

ASSEMBLY, OPERATING, MAINTENANCE AND TESTING INSTRUCTIONS

ICS Mill Master Slurry Pumps



**MANUAL FOR:
METAL AND RUBBER PUMP SIZES:**

- ICSHDMMD/E64
- ICSHDMME/F86
- ICSHDMMG/ST108
- ICSHDMMG1210

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SAFETY

ICS Wear Group Inc. Heavy Duty Mill Master (HDMM) slurry pumps have been designed for safe and reliable operation. A pump is a pressure-containing device with rotating parts that could be hazardous. Operators and maintenance personnel must realize this and follow the necessary safety measures. All statutory requirements relating to this equipment must be complied with at all times and site safety procedures strictly adhered to.

ICS shall not be liable for damage or delays caused by a failure to observe either the instructions in this manual or the usual industry safety procedures.

CAUTION

Never completely restrict the discharge flow. It may result in adverse temperature increase and possible explosion (as applicable to all centrifugal pump brands).

Never apply heat to the impeller to assist removal from shaft. Heating may result in shattering the impeller

RESULTING IN INJURY OR EQUIPMENT DAMAGE

Direction test driven **WITHOUT** belt drives or couplings fitted. The impeller is threaded and incorrect rotation may cause personnel injury or equipment damage.

If pump is operating with a very hot or very cold liquid, gradually change pump temperature to prevent damage by thermal shock. Thermal shock may cause personnel injury or equipment damage

NOTE

Proper alignment is essential for long pump life.

GENERAL PRECAUTIONS

Warning: Personal injuries will result if procedures outlined in this manual are not followed.

- Never work on the pump set with the power connected.
- Never work on the pump set without the appropriate work tags (eg 'Danger Tags') fitted in compliance with site safety procedures.
- Never operate pump without drive guard correctly installed.
- Never operate pump beyond the rated conditions for which the pump was sold.
- Never run pump below the recommended minimum flow or when dry.
- Never operate pump without safety devices installed.
- Never operate pump with discharge valve closed.
- Never use heat to disassemble pumps due to risk of explosion from trapped liquid.
- With the pump disconnected from the driver, check the motor rotation. Incorrect motor rotation can cause the impeller to back off of its threads and rupture the casing. It may also cause personal injury.

WHERE AUXILIARY EQUIPMENT IS ASSOCIATED WITH A PUMP (eg MOTORS, DRIVE BELTS, DRIVE COUPLINGS, SPEED REDUCERS, VARIABLE SPEED DRIVES, ETC), ALL RELEVANT INSTRUCTION MANUALS SHOULD BE CONSULTED, AND RECOMMENDED PROCEDURES IMPLEMENTED, DURING INSTALLATION, OPERATION AND MAINTENANCE OF THE PUMP SYSTEM.



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PARTS INDEX

NOTE:

- Stuffing boxes are designed as ICSMM ** SBOX, the Stars represent the size for example, A stuffing box to suit a 6x4 E frame pump would be ICSMMESBOX.
- * Represent not present on all sizes or select layouts, consult ICS for your pumps specific bill of materials.

Bearing Assembly:

Description	ICS Part Number
Bearing	MMBR
Bearing Drive End	MMBRD
Bearing Housing	MMBH
Bearing V-Seal	MMBRS
End Cover	MMECV
Laby Seal	MMLBL
Laby Seal	MMLBS
Piston Ring	MMPIST
Shaft	MMSFTM
Shaft Key	MMSFK
Shim Set	MMSHM

Expeller Seal Kit:

Description	ICS Part Number
Expeller	MMEXP
Expeller Ring	MMEXR
Gland	MMGS
Gland Bolt	MMGB
Grease Cap Adaptor	MMGCA
Impeller O-Ring	MMIOR
Lantern Ring	MMLTR
Neck Ring	MMNKR
Packing	MMPAK
Seal Ring	MMSLR
Shaft O-Ring	MMSOR
Short Shaft Sleeve	MMSSLV

Stuffing Box Seal Kit:

Description	ICS Part Number
Gland	MMGS
Gland Bolt	MMGB
Grease Cap Adaptor	MMGCA
Impeller O-Ring	MMIOR
Lantern Restrictor	MMLTRR
Long Shaft Sleeve	MMLSLV
Packing	MMPAK
Seal Ring	MMSLR
Shaft O-Ring	MMSOR
Shaft Sleeve Spacer *	MMSTS
Stuffing Box	MMSBOX

Metal Wet End Kit and Frame Assembly

Description	ICS Part Number
Adjusting Screw	MMAB
Base	MMBAS
Clamp Bolt	MMCLB
Clamp Washer	MMCLW
Cotters	MMCOT
Cover Plate	MMCP
Cover Plate Bolt	MMCPB
Discharge Seal Ring	MMDJR
Frame Plate	MMFP
Frame Plate Liner Insert	MMFPLI
Frame Plate Liner Stud	MMFPLIS
Frame Plate Stud	MMFPS
Impeller	MMIMP
Impeller Release Collar *	MMIRC
Intake Joint Ring	MMINJR
Keeper Plates	MMKP
Retaining Ring *	MMRR
Throat Bush	MMTRB
Throat Bush Stud	MMTBS
Volute	MMVOL
Volute Liner Seal	MMVLS

Rubber Wet End Kit and Frame Assembly

Description	ICS Part Number
Adjusting Screw	MMAB
Base	MMBAS
Clamp Bolt	MMCLB
Clamp Washer	MMCLW
Cotters	MMCOT
Cover Plate	MMCP
Cover Plate Bolt	MMCPB
Cover Plate Liner	MMCPL
Cover Plate Liner Stud	MMCPLS
Discharge Seal Ring	MMDJR
Frame Plate	MMFP
Frame Plate Liner	MMFPL
Frame Plate Liner Insert *	MMFPLI
Frame Plate Liner Stud	MMFPLS
Frame Plate Stud	MMFPS
Impeller	MMIMP
Impeller Release Collar *	MMIRC
Intake Joint Ring	MMINJR
Retaining Ring *	MMRR
Throat Bush	MMTRB
Throat Bush Stud	MMTBS
Volute	MMVOL
Volute Liner Seal	MMVLS

1. INTRODUCTION

This manual is applicable for ICS Heavy Duty Mill Master slurry pumps from the 6x4 to 12x10. The Mill Master line of pumps feature a wide choice of replaceable abrasion resistant metal or molded elastomer casing liners and impellers, which are all interchangeable within a common casing assembly.

The pumps may be fitted with a range of seal types depending on the particular duty requirements: a water-flushed packed gland seal (standard); an expeller; or an ICS Patented Mechanical Seal.

If problems are experienced during pump operation, reference should be made to the ICS Fault Detection Chart. If operating problems are not rectified by following instructions in the Chart, assistance should be sought from the nearest local representative or via our technical support e-mail (detailed in the footer).

Important design features of this range of ICS Heavy Duty Mill Master Slurry Pumps include:

- Cartridge type upgraded ICS Bearing Assembly for extended life compared to competitors' pumps.
- Replaceable casing liners (hard metal, rubber or urethane can be site retrofitted).
- Heavy duty screw thread Impeller attachment.
- Through-bolt design throughout for easier maintenance.
- Self-setting and self-aligning Patented Slurry Seals.
- Minimum number of casing bolts

2. IDENTIFICATION OF PARTS

Each part has a basic part identification. Parts with the same name have the same basic part abbreviation, regardless of pump size. For example, all stuffing boxes are designed as ICSMM ** SBOX, the Stars represent the size for example, A stuffing box to suit a 6x4 E frame pump would be ICSMMESBOX.

