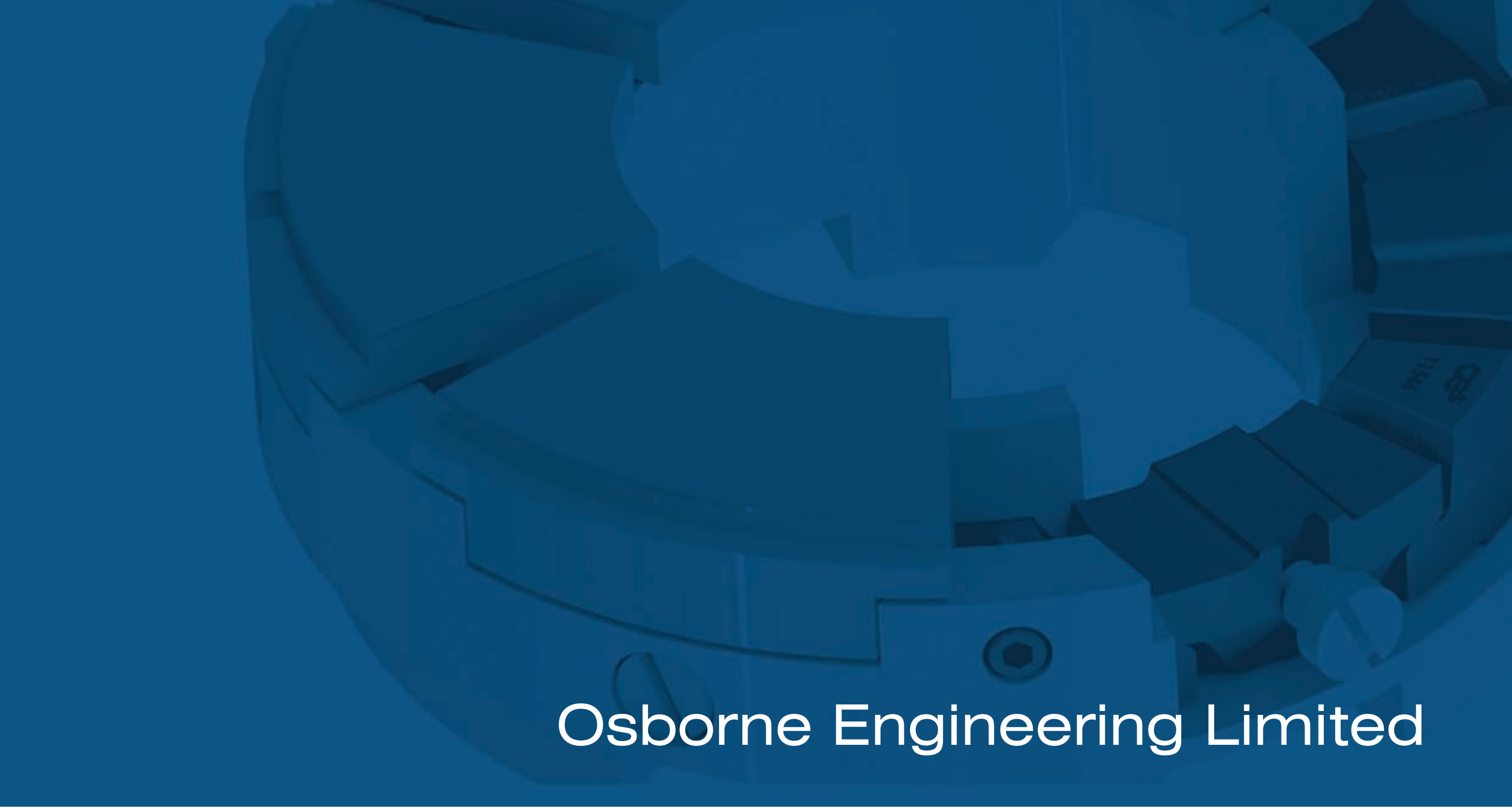


Osborne Engineering Limited

OEJ Equalised thrust bearing internals

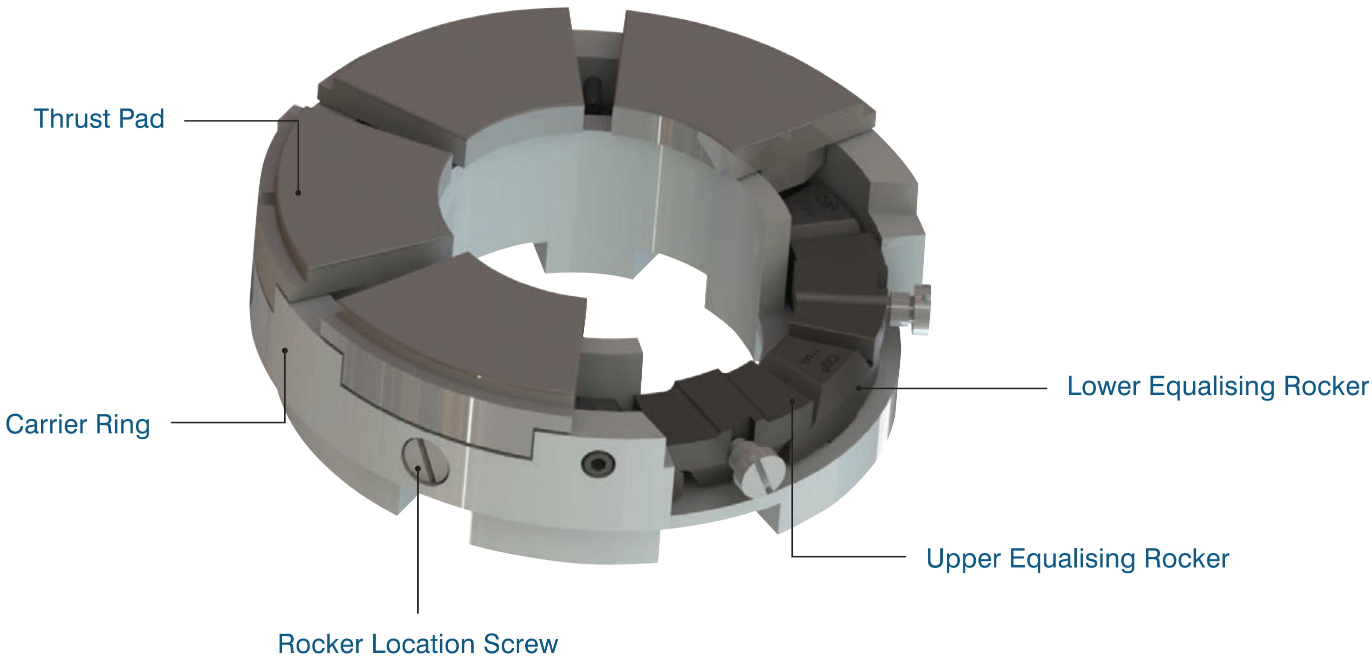
Total Shaft Solutions

General Description

The Osborne Equalised J style thrust bearing assembly operates by generating and maintaining a substantial oil film between the working faces of the tilting thrust pads and rotating thrust collar. This oil film prevents any physical contact between the two parts which greatly increases resistance to wear. Only during start-up and shut down is there an increased risk of contact between the working faces.

Osborne Engineering understands that customers are occasionally reluctant to change bearing designs when existing bearings have operated successfully within their machinery. With this in mind OEL can offer three standard designs as an alternative to OEM bearings. Assemblies are fully interchangeable resulting in greater choice, whilst retaining confidence in bearing operation.

- J Style 6 Pad design, overall length greater than B style, sizes available up to 431.8mm
- B Style 6 pad design, overall length shorter than J style, sizes available up to 482.6mm
- E Style 8 pad design, completely interchangeable with B style.



Each of the above bearings can be supplied with separable thrust collars. These are attached to the shaft to allow axial load to be transmitted through into the bearing assembly. The standard sizes of which can be obtained from the corresponding table shown later in the catalogue.

Thrust pads are of a button pivot design. This hardened spherical pivot allows the thrust pad to tilt in all directions allowing for the generation of the oil film and ability to account for a degree of misalignment. The pivots are centrally located which allows running in either direction of rotation, but can be offset to facilitate the thermal performance of the bearing assembly if required.

