ORION
CORPORATION

HYDRODYNAMIC TILTING PAD JOURNAL BEARINGS

METRIC CATALOG

The Hydrodynamic Bearing Specialists

Orion Corporation is a leading manufacturer of hydrodynamic bearings for rotating machinery. Products include a complete line of tilting pad journal bearings, sleeve bearings, equalizing and non-equalizing tilting pad thrust bearings, and flat and tapered-land thrust plates. Our new high performance directed lube type designs, Advantage™ journal and OCI™ thrust bearing, provide dramatically higher efficiency, cooler operation and higher load capacities.

Our engineering group is exceptionally skilled in helping manufacturers find solutions to difficult applications. We offer machinery builders extensive design and manufacturing capabilities. For nearly 50 years, we have designed and built bearings for turbines, turbochargers, compressors, expanders, gear drives, electric motors, generators, pumps, diesel locomotives and similar equipment for industrial, utility and marine use.

This Atlas Copco compressor features Orion tilting pad journal bearings on all stages. Photo courtesy of Atlas Copco Comptec.

Quality Management

Quality Management Systems are certified to ISO 9001:2000 standards by Lloyd's Register Quality Assurance, LTD. This includes accreditation by the Dutch Council of Certification, National Accreditation Council (British), and DAR Accreditation (German). All critical operations in bearing manufacture are performed at our factories, from centrifugal casting, to machining, to assembly and inspection.

Introduction

In turbo machinery operating at high speeds, plain cylindrical bearings are susceptible to oil film instability. In this condition, also known as oil whirl, the shaft orbits within the clearance of the bearing.

Headquarters and manufacturing facilities

Corporate, sales and engineering offices, and complete manufacturing facilities are located in Grafton, Wisconsin, USA. Products include tilting pad journal bearings, sleeve bearings, large thrust bearings, special bearings and bearing assemblies. Bearing diameters range from 16 mm to 1500 mm.

To improve bearing stability, the cylindrical bore can be modified with different geometries. Special geometries include elliptical bores, three- and four-lobe bores, tapered land bores, offset halves and pressure dams. All geometries are fixed, and are optimized for a specific operating condition of load and speed.

The tilting pad journal bearing uses tilting pads to provide geometries that change with variations in load or speed. This bearing offers the best stability at all conditions.

Ingersoll Rand's Centac air compressor uses Orion tilting pad bearings. *Photo courtesy of Ingersoll Rand.*

Orion Corporation offers a full line of standard metric tilting pad bearings from 40 to 300 mm shaft diameter. The standard bearings are available in three length-to-diameter ratios: Length/Diameter (L/D) = 0.4, 0.7 and 1.0. Three housing styles, which allow different types of mounting, are available. Two lubrication options are available: flooded lubrication and Orion Advantage™ bearing (non-flooded, directed inlet and exit lubrication).

This catalog encompasses the most economical standard designs. All designs can be customized for specialized casings, diameters and bores.

Description

The Orion standard tilting pad bearing consists of an outer retainer, five tilting pads, one integral end plate and one removable end plate. The oil seal is the floating type, the most effective means to reduce oil spray along the shaft. Fixed seals can be provided on special request. Standard materials for the retainer and pads are steel. The pad lining is (babbit) white metal to specification BS 3332/1, SAE 11, DIN 1703-WM80, and ASTM B-23 Grade 2. The seal rings are bronze.

Orion's manufacturing facility in Columbus, Nebraska, USA produces equalizing thrust bearings, sleeve bearings and special thrust bearings in sizes from 16 mm to 600 mm diameter. Quality management systems at all facilities are certified to ISO 9001:2000.

Visit our Web site at **www.orion-corp.com** and find out how easy bearing selection can be. Just click on **"Performance Direct."** This special tool will help you select the right bearing. It quickly displays its physical and performance characteristics, including power loss and lubrication requirements.

Lubrication

The lubricant in tilting pad bearings serves two primary functions. The first is to lubricate the bearing and the second is to carry away heat generated during operation. Two commonly used methods of lubrication are flooded lube, where the bearing inner cavity is completely filled with oil, and non-flooded lube, where the oil is fed directly in

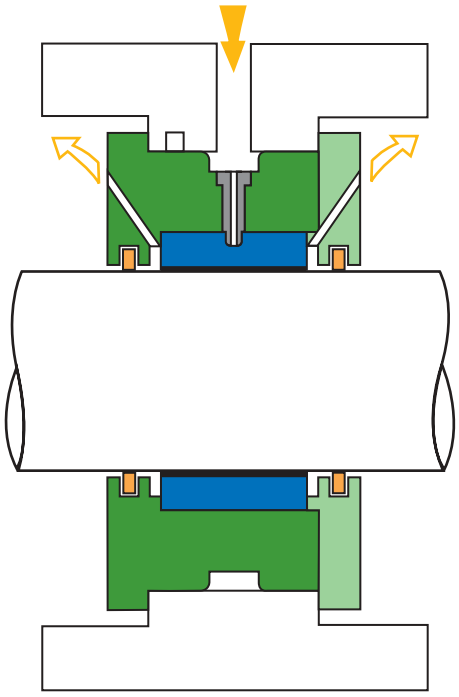


Figure 1. Orion Standard Tilting Pad Bearing, flooded design

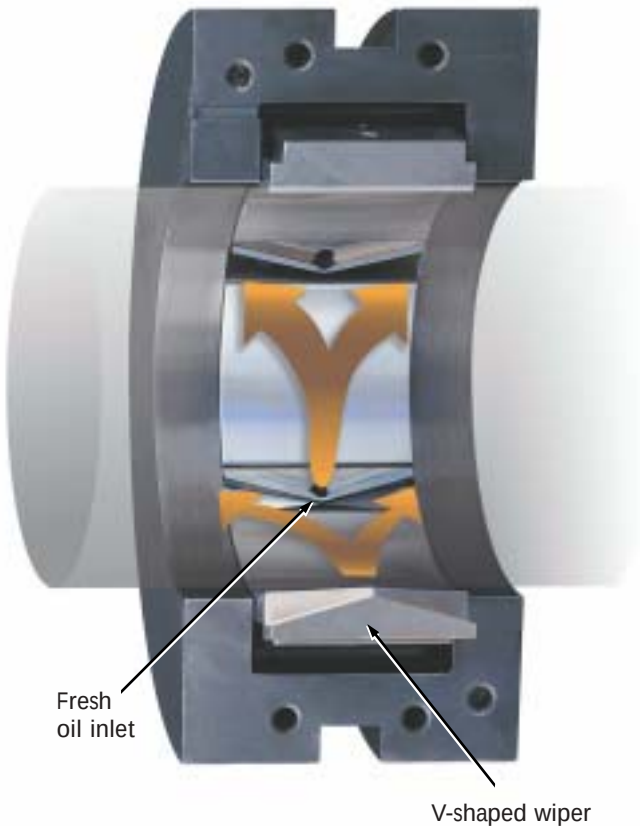
front of each pad. In the flooded design, the bearing pads obtain their lubrication from the surrounding oil bath. In the non-flooded design, the oil is drained by either removing the floating seals or by adding strategically placed bottom drain holes.

Orion Advantage™ tilting pad bearings are used on this Dresser-Rand "Datum" barrel type process gas compressor. Photo courtesy of Dresser-Rand.

Orion Standard Tilting Pad Bearings

The Orion standard design tilting pad bearing operates in a completely flooded condition. Inlet orifices located in the lubricant inlet groove control lubricant supply. The inlet orifices are individually sized to suit each bearing's operating conditions. After exiting the orifice, the lubricant flows between the shaft and journal pad, forming a hydrodynamic oil film wedge. Hot lubricant is allowed to exit at the top of the bearing through drain holes.

Seals that float with shaft displacement maintain the flooded condition and minimize leakage. Floating seals are standard on Orion bearings. Most other manufacturers offer them as an optional add-on.



Orion Advantage™ Tilting Pad Bearing

The Orion Advantage™ bearing is an advanced form of non-flooded bearing, which combines the features of non-flooded designs with patented oil direction technology. The V-shaped wiper design directs hot oil away from the next bearing pad, minimizing hot oil carryover. Fresh oil is fed and metered to the pads by independent nozzle orifices positioned between each pad. The directed flow design provides effective removal of oil from the bearing cavity.

Advantage™ high performance tilting pad bearings offer up to 35% higher efficiency over standard bearing designs. Maximum pad temperatures are reduced up to 30%. Lower oil flow requirements reduce horsepower loss as much as 50%. Improved cooling, lower losses and lower pad temperatures allow higher loading, up to 150% of standard designs.

New Advantage™ tilting pad bearings fit standard bearing packages for easy retrofitting.