Refer to the Sectional Arrangement Drawing for the appropriate size of ICSHDMM Pump for complete identification and description of component parts.

In all communication with ICS, or its distributors, and particularly when ordering spare parts, the correct component names and Part Numbers should be used at all times to avoid supply of incorrect parts.

3. BEARING ASSEMBLY – ASSEMBLY AND MAINTENANCE

The Bearing Assembly is assembled and maintained as described in separately available ICS manuals.

4. PUMP ASSEMBLY INSTRUCTIONS

Reference to a Sectional Arrangement Drawing provided by ICS for the particular pump being assembled will be of assistance in the instructions outlined in the following sections.

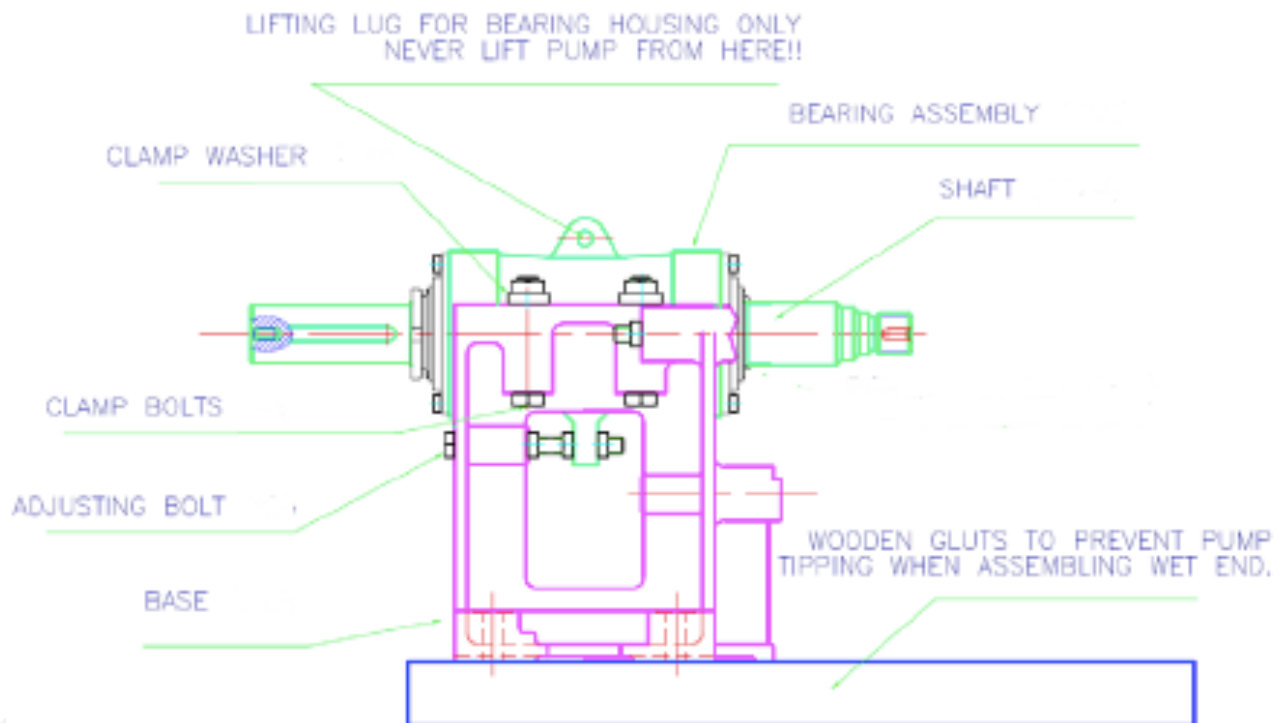
All parts dismantled during pump overhaul should be inspected to determine suitability for reuse, and identification of new parts should be checked.

Parts suitable for re-use should be cleaned and if necessary re-painted. Matching faces should be free of rust, dirt, and burrs, and have a coating of anti-seize compound applied prior to assembly, so that the pump remains easy to fix in future overhauls.

Small standard fasteners should preferably be replaced, and all threads coated with suitable compound (such as anti-seize) before assembly.

4.1 FRAME ASSEMBLY

4.1.1 FITTING BEARING ASSEMBLY TO BASE - Refer Fig 1



Replacement of all elastomer seals (such as O rings and joint rings) is recommended at major overhauls, as these materials usually deteriorate with use. Direct exposure to sunlight causes accelerated deterioration of elastomers and will result in more frequent changing of parts.

- i. Insert Adjusting Bolt in Base from drive end. Fix Adjusting Bolt into Base by screwing on one nut and fully tighten. Fit the additional two nuts supplied with the Adjusting Bolt and separate with two flat washers. These nuts should remain loose on Adjusting Screw and spaced well apart so that the Bearing Assembly will slot into place.
- ii. Apply anti-seize compound to semi-circular machined surfaces on the bottom of the Bearing Housing and onto the mating support cradle in the Base. This helps reduce corrosion in this area (which is important for maintaining low maintenance costs for packing and expellers).
- iii. Approximately match the Bearing Housing ears with the hold down bolt holes in the base then lower the Bearing Assembly into the Base and ensure the lug has fitted over the Adjusting Screw and between the nuts and washers.
- iv. Fit Clamp Bolts through Base from below. Mount a Clamp Washer on each bolt (domed side up) then screw on the nuts. Fully tighten Bolts on the left-hand side of Base as viewed from the Impeller end. At this stage the Clamp Bolts on the other side should remain finger tight only, to maintain alignment but allow axial movement of the Bearing Assembly.
- v. Apply anti-seize compound to Shaft protruding at Impeller end. This will assist fitting and removal of shaft components, and prevent damage to Shaft surfaces by moisture.
- vi. If not repaired in-situ, fit an appropriate assembly cradle (such as two blocks of timber with coach screws), to underside of Base to prevent the pump from tipping forward during assembly of the wet end, as shown in Fig 1. Ensure that the Base is high enough above the floor for the frame plate and components to be assembled.

