

ASSEMBLY, OPERATING, MAINTENANCE AND TESTING INSTRUCTIONS

ICS Mill Master Slurry Pumps



MANUAL FOR: METAL AND RUBBER PUMP SIZES:

- ICSHDMMB215
- ICSHDMMC32
- ICSHDMMC43
- ICSHDMMD43

Issue Date: April 2008 Revised November 2019



SAFETY

ICS Wear Group Inc. slurry pumps have been designed for safe and reliable operation. A pump is a pressurecontaining 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

<mark>NOTE</mark>

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 pumpsets 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 AUXHILIARY 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

SA	1FETY	2
1.	INTRODUCTION	7
2.	IDENTIFICATION OF PARTS	7
3.	BEARING ASSEMBLY – ASSEMBLY AND MAINTENANCE	7
4.	PUMP ASSEMBLY INSTRUCTIONS	8
	4.1 FRAME ASSEMBLY	8
	4.1.1 FITTING BEARING ASSEMBLY TO BASE – Ref Fig 1	8
	4.1.2 FITTING FRAME PLATE AND COVER PLATE BOLTS – Ref Fig 2	10
	4.2 SEAL ASSEMBLY	12
	4.2.1 GLAND SEAL ASSEMBLY - Ref Fig 4	12
	4.2.2 EXPELLER SEAL ASSEMBLY -Ref Fig 8	16
	4.2.3 MECHANICAL SEAL ASSEMBLY Error! Bookmark not de	efined.
	4.3 PUMP CASING ASSEMBLY	18
	4.3.1 TWO PIECE RUBBER LINERS-Ref Fig 9	18
	4.4 MISCELLANEOUS FITTINGS - Ref Fig 13	23
5.	IMPELLER ADJUSTMENT - Ref Fig 12	24
6.	DISMANTLING PUMP AND REMOVAL OF IMPELLER	25
Aŀ	PPENDIX A	26
Gl	LAND SEALING WATER FLOWRATE	26





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			
Expelle	r 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			



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	ММСОТ		
Cover Plate	ММСР		
Cover Plate Bolt	ММСРВ		
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	ММКР		
Retaining Ring *	MMRR		
Throat Bush	MMTRB		
Throat Bush Stud	MMTBS		
Volute	MMVOL		
Volute Liner Seal	MMVLS		

Stuffing Box Seal Kit:



Description	ICS Part Number	
Adjusting Screw	MMAB	
Base	MMBAS	
Clamp Bolt	MMCLB	
Clamp Washer	MMCLW	
Cotters	ММСОТ	
Cover Plate	ММСР	
Cover Plate Bolt	ММСРВ	
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	

Rubber Wet End Kit and Frame Assembly



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 waterflushed 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 SBOX forwarded by a specific letter to the size. A stuffing box to suit a 4x3 D frame pump would be MMDSBOX.

Refer to the Sectional Arrangement Drawing for the appropriate size of ICS 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.

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.



<u>4.1 FRAME ASSEMBLY</u> 4.1.1 FITTING BEARING ASSEMBLY TO BASE – Ref Fig 1

Figure 1 -Bearing Frame Assembly in Base.



- (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. 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 – Ref Fig 2

- (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 or Frame Plate Bolts, depending on pump size. Fit and fully tighten nuts. Depending on the pump size, the Frame Plate is bolted externally using studs. whilst 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.
- (iii) Ensure the cover plate bolts are clean, and remove any burrs. Cover threads with anti-seize. Fit Cover Plate Bolts Through Frame Plate lugs.



Screw on nuts, and tighten bolts in the manner and sequence below.



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 by the full effort of an average man (approximately 70kg) using a standard podger spanner, 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 3, turn the bolts/nuts, according to the tightening sequence shown in Figure 3, 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 Torsional 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



4.2 SEAL ASSEMBLY

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

4.2.1 STUFFING BOX SEAL ASSEMBLY - Ref Fig 4



Figure 4-Assemble Gland Seal

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 Figure 5, 6 and 7 for arrangement options.



