Kirloskar Pneumatic

ASSEMBLY INSTRUCTION MANUAL FOR KRS3193

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 both side's radial bearings are installed.

A. ASSEMBLY SLIDE VALVE AND SLIDE STOP:-

1) Assemble the plug [300.20.983.50.] to the end of the push rod [386.20.070.03]. Use the loctite 554 before tightening the plug.
2) 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 push rod [383.20.070.06] with care. The depth of aluminium rod should be such that it matches face of push rod.
3) Keep the assembly of aluminum tube and push rod separately on the clean surface and let it dry for a minimum of 8 hrs.
4) Assemble the push rod [383.20.070.06] to the slide valve [383.20.070.01]. Make sure to keep this assembly separately on the clean surface.

B. SLIDE STOP ASSEMBLY:-

1) Bring following following parts near to the assembly:-
   a) SLIDE STOP [383.20.070.02]- 1 Nos
   b) VI ADJUSTING ROD, SLIDE STOP [383.20.070.10] -1 Nos
   c) GUIDE, MANUAL VI ROD [383.20.070.12] -1 Nos
   d) SLEEVE, SLIDE STOP [383.20.070.04] - 1 Nos
   e) LOCK PLATE, SLIDE STOP[383.20.070.13]- 1 Nos
   f) WASHER THRUST[383.20.070.14]-2 Nos
   g) COVER, MANUAL VI ROD [383.20.070.15]-1 Nos
   h) O RING, GUIDE,MANUAL VI ROD ,OD [383.20.070.16]-1 Nos
   i) O RING, GUIDE,MANUAL VI ROD SLEEVE,ID[383.20.070.17]-1 Nos
   j) SOCKET HEX HEAD BOLT, M6 X 1 X 20L [999.02.607.50]-5 Nos
   k) SPRING WASHER 8.2 X 14.8 X 2 THK [999.11.262.50]-2 Nos
   l) SOCKET HEX HEAD BOLT, M8 X 1.25 X 30L [999.02.624.50]-7 Nos
   m) SOCKET HEX HEAD BOLT, M10 X 1.5 X 30L [383.02.090.04]-5 Nos
2) Assemble sleeve [383.20.070.04] to slide stop [383.20.070.02] on the stepped face of the slide stop using hex head socket bolt [999.02.607.50] and make sure to keep this assembly separately on the clean surface.
3) Mount o ring [383.20.070.17] on the ID of the guide [383.20.070.12] and another o ring [383.20.070.16] on the OD of the guide.
4) Insert thrust washer [383.20.070.14] inside the guide and then insert VI adjusting rod [383.20.070.10] inside the guide, Again insert another thrust washer [383.20.070.14] inside the guide.
5) Lock the above assembly using cover [383.20.070.15] and fasten the cover to guide using hex head socket bolt [999.02.624.50].
6) Lift the suction casing [383.20.020.01] using eyebolt [386.20.090.02] and place it on the workbench (flat surface).

7) Mount the above assembly in the slide stop bore on suction casing and tighten bottom 5 full holes using hex head socket bolt [383.02.090.04- M10x1.5x30L].
8) Now assemble the slide stop and sleeve assembly on the VI rod by slowly rotating the VI rod so that the threads of VI rod and sleeve get engaged.
9) Fix the lock plate [383.20.070.13] on the VI rod facing the suction flange of the suction casing using 2 nos of hex head socket bolt [999.20.624.50-M8x1.25x30L] along with spring washer [999.11.262.50].
10) Fix the spring guide on slide stop by applying loctite 554.
11) Keep the above assembly separately on a clean surface.

C. Rotor Casing:-

1) Lift the rotor casing [383.20.010.01] using two eye bolts [386.20.090.02] 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.
2) 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.
3) Assembly guide block [383.20.010.04] in the key way given on both the sides of the rotor casing using socket head bolt [999.02.622.50-M8x1.25x25L] along with spring washer [999.11.262.50-8.2x14.8x2Thk].

D. Installing the Rotors:-

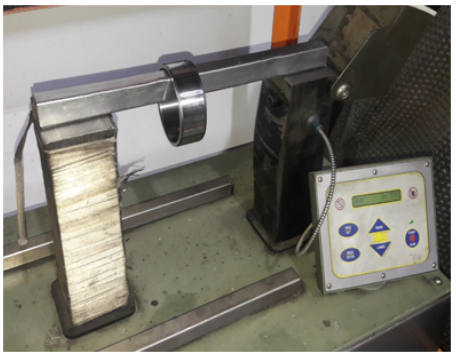
1) Bring below set of radial bearings near to the assembly:-
   i) SKF-NU 314 ECP\DR\CNH [383.20.050.01] - 2 pairs of bearing
   ii) SKF-NU 2314 ECPH / ECPP [300.20.710.50] - 3 No of bearings.
2) Clean the rotor casing and the rotors (Male and Female) with cotton cloth. Fine polish paper can be used 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 on the discharge side.
4) Lift female rotor [383.20.030.02] from discharge side with the help of eye bolt (M20x2.5) and crane.
5) Place the female 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) Take one pair of bearing [383.20.050.01] from the box carefully. Dismantle the inner ring one by one by sliding it and mark respective inner and outer race for easy identification of the inner race and outer race as provided and clean it with oil using the cotton cloth. Ensure to use the clean cloth.