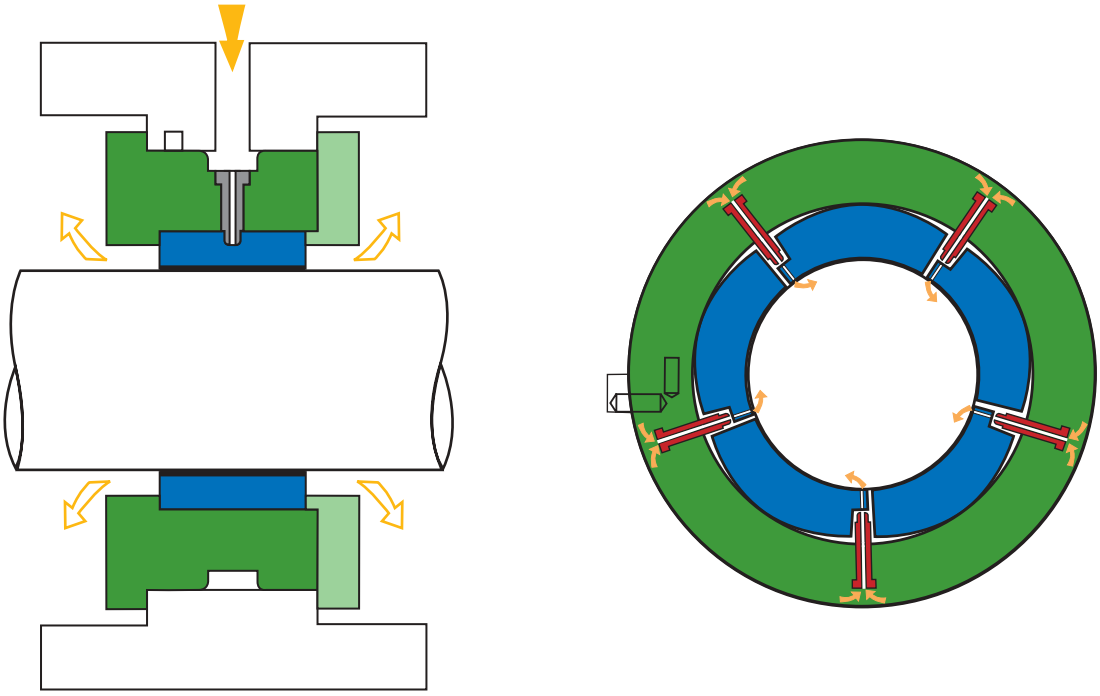


Figure 2. Orion Advantage™ bearing, non-flooded design

Selecting Tilting Pad Bearings

You can select a bearing using the performance charts in this catalog, or **Performance Direct**, the automated bearing selection program on the Orion Web site at **www.orion-corp.com**. ***Orion recommends that you use Performance Direct for accuracy, speed and ease-of-use when selecting a bearing.***

Make Your Bearing Selection On-Line with Orion Performance Direct

Because there are so many combinations of operating conditions, Orion has developed **Performance Direct**, an on-line tool to help you select the right bearing. **Performance Direct** is fast and easy, and it takes into account a greater number of considerations than can be addressed in a catalog. For example, **Performance Direct** incorporates factors such as unusual viscosities and between pad load direction.

If your application requires this versatility, or if you would just like to make your selection as easy as possible, we invite you to visit our Web site at **www.orion-corp.com** and click on **Performance Direct**. After registering to use this advanced tool, you select bearing type and enter your parameters. **Performance Direct** calculates power loss, oil flow and maximum pad temperature and displays the bearing's physical characteristics. You can quickly compare performance of different bearings to determine which is most suitable for your application.

Performance Curve Charts

If you prefer to use performance curves for your bearing selections, follow these steps:

Step 1 Preselection

Choose an appropriate L/D from Maximum Load Chart (Figure 3) using the bearing load and journal diameter. Find journal shaft diameter in the first column. Move to the right until load does not exceed rated load.

Example: 14.7 kN load, 10,800 rpm, 100 mm diameter journal.

Find the journal diameter, 100 mm, in the left column, and move to the right until the desired bearing is found where 14.7 kN load does not exceed the maximum load rating. In this example a 0.7 L/D has a rating of 15.4 kN for "Load On Pad." In this example, load is less than the rating of 15.4 kN. A suitable choice is 0.7 L/D.

Step 2 Lubrication Options

Choose the lubrication option of either flooded lube or non-flooded lube Advantage™ bearing.

Note: A common guideline is to start with a flooded lube selection. The additional power saving and cooler operating benefits of the Advantage™ bearing are realized at speeds on the right ends of the performance curves. Until a selection is made for a flooded lube bearing, the potential Advantage™ bearing design benefits cannot be compared.

Example: 14.7 kN load, 10,800 rpm, 100 mm diameter journal. For the purpose of this example, choose "flooded lube."

Step 3 Selection

Choose the appropriate performance chart by matching the combination of L/D ratio and lubrication option.

Figures 7 through 9 are for L/Ds of 0.4, 0.7 and 1.0 respectively for the flooded lube bearing. Figures 10 through 12 are for L/Ds of 0.4, 0.7 and 1.0 respectively for the Advantage™ bearing.

To determine if the bearing selection falls within the operating speed range of the bearing, locate the intersection of the journal diameter curve and shaft speed.

Note: If the intersection of the operating point is above the dashed "minimum oil film thickness" line @ 2.24 MPa and below the top end of the curve, then the bearing is in its operating speed range.

Example: 14.7 kN load, 10,800 rpm, 100 mm diameter journal.

From Step 1, L/D = 0.7; from Step 2, flooded lube. The matching performance chart is Figure 8. The intersection of 100 mm shaft curve and 10,800 rpm is within the operating speed range. This is an acceptable choice.

Note: If the intersection shaft diameter curve and speed line had been below the "minimum oil film thickness" dashed line @ 2.24 MPa, typically a longer L/D should be selected and Step 3 repeated.

Example: 14.7 kN load, 5,500 rpm, 100 mm diameter.

The intersection is below the "minimum oil film thickness" dashed line. When the intersection is below the dashed line more bearing surface area is needed. The options available are to increase the journal diameter or lengthen the bearing pad. Our example is a 0.7 L/D. Increase the bearing length to L/D = 1.0. Proceed to Figure 9. The intersection of 100 mm shaft diameter and 5500 rpm speed is now located above the minimum oil film line. The selection falls within the operating speed range of the bearing and is an acceptable choice.

Maximum Load (kN) for ORION Tilting Pad Journal Bearings

Journal Shaft Diameter	0.4 L/D			0.7 L/D			1.0 L/D		
	Load On Pad	Load Between Pad	ADVANTAGE Load Between Pad	Load On Pad	Load Between Pad	ADVANTAGE Load Between Pad	Load On Pad	Load Between Pad	ADVANTAGE Load Between Pad
40	1.41	1.79	2.24	2.46	3.14	3.93	3.52	4.48	5.60
45	1.78	2.67	2.83	3.12	3.97	4.96	4.45	5.67	7.08
50	2.20	2.80	3.50	3.85	4.90	6.13	5.50	7.00	8.75
55	2.66	3.39	4.23	4.66	5.93	7.41	6.65	8.47	10.59
60	3.17	4.03	5.04	5.54	7.06	8.83	7.92	10.08	12.60
70	4.31	5.49	6.86	7.55	9.60	12.00	10.78	13.72	17.15
80	5.62	7.17	8.96	9.86	12.54	15.68	14.08	17.92	22.40
90	7.13	9.07	11.34	12.47	15.88	19.85	17.82	22.70	28.38
100	8.80	11.20	14.00	15.40	19.60	24.50	22.00	28.00	35.00
110	10.65	13.55	16.94	18.60	23.70	29.63	26.60	33.90	42.38
125	13.75	17.50	21.88	24.10	30.60	38.25	34.40	43.80	54.75
140	17.25	22.00	27.50	30.20	38.40	48.00	43.10	54.90	68.63
160	22.50	28.70	35.88	39.40	50.20	62.75	56.60	71.70	89.63
180	28.50	36.30	45.38	49.90	63.50	79.38	71.30	90.70	113.38
200	35.20	44.80	56.00	61.60	78.40	98.00	88.00	112.00	140.00
220	42.59	54.20	67.76	74.53	94.86	118.58	106.48	135.52	169.40
250	55.00	70.00	87.50	96.30	122.50	153.13	137.50	175.00	218.75
280	69.00	87.80	109.75	120.70	153.70	192.13	172.50	220.00	275.00
300	79.20	100.70	125.88	138.60	176.40	220.50	198.00	252.00	315.00

Figure 3. Maximum load (kN) for tilting pad journal bearings

Step 4 Determine Power Loss

To determine power loss, start at the intersection point located in Step 3 and draw a horizontal line to the power loss axis. The intersection point on the power loss axis is the power loss for the bearing selected.

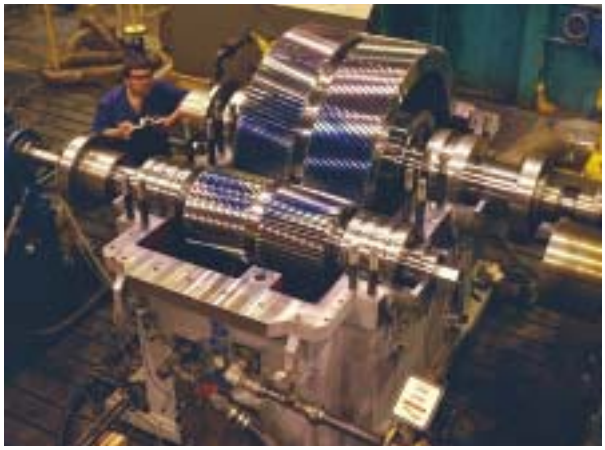
Example: 14.7 kN, 10,800 rpm, 100 mm shaft diameter. Power loss in our example is approximately 12 kW (Figure 8).

Step 5 Determine Oil Requirements

The oil flow rate required for the operation of the bearing can be determined using the power loss from the performance charts and the following formula:

Oil Flow Rate Required (liters/min) = Power loss (kW) x 2.11

Oil grade = ISO VG 32
Oil inlet temperature = 50°C
Lubricant temperature rise = 17°C



This Lufkin gear box uses Orion Advantage™ tilting pad bearings on the pinion, and Orion Advantage™ sleeve bearing on the bull gear.
Photo courtesy of Lufkin Industries.

Example: For the 100 mm bearing in the description above, the power loss from the performance charts is 12 kW.

Oil Flow Rate Required = Power loss (kW) x 2.11 l/min. kW
25 l/min. = 12 kW x 2.11 l/min. kW

Step 6 Determine Shaft Size

To determine the exact shaft size use the table in Figure 4. Find the bearing size and move horizontally to find the recommended shaft size and bearing clearance.

