	24.000	22.75	8.75	6.00	1.00	2.00	1.00	1.00	1.38	24740	40030
16.000	6.50	25.500	24.00	9.25	6.50	1.00	2.13	1.00	1.00	1.38	28589	46257
17.000	7.00	27.000	25.50	10.00	7.00	1.00	2.38	1.00	1.00	1.50	32712	52929
18.000	7.25	28.500	26.75	10.50	7.25	1.25	2.50	1.25	1.25	1.63	35873	58044
19.000	7.63	30.000	28.50	11.00	7.63	1.25	2.50	1.25	1.25	1.69	39825	64438
20.000	8.00	31.500	30.00	11.50	8.00	1.25	2.75	1.25	1.25	1.75	43982	71165

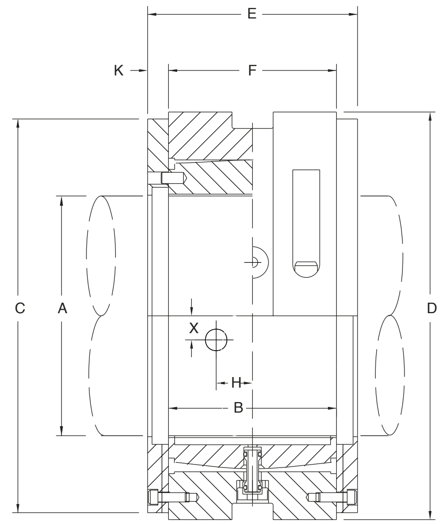
POWER LOSS/OIL FLOW



Oil Viscosity = ISO VG 32. Oil Inlet Temperature, 120°F
Oil Outlet Temperature, 162°F, .0015 in/in clearance, .25 preload

AVERAGE 75% SHOE TEMPERATURE

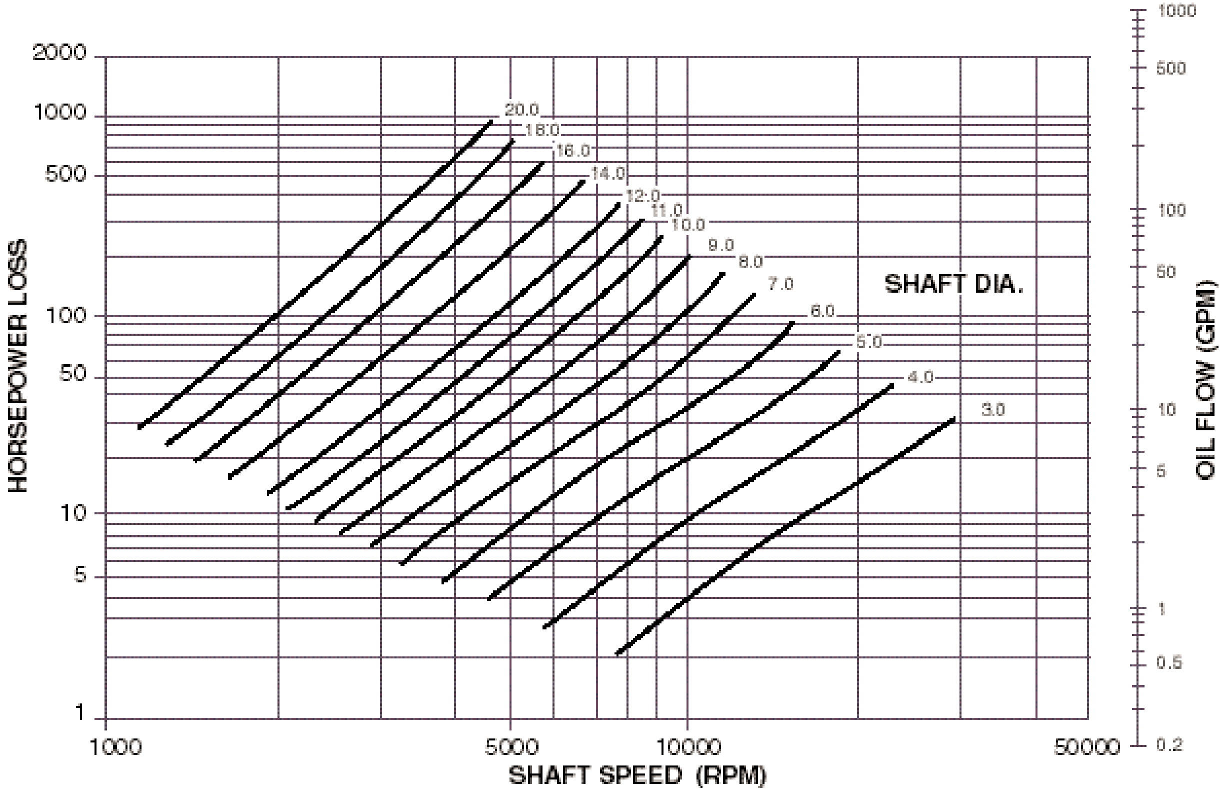
0.7 B/A BEARINGS (ENGLISH)



