ASSEMBLY, OPERATING, MAINTENANCE AND TESTING INSTRUCTIONS

ICS Mill Master Slurry Pumps

MANUAL FOR:
METAL AND RUBBER PUMP SIZES:

- **ICSHDMMF1412 and Larger**

Issue Date: April 07, 2008
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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’) fittedin 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.

Table of Contents

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.

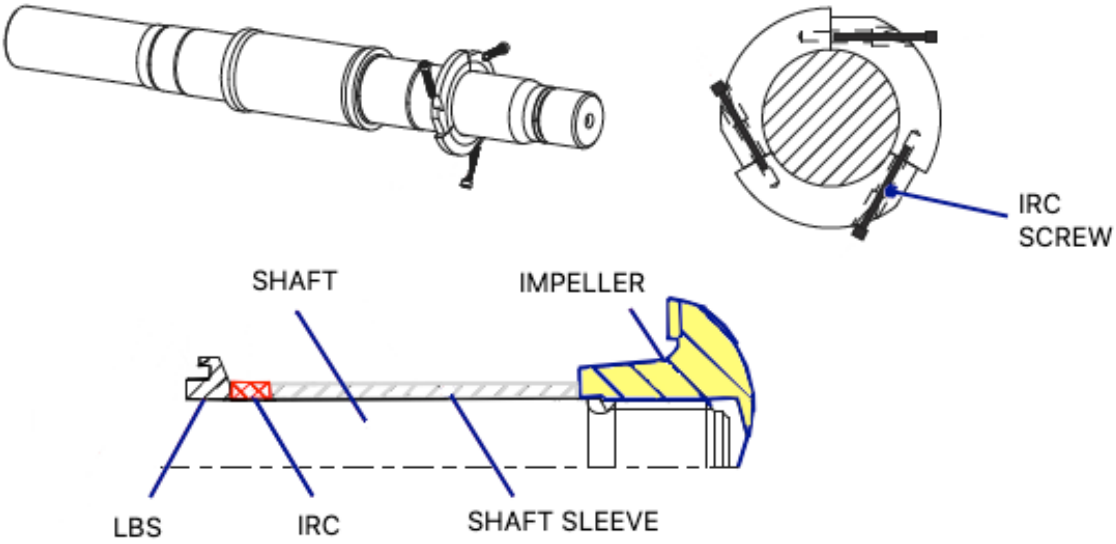
In all communication with ICS, or its distributors, and particularly when ordering spare parts, the correct component names and Part Numbers should be used at all times to avoid supply of incorrect parts.

3. BEARING ASSEMBLY – ASSEMBLY AND MAINTENANCE

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

4. FITTING IMPELLER RELEASE COLLAR – ASSEMBLY AND MAINTENANCE

The larger ICS Mill Master pumps incorporate an Impeller Release Collar (IRC) to help with impeller removal. The IRC fits against the labyrinth on the wet end of the bearing assembly. When wanting to remove the impeller unscrew the impeller release screws allowing the three pieces of the IRC to fall off the shaft. This action will relieve any force on the impeller thread, allowing for the impeller to be unscrewed.



4.1 Installation

Installing the impeller release collar is best done after the bearing assembly is complete and set on the base.

i. Clean the impeller release collar to insure there are no burs from machining, paying attention to the two sides facing the labyrinth and shaft sleeve.
ii. The pieces must be joined in particular sequence as determined by the markings
    a. A 3-piece collar will have, 1 of the joint faces is marked with a punch mark on either side.
    b. A 4-piece collar will have, 1 of the joint faces if marked with a “1” on either side. The other joint face will be marked with a “2”.
iii. Join the 3 or 4 pieces of the split impeller release collar with its socket-head screws, ensuring that Loctite is applied. Tighten the cap screws till tight and following the listed torque’s below.

Impeller Release Collar	IRC Screw	Recommended Torque (+/- 10%Nm)
FMIRC & SIRC	M10	20
TIRC	M12	50
UIRC	M20	165

iv. Before installing the impeller release collar to the shaft apply Never Seez to the internal diameter
v. Fit the shaft o-ring into the groove on the labyrinth, if applicable

vi. While sliding the impeller release collar on the shaft make sure the tapered face of the collar matches that of the labyrinth

vii. Fit a shaft O-ring into the groove on the impeller release collar, if applicable

Retaining Rings:
The retaining ring is added to impeller release collars at the request of the clients based on pumping conditions. The retaining ring is a solid ring that fits around the impeller release collar and holds all 3 pieces firmly on the shaft. Ask us today if your pump requires an Retaining Ring, ICSMMIRCRR

5. 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.