FULL FLOW – STANDARD

Used for normal slurry applications with positive suction head or suction lifts to approx 2m.



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.





ULTRA LOW FLOW

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



To assemble stuffing box seal:

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

Full Flow & 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

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
- 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. For pumps to 4x3 in size the order is as follows:
 - Shaft O Ring
 - Shaft Sleeve
 - Impeller O Ring
 - 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.

- V. Check that all Shaft O-Rings are correctly positioned in grooves and have not been damaged during assembly.
- VI. Fit remaining O-Rings. Using heavy grease that is compatible with the O ring material will assist keeping the O ring in its correct location during assembly.
- VII. 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 -Ref Fig 8

ICS pumps are supplied with metal Expeller Ring's. On corrosive applications they can be lined with urethane. The gland of 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 you site specific requirements.



Figure 8- Assemble Expeller Sealed Pump

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.
- VI. Insert remaining Packing (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 soft mallet.
- IX. Locate Expeller Ring with the grease inlet connection at the top.
- X. Check that all Shaft O-Ring before the Sleeve is 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 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.





4.3 PUMP WET END ASSEMBLY

Pumps described in this manual, to the 4x3 in size, have two-piece metal, urethane or elastomer liners.

Liner configuration is independent of Bearing Assembly size. Metal and Elastomer 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.



4.3.1 TWO PIECE RUBBER LINERS-Ref Fig 9

Figure 9- Assembling Two Piece Liners

4.3.1.1 ASSEMBLE FRAME PLATE LINER

- I. Fit and tighten Frame Plate Liner Studs to tapped bosses in Frame Plate Liner. If Studs are not square to the face of the Liner, screw a nut on the thread, and straighten by tapping lightly with a hammer.
- II. Lift Liner in position, line up the Studs with holes in the Frame Plate, then push into Frame Plate. Fit Nuts to Studs, then finger tighten plus a quarter of a turn. These studs are only required to hold the part in place and prevent collapse if the pump is under vacuum. DO NOT OVER TIGHTEN.
- III. Place the impeller, suction down on a flat surface, check to ensure the thread is clean and free of burrs, using gloves liberally apply anti-seize compound to thread, and screw Impeller to Shaft.
- IV. Fit Shaft Key in Shaft keyway, and using a shaft locking device (Shaft Wrench recommended) turn the Impeller with a bar between vanes until it locks firmly to the shaft, but do not over tighten. Ensure that the various O-Rings on the Shaft are not damaged, and are in their correct O ring seat.



4.3.1.2 ASSEMBLE COVER PLATE LINER AND COVER PLATE

- I. Fit and tighten Studs to tapped bosses in Cover Plate Liners (4x3 and 3x2 ICS Mill Master pumps only). If Studs are not square to the face of the Liner, screw a nut on the thread, and straighten by tapping lightly with a hammer.
- II. Place two blocks of wood on the floor spaced so that they are secure but towards the edge of the suction inlet of the Cover Plate. Apply generous amounts of rubber lubricant or soap to the intake flange and intake surface of the Cover Plate.
- III. Place Cover Plate Liner, suction side down with corresponding holes lining up with the Cover Plate (3x2 and 4x3 pumps only), then push elastomer intake flange through the Cover Plate bore. Press down until the Cover Plate Liner firmly engages with the Cover Plate and the elastomer intake flange protrudes. This may require force and use of a small tire lever, or similar, between intake flange and Liner. Fit Nuts to Studs, and tighten finger tight plus quarter of a turn (max). These studs are only required to prevent collapse if the pump is under vacuum. DO NOT OVER TIGHTEN.
- IV. Lift Cover Plate, with Liner fitted, and align holes with Cover Plate Bolts assembled in the Frame Plate. Fit Nuts to Cover Plate Bolts, and tighten evenly, and in accordance with the tightening sequence indicated above in figure 3 and ensure that the Cover Plate lugs engage firmly with shoulders on Cover Plate Bolts.
- V. Fit gland flushing or grease connections.
- VI. The pump is now ready for fitting of Joint Rings (if provided for pump configuration) and Impeller adjustment.







