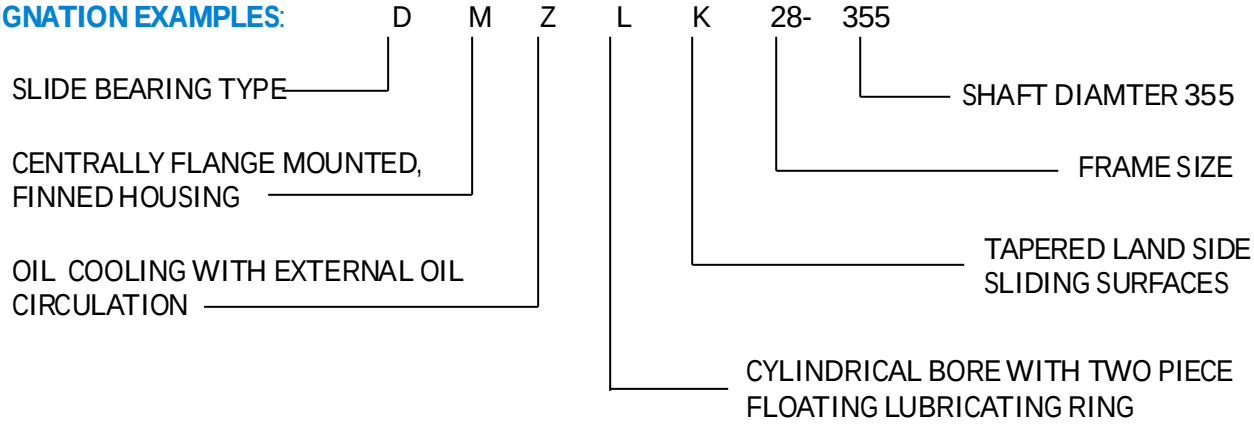
EXPLANATION OF DESIGN FEATURES AND DESIGNATION

1.	**TYPE:**	**D**	DVB TECHNOLOGIES
2.	**HOUSING:**	**M**	CENTRALLY FLANGE MOUNTED, FINNED
		F	SIDE FLANGE MOUNTED, FINNED
		R	PEDESTAL MOUNTED, FINNED
		G	PEDESTAL MOUNTED, PLAIN
3.	**HEAT DISSIPATI0N:**	**N**	NATURALLY COOLED WITH OIL RINGS
		W	WATER COOLER IN OIL SUMP
		U	CIRCULATING PUMP AND NATURAL COOLING
		T	CIRCULATING PUMP AND WATER COOLING IN OIL SUMP
		Z	OIL COOLING WITH EXTERNAL OIL CIRCULATION
		X	LUBRICATION BY OIL CIRCULATION WITH EXTERNAL OIL COOLING FOR HIGH VOLUME
4.	**BORE SHAPE AND TYPE OF LUBRICATION:**	**C**	CYLINDRICAL BORE WITHOUT LUBRICATING RING
		L	CYLINDRICAL BORE WITH TWO PIECE FLOATING LUBRICATING RING
		Y	TWO FACE (LEMON SHAPE) BEARING WITHOUT LUBRICATING RING
5.	**THRUST FACES:**	**Q**	WITHOUT SIDE SLIDING SURFACES (NON-LOCATING)
		B	WITH PLAIN SIDE SLIDING SURFACES AND LUBRICATING GROOVES
		K	WITH TAPERED LAND SIDE SLIDING SURFACES
		A	RD TYPE THRUST PADS ON SIDES

6. **DESIGNATION EXAMPLES:**



7. **DIMENSIONS, DESIGN AND LARGER SIZES:**

THE DIMENSIONS AND DESIGN ILLUSTRATED HERE ARE NOT STRICTLY BINDING, AS THEY ARE SUBJECT TO CONTINUOUS IMPROVEMENT. MOUNTING DIMENSIONS, HOWEVER, SHALL CONFORM TO DIN 31690, DIN 31693 AND DIN 31694.

LARGER SIZES ARE ALSO DESIGNED, MANUFACTURED AND CUSTOMIZED ON ORDER BASIS.

TECHNICAL INFORMATION
DF, DM, DR AND DG TYPE BEARINGS FOR SHAFT DIA 80-355

BASIC CONCEPT

'D' type bearings are conceptually based on DIN 31690, 31693 and 31694 or ISO 11687-1, 11687-2 and 11687-3 with respect to dimension, nomenclature and mountings etc. The design permits the flexibility of using minimum three and maximum six bore size shells, either with or without thrust, a number of variations in enclosure protections, self lubrication, forced lubrication, or with water cooled coolers without changing the mounting details as a result of adapting a modular concept in the design.

'D' type bearings have been designed specially for adaptation to electrical rotating machines and turbines. But due to their modular concept, these can be used almost universally throughout the engineering industry with satisfactory performance.

MOUNTING

The housing of 'DF' and 'DM' types are for mounting directly on the End Shield flange of the machine, while the 'DR' and 'DG' type are for pedestal mounting. The housing body is ribbed for greater heat dissipation capabilities and is made of FG 260 as standard. Higher grades as FG 300 or Cast steel can be supplied on special arrangements. Type 'DG' housings are without ribs.

BABBITTED BUSH

The bearing bush is spherically seated on the housing which permits a self aligning characteristic to take care of the imperfections in mounting and alignment to a certain degree.

The white metal is standard for Gr. 84 to IS: 25. Other grades if required, due to load, speed and environment conditions are possible with pre-arrangement.

The technology for babbitting and machining are in accordance with the highest standard required in engineering application and conforms to international practice which ensures trouble free assembly and long life.

The 'D' type bearings are supplied with plain bore and loose lubricating ring as standard. Option for a two lobbed bore is available depending on the operating conditions.

The bushes are of 'Q' type (without thrust), 'B' type plain with grooves, (non-continuous axial thrust) and 'K' type built-on taper land (medium thrust load). Higher thrust loads, as in horizontal mini hydro applications, are catered by 'RD' type tilting pads specially for Kaplan & Francis application.

Please see dimensional leaflet for type explanation & Table 2 for admissible axial load for load rating.

LABYRINTH SEALS

Floating labyrinth seals are used on both machine side and non machine side of the bearing housing as standard fitment.

The seal consists of heat resistant fabric reinforced insulating material. The material is so selected to provide a balance between the properties to withstand higher temperature, dimension stability, gliding property and ability to give-in, in case of undue forces being exerted due to a mismatch in assembly or for any other reason, to save the shaft from scoring. The standard seal provides IP 44 protection. Higher degrees of protection up to IP 55, both metallic and non-metallic (insulated) can be provided on request.

Both 'DF' and 'DM' type bearings are protected against turbulance from inside the machine by a inside machine seal in aluminium. Exceptions are to be specified with the enquiry. The seal is fitted to the inside of the machine End Shield and provided with felt wipers as seals. The inside space of the machine seal is connected to atmosphere to avoid creation of vacuum or strong air turbulence inside the machine.

Special seals can be developed on request to cater for higher pressure or vacuum created by high pressure fans or otherwise inside the machine.

LUBRICATION

The bearing assemblies are always provided with a loose lubricating oil ring for self lubrication up to a speed of 16 m/s subject to verification of operating temperature being within limit. For external oil supply application, identical oil entry holes are provided on both sides of the bearing. For externally oil cooled bearings, loose oil rings are also additionally supplied to prevent oil starvation in case of oil supply failure up to peripheral speed of 26 m/s.

Lubricating rings can be used for marine application with an insulated guide bush as an additional feature.

TECHNICAL INFORMATION
DF, DM, DR AND DG TYPE BEARINGS FOR SHAFT DIA 80-355

INSULATION

'D' type bearings are provided with built-in insulation on spherical seating and seal carriers as a variant to avoid eddy currents passing through the bearings and causing damage to white metal. In an insulated bearing, all contacts of housing with shaft or bearing bush is made through insulated component such as oilring, guide bush, guide pin bush, seal carrier bolts and nylon bush in IP 55 protection

THERMOSENSORS

Identical and interchangeable provisions have been made to accommodate thermo sensors, one each from each side for oil sump and bearing bush. Commercially available resistance bimetallic or mercury vapour filled thermometers can be used. Temperature sensors for both bush and oil sump can be provided on request. The interchangeable and identical openings for thermo sensors, oil inlet and viewing windows permit fixing from any two sides.

HEAT DISSIPATION

The heat generated as a result of frictional loss is dissipated by radiation and convection due to larger exposed area created by judicious fining of the housing specially for self lubricated bearings. The feature enables application of self cooled bearings for a wider range of application for self cooled bearings. For externally oil circulated bearings, however, the heat transfer is mainly by cooling oil.

For self cooled bearings, in special application, where temperature rise marginally goes beyond permissible limit and forced lubrication facility is not available, oil coolers with water cooling arrangement is possible to be fitted.

OIL GRADE SELECTION

Oil grade selected by customers can be checked by computer calculation for the correct viscosity for the operating condition. Recommendation is also available subject to application data being made available to us. Generally; any unalloyed brand of lubricating oil can be used. Additive treated and synthetic oils can also be used for ensuring that the oil will not have harmful effect on white metal and will not coke when operating oil at prolonged rated temperature or when immersion heaters are used.

