ZOLLERN

Solid metals. Fine solutions.

Plain Bearing Technology

ZF end flange mounted bearing

The ZOLLERN Group
ZOLLERN is one of the pioneers of the metal industry. 3,000 employees at 15 production locations and seven subsidiaries in Europe, North and South America and Asia develop, manufacture and supervise a range of innovative metal products. ZOLLERN supplies sophisticated solutions for diverse applications through its business units drive technology, plain bearing technology, foundry technology, mechanical engineering elements and steel profiles.

Content Side

Description of the ZF design

The ZOLLERN type ZF horizontal bearing is designed according to DIN 31 693 norm specifications for a wide range of heavy duty applications (electrical machines, turbines and test rigs). The modular system applies to the different types of bearings (pedestal, end flange and center flange), i.e. it is always possible to combine different modules of this system. Thus, assembly is simple and mistakes due to the positioning of screws and pins are avoided during installation, commissioning and maintenance procedures.

Housing
The bearing housings are finned, and are manufactured from gray cast iron EN-GJL-300 (GG 30), which combines a better heat dissipation with high strength. Upon request, they can also be supplied in nodular cast iron. The spherical seat in the housing ensures easy alignment during assembly and the loads are evenly distributed into the lower part of the housing. Therefore these bearings are designed for highest stress applications. Thread holes for monitoring the temperature, for oil inlet and outlet, as well as for oil level, are provided on both sides of the housing as standard. The housing comes with an oil sight glass on one side. The opposite side is supplied plugged and may be used as an oil outlet. If needed, their positions can be exchanged by reversing these parts. In the top half of the housing, a sight glass, which permits the loose oil ring to be viewed, and a plugged manual oil feeder are provided. The basic design can be easily amended, if required, to incorporate water cooling tubes, oil sump heater, vibration detectors (angled at 45°), horizontal, vertical and axial vibration sensors and earthing devices. Upon request, thread holes can be provided in the ZF housing to meet all 541 and 546 requirements for API norms.

Bearing shells
The shell is supplied in halves and spherically seated in the housing, ensuring easy self-alignment during assembly. The material is low carbon steel, lined with high tin-based white metal. This construction ensures an easy assembly and a long life cycle. Bearing shells with plain cylindrical bore and loose oil ring are used in most cases, but other shapes of bore are possible. When the specific load on start-up is too high, or for very slow-speed applications, a hydrostatic jacking system can be incorporated. Bearing shells can be provided with or without thrust faces.

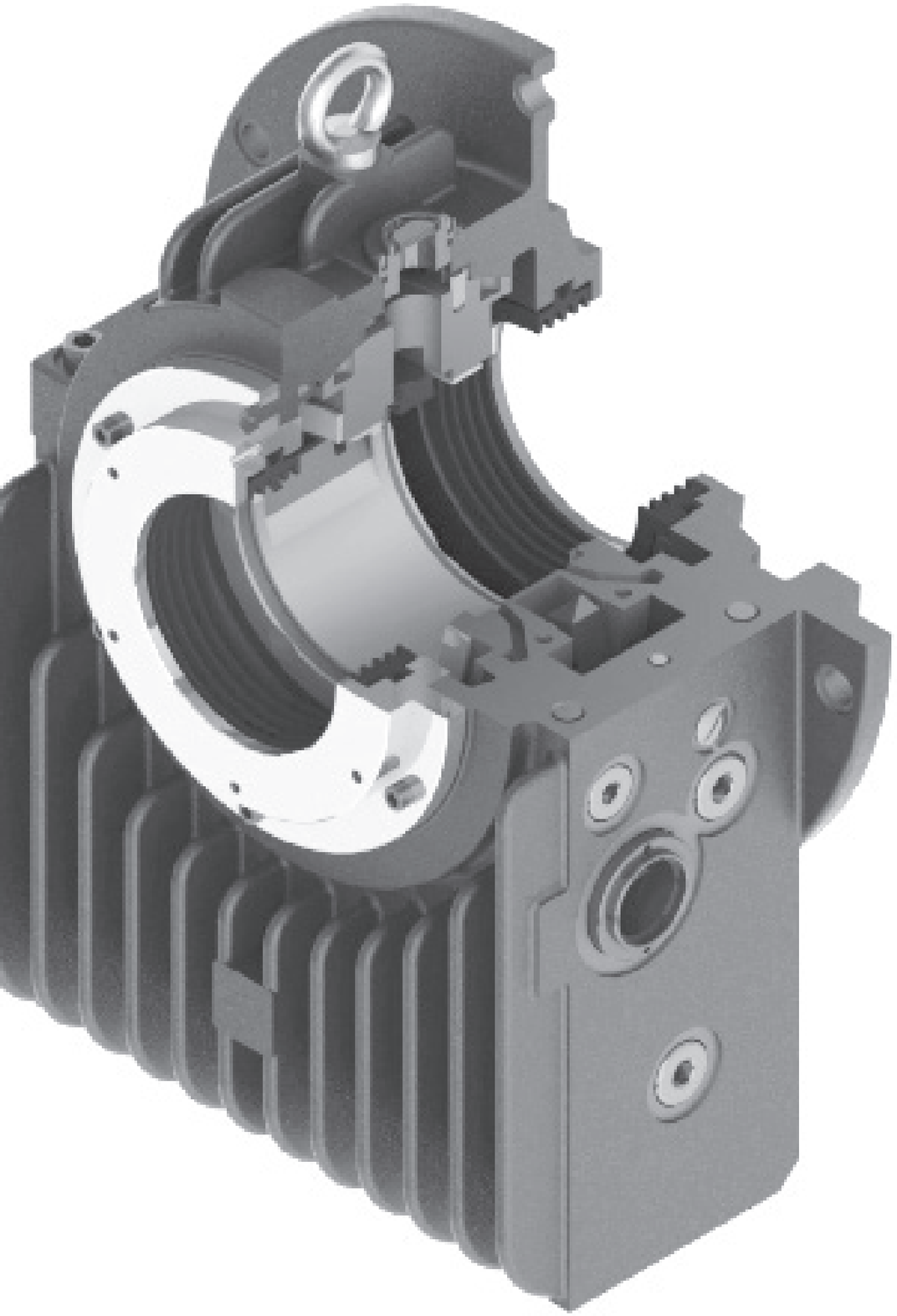
Q-type shells have no thrust capability for non-locating bearings.