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. • As radial bearings [383.20.050.01] are the special berings mark the outer race and inner race with the same color, take care that mismatch of inner race and outer race should not occur.

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 the female 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) Now repeat the same procedure 8 to 11 to mount the 2nd inner race on the shaft.
13) 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.
14) After turning the rotor, 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 and repeat the same procedure (7 to 9) to mount the inner race on the suction side of the male rotor.

15) After successfully mounting the inner race, lift the rotor with the help of an eyebolt (M20x2.5) and crane and carefully place it horizontally on the workbench and ensure that the rotor is kept steady and safe.
16) Now repeat the above procedure (3-15) to mount the inner race of bearings [300.20.710.50] on the discharge side and suction side of male rotor [383.20.030.01].
17) Install the balance piston key [383.20.030.03] on male rotor [383.20.030.01] to ensure that it should not lose for the next stages, transparent cello tape can be used to hold the key.
18) Lift up the male rotor from midpoint using a crane or a chain block with a belt sling, and insert the rotor into the rotor casing [383.20.010.01] halfway along its length while keeping it balanced on the belt sling. Then detach the belt sling from the rotor and push the rotor fully into the casing. Use of the lubricating oil is acceptable for smooth entry and movement inside the rotor casing and delivery casing.

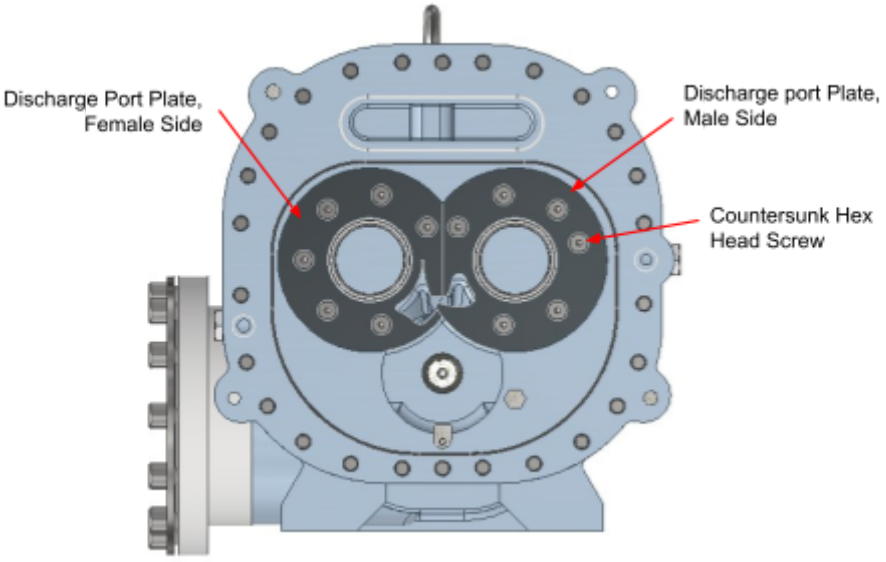
Rotor assembly with rotor casing

19) Same procedure to be followed for installation of female rotor. 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.

E. Assembly of Labyrinth seal and Discharge port plate on Delivery casing:-

1) Lift the delivery casing [383.20.040.01] and place it on the workbench. Remove the sharp edges, if any. Clean the delivery casing using cotton cloth. Use of thinner for cleaning is acceptable.
2) Rest the delivery casing on the cover face side i.e. discharge face should be on the upper side. Refer below image.