4.3.2 TWO PIECE METAL LINERS - Fig 10

Figure 10- Assembling Two 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. The Volute Liner Seal comprises an O-ring for these small sizes, except the 4x3 which has a 'C'-section seal.
- III. Fit Frame Plate Liner Insert. The Frame Plate Liner Insert is clamped in position by engagement of its tapered periphery with a corresponding tapered surface on the Volute Liner. Radial alignment of the Insert is provided by engagement of a spigot on the Insert with a recess in the Frame Plate (1.5x1, 2x1.5, and 3x2 pumps). In the 4x3 ICS pump, radial alignment of the Insert is provided only by engagement with the Volute Liner and its Frame Plate Liner Insert studs are simply to assist holding it in place during assembly.



1.5x1, 2x1.5, and 3x2 ICS Mill Master Pumps only:

- a. Place IMPELLER (MMIMP), suction side down, on a flat surface. Check the impeller thread is clean of debris and has no burrs. Using gloves, liberally apply anti-seize compound to thread.
- b. Place FRAME PLATE LINER INSERT (MMFPLI) over the boss of the impeller thread, with vortex breaking ribs on the frame plate liner insert away from Impeller, and screw Impeller with Frame Plate Liner Insert to Shaft. Ensure that the various O rings are not displaced, and that the spigot on the back face of the Frame Plate Liner Insert engages with its corresponding bore in the Frame Plate.
- c. Fit SHAFT KEY (MMSFK) in Shaft (MMSFTM) key way, and using a shaft locking device (Shaft Wrench recommended) turn the Impeller with a bar between vanes until it locks firmly to the shaft, but do not over tighten. Ensure that the various O-Rings on the Shaft are not damaged, and are in their correct O ring seat.
- d. Ensure that HEX HEAD BOLTS on right hand side of the base looking from wet end are sufficiently tight to hold Bearing Assembly horizontal, but not lock it. Move Bearing Assembly back by adjusting nut on Adjusting Screw (MMAB) to temporarily clamp Frame Plate Liner Insert in its correct position.
- e. Fit O-Ring type MMVLS over periphery of Frame Plate Liner Insert, and adjacent Frame Plate.
 4x3 ICS Mill Master Pump only:
- **a.** Fit the 'C'-Section Volute Liner Seal into the groove in the Frame Plate, mounted flat face in, using contact cement adhesive if required.
- b. Screw FRAME PLATE LINER INSERT STUDS (MMFPLIS) into the frame plate liner, with vortex breaking ribs facing the frame plate. Line the studs up with the holes in the Frame Plate, push Frame Plate Liner Insert into place. Place washers and nuts on studs loosely to securely hold the Frame Plate Liner Insert. Note these studs are only required to facilitate assembly.
- **c.** Place IMPELLER (MMIMP) suction side down, on a flat surface. Check the impeller thread is clean of debris and has no burrs. Using gloves, liberally apply anti-seize compound to thread.
- d. Ensure that the various O rings are not displaced, and that the spigot on the back face of theFrame Plate Liner Insert engages with its corresponding bore in the Frame Plate.
- e. Fit SHAFT KEY (MMSFK) in Shaft (MMSFTM) keyway, and using a shaft locking device (Shaft Wrench recommended) turn the Impeller with a bar between vanes until it locks firmly



to the shaft, but do not over tighten. Ensure that the various O-Rings on the Shaft are not damaged, and are in their correct O ring seat.

f. Ensure that HEX HEAD BOLTS on right hand side of the base looking from wet end are sufficiently tight to hold Bearing Assembly horizontal, but not lock it. Move Bearing Assembly back by adjusting nut on Adjusting Screw (MMAB) to temporarily clamp Frame Plate Liner Insert in its correct position.