B-type shells with plain white metal lined shoulders with oil grooves are suitable for small, temporary thrust loads.

K-type shells have taper land faces for medium thrust loads and both directions of rotation.

D-type shells, with taper land faces suitable for only one direction of rotation, are capable of absorbing higher thrust loads.

A-type shells, for the highest loads, are equipped with thrust tilting pads.



Oil supply
Fully self-contained lubrication is achieved by using a loose oil ring. Alternatively, where bearings are lubricated by an external oil circulation system, this loose oil ring can be used to permit an emergency shutdown without damage in case an oil system failure occurs. Z-bearings can be used for marine applications, where an oil ring guide assures proper lubrication even if extreme vessel motions occur.

Electrical insulation
To prevent stray currents conducted by the shaft, Z-bearings can be supplied electrically insulated as an option. In this case, the spherical seat of the housing is coated with a wear-resistant and temperature-resistant synthetic material. Upon request, a grounding wire is provided to short out this insulation, passing through a thread hole (M12x1.5) in the housing.

Sealing
The seals are selected for the different operation conditions and environments and for the requested protection level. The standard arrangement is the floating labyrinth seal (IP 44) made of high heat resistant, fiber-reinforced synthetic material. Bearings for high oil throughput are equipped with adjustable rigid seals (IP 44) made of aluminum alloy. Both types of seals can be equipped with bolt-on baffles (IP 55) or dust flingers (IP 54) if the bearing is operating in a dusty or a wet environment, or if rotating parts (clutches, couplings, fans etc.) are fitted close to the bearing. Special seals offering higher protection, or pressurized seals etc., can be supplied for special applications upon request. An end cover is used when the end of the shaft is inside the bearing housing.

Temperature control
Provisions for the fitting of thermo sensors in the journal bush and oil sump are provided as standard. The type of sensor to be used depends on the type required by the readout equipment used (direct reading, centralized control system, recording instrument, etc.). For bearings with high thrust loads, additional thermometers for the thrust part can be integrated.

Machine seal
Where negative or positive pressures occur near the internal floating seals ZF bearings should be used with an additional machine seal to avoid interference from inside the machine. This machine seal is fitted to the inside of the machine housing, creating a chamber between the machine seal and the bearing seal.
To equalize the pressure, the chamber is connected to atmosphere, which prevents oil leakage from the bearing into the machine enclosure.

Selection of oil
It is recommended that any branded mineral oil which is inhibited against foaming, ageing and oxidation is used as lubricant. The viscosity is suggested by ZOLLERN if the customer doesn`t have preferences.

Bearing calculation
ZOLLERN uses a state of the art calculation program which can provide the following outputs.

- Minimum oil film thickness
- Maximum hydrodynamic pressure
- Maximum bearing temperature
- Oil outlet temperature
- Minimum permissible oil flow
- Frictional power loss
- Stiffness and damping coefficients

Radial bore profile selection

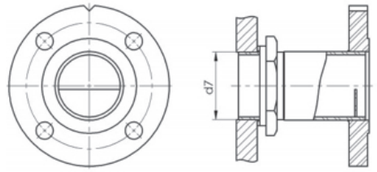
The radial bore profile type selection depends on several conditions. Among them we have the circumferential speed and the specific pressure. The following table should help in a preliminary selection.

