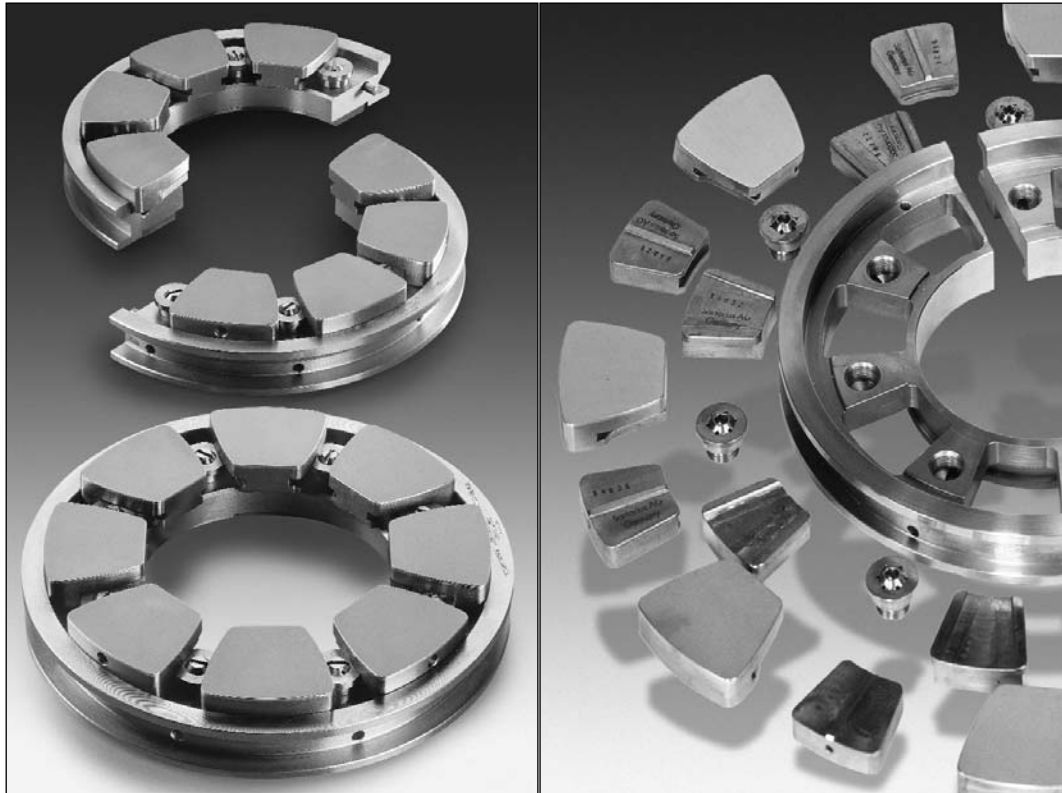




TILTING PAD THRUST BEARINGS

TILTING PAD THRUST BEARINGS



Introduction

Tilting pad thrust bearings are mainly used in medium to high speed/load applications such as turbines, turbocompressors, turbogears and pumps.

Similar to tilting pad journal bearings, the thrust bearing pads automatically adjust themselves to any running condition, thereby optimising power loss, oil flow and oil film temperature.

The load capacity of these bearings is maximised by using one or more of the following:

- Directed lubrication instead of flooded lubrication. This reduces power losses and bearing temperatures
- Offset pivoted pads instead of centre pivoted pads. This significantly reduces the maximum oil film temperature down by 20°C
- CuCr as a base material for the pads instead of steel. The excellent heat conduction of CuCr significantly reduces the maximum oil film temperature down by 15°C
- A self equalising facility which ensures equal load distribution over all pads

Design Characteristics

All John Crane tilting pad thrust bearings are supplied as a cartridge. For standard thrust bearings, the pads are retained by either special screws or oil nozzles. In the self equalising design the carrier ring is replaced by an integrated cage.

The pads are made from steel, with a white metal bearing surface. Other bearing materials are available on request. The geometrical form of the pads is optimised to enable standardisation across the range, resulting in stock rationalisation and shorter lead time benefits for the user.

Tilting pad thrust bearings can be designed with different rotational characteristics. These include centre pivoted pads for bidirectional rotation and offset pivoted pads for uni-directional rotation. Centre pivoted pads permit interchangeability while offset pivoted pads have a higher load capacity but have a limited reverse direction rotation capability.

Thrust bearings are available in both split and unsplit versions. The flooded and directed lubricated ranges are identified separately.



TILTING PAD THRUST BEARINGS

Calculation Of Tilting Pad Bearings

The calculation reflecting pressure development in the hydrodynamic surface is the result of solving the Reynolds Differential Equation on the basis of the following assumptions:

- The lubricant shows 'Newtonian behavior' with respect to its viscosity
- The flows in the gap are laminar
- The lubricant cannot be compressed
- All generated heat is dissipated by the lubricant

Based on the Reynolds flow equation together with a subsequent energy equation a model has been developed that takes account of the blending of freshly added oil and oil leaving the hydrodynamic surfaces. Numeric solutions for the differential equation, reflecting the characteristic values for friction, oil flow, maximum pressure, max temperature, oil film thickness as well as the dynamic characteristics are recorded in tables within our calculation programs.

The John Crane Bearing Technology program determines all required operating characteristics of the bearing including:

- Load capacity
- Film thickness
- Power loss
- Required oil flows and associated temperatures

Instrumentation

All John Crane bearings can be supplied with temperature sensors such as Thermocouples or Resistant Temperature Detectors (RTDs). RTDs are available as single or double PT100 types (see page 21).

The use of temperature sensors permits permanent control of bearing temperatures. This guarantees higher operational safety.

Inspection And Quality Control

To meet today's stringent quality requirements and associated certification standards, John Crane tilting pad thrust bearings must pass strict control and test procedures.

All functional dimensions are measured and analysed with a Computer Aided Quality Assurance System and material certificates are issued for each single production batch. In-house ultrasonic testing ensures a perfect bond between steel and the white metal coating, while crack detection on all in-house manufactured pads is achieved by dye penetration testing.

All quality control procedures can be documented on individual certificates and each bearing can be marked in accordance with individual customer requirements.



TILTING PAD THRUST BEARINGS

Tilting Pad Thrust Bearing Calculation Example

Customer:	Sample customer
Department:	development
Customer-Reference:	516603
Date of enquiry:	26.02.2008
Drawing-No.:	catalogue type
JCBT-Order:	
Bearing type :	8_8S DM H97
JCBT-Reference:	LB5678x
Date of calculation:	26.02.08/11:49
Author:	Uwe Klein

Inner diameter	[mm]	225
Outer diameter	[mm]	419
Pad type		H 97
Number of pads		8
Offset position of pivot		0.6
Rotating direction		one direction
Thrust surface	[mm ²]	75870
Shape		1 / 1405

Speed of shaft rotation	[rpm]	5000
Mean sliding speed	[m/s]	84.3
Thrust load	[N]	189675
Specific load	[MPa]	2.5
Oil type		ISO VG 46
Oil supply pressure	[bar]	1.5
Kind of lubrication		directed
Oil supply temperature	[deg C]	45
Oil drain temperature	[deg C]	64.3
Mean bearing temperature	[deg C]	71.5
Mean viscosity	[Pas]	0.0115
Max. bearing temperature	[deg C]	80.2
Permissible temperature	[deg C]	110
Power loss	[kW]	88.81
Oil quantity	[l/min]	157.78
Min. film thickness	[mm]	0.052
Permis. film thickness	[mm]	0.018
Oil nozzles at directed lubrication		
Number x Diameter		24 x 3.6 mm

Results for the reverse bearing side

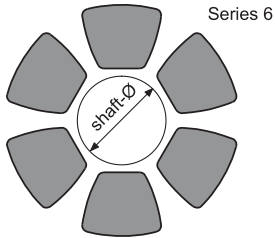
Axial clearance	[mm]	0.6
Pad number		8
Thrust surface	[mm ²]	75870
Power loss	[kW]	25.58
Oil quantity	[l/min]	157.78
Oil nozzles at directed lubrication		
Number x Diameter		24 x 3.6 mm

Total power loss	[kW]	114.39
Total oil quantity	[l/min]	315.6

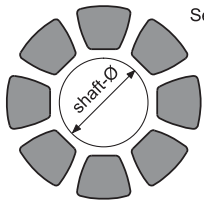


TILTING PAD THRUST BEARINGS

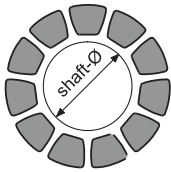
Thrust Bearing Configuration Table



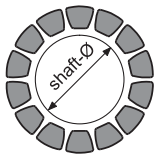
Series 6



Series 8



Series 11



Series 14

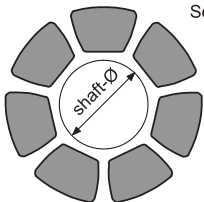
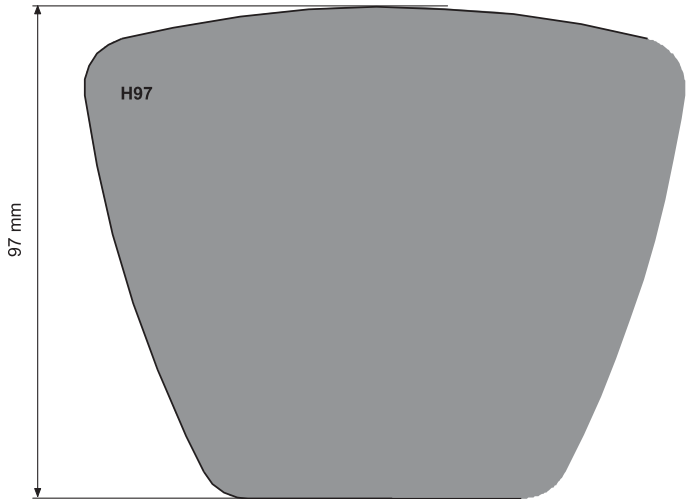
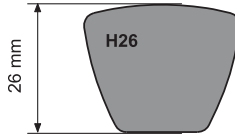
reduced
power loss

high load

Available pad sizes:

- H12
- H14
- H17
- H20
- H23
- H26
- H28
- H31
- H34
- H37
- H40
- H44
- H48
- H52
- H57
- H61
- H68
- H74
- H81
- H89
- H97
- H105
- H115
- H125
- H136

dimension examples



Heavy Load
Series 7

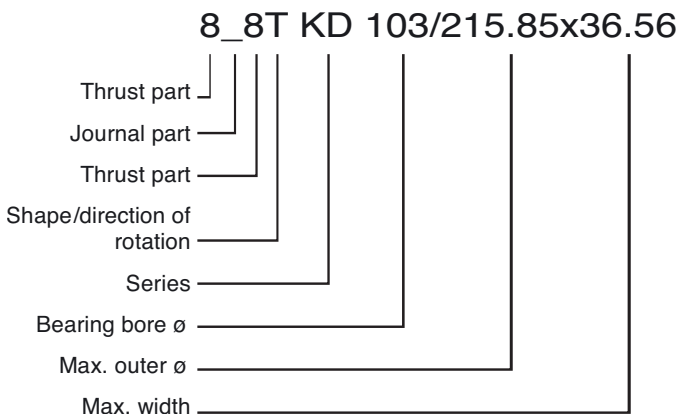
pad sizes:

- H26s
- H31s
- H37s
- H44s
- H52s
- H57s
- H68s
- H74s
- H89s
- H97s

Pads in special design for high loads.
Fits into common US envelope
dimensions.

