Innovation in Motion

Miba Industrial Bearings
Tilting Pad Thrust Bearings

Miba Industrial Bearings

Miba Industrial Bearings is one of the largest international hydrodynamic bearing supplier for turbomachinery. Our roots date back over 100 years when the German site first started producing bearings. Equipped with this experience we are now a center of excellence in bearing design, repair, troubleshooting and analysis as well as reversed engineering solutions.

Selecting Miba Industrial Bearings offers numerous benefits:

- A worldwide Miba Group with contacts in Europe, Americas and Asia is focused on customer support, competitive lead times and highest product quality
- Decades of technical experience help us to understand and satisfy the needs of our customers
- Tailored bearings for specific applications, where catalog bearings reach their limits
- Comprehensive technical support, including bearing consultation and detailed calculations
- Up-to-date calculation tools for the prediction of bearing performance and to guarantee long-term operational safety
- Miba's in-house R&D test rig capacity and external research partners, to constantly validate and improve bearing performance

Content

Tilting Pad Thrust Bearings

Tilting pad bearings are designed for the most demanding turbomachinery applications. Due to the tilting capability of the individual pads, thrust bearings allow sliding speeds up to 160 m/s and above.
With appropriate oil supply, bearing loads of >4 MPa are achievable for continuous operation.

Technical Information

Anti-rotation pin
By standard bearings are equipped with an anti-rotation pin. The pin position can be defined individually.

Operating load
The permissible load depends on the operating conditions and specified limits and can be determined with a bearing calculation.

Pad sizes
The catalog pad sizes for non-equlized bearings range from 12 to 97 mm. For equalized bearings the sizes range from 23 to 136 mm. Larger pad sizes are possible upon request. The catalog comprises bearings of the standard series with 6, 7, 8, 11 and 14 pads. Invidvidual solutions and customized bearings are our specialty. Please contact us for consultation.

Pivot position
There are two common pivot positions:
- Center pivot: Pivot at 50% of the circumferential pad length. Bi-directional operation possible.
- 60% offset pivot: A pivot position at 60% of the circumferential pad length is suitable for unidirectional operation. One benefit is the reduced temperature level compared to center pivot. Reverse rotation is also possible at reduced loads.

Self-equalizing system
For handling any misalignment between the thrust collar and the bearing, a self-equalizing system is available. This consists of a closed ring of mechanical links and allows the highest loaded pads to give way and additionally distribute load to the lower loaded pads. As a result, overloads are reduced and a significantly improved thrust force distribution is achieved.

Sliding (circumferential) speed
The sliding or circumferential speed v [m/s] is defined by $v = n * d * \pi/60000$ with n = rotor speed [rpm], d = average bearing diameter [mm].

Slow roll / turning gear operation
Depending on the individual operating conditions of the machine, Miba can specify a minimum slow-roll or turning gear speed to avoid wear. For lower speeds, a hydrostatic jacking device is recommended.

Specific bearing load
The specific bearing load $\bar{p}$ [MPa] is defined by $\bar{p} = \frac{F}{A}$ with F = bearing load [N], A = effective pad area [mm²]. Permissible bearing loads can be stated for the machine start-stop and during operation.

Start-up load
The maximum start-up load is 2,0 MPa. For higher start-up loads Miba recommends a hydrostatic jacking device.

Start-up temperature
Miba recommends a minimum oil inlet temperature at the machine start-up of 20 °C. For lower temperatures a tank heating is recommended.

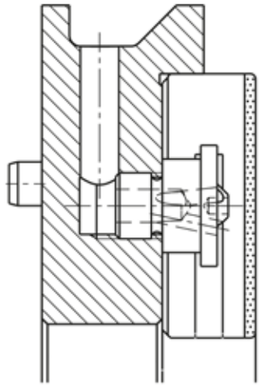
Temperature limits
Miba recommends a temperature limit based on the bearing calculation. E.g. the alarm temperature could be set 10 °C above the prediction and the shut-down temperature 15 °C above the prediction. The bearing's absolute limits are typically higher.

Lubrication

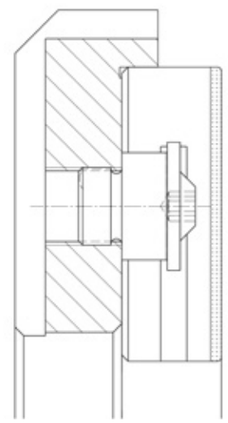
Tilting pad thrust bearings are available with directed or flooded lubrication:

Directed lubrication:
Oil inlet nozzles control the flow. Recommended for high speed applications leading to lower bearing temperatures and power loss. As an addition, if requested,direct lubrication with a pad oil distribution feature at the pad inlet can be provided.

Flooded lubrication:
With a sealed bearing housing and controlled oil outlet, the bearing cavity is filled with oil. Mainly recommended for low to medium speed applications.



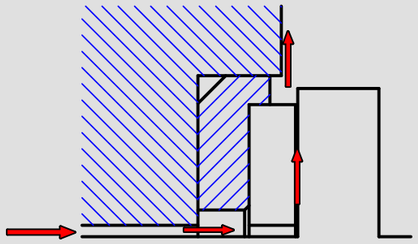
Directed lubrication



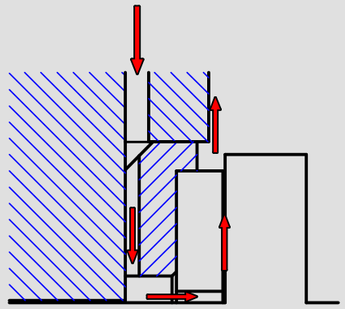
Flooded lubrication

Miba recommends a separate oil supply for both sides of the thrust bearing.

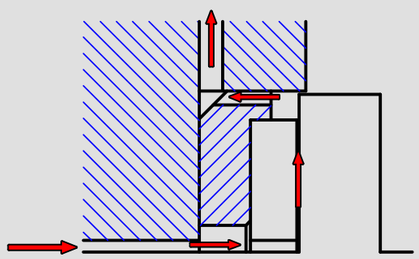
Oil supply schemes for flooded lubrication:



1. Axial oil inlet (from the shaft)
Oil outlet near thrust collar



2. Radial oil inlet (from the chamfer)
Oil outlet near thrust collar



3. Axial oil inlet
Oil outlet over the chamfer

Pivot Design

Miba bearings are available with different pivot designs:

Line contact:
Most bearings up to a pad size of H89 are equipped with line contact pivot.

Spherical contact:
Larger bearings with pads size >=97 mm length and the 7 pad catalog bearing are typically equipped with a spherical pivot design. This allows pad tilting also in radial direction, which is especially useful for large pad sizes.

Line contact pivot

Spherical contact pivot

Materials

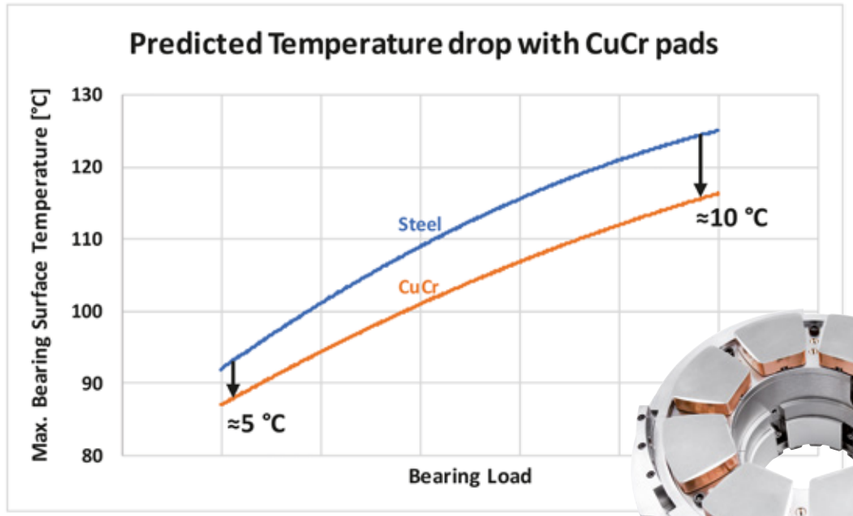
Steel – White metal
16MnCr5 steel with a high-quality white metal is the standard material combination for the tilting pads.

The material combination offers a high bonding strength (according to ISO 4186-2 / Chalmers Test) and mechanical properties which clearly exceed the demand of even highly loaded bearings.

CuCr – White metal
For the reduction of maximum bearing temperatures under extreme conditions, Miba Industrial Bearings offers CuCr pad base material with a 6x higher thermal conductivity than steel. The effect is depicted in the below chart.

Steel – Bronze
The higher temperature limit of bronze allows increased pad temperatures for special applications. A hardened shaft is recommended (HB > 160).

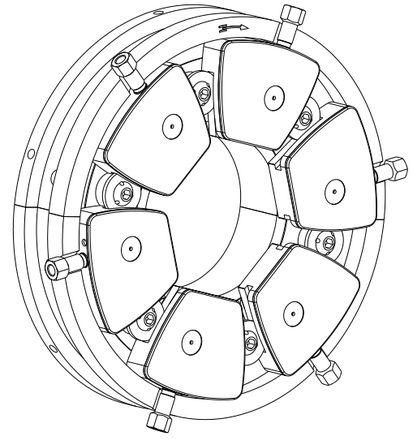
Solid Peek
Solid carbon fiber reinforced Peek composite material offers high chemical and high wear resistance for water or other media lubrication.
Due to the material's high mechanical strength and temperature limit it is suitable for demanding applications.