// Type of radial bearing bore profile

Type of bore	Circumferential speed U (m/s)	Specifc load p (N/mm²)
C Cylindrical	0 to 30	0,1 to 4
Y Two-lobe	25 to 75	0,1 to 3
V Four-lobe	25 to 125	0 to 2
K Radial tilting pads	15 to 150	0 to 2

Oil flow

Z bearings are supplied without oil inlet or outlet flanges. Under request, as additional items, ZOLLERN can supply these flanges according to DIN 2573 or ANSI B16.5 norms. Oil outlet flanges with weir are to be mounted with the weir horizontal at the bottom. The mark on the flange will then be visible in the center of the top side.



Size	Oil outlet thread	Oil outlet DN	Maximum flow for oil ISO VG 32 and 46 at 40°C (l/min)	Maximum flow for oil ISO VG 68 and 100 at 40°C (l/min)	Oil outlet threads (using both oil outlets)	Maximum flow for oil ISO VG 32 and 46 at 40°C (l/min)	Maximum flow for oil ISO VG 68 and 100 at 40°C (l/min)
7	G 1"	DN 25	7	5	2 x G 1"	14	10
9	G 1 ¼"	DN 32	9	7	2 x G 1 ¼"	18	14
11	G 1 ¼“	DN 32	9	7	2 x G 1 ¼“	18	14
14	G 1 ½"	DN 40	11	9	2 x G 1 ½"	22	18
18	G 1 ½“	DN 40	11	9	2 x G 1 ½“	22	18
22	G 2"	DN 50	18	16	2 x G 2"	36	32
28	G 2 ½"	DN 65	28	25	2 x G 2 ½"	56	50

Radial and axial loads

Ratio	Diameter (mm)	F_{Radial} (kN)	F_{Axial} (kN) - Type			
			B	K	D	A
7	60	7.800	540	1.660	-	-
	70	9.100	620	1.940	-	-
	80	10.400	700	2.210	-	-
9	80	12.780	860	3.430	4.940	9.680
	90	14.370	950	3.840	5.600	11.060
	100	16.900	1.050	4.110	6.250	6.840
11	100	21.170	1.190	4.740	7.320	11.060
	110	23.290	1.570	6.220	9.750	12.450
	125	27.630	1.460	5.730	9.190	7.520
14	125	34.260	1.940	7.650	11.760	23.860
	140	38.370	2.500	10.040	15.380	26.510
	160	44.270	2.050	7.970	12.730	16.590
	180	49.800	2.290	9.680	14.370	-
18	160	56.460	3.080	12.420	18.340	46.300
	180	63.510	3.860	15.580	23.490	51.440
	200	73.010	3.280	12.890	20.110	32.990
	225	82.140	3.650	15.570	22.750	-
22	200	87.620	4.500	17.410	27.210	79.170
	225	98.580	5.000	19.280	30.640	87.970
	250	114.210	5.500	22.280	34.170	65.470
	280	127.910	6.100	26.570	38.350	54.980
	300	137.050	4.300	18.230	26.320	-
28	250	138.580	6.500	26.770	39.280	123.710
	280	155.210	7.190	30.050	44.110	137.450
	300	170.430	7.660	31.720	47.330	105.560
	315	178.960	8.000	34.080	49.810	96.510
	335	190.320	8.470	30.860	53.030	74.820
	355	201.680	5.750	20.890	28.050	40.220

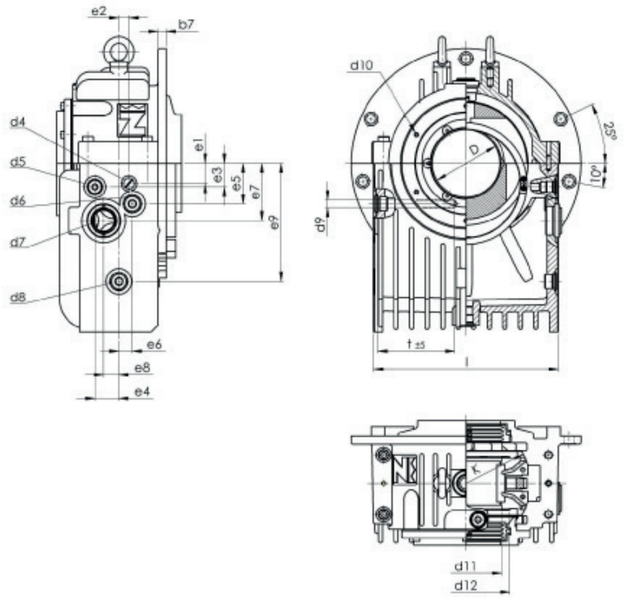
Please note: The loads presented within the table are values for a preliminary dimensioning of the bearing size. We recommend a specific bearing calculation to review the bearing dimensions selected.