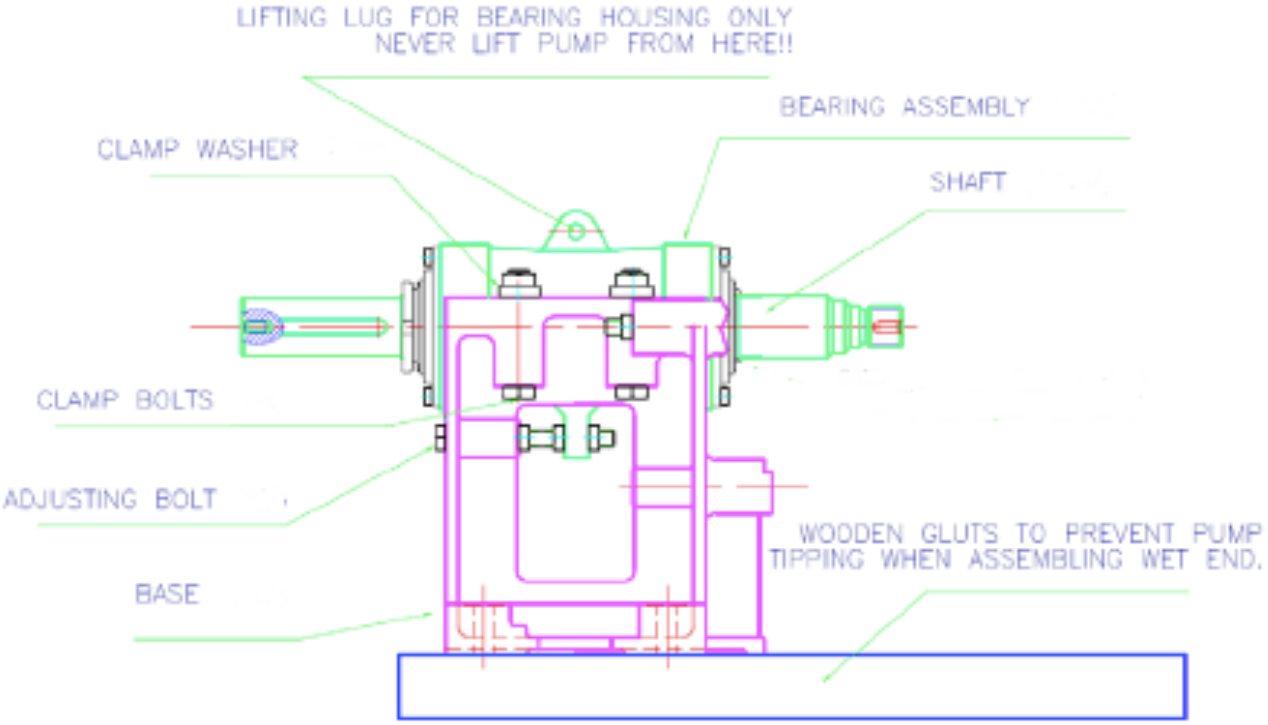
All parts dismantled during pump overhaul should be inspected to determine suitability for reuse, and identification of new parts should be checked.

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.

5.1 FRAME ASSEMBLY

5.1.1 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.

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

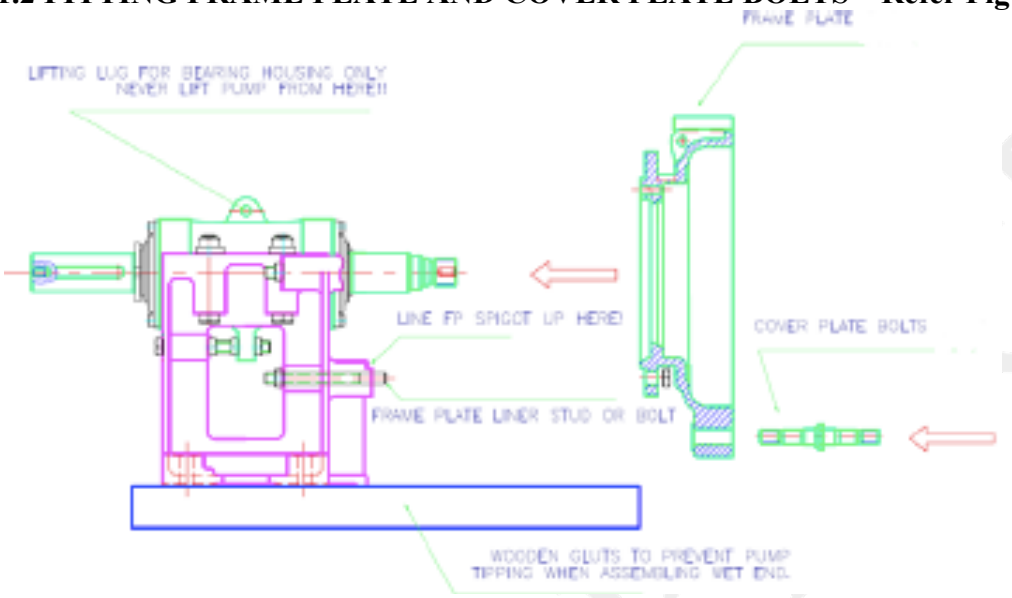


Figure 2-Assembling Frame Plate and Cover Plate Bolts

(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.