Combined Bearing;
CuCr/White metal Thrust Part

Hydrostatic Jacking

For start-up loads above 2,0 MPa or continuous turning gear operation, Miba Industrial Bearings can be equipped with oil pockets, check valves, pipes and hoses for the connection of a high-pressure lift oil system. This feature is available for the pad size of 30mm and above.

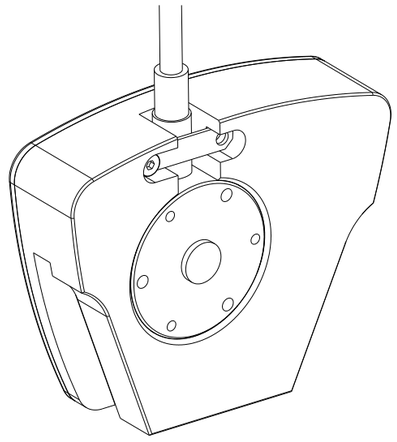


Thrust bearing equipped with
hydrostatic jacking pockets

Thrust load measurement

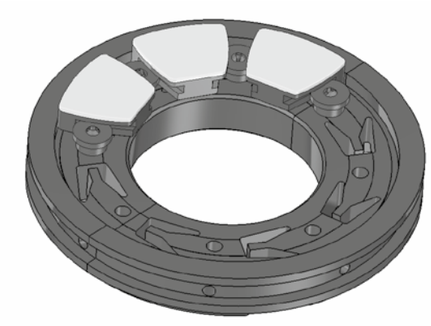
Miba offers two options for the measurement of thrust loads:

Load cells:
Thrust bearings equipped with tilting pads of size H68 and above can be equipped with load cells. This system is recommended for bearings with self-equalizing system.



Thrust pad with load cell

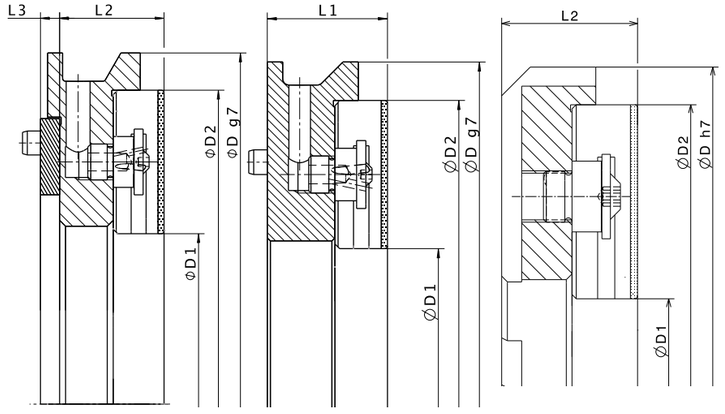
Strain gages:
For smaller pad sizes and for non-equalized bearings, Miba developed the patented thrust load measuring support ring. The incorporated flexible pivots are equipped with strain gages. Regarding the space requirements, the bearing design is fully interchangeable with catalog bearings.



Patented measuring support ring for thrust
load measurement with strain gages

Dimension Tables

6 Pads – non equalized (Design Example Germany)



Directed w spacer | Directed w/o spacer | Flooded w/o spacer

Design Options

Directed Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Flooded Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Carrier ring
- › split
- › unsplit

Definition of direction
- › clockwise
- › bidirectional
- › counter clockwise

6 Pads – non equalized

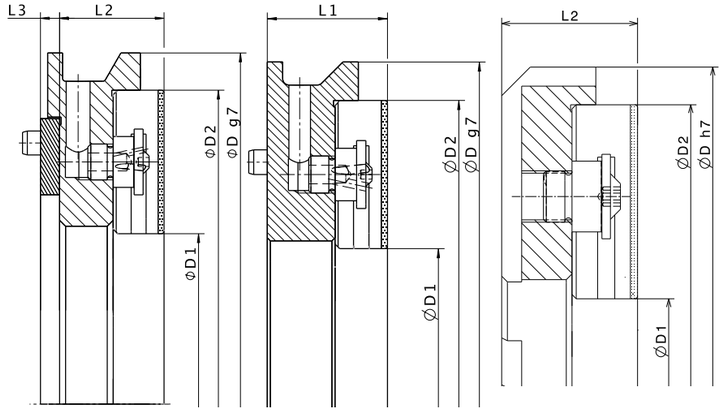
Size	D1	D2	D g7	L1	L2	L3
H12	-	-	-	-	-	-
H14	-	-	-	-	-	-
H17	25,49	60,08	71,41	18,09	15,89	3,2
H20	29,88	70,58	82,51	19,67	17,47	3,2
H23	36,19	84,43	98,39	21,26	19,06	3,2
H26	39,03	91,94	107,91	23,95	20,65	4,8
H28	42,94	99,93	115,85	25,54	22,24	4,8
H31	47,33	110,42	126,96	27,12	23,82	4,8
H34	50,98	120,17	139,66	28,71	25,41	4,8
H37	55,37	130,66	147,60	30,30	27,00	4,8
H40	60,50	141,90	165,06	31,89	28,56	4,8
H44	65,36	154,90	179,35	35,06	31,76	4,8
H48	71,71	169,39	193,63	38,94	34,94	6,4
H52	78,79	184,62	209,50	42,11	38,11	6,4
H57	85,05	202,56	228,55	45,29	41,29	6,4
H61	92,66	219,83	247,60	48,46	44,46	6,4
H68	101,22	239,59	266,64	51,64	47,64	6,4
H74	110,74	261,32	292,04	57,81	50,81	9,5
H81	120,73	285,56	317,44	64,16	57,16	9,5
H89	128,99	310,06	342,84	67,35	60,34	9,5
H97	140,94	338,29	371,42	73,70	66,70	9,5

Surface Area and Max. Load

Size	Surface [mm²]	Nominal max. Load [N]
H12	869	2.607
H14	1.188	3.563
H17	1.752	5.256
H20	2.422	7.265
H23	3.471	10.413
H26	4.096	12.698
H28	4.757	15.697
H31	5.826	19.807
H34	6.999	24.497
H37	8.294	29.029
H40	9.694	36.836
H44	11.722	46.887
H48	13.948	55.792
H52	16.388	65.553
H57	19.868	79.474
H61	23.671	94.682
H68	27.989	111.957
H74	33.157	132.627
H81	39.729	158.916
H89	47.907	191.628
H97	56.904	227.615

Dimension Tables

8 Pads – non equalized (Design Example Germany)



Directed w spacer | Directed w/o spacer | Flooded w/o spacer

Design Options

Directed Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Flooded Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Carrier ring
- › split
- › unsplit

Definition of direction
- › clockwise
- › bidirectional
- › counter clockwise

8 Pads – non equalized

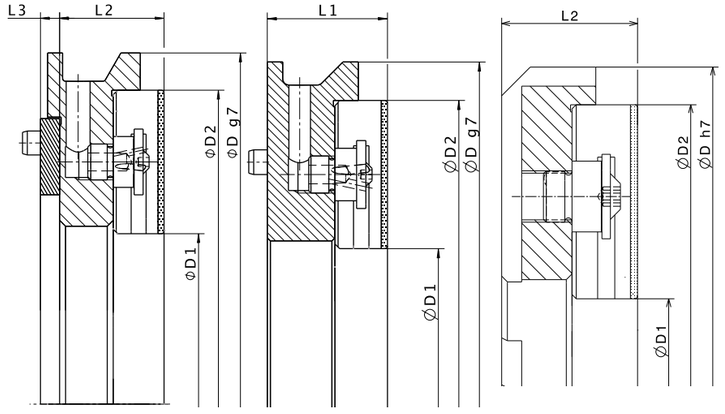
Size	D1	D2	D g7	L1	L2	L3
H12	28,5	52,5	-	-	12,71	3,2
H14	33,5	62,0	73,00	16,50	14,30	3,2
H17	39,5	74,5	85,69	18,09	15,89	3,2
H20	47,5	87,5	101,56	19,67	17,47	3,2
H23	55,5	105,0	120,61	21,26	19,06	3,2
H26	62,5	114,0	130,14	23,95	20,65	4,8
H28	66,5	124,0	139,66	25,54	22,24	4,8
H31	73,0	137,0	152,36	27,12	23,82	4,8
H34	79,5	149,0	168,24	28,71	25,41	4,8
H37	87,5	162,0	180,91	30,30	27,00	4,8
H40	93,5	176,0	196,80	31,89	28,56	4,8
H44	103,0	192,0	215,85	35,06	31,76	4,8
H48	113,0	210,0	234,90	38,94	34,94	6,4
H52	122,0	229,0	253,94	42,11	38,11	6,4
H57	135,0	251,0	279,34	45,29	41,29	6,4
H61	148,0	273,0	301,57	48,46	44,46	6,4
H68	159,0	297,0	323,79	51,64	47,64	6,4
H74	175,0	324,0	355,54	57,81	50,81	9,5
H81	191,0	254,0	384,12	64,16	57,16	9,5
H89	204,0	384,0	415,86	67,35	60,34	9,5
H97	223,0	419,0	453,96	73,70	66,70	9,5

Surface Area and Max. Load

Size	Surface [mm²]	Nominal max. Load [N]
H12	1.159	3.476
H14	1.583	4.750
H17	2.336	7.008
H20	3.229	9.687
H23	4.628	13.884
H26	5.461	16.930
H28	6.342	20.929
H31	7.768	26.410
H34	9.332	32.663
H37	11.059	38.706
H40	12.925	49.115
H44	15.629	62.516
H48	18.597	74.389
H52	21.851	87.404
H57	26.491	105.965
H61	31.561	126.243
H68	37.319	149.276
H74	44.209	176.836
H81	52.972	211.887
H89	63.876	255.504
H97	75.872	303.487