4.1.2 FITTING FRAME PLATE AND COVER PLATE BOLTS – Refer Fig 2

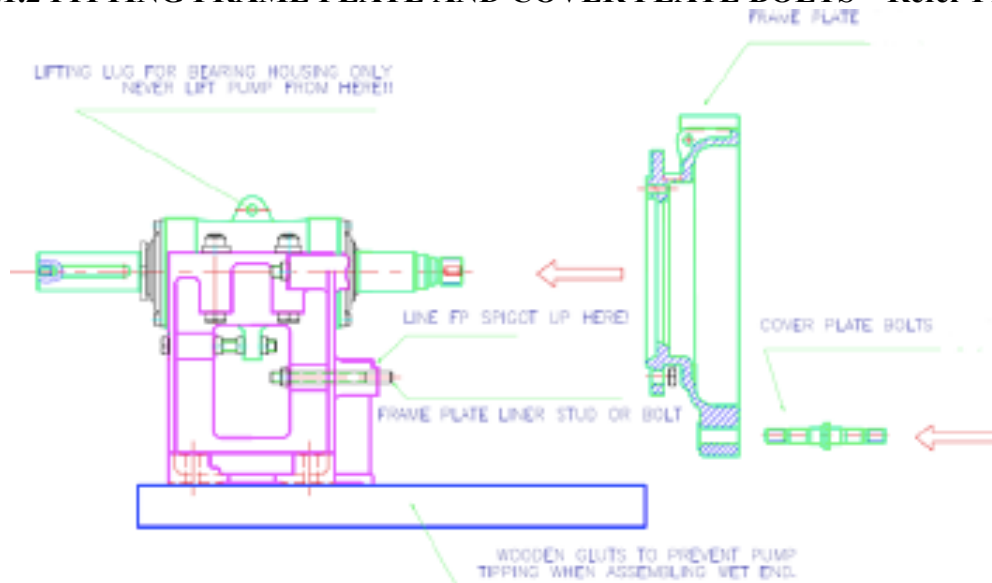


Figure 2-Assembling Frame Plate and Cover Plate Bolts

- (i) Apply anti-seize compound to the recesses in the base where the Frame Plate spigot engages. Fit Frame Plate to Base, ensuring that the Frame Plate locating spigot engages with the corresponding Base arms. For pumps 6x4 and larger, Frame Plates are provided with either radially tapped holes for eyebolts or lifting lugs to assist fitting.
- (ii) Insert Frame Plate Studs. Fit and fully tighten nuts. Depending on the pump size, the Frame Plate is bolted externally using studs. Others use bolts which are inserted from within the Frame Plate. In most pump sizes, the Frame Plate can be rotated to provide eight alternative angular discharge positions. Ensure the cover plate bolts are clean, and remove any burrs. cover threads with anti-seize. Fit Cover Plate Bolts through Frame Plate lugs.

4.2 STUFFING BOX SEAL ASSEMBLY

ICS Pumps are supplied with a standard flush gland assembly. Refer to ICS or our nearest agent to determine the most appropriate method of sealing in your specific application.

4.2.1 GLAND SEAL ASSEMBLY - Refer Fig 3/4/5/6

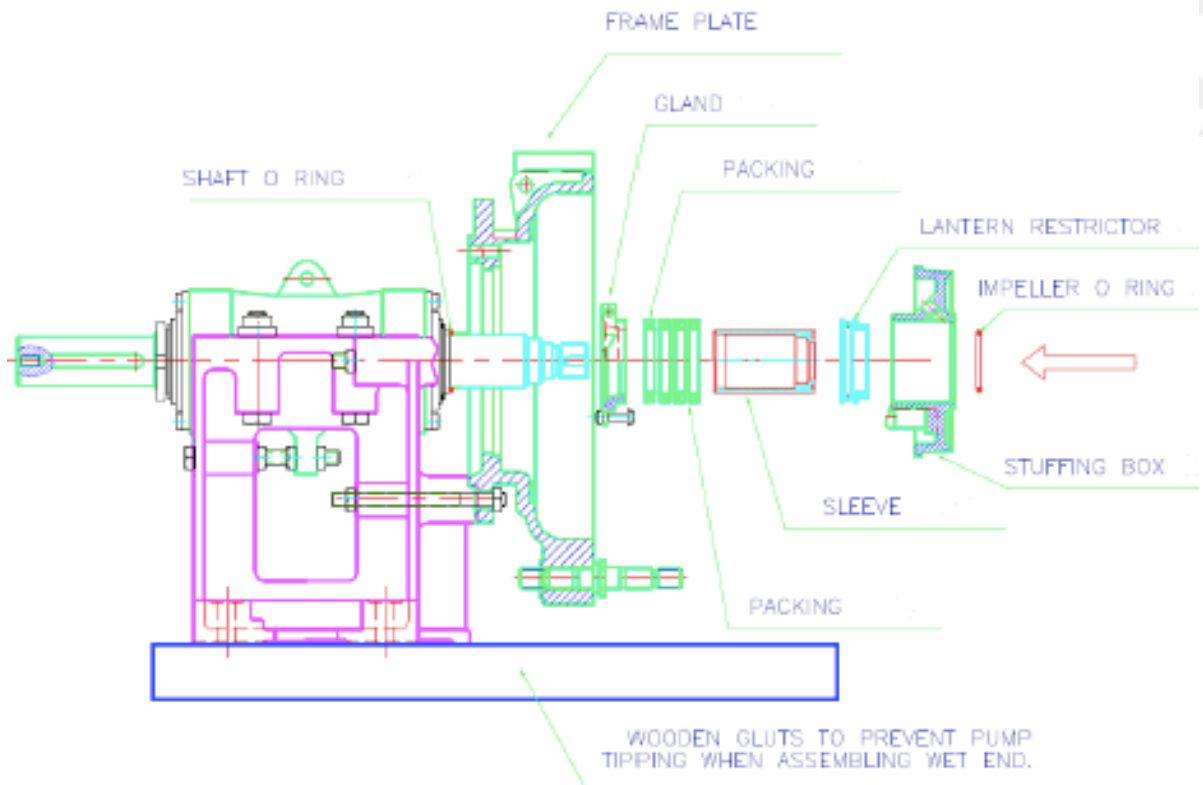


Figure 3- Stuffing Box Seal Assembly

For longevity, ALL gland packed pumps require a reliable external water flush as detailed in Appendix A. The standard ICS supply incorporates a Lantern Restrictor which is located at the impeller end of the stuffing box. ‘Low Flow’ lantern restrictors are available as an option, however when pumping abrasive slurries these reduce are not as effective as the ‘Full Flow’ standard version. Refer to Figure 4, 5, and 6 for arrangement options.

ULTRA LOW FLOW - Standard

Used where slurry dilution is not desirable and can be used on high suction lifts.

ICS recommends this method of sealing as standard because on many services, particularly with fines, it generally improves the life of gland packing and shaft sleeves. When the pump is shut down and the flush water then turned off, the lip seal prevents slurry ingress under the packing.

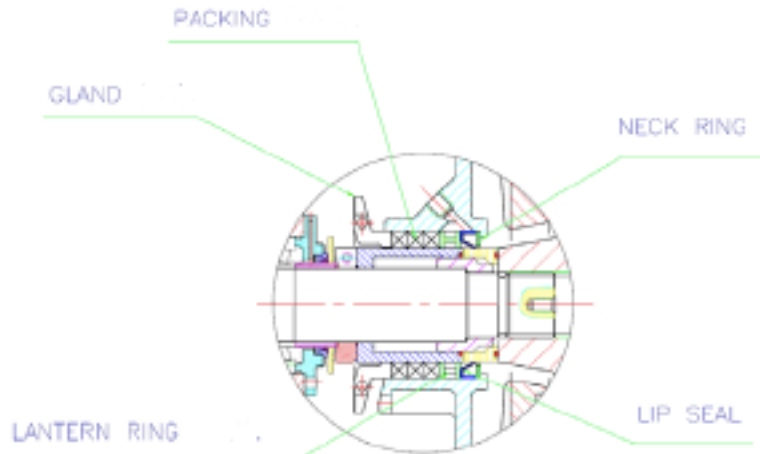


Figure 4 – Ultra Low Flow Arrangement

FULL FLOW

Used For normal slurry applications with positive suction head or section lifts to approx. 2M. This method is recommended for severe duties such as mill discharge.