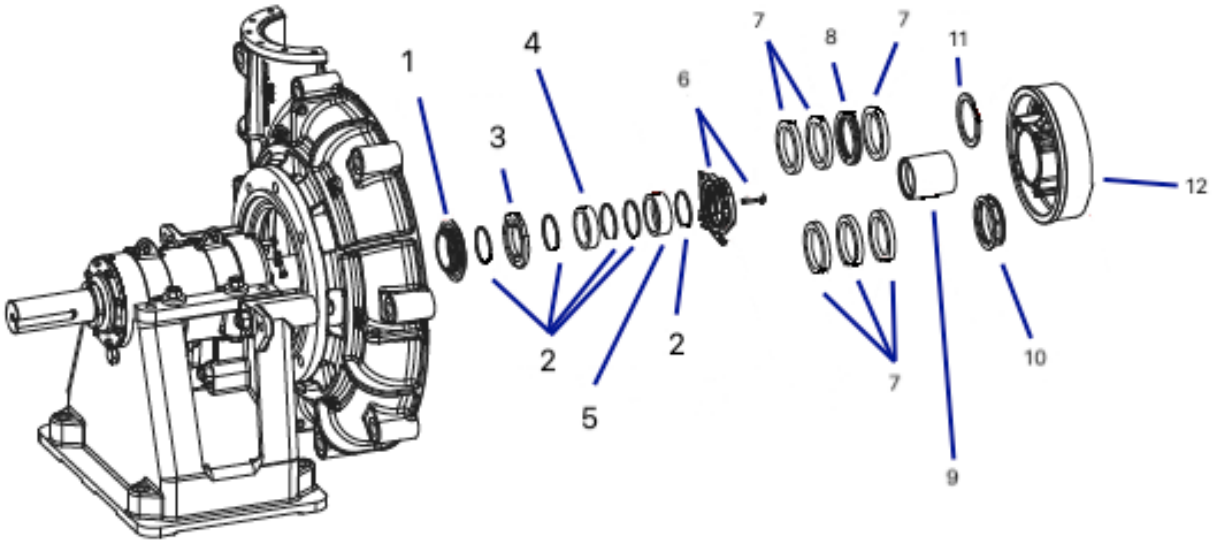
Cover Plate Bolt Torques

Pump	Recommended Torque (+/- 10%)
14/12	1200
16/14	1500
20/18	1500

5.2 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.

5.2.1 GLAND WATER SEAL ASSEMBLY - Refer Fig 3/4/5/6



1. MMLBS	2. Various O-Rings (Depending on size & model)
3. MMIRC	4. MMSTS-1
5. MMSTS	6. MMGS + MMGB
7. MMPAK	8. MMLTR
9. MMS/SLV or L/SLV	10. MMLTRR
11. MMNKR	12. MMSBOX

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 are not as effective as the 'full flow' standard version. Refer to figure 4, 5, and 6 for arrangement options.

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.

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 ingression under the packing.

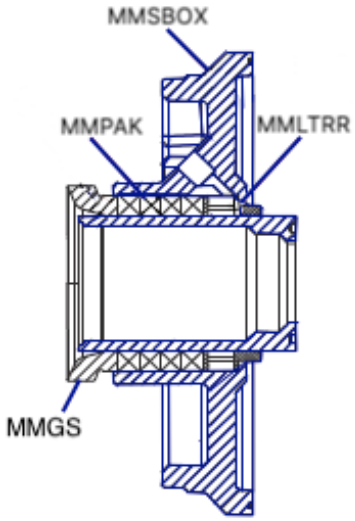


Figure 4 – Full Flow Arrangement

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.