Dimension Tables

11 Pads – non equalized (Design Example Germany)



Directed w spacer | Directed w/o spacer | Flooded w/o spacer

Design Options

Directed Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Flooded Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Carrier ring
- › split
- › unsplit

Definition of direction
- › clockwise
- › bidirectional
- › counter clockwise

11 Pads – non equalized

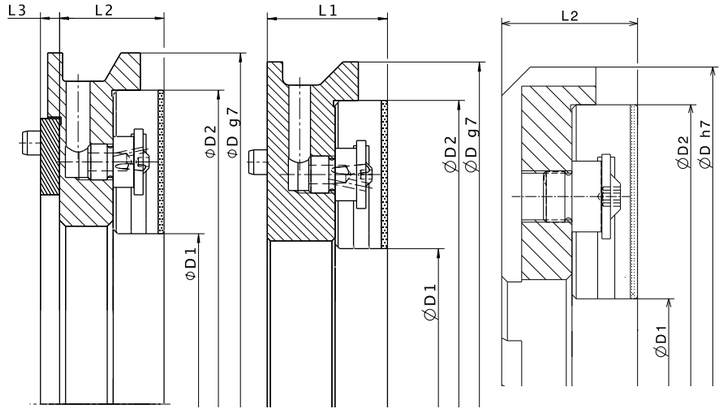
Size	D1	D2	D g7	L1	L2	L3
H12	43,87	67,87	-	-	12,71	3,2
H14	52,21	80,21	92,40	16,50	14,30	3,2
H17	62,31	96,31	111,09	18,09	15,89	3,2
H20	73,11	113,11	130,14	19,67	19,06	3,2
H23	88,71	136,11	152,36	23,95	20,65	4,8
H26	95,39	147,39	168,24	25,54	22,24	4,8
H28	104,43	160,43	180,93	27,12	23,82	4,8
H31	115,22	177,22	196,80	28,71	25,41	4,8
H34	124,63	192,63	212,68	30,30	27,00	4,8
H37	135,43	209,43	234,90	32,59	28,59	6,4
H40	147,60	227,60	253,94	34,17	30,17	6,4
H44	160,15	248,15	279,34	35,76	31,17	6,4
H48	175,47	271,47	301,57	38,94	34,94	6,4
H52	192,16	296,16	323,79	42,11	38,11	6,4
H57	208,82	324,32	355,54	48,29	41,29	9,5
H61	228,44	353,44	384,12	51,46	44,46	9,5
H68	247,89	383,89	415,86	54,64	47,64	9,5
H74	270,86	418,86	453,96	57,81	50,81	9,5
H81	295,58	457,58	495,23	64,16	57,16	9,5
H89	317,93	495,93	539,67	67,35	60,34	9,5
H97	347,17	541,17	584,12	73,70	66,70	9,5

Surface Area and Max. Load

Size	Surface [mm²]	Nominal max. Load [N]
H12	1.593	4.780
H14	2.177	6.531
H17	3.212	9.636
H20	4.440	13.320
H23	6.364	19.091
H26	7.509	23.279
H28	8.720	28.778
H31	10.680	36.314
H34	12.832	44.911
H37	15.206	53.220
H40	17.772	67.533
H44	21.490	85.960
H48	25.571	102.285
H52	30.045	120.180
H57	36.425	145.702
H61	43.396	173.584
H68	51.314	205.255
H74	60.787	243.149
H81	72.836	291.345
H89	87.830	351.318
H97	104.324	417.295

Dimension Tables

14 Pads – non equalized (Design Example Germany)



Directed w spacer | Directed w/o spacer | Flooded w/o spacer

Design Options

Directed Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Flooded Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Carrier ring
- › split
- › unsplit

Definition of direction
- › clockwise
- › bidirectional
- › counter clockwise

14 Pads – non equalized

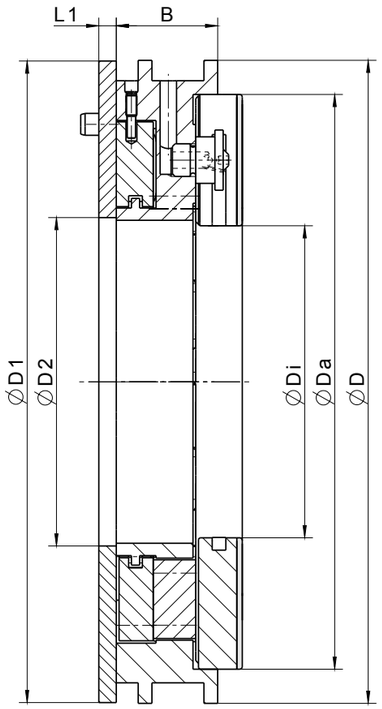
Size	D1	D2	D g7	L1	L2	L3
H12	58,99	82,99	-	-	12,71	3,2
H14	70,13	98,13	111,90	16,50	14,30	3,2
H17	83,78	117,78	130,14	18,09	15,89	3,2
H20	98,31	138,31	152,36	22,36	19,06	4,8
H23	119,33	166,73	184,10	23,95	20,65	4,8
H26	128,24	180,24	199,98	25,54	22,24	4,8
H28	140,27	196,27	219,03	27,12	23,82	4,8
H31	154,79	216,79	238,08	28,71	25,41	4,8
H34	167,57	235,57	260,29	31,00	27,00	6,4
H37	182,09	256,09	282,52	32,59	28,59	6,4
H40	198,38	278,38	307,92	35,76	30,17	6,4
H44	215,41	303,41	322,32	38,94	34,94	6,4
H48	235,95	331,95	361,89	42,11	38,11	6,4
H52	258,24	362,24	393,64	48,29	41,29	9,5
H57	280,97	396,47	425,38	51,46	44,46	9,5
H61	307,59	432,59	463,48	54,64	47,64	9,5
H68	333,39	469,39	501,57	57,81	50,81	9,5
H74	364,19	512,19	546,02	60,99	53,99	9,5
H81	397,51	559,51	596,82	67,35	60,34	9,5
H89	428,07	606,07	647,62	73,70	66,70	9,5
H97	-	-	-	-	-	-

Surface Area and Max. Load

Size	Surface [mm²]	Nominal max. Load [N]
H12	2.028	6.084
H14	2.771	8.313
H17	4.088	12.264
H20	5.651	16.952
H23	8.099	24.297
H26	9.557	29.628
H28	11.099	36.626
H31	13.593	46.217
H34	16.331	57.160
H37	19.353	67.735
H40	22.619	85.952
H44	27.351	109.403
H48	32.545	130.181
H52	38.239	152.956
H57	46.360	185.438
H61	55.231	220.925
H68	65.308	261.234
H74	77.366	309.463
H81	92.701	370.803
H89	111.783	447.132
H97	132.776	531.102

Dimension Tables

6 Pads – equalized (Design Example Germany)



Design Options

Directed Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Flooded Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Carrier ring
- › split
- › unsplit

Definition of direction
- › clockwise
- › bidirectional
- › counter clockwise

6 Pads – equalized

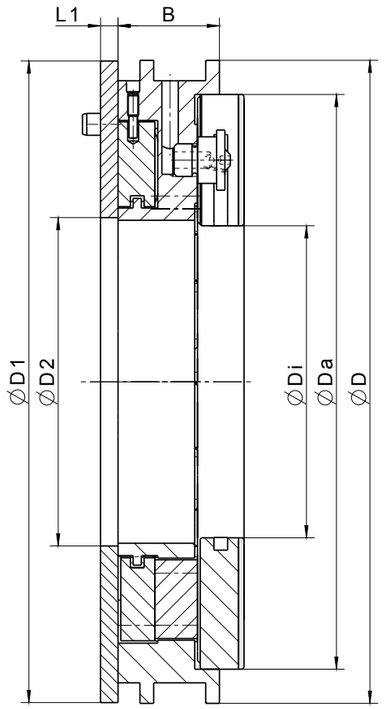
Size	Di	Da	D g7	B h9	D1	D2	L1
H23	36,19	84,43	98,39	23,5	97,8	40	3,2
H26	39,03	91,94	107,91	25,5	107,3	43	4,8
H28	42,94	99,93	115,85	28,0	115,3	47	4,8
H31	47,33	110,42	126,96	30,0	126,4	55	4,8
H34	50,98	120,17	139,66	34,0	139,1	59	4,8
H37	55,37	130,66	147,60	36,0	147,0	63	4,8
H40	60,50	141,90	165,06	41,0	164,5	71	4,8
H44	65,36	154,90	179,35	43,0	178,8	75	4,8
H48	71,71	169,39	193,63	46,0	193,0	82	6,4
H52	78,79	184,62	209,50	52,0	208,9	91	6,4
H57	85,05	202,56	228,55	56,0	228,0	97	6,4
H61	92,66	219,83	247,60	61,0	247,0	105	6,4
H68	101,22	239,59	266,64	65,0	266,0	116	6,4
H74	110,74	261,32	292,04	68,0	291,4	126	9,5
H81	120,73	285,56	355,54	76,0	316,8	136	9,5
H89	128,99	310,06	342,84	80,0	342,2	147	9,5
H97	140,94	338,29	371,42	88,0	370,8	159	9,5
H105	-	-	-	95,0	-	-	9,5
H115	-	-	-	102,0	-	-	12,7
H125	-	-	-	110,0	-	-	12,7
H136	-	-	-	121,0	-	-	12,7

Surface Area and Max. Load

Size	Surface [mm²]	Nominal max. Load [N]
H23	3.471	10.413
H26	4.096	14.336
H28	4.757	18.075
H31	5.826	22.720
H34	6.999	27.997
H37	8.294	33.176
H40	9.694	41.683
H44	11.722	52.748
H48	13.948	62.766
H52	16.388	73.747
H57	19.868	89.408
H61	23.671	106.517
H68	27.989	125.952
H74	33.157	149.205
H81	39.729	178.780
H89	47.907	215.582
H97	56.904	256.067
H105	67.368	303.156
H115	80.817	363.679
H125	96.672	435.024
H136	120.120	540.540

