CARB®

A TOROIDAL ROLLER BEARING FROM SKF

Mounting, dismounting and grease lubrication of CARB® toroidal roller bearings

SKF

Mounting

CARB® toroidal roller bearing

The CARB toroidal roller bearing is a standard bearing having high radial load carrying capacity and a unique combination of characteristics including

- the low sectional height of needle roller bearings,
- the properties of cylindrical roller bearings in accommodating axial displacement within the bearing, and
- the ability of spherical roller bearings to accept misalignment

CARB is available with a cage or in a full complement design without cage, with a choice of cylindrical or tapered bore. Brief recommendations for mounting and dismounting and guidelines for grease lubrication are given in the following. The same rules are valid for CARB toroidal roller bearings as for other standard bearings. For more detailed instructions see the SKF Bearing Maintenance Handbook.

Axial location

CARB can accommodate axial displacement within the bearing. This means that the inner ring as well as the roller assembly can be axially displaced in relation to the outer ring. The CARB can be secured with lock nuts KMF .. E or KML. If a standard KM lock nut and an MB locking washer are used instead, a spacer may be needed between the bearing inner ring and the washer to prevent washer contact with the cage, *if axial displacement or misalignment are extreme,* see fig 1.

The spacer dimensions shown in fig 1 will ensure safe operation with axial offset of ±10 % of bearing width, and 0,5° misalignment.

Note that both the inner and outer ring must be locked in the axial direction as shown in figs 1 and 2.

Spacer dimensions

For mounting with standard KM lock nut and MB locking washer, as shown in fig 1, spacers with the following dimensions are needed:

$d < 35$ mm	$B_1 = 2$ mm
35 mm $< d <$ 120 mm	$B_1 = 3$ mm
$d >$ 120 mm	$B_1 = 4$ mm

Measure d and d_1 as shown in the SKF General Catalogue 4000, page 894.

Axial mounting position

Initial axial displacement of one ring in relation to the other can be used to increase the available axial clearance for shaft movement in one direction, see fig 1.

It is also possible to accurately adjust the radial clearance or the radial position of the bearing by displacing one of the rings.

Axial and radial clearance are interdependent, i.e. an axial displacement of one ring from the centre position reduces the radial clearance. The principle is shown in fig 3 as applied to CARB C 2220.

For example, if the axial displacement is 2,5 mm, the radial clearance is reduced from 100 to 90 µm and the radial position of the bearing changes from –50 to –45 µm, see fig 3. For more information please contact SKF.

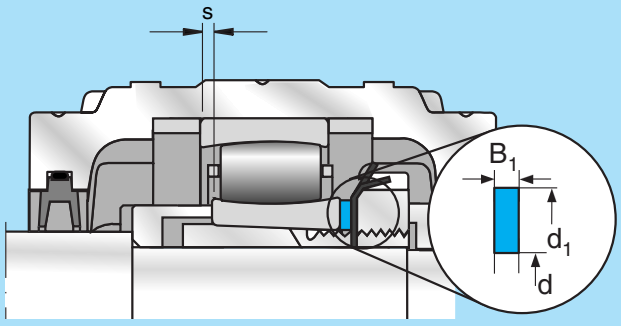


Fig 1 Initial axial displacements and spacer dimensions

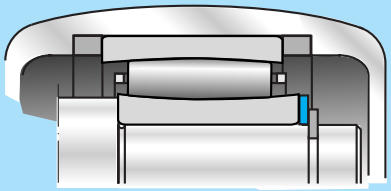


Fig 2 Axial location and axial displacement

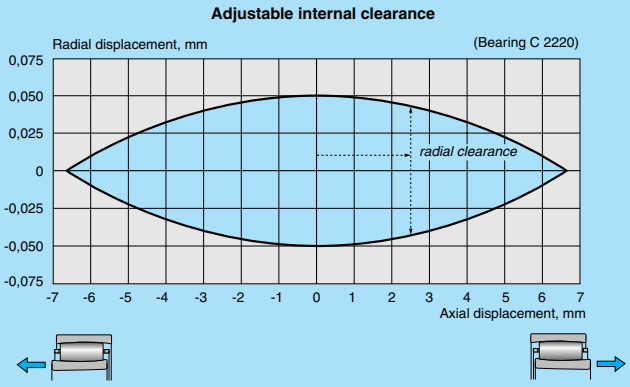


Fig 3 The clearance window

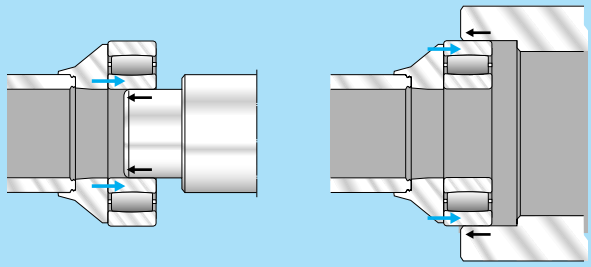


Fig 4 Mounting CARB with SKF TMFT fitting tool

Precautions before mounting

- Choose a clean working environment and correct mounting methods and tools to ensure good results.
- Inspect the bearing arrangement parts and make sure that they are clean and dry.
- Check the seatings on the shaft and in the housing with regard to diameter tolerance and accuracy of form.
- Leave the bearing packaging intact until immediately before mounting
- Remove the rust-inhibiting compound in the bearing bore and on the outer ring outside diameter.

Protect the bearing

If the mounting is interrupted the bearings should immediately be tightly wrapped in plastic film.

- *Never use cotton waste.*

Mounting of bearings with cylindrical bore

I. Cold mounting

There are some basic rules for mounting bearings with cylindrical bore.

- *Never directly strike the ring, cage or rolling elements of a bearing.*
- *Never apply force to one ring in order to mount the other.*

Small bearings with a bore diameter up to 55 mm can be mounted by hammer blows applied to a specially designed sleeve, abutting the ring with the interference fit and guiding the other. It is important that correct mounting tools are used, see fig 4.

For bearings with bore diameters from 60 mm and above the use of a press is recommended.

II. Hot mounting

The force needed to mount a bearing increases rapidly with bearing size. Larger bearings cannot easily be pressed on to a shaft or into a housing because of the mounting force required. Therefore the bearing or the housing may be heated before mounting. Never heat a bearing to a temperature greater than 125 °C (255 °F).

- *Never overheat a bearing.*
- *Never heat a bearing using an open flame.*

Wear clean protective gloves when mounting a hot bearing. Lifting (hoisting) gear can facilitate mounting. Push the bearing along the shaft to its abutment and hold the bearing in position, until a tight fit is obtained.

Induction heater

SKF induction heaters, with automatic demagnetisation, heat the bearing by inducing an electric current. It takes only a short time to heat a bearing.

Electric hot plate

Small bearings can be heated on a thermostatically controlled electric hot plate.

Mounting of tapered bore bearings

CARB toroidal roller bearings, as well as other bearings with a tapered bore, are always mounted with an interference fit on the shaft. As a measure of the degree of interference of the fit, either the reduction in radial internal clearance or the axial displacement of the inner ring on the tapered bearing seating can be used.

Below, three methods for mounting bearings on a tapered seating are described:

I Measurement of the nut turning angle (adapter sleeves)
II Measurement of the reduction of bearing internal clearance during drive-up
III The use of hydraulic equipment and drive-up with predetermined pressure

I. Axial drive-up on adapter sleeve, angle method

Using the turning angle of the sleeve nut to determine the drive-up needed to achieve correct interference is successfully used on self-aligning ball bearings, and is also suitable for CARB for shaft diameters up to approximately 100 mm. It is important to establish a standard procedure for determining the starting point, "zero turning angle".