0.7 B/A English (Inches)

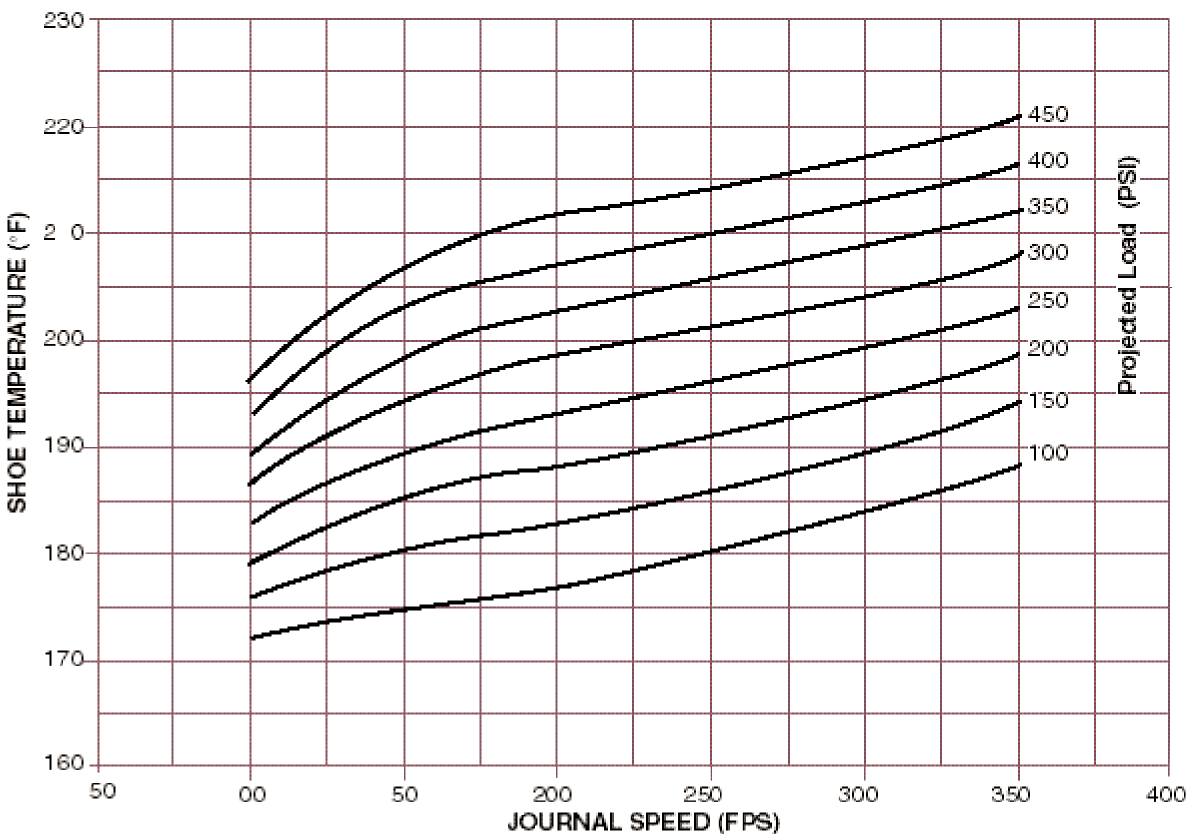
Shaft Diameter **A**	Shoe Width **B**	Housing Bore **D**	Endplate O.D. **C**	Overall Width **E**	Seat Width **F**	Locating Pin Diameter **G**	Locating Pin Location **H**	Locating Pin Projection **J**	Locating Pin Location **X**	Endplate Projection **K**	Rated Load (Lbs) Load on Shoe	Rated Load (Lbs) Load Betwn. Shoe
3.000	2.13	5.500	5.31	3.00	2.13	0.25	0.56	0.25	0.25	0.44	1669	2700
3.500	2.50	6.125	5.88	3.50	2.50	0.25	0.63	0.25	0.25	0.50	2291	3707
4.000	2.88	7.000	6.56	4.00	2.88	0.31	0.65	0.31	0.31	0.56	3161	5115
4.500	3.25	7.500	7.19	4.37	3.25	0.31	0.72	0.31	0.31	0.56	4020	6505
5.000	3.50	8.500	7.88	4.75	3.50	0.38	0.78	0.38	0.38	0.63	4811	7784
5.500	3.88	9.000	8.63	5.13	3.88	0.38	0.81	0.38	0.38	0.63	5859	9479
6.000	4.25	10.000	9.50	5.62	4.25	0.50	1.00	0.50	0.50	0.69	7010	11342
7.000	5.00	11.750	11.00	6.37	5.00	0.50	1.06	0.50	0.50	0.69	9621	15567
8.000	5.63	13.250	12.75	7.13	5.63	0.63	1.31	0.63	0.63	0.75	12370	20015
9.000	6.38	14.750	14.00	8.38	6.38	0.63	1.44	0.63	0.63	1.00	15772	25519
10.000	7.00	16.000	15.31	9.00	7.00	0.75	1.69	0.75	0.75	1.00	20159	32617
11.000	7.75	17.750	16.75	10.00	7.75	0.75	1.75	0.75	0.75	1.13	24550	39723
12.000	8.50	19.000	18.25	10.75	8.50	0.75	1.88	0.75	0.75	1.13	29374	47528
13.000	9.13	20.750	19.75	11.63	9.13	0.75	1.88	0.75	0.75	1.25	34162	55275
14.000	9.88	22.500	21.25	12.38	9.88	1.00	2.00	1.00	1.00	1.25	39813	64419
15.000	10.50	24.000	22.75	13.25	10.50	1.00	2.25	1.00	1.00	1.38	45357	73389
16.000	11.25	25.500	24.00	14.00	11.25	1.00	2.31	1.00	1.00	1.38	51836	83873
17.000	12.00	27.000	25.50	15.00	12.00	1.00	2.50	1.00	1.00	1.50	58748	95056
18.000	12.63	28.500	26.75	15.88	12.63	1.25	2.75	1.25	1.25	1.63	65443	105890
19.000	13.38	30.000	28.50	16.75	13.38	1.25	3.00	1.25	1.25	1.69	73183	118412
20.000	14.00	31.500	30.00	17.50	14.00	1.25	3.00	1.25	1.25	1.75	80634	130469

POWER LOSS/OIL FLOW

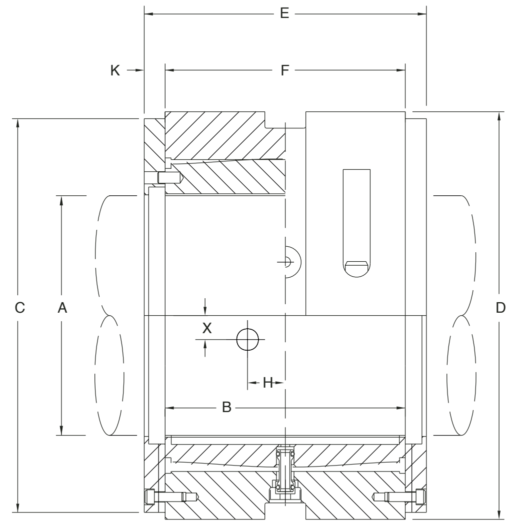


Oil Viscosity = ISO VG 32. Oil Inlet Temperature, 120°F
Oil Outlet Temperature, 162°F, .0015 in/in clearance, .25 preload

AVERAGE 75% SHOE TEMPERATURE



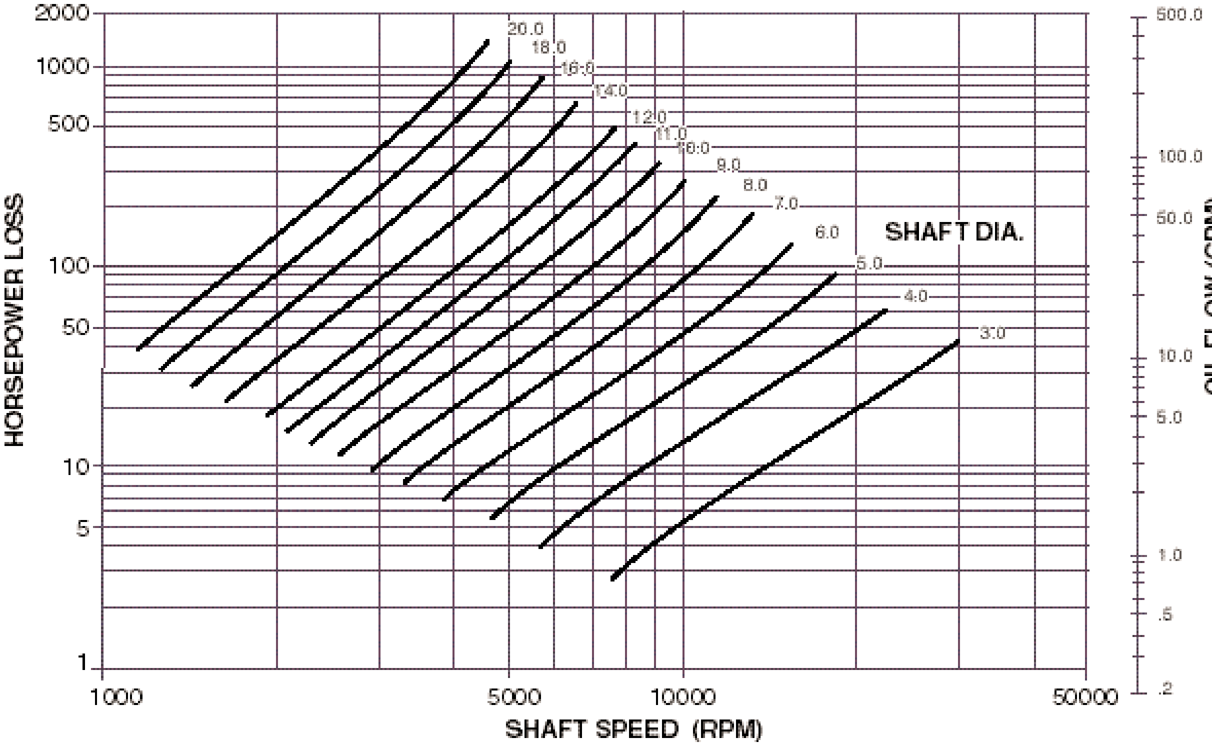
1.0 B/A BEARINGS (ENGLISH)



