

ZOLLERN

Solid metals. Fine solutions.

Plain bearing technology
ZM center
flange
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.

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Description of the design ZM

The ZOLLERN type ZM horizontal bearing is designed according to DIN 31 694 norm specifications for a wide range of heavy duty applications (electrical machines, turbines and test rigs). The modular system applies for the different types of bearings (pedestal, end flange and center flange), i.e. the combination of different modules of this modular system is always possible. This has resulted in simple assembly and elimination of mistakes during installation, commissioning and maintenance procedures due to the positioning of screws and pins.

Housing

The bearing housings are finned and manufactured from gray cast iron EN-GJL-300 (GG 30) giving high strength and best heat dissipation. Under (Upon?) request, they can be supplied also in nodular cast iron. The spherical seat in the housing ensures easy alignment during assembly and the loads are steady induced to the lower part of the housing. Therefore these bearings are designed for highest stress. 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 at one side. The opposite side will be supplied plugged and may be used as oil outlet. If needed, their positions can be exchanged by reversing these parts. The housing top half is provided

with a sight glass to permit the loose oil ring to be viewed and with a plugged manual oil feeder. Water cooling tubes, oil sump heater, vibration detectors (angled at 45°), horizontal, vertical and axial vibration sensors and earthing devices can be easily fitted by small amendments, if required. Under request, ZM housing can be provided with thread holes to accomplish 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 allows easy assembly and 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 without thrust capability (Q type), or with either plain white metal lined shoulders with oil grooves for small, temporary thrust loads (B type), or taper land faces for medium thrust loads for both senses of rotation (K type), as well as taper land faces suitable for only one sense of rotation to absorb higher thrust loads (D type). For highest capacity the bearing shells can be equipped with thrust tilting pads (A type).

Oil supply

Fully self-contained lubrication is achieved from a loose oil ring. Alternatively, where bearings are lubricated by an external oil circulation system, this loose oil ring can be used to permit emergency shutdown without damage in case an oil system failure occurs. Z-bearings can be used for marine applications by using an oil ring guide to assure 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. Under 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 condition 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 is 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 added.

Machine seal

ZM bearings should be used with an additional machine seal to avoid interference from inside the machine where, negative or positive pressures occur near the internal floating seals. This machine seal is fitted to the machine side of the bearing assembly, creating a chamber between machine seal and bearing seal. The chamber is connected to atmosphere for pressure equalization, which prevents oil leakage from the bearing into the machine enclosure.

Selection of oil

It is recommended that any branded mineral oil (preferably inhibited against foaming, ageing and oxidation) is used as lubricant. The viscosity is provided by ZOLLERN if the customer doesn't have preferences.

Bearing calculation

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

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

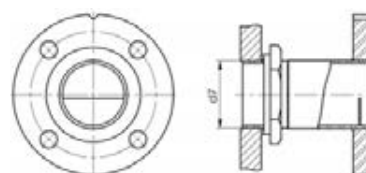
Radial bore profile selection

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)	Specific load p (N/mm ²)
C Cylindrical	0 to 30	0,1 to 4
Y Two-lobe	25 to 75	0,1 to 3
V For-lobe	25 to 125	0 to 2
K Radial tilting pads	15 to 150	0 to 2

Oil flow



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 1/4"	DN 32	9	7	2 x G 1 1/4"	18	14
11	G 1 1/4"	DN 32	9	7	2 x G 1 1/4"	18	14
14	G 1 1/2"	DN 40	11	9	2 x G 1 1/2"	22	18
18	G 1 1/2"	DN 40	11	9	2 x G 1 1/2"	22	18
22	G 2"	DN 50	18	16	2 x G 2"	36	32
28	G 2 1/2"	DN 65	28	25	2 x G 2 1/2"	56	50