Delivery casing with Discharge port plates view from discharge face

3) Bring following components:-
   i) DISCHARGE PORT PLATE, FEMALE [383.20.040.04] :-1 nos
   ii) DISCHARGE PORT PLATE, MALE [383.20.040.05] :-1 nos
   iii) COUNTERSUNK HEX SOCKET SCREW, M12X1.75X40 [386.20.040.08] :- 12 qty
   iv) SOCKET HEAD BOLT, M8X1.25X25L [999.02.622.50] :- 1 qty
   v) SPRING WASHER 8.2 X 14.8 X 2 THK [2999.11.62.50]:- 1 qty
   vi)DOWEL PIN [386.20.040.09]:- 2 qty
   vii) LABYRINTH SEAL[300.20.511.50]:-2 qty
   viii) O RING [300.20.525.50] :-4 qty
   ix) OIL SPACER, MALE SIDE [383.20.040.06]:-1 qty
   x) OIL SPACER, FEMALE SIDE [383.20.040.07]:-1 qty
   xi) SOCKET HEAD BOLT [999.02.604.50]:- 8 qty

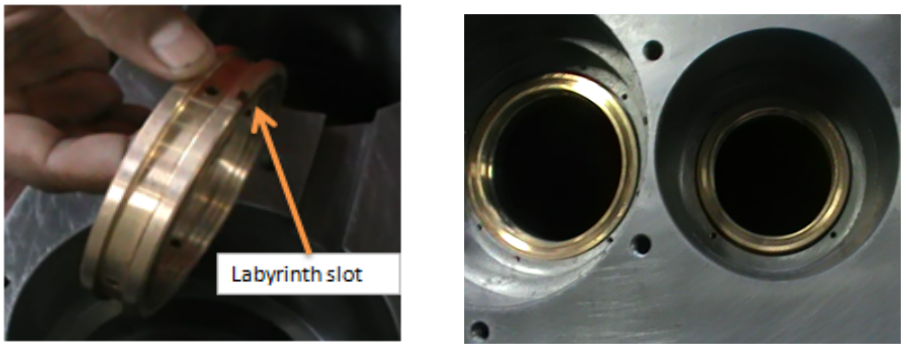
4) Mark male and female rotor bores on delivery casing [383.20.040.01], then mount discharge port plate, male [383.20.040.05] on male bore side and lightly fasten it with countersunk hex socket screw [386.20.040.08]
5) Mount discharge port plate, female[383.20.040.04] on female bore side and lightly fasten it with countersunk hex socket screw [386.20.040.08].
6) Fasten both the plates using socket head bolt M8x 1.25 x 25L [999.02.622.50] with the help of spring washer [2999.11.62.50]. Note this bolt is a shared bolt used to tighten both the plate and both plates will have half counter bores.
7) After both the discharge port plates are installed in place, Apply the loctite 2701 and tighten the countersunk hex socket head screws with the help of torque wrench one by one. Apply torque as specified in annexure A.
8) After both the plates are tightly mounted ensure both plates are at the same level.
9) Refer above image for the orientation of the discharge port plate
10) Lift the delivery casing with the help of an eye bolt and rest it on its discharge face.

11) Take a dowel pin [386.20.040.09] and fit in the dowel hole in male and female side provided on the discharge port plates. Measure the length of the dowel pin and depth of the dowel hole in the delivery casing. 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

12) Take a labyrinth seal [300.20.511.50] and place it in the delivery casing. Ensure the slot fits on the dowel pin properly.

13) Ensure the dowel pin does not touch the labyrinth seal, check it for male and female side.



Labyrinth seal and assembly

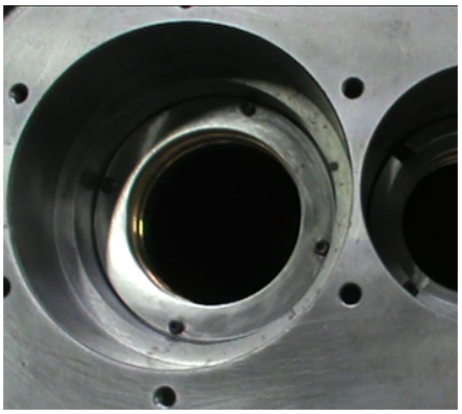
14) Remove the dowel pin and apply loctite 554. Fit both the dowel in male side and female side in the dowel hole. Clean excess loctite.

Dowel pin assembly

15) 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
16) Place labyrinth seal in delivery casing and ensure slot matches with dowel pin.


Labyrinth seal with O-ring and assembly

17) Take the labyrinth seal support plate/oil spacer of male side [383.20.040.06]. Ensure the oil injection holes are open and through. Place a labyrinth seal support plate in the delivery casing of male side.
18) Tight it with socket head bolts M6 x1 x 12L [999.02.604.50]. 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

19) Follow the same procedure on the female side as well. Ensure to use a different seal support plate/oil spacer of the female side [383.20.040.07].

F. Assembly of delivery casing:-

1) On rotor casing [383.20.010.01] mount O ring [383.20.010.02] on delivery face around rotor bores and and O ring [383.20.010.05] on upper chamber on delivery side face,apply sufficient grease to fix them properly.
2) Install O-ring [385.20.106.50] in the groove provided around both oil hole's on the discharge face of the rotor casing and apply sufficient grease to fix it properly.