The required bearing diametral clearance is obtained by machining the journal to a diameter smaller than the bearing bore diameter. This method allows the use of standard pad sizes and minimizes inventory required. The chart in Figure 4 combines the DIN standards on shaft machining tolerance and Orion recommended clearance between the shaft and bearing bore to provide the upper and lower limits for shaft machining. The bearing clearance is the compilation of the high and low limits for shaft machining and high and low limits of bearing machining.

Example: 14.7 kN, 10,800 rpm, 100 mm diameter journal. Nominal bearing diameter 100 mm.

From table in Figure 4:
Shaft diameter 99.840 mm minimum
Shaft diameter 99.862 mm maximum
Bearing clearance 0.138 mm minimum
Bearing clearance 0.211 mm maximum

Nominal Bearing Diameter mm	Shaft Diameter Manufacturing Limits Minimum mm	Shaft Diameter Manufacturing Limits Maximum mm	Bearing Clearance Manufacturing Limits Minimum mm	Bearing Clearance Manufacturing Limits Maximum mm
40	39.906	39.922	0.078	0.145
45	44.901	44.917	0.083	0.150
50	49.896	49.912	0.088	0.155
55	54.889	54.908	0.092	0.162
60	59.881	59.900	0.100	0.170
70	69.873	69.892	0.108	0.178
80	79.860	79.879	0.121	0.191
90	89.849	89.871	0.129	0.202
100	99.840	99.862	0.138	0.211
110	109.826	109.848	0.152	0.225
120	119.812	119.834	0.166	0.239
140	139.782	139.807	0.193	0.269
160	159.755	159.780	0.220	0.296
180	179.728	179.753	0.247	0.323
200	199.698	199.727	0.273	0.353
220	219.671	219.700	0.300	0.380
250	249.631	249.660	0.340	0.420
280	279.589	279.621	0.379	0.462
300	299.563	299.595	0.405	0.488

Figure 4. Diametral clearance and shaft diameter

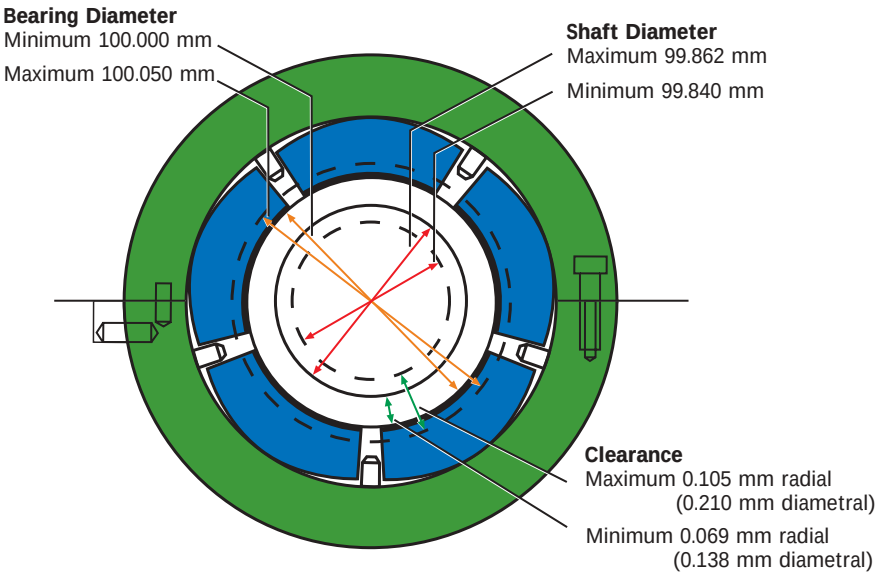


Figure 5. Clearance and shaft diameter

Additional Variables

Oil Viscosity

The lubricating oil's viscosity will affect the load capacity of the bearing. Higher oil viscosities will generate thicker oil films, yielding greater pad-to-journal separation and greater film capacities. However, higher viscosities also result in higher oil shearing, and consequently greater power loss and higher pad temperatures. Orion has chosen an oil viscosity of ISO VG 32 at an inlet temperature of 50° C as a typical oil for most applications. The performance curves in this catalog are based on these oil parameters. If different oil viscosities are used, go to the **Performance Direct** bearing calculator at **www.orion-corp.com**, or consult Orion Corp.

Load Direction

The standard bearing has a "load on pad" which means the direction of load is on one pad (shown in Figure 6a). If the load chart indicates the load exceeds the bearing capacity, "load between pad" can be considered. This directs the load between adjacent pads for additional load carrying capacity (shown in Figure 6b). Go to the **Performance Direct** bearing calculator at **www.orion-corp.com**, or consult Orion Corp.

Definition of Preload

"Preload" describes the relationship between the pad diameter, shaft diameter and bearing diameter. Orion's bearings have a positive preload, which means the pad radius is larger than the bearing radius. As shown in Figure 5, the opening C (clearance) is larger at the leading edge of the pad. This allows better oil wedge formation.

$$\text{Preload} = \frac{1 - \text{Bearing Diameter} - \text{Shaft Diameter}}{\text{Pad Diameter} - \text{Shaft Diameter}}$$

The standard preload of the cataloged bearings is 0.33. A change in the preload can have an effect on power loss, pad temperature and dynamic characteristics of stiffness and damping. Bearings with preloads from 0 to 0.7 also are available. Contact Orion if your application requires a special preload.

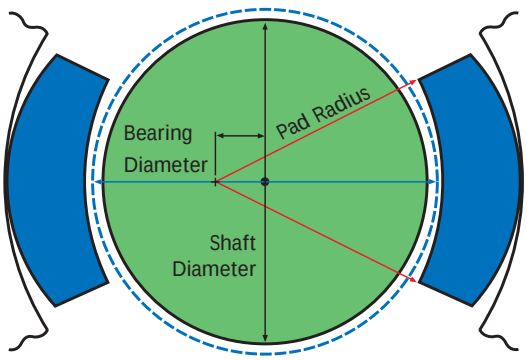


Figure 6. Preload definition

Select Your Bearing with Performance Direct

Selecting the right bearing is fast and easy with Orion's on-line selection tool. Go to our Web site and click on **Performance Direct**. After you register, all you have to do is select the bearing type and enter your bearing parameters. **Performance Direct** does all the work. It selects the appropriate bearing, and then calculates and displays the bearing's physical and performance characteristics. You can compare performance of different bearings quickly to determine which is most suitable for your application.

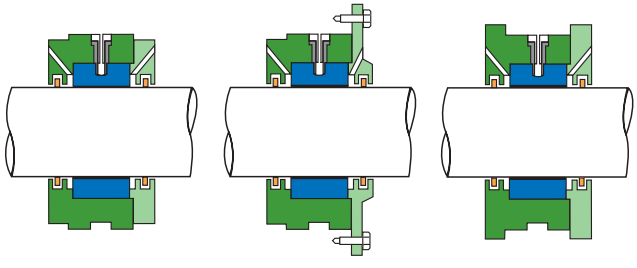
Basic Configurations

Three basic models of Orion bearings include:

- **"S"** straight seat split bearing
- **"F"** single flange non-split bearing
- **"2F"** double flange split bearing

Special materials, configurations and combinations of tilting pad bearings with double thrust plates or tilting pad thrust bearings are also available.

Housing Types



Bearing Lengths

Three bearing pad lengths are available in each bearing model, cataloged by approximate pad length-to-diameter (L/D) ratios: Narrow (L/D=0.4), Intermediate (L/D=0.7) and Wide (L/D=1.0).

Light Load Exceptions

The performance curves have dashed lines labeled as “minimum film thickness” @ 2.24 MPa which represents the minimum speed at which the bearing can operate at the maximum rated unit load* of 2.24 MPa. The 0.4 L/D performance curves have an additional dashed line for light loads labeled as “minimum film thickness” @ 1.25 MPa which represents the minimum speed at which the bearing can operate at the maximum unit load* of 1.25 MPa.

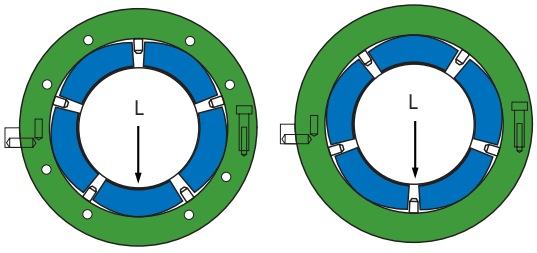
If the unit load* is less than 2.24 MPa or 1.25 MPa, operation at less than the respective speed is possible, but it is necessary to verify that acceptable film thickness is being generated either with the web site selector (this will enable you to evaluate lower speed, lighter load operation yourself) or by contacting Orion. With the 0.4 L/D performance curves, if the unit load* is less than 1.25 MPa, operation in the entire area above the 1.25 MPa dashed lines is possible.

Load at Start

The unit load* should not exceed 1.2 MPa at the instant of start. If the load exceeds this, the oil film generation will not be sufficient, and a larger diameter bearing, or longer pad length will be required. If the bearing area cannot be increased in this manner, then hydrostatic lift (high pressure jacking oil) will be required to provide hydraulic lift between the pad and the shaft. See Figure 16.

