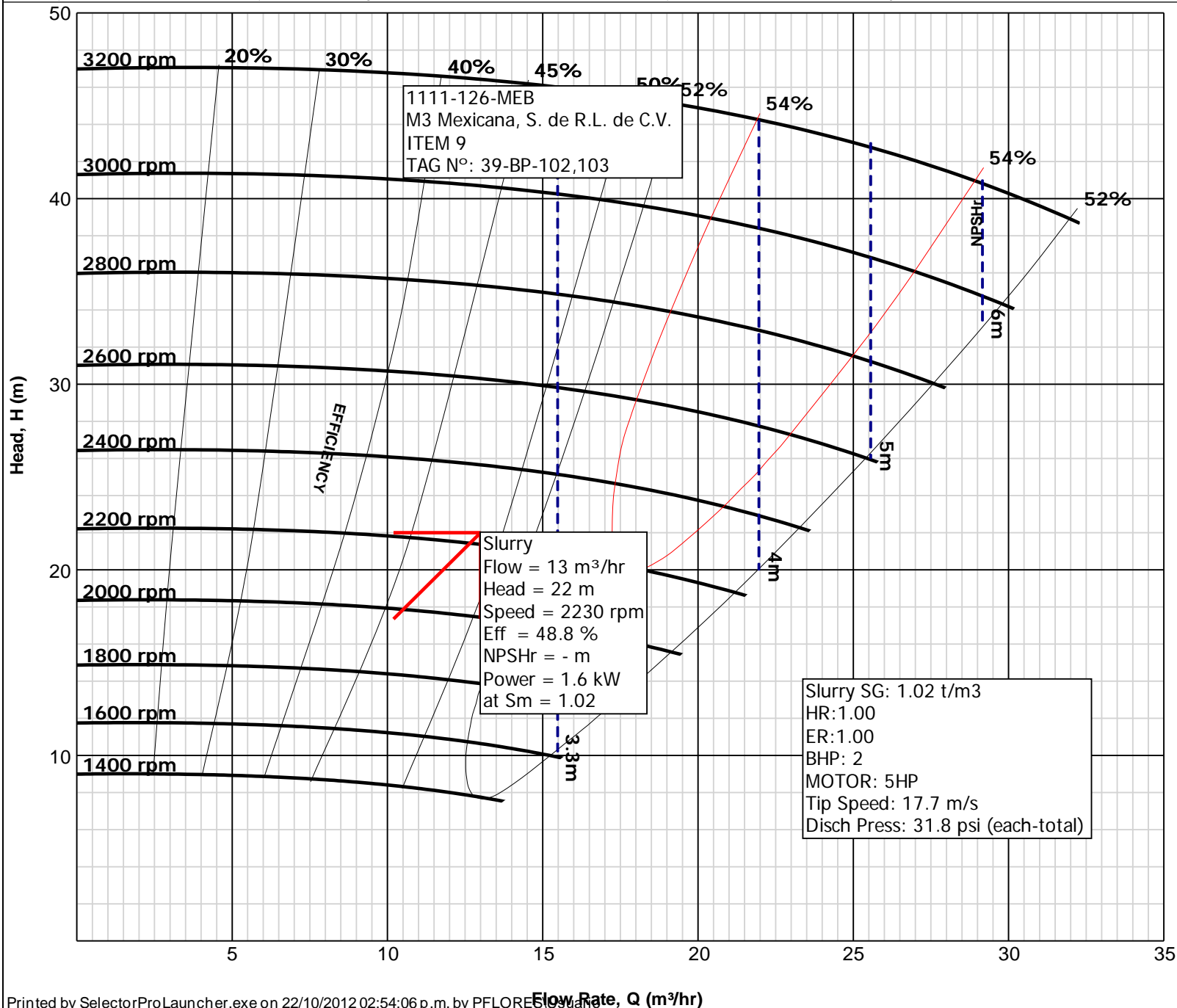


# Horizontal Pump 1.5/1 AH

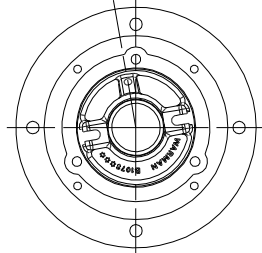
CURVE SHOWS APPROXIMATE PERFORMANCE FOR CLEAR WATER (International Test Standard ISO9906:1999 - Grade 2 unless otherwise specified). For media other than water, corrections must be made for density, viscosity and/or other effects of solids. WEIR MINERALS reserves the right to change pump performance and/or delete impellers without notice. Frame suitability must be checked for each duty and drive arrangement. Not all frame alternatives are necessarily available from each manufacturing centre.



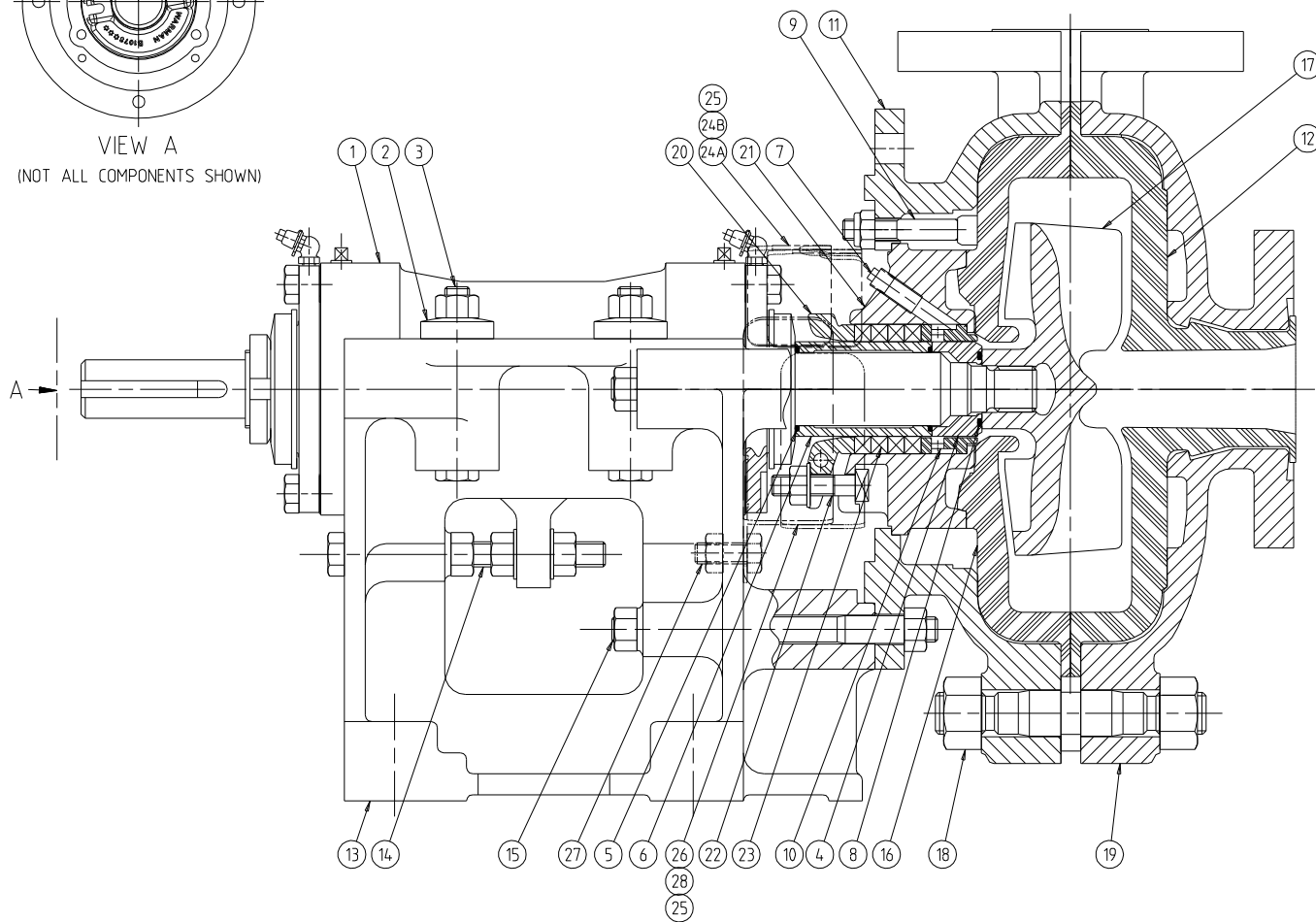
Pump	
Discharge	25mm
Suction	38mm
Impeller	
Vanes	5
Vane ø	152mm
Type	Open
Part No	Material
B1127	Metal
Frame (Rating - KW)	
B	15
Seal	
Gland Sealed Pump	
Liner (Norm Max r/min)	
Polymer	3200
Min Passage Size	
14mm	
Curve	
Revision	1
Revision Notes	EFFICIENCY UPDATED
Reference	TESTS: 45, 87B2, 87B3, 87B4
Issued	Feb 01
© 10/2012 Weir Minerals Australia All Rights Reserved	
TYPICAL PUMP PERFORMANCE CURVE	
<b>WPA151B01A/1</b>	



10° ROTATE STUFFING BOX AS SHOWN



VIEW A  
(NOT ALL COMPONENTS SHOWN)



