

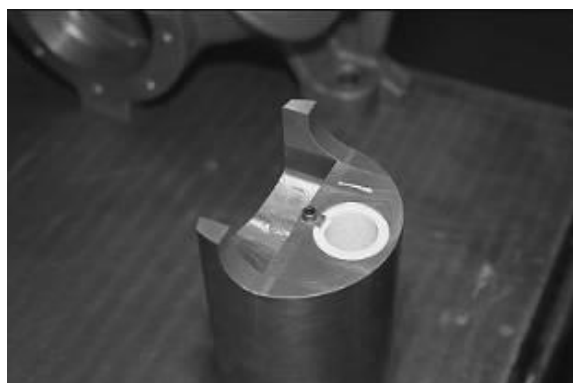
ASSEMBLY
INSTRUCTION MANUAL
FOR
KRS3165
(HORIZONTAL METHOD)

Note- 1) Before starting the assembly, ensure all parts are available.

2) After installing the rotors into casings do not rotate the rotors unless and until the both side's radial bearings are installed

A. Assembly slide valve and rotor casing:-

- 1) Mount the O-ring [300.20.225.50] inside the unloader slide valve [300.20.610.50]. Apply sufficient grease to fix the o-ring properly.
- 2) Mount the Teflon bushing [300.20.612.50] by pushing in the Vi adjusting rod hole of the unloader slide Valve.



Teflon Bushing



Install the Unloader Slide Valve

- 3) Lock the rotation of the teflon bushing with the use of a square washer [300.20.611.50] and tighten it with the hex socket head bolt M5x20L [999.02.602.50]. Apply the tightening torque of 7 Nm using the torque wrench.
- 4) Assemble the plug [300.20.983.50.] to the end of the push rod [300.20.618.50]. Use the loctite 554 before tightening the plug.
- 5) Remove the aluminum tube from the LPI assembly [300.20.310.50]. Apply a uniform thin layer of sealant (Bondone-Super Speed Sealant) on the aluminum tube and install it on the slide valve push rod [300.20.618.50] with care. The depth of aluminium rod should be such that it matches face of push rod.
- 6) Assemble the push rod [300.20.618.50] to the slide valve and tighten it with the hex socket head bolt M8 x 40L[999.02.628.50] with specified torque given in the annex. A. Make sure to keep this assembly separately on the clean surface.
- 7) Lift the rotor casing [300.20.100.50] using an eye bolt [300.20.912.50] and place it on the workbench (flat surface) horizontally. Remove all sharp edges, if any. Clean the rotor casing using cotton cloth. Use of thinner for cleaning is acceptable. Make sure that sufficient space is available on all sides to move and assemble the other components.
- 8) Keeping the rotor casing in horizontal direction, install the unloader slide valve assembly into the slide valve bore of the main rotor casing from the suction side. Mark the suction side and discharge side on the rotor casing for better understanding. After installing, ensure the slide valve moves smoothly.
- 9) Assemble the Vi auxiliary slide stop [300.20.630.50] on the push rod and insert in the rotor casing. While installing ensure that the stepped side of the slide stop faces towards the suction side of the compressor block

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- 10) Install the plug [300.20.983.50] to the oil hole on the delivery side face and make sure it is fixed properly and does not create hindrance for assembly of rotor casing and delivery casing.
- 11) Apply sufficient oil to both sides of the gasket [300.20.972.50] between rotor casing and delivery casing and attach it to the main rotor casing. Screw in the stud bolts to the main rotor casing to hold the gasket.

CAUTION

- As the bearing head gasket is not symmetrically shaped, carefully check the orientation when attaching the gasket.
- If you place the bearing head gasket by just hanging it on the stud bolts, the gasket will protrude into the inside of the rotor casing when the casing is assembled. Apply sufficient amount of oil, etc. to the gasket to make it fully attached to the surface to prevent protruding upon the assembly.

B. Installing the Rotors:-

- 1) Bring below set of radial bearings near to the assembly:-
 - i) SKF-NU 2314 ECP- 1 No. [300.20.710.50] - Male discharge radial bearing
 - ii) SKF-NU 314 ECP- 2 Nos. [300.20.711.50] - Female discharge radial bearing
 - iii) SKF-NU 2312 ECPH / ECP 1 No. [300.20.712.50] - Male suction radial bearing
 - iv) SKF-NU 2215 ECPH / ECP-1 No. [300.20.713.50] - Female suction radial bearing
- 2) Clean the rotor casing and the rotors (Male and Female) with cotton cloth. Fine polish paper can be used to remove the sharp edges if any.
- 3) Mark the suction and discharge sides of the rotors for easy identification. Note that the threaded side of the rotors are the discharge side.
- 4) Lift male rotor (300.20.410.50) from discharge side with the help of eye bolt (M16) and crane.
- 5) Place the male rotor in the fixture shown below/similar to rest the rotors in a vertical position in such a way that the discharge side faces the sky.



Fixture to Hold Rotor In Vertical position

- 6) Remove the bearing [300.20.710.50] from the box carefully. Dismantle the inner ring by sliding it and clean the oil using the cotton cloth. Ensure to use the clean cloth.

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CAUTION

- After removing the inner race of the bearings, do not keep the outer race of the bearings open to the atmosphere, place them in their respective boxes.

- 7) Heat Inner race of the radial bearing for 120° C temp. using the induction heater as shown below. Heating time= 3-4 min. Do not overheat till the color changes
- 8) While Inner race is being heated, apply anti seize lubricant (LB-771 Nickel Anti Seize) uniformly on the shaft where the inner ring is to be mounted.
- 9) After heating, use heat resistant hand gloves to lift the inner race & mount it on male rotor shaft. Use the bearing assembly tool to ensure the proper fitment.
- 10) After mounting the inner ring let it cool down and fit properly on the required location.



Bearing inner race heating

- 11) Before inverting the rotor upside down, ensure that the inner race mounted on the discharge side of the rotor is cooled down and properly mounted at its location. Also protect the threaded part on the discharge side of the rotor by wrapping it using teflon tape.
- 12) After confirming that the inner races are mounted properly and the threaded part is wrapped using teflon tape, turn the rotor upside down in such a way that the suction side of the rotor faces the sky.
- 13) After turning the rotor, remove the bearing [300.20.712.50] from the box carefully. Dismantle the inner ring by sliding it and clean the oil using the cotton cloth and repeat the same procedure (7 to 9) to mount the inner race on the suction side of the male rotor.
- 14) After successfully mounting the inner race, lift the rotor with the help of an eyebolt (M16) and crane and carefully place it horizontally on the workbench and ensure that the rotor is kept steady and safe
- 15) Now repeat above procedure (3-13) to mount inner race of bearings [300.20.711.50- Discharge side and 300.20.713.50- Suction side] on female rotor (300.20.411.50)
- 16) Install the balance piston key [300.20.412.50] on male rotor [300.20.410.50] to ensure that it should not lose for the next stages, transparent cello tape can be used to hold the key.
- 17) Lift up the male rotor [300.20.410.50] from midpoint using a crane or a chain block with a belt sling, and insert the rotor into the casing halfway along its length while keeping it balanced on the belt sling. Then detach the belt sling from the rotor and push the rotor

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fully into the casing. Use of the lubricating oil is acceptable for smooth entry and movement inside the rotor casing and delivery casing.



Rotor assembly with rotor casing

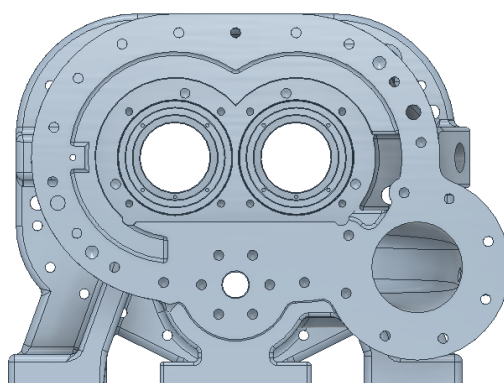
- 18) Same procedure to be followed for installation of female rotor [300.20.411.50]. Ensure to match the female rotor lobes properly with the male rotor for smooth engagement.

CAUTION

- As the circumference of the rotor is touching the rotor casing in this condition, any rotation of the rotor should be kept to the minimum required. Otherwise, the lobes tip of the rotor may be worn.