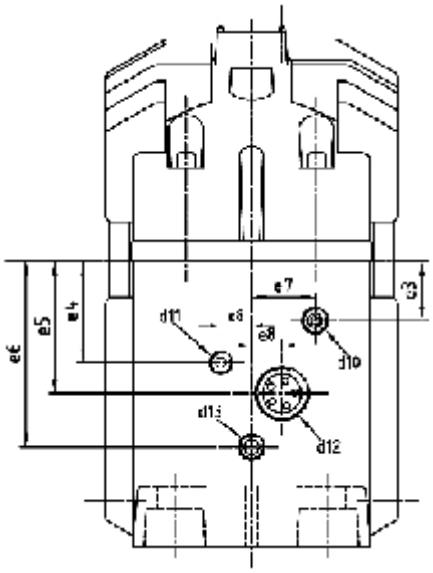
SHAFT DETAILS

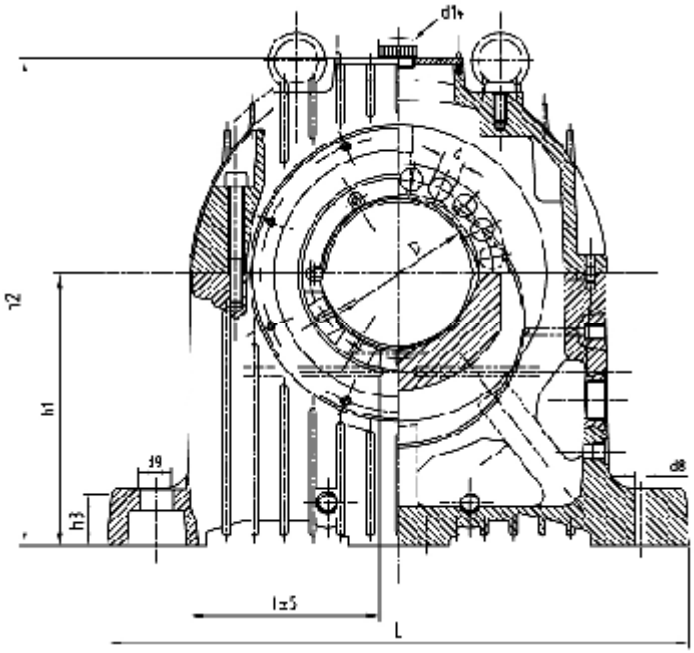
Recommendatory shaft details are given in the leaflet. The journal bearing dia and the clearance is given in the computer application. Any deviation from the recommended shaft dia or tolerance to be informed to us for a computer calculation check.

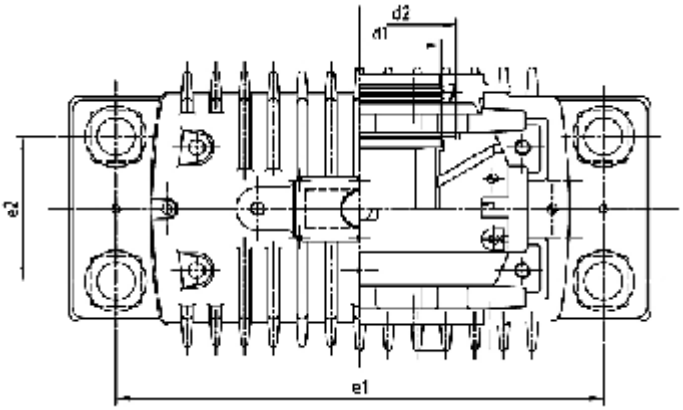
BEARING CALCULATION

In the quotation stage, each of the bearings to be offered by us will be checked on the basis of hydrodyanamic / thermic computer calculation, if customer states operating conditions. The values as for instance, speed, load, oil grade, ambient temperature are basic input for calculation of the operational behaviour. In addition, insulated or non-insulated type oil seal dia non machine side, bore of machine seal dia and type of enclosure protection (IP 44 etc.) and any other special requirement to be specified at the time of enquiry.

PEDESTAL MOUNTED SLIDE BEARINGS TYPE: DR
FOR SHAFT DIA RANGE : 80-355







d10 : Oil inlet when connected to oil circulating unit or circulating pump.

d11 : Shell thermometer entry.

d12 : Oil level or oil outlet when connected to oil circulating unit.

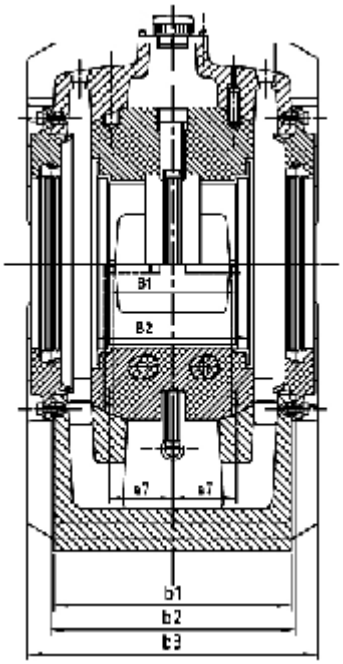
d13 : Plug (connection for heater, oil sump thermometer, suction line of circulating pump, oil cooler)

All threaded holes are plugged before despatch

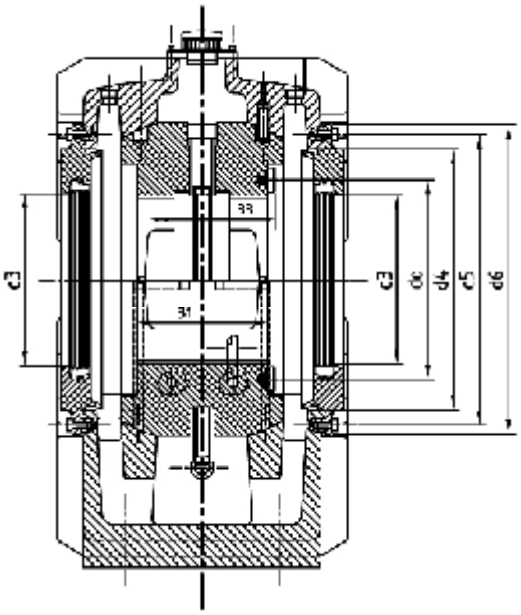
Size	D	B1	B2	B3	b1	b2	b3	d	d0	d1	d2	d3	d4	d5	d6	d7	d8	d9
	80							20	110	86	110							
9	90	60	80	80	145	150	190	20	120	96	120	80/90/100/110	150	170	190	11	10	22
	100							16	125	106	130							
	100							20	135	108	135							
11	110	80	100	100	165	170	205	20	140	118	150	100/110/125/140	180	195	215	11	10	26
	125							16	150	133	160							
	125							25	165	135	170							
14	140	105	125	125	205	215	255	25	180	150	190	125/140/160/180	230	270	290	11	10	30
	160							20	195	170	200							
	180							-	-	190	220							
	160							31.5	210	172	215							
	180	135	160	160	245	255	300	31.5	230	192	240	160/180/200/225	275	320	340	13	15	40
18	200							25	245	212	250							
	225							-	-	237	275							
	200							40	265	214	265							
	225	170	200	200	310	320	380	40	285	239	290	200/225/250/280/300	340	380	400	13	15	46
22	250							31.5	305	264	315							
	280							-	-	294	345							
	300							-	-	310	325							
	250							50	325	266	325							
	280							50	355	296	355							
28	300	215	250	250	370	380	450	40	365	316	375	250/280/300/315/355	440	500	525	13	20	55
	315							40	380	331	390							
	335							-	-	351	410							
	355							-	-	371	430							

The dimensions and designs are not strictly binding as they are subject to continuous improvment. We reserve the right to introduce modifications.

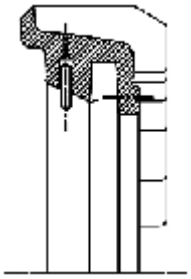
PEDESTAL MOUNTED SLIDE BEARINGS TYPE: DR
FOR SHAFT DIA RANGE : 80-355



DR, LB
DR, LK



DR, LQ
DR, LA



INSULATED TYPE

Model D

Housing R : Finned pedestal bearing

Heat Dissipation N : By natural cooling

Z : Lubrication by oil circulation with external oil cooling

W : Water cooling(finned tube cooler in oil sump)

U : Circulating pump and natural cooling

Shape of bore L : Plain cylindrical bore with loose ring lubrication

Thrust Face B : Locating bearing (plain shoulder with oil grooves)