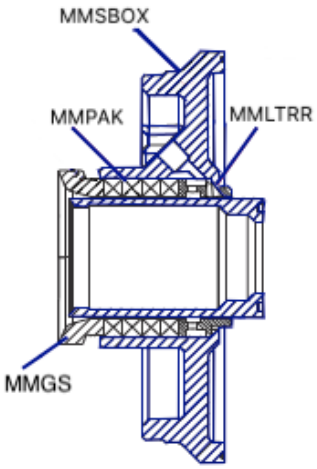


Figure 5 – Low Flow Arrangement

ULTRA LOW FLOW - Standard

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

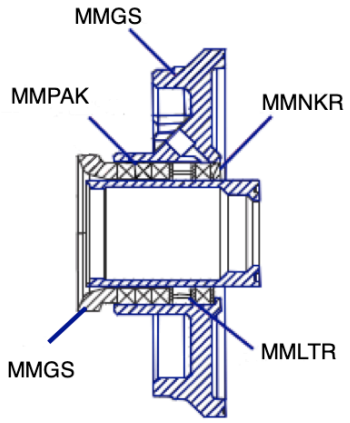


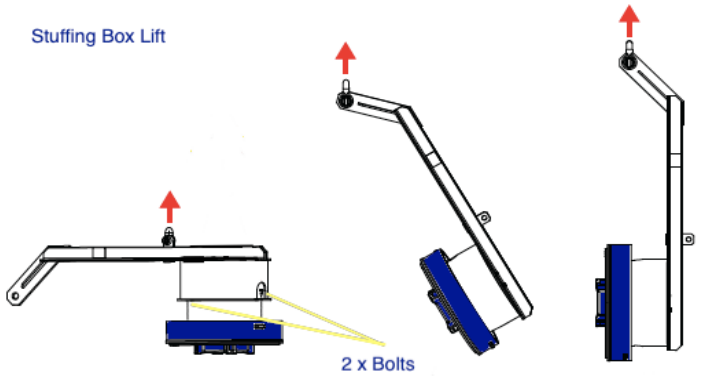
Figure 6- Ultra-Low Flow Arrangement

To assemble stuffing box seal arrangement:

I. Place stuffing box flat on surface, gland side up.
   1) **Full & low flow packed glands**
      i. Place lantern restrictor, small inner diameter down, into stuffing box chamber
      ii. Stand shaft sleeve on its end and slide through lantern restrictor
      iii. Fit first packing ring to fill the stuffing box
      iv. Fit packing rings, staggering joints and flattening each ring separately, until they almost completely fill the stuffing box chamber
   2) **Ultra-low flow packed glands**
      i. Place neck ring into stuffing box chamber
      ii. Place lip seal into stuffing box chamber, with flat side of lip seal facing upwards.
      iii. Stand shaft sleeve on its end with small id down, and slide through lip seal.
      iv. Fit lantern ring
      v. 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, figure 3 on page 12.
IV. Apply anti-seize to recess in frame plate where the stuffing box will sit to assist future removal
V. Fit stuffing box lifting to the stuffing box and lift with a crane and insert the stuffing box into the frame plate, tap into position with a soft mallet, you may use a clamp bracket to temporarily hold the stuffing box into the frame plate.



VI. Push the shaft sleeve back until all components on the shaft from the bearing spacer onwards are firmly in position.
VII. Check that all shaft o-rings are correctly positioned in grooves and have not been damaged during assembly. Fit remaining o-rings. To help hold the o-rings in position apply a liberal amount silicone-based grease.
VIII. Ensure the shaft thread is clean and free of burrs and sharp edges. Using gloves, apply anti-seize compound liberally to shaft thread.

Please see the table below for a list of each required item for your specific pump. The parts will be listed in order from bearing housing to impeller

Pump	Required Parts for the SBOX Arrangements
ICSMMF1210 ICSMMF1412	MMFSOR MMFMIRC MMFSOR MMFMS/SLV MMFMSTS MMGSOR MMGSTS MMGSOR
ICSMMG1210 ICSMMG1412	MMGSOR MMGS/SLV MMGSOR MMGSTS MMGSOR
ICSMMG1614	MMGSOR MMGL/SLV MMGSOR
ICSMMG2018	MMGSOR MMGIRC MMGSOR MMGML/SLV MMGSOR

ICSMMST108 ICSMMST1210 ICSMMST1412	MMSSOR MMSIRC MMSSOR MMSHL/SLV MMSSOR
ICSMMT108 ICSMMT1210 ICSMMT1412	MMTSOR MMTIRC MMTSOR MMTSTS-1 MMGSOR MMGL/SLV MMGSOR
ICSMMTU1614	MMTSOR MMTIRC MMTSOR MMTHL/SLV MMGSOR

5.2.2 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, where elastomer expeller rings need lip seals do to heat conduction.

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.