Reference Codes For Ordering

In order to provide clear identification, the products are coded as follows:



Examples of John Crane bearing reference codes

1. Reference code **_K_T S6 50/110x52.2**

Tilting pad journal bearing with five journal pads, split design for both directions of rotation, Series 6 catalogue type with L/D = 0.6, bearing bore diameter $\varnothing 50$ mm, max. external diameter $\varnothing 110$ mm, max. bearing width 52.2 mm.

2. Reference code **8_8T KD 103/215.85x36.56 (or 8_8T KD H44)**

Double tilting pad thrust bearing, Series 8 catalogue type with 8 thrust pads, split design for both directions of rotation, directed lubrication with spacer and shims, inner diameter $\varnothing 103$ mm, outer diameter $\varnothing 215.85$ mm, bearing width 36.56 mm (including spacers and shims), thrust pad size H44.

3. Reference code **8__R DM 148/301.63x61 (or 8__R DM H61)**

Self equalising single tilting pad thrust bearing, Series 8 catalogue type, unsplit design for one direction of rotation, self equalising with directed lubrication, inner diameter $\varnothing 148$ mm, outer diameter $\varnothing 301.63$ mm, bearing width 61 mm, thrust pad size H61, spacer optional.

4. Reference code **8M8T SL 70/150x69**

Combined bearing with 4-lobe journal bearing and double tilting pad thrust bearing, split design for both directions of rotation, none catalogue type, inner diameter $\varnothing 70$ mm, outer diameter $\varnothing 150$ mm, bearing width 69 mm.

5. Reference code **_H_S SD 300/410x310**

Offset-Half journal bearing, split design for one direction of rotation, catalogue type, inner diameter $\varnothing 300$ mm, outer diameter 410 mm, bearing width $\varnothing 310$ mm.

The individual parts of the reference codes are explained in more detail below.

Thrust parts

- _ = No thrust part
- 3 = 3 Thrust tilting pad
- 4 = 4 Thrust tilting pad
- 5 = 5 Thrust tilting pad
- 6 = 6 Thrust tilting pad
- 7 = 7 Thrust tilting pad
- 8 = 8 Thrust tilting pad
- A = 10 Thrust tilting pad
- B = 11 Thrust tilting pad
- C = 12 Thrust tilting pad
- D = 14 Thrust tilting pad
- E = 16 Thrust tilting pad
- F = 18 Thrust tilting pad
- M = Taper land thrust
- N = Stop collar

Journal part

- _ = No journal part
- 3 = 3 Journal tilting pad
- 4 = 4 Journal tilting pad
- D = 3 Hydrodynamic surfaces
- H = 2 Hydrodynamic surfaces (offset half)
- K = 5 Journal tilting pad
- L = 2 Hydrodynamic surfaces (lemon-bore)
- M = 4 Hydrodynamic surfaces
- Y = ZYBLO bearing
- Z = Cylindrical bearings

Shape/direction of rotation

- A = Unsplit, spherical seating, rotation in both directions
- B = Unsplit, rotation in both directions
- C = Unsplit, spherical seating, right-hand rotation
- D = Split, spherical seating, rotation in both directions
- E = Split, spherical seating, left-hand rotation
- F = Split, spherical seating, right-hand rotation
- K = Unsplit, spherical seating, left-hand rotation
- L = Unsplit, left-hand rotation
- R = Unsplit, right-hand rotation
- S = Split, right-hand rotation
- T = Split, rotation in both directions
- U = Split, left-hand rotation

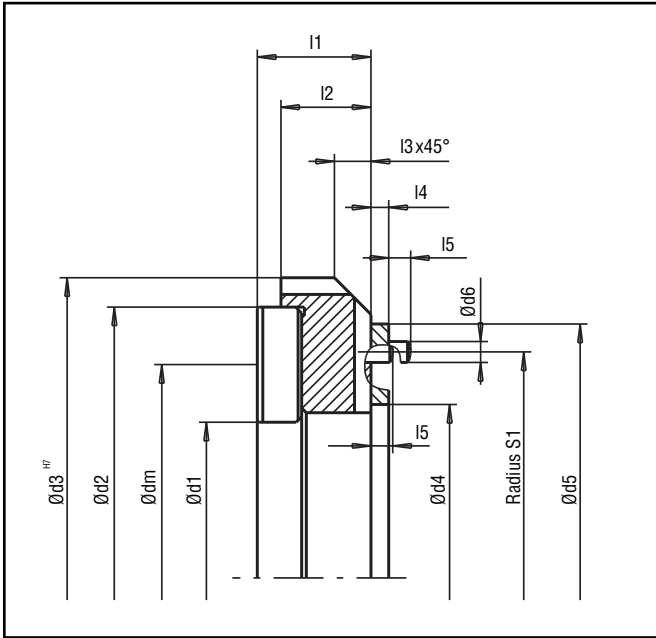
Series/product line

These parameters are assigned to specific product lines. In some of the scale drawings in the catalogues, the appropriate product type parameters have already been assigned.

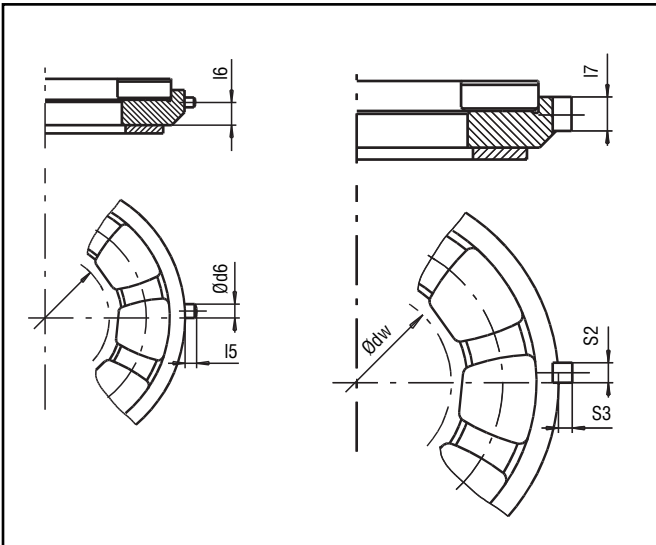


TILTING PAD THRUST BEARINGS

Flooded Lubrication, Series 6, Carrier Ring Split Or Unsplit



Size	d1	d2	d3	l1	l4
H12					
H14					
H17	25.49	60.08	71.41	15.89	3.20
H20	29.88	70.58	82.51	17.47	3.20
H23	36.19	84.43	98.39	19.06	3.20
H26	39.03	91.94	107.91	20.65	4.80
H28	42.94	99.93	115.85	22.24	4.80
H31	47.33	110.42	126.96	23.82	4.80
H34	50.98	120.17	139.66	25.41	4.80
H37	55.37	130.66	147.60	27.00	4.80
H40	60.50	141.90	165.06	28.59	4.80
H44	65.36	154.90	179.35	31.76	4.80
H48	71.71	169.39	193.63	34.94	6.40
H52	78.79	184.62	209.50	38.11	6.40
H57	85.05	202.56	228.55	41.29	6.40
H61	92.66	219.83	247.60	44.46	6.40
H68	101.22	239.59	266.64	47.64	6.40
H74	110.74	261.32	292.04	50.81	6.40
H81	120.73	285.56	317.44	57.16	6.40
H89	128.99	310.06	342.84	60.34	6.40
H97	140.94	338.29	371.42	66.70	9.50



All other dimensions available on request

Definition of type

- KA** with spacer
- KB** with spacer and shims
(shim thickness: 1+0.2 mm; 2+0.15 mm)
- KE** without spacer

Definition of direction

- | carrier ring split | | carrier ring unsplit |
|--------------------|----------------|----------------------|
| S | clockwise | R |
| T | bidirectional | B |
| U | anti clockwise | L |

Order example

- 6 - T KE H34
- Pad size
 - Type
 - Direction of rotation

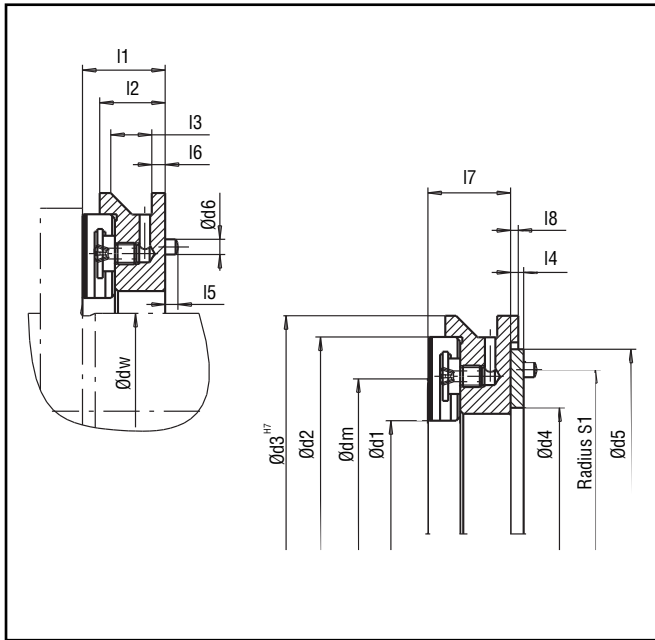
Standard KA, KB and KE

- Materials Carrier ring: C 15
- Tilting pads: C 15
- Bearing metal: Tegostar 738



TILTING PAD THRUST BEARINGS

Directed Lubrication, Series 6, Carrier Ring Split Or Unsplit



Size	d1	d2	d3	I1	I4	L7
H12						
H14						
H17	25.49	60.08	71.41	18.09	3.20	15.89
H20	29.88	70.58	82.51	19.67	3.20	17.47
H23	36.19	84.43	98.39	21.26	3.20	19.06
H26	39.03	91.94	107.91	23.95	4.80	20.65
H28	42.94	99.93	115.85	25.54	4.80	22.24
H31	47.33	110.42	126.96	27.12	4.80	23.82
H34	40.98	120.17	139.66	28.71	4.80	25.41
H37	55.37	130.66	147.60	30.30	4.80	27.00
H40	60.50	141.90	165.06	31.89	4.80	28.59
H44	65.36	154.90	179.35	35.06	4.80	31.76
H48	71.71	169.39	193.63	38.94	6.40	34.94
H52	78.79	184.62	209.50	42.11	6.40	38.11
H57	85.05	202.56	228.55	45.29	6.40	41.29
H61	92.66	219.83	247.60	48.46	6.40	44.46
H68	101.22	239.59	266.64	51.64	6.40	47.64
H74	110.74	261.32	292.04	54.81	6.40	50.81
H81	120.73	285.56	317.44	61.16	6.40	57.16
H89	128.99	310.06	342.84	64.34	6.40	60.34
H97	140.94	338.29	371.42	73.70	9.50	66.70

Standard KC, KD and KF

Materials Carrier ring: C 15
 Tilting pads: C 15
 Bearing metal: Tegostar 738

Total Thrust Surface

Size	Total Thrust Surface (mm ²)
H12	870
H14	1188
H17	1752
H20	2418
H23	3486
H26	4092
H28	4758
H31	5826
H34	6996
H37	8292
H40	9690
H44	11610
H48	13944
H52	16386
H57	19866
H61	23670
H68	27984
H74	33156
H81	39726
H89	47904
H97	56904

All other dimensions available on request

Definition of type

KC	with spacer
KD	with spacer and shims (shim thickness: 1+0.2 mm; 2+0.15 mm)
KF	without spacer