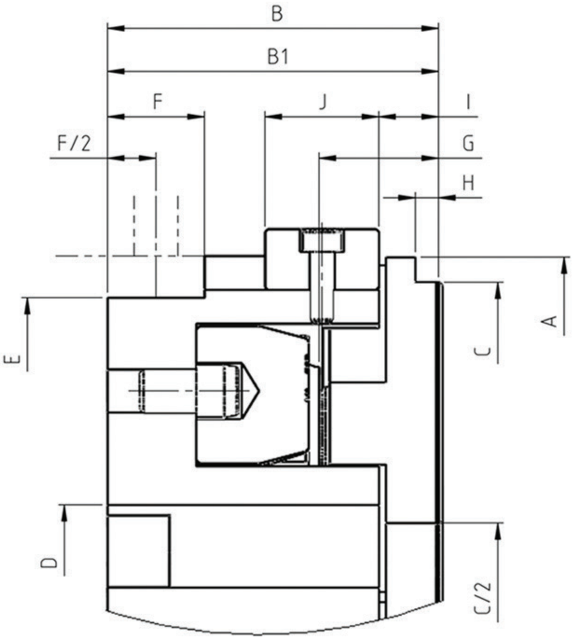
Each of the thrust pads are located on a set of equalising rockers to allow the entire working face of the bearing assembly to adapt to any misalignment between the working faces. The rockers allow each thrust pad to move independently to ensure that each is subject to an equal amount of force.

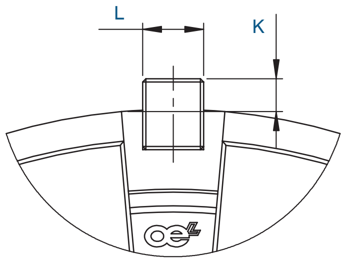
All of the components which make up the bearing assembly are contained within the carrier ring. This carrier ring is fitted with location dowels and screws to locate the equalising rocker assembly and axial slots which fix the radial position of each tilting thrust pad. The oil feed annulus is machined into the outer diameter with corresponding oil feed slots to deliver cool oil to the working faces.

Table 1 – OEJ General Details

REF	SIZE	MAX SHAFT (SEPERABLE)	MAX SHAFT (INTEGRAL)	THRUST SURFACE (MM²)	APPROX WEIGHT (KG)	THRUST PAD MPD
4"	OEJ 101	44.5	41.2	5160	1.6	80.32
5"	OEJ 127	57.2	53.8	8065	2.6	100.4
6"	OEJ 152	69.9	66.6	11615	4.1	120.48
7"	OEJ 177	82.6	79.3	15805	6.7	140.56
8"	OEJ 203	95.3	92	20260	9.5	160.64
9"	OEJ 228	108	104.7	26130	13.8	180.3
10.5"	OEJ 266	124	120.7	35550	20.4	210.84
12"	OEJ 304	142.8	139.7	46450	29.2	240.97
13.5"	OEJ 342	162.1	158.8	58775	41.2	271.09
15"	OEJ 381	177.8	174.8	72580	56.1	301.21
17"	OEJ 431	203.2	200.2	93225	80	341.37
19"	OEJ 482	225.6	222.3	116450	107.5	381.53
21"	OEJ 533	251	247.7	142260	141.5	421.69
23"	OEJ 584	273.1	266.7	170645	184.2	461.85
25"	OEJ 635	298.5	292.1	201610	229.5	502.01
27"	OEJ 685	320.6	311.2	235160	292	542.17

Nominal axial length of J Style thrust bearing is denoted by 'B'. Nominal axial length of B and E Style thrust bearings is denoted by 'B1'
Increased axial length is to accommodate for greater oil throughput