Radial and axial loads

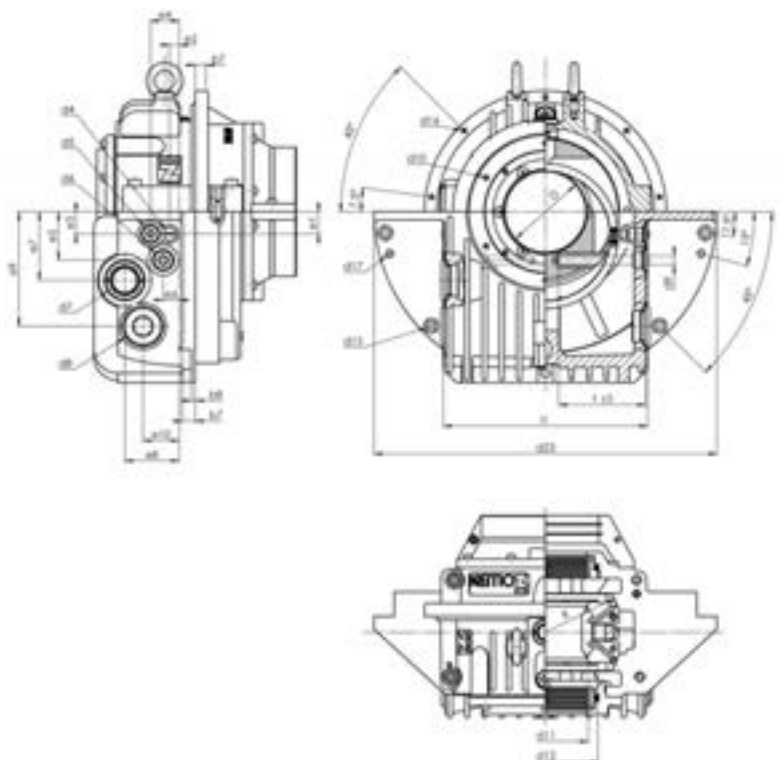
Ratio	Diameter (mm)	F _{Radial} (kN)	F _{Axial} (kN) - Type			
			B	K	D	A
7	60	7.800	540	1.660	-	-
	70	9.100	620	1.940	-	-
	80	10.400	700	2.210	-	-
9	80	12.780	860	3.430	4.940	9.680
	90	14.370	950	3.840	5.600	11.060
	100	16.900	1.050	4.110	6.250	6.840
11	100	21.170	1.190	4.740	7.320	11.060
	110	23.290	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
18	180	49.800	2.290	9.680	14.370	-
	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
28	300	137.050	4.300	18.230	26.320	-
	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

ZM bearing dimensions

Size	D (H7)	B	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10	b11	b12	nom. size d1 seal (optional)	d2	d3	d5	d7	d10	d11	d12	d13	d14	d15	d16	d18
7	60	50													60/70 80/90	80	130	G 1/4	G1	6 x M6	66	86	150	170	11	M6	250
	70	50	60	101	79	20	15	22	10	5	86	59	115	25							96	96					
	80	50																			106	106					
9	80	61,4													80/90 100/110	100	150	G 3/8	G1 1/4	6 x M6	86	110	170	190	11	M6	285
	90	61,4	80	122	100	20	30	20	16	5	106	80	145	35							96	120					
	100	65,0																			106	130					
11	100	81,4													100/110 125/140	125	180	G 3/8	G1 1/4	6 x M6	108	135	195	215	14	M6	340
	110	81,4	100	137	115	20	30	20	18	3	122	95	160	35							118	150					
	125	85,0																			133	160					
14	125	105,4													125/140 160/180	160	230	G 3/8	G1 1/2	6 x M6	135	170	270	290	18	M6	400
	140	105,4	125	159,5	137,5	25	30	22,5	20	5	144	112,5	185	35							160	160					
	160	106,4																			160	160					
	180	106,4																			180	180					
18	160	135,7													160/180 200/225	200	275	G 1/2	G1 1/2	8 x M8	172	215	320	340	22	M8	475
	180	135,7	160	179,5	157,5	25	30	17,5	25	6	165	132,5	210	40							200	200					
	200	140,4																			200	200					
	225	140,4																			225	225					
22	200	168,5													200/225 250/280 300	250	340	G 3/4	G2	8 x M8	214	265	380	400	26	M10	600
	225	168,5																			250	250					
	250	175,7	200	219,5	197,5	30	30	17,5	30	8	200	167,5	245	40							250	280					
	280	175,7																			280	280					
	300	175,7																			300	300					