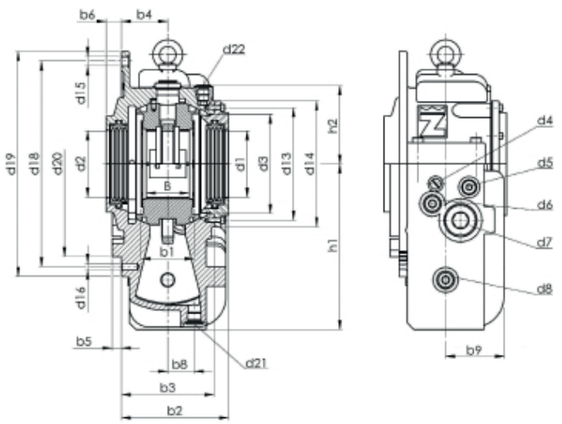
ZF bearing dimensions

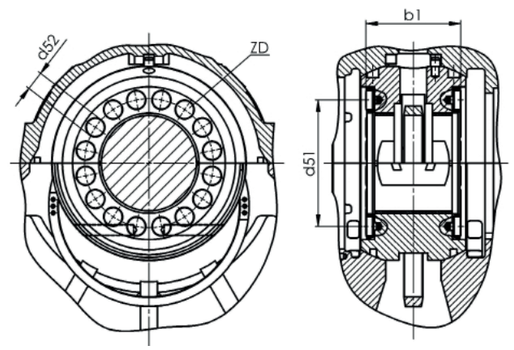
Size	D (H7)	B	b1	b2	b3	b4	b5	b6	b7	b8	b9	d1 nom. size seal (optional)	d2	d3	d5	d7	d9	d10	d11	d12	d13	d14	d15	d16	d18	d19	d20 (h8)	d51	d52	e1	e2	e3	e4	e5	e6	e7	e8	e9	h1	h2	l	t ±5	dia. k	ZD titling pads number per side	weight appr. kg	Oil content appr. l
7	60	50,0	60	130	108	50	12	31	12	0	78	60/70	80	130	G 1/4	G 1	8	6 x M6	66	86	150	170	11	M10	235	260	210	-	-	16	15	24	26	45	15	70	22	125	180	95	200	80	140	-	25	1
	70	50,0										80/90							76	96																										
	80	50,0																	86	106																										
9	80	61,4	80	162	140	70	14	23	12	40	88	80/90	100	150	G 3/8	G 1 1/4	11	6 x M6	86	110	170	190	14	M12	310	340	280	110	20	30	15	35	35,5	60	20	85	22,5	175	250	118	270	115	190	14	47	2,7
	90	61,4										100/110							96	120								120	20														115		16		
	100	65,0																	106	130								125	16														115		20		
11	100	81,4	100	187	165	80	15	29	17	50	101	100/110	125	180	G 3/8	G 1 1/4	11	6 x M6	108	135	195	215	14	M12	350	380	315	135	20	30	17,5	40	42	70	22,5	100	22,5	195	280	135	310	135	212	16	72	4
	110	81,4										125/140							118	150								140	20														135		18		
	125	85,0																	133	160								150	16														125		22		
14	125	105,4	125	227	205	100	16	26	23	65	117	125/140	160	230	G 3/8	G 1 1/2	11	6 x M6	135	170	270	290	18	M16	415	460	355	165	25	30	27,5	60	55	85	27,5	125	27,5	240	340	165	370	165	280	18	128	7,5
	140	105,4										160/180	160						150	190								180	25														165		20		
	160	106,4											160						170	200								195	20														145		24		
	180	106,4											180						190	220								-	-														125		-		
18	160	135,7	160	265	241	116	18	31	25	70	157	160/180	200	275	G 1/2	G 1 1/2	13	8 x M8	172	215	320	340	22	M20	490	540	400	210	31,5	30	30	70	68	105	30	155	30	270	400	225	440	197	335	18	210	14
	180	135,7										200/225	200						192	240								230	31,5														197		20		
	200	140,4											200						212	250								245	25														175		24		
	225	140,4											225						237	275								-	-														150		-		
22	200	168,5	200	336	314	150	20	32	37	100	202	200/225	250	340	G 3/4	G 2	13	8 x M8	214	265	380	400	26	M24	620	680	500	265	40	35	35	80	83	135	40	175	40	350	450	275	550	252	425	18	410	24
	225	168,5										250/280	250						239	290								285	40														252		20		
	250	175,7										300	250						264	315								305	31,5														236		24		
	280	175,7											280						294	345								320	25														198		32		
	300	175,7											300						310	345								-	-														174		-		
28	250	213,2	250	387	365	170	24	43	42	110	233	250/280	315	440	G 3/4	G 2 1/2	13	8 x M8	266	325	500	525	33	M30	770	850	600	325	50	45	45	95	106	155	50	220	50	400	500	330	690	323	530	18	700	35
	280	213,2										300/315	315						296	355								355	50														323		20		
	300	218,5										355	315						316	375								365	40														273		24		
	315	218,5											355						331	390								380	40														268		24		
	335	218,5											355						351	410								380	31,5														243		30		
	355	218,5											355						371	430								-	-														225		-		