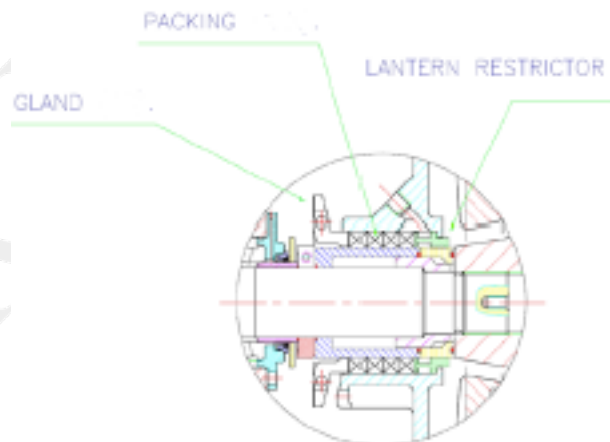


Figure 5 – Full Flow Arrangement

LOW FLOW

As full flow except lantern restrictor has reduced clearance on sleeve. Used on pumps with suction lifts greater than 2m or where full flow flush is not possible.

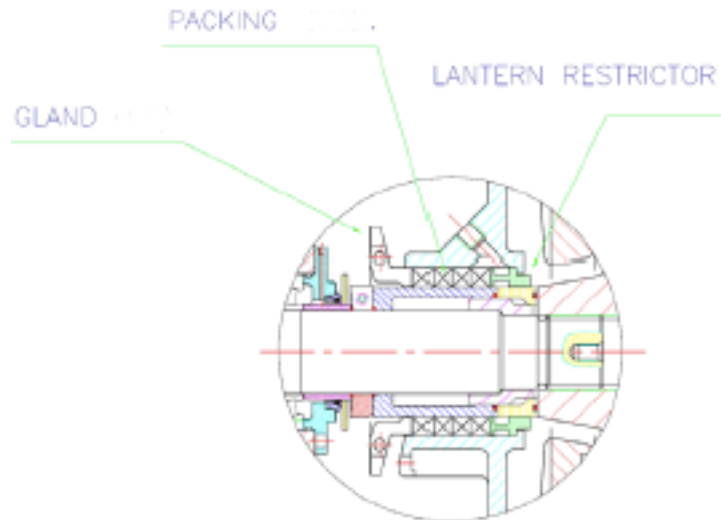


Figure 6- Low Flow Arrangement

To assemble stuffing box seal:

- I. Place Stuffing Box flat on surface, wet end side down.

Ultra Low Flow Packed Glands

- 1) Place Neck Ring into stuffing box bore.
- 2) Place Lip Seal into stuffing box bore, with flat side of lip seal facing upwards.
- 3) Stand Shaft Sleeve on its end with small ID down, and slide through Lip Seal.
- 4) Fit Lantern Ring
- 5) Fit Packing Rings, staggering joints and flattening each ring separately, until they almost completely fill the Stuffing Box chamber.

Full & Low Flow Packed Glands

- 1) Place Lantern Restrictor, small ID down, into stuffing box bore.
 - 2) Stand Shaft Sleeve on its end with small ID down, and slide through Lantern Restrictor.
 - 3) Fit first Packing Ring to fill the Stuffing Box.
 - 4) Fit Packing Rings, staggering joints and flattening each ring separately, until they almost completely fill the Stuffing Box chamber.
- II. Fit Gland Assembly over Shaft Sleeve and press to engage bore of Stuffing Box. Press down to compress Packing Rings. Fit Gland Bolts to recesses in Stuffing Box, engaging holes in Gland Assembly, fit washers and nuts, and tighten just sufficiently to hold Shaft Sleeve (final adjustment will be made when running the pump). A cable tie or similar may be used to secure bolts in position.

- III. Refer to the Sectional Arrangement Drawing supplied with the pump to schematically view the order of components from the bearing spacer to the impeller.
- IV. Apply anti-seize to recess in Frame Plate where the Stuffing Box will sit to assist future removal.

Remember to fit shaft O ring (and if applicable Impeller Release Collar) to the pump shaft, then fit the Stuffing Box you have assembled to the Frame Plate, engaging Shaft Sleeve with Shaft, and tap into position in Frame Plate with a soft mallet.

Push the Shaft Sleeve back until all components on the shaft from the bearing spacer onwards are firmly in position.

Check that all Shaft O-Rings are correctly positioned in grooves and have not been damaged during assembly.

- 1) Fit remaining O-Rings. Using a heavy grease that is compatible with the O ring material will assist keeping the O ring in its correct location during assembly.
- 2) Ensure the shaft thread is clean and free of burrs and sharp edges. Using gloves, apply anti-seize compound liberally to Shaft thread.

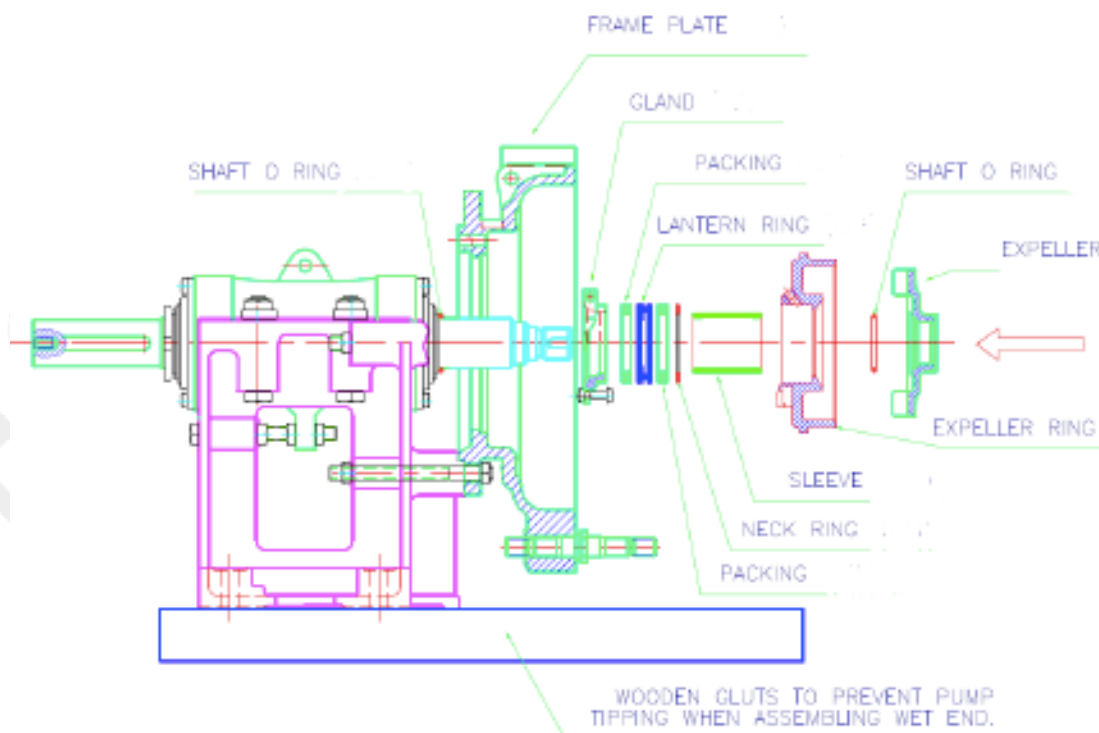
4.2.2 EXPELLER SEAL ASSEMBLY – Refer Fig 7

ICS Heavy Duty pumps are supplied with metal Expeller Rings On corrosive applications they can be lined with urethane. The gland of the Expeller Ring is normally fitted with packing, but can also be used with Lip Seals.