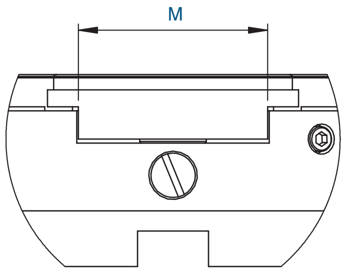


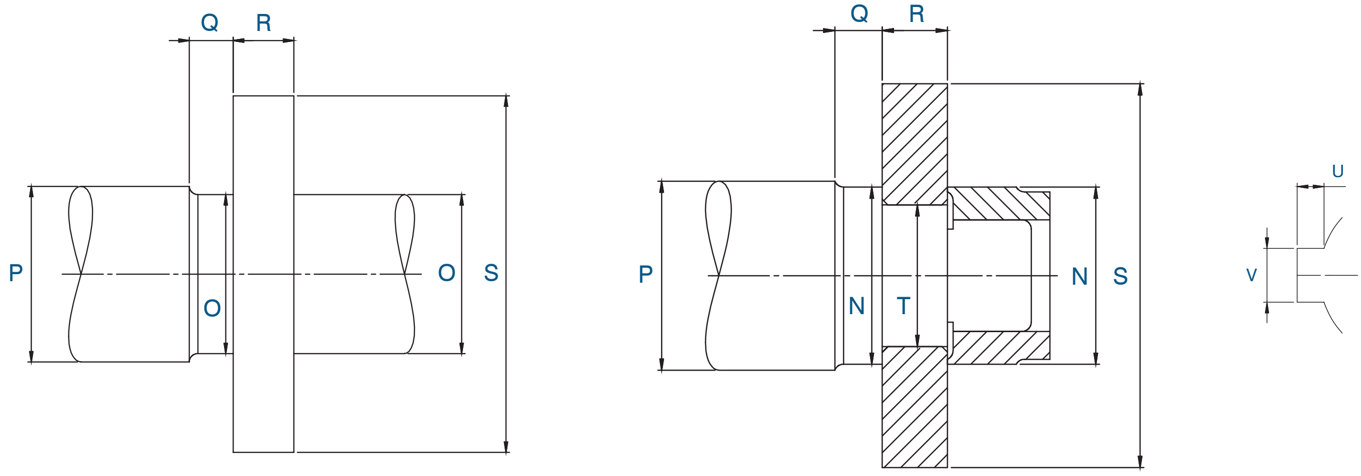
Table 2 – OEJ Standard Dimensions

SIZE	A	B	B1	C	D	E	F	G	H	I	J	K	L	M
OEJ 101	111.12	36.6	35.1	101.6	55.6	104.7	7.9	12.7	3.1	7.1	9.7	3.1	6.4	32.5
OEJ 127	136.52	44.5	41.2	127	69.9	125.5	9.7	15.88	4.1	7.9	14.2	4.1	7.9	40.5
OEJ 152	161.92	52.3	47.8	152.4	82.6	150.9	9.7	19.05	4.1	9.7	16.8	4.8	9.7	50
OEJ 177	187.32	60.5	53.9	177.8	95.3	171.5	11.2	22.23	4.8	11.9	20.6	4.8	9.7	59.5
OEJ 203	212.72	68.3	60.5	203.2	109.5	193.6	12.7	25.4	5.6	12.7	23.9	4.8	11.2	69.1
OEJ 228	238.12	76.2	68.3	228.06	124	219	14.2	28.58	7.9	14.2	23.9	4.8	11.2	77
OEJ 266	279.4	85.9	74.7	266.7	144.5	254	14.2	31.75	7.1	15.8	28.5	5.6	12.7	80.9
OEJ 304	317.5	95.3	82.6	304.8	165.1	293.6	17.5	34.93	8.6	17.5	30.2	5.6	14.2	100.8
OEJ 342	355.6	108	90.4	342.9	185.7	330.2	19.1	38.1	9.7	19.1	34.1	6.4	15.8	107.2
OEJ 381	393.7	117.4	98.6	381	206.3	368.3	15.8	41.28	3.1	20.6	38.1	7.9	17.5	129.4
OEJ 431	447.68	133.4	111.3	431.8	233.4	419.1	23.9	46.03	3.1	23.9	41.2	7.9	19.1	145.3
OEJ 482	514.35	-	120.7	482.6	269.8	469.9	22.4	50.8	9.7	25.4	44.5	8.6	22.4	151.6
OEJ 533	656.15	-	133.4	533.4	298.5	514.4	25.4	55.58	12.7	28.5	44.5	9.7	25.4	177
OEJ 584	622.3	-	144.5	584.2	323.9	568.5	25.4	60.33	12.7	33.3	53.9	9.7	25.4	195.3
OEJ 635	663.1	-	157.2	635	673.1	622.2	28.5	68.28	12.7	35.1	57.2	12.7	31.8	203.2
OEJ 685	730.25	-	169.9	685.8	400	673.1	30.2	69.85	12.7	36.6	60.5	12.7	31.8	211.1