* Unit load (MPa) = Load (N) / [pad length (mm) x shaft diameter (mm)]

Figure 6a and b. Load definition:



Load on Pad **6a** Load Between Pads **6b**

Bearing Configuration Key

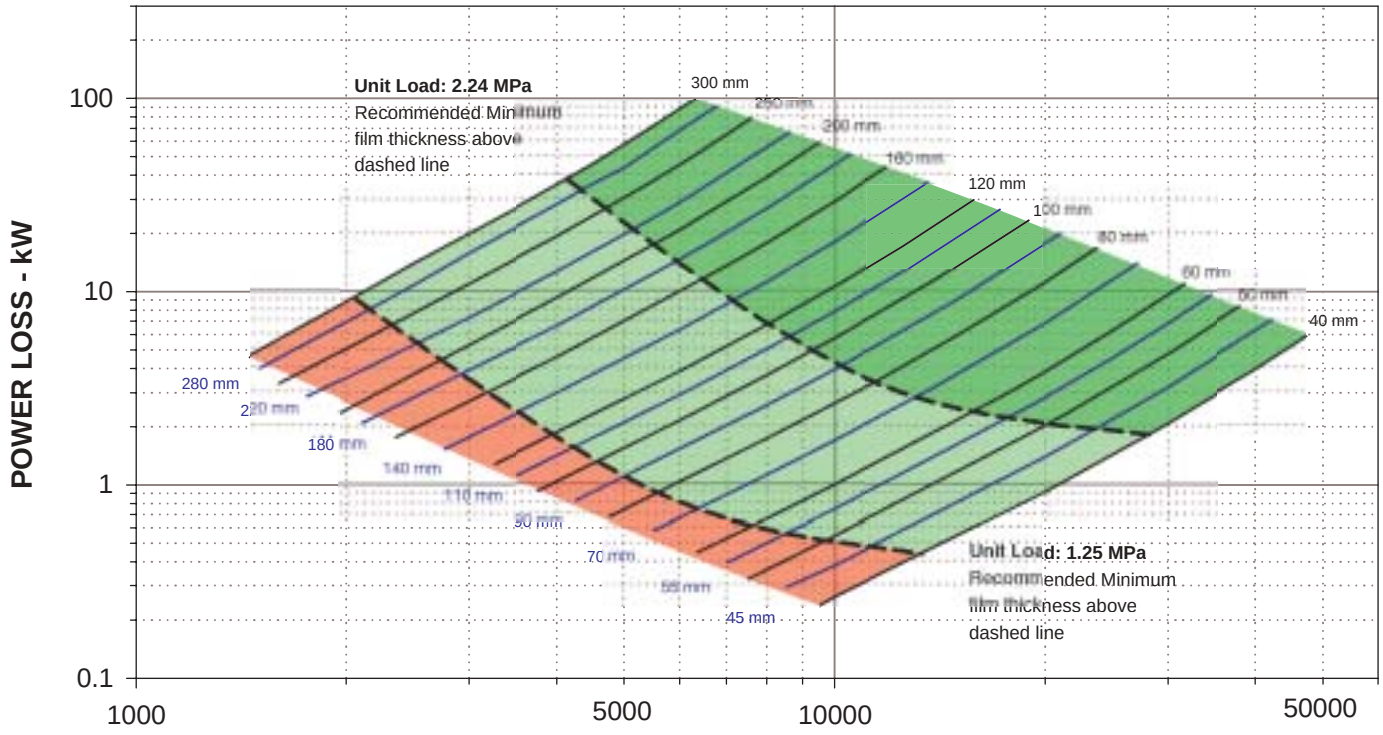
Housing Type	Bearing Length	Nominal Shaft Diameter (mm)	Metric	Pad Configuration	Bearing Options	Advantage Bearing
S – Straight **F** – One flange **2F** – Two flanges	**N** – Narrow (.4 L/D) **I** – Intermediate (.7 L/D) **W** – Wide (1 L/D)	40 to 300	**M**	**O** – load on pad **B** – load between pads	**T** – Thrust Face **2T** – Double Thrust Face **TP** – Tilting Pad Thrust **2TP** – Double Tilting Pad Thrust **H** – Hydrostatic Lifting Provision **TC** – Thermocouple **RTD** – Resistance Temperature Detector	**A** – Advantage High Performance Design **S** – Standard Flooded Lube Design
S	**I**	**55**	**M**	**O**		**A**

Examples: SI55MO A describes a bearing with a straight housing (described above), Intermediate length, 55 mm diameter shaft size, metric range, with load on pad, no bearing options selected, **Advantage™** design.

FN100MBTPHS describes a bearing with a single mounting flange, narrow length, 100 mm diameter shaft size, metric range, with load between pads, with tilting pad thrust, hydraulic lifting options and standard design.

Performance Curves

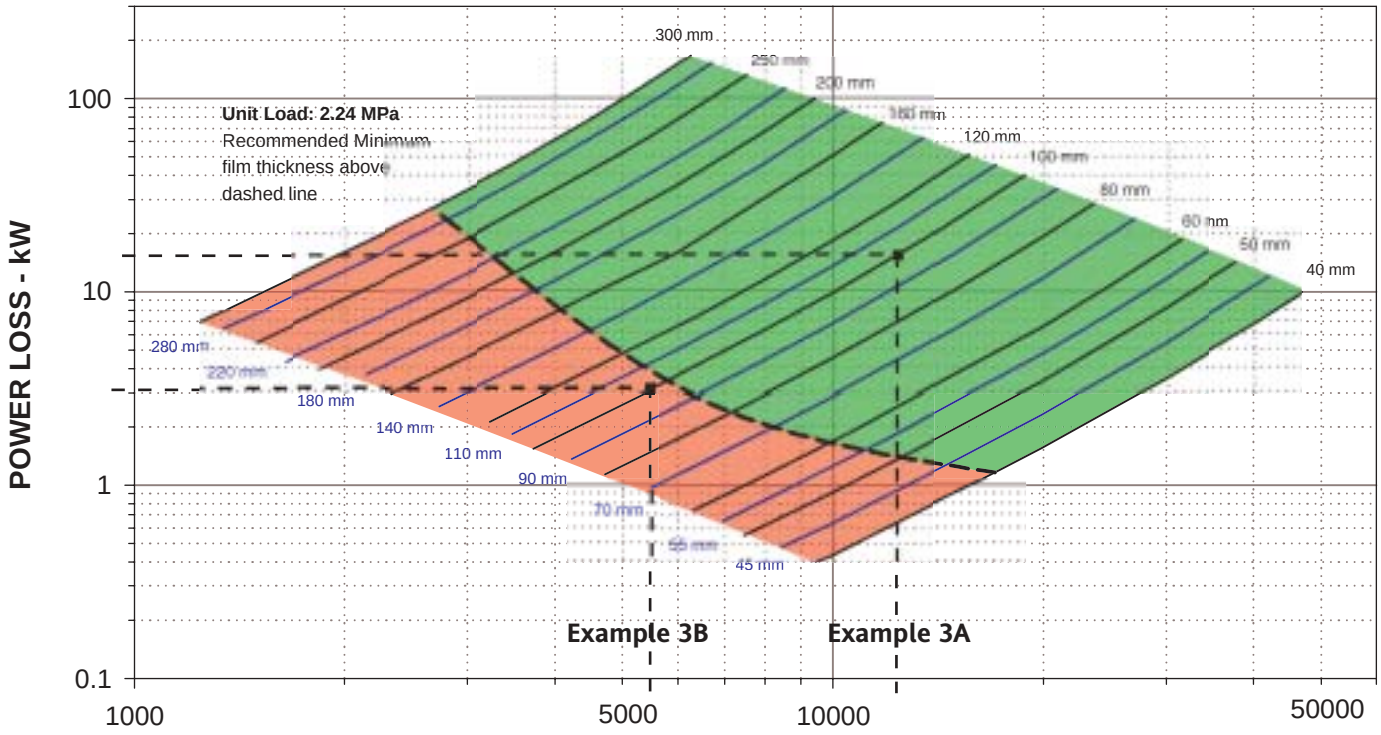
STANDARD FLOODED LUBE TILTING PAD JOURNAL BEARING
NARROW PAD LENGTH - L/D = 0.4



Oil grade: ISO VG 32
Oil inlet temperature: 50 °C
Lubricant temperature rise: 17 °C
Unit load: 2.24 MPa
Load direction: On Pad

Figure 7.

STANDARD FLOODED LUBE TILTING PAD JOURNAL BEARING
INTERMEDIATE PAD LENGTH - L/D = 0.7



Oil grade: ISO VG 32
Oil inlet temperature: 50 °C
Lubricant temperature rise: 17 °C
Unit load: 2.24 MPa
Load direction: On Pad

Example 3 B

Invalid Selection from page 7 Step 3
14.7 kN load, 100 mm diameter shaft
5500 rpm