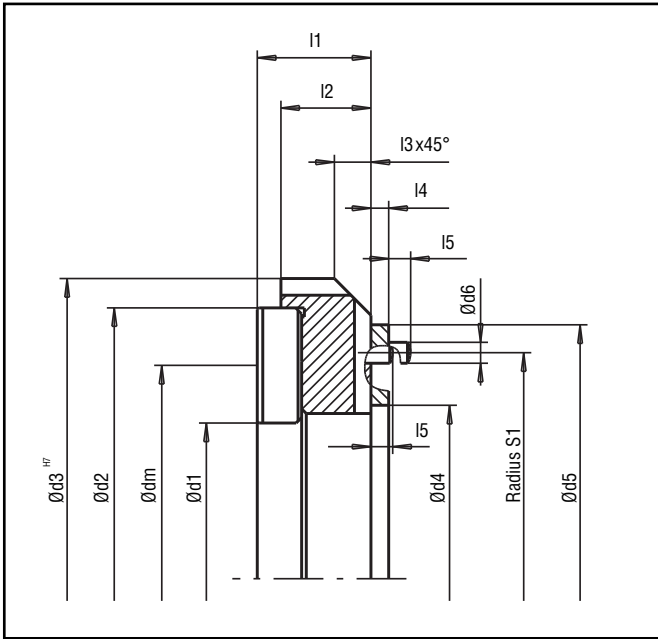
Definition of direction

carrier ring split		carrier ring unsplit
S	clockwise	R
T	bidirectional	B
U	anti clockwise	L

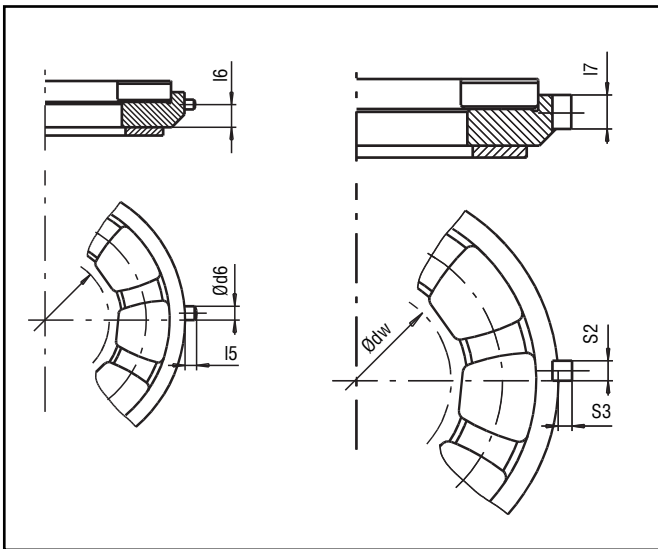
Order example



Flooded Lubrication, Series 8, Carrier Ring Split Or Unsplit



Size	d1	d2	d3	l1	l4
H12	28.5	52.5		12.71	3.2
H14	33.5	62.0	73.00	14.30	3.2
H17	39.5	74.5	85.69	15.89	3.2
H20	47.5	87.5	101.56	17.47	3.2
H23	55.5	105.0	120.61	19.06	3.2
H26	62.5	114.0	130.14	20.65	4.8
H28	66.5	124.0	139.66	22.24	4.8
H31	73.0	137.0	152.36	23.82	4.8
H34	79.5	149.0	168.24	25.41	4.8
H37	87.5	162.0	180.91	27.00	4.8
H40	93.5	176.0	196.80	28.59	4.8
H44	103.0	192.0	215.85	31.76	4.8
H48	113.0	210.0	234.90	34.94	6.4
H52	122.0	229.0	253.94	38.11	6.4
H57	135.0	251.0	279.34	41.29	6.4
H61	148.0	273.0	301.57	44.46	6.4
H68	159.0	297.0	323.79	47.64	6.4
H74	175.0	324.0	355.54	50.81	9.5
H81	191.0	354.0	384.12	57.16	9.5
H89	204.0	384.0	415.86	60.34	9.5
H97	223.0	419.0	453.96	66.70	9.5



All other dimensions available on request

Definition of type

- KA** with spacer
- KB** with spacer and shims
(shim thickness: 1+0.2 mm; 2+0.15 mm)
- KE** without spacer

Definition of direction

- | carrier ring split | | carrier ring unsplit |
|--------------------|----------------|----------------------|
| S | clockwise | R |
| T | bidirectional | B |
| U | anti clockwise | L |

Order example

- 8 - U KE H37
- Pad size
 - Type
 - Direction of rotation

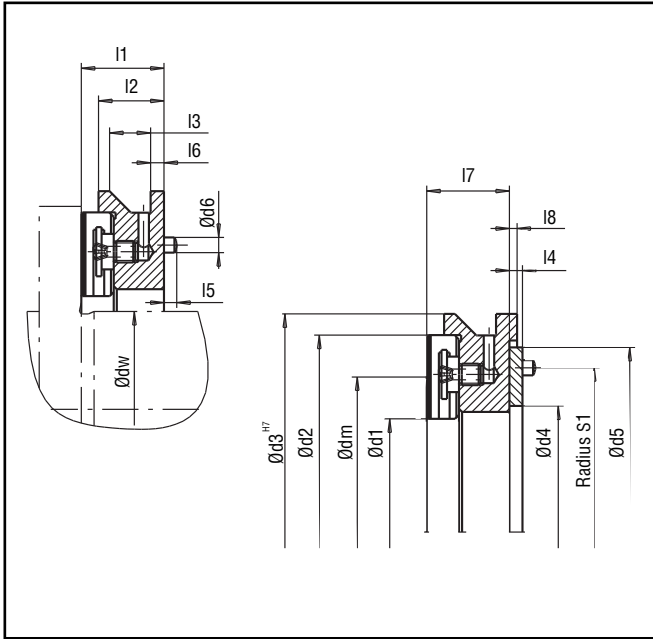
Standard KA, KB and KE

Materials Carrier ring: C 15
 Tilting pads: C 15
 Bearing metal: Tegostar 738



TILTING PAD THRUST BEARINGS

Directed Lubrication, Series 8, Carrier Ring Split Or Unsplit



Size	d1	d2	d3	l1	l4	l7
H12	28.5	52.5			3.2	12.71
H14	33.5	62.0	73.00	16.50	3.2	14.30
H17	39.5	74.5	85.69	18.09	3.2	15.89
H20	47.5	87.5	101.56	19.67	3.2	17.47
H23	55.5	105.0	120.61	21.26	3.2	19.06
H26	62.5	114.0	130.14	23.95	4.8	20.65
H28	66.5	124.0	139.66	25.54	4.8	22.24
H31	73.0	137.0	152.36	27.12	4.8	23.82
H34	79.5	149.0	168.24	28.71	4.8	25.41
H37	87.5	162.0	180.91	30.30	4.8	27.00
H40	93.5	176.0	196.80	31.89	4.8	28.56
H44	103.0	192.0	215.85	35.06	4.8	31.76
H48	113.0	210.0	234.90	38.94	6.4	34.94
H52	122.0	229.0	253.94	42.11	6.4	38.11
H57	135.0	251.0	279.34	45.29	6.4	41.29
H61	148.0	273.0	301.57	48.46	6.4	44.46
H68	159.0	297.0	323.79	51.64	6.4	47.64
H74	175.0	324.0	355.54	57.81	9.5	50.81
H81	191.0	354.0	384.12	64.16	9.5	57.16
H89	204.0	384.0	415.86	67.35	9.5	60.34
H97	223.0	419.0	453.96	73.70	9.5	66.70

Standard KC, KD and KF

Materials Carrier ring: C 15
 Tilting pads: C 15
 Bearing metal: Tegostar 738

Total Thrust Surface

Size	Total Thrust Surface (mm ²)
H12	1160
H14	1584
H17	2336
H20	3224
H23	4624
H26	5456
H28	6344
H31	7768
H34	9328
H37	11056
H40	12920
H44	15624
H48	18592
H52	21848
H57	26488
H61	31560
H68	37312
H74	44208
H81	52968
H89	63872
H97	75872

All other dimensions available on request

Definition of type

KC with spacer
KD with spacer and shims
 (shim thickness: 1+0.2 mm; 2+0.15 mm)
KF without spacer

Definition of direction

carrier ring split		carrier ring unsplit
S	clockwise	R
T	bidirectional	B
U	anti clockwise	L

Order example

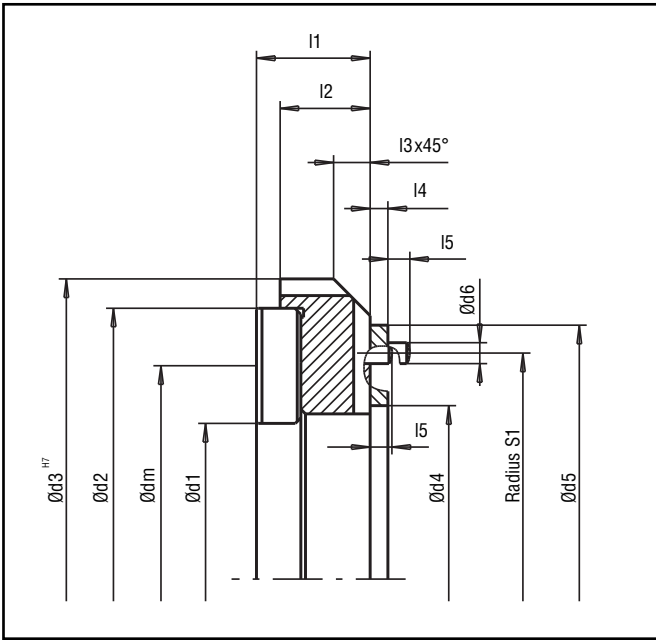
8 - T KC H68

8: Direction of rotation
 T: Type
 KC: Pad size
 H68: Direction of rotation

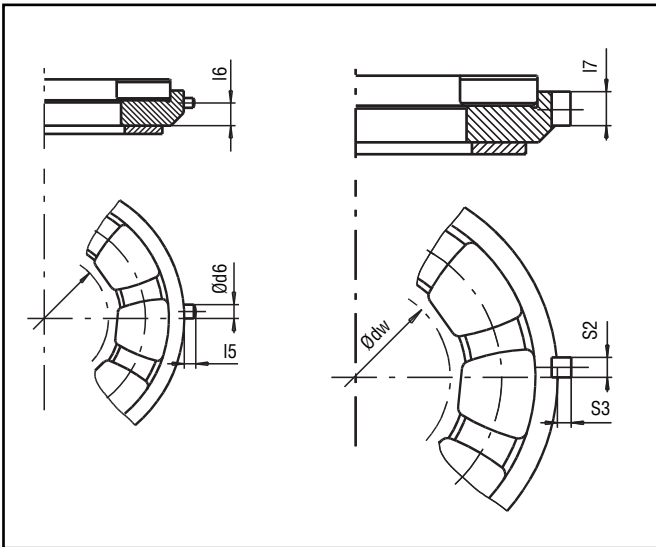


TILTING PAD THRUST BEARINGS

Flooded Lubrication, Series 11, Carrier Ring Split Or Unsplit



Size	d1	d2	d3	l1	l4
H12	43.87	67.87		12.71	3.20
H14	52.21	80.21	92.40	14.30	3.20
H17	62.31	96.31	111.09	15.89	3.20
H20	73.11	113.11	130.14	17.47	3.20
H23	88.71	136.11	152.36	20.65	4.80
H26	95.39	147.39	168.24	22.24	4.80
H28	104.43	160.43	180.93	23.82	4.80
H31	115.22	177.22	196.80	25.41	4.80
H34	124.63	192.63	212.68	27.00	4.80
H37	135.43	209.43	234.90	28.59	6.40
H40	147.60	227.60	253.94	30.17	6.40
H44	160.15	248.15	279.34	31.76	6.40
H48	175.47	271.47	301.57	34.94	6.40
H52	192.16	296.16	323.79	38.11	6.40
H57	208.82	324.32	355.54	41.29	9.50
H61	228.44	353.44	384.12	44.46	9.50
H68	247.89	383.89	415.86	47.64	9.50
H74	270.86	418.86	453.96	50.81	9.50
H81	295.58	457.58	495.23	57.16	9.50
H89	317.93	495.93	539.67	60.34	9.50
H97	347.17	541.17	584.12	66.70	9.50