K : Shoulder with taper lands

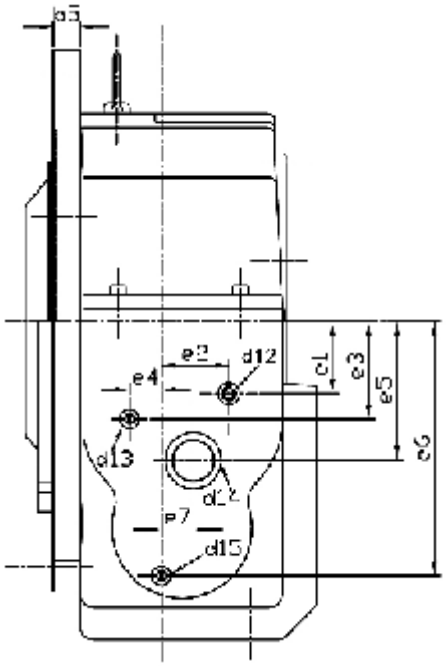
Q : Without thrust part shoulder

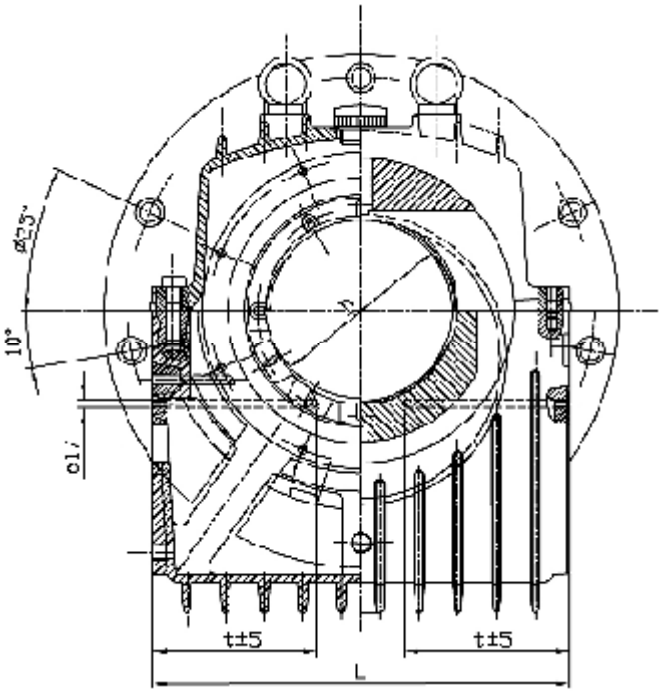
A : With RD Thrust pads

d10	d11	d12	d13	d14	e1	e2	e3	e4	e5	e6	e7	e8	h1	h2	h3	L	f 5	RD Thrust pads (Nos.)	Weight (Kg.)	Oil Capacity (Litre)
																	105	14		
3/8'' BSP.	1/2'' BSP.	1 1/4" BSP.	1/2'' BSP.	1" BSP.	300	90	30	60	85	135	37	22.5	190	321	35	355	105	16	53	1.8
																	100	20		
																	140	16		
3/8'' BSP.	1/2'' BSP.	1 1/4" BSP.	1/2'' BSP.	1 1/4" BSP.	375	100	40	70	90	150	42	22.5	225	375	50	450	140	18	82	3.8
																	132	22		
																	165	18		
3/8'' BSP.	1/2'' BSP.	1 1/2" BSP.	1/2'' BSP.	1 1/2" BSP.	450	125	60	85	125	180	55	27.5	265	455	60	540	165	20	158	5.4
																	145	24		
																	132	-		
																	207	18		
3/8'' BSP.	1/2'' BSP.	1 1/2" BSP.	1/2'' BSP.	1 1/2" BSP.	560	150	70	105	155	215	68	30	315	560	70	660	207	20	283	9.2
																	185	24		
																	170	-		
																	262	18		
1/2" BSP.	1/2'' BSP.	2" BSP.	1/2'' BSP.	2" BSP.	670	200	80	135	175	245	83	40	375	675	80	880	262	20	525	17.5
																	248	24		
																	206	-		
																	187	-		
																	317	18		
																	317	20		
1/2'' BSP.	1/2" BSP.	2'' BSP.	1/2'' BSP.	2'' BSP.	800	250	95	155	220	310	106	50	450	824	90	950	267	24	925	28.6
																	260	24		
																	230	-		
																	210	-		

Larger sizes are also manufactured & customized on order basis.

ENDSHIELD MOUNTED SLIDE BEARINGS TYPE: DF
FOR SHAFT DIA RANGE : 80-355





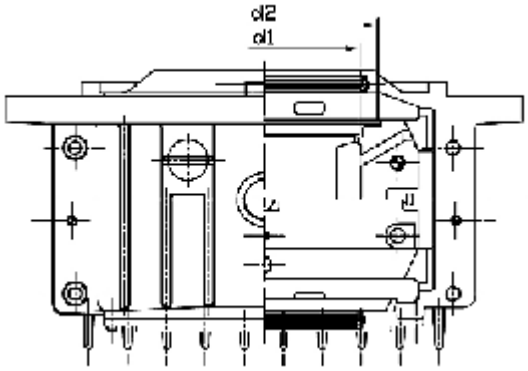
d12 : Oil inlet when connected to oil circulating unit or circulating pump.

d13 : Shell thermometer entry.

d14 : Oil level or oil outlet when connected to oil circulating unit.

d15 : Plug (connection for heater, oil sump thermometer, suction line of circulating pump, oil cooler)

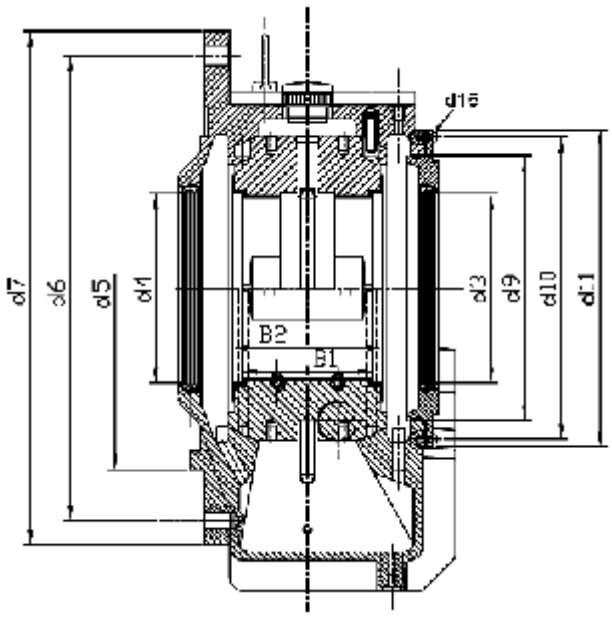
All threaded holes are plugged before despatch



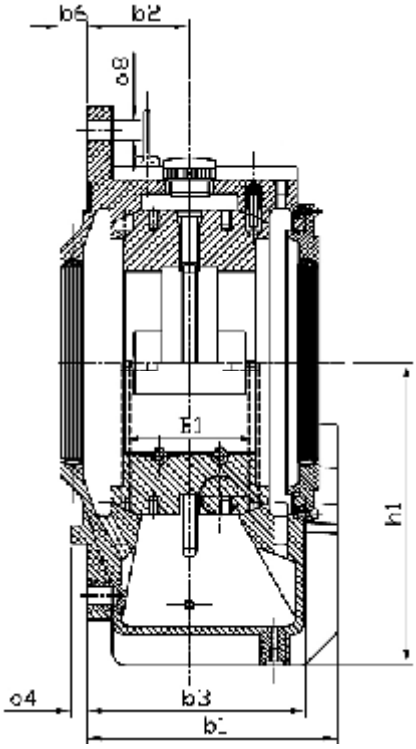
Size	D	B1	B2	b1	b2	b3	b4	b5	b6	d1	d2	d3	d4	d5	d6	d7	d8	d9
9	80 90 100	60	80	162	70	140	15	12	23	86 96 106	110 120 130	80/90/100/110	100	280	310	340	14	150
11	100 110 125	80	100	192	80	165	15	17	29	108 118 133	135 150 160	100/110/125/140	125	315	350	380	14	180
14	125 140 160 180	105	125	232	100	205	15	23	26	135 150 170 190	165 180 195 -	125/140/160/180	160 160 160 180	355	415	460	18	230
18	160 180 200 225	135	160	273	116	241	20	25	31	172 192 212 237	210 230 245 -	160/180/200/225	200 200 200 225	400	490	540	22	275
22	200 225 250 280 300	170	200	354	150	314	20	37	32	214 239 264 294 310	265 285 305 - -	200/225/250/280/300	250 250 250 280 300	500	620	680	26	340
28	250 280 300 315 335 355	215	250	414	170	365	24	42	43	266 296 316 331 351 371	325 355 375 390 410 430	250/280/300/315/355	315 315 315 315 355 355	600	770	850	33	440

The dimensions and designs are not strictly binding as they are subject to continuous improvment. We reserve the right to introduce modifications.

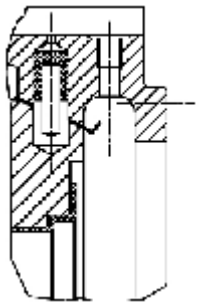
ENDSHIELD MOUNTED SLIDE BEARINGS TYPE: DF
FOR SHAFT DIA RANGE : 80-355



DF, LB
DF, LK



DF, LQ
DF, LA



INSULATED TYPE

Model D

Housing F : End Shield mounted bearing

Heat Dissipation N : By natural cooling
Z : Lubrication by oil circulation with external oil cooling
W : Water cooling(finned tube cooler in oil sump)
U : Circulating pump and natural cooling

Shape of bore L : Plain cylindrical bore with loose ring lubrication

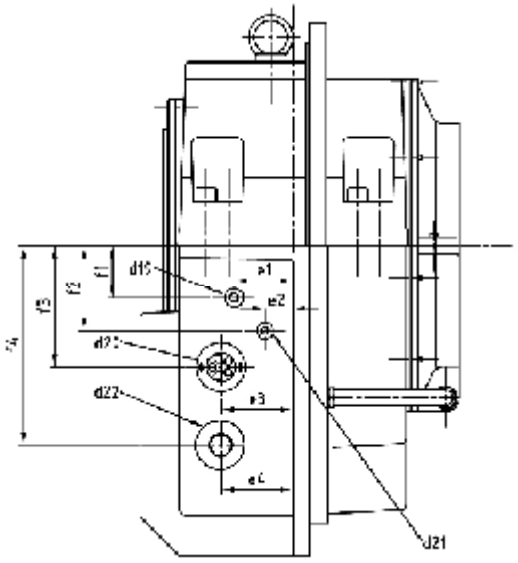
Thrust Face B : Locating bearing (plain shoulder with oil grooves)
K : Shoulder with taper lands
Q : Without thrust part shoulder
A : With RD Thrust pads

d10	d11	d12	d13	d14	d15	d16	d17	e1	e2	e3	e4	e5	e6	e7	L	t 5	h1	Weight (Kg)	Oil Capacity(Lt)
170	190	3/8" BSP	1/2" BSP	1 1/4" BSP	1/2" BSP	6xM6	11	35	37	60	22.5	85	20	175	270	115 115 115	250	58	2.8
195	215	3/8" BSP	1/2" BSP	1 1/2" BSP	1/2" FP	6xM6	11	40	42	70	22.5	90	22.5	195	310	135 135 127	280	93	4.7
270	290	3/8" BSP	1/2" BSP	1 1/2" BSP	1/2" BSP	6xM6	11	60	55	85	27.5	125	27.5	240	370	165 165 145 125	340	157	8
320	340	3/8" BSP	1/2" BSP	1 1/2" BSP	1/2" BSP	6xM6	13	70	68	105	30	155	30	270	440	197 197 175 150	400	250	13
380	400	1/2" BSP	1/2" BSP	2" BSP	1/2" BSP	8xM8	13	80	83	135	40	175	40	350	550	252 252 238 192 177	450	540	23
500	525	1/2" BSP	1/2" BSP	2 1/2" BSP	1/2" BSP	8xM8	13	115	106	155	50	220	50	400	690	322 322 272 267 242 229	500	965	34

Larger sizes are also manufactured & customized on order basis.