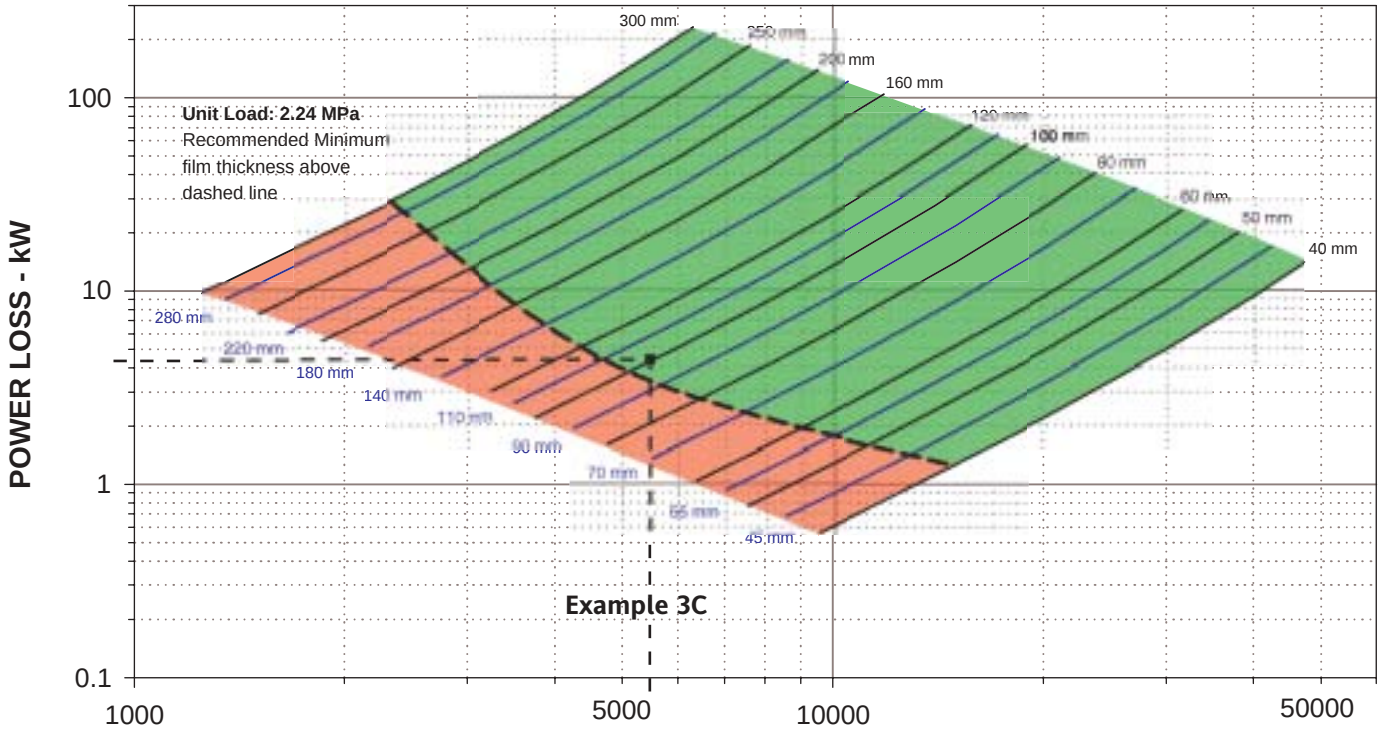
Example 3 A

Valid Selection from page 7 Step 3
14.7 kN load, 100 mm diameter shaft
14,000 rpm, Power loss 15.5 kW

Figure 8.

Performance Curves

STANDARD FLOODED LUBE TILTING PAD JOURNAL BEARING
WIDE PAD LENGTH - L/D = 1.0



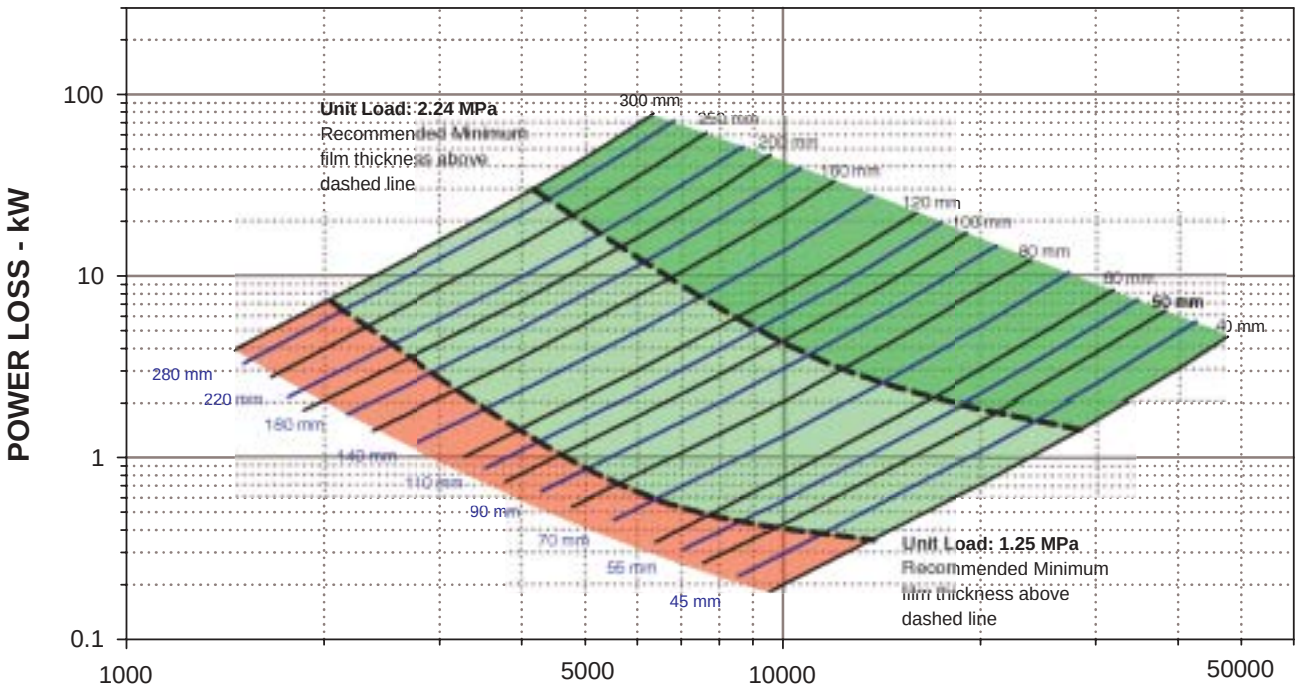
Oil grade: ISO VG 32
Oil inlet temperature: 50 °C
Lubricant temperature rise: 17 °C
Unit load: 2.24 MPa
Load direction: On Pad

Example 3C

Valid Selection from page 7 Step 3
14.7 kN load, 100 mm diameter shaft
5500 rpm, Power loss 11 kW

Figure 9.

ADVANTAGE™ TILTING PAD JOURNAL BEARING
NARROW PAD LENGTH - L/D = 0.4

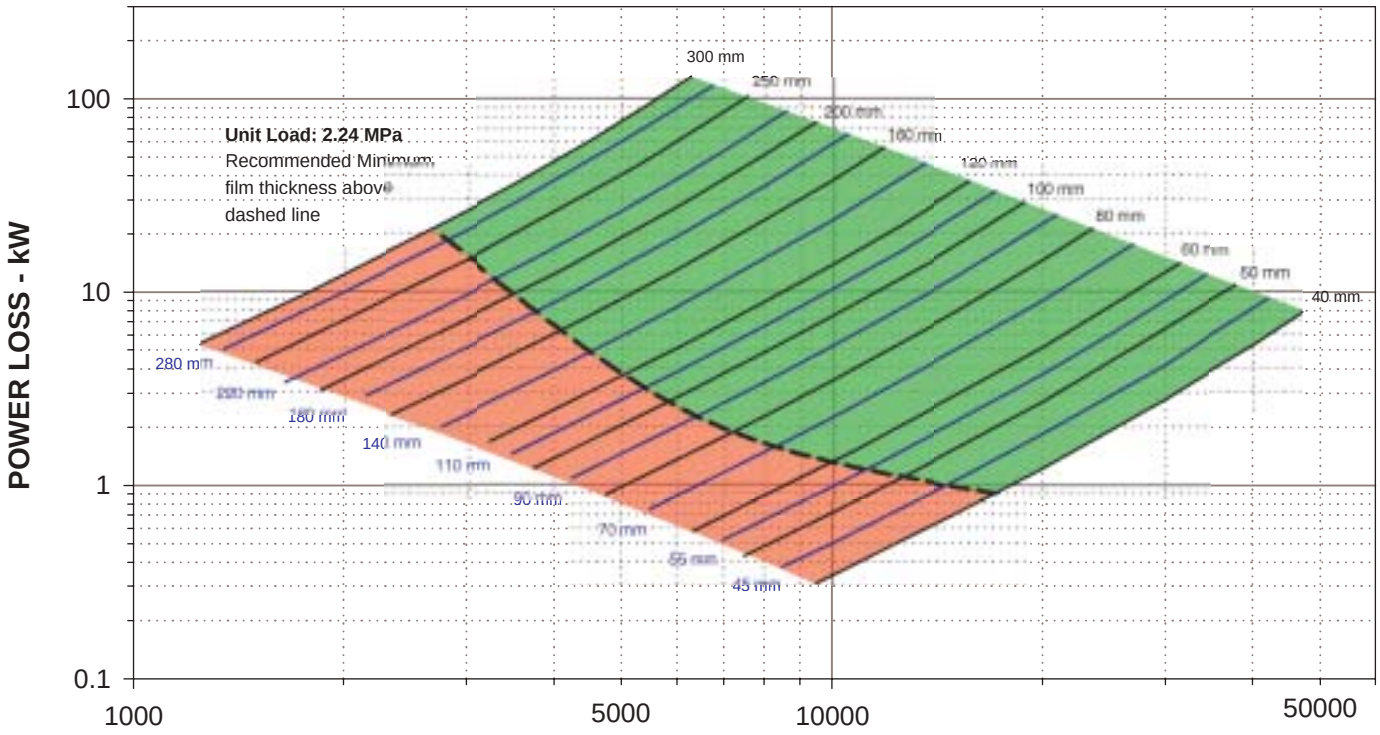


Oil grade: ISO VG 32
Oil inlet temperature: 50°C
Lubricant temperature rise: 17°C
Unit load: 2.24 MPa
Load direction: On Pad

Figure 10.