ITEM	QTY	DESCRIPTION	PART No.
1	1	BEARING ASSEMBLY (REF DRG A104891)	B005M
2	4	CLAMP WASHER	B011E62
3	4	CLAMP BOLT - 1 NUT	B012ME69
4	1	SHAFT SPACER	B117C21
5	2	SHAFT SLEEVE O-RING	B109S50
6	1	SHAFT SLEEVE	B075C21
7	1	PIPE PLUG - .125" NPT MALE	UP2P1-E
8	1	IMPELLER O-RING	B217S50
9	3	FRAME PLATE LINER STUD - 1 NUT	B026ME62
10	1	LANTERN RESTRICTOR	B118C23
11	1	FRAME PLATE	B1032D21
12	1	COVER PLATE LINER	B1017-88249U38
13	1	BASE	B003MD21
14	1	ADJUSTING SCREW - 3 NUTS - 2 WASHERS	B001ME62
15	3	FRAME PLATE STUD - 2 NUTS	B039ME62
16	1	FRAME PLATE LINER	B1036M-88250U38
17	1	IMPELLER	B1127A05
18	4	COVER PLATE BOLT - 2 NUTS	B015ME65
19	1	COVER PLATE	B1013D21
20	1	GLAND (2 PIECE) INCLUDES (2) GLAND CLAMP BOLT - 1 NUT (M6H1-50SN)	B044C23
21	1	STUFFING BOX	B078D21
22	2	GLAND BOLT - 1 NUT - 1 WASHER	A045MC23
23	4	PACKING	B111Q21
24A	1	SEAL GUARD - TOP - UPPER	B485T389281AC23
24B	1	SEAL GUARD - TOP - LOWER	B485T389281BC23
25	4	SEAL GUARD BOLT - 1 WASHER	M6H2-16SW
26	1	SEAL GUARD - BOTTOM	B485B389105C23
27	2	SEAL GUARD BOLT - 1 NUT	M10H2-25SN
28	2	SEAL GUARD - SHROUD	B485B389282C23
TAG	1	TAG KIT - NOT SHOWN - (REF. DWG. A390069)	ZTAGKITBGM
TOOL	1	SHAFT WRENCH - NOT SHOWN	B306M65979

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The drawing must not be copied in whole or in part, in any form or by any means, and the information in it must not be disclosed to any person, or used for any purpose other than the specific purpose for which it has been provided, without the prior written consent of the Company.

5					
4					
3					
2					
1					
No.	DESCRIPTION	BY	DATE	CHK	
REVISIONS					

APP.	A.SCHMIT
CHECK	A.BROWN
DRN.	E.FIRKUS
DATE	MAY23,2012
SCALE	

PRODUCT :	<b>WARMAN®</b>
	<b>Centrifugal Slurry Pumps</b>
DESIGN CENTRE OF ORIGIN :	MADISON

TITLE :	1.5/1 BAH PUMP COMPONENTS DIAGRAM 015BAHUUCGM, 015BAHUUCGMG, 015BAHUUCGMSTM
DRAWING No.	A2-110-0-391996
REV.	0



08/03/2012

**Equipment Parts List**

**Model...** 015BAHUUCGM  
**Desc...** 1.5/1BAH /B1052/566/GLAND  
**Effective Date...** 08/03/2012  
**Drawing...** A391996\_00

Item No.	Part Number	Description	Drg No.	Matl	Qty	Unit Weight
	B015ME65	COVER PLATE BOLT W/2 NUTS	A14427_03	E65	4	1
	B039ME62	FRAME PLATE STUD W/2 NUTS MTRC	ESY7224_31MK1	E62	3	0.4
	B1013D21	COVER PLATE	BSY1722_10	D21	1	26
	B1032D21	FRAME PLATE	BSY1720_14	D21	1	30
	B001ME62	ADJUSTING BOLT W/3-NUTS&2-WSHR	ESY6245_16	E62	1	0.4
	B003MD21	BASE METRIC	BSY792_14	D21	1	45
	B005M	BEARING ASSEMBLY METRIC/-10	A104891_04		1	34
	A365P30	FS GREASE CAP PVC		P30	2	0.2
	B004MD21	BEARING HOUSING METRIC	CSY1399_17 &	D21	1	15
	B009	BEARING	ESY7478_55		2	1.5
	B024-10D81	END COVER	A119945_03	D81	2	1.6
	B025	FS SHIM SET	ESY2111_05		1	0.2
	B046G01	GREASE RETAINER	ESY2114_06	G01	2	0.4
	B061E62	LABYRINTH LOCKNUT	ESY2116_05	E62	1	0.2
	B062-10D81	LABYRINTH	A119920_03	D81	2	0.5
	B070ME05	SHAFT KEY METRIC	ESY7482_07MRK	E05	1	0.1
	B073ME05	SHAFT METRIC	CSY1409_10	E05	1	9
	B089-10S10	BRNG.SEAL RING CRW400500/V-50A	A119582_14	S10	2	0.1
	B108HG01	PISTON RING HOOK STYLE	A371734_04	G01	4	0.1
	M10H2-25V	FS B027M HX HD STSCRW 10X25MM	A15237_35		8	0
	NPL97	FS BEARING PROTECTION TAG	A376991_06		1	0
	UP2P1-E	FS PIPE PLUG 1/8"NPT(ZPL 10MS)	A18355_16		2	0.2
	ZFF250MS	FS GREASE ZERK 1/4"-28 THREAD			2	0.2
	B011E62	CLAMP WASHER	ESY3418_15	E62	4	0.1
	B012ME69	CLAMP BOLT W/NUT METRIC	ESY7483_42	E69	4	1
	B026ME62	LINER STUD METRIC W/M10H12-Z	ESY7486_41	E62	3	0.1
	B1017-88249U38	COVER PLATE LINER, URETHANE	A388249_01	U38	1	3.5
	B1036M-88250U38	FRAME PLATE LINER URETHANE	A388250_01	U38	1	3.2
	A045MC23	GLAND BOLT W/NUT&WASHER METRIC	ESY2345_25MRK	C23	2	0.1
	B044C23	GLAND SPLIT W/BOLTS&NUTS	CSY1405_11	C23	1	0.8
	B075C21	SHAFT SLEEVE	ESY2122_11MRK	C21	1	0.6
	B078D21	STUFFING BOX	CSY2301_08	D21	1	5.5
	B109S50	SHAFT O-RING	ESY7494_43	S50	2	0.2
	B111Q21	GLAND PACKING	ESY7495_30	Q21	4	0.2
	B117C21	SHAFT SPACER	ESY2131_09	C21	1	1
	B118C23	LANTERN RESTRICTOR	ESY2132_06	C23	1	0.4
	B217S50	O-RING IMPELLER SEAL	ESY7494_43	S50	1	0.2
	B485B389105C23	SEAL GUARD BOTTOM	A389105_02	C23	1	1
	B485B389282C23	SEAL GUARD SHROUD CENTR SEAL	A389282_02	C23	2	0.2
	B485T389281AC23	SEAL GUARD TOP CENTR SEAL	A389281_01	C23	1	0.2
	B485T389281BC23	SEAL GUARD TOP CENTR SEAL	A389281_01	C23	1	0.2
	M10H2-25SN	10X25MM HX ST SCRW&NT 316SS	A15237_35		2	0.1
	M6H2-16SW	6X16MM SET SCREW 316SS W.WASHR	A15237_35		4	0.2
	UP2P1-E	FS PIPE PLUG 1/8"NPT(ZPL 10MS)	A18355_16		1	0.2
	B1127A05	IMPELLER 5VOG	CSY2370_06 &	A05	1	8.8
	NPLW389656	FS GLAND CONNECTION TAG	A389656_00		1	0
	NPLW389659XS	DO NOT OPERATE W/O GUARDS X-SM	A389659_01		1	0
	NPLW81551	IMPORTANT TAG, INITIAL STARTUP	A381551_01		1	0.4
	NPL1989C22	FS NAMEPLATE WARMAN SERIAL #	A46-1989_06		1	0
	SB73C22	WARNING TAG HAZARDOUS	A380734_03		1	0
	SB80C22	BURSTING	A387920_02		1	0
	SB83C22	WARNING TAG FOR LIFTING PARTS	A387920_02		1	0
		FSWARNING TAG,IMPELLER REMOVAL	A387922_02	C22	1	0

\*\*\* Prices are FOB shipping point and are subject to change without notice \*\*\*

\*\*\* Prices are in US Dollars \*\*\*

# TECO Westinghouse

ISSUED <b>5/5/2006</b>	<b>PERFORMANCE DATA</b> <b>3-PHASE INDUCTION MOTOR</b>	ENCLOSURE <b>TEFC</b>
TYPE <b>AEHH8N</b>		CATALOG# <b>EP0054</b>

## NAMEPLATE INFORMATION

OUTPUT HP	KW	POLE	FRAME SIZE	VOLTAGE	HZ	RATED AMBIENT	INS. CLASS	NEMA DESIGN	TIME RATING	SERVICE FACTOR
<b>5</b>	<b>3.73</b>	<b>4</b>	<b>184T</b>	<b>230/460</b>	<b>60</b>	<b>40°C</b>	<b>F</b>	<b>B</b>	<b>CONT.</b>	<b>1.15</b>

## VARIABLE FREQUENCY DRIVE SERVICE

VARIABLE TORQUE				OHMS/PHASE EQUIVALENT WYE CIRCUIT (AT RATED OPERATING TEMPERATURE 25°C)				
HZ	HP	RPM	TORQUE (lb-ft)	R1	R2	X1	X2	X <sub>m</sub>
<b>3~60</b>	<b>0.0006~5</b>	<b>90~1800</b>	<b>0.035~15.04</b>	<b>1.2825</b>	<b>1.5103</b>	<b>4.2242</b>	<b>5.2599</b>	<b>115.57</b>

CONSTANT TORQUE				CONSTANT HORSEPOWER			
HZ	HP	RPM	TORQUE (lb-ft)	HZ	HP	RPM	TORQUE (lb-ft)
<b>6~60</b>	<b>.5~5</b>	<b>180~1800</b>	<b>15.04</b>	<b>60~120</b>	<b>5</b>	<b>1800~3600</b>	<b>15.04~7.520</b>

## TYPICAL PERFORMANCE

FULL LOAD RPM	EFFICIENCY				POWER FACTOR			SOUND PRESSURE LEVEL @ 3 FT Db(A)
	FULL LOAD		3/4 LOAD %	1/2 LOAD %	FULL LOAD %	3/4 LOAD %	1/2 LOAD %	
	MIN.%	NOM.%						
1745	87.5	89.5	88.5	88.5	85.5	81.5	71.5	54

CURRENTS									NEMA KVA CODE LETTER	SAFE STALL TIME IN SECONDS	
NO LOAD			FULL LOAD			LOCKED ROTOR				COLD	HOT
AT 208 VOLT	AT 230 VOLT	AT 460 VOLT	AT 208 VOLT	AT 230 VOLT	AT 460 VOLT	AT 208 VOLT	AT 230 VOLT	AT 460 VOLT			
4.90	4.44	2.22	13.5	12.24	6.12	101.0	92.0	46	J	35	25

TORQUE				INERTIA			ACCEL TIME (DOL)		ALLOWABLE STARTS PER HOUR	
FULL LOAD (lb-ft)	LOCKED ROTOR %FLT	PULL UP %FLT	BREAK DOWN %FLT	ROTOR WR <sup>2</sup> (lb-ft <sup>2</sup> )	NEMA LOAD WK <sup>2</sup> (lb-ft <sup>2</sup> )	MAX ALLOWABLE WK <sup>2</sup> (lb-ft <sup>2</sup> )	NEMA LOAD WK <sup>2</sup> Sec	MAX ALLOWABLE WR <sup>2</sup> Sec	COLD	HOT
<b>15.04</b>	<b>185</b>	<b>140</b>	<b>285</b>	<b>0.422</b>	<b>27</b>	<b>88</b>	<b>4.68</b>	<b>15.08</b>	<b>2</b>	<b>1</b>

APPROVED:	<b>M. PRATER</b>	DRAWING NO.	<b>31057EP0054</b>	REVISION:	<b>0</b>
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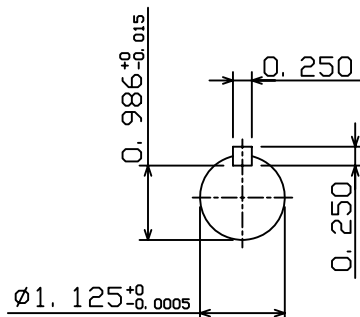
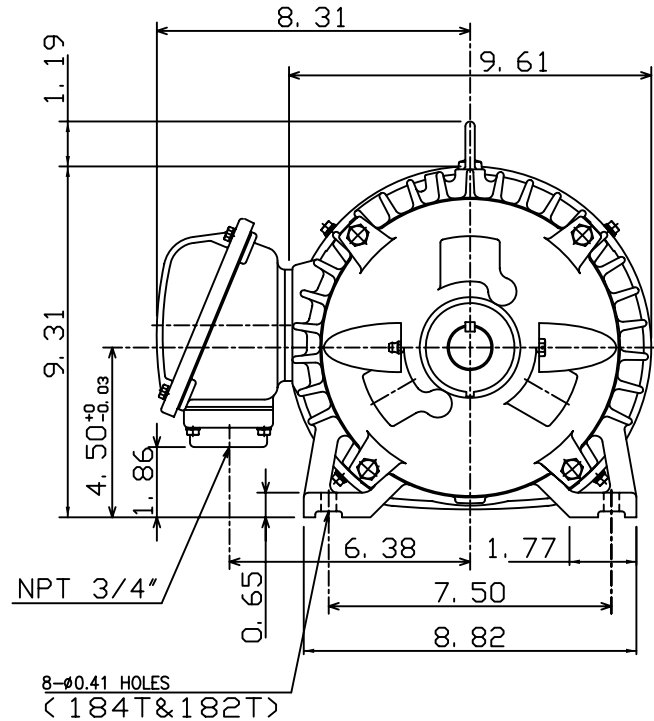
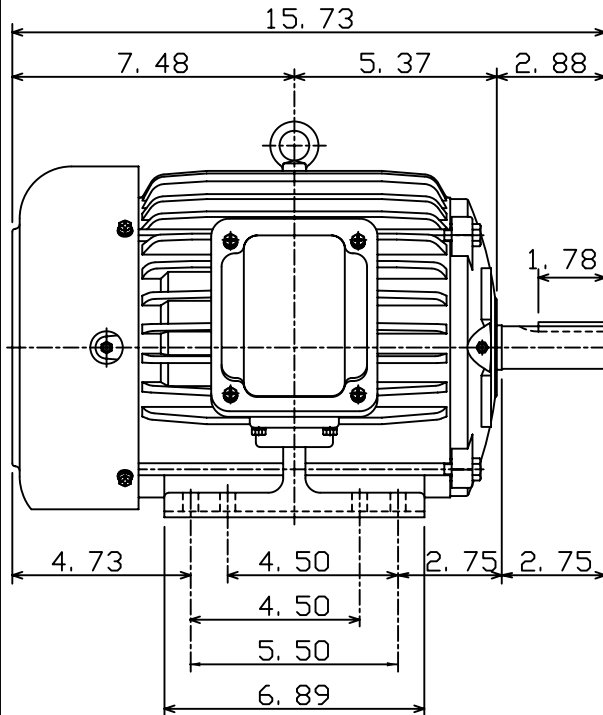
DATE  
Sept. 8, 2005  
CAT. #: EP0054

# OUTLINE DIMENSIONS 3-PHASE INDUCTION MOTOR

MOTOR TYPE:  
AEHH8N  
FRAME NO. 184T

Pole	HP	kW	Hz	VOLT	Syn. Speed r/min(rpm)
4	5	3.7	60	230/460	1800
Ins	Rating	Dimension in	Approx Weight	Bearings	
F	CONT.	inch	117 lbs.	DE: 6306ZZ	NDE: 6306ZZ

Totally Enclosed Fan-Cooled Type, Squirrel-Cage Rotor.



DWN.	C. S. LO	12-22-04
CHKD.	C. S. LO	12-27-04
APPD.	M. C. TSAI	12-27-04

TEC   Westinghouse

DWG NO.  
31057H354030

# WARMAN INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

AH, AHP, AHU, HH, L, M, XU SLURRY PUMPS

THIS MANUAL IS DESIGNED TO BE WEIR SLURRY GROUP INC.'S STANDARD MANUAL FOR ALL WARMAN HORIZONTAL PUMPS. IF SPECIALIZED OR JOB SPECIFIC MANUALS FOR PURCHASED PUMPS ARE REQUIRED, THEY MAY BE SUPPLIED AT ADDITIONAL COST.

The information in this manual has been checked and is believed to be accurate and reliable. HOWEVER, NO RESPONSIBILITY IS ASSUMED BY WEIR SLURRY GROUP INC. FOR ITS USE OR FOR ANY INACCURACIES. Specifications are subject to change without notice. WEIR SLURRY GROUP INC. DOES NOT ASSUME ANY LIABILITY ARISING OUT OF USE OR OTHER APPLICATION OF ANY PRODUCT DESCRIBED HEREIN. This document does not convey any license under Weir Slurry Group Inc.'s patents or the rights of others.

**REVISION HISTORY**

<b>Revision Level</b>	<b>Principal Changes</b>	<b>Date of Publication</b>
A	First Publication	July 1990
B	General Revision	September 1991
C	General Revision	October 1994
D	General Revision	May 1997
E	Identity Update	September 2000
F	Added XU	June 2004
G	Updated format	December 2007
H	General Revision	November 2008



# Table of Contents

<b>SECTION 1</b>	<b>PAGE</b>	<b>SECTION 4 –</b>	<b>FRAME PAGE</b>
PREFACE .....	1	FRAME ASSEMBLY INSTRUCTIONS .....	1
SAFETY INFORMATION .....	2	FITTING BEARING ASSEMBLY TO BASE .....	1
PUMP IDENTIFICATION CODES .....	3	FITTING FRAME PLATE AND COVER	
OPERATING INFORMATION .....	4	PLATE BOLTS .....	2
INSTALLATION OF PUMP UNITS ON BASE PLATES ..	4		
FOUNDATIONS .....	4	<b>SECTION 5 – PUMP SEAL ASSEMBLY</b>	
SHAFT ALIGNMENT .....	4	GLAND ASSEMBLY .....	1
PIPING .....	4	RELEASE COLLAR .....	9
SUCTION CONDITIONS .....	5	INSTALLATION .....	9
PRESSURE CONDITIONS .....	5	REMOVAL .....	9
START-UP OF PUMP .....	6	CENTRIFUGAL SEAL ASSEMBLY .....	11
SHUTTING DOWN PROCEDURE .....	8	METAL EXPELLER RING .....	11
MAINTENANCE .....	9	RESTRICTED FLOW CENTRIFUGAL SEAL .....	14
IMPELLER ADJUSTMENT .....	9	RUBBER EXPELLER RING .....	21
BEARING LUBRICATION .....	9	MECHANICAL SEAL .....	23
GREASE LUBRICANTS .....	10		
BEARING SEALS .....	11	<b>SECTION 6 – PUMP LINER ASSEMBLY</b>	
SHAFT SEAL CARE .....	12	GENERAL NOTES .....	1
GREASE LUBRICATION OF CENTRIFUGALLY		LINER CONFIGURATION CHART .....	1
SEALED IMPELLER RINGS .....	12	TORQUE TABLE FOR COVER PLATE BOLTS .....	2
SPARE PARTS .....	13	PUMP ASSEMBLY, METAL LINERS – 2 PARTS .....	3
WEARING PARTS REPLACEMENT .....	13	PUMP ASSEMBLY, METAL LINERS – 3 PARTS .....	6
STOCK LEVELS .....	13	PUMP ASSEMBLY, ELASTOMER LINERS – 2 PARTS .....	9
PART NUMBERS .....	13	PUMP ASSEMBLY, ELASTOMER LINERS – 3 PARTS	
WARMAN PATENTS .....	14	WITH INTEGRAL VOLUTE LINER SEALS .....	11
PUMP STORAGE PROCEDURES .....	15	PUMP ASSEMBLY, ELASTOMER LINERS – 3 PARTS	
		WITH SEPARATE VOLUTE LINER SEALS .....	13
<b>SECTION 2</b>		PUMP ASSEMBLY, ELASTOMER LINERS – 4 PARTS	
BEARING ASSEMBLY INSTRUCTIONS .....	1	WITH INTEGRAL VOLUTE LINER SEALS .....	15
SIZES ASC, B, C, CAM, D, DAM, DSC,		PUMP ASSEMBLY, ELASTOMER LINERS – 4 PARTS	
E, EAM, ESC, F, FAM, FG, G, GAM AND GH .....	1	WITH SEPARATE VOLUTE LINER SEALS .....	17
GENERAL NOTES .....	1	PUMP ASSEMBLY, UNLINED PUMPS .....	19
ROLLER BEARING CLEANLINESS .....	1	IMPELLER CLEARANCE ADJUSTMENT .....	28
BEARING ASSEMBLY .....	2	PUMP DISMANTLING .....	29
FITTING GREASE RETAINERS AND BEARING		PUMP ASSEMBLY TOOLS .....	30
CONES .....	2		
FITTING IMPELLER END BEARING CUP TO		<b>SECTION 7</b>	
HOUSING .....	2	FAULT FINDING CHART .....	1
FITTING SHAFT TO BEARING HOUSING .....	3		
GAP MEASUREMENT .....	3		
ADJUSTMENT OF BEARING .....	4		
END PLAY MEASUREMENT .....	5		
FITTING LABYRINTHS, V-RINGS, PISTON RINGS,			
AND LOCKNUT .....	6		
BEARING SEAL ASSEMBLY – TYPE -10			
STARTING JUNE 1, 1990 .....	6		
BEARING SEAL ASSEMBLY – UNITS MANUFACTURED			
PRIOR TO JUNE 1, 1990 .....	7		
<b>SECTION 3</b>			
BEARING ASSEMBLY INSTRUCTIONS .....	1		
SIZES N, P, Q, R, RS, S, SH, T, TH, U,			
CC, DD, EE, FF, AND GG .....	1		
GENERAL NOTES .....	1		
ROLLER BEARING CLEANLINESS .....	1		
OIL LUBRICATED OR FILLED BEARING ASSEMBLIES ..	1		
BEARING ASSEMBLY .....	2		
FITTING OF DRIVE END INNER RING BEARING			
AND IMPELLER END BEARING .....	2		
FITTING OF DRIVE END OUTER BEARING TO			
HOUSING .....	3		
FITTING SHAFT TO BEARING HOUSING .....	3		
FITTING LABYRINTHS, PISTON RINGS, AND			
LOCKING SCREWS .....	4		
CHECKING BEARING FITTED END PLAY .....	4		

# WARMAN SERIES 'A' SLURRY PUMP

## ASSEMBLY AND MAINTENANCE INSTRUCTIONS

### PREFACE

To insure long, trouble-free service from your Warman pump, the instructions contained in this manual must be followed carefully. When ordering spare parts, it is advisable to provide the pump model, serial number, part description, and complete part number.

We reserve the right to make changes or improvements in the design or construction.

For information not covered in this manual, contact:

Customer Service Department  
Weir Minerals  
2701 S. Stoughton Road  
P.O. Box 7610  
Madison, Wisconsin 53707-7610

Telephone: (608) 221-2261  
Fax: (608) 221-5809

### PUMP ASSEMBLY

The following pages contain step-by-step illustrated instructions for complete and correct assembly and maintenance of type AH, AHP, AHU, HH, L, M, and XU Warman pumps.

### NOTE

Pumps fitted with mechanical shaft seals require special attention to seal removal and installation. Refer to the seal manufacturer's supplementary instructions.

This manual does not contain instructions specific to the Warman "HS" High Seal centrifugal shaft seal. For these, refer to manual supplement "M8", along with the specific pump component diagram.

The manual is written in an assembly format. We recommend reading through applicable sections prior to beginning disassembly to ensure safety concerns are addressed before handling parts.

# SAFETY INFORMATION

## **!! WARNING !!**

**WEIR SLURRY INC. WOULD LIKE TO BRING TO YOUR ATTENTION THE POTENTIAL HAZARD CAUSED BY THE CONTINUED OPERATION OF CENTRIFUGAL PUMPS WHEN THE INTAKE AND DISCHARGE ARE BLOCKED. EXTREME HEAT IS GENERATED AND RESULTS IN VAPORIZATION OF THE ENTRAPPED LIQUID. THIS CAN RESULT IN A LIFE THREATENING EXPLOSION.**

The operation of centrifugal pumps on slurry applications can increase this potential hazard due to the nature of the material being pumped. The additional hazard believed to be presented by slurry applications stem from the possibility of solids blocking the pump discharge and remaining undetected. This situation has been known in some instances to lead to the intake side of the pump also becoming blocked with solids. The continued operation of the pump under these circumstances can be extremely dangerous. If you have an installation that may be prone to this occurrence, we suggest you adopt measures to prevent this blockage situation.

## **!! GENERAL WARNINGS !!**

1. **DO NOT OPERATE THE PUMP AT LOW OR ZERO FLOW CONDITIONS, OR UNDER ANY CIRCUMSTANCES THAT COULD CAUSE THE PUMPING LIQUID TO VAPORIZE. Slurry pumps should not be operated at flow less than 25% of the best efficiency point for a given RPM. PERSONAL INJURY AND EQUIPMENT DAMAGE COULD RESULT.**
2. The WARMAN PUMP is both a PRESSURE VESSEL and a piece of ROTATING EQUIPMENT. All standard safety precautions for such equipment should be followed before and during installation, operation, and maintenance.
3. UNDER NO CIRCUMSTANCE SHOULD HEAT BE USED TO EXPAND OR CUT AN IMPELLER FROM THE SHAFT. Personal injury and damage to equipment could occur as a result of an explosion. A shaft wrench has been provided to assist impeller removal. In some cases, a release collar has also been provided to assist with impeller removal.
4. DRIVER ROTATION MUST BE CHECKED before belts or coupling are connected. Personal injury and damage to equipment could result from operating the pump in the wrong direction. Do not touch rotating members with hand to find the direction of rotation.
5. For AUXILIARY EQUIPMENT (motors, belt drives, couplings, gear reducers, variable speed drives, etc.), standard safety precautions should be followed and

appropriate instruction manuals consulted before and during installation, operation, and maintenance. Some gear reducers are shipped without lubricating oil for fire safety reasons. Be certain that oil of the proper grade is filled to the proper level in the gear case before start-up. **All guards for rotating parts must be correctly fitted before operating the pump including guards removed temporarily for gland inspection and adjustment**

6. A PUMP SUBJECT TO VACUUM MUST BE ISOLATED during maintenance and non-pumping periods. Failure to isolate properly could allow impeller to "free-wheel", resulting in equipment damage and personal injury.
7. DO NOT OPERATE THE PUMP without properly installed v-belt or coupling guards in place.
8. DO NOT OPERATE THE PUMP if solids have settled and the rotating element cannot be turned by hand.
9. Do not feed very hot liquid into a cold pump or very cold liquid into a hot pump. Thermal shock will cause damage to the internal components and rupture of the pump casing.
10. Do not start a pump that is rotating in reverse, such as the backward rotation caused by slurry runback. Personal injury and damage to equipment could result.
11. Worn pump components can have sharp or jagged edges. Caution must be taken in handling worn parts to prevent damage to slings or personal injury.
12. For the safety of operating personnel, please note that the information supplied in this manual only applies to the fitting of genuine Warman parts and Weir Slurry Inc. recommended bearings to Warman pumps.
13. Tapped holes (for eyebolts) and lugs (for shackles) on Warman parts are for lifting **individual parts only**.
  - Lifting devices of adequate capacity must be used in conjunction with these assembly and maintenance instructions wherever they are required to be used
  - Sound, safe workshop practices should be applied during all assembly and maintenance work.
  - Personnel should never work under suspended loads.
14. WARMAN PUMP CASTINGS made from the materials listed are brittle and have low thermal shock resistance. Attempts to repair or rebuild by welding procedures may cause catastrophic failure. Materials where repairs should not be attempted includes but is not limited to the following, A03, A04, A05, A06, A07, A08, A09, A12, A14, A49, A51, A52, A53, A61, A210, A211, A217, A218.

# PUMP IDENTIFICATION

## PUMP IDENTIFICATION CODES

Every Warman pump has a nameplate attached to the base. The pump serial number and identification code are stamped on the nameplate.

The pump identification code is made up of digits and letters arranged as follows:

Digits	Digits	Letters	Letters
(A) Intake Diameter	(B) Discharge Diameter	(C) Frame Size	(D) Wet End Type

- A. The intake diameter is expressed in inches, such as 1.5, 2, 4, 10, 20, 36, etc.
- B. The discharge diameter is also expressed in inches, such as 1, 1.5, 3, 8, 18, 36, etc. **Note:** Series 'A', Type pumps are identified by discharge diameter expressed in millimeters – the intake diameter is not specified.
- C. The frame of the pump consists of the base and the bearing assembly. The size of the base is identified by one or two letters, such as B, C, D, ST, etc. The size of the bearing assembly may be the same or have a different designation.
- D. The type of pump wet end is identified by one or two letters. Some of these are:
  - AH, AHP, HH, L, M – Slurry Pumps with replaceable liners.
  - AHU – Unlined Slurry Pumps
  - D, G – Dredge Pumps and Gravel Pumps
  - S, SH – Heavy-Duty Solution Pumps
  - XU – Sand & Gravel, Unlined

### Examples:

2/1.5 BAH:  
 2" intake diameter  
 1.5" discharge diameter  
 B = frame size  
 AH = slurry pump with replaceable liners

10/8 FG:  
 10" intake diameter  
 8" discharge diameter  
 F = frame size  
 G = gravel duty wet end

250 FL:

250 mm discharge diameter  
 F = frame size  
 L = slurry pump with replaceable liners

16/14 TUAHP:

16" intake diameter  
 14" discharge diameter  
 TU = frame size  
 AHP = slurry pump with replaceable liners – high pressure design

# OPERATING INFORMATION

## 1. SYSTEM REVIEW

A review of the entire pumping system including sumps, piping, valves, controls, etc. should be made prior to pump start-up to prevent adverse effects on the pump.

## 2. CHECK IMPELLER CLEARANCE

Impeller clearance must be checked prior to start-up of the pump. Failure to do so may result in damage to the pump. All impellers are adjusted at the factory; however, final adjustment must be made on site. With suction piping attached, adjust impeller as outlined in PUMP ASSEMBLY – Impeller Clearance Adjustment.

## 3. GLAND SEAL WATER & PACKING ADJUSTMENT

Turn on gland seal water before starting the pump. Both pressure and flow must be regulated to levels shown on the Arrangement Drawing.

## 4. MECHANICAL SEAL ADJUSTMENT

Consult factory prior to operating pump.

## INSTALLATION OF PUMP UNITS ON BASEPLATES

### BASEPLATES

Before shipment from the factory, the pump and its driving unit can be purchased erected on a common baseplate, which, in turn, should be supported on a level assembly bed.

Pump and driving units which share the same baseplate have their driving and driven shafts aligned while the set is mounted on the assembly bed at the factory. SHIMS USED DURING FACTORY ALIGNMENT ARE SOMETIMES REMOVED PRIOR TO SHIPMENT IF NEEDED THEY ARE TO BE SUPPLIED AND INSTALLED BY THE INSTALLATION CONTRACTOR.

### NOTE

Regardless of the fact that this equipment has been factory aligned, the installation contractor at the site must verify and correct coupling alignment as necessary after the baseplate has been bolted in place and piping has been connected to the pump flanges.

Uneven foundations on site, such as concrete bases, can cause the bedplates to distort. To prevent distortion, level the foundation surface as described in the following procedure.

### LEVELING A COMMON BASEPLATE

1. Mount the baseplate complete with pump and driving unit onto the foundation block. Support with iron or steel shims placed at frequent intervals between the under side of the baseplate and the top surface of the foundation block.

Sufficient shims must be used to support the baseplate without distortion. In addition, at least one shim should be placed each side of each securing bolt.

2. When the baseplate is level, grout in the securing bolts.
3. When the grouting has set, gently but firmly tighten the securing bolts. Over-tightening can distort the baseplate or loosen the securing bolts in the grout. At this stage make any adjustments necessary to level the baseplate. Check the alignment of the pump and its driving unit.
4. When both the baseplate level and the shaft alignment are satisfactory, the finishing grout can be run in and the concrete base finished.

### FOUNDATIONS

To obtain efficient pump service, you must install the pump on adequate foundations. Steel foundations should be rugged; concrete foundations should be heavy. Both should be designed to take all loads from the pump and motor, and to absorb any vibrations.

Keep in mind that an electric motor can exert twice the rated horsepower during the start-up.

All hold down bolts should be fully tightened and retightened after a few days of running time.

In general, the location selected for installation should be as close to the source as possible, with a suction pipe as short as possible. The pump should be located as low in elevation as possible to increase suction pressure. Adequate space allowance must be made to provide access for inspection and maintenance.

### SHAFT ALIGNMENT

Whether direct coupled or v-belt driven, the pump and motor shafts should be accurately aligned. In direct coupled drives, misalignment causes unnecessary vibration and wear of the coupling. In v-belt drives, non-parallel shafts cause excessive belt wear. Consult coupling or v-drive manufacturer's maintenance manual for alignment tolerances. Coupling alignment should be checked after piping installation.

### PIPING

**IMPORTANT:** APPROPRIATE WARMAN JOINT RINGS MUST BE USED AT THE PUMP FLANGES WHEN SUCH ARE PART OF THE PUMP DESIGN.

**! CAUTION !**

To avoid damaging the joint rings (gaskets), do not over-tighten the flange bolts.

No strain should be imposed on the pump casing either by the weight of pipes or by tightening badly fitted pipes. Experience has shown that such strain can seriously affect the alignment of the pumping unit. All pipe work attached to the pump must be the correct size and fully supported. The mating faces of the pipe flanges must abut squarely, with all bolt holes in line.

**! CAUTION !**

When joining the pipe work to the pump, **DO NOT USE excessive force**, as this could result in flange or casing damage.

A removable piece of pipe should be fitted to the intake and discharge pipe work. This removable spool piece should be of sufficient length to allow removal of the casing for easy access when replacing worn parts. Refer to the pump outline dimension drawing for proper spool piece length for your pump.

In some pumps, the metal liner projects a short distance past the flange. Care should be taken in such instances not to over-tighten the flange bolts or pump damage could result.

Do not install unrestrained expansion joints between the pump and the nearest point of anchor. Reaction forces can result of such magnitude to cause damage to the pump.

**NOTE**

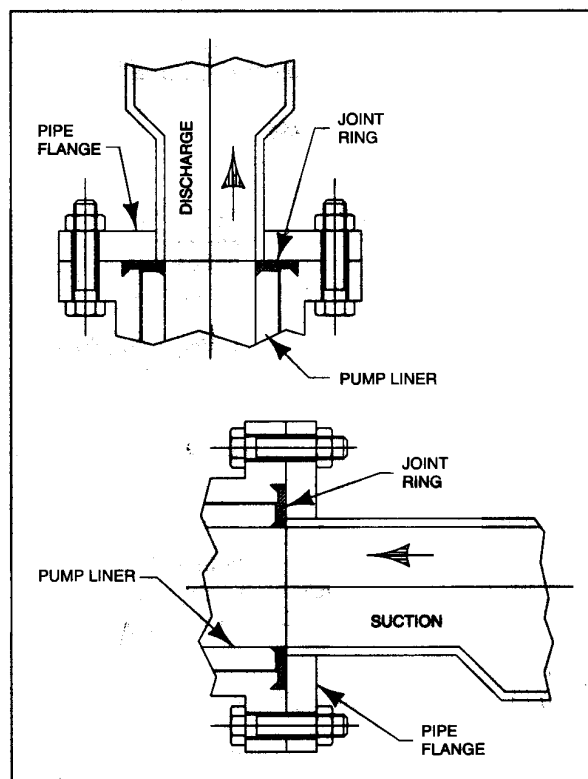
**Interstaging Pumps** – Consult the factory for piping procedures and recommendations when the pressure pipe of one pump charges the suction pipe of another pump.

**SUCTION CONDITIONS**

Suitable isolation should be fitted in the suction pipe as required by the installation. All pipe joints must be airtight to ensure priming of the pump.

The suction pipe should be as short as possible and have as few bends as possible. An arrangement of suction pipe work which is common to two or more pumps operating on suction lift is not recommended.

The diameter of the suction pipe must be such that the velocity is kept to a minimum, but above the Solids Particle Critical Settling Velocity of the slurry. To reduce friction losses, a long suction pipe must be of larger bore than a short straight one passing the same quantity of liquid.



*Figure 1-1 • Typical Joint Ring Arrangement*

When the bore of suction pipe is increased to a size larger than that of the pump suction inlet, an eccentric reducer should be used with the reducing step installed at the bottom as shown in *Figure 1-1*, to prevent the formation of air pockets.

**PRESSURE CONDITIONS**

Suitable isolation should be fitted in the pump discharge piping as required by the installation.

**! CAUTION !**

**When piping up the suction and discharge flanges of the pump, it is important that the appropriate Warman joint rings be used. The joint rings form an effective seal between the pipe work and pump casing.**

**START-UP OF PUMP**

Before starting a Warman pump for the first time, the following steps must be taken:

**1. Shaft Seal Check:**

- a) Gland Sealed Pumps

Check gland water available at both correct capacity and pressure.

In solids handling pumps, gland water pressure should be approximately five pounds per square inch above pump discharge pressure.

The seal water has to be clean, without any abrasives such as sand, rust, etc. As a guideline, foreign particles should not be larger than 40 microns and no more than 200 parts per million. Seal water supplies containing fines of hard particles such as silica or alumina may require lower concentrations to result in proper seal operation.

Seal water flow must be regulated externally to the pump flow recommended by Weir. The pump seal cannot regulate flow.

The gland should be adjusted so that a small flow is obtained along the shaft.

#### NOTE

Pumps supplied directly from Weir factories usually have tight glands to minimize shaft vibration during transport.

#### b) Centrifugally Sealed Pumps

For centrifugally sealed pumps with grease cups, screw the grease cup down 2-3 turns to charge the static chamber with grease.

## 2. Shaft Unlocking

In some instances the pump shaft may be locked during transport with a shaft wrench. This is done by attaching the shaft wrench (one of the pump assembly tools) to the shaft. A hex head bolt in the handle of the wrench is then screwed up hard against the pump base. Before using the pumps, remove the hex bolt to free the shaft. Then, using the wrench, rotate the shaft manually in the direction of the arrow on the pump casing to insure that the impeller turns freely within the pump. If there are any scraping noises from the pump, the impeller must be adjusted as described in the IMPELLER CLEARANCE ADJUSTMENT section.

YOU MUST REMOVE THE SHAFT WRENCH WHEN YOU COMPLETE THIS PROCEDURE.

## 3. Motor Rotation Check

Remove all v-belts or completely disconnect shaft coupling, as the case may be.

#### **!! WARNING !!**

**ROTATION IN THE DIRECTION OPPOSITE TO THE ARROW ON THE PUMP WILL UNSCREW THE IMPELLER FROM THE SHAFT, CAUSING SERIOUS DAMAGE TO THE PUMP.**

Start the motor, check rotation, and correct it if necessary to produce pump shaft rotation indicated by arrow on pump casing.

Refit v-belts or reconnect shaft coupling. When tensioning belts, maintain shaft alignment.

## 4. Pump Start-Up

Grease lubricated bearing assemblies are factory lubricated. **Do not add additional grease at startup.** It is common for grease lubricated bearing assemblies to run warm during their initial start up and run in period. The graph below shows typical time verses temperature characteristics of a new grease lubricated bearing assembly.

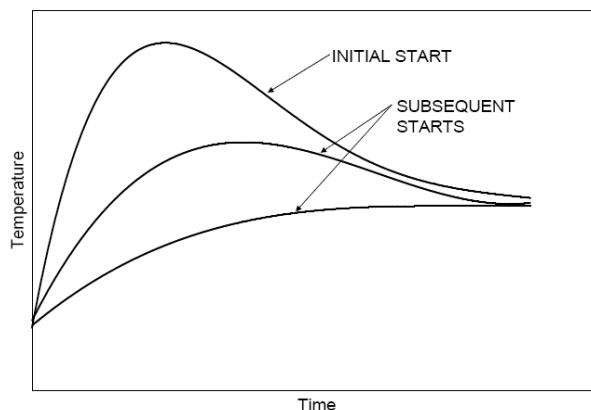


Figure 1. Time versus Temperature Characteristics of a Grease Lubricated Bearing Assembly.

The most common causes for high initial bearing assembly temperatures are:

1. Customer adding grease to the assembly during initial start-up.
2. Belt drive tension being high for the initial runs.
3. Off duty point operation.
4. Initial charge of grease being high to improve likelihood of bearings surviving the initial storage period.

#### Recommended Grease Start-up and Run in Procedure

1. Do not add grease at any time during initial start-up and run in. If grease is added or the wrong type of grease is added the warranty may be affected.
2. Check belt tension to ensure it is as recommended. Use a belt tension gauge to set the belt tension.
3. Operate the pump at or near the duty operating point. Off duty point operation can cause bearing overloading.
4. After initial start monitor the bearing housing surface temperature. A graph similar to Figure 1) above should be created. Allow the temperature to rise to 105 C (222 F). Shut the pump down and allow the

assembly to cool to ambient temperature. 4 hours is usually adequate.

5. Restart the pump and monitor the bearing housing surface temperature. If the temperature is leveling off as shown by the graph, allow the assembly to continue to operate up to 115 C (240 F) before shutting down. Grease characteristics must be equal to those indicated in Section 1, Page 11 or operation at this temperature may cause bearing failure.
6. Allow assembly to cool and repeat step 5). It may take several start and stop sequences to have the housing temperature reach its peak and begin dropping.
7. If assembly continues to heat, recheck belt tension, operating point and speed.

#### **Recommended Oil Start-up and Run in Procedure**

If oil lubricated, fill reservoir to proper level prior to operating pump. Do not overfill bearing assembly or leakage may occur during operation.

#### **Additional Notes Prior to Pump Start-Up**

Remove any objects that may have entered the pump casing during shipment or installation and check once more that all bolts are tight and that impeller turns freely. Check that the shaft seal is in order and that the pressure and flow of gland water supply, where used, is correct.

Open the suction valve (if one is present) and check that water is available at the suction inlet.

Whenever possible, start up pumps on water before introducing solids or slurry into the stream. If possible, allow the pumps to pump water only for a short period before shutdown. This will remove solids from the pump casing and reduce the degree of scaling that normally occurs.

Overloading of the motor, drive, bearings and pump may occur when the pump is discharging into any empty system, when the delivery head will be lower, or the throughput is in excess of that for which the pump is designed. Careful regulation of the delivery valve until the system is fully charged will prevent this.

#### **NOTE**

At no time should the pump be operated at flows below 25% of the flow at Best Efficiency Point (BEP) at a given RPM.

When the pump is primed, isolate the priming system (if any). Start the pump and motor, allowing the pump to get up to speed. If the pump is on suction lift, execute operating procedure for the priming system. Open the discharge valve slowly to avoid overloading the motor or the v-drive. Check suction and discharge pressure (if gauges have been provided).

Check flow rate by inspecting meters or pipe discharge.

Check gland leakage. If leakage is excessive, tighten gland nuts until flow is reduced to required level. If leakage is insufficient and the gland shows signs of heating, loosen the gland nuts. If the gland continues to heat up, the pump should be stopped and the gland allowed to cool. Do not loosen the gland nuts to the extent that the gland follower is allowed to disengage the stuffing box.

#### **NOTE**

It is normal for gland leakage water to be hotter than the supply, because it is conducting away the heat generated by friction in the gland.

At low pressures (single stage operation), very little leakage is required, and it is possible to operate with only a small amount of water issuing from the gland. It is not essential to stop a pump because of gland heating unless steam or smoke are produced.

Generally, gland heating is only experienced on initial start-up on gland sealed pumps. When initial heat-up of the gland is encountered, it is usually only necessary to start-up/stop/cool and start the pump two or three times before the packing beds in correctly and the seal operates satisfactorily. It is preferable at start-up to have too much leakage than not enough.

#### **5. Abnormal Start-Up**

If the pump fails to prime, one or more of the following conditions may be the cause:

##### **Blocked Suction Pipe**

When the pump has not been operated for some time, it is possible for slurry to settle in or around the suction pipe if operating from a pit. This condition prevents water rising to the pump impeller. Use the pressure gauge on the suction side of the pump to check the level of water in the pump.

##### **Air Entering Gland**

If one of the following conditions apply, air may be induced into the pump through the gland.

- Sealing water pressure is too low.
- Packing is excessively worn.
- Shaft sleeve is excessively worn.
- Gland sealing water connection into stuffing box is blocked.



This may prevent the pump from maintaining its prime or cause it to lose its prime during operation. Inspection of gland will reveal if the above faults are occurring and remedial action is necessary.

## 6. Operating Faults

### Blocked Suction Pipe

A partial obstruction can be caused by a piece of foreign material being drawn across the bottom of the suction pipe during the operation of the pump. Such an obstruction may not be sufficient to stop operation completely, but will result in a reduced output from the pump. It will also cause a drop in discharge pressure and amps, and will increase the vacuum reading on the pump suction. Rough running and vibration of the pump may also occur due to cavitation within the pump.

### Blocked Impeller

Impellers are capable of passing a certain size particle. If a particle larger in size enters the suction pipe, it may become lodged in the eye of the impeller, restricting the output of the pump. Such an obstruction will usually result in a drop of amperes and a drop in both discharge pressure and suction vacuum readings. The out-of-balance effects resulting from this condition may cause pump vibration.

### Blocked Discharge Pipe

A blocked discharge pipe may be caused by an abnormally high concentration of coarse particles in the pump discharge pipe. It can also be caused by the velocity in a section of the discharge pipe dropping below that of the Critical Settling Velocity. This is normally accompanied by a drop in amps and suction vacuum readings.

Suction or discharge pipes run at angles other than horizontal or vertical can result in settling and potential blockage.

### **!! WARNING !!**

**A PUMP SUBJECT TO A VACUUM MUST BE ISOLATED DURING MAINTENANCE AND NON-PUMPING PERIODS. FAILURE TO PROPERLY ISOLATE COULD ALLOW THE IMPELLER TO "FREE WHEEL," CAUSING EQUIPMENT DAMAGE AND PERSONAL INJURY.**

## SHUTTING DOWN PROCEDURE

Before you shut down the pump, it should be allowed to operate for a short period on only clean water to clear the system.

Then proceed as follows:

1. Depress the 'STOP PUMP' push-button on the control panel.

2. Gland seal water (if any) must be left on during all subsequent operations, namely: start-up, running, shutdown, runback and system drain. Gland water may only then be turned off.

### NOTE

For interstage pump systems, consult factory for recommendations on shutdown procedures.

# MAINTENANCE

Warman pumps are of sturdy construction and, when correctly assembled and installed, they will give long, trouble-free service with a minimum amount of maintenance.

## IMPELLER ADJUSTMENT

Warman pump performance changes inversely with the clearance existing between the impeller and the intake side liner. This is less pronounced with closed impellers. There are some exceptions; but typically, with wear, the clearance increases and pump efficiency drops.

For best performance it is necessary to stop the pump occasionally and move the impeller forward (see PUMP ASSEMBLY; IMPELLER CLEARANCE ADJUSTMENT). This adjustment can be carried out in a few minutes without any dismantling. (*Refer to Section 6, Page 25.*)

On pumps fitted with a centrifugal shaft seal, forward impeller adjustment may increase seal area pressure. Thus on some applications it may be necessary to operate the pump with a slightly greater impeller clearance to ensure proper shaft sealing is achieved.

Before restarting, be sure impeller turns freely and bearing housing clamp bolts are tight.

## BEARING LUBRICATION

A correctly assembled and pre-greased bearing assembly (see BEARING ASSEMBLY; FITTING SHAFT TO BEARING HOUSING) will have a long, trouble-free life,

provided it is protected against entrance of water or other foreign matter and is adequately maintained. It must be left to the judgment of maintenance personnel to open bearing housings at regular intervals (not longer than twelve months) for bearing inspection.

During this inspection, you must also determine the frequency and amount of lubricant to be added, and when the next inspection will be required.

The frequency and amount of lubricant to be added periodically depends upon a number of factors:

- Speed and size of bearing;
- Duration and extent of on/off operation;
- Ambient and operating temperature;
- The presence of contaminants.

Most pump bearings operate in the lower speed ranges, but there is still the risk of damage due to over-lubrication. However, operating in the lower speed ranges does not warrant neglecting the bearings completely.

Judgment and experience should be the final determining factors in establishing routine lubrication procedures. Consequently, you should observe the bearings frequently at the outset of operation, taking careful note of any unusual conditions regarding temperature and cleanliness. For ordinary conditions of continuous operation the guidelines shown on *Table 1-1* can be followed. Caution should be taken not to over grease bearings, which can cause elevated temperatures during operation.

BEARING FRAME SIZE		ADD		BEARING RPM											
		OZ.	GRAM	200	300	400	600	800	1000	1200	1500	2000	2500	3000	4000
BOTH ENDS	ASC	.1	3							2100	1700	1300	1000	800	400
	B	.2	6					3000	2400	1800	1500	1000	800	650	300
	C, CAM	.3	9				3600	2400	1800	1600	1200	900	580	500	*
	D, AM,DSC	.5	14				2500	2000	1500	1200	800	500	500	*	*
	E,EAM,ESC	.8	24		5000	3600	2200	1600	1100	800	500	500	*	*	*
	F, FAM, FG	1.2	35	7000	4200	2000	1800	1200	700	400	400	*	*	*	*
	G, GAM,GH	2.1	60	5000	3600	2400	1200	600	600	*	*	*	*	*	*
PUMP END	N	.4	12						2300	1800	1500	1050	820	650	*
	P, CC	.7	20				2900	2200	1700	1400	1100	800	500	500	*
	Q, DD	1.0	28				2300	1800	1400	1000	700	400	400	*	*
	R, RS, EE	1.8	50		3000		2000	1400	1000	600	400	400	*	*	*
	S, SH, FF	2.3	66		3800	2800	1500	900	500	300	*	*	*	*	*
	T, TH, GG	4.4	125	4800	3000	1800	900	400	400	*	*	*	*	*	*
	U	8.6	245	4000	2400	1500	500	*	*	*	*	*	*	*	*
DRIVE END	N	.2	7						2300	1800	1500	1050	820	650	*
	P, CC	.5	14				2900	2200	1700	1400	1100	800	500	500	*
	Q, DD	.6	17				2300	1800	1400	1000	700	400	400	*	*
	R, RS, EE	1.2	33		3000		2000	1400	1000	600	400	*	*	*	*
	S, SH, FF	1.8	50		3800	2800	1500	900	500	300	*	*	*	*	*
	T, TH, GG	1.5	42	4800	3000	1800	900	400	400	*	*	*	*	*	*
	U	3.4	95	4000	2400	1500	500	*	*	*	*	*	*	*	*

Note: One shot from a standard grease gun is approximately one gram.

\* Grease lubrication is not recommended at this speed. Consult factory for oil lubricated.

\*\* All speeds highlighted in the grey area require the use of synthetic grease lubricant only.

*Table 1-1 • Suggested Lubrication Interval (Hours) Based on Standard Mobil XHP 222 Mineral Grease*

#### NOTE

All bearing assemblies as covered in Sections 2 and 3, shipped after 1981, are equipped with a grease purge fitting located in the end cover at the very end of each bearing. This grease fitting purges the bearing seal (see *Figure 1-2*). Just inboard of this fitting, at each end of the bearing housing, a pipe plug is provided. This plug should be removed and a grease zerk installed for inserting lubrication directly into the bearing (see *Table 1-1 for quantities and frequency*). Use only recommended, clean grease. Remove the grease zerk each time to prevent over greasing.

### GREASE LUBRICANTS

#### NOTE

Tables of quantities and intervals apply to the inboard fitting (or plug). Outboard fittings are for purging labyrinth seals as shown in *Figure 1-2*.

For lubrication, remove the plug and install a grease fitting with the same thread as the plug.

Mineral grease used in roller bearings should have the following characteristics:

A lithium complex grease with oxidation inhibitor, rust preventative, and EP additive. Mobilgrease® XHP 222 is a type which we have found to be satisfactory. The recommended initial quantity of grease to be used for each bearing is shown in *Table 1-2*.

N.L.G.I. Grade Number	2
Dropping Point, ASTM D 2265, °C	280
Worked Penetration, ASTM D 217, 25°C	280
Viscosity of Oil, ASTM D 445, cST at 40°C	220

Synthetic grease used in roller bearings should have the following characteristics:

A full synthetic PAO lithium complex oxidation inhibitor, rust preventative, and EP additive. Mobilith® SHC 220 is a type which we have found to be satisfactory.

N.L.G. I Grade	2
Dropping Point, ASTM D 2265, °C	265
Worked Penetration, ASTM D 217, 25°C	280
Viscosity of Oil, ASTM D 445, cST at 40°C	220

For higher operating speeds synthetic lubricant is recommended. Synthetic grease is also used in all double letter (example: FF) bearing assemblies due to higher loading and speeds. Bearing assembly part numbers ending with "SYN" contain synthetic grease.

*Table 1-2* applies only to the amount of grease required for bearing assembly building or rebuilding. All factory supplied bearing assemblies are lubricated per this chart.

The recommended lubrication interval for operating pumps is shown in *Table 1-1*. This table is only for the amount of grease to be added to bearing assemblies already in operation.

#### NOTE

*Table 1-1* is based on normal operating conditions and intended to be a guideline. Quantities shown may need to be adjusted based on observations made during normal operation. For reference purposes, one shot from a standard grease gun is approximately one gram.

Normal operating conditions would include:

- Clean environment.
- Pumps under cover or protected from the weather (rain, snow, ice, dust, etc.).
- Normal ambient temperatures 32°F to 95°F (0°C to 35°C).
- No spray from either badly maintained gland or from heavy washing down.
- Normal operating conditions – below full rating.
- Very dirty or damp atmospheric conditions or conditions that varied from those listed above would require that the recommendations be stepped up to a level that prevents contaminants from entering the bearings.

### OIL LUBRICATED BEARING ASSEMBLIES

For lubrication information refer to manual supplement "BA6" for units identified with a "Y" suffix and supplement "BA4" for units with a "K" or "KH" suffix.

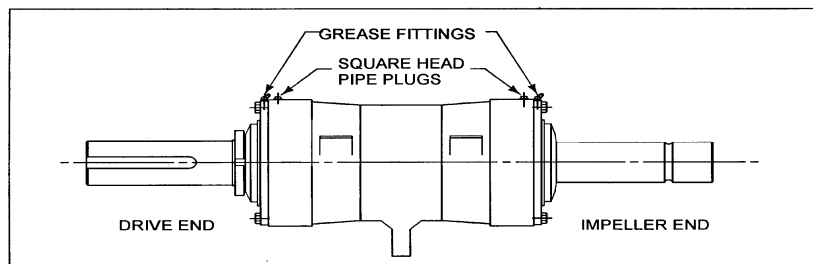


Figure 1-2 • Bearing Assembly

PUMP FRAME	OUNCES/BEARING (Drive End/Wet End)	GRAMS/BEARING (Drive End/Wet End)
ASC	.7/.7	20/20
B	1.5/1.5	30/30
C, CAM	1.75/1.75	50/50
D, DAM, DSC	3.5/3.5	100/100
E, EAM, ESC	7.0/7.0	200/200
F, FAM, FG	17.5/17.5	500/500
G, GAM, GH	40.0/40.0	1150/1150
N	1.4/2.3	40/65
P, CC	2.8/3.5	80/100
Q, DD	5.5/8.75	160/250
R, RS, EE	12/18	350/500
S, SH, FF	19/21	550/600
T, TH, GG	28/84	800/1600
U	49/104	1300/3000

Note: One shot from a standard grease gun is approximately one gram.

Table 1-2 • Recommended Initial Quantity of Grease to Be Used for Each Bearing

## BEARING SEALS

All Warman pumps manufactured after June 1, 1990 (serial numbers above 8600) are manufactured using the type "-10" seal. This arrangement is shown in *Figure 1-3a* and incorporates a lip seal with the flinger, piston rings and labyrinth grease purge features.

Warman pumps manufactured between 1981 and June 1, 1990 utilize the bearing seal shown in *Figure 1-3b*. This seal uses the flinger, piston rings and labyrinth grease purge to seal the bearings from contamination.

Purging frequencies for seals are listed on *Table 1-3*. As with bearing lubrication some judgment must be made by the operator depending on the environment in which the equipment is operated.

Warman pumps manufactured prior to 1981 have bearing end covers as shown in *Figure 1-3c* or *1-3d*.

	Continuous (24 Hour) Operation	16 Hour Operation Per Day	8 Hour Operation Per Day
Pump End Labyrinth	4 shots every 24 hours*	4 shots every 48 hours*	2 shots every 60 hours*
Drive End Labyrinth	4 shots every 120 hours*	4 shots weekly*	2 shots weekly*

\* Shots are from a standard hand operated grease gun. Use less on smaller bearing frame sizes.

Table 1-3 • Recommended Intervals for Labyrinth Grease Purging

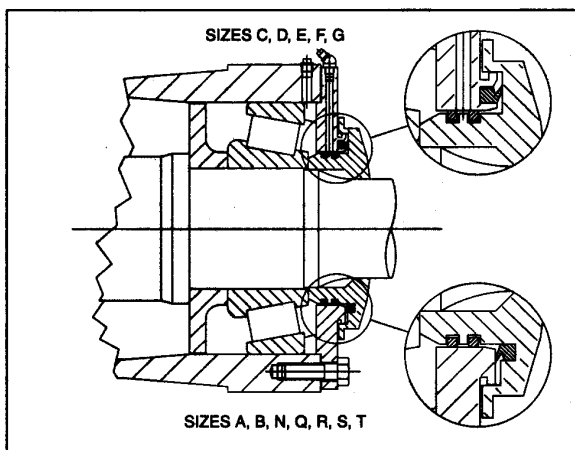


Figure 1-3a • Pumps Manufactured After June 1, 1990

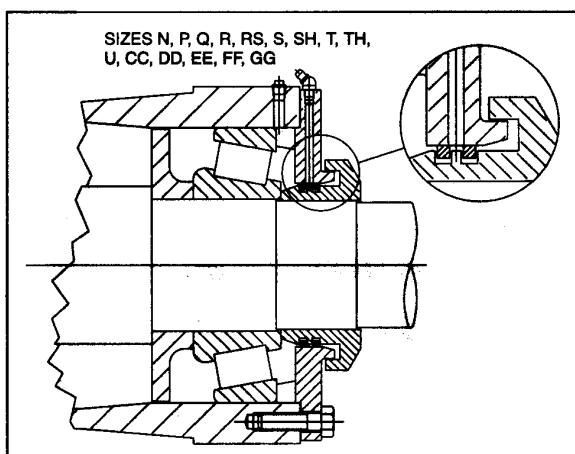


Figure 1-3c • Pumps Manufactured Before 1981

### SHAFT SEAL CARE

In gland sealed pumps, periodically check gland seal water supply and pressure. Always maintain a small amount of clean water leakage along the shaft by regularly adjusting the gland. When gland adjustment is no longer possible, remove and replace all packing rings.

### GREASE LUBRICATION OF CENTRIFUGALLY SEALED EXPELLER RINGS

#### NOTE

If water assist is recommended for the centrifugal seal, then grease lubrication is not required. For grease lubricated centrifugal seals, the pump expeller ring is fitted with a grease cup and should be filled with grease having the specifications shown below. At 12 hour intervals, the grease cup cap should be tightened to force a small amount of grease into the seal. Monitor the grease level as

often as necessary to insure grease is available at all times.

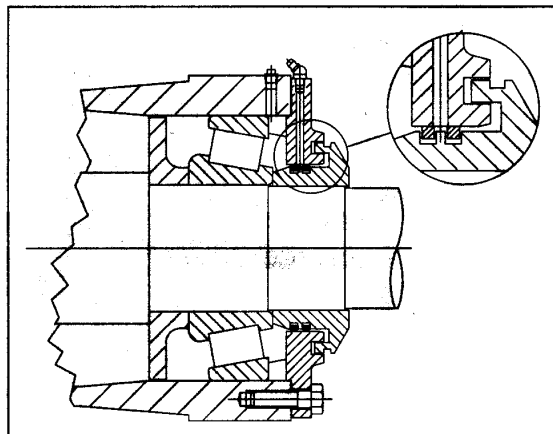


Figure 1-3b • Pumps Manufactured Between 1981 and 1990

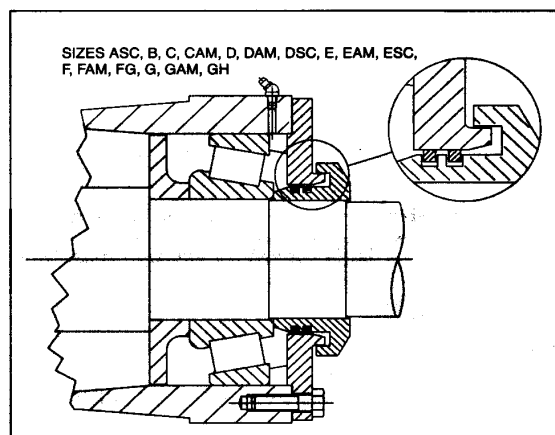


Figure 1-3d • Pumps Manufactured Before 1981

The centrifugally sealed pumps that utilize grease cups should be fitted with a grease having the following specifications:

N.L.G.I. Grade Number	2
Dropping Point, ASTM D 2265, °C	280
Worked Penetration, ASTM D 217, 25°C	280
Viscosity of Oil, ASTM D 445, cST at 40°C	220

Mobilgrease® XHP 222 is a type which has been found to be satisfactory.

# SPARE PARTS

## WEARING PARTS REPLACEMENTS

The wear rate of a solids handling pump is a function of the severity of the pumping duty and the abrasive properties of the material handled. Therefore, the life of wearing parts, such as impellers and liners, varies from pump to pump and from one installation to another.

Wearing parts must be replaced when the performance of a given pump no longer satisfies the requirements of a particular installation. Where a pump is used on a particular duty for the first time, and especially where failure of a wearing part during service could have serious consequences, Weir Slurry Inc. recommends that the pump be opened at regular intervals, parts inspected, and their wear rate estimated so that the remaining life of the parts may be established. For installation of new wearing parts, see appropriate sections of this manual.

## STOCK LEVELS

Spare parts for Warman pumps consist mainly of liners, impellers, bearings, shaft sleeves, seals, and shaft seal parts. Depending on the expected life of each part, you should keep a number of spares of each in stock to ensure a minimum of downtime. Major plants typically stock an additional bearing assembly for every ten (or less) pumps of the same size. This enables a quick exchange of the bearing assembly in any one of the pumps. Often this operation is carried out when wearing parts are being replaced. The removed bearing assembly can then be inspected in a workshop, overhauled if required, and kept ready for the next pump. In this way, damage is prevented and all pumps are always kept in optimum conditions with a minimum of downtime.

## PART NUMBERS

Warman pump parts are described by a part number consisting of three segments.

1. The (1) to (5) digit alpha or alpha/numeric prefix which references the relative pump or frame size of the part.
2. The (3) digit numeric "basic part number" which indicates the part type.
3. The (3) digit alpha/numeric material code.

The following are example part numbers:

Prefix	Basic Number	Material Code
F6 For 8/6 FAH	147 Impeller F6147A03	A03 Ni-Hard
E4 For 6/4 EAH	110 Volute Liner E4110A05	A05 Hi-Chrome

You can use Warman components diagrams to determine part numbers for your pump minus the material code. Weir Slurry Inc. recommended spare parts lists should be used to verify the complete part number for your pump, including material codes.

If you have any question concerning the proper part number or material code for your application, please contact your Weir Minerals representative or the factory.

The following list provides the basic part number and description for most Warman pump parts. This list will be useful in identifying basic part numbers referenced in the body of this text. Parts are shown in diagrams on the pages listed for reference.

Basic Part Number	Part Name	Section & Page Number
001	Adjusting Screw or Adjusting CAM	4-1
003	Base	4-1
004	Bearing Housing	2-2
005	Bearing