All other dimensions available on request

Definition of type

- KA** with spacer
- KB** with spacer and shims
(shim thickness: 1+0.2 mm; 2+0.15 mm)
- KE** without spacer

Definition of direction

- | carrier ring split | | carrier ring unsplit |
|--------------------|----------------|----------------------|
| S | clockwise | R |
| T | bidirectional | B |
| U | anti clockwise | L |

Order example

- B** — **U** **KE** **H23**
- Pad size
 - Type
 - Direction of rotation

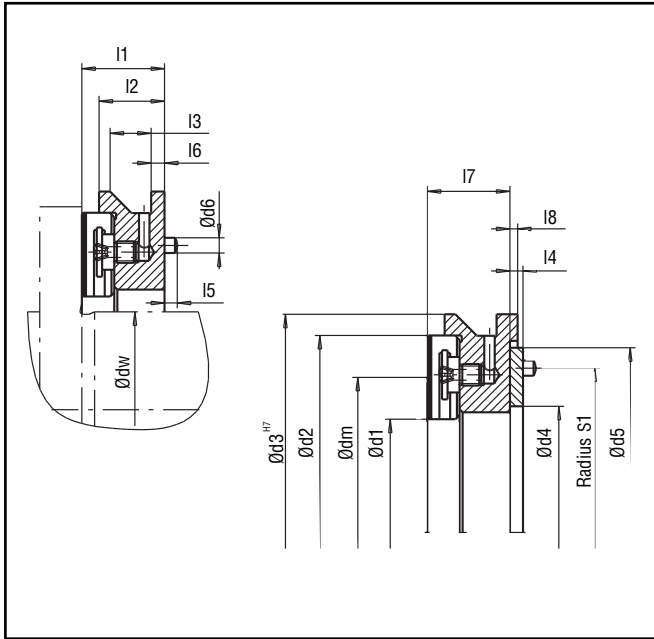
Standard KA, KB and KE

Materials Carrier ring: C 15
 Tilting pads: C 15
 Bearing metal: Tegostar 738



TILTING PAD THRUST BEARINGS

Directed Lubrication, Series 11, Carrier Ring Split Or Unsplit



Size	d1	d2	d3	I1	I4	L7
H12	43.87	67.87			3.20	12.71
H14	52.21	80.21	92.40	16.50	3.20	14.30
H17	62.31	96.31	111.09	18.09	3.20	15.89
H20	73.11	113.11	130.14	19.67	3.20	17.47
H23	88.71	136.11	152.36	23.95	4.80	20.65
H26	95.39	147.39	168.24	25.54	4.80	22.24
H28	104.43	160.43	180.93	27.12	4.80	23.82
H31	115.22	177.22	196.80	28.71	4.80	25.41
H34	124.63	192.63	212.68	30.30	4.80	27.00
H37	135.43	209.43	234.90	32.59	6.40	28.59
H40	147.60	227.60	253.94	34.17	6.40	30.17
H44	160.15	248.15	279.34	35.76	6.40	31.17
H48	175.47	271.47	301.57	38.94	6.40	34.94
H52	192.16	296.16	323.79	42.11	6.40	38.11
H57	208.82	324.32	355.54	48.29	9.50	41.29
H61	228.44	353.44	384.12	51.46	9.50	44.46
H68	247.89	383.89	415.86	54.64	9.50	47.64
H74	270.86	418.86	453.96	57.81	9.50	50.81
H81	295.58	457.58	495.23	64.16	9.50	57.16
H89	317.93	495.93	539.67	67.35	9.50	60.34
H97	347.17	541.17	584.12	73.70	9.50	66.70

Standard KC, KD and KF

Materials Carrier ring: C 15
 Tilting pads: C 15
 Bearing metal: Tegostar 738

Total Thrust Surface

Size	Total Thrust Surface (mm ²)
H12	1595
H14	2178
H17	3212
H20	4433
H23	6358
H26	7502
H28	8723
H31	10681
H34	12826
H37	15202
H40	17765
H44	21483
H48	25564
H52	30041
H57	36421
H61	43395
H68	51304
H74	60786
H81	72831
H89	87824
H97	104324

All other dimensions available on request

Definition of type

KC with spacer
KD with spacer and shims
 (shim thickness: 1+0.2 mm; 2+0.15 mm)
KF without spacer

Definition of direction

carrier ring split		carrier ring unsplit
S	clockwise	R
T	bidirectional	B
U	anti clockwise	L

Order example

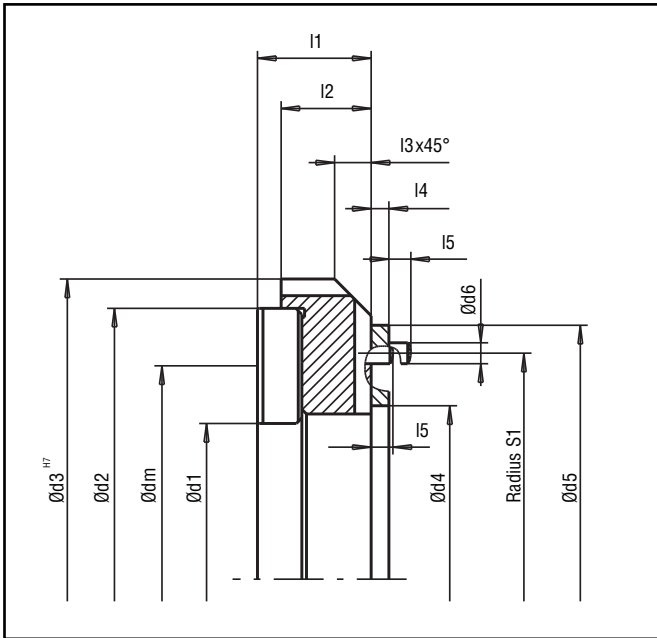
B — **U** **KF** **H17**

— Pad size
 — Type
 — Direction of rotation

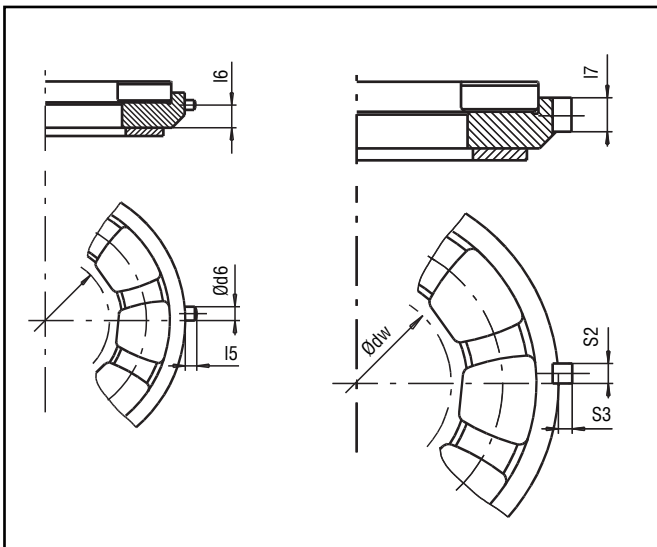


TILTING PAD THRUST BEARINGS

Flooded Lubrication, Series 14, Carrier Ring Split Or Unsplit



Size	d1	d2	d3	l1	l4
H12	58.99	82.99		12.71	3.20
H14	70.13	98.13	111.90	14.30	3.20
H17	83.78	117.78	130.14	15.89	3.20
H20	98.31	138.31	152.36	19.06	4.80
H23	119.33	166.73	184.10	20.65	4.80
H26	128.24	180.24	199.98	22.24	4.80
H28	140.27	196.27	219.03	23.82	4.80
H31	154.79	216.79	238.08	25.41	4.80
H34	167.57	235.57	260.29	27.00	6.40
H37	182.09	256.09	282.52	28.59	6.40
H40	198.38	278.38	307.92	31.76	6.40
H44	215.41	303.41	322.32	34.94	6.40
H48	235.95	331.95	361.89	38.11	6.40
H52	258.24	362.24	393.64	41.29	9.50
H57	280.97	396.47	425.38	44.46	9.50
H61	307.59	432.59	463.48	47.64	9.50
H68	333.39	469.39	501.57	50.81	9.50
H74	364.19	512.19	546.02	53.99	9.50
H81	397.51	559.51	596.82	60.35	9.50
H89	428.07	606.07	647.62	66.70	9.50
H97					



All other dimensions available on request

Definition of type

- KA** with spacer
- KB** with spacer and shims
(shim thickness: 1+0.2 mm; 2+0.15 mm)
- KE** without spacer

Definition of direction

- | carrier ring split | | carrier ring unsplit |
|--------------------|----------------|----------------------|
| S | clockwise | R |
| T | bidirectional | B |
| U | anti clockwise | L |

Order example

- D** - **T** **KB** **H37**
- Pad size
 - Type
 - Direction of rotation

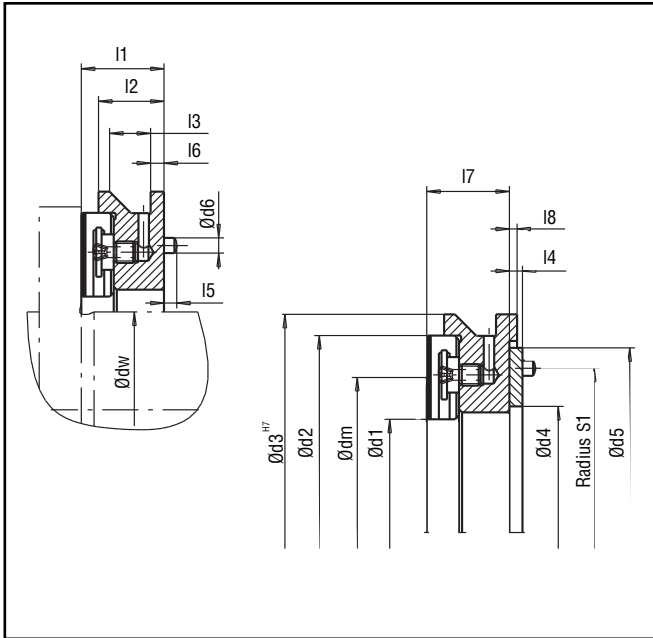
Standard KA, KB and KE

- Materials Carrier ring: C 15
- Tilting pads: C 15
- Bearing metal: Tegostar 738