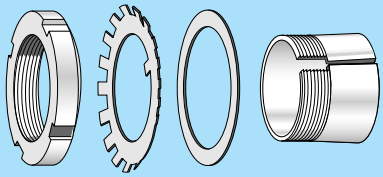
Table A shows turning angles and corresponding axial drive-up distances for CARB toroidal roller bearings of series C 22 and C 23. The sequence described on page 5 should be followed. The starting point for measuring the turning angle (see item 6, page 5) is reached when the nut is tightened sufficiently to make the sleeve just lock on the journal, but not more.

It is advisable to mark the starting point on the nut and on the journal before tightening the nut according to Table A.

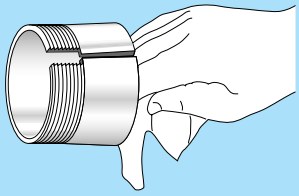
Table A Angular drive-up for CARB toroidal roller bearings

Bearing designation	Clearance reduction	Axial drive-up	Turning angle
–	mm	mm	degrees
22			
C 2205 K	0,011	0,42	100
C 2206 K	0,013	0,45	105
C 2207 K	0,016	0,48	115
C 2208 K	0,018	0,52	125
C 2209 K	0,020	0,54	130
C 2210 K	0,023	0,58	140
C 2211 K	0,025	0,60	110
C 2212 K	0,027	0,65	115
C 2213 K	0,029	0,67	120
C 2214 K	0,032	0,69	125
C 2215 K	0,034	0,72	130
C 2216 K	0,036	0,77	140
C 2217 K	0,038	0,80	145
C 2218 K	0,041	0,84	150
C 2219 K	0,043	0,84	150
C 2220 K	0,045	0,87	155
C 2221 K	0,047	0,94	170
C 2222 K	0,050	0,95	170
C 2224 K	0,054	1,01	180
23			
C 2304 K	0,009	0,38	140
C 2305 K	0,011	0,42	100
C 2306 K	0,013	0,46	110
C 2307 K	0,016	0,48	115
C 2308 K	0,018	0,52	125
C 2309 K	0,020	0,54	130
C 2310 K	0,023	0,58	140
C 2311 K	0,025	0,62	110
C 2312 K	0,027	0,65	115
C 2313 K	0,029	0,70	125
C 2314 K	0,032	0,72	130
C 2315 K	0,034	0,75	135
C 2316 K	0,036	0,78	140
C 2317 K	0,038	0,81	145
C 2318 K	0,041	0,86	155
C 2319 K	0,043	0,87	155
C 2320 K	0,045	0,90	160
C 2321 K	0,047	0,95	170
C 2322 K	0,050	1,00	180
C 2324 K	0,054	1,03	185

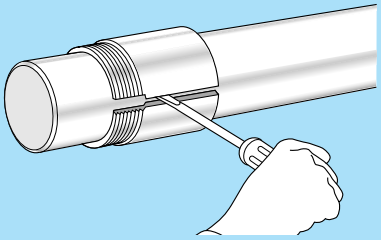
For existing and planned range please contact your local SKF sales company



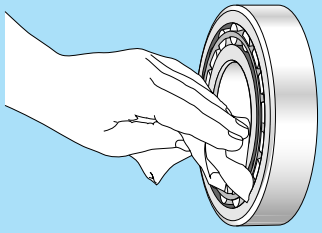
1. Screw off the nut and remove the locking washer.



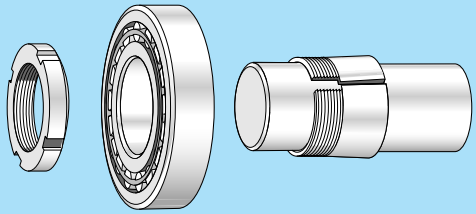
2. Wipe the preservative from the surfaces of the sleeve and then oil the bore surface lightly. Use a thin mineral oil.



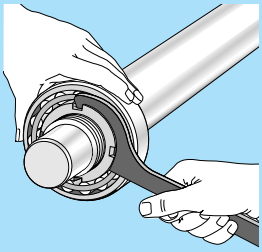
3. Open up the sleeve by inserting a screwdriver in the slit; then slide the sleeve along the shaft to the correct position.

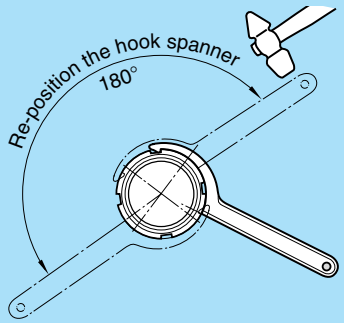


4. Wipe the preservative from the bore of the bearing and then oil the surface lightly. Use a thin mineral oil.

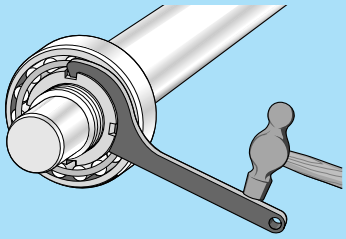


5. Place the bearing on the sleeve. Screw on the nut with its chamfer facing the bearing, but do **not** mount the locking washer. Do **not** push the inner ring up on the taper.

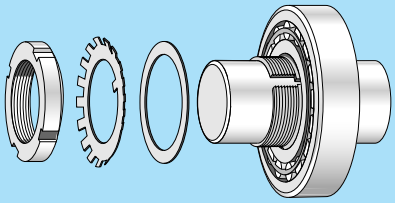




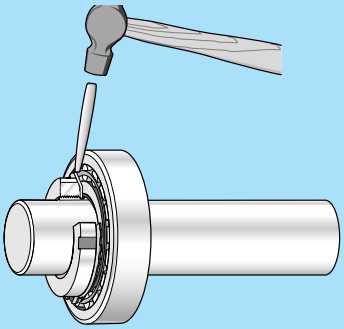
6. Turn the nut sufficiently to ensure that the shaft makes proper contact (self-locking) with the sleeve, but do not drive the bearing any further up the sleeve. Then tighten the nut, preferably using an SKF hook spanner, through the angles for the different bore diameters shown in Table A.



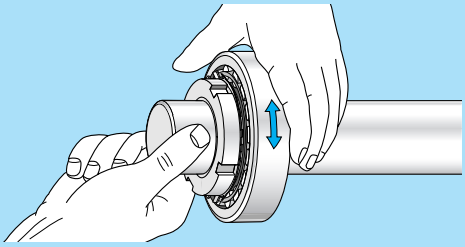
7. Re-position the spanner 180° and then tighten the nut a few degrees more by tapping the spanner handle lightly with a hammer.



8. Unscrew the nut, place the locking washer and spacer in position, and tighten the nut firmly again. Make sure that the bearing is not driven any further up the sleeve.



9. Lock the nut by bending one of the locking washer tabs down into one of the slots in the nut. Do not bend it to the bottom of the slot.



10. Check that the shaft or outer ring can be rotated easily by hand.

Fig 5 Mounting CARB toroidal roller bearings on adapter sleeves

II. Axial drive-up, clearance reduction method

For larger bearings the measurement of clearance reduction is often used to establish the required interference fit.