Alternative assembly methods are described below for the centrifugal seal depending upon pump and frame size.

Please contact an ICS Wear Group representative to discuss your site specific requirements.

Figure7-Expeller Sealed Pump Assembly



Metal/Polyurethane Lined Expeller Ring - refer Fig 7

The following instructions describe the procedure to pack the gland of the metal or urethane lined Expeller Ring, which differs according to the pump frame size.

- (i) Place Expeller Ring flat on bench, gland side up.
- (ii) Push Neck Ring into gland bore.
- (iii) Stand Shaft Sleeve on end, and slide through Neck Ring.
- (iv) Insert first Packing Ring into the Expeller Ring (or Lip Seal if not using Packing).
- (v) Insert Lantern Ring and press down to flatten first Packing ring.
- (vi) Insert remaining Packing Ring (or Lip Seal if not using Packing).
- (vii) Fit Gland Seal over Shaft Sleeve, until it slots into the bore of Expeller Ring. Press down to compress Packing Rings. Fit Gland Bolts to recesses in Expeller Ring, with the bolts extending through the holes in Gland Assembly, fit washers and nuts, and finger tighten to hold Shaft Sleeve (final adjustment will be made when running pump). A cable tie may be used to secure bolts in position.
- (viii) Apply anti-seize to recess in Frame Plate where the Expeller Ring will sit to assist future removal. Fit the Expeller Ring you have assembled to the Frame Plate, and tap into position with a softmallet.
- (ix) Locate Expeller Ring with the grease inlet connection at the top.
- (x) Check that all Shaft O-Ring between Bearing Spacer and Sleeve are correctly positioned in groove and have not been damaged during assembly.
- (xi) Fit second Shaft O-Ring on end of sleeve protruding through Expeller Ring.
- (xii) Fit Expeller to Shaft, and push to ensure there is contact of all components mounted back to the bearing spacer.
- (xiii) Fit Impeller O-Ring to groove in Expeller using a thick compatible grease to ensure it does not move when screwing on impeller.
- (xiv) Ensure the shaft thread is clean and free of burrs and sharp edges. Using gloves, apply anti-seize compound liberally to Shaft thread.
- (xv) Fit Grease Nipple to Expeller Ring. Apply grease to Nipple with grease gun, to charge Lantern Ring cavity.



5. PUMP WET END ASSEMBLY

Pumps described in this manual, from the 6x4 to 12x10 in size, have three-piece metal, urethane or elastomer liners.

Liner configuration is independent of Bearing Assembly size. Metal and Rubber liners can be retrofitted into the same wet ends and a mix of Metal and Elastomer liners is also possible where mixing the components will extend component life.

5.3.1 WET END ASSEMBLY TOOLS

ICS recommends the use of special tools to assist with the assembly and maintenance of the ICSHDP pumps. These tools can be fabricated on site or purchased from ICS as an optional extra. These tools include:

- ICS-LT- Lifting Tube to assist inserting the frame plate liner insert.
- ICS-LN- Locating Nut to assist locating the frame plate liner insert.
- ICS-VLB- Volute Lifting Beam to assist lifting the volute liner.

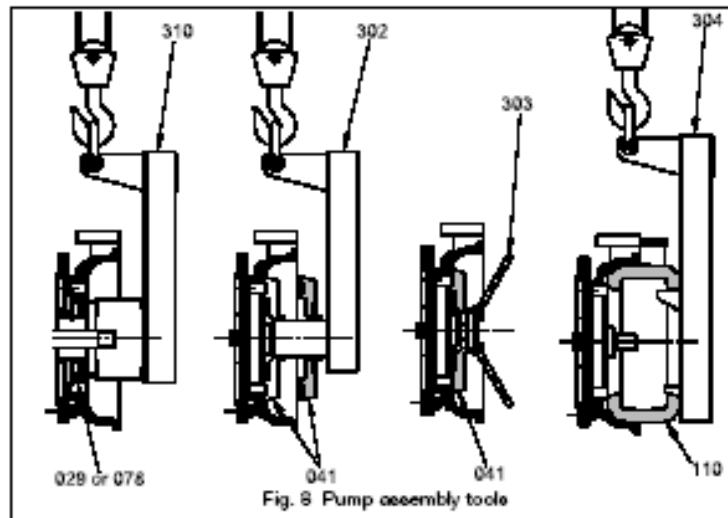


Figure 8-Wet End Assembly Tools

5.3.2 RUBBER LINERS - THREE PIECE – Ref Fig 9

Fitting Frame Plate Liner, Impeller, Throatbush, Cover Plate Liner, and Cover Plate
Refer Figs 8 and 9

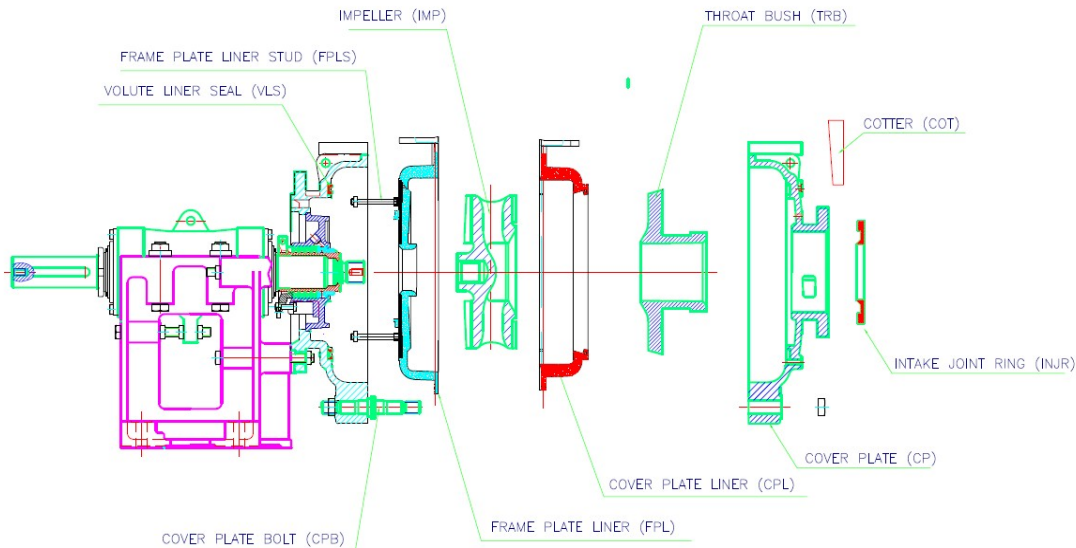


Figure 9-Assembling Three Piece Liners

I. Fit Frame Plate Liner as follows:

- a. Fit and tighten Frame Plate Liner Studs to the tapped bosses in the Frame Plate Liners. If the Studs are not square to the face of the Liner, screw a nut on the thread, and straighten it by tapping lightly with a hammer.
- b. Lift Liner in position, lining up Studs with corresponding holes in the Frame Plate, then push it into Frame Plate. Fit Nuts to Studs, and hand tighten sufficiently to hold Liner in its place.
- c. Restrain Shaft with wrench, and fit Locking Nut on Shaft thread, as shown in Fig 8. Move the Frame Plate Liner so that its inner diameter is approximately concentric with the tapered surface of the Locating Nut. Tighten all Studs on the Frame Plate Liner finger tight plus half a turn (max), and then remove the Locating Nut.