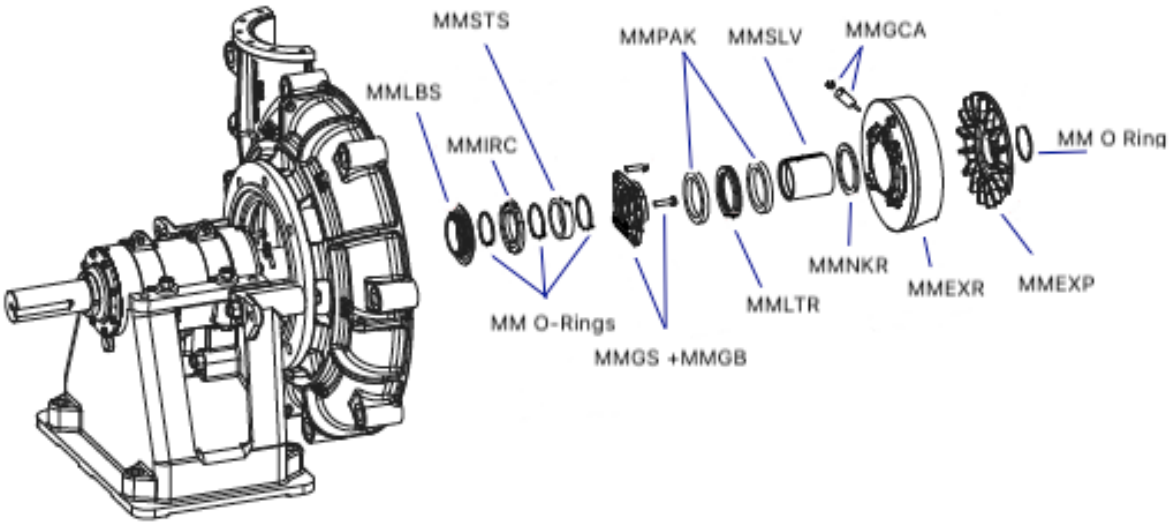
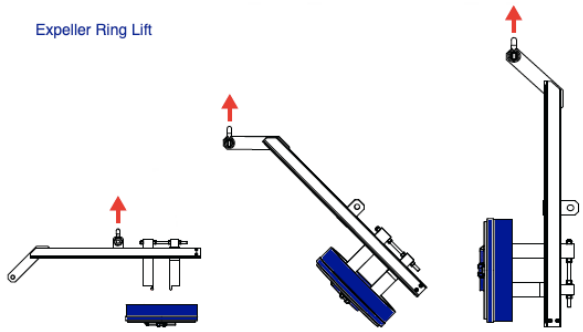


Figure7-Expeller Sealed Pump Assembly

Metal/Polyurethane Lined Expeller Ring - refer Fig 7



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

i. Assembly the required parts as per Fig. 7 and table below state depending on your pump size
ii. Place the lantern ring then neck ring over the sleeves and push up to the bearing housing
iii. Fit the expeller ring lifting tool to expeller ring on the opposite side of the lugs, ensuring the grease inlet is towards the top and lifting tool. Now lift the expeller ring with a crane or hoist and insert the expeller ring into the frame plate, tap in with a mallet. Greasing the frame plate will allow for easier removal at a later date
iv. Assembly of the gland parts are now conducted
   a. Push the neck ring to the bottom of the expeller ring
   b. Fit the first packing ring, use liberal amounts of grease and push as close to the neck ring as possible.
   c. Push the lantern ring against the first packing ring, again greasing the outer diameter of the lantern ring
   d. Assemble the remaining packing rings and alternating the location of joints, use grease and can tap lightly with a mallet
   e. Fit the gland halves over the shaft sleeve with gland seal bolts towards the expeller ring. Attach the gland bolts and fully tighten. Final adjustments are made once testing the pump
   f. Screw in grease cap adaptor and grease cup to expeller ring, fill cup with grease to allow lantern ring to be greased
v. The remaining O-rings and shaft spacers can be assembled now as per fig.7, they fit between the sleeve and expeller
vi. Lift the expeller with expeller lifting tool and insert into expeller ring
vii. Apply last o-ring into groove on the expeller
viii. Grease the shaft threads in preparation for the impeller

Pump	Required Parts for the Expeller Seal Arrangements
ICSMMST108	MMSSOR MMSIRC
ICSMMST1210	MMSSOR MMSHS/SLV
ICSMMST1412	MMSSOR MMSHEXP MMSSOR
ICSMMTU1614	MMTSOR MMTIRC MMTSOR MMTHS/SLV MMTSOR MMTHEXP MMGSOR

6. PUMP WET END ASSEMBLY

Pumps described in this manual, from the 14 x 12 and larger in size, these pumps are designed with a three-piece metal wet end assembly and four-piece rubber assembly. 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 – Ref Fig 8

ICS recommends the use of special tools to assist with the assembly and maintenance of the ICS Heavy Duty Mill Master 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.

