ŽOLLERN

Solid metals. Fine solutions.

Plain Bearing Technology

ZR pedestal 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 ZR design

The ZOLLERN type ZR horizontal bearing is designed according to DIN 31 690 norm specifications for a wide range of heavy duty applications (electrical machines, turbines, blowers 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 such as shell, lubricating ring and other equipment. Thus, assembly is simple and mistakes due to the positioning of screws and pins are avoided during installation, commissioning and maintenance procedures.

Housing
The The bearing housings are finned, and are manufactured from high quality cast iron EN-GJL-300 or nodular cast iron EN-GJS-400-15. 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 ZR housing to meet all 541 and 546 requirements for API norms.

Bearing shells
The 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.

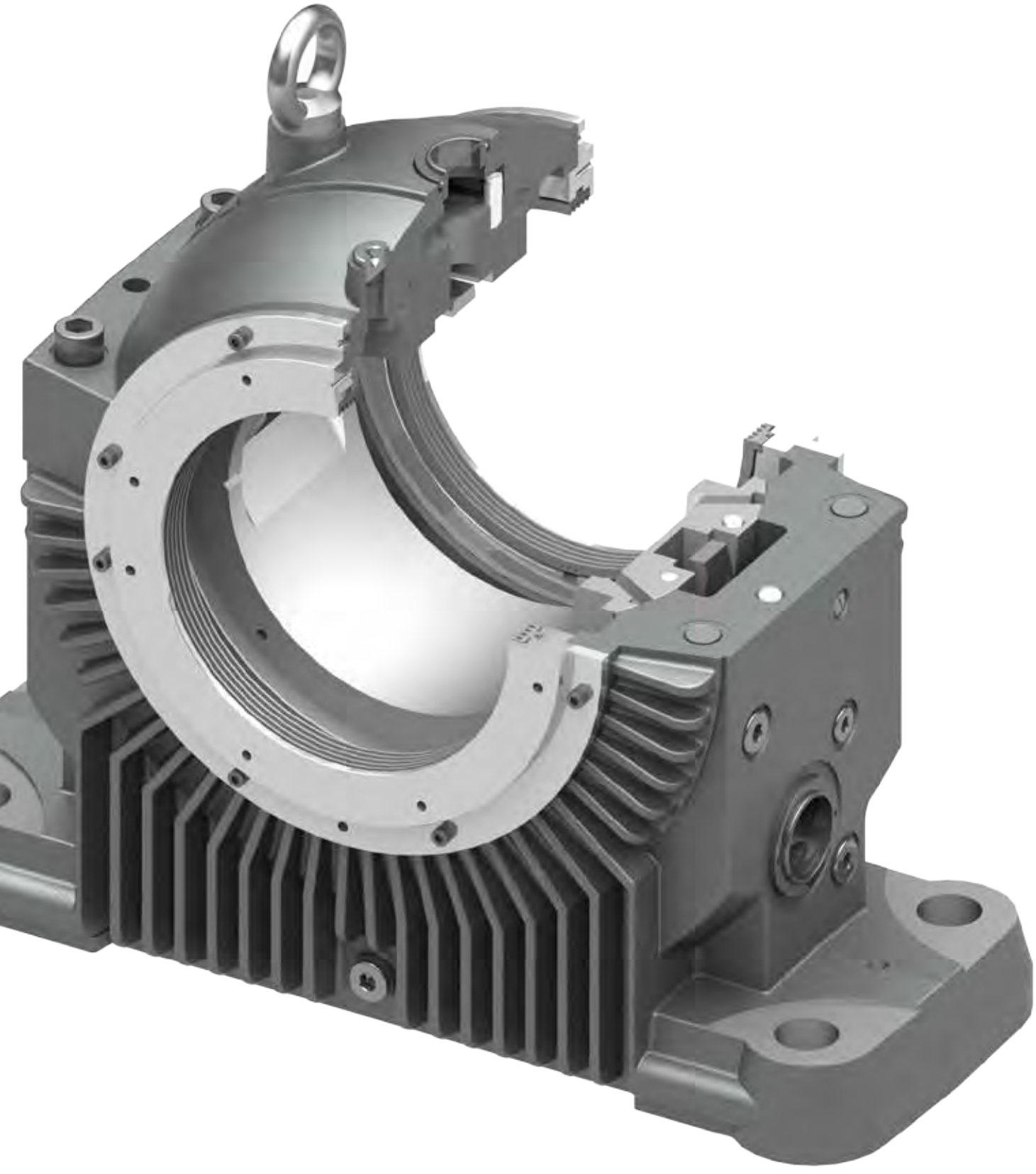
Q-type shells have no thrust capability for non-locating bearings.

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.

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

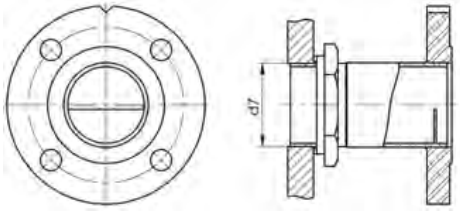
The radial bore profile type selection depends on several conditions. Among them we have the circumferential speed and the specific pressure. The following table should help in a preliminary selection.

// 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)
9	G 1 ¼"	DN 32	9	7	2 x G 1 ¼"	18	14
11	G 1 ½"	DN 40	11	9	2 x G 1 ½"	22	18
14	G 2"	DN 50	18	9	2 x G 2"	22	18
18	G 2"	DN 50	18	16	2 x G 2"	36	32
22	G 2 ½"	DN 65	28	25	2 x G 2 ½"	56	50
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
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.

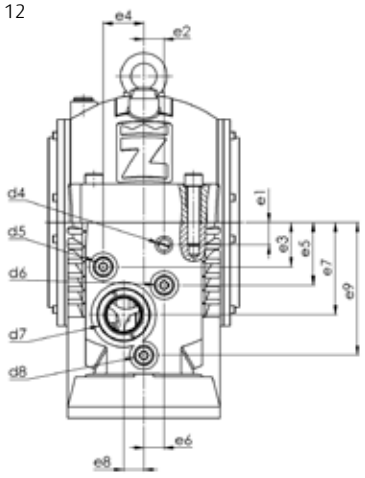
ZR bearing dimensions

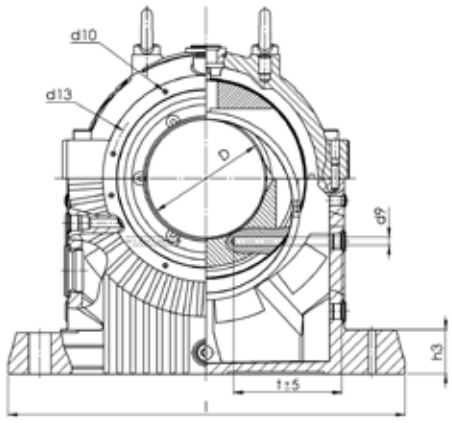
Size	D (H7)	B	b1	b2	b3	b13	d1/d2 nom. size seal (optional)	d3	d5	d7	d8	d9	d10	d11	d12	d13	d14	d15	d17[1)]	d51	d52
9	80	61,4	80	194	150	104	80/90 100/110	160	G 3/8	G 1 1/4	G 1/2	11	8 x M6	86	110	180	200	22	10,4	110	20
	90	61,4												96	120					120	20
	100	65,0												106	130					125	16
11	100	81,4	100	214	170	122	100/110 125/140	190	G 3/8	G 1 1/2	G 1/2	11	8 x M6	108	135	210	230	26	10,4	135	20
	110	81,4												118	150					140	20
	125	85,0												133	160					150	16
14	125	105,4	125	295	215	158	125/140 160/180	240	G 1/2	G 2	G 1/2	11	8 x M6	135	170	260	280	30	10,4	165	25
	140	105,4												150	190					180	25
	160	106,4												170	200					195	20
	180	106,4												190	220					-	-
18	160	135,7	160	299	255	188	160/180 200/225	285	G 1/2	G 2	G 1/2	13	8 x M8	172	215	320	350	40	15	210	31,5
	180	135,7												192	240					230	31,5
	200	140,4												212	250					245	25
	225	140,4												237	275					-	-
22	200	168,5	200	364	320	244	200/225 250/280 300	350	G 3/4	G 2 1/2	G 3/4	13	8 x M8	214	265	390	420	46	15	265	40
	225	168,5												239	290					285	40
	250	175,7												264	315					305	31,5
	280	175,7												294	345					320	25
	300	175,7												310	345					-	-
28	250	213,2	250	424	380	302	200/280 300 315/355	450	G 3/4	G 2 1/2	G 3/4	13	8 x M8	266	325	510	540	55	20	325	50
	280	213,2												296	355					355	50
	300	218,5												316	375					365	40
	315	218,5												331	390					380	40
	335	218,5												351	410					380	31,5
	355	218,5												371	430					-	-

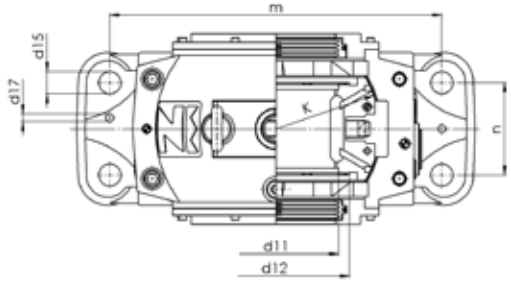
Dimensions in millimeters / Dimensions not shown for seals see page 12

[1)] bore for dowel pin

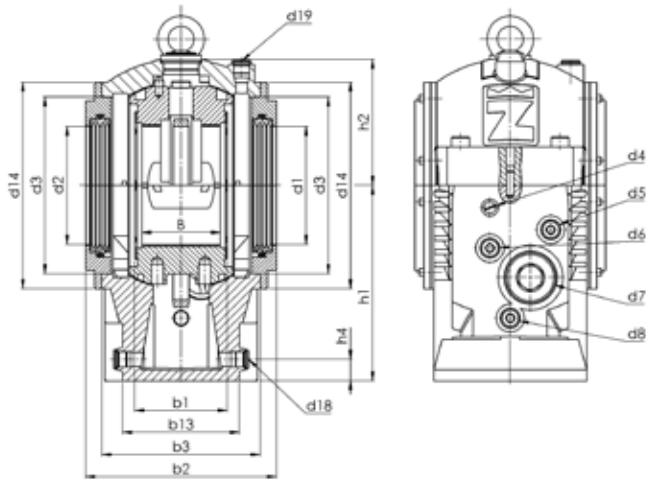
d4 = Earthing device or plug M12x1,5
d5 = Oil inlet (oil circulation or recirculating pump)
d6 = Provision for thermometer G 1/2“
d7 = Oil sight glass or oil outlet (oil circulation)
d8 = Plug (connection for heater, oil sump thermometer, water cooler)
d18 = Oil drain plug
for size 9 to 18: G 1/2“
for size 22 and 28: G 3/4“
d19 = 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

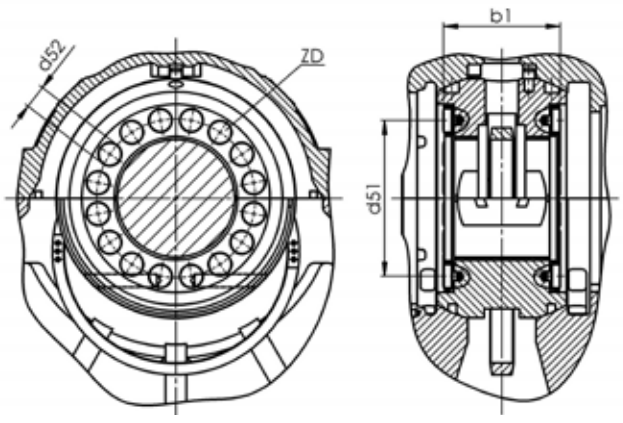






e1	e2	e3	e4	e5	e6	e7	e8	e9	h1	h2	h3	h4	l	m	n	t ±5	dia. Ø K	ZD titling pads number per side	weight appr. kg	Oil content appr. l
20	15	35	37	60	20	85	15	135	190	123	35	23	355	300	90	117,5 117,5 117,5	190	14 16 20	45	1,8
35	15	40	42	70	22,5	100	20	145	225	141	50	24	450	375	100	138 138 12,8	212	16 18 22	70	3
30	27,5	60	55	85	27,5	125	27,5	180	265	168	60	29	540	450	125	168 168 146 134	280	18 20 24 -	135	4,5
30	30	70	68	105	30	155	30	215	315	208	70	29	660	560	150	209 209 188 163	335	18 20 24 -	240	8
35	35	80	83	135	40	175	40	245	375	254	80	37	800	670	200	259 259 243 201 179	425	18 20 24 32 -	430	16,5
45	45	95	106	155	50	220	50	310	450	320	90	42	950	800	250	323 323 273,5 268,5 243,5 231	530	18 20 24 24 30 -	780	27,5





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] (± 0,1)	b21 [3]	b22	b23 [5]	d30
9	80	80,4	90	100	50	110
	90					120
	100					130
11	100	100,4	110	120	50	135
	110					150
	125					160
14	125	125,4	140	150	60	170
	140					190
	160					200
	180					220
18	160	160,4	180	190	60	215
	180					240
	200					250
	225					275
22	200	200,4	220	240	70	265
	225					290
	250					315
	280					345
	300					345
28	250	250,4	280	300	70	325
	280					355
	300					375
	315					390
	335					410
	355					430

[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.

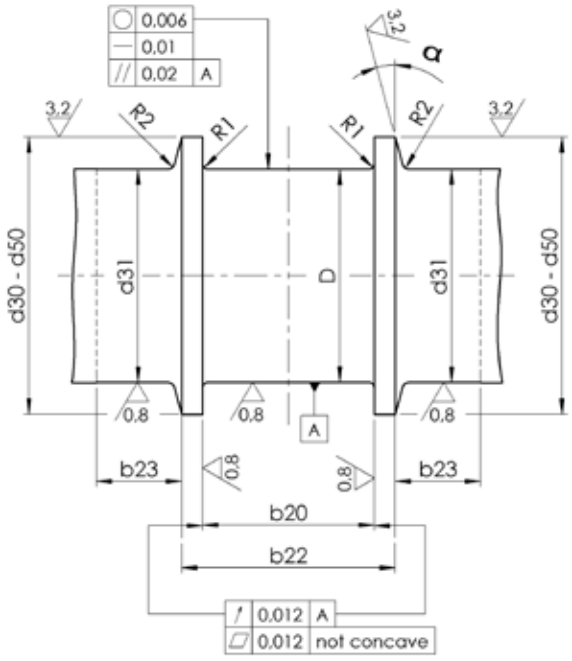
[4] The plunge cut d32 is dropped, if it is equal or smaller as the shaft diameter D.

[5] Dimension b23 is valid for a bearing with a floating labyrinth seal.

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

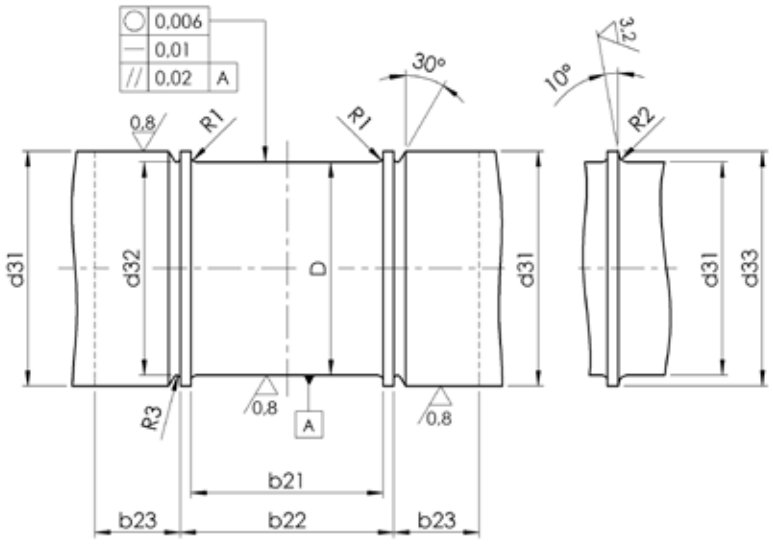
For locating bearing shell

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



d31 (e8) d32 [4]	d33	d50	R1 [6]	R2 [6]	R3
80 / 90 / 100 / 110	90	132	2,5	4	1,6
	100	142			
80 / 80 / 90 / 100	110	143			
100 / 110 / 125 / 140	110	157	2,5	4	1,6
	125	162			
100 / 100 / 110 / 125	140	168			
125 / 140 / 160 / 180	140	192	4	6	2,5
	160	207			
125 / 125 / 140 / 160	180	217			
	200	-			
160 / 180 / 200 / 225	180	244	4	6	2,5
	200	264			
160 / 160 / 180 / 200	225	273			
	250	-			
200 / 225 / 250 / 280 / 300	225	308	6	6	4
	250	328			
	280	339			
200 / 200 / 225 / 250 / 280	315	348			
	335	-			
250 / 280 / 300 / 315 / 335 / 355	280	378	6	10	6
	310	408			
	330	408			
	345	423			
250 / 250 / 280 / 280 / 315 / 335	365	414			
	385	-			

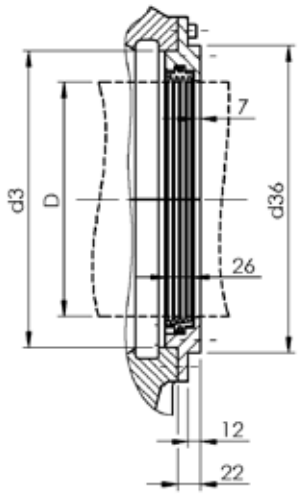
For non-locating bearing shell
Z...Q



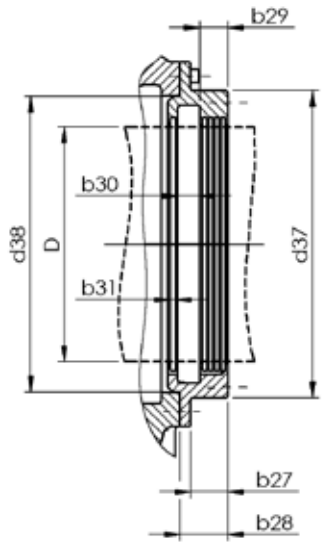
Dimensions in millimeters

Types and dimensions of seals

Size	D	b27	b28	b29	b30	b31	b32
9	80	29	39	27	14	8	21,5
	90						
	100						
	110						
11	100	31	41	27	16	8	21,5
	110						
	125						
	140						
14	125	33	43	27	18	8	21,5
	140						
	160						26,5
	180						
18	160	36	46	27	21	10	26,5
	180						
	200						
	225						
22	200	39	49	27	24	10	26,5
	225						
	250						31,5
	280						
	300						
28	250	42	52	27	27	10	31,5
	280						
	300						
	315						
	335						
	355						



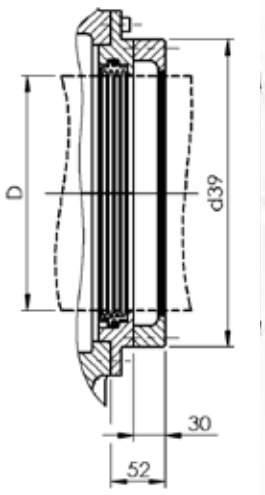
Floating labyrinth seal
(Protection IP 44)



Rigid seal *
(Protection IP 44)

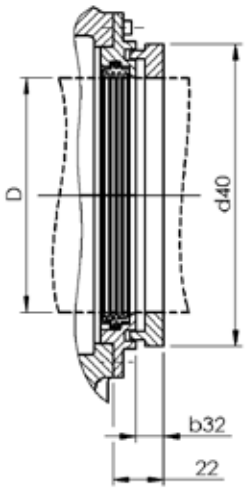
* Can be combined either with a bolt-on baffle (IP 55) or with a dust flinger (IP 54).

d3	d14	d36	d37	d38	d39	d40
160	200	160	160	158	160	160
190	230	190	190	188	160 190	160 190
240	280	240	240	238	190 240	190 240
285	350	295	295	282	240 295	240 295
350	420	365	365	347	295 365	295 365
450	540	480	365 480	447	365 480	365 460



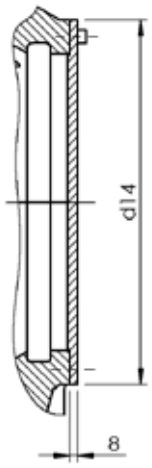
Floating labyrinth seal with bolt-on baffle

(Protection IP 55)



Floating labyrinth seal with dust flinger

(Protection IP 54)



End cover

Special seal designs for specific applications upon request.

Bearing types and designations

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

1 // Type

Z	ZOLLERN plain bearing

2 // Housing

R	Pedestal 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 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

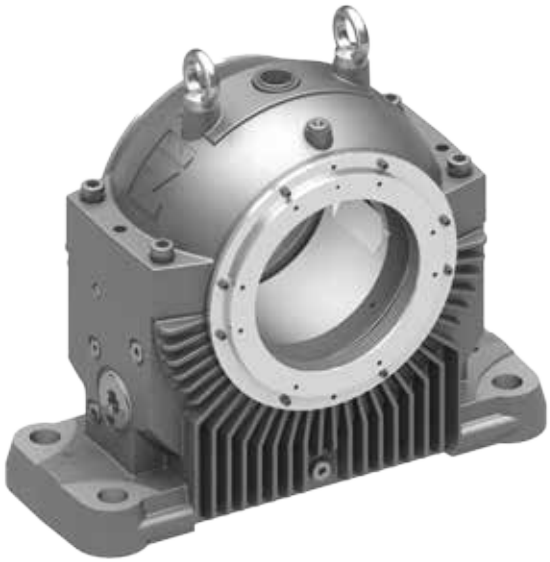
6 // Size

7 // Shaft diameter (mm)

Example of a bearing designation:

Z R N L B - 11 – 125

ZOLLERN pedestal bearing, finned, 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.

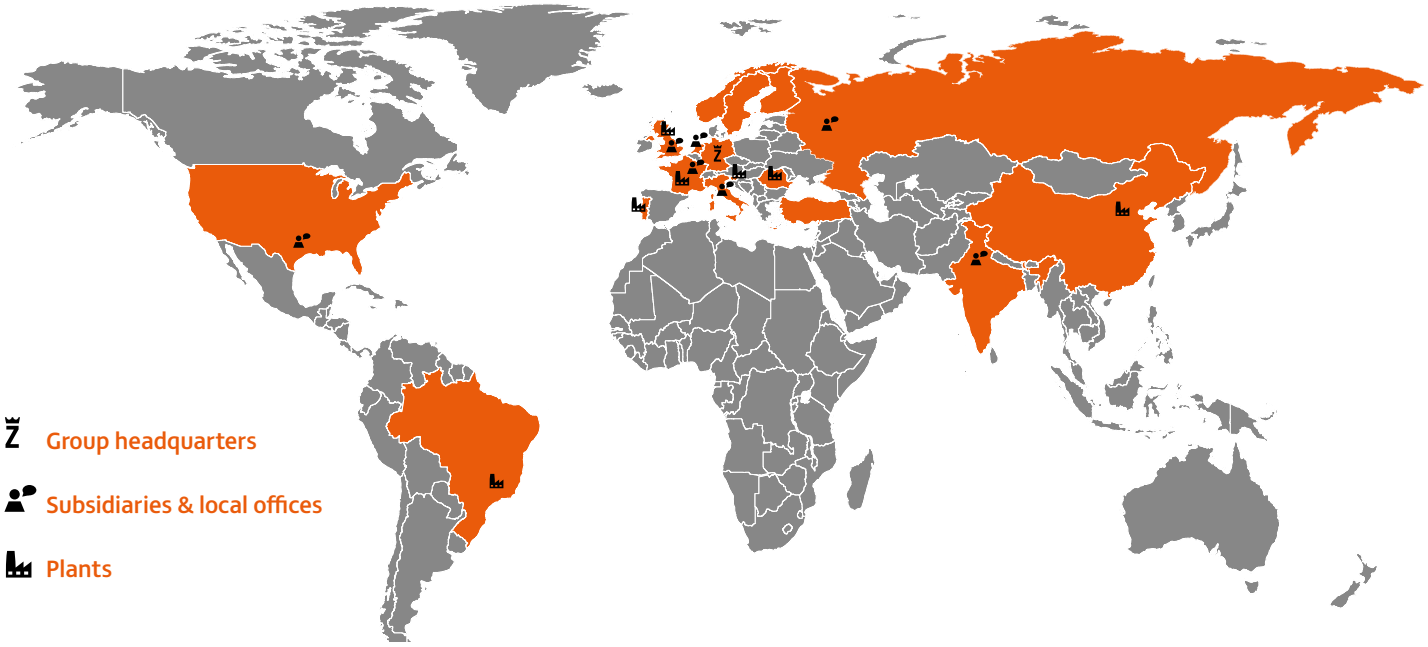


ZF - End flange mounted bearing
The ZOLLERN type ZF horizontal bearing is designed acc. to DIN 31 693 norm specifications for a wide range of heavy duty applications (electrical machines, turbines and test rigs)

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)

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

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