Performance Curves

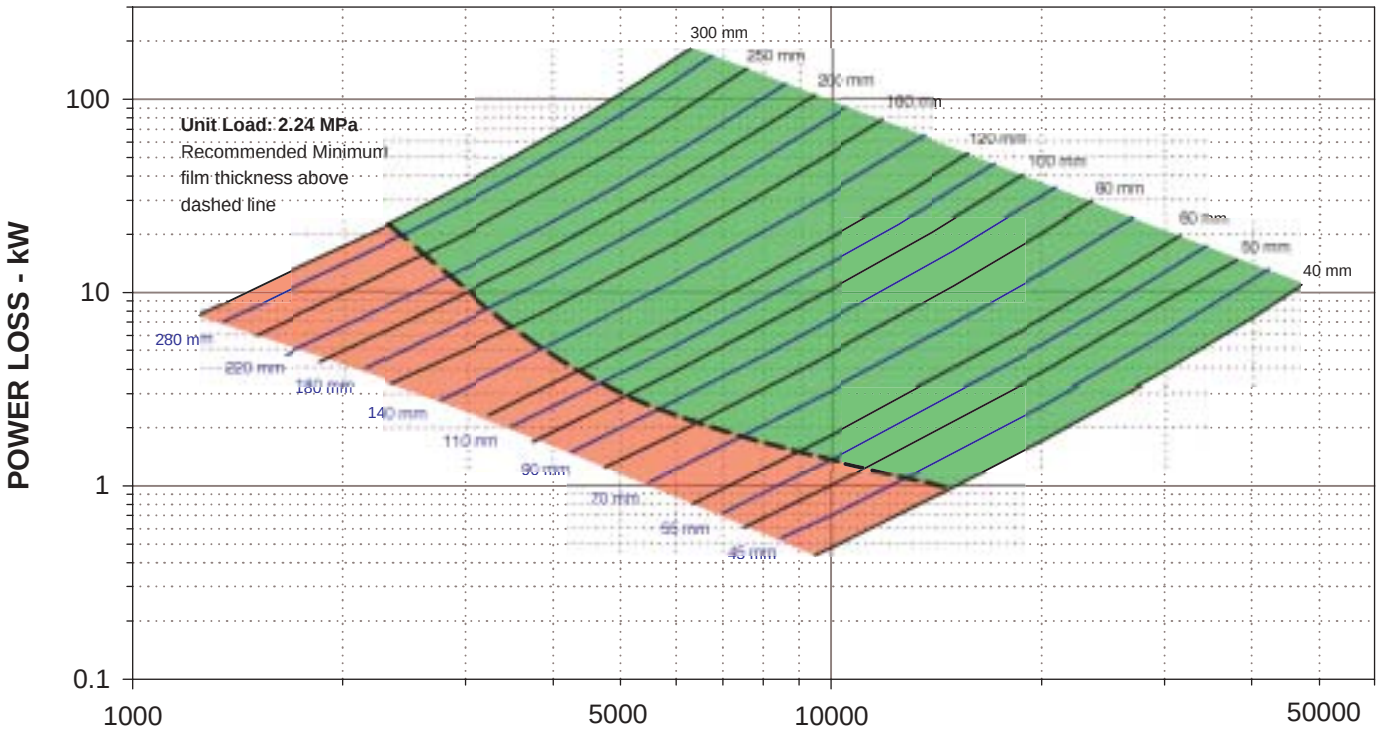
ADVANTAGE ™ TILTING PAD JOURNAL BEARING
INTERMEDIATE PAD LENGTH - L/D = 0.7



Oil grade: ISO VG 32
Oil inlet temperature: 50°C
Lubricant temperature rise: 17°C
Unit load: 2.24 MPa
Load direction: On Pad

Figure 11.

ADVANTAGE ™ TILTING PAD JOURNAL BEARING
WIDE PAD LENGTH - L/D = 1.0



Oil grade: ISO VG 32
Oil inlet temperature: 50°C
Lubricant temperature rise: 17°C
Unit load: 2.24 MPa
Load direction: On Pad

Figure 12.

Optional Features

Taperland Faces or Tilting Pad Thrust

Any tilting pad bearing can be supplied with thrust faces to accommodate axial loads. The taperland thrust face provides the most compact package. Use tilting pad thrust for higher axial loads.

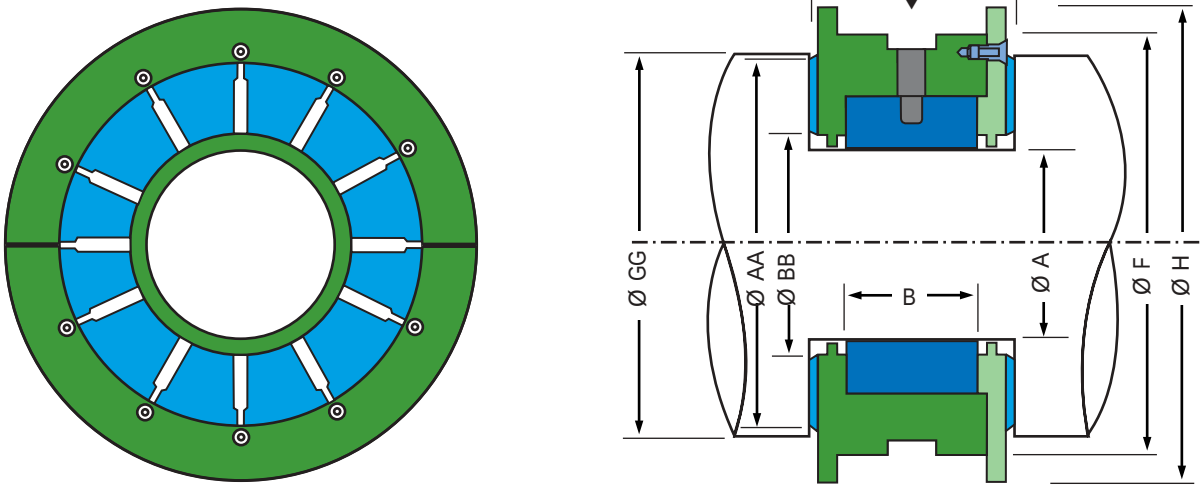


Figure 13. Taperland Faces

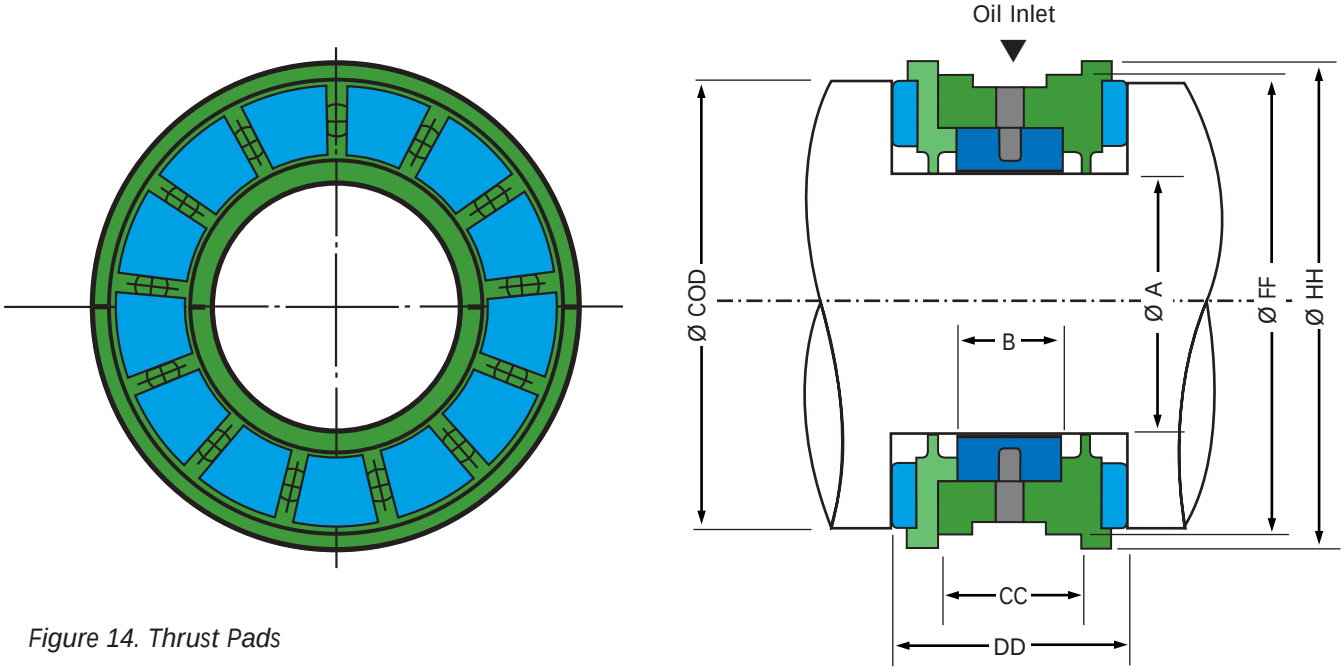


Figure 14. Thrust Pads

Dimensions and Load Capacities

Taperland Faces

Tilting Pad Journal Brg Size	Thrust Face Outside Diameter	Thrust Face Inside Diameter	Thrust Collar Outside Diameter	Load Capacity (N) Taperland Face (See note 1)
	AA	BB	GG	
40	80	50	82	5500
45	85	55	87	5500
50	95	60	98	7000
55	100	70	103	5756
60	105	75	108	5750
70	120	85	123	8000
80	130	95	133	8500
90	155	105	158	16500
100	165	120	168	14500
110	175	130	178	15000
120	190	140	193	18900
140	215	160	218	28000
160	245	185	248	28000
180	280	210	283	40000
200	305	230	309	50555
220	325	250	329	52500
250	370	285	374	75000
280	410	320	415	98000
300	430	340	435	98000

Tilting Pad Thrust

Tilting Pad Thrust Brg Size (see note 2)	Fit Length (see note 2) CC	Housing Outside Diameter FF	Thrust Collar Outside Diameter COD	Axial Flange Outside Diameter HH	Length (See note 2) DD	Load Capacity (N) (See note 1)
40	21	82	79	90	48	3980
45	23	89	88	98	51	5860
50	25	95	94	104	54	6350
55	27	111	100	120	58	6816
60	29	120	113	130	61	9910
70	33	130	133	140	68	15280
80	37	139	141	150	75	16530
90	42	165	158	177	82	24220
100	46	177	172	190	89	29450
110	50	190	188	204	97	35860
120	54	215	204	230	105	43390
140	63	228	243	244	118	64100
160	71	266	260	284	132	69120
180	80	298	294	317	146	102560
200	88	336	335	357	160	120250
220	96	374	365	397	174	143190
250	109	406	400	431	196	172550
280	122	450	448	477	217	229640
300	130	482	476	511	231	247000

***Note 1**: Load capacities for thrust faces are guidelines based on standard unit loads for taperlands and tilting pad thrust bearings. Consult factory for design confirmation.*

***Note 2**: The dimensions in the table refer to L/D = .4 (bearing length N, page 17). Thrust faces are available on other L/D ratio bearings that increase dimensions, CC and XX, by the increase in the pad length.*

See pages 17-19 for single letter dimensions.