Dimension Tables

8 Pads – equalized (Design Example Germany)



Design Options

Directed Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Flooded Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Carrier ring
- › split
- › unsplit

Definition of direction
- › clockwise
- › bidirectional
- › counter clockwise

8 Pads – equalized

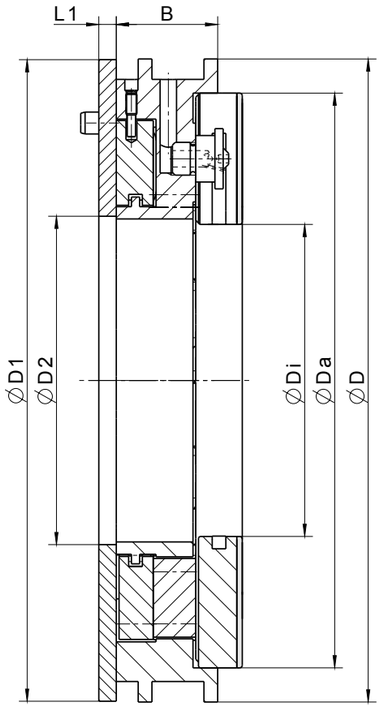
Size	Di	Da	D g7	B h9	D1	D2	L1
H23	57,6	105,0	120,65	23,5	120,1	64	3,2
H26	62,0	114,0	130,18	25,5	129,6	66	4,8
H28	68,0	124,0	139,70	28,0	139,2	73	4,8
H31	75,0	137,0	152,40	30,0	151,9	83	4,8
H34	81,0	149,0	168,28	34,0	167,7	90	4,8
H37	88,0	162,0	180,96	36,0	180,4	97	4,8
H40	96,0	176,0	196,85	41,0	196,3	106	4,8
H44	104,0	192,0	215,90	43,0	215,4	114	4,8
H48	114,0	210,0	234,95	46,0	234,4	126	6,4
H52	125,0	229,0	254,00	52,0	253,5	135	6,4
H57	135,5	251,0	279,40	56,0	278,9	151	6,4
H61	148,0	273,0	301,63	61,0	301,1	164	6,4
H68	161,0	297,0	323,85	65,0	323,2	178	6,4
H74	176,0	324,0	355,60	68,0	355,0	190	9,5
H81	192,0	354,0	384,18	76,0	383,5	209	9,5
H89	206,0	384,0	415,93	80,0	415,3	225	9,5
H97	225,0	419,0	454,03	88,0	453,4	244	9,5
H105	247,0	457,0	495,30	95,0	494,7	268	9,5
H115	272,0	502,0	539,75	102,0	539,0	295	12,7
H125	296,0	546,0	584,20	110,0	583,5	320	12,7
H136	325,0	597,0	641,35	121,0	640,6	348	12,7

Surface Area and Max. Load

Size	Surface [mm²]	Nominal max. Load [N]
H23	4.628	13.884
H26	5.461	19.115
H28	6.342	24.100
H31	7.768	30.294
H34	9.332	37.329
H37	11.059	44.235
H40	12.925	55.578
H44	15.629	70.331
H48	18.597	83.688
H52	21.851	98.329
H57	26.491	119.210
H61	31.561	142.023
H68	37.319	167.936
H74	44.209	198.940
H81	52.972	238.373
H89	63.876	287.442
H97	75.872	341.423
H105	89.824	404.208
H115	107.757	484.905
H125	128.896	580.032
H136	160.160	720.720

Dimension Tables

11 Pads – equalized (Design Example Germany)



Design Options

Directed Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Flooded Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Carrier ring
- › split
- › unsplit

Definition of direction
- › clockwise
- › bidirectional
- › counter clockwise

11 Pads – equalized

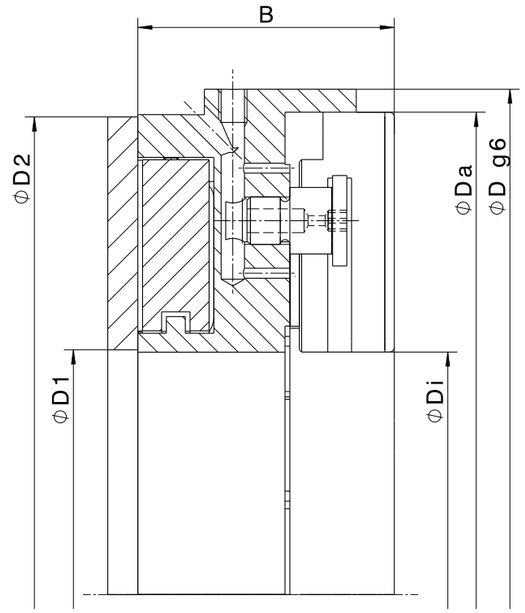
Size	Di	Da	D g7	B h9	D1	D2	L1
H23	88,7	136,1	152,40	23,5	151,9	95	3,2
H26	95,4	147,4	168,28	25,5	167,7	102	4,8
H28	104,4	160,4	180,98	28,0	180,4	113	4,8
H31	115,2	177,2	196,85	30,0	196,3	123	4,8
H34	124,6	192,6	212,73	34,0	212,2	133	4,8
H37	135,4	209,4	234,95	36,0	234,4	147	6,4
H40	147,6	227,6	254,00	41,0	253,5	161	6,4
H44	160,2	248,2	279,40	43,0	278,9	174	6,4
H48	175,5	271,5	301,63	46,0	301,1	189	6,4
H52	192,2	296,2	323,85	52,0	323,2	204	6,4
H57	208,8	324,3	355,60	56,0	355,0	227	9,5
H61	228,4	353,4	384,18	61,0	383,5	246	9,5
H68	247,9	383,9	415,93	65,0	415,3	268	9,5
H74	270,9	418,9	454,03	68,0	453,4	289	9,5
H81	395,6	457,6	495,30	76,0	494,7	316	9,5
H89	317,9	495,9	539,75	80,0	539,1	343	9,5
H97	347,2	541,2	584,20	88,0	583,5	376	9,5
H105	383,0	594,0	641,35	95,0	640,6	410	9,5
H115	417,0	647,0	692,15	102,0	691,4	446	12,7
H125	455,0	706,0	755,65	110,0	754,9	486	12,7
H136	496,0	769,0	825,50	121,0	824,7	526	12,7

Surface Area and Max. Load

Size	Surface [mm²]	Nominal max. Load [N]
H23	6.364	19.091
H26	7.509	26.283
H28	8.720	33.138
H31	10.680	41.654
H34	12.832	51.327
H37	15.206	60.823
H40	17.772	76.419
H44	21.490	96.705
H48	25.571	115.071
H52	30.045	135.202
H57	36.425	163.914
H61	43.396	195.282
H68	51.314	230.912
H74	60.787	273.543
H81	72.836	327.763
H89	87.830	395.233
H97	104.324	469.457
H105	123.508	555.786
H115	148.165	666.744
H125	177.232	797.544
H136	220.220	990.990

Dimension Tables

7 Pads HD – equalized (Design Example Germany)



Design Options

Directed Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Flooded Lubrication
- › with spacer
- › with spacer and shims (shim thickness: 0.5mm) (1x0.2mm; 2x0.15mm)
- › without spacer

Carrier ring
- › split
- › unsplit

Definition of direction
- › clockwise
- › bidirectional
- › counter clockwise

7 Pads HD – equalized

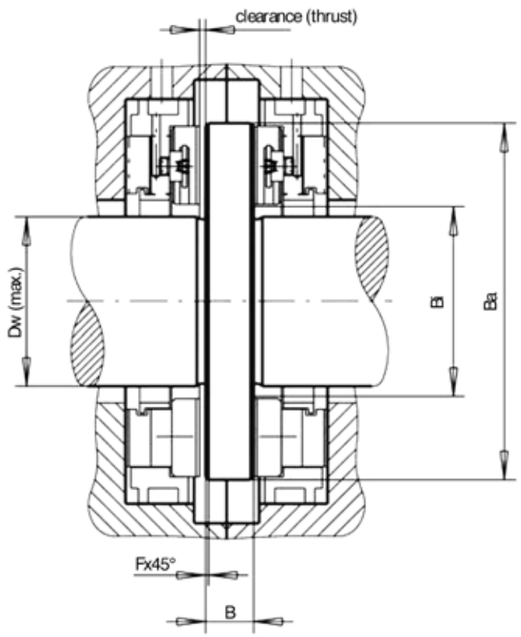
Size	Di	Da	Dg⁶	B	D1	D2
H26S	-	-	-	-	-	-
H31S	64,0	127,0	136,450	32,0	128,0	66,5
H37S	77,5	152,0	161,900	38,0	155,0	78,0
H44S	89,0	177,8	187,325	45,0	180,0	90,0
H52S	102,0	203,0	212,725	54,0	201,0	103,0
H57S	114,0	228,0	238,070	58,0	229,0	116,0
H68S	133,0	267,0	279,320	67,0	261,0	135,0
H74S	155,8	304,8	317,440	70,0	299,0	157,0
H89S	171,0	345,0	355,600	82,0	337,0	172,0
H97S	-	-	-	-	-	-

Surface Area and Max. Load

Size	Surface [mm²]	Nominal max. Load [N]
H26S	-	-
H31S	7.364	28.722
H37S	11.041	44.164
H44S	15.036	67.663
H52S	19.227	86.522
H57S	25.626	115.319
H68S	35.536	159.912
H74S	46.450	198.897
H89S	58.657	263.957
H97S	-	-