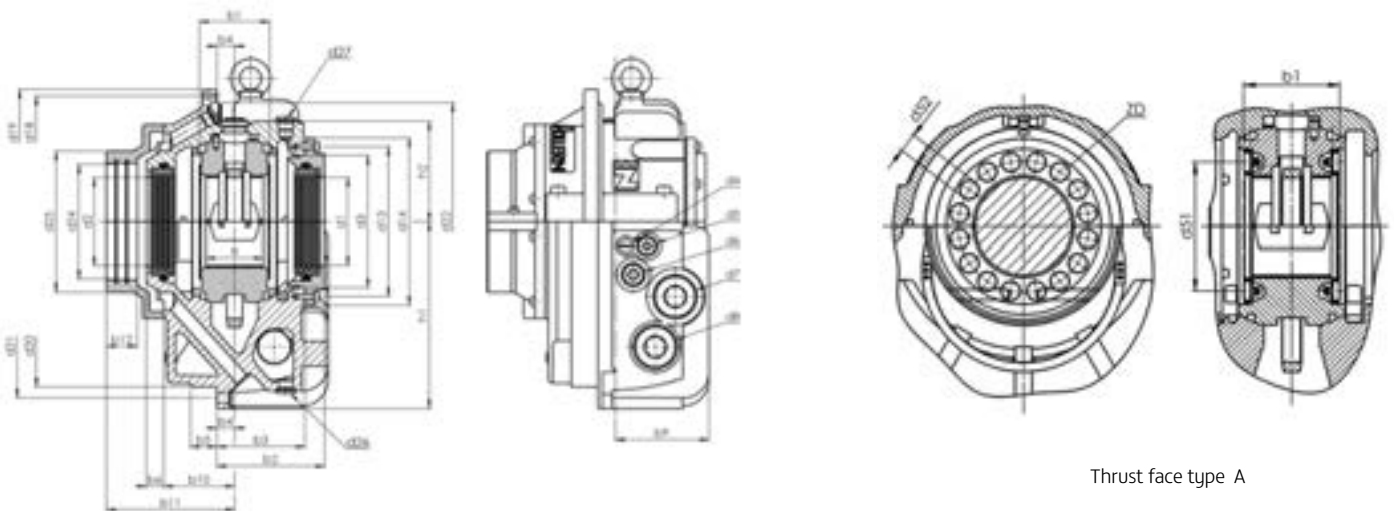
Dimensions in millimeters / Dimensions not shown see page 8

- 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 (connection for heater, oil sump thermometer, water cooler) G1 1/4"
- d9 = Up to size 14: Ø11,
From size 18: Ø13
- d17 = bore for dowel pins Ø9
- d26 = Oil drain plug
for size 7: G 1/4"
for size 9 and 11: G 3/8"
for size 14 and 18: G 1/2"
for size 22: G 1/2"
- d27 = Oil filling or breather
for size 7: G 1/4"
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



d19	d20 (h8)	d21	d22	d23	d24	d25	d51	d52	e1	e2	e3	e4	e5	e6	e7	e8	e9	e10	h1	h2	l1	t ±5	dia. k	ZD titling pads number per side	weight appr. kg	Oil content appr. l
265	300	325	235	350	90 100 110	135	-	-	24	6	24	26	45	15	70	48	125	30	175	98,5	206	93 93 83	140	-	32	1
300	375	400	270	425	110 120 130	160	110 120 125	20 20 16	27,5	12	27,5	35,5	60	20	85	67,5	142	45	212	114	250	104 104 104	190	14 16 20	58	2,2
355	450	475	320	500	135 150 160	190	135 140 150	20 20 16	25	15	35	42	70	22,5	100	70	167	55	250	132	300	130 130 130	212	16 18 22	87	4
425	530	560	380	600	170 190 200 220	250	165 180 195	25 25 20	30	27,5	45	55	85	27,5	125	85	200	70	300	167	355	157 157 135 123	280	18 20 24 -	150	6,3
500	630	670	450	710	215 240 250 275	270	210 230 245	31,5 31,5 25 -	35	30	60	68	105	30	155	80	240	80	355	195	425	189 189 168 143	335	18 20 24 -	230	9,5
630	800	850	570	900	265 290 315 345 345	335	265 285 305 320	40 40 31,5 25 -	40	35	70	83	135	40	175 175 175 195 195	100	310	100	450	251	530	242 242 226 188 164	425	18 20 24 32 -	425	22,5

Please note: The loads presented within the table are values for a preliminary dimensioning of the bearing size. Any determination of bearing dimensions should be reviewed by a specific bearing calculation.



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

ZM 28 bearing dimensions

ZOLLERN revised the ZM 28 housing design to achieve market needs in several aspects, improving bearing performance, enlarging design limits and facilitating assembly although maintaining the equipment interface as in the old design. In other words, machine flange and bolt circle dimensions are the same. The ZOLLERN bearing liner stays unmodified and is still exchangeable with the ones from our competitors. The proven Zollern machine seal with its internal chamber pressure compensation made by air passages to the top and to the bottom of the housing through its body remains unchanged.

The bearing convective cooling ability was improved due to the increase in heat exchange surface and material change. The new housing design has bigger and extra fins, and it is made now in grey cast iron EN-GJL-300 (former GG 30), although upon request it can be made in nodular cast iron.