C. Assembly of labyrinth seal [300.20.511.50] :-

- Lift the delivery casing [300.20.510.50] and place on the workbench. Remove the sharp edges, if any. Clean the delivery casing using cotton cloth. Use of thinner for cleaning is acceptable.
- Rest the delivery casing on the discharge face i.e. cover face should be on the upper side. Refer below image.



Delivery casing

- Take a dowel pin [300.20.913.50] and fit in the dowel hole in male and female side. Measure the length of the dowel pin and depth of the dowel hole in the delivery casing.

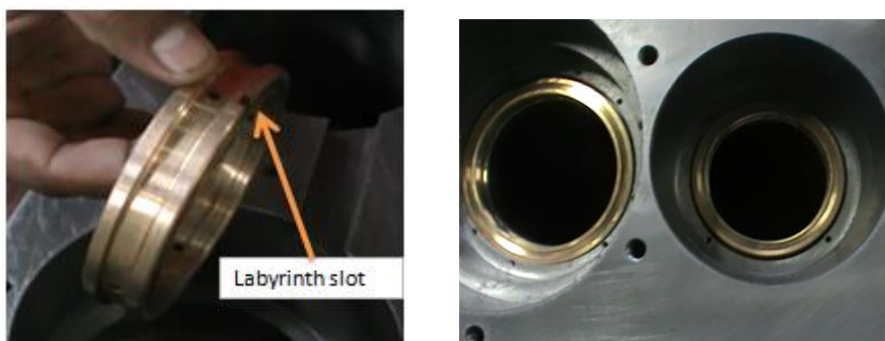
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Ensure that the dowel pin should be above the mating face with minimum 1.5 to 2 mm.
For better understanding write the male and female side with markers.



Dummy dowel pin assembly

- 4) Take a labyrinth seal [300.20.511.50] and place it in the delivery casing. Ensure the slot fits on the dowel pin properly.
- 5) Ensure the dowel pin does not touch the labyrinth seal, check it for male and female side.



Labyrinth seal and assembly

- 6) Remove the dowel pin and apply loctite 554. Fit both the dowel in male side and female side in the dowel hole. Clean excess loctite.



Dowel pin assembly

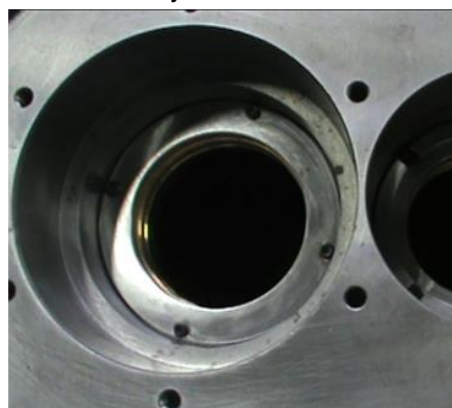
- 7) Take O-ring 4 nos. [300.20.525.50] and apply grease on it. Fit 2 nos. of O-ring on both side of each Labyrinth seal groove
- 8) Place labyrinth seal in delivery casing and ensure slot matches with dowel pin.

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Labyrinth seal with O-ring and assembly

- 9) Take the labyrinth seal support plate/oil spacer of male side [300.20.513.50]. Ensure the oil injection holes are open and through. Place a labyrinth seal support plate in the delivery casing of male side.
- 10) Tight it with socket head bolts (M6 x 20L) 4 nos. [999.02.607.50]. Make sure the bolt fits properly in the counterbore. Apply torque as specified in the annex. A with a torque wrench. After application of torque ensure freeness of labyrinth seal.



Labyrinth support plate assembly

- 11) Follow the same procedure on the female side as well. Ensure to use a different seal support plate/oil spacer of the female side [300.20.514.50].

D. Assembly of delivery casing [300.20.510.50] :-

- 1) Slide/lift the delivery casing and match the flange surfaces of the main rotor casing and the delivery casing.
- 2) After lightly fastening some bolts, drive in the dowel pins [300.20.910.50-D20 x 65L] to fix the position by using a copper or an aluminum hammer.
- 3) Apply the loctite 554 and tighten the hexagon socket head bolts [999.02.711.50] in a diagonal sequence, a little at a time. Apply torque as specified in annexure A.
- 4) After tightening the bolts, check that the gasket is not protruding into the inside of the casing. If any part of the gasket is extending into the bores, there is a possibility that the performance of the compressor will deteriorate.
- 5) Also check that the unloader slide valve and slide stop can be moved smoothly along the surface of the port section in the rotor casing.

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- 6) Install 2 O-rings [300.20.225.50] in the delivery casing [300.20.510.50] and apply sufficient grease to fix them properly.
- 7) Take the Vi adjusting rod [300.20.634.50] and install a thrust washer [300.20.635.50] on both sides of the Vi adjusting rod.
- 8) Install the manual Vi adjusting rod [300.20.634.50] from the delivery casing side, and screw in it to the screw thread of the variable auxiliary slide valve. Do not forget attaching the thrust washer.

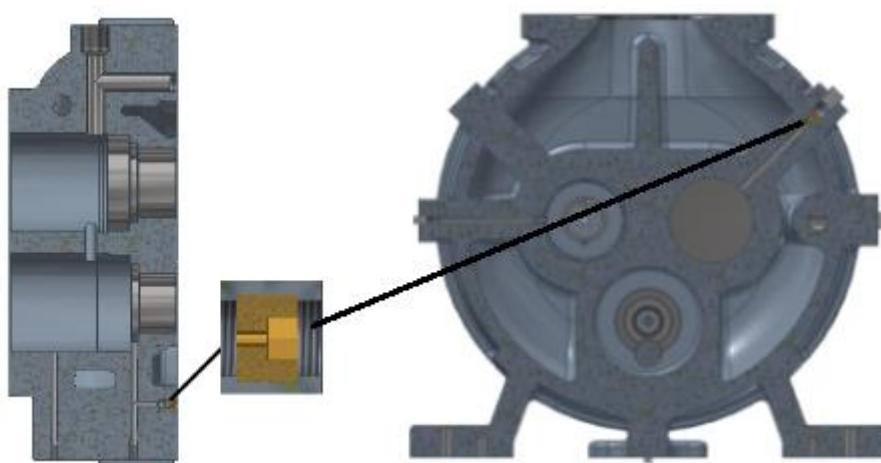
CAUTION

- Assemble the Vi adjusting rod carefully as it has to cross the unloader slide valve taking support of O-ring. Ensure that the O-ring should not come out from the location.

- 9) Install the lock plate [300.20.633.50] and fasten it to the manual Vi adjusting rod using hexagon socket head bolts [999.02.607.50-M6X20L] along with the spring washer [999.11.517.50]. Please apply loctite 554 to bolts before fastening. Ensure to apply the specified torque as per the annex. A.

E. Assembly of the Suction Casing [300.20.210.50]:-

- 1) Push the slide stop inside the rotor casing, ensuring that the flat surface of the slide stop faces towards the slide valve and stepped side faces towards suction casing. Ensure that it should not interfere with suction casing during assembly.
- 2) Lift the suction casing [300.20.210.50]
- 3) Place it on the workbench on the resting pad. Remove the sharp edges, if any.
- 4) Assemble oil injection plug 2 nos. [300.20.914.50] in suction casing as shown to below locations. Use the loctite 554 for proper fitment.



Oil injection plug assembly

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CAUTION

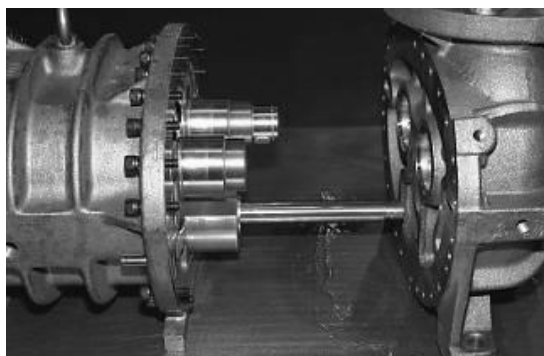
Plug should be below the mating face of suction casing to avoid the restriction with rotor casing assembly.

- 5) Apply oil on both sides of the gasket [300.20.971.50] and attach it to the main rotor casing [300.20.100.50] while carefully checking the position of oil supply holes. Screw in stud bolts to the main rotor casing to retain the gasket in position.