Dimension Tables

Bearing Clearance and Thrust Collar Geometry



8 Tilting pads

Size	clearance [mm]	Dw	Bi	Ba	B	F
H23	0,25	49	54	108	16	0,8
H26	0,30	54	58	117	17	0,8
H28	0,30	58	64	127	19	0,8
H31	0,30	64	70	140	21	0,8
H34	0,35	70	76	152	22	0,8
H37	0,35	76	84	165	25	0,8
H40	0,35	82	91	179	27	0,8
H44	0,40	90	100	195	30	0,8
H48	0,40	98	110	212	32	0,8
H52	0,40	107	119	232	35	0,8
H57	0,50	118	132	254	38	0,8
H61	0,50	128	141	276	43	0,8
H68	0,50	138	156	300	48	0,8
H74	0,50	152	170	327	51	0,8
H81	0,60	166	187	357	56	0,8
H89	0,60	180	200	391	60	1,5
H97	0,60	196	219	425	67	1,5
H105	0,60	215	240	464	73	1,5
H115	0,70	235	264	508	79	1,5
H125	0,70	252	287	552	86	1,5
H136	0,70	280	314	603	95	1,5

11 Tilting pads

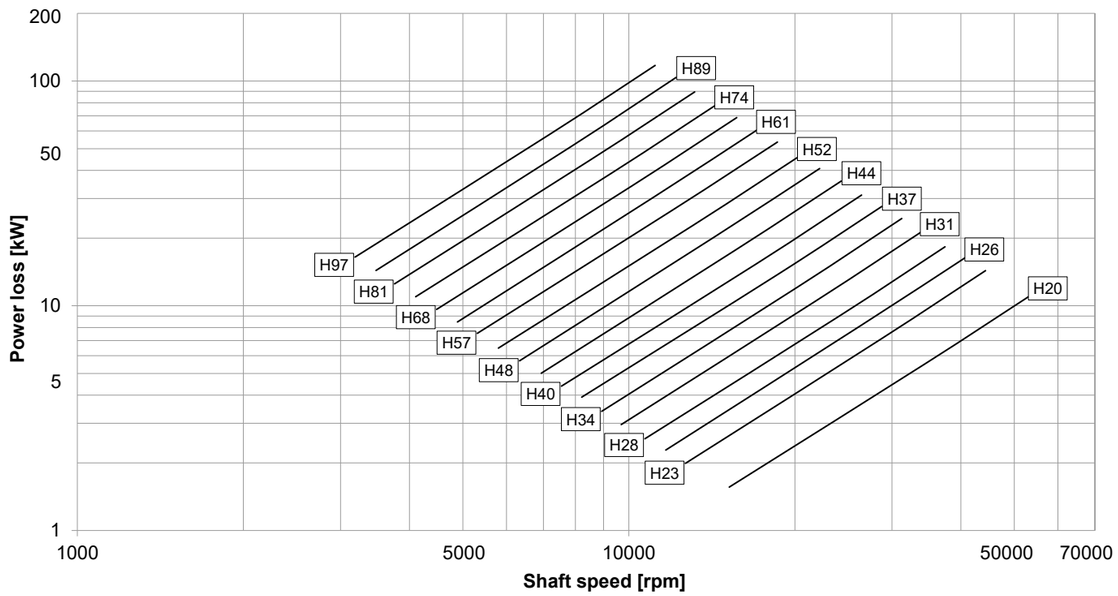
Size	clearance [mm]	Dw	Bi	Ba	B	F
H23	0,25	80	84	138	16	0,5
H26	0,30	87	92	151	17	0,5
H28	0,30	96	102	165	19	0,5
H31	0,30	105	110	178	21	0,5
H34	0,35	115	119	194	22	0,5
H37	0,35	125	132	213	25	0,8
H40	0,35	135	144	232	27	0,8
H44	0,40	148	157	252	30	0,8
H48	0,40	160	171	275	32	0,8
H52	0,40	175	187	298	35	0,8
H57	0,50	192	206	327	38	0,8
H61	0,50	210	224	357	43	0,8
H68	0,50	230	241	391	48	0,8
H74	0,50	250	264	425	51	0,8
H81	0,60	270	289	464	56	0,8
H89	0,60	295	314	505	60	1,5
H97	0,60	325	346	552	67	1,5
H105	0,60	355	376	600	73	1,5
H115	0,70	385	410	653	79	1,5
H125	0,70	420	447	714	86	1,5
H136	0,70	460	487	779	95	1,5

Performance Charts 6 Pads

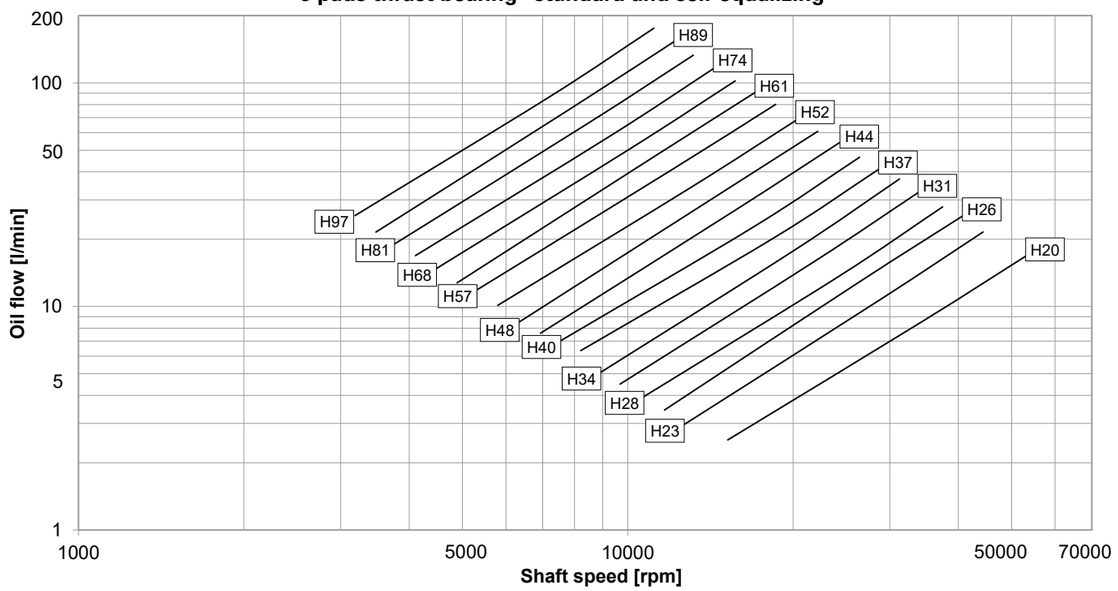
Power loss / Oil supply charts:

- Oil type: VG32 @ 50 °C; Directed lubrication; Offset pivot; ΔT ≈ 22.5 K; Specific bearing load: 2.5 MPa.
- The charts represent the active thrust side only. Miba recommends identical oil supply for both sides.
- When supplied with the recommended flow, the power loss of the inactive side increases the total power losses by ≈ 25%.
- For ISO VG 46 power loss and oil flow are approximately 20% increased.
- Calculations for higher speeds and specific parameters are possible on request.