Old design limitations were enlarged now. The possible end play is increased to +/- 8 mm. On demand and with some small changes on shaft standard design +/- 14 mm can be achieved.

In terms of sizes and types, more combinations of internal seal can be made, since now its carrier is bolt on to the housing, just like the outer one, totally independent from the machine seal.

Oil outlet sizes and types (for example SAE flange) can vary in a wider range.

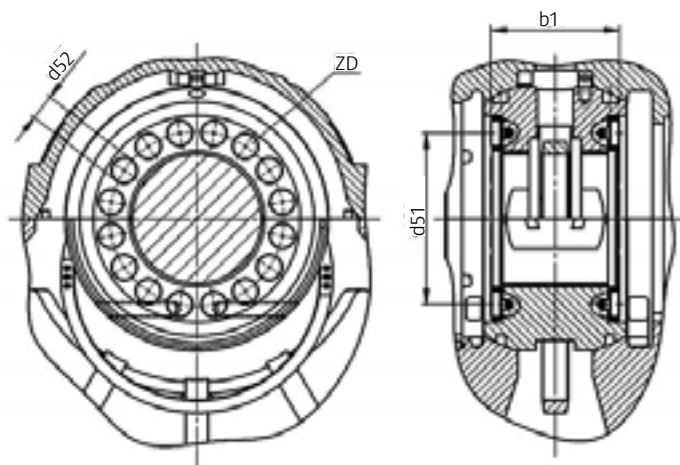
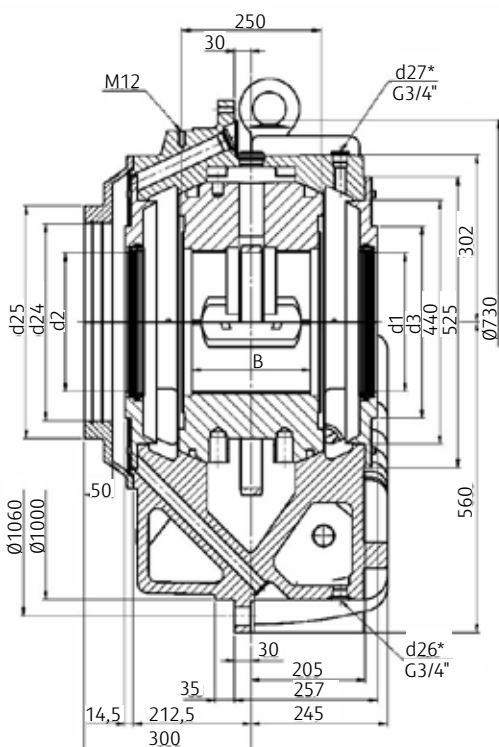
A direct oil flow can be supplied to the bearing inner side (for example axial oil supply). There is no more need to make a passage through the equipment front frame.

The oil return drain from the floating seal increasing with a conical slot instead of bores and especially at the inner side with enlargement of the housing slots between the liner and the seal.

Casted surfaces are prepared for placing bores for shaft vibration sensors (2 x 45°) and monitoring the housing vibration.

It became easier to lift up the housing cover without tipping it, due to the new thread for additional eye bolt. Now there are three points to hold it.

