FBJ

9. Mounting And Dismounting

9.1 Mounting

Ball and roller bearings should be mounted by qualified personnel paying special attention to keeping them clean: this is very important for ensuring satisfactory operation of bearings and preventing their premature breakdown.

9.2 Preparation of Mounting

The mounting should be preferably done in a room with dry clean air located far from the sources of dust, emulsion, dirt. The shaft and housing surfaces mating with the bearings should be thoroughly washed with gasoline or kerosene, wiped, dried and coated with a thin layer of lubricant. Care must be taken to check the accuracy of dimensions and shapes of all the parts mating with the bearing; they should not exceed the dimensions.

The manufacturer's packing is to be removed from the bearings immediately before mounting to prevent penetration of dirt. Preservative coating is removed from the mounting surfaces only. The mounting surfaces are to be washed with gasoline or kerosene and wiped dry with clean nap-free cloth. If a bearing is dirty or its packing is damaged, it should be thoroughly washed prior to mounting. The mounting surfaces in this case are to lubricated with medium-viscosity oil.

Prior to mounting, check the bearing appearance, marking, ease of rotation, clearances for compliance with the requirements of the technical documents and this Catalogue.

Radial clearance in spherical roller bearings are measured with the aid of a set of feeler gauges, or by other methods. Feeler gauges are used to measure clearances between the outer ring and the unloaded roller. Prior to mounting, bearings, especially those with the ratio of the length and the largest shaft diameter exceeding 8, must be tested for straightness (absence of bending).

9.3 Mounting of bearings

The method of bearings mounting (mechanical, hydraulic, thermal) depends on their type and size. In all the cases, it is very important to protect rings, bearing cages, rolling elements against direct knocks, because they can damage the bearings. The principal rule to be observed when mounting a bearing is never to allow the compressing force to be transferred through rolling elements.

When mounting a bearing, it is necessary to ensure the required precision of the bearing rings location with respect to the rotation axis which mainly depends on the absence of misalignment. Misalignments of rings is one of the factors causing initial damages of bearings and concentration of contact stresses. The operating misalignment of the rings should not exceed 0.7 maximum design-permissible angle of alignement of the bearing rings under normal operating conditions (this parameter is to be taken from the description of bearing groups).

It is should be borne in mind that the outer ring of a spherical radial bearing has the property of readily swivel out. To replace the ring in its original position, it is necessary to set the dislocated (braking) rollers, with the aid of fingers, back into the outer ring and restore the latter to its original position. NEVER knock on the ring or rollers with a hammer.

9.4 Bearings with Cylindrical Bore

When mounting inseparable bearings, usually the ring with a tighter fit is to be mounted the first. If pre-loading in the tight fit is not too high, small-size bearings can be mounted by knocking lightly with a hammer on the sleeve installed on the front end or the bearings ring.

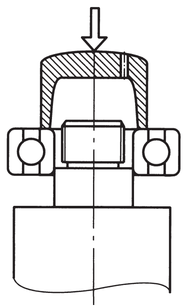


Figure 9.1

Knocks should be uniformly distributed over the circumference to prevent the bearing from misalignment. When an aligning bar is used instead of the sleeve, the force must be applied at the center

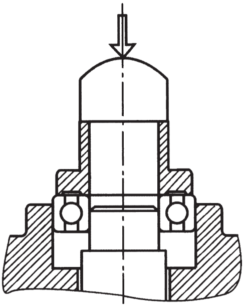


Figure 9.2

(see Figure 9.1). If the bearing is inseparable, it should be simultaneously pressure-fitted onto the shaft and into the housing seat (see Figure 9.2) with the aid of the mounting tool shown in the sketch, a mounting ring is inserted between the bearing and aligning bar, resting on the front ends of the inner and outer rings. The supporting surfaces of the mounting ring should lie in the same plane to ensure even distribution of the forces applied to both Rings during the mounting procedure. When mounting self-

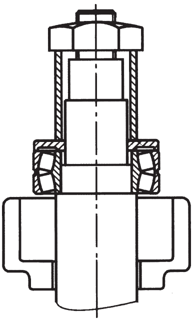


Figure 9.3

aligning bearings, for example, spherical roller bearings, the use of an intermediate mounting rings permits to prevent misalignment and turning of the outer ring after the bearing with the shaft has been installed in the housing seat (see Figure 9.3).

The intermediate mounting ring must have a groove to keep it form touching the rolling elements or bearing cages. Bearings having a diameter of up to 100 mm can be pressure-fitted onto the shaft in cold state with the use of mechanical or hydraulic presses.

The inner ring of a separable bearing can be mounted independently of the outer ring. When

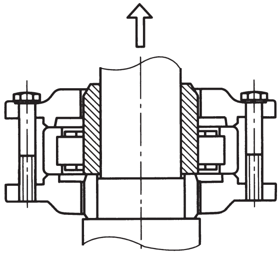
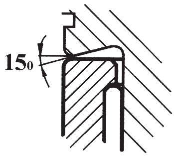


Figure 9.4

mounting a shaft already carrying the inner ring into the housing with the outer ring care should be taken to make them properly centered, otherwise the raceways, balls or rollers can get scored. That is why, when mounting bearings with needle and cylindrical



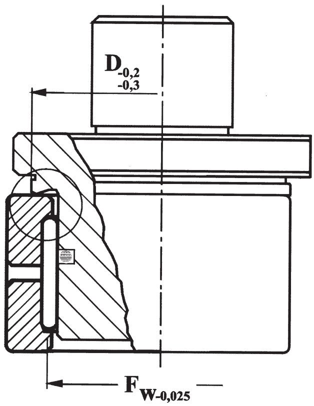


Figure 9.5

rollers, it is recommended to use a mounting sleeve (see Figure 9.4). The outer diameter of the sleeve must be equal to the raceway diameter F of the inner ring machined with a d10 accuracy. The values of F are given in the bearings table. Needle roller bearings with a die-stamped outer ring best mounted with the aid of a special aligning bar (see Figure 9.5).

Large-size bearings or those with tight fit should be heated before mounting. NEVER pre-heat bearings in excess of 120ºC, for this may cause changes of both the bearing material, as well as possible burning or deformation of polya-mide bearing cages. DO NOT pre-heat bearings having protective shields or seals, because they are filled with grease.

When pre-heating bearings, care should to be taken to avoid local overheating. Uniform safe Heating can be achieved with the aid of electric heaters, heating furnaces and oil bath.

It is also recommended to use special electric induction heaters. Here the bearing (ring) is heated by an alternating magnetic field which gives rise to eddy currents. After induction heating the bearings (rings) need to be demagnetized.

9.5 Bearings with Tapered Bore

Inner rings of tapered-bore bearings are always mounted with a tight fit. The amount of interference in this case is determined not by the shaft size tolerances as for cylindrical-bore bearings, but by shifting the bearings along the conical surface of the shaft mounting journal, of adapter or withdrawal sleeve.

Double-row spherical roller bearings with tapered bore are mounted onto cylindrical shaft with the aid of adapter or withdrawal sleeves, while on tapered-journal shafts they are installed directly on the shaft. Before mounting, the washed bearing bore and the sleeve may be covered with a thin coat of lubricant. A thicker lubricant layer will reduce friction and, in so doing, facilitate mounting, but in the course of operation the lubricant will be pressed out from the mounting joints. As a result, the fit will lose tightness and the ring or the sleeve will run wearing out the mounting surfaces.

It is a good practice to mount bearings with the bore of up to 70 mm and normal tightness using a hammer and a mounting sleeve screwed onto the threaded shaft end. The pressure part acts on the adapter sleeve end or directly on the inner ring end-face (when mounting is carried out without adapter and withdrawal sleeves). Bearings with a diameter exceeding 100 mm should be mounted using a hydraulic formed (expanded) along with the axial shift of the adapter sleeve.

When any previously dismounted bearing is to be mounted again, it is not sufficient to restore the lock nut to its original position, because after a prolonged operation the radial clearance fit loose due to the wear of the thread and smoothing of the mounting seats, the shift gets longer. For self-aligning spherical roller bearings the values of teh decrease in teh original radial clearance which are neccessary to ensure a tight static fit. The radial clearance of spherical roller bearings is measured with the use of feelre gauges in both roller rows simultaneously. It is necessary to observe that the rollers are pressed against the meddle flange (a guiding lip). Yhe outer and inner rigns should be located so as to ensure equal radial calearance for both rows.

The method of mounting bearings is selected based on teh mounting conditions.

Small-and medium-size bearings can be fitted onto the mounting seats with the aid of the lock nut. The nut is tighteded using a box wrench (see Figure 9.6).

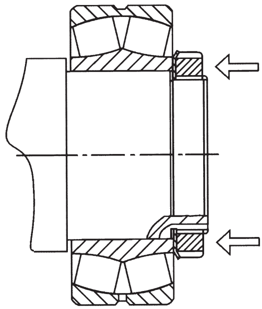


Figure9.6

Small-size bearings with an adapter sleeve are mounted onto the tapered surface of the adapter sleeve with the aid of teh lock nut (see Figure 9.7).

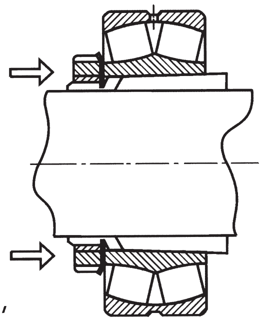


Figure 9.7

Small-size withdrawal sleeves are pressure-fitted with the aid of the lock nut into the gap between the shaft and the inner ring (see Figure 9.8).

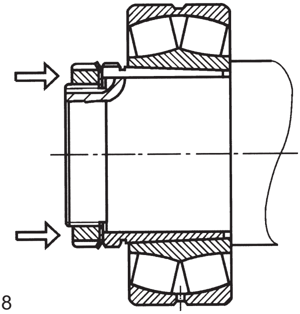


Figure 9.8

The nuts of larger-size bearings require a greater tightening force. In these cases mounting can be made easier with the use of a mut with thrust bolts shown in Figure 9.9. To prevent the bearing or sleeve from being wedged, it is necessary to screw up the

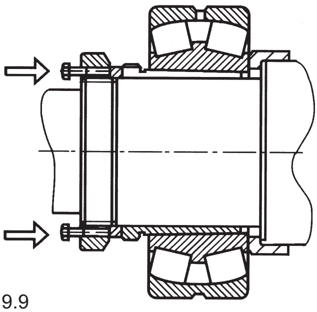


Figure 9.9

nut preliminarily unitl it comes fully against the mounting sleeve. The thrust bolts made of improved steel and located evenly along the circumference (the number of bolts depends on the force required) are screwed in uniformly in a cross manner until the necessary decrease of radial clearance is obtained. Since a tapered mounting surface provides self-braking, the accessory may be, then, removed and the bearing can be fastened tight with it own fastening nut. This principle is applicable for bearings mounted on a sleeve or directly on a tapered journal.

When mounting large-size bearings, a hydraulic accessory, for example, a circular piston pump, is normally usrd, to mount a bearing or to press-fit a sleeve (see Figure 9.10). The ring can be shifted axially with the aid of a screw - or hydraulically-operated nut (for large-sizebearings). A hydraulically driven nut has

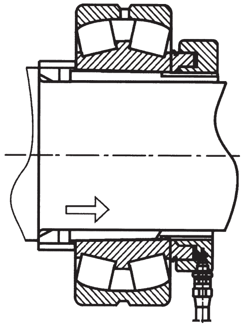


Figure 9.10

a cylindrical groove on one of the end which serves for insertion of a round piston provided with an O-ring seal. The nut is connected, by means of a hose, with a pump feeding oil to the nut. the pump is a jet-type oil pump with a flexible high pressure hose. The nut piston is moved by oil pressure, then it is extended and pressure-fits the bearing onto the mounting seat.

The most expedient method of mounting large-size bearings (with the bore diameter of over 300-mm) is the use of a hydraulic outward thrust which affords high - quality mounting of a bearing. For this purpose, special channels and grooves are made on the shaft to enadle oil to be fed to under the bearing inner ring. When employing hydraulically-aided mounting, pump-driven oil is supplied via the oil-conducting channels and grooves to the contact zone of the bearing inner ring and the shaft. The pressurized oil fed to the contact zone of the rings and the shaft thrusts the ring outwards, thus permitting axial displacement of the ring along the shaft (see Figure 9.11).

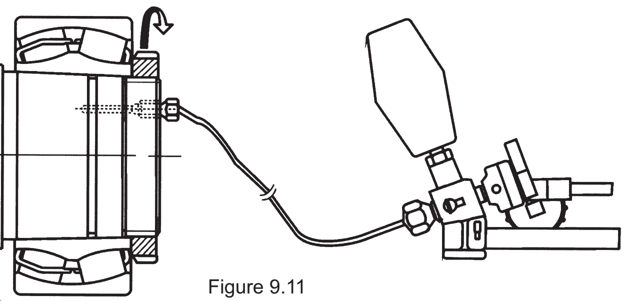


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Figure 9.11

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Table 9.1 Reduction in Radial Clearance (Gap) Depending on Axial Displacement a Tapered Shaft or Sleeve (Reference)

Bearing bore nominal size, d, mm		Reduction in radial clearance*, mm		Minimum permissible residual clearance ** after mounting of bearing with initial clearance, mm		
Over	Up to	min	max	Normal	Group 3	Group 4
24	30	0.015	0.02	0.015	0.020	0.035
30	40	0.020	0.025	0.015	0.025	0.040
40	50	0.025	0.03	0.020	0.030	0.050
50	65	0.030	0.04	0.025	0.035	0.055
65	80	0.040	0.05	0.025	0.040	0.070
80	100	0.045	0.06	0.035	0.050	0.080
100	120	0.050	0.07	0.050	0.065	0.100
120	140	0.065	0.09	0.055	0.08	0.11
140	160	0.075	0.10	0.055	0.09	0.13
160	180	0.080	0.11	0.06	0.10	0.15
180	200	0.090	0.13	0.07	0.10	0.16
200	225	0.100	0.14	0.08	0.12	0.18
225	250	0.110	0.15	0.09	0.13	0.20
250	280	0.120	0.17	0.10	0.14	0.22
280	315	0.130	0.19	0.11	0.15	0.24
315	355	0.150	0.21	0.12	0.17	0.26
355	400	0.170	0.23	0.13	0.19	0.29
400	450	0.200	0.26	0.13	0.20	0.31
450	500	0.210	0.28	0.16	0.23	0.35
500	560	0.240	0.32	0.17	0.25	0.36
560	630	2.260	0.35	0.20	0.29	0.41
630	710	0.300	0.40	0.21	0.31	0.45
710	800	0.340	0.45	0.23	0.35	0.51
800	900	0.370	0.50	0.27	0.39	0.57
900	1000	0.410	0.55	0.30	0.43	0.64
1000	1120	0.450	0.60	0.32	0.48	0.70
1120	1250	0.490	0.65	0.34	0.54	0.77
1250	1400	0.550	0.72	0.36	0.59	0.84

*Valid for solid steel shafts and hollow shafts with bore diameter of up to half diameter of the shaft, only.

** Bearings with the radial clearance in the upper-half o ftolerance limit, prior to mounting, shall be mounted with provision of reduced radial clearance or axial shift at an upper limit; bearings kwith the radial clearance in the lower half of tolerance limite-with reduced radial clearance or axial shift at lower value.

Axial displacement*. mm							
1:12 Taper				1:30 Taper			
Shaft		Sleeve		Shaft		Sleeve	
min	max	min	max	min	max	min	max
0.30	0.35	0.30	0.40	-	-	-	-
0.35	0.40	0.35	0.45	-	-	-	-
0.40	0.45	0.45	0.50	-	-	-	-
0.45	0.60	0.50	0.70	-	-	-	-
0.6	0.75	0.70	0.85	-	-	-	-
0.7	0.9	0.75	1.0	1.7	2.2	1.8	2.4
0.7	1.1	0.8	1.2	1.9	2.7	2.0	2.8
1.1	1.4	1.2	1.5	2.7	3.5	2.8	3.6
1.2	1.5	1.3	1.7	3.0	4.0	3.1	4.2
1.3	1.7	1.4	1.9	3.2	4.2	3.3	4.6
1.4	2.0	1.5	2.2	3.5	4.5	3.6	5.0
1.6	2.2	1.7	2.4	4.0	5.5	4.2	5.7
1.7	2.4	1.8	2.6	4.2	6.0	4.6	6.2
1.9	2.6	2.0	2.9	4.7	6.7	4.8	6.9
2.0	3.0	2.2	3.2	5.0	7.5	5.2	7.7
2.4	3.4	2.6	3.6	6.0	8.2	6.2	8.4
2.6	3.6	2.9	3.9	6.5	9.0	6.8	9.2
3.1	4.1	3.4	4.4	7.7	10.0	8.0	10.4
3.3	4.4	3.6	4.8	8.2	11.0	8.4	11.2
3.7	5.0	4.1	5.4	9.2	12.5	9.6	12.8
4.0	5.4	4.4	5.9	10.0	13.5	10.4	14
4.6	6.2	5.1	6.8	11.5	15.5	12.0	16
5.3	7.0	5.8	7.6	13.3	17.5	13.6	18
5.7	7.8	6.3	8.5	14.3	19.5	14.8	20
6.3	8.5	7.0	9.4	15.8	21	16.4	22
6.8	9.0	7.6	10.2	17.0	23	18.0	24
7.4	9.8	8.3	11.0	18.5	25	19.6	26
8.3	10.8	9.3	12.1	21.0	27	22.2	28.3

When mounting a bearing on a tapered sleeve, hydraulic fluid can be supplied through the channels located in the sleeve itself.

When mounting a bearing into the housing with a tight fit, it is recommended, before mounting, either to pre-cool the bearing (with liquid nitrogen or dry ice) or to preheat the housing.

When mounting bearings, especia those that are subjected to axial loads, it is advisable whenever possible to make sure, with the use of a feelre gauge or a light slit, that the bearing ring end-faces abut properly and tightly (without misalignment) to the shoulder ends. A similar check should be made on the opposite bearing ends and the ends of the parts pressing them in the axial direction.

It is necessary to check the correctness of the mutual loaciton of bearings in the supports of one shaft. When the supports of one shaft are installed in different split housings, they should be checked, after installation of the housing, for correctness of their mutual position, i.e.; they must be accurately in line with each other. After mounting, the shaft must be easily started by hand and rotate freely and evenly.

9.6 Running Tests

After the bearing has been mounted and checked for ease of rotation, the unit is filled with a prescribed type of lubricant and subjected to running tests aimed at checking the noise level created by the runnung bearing and the working temperature.

The running test should be performed under partial loading at low and medium rotational speeds. NEVER can bearings, especially thrust-type and angular contact thrust bearings, be tested under no-load conditions, nor be accelerated immediately to high speeds, because in this case balls and rollers will slip over raceway and damage it, or excessive stresses may arise in the bearing cage, Noise credted by the bearing retation should be checked with the use a stethoscope, tube or hollow rod. Properly mounted and well lubricated bearings produce a soft, slightly buzzing noise in their operation.

The ocurrence of a shrill noise may be the evidence of improper mounting, misalignment, damage form the use of hammer; non-uniform noise or knocking reveals teh presence of foreign particles in teh bearing; a metallic sound is indicative of an insufficient clearance in the bearing; a whishtling or gritting sound points to insufficient lubrication.

A rise of bearing temperature immediately after starting is a normal event, with time temperature gets stabilized. Abnormally high temperatures or persisten temperature variations point to an excessive amount of lubricant in the unit, an unduly tight fit of the bearing in teh radial or axial direction, an improper workmanship of teh mating parts which causes catching of the bearing cage or rolling elements, s stronger friction of seals, or mutual tiltness of the rings. Make sure to check the quality of seales and operation of the lubricating equipment during the running tests. The running test process can be considered completed only after stabilization of the bearing temperature conditions.

9.7 Dismounting

Bearing dismounting should be made without damage of bearings of bearings and mating parts. If bearings are to be used again after the machine has been disassembled, the dismounting effort shall not be transmitted through rolling elements. With separable bearings, one ring, together with the rolling elements and the bearing cage, can be removed independently of the other ring. Dismantling of non-separable bearings should begin with the removal of a more loosely fitted ring.

9.8 Bearings with Cylindrical Bore

Small-size bearings can be removed from the shaft by lightly knocking with a hammer on the aligning bar made from light metals, shifting the bar over teh bearing ring circumference. Larger-size bearings are normally dismantled with the use of various extractor: mechanical screw-type and hydraulically-driven

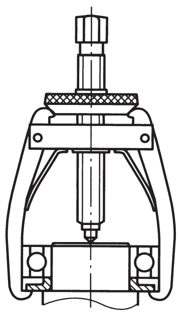

Figure 9.12

removers (see Figure 9.12). the remover rods are pressed directly to the face of the ring to be removed or to the adjacent part. Use may be made of removers carrying stripping rings or half-rings, as well as of three-rod screw removers.

To facilitate future dismantling, designers should make provision for slots in the shaft or housing shoulders permitting insertion of the extraction tools, or for insertion of withdrawal ringshoulders.

The outer ring will be more readily removed from housings if teh latter have threaded holes for driving in thrust screws.

The force applied to remove a bearing is generally much greater than that necessary for pressure-fitting, as teh ring sets down with time or fretting can occur, i.e., corrosion (rust from friction) and microseizure of the ring and shaft metal.

Large-size bearings mounted with a tight fit usually require great effort for removal. The use of an oil-pressure fitting method (Supply of oil under pressure to teh mounting surface) will substantially facilitate the dismantling procedure. Of course, oil channels and distribution grooves necessary for this purpose should be provided for at the stage of the bearing assembly design.

9.9 Bearings with Tapered Bore

Dismantling of bearings located on an adapter sleeve starts with loosing the lock nut and screwing it out a few turns. Then a special intermediate part-a knock-out bar and a hammer are used to loosen the fit between the sleeve and the bearing (see Figure 9.13). When a press is used. the adapter sleeve or

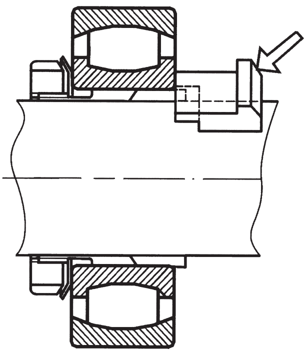

Figure 9.13

the loosended nut should be supported and the bearing should be pressed off from the adapter sleeve.

Dismounting of withdrawal sleeve of mounted bearings beings with the removeal of teh axial locking elements (the shaft nut, thrust washer, end cover, and

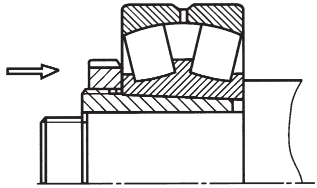

Figure 9.14

the like), then a withdrawal nut is screwed onto the sleeve thread until the sleeve fit in the bearing ring gets loose (see Figure 9.14). If the threaded portion of the sleeve goes beyong the shaft journal, a supporting ring should be inserted into the sleeve bore to protect the thread from damage when the nut is being screwed on. Ind difficult cases, especially when dismantling large-size bearings, use can be made of extraction

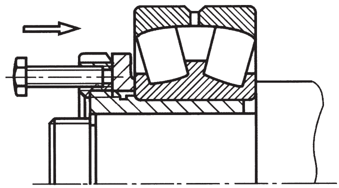

Figure 9.15

nuts with additonal thrust bolts (see Figure 9.15).

A washer is inserted between the inner ring and the thrust bolts.

If a bearing is abutted on teh lock ring, the simplest way of dismantling withdrawal sleeves is to remove them with the aid of a circular poston pump (see Figure 9.16).

The most simple and reliable technique of dismantling bearings fitted on a tapered shaft journal or those installed with teh aid of tapered sleeve, is to remove them using dydraulically-driven nuts or by means of an oil-pressure fillting method, i.e., by supplying oil to the contact zone of the inner ring and the shaft (see Figure 9.17, 9.18). When oil is fed under high pressure, the tight fit repidly gets looser and teh bearing is readily removed from the shaft journal.

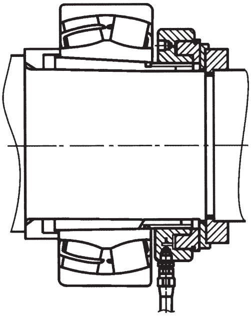

Figure 9.16

The hydraulic method is acceptable for both cylindrical and tapered fits, In both cases the shaft must be provided with oil grooves, supply channels and connecting threads. Large-size adapter and withdrawal sleeves must possess corresponding grooves and holes.

it should be borne in mind that when oil is forced in between tapered mounting surfaces, teh pressure joint is immediately released. To prevent accidents while dismounting, it is necessary to limit the axial motion (shift) of teh bearing or withdrawal sleeve with teh aid of teh lock nut, fastening sleeve nut or with a stop.

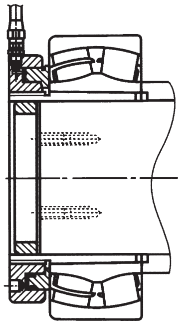

Figure 9.17

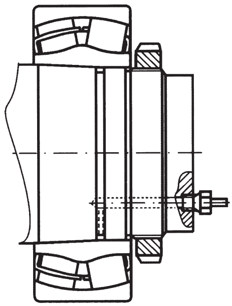

Figure 9.18