All ICS Heavy Duty pumps come with lock washer's, we recommend lock washers to maintain a proper torque.

II. Fit Impeller:

- a. Fit Shaft Key in Shaft keyway, and fit a shaft locking device (Shaft Wrench recommended).
- b. Ensure the shaft thread is clean and free of burrs or other foreign objects that could impede screwing on the impeller.
- c. Ensure that the O-Ring that will seal against the impeller hub is positioned in its locating groove.
- d. Clean the impeller thread and ensure there are no burrs or other foreign objects that could impede screwing the assembly onto the shaft. Apply anti-seize compound to thread. Lift the Impeller with hoist, supported on a rope, and using the shaft clamp turn the Shaft so that it engages into the impeller thread. Tighten the Impeller on Shaft, with bar between Impeller vanes, by tapping the Shaft Wrench. Ensure that the various O-Rings on the Shaft are not damaged, and are covered by neighboring parts.

IV. Make Cover Plate, Cover Plate Liner and Throat Bush Assembly.

- a. Place the Cover Plate Liner on a flat surface, such as a concrete floor, with the large outside sealing flange down. Position two equal length timber spacers in the center of the Cover Plate Liner, so that they protrude slightly above the Liner. Place the large flat section of the Throat Bush on the timber spacers.
- b. Apply substantial amounts liquid soap or rubber lubricant to the sealing surface of the Throatbush (the tapered outside section) and the inner sealing lip of the Liner (where the two pieces mate together). **This Operation should be carried out carefully to avoid damaging seal lip.**
- c. Lift the Cover Plate Liner and tilt it then slide one third of the sealing area over the outside of the Throatbush. Insert a small tire lever, with rounded edges (to prevent damage to the elastomer), between Throatbush and Cover Plate Liner, and rotate the tire level to engage the Cover Plate Liner over the Throatbush, in a similar fashion as when installing a bike tire over a rim. Ensure that the seal lip is uniformly engaged.
- d. Lift the Cover Plate, suction flange upwards, and place it over the assembled Throatbush and Cover Plate Liner.
- e. Insert the tapered Cotters through holes in the neck of the Cover Plate suction nozzle, and tap the cotters carefully and evenly until the Throatbush is held securely in the Cover Plate.

V. Fit the cover plate liner assembly to the pump.

Review the rotation of the assembled frame plate then fit a D bolts into the appropriate lifting point provided in the cover plate. Lift the cover plate liner assembly and slide the holes over the cover plate bolts. Fit Nuts to Cover Plate Bolts, tighten evenly, and in accordance with the tightening sequence indicated in Section 5.3.3. Once tight, ensure that all the Cover Plate lugs fully butt up against the shoulders on Cover Plate Bolts.

VI. Complete the assembly of your selected Seal Assembly.

VII. The pump is now ready for fitting of Joint Rings and Impeller adjustment.

5.3.3 METAL LINERS - THREE PIECE – Ref Fig 10

Fitting Seal Ring, Frame Plate Liner Insert, Volute Liner Seals, Volute Liner, Impeller, Throatbush, and Cover Plate
Refer to Figs 8 and 10

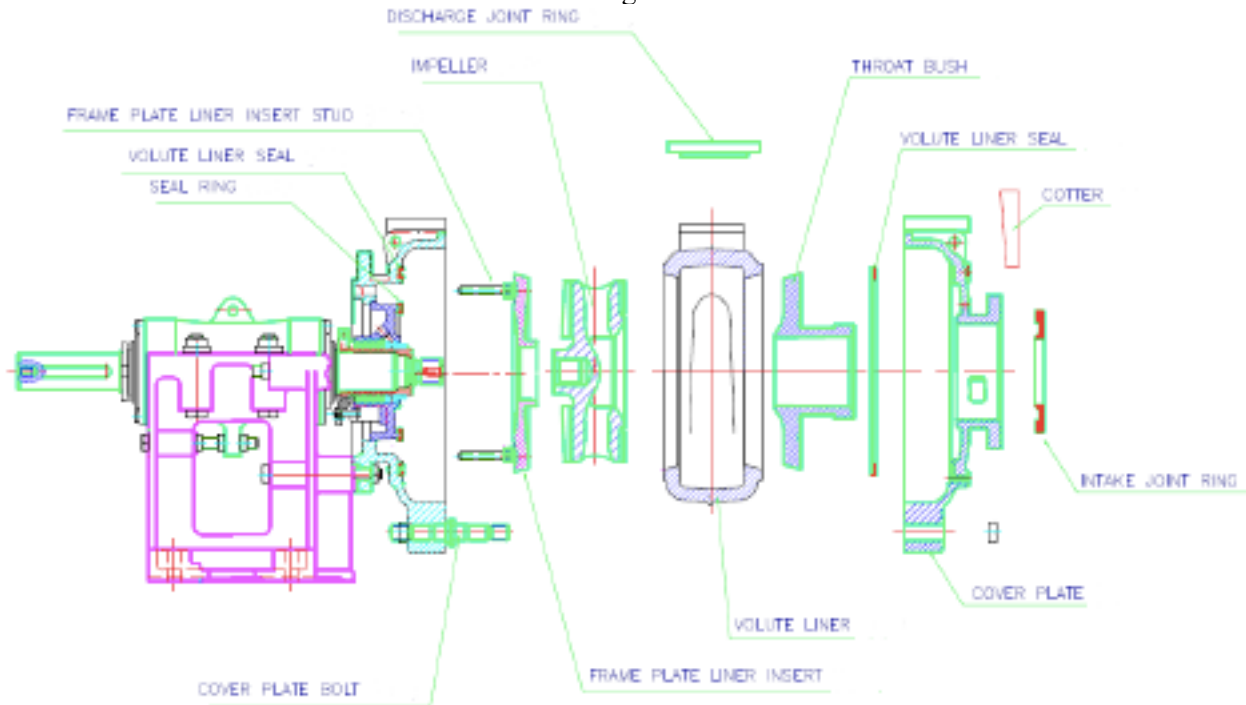


Figure 10-Assembling Three Piece Metal Liners

- I. Fit 'C'-section Seal Ring to the outside spigot of the Stuffing Box or Expeller Ring, preferably using compatible thick grease to hold Seal Ring during assembly.
- II. Fit the 'C'-section Volute Liner Seal into the groove of the Frame Plate, with the flat side in contact with the Frame Plate. Use compatible thick grease if necessary to hold in place.
- III. Fit Frame Plate Liner Insert;
 - a. Screw the Frame Plate Liner Insert Studs into the Frame Plate Liner Insert.
 - b. Suspend a Lifting Tube - special tool which can be made on site or provided by ICS - from a hoist (refer Fig 8). Stand the Frame Plate Liner Insert on its edge, being careful not to damage the mating face, then slide the Lifting Tube into the bore of the Frame Plate Liner Insert. Lift the Tube with Insert attached, and slide the tube over shaft thread. Rotate the Frame Plate Liner Insert until the Studs line up with the holes in the Frame Plate, then slide the Frame Plate Liner Insert back until it butts up against the Frame Plate. Ensure that the Seal Ring and Volute Liner Seal have not been displaced. Fit nuts to Studs, and leave loose. Then slide Lifting Tube out.
 - c. Ensure that Clamp Bolts on the right-hand side of the base looking from the wet end are sufficiently tight to hold Bearing Assembly horizontal, but not lock it. Restrain Shaft with Wrench, and fit Locating Nut on Shaft thread, as shown in Fig 8. The tapered face will locate the Frame Plate Liner Insert in its correct radial position. Fully tighten all Studs on Insert, and remove Locating Nut.
 - d. Move the Bearing Assembly back by adjusting nut on Adjusting Bolt to temporarily clamp Frame Plate Liner Insert in its correct position.
 - e. Fit Shaft Key in Shaft keyway, and fit a shaft locking device (Shaft Wench recommended).
 - f. Ensure the shaft thread is clean and free of burrs or other foreign objects that could impede screwing on the impeller.
 - g. Ensure that the O-Ring that will seal against the impeller hub is positioned in its locating groove.