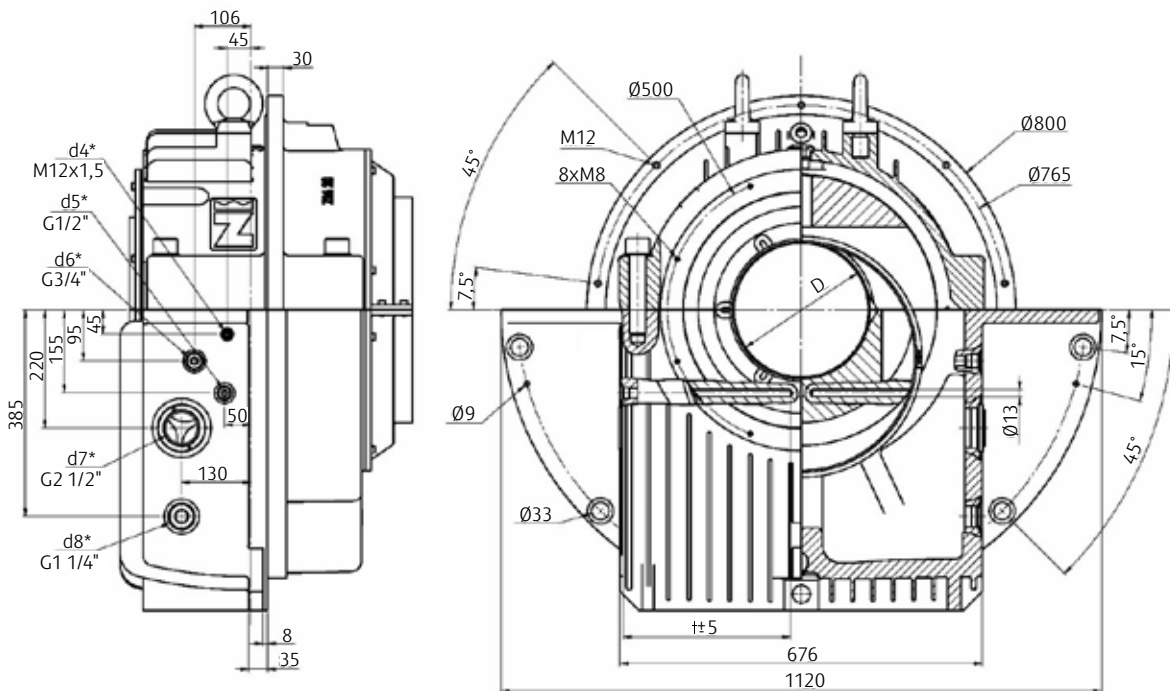
If you plan to replace the old housing design by this one, you should be aware that the outlet pipe line position and the thermal sensor length changed.



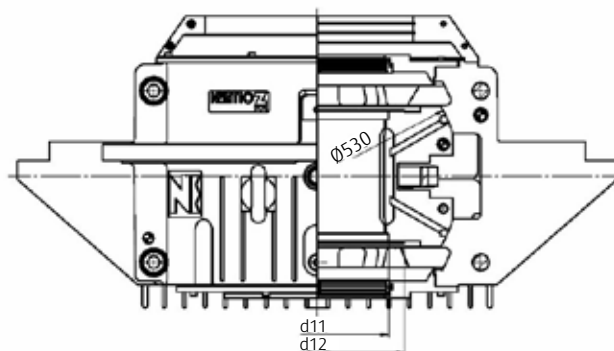
Thrust face type A

Size	D (H7)	B	nom. size d1 seal (optional)	nom. size d2 seal (optional)	d3	d4	d5	d6	d7	d51	d52	t ±5	ZD titling pads number per side	weight appr. kg	Oil content appr. l
28	250	213,2				325		266	325	325	50	312	18	800	45
	280	213,2				355		296	355	355	50	312	20		
	300	218,5	250/280	250/280	346	375	390	316	375	365	40	262	24		
	315	218,5	300/315	300/315		390	425	331	390	380	40	257	24		
	335	218,5			410	395		351	410	380	31,5	232	30		
	355	218,5				395		371	430	-	-	219	-		

*Under request, these thread holes will be supplied according to customer's need



- d4 = Earthing device or plug
- d5 = Provision for thermometer
- d6 = Oil inlet (oil circulation or recirculating pump)
- d7 = Oil sight glass or oil outlet (oil circulation)
- d8 = Plug (connection for heater, oil sump thermometer, water cooler)
- d26 = Oil drain plug
- d27 = Oil filling or breather
- t = Depth of thermometer bore



Dimensions of shaft

Size	D ¹⁾	b20 ²⁾	b21 ³⁾	b22	b23 ⁴⁾	b24	b25	d30
7	60							86
	70	60,4	67	75	51,5	51,5	85,5	96
	80							106
9	100							110
	90	80,4	90	100	55	60	95	120
	100							130
11	100							135
	110	100,4	110	120	60	65	105	150
	125							160
14	125							170
	140	125,4	140	150	65	75	115	190
	160							200
18	180							220
	160	160,4	180	190	65	75	120	215
	200							240
22	225							250
	200	200,4	220	240	75	80	130	275
	250							265
28	280							290
	300	250,4	280	300	90	90	155	315
	315							345
	335							345
	355							325
								355

¹⁾ Limit dimensions of the shaft acc. DIN 31 698, form and positional tolerance and surfaces roughness acc. 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 has to allow larger motions (due to heat expansion or to large thrust clearances caused by the unit), dimension b21 can be enlarged.

⁴⁾ The dimension b24 is valid for a bearing with a floating labyrinth seal.

⁵⁾ The dia. d35 can be combined with every shell dia. D within one size.

⁶⁾ The radii R1 and R2 can be replaced by a plunge cut acc. DIN 509.