TILTING PAD THRUST BEARINGS

Directed Lubrication, Series 14, Carrier Ring Split Or Unsplit



Size	d1	d2	d3	l1	l4	L7
H12	58.99	82.99			3.20	12.71
H14	70.13	98.13	111.90	16.50	3.20	14.30
H17	83.78	117.78	130.14	18.09	3.20	15.89
H20	98.31	138.31	152.36	22.36	4.80	19.06
H23	119.33	166.73	184.10	23.95	4.80	20.65
H26	128.24	180.24	199.98	25.54	4.80	22.24
H28	140.27	196.27	219.03	27.12	4.80	23.82
H31	154.79	216.79	238.08	28.71	4.80	25.41
H34	167.57	235.57	260.29	31.00	6.40	27.00
H37	182.09	256.09	282.52	32.59	6.40	28.59
H40	198.38	278.38	307.92	35.76	6.40	30.17
H44	215.41	303.41	322.32	38.94	6.40	34.94
H48	235.95	331.95	361.89	42.11	6.40	38.11
H52	258.24	362.24	393.64	48.29	9.50	41.29
H57	280.97	396.47	425.38	51.46	9.50	44.46
H61	307.59	432.59	463.48	54.64	9.50	47.64
H68	333.39	469.39	501.57	57.81	9.50	50.81
H74	364.19	512.19	546.02	60.99	9.50	53.99
H81	397.51	559.51	596.82	67.35	9.50	60.34
H89	428.07	606.07	647.62	73.70	9.50	66.70
H97						

Standard KC, KD and KF

Materials Carrier ring: C 15
 Tilting pads: C 15
 Bearing metal: Tegostar 738

Total Thrust Surface

Size	Total Thrust Surface (mm ²)
H12	2030
H14	2772
H17	4088
H20	5642
H23	8092
H26	9548
H28	11102
H31	13594
H34	16324
H37	19348
H40	22610
H44	27342
H48	32536
H52	38234
H57	46354
H61	55230
H68	65296
H74	77364
H81	92694
H89	111776

All other dimensions available on request

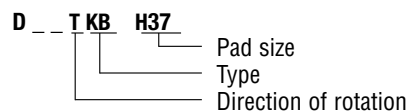
Definition of type

KC	with spacer
KD	with spacer and shims (shim thickness: 1+0.2 mm; 2+0.15 mm)
KF	without spacer

Definition of direction

carrier ring split		carrier ring unsplit
S	clockwise	R
T	bidirectional	B
U	anti clockwise	L

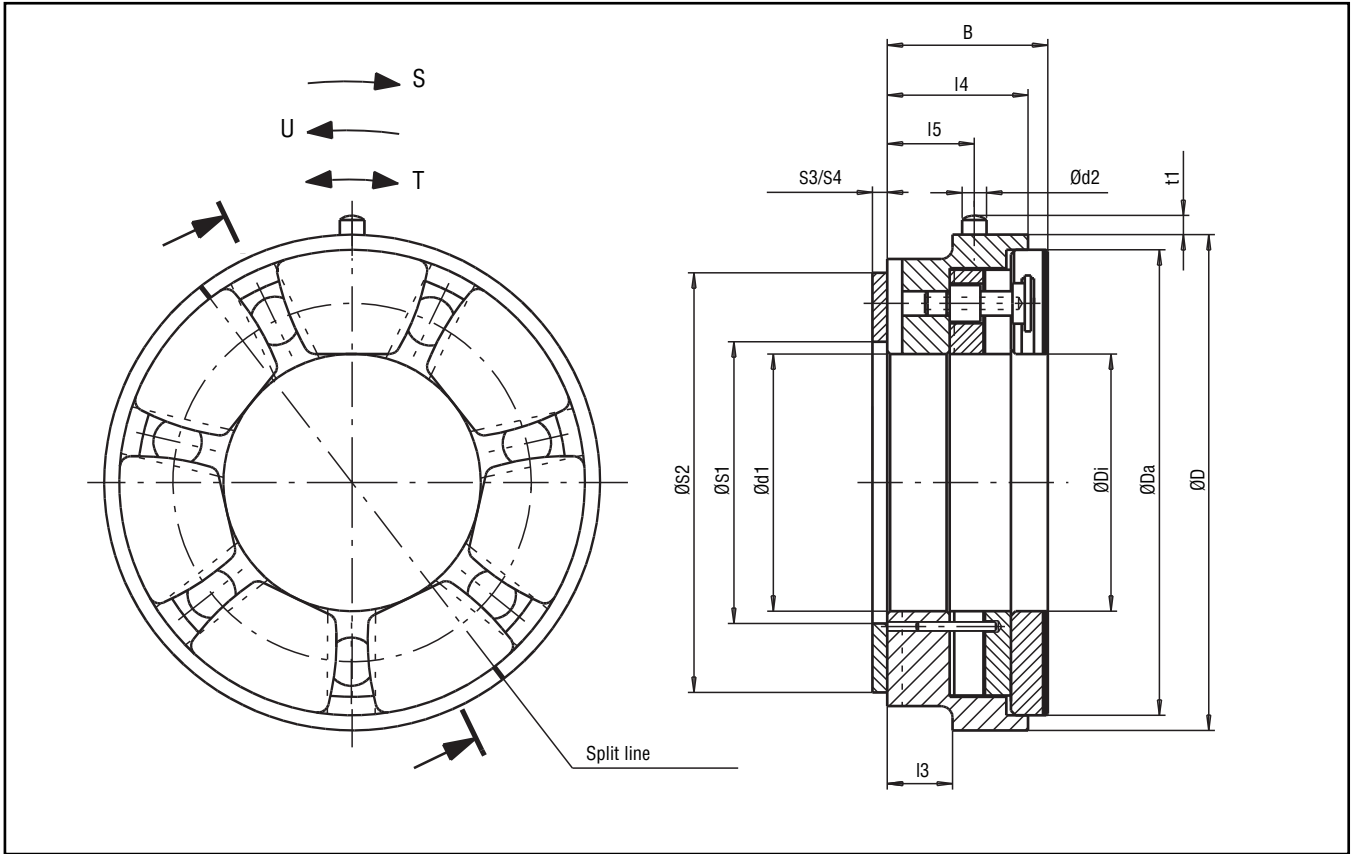
Order example





TILTING PAD THRUST BEARINGS

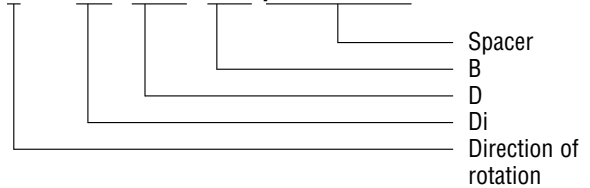
Self Equalising, Split, Series 7, Flooded Lubrication



Size	Di	Da	D h7	S1	S2	S3	S4	B h9	d1	d2	l3	l4	l5	t1	Total Thrust Surface (mm ²)
H26S	51.0	100.0	111.09	60	92	4.8	6.4	36.5	53	4.8	9.5	32.0	22	3.2	4642
H31S	64.5	127.0	136.48	76	114	4.8	6.4	44.5	68	6.4	15.5	39.5	27	4.0	7715
H37S	77.5	152.0	161.88	92	137	4.8	6.4	52.4	82	7.9	16.0	46.0	32	4.8	11116
H44S	89.2	178.0	187.27	108	159	4.8	6.4	60.3	95	7.9	19.0	52.0	38	4.8	15052
H52S	102.0	201.8	212.67	122	183	6.4	8.7	68.3	109	9.5	22.0	59.0	43	4.8	19191
H57S	112.3	227.8	238.07	140	203	6.4	8.7	76.2	124	11.1	29.0	66.0	46	4.8	24938
H68S	129.6	265.6	279.34	162	238	6.4	8.7	85.7	144	12.7	32.0	73.0	51	5.6	33892
H74S	156.0	305.0	317.44	187	270	6.4	8.7	95.3	165	14.3	35.0	81.0	57	5.6	44676
H89S	163.3	343.0	355.54	210	305	9.5	12.7	107.9	186	15.9	38.0	91.0	67	6.4	55985
H97S	185.3	381.0	393.64	233	338	9.5	12.7	117.5	206	17.5	41.0	98.0	73	7.9	69525

Order example

7 _ _ T QF 77.5/161.88x52.4 + Spacer S3

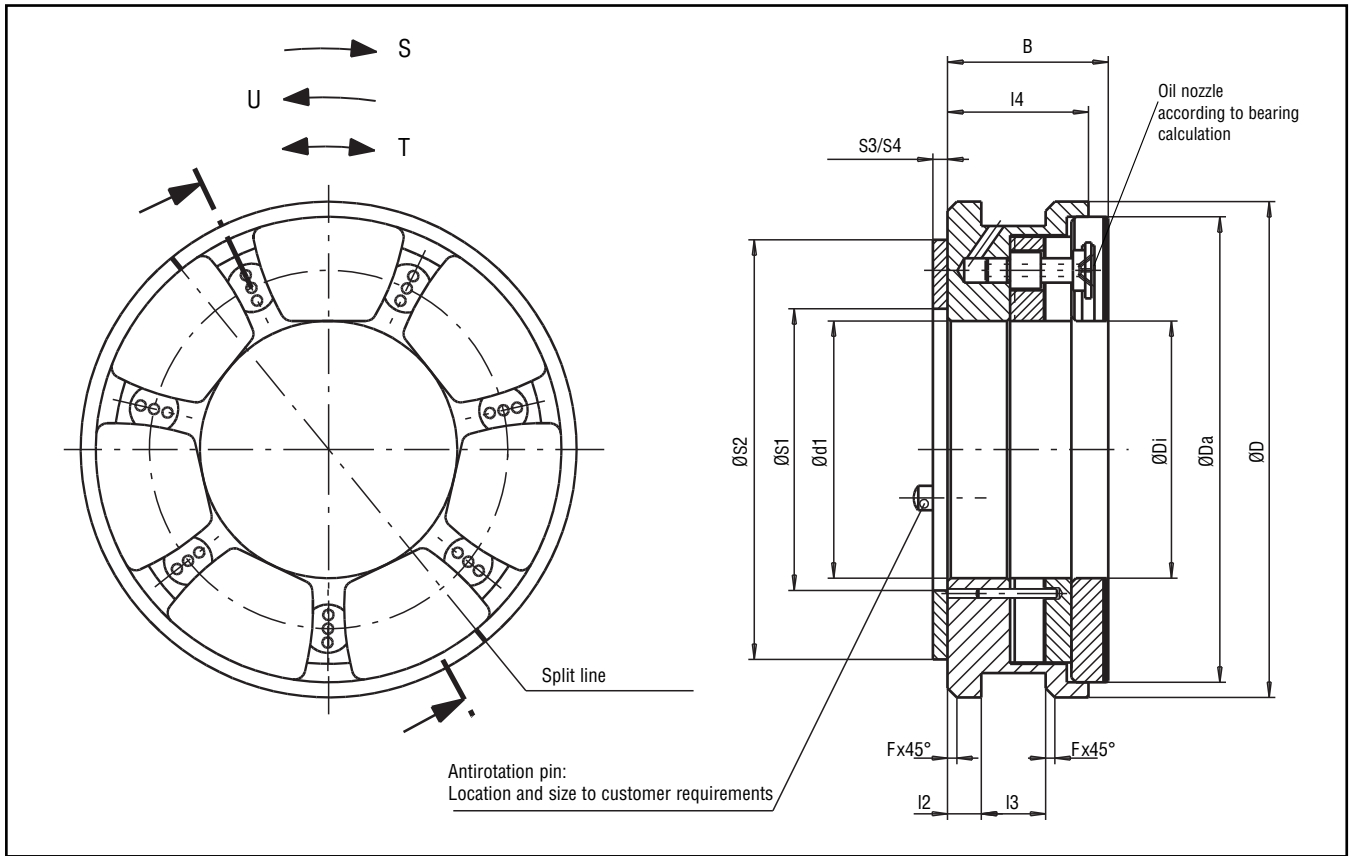


Materials Carrier ring: C15
 Spacer: C15
 Tilting pads: C15/Tegostar738
 Equalising segments: 42CrMo4