1.0 B/A English (Inches)

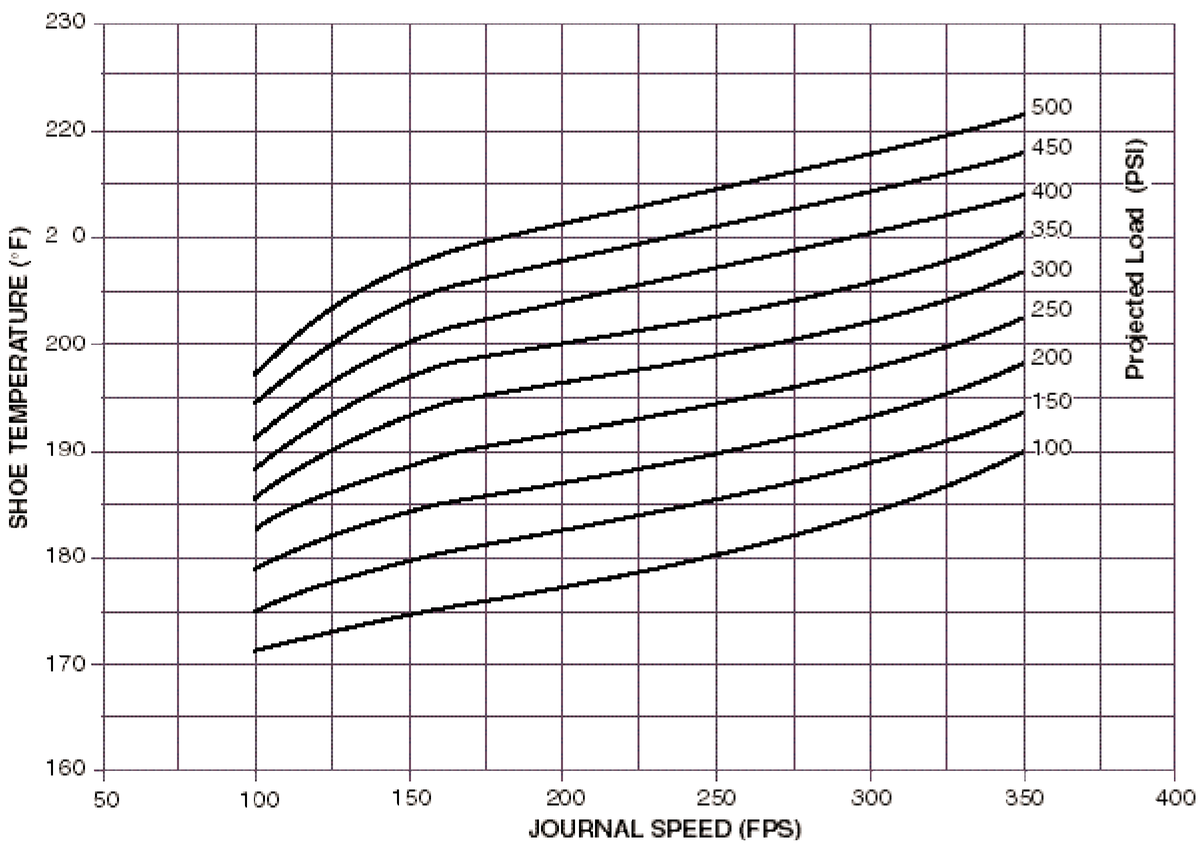
Shaft Diameter A	Shoe Width B	Housing Bore D	Endplate O.D. C	Overall Width E	Seat Width F	Locating Pin				Endplate Projection K	Rated Load (Lbs)	
						Diameter G	Location H	Projection J	Location X		Load on Shoe	Load Betwn. Shoe
3.000	3.00	5.500	5.31	3.88	3.00	0.25	0.63	0.25	0.25	0.44	2474	4003
3.500	3.50	6.125	5.88	4.50	3.50	0.25	0.69	0.25	0.25	0.50	3367	5449
4.000	4.00	7.000	6.56	5.12	4.00	0.31	0.75	0.31	0.31	0.56	4608	7455
4.500	4.50	7.500	7.19	5.62	4.50	0.31	0.88	0.31	0.31	0.56	5832	9436
5.000	5.00	8.500	7.88	6.25	5.00	0.38	0.94	0.38	0.38	0.63	7200	11649
5.500	5.50	9.000	8.63	6.75	5.50	0.38	1.00	0.38	0.38	0.63	8711	14095
6.000	6.00	10.000	9.50	7.37	6.00	0.50	1.23	0.50	0.50	0.69	10367	16775
7.000	7.00	11.750	11.00	8.37	7.00	0.50	1.25	0.50	0.50	0.69	14111	22832
8.000	8.00	13.250	12.75	9.50	8.00	0.63	1.63	0.63	0.63	0.75	18431	29822
9.000	9.00	14.750	14.00	11.00	9.00	0.63	1.75	0.63	0.63	1.00	23326	37743
10.000	10.00	16.000	15.31	12.00	10.00	0.75	2.00	0.75	0.75	1.00	30107	48714
11.000	11.00	17.750	16.75	13.25	11.00	0.75	2.13	0.75	0.75	1.13	36429	58944
12.000	12.00	19.000	18.25	14.25	12.00	0.75	2.25	0.75	0.75	1.13	43354	70148
13.000	13.00	20.750	19.75	15.50	13.00	0.75	2.38	0.75	0.75	1.25	50881	82327
14.000	14.00	22.500	21.25	16.50	14.00	1.00	2.63	1.00	1.00	1.25	59010	95480
15.000	15.00	24.000	22.75	17.75	15.00	1.00	2.75	1.00	1.00	1.38	67741	109607
16.000	16.00	25.500	24.00	18.75	16.00	1.00	2.88	1.00	1.00	1.38	77074	124708
17.000	17.00	27.000	25.50	20.00	17.00	1.00	2.88	1.00	1.00	1.50	87009	140784
18.000	18.00	28.500	26.75	21.25	18.00	1.25	3.38	1.25	1.25	1.63	97547	157834
19.000	19.00	30.000	28.50	22.38	19.00	1.25	3.63	1.25	1.25	1.69	108686	175858
20.000	20.00	31.500	30.00	23.50	20.00	1.25	3.75	1.25	1.25	1.75	120428	194857

