

# COOPER<sup>®</sup>

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## **ASSEMBLY, MAINTENANCE AND LUBRICATION INSTRUCTIONS FOR COOPER SPLIT BEARING # 03E BCPN 613.30MM EXILOG RJ ALF IH LAB TE SLUB**



*Please ensure that you have read and fully understand these instructions before proceeding!*

<b>REFERENCE:</b>	<b>CCG Contract F3017-16N777/001/QCL</b>
<b>SKF Service Request:</b>	<b>1-3740975561 (Canada)</b>
<b>DATE:</b>	<b>OCTOBER 2017</b>
<b>CUSTOMER:</b>	<b>CCGS Des Groseilliers</b>
<b>DRAWING OF PARTS:</b>	<b>Cooper 3L17835-1C</b>

## **CONTENTS**

- PRELIMINARY NOTES.
- CHECKLIST
- HEALTH & SAFETY

### **SECTIONS:**

- 0) PART NUMBERS, SPARE PARTS AND TOOLS
- 1) PEDESTAL BASES
- 2) MOUNTING OF BEARING INNER RACES ON SHAFT
- 3) TIGHTENING THE INNER RACE
- 4) ASSEMBLING BEARING OUTER RACE IN CARTRIDGE
- 5) BEARING LUBRICATION AT INSTALLATION
- 6) CAGE & ROLLER ASSEMBLY
- 7) ASSEMBLY OF CARTRIDGE BOTTOM HALF IN PEDESTAL BASE
- 8) ASSEMBLY OF CARTRIDGE TOP HALF
- 9) ASSEMBLY OF PEDESTAL CAP
- 10) BEARING ALIGNMENT PROCEDURE
- 11) TEMPERATURE SENSOR
- 12) STORAGE WHILST ASSEMBLED
- 13) BEARING RELUBRICATION
- 14) ROUTINE MAINTENANCE
- 15) CONTACTS
- 16) DRAWINGS

**Cooper Roller Bearings** drawing 3L17835/1C shows the general arrangement and overall dimensions of the components **03E BCPN 613.3mm EXILOG RJ ALF IH LAB TE SLUB**.

All bearings are supplied with an assembly / lubrication instruction leaflet wrapped in with the bearing.

## **PRELIMINARY NOTES**

Ensure all necessary tools and lifting equipment is available before commencing. Metric hexagon head keys are required, other tools include a soft headed mallet, extension tubes to fit over keys for tightening screws, or alternatively a torque wrench with adapters down to hexagon keys would be advantageous to obtain the correct screw torque settings.

Jacks or other lifting equipment are needed to raise the shaft, and support it whilst the bearings are assembled.

When unwrapping the bearings, do not interchange bearing parts. Complete bearings can be interchanged between similar Cooper cartridges, but individual bearing parts must not be interchanged. Each component has a match marking number, a random number stamped each side of the split. When assembling, these numbers must coincide. Clean bearing parts to remove the preservative, then keep the components clean and protected until they are ready for fitting.

## **CHECKLIST**

- ✓ The correct shaft limit is important.
- ✓ Parts should not be interchanged.
- ✓ Match marking numbers should coincide.
- ✓ Lightly oil threads and interfaces.
- ✓ Fully tighten the inner race.
- ✓ Lubricate before closing the cartridge.
- ✓ Lubricate swivel seatings.
- ✓ Safeguard rolling surfaces during transit.

Read these instructions in conjunction with the information supplied and packed in with the roller bearing, before commencing the installation.

## **HEALTH AND SAFETY AT WORK.**

We draw attention to the safety aspects in bearings. Damage to equipment and personal injury may result if the bearing is not installed according to these instructions, or operated outside the limits of load and speed given in the Technical Data catalogue.

Due to the large size of this unit, there are additional lifting holes in the components to assist with installation and handling. All threaded holes lifting holes are marked with their appropriate thread size "M16" etc, next to the hole.

Due to the presence of very sharp edges on component parts, handle all items with care.

## 0) PART NUMBERS, SPARE PARTS AND TOOLS

The bearings assemblies are intended for T1200 ice breakers in the CCG fleet (CCGS Des Groseilliers, CCGS Amundsen, CCGS Pierre Radisson). Each tail shaft will be supported by:

Assembly part number: **Cooper 03E BCPN 613.3mm EXILOG RJ ALF IH LAB TE SLUB**

Each assembly includes:

- (1) Pedestal PN9511
- (1) Cartridge 03EC613.30MGR10
- (1) Bearing 03EB613.30MEX10
- Relevant bolts and fittings to assemble the unit are included