Power loss
6 pads thrust bearing - standard and self-equalizing



Oil supply
6 pads thrust bearing - standard and self-equalizing

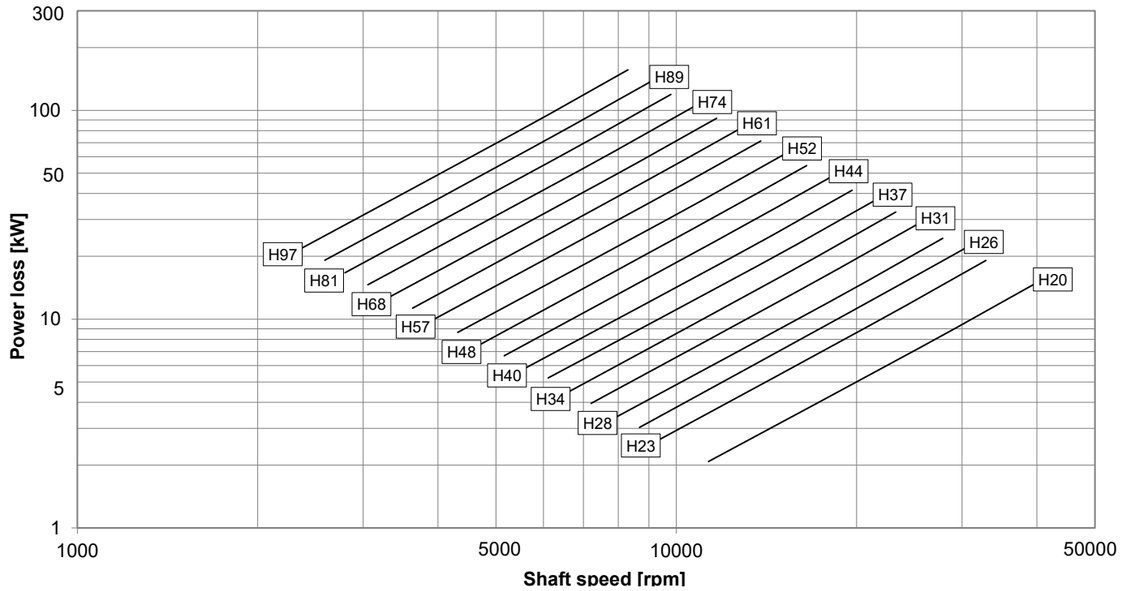


Performance Charts 8 Pads

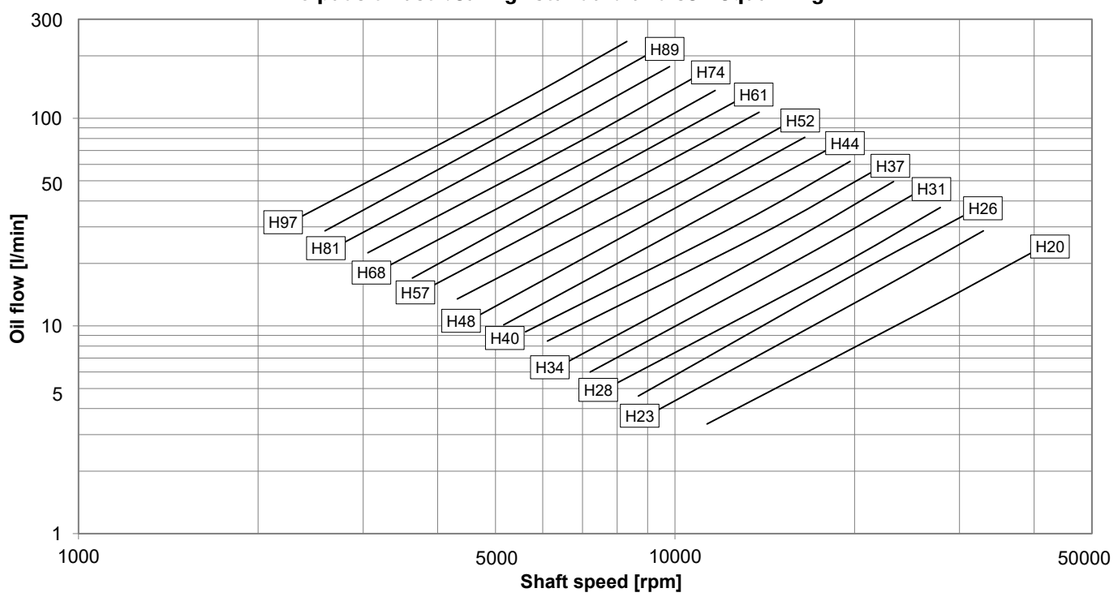
Power loss / Oil supply charts:

- Oil type: VG32 @ 50 °C; Directed lubrication; Offset pivot; ΔT ≈ 22.5 K; Specific bearing load: 2.5 MPa.
- The charts represent the active thrust side only. Miba recommends identical oil supply for both sides.
- When supplied with the recommended flow, the power loss of the inactive side increases the total power losses by ≈ 25%.
- For ISO VG 46 power loss and oil flow are approximately 20% increased.
- Calculations for higher speeds and specific parameters are possible on request.

Power loss
8 pads thrust bearing - standard and self-equalizing



Oil supply
8 pads thrust bearing - standard and self-equalizing

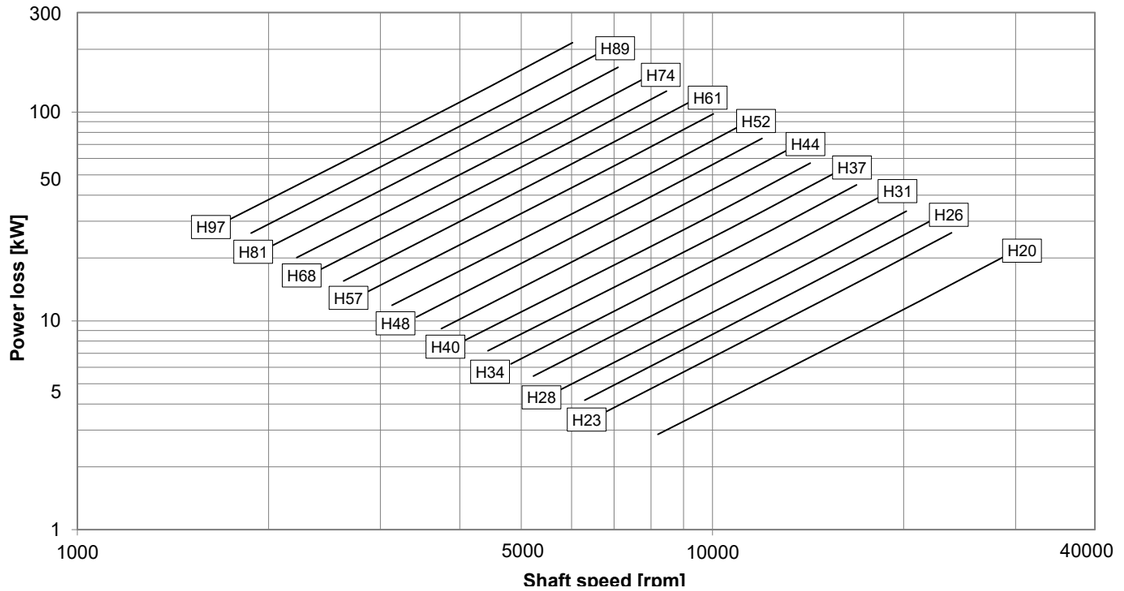


Performance Charts 11 Pads

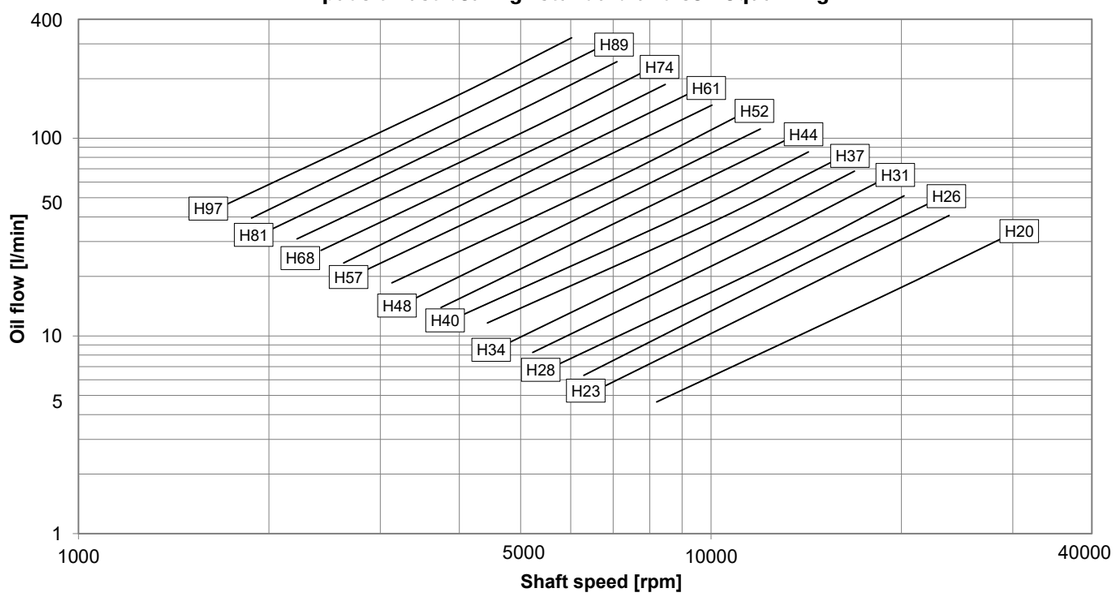
Power loss / Oil supply charts:

- Oil type: VG32 @ 50 °C; Directed lubrication; Offset pivot; ΔT ≈ 22.5 K; Specific bearing load: 2.5 MPa.
- The charts represent the active thrust side only. Miba recommends identical oil supply for both sides.
- When supplied with the recommended flow, the power loss of the inactive side increases the total power losses by ≈ 25%.
- For ISO VG 46 power loss and oil flow are approximately 20% increased.
- Calculations for higher speeds and specific parameters are possible on request.