Dimensions in millimeters

d4 = Earthing device or plug M12x1,5
d5 = Oil inlet (oil circulation or recirculating pump)
d6 = Provision for thermometer G 1/2“
d7 = Oil sight glass or oil outlet (oil circulation)
d8 = Plug G 1/2“ (connection for heater, oil sump thermometer, water cooler)
d21 = Oil drain plug
for size 9 up to 18: G 1/2“
for size 22 and 28: G 3/4“
d22 = Oil filling or breather
for size 9 and 11: G 3/8“
for size 14 and 18: G 1/2“
for size 22 and 28: G 3/4“
t = Depth of thermometer bore







Thrust face type A

Drawings shown here are for reference only. Some fin details, for example, may vary from size to size.

Dimensions of shaft

Size	D [1]	b20 [2]	b21 [3]	b22	b23 [4]	b24	b25	d30	d31 (e8) d32	d33	d34 (e8)	d35 [5] (e8)	d50	R1 [6]	R2 [6]	R3
7	60	60,4	67	75	51,5	51,5	94	86	60 / 70 / 80 / 90	70	80	90	-	2	2	1,5
	70							90	- / 64 / 74 / 84	80		100				
	80							106		90		110				
9	80	80,4	90	100	50	50	106	110	80 / 90 / 100 / 110	90	100	110	132	2,5	4	1,6
	90							120	- / 80 / 90 / 100	100		120	142			
	100							130		110		130	143			
11	100	100,4	110	120	50	55	113	135	100 / 110 / 125 / 140	110	125	135	157	2,5	4	1,6
	110							150	- / 100 / 110 / 125	125		150	162			
	125							160		140		160	168			
14	125	125,4	140	150	60	60	123	170	125 / 140 / 160 / 180	140	160	170	192	4	6	2,5
	140							190		160		190	207			
	160							200	- / 125 / 140 / 160	180	180	200	217			
	180							220		200		220	-			
18	160	160,4	180	188	60	65	127	215	160 / 180 / 200 / 225	180	200	215	244	4	6	2,5
	180							240		200		240	264			
	200							250	- / 160 / 180 / 200	225	225	250	273			
	225							275		250		275	-			
22	200	200,4	220	240	70	70	140	265	200 / 225 / 250 / 280 / 300	225	-	265	308	6	10	4
	225							290		250	-	290	328			
	250							315		280	250	315	339			
	280							345	- / 200 / 225 / 250 / 280	315	280	345	348			
	300							345		335	300	345	-			
28	250	250,4	280	296	70	75	139	325	250 / 280 / 300 / 315 / 335 / 355	280	315	325	378	6	10	6
	280							355		300		355	408			
	300							375		315		375	408			
	315							390	- / 250 / 280 / 280 / 315 / 335	335		390	423			
	335							410		355	355	395	414			
	355							430		375		395	-			

[1] Limit dimensions of the shaft acc. DIN 31 698, form and positional tolerance and surfaces roughness acc. to DIN 31 699.

[2] Standard thrust clearance is 0,5 mm. If reversible thrust loads or shock load occur, dimension b20 can be reduced by 0,2 mm. If a locating bearing (shell type B,K) is needed only for test runs, dimension b20 can be enlarged by 4 up to 6 mm.

[3] If the non-locating bearing must allow larger motions (due to heat expansion or to large thrust clearances caused by the unit), dimension b21 can be enlarged.