### Breakdown of the assembly part number:

03E	Series of the bearing which has rollers that are larger and greater in quantity
BCPN	Denotes the assembly including a <u>B</u> earing, <u>C</u> artridge, <u>P</u> edestal, and made of <u>N</u> odular (ductile) iron material
613.3mm	Nominal shaft diameter intended for the bearing
EXILOG	<u>E</u> Xpansion type, <u>I</u> nnner ring <u>L</u> ong, <u>O</u> uter race <u>G</u> rooved. This allows the bearing to accept axial displacement without changing the centerline of the bearing.
RJ	<u>R</u> ing <u>J</u> oint, a sturdy cage joining mechanism that is preferred for ice class duty
ALF	<u>A</u> luminium <u>L</u> and riding <u>F</u> lange, a design that reduces clearance between the outer diameter of the cage and the inner diameter of the outer race flanges, which prevents cage shock loading during ice breaking operations.
IH	<u>I</u> nspection <u>H</u> ole, a hole machined on the side of the cartridge that allows the user to measure the distance between the side face of the cartridge and the side face of a rolling element. This distance can be measured over time to identify the axial shift of the bearing, and this can in turn identify the amount of wear in the thrust pad bearings.
LAB	<u>L</u> abyrinth seal type grooves, also known as grease grooves, machined into the cartridge. This forms a very narrow gap between the shaft and the cartridge.
TE	<u>T</u> emperature <u>E</u> lement hole, which allows an RTD to be inserted within the hole to measure operating temperature of the bearing.
SLUB	Swivel seating lubrication, which allows changing alignment of the shaft and cartridge relative to the pedestal in service.

Spare bearing and cartridge includes:

- (1) Cartridge 03EC613.30MGR10
- (1) Bearing 03EB613.30MEX10
- Relevant bolts and fittings are included

Breakdown of the bearing and cartridge part number:

03E                Series of the bearing which has rollers that are larger and greater in quantity

B                 Denotes Bearing

C                 Denotes Cartridge

613.3M           Nominal shaft diameter intended for the bearing (613.3 mm)

GR10, EX10    GR indicates Grooved Race (locating type), EX indicates Expansion type, number 10 indicates special modification for ice breaker duty.

Details of the spare parts kit and tools that are supplied with the bearing are shown in the table below. SHCS means **S**ocket **H**ead **C**ap **S**crew.

Spare Part Description			Used for:	Qty	SPARESKIT1
M16 x 65mm long SHCS			radial hold back	4	
M16 plain washer			radial hold back	4	
M30 x 120mm long SHCS			clamping ring	2	
M6 x 25mm long drilled head SHCS			ring joint	8	
No 2 Ring Joint			ring joint	2	
M16 x 25mm long dog point set screw			cart sidescrew/cart jacking	4	
12 dia x 70mm long side rod			cart siderods	4	
M24 x 100mm long SHCS			cart joint	2	
M36 x 220mm long SHCS			ped joint	4	
M24 Collared Eyebolt			cart bottom lifting	2	
M30 Collared Eyebolt			clamping ring half	1	
M16 Collared Eyebolt			inner and outer races	2	
M12 Collared Eyebolt			cage lifting	2	
01 - 1000 Outer Race Ring Forgings			support cartridge	2	
Type of tool	Size	Qty	Used for:		TOOLS LIST
Hex Key	5mm	1	Cage ring joint		
Hex Key	8mm	1	cartridge side screw & cartridge jacking		
Hex Key	14mm	1	outer race radial holdback		
Hex Bit Socket	19mm	1	cartridge joint		
Hex Bit Socket	22mm	1	clamping ring joint		
Hex Bit Socket	27mm	1	pedestal joint		
Hex Bit Socket	36mm	1	pedestal jacking		

## 1) PEDESTAL BASES.

The pedestal bases can be placed in position, squared up to the shaft and their fixing bolts loosely applied, prior to commencing bearing installation. This will enable minor movements / adjustments to be carried out after the bearing & cartridge assembly.

**NOTE:** Cooper does not supply the pedestal base fixing bolts. The bolts should be selected in size, grade and installed with a torque based on a bolted connection calculation done by the Canadian Coast Guard. Note that new holes will need to be drilled in the green platform on the CCGS Des Groseilliers to bolt the Cooper split bearing to the frame of the ship. It was anticipated the Cooper Split bearing would be installed on the shaft approximately 3.5 inches further towards the front of the ship, compared to the previous position of the Michell sleeve bearings. See drawing in section 16 of this manual for details. The drawing is a result of the measurements taken by Cooper onboard the CCGS Des Groseilliers in May 2017.

As the pedestal will eventually be lifted to preload the bearing, there should be no need to lift the shaft 2-3mm above its normal position to enable bearing installation. Then project the centre of the pedestal spherical surface onto the shaft, and then make two marks 185mm either side of this to mark the axial location of the bearing inner race.