POWER LOSS/OIL FLOW

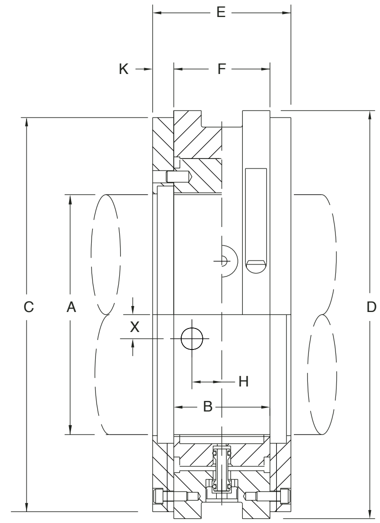


Oil Viscosity = ISO VG 32. Oil Inlet Temperature, 120°F
Oil Outlet Temperature, 162°F, .0015 in/in clearance, .25 preload

AVERAGE 75% SHOE TEMPERATURE



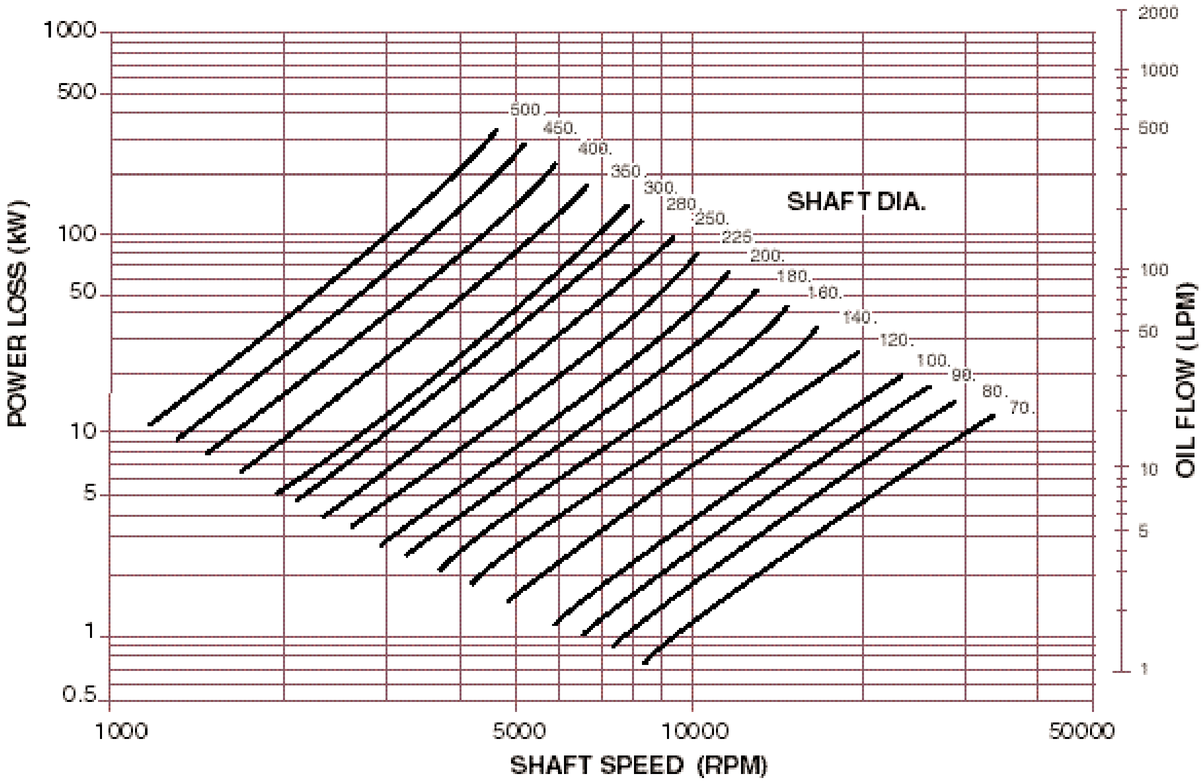
0.4 B/A BEARINGS (METRIC)



0.4 B/A Metric (mm)

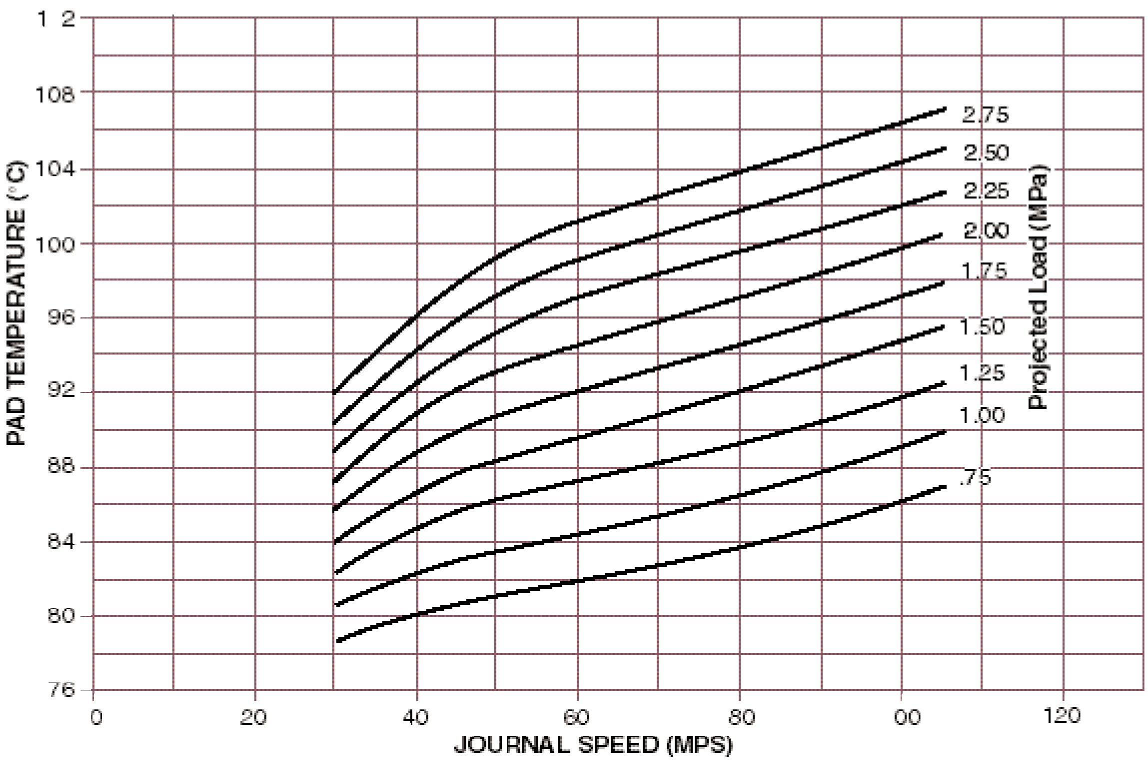
Shaft Diameter **A**	Shoe Width **B**	Housing Bore **D**	Endplate O.D. **C**	Overall Width **E**	Seat Width **F**	Locating Pin				Endplate Projection **K**	Rated Load (N)	
						Diameter **G**	Location **H**	Projection **J**	Location **X**		**Load on Shoe**	**Load Betwn. Shoe**
70	28	130	125.0	50	28	5	9.3	5	5	11	3361	5438
80	32	139	134.5	54	32	6	10.6	6	6	11	4390	7103
90	36	165	154.0	62	36	6	12.0	6	6	13	5556	8990
100	40	177	166.0	68	40	8	13.3	8	8	14	7220	11682
110	44	190	183.5	72	44	8	14.6	8	8	14	8736	14136
120	48	215	202.5	78	48	8	16.0	8	8	15	10397	16823
140	56	228	223.5	88	56	10	18.6	10	10	16	14152	22898
160	64	266	255.0	100	64	10	21.4	10	10	18	18484	29907
180	72	298	281.5	108	72	12	24.0	12	12	18	23393	37851
200	80	336	316.0	120	80	12	26.6	12	12	20	28881	46730
225	90	379	352.5	142	90	16	30.0	16	16	26	36552	59142
250	100	406	380.5	152	100	16	33.4	16	16	26	47382	76666
280	112	450	419.0	172	112	20	37.4	20	20	30	59436	96170
300	120	482	456.0	180	120	20	40.0	20	20	30	68230	110399
350	140	570	529.5	204	140	25	46.6	25	25	32	92869	150266
400	160	645	605.0	228	160	25	53.4	25	25	34	121299	196265
450	180	720	670.5	264	180	25	60.0	25	25	42	153519	248398
500	200	800	747.5	290	200	25	66.6	25	25	45	189529	306664