CAUTION

As the gasket of the suction cover is not symmetrically shaped, take care of the gasket direction when attaching to the main rotor casing.

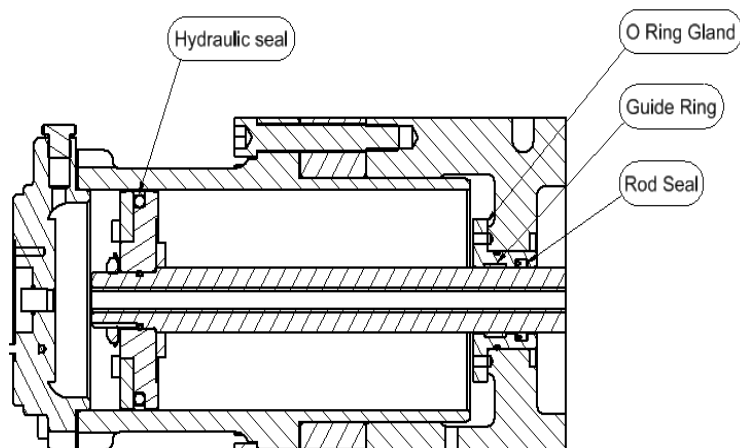
- 6) Slide (or use a lifting device to move) the suction casing [300.20.210.50] in parallel along the shaft axis, and align the unloader push rod [300.20.618.50]. At this time, be careful not to damage the inner surfaces of the clearance bores and push rod bore.
- 7) Then, engage the shaft ends of the rotors while pushing the suction casing gradually.



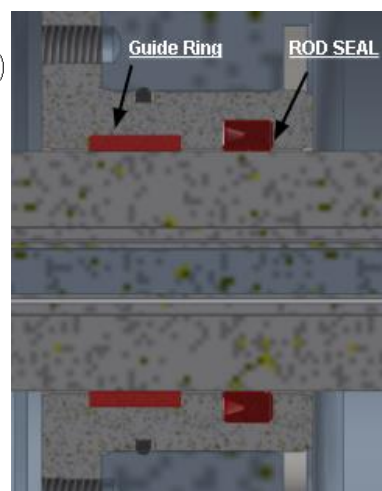
Sliding the suction casing on workbench using a Crane

- 8) After the suction casing has been pushed in up to the flange surface of the main rotor casing, lightly fasten some of the hexagon socket head bolts [999.02.711.50-M16 x 65L].
- 9) Using a copper hammer or an aluminum hammer, drive in the dowel pins [300.20.910.50-D20 x 65L].
- 10) Tighten the hexagon socket head cap screws evenly up to the specified tightening torque as per annex. A. The bolts on the bottom side (about 6 bolts) are to be tightened carefully due to accessible limitations.
- 11) Bring below set of parts near to the assembly:-
 - i) 300.20.211.50 - 1 qty, O ring
 - ii) 300.20.640.50 - 1 qty, - O ring Gland
 - iii) 300.20.643.50 - 1 qty, - Guide Ring
 - iv) 300.20.642.50 - 1 qty, - Rod Seal

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(a)



(b)

Hydraulic seal assembly

- 12) Install O-ring [300.20.211.50] - 1 nos on the groove provided on the outer dia of o-ring gland [300.20.640.50].
- 13) Gently press the guide ring holding at its outer diameter, so that its outer diameter shrinks and passes through the inner dia of the o-ring gland and then insert it in the groove provided on the inner dia of the o ring gland refer .
- 14) Bring rod seal near to the assembly, carefully bend the profile similar to kidney shape and before inserting ensure the orientation of the rod seal for that refer above image (b) and then insert it into the groove provided on the inner dia of the o ring gland and after installation ensure that the seal is reshaped to round form, refer fig a) and b) below.



a)



b)

Reference images for installation of rod seal with hand

- 15) If you are unable to install the seal with hand please use the seal installation tool and follow the steps as shown in below images and after installation ensure that the seal is reshaped to round form

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a) Tool, Rod seal and Housing



b) Tool Positioned for grasping the seal



c) Seal properly folded



d) Inserting seal into housing



e) Seal Positioned for housing



f) Ensure seal is installed properly

Reference images for installation of rod seal with help of tool

CAUTION

- While bending the seal please avoid sharp bending of the profile

16) Once the guide ring and rod seal is installed please carefully install o ring gland by sliding it on the push rod and then slowly slide it towards suction casing and then install it on the o-ring gland bore of suction casing (Lightly tap the the o-ring gland with the help of mallet, if required).

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- 17) Fasten the O ring gland by tightening the bolts [999.02.607.50-M6 x 20L] with specified torque (refer annexure A).

CAUTION

Slide stop and slide valve to be rest properly while lifting the entire assembly and placing it vertically.
Ensure that the push rod does not interfere with the flat surface.

F. Delivery side bearing assembly :-

- 1) Bring below outer races of radial bearings near to the assembly:-
 - i) SKF-NU 2314 ECP- 1 No. [300.20.710.50] - Male discharge radial bearing
 - ii) SKF-NU 314 ECP- 2 Nos. [300.20.711.50] - Female discharge radial bearing
- 2) Mount outer race of bearings over cooled inner races by light tapping. Use of a mallet or other bearing assembly tool is acceptable. Lubricating oil can be used for smooth assembly.
- 3) Use the same procedure to mount the both radial bearings [300.20.711.50] on the female rotors side as well.

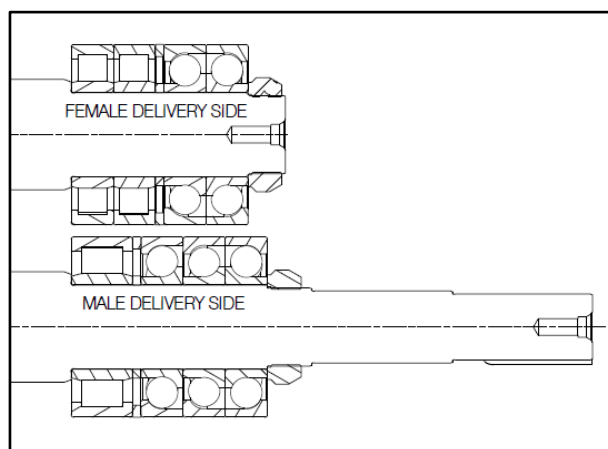
CAUTION

- Assembly of the heated inner ring over the rotor shaft should be done carefully considering the proper alignment. Slight mismatch can restrict the bearing in between and make the assembly difficult.
- Ensure that the bearing will rest properly to the bottom face/mating face of the rotor. Bearings hitting to be done using teflon/rubber type tools only. Do not use metallic type assembly tools. Do not hit on the cages or rollers of the bearings.

- 4) Mount small spacer [300.20.516.50] and large spacer [300.20.515.50] on male and female side after arrangement of radial bearings.
- 5) Bring below set of thrust ball bearings near to the assembly:-
 - i) SKF-7314 BECBP- 5 Nos. [300.20.714.50]- Angular contact ball bearing
- 6) Remove the bearing from the box carefully. Clean the rust preventive oil of the bearing using cotton cloth from the outer surfaces.
- 7) Mount the bearing on the rotor shaft with proper alignment and fit using the bearing assembly tool.
- 8) Repeat the same procedure for male side and female side bearing assembly. Assemble the bearings as per the orientation given in the image below.
- 9) Bring Lock nut SKF-KMT 14 - 2 qty [300.20.414.50]. Remove the lock nut from the box carefully. Do not damage the locking threads. Make sure that the grub screws are loose and not protruding outside the internal threads of the locknut.
- 10) Assemble the lock nut -1 qty on male rotor shaft threading and 1 qty on female shaft threading, tighten it using the special locking tool. Apply the torque as specified in annexure A. While applying specified torque use rotor rotation locking fixture.

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- 11) Tighten the 3 grub screws attached to the lock nut by hand. Do not use any loctite. Use 'L' type allen key for proper tightening of the grub screw.



Bearing arrangement delivery side

CAUTION

- Special precautions need to be taken for the angular contact ball bearing assembly orientation. Strictly ensure that the bearing arrangement should be as per above orientation only.