CENTRAL FLANGED MOUNTED SLIDE BEARINGS TYPE: DM

FOR SHAFT DIA RANGE : 80-355



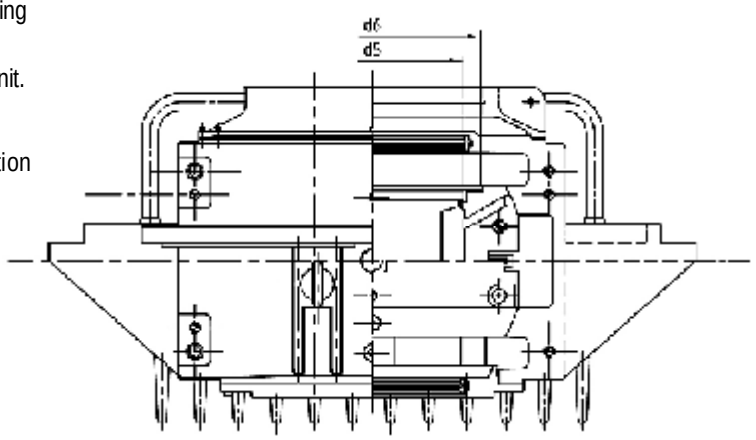
d19 : Oil inlet when connected to oil circulating unit or circulating pump.

d20 : Oil level or oil outlet when connected to oil circulating unit.

d21 : Shell thermometer entry.

d22 : Plug (connection for heater, oil sump thermometer, suction line of circulating pump, oil cooler)

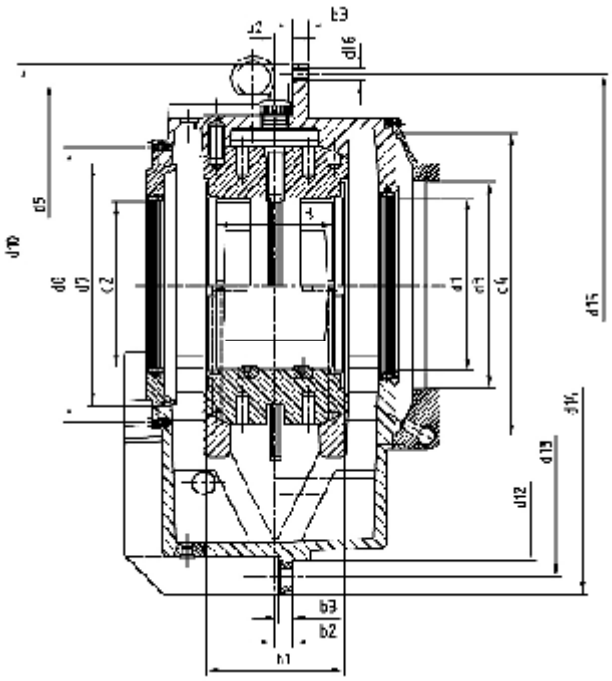
All threaded holes are plugged before despatch

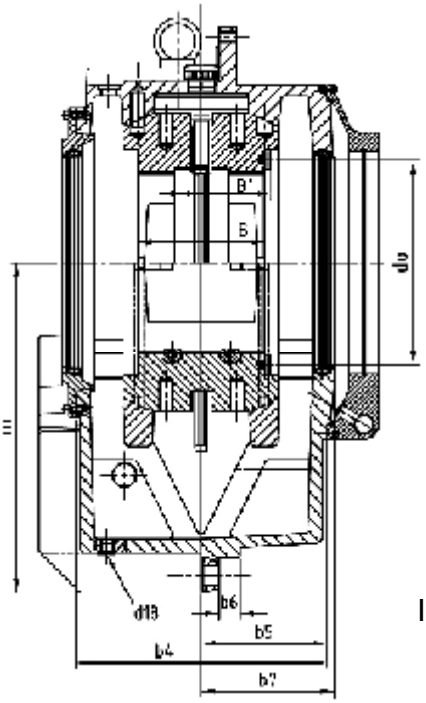


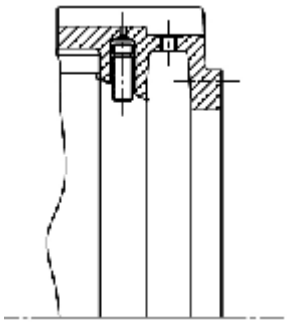
Size	D	B	B1	b1	b2	b3	b4	b5	b6	b7	d	d0	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11
9	80 90 100	60	80	80	20	16	160	80	30	100	20 20 16	110 120 125	100	80/90/100/110	111.5 121.5 131.5	180	86 96 106	110 120 130	150	170	270	300	11
11	100 110 125	80	100	100	20	18	190	95	30	115	20 20 16	135 140 150	125	100/110/125/140	136.5 151.5 161.5	220	108 118 133	135 150 160	180	195	320	355	13.5
14	125 140 160 180	105	125	125	25	20	225	112.5	30	135	25 25 20 -	165 180 195 -	160	125/140/160/180	171.5 191.5 201.5 221.5	280	135 150 170 190	170 190 200 220	230	270	380	425	17.5
18	160 180 200 225	135	160	160	25	25	265	132.5	30	150	31.5 31.5 25 -	210 230 245 -	200	160/180/200/225	216.5 241.5 251.5 276.5	330	172 192 212 237	215 240 250 275	275	320	450	500	22
22	200 225 250 280 300	170	200	200	30	30	335	167.5	30	185	40 40 31.5 - -	265 285 305 - -	250	200/225/250/280 /300	266.5 291.5 316.5 346.5 346.5	420	214 239 264 294 310	265 290 315 345 325	340	380	570	630	26
28	250 280 300 315 335 355	215	250	250	30	30	425	212.5	35	225	50 50 40 40 - -	325 355 365 380 - -	315	250/280/300/315 /355	326.5 356.5 376.5 391.5 431.5 431.5	550	266 296 316 331 351 371	325 355 375 390 410 430	440	500	730	800	33

The dimensions and designs are not strictly binding as they are subject to continuous improvment. We reserve the right to introduce modification.

CENTRAL FLANGED MOUNTED SLIDE BEARINGS TYPE: DM
FOR SHAFT DIA RANGE : 80-355







INSULATED TYPE

DM, LB
DM, LK

Model D

Housing M : Finned Centre Flange mounted bearing

Heat Dissipation N : By natural cooling

Z : Lubrication by oil circulation with external oil cooling

W : Water cooling(finned tube cooler in oil sump)

U : Circulating pump and natural cooling

DM, LQ
DM, LA

Shape of bore L : Plain cylindrical bore with loose ring lubrication

Thrust Face B : Locating bearing (plain shoulder with oil grooves)