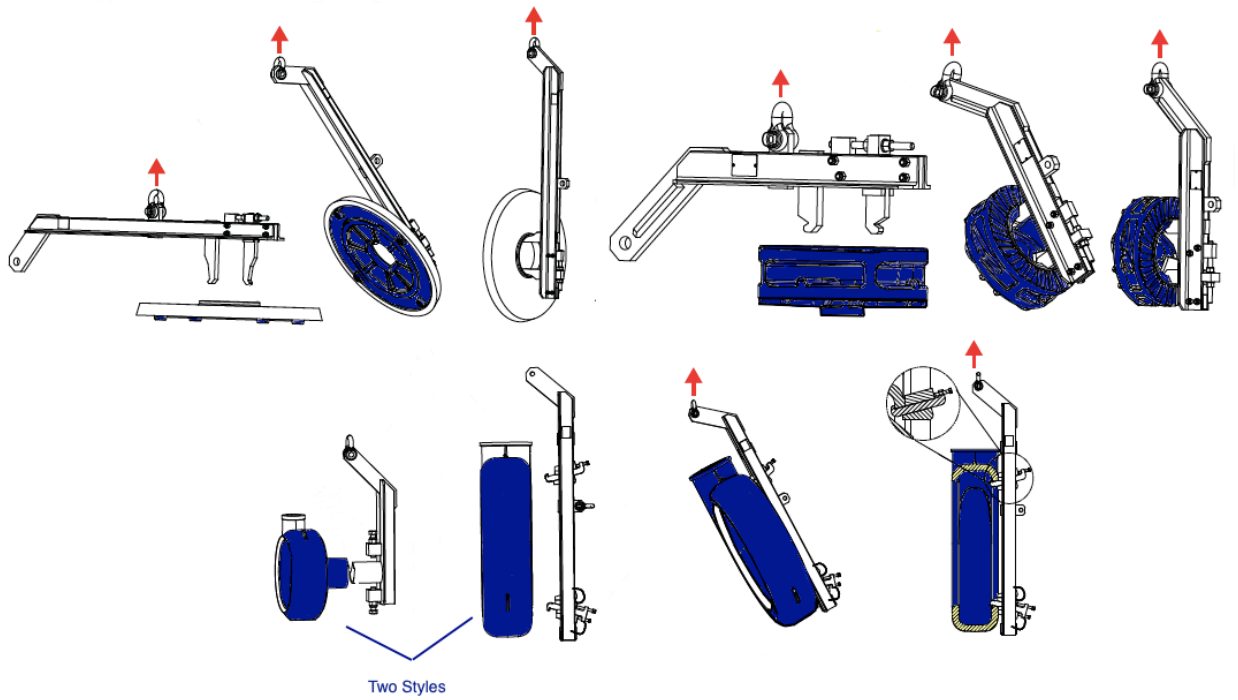


Figure 8-Wet End Assembly Tools

5.3.2 RUBBER LINERS - FOUR PIECE – Ref Fig 9

Fitting Frame Plate Liner, Frame Plate liner insert, Impeller, Throatbush, Cover Plate Liner, and Cover Plate Refer Fig.9

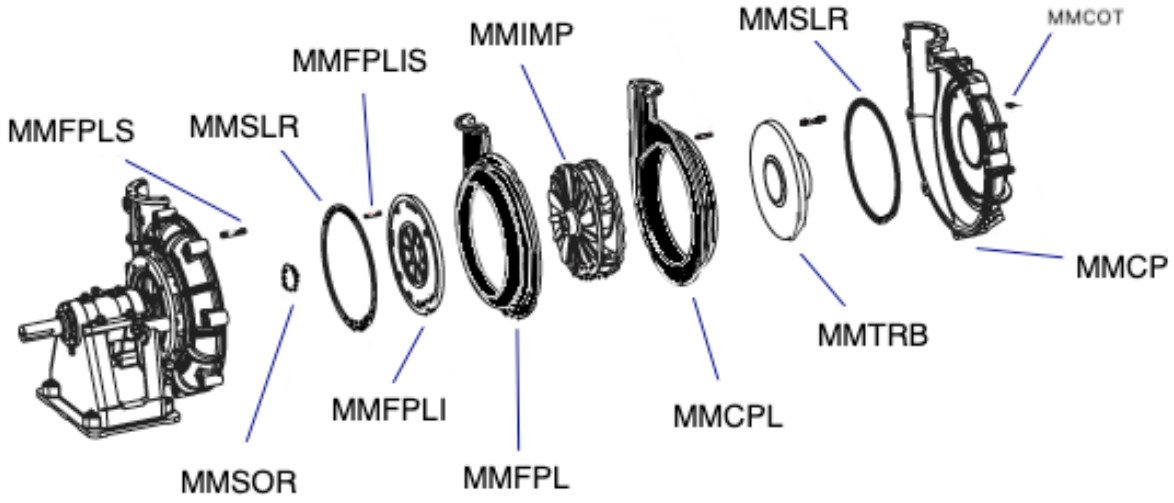


Figure 9-Assembling Four Piece Liners

I. Fit frame plate liner insert, frame plate liner and volute liner seal as follows:
   a. Place the volute liner seal into groove in the frame plate, use rubber cement to hold in place
   b. Fit and tighten frame plate liner insert studs to the tapped bosses in the frame plate liner insert. If the studs are not square to the face of the liner insert, screw a nut on the thread, and straighten it by tapping lightly with a hammer.
   c. Attach the frame plate liner insert lifting tool and 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 insert in its place. Remove lifting tool.
   d. Screw and tighten frame plate liner studs into the frame plate liner
   e. Lift the frame plate liner into place with the help of crane or hoist with a sling. Attach the nuts and remove the sling before completely tightening the nuts.

All ICS Heavy Duty Mill Master 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.

III. 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. Fit liner seal into the groove into the cover plate
   c. Fit Throatbush studs into the Throatbush, now using three-person lift pick up the Throatbush and flip it over and lower into the cover plate. Now screw on the nuts to hold Throatbush in place
   d. Screw the liner studs into the cover plate liner, lift and fit the liner into place in the cover plate, once studs and holes are lined up and through. Apply nuts and tighten.