POWER LOSS/OIL FLOW

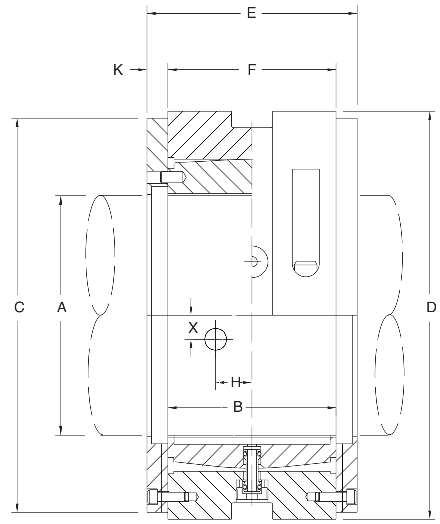


Oil Viscosity = ISO VG 32. Oil Inlet Temperature, 50°C.
Oil Outlet Temperature, 73°C, .0015 mm/mm clearance, .25 preload

AVERAGE 75% SHOE TEMPERATURE



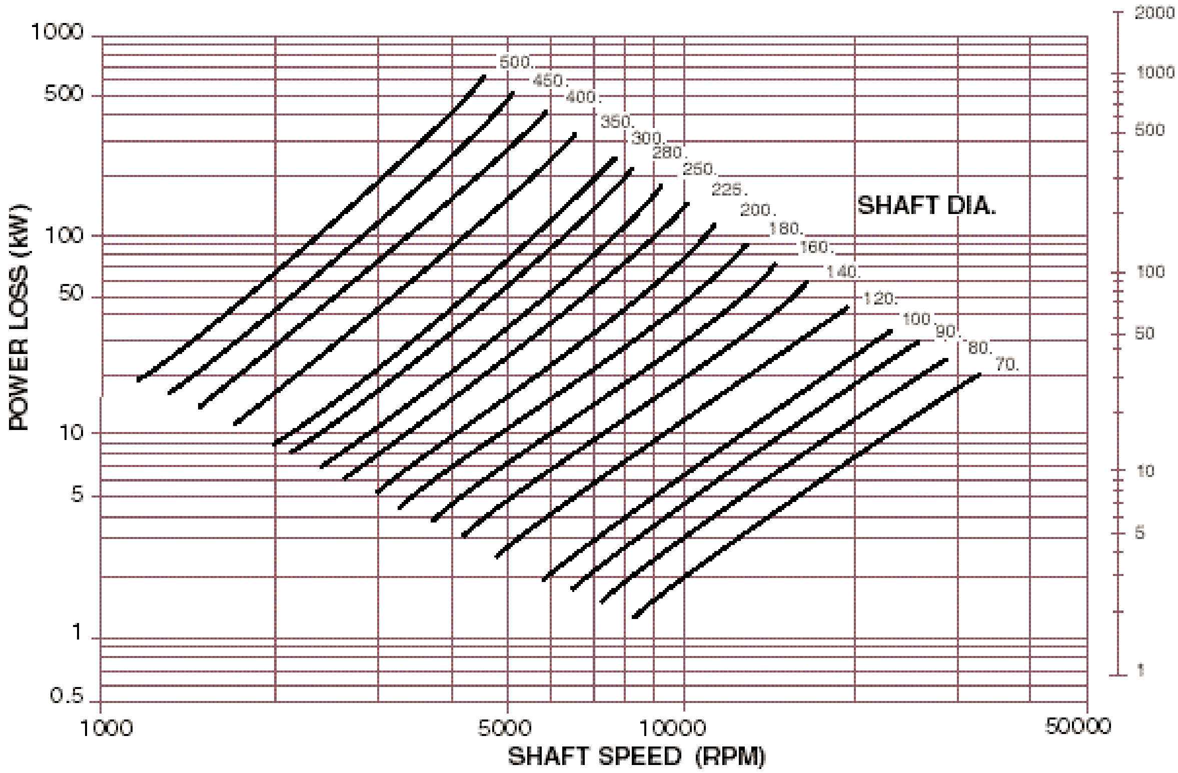
0.7 B/A BEARINGS (METRIC)