K : Shoulder with taper lands

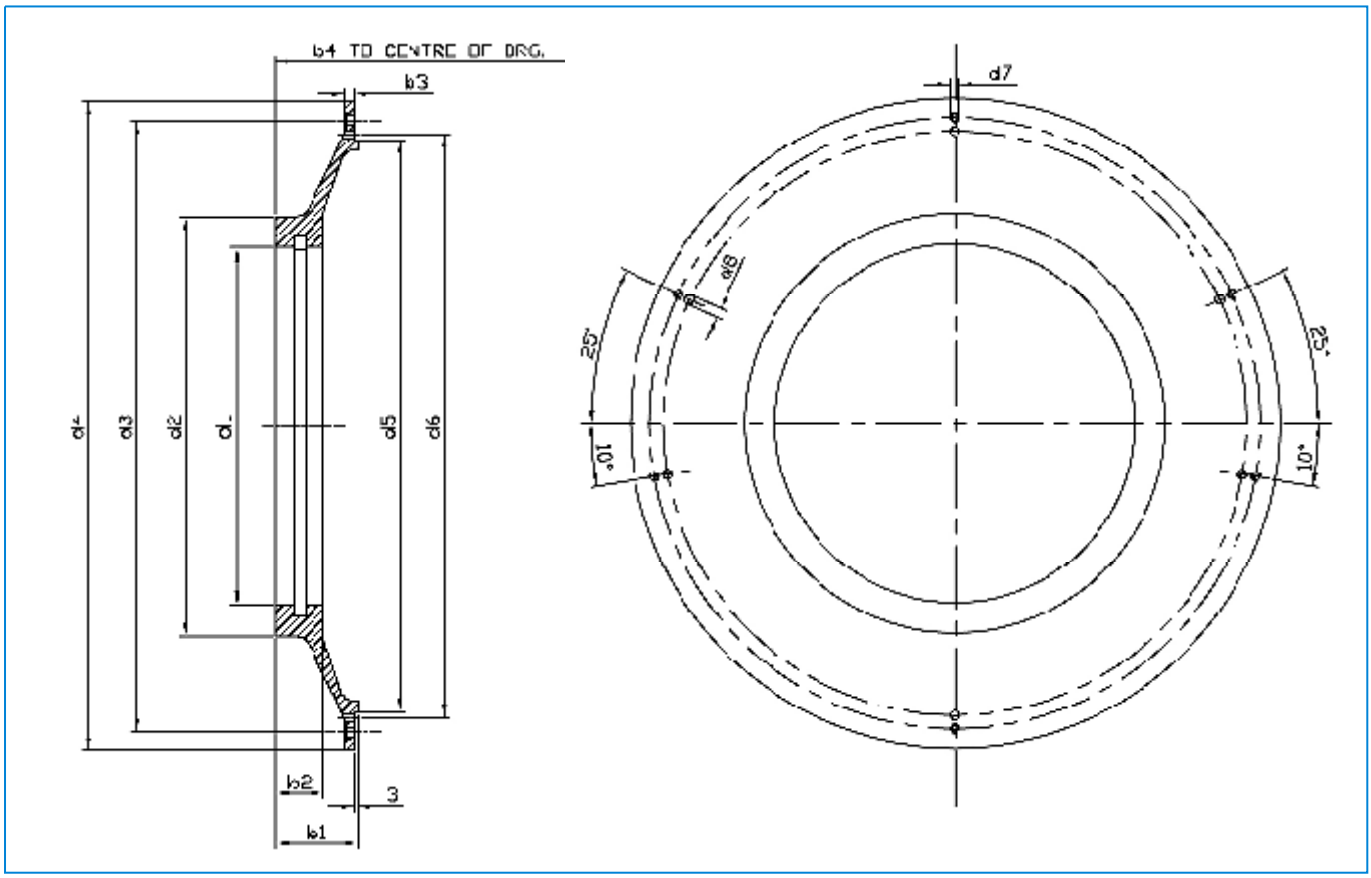
Q : Without thrust part shoulder

A : With RD Thrust pads

h6 d12	d13	d14	d15	d16	d17	d18	d19	d20	d21	d22	d23	e1	e2	e3	e4	f1	f2	f3	f4	h1	L	f 5	RD thrust pads (Nos.)	Weight (Kg.) (Kg.)	Oil Capacity (Litre)
375	400	425	285	M-6	11	3/8" BSP	3/8" BSP	1" BSP	1/2" BSP	1/4" BSP	1" BSP	35.5	20	67.5	45	27.5	60	85	142	212	250	105 105 105	14 16 20	60	2.4
450	475	500	340	M-6	11	3/8" BSP	3/8" BSP	1 1/4" BSP	1/2" BSP	1 1/4" BSP	1" BSP	40	22.5	70	60	30	70	90	160	250	300	130 130 122	16 18 22	97	4.2
530	560	600	400	M-6	11	3/8" BSP	1/2" BSP	1 1/2" BSP	1/2" BSP	1 1/4" BSP	1 1/4" BSP	55	27.5	85	70	45	85	125	200	300	355	158 158 138 117	18 20 24 -	164	6.8
630	670	710	475	M-8	13	3/8" BSP	1/2" BSP	1 1/2" BSP	1/2" BSP	1 1/4" BSP	1 1/4" BSP	68	30	80	80	60	105	155	240	355	425	190 190 170 145	18 20 24 -	242	10
800	850	900	600	M-10	13	1/2" BSP	3/4" BSP	2" BSP	1/2" BSP	1 1/4" BSP	1 1/2" BSP	83	40	100	100	70	135	175	310	450	530	242 242 228 182 166	18 20 24 - -	460	24.4
1000	1060	1120	765	M-12	13	1/2" BSP	3/4" BSP	2 1/2" BSP	1/2" BSP	1 1/4" BSP	2" BSP	106	50	130	130	95	155	220	360	560	670	312 312 262 257 232 219	18 20 24 24 - -	850	44.5

Larger sizes are also manufactured & customized on order basis.

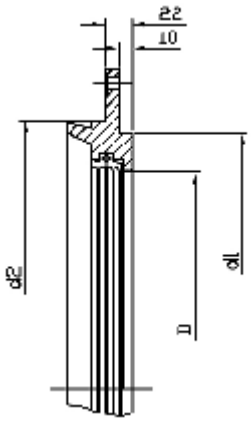
DIMENSIONS OF MACHINE SEALS
DF TYPE



Size	D	d1	d2	d3	d4	d5	d6	d7	d8	b1	b2	b3	b4
9	80 90 100	111.5 121.5 131.5	160	360	380	280	310	7	14	60	35	10	148
11	100 110 125	136.5 151.5 161.5	180	400	420	315	350	7	14	65	35	10	163
14	125 140 160	171.5 191.5 201.5	230	375	395	355	-	7	-	70	35	10	188
18	160 180 200	216.5 241.5 251.5	290	430	460	400	-	10	-	75	40	10	214
22	200 225 250	266.5 291.5 316.5	360	535	570	500	-	10	-	80	40	10	255
28	250 280 300	326.5 356.5 376.5	440	640	680	600	-	10	10	85	50	10	288

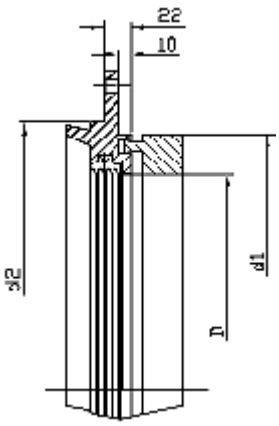
The dimensions and designs are not strictly binding as they are subject to continuous improvement. We reserve the right to introduce modification.

TYPES OF ENCLOSURES AND DIMENSIONS



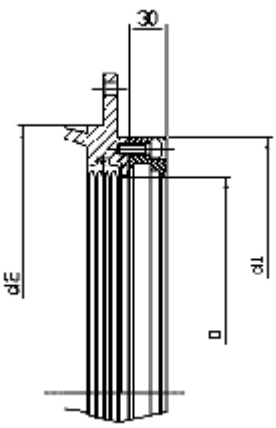
Type 10
Floating Oil Seal in insulating material

IP. 44



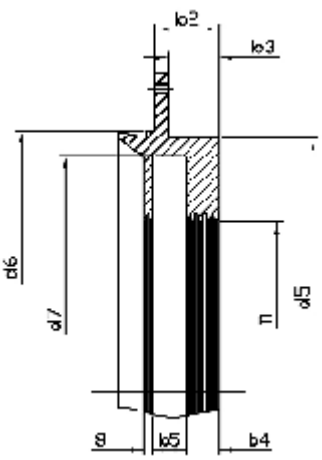
Type 11
Floating Oil Seal with rotating dust seal

IP. 54



Type 12
Floating Oil Seal in insulating material and fixed wiper in brass or nylon

IP. 55



Type 20
Rigid aluminium oil seal

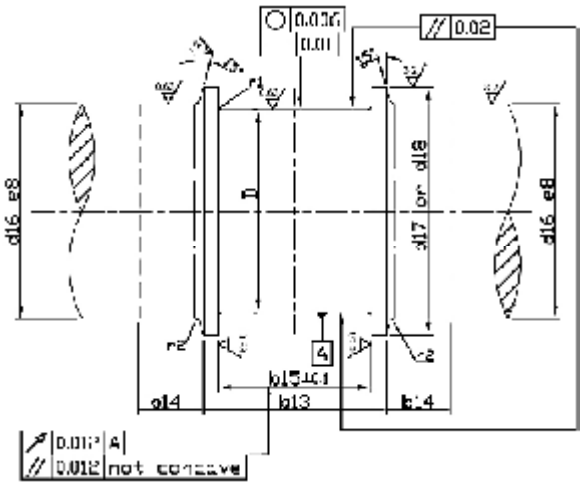
IP. 44

Size	D	d1	d2	d3	d4	d5	d6	d7	b1	b2	b3	b4	b5
9	80 90 100 110	150	150	155 155 155 155	150	155	148	140	21 21 21 21	39	29	27	14
11	100 110 125 140	180	180	155 155 180 180	180	180	178	170	21 21 21 21	41	31	27	16
14	125 140 160 180	230	230	180 186 240 240	228	240	228	212	21 21 26 26	43	33	27	18
18	160 180 200 225	275	275	240 240 280 280	274	280	273	260	26 26 26 26	46	36	27	21
22	200 225 250 280	340	340	280 280 340 340	338	340	338	316	26 26 33 33	49	39	27	24
28	250 280 315 355	410	440	340 340 410 410	410	410	438	390	33 33 33 33	53	43	28	27

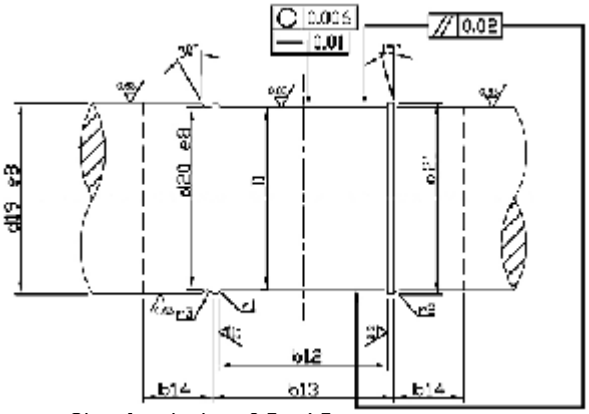
The dimensions and designs are not strictly binding as they are subject to continuous improvement. We reserve the right to introduce modification.