Before mounting, the internal radial clearance of the bearing should be measured with a feeler gauge.
Place the bearing on a clean work surface and rotate the inner ring a few times. Align the rings so they are parallel and centre the roller assembly, see figs 6 and 7. Use a blade slightly thinner than the minimum value of the clearance before mounting. Insert it over the roller next to the uppermost roller so that it passes the middle of the roller. Move the blade to and fro a few times. Measure with an increasingly thicker blade until, when attempting to pull out the blade, there is a slight resistance. Push the bearing up on to the shaft and check the reduction in internal clearance during drive-up under the lowest roller with the rings parallel and the roller set centred, see page 8.

The minimum values for internal clearance given in Table C, page 7, apply mainly to bearings in which clearance is close to the lower limit. This will give the minimum permissible clearance.

To ensure proper shaft fitting when driving up bearings with greater clearance than Normal – for example, C3 or C4 – it is recommended to keep to the upper half of the clearance reduction range.

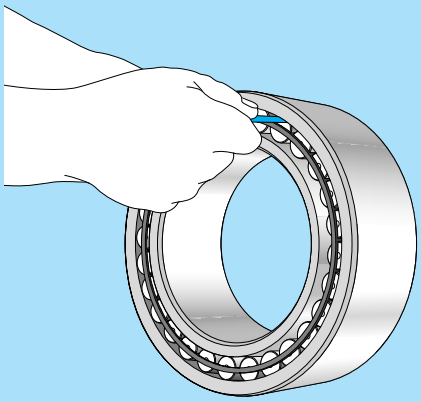


Fig 6 Measurement of radial clearance

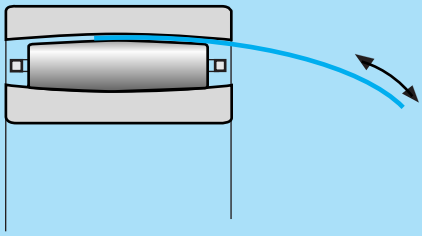


Fig 7 The feeler gauge should be moved to and fro

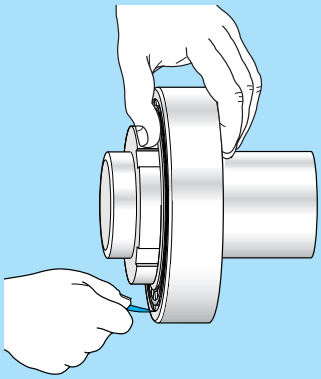


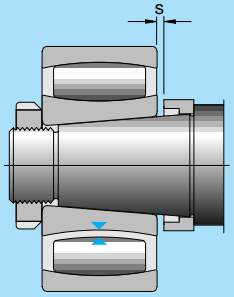
Fig 8 Measurement of clearance reduction

Table B Radial internal clearance of CARB toroidal roller bearings with tapered bore

Bore diameter d		Radial internal clearance C2		Normal		C3		C4	
over	incl.	min	max	min	max	min	max	min	max
mm		µm							
18	**24**	19	31	31	43	43	55	55	69
24	**30**	23	37	37	51	51	65	65	81
30	**40**	28	46	46	62	62	80	80	100
40	**50**	33	53	53	73	73	93	93	117
50	**65**	42	63	63	88	88	113	113	148
65	**80**	52	78	78	108	108	136	136	176
80	**100**	64	96	96	132	132	172	172	218
100	**120**	75	115	115	155	155	201	201	255
120	**140**	90	135	135	180	180	231	231	294
140	**160**	104	155	155	212	212	269	269	338
160	**180**	118	173	173	238	238	301	301	382
180	**200**	130	193	193	260	260	329	329	416
200	**225**	144	213	213	288	288	363	363	460
225	**250**	161	235	235	315	315	401	401	511
250	**280**	174	258	258	344	344	444	444	556
280	**315**	199	283	283	377	377	481	481	617
315	**355**	223	318	318	419	419	542	542	679
355	**400**	251	350	350	471	471	598	598	751
400	**450**	281	383	383	525	525	653	653	835
450	**500**	305	435	435	575	575	733	733	911
500	**560**	335	475	475	633	633	803	803	1 005
560	**630**	380	530	530	702	702	886	886	1 110
630	**710**	422	590	590	772	772	986	986	1 230
710	**800**	480	674	674	860	860	1 100	1 100	1 380

Table C Axial drive-up table for CARB toroidal roller bearings with tapered bore

Bore diameter d		Reduction in radial internal clearance		Axial drive-up s[1] Taper 1:12 on diameter		Taper 1:30 on diameter		Minimum permissible residual radial clearance[2] after mounting bearings with initial clearance		
over	incl.	min	max	min	max	min	max	Normal	C3	C4
mm		mm		mm				mm		
18	**24**	0,009	0,014	0,21	0,29	0,53	0,72	0,022	0,029	0,041
24	**30**	0,012	0,018	0,25	0,34	0,64	0,85	0,025	0,033	0,047
30	**40**	0,015	0,024	0,30	0,42	0,74	1,06	0,031	0,038	0,056
40	**50**	0,020	0,030	0,37	0,51	0,92	1,27	0,033	0,043	0,063
50	**65**	0,025	0,039	0,44	0,64	1,09	1,59	0,038	0,049	0,074
65	**80**	0,033	0,048	0,54	0,76	1,36	1,91	0,041	0,055	0,088
80	**100**	0,040	0,060	0,65	0,93	1,62	2,33	0,056	0,072	0,112
100	**120**	0,050	0,072	0,79	1,10	1,98	2,75	0,065	0,083	0,129
120	**140**	0,060	0,084	0,93	1,27	2,33	3,18	0,075	0,106	0,147
140	**160**	0,070	0,096	1,07	1,44	2,68	3,60	0,085	0,126	0,173
160	**180**	0,080	0,108	1,21	1,61	3,04	4,02	0,093	0,140	0,193
180	**200**	0,090	0,120	1,36	1,78	3,39	4,45	0,103	0,150	0,209
200	**225**	0,100	0,135	1,50	1,99	3,74	4,98	0,113	0,163	0,228
225	**250**	0,113	0,150	1,67	2,20	4,18	5,51	0,123	0,175	0,251
250	**280**	0,125	0,168	1,85	2,46	4,62	6,14	0,133	0,186	0,276
280	**315**	0,140	0,189	2,06	2,75	5,15	6,88	0,143	0,198	0,292
315	**355**	0,158	0,213	2,31	3,09	5,77	7,73	0,161	0,226	0,329
355	**400**	0,177	0,240	2,59	3,47	6,48	8,68	0,173	0,251	0,358
400	**450**	0,200	0,270	2,91	3,90	7,27	9,74	0,183	0,275	0,383
450	**500**	0,225	0,300	3,26	4,32	8,15	10,80	0,210	0,295	0,433
500	**560**	0,250	0,336	3,61	4,83	9,04	12,07	0,225	0,327	0,467
560	**630**	0,280	0,378	4,04	5,42	10,09	13,55	0,250	0,364	0,508
630	**710**	0,315	0,426	4,53	6,10	11,33	15,25	0,275	0,386	0,560
710	**800**	0,355	0,480	5,10	6,86	12,74	17,15	0,319	0,430	0,620



[1] Valid for solid steel shafts only

[2] The residual clearance must be checked in cases where the initial radial internal clearance is in the lower half of the tolerance range and where large temperature differentials between the bearing rings can arise in operation. The residual clearance must not be less than the minimum values quoted above. When doing so, make sure that the rings and roller assembly are aligned and centred

III. SKF drive-up method

When measurement of the axial drive-up is used to achieve the required interference fit it can be difficult, for larger bearings, to establish where the drive-up starts. An accurate method for axial drive-up measurements is described below where the correct fit is achieved by controlling the axial drive-up of the bearing from a predetermined position.