Instrumentation

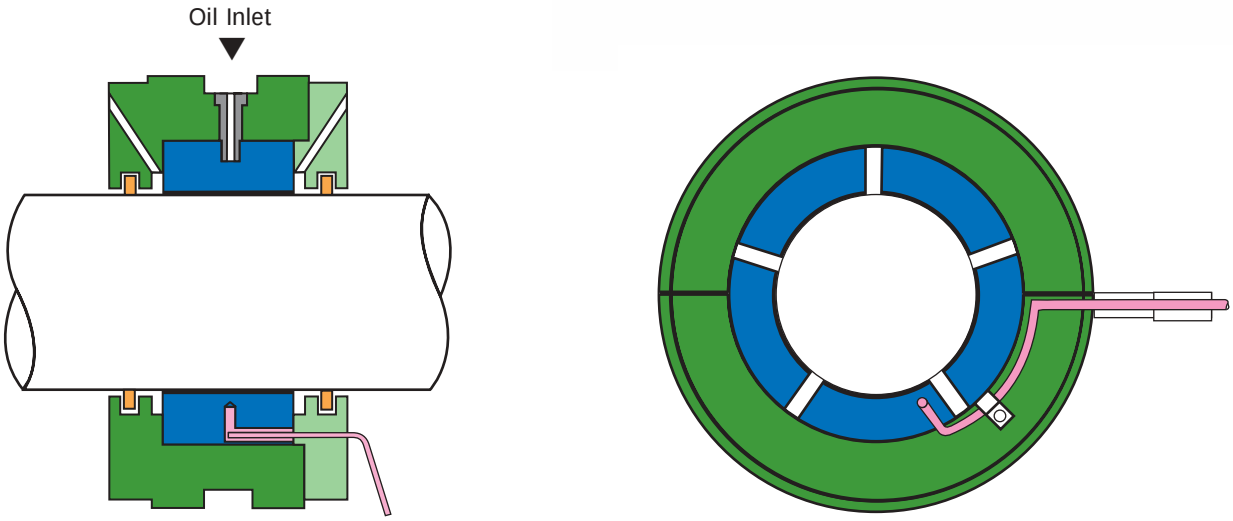


Figure 15. Typical Temperature Sensor Installation

Hydrostatic Lift

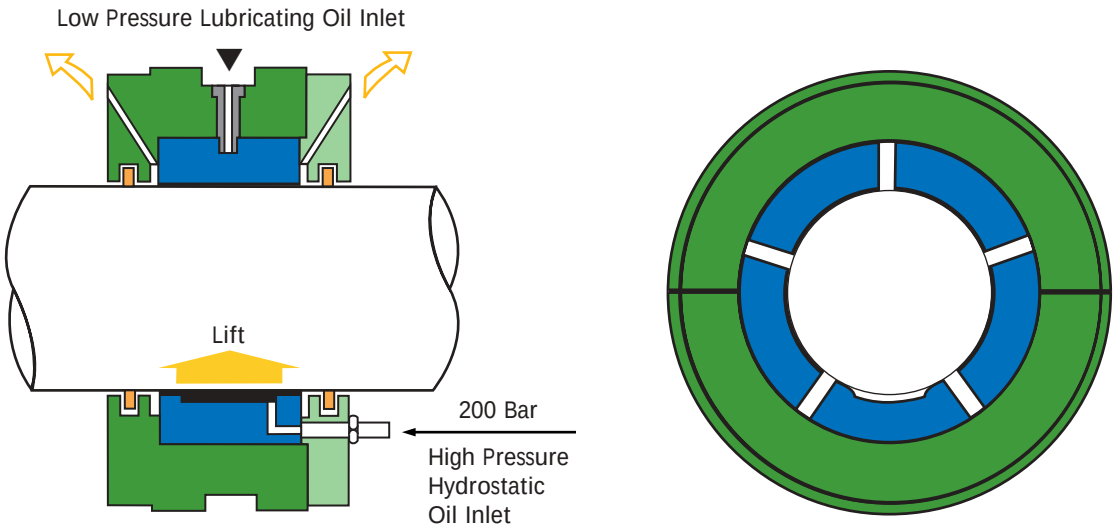
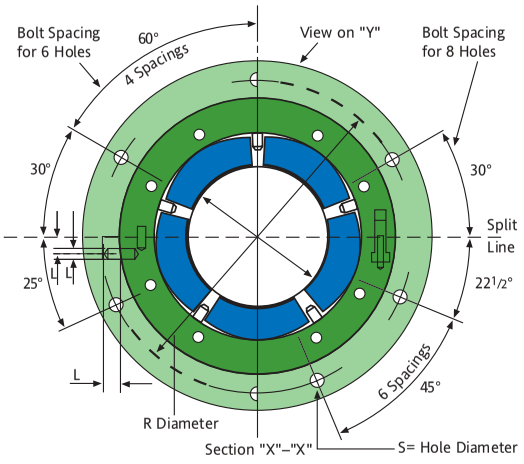
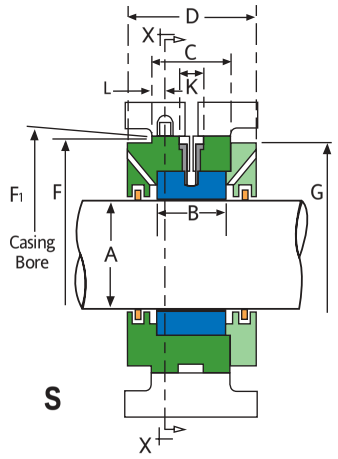


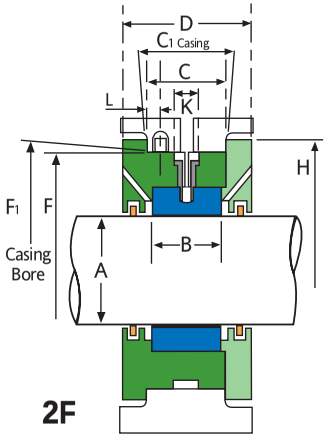
Figure 16. Hydrostatic Lift

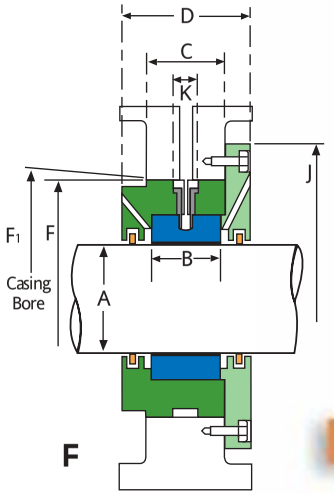
Bearing Dimensions Length N

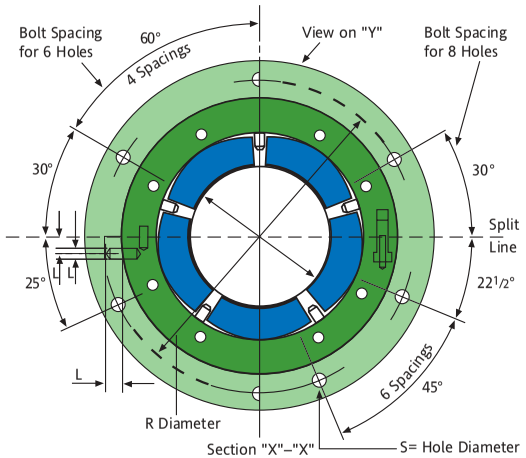
Bearing Size	Nom. Shaft Diameter A	Pad Length B	Fit Length C	Recommended Casing C1	Overall Length D	Fit Dia. F	Recommended Casing Bore F1 Dia.	G Dia.	H Dia.	J Dia.	Oil Inlet Groove K	L	R	S	Bearing Area (mm²)	Weight (kg)
40	40	16	21	20.993 20.972	50	82	82.022 82.000	78	90	110	6	4	96	5.5	640	0.8
45	45	18	23	22.993 22.972	52	89	89.022 89.000	85	98	117	6	4	103	5.5	810	0.9
50	50	20	25	24.993 24.972	54	95	95.022 95.000	92	104	127	7	4	111	6.6	1000	1
55	55	22	27	26.993 26.972	56	111	111.022 111.000	100	120	143	7	5	127	6.6	1210	1.6
60	60	24	29	28.993 28.972	58	120	120.022 120.000	106	130	152	8	5	136	6.6	1440	2
70	70	28	33	32.991 32.966	63	130	130.025 130.000	118	141	162	10	5	146	6.6	1960	2.6
80	80	32	37	36.991 36.966	77	139	139.025 139.000	130	150	171	11	6	155	6.6	2560	3
90	90	36	42	41.991 41.966	82	165	165.025 165.000	152	177	197	13	6	181	6.6	3240	5
100	100	40	46	45.991 45.966	86	177	177.025 177.000	164	190	217	14	8	197	9	4000	6
110	110	44	50	49.991 49.966	90	190	190.029 190.000	176	204	230	15	8	210	9	4840	8
120	120	48	54	53.990 53.960	95	215	215.029 215.000	188	230	255	17	10	235	9	5760	11
140	140	56	63	62.990 62.960	104	228	228.029 228.000	212	244	268	20	10	248	9	7840	13
160	160	64	71	70.990 70.960	112	266	266.032 266.000	245	284	314	22	12	290	11	10200	20
180	180	72	80	79.990 79.960	121	298	298.032 298.000	278	317	354	25	12	326	14	13000	27
200	200	80	88	87.988 87.953	130	336	336.036 336.000	302	357	392	28	16	364	14	16000	38
220	220	88	96	95.988 95.953	153	374	374.036 374.000	326	397	430	31	16	402	14	19400	53
250	250	100	109	108.988 108.953	166	406	406.040 406.000	371	431	478	35	20	442	18	25000	65
280	280	112	122	121.986 121.946	179	450	450.040 450.000	407	477	522	39	20	486	18	31400	86
300	300	120	130	129.986 129.946	188	482	482.040 482.000	431	511	554	42	20	518	18	36000	110