Power loss
11 pads thrust bearing - standard and self-equalizing



Oil supply
11 pads thrust bearing - standard and self-equalizing

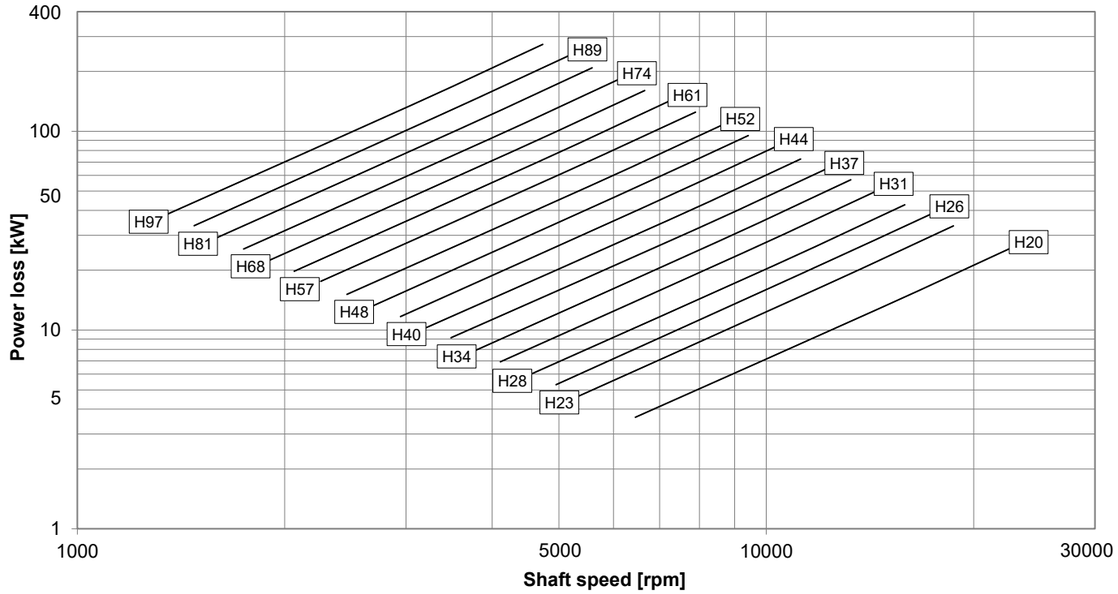


Performance Charts 14 Pads

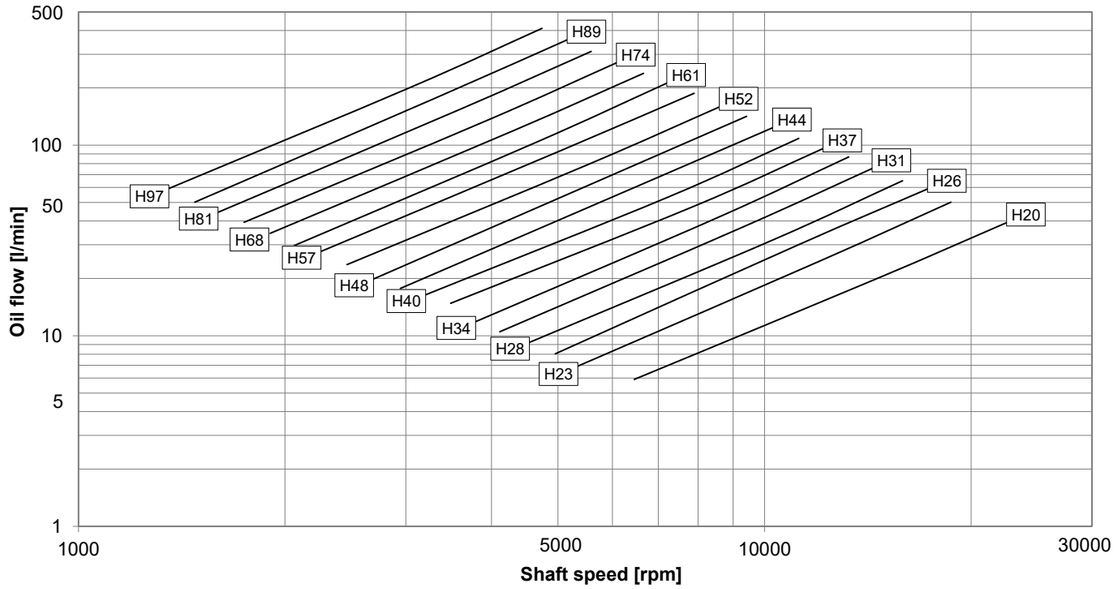
Power loss / Oil supply charts:

- Oil type: VG32 @ 50 °C; Directed lubrication; Offset pivot; ΔT ≈ 22.5 K; Specific bearing load: 2.5 MPa.
- The charts represent the active thrust side only. Miba recommends identical oil supply for both sides.
- When supplied with the recommended flow, the power loss of the inactive side increases the total power losses by ≈ 25%.
- For ISO VG 46 power loss and oil flow are approximately 20% increased.
- Calculations for higher speeds and specific parameters are possible on request.

Power loss
14 pads thrust bearing - standard and self-equalizing



Oil supply
14 pads thrust bearing - standard and self-equalizing

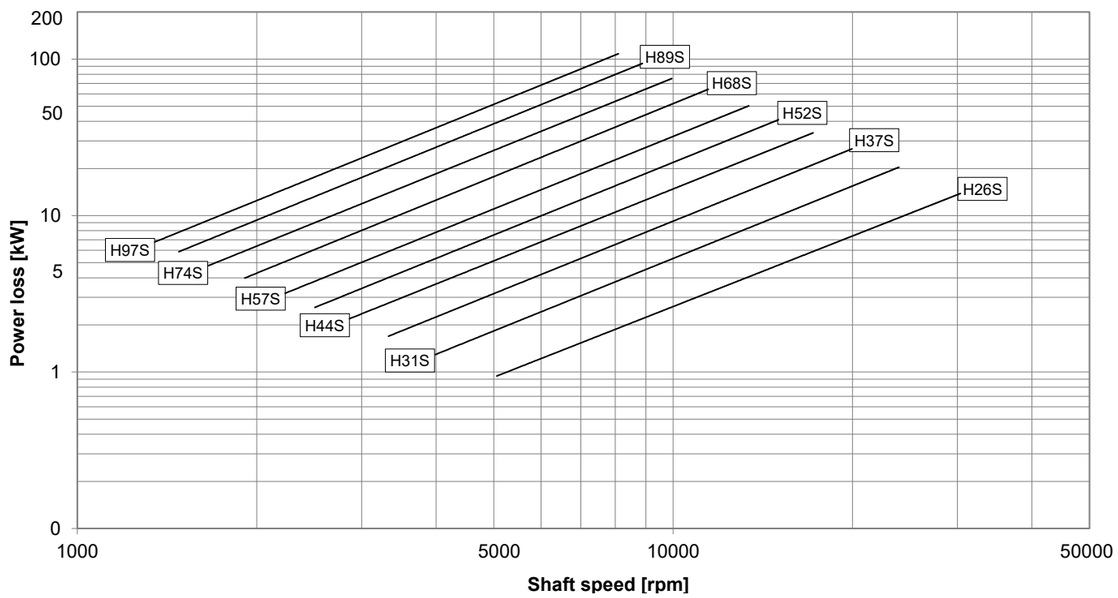


Performance Charts 7 Pads HD

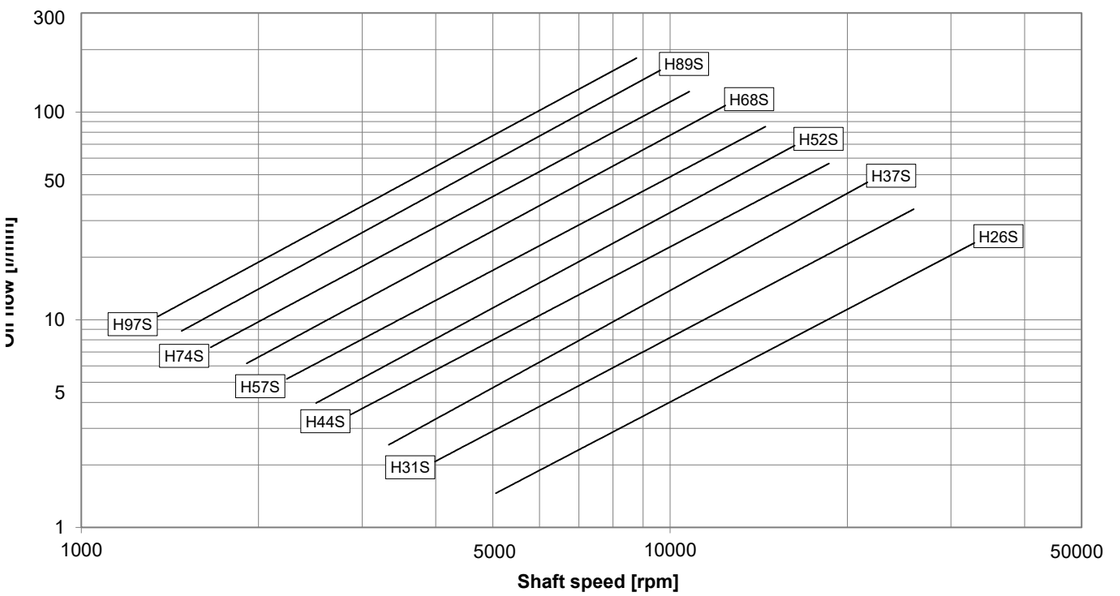
Power loss / Oil supply charts:

- Oil type: VG32 @ 50 °C; Directed lubrication; Offset pivot; ΔT ≈ 22.5 K; Specific bearing load: 2.5 MPa.
- The charts represent the active thrust side only. Miba recommends identical oil supply for both sides.
- When supplied with the recommended flow, the power loss of the inactive side increases the total power losses by ≈ 25%.
- For ISO VG 46 power loss and oil flow are approximately 20% increased.
- Calculations for higher speeds and specific parameters are possible on request.

Power loss
7 pads thrust bearing - self equalizing design with spacer



Oil supply
7 pads thrust bearing - self equalizing design with spacer



Miba Services

Technical Support

Miba's technical support provides customer consultation, bearing calculations and troubleshooting assistance. Providing excellent customer support and quick help when our customers need us most. A Miba bearing calculation contains comprehensive information and indicates the operational safety of the bearing under the given conditions.