The method may incorporate the use of an SKF hydraulic nut, HMV .. E fitted with a dial indicator, and a specially calibrated pressure gauge, mounted on a selected pump. The equipment is shown in fig 9.

The required pressure for each CARB bearing is given in Table D, page 9. This enables accurate positioning of the bearing at the starting point, from where the axial drive-up (s_s) is measured.

Mounting on sleeves

Adapter and withdrawal sleeves are often used and the bearings are in principle mounted in the same way as for a tapered shaft. Detailed information is found in the SKF Bearing Maintenance Handbook.

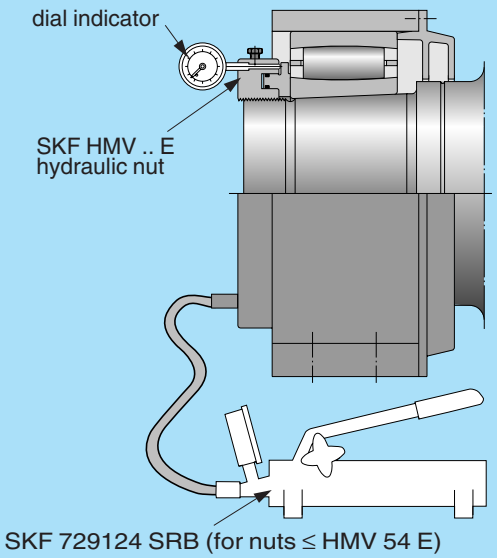
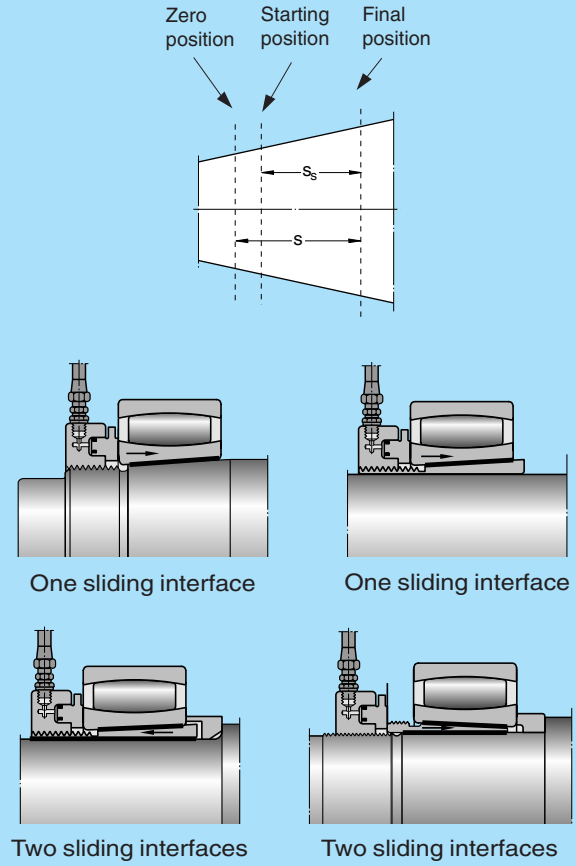


Fig 9 The equipment for accurate drive-up



1. Ensure that the bearing size is the same as the HMV .. E nut size (otherwise the pressure in the table must be adjusted).
2. Determine whether one or two interfaces slide during mounting; see figures above.
3. Lightly oil all mating surfaces with a thin oil e.g. SKF LHMF 300 and carefully put the bearing on the shaft.
4. Drive the bearing up to the starting position by applying the pressure found in Table D. Monitor the pressure using the gauge mounted on the pump. The appropriate pumps are listed in fig 9.
   As an alternative SKF mounting gauge 1077587/3 can be screwed directly into the hydraulic nut.
5. Drive the bearing up on the taper by the required distance s_s. The axial drive-up is best monitored by a dial indicator. The SKF hydraulic nut HMV .. E is prepared for dial indicators, see fig 9.