- h. Clean the impeller thread and ensure there are no burrs or other foreign objects that could impede screwing the assembly onto the shaft. Apply anti-seize compound to thread. Lift the Impeller with hoist, supported on a rope, and using the shaft clamp turn the Shaft so that it engages into the impeller thread. Tighten the Impeller on Shaft, with bar between Impeller vanes, by pushing down the Shaft Wrench. Ensure that the various O-Rings on the Shaft are not damaged, and are covered by neighboring parts.
- IV. Fit Volute Liner to Frame Plate as described below.
 - a. Using the hoist, lift the Volute Liner with the Volute Lifting Beam. Place the Volute Liner over the Impeller, then move it back towards the Frame Plate Liner Insert until the tapered bore engages. Check that the Volute Frame Seal has remained properly in position.
 - b. Lugs are provided on the outside of the Volute Liner to assist holding it in position. Unscrew the nuts of the Cover Plate Bolts that are in the same rotation as the Volute liner lugs. Slide the Keeper Plates into the special slots of the Cover Plate Bolts, with the bend in the Keeper Plate bending away from the frame plate. Replace the nuts with locking washers.
- V. Fit Throatbush to Cover Plate.
 - a. Place the Cover Plate on suitable supports (at least 30mm high) on a flat surface, such as level concrete floor, suction flange down.
 - b. Fit the 'C'-Section Volute Liner Seal, into the groove of the Cover Plate, with its flat side against the cover plate. Use compatible rubber compound if necessary to hold the seal in place.
 - c. Lift the Throatbush using a hoist and lower it into the Cover Plate.
 - d. Insert the tapered Cotters through holes in the neck of the Cover Plate suction nozzle, and tap the cotters carefully and evenly. Leave the Cotters loose at this stage, but sufficiently engaged to safely lift the throat bush with Cover Plate.
- VI. Lift the Cover Plate assembly with hoist, place over Volute Liner, and rotate bolt holes so they line up with the Cover Plate Bolts. Slide the cover plate into position. Fit nuts to Cover Plate Bolts, and leave loose. Tighten Cover Plate bolts evenly to torque values not less than indicated in Section 5.3.4, ensuring that Cover Plate lugs fully butt against the Cover Plate Bolts, ensuring the lock washers are installed.
- VII. Tap Throatbush Cotters in securely.
- VIII. Complete the assembly of you Seal Assembly in the Stuffing Box or Expeller Ring.
- IX. The pump is now ready for fitting of Joint Rings and Impeller Adjustment.

5.3.4 COVER PLATE BOLT TIGHTENING SEQUENCE – Ref Fig 11

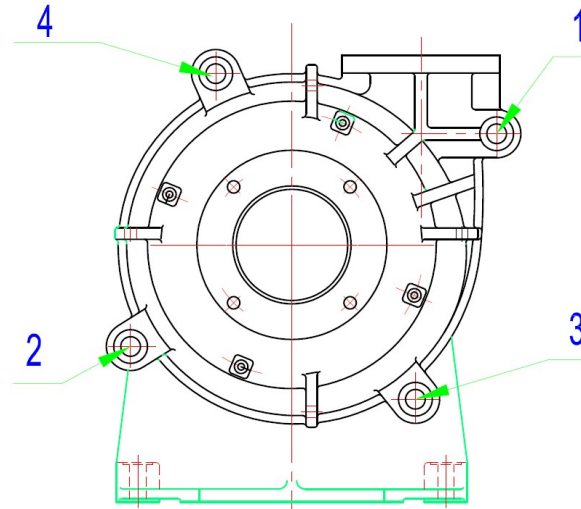


Figure 11.1 Tightening Sequence 6x4

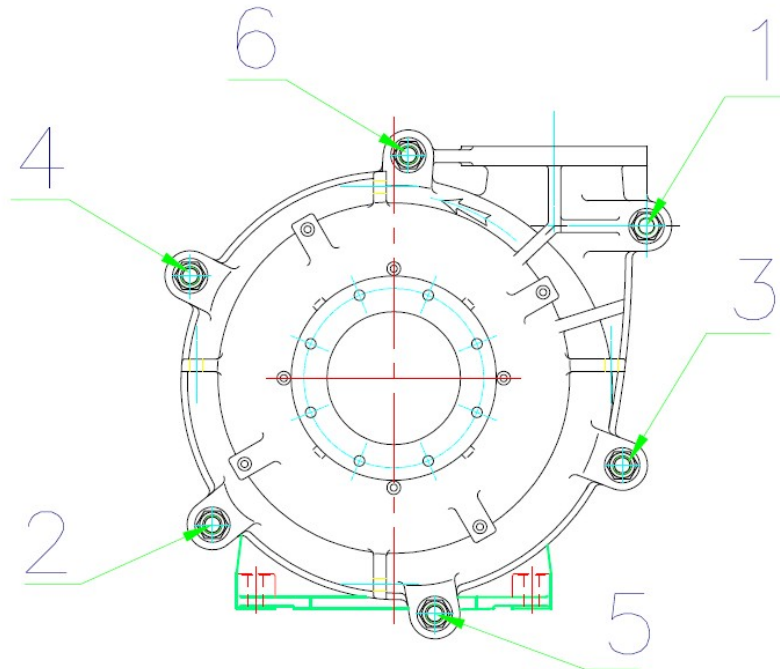


Figure 11.2 Tightening Sequence 8x6 and Larger

Bring the parts of the joint into full contact by tightening sufficient bolts to achieve a “snug-tight” condition. The “snug-tight” condition is 10% of the bolt’s full tension or yield tension. This is achieved to reasonable accuracy and repeatability using a standard podging wrench, or by a few impacts from an impact wrench, after initial slackness in the nut has been taken up.

Make corresponding permanent marks on the nut and the protruding thread of the bolt, from which subsequent rotation of the nut or bolt can be measured. Then using the appropriate turns in Figure 11, turn the bolts/nuts, according to the tightening sequence shown in Figure 11, if appropriate, to achieve 70% of yield tension in the bolts.