## 2) MOUNTING OF BEARING INNER RACES ON SHAFT.

Check the shaft diameter. For this application the shaft must be to BS4500 ISO h7 IT6. The shaft should be concentric and parallel to IT6 tolerance.

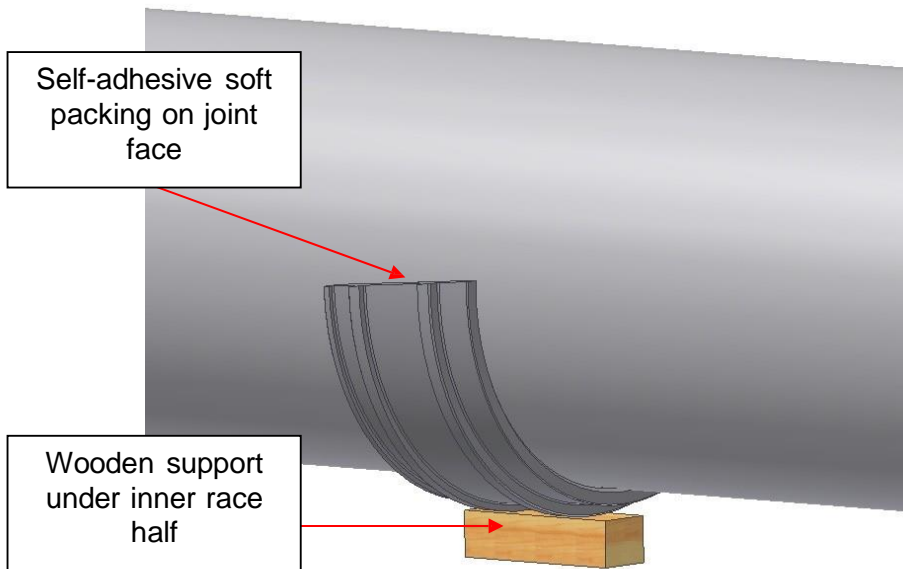
As a guide, the shaft should be measured at two or three points, usually to the left and right, and central to where the bearing will seat. This will indicate degree of shaft taper if any. To check for shaft roundness, the diameter should be checked at three places around its circumference, i.e., vertically, at 60° to top centre, and at 120° to top centre.

**NOTE:** The inner race, before assembly, measures undersize equivalent to the final gap at the joints. This gap is a feature of the design, to ensure that the inner race halves seat on the shaft.

The inner race positions should be determined, and marked on the shaft before commencing installation (as described above).

Lightly oil the bore of the inner race and the shaft, with thin machine oil. Lift one half of the inner race (using lifting eyes, shackles, strop and hoist) and lower onto the top of the shaft. Gently lower the race to enable it to rotate around the shaft approximately  $\frac{1}{4}$  of a rotation, and then support the race with lifting straps whilst continuing the lower, until the race is under the shaft. Alternatively, with the race joints facing upwards and a lifting strap positioned around the roller track, lift the race up to the shaft from underneath.

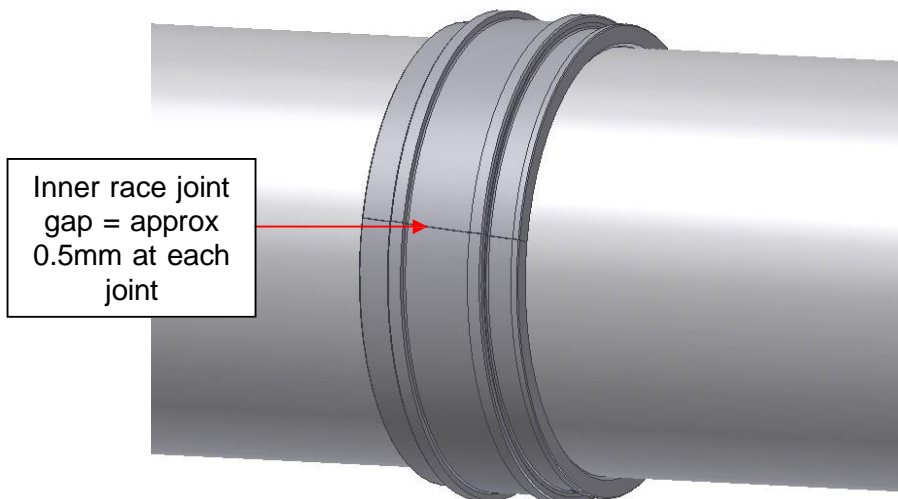
Support with a jack or wooden block under the inner race, however care must be taken to ensure that only soft materials come into contact with the race.



Place soft packing onto joint face of the inner race positioned under the shaft.