G. Suction side bearing assembly:-

- 1) Bring below outer races of radial bearings near to the assembly:-
 - i) SKF-NU 2312 ECPH / ECP 1 No. [300.20.712.50] - Male suction radial bearing
 - ii) SKF-NU 2215 ECPH / ECP-1 No. [300.20.713.50] - Female suction radial bearing
- 2) Ensure the position of bearing in such a way that bearing number faces towards sky. It is not wrong if the position is reversed.
- 3) Mount outer race of bearings over cooled inner races by light tapping on the male rotor. Use of a mallet or other bearing assembly tool is acceptable. Lubricating oil can be used for smooth assembly.
- 4) Use the same procedure to mount the radial bearings [300.20.713.50] on the female rotors side as well.

CAUTION

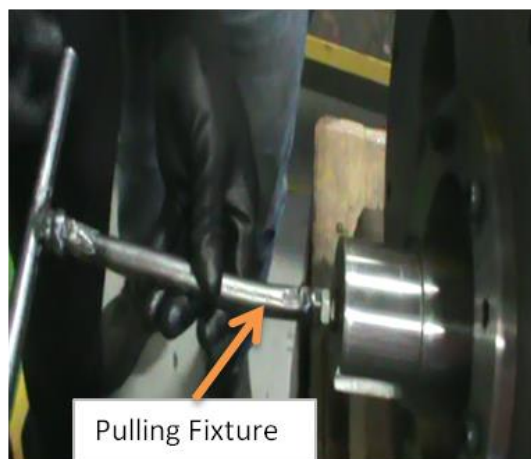
- Ensure that the bearing will rest properly to the bottom face/mating face of the rotor.
- Bearings hitting to be done using teflon/rubber type tools only. Do not use metallic type assembly tools. Do not hit on the cages or rollers of the bearings.

- 5) Mount the circlip [999.13.791.50- D130x134] on the female side bore to support the outer race of the bearing.

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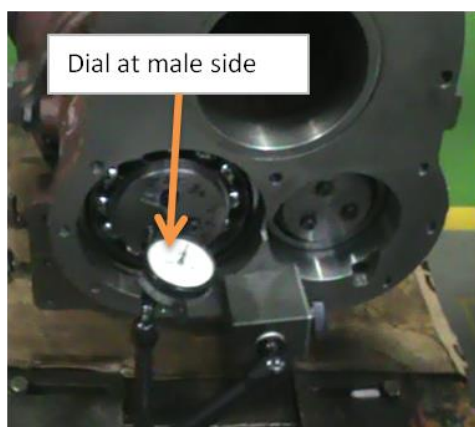
H. Adjustment of end clearance:-

- 1) For pressing the rotor shaft on to the discharge side, hit the rotor shaft strongly from the suction side while putting a jig (Teflon block or like).
- 2) Fit pulling fixture to male rotor shaft on suction side as shown below,



Pulling fixture connected to male rotor suction

- 3) Fix the dial gauge base on the suction casing face and place dial plunger on the rotor shaft end face. Refer below image.
- 4) Set the indication needle to zero point while the rotor is fully pressed onto the discharge end face.
- 5) Pull fixture gently from the suction side, record dial gauge clearance male side (X). Repeat this process 2-3 times for checking repeatability. Note down the readings.
- 6) Remove the pulling fixture and fit it to the female rotor shaft. Repeat the steps 1 to 5 and note down the readings.
- 7) Confirm both the readings should be between below given clearance range, if any of clearance is more/less than the required clearance then follow the dismantling procedure to maintain required clearance.



Dial gauge placement

- 8) Clearance range should be as given below,

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Sr. No.	Parameters	Values (µm)
1	Axial end clearance	80±10 (Y)

9) If the clearance is less than the required range follow below procedure,

- Loose the grub screws and remove the lock nut by loosening it carefully.
- Remove the angular contact ball bearings and spacers. Measure the size of the outer spacer (Z i.e thickness of spacer) mm.
- Calculate the spacer size required to achieve the clearance as below,

$$Z' = Z - (Y - X) \text{ mm}$$

- Grind the outer spacer on a surface grinding machine and make as per above size. Tolerance range is applicable as per the above given clearance range.
- Reassemble the complete assembly using the modified spacer and repeat the steps from 1 to 8.

10) If the clearance is more than the required range follow below procedure,

- Loose the grub screws and remove the lock nut by loosening it carefully.
- Remove the angular contact ball bearings and spacers. Measure the size of the inner spacer (Z i.e thickness of spacer) mm.
- Calculate the spacer size required to achieve the clearance as below,

$$Z' = Z - (Y - X) \text{ mm}$$

- Grind the inner spacer on a surface grinding machine and make as per above size. Tolerance range is applicable as per the above given clearance range.
- Reassemble the complete assembly using the modified spacer and repeat the steps from 1 to 8.

11) Repeat the procedure till clearance is achieved within the range.

- After clearance is achieved within the specified range then remove the grub screw of the locknut. Apply the loctite 554 and tighten the grub screw. Apply the specified torque given in annexure A.

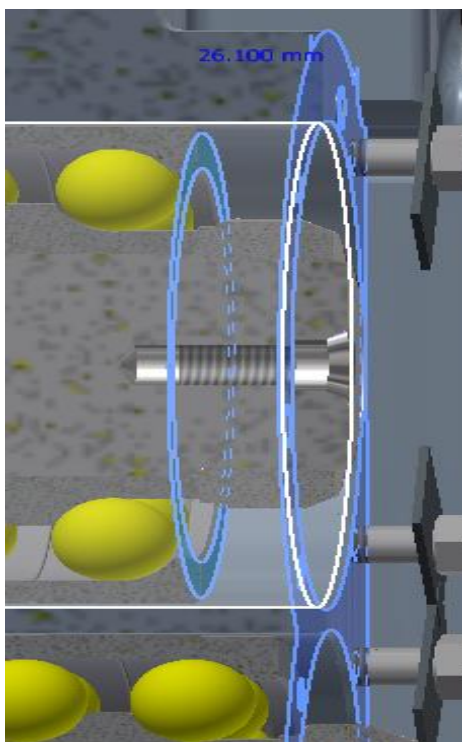
CAUTION

- Do not forget to apply the loctite to the grub screws of the locknut and tight it properly. Tightening each grub screw at once at the specified torque must be avoided because it will result in uneven tightening. So, repeat it to sequentially tighten the bolts several times.
- Do not forget to bend the plate type lock washer.

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I. Assembly of bearing lock plate :-

- 1) Bring the male delivery side bearing lock plate [300.20.512.50] and ensure that there are no sharp edges.
- 2) Follow the below procedure to calculate the sizing of the bearing lock plate, for more clarity see below image



Reference faces to be considered for measuring the depth (i.e. value of X)

- i) Measure the depth of the bearing face from the delivery casing top face/lock plate resting face (Nominal distance, X=10.1mm (on male rotor) and X=26.1 (on female rotor)).
- ii) Measure the step length of the bearing lock plate [300.20.512.50] (Y) mm.
- iii) Calculate the size required of the step length,

$$Y'=(X+0.6\pm0.1) \text{ mm}$$

- iv) Adjust the step length Y by grinding/machining and match with the distance Y'.
 - v) Assemble the bearing lock plate and tighten using the hex bolt M12 x 45L [999.01.671.50] and apply specified torque given in annexure A. Use the lock washer [300.20.981.50] before tightening the bolts. Do not bend the corners of the lock washer at this stage. Tightening each bolt at once at the specified torque must be avoided because it will result in uneven tightening. So, repeat it to sequentially tighten the bolts several times.
- 3) Repeat the same procedure for the female delivery side as well. Use the bearing lock plate [300.20.517.50] for the female side.
 - 4) Apply loctite 554 on hex bolt M12 x 45L [999.01.671.50] of the bearing lock plate and tighten the bolt by applying the torque as per Annexure A. Do not forget to insert the plate type lock washer [300.20.981.50] before tightening the bolts. Tightening each bolt

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at once at the specified torque must be avoided because it will result in uneven tightening. So, repeat it to sequentially tighten the bolts several times.

- 12) Bend the inner overhang part of the lock washer [300.20.981.50] inside the bearing lock and outer portion over the hex bolt as shown below. Keep the non contact side corners flat and matching with the lock plate face.