3) Slide/lift the delivery casing [383.20.040.01] and match the flange surfaces of the main rotor casing and the delivery casing.
4) After lightly fastening some bolts, drive in the dowel pins [383.20.090.01-D20 x 56L] to fix the position by using a copper or an aluminum hammer.
5) Apply the loctite 554 and tighten the hexagon socket head bolts [383.02.090.03-M16X2X45L] in a diagonal sequence, a little at a time. Apply torque as specified in annexure A.
6) After tightening the bolts, check that the both oring are in place.
7) 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.
8) Install 1 O-ring [385.20.412.50] in the groove provided on push rod bore on delivery casing [383.20.040.01].
9) Now move the slide valve towards the delivery casing such that the push rod passes through the support bore provided on the delivery casing.
10) After assembly, move the slide valve to ensure that it is moving freely

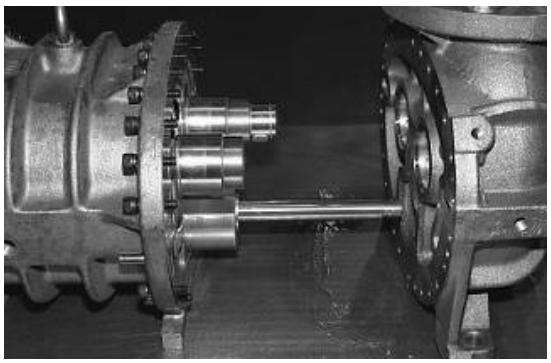
G. Assembly of the Suction Casing :-

1) Lift the suction casing [383.20.020.01] along with slide stop assembly .
2) Place it on the workbench on the resting pad. Remove the sharp edges, if any.
3) Assemble oil injection plug 1 nos. [385.20.914.50] in suction casing on the flange face which mates rotor casing [38.20.010.01]. Use the loctite 554 for proper fitment.

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

4) Install O-ring [383.20.010.03] on the suction side of the rotor casing [383.20.010.01] and apply sufficient grease to fix them properly.
5) Install O-ring [385.20.106.50] on the oil hole of the rotor casing and apply sufficient grease to fix them properly
6) Mount unloader spring [383.20.070.20] on the outer surface of spring guide and on inner diameter of slide stop, ensure that the flat face of the spring rests on the step provided inside the slide stop.
7) Slide (or use a lifting device to move) the suction casing [383.20.020.01] in parallel direction along the shaft axis, and align the slide stop to the slide valve bore.Before Engage the slide stop in the slide valve bore ensure that the unloader spring [383.20.070.20] is inserted in the bore provided on slide valve and then slowly slide the suction casing towards the rotor casing. If required slide the
8) Then, engage the shaft ends of the rotors while pushing the suction casing gradually.
9) 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 [383.20.090.3-M16X2X45L] and confirm all the O rings are in place.

10) Using a copper hammer or an aluminum hammer, drive in the dowel pins [383.20.090.01-D20 x 56L].
11) Tighten the remaining hexagon socket head cap screws evenly up to the specified tightening torque as per annex. A.




Sliding the suction casing on workbench using a Crane

H. Radial bearing assembly:-

1) Bring below outer races of radial bearings near to the assembly:-
   i) SKF-NU 314 ECP\DR\CNH [383.20.050.01] - 2 pairs of bearings with same internal clearance.
   ii) SKF-NU 2314 ECP [300.20.710.50] - ALL 3 outer races,
2) Carefully mount outer race of bearing [300.20.710.50] over cooled inner races on discharge side of male rotor by light tapping. Use of a mallet or other bearing assembly tool is acceptable. Lubricating oil can be used for smooth assembly.
3) Carefully mount outer race of bearing [383.20.050.01] over cooled inner races on discharge side of female rotor by light tapping one after the other since the bearings are provided in pairs. Use of a mallet or other bearing assembly tool is acceptable. Lubricating oil can be used for smooth assembly.
4) Use the same procedure (2) to mount the radial bearings [300.20.710.50.] on the suctio side of male rotor and female rotors side as wel- 1 nos each side.