Table 3 – OEJ Shaft Details

N	O	P	Q	R	S	T	U	V
44.5	41.2	49.3	12.7	22.4	104.7	31.75	4.1	7.9
57.2	53.8	63.5	15.8	22.4	130.1	44.45	4.8	9.7
69.9	66.6	76.2	19.1	25.4	155.5	53.98	4.8	9.7
82.6	79.3	88.9	22.4	31.8	180.8	63.5	6.4	12.7
95.3	92	101.6	25.4	35.1	206.3	76.2	7.9	15.8
108	104.7	114.3	28.5	38.1	231.7	88.9	7.9	15.8
124	120.7	133.4	31.8	44.5	271.5	104.78	9.7	19.1
142.8	139.7	152.4	35.1	50.8	309.6	120.65	9.7	19.1
162.1	158.8	171.5	38.1	57.2	347.7	136.53	11.2	22.4
177.8	174.8	190.5	41.2	63.5	385.8	152.4	12.7	25.4
203.2	200.2	215.9	44.5	73.2	438.2	168.28	12.7	25.4
225.6	222.3	247.7	50.8	82.6	489	190.5	14.2	28.5
251	247.7	273.1	57.2	92	539.8	215.9	15.8	31.8
273.1	266.7	298.5	60.5	98.6	590.6	238.15	15.8	31.8
298.5	292.1	327.2	63.5	108	64.4	254	19.1	38.1
320.6	311.2	352.6	69.9	117.4	692.9	279.4	19.1	38.1

Within the OEJ thrust bearing assembly the axial position of the shaft does not move forward under increasing thrust load. This prevents problems associated with reduced axial stiffness which occurs in spring mounted thrust arrangements. The assembled ring of equalising segments ensure an unreactive and even distribution of the thrust load from the working faces to the seating of the machine.