Bolt Size (mm)	Shank Length Between Load Faces Of Bolt and Nut (mm)	Final Torsion Displacement Between Bolt and Nut (turns)
M16 – M22	<120	0.5
	>120	0.75
M24 – M36	<160	0.5
	>160	0.75
M38 – M64	<200	0.5
	>200	0.75

5.3.5 MISCELLANEOUS FITTINGS - Ref Fig 12

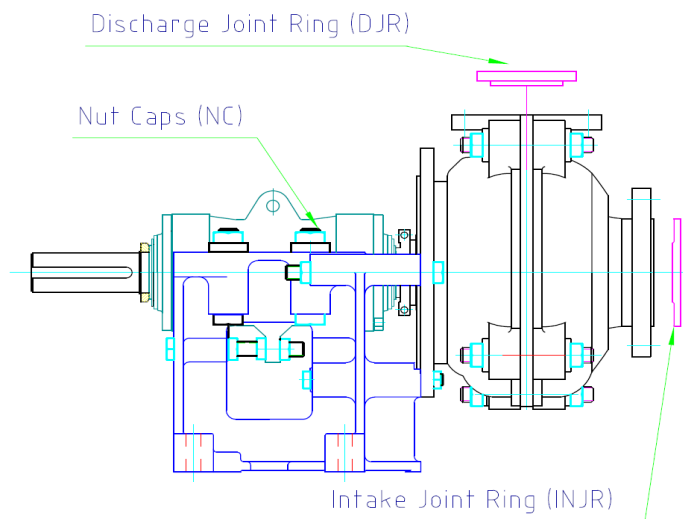
The pump assembly is now substantially complete, and requires only fitting of miscellaneous external components.

- (i) The Intake Joint Ring and Discharge Joint Ring are supplied loose with pumps requiring these items. Fit Intake Joint Ring and Discharge Joint Ring as shown in Fig 12, using contact cement adhesive to provide support during fitting of intake and discharge pipe work.

ENSURE PIPEWORK ID IS SUFFICIENT TO GIVE FULL SUPPORT TO THESE RINGS.

- (ii) Fit optional piping from Drip Tray in Base, to convey leakage from gland seal.

Figure 12- Miscellaneous Fittings



5.3.6 IMPELLER ADJUSTMENT - Ref Fig 13

ADJUST BEARING ASSEMBLY FORWARD
UNTIL IMPELLER TOUCHES LINER HERE
THEN BACK OFF ADJUSTING BOLT
 $\frac{1}{6}$ th OF A TURN AND TIGHTEN

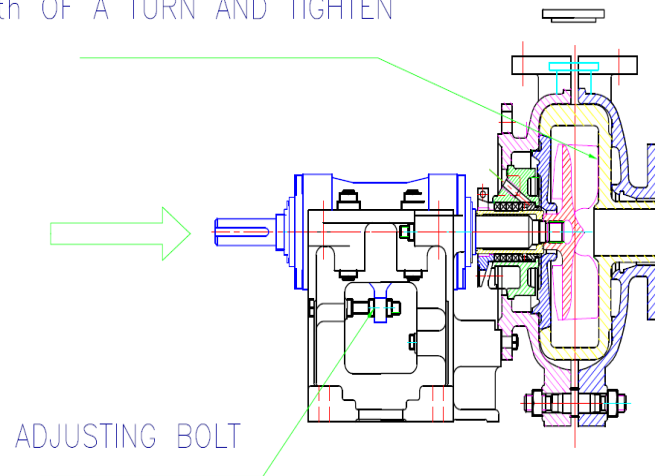


Figure 13 – Adjusting Bolt

Gland Packed or Mechanically Sealed Pumps:

Initial Adjustment:

For optimum hydraulic performance, pumps should be adjusted to operate with the Impeller having minimum axial clearance with the Front Casing.

Adjustment of Impeller front-end clearance is carried out as follows:

- (i) Rotate the Shaft clockwise (as viewed from the drive end) by hand, and move the Bearing Assembly forward (towards the pump suction) by adjusting the rear nut on the Adjusting Bolt until the Impeller rubs on the front Liner.
- (ii) Unscrew the rear nut by one sixth of a turn, and move the Bearing Assembly back by adjustment of the front nut on the Adjusting Screw until the lug on the Bearing Assembly contacts the rear nut. Fully tighten the front nut to secure the Bearing Assembly in position.
- (iii) Ensure that the Shaft can now rotate freely without contact of the Impeller with the front Liner. If contact occurs, repeat step (ii).

NOTE: After each Impeller adjustment is completed, the Bearing Housing Clamp Bolts must be tightened as described in Section 4.1.2.

Expeller Sealed Pumps:

If an expeller is fitted, the pump should be adjusted to operate with the Impeller having approximately equal axial clearance with the front and rear casing liners. This slightly reduces the hydraulic pump performance, but enables the expeller to seal the pump more efficiently (as the pump out vanes on the expeller side of the impeller work more efficiently when closer to the frame plate liner). If excessive leakage occurs from the Expeller Seal during pump operation, the Impeller should be adjusted rearwards to minimize axial clearance between the Impeller and rear casing liner. If seal leakage persists after Impeller adjustment, this indicates that the intake pressure is excessive for the Expeller fitted and the impeller requires modification. Leakage may be reduced by fitting a ‘Differential Impeller’, please ask ICS Wear Group representatives about this option.

Periodic Adjustment:

Periodic adjustment of Impeller clearance over its operating life is an important factor in maximizing wear life of both Impeller and front Liner. Regular Impeller adjustment has shown an increase in wear life of typically 20 percent compared with pumps subjected only to initial adjustment; however careful gland maintenance is required to prevent excessive leakage occurring when the impeller is adjusted.

The recommended procedure for periodic Impeller adjustment is as follows:

- (i) At initial pump assembly, adjust Impeller to “just clear” the front Liner.
- (ii) After 50 to 100 hours of pump operation, re-adjust Impeller front-end clearance.
- (iii) Re-adjust Impeller front-end clearance a further two or three times at regular intervals over its wear life. This may coincide with regular pump maintenance intervals, typically 500 hours.

NOTE: After each Impeller adjustment is completed, the Bearing Housing Clamp Bolts must be tightened as described in Section 4.1.2

6. DISMANTLING PUMP AND REMOVAL OF IMPELLER

The Procedure for dismantling the pump is generally the reverse of assembling the pump.



APPENDIX A

GLAND SEALING WATER FLOWRATE

Alternative Stuffing Box gland packing configurations may be used depending on the particular pump application, as shown in Fig 4,5 & 6, with each one having different gland sealing water flow rates.

Fig 5 shows the Full Flow Water Seal arrangement, with a metal Lantern Restrictor, being suitable for positive intake head and small suction lifts. This seal arrangement has maximum gland sealing water consumption.

The Low Flow Water Seal arrangement shown in Fig 6 has a close-fitting Lantern Restrictor, and is suitable for high suction lift applications. Gland sealing water flow rates for this sealing option are about thirty percent of that shown in Fig 5.

The Ultra-Low Flow Water Seal arrangement shown in Fig 4 has a ring of packing between the Lantern Ring and the pump casing interior to limit gland sealing water flow rate to a very small value, typically about one percent of that shown in Fig 5.

This type of sealing arrangement is used where only very small quantities of gland water addition to the pumped fluid can be tolerated, eg in aluminum process pumping applications.

Recommended values of gland sealing water flow rates to be provided are shown in Table C.

These flow rates include a provision for wear, which progressively reduces the velocity of sealing water issuing from Stuffing Box chamber into the pump casing, and the corresponding effectiveness of excluding solid particles from the packed gland.

TABLE A
GLAND SEALING WATER FLOW RATE

Pump Frame	Flow rate - L/min		
	Full Flow	Low Flow	Ultra Low Flow
D	60	6	0.5
E	70	7	1
F	90	9	1.5

NOTE - Refer to Fig 4,5 & 6 for alternative gland arrangements corresponding with FULL FLOW, LOW FLOW, and ULTRA LOW FLOW Stuffing Box configurations.