Lift second half of inner race and carefully lower onto the top of the shaft, aligning the clamping ring seatings on the two halves.

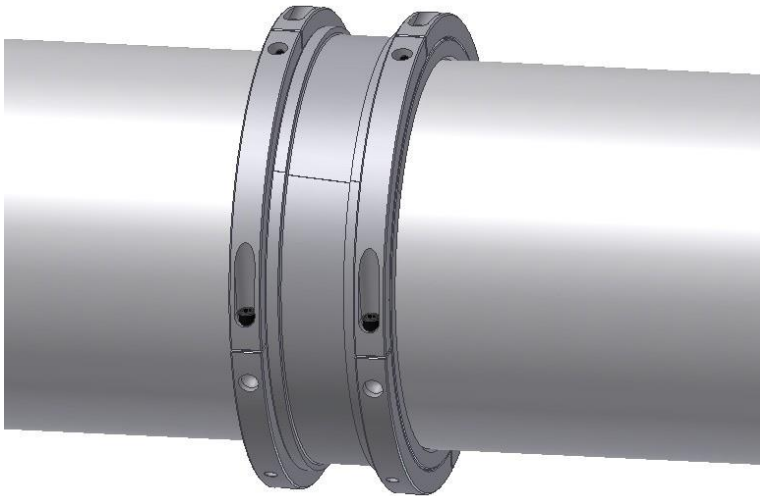
Once lowered into position the inner race joint gaps created by the soft packing, should remain approximately equal. Ensure the race halves are securely held in position before and during assembly of the clamping ring halves.



The clamping rings are divided into four equal parts. To aid fitting, assemble these into two two-section 'halves' and hand tighten the joint screws.

Fit the clamping rings with the joints at 45° to the inner race joints. There should be an equal gap at each of the clamping ring joints, approximately equal to the inner race joint. This can be achieved by slackening the screws inserted earlier to create the two halves. Progressively tighten each clamping ring joint screw, keeping the joint gaps approximately equal. Check race is in the correct position on the shaft.

### **3) TIGHTENING THE INNER RACE.**



Using a soft-faced hammer, tap down each section of each clamping ring. Retighten each screw with hexagon head key and torque wrench, or with extension tube. Repeat this procedure until the screws are fully tightened.

If using a torque wrench, torque figure for the clamping ring screws:

M30 x 120mm long, torque = 2,090Nm

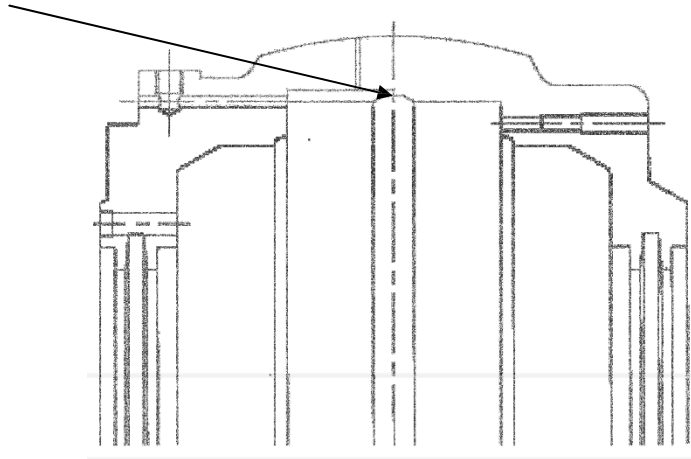
Check the gaps at the joints are still equal. The total gap varies and is not critical provided the shaft is in tolerance. Re-check that the inner races are in the correct position on the shaft.

### **4) ASSEMBLING BEARING OUTER RACE IN CARTRIDGE.**

Locate both cartridge halves onto the support rings supplied in SPARESKIT1 (part identified as 01 - 1000 Outer Race Ring Forgings). The non-turning peg and the grease nipple identify the top half of the cartridge. Lightly oil the outside face of the bearing outer race. Fill the radial lubrication groove in the cartridge with grease (this is a rough surfaced groove, positioned central to the outer race seating).