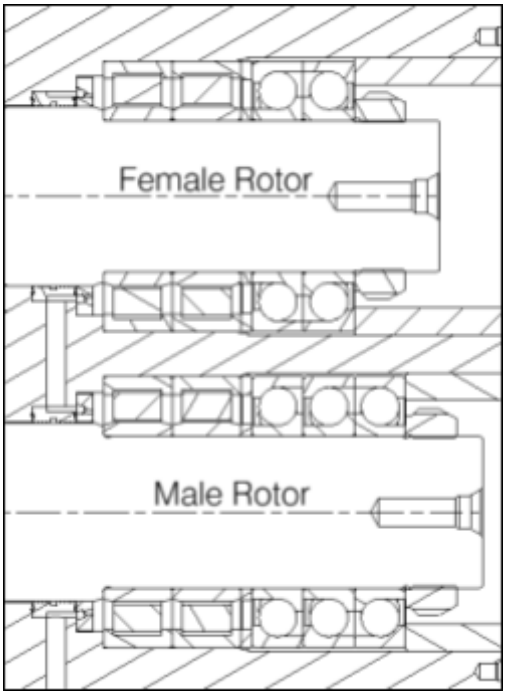
CAUTION
• Assembly of the heated inner ring over the rotor shaft should be done carefully considering the proper alignment. Slight mismatch can restrict the bearing in between and make the assembly difficult. • Ensure that the bearing will rest properly to the bottom face/mating face of the rotor. Bearings 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.

5) Ensure the position of bearing in such a way that bearing number faces towards sky. It is not wrong if the position is reversed.
6) After assembling the bearings kindly assure all radial bearings are assembled properly.

7) Install external circlip [999.13.625.50] using pliers in the grooves provided on suction side of both rotors to lock the axial movement of radial bearing.
8) To lock the outer race of the radial bearing mounted on suction side of female rotor install internal Circlip [999.13.793.50] using plier in the groove provided in the suction housing female side bore.

I. AXIAL BEARING ASSEMBLY:-

1) Mount small spacer- [300.20.516.50] and large spacer [300.20.515.50] on male and female side after arrangement of radial bearings.- 1 nos on each side of the rotor.
2) Bring below set of thrust ball bearings near to the assembly:-
   i) SKF-7314 BECBHP / BECBP- 5 Nos. [300.20.714.50]- Angular contact ball bearing
3) Remove the bearing from the box carefully. Clean the rust preventive oil of the bearing using cotton cloth from the outer surfaces.
4) Mount the bearing on the rotor shaft with proper alignment and fit using the bearing assembly tool.
5) Repeat the same procedure for male side and female side bearing assembly. Assemble the bearings as per the orientation given in the image below.
6) 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.
7) 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.
8) Tighten the 3 grub screws (Size M8) attached to the lock nut by providing torque of 18 N-m. Use loctite 554 for the grub screws. Use proper tools for the same.

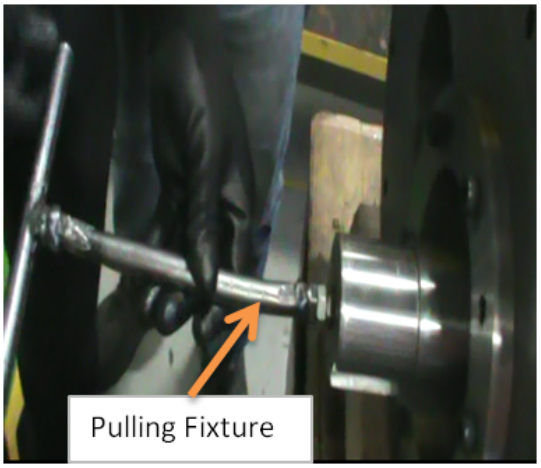


Bearing arrangement delivery side

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.

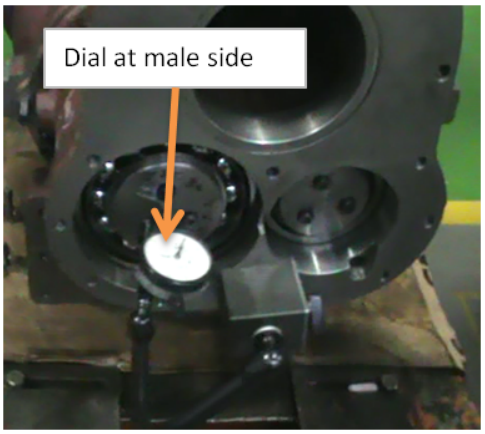
J. Adjustment of end clearance:-

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,

Sr. No.	Parameters	Values (µm)
1	Axial end clearance	**90±10** (Y)

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

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

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

iv) 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.
v) 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,

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

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

iv) 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.

v) 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.

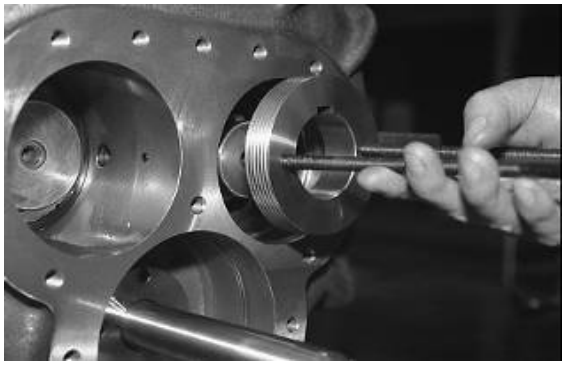
12) After clearance is achieved within the specified range then remove the grub screw of the locknut. Apply the loctite 554 and tighten the grub screw. Apply the specified torque given in annexure A.