TILTING PAD THRUST BEARINGS

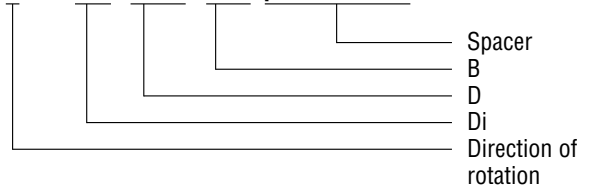
Self Equalising, Split, Series 7, Directed Lubrication



Size	Di	Da	D h7	S1	S2	S3	S4	B h9	d1	I2	I3	I4	F	Total Thrust Surface (mm ²)
H26S	51.0	100.0	111.09	60	92	4.8	6.4	36.5	53	6	14	32.0	3	4642
H31S	64.5	127.0	136.48	76	114	4.8	6.4	44.5	68	8	18	39.5	3	7715
H37S	77.5	152.0	161.88	92	137	4.8	6.4	52.4	82	11	21	46.0	3	11116
H44S	89.2	178.0	187.27	108	159	4.8	6.4	60.3	95	13	22	52.0	5	15052
H52S	102.0	201.8	212.67	122	183	6.4	8.7	68.3	109	14	26	59.0	5	19191
H57S	112.3	227.8	238.07	140	203	6.4	8.7	76.2	124	18	28	66.0	5	24938
H68S	129.6	265.6	279.34	162	238	6.4	8.7	85.7	144	20	30	73.0	5	33892
H74S	156.0	305.0	317.44	187	270	6.4	8.7	95.3	165	22	34	81.0	6	44676
H89S	163.3	343.0	355.54	210	305	9.5	12.7	107.9	186	25	39	91.0	6	55985
H97S	185.3	381.0	393.64	233	338	9.5	12.7	117.5	206	27	41	98.0	8	69525

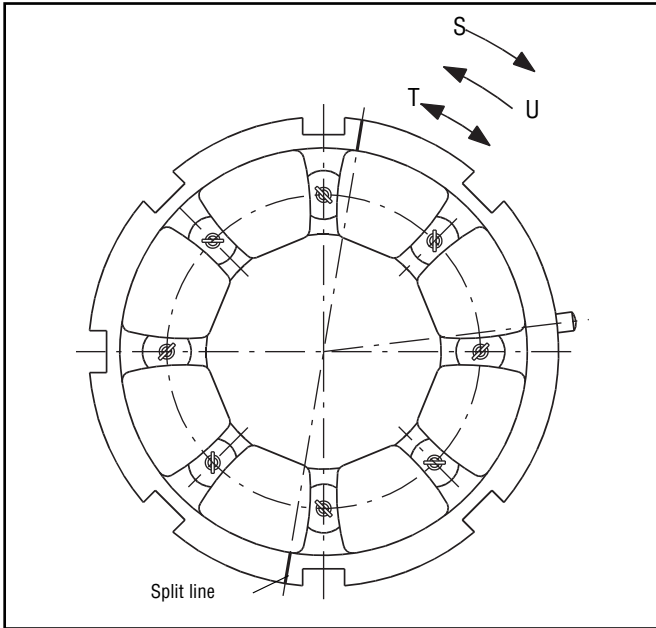
Order example

7 _ _ T QD 77.5/16188x52.4 + Spacer S3

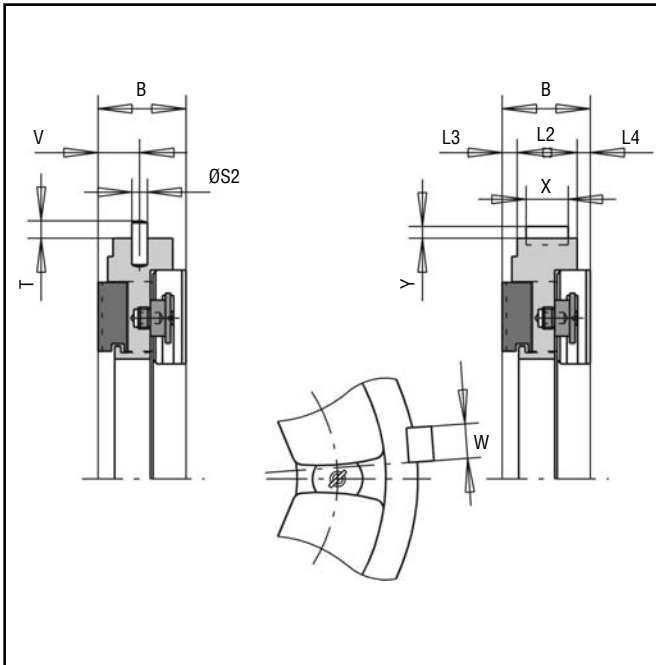


Materials Carrier ring: C15
 Spacer: C15
 Tilting pads: C15/Tegostar738
 Equalising segments: 42CrMo4

Self Equalising, Split, Flooded Lubrication, Standard DN, Series 8

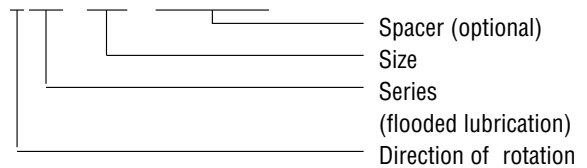


Size	Total Thrust Surface (mm ²)	S2	V	W	X	Y
H23	4283	4.8	11.0			
H26	5453	6.4	12.5			
H28	6333	6.4	13.5			
H31	7757	6.4	15.0			
H34	9322	7.9	16.5			
H37	11047	7.9	18.0			
H40	12911	7.9	19.8			
H44	15616	9.5	20.5			
H48	18583	9.5	22.5			
H52	21834	11.1	25.0			
H57	26242	12.7	28.0			
H61	30083			15.9	25.4	5.6
H68	37297			15.9	28.6	5.6
H74	44186			15.9	28.6	5.6
H81	52945			15.9	31.8	5.6
H89	63848			19.1	31.8	6.4
H97	75840			19.1	38.1	6.4
H105	90391			19.1	38.1	6.4
H115	107755			22.2	44.5	8.0
H125	127197			22.2	44.5	8.0
H136	160239			22.2	50.8	8.0



Order example

8 _ _ T DN H34 + Spacer



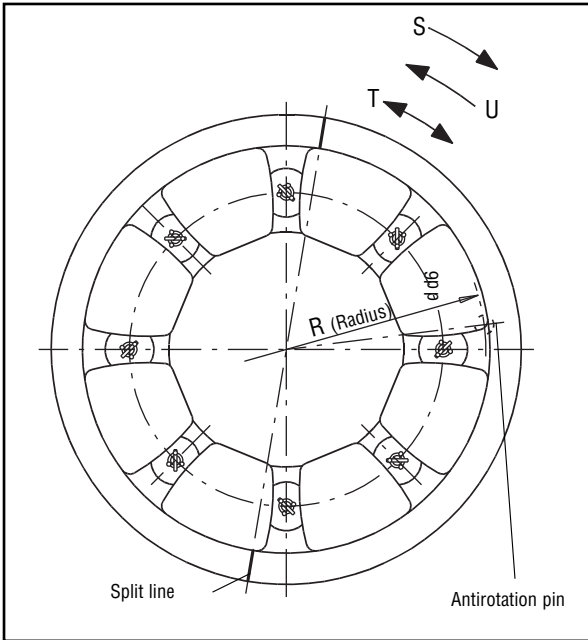
Standard DN

Materials Carrier ring: C15
 Spacer: C15
 Tilting pads: C15/Tegostar738
 Equalising segments: 42CrMo4

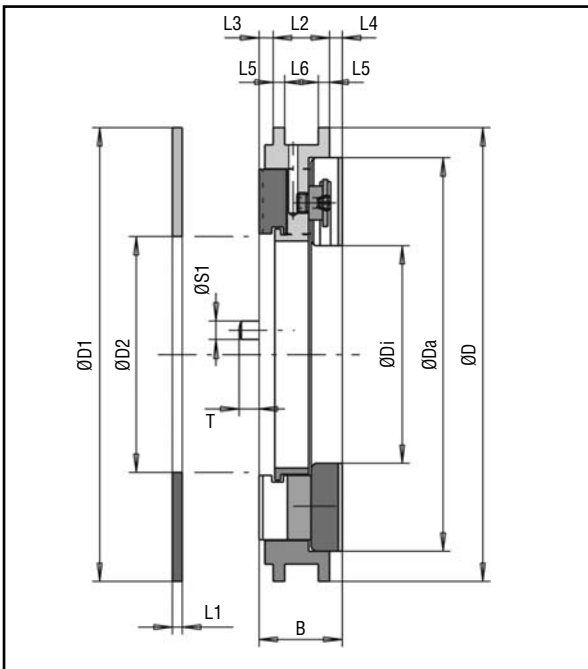


TILTING PAD THRUST BEARINGS

Self Equalising, Split, Directed Lubrication, Standard DM, Series 8



Size	Di	Da	D g7	B h9	D1	D2	L1	L2
H23	57.6	105.0	120.65	23.5	120.1	64	3.2	14.0
H26	62.0	114.0	130.18	25.5	129.6	66	4.8	15.0
H28	68.0	124.0	139.70	28.0	139.2	73	4.8	17.0
H31	75.0	137.0	152.40	30.0	151.9	83	4.8	17.5
H34	81.0	149.0	168.28	34.0	167.7	90	4.8	20.5
H37	88.0	162.0	180.96	36.0	180.4	97	4.8	21.5
H40	96.0	176.0	196.85	41.0	196.3	106	4.8	25.0
H44	104.0	192.0	215.90	43.0	215.4	114	4.8	27.0
H48	114.0	210.0	234.95	46.0	234.4	126	6.4	29.0
H52	125.0	229.0	254.00	52.0	253.5	135	6.4	32.0
H57	135.5	251.0	279.40	56.0	278.9	151	6.4	34.0
H61	148.0	273.0	301.63	61.0	301.1	164	6.4	37.0
H68	161.0	297.0	323.85	65.0	323.2	178	6.4	40.0
H74	176.0	324.0	355.60	68.0	355.0	190	9.5	42.0
H81	192.0	354.0	384.18	76.0	383.5	209	9.5	46.0
H89	206.0	384.0	415.93	80.0	415.3	225	9.5	48.0
H97	225.0	419.0	454.03	88.0	453.4	244	9.5	51.0
H105	247.0	457.0	495.30	95.0	494.7	268	9.5	55.0
H115	272.0	502.0	539.75	102.0	539.0	295	12.7	58.0
H125	296.0	546.0	584.20	110.0	583.5	320	12.7	60.0
H136	325.0	597.0	641.35	121.0	640.6	348	12.7	63.0