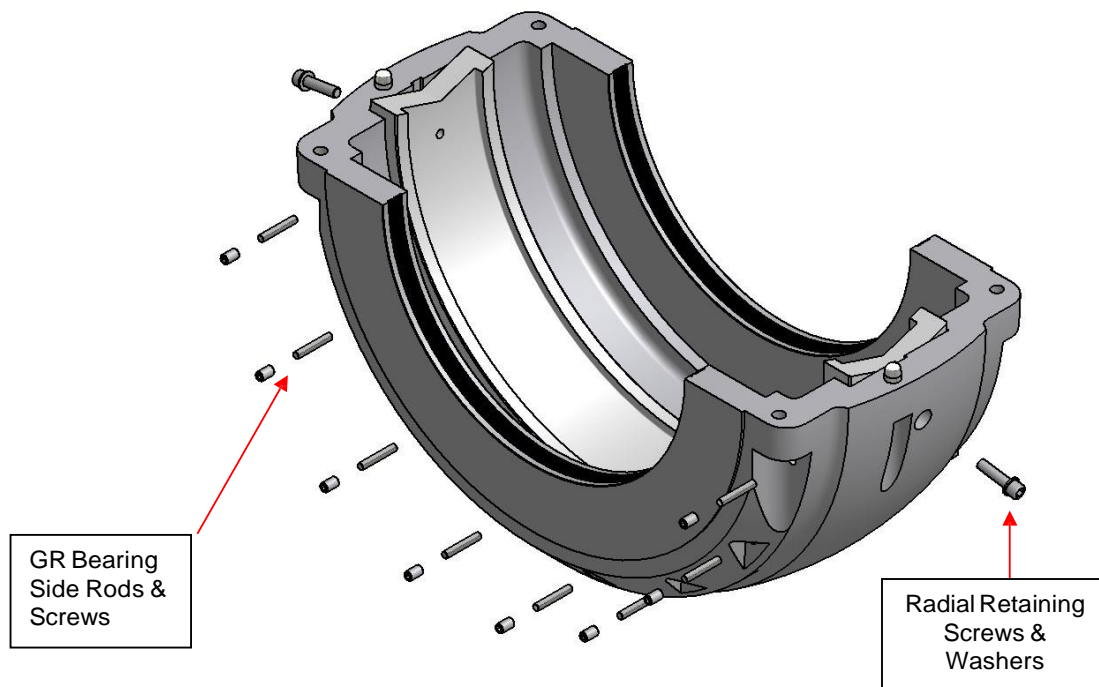


Fill groove with grease



Fit the top half of the outer race (having a lubrication hole at 90° to the joints) in the top half of the cartridge. The ends of the race should protrude beyond the cartridge joints, at equal amounts both sides. Fit the bottom half of the outer race to the bottom half of the cartridge. Ensure that the races are fully pushed into the outer race seating, and the match marking numbers coincide. Radial retaining screws are provided. Ensure these are fitted with the special 5mm washers provided. Do not fully tighten the radial retaining screws until the side screws & rods have been fitted have been fully tightened.

Put the two cartridge halves together, off the shaft, and tighten the cartridge joint screws. As these are GR cartridges, fit and tighten the side rods & screws. These axially position the GR outer race in the cartridge and must be installed. Tighten the radial retaining screws 'hand' tight.



The cartridge can then be split, ready for fitting to shaft. Care must be taken when lifting cartridge halves so that the outer race joints are undamaged. Cartridge halves with outer races fitted must be laid on their sides between assembling and fitting (or cartridge joint faces located on blocks of wood), so that the outer race joint surfaces protruding beyond the cartridge joint does not get damaged.

Grease groove seals should have a layer of grease added before the cartridge is assembled around the shaft.

## **5) BEARING LUBRICATION AT INSTALLATION.**

Based on a maximum operating temperature of approximately 70°C, it is recommended the grease should be of NLGI grade 2, having a metallic or synthetic thickener, and containing Extreme Pressure (EP) additives. It is also recommended for this grease to have a base oil viscosity grade (ISO VG) of 150 to 220 cSt at 40°C, such as Petro-Canada Precision XL EP2 or equivalent.

Based on an operating speed of 0 to 180 RPM, the bearings should be initially coated during installation with approximately 18 kg of grease. This represents a 75% fill quantity for this bearing. This grease quantity should be used during the bearing and cartridge assembly procedure.

Grease is to be applied to both cartridge halves just prior to locating them around the bearing (and ideally not before). This is to avoid contamination sticking to the grease during the assembly process.

The lubrication port should be primed with additional grease.

## **6) CAGE AND ROLLER ASSEMBLY.**

Smear a layer of grease around the roller path of the inner race and clamping rings.

The two cage halves have match mark correlation numbers.