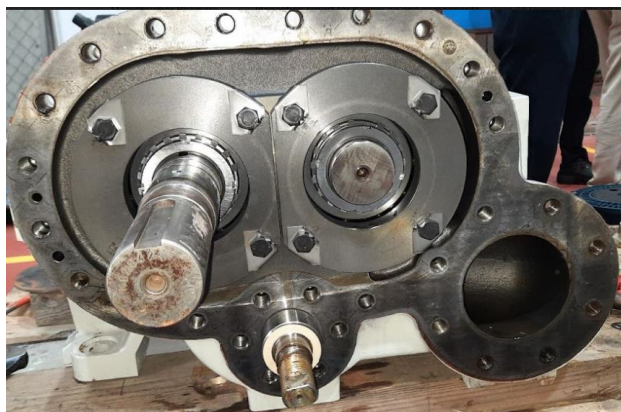
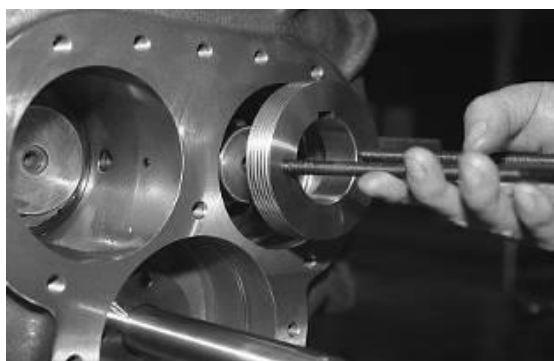


Plate type lock washer

J. Assembly of Balance Piston on suction side:-

- 01) Mount spacer [300.20.218.50] on male suction side for holding the radial bearing. Rotate the spacer gently and match the slot to the suction casing oil return slot. Ensure that no sharp edges exist.
- 02) After fitting the spacer, place the O-ring [300.20.217.50] on the face of the spacer and install the balance piston sleeve [300.20.215.50] by matching the orientation of the spacer to the oil lubrication hole and the step on the spacer.
- 03) Insert the chamfered side of the balance piston sleeve towards the O-ring. Ensure that the O-ring should fit on the chamfer portion only.
- 04) Install the balance piston [300.20.213.50] by using studs as shown below on the male rotor suction side. Ensure that the balance piston should match with the key and keyway slot.



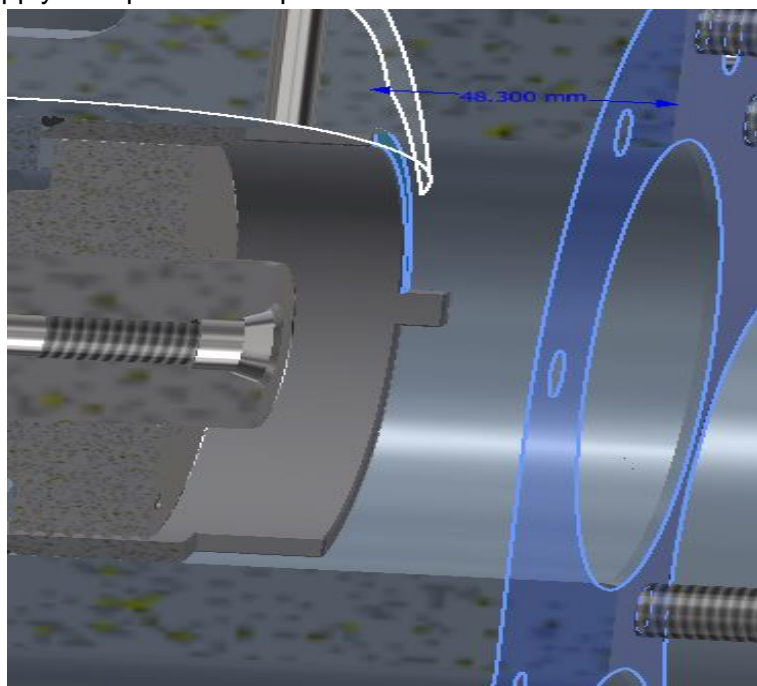
Balance piston installation

- 6) Install the external circlip [999.13.602.50-D50x47] on the male rotor shaft using external circlip pliers and fix it in position. Check that the circlip is fully seated in the groove.

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K. Assembly of Balance Piston cover and unloader cylinder:-

- 1) Measure the depth of the balance piston sleeve face and the suction casing face. Measure 2-3 locations except the two protruded portions. Note down the average value (X) mm.
- 2) Bring the balance piston cover [300.20.226.50] and break sharp edges, if any. Measure the step length of the balance piston cover (Y) mm.
- 3) Required step length $Y = X + 0.3 \pm 0.1$ mm. Adjust the step length by machining the balance piston cover face.
- 4) Apply oil on both sides of the gasket [300.20.974.50] and attach it to the suction casing/balance piston cover. Screw in stud bolts to the suction casing/balance piston cover to retain the gasket in position.
- 5) Align the bolt hole positions and assemble the balance piston cover to suction casing. Use of puller holes is recommended to hold the balance piston cover.
- 6) Insert the hexagon socket head cap screws [300.20.921.50-M16 x 50L] and tighten with loctite 554 & apply the specified torque in annexure A.

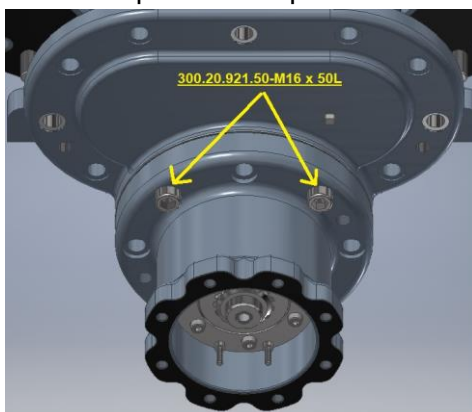


**Reference faces to be considered to measure the value of X
(Nominal Value of X is =48.3mm)**

- 7) Apply oil on both sides of the gasket [300.20.979.50] and attach it to the balance piston cover.
- 8) Align the position of the balance piston cover with the unloader cylinder [300.20.636.50] and lightly tap the flange surface with a soft hammer to install it.

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- 9) Then, insert two hexagon socket head cap screws [300.20.921.50-M16 x 50L] in the positions shown in the picture below to the right and to fasten the unloader cylinder to the balance piston cover.
- 10) Assemble the other hexagon socket head cap screws [300.20.922.50-M16 x 100L]. Apply the loctite & tighten at the specified torque in annexure A.



**Position of hexagon socket head cap screws
[300.20.921.50-M16x 50L]**

L. Assembly of Unloader piston :-

- 1) Bring below set of parts near to the assembly:-
 - i) 300.20.613.50- 1 qty, Lock Plate,Unloader Piston
 - ii) 300.20.614.50- 1qty, Unloader piston
 - iii) 300.20.641.50-1qty, Hydraulic seal
 - iv) 300.20.638.50-1 qty, Locknut
 - v) 300.20.639.50- 1 qty, Lockwasher
 - vi) 999.02.618.50- M8 x 16L- 6 qty, Socket head screw
 - vii) 300.20.632.50- 1 qty, Unloader positioning spacer
- 2) Carefully place the hydraulic seal [300.20.641.50] on its location i.e. seal groove on the unloader piston [300.20.614.50].
- 3) Place the lock plate [300.20.613.50] on the unloader piston and reassure the hydraulic seal is at its place, fasten the lock plate to the unloader piston with socket head screw [999.02.618.50- M8 x 16L] and apply the specified torque as per annexure A.

CAUTION

Ensure the assembly of unloader piston with seal should not be loose while assembling with unloader cylinder.

- 4) Pull the unloader push rod [300.20.618.50] to the maximum accessible location in the unloader cylinder.