All sizes up to and including 4x3 Pumps.

IV. Fit VOLUTE LINER (MMVOL) – Gently place Volute Liner over Impeller so that it cannot drop down and cause injury. Move it back towards Frame Plate until the conical bore engages with the matching periphery of the Frame Plate Liner Insert. Ensure that the Volute Liner Seal ('O' Ring) has not been displaced. Fit a G clamp to temporarily clamp the Volute Liner discharge nozzle to the flange of the Frame Plate, as shown in Fig 11.

NOTE: THIS WILL PREVENT DROPPING THE VOLUTE AND CAUSING POTENTIAL

INJURY OR DAMAGE.

V. Lift COVER PLATE (MMCP) DISCHARGE JOINT RING (DJR) over Volute Liner and align bolt holes with Cover Plate 'G' CLAMP Bolts that were earlier fitted to VOLUTE LINER (VOL) Frame Plate. Fit nuts to Cover Plate Bolts, and leave loose. COVER PLATE (CP) Remove G clamp supporting Volute Liner, and tighten Cover Plate. VI. Complete the assembly of gland flush or greasing. The INTAKE JOINT RING (INJR) pump is now ready for fitting đ 🖿 🖚 of Joint Rings (refer Figure 12) and Impeller adjustment. COVER PLATE BOLT (CPB)

Figure 11-G Clamp Volute Liner to Frame Plate

ENSURE THAT THE VOLUTE LINER IS FIRMLY CLAMPED DURING ASSEMBLY TO PREVENT INJURY TO PERSONNEL.





Figure 11-Miscellaneous Fittings

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

- I. The INTAKE JOINT RING (MMINJR) and DISCHARGE JOINT RING (MMDJR) are supplied loose with pumps requiring these items. Fit Intake Joint Ring and Discharge Joint Ring as shown in Fig 15, using contact cement adhesive to provide support during fitting of intake and discharge pipework. ENSURE PIPEWORK ID IS SUFFICIENT TO GIVE FULL SUPPORT TO THESE RINGS.
- II. Fit optional piping from Drip Tray in BASE (MMBAS), to convey leakage from gland seal.
- III. Fit optional elastomer NUT COVERS to all external nuts to prevent fouling of threads with slurry.



5. IMPELLER ADJUSTMENT - Ref Fig 12

ADJUST BEARING ASSEMBLY FORWARD UNTIL IMPELLER TOUCHES LINER HERE THEN BACK OFF 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 liner.

- I. Adjustment of Impeller front-end clearance is carried out as follows:
- II. 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 (MMAB) until the Impeller rubs on the front Liner.
- III. 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.
- IV. 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.



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 minimise 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'.

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 patented ICS Slurry Seal is self adjusting and unlike gland packed and expeller sealed pumps is not impacted by impeller adjustment.

The recommended procedure for periodic Impeller adjustment is as follows:

- At initial pump assembly, adjust Impeller to "just clear" the front Liner, as described in (a).
- After 50 to 100 hours of pump operation, re-adjust Impeller front-end clearance.
- 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.

6. DISMANTLING PUMP AND REMOVAL OF IMPELLER

The procedure for dismantling the pump is generally the reverse of that described for pump assembly.





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, with each one having different gland sealing water flow rates. Fig 4(a) 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 4(b) 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 4(a).

The Ultra Low Flow Water Seal arrangement shown in Fig 4(c) 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 4(a). 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 alumina 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 FLOWRATE

	Flow rate -	L/min	
Pump Size	Full Flow	Low Flow	Ultra Low Flow
ICSHDPB151	18	6	0.3
ICSHDPB215	18	6	0.3
ICSHDPC32	36	11	0.45
ICSHDPC43	36	11	0.45
ICSHDPD43	54	15	0.75

NOTE - Refer to Fig 5,6,7 for alternative gland arrangements corresponding with FULL FLOW, LOW FLOW, and ULTRA LOW FLOW Stuffing Box configurations.