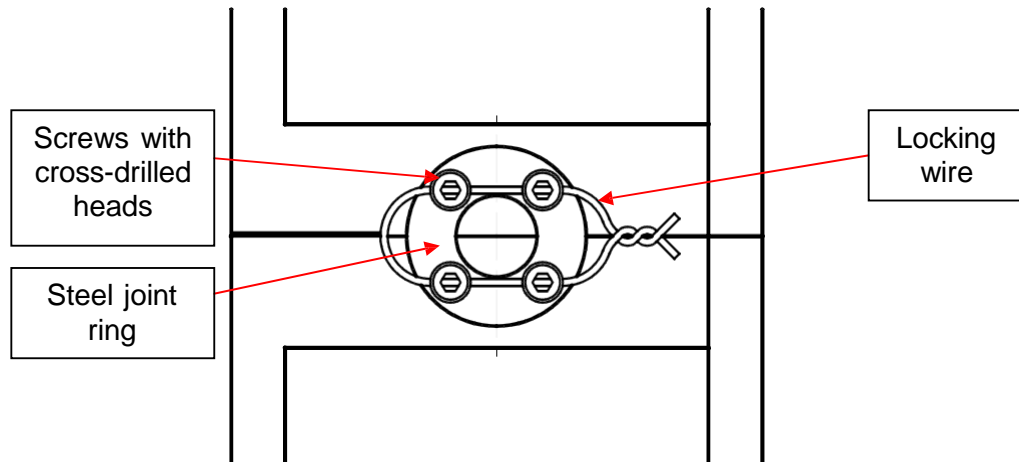
The cage halves & rollers should be coated with grease. Lift one cage half over the shaft and gently lower until rollers sit on the inner race ie 90°/270° position (if shaft top dead center is 0° position).

Continue lowering, rotating the cage around the inner race, supporting the outer diameter of the cage half when necessary, until the cage is positioned underneath the shaft.

Paying attention to the aspect / correlation numbers of the first cage half, lift the second cage half over the shaft and lower into position as before.

Ensuring both cage halves are supported, rotate both cage halves until one of the joints becomes fully accessible. The cage joints should butt together however the weight of the lower half may cause a slight gap. Close the joint together and apply the steel joint ring. Align the screw holes and insert the screws but do not fully tighten at this stage.

With both cage halves still supported, rotate the cage to access the opposite joint 180° away and fit the steel joint ring at the other position on the cage. Tighten screws to 12.75 Nm and then slacken slightly to align holes through screw heads with each other to permit installation of locking wire. Twist ends of wire together to prevent screws from loosening and ensure twisted wire ends are pressed flat against the cage.



Repeat on the other cage joint and ensure again that both of the twisted wire ends are pressed flat against the cage. Apply more grease to the outside of cage & rollers, rotating the cage whilst doing so to distribute the grease.

## 7) ASSEMBLY OF CARTRIDGE BOTTOM HALF IN PEDESTAL BASE.

Lubricate the spherical surface of the cartridge bottom half and pedestal base with a thin layer of grease/copaslip, and prime the grease slots in the pedestal base. Apply a liberal coating of grease over the entire inside surface of the cartridge bottom half and outer race, and a layer around the grease groove seals.

Lift the bottom half of cartridge over the shaft and lower slowly onto the top of the shaft central to the assembled cage and roller assembly, so that the rollers fit into the lips of the outer race. Use an alternate method of supporting the cartridge bottom half in this position, to enable the removal of the lifting eyebolt from the cartridge bottom half, and insert a threaded blanking plug in its place. Then roll the cartridge bottom half around the shaft so that the spherical surface of the cartridge bottom half fits into the spherical surface of the pedestal base.

The position of the cartridge bottom half and pedestal base can then be maneuvered so that the inner race (mounted on the shaft) and outer race (mounted in the cartridge) are axially aligned with each other.

Alternatively, if the pedestal base is not on position, the cartridge bottom half can be lifted up under the shaft from below, using eyebolts in the tapped cartridge joint screw holes. When in position, the cartridge bottom half should be supported on chocks to maintain it securely in position central to the shaft and inner race.

## **8) ASSEMBLY OF CARTRIDGE TOP HALF.**

Before the cartridge top half is fitted, the EX bearing axial positions should be checked. It is important to centralize the rollers on the expansion inner races, to within +/- 5mm.

Apply a liberal coating of grease over the entire inside surface of the cartridge top half and outer race, and a layer around the grease groove seal. Place the remainder of the 'initial grease quantity' on top of the cage & rollers inside the bearing at this stage.

Lift the top half of the cartridge and position over the bottom half assembly, paying attention to the aspect & joint match markings.

Lower into position, inching gently over the last 40-50mm to ensure correct alignment of the two halves of bearing components, in particular the cartridge joint dowels and the GR outer race / rollers.

Once fully lowered, a small gap may be evident at the cartridge joints. This is due to the shaft being raised. Releasing the shaft jack should remove this gap and enable the cartridge joint screws to be installed and tightened. Remove the lifting eyebolt from cartridge top half and insert the threaded non-turn peg. Tighten the cartridge screws.

The tightening torque for the cartridge joint screws:

M24 x 100mm long, torque = 712.5Nm

Check cartridge joint is fully closed by trying to insert a 0.05/0.06mm feeler gauge along the housing joints.