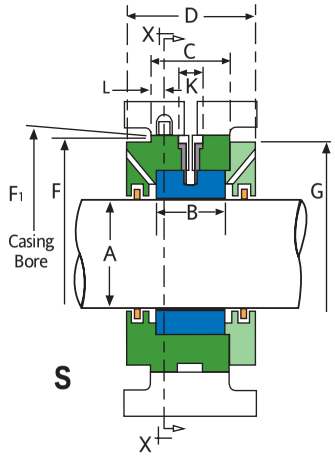


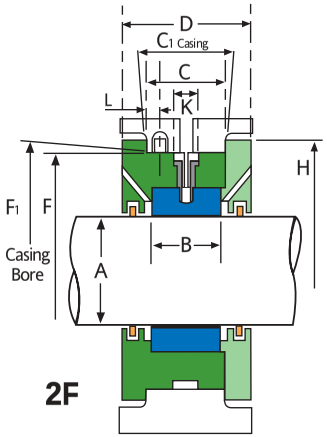


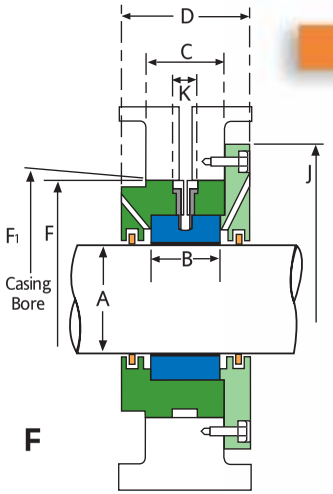










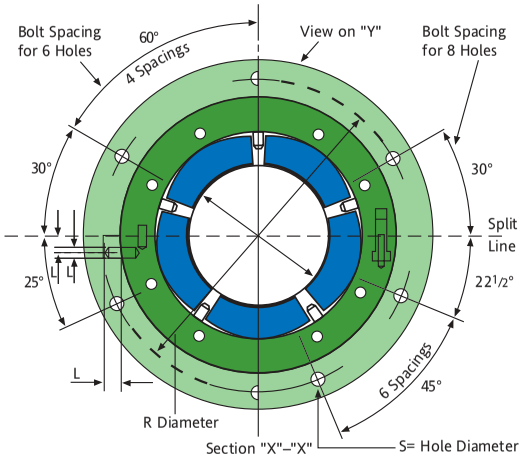


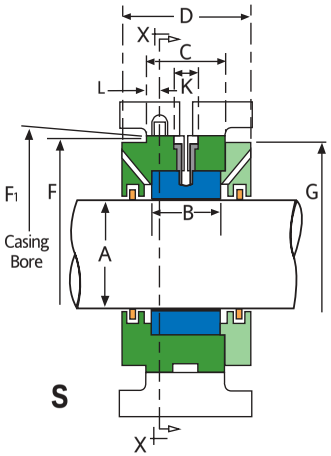
Bearing Dimensions Length I

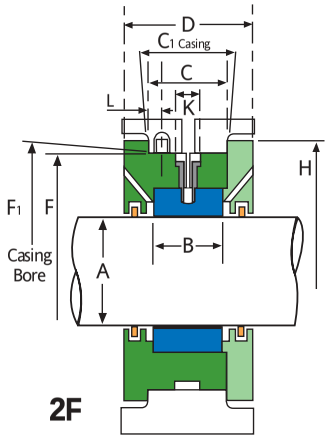
Bearing Size	Nom. Shaft Diameter A	Pad Length B	Fit Length C	Recom-mended Casing C1	Overall length D	Fit Dia. F	Recom-mended Casing Bore F1 Dia.	G Dia.	H Dia.	J Dia.	Oil Inlet Groove K	L	R	S	Bearing Area (mm²)	Weight (kg)
40	40	28	33	32.991 32.966	62	82	82.022 82.000	78	90	110	10	4	96	5.5	1120	1.2
45	45	31	36	35.991 35.966	65	89	89.022 89.000	85	98	117	11	4	103	5.5	1420	1.4
50	50	35	40	39.991 39.966	69	95	95,022 95.000	92	104	127	12	4	111	6.6	1750	1.6
55	55	38	43	42.991 42.966	72	111	111.022 111.000	100	120	143	13	5	127	6.6	2120	2.4
60	60	42	47	46.991 46.966	76	120	120.022 120.000	106	130	152	15	5	136	6.6	2520	3.3
70	70	49	54	53.990 53.960	84	130	130.025 130.000	118	141	162	17	5	146	6.6	3430	4
80	80	56	61	60.990 60.960	101	139	139.025 139.000	130	150	171	20	6	155	6.6	4480	5
90	90	63	69	68.990 68.960	109	165	165.025 165.000	152	177	197	22	6	181	6.6	5670	8
100	100	70	76	75.990 75.960	116	177	177.025 177.000	164	190	217	25	8	197	9	7000	10
110	110	77	83	82.988 82.953	123	190	190.029 190.000	176	204	230	27	8	210	9	8470	12
120	120	84	90	89.988 89.953	131	215	215.029 215.000	188	230	255	29	10	235	9	10100	17
140	140	98	105	104.988 104.953	146	228	228.029 228.000	212	244	268	34	10	248	9	13700	21
160	160	112	119	118.988 118.953	160	266	266.032 266.000	245	284	314	39	12	290	11	17900	31
180	180	126	134	133.986 133.946	175	298	298.032 298.000	278	317	354	44	12	326	14	22700	43
200	200	140	148	147.986 147.946	190	336	336.036 336.000	302	357	392	49	16	364	14	28000	61
220	220	154	162	161.986 161.946	219	374	374.036 374,000	326	397	430	54	16	402	14	33900	85
250	250	175	184	183.985 183.939	241	406	406.040 406.000	371	431	478	61	20	442	18	43700	102
280	280	196	206	205.985 205.939	263	450	450.040 450.000	407	477	522	69	20	486	18	54900	142
300	300	210	220	219.985 219.939	278	482	482.040 482.000	431	511	554	74	20	518	18	63000	175

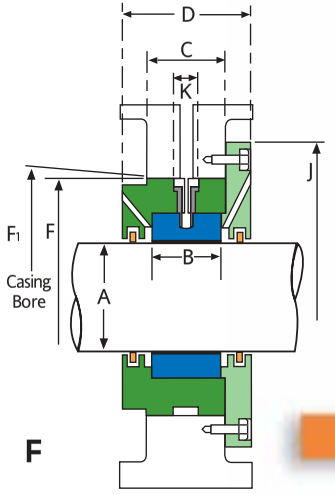
Bearing Dimensions Length W

Bearing Size	Nom. Shaft Diameter A	Pad Length B	Fit Length C	Recommended Casing C1	Overall Length D	Fit Dia. F	Recommended Casing Bore F1 Dia.	G Dia.	H Dia.	J Dia.	Oil Inlet Groove K	L	R	S	Bearing Area (mm²)	Weight (kg)
40	40	40	45	44.991 44.966	74	82	82.022 82.000	78	90	110	14	4	96	5.5	1600	1.4
45	45	45	50	49.991 49.966	79	89	89.022 89.000	85	98	117	16	4	103	5.5	2020	1.8
50	50	50	55	54.990 54.960	84	95	95.022 95.000	92	104	127	18	4	111	6.6	2500	2.3
55	55	55	60	59.990 59.960	89	111	111.022 111.000	100	120	143	19	5	127	6.6	3020	3.3
60	60	60	65	64.990 64.960	94	120	120.022 120.000	106	130	152	21	5	136	6.6	3600	4.2
70	70	70	75	74.990 74.960	105	130	130.025 130.000	118	141	162	25	5	146	6.6	4900	5
80	80	80	85	84.988 84.953	125	139	139.025 139.000	130	150	171	28	6	155	6.6	6400	6
90	90	90	96	95.988 95.953	136	165	165.025 165.000	152	177	197	32	6	181	6.6	8100	10
100	100	100	106	105.988 105.953	146	177	177.025 177.000	164	190	217	35	8	197	9	10000	13
110	110	110	116	115.988 115.953	156	190	190.029 190.000	176	204	230	39	8	210	9	12100	16
120	120	120	126	125.986 125.946	167	215	215.029 215.000	188	230	255	42	10	235	9	14400	22
140	140	140	147	146.986 146.946	188	228	228.029 228.000	212	244	268	49	10	248	9	19600	26
160	160	160	167	166.986 166.946	208	266	266.032 266.000	245	284	314	56	12	290	11	25600	41
180	180	180	188	187.985 187.939	229	298	298.032 298.000	278	317	354	63	12	326	14	32400	58
200	200	200	208	207.985 207.939	250	336	336.036 336.000	302	357	392	70	16	364	14	40000	84
220	220	220	228	227.985 227.939	285	374	374.036 374.000	326	397	430	77	16	402	14	48400	115
250	250	250	259	258.983 258.938	316	406	406.040 406.000	371	431	478	88	20	442	18	62500	144
280	280	280	290	289.983 289.938	347	450	450.040 450.000	407	477	522	98	20	486	18	78400	194
300	300	300	310	309.983 309.938	368	482	482.040 482.000	431	511	554	105	20	518	18	90000	239









ORION
CORPORATION

Orion Corporation

1111 Cedar Creek Road
Grafton, WI 53024 USA
Phone: 262.377.2210
Fax: 262.377.0729

sales@orion-corp.com
www.orion-corp.com