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.

13) Bring the male delivery side bearing lock plate [383.20.040.02] and ensure that there are no sharp edges.
14) Bring the female delivery side bearing lock plate [383.20.040.03] and ensure that there are no sharp edges.
15) Install the lock plate [383.20.040.03] on male side bore in the delivery casing to lock the outer race on the axial thrust bearings.
16) While assembling carefully check that the end face of the lock plate inside the bore is resting on the outer race of the bearing.
17) Repeat above procedure while assembling the female lock plate and ensure that the oil hole slot provided on the lock plate matches the oil return hole on the delivery casing.
18) Apply loctite 554 on the hex head bolt [383.20.090.04- M10x30L] of the bearing lock plate and tighten the bolt by applying the torque as per Annexure A. Tightening each bolt at once at the specified torque must be avoided because it will result in uneven tightening. So, repeat it sequentially and tighten the bolts several times.

K. Assembly of Balance Piston on suction side:-

1) Insert sleeve [383.20.020.04] in the bore of suction casing on male suction side, insert it till it rests on outer race of radial bearing. Ensure that the slot side of the sleeve is facing the radial bearing.
2) Rotate the sleeve gently and match the slot to the suction casing oil return slot. Ensure that no sharp edges exist.
3) Kindly ensure that the balance piston key [383.20.030.03] is in the key way and remove cello tape applied .
4) Install the balance piston [383.20.020.03] by using studs M6x1 as shown below on the male rotor suction side. Ensure that the stepped face is facing the radial bearing and balance piston should match with the key and keyway slot.



Balance piston installation

5) Install the external circlip [999.13.609.50] on the male rotor shaft using external circlip pliers and fix it in position. Check that the circlip is fully seated in the groove.

L. Assembly Discharge cover:-

1) Install O-ring [383.20.040.09] on the discharge cover face of delivery casing [383.20.040.01] and apply sufficient grease to fix them properly.
2) Lift discharge cover [383.20.040.08] carefully using and place it on workbench.Remove the sharp edges, if any
3) Now lightly fasten some of the hexagon socket head bolts [999.02.670.50-M12X1.75X40L] and confirm all the oring are in place. Mount bolts only on locations where there are counterbores.
4) Using a copper hammer or an aluminum hammer, drive in the dowel pins [383.20.090.02-D16 x 56L].
5) Apply loctite 554 on the hex head bolt [999.02.670.50-M12X1.75X40L] tighten the bolt by applying the torque as per Annexure A. Tightening each bolt at once at the specified torque must be avoided because it will result in uneven tightening. So, repeat it sequentially and tighten the bolts several times.

M. Seal Gland Assembly:-

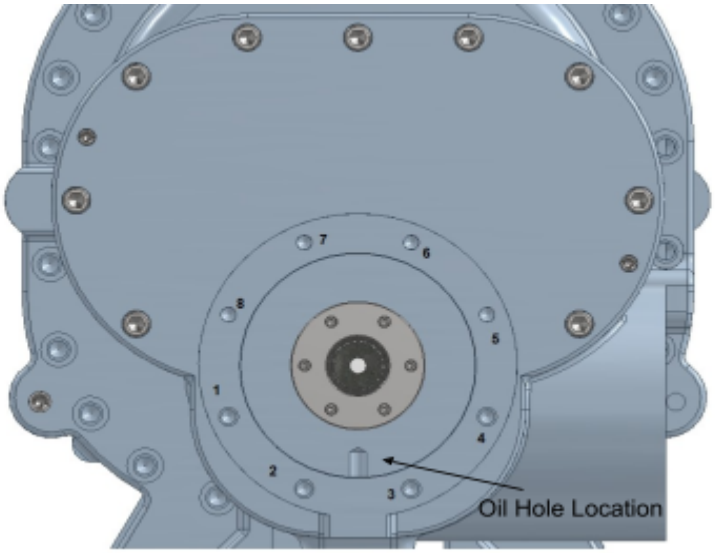
1) Install O-ring [385.20.711.50] - 1 nos on the groove provided on the outer dia of o-ring gland [383.20.070.22].
12) Gently press the guide ring [383.20.070.22] holding at its outer diameter, so that its outer diameter shrinks and passes through the inner dia of the o-ring gland [383.20.710.50] and then insert it in the groove provided on the inner dia of the o ring gland refer above image for reference.
13) Mount the above assembly carefully on the push rod by sliding on to it and use of lubricant is acceptable. (Lightly tap the o-ring gland with the help of a mallet, if required).
14) Fix the gland to discharge cover [383.20.040.08] with the help of hex head bolt [999.02.607.50-M6X1X20 - 6nos],apply loctite 554 on the hex head bolt and tighten the bolt by applying the torque as per Annexure A. Tightening each bolt at once at the