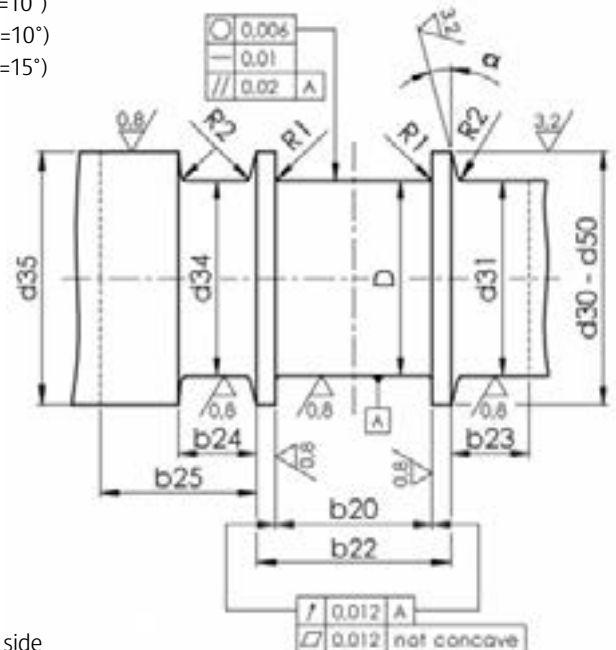
For locating bearing shell

Z...B (d30; $\alpha=10^\circ$)

Z...K (d30; $\alpha=10^\circ$)

Z...D (d30; $\alpha=10^\circ$)

Z...A (d50; $\alpha=15^\circ$)

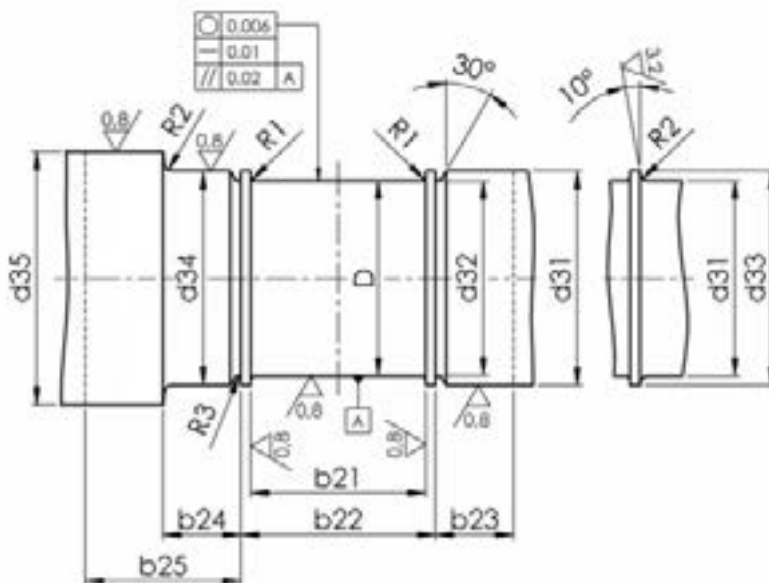


Machine side

d31 (e8) d32	d33	d34 (e8)	d35 ⁵⁾ (e8)	d50	R1 ⁶⁾	R2 ⁶⁾	R3
60 / 70 / 80 / 90	70		90				
- / 64 / 74 / 84	80	80	100	-	2	2	1,5
	90		110				
80 / 90 / 100 / 110	90		110	132			
- / 80 / 90 / 100	100	100	120	142	2,5	4	1,6
	110		130	143			
100 / 110 / 125 / 140	110		135	157			
- / 100 / 110 / 125	125	125	150	162	2,5	4	1,6
	140		160	168			
125 / 140 / 160 / 180	140		170	192			
- / 125 / 140 / 160	160	160	190	207	4	6	2,5
	180	180	200	217			
	200		220	-			
160 / 180 / 200 / 225	180		215	244			
- / 160 / 180 / 200	200	200	240	264	4	6	2,5
	225		250	273			
	250	225	275	-			
200 / 225 / 250 / 280 / 300	225	-	265	308			
- / 200 / 225 / 250 / 280	250	-	290	328	6	10	4
	280	250	315	339			
	315	280	345	348			
	335	300	345	-			
250 / 280 / 300 / 315 / 335 / 355	280		325	378			
- / 250 / 280 / 280 / 315 / 335	300	315	355	408	6	10	6
	315		375	408			
	335		390	423			
	355	355	395	414			
	375		395	-			