If the shaft is to be assembled with the bearing & cartridge away from the pedestal bases, the cartridges must be retained to prevent axial movement of the bearings during transportation. Before lowering the shaft assembly into the pedestal bases, grease/copaslip the cartridge and pedestal spherical surfaces and prime the grease slots in pedestal base.

An inspection hole is provided in the cartridge top half side face. All Cooper split bearing intended for marine applications are supplied with this inspection hole feature. The position of the hole is shown on the bearing layout drawing in section 16 of this manual.

It is suggested to record, immediately after installation, through the inspection hole and while the bearing is stationary, the axial position of the shaft. To achieve this, remove the plug in the inspection hole of the cartridge, and use a depth mic to measure from the front face of the cartridge to the side face of the clamp ring. This is the stationary reference measurement. As the thrust bearing wears over time, this distance will vary. The distance can be used to determine the amount of axial displacement of the shaft which correlates to the quantity of wear in the thrust bearing.

Note: The thrust bearings are not the Cooper split bearings subject of this manual.

See section 14 of this manual for further information.

## **9) ASSEMBLY OF PEDESTAL CAP.**

Apply a smear of grease/copaslip to the spherical surfaces of the cartridge top half and pedestal cap.

Fit the pedestal cap, ensuring joint match marks & labels coincide. Insert pedestal joint screws and firm / hand-tighten the screws, and then release approx. one half of a turn.

The pedestal base holding-down bolts should be fully tightened once the correct position and final alignment of the complete bearing assembly is completed.

## **10) BEARING ALIGNMENT PROCEDURE.**

To enable the bearing and cartridge to align in the pedestal spherical, the shaft should be rotated for a short while, (i.e. 2-3 minutes), with the pedestal joint screws slightly loose. After this initial alignment has been performed, stop the shaft, and fully tighten the pedestal joint screws, to the following torques:

M36 socket head cap screw, Torque = 2,700Nm

## **11) TEMPERATURE SENSOR.**

Each cartridge housing is supplied with a tapped hole to accommodate a temperature sensor. The sensor and fitting should be installed after the final alignment has been performed. Once wired to the processing unit, the normal running temperatures can be established during trials / commissioning.

The bearing operating temperature should not exceed 100°C and we recommend the alarm / trip is set at 85°C.

Consideration should be given for the temperature drop between the bearing's load zone (normally bottom centre) and the position of the temperature sensor. Measure the temperature drop between these points using a separate non-contact indicator and calibrate the monitoring system accordingly.

Note: The temperature sensor is not supplied by Cooper.

## **12) STORAGE WHILST ASSEMBLED.**

When bearings are assembled on the shaft & not used, the shaft should be rotated a minimum of half a rotation every week. This can be achieved with a soft start of the shaft.

Rotating the shaft will redistribute the grease and prevent metal to metal contact between the rollers and races when idle.

### **13) BEARING RE-LUBRICATION.**

Any re-greasing operation should be done as the shaft rotates.

The same grease as the one used during installation should be used for re-lubrication to avoid chemical compatibility issues. See section 5 of this manual.

Routine greasing should occur once every month of operation, using a hand held grease gun. Quantities recommended are 7 grams (4 to 6 shots) of grease once a month for the bearing, and 1 shot per month to each spherical grease point.

If an automated system is used, this should be set to achieve this quantity over the same period. It is preferable to re-grease with small amounts often, rather than large amounts with a longer period between greasing. The grease points on the housings are tapped ¼" NPT.

### **14) ROUTINE MAINTENANCE AFTER INSTALLATION.**

The Cooper bearing does not require any routine maintenance other than what is described in the assembly and lubrication sections of this manual.

However, it is recommended that the internal bearing, including the running surfaces, are inspected at least every two years of operation, by removal of the pedestal cap and the cartridge top half.

Periodically check all external screws for tightness and check housings for signs of damage.

A full inspection of all running surfaces can be performed by raising the shaft and removing the cartridge halves, and then removing the cage assembly from the inner race.

The inspection hole in the cartridge can be used to determine how the axial position of the shaft changes over time due to wear of the thrust bearings.

Note that in section 9 of this manual, it was suggested to record distance between the cartridge side face and the clamping ring side face immediately after installation through the inspection hole. This distance was to be considered the "reference" distance. Over time, as this distance changes, it would correlate the change in position of the shaft, and consequently the amount of wear in the thrust bearings.

The distance is therefore recommended to be checked during routine servicing of the bearing. The measurement should be done when the bearing is stationary. The measurement can be done by removing the plug in the inspection hole and using a depth mic to measure from the external face of the cartridge to the side face of the clamp ring. Record the distance during routine servicing to identify change in position of the shaft, and consequently the quantity of wear in the thrust bearing.