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

15) Close the open rod seal groove using lock plate [383.20.070.23] and fasten it to gland [383.20.070.22] with help of [999.02.607.50-M6X1X20-6nos] with specified torque (refer annexure A) , do not forget to use loctite554 before tightening the bolts.
16) After assembly try to pull the push rod [383.20.070.06] and apply lubricant over its surface and then again push back to its previous position.

N. Assembly of Unloader piston :-

1. Bring below set of parts near to the assembly:-
   i) 383.20.070.07- 1 qty, Lock Plate,Unloader Piston
   ii) 383.20.070.03- 1qty, Unloader piston
   iii) 383.20.070.24-1qty, Hydraulic seal
   iv) 300.20.638.50-1 qty, Locknut
   v) 300.20.639.50- 1 qty, Lockwasher
   vi) 383.20.070.11- 2 qty, Guide Ring
   vii) 999.02.624.50– 6 qty ,Socket Hex Head Bolt-M8 X 1.25 X 30L
   viii)999.02.670.50- M12 x 40L- 8 qty, Socket head screw
2. Carefully mount the guide ring on the groove provided on the outer dia of unloader piston [383.20.070.03] and Lock Plate [383.20.070.07]- 1 nos each.
3. Carefully place the hydraulic seal [383.20.070.24] on its location i.e. seal groove on the unloader piston [383.20.070.03].
4. Place the lock plate [383.20.070.07] 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 [999.02.624.50- M8 x 30L] and apply the specified torque as per annexure A.
5. Lift Unloader Cylinder [383.20.070.08] and place it on the workbench.
6. Mount O ring [383.20.070.18] on axial o ring groove provided on the stepped and 4 slotted side of the cylinder. Use of grease to assemble is recommended.
7. Lift the unloader cylinder [383.20.070.08] and insert the stepped side into the bore provided on discharge cover [383.20.040.08] and lightly fasten the unloader cylinder using hex head bolt. [999.02.677.50.-M12X1.75X90L] on location 1 to 4 and [999.02.670.50-M12X1.75X40L] on location 5 to 8 as shown in below image.
8. While aligning kindly ensure that o ring is in place and also ensure that one of the slots provided on step of unloader cylinder matches the oil hole. Refer image provided below.



Bolt Location on discharge Cover

9. Apply loctite and tighten the hex head bolts.(Torque as per annexure A).
10. Pull the unloader push rod to the maximum accessible location in the unloader cylinder. and ensure that oring [385.20.412.50] is in place , if not mount it and apply sufficient grease over it. Kindly do it carefully.
11. 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.
12. Install the lock washer [300.20.639.50] by matching the lock washer tooth to the keyway of the push rod.
13. 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.

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

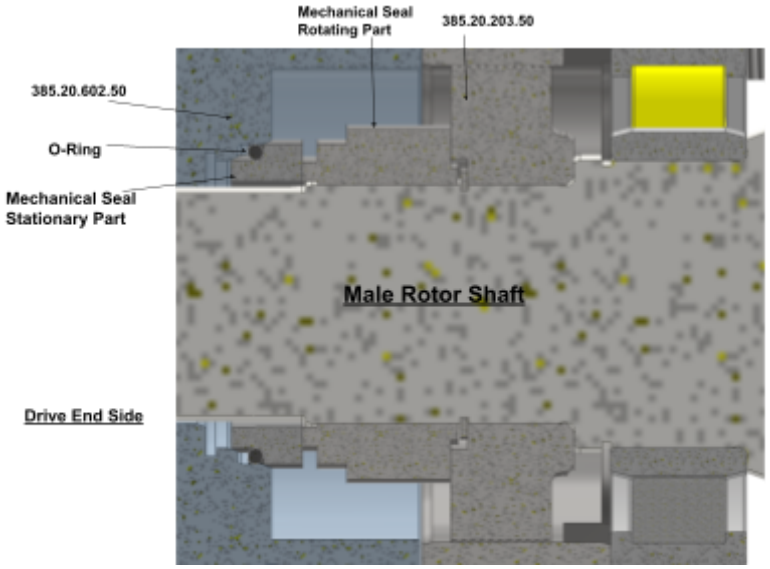
O. Unloader Cylinder Cover and LPI Assembly :-

1) Pull the push rod near the outer part of the unloader cylinder or till sleeve face. This is for easy assembly of the LPI components.
2) Mount the o'ring [383.20.070.19] on the groove provided on the unloader cylinder, use sufficient amount of grease so that o'ring remains in place.
3) Attach the unloader cylinder cover flange to the unloader cylinder flange keeping the oil inlet hole at the bottom and secure the unloader cover by fastening the hexagon socket head cap screws [999.02.670.50.-M12 x 40L] 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.
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.