For non-locating bearing shell

Z...Q

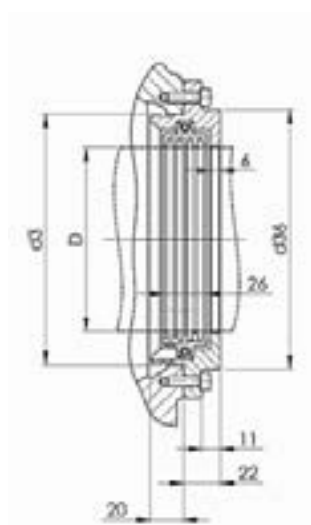


Machine side

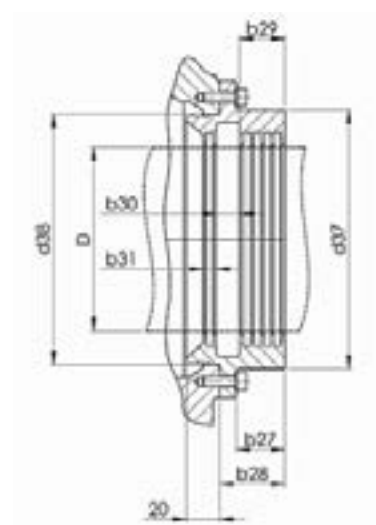
Drawing dimensions in millimeters

Types and dimensions of seals

Size	D	b27	b28	b29	b30	b31	b32
7	60						
	70						
	80	21	31	21	12	8	21,5
	90						
9	80						
	90						
	100	29	39	27	14	8	21,5
	110						
11	100						
	110						
	125	31	41	27	16	8	21,5
	140						
14	125						
	140						21,6
	160	33	43	27	18	8	26,5
	180						
18	160						
	180						
	200	36	46	27	21	8	26,5
	225						
22	200						
	225						26,5
	250	39	49	27	24	8	
	280						31,5
	300						
28	250						
	280						
	300	43	53	27	27	10	31,5
	315						
	355						



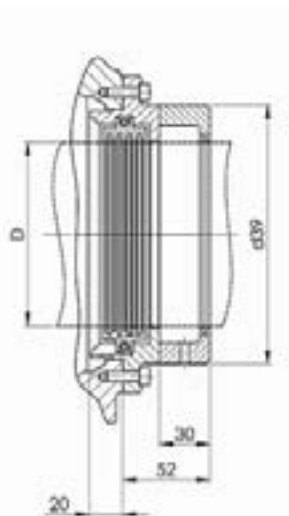
Floating labyrinth seal
(Protection IP 44)



Rigid seal *
(Protection IP 44)

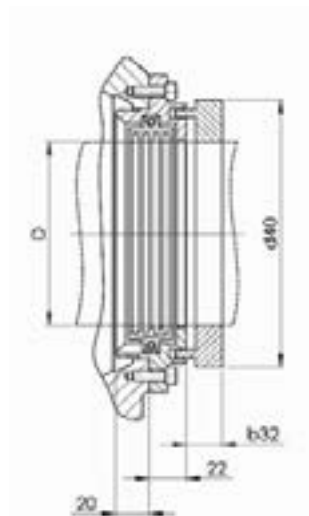
* Can be combined with a bolt-on baffle (IP 55) or a dust flinger (IP 54) too.

d3	d14	d36	d37	d38	d39	d40
130	170	135	135	128	135	135
150	190	155	155	148	155	155
180	215	180	180	178	155 180	155 180
230	290	240	240	228	180 240	180 240
275	340	240 280	240 280	273	240 280	240 280
340	400	280 346	280 346	338	280 346	280 346
440	525	346 410	346 410	438	346 410	346 410



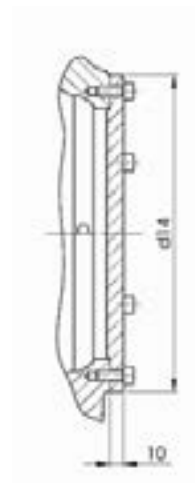
**Floating labyrinth seal
with bolt-on baffle**

(Protection IP 55)



**Floating labyrinth seal
with dust flinger**

(Protection IP 54)



End cover

Special seal designs for specific applications upon request.