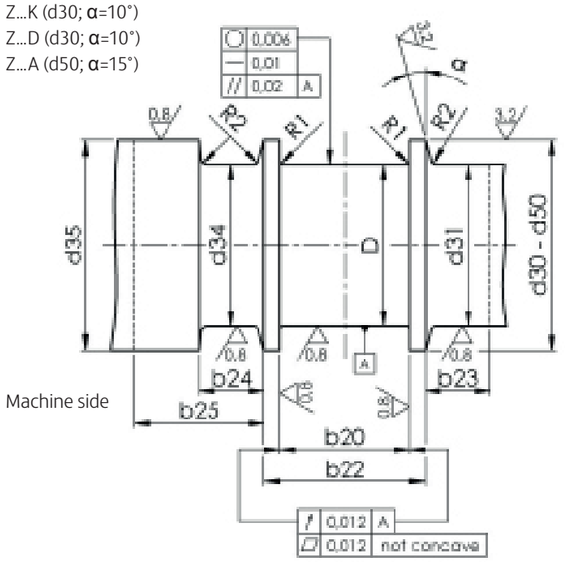
[4] Dimension b24 is valid for a bearing with a floating labyrinth seal.

[5] Diameter d35 can be combined with every shell of dia. D within one size.

[6] Radii R1 and R2 can be replaced by a plunge cut acc. to DIN 509.

For locating bearing shell

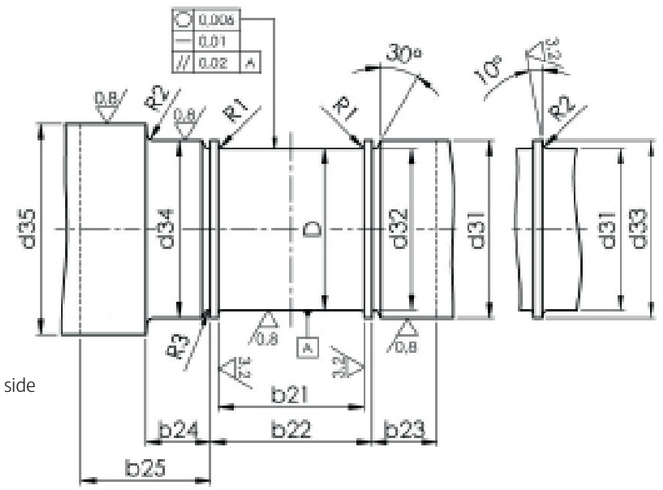
Z...B (d30; α=10°)
Z...K (d30; α=10°)
Z...D (d30; α=10°)
Z...A (d50; α=15°)



Machine side

For non-locating bearing shell

Z...Q



Machine side

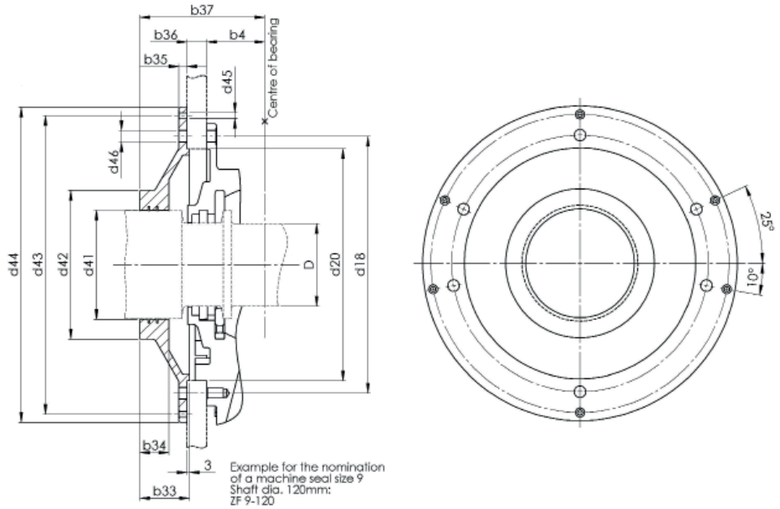
Dimensions in millimeters

Dimensions of machine seals

Size	b33	b34	b35	b36[7)]	b37	d18	d20	d41[8)] (optional)	d42	d43	d44	d45	d46	weight appr. kg
7	60	25	10	16	123	235	210	91,5	135	265	280	6,6	11	5,0
								101,5						4,7
								111,5						4,5
9	60	35	10	24	151	310	280	111,5	180	360	380	6,6	14	10,5
								121,5						10,0
								131,5						9,5
11	65	35	10	26	168	350	315	136,5	210	400	420	6,6	14	12,6
								151,5						11,7
								161,5						11,1
14	70	35	10	26	193	415	355	171,5	250	375	390	6,6	–	12,6
								191,5						11,1
								201,5						10,3
								221,5						9,5
18	75	40	10	28	216	490	400	216,5	270	430	455	9	–	18,7
								241,5						16,1
								251,5	310					15,0
								276,5						14,0
22	80	40	10	28	255	620	500	266,5	320	535	570	9	–	24,5
								291,5						21,3
								316,5						17,8
								346,5	375					16,1
								346,5						16,1
28	85	50	10	30	282	770	600	326,5	390	640	680	9	–	43,0
								356,5						37,2
								376,5						33,0
								391,5	440					30,0
								396,5						29,0