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- 5) Install the unloader positioning spacer [300.20.632.50] in the unloader push rod and push it till the O-ring gland.
- 6) Install the O-ring [300.20.617.50] on the unloader push rod. Apply the sufficient grease to the O-ring for proper installation.
- 7) One side of the unloader piston is with puller holes (M10X1.5mm), while the other side does not have such holes. Use the studs and push the unloader piston assembly inside the unloader cylinder carefully. Use of lubricating oil is acceptable. Match the unloader inner dia of the piston with a push rod and push it slowly over the threadings of the rod. After the installation, check that the hydraulic seal is not broken or pinched.
- 8) Install the lock washer [300.20.639.50] by matching the lock washer tooth to the keyway of the push rod.
- 9) Fasten the lock nut [300.20.638.50] by gently rotating with the push rod threads. Tighten the lock nut at the specified torque given in annexure A. To prevent loosening, bend the claw of the lock washer at the notch of the lock nut.

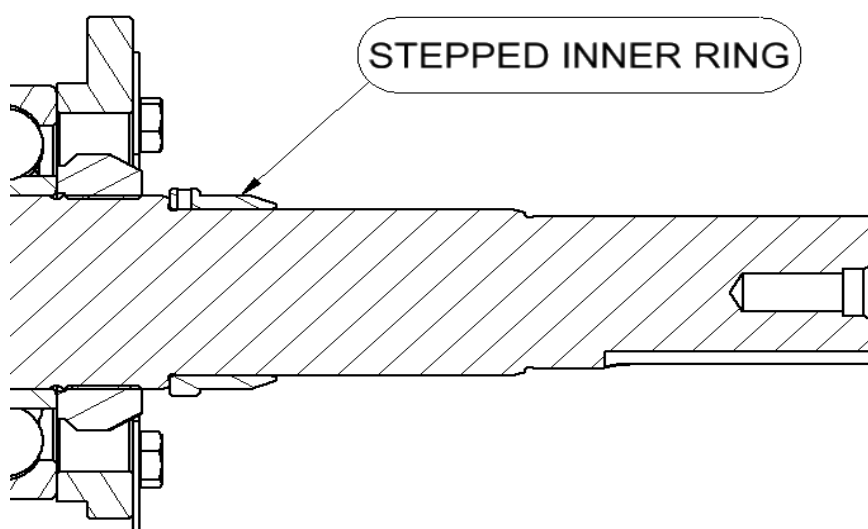
CAUTION

- Precautions need to be taken while bending the claw of the lock washer. Adjust the lock nut slightly to match the teeth of the lock washer.

- 10) Lastly, use the M10 x 1.5mm bolts to check the smooth movement of the piston and the slide valve.

M. Assembly of Discharge cover:-

- 1) Bring below parts near to the assembly:-
 - i) [300.20.815.50] - Stepped inner ring-oil seal
 - ii) [999.02.872.50]- 3 qty Grub Screws
- 2) Remove the inner ring from the box carefully. Clean the oil using the cotton cloth. Ensure to use the clean cloth.
- 3) Mount the stepped inner ring on the male rotor shaft and tighten it using grub screws to check the mounting orientation refer to the below picture.



Orientation of inner ring

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- 4) Mount the anti rotation lock screw [999.02.791.50] on the discharge cover to lock the rotation of the oil seal retainer.
- 5) Install 2 O-rings [300.20.225.50] inside the discharge cover [300.20.222.50]. Apply the sufficient grease to the O-ring for proper installation.
- 6) Apply oil on both the sides of the gasket [300.20.973.50] and attach it to the delivery casing [300.20.510.50] while carefully checking the position of oil supply holes and bolting holes. Screw in stud bolts to the delivery casing to retain the gasket in position
- 7) Combine the flange surfaces of the delivery casing and the discharge cover [300.20.222.50]
- 8) After lightly fastening all the bolts, drive in the dowel pins [300.20.911.50-D20 x 65L] to fix the position by using a copper or an aluminum hammer.
- 9) Tighten the hexagon socket head cap screws in a diagonal sequence, a little at a time, and finally tighten them to the specified torque using a torque wrench. The bottom bolts that cannot be fastened on the workbench are to be fastened later on.
- 10) Install a thrust washer [300.20.635.50] on the delivery cover side of the manual Vi adjusting rod.
- 11) Install the hex nut [999.06.796.50] followed by M30 nut [999.06.797.50] on the manual Vi adjusting rod. Do not use the loctite and do not apply the torque.
- 12) Fix the hexagon domed cap nut [300.20.960.50] on the manual Vi adjusting rod.

N. Oil seal assembly:-

Bring the oil seal retainer/seal cover [300.20.810.50] and oil seal [300.20.812.50] near the seal assembly area (Hand press machine is required for the seal assembly). Clean the oil seal retainer and remove the sharp edges, if any.

Locate the oil seal in the seal retainer carefully using the chamfer as a reference. Install the oil seal [300.20.812.50] inside the oil seal retainer using the hand press shown below. Use of oil is acceptable for smooth assembly. Strictly do not touch the inner side/lip side of the oil seal. Refer to the image (b) for the orientation of the oil seal.

CAUTION

- Proper tooling to be used for the oil seal assembly. Assembly tool part should not touch the oil seal lip portion. Use the middle portion for resting the assembly tool.
- Ensure to apply the uniform force diagonally for proper seal assembly. Do not tilt the seal and do not touch the inner lip portion of the seal.
- Oil seal orientation should be as per drawing only.

Install the oil seal retainer along with the oil seal and slide on the inner ring [300.20.815.50] using two M8 studs. Use the taper tool available with an oil seal for smooth sliding the seal assembly on the inner ring.

Ensure that the position of the oil escape hole of the oil seal retainer on the upper side of the rotor shaft, and the dowel pin notch is at the bottom side of the retainer.

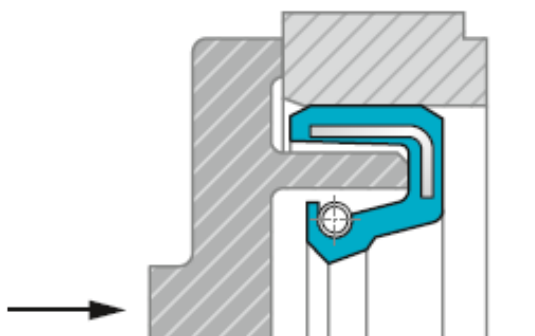
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Install the guide pin [300.20.913.50] on the seal retainer. Just push the pin till resting to the bottom.

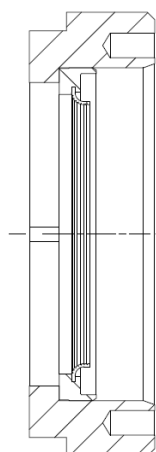
Insert the O-ring [300.20.811.50] for the oil seal retainer. Apply the sufficient grease to the O-ring for proper installation. Take care that the O-ring should not fall down during the next stage of assembly.



(a)



(b)



(c)

Seal assembly references

CAUTION

- Ensure that the position of the oil escape hole of the seal retainer is on the upper side only.

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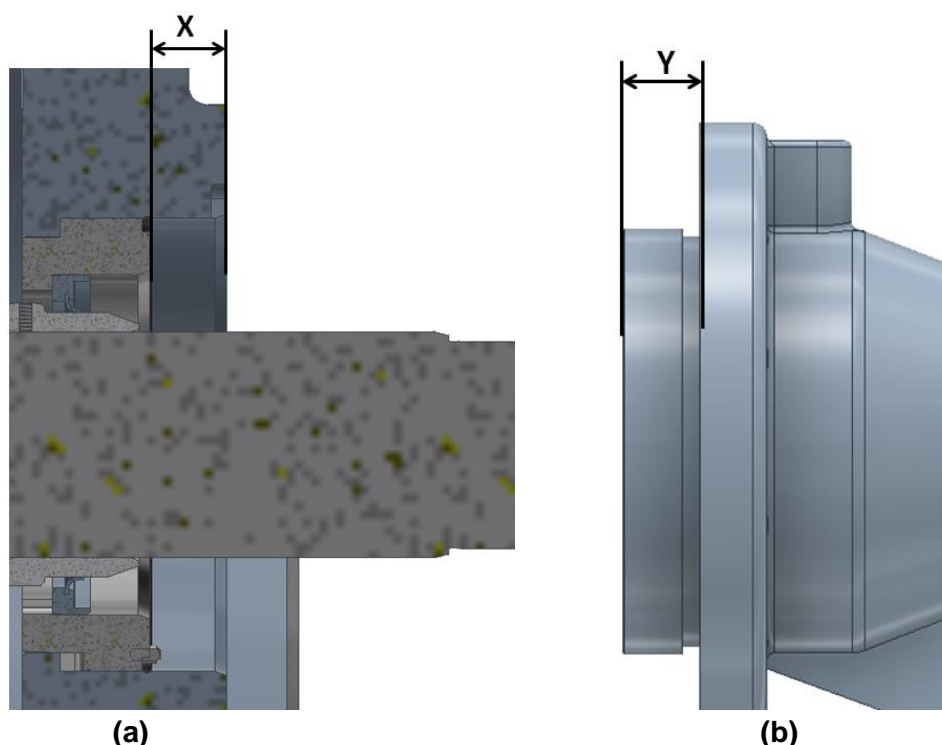