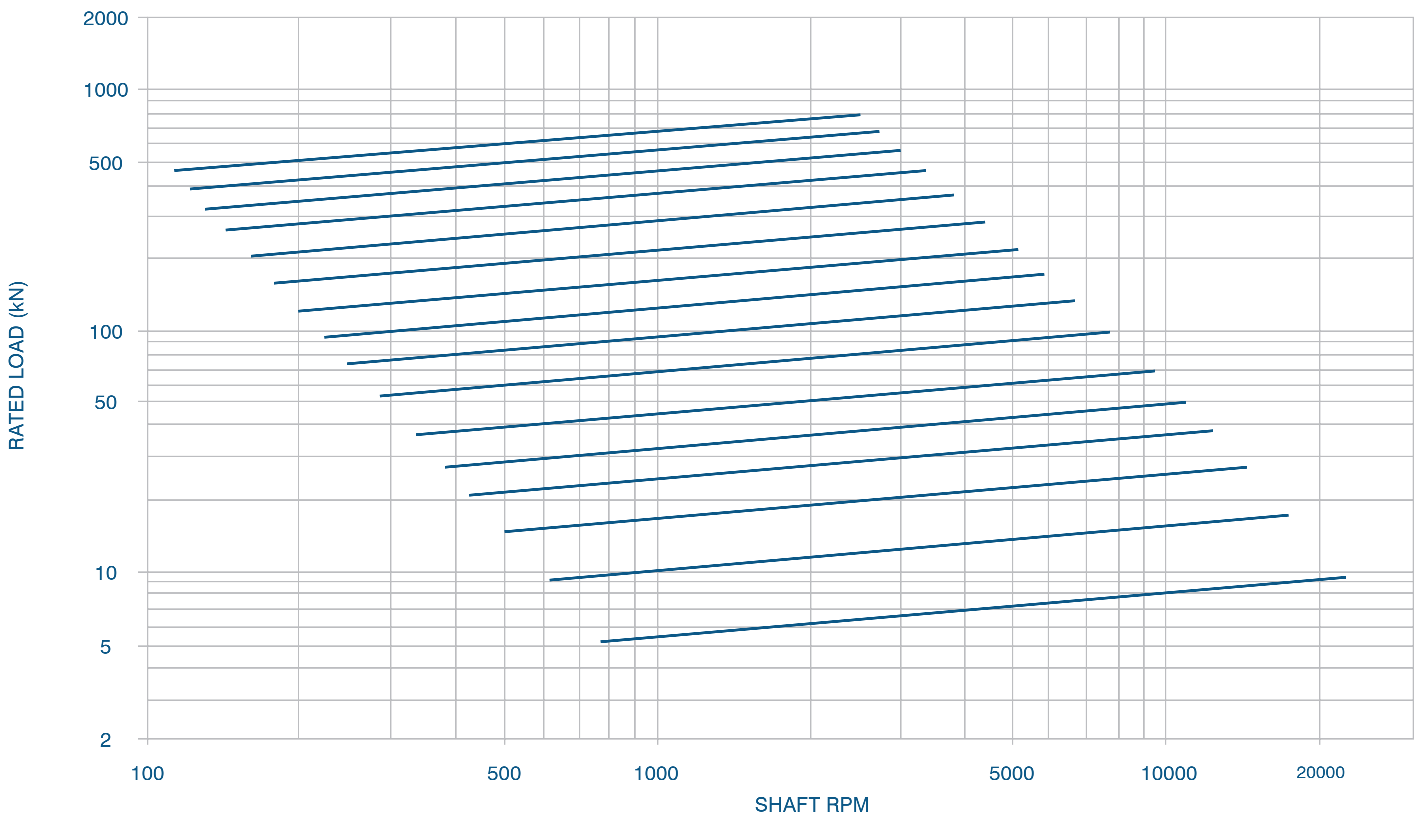
Technical Documentation

With every order OEL engineers will provide a detailed arrangement drawing, operating and maintenance instruction manual and comprehensive bearing performance prediction calculation providing the following information;

- Bearing temperature
- Required oil viscosity grade
- Bearing power loss
- Maximum operating pressure
- Minimum film thickness

Rated Load for OEJ, B and E Style thrust bearing internals

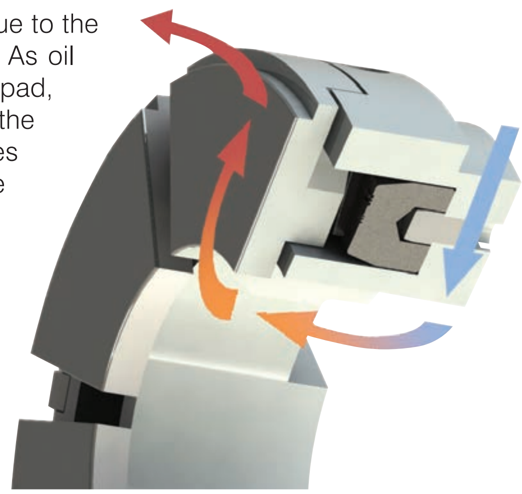
Load capacity selection curves shown below are based upon ISO VG 32 oil with an inlet temperature of 50°c.



Lubrication Methods

Oil enters the bearing via the oil slots located on the rear of the carrier ring. Due to the rotation of the shaft, oil is carried along the shaft towards the working faces. As oil enters the working faces it is drawn across the face of each individual thrust pad, generating an oil film. When hot the oil leaves the pad face it is thrown towards the outer thrust collar diameter, exiting the bearing assembly. The hot oil then leaves the bearing housing, which is then pumped through a filter and oil cooler. The cool oil is then returned to the bearing via an orifice plate to control the flow rate.

Small particles present in the oil will be absorbed by the babbit, which reduces the change of damage to the collar face. It is recommended that the oil is filtered so that the average particle size is no greater than 25 micron. When the bearing is intended for moderate to high speed applications ISO VG 32 oil is recommended. At high shaft velocities the major source of power loss is from oil turbulence caused by the thrust collar rotating in a flooded environment.



Oil circulation path during bearing operation

Temperature Measurement

Temperature measurement is the preferred condition monitoring tool for most bearing assemblies. OEJ bearing assemblies can be supplied with RTD's for accurate measurement of the thrust pad temperature. If such instrumentation is required OEL engineering require the primary direction of rotation to ensure the probes are mounted in the correct area of the thrust pad to provide the most accurate temperature reading.

Generally alarm and trip settings are based upon predicted bearing performance. It is recommended that the alarm and trip levels should be set at 8°c and 15°c respectively above the predicted bearing operating temperature.
However babbit temperatures should never exceed 120°c. If this maximum permitted temperature is exceeded, then copper alloy or offset pivoted pads should be used.

Customer preferred instruments can be incorporated into our designs or details of our preferred standard instruments can be provided upon request.

Oil Inlets, Outlets and Oil Drains for flooded bearings

The positions of oil inlets and oil outlets in flooded bearings can vary greatly, however there are some rules which must be observed to ensure optimum bearing performance.