Nomination of bearing



1 // Type

Z ZOLLERN plain bearing

2 // Housing

M Centre flange mounted bearing, finned

3 // Heat dissipation

N Natural cooled by convection

Z Lubrification by oil circulation with external oil cooling

X Lubrification 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 without 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

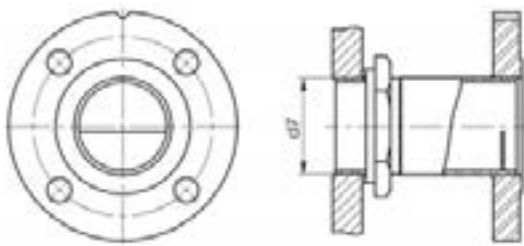
6 // Size

7 // Shaft diameter (mm)

Example for the nomination of a bearing:

Z M N L B - 11 - 125

ZOLLERN centre flange mounted bearing, finned bearing, natural 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.



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 is to be mounted horizontally at the bottom. The mark at the flange will then be visible vertically up.

ZF - End flange mounted bearing

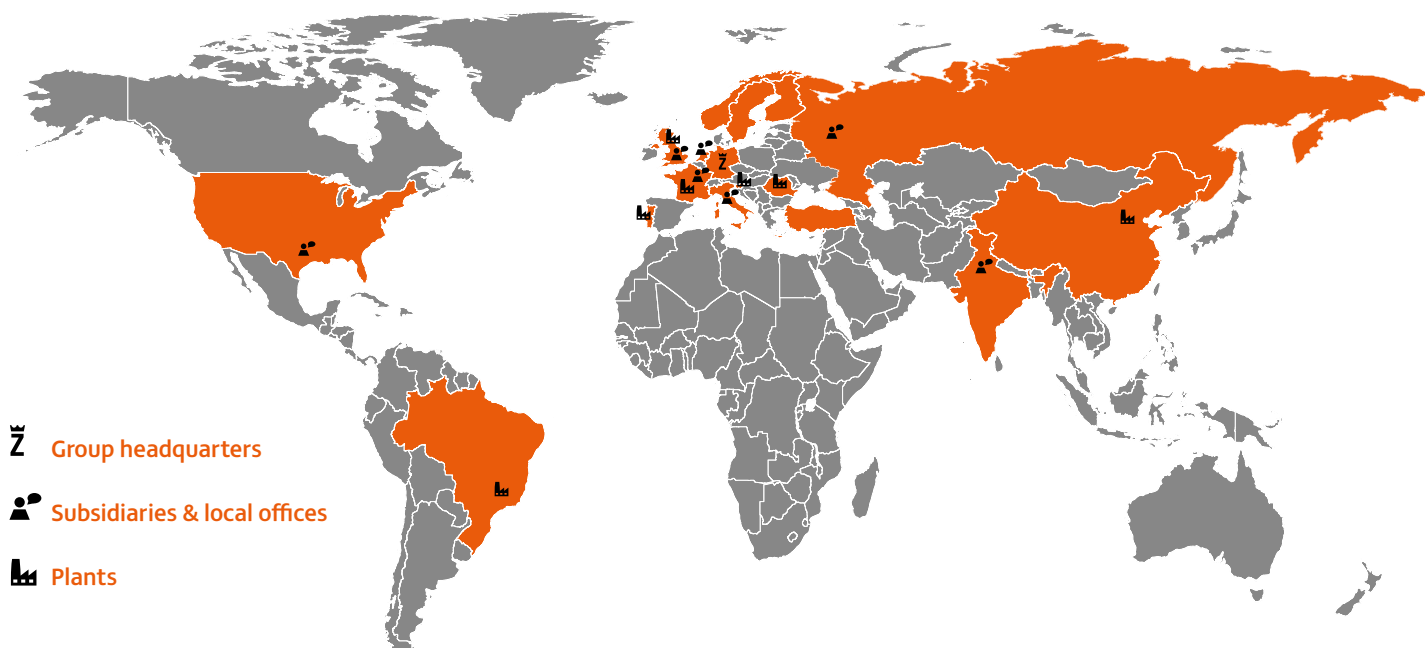
The ZOLLERN type ZF of horizontal bearing is designed acc. to DIN 31 693 norm specifications for a wide range of heavy duty applications (electrical machines, turbines and test rigs)


ZR - Pedestal bearing

The ZOLLERN type ZR of 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?
- Electrical insulation required?
- Earthing device required?
- Protection class specified?
- Sealing type and diameter (outside)?
- Sealing type and diameter (inside)?
- Sealing diameter machine seal?
- Shaft drawing available?
- Shaft vibration sensors required (thread...)?
- Speed sensor required (thread...)?
- Absolute vibration sensor required (position, thread...)?



-  **Group headquarters**
-  **Subsidiaries & local offices**
-  **Plants**

ZOLLERN

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