0.7 B/A Metric (mm)

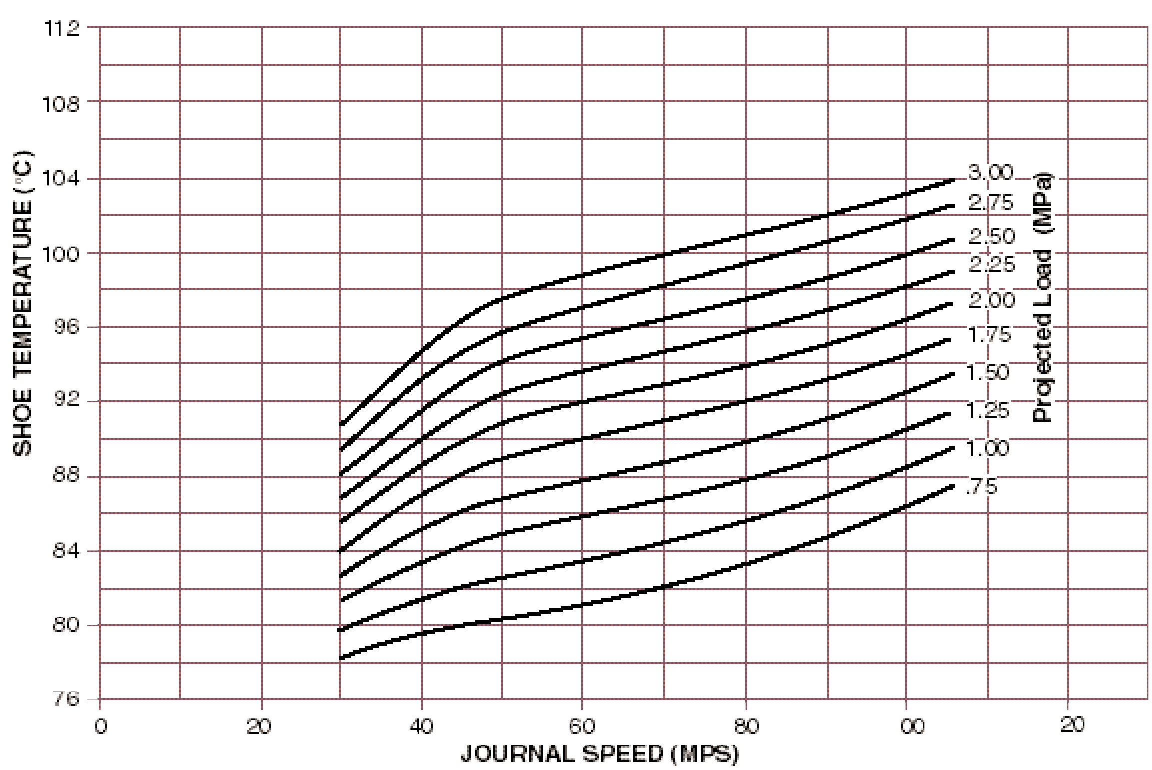
Shaft Diameter A	Shoe Width B	Housing Bore D	Endplate O.D. C	Overall Width E	Seat Width F	Locating Pin				Endplate Projection K	Rated Load (N)	
						Diameter G	Location H	Projection J	Location X		Load on Shoe	Load Betwn. Shoe
70	49	130	125.0	71	49	5	11	5	5	11	6191	10018
80	56	139	134.5	78	56	6	13	6	6	11	8087	13084
90	63	165	154.0	89	63	6	14	6	6	13	10235	16560
100	70	177	166.0	98	70	8	17	8	8	14	13267	21467
110	77	190	183.5	105	77	8	18	8	8	14	16053	25974
120	84	215	202.5	114	84	8	21	8	8	15	19105	30912
140	98	228	223.5	130	98	10	23	10	10	16	26003	42074
160	112	266	255.0	148	112	10	26	10	10	18	33964	54954
180	126	298	281.5	162	126	12	28	12	12	18	42985	69552
200	140	336	316.0	180	140	12	34	12	12	20	53068	85866
225	158	379	352.5	210	158	16	36	16	16	26	67378	109019
250	175	406	380.5	227	175	16	42	16	16	26	86867	140555
280	196	450	419.0	256	196	20	45	20	20	30	108967	176312
300	210	482	456.0	270	210	20	48	20	20	30	125089	202399
350	245	570	529.5	309	245	25	56	25	25	32	170260	275487
400	280	645	605.0	348	280	25	60	25	25	34	222381	359820
450	315	720	670.5	399	315	25	65	25	25	42	281451	455397
500	350	800	747.5	440	350	25	70	25	25	45	347470	562218

POWER LOSS/OIL FLOW

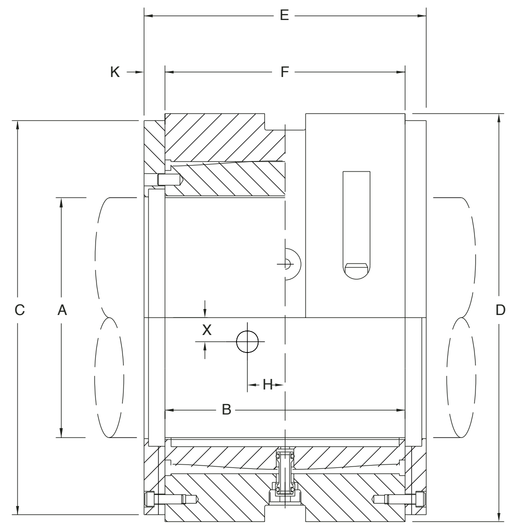


Oil Viscosity = ISO VG 32. Oil Inlet Temperature, 50°C.
Oil Outlet Temperature, 73°C, .0015 mm/mm clearance, .25 preload

AVERAGE 75% SHOE TEMPERATURE



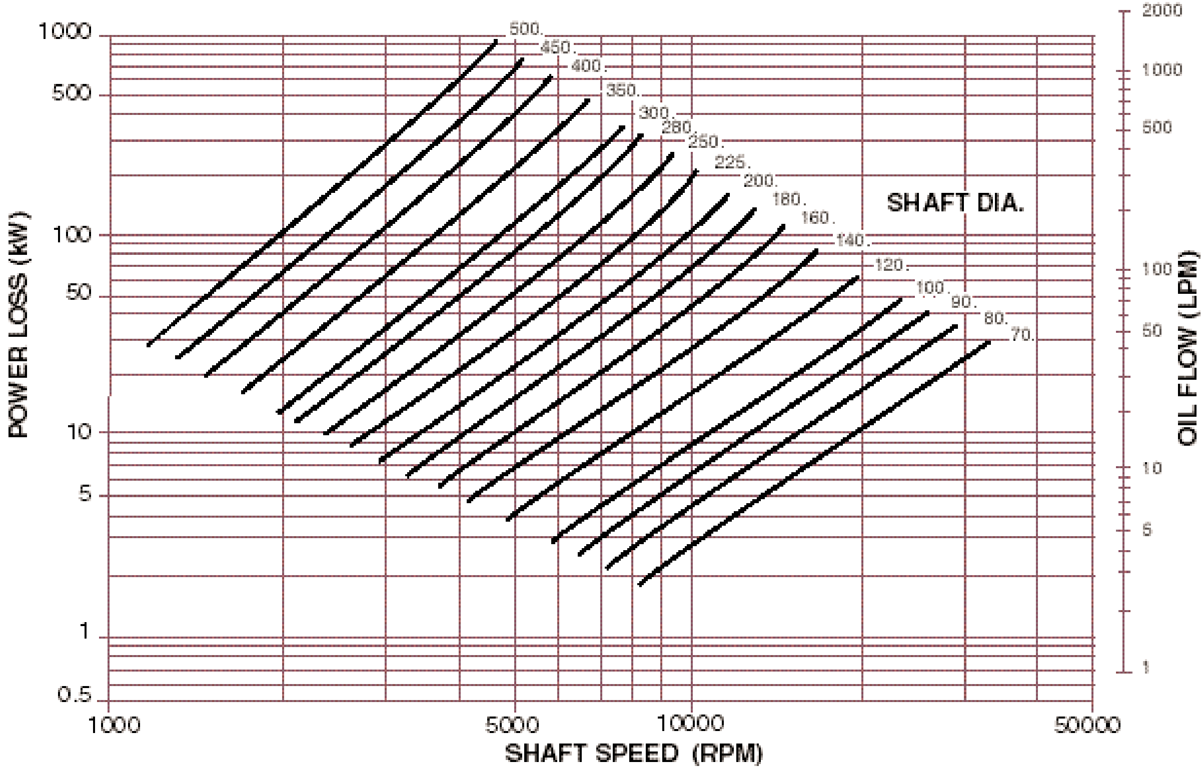
1.0 B/A BEARINGS (METRIC)