IV. Fit the cover plate assembly to the frame plate, by lifting with lifting lugs or the lifting tool.
   a. 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.

V. Complete the assembly of your selected Seal Assembly.

VI. 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

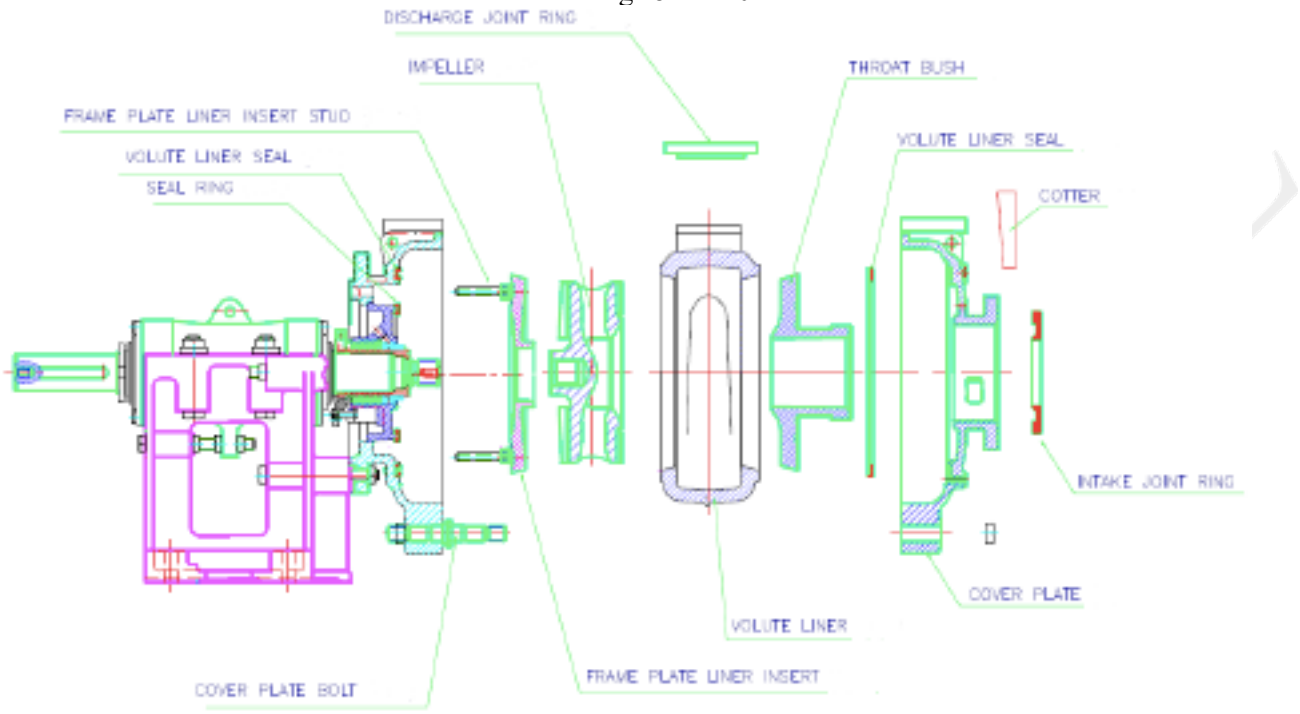


Figure 10-Assembling Three Piece Metal Liners

I. Insert the seal ring into the groove of the stuffing box or expeller ring, use a silicone-based grease to hold the seal o-ring in place
II. Fit the c-section style volute liner seal into the groove of the frame plate, with the flat side in contact with the frame plate. Use compatible thick grease or contact cement if necessary, to hold in place.
III. Fit frame plate liner insert and impeller;
    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.
i. Lift the impeller with hoist, supported by a choke sling, 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. Do not over tighten.
j. 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:
   a. Using a crane or 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.

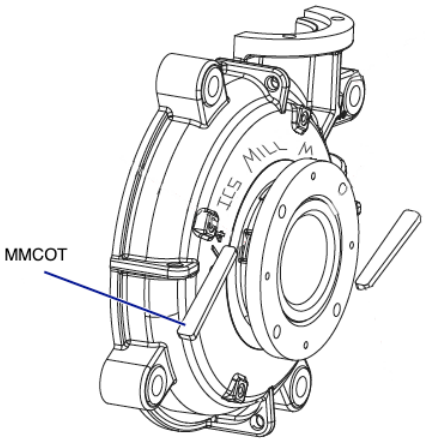
V. Fit throatbush to cover plate:
   a. Place the cover plate on suitable supports (at least 30mm high) on a flat surface, such as level concrete floor, suction flange down.
   b. Fit the c-section style volute liner seal, into the groove of the cover plate, with its flat side against the cover plate. Use compatible rubber cement if necessary, to hold the seal in place.
   c. Screw throatbush studs into the throatbush.
   d. Lift the throatbush using a hoist and lower it into the cover plate.
   e. 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 a crane or 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

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.