Fig 10 Step-by-step drive-up

Table D Axial drive-up of CARB toroidal roller bearings with tapered bore

Bearing designation	Starting position: Pressure at start* 1	2	Final position: Radial clearance reduction from starting position	Axial drive-up s_s from starting position 1	2
–	MPa		mm	mm	
22					
C 2210 K	0,7	1,2	0,023	0,34	0,41
C 2211 K	0,6	1,0	0,025	0,35	0,42
C 2212 K	1,1	1,9	0,027	0,39	0,46
C 2213 K	0,8	1,4	0,029	0,40	0,47
C 2214 K	0,8	1,3	0,032	0,43	0,50
C 2215 K	0,7	1,2	0,034	0,44	0,52
C 2216 K	0,8	1,3	0,036	0,46	0,54
C 2217 K	1,1	1,9	0,038	0,50	0,57
C 2218 K	1,4	2,3	0,041	0,55	0,62
C 2219 K	1,0	1,7	0,043	0,54	0,62
C 2220 K	1,1	1,9	0,045	0,56	0,64
C 2221 K	1,9	3,2	0,047	0,62	0,69
C 2222 K	1,5	2,5	0,050	0,63	0,71
C 2224 K	1,6	2,7	0,054	0,67	0,74
C 2226 K	1,4	2,5	0,059	0,71	0,79
C 2228 K	2,4	4,0	0,063	0,79	0,86
C 2230 K	1,8	3,1	0,068	0,82	0,89
C 2232 K	2,6	4,5	0,072	0,90	0,97
C 2234 K	2,6	4,4	0,076	0,94	1,0
C 2236 K	2,5	4,2	0,081	0,99	1,1
C 2238 K	1,8	3,0	0,086	1,0	1,1
C 2240 K	2,8	4,8	0,090	1,1	1,2
C 2244 K	2,0	3,3	0,099	1,2	1,2
23					
C 2310 K	1,4	2,3	0,023	0,34	0,42
C 2311 K	1,7	2,9	0,025	0,37	0,45
C 2312 K	1,8	3,1	0,027	0,39	0,47
C 2313 K	2,5	4,3	0,029	0,44	0,51
C 2314 K	2,0	3,4	0,032	0,45	0,53
C 2315 K	2,3	3,8	0,034	0,48	0,55
C 2316 K	2,1	3,6	0,036	0,49	0,56
C 2317 K	2,4	4,1	0,038	0,52	0,59
C 2318 K	2,9	4,9	0,041	0,57	0,64
C 2319 K	2,2	3,8	0,043	0,57	0,64
C 2320 K	2,6	4,4	0,045	0,59	0,66
C 2321 K	3,3	5,7	0,047	0,63	0,70
C 2322 K	3,9	6,7	0,050	0,69	0,76
C 2324 K	3,2	5,5	0,054	0,70	0,77
C 2326 K	2,7	4,6	0,059	0,73	0,81
C 2328 K	4,9	8,3	0,063	0,83	0,90
C 2330 K	6,8	11,5	0,068	0,95	1,0
30					
C 3010 K	0,4	0,6	0,023	0,32	0,39
C 3011 K	0,5	0,8	0,025	0,34	0,41
C 3012 K	0,5	0,8	0,027	0,36	0,43
C 3013 K	0,5	0,8	0,029	0,38	0,45
C 3014 K	0,6	1,1	0,032	0,42	0,49
C 3015 K	0,5	0,8	0,034	0,43	0,50
C 3016 K	0,6	1,1	0,036	0,46	0,53
C 3017 K	0,5	0,9	0,038	0,47	0,54
C 3018 K	0,8	1,4	0,041	0,52	0,59
C 3019 K	0,7	1,2	0,043	0,53	0,61
C 3020 K	0,6	1,1	0,045	0,55	0,62
C 3021 K	0,8	1,4	0,047	0,58	0,65
C 3022 K	1,0	1,7	0,050	0,61	0,69
C 3024 K	0,9	1,6	0,054	0,65	0,72
C 3026 K	1,2	2,1	0,059	0,72	0,79
C 3028 K	1,3	2,1	0,063	0,76	0,83
C 3030 K	1,0	1,7	0,068	0,80	0,87
C 3032 K	1,3	2,3	0,072	0,86	0,93
C 3034 K	1,5	2,6	0,076	0,90	0,98
C 3036 K	1,4	2,4	0,081	0,95	1,0
C 3038 K	1,6	2,7	0,086	1,0	1,1
C 3040 K	1,6	2,8	0,090	1,1	1,1
C 3044 K	1,6	2,7	0,099	1,2	1,2
C 3048 K	1,3	2,3	0,108	1,2	1,3
C 3052 K	1,8	3,0	0,117	1,4	1,4
C 3056 K	1,7	2,9	0,126	1,5	1,5
C 3060 K	1,9	3,2	0,135	1,6	1,6
C 3064 K	1,8	3,1	0,144	1,7	1,7
C 3068 K	2,0	3,5	0,153	1,8	1,8
C 3072 K	1,7	2,8	0,162	1,8	1,9
C 3076 K	1,4	2,3	0,171	1,9	2,0
C 3080 K	1,5	2,6	0,180	2,0	2,1
31					
C 3110 K	0,7	1,1	0,023	0,33	0,41
C 3111 K	0,7	1,1	0,025	0,35	0,42
C 3112 K	0,8	1,3	0,027	0,37	0,45
C 3113 K	0,8	1,3	0,029	0,39	0,46
C 3114 K	0,6	1,0	0,032	0,42	0,49
C 3115 K	0,8	1,4	0,034	0,44	0,52
C 3116 K	0,7	1,3	0,036	0,46	0,53
C 3117 K	0,8	1,3	0,038	0,48	0,55
C 3118 K	1,2	2,0	0,041	0,53	0,60
C 3119 K	1,3	2,2	0,043	0,55	0,62
C 3120 K	1,3	2,2	0,045	0,57	0,64
C 3121 K	1,3	2,2	0,047	0,58	0,65
C 3122 K	1,3	2,2	0,050	0,62	0,69
C 3124 K	1,8	3,0	0,054	0,67	0,75
C 3126 K	1,5	2,6	0,059	0,72	0,79
C 3128 K	1,8	3,1	0,063	0,77	0,84
C 3130 K	2,4	4,1	0,068	0,84	0,91
C 3132 K	2,1	3,5	0,072	0,87	0,94
C 3134 K	1,8	3,1	0,076	0,90	0,97
C 3136 K	1,7	2,9	0,081	0,94	1,0
C 3138 K	2,3	3,9	0,086	1,0	1,1
C 3140 K	2,7	4,6	0,090	1,1	1,2
C 3144 K	2,8	4,7	0,099	1,2	1,3
C 3148 K	2,0	3,4	0,108	1,2	1,3
C 3152 K	2,8	4,7	0,117	1,4	1,4
C 3156 K	2,6	4,5	0,126	1,5	1,5
C 3160 K	2,8	4,8	0,135	1,6	1,6
32					
C 3210 K	1,0	1,7	0,023	0,34	0,42
C 3211 K	0,7	1,2	0,025	0,35	0,42
C 3212 K	0,9	1,5	0,027	0,37	0,44
C 3213 K	1,1	1,8	0,029	0,40	0,47
C 3214 K	0,9	1,6	0,032	0,43	0,50
C 3215 K	0,9	1,6	0,034	0,45	0,52
C 3216 K	1,3	2,2	0,036	0,48	0,55
C 3217 K	1,2	2,1	0,038	0,49	0,56
C 3218 K	1,8	3,1	0,041	0,55	0,62
C 3219 K	1,3	2,2	0,043	0,54	0,61
C 3220 K	2,1	3,6	0,045	0,59	0,66
C 3221 K	2,4	4,1	0,047	0,61	0,69
C 3222 K	2,6	4,4	0,050	0,66	0,73
C 3224 K	2,5	4,2	0,054	0,68	0,76
C 3226 K	2,5	4,3	0,059	0,74	0,81
C 3228 K	2,9	5,0	0,063	0,79	0,86
C 3230 K	2,3	3,9	0,068	0,82	0,89
C 3232 K	2,7	4,6	0,072	0,87	0,94
C 3234 K	3,9	6,6	0,076	0,96	1,0
C 3236 K	3,7	6,3	0,081	1,0	1,1
C 3238 K	2,9	5,0	0,086	1,0	1,1
C 3240 K	2,6	4,4	0,090	1,1	1,1
40					
C 4010 K30	0,4	0,8	0,023	0,80	0,99
C 4011 K30	0,7	1,2	0,025	0,87	1,1
C 4012 K30	0,5	0,9	0,027	0,89	1,1
C 4013 K30	0,5	0,9	0,029	0,95	1,1
C 4014 K30	0,6	1,1	0,032	1,0	1,2
C 4015 K30	0,7	1,3	0,034	1,1	1,3
C 4016 K30	0,8	1,4	0,036	1,2	1,3
C 4017 K30	0,6	1,2	0,038	1,2	1,4
C 4018 K30	0,9	1,7	0,041	1,3	1,5
C 4019 K30	0,8	1,5	0,043	1,3	1,5
C 4020 K30	0,7	1,3	0,045	1,4	1,6
C 4021 K30	1,0	1,9	0,047	1,5	1,6
C 4022 K30	0,9	1,6	0,050	1,5	1,7
C 4024 K30	0,8	1,5	0,054	1,6	1,8
C 4026 K30	1,2	2,2	0,059	1,8	2,0
C 4028 K30	1,2	2,3	0,063	1,9	2,1
C 4030 K30	1,2	2,2	0,068	2,0	2,2
C 4032 K30	1,1	2,0	0,072	2,1	2,3
C 4034 K30	1,4	2,5	0,076	2,2	2,4
C 4036 K30	1,2	2,2	0,081	2,5	1,1
C 4038 K30	1,5	2,8	0,086	2,5	2,7
C 4040 K30	1,4	2,5	0,090	2,6	2,8

* = Values given for same HMV .. E nut size as bearing size

1 = Should be applied when there is one sliding interface during mounting. Surfaces lightly oiled

2 = Should be applied when there are two sliding interfaces during mounting. Surfaces lightly oiled

The table is only valid for solid steel shafts. For hollow shafts or other materials please contact SKF

For existing and planned range please contact your local SKF sales company

Dismounting

There are three dismounting methods: mechanical, hydraulic and oil injection.

- *When dismounting the bearings, never apply the force through the rolling elements.*

Interference fit on the shaft

Bearings, with bore diameters up to 120 mm, mounted with an interference fit on the shaft, can be dismounted using a conventional puller. The puller should engage the inner ring, and the bearing is then removed with a steady force until the bearing bore completely clears the entire length of the cylindrical seating, see fig 11.

Larger bearings with an interference fit on the shaft often require considerable dismounting force. In these cases a hydraulic tool is more suitable than a mechanical one.

Interference fit in the housing

A bearing mounted in a housing without shoulders can be removed by hammer blows directed on a sleeve that abuts the outer ring. Larger bearings require greater force to dismount and the use of a press is recommended.