[7)] Min. thickness of the machine shield

[8)] In order to allow the assembly of the machine seal, the inner dia. d41 must be larger than the dia. of the shaft collar d30 of the locating bearing

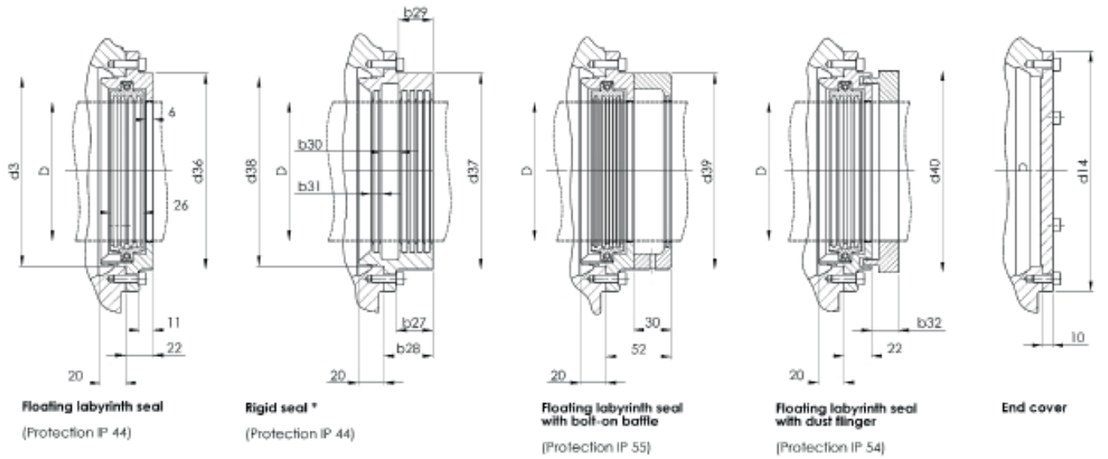


Dimensions in millimeters

Types and dimensions of seals

Size	D	b27	b28	b29	b30	b31	b32	d3	d14	d36	d37	d38	d39	d40
7	60	21	31	21	12	8	21,5	130	170	135	135	128	135	135
	70													
	80													
	90													
9	80	29	39	27	14	8	21,5	150	190	155	155	148	155	155
	90													
	100													
	110													
11	100	31	41	27	16	8	21,5	180	215	180	180	178	155	155
	110													
	125												180	190
	140													
14	125	33	43	27	18	8	21,6	230	290	240	240	228	180	180
	140													
	160						26,5						240	240
	180													
18	160	36	46	27	21	8	26,5	275	340	240	240	273	240	240
	180													
	200									280	280		280	280
	225													
22	200	39	49	27	24	8	26,5	340	400	280	280	338	280	280
	225													
	250						31,5			346	346		346	346
	280													
	300													
28	250	43	53	27	27	10	31,5	440	525	346	346	438	346	346
	280													
	300									410	410		410	410
	315													
	355													

* Can be combined either with a bolt-on baffle (IP 55) or with a dust flinger (IP 54).



Special seal designs for specific applications upon request.

Bearing types and designations

Z	F				–		–	
1 //	2 //	3 //	4 //	5 //		6 //		7 //

1 // Type

Z	ZOLLERN plain bearing

2 // Housing

F	End flange mounted bearing, finned

3 // Heat dissipation

N	Naturally cooled by convection
Z	Lubrication by oil circulation with external oil cooling
X	Lubrication by oil circulation with external oil cooling for high oil throughput
W	Finned water cooler in the oil sump
U	Recirculating oil pump and natural cooling
T	Recirculating oil pump and water cooler in the oil sump

4 // Shape of bore and type of lubrication

C	Plain cylindrical bore without oil ring
L	Plain cylindrical bore with loose oil ring
F	Plain cylindrical bore with oil disk
Y	Two-lobe bore without oil ring
V	Four-lobe bore without oil ring
K	Journal tilting pads without oil ring

5 // Geometry of thrust bearing

Q	Without thrust capability
B	Plain white metal lined shoulders with oil grooves
K	Tapered land thrust faces for both sense of rotation
D	Tapered land thrust faces for one sense of rotation
A	Round tilting thrust pads, cup spring supported

6 // Size

7 // Shaft diameter (mm)

Example of a bearing designation:

Z F N L B - 11 - 125

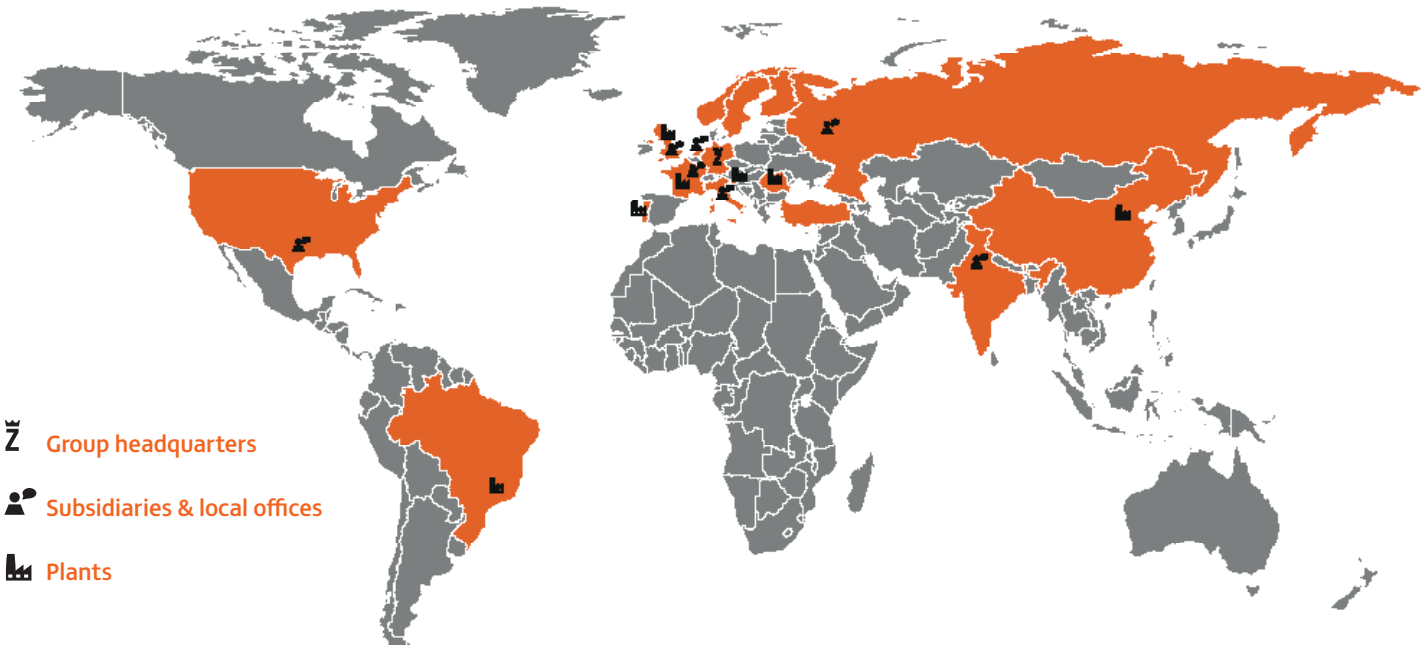
ZOLLERN end flange mounted, finned bearing, naturally cooled by convection, plain cylindrical bore with loose oil ring, plain white metal lined shoulders with oil grooves (locating or non-locating bearing), size 11, for shaft diameter 125 mm.

ZM - Center flange bearing
The ZOLLERN type ZM horizontal bearing is designed acc. to DIN 31 694 norm specifications for a wide range of heavy duty applications (electrical machines, turbines and test rigs)

ZR - Pedestal bearing
The ZOLLERN type ZR horizontal bearing is designed acc. to DIN 31 690 norm specifications for a wide range of heavy duty applications (electrical machines, turbines, blowers and test rigs)

ZOLLERN Checklist

- ☐ Operating conditions for calculation complete?
- ☐ Certification necessary (Lloyd`s, RINA...)?
- ☐ Atex class?
- ☐ Watercooler required?
- ☐ Hydrostatic oil supply required?
- ☐ Oil inlet or outlet flanges required (flange DIN)?
- ☐ Connecting diagram filled out?
- ☐ Electrical insulation required?
- ☐ Earthing device required?
- ☐ Protection class specified?
- ☐ Sealing type and diameter (outside)?
- ☐ Sealing type and diameter (inside)?
- ☐ Sealing diameter of machine seal?
- ☐ Shaft drawing available?
- ☐ Shaft vibration sensors required (thread...)?
- ☐ Speed sensor required (thread...)?
- ☐ Absolute vibration sensor required (position, thread...)?



ZOLLERN

ZOLLERN Transmissões Mecânicas LTDA

Av. Manoel Inácio Peixoto, 2147
36.771-000 Cataguases
Brazil
T +55 32 34 29 53 02
F +55 32 34 29 53 26
ztm@zollern.com.br

ZOLLERN BHW Gleitlager GmbH & Co. KG

Rolandsweg 16-20
37520 Osterode am Harz
Germany
T +49 5522 3127-0
F +49 5522 3127-99
bhw@zollern.com

www.zollern.com