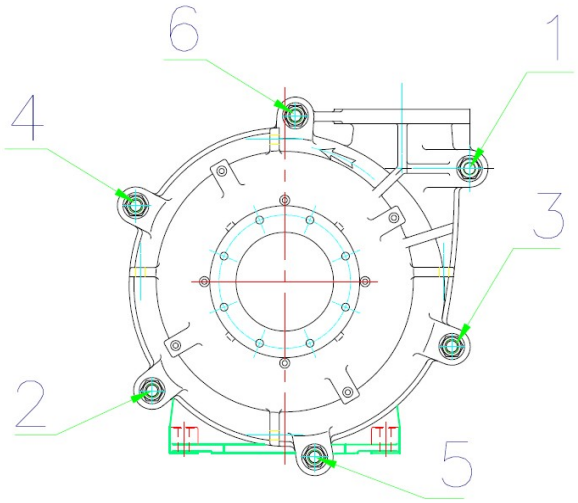


Figure 11 Tightening Sequence 8x6 and Larger

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 >120	0.5 0.75
M24 – M36	<160 >160	0.5 0.75
M38 – M64	<200 >200	0.5 0.75

Pump	Recommended Torque (+/- 10%)
14/12	1200
16/14	1500
20/18	1500

5.3.5 MISCELLANEOUS FITTINGS - Ref Fig 12

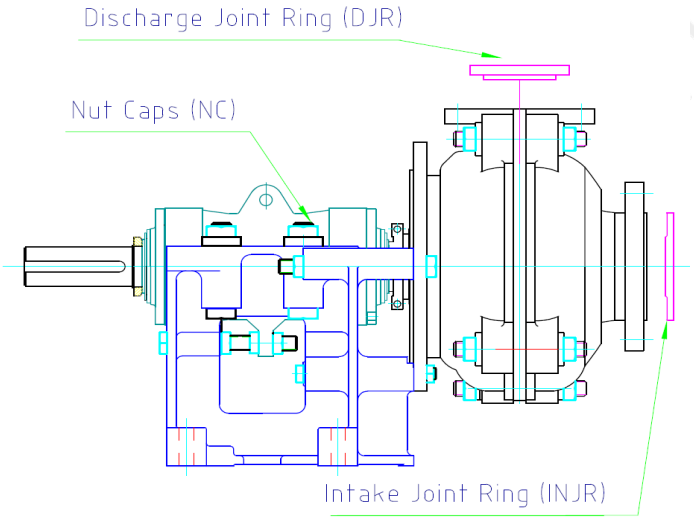
The pump assembly is now substantially complete, and requires only fitting of miscellaneous external components.

(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

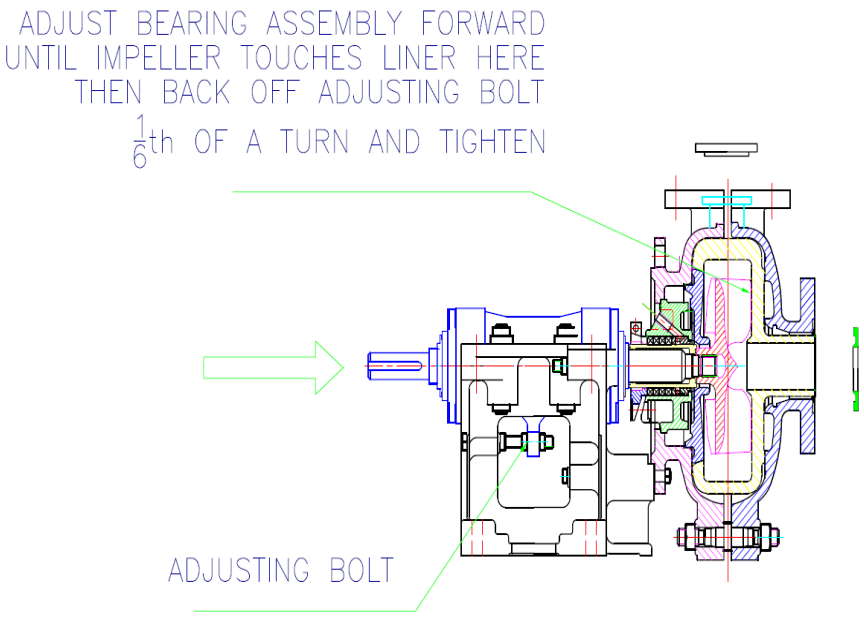


Figure 13 – Adjusting Bolt

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

7. 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/Sec		
	Full Flow	Low Flow	Ultra Low Flow
F	1.20	.26	.09
G	1.60	.40	.14
H	2.10	.60	.20

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