Interference fit both in the housing and on the shaft

One of the opportunities offered by CARB toroidal roller bearings is that both outer and inner rings can be mounted with an interference fit.

For CARB bearings with an interference fit on both rings, the best method is to allow the bearing to be pressed out of the housing with the shaft. If this is not suitable the opposite procedure – allowing the bearing to come off the shaft with the housing – can be used.

Dismounting from a tapered journal

Smaller bearings can be dismounted using a conventional puller which engages the inner ring. Centre the puller accurately to avoid damage to the bearing seating.

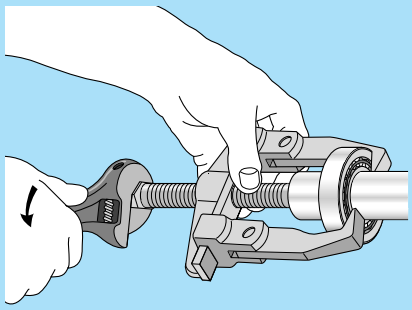


Fig 11 The puller should engage the inner ring

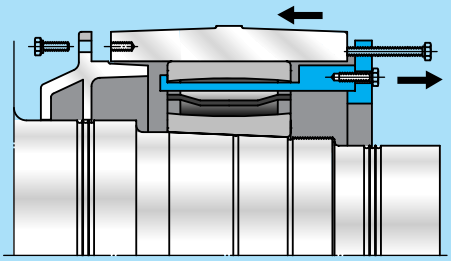


Fig 12 Puller for CARB

Larger bearings may require considerable force to dismount, so a hydraulic withdrawal tool may be more suitable than a mechanical one.

The SKF puller for CARB allows easy dismounting from housings with loose fit after dismounting of the inner ring. The puller arms are inserted between the bearing cage and outer ring and engage on the outer ring, see fig 12.

The best way to facilitate dismounting of inner rings is to utilise the SKF oil injection method. Detailed information is found in the SKF Bearing Maintenance Handbook.

Dismounting from sleeves

Adapter and withdrawal sleeves are often used and CARB toroidal roller bearings are in principle dismounted in the same way as other bearings. Detailed information is given in the SKF Bearing Maintenance Handbook.

Grease lubrication

Why lubricate?

Grease reduces friction, prevents wear and corrosion and also protects against contaminants. It forms a film which separates the surfaces in contact when the bearing rotates even under heavy loads.

Cleanliness

One of the most important factors for obtaining a long bearing life is cleanliness. It is very important that clean grease is used to lubricate the bearings and that the grease remains clean during operation. The bearing arrangement must therefore incorporate efficient seals so that contaminants from the surroundings cannot enter.

The first step when bearings are to be relubricated is to wipe the grease nipple and the surrounding area clean.

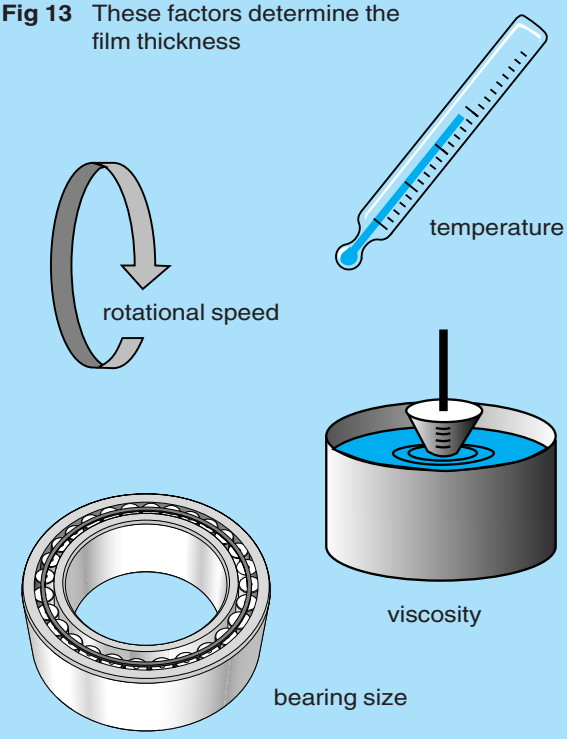


Fig 13 These factors determine the film thickness

Grease lubrication

Grease lubrication is used for applications where operating conditions for the bearing are normal. Grease lubrication allows for simple arrangement designs and provides good protection against moisture and contamination.

Grease handling

Grease should be kept in its original packaging until required and should never be left unprotected. Uncovered grease soon becomes dusty and dirty. Tools, grease guns etc., should be carefully cleaned before use.

The grease used for bearing lubrication should be of high, consistent quality. Greases supplied by SKF are carefully checked and always meet the quality and cleanliness specifications.

Selection of grease

Grease for CARB toroidal roller bearings is selected on the same basis as for other rolling bearings. The grease should normally have a consistency of 2 or possibly 3 to the NLGI Scale and should be rust inhibiting and of good quality. The most important factors to be considered when selecting a grease are

- operating temperature,
- speed,
- vertical or horizontal shaft,
- operating conditions such as vibration,
- bearing type and size,
- bearing load, and
- full complement or caged bearing

The viscosity of the base oil of a grease partly determines the thickness of the lubricant film in the rolling contact.

Applying the grease

On delivery, CARB toroidal roller bearings are coated with a rust inhibiting compound. There is no need to remove this.

Generally a CARB bearing is first greased when it has been mounted in order to minimise the risk of contamination. Only in cases where it is impossible to apply the grease evenly to the bearing should the grease be applied before the bearing is mounted.

The application of grease to CARB bearings is shown on page 15.

How to lubricate CARB toroidal roller bearings

As CARB bearings only have one row of rollers they can be lubricated from the side and the housing should be fitted with a grease nipple at the side opposite to the lock nut (if they are mounted on an adapter sleeve). If they are to be frequently relubricated it is advisable for the housing base to have a grease escape hole at the side of the bearing opposite to the grease nipple, see figure on page 13.

Experience gained with all roller bearings indicates that a first relubrication after a few days of operation is very beneficial, and may even be a prerequisite if the expected relubrication interval is to be attained when operating speeds are high. For this first relubrication half of the normal quantity recommended for regular relubrication will be sufficient.

Full complement bearings cannot retain grease as well as caged bearings. Unless the speed is very low, therefore, full complement bearings should be relubricated much more often than caged bearings, and continuous relubrication may be required if speeds are high.

Relubrication

The length of time during which a grease lubricated bearing will function satisfactorily without relubrication depends on bearing size and speed and on the operating temperature etc., see diagram on page 13 (bearings with cage).

The grease used for relubrication should be the same as that used for the original greasing. Certain greases lose their lubricating properties when mixed with other greases. For this reason, greases should never be mixed if it is not known whether they are compatible.

Correct amount of grease

The following general rules apply:

- CARB with cages should be filled to approximately 50 % except at low speeds when they should be completely filled
- Full complement bearings should be completely filled
- Bearing housings should be partly filled (between 30 and 50 % of the free space)

In non-vibrating applications it is possible when using most lithium base greases of the “full fill” type to apply more grease to the housing than recommended above, without any risk of increasing the temperature. The increased grease quantity provides greater protection against the penetration of contaminants to the bearing.