• The oil outlet should be positioned at the top of the bearing housing, preferably directly above the collar to ensure that the bearing is fully submerged and that there is no trapped air within the housing.

• The oil inlet should be positioned so that the oil is fed to the inside diameter of the thrust pads to allow the pumping action of the collar face to force cool oil over the working faces.

• Adequate sealing is to be provided at either end of the shaft to maintain a full head of oil.

Oil Inlets, Outlets and Oil Drains

The oil inlet orifice size required should be calculated using the following thin plate orifice formula.

$$Q = 19.4d^2\sqrt{\frac{P}{S}}$$

Where

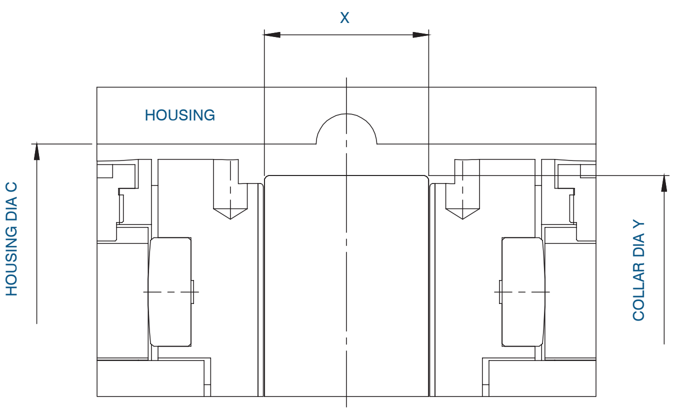
Q = Required oil flow, gallons per minute
d = Inlet orifice diameter, inches
P = Oil pressure, lb/in^2
S = Specific gravity

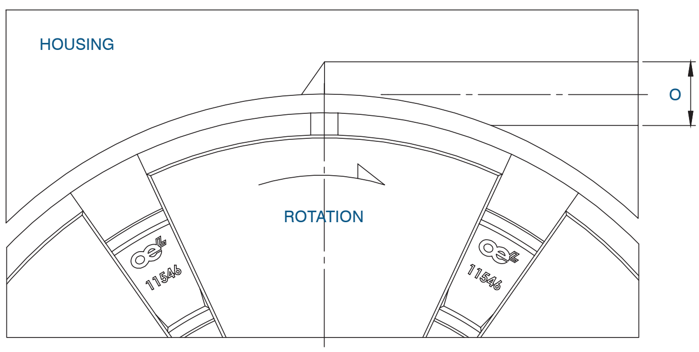
If the oil inlet orifice is substantially long then flow losses should be considered.

$$\frac{Q}{264.2} = \text{Oil flow, cubic meters per minute}$$

Recommended Oil Discharge Configuration

SIZE	HOUSING BORE 'C'	COLLAR DIAMETER 'Y'	COLLAR THICKNESS 'X'	OUTLET DIAMETER 'O'
OEJ 101	111.13	104.6	22.4	5.6
OEJ 127	136.53	130	22.4	5.6
OEJ 152	161.93	155.4	25.4	11.2
OEJ 177	187.33	180.8	31.8	12.7
OEJ 203	212.73	206.2	35.1	16.8
OEJ 228	238.13	231.6	38.1	20.6
OEJ 266	279.4	271.6	44.5	26.9
OEJ 304	317.5	309.6	50.8	30.2
OEJ 342	355.6	347.7	57.2	33.3
OEJ 381	393.7	385.8	63.5	35.1
OEJ 431	447.68	438.2	73.2	35.1





Recommendations

Cleanliness

It is important that the oil supply pipes and bearing housing are perfectly clean, free from dirt or metal particles. It is advised that cotton waste should not be used for cleaning of any parts mentioned. Apply a liberal amount of lubricating oil to the housing, shaft, collar and bearing parts when fitting and ensure that the housing is closed as soon as possible to ensure that the interior remains clean.

Axial Clearance

Always ensure on double thrust arrangements that the axial clearance is correct. This is done by moving the collar hard against one of the thrust faces, then using feeler gauges measure behind the thrust ring of the opposite thrust ring. Do not measure between the collar and thrust face in case damage occurs.