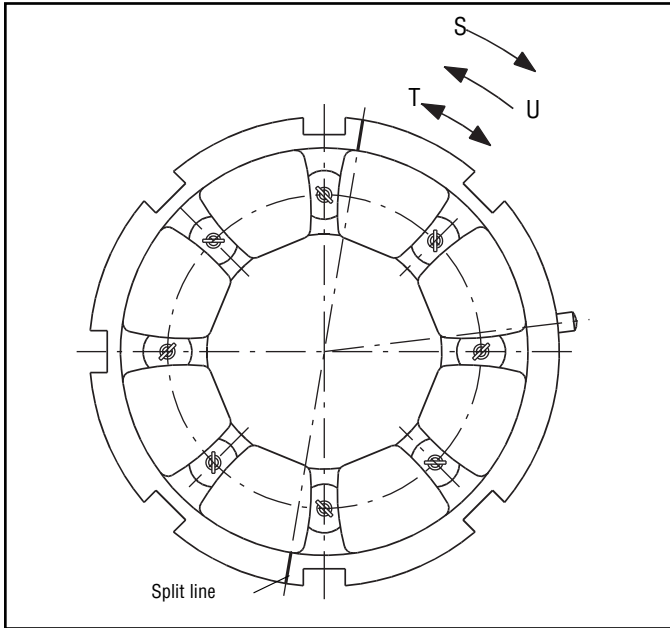
Size	L3	L4	L5	L6	S1	T	R
H23	4.0	5.5	3.0	8.0	5.6	6	53.5
H26	5.0	5.5	3.0	9.0	6.4	7	57.0
H28	5.0	6.0	3.5	10.0	6.4	7	61.0
H31	6.3	6.2	3.5	10.5	6.4	7	67.5
H34	6.3	7.2	4.0	12.5	7.9	8	73.0
H37	7.3	7.2	4.0	13.5	7.9	8	79.5
H40	7.3	8.7	4.5	16.0	7.9	8	86.0
H44	7.0	9.0	5.0	17.0	9.5	8	94.0
H48	8.0	9.0	5.0	19.0	9.5	8	104.0
H52	9.0	11.0	6.0	20.0	11.1	8	112.5
H57	11.0	11.0	6.0	22.0	12.7	10	122.5
H61	11.3	12.7	7.0	23.0	12.7	10	134.0
H68	12.3	12.7	7.0	26.0	15.9	13	145.0
H74	13.0	13.0	8.0	26.0	15.9	13	157.5
H81	15.5	14.5	9.0	28.0	19.1	13	171.5
H89	17.5	14.5	9.0	30.0	19.1	13	186.0
H97	20.3	16.7	9.0	33.0	22.2	16	202.0
H105	22.0	18.0	10.0	35.0	22.2	16	222.0
H115	25.0	19.0	10.0	38.0	25.4	16	242.5
H125	28.0	22.0	10.0	40.0	25.4	16	265.0
H136	31.0	27.0	10.0	43.0	28.6	19	290.0

Standard DM

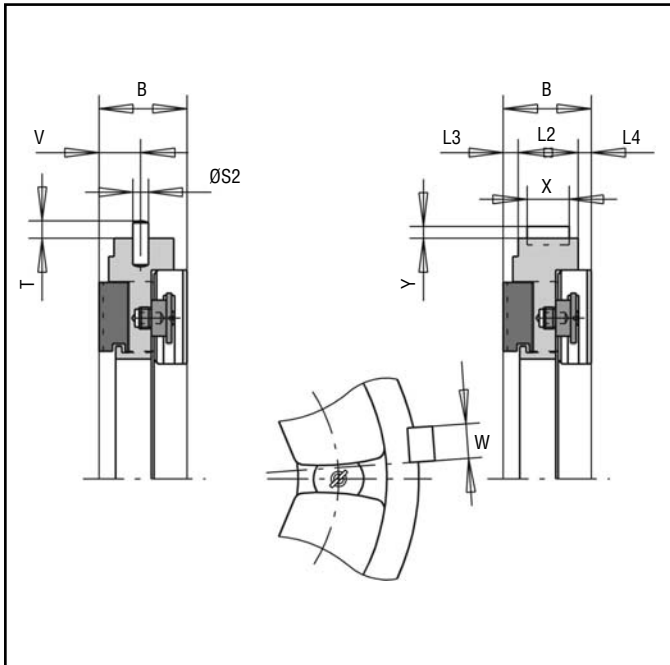


TILTING PAD THRUST BEARINGS

Self Equalising, Split, Flooded Lubrication, Standard DN, Series 11

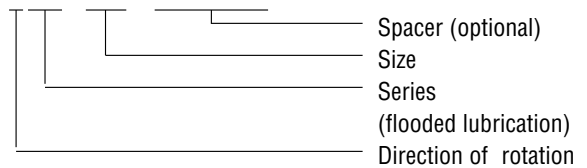


Size	Total Thrust Surface (mm ²)	S2	V	W	X	Y
H23	5889	5.6	11.0			
H26	7498	6.4	12.5			
H28	8708	6.4	13.5			
H31	10666	7.9	15.0			
H34	12818	7.9	16.5			
H37	15190	9.5	18.0			
H40	17753	9.5	19.8			
H44	21742	9.5	20.5			
H48	25552	11.1	22.5			
H52	30022			15.9	22.2	5.6
H57	36083			15.9	22.2	5.6
H61	41364			15.9	25.4	5.6
H68	51283			19.1	28.6	6.4
H74	60756			19.1	28.6	6.4
H81	72800			19.1	31.8	6.4
H89	87791			22.2	31.8	8.0
H97	104280			22.2	44.5	8.0
H105	124287			25.4	44.5	10.0
H115	148163			38.1	44.5	12.7
H125	174895			38.1	44.5	12.7
H136	220329			44.5	50.8	15.9



Order example

B _ _ T DN H52 + Spacer



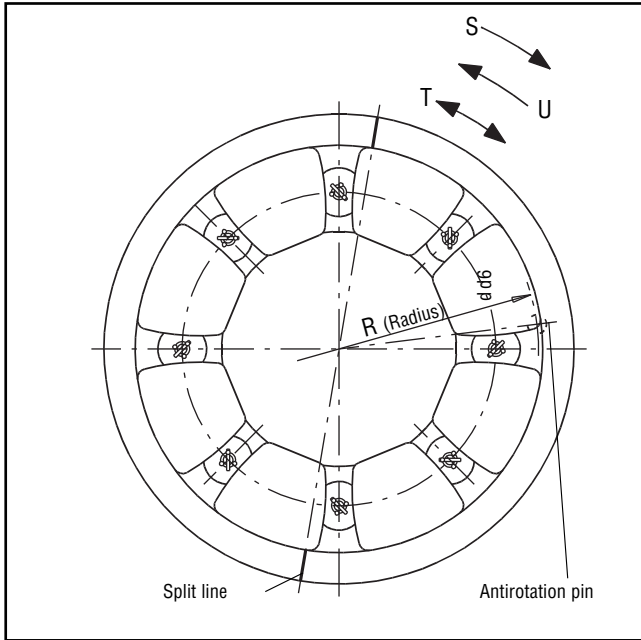
Standard DN

Materials Carrier ring: C15
 Spacer: C15
 Tilting pads: C15/Tegostar738
 Equalising segments: 42CrMo4

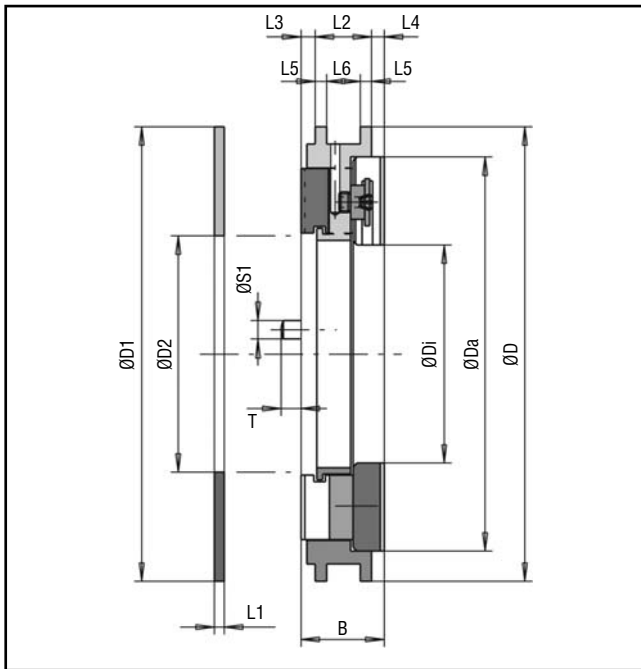


TILTING PAD THRUST BEARINGS

Self Equalising, Split, Directed Lubrication, Standard DM, Series 11



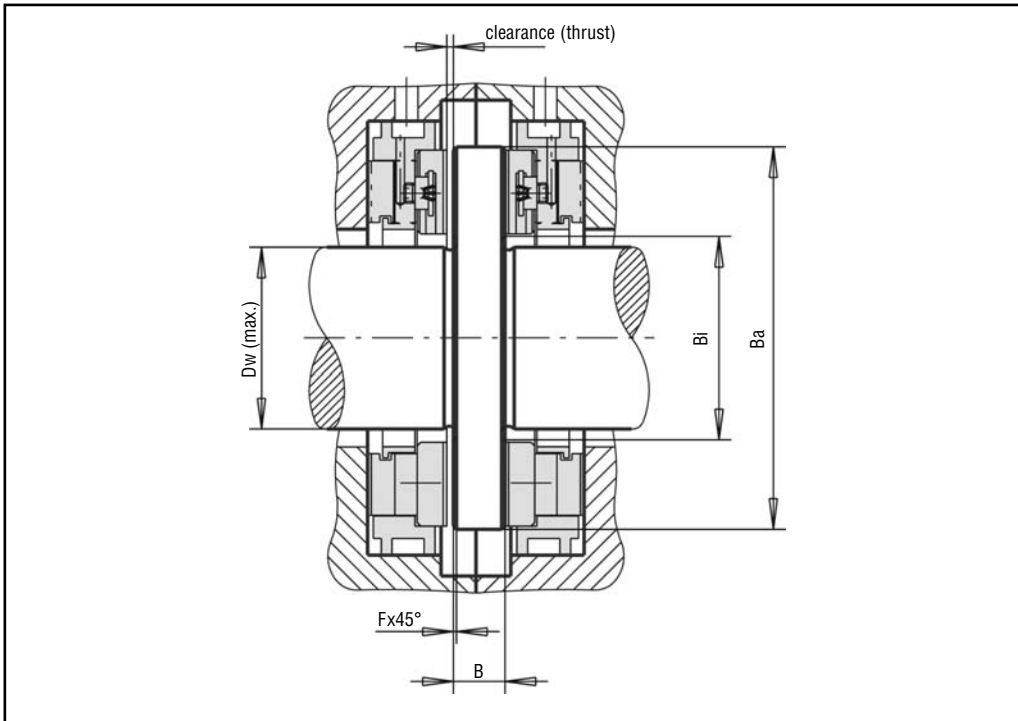
Size	D_i	D_a	D_{g7}	B	h_9	D_1	D_2	L_1	L_2
H23	88.7	136.1	152.40	23.5	151.9	95	4.8	14.0	
H26	95.4	147.4	168.28	25.5	167.7	102	4.8	15.0	
H28	104.4	160.4	180.98	28.0	180.4	113	4.8	17.0	
H31	115.2	177.2	196.85	30.0	196.3	123	4.8	17.5	
H34	124.6	192.6	212.73	34.0	212.2	133	4.8	20.5	
H37	135.4	209.4	234.95	36.0	234.4	147	6.4	21.5	
H40	147.6	227.6	254.00	41.0	253.5	161	6.4	25.0	
H44	160.2	248.2	279.40	43.0	278.9	174	6.4	27.0	
H48	175.5	271.5	301.63	46.0	301.1	189	6.4	29.0	
H52	192.2	296.2	323.85	52.0	323.2	204	6.4	32.0	
H57	208.8	324.3	355.60	56.0	355.0	227	9.5	34.0	
H61	228.4	353.4	384.18	61.0	383.5	246	9.5	37.0	
H68	247.9	383.9	415.93	65.0	415.3	268	9.5	40.0	
H74	270.9	418.9	454.03	68.0	453.4	289	9.5	42.0	
H81	295.6	457.6	495.30	76.0	494.7	316	9.5	46.0	
H89	317.9	495.9	539.75	80.0	539.1	343	9.5	48.0	
H97	347.2	541.2	584.20	88.0	583.5	376	9.5	51.0	
H105	383.0	594.0	641.35	95.0	640.6	410	9.5	55.0	
H115	417.0	647.0	692.15	102.0	691.4	446	12.7	58.0	
H125	455.0	706.0	755.65	110.0	754.9	486	12.7	60.0	
H136	496.0	769.0	825.50	121.0	824.7	526	12.7	63.0	