O-ring installation

O. Seal cover sizing :-

- 1) Before starting the mechanical seal assembly, seal cover sizing needs to be checked. If required resizing to be done.
- 2) Check the step length from the outer face of the oil seal retainer to the delivery cover face in the assembly (X, Nominal distance=20.3mm) as shown in the image below. Note down the readings.
- 3) Bring the seal cover [300.20.813.50] and make sure no sharp edges exist. Clean all the surfaces using the cotton cloth.
- 4) Measure the step length Y of the oil seal cover as shown below. Ensure to measure the length carefully and note down the readings.
- 5) Required step length from the outer resting face of seal cover, $Y=(X+1)\pm 0.1$
- 6) If the dimension is not within the above mentioned range then follow below procedure,
 - i) If it is more than mentioned above, machine/grind the front face and adjust the dimension within range.
 - ii) If it is less than mentioned above, machine/grind the step resting face of seal cover and adjust the dimension within range.

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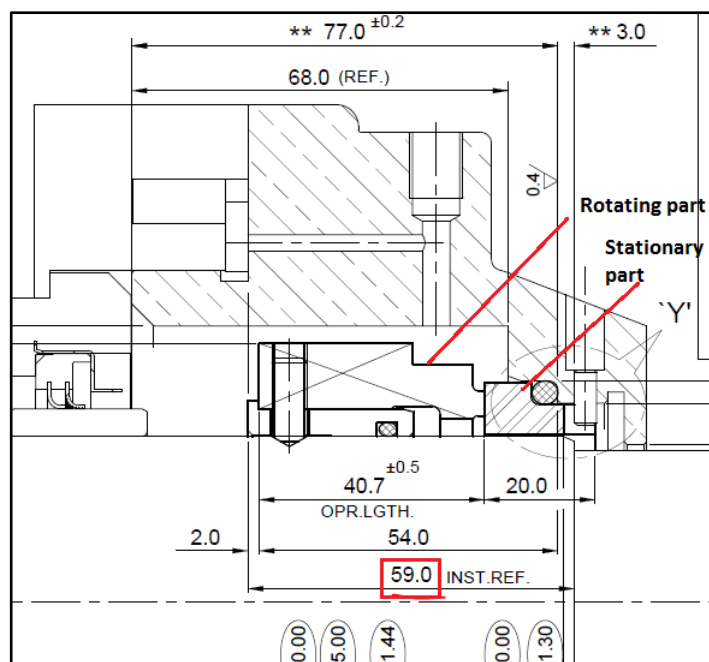


Seal cover sizing

P. Assembly of the Mechanical seal and oil seal cover :-

- 1) Bring the mechanical seal assembly [300.20.814.50] near the main assembly area.
- 2) Mount the anti rotation grub screw M4 x 0.7 x 14L [999.02.791.50] on the seal cover.
- 3) Before installing the mechanical seal, clean the seal installation area on the rotor shaft. In particular, immediately prior to the assembly, check again that no flaw is present on the step area of the shaft where the seal is to be installed.
- 4) Measure the installation reference dimension **59 mm** on the male rotor shaft as shown below. Mark the dimension with the use of a marker pen.
- 5) Remove the mechanical seal from the packet carefully. Disassemble the stationary and rotating part of the assembly. Extra precautions need to be taken care during disassembly as the mechanical seal contains separate small components as well.
- 6) Slide the rotating part of the mechanical seal on the shaft and stop the end face to the marked position. Ensure the position after installation. Tighten the grub screw of the stationary part using the 'L' type allen key. Do not tighten once at all. Tighten slowly in the sequence and finally apply the torque as specified in the annexure A.
- 7) Bring the oil seal cover [300.20.813.50] near the assembly and remove the sharp edges, if any. Clean all the surfaces using the cotton cloth.
- 8) Install the stationary part of the mechanical seal in the seal cover with the help of a hand press. Ensure that the O-ring should be fitted properly during the assembly.

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Mechanical seal assembly

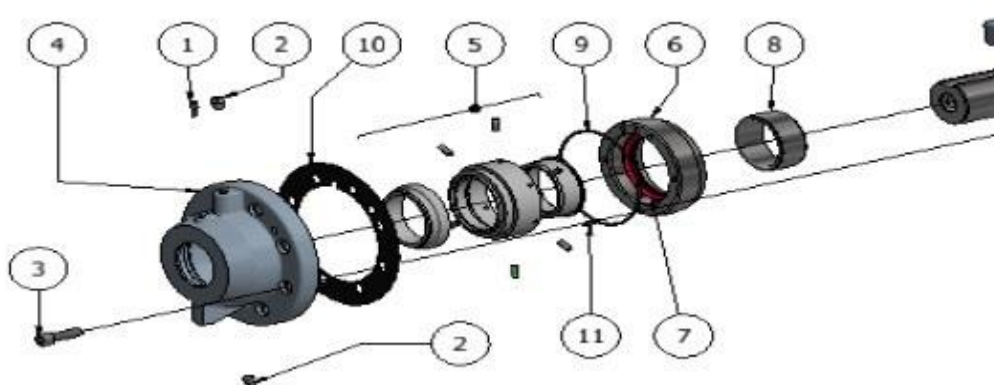


Grub screw fitment of mechanical seal

- 9) Apply oil on the seal cover gasket [300.20.975.50] and attach it to the seal cover flange by carefully aligning the oil hole position on the gasket and the one on the flange.
- 10) Install the seal cover with the gasket such that the oil drain tube comes to the bottom side. At this time, carefully install the seal cover not to hit the mating ring in the seal cover with the rotor shaft. For this, hold the seal cover at the right angle to the rotor shaft or only slightly incline it such that the top side follows the bottom side.
- 11) At a midway point, the sliding surface of the seal ring comes in contact with that of the mating ring. At this point, use a taper gauge to check the clearance between the surfaces of the seal cover gasket and the bearing cover flange. This clearance is called "fastening margin" of the seal should be in the range to 2mm to 3mm, and is used as a guideline in determining the sliding surface pressure between the rotating ring and stationary ring of the seal

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- 12) If it is confirmed that the fastening margin of the seal is appropriate, firmly press the seal cover onto the bearing cover. While you will feel the reaction of the seal springs, keep pressing the cover and fasten two hexagon socket head cap screws [999.02.646.50-M10 x 35L] evenly to secure the seal cover at opposite positions separated by 180°. When there is no clearance between the surface of the flange and gasket, tighten all other bolts at the specified torque.
- 13) Also ensure that the seal cover should match the O-ring properly. Tighten the seal cover with the hexagon socket head screws [999.02.646.50-M10 x 35L] with the specified torque given in annexure A.



PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	300.20.816.50	PIN, ANTI-ROTATION, MECHANICAL SHAFT SEAL
2	2	999.30.853.50	PLUG, TAPER, SQUARE HEAD, R 1/8"
3	8	999.02.646.50	BOLT HEX SOCKET HEAD, M10 x 35L
4	1	300.20.813.50	MECHANICAL SEAL COVER
5	1	300.20.814.50	ASSEMBLY MECHANICAL SEAL
6	1	300.20.810.50	OIL SEAL RETAINER
7	1	300.20.812.50	OIL SEAL
8	1	300.20.815.50	INNER RING, OIL SEAL
9	1	300.20.811.50	O RING, NBR, OIL SEAL RETAINER
10	1	300.20.975.50	GASKET, SEAL COVER AND DISCHARGE COVER
11	1	300.20.913.50	GUIDE PIN, DIA. 4.8 X 12L

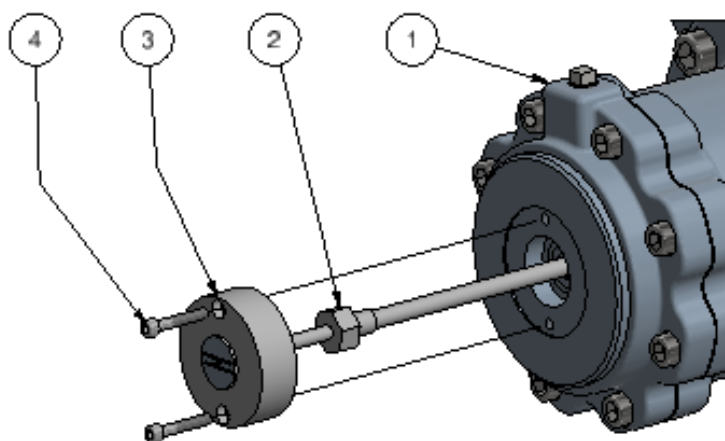
Figure. Exploded view of oil seal assembly

Q. Unloader Cylinder Cover and LPI Assembly :-

- 1) Pull the push rod near the outer part of the unloader cylinder. This is for easy assembly of the LPI components.
- 2) Apply oil on both sides of the gasket [300.20.980.50] and attach it to the unloader cylinder cover [300.20.620.50] flange and carefully align the bolt holes.
- 3) Attach the unloader cylinder cover flange to the unloader cylinder flange keeping the oil inlet hole at the top and secure the unloader cover by fastening the hexagon socket head cap screws [999.02.668.50-M12 x 35L] at the specified torque given in annexure A. Do not forget to apply the loctite 554.
- 4) Install O ring [300.20.311.50] on the sensor well tube and then install the sensor well tube of the LPI mechanism on the unloader cylinder. Ensure that the sensor well tube should match the aluminum tube inside the push rod. Handle the sensor well tube carefully as any damage is not allowed to this part.

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- 5) Install the Linear position Indicator/Sensor Element [300.20.310.50] on the unloader cylinder cover and fasten it with the M6 x 35L bolts [999.02.611.50]. Apply the specified torque as per the annexure A.



PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	300.20.620.50	Unloader Cylinder Cover
2	1	300.20.310.50-A	Sensor well Tube
3	1	300.20.310.50-B	Sensor element
4	2	999.02.615.50	Hexagon Socket Head Cap Screw

LPI assembly

R. Assembly of the other parts :-

- 1) Assemble the key [300.20.413.50] on the male rotor. Adjust the key by filing and match to the keyway. Ensure that the key should not fall down during further movement of assembly. Use of cello tape is acceptable for holding the key.
- 2) Cover the inlet port with the blind flange [995.00.612.40.] and outlet port with the blind flange [995.00.612.30.]. Assemble respective gaskets [suction port- 993.00.211.00.], [discharge port- 993.00.209.00.] before the blind flanges assembly.
- 3) Tighten the suction flange with the socket head bolts [999.02.730.50.] and apply specified torque given in annexure A. Do not use loctite.
- 4) Tighten the discharge flange with the socket head bolts [300.20.982.50.] and apply specified torque given in annexure A. Do not use loctite.

S. Assembly of the plugs :-

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- 1) Identify the temporary and permanent plug location as shown in the general assembly drawing. Assemble all the temporary square head plugs using teflon/PTFE and permanent square head plugs using teflon and loctite.
- 2) Tighten the plugs as per the torque specified in the annexure A. It is acceptable by hand tight for the non accessible torque wrench locations.

Sr.No	Plug size	Part Number	Location
1	HEX PLUG BSPP- 1/4"	082.07.230.50	<u>A) On Discharge Cover[300.20.222.50]</u> 1) Near seal cover-1nos 2) To close the oil line drill hole-1nos <u>B) On Suction casing [300.20.210.50]</u> 1) Auxiliary oil supply to balance piston-1nos 2) Oil port on near male bearing- 1 nos 3) Unloader Control (Loading)- 1 nos 4) Oil drain port- 1 nos 5) Balance Piston cover PT-1 nos
2	HEX PLUG BSPP- 1/8"	082.07.380.50	On seal Cover [300.20.813.50]- 2 nos
3	HEX PLUG BSPP- 1/2"	082.28.920.50	1) Below Rotor casing [300.20.100.50]-1 no's <u>On Suction casing [300.20.210.50]</u> 1) Auxiliary oil supply port for bearing on female rotor side- 1 no's <u>On Delivery Casing [300.20.510.50]</u> 1) At discharge port-1 nos
4	HEX PLUG BSPP- 1 1/4"	300.20.989.50	<u>On Delivery Casing [300.20.510.50]</u> 1) Economiser connecting Port- 1 nos 2) Connecting port for liquid injection 1- 1nos <u>B)On Suction casing [300.20.210.50]</u> 1) On female rotor side- 1 nos
5	HEX PLUG BSPP- 1"	300.20.990.50	<u>On Delivery Casing [300.20.510.50]</u> 1) Connecting port for liquid injection 2- 1nos <u>On Rotor casing [300.20.100.50]</u> 1) Rotor Oil injection- 1 nos
6	HEX PLUG BSPP- 3/4"	300.20.991.50	<u>On Delivery Casing [300.20.510.50]</u> 1) Lubricating oil main supply port- 1 nos <u>On Rotor Casing [300.20.100.50]</u> 1)Oil return port- 1 nos
7	HEX PLUG BSPP- 3/8"	300.20.992.50	<u>On Unloader cylinder cover [300.20.620.50]</u> -1 nos
8	HEX PLUG 9/16 UNF 2A	300.20.993.50	<u>On Unloader cylinder cover [300.20.620.50]</u> at LPI hole.- 1 nos

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9)	HEX PLUG BSPT-1/4 "	300.20.914.50	<u>On Suction Casing [300.20.210.50]</u> 1) Reducer plug at auxiliary oil supply port for bearing on female rotor side- 1 nos 2) Reducer plug at Main oil injection line- 1 nos
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T. Pneumatic testing :-

- 1) Before starting the procedure of pneumatic testing, safely remove the sensor element of the linear position indicator i.e. LPI (300.20.310.50-B) mounted on the unloader cylinder cover and please ensure that the sensor well tube (300.20.310.50-A) is intact to unloader cylinder cover.
- 2) Open the plug 082.07.380.50 located on the upper side of the mechanical seal cover and pour 200-300ml of oil (ISO VG68) in the cavity through the opened bore, replace the plug and apply sufficient torque to it. Now rotate the rotors 10-15 times.
- 3) Also note that everytime rotate the rotors before the pneumatic test.
- 4) Use the main oil injection hole for the pneumatic testing. Pneumatic test pressure= 25 kg/cm²g.
- 5) Rotate the male rotor shaft to check the leakages using soap solution from the shaft seal assembly. Check all the flange connections & plug connections as well and confirm that there are no leakages.
- 6) Replace or tighten the plugs if found any leakages. Repeat the above procedure and ensure that there are no leakages.
- 7) Release the pressure and check the starting torque as below.
- 8) Rotate the male rotor shaft using a torque wrench to identify the starting torque (minimum required torque to rotate the compressor block) of the compressor block. Note down the starting torque values.



Starting torque measurement
Annexure A

DATE OF RELEASE	PREPARED BY	APPROVED BY	LATEST REVISION			DOCUMENT NO.	300.200.D46
			CODE	DATE	INITIALS		
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TIGHTENING TORQUE VALUES

Sr No	Description	Grade	Torque (N.m)
1	M4 X 14L	12.9	5-6
2	M6 X 35	12.9	10-12
3	M12 X 35L	12.9	90-100
4	M16 X 65L	12.9	240-250
5	M16 X 50L	12.9	240-250
6	M16 X 100L	12.9	240-250
7	M10 X 35L	12.9	50-60
7	M6 X 20L	12.9	6-7
8	M8 X 40L	12.9	25-30
9	M6 X 20L	12.9	10-12
10	M12 X 45L	8.8	90-100
11	M8 X 16L	12.9	25-30
12	M20 X 90L	12.9	450-470
13	M20 X 85L	12.9	450-470
14	KMT 13	–	100-110
15	GRUB SCREW (M8)	–	18-20
16	GRUB SCREW (MECH. SEAL)	–	6.9-7

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