Alignment

It is essential to obtain correct bearing alignment to maximise the operation safety margin. The working faces of the thrust collar must be flat, parallel and normal to the shaft axis. This can be checked during manufacture and if the collar is integral to the shaft no additional checks should be required. Separate thrust collars should always be re-checked after final assembly onto the shaft.

Thrust Collars

OEL recommend that thrust collars are manufactured from plain carbon steel. High alloy steels can cause operational problems, also do not use plate material. Suggested thrust collar sizes are given in the shaft details section earlier in this catalogue. To avoid expensive forgings and ease of replacement it is sometimes preferred to use a separate collar keyed onto the shaft and held in position with a shaft nut. It is essential to ensure that the thrust collar is normal to the shaft axis.

Ordering Code

Thrust requirement - Style - Size - Collar - Pad Material

S = Single thrust, D = Double thrust

Style = OEJ, OEE, OEB

X = No collar, Y = Separable Collar

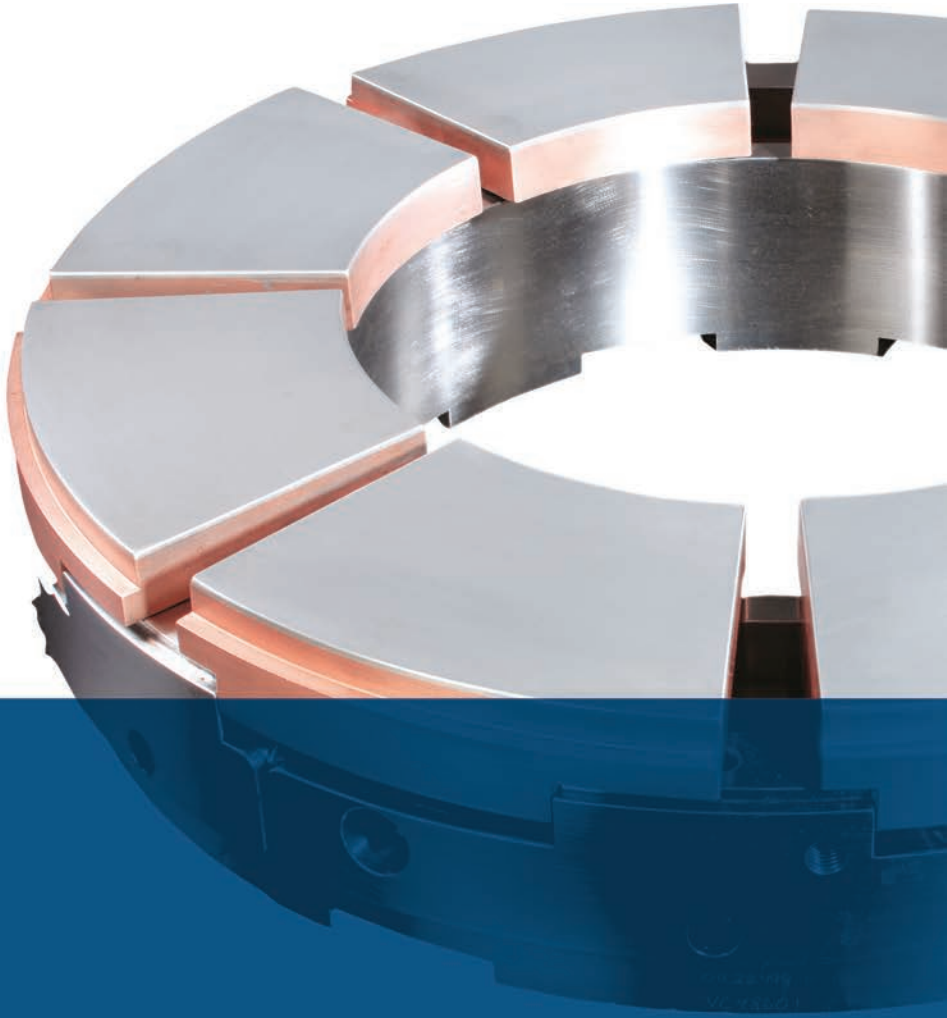
S = Steel pads, C = Copper pads

Example 1 = DOEJ-228-X-S

Example denotes a double thrust OEJ style bearing assembly, size 228, with no collar supplied and fitted with steel pads.

Example 2 = SOEB-127-Y-C

Example denotes a single thrust OEB style bearing assembly, size 127, supplied with separable collar and fitted with copper pads.



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