1.0 B/A Metric (mm)

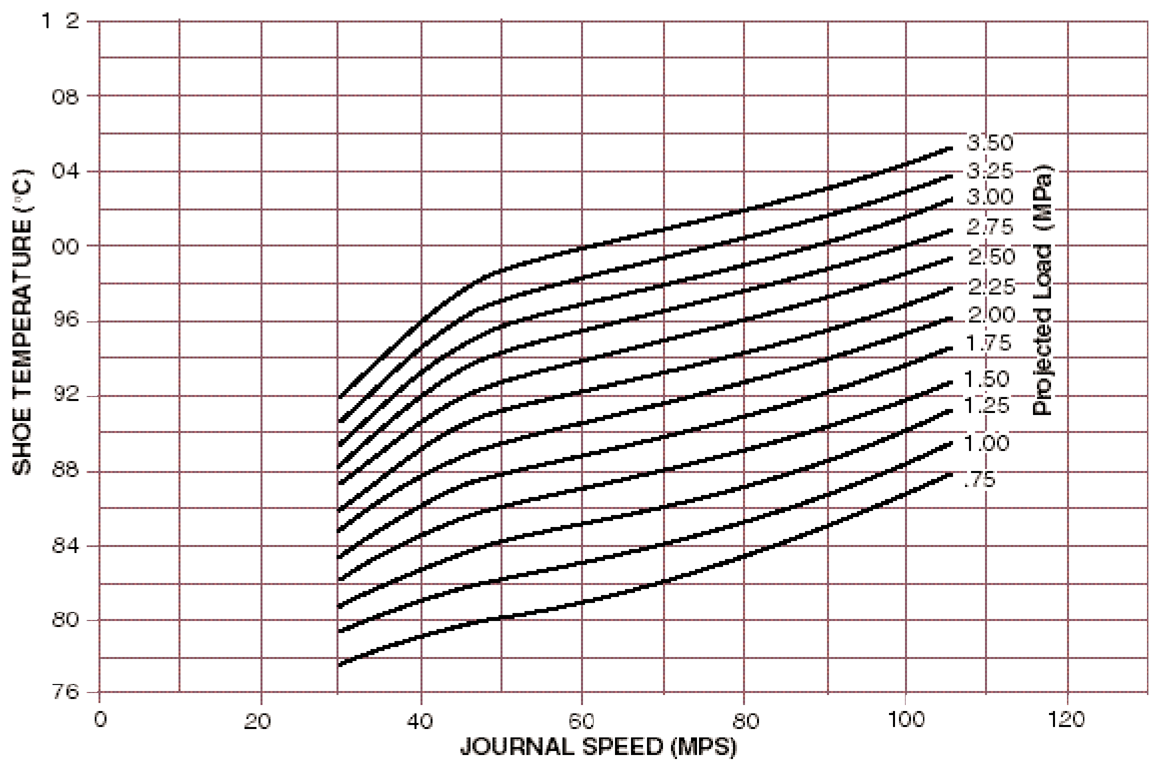
Shaft Diameter	Shoe Width	Housing Bore	Endplate O.D.	Overall Width	Seat Width	Locating Pin				Endplate Projection	Rated Load (N)	
A	B	D	C	E	F	Diameter G	Location H	Projection J	Location X	K	Load on Shoe	Load Betwn. Shoe
70	70	130	125.0	92	70	5	14	5	5	11	9287	15027
80	80	139	134.5	102	80	6	16	6	6	11	12130	19627
90	90	165	154.0	116	90	6	18	6	6	13	15352	24840
100	100	177	166.0	128	100	8	21	8	8	14	19855	32127
110	110	190	183.5	138	110	8	22	8	8	14	24025	38873
120	120	215	202.5	150	120	8	25	8	8	15	28592	46263
140	140	228	223.5	172	140	10	28	10	10	16	38917	62968
160	160	266	255.0	196	160	10	32	10	10	18	50830	82244
180	180	298	281.5	216	180	12	35	12	12	18	64332	104091
200	200	336	316.0	240	200	12	41	12	12	20	79422	128507
225	225	379	352.5	277	225	16	45	16	16	26	100518	162642
250	250	406	380.5	302	250	16	52	16	16	26	129737	209919
280	280	450	419.0	340	280	20	55	20	20	30	162742	263323
300	300	482	456.0	360	300	20	58	20	20	30	186822	302284
350	350	570	529.5	414	350	25	70	25	25	32	254285	411441
400	400	645	605.0	468	400	25	75	25	25	34	332127	537393
450	450	720	670.5	534	450	25	82	25	25	42	420348	680138
500	500	800	747.5	590	500	25	88	25	25	45	518949	839677

POWER LOSS/OIL FLOW



Oil Viscosity = ISO VG 32. Oil Inlet Temperature, 50°C.
Oil Outlet Temperature, 73°C, .0015 mm/mm clearance, .25 preload

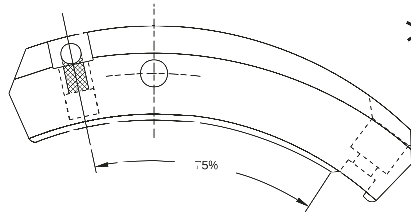
AVERAGE 75% SHOE TEMPERATURE

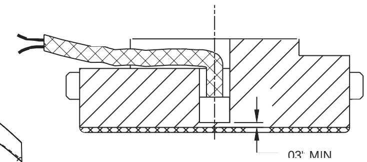


OPTIONS AND INSTRUMENTATION

Instrumentation

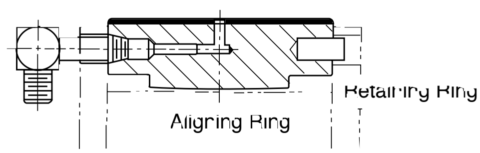
Journal shoes can be instrumented with thermocouples or RTDs to monitor bearing temperature. Kingsbury strongly recommends placing the detector at the 75% location and at a depth that allows a minimum of 0.03" (.76 mm) of base metal between the tip of the detector and babbitt interface. See discussion on temperature detector location, page 50.





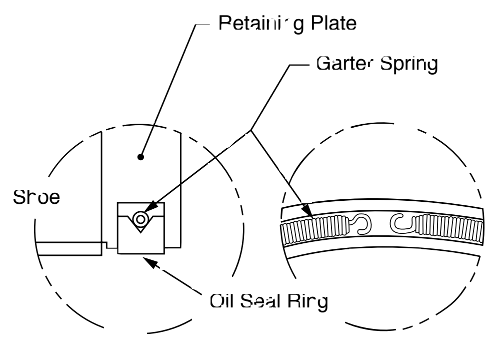
High Pressure Lift

Shoes can be modified for the injection of high pressure oil to establish an oil film at start-up or during very low speed operation. Kingsbury can also supply the high pressure lift systems.



Floating Seals

When oil flow out of the bearing along the shaft has to be controlled, floating seal rings can be utilized.
See “Discharge Configuration,” page 49.