P. Assembly of the Mechanical seal and oil seal cover and suction cover

1) Bring the mechanical seal assembly [300.20.814.50] near the main assembly area.
2) 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.
3) 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.
4) Slide the rotating part of the mechanical seal on the shaft and touch the end face to the balance piston[. 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 by the supplier. Due to space constraints and unavailability of proper tools, the grub screws can be tightened by hand.
5) Bring the oil seal cover [383.20.060.01] near the assembly and remove the sharp edges, if any. Clean all the surfaces using the cotton cloth.
6) Install the antirotation key [provided by the supplier along with seal] inside the seal cover.
7) 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.
8) Mount O ring [383.20.020.05] on the outer dia of the seal cover and apply sufficient grease.
9) Mount Sleeve antirotation key [383.20.020.06] on the hole provided on the outer step of the seal cover which touches the sleeve.

10) Insert the seal cover carefully and with that match the slot provided on sleeve with the antirotation pin and also match the slot with the oil supply hole provided inside the casing.
11) Mount O ring [383.20.020.06] on the outer dia of the suction cover[383.20.020.02] cover and apply sufficient grease.
12) Lightly fasten both the covers using hex head bolts [383.20.090.04-M10x1.5x30L], make sure the covers are properly in place.
13) After the covers are properly positioned, tighten the hex head bolts with torque as per annexure A. while assembling ensure the washer [385.20.090.01] is used along with highlighted bolts.
14) Also fix the 4 bolts [383.20.090.04- M10x1.5x30L] at 4 shared location of all the three covers along with plane washer [999.18.730.50]



Assembly Mechanical Seal

Q. 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) Mount o ring [383.20.040.10] on the groove provided on discharge pipe face of delivery casing [383.20.040.01] and apply sufficient grease over it and fix adapter flange [383.20.040.11] on the discharge pipe face with the help of socket head bolt [383.20.090.0-10 Nos] with help of torque wrench apply torque as specified in annex A
3) Cover the inlet port with the blind flange [386.20.040.10.] and outlet port with the blind flange [383.20.040.12]. Assemble respective gaskets [suction port-993.00.212.00.], [discharge port- 993.00.210.00] before the blind flanges assembly.

R. Assembly of the plugs :-

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	PLUG-1/2" BSPP	20.173.170.00	A)Suction casing:-[383.20.020.01]:- 1) Mechanical Seal–1nos 2) To close the oil line drill hole–1nos B)[Rotor Casing:-383.20.010.01:- 1) To Close oil return line-1 nos C)On Unloader cylinder cover:- [383.20.070.09]-1 nos D) On Discharge Cover:- [383.20.040.08]-1 nos
2	PLUG, OIL, SUCTION	300.20.914.50	Suction casing:-[383.20.020.01]- 1) Reducer plug at Main oil injection line on flange mating rotor casing-1 nos
3	HEX PLUG BSPP-3/4''	300.20.991.50	On Delivery Casing [386.20.040.01]:- 2) Oil return line closure.-1 nos
4	HEX PLUG 9/16 UNF 2A	300.20.993.50	On Unloader cylinder cover [385.20.706.50] at LPI hole.- 1 nos
6	PLUG-1/2" BSPP.	300.20.983.50	On Pushrod [300.20.983.50]-1 nos
7	PLUG-1" BSPP.		A) On Rotor Casing [383.20.010.01] 1) On Oil Injection Oil Line-1 nos B) On delivery casing [383.20.040.01] 1) Bearing Oil Injection -1 nos
7	PLUG M50 X 5.5 P, ECONOMIZER PORT	383.20.090.06	On Rotor casing [383.20.010.01]:-1 nos

S. 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 20.173.170.00 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

TIGHTENING TORQUE VALUES			
Sr No	**Description**	**Grade**	**Torque (N.m)**
2	M6 X 12	12.9	10-12
3	M6 X 20	12.9	10-12
4	M6 X 25	12.9	10-12
7	M8 X 25L	12.9	25-30
8	M10 X 30L	12.9	50-60
9	M10 X 50L	12.9	50-60
10	M12 X 35L	12.9	90-100
11	M12 X 40L	12.9	90-100
12	M12 X 90L	12.9	90-100
13	M16 X 45L	12.9	220-240
16	KMT 14	–	370-400
17	KM 7	–	100-110