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KSA-DIN - PROGRAMM DER MIBA INDUSTRIAL BEARINGS GERMANY GmbH
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          Calculation method according to DIN 31654

T I L T I N G  P A D  T H R U S T  B E A R I N G  C A L C U L A T I O N

Kunde/Customer:                              Miba Industrial Bearings
Abteilung/Department:                        Engineering
Referenz/Reference:                          Example
Anfrage-Datum/Date of enquiry:               23.09.2020
MIBA-Info:                                   Case 1
Berechnungs-Nr./Calculation-No.:             LC9999x1
Zeichnungs-Nr./Drawing-No.:                  KF-Standard
Lagertyp/Bearing type:                       6_6U KF 51/140x57
Rechnungsdatum/Date of Calculation:          23-Sep-20 /16:43:08
Bearbeiter/Author:                           Miba Technical Support
-------------------------------------------------------------------------
Inner diameter                  [mm]              51.0
Outer diameter                  [mm]             120.2
Pad type                                          H 34
Number of pads                                       6
Pivot position (XF)                               0.60
Direction of rotation                              One
Thrust surface                  [mm^2]           6999
-------------------------------------------------------------------------
Speed                           [rpm]         31247.0
Mean sliding speed              [m/s]           140.0
Thrust load                     [N]           17498.0
Specific load                   [MPa]             2.50

Oil type                                      ISO VG 32
Oil supply pressure             [bar]             1.5
Kind of lubrication                            Directed

Oil supply temperature          [°C]              50.0
Oil drain temperature           [°C]              72.8
Max. bearing temperature        [°C]              87.7

Power loss                      [kW]              23.9
Rate of oil flow                [l/min]           35.0
Min. film thickness             [mm]             0.031
Permis. film thickness          [mm]             0.007

Oil nozzles (directed lubrication)
Number x Diameter                           18 × 1.7 mm
-------------------------------------------------------------------------

Results for the reverse bearing side
-------------------------------------------------------------------------
Axial clearance                 [mm]              0.24
Number of pads                                       6
Thrust surface                  [mm^2]           6999
Power loss                      [kW]              8.6
Rate of oil flow                [l/min]           35.0

Oil nozzles (directed lubrication)
Number x Diameter                           18 × 1.7 mm
-------------------------------------------------------------------------
Total power loss                [kW]              32.5
Total rate of oil flow          [l/min]           70.0
Total oil drain temperature     [°C]              65.5
```

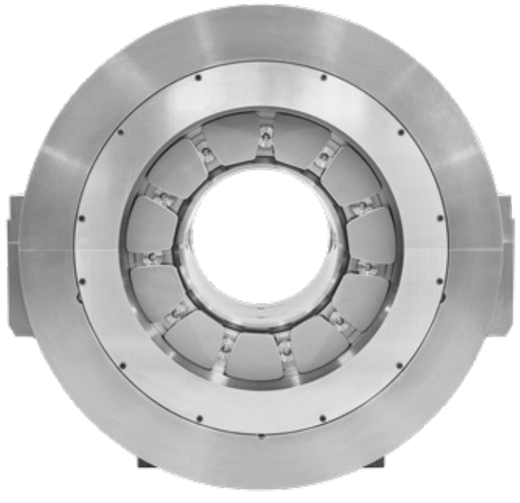
Calculation Example

Engineered Bearings

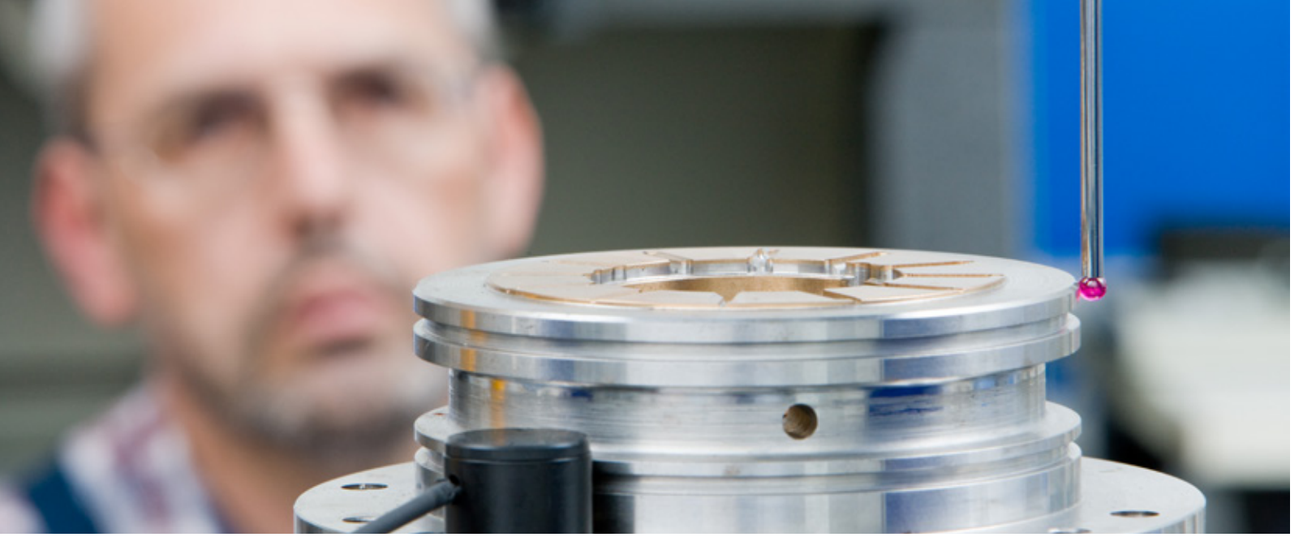
Miba Industrial Bearings always had and still has its focus on customized bearing solutions. No matter whether you need individual bearing dimensions, requirements for bearing adjustments or a tailored combined journal and thrust bearing, our technical department can assist you to reach the best solution for your application. Please contact us for information and consultation.

Engineered Thrust Bearing

Combined Journal and Thrust Bearing



Fixed Geometry Journal Bearing combined with a Tilting Pad Thrust Bearing



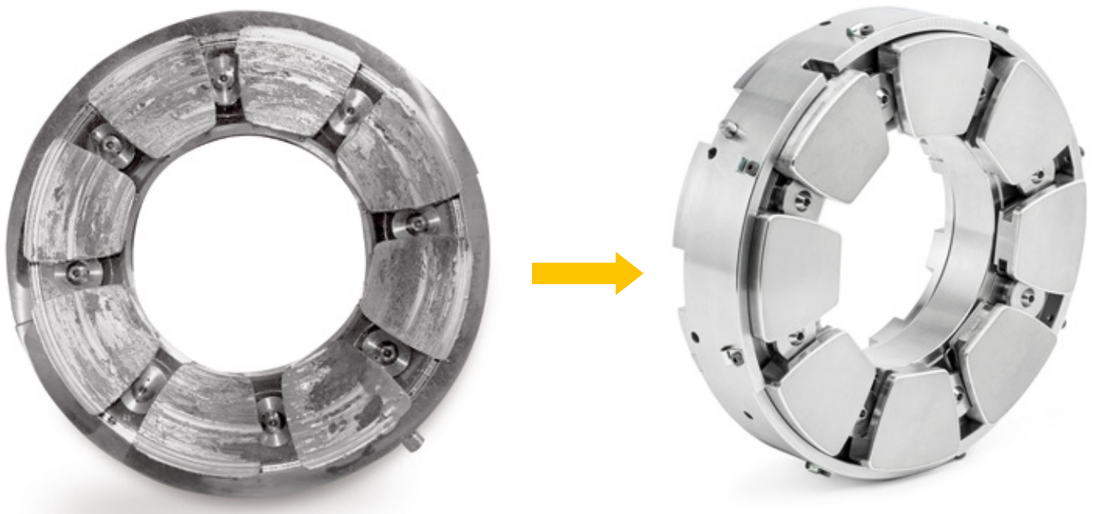
Bearing Repair, Service and Upgrade

Damage to bearings generally results in machine failure and thus in costly downtimes. This is why Miba has expanded the area of bearing repair, in addition to the specialization in the development and manufacturing of new bearings. We help customers to increase efficiency and lower costs by upgrading or reengineering old bearings.

Starting with an evaluation of the existing bearing, we can recommend the best solution and realize the repair of your bearing. Please contact us for information and consultation.

Our services:

- Bearing failure analysis
- Rotordynamics analysis
- Bearing design and optimization
- Labyrinth seal design and optimization
- Reverse engineering
- Training
- On-site service
- Localized repairs

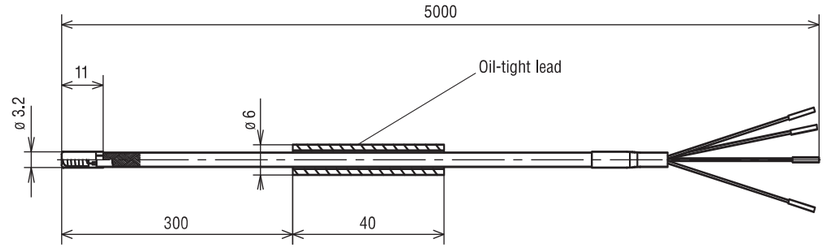


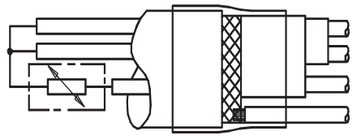
Instrumentation

The most common bearing instrumentation of a bearing is one or two single or double RTDs (PT100), according to the below drawings. However, depending on our customers' needs, Miba Industrial Bearings offers a range of options, including other sensor dimensions (cable length, sensor diameter), various types of thermocouples, etc. Numerous certificates (e.g. ATEX) are available on request.

Single resistance temperature probe
with additional mass-conductor

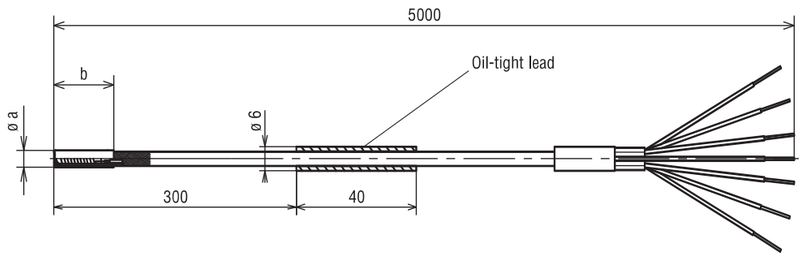
Temperature range: 0–200 °C

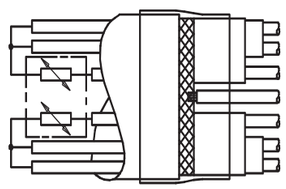




Double resistance temperature probe
with additional mass-conductor

Temperature range: 0–200 °C





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