Size	L_3	L_4	L_5	L_6	S_1	T	R
H23	4.0	5.5	3.0	8.0	5.6	6	69.5
H26	5.0	5.5	3.0	9.0	6.4	7	75.0
H28	5.0	6.0	3.5	10.0	6.4	7	81.0
H31	6.3	6.2	3.5	10.5	7.9	8	88.0
H34	6.3	7.2	4.0	12.5	7.9	8	95.0
H37	7.3	7.2	4.0	13.5	9.5	8	105.5
H40	7.3	8.7	4.5	16.0	9.5	8	114.0
H44	7.0	9.0	5.0	17.0	9.5	8	125.0
H48	8.0	9.0	5.0	19.0	11.1	8	136.0
H52	9.0	11.0	6.0	20.0	12.7	10	147.0
H57	11.0	11.0	6.0	22.0	15.9	13	161.0
H61	11.3	12.7	7.0	23.0	15.9	13	176.0
H68	12.3	12.7	7.0	26.0	15.9	13	190.0
H74	13.0	13.0	8.0	26.0	19.1	13	207.0
H81	15.5	14.5	9.0	28.0	19.1	13	225.0
H89	17.5	14.5	9.0	30.0	22.2	16	246.0
H97	20.3	16.7	9.0	33.0	22.2	16	267.0
H105	22.0	18.0	10.0	35.0	25.4	16	294.0
H115	25.0	19.0	10.0	38.0	28.6	19	317.5
H125	28.0	22.0	10.0	40.0	31.8	19	349.0
H136	31.0	27.0	10.0	43.0	34.9	26	380.0

Standard DM

Bearing Tolerances And Geometry For The Thrust Collar



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

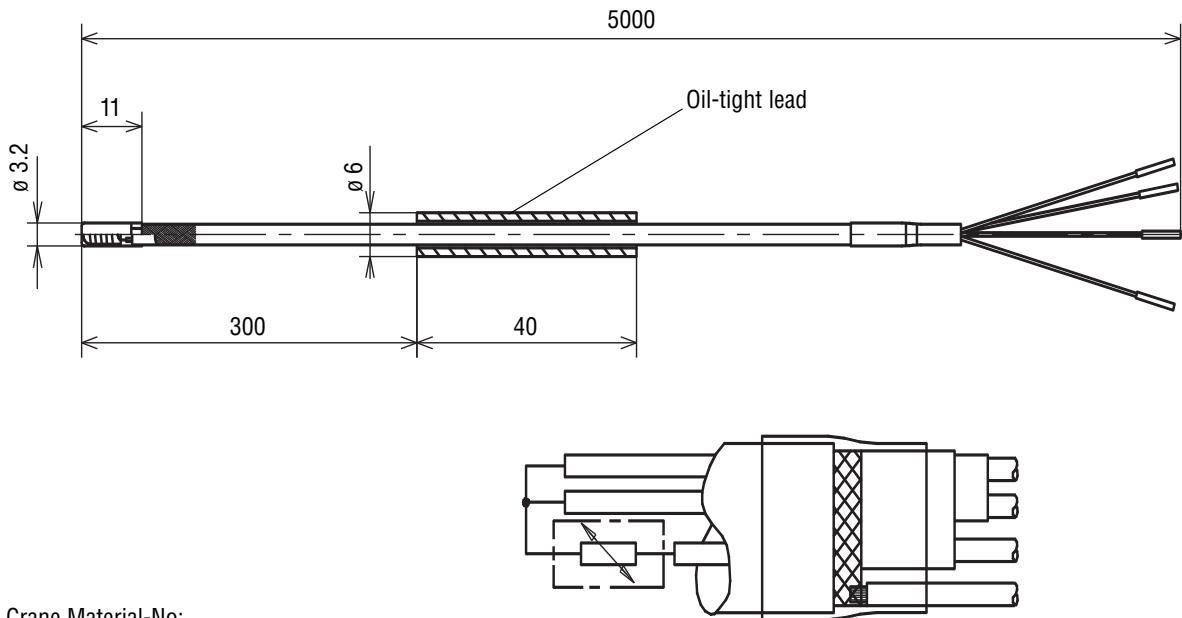


TILTING PAD THRUST BEARINGS

Instrumentation

Single resistance temperature probe
with additional mass-conductor

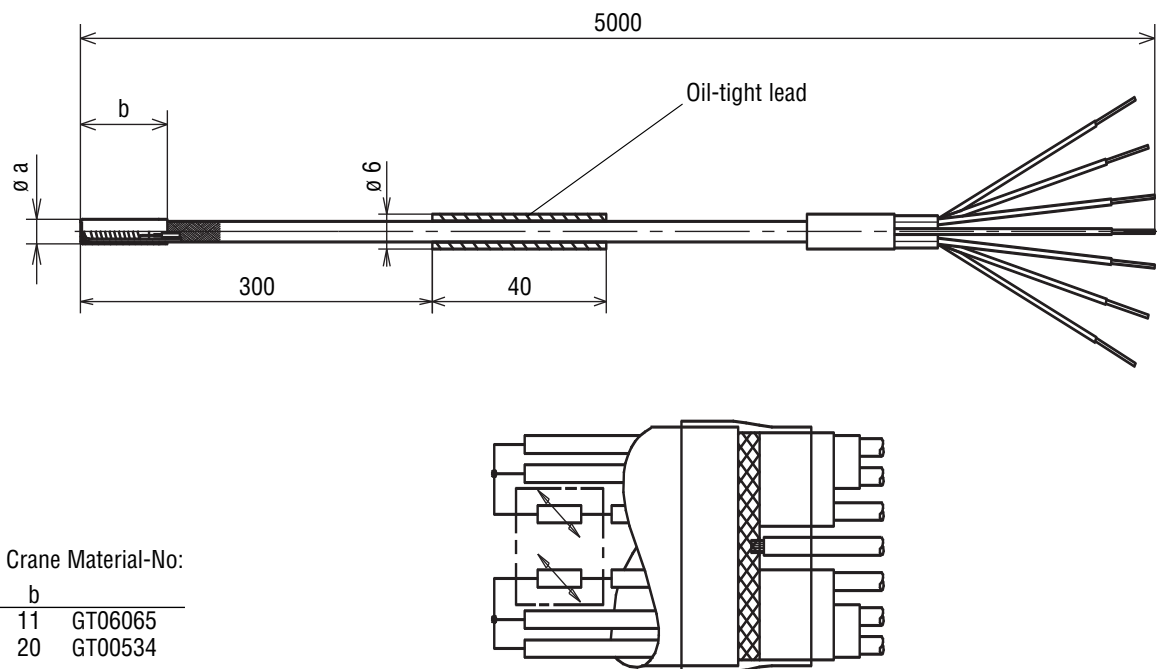
Temperature range: 0–200 °C



John Crane Material-No:
GT00533

Double resistance temperature probe
with additional mass-conductor

Temperature range: 0–200 °C



John Crane Material-No:

$\varnothing a$	b	Material-No.
3.2	11	GT06065
4.2	20	GT00534



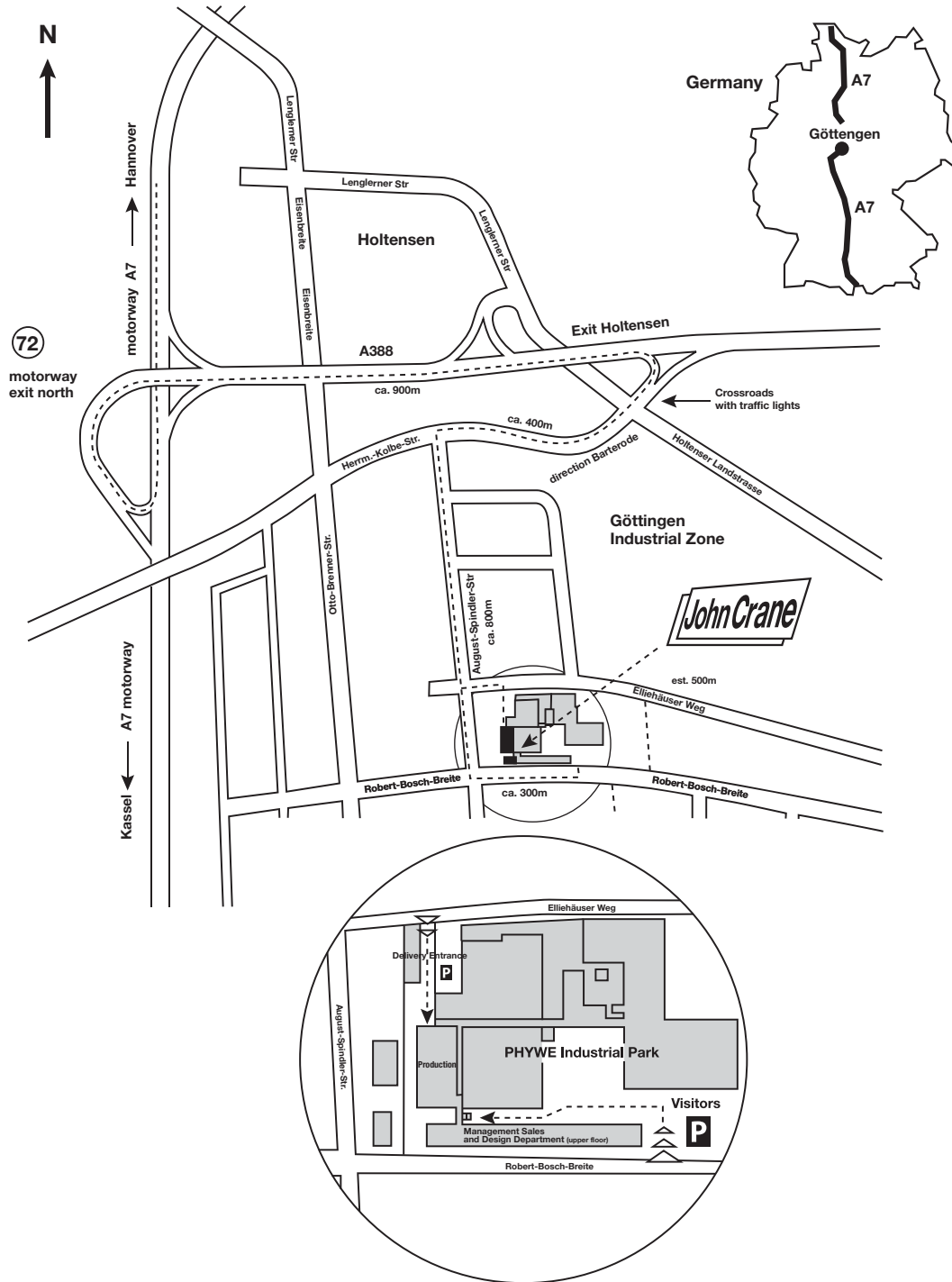
TILTING PAD THRUST BEARINGS

Notes



TILTING PAD THRUST BEARINGS

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