Note: The thrust bearings are not the Cooper split bearings subject of this manual.

## 15) CONTACT DETAILS.

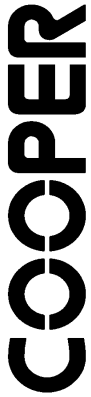
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CANADA	USA	INTERNATIONAL
SKF Canada Limited  40 Executive Court Scarborough, ON M1S 4N4, Canada  Tel: +1 866 832 6753 Fax: +1 416 292 0399  EMAIL: SKFClientSales@skf.com	The Cooper Split Roller Bearing Corp.  2115 Aluminum Avenue, Hampton, VA 23661, USA  Tel: +1 757 460 0925 Fax: +1 757 464 3067  EMAIL : CoopersalesUS@kaydon.com	Cooper Roller Bearings Company Ltd.  Wisbech Road Kings Lynn, Norfolk PE30 5JX, United Kingdom  Tel: +44 (0) 1553 763447 Fax: +44 (0) 1553 761113  EMAIL: CoopersalesUK@kaydon.com

## 16) DRAWINGS.

The following pages of the manual shows the following drawings:

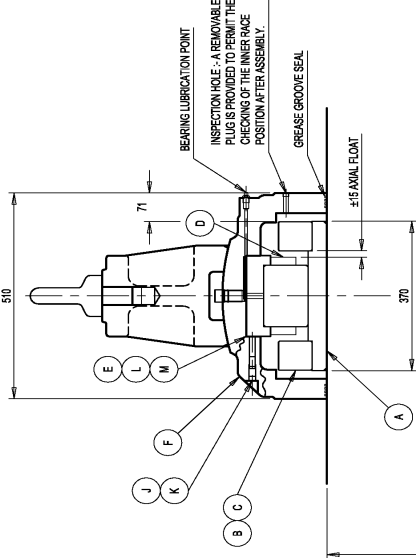
- Drawing 3L17835/1C of the Cooper bearing and assembly number **03E BCPN 613.30MM EXILOG RJ ALF IH LAB TE SLUB.**
- Drawing of the bearing bolting pattern on the CCGS Des Groseilliers frame, to indicate where it is anticipated the new Cooper Split bearing will be bolted compared to the original Michell sleeve bearing.



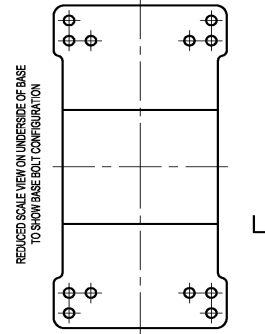
LAYOUT OF  
03E BCPN 613.3mm EXILOG  
RJ / ALF / IH / LAB / TE / SLUB

ITEM NO	NAME OF PART.	UNIT QTY	MATERIAL
A	INNER RACE	1	CARBON CHROME STEEL
B	INNER RACE CLAMPING RING.	2	MILD STEEL
C	CLAMPING RING SCREW.	8	HIGH TENSILE STEEL
D	CAGE & ROLLERS.	1	ALUMINUM & CARBON CHROME STEEL.
E	OUTER RACE.	1	CARBON CHROME STEEL
F	CARRIDGE.	1	CAST IRON
G	CARRIDGE JOINT SCREW.	4	HIGH TENSILE STEEL
H	PEDESTAL BASE AND CAP.	1	MODULAR CAST IRON.
I	PEDESTAL JOINT SCREW.	16	HIGH TENSILE STEEL.
J	SIDE SCREW.	16	HIGH TENSILE STEEL.
K	SIDE ROD.	16	SILVER STEEL.
L	RADIAL RETAINING SCREW.	4	HIGH TENSILE STEEL.
M	RADIAL RETAINING SCREW WASHER.	4	MILD STEEL.

APPROXIMATE TOTAL WEIGHT = 4484kg  
BEARING RATINGS - DYNAMIC (Ct) : ISO 281 - 1990 = 6,053 kN  
STATIC (Cor) : ISO 76 - 1987 = 10,959kN



**SCRAP SECTION**  
**THRO' TEMPERATURE ELEMENT HOLE**



ORDER	IMR9172	DATE	DRAWING NUMBER  3L17835/1  ISSUE C	
DRAWN	BRH	16-05-17		
CHECKED				
APPROVED				
SCALE	1:8	SHEET	OF	SHEETS

THIS DRAWING IS THE PROPERTY OF COOPER ROLLER BEARINGS CO. LTD. AND MUST NOT, WITHOUT THEIR WRITTEN CONSENT, BE PASSED ON, COPIED OR USED FOR ANY OTHER PURPOSE.