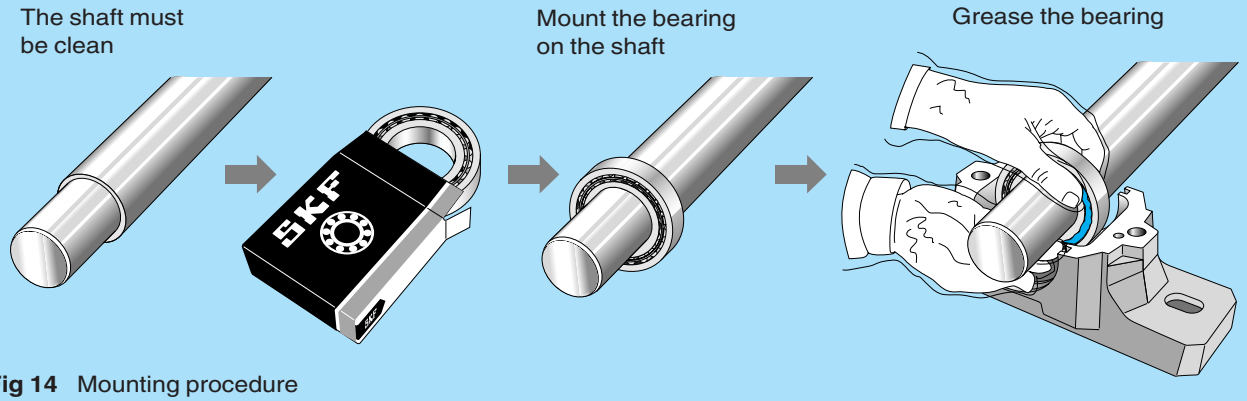


Fig 14 Mounting procedure

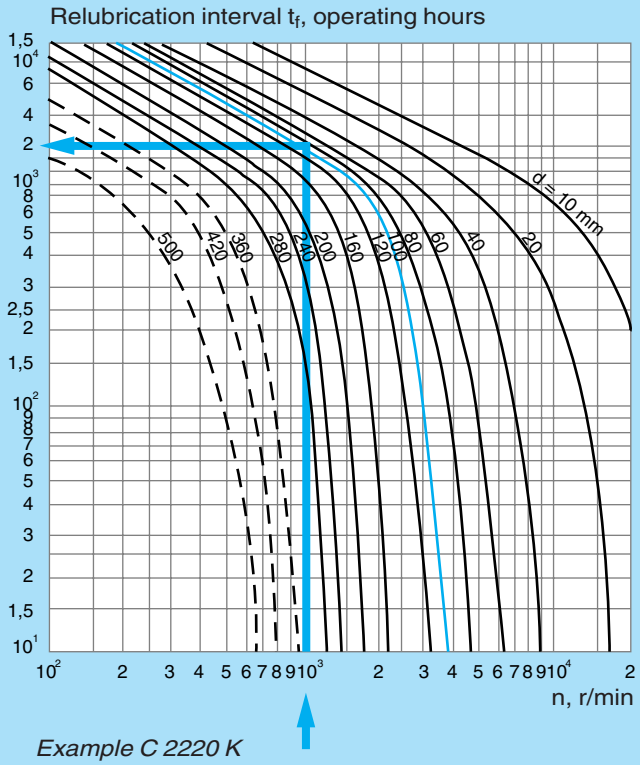
Relubrication diagram

The diagram gives suitable relubrication intervals, expressed in operating hours for oxidation resistant lithium base greases of good quality. The diagram is valid for bearings on horizontal shafts in stationary machines under normal operating conditions.

At bearing temperatures above 70 °C, the relubrication interval obtained from the diagram should be halved for every 15 °C increase. The relubrication interval can be extended for temperatures well below 70 °C.

Where there is a risk of contamination of the grease during operation, relubrication should be more frequent than indicated. This is also true for bearings in paper-making machines, for example, where the housings are often exposed to water.

For bearings on vertical shafts, the relubrication intervals obtained from the diagram should be halved.



Example C 2220 K

The bearing has a bore diameter of d = 100 mm and is to rotate at 1 000 r/min.The operating temperature varies between 50 and 70 °C. What is the recommended relubrication interval?

A line from 1 000 r/min on the x axis is followed until it meets the curve for 100 mm bore. A line at right angles is then followed to the y axis where the value is found to be 2 000 h. Thus the relubrication interval is 2 000 operating hours.

Fig 17 Relubrication diagram

Care should be taken when using a grease gun operated by pressurised air. The seals may be damaged by the pressure

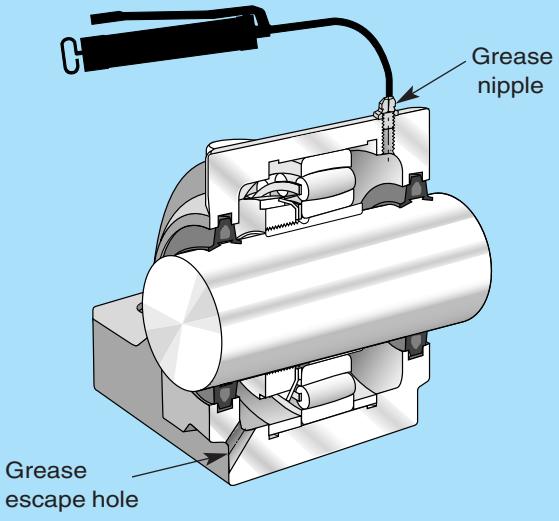
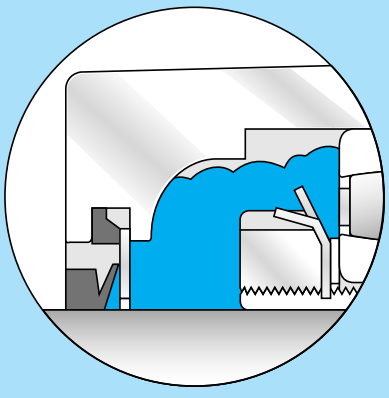


Fig 15 Grease lubrication of CARB toroidal roller bearing



Leave some space in the bearing housing for grease which is thrown out of the bearing when starting up

It is possible with most lithium base greases to fill more than 50 % of the free space in the housing

Fig 16 Grease filling

How much grease?

Only the grease in the bearing should be replaced. The quantity of grease should thus be appropriate to the bearing size. If greasing instructions are available, these should be followed. If not, the quantity can be determined from

$G_p = 0{,}005\ D\ B$

where
G_p = grease quantity for periodic relubrication, g
D = bearing outside diameter, mm
B = bearing width, mm

Grease valve

When a bearing has to be relubricated frequently, too much grease may collect in the bearing housing, This can be prevented by removing excess grease using a grease valve.

The grease valve typically consists of a disc which rotates with the shaft and forms a narrow gap to the housing, Excess grease is caught by the disc and ejected via an opening at the bottom of the housing.

If possible the grease should be fed in so that it can enter the bearing.

How to grease CARB toroidal roller bearings

I. Bearings with cage

CARB has a relatively large free volume available for grease. If the bearing is run at relatively high speed (greater then ~75 % of catalogue speed rating for grease) then there is a chance that the temperature will be elevated with a full pack of grease.

The recommendation is therefore to only fill the space between inner ring and cage when initially greasing the bearing for high speed applications.

For low or moderate speeds, the bearing may be fully packed with grease.

II. Full complement bearings

All free space in the bearing should be packed with grease.