NOTES ON SELECTING LEG JOURNAL BEARINGS

Discharge Configuration

A significant power loss reduction is obtained in direct lubrication by the quick evacuation of oil from the bearing. This is best accomplished in journal bearings by allowing the oil to exit freely in the axial direction which is the flow path generated by side leakage. Attempts to restrict this flow typically defeat the power advantage. In Kingsbury's standard LEG journal, the bulk quantity of oil is stopped by a single tooth labyrinth seal on the outboard sides of the bearing, and centrifugal forces send the oil out amply sized discharge drains. Similarly, casing drains should be adequately sized and vented to allow free drainage of the cavity.

Other discharge and flow configurations are available for situations which can tolerate no axial discharge. Please contact your Kingsbury Sales Engineer.

Pivots

For axial misalignment, spherical pivots are subject to damage and vibration which can increase bearing clearance and rotor vibration over time. Fitted pivot designs prevent such damage but have been reported to give other undesirable effects by behaving as fixed geometry bearings because pivot friction resists adjustment to changing conditions.

Kingsbury's journal shoe pivot has a compound surface designed to allow axial misalignment capability while significantly lowering pivot contact stresses and susceptibility to damage. The design was developed for earthquake and naval applications where the contact area rapidly increases under load giving added protection against damage from unusual or adverse conditions (large rotor imbalance, vibration, etc). The low stresses resist damage. The rolling contact design assures that the shoe angle readily responds to changing operating conditions, and the compound surface easily adjusts for static and dynamic misalignment of the shaft.

High Speed Clearance

Radial clearance recommendations presented in this catalog are a generic guideline to cover a wide range of applications. Special cases such as very high speeds, extreme ambient conditions, shaft heat, etc., may require special consideration and recommendations. Please contact your Kingsbury Sales Engineer for situations not addressed by this catalog.

GENERAL INFORMATION ON LEG THRUST AND JOURNAL BEARINGS

Hydrodynamic Principle

Because of its adhesion, oil is dragged by the rotating member so as to form a wedge-shaped film between the bearing surfaces. Like a flooded bearing, the LEG is a hydrodynamic bearing and has the fluid film properties of a hydrodynamic bearing. The difference is in the lubrication method. In a flooded bearing, oil is provided to the rotating surface by flooding the space between shoes. In an LEG bearing, cool oil is provided directly to the rotating surface at the entrance to the oil film.

LEG Catalog Curves

Power loss and shoe temperature curves are provided to allow a quick, reasonably accurate estimation of loss and temperature for the various bearings available in this catalog. To accomplish this, curves have been reduced in quantity to average values for a variety of configurations. This results in a possible 5% variation which is a reasonably good estimate for design purposes. If your estimations fall too close to design limits, our engineering department can assist with your particular selection, application, and criteria.

Temperature Detector Location

The most accurate measurement of surface temperature is obtained with the detector installed in the babbitt. However, babbitt is a soft material and can deform over time under hydrodynamic film forces resulting in a dimple in the surface. The detector may read inaccurate values because of the local distortion and can be damaged by the forces. Unsupported babbitt is also subject to fatigue which can lead to more severe damage and eventual failure.

Such problems are prevented by installing the detector in the shoe body assuring there is base metal above the detector hole to support the babbitt. There is only a small difference in temperature which we can relate to surface temperature and set alarm and trip appropriately to accommodate the slight change in depth. Considering the problems associated with installation in the babbitt, installation in the shoe body provides a more effective level of protection and is recommended by Kingsbury.

Pressure And Flow Orifice

For flow control, Kingsbury recommends an upstream orifice in the line to each bearing (loaded thrust, slack thrust, and each journal). If these are external to the housing, adjustments to flow can be made without disassembling and machining the bearings or bearing casings. Such adjustments may be required to optimize flow for bearing temperature or power loss, or to increase flow in cases of upgrades.

Orifice sizing is a straightforward procedure. The major pressure drops consist of the pressure drop through the upstream orifice and the drop through the bearing. The recommended flow for the bearing depends on operating conditions. For lower speeds, less flow is required and, since pressure is proportional to flow, less pressure is required at the bearing. The required pressure at the bearings ranges from .25 atmosphere for flows at the low speed end of the charts, to .5 atmosphere at mid range, to 1.0 atmosphere at the high speed end. Each upstream orifice can be sized to drop the system supply pressure to the pressure required at each bearing.

Alarm & Shutdown Limits For Temperature

Temperatures on the order of 160° C cause plastic flow of the babbitt. Maximum temperatures are conservatively limited to 135° C. Allowing 8° C for alarm and 15° C for trip settings, maximum operating babbitt temperature is 120° C. It is important to note that alarm and trip are set relative to normal design temperatures. Specifically, if the design temperature is 85° C, the trip should be set at 100° C, not 120° C.

In addition to the bearing, consideration has to be given to the temperature limitations of the lubricant. Consult the lubricant supplier for information on the lubricant's limitation.

Maximum Speeds

It is difficult to set a rule of thumb on maximum speed because of the many factors that affect the limits. The curves and charts listed in this catalog are purposely limited to conservative speeds. The bearings are suitable for higher speeds, but may require special consideration in regard to shoe material, oil flow, flow paths, and housing configuration. Therefore, if your application exceeds the speeds shown in the charts, please contact us for assistance.

Optimized Offset

A 60% offset is designed as standard because it is suitable for most of the speeds and loads covered in this catalog. For other applications, or for special requirements, the offset can be optimized for the specific application.

In order to achieve the best performance from a bearing, it should be optimized for one direction of rotation. Significant gains in performance are realized by offsetting the pivot and using leading edge groove lubrication. Bearings designed this way, such as the LEG, will operate in reverse with approximately 60% of the load capacity of the forward direction depending on the speed. Since most reversals are temporary, the lower reverse load capacity is not usually a problem. Center pivot, bi-rotational bearings are typically instrumented with temperature detectors toward the trailing edge of the pad. This makes them unidirectional in the sense that they must be purchased, labeled, and installed for one direction. As long as the thrust bearing is going to be operated and instrumented for one direction, it is logical to optimize the design for that rotation, especially at high speeds.

Backing Material

Data is presented in the catalog for steel and chrome copper shoes which are suitable for most applications. Other materials are available for special applications.

INQUIRY CHECKLIST

To help you select the proper LEG thrust and/or journal bearings, please provide the following information about your applications. For applications outside the standard range, or for special features not listed in this catalog, please consult your Kingsbury Sales Engineer directly. In an effort to continually improve quality and performance, Kingsbury reserves the right to upgrade materials and/or design.

THRUST BEARINGS

- Type of application
- Thrust load on active side
- Reverse thrust, if any
- Shaft speed
- Shaft diameter at ID of bearing
- Oil type - viscosity
- Oil inlet temperature
- Maximum shoe temperature requirements if any

Additional equipment/options

- Instrumentation - type, quantity, location
- Filler plates - thickness
- Shims - thickness
- Collar - bore and key size
- Special specifications - Military, Industrial, API, etc.
- Any other requirements

JOURNAL BEARINGS

- Type of application
- Radial load
- Load direction
- Load between or on shoes
- Shaft speed
- Shaft diameter - preferred
- Shoe length - preferred
- Preload - preferred (other than .25 nominal)
- Oil type - viscosity
- Oil inlet temperature
- Maximum shoe temperature requirements if any

Additional equipment/options

- Instrumentation - type, quantity, location
- Special seals
- Special specifications - Military, Industrial, API, etc.
- Any other requirements