RECOMMENDED SHAFT DIMENSIONS
TYPE: DR&DG

LOCATING BEARING
Types of
bearing shell D... B (with d17)
D... K (with d17)
D ...A (with d18)



NON-LOCATING BEARING
Types of
bearing shell D... Q
D ...B



Chamfered edges 0.5 x 4.5
Surface condition DIN ISO 1302

Size	D[1]	d16	d17	d18	d19/d20[4]	d21	b12[2]	b13	b14 seal type 10	b14 seal type 20	b15[3]	r1	r2	r3
	80		110	132		90								
9	90	80/90/100/110	120	142	80/-90/80 100/90 110/100	100	90	100	50	75	80.4	2.5	4	1.6
	100		130	143		110								
	100		135	157		110								
11	110	100/110/125/140	150	162	100/-110/100 125/110 140/125	125	110	120	50	75	100.4	2.5	4	1.6
	125		160	168		140								
	125		170	192		140								
14	140	125/140/160/180	190	207	125/-140/125 160/140 180/160	160	140	150	60	85	125.4	4	6	2.5
	160		200	217		180								
	180		220	-		250								
	160		215	244		180								
18	180	160/180/200/225	240	264	160/-180/160 200/180 225/200	200	180	190	60	85	160.4	4	6	2..5
	200		250	273		225								
	225		275	-		250								
	200		265	308		225								
22	225	200/225/250/280	290	328	200/-225/200 250/225 280/250	250	220	240	70	105	200.4	6	10	4
	250		315	339		280								
	280		345	-		315								
	300		345	-		330								
	250		325	378		280								
28	280	250/280/315/355	355	408	250/-280/250/ 315/280 355/315	315	280	300	70	105	250.4	6	10	6
	300		375	408		315								
	315		390	423		345								
	335		430	-		365								
	355		430	-		385								

1. Recommended Shaft dia and tolerance as per EDP calculation.
2. If the locating bearing has to cope with considerable axial expansion (e.g., due to heat transfer), the distance b12 between the collars can be increased.
3. The normal axial clearance considered is approx. 0.5 mm. For changing directions of thrust or shock loads, dimensions b15 may be reduced by further 0.2 mm. If the locating bearing is used for test run only, dimension b15 may be increased by 3 to 6 mm., depending on the bearing size.
4. Omit recess d20 if d19 is equal or smaller than shaft diameter D.
   In case the shaft ends within the bearing, the length of journal corresponds to dimension b12.
   Tolerance of form and position follow DIN 31699
   Degree of accuracy B 10 (radial). Degree of accuracy B 20 (axial); others upon request. General tolerance DIN 7168 mS.

RECOMMENDED SHAFT DIMENSIONS
TYPE: DF&DM

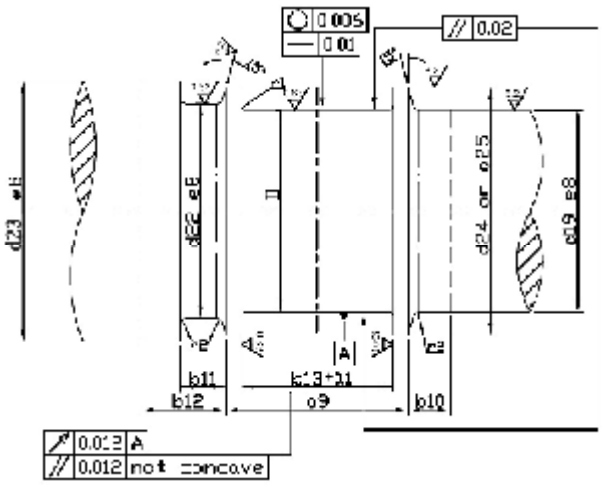
LOCATING BEARING

Types of

bearing shell D... B (with d24)

D... K (with d24)

D ...A (with d25)

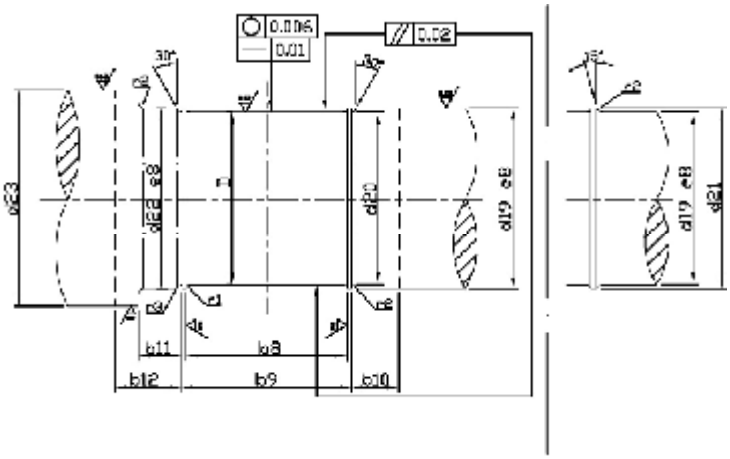


NON-LOCATING BEARING

Types of

bearing shell D... Q

D ...B



Chamfered edges 0.5 x 4.5"

Surface condition DIN ISO 1302

Size	D[1]	d19/d20	d21	d22	d23[4]	d24	d25	b8[2]	b9	b10	b11	b12	b13[3]	r1	r2	r3
	80		90		110	110	132									
9	90	80/-90/80 100/90 110/100	100	110	120	120	142	90	100	50	50	100	80.4	2.5	4	1.6
	100		110		130	130	143									
	100		110		135	135	157									
11	110	100/-100/100 125/100 140/125	125	125	150	150	162	110	120	50	55	105	100.4	2.5	4	1.6
	125		140		160	160	168									
	125		140	160	170	170	192									
14	140	125/-140/125 160/140 180/160	160	160	190	190	207	140	150	60	60	115	125.4	4	6	2.5
	160		180	160	200	200	217									
	180		200	180	220	220	-									
	160		180	200	215	215	244									
18	180	160/-180/160 200/180 225/200	200	200	240	240	264	180	188	60	65	120	160.4	4	6	2.5
	200		225	200	250	250	273									
	225		250	225	275	275	-									
	200		225	250	265	265	308									
	225	200/-225/200 250/225 280/250	250	250	290	290	328	220	240	70	70	135	200.4	6	10	4
22	250		280	250	315	315	339									
	280		315	280	345	345	-									
	300		330	300	345	345	-									
	250		280	315	325	325	378									
	280	250/-280/250 300/280 315/280 335/315 355/335	315	315	355	355	408	280	296	70	75	140	250.4	6	10	6
28	300		315	315	375	375	408									
	315		345	315	390	390	423									
	335		365	355	430	410	-									
	355		385	355	430	430	-									

1. Recommended Shaft dia and tolerance as per EDP calculation.
2. Where a non-locating bearings is to permit greater axial movement (e.g., to allow for thermal expansion), the distance b8 between the collars can eb increased.
3. The normal axial clearance considered is approx. 0.5 mm. Where directional changes of thrust loads or where axial shocks are to be anticipated, the dimension may be reduced by further 0.3 mm. If the locating bearing is used for test run only, dimension b13 may be increased by 3 to 6 mm. In this case, the dimension b6 and b8 have to be considered.
4. All diameters d23 are valid for each shaft diameter D.

   Tolerance of form and position follow DIN 31699

   Degree of accuracy B 10 (radial). Degree of accuracy B 20 (axial); others upon request. General tolerance DIN 7168 mS.

GUIDE TO DESIGN AND SELECTION OF SLIDE BEARINGS FOR APPLICATION IN ROTATING ELECTRICAL MACHINES AND TURBINES

The design of a suitable hydrodynamic bearing involves numerous mathematical calculations and may produce equal number of solutions to choose from, making design activity a very complex issue. There also exist empirical guide lines approximation leading to an unsatisfactory performance.

The following guide lines are for a preliminary selection of a suitable hydrodynamic bearing and explore areas which a machine designer should take into consideration while selecting a bearing. In any case, it is always advisable to get the selection verified by computer application for thermic and hydrodynamic performance by us.

I. OIL FILM LIMIT

In a hydrodynamic bearing, the shaft and the bearing white metal are always separated by a minimum layer of oil which prevents a severe wear, overheating and ultimately destruction of the bearing. The minimum oil film thickness is important in this respect.

Fig. 1 indicates an appropriate relationship between the surface roughness of the shaft and minimum oil film thickness to prevent a metalic contact. It is assumed that the surface finish of the bearing white metal is of same order after running in. Please see Fig. 1 and Table 1.

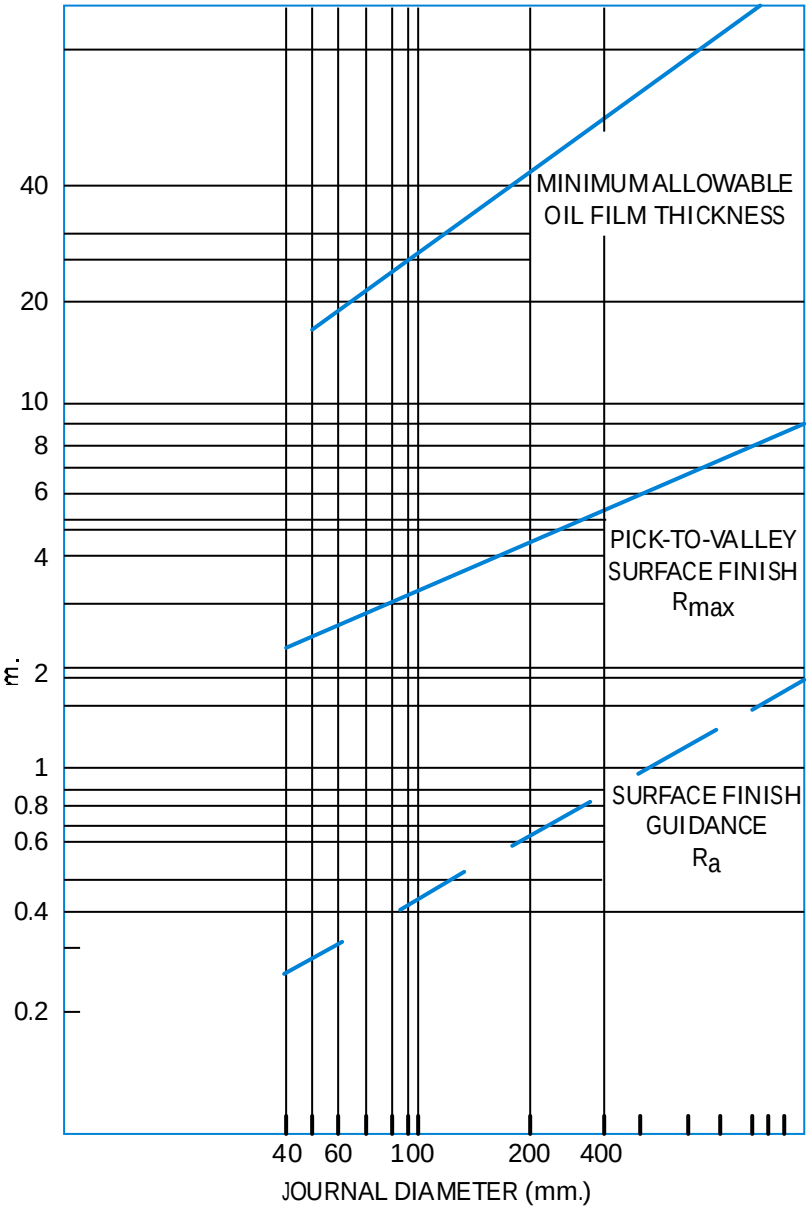


Fig. 1: Recommended Minimum Allowable Oil Film Thickness

Table 1 : Minimum admissible oil film thickness in μ mm.

Shaft Ø (mm.)	**Sliding Velocity (m/s)**		
	≤ 3 to 10	**< 10 to 30**	**< 30**
20 to 65	15	19	22
65 to 165	18	22	29
165 to 400	22	28	36
400 to 1000	28	34	48

II. OIL FILM INSTABILITY

In a condition of low load and high surface speed in a cylindrical bearing, there can set in a self-sustaining motion of shaft centre around the bearing centre at approximately half the synchronous speed. In this condition, an instability of shaft motion sets in causing first of all break in oil film, surface to surface contact and severe shaft vibration leading to the destruction of the bearing.

Fig. 2 gives a preliminary guide to prediction of instability. While the subject is discussed here to draw the attention of the machine designer at the time of selecting the bearing, to this aspect, it is best to leave the final decision to the bearing designers EDP calculation and recommendations.

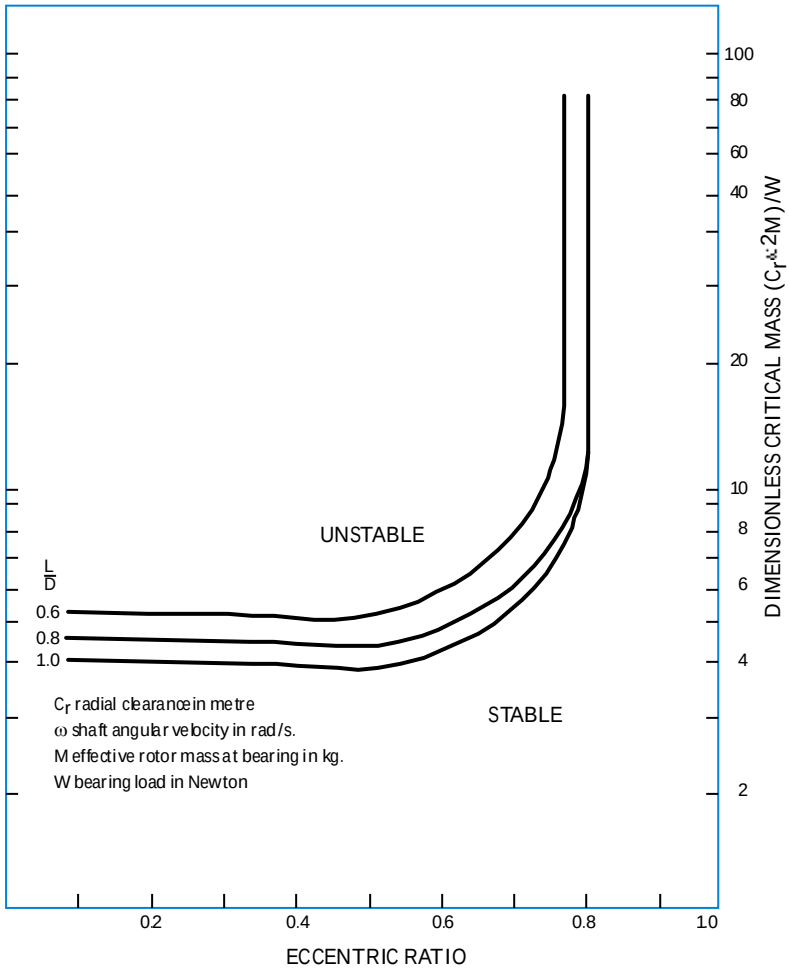


Fig. 2: Oil Whirl Instability of Cylindrical Bore Journal Bearings-Limiting Dimensionless Mass

III. SELECTION OF BEARING SIZE ON RADIAL LOAD BASIS

In a given condition of a hydrodynamic bearing, the load may have an effect on stability, temperature and bearing life. Some aspect of these have been discussed earlier.

Fig. 3 has been devised to help the machine designer to select a bearing bore and frame size in preliminary stage. The approximate unit load considered is 2 N/mm^2. Please see Fig. 3.

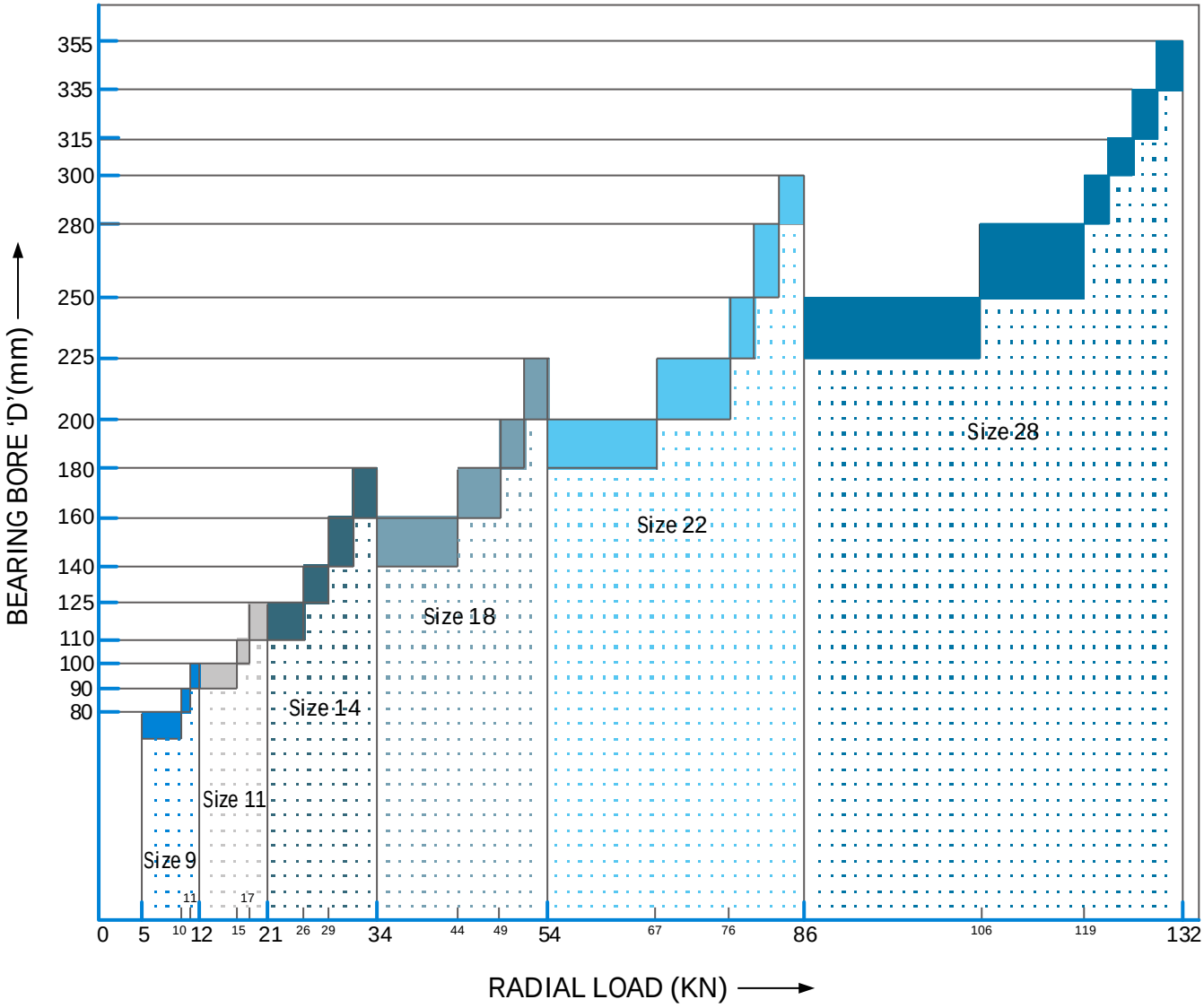


Fig. 3: Recommended bearing size selection on Radial load basis

GUIDE TO DESIGN AND SELECTION OF SLIDE BEARINGS FOR APPLICATION IN ROTATING ELECTRICAL MACHINES AND TURBINES

IV. RECOMMENDED MINIMUM BEARING CLEARANCE

The bearing bore is machined to Standard ISO (286-2) tolerance of H7. The bearing clearances are made within the shaft tolerances. Standard shaft tolerances, being too large for consideration in hydrodynamic bearings, shaft tolerances are taken from DIN 31698 and consequently, the minimum and maximum clearances are results of maximum and minimum deviations of both shaft and bearing bore. The values of shaft tolerances are given for five relative bearing clearances 'ψ**m**' which have a relationship with peripheral speed of shaft. Fig. 4 gives recommended shaft deviations for different shaft diameters corresponding to different surface speed (rpm).

	ψm [‰] cylindrical bearing Ø D [mm]		
Peripheral speed(m/s)	**≤ 100**	**≤ 100 to 250**	**< 250**
≤ 3	1.32	1.12	1.12
< 3 to 10	1.6	1.32	1.12
< 10 to 25	1.9	1.6	1.32
< 25 to 50	2.24	1.9	1.6

For normal operating conditions, the following recommendations apply for the choice of mean bearing clearance ψm in relation to peripheral velocity v:
This table does not take into account any extraordinary factors, such as, for example:

- High shaft temperature within the bearing in case of heat transfer through the shaft, for example, hot gas fan drive.
- Loading of the bearing beyond safe value
- Very high or low viscosity lubricants

Nominal Shaft range (mm)		**Permissible deviations of the shaft in µm for ψm**				
over	**upto**	**1.12**	**1.32**	**1.6**	**1.9**	**2.24**
70	80	-60 -79	-75 -94	-96 -115	-118 -137	-144 -163
80	90	-67 -89	-84 -106	-108 -130	-133 -155	-162 -184
90	100	-78 -100	-97 -119	-124 -148	-152 -174	-184 -206
100	110	-89 -111	-110 -132	-140 -162	-171 -193	-207 -229
110	120	-100 -122	-122 -145	-156 -178	-190 -212	-229 -251
120	140	-113 -138	-139 -164	-176 -201	-215 -240	-259 -284
140	160	-136 -161	-166 -191	-208 -233	-253 -278	-304 -329
160	180	-158 -183	-192 -217	-240 -265	-291 -316	-348 -373
180	200	-175 -204	-213 -242	-267 -296	-324 -353	-388 -417
200	220	-201 -230	-243 -272	-303 -332	-366 -395	-439 -468
225	250	-229 -258	-276 -305	-343 -372	-414 -443	-495 -524
250	280	-255 -287	-308 -340	-382 -414	-462 -494	-552 -584
280	315	-291 -323	-351 -383	-434 -466	-523 -555	-624 -656

Fig. 4

V. THRUST LOAD

DIN-type bearings can take up thrust loads normally encountered in rotating electrical machines or, horizontal hydro-turbine applications.

The types of thrust collars and their axial load carrying capacity is enumerated in Table 2.

AXIAL THRUST

Type 'B' : Plain white metal thrust surface with radial oil grooves can take only locating thrust load.

Type 'K' : Taper land thrust surface created on the white metal thrust faces of the bush and can carry continuous load in both direction of rotation.

Type 'A' : It can take high continuous thrust load by the 'RD pads' mounted on cup springs as centrally pivoted.

Type 'Q' : Plain non-white metalled side face not meant for carrying any thrust load. 'RD pads' can be mounted on this surface.

Table 2

Size	Diameter 'D' (mm)	Thrust Load 'B' surface	'K' surface	'A' surface
9	80	950	3200	6900
	90	1100	3700	8000
	100	1200	3700	4800
11	100	1400	4200	8000
	110	1850	5800	9000
	125	1650	5250	5250
14	125	2250	6350	17650
	140	2900	9100	19600
	160	2300	7050	12000
	180	1950	6100	10500
18	160	3500	11050	33650
	180	4400	12900	37400
	200	3700	11050	23500
	225	3100	10050	21400
22	200	5200	16000	54250
	225	5700	18450	60300
	250	6100	19500	44850
	280	6500	20500	42500
	300	6900	22000	40500
28	250	7400	23500	84800
	280	8200	26200	94200
	300	8700	28350	72300
	315	9150	30050	68000
	335	9450	32000	65050
	355	9750	34000	62100

GUIDE TO DESIGN AND SELECTION OF SLIDE BEARINGS FOR APPLICATION IN ROTATING ELECTRICAL MACHINES AND TURBINES

VI. SELECTION OF LUBRICANT OIL

Selection of lubricating oil is often guided by the environment or, the compulsion of an existing system with a specific grade. However, when an opportunity exists to select the viscosity grade w.r.t. specific load and surface speed, a general guide is available in Table 3. While selecting a lubricating oil for sub-zero temperature, the pour point temperature of the oil is of most importance.

In the calculation for bearing performance, the oil viscosity at the operating temperature is most important for the performance of the bearing. Any change in oil with different viscosity may seriously impair the performance. In such case, it is necessary to ask DVB for a recalculation.

Table 4 provides for the oil outlet dimensions w.r.t. volume and viscosity of oil. Both DIN 2573 and ANSI flanges are available, if specified with order. Please see Table 4 and Table 3.

Table 3 : General guide to the selection of viscosity for lubricant oil

Specific load (N/mm^2)	Surface Speed (m/s)					ISO VG
	< 3	**< 3 to 10**	**< 10 to 25**	**< 25 to 50**	**<50**	
≤ 1.25	68	46	46	32	32	
> 1.25 to 2.5	100	68	46	46	32	
> 2.5	150	100	68	46	46	

Table 4 : Recommended size of oil outlet for viscosity & quantity of oil

Size	Oil Outlet	ISO VG 32 & 46 lit/min at 40^0C	ISO VG 68 & 100 lit/min at 40^0C	Oil Outlet	ISO VG 32 & 46 lit/min at 40^0C	ISO VG 68 & 100 lit/min at 40^0C
9	G $1^1/_4$	8	7	2 x G $1^1/_4$	16	14
11	G $1^1/_4$	8	7	2 x G $1^1/_4$	16	14
14	G $1^1/_2$	10	9	2 x G $1^1/_2$	20	18
18	G $1^1/_2$	10	9	2 x G $1^1/_2$	20	18
22	G 2	19	17	2 x G 2	38	34
28	G $2^1/_2$	28	25	2 x G $2^1/_2$	56	50

VII. SELECTING A BORE

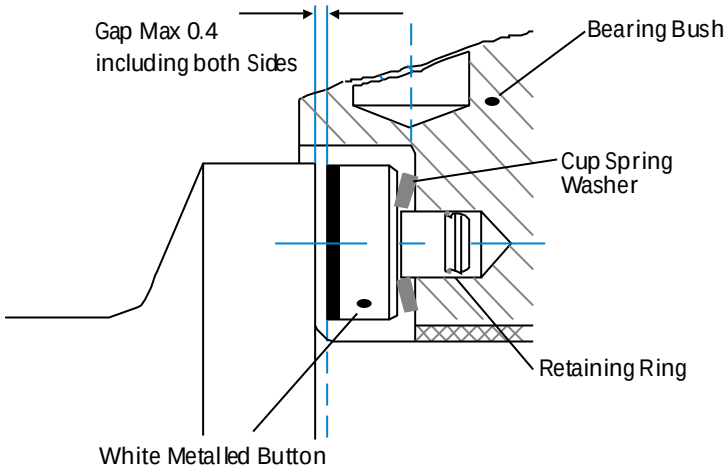
All DVB bearings in general are made with 'L' type cylindrical bearings and the performance calculations are also based on this aspect. However, in certain special circumstances, for example, with high speed and low radial load, special adaptation may be necessary.

Table 5 gives a broad guide line.

Table 5 : General guide to the selection of radial bearing bore configuration for rotating electrical machines, fans, compressors and turbines.

Bearing Type	**Cylindrical**	**Two Lobe**
Designation	**C**	**Y**
Peripheral Speed (m/s)	0 to 30	25 to 75
Specific load (N/mm^2)	0.1 to 4	0.1 to 1.8

RD PAD BUTTON TYPE THRUST BEARING



SALIENT DESIGN FEATURES OF THRUST PADS

The design of button type thrust bearing is a significant improvement over segment type both technically and economically. The design allows a possibility of a wide range of numbers, size and pitch circle to cater to exact need of the application. The cup shape provides resilience and compensation for unequal height.

The cup shape provides an ideal base for tilting of the pads and creates conditions for a lubricating oil wedge. This wedge formation is self adjusting depending on operation condition, lubricant, speed, number and size of pads etc. The cup springs are made from specific spring steel, heat-treated, ground to have equal height and are calibrated to the designed load deflection characteristics. For recommended combination of RD pads and corresponding load rating, please see dimensions diagrams and thrust load ratings.

PERMISSIBLE LOADING

The table below gives the permissible specific surface pressure.

Size(Ø)	16	18	20	25	31	40	50	63	71	80	
Start up N/mm^2	1.25			2.0							
	1.6			2.0		2.4		2.6			

Please also see Fig. 3 and Table 2 for both radial and axial load respectively

SHROUD AND CARRIER

Up to the range of frame 28, the design provides for assembly for RD pads directly on the bush face. For frames above, the pads are generally mounted on a Carrier or, a Shroud to ensure easy maintenance and oil supply.