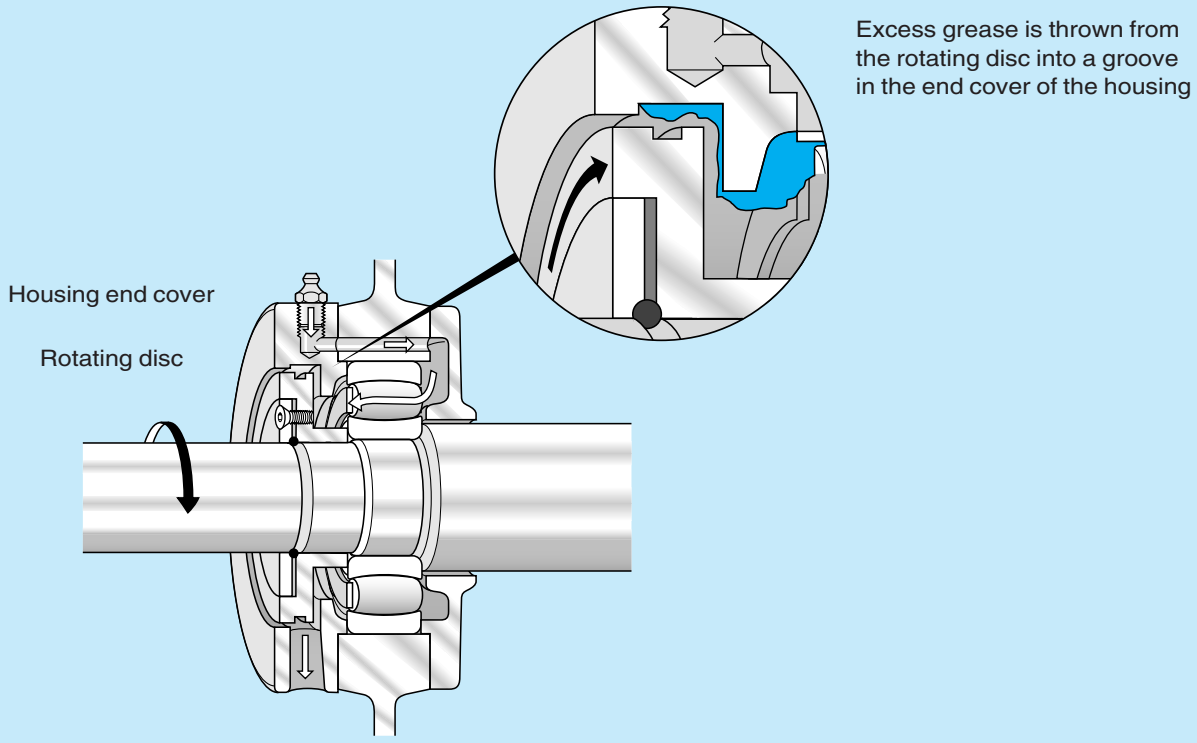
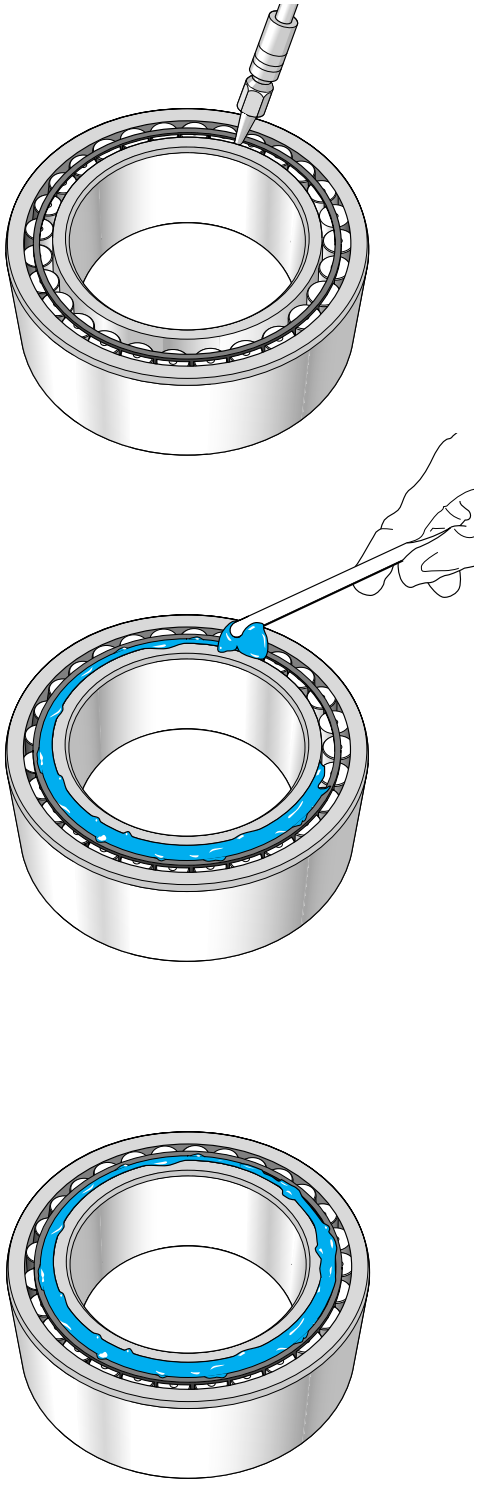


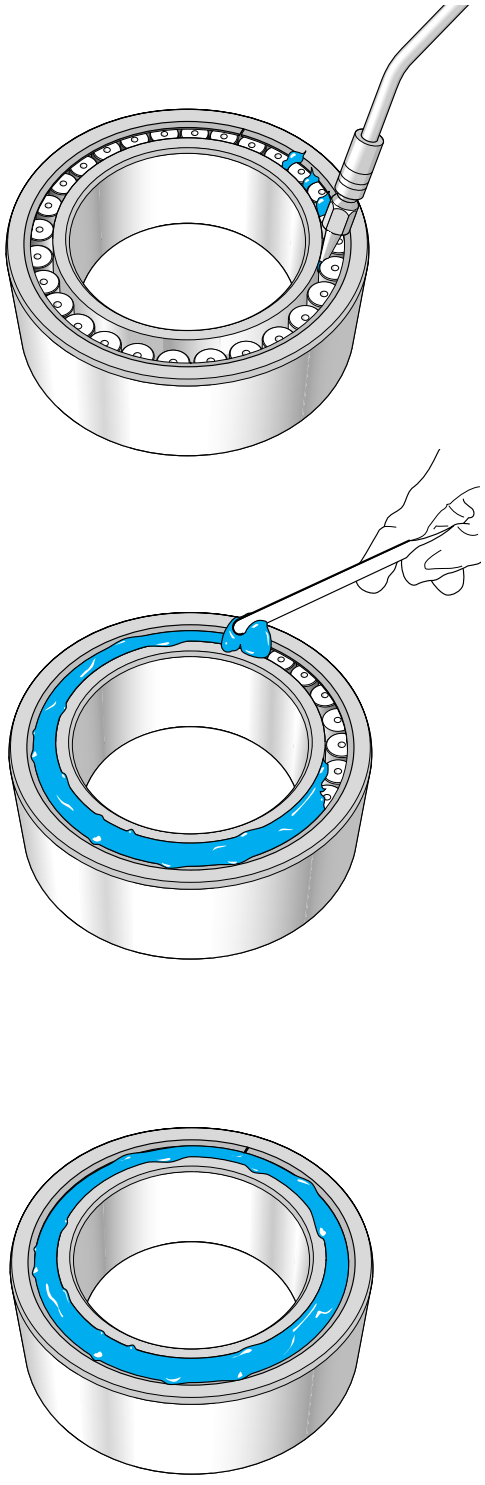
Fig 18 Grease valve

How to grease CARB toroidal roller bearings

Bearings with cage



Full complement bearings (without cage)



Publication **4691/II E**

Printed in Sweden on environmentally friendly, chlorine-free paper (Multiart Silk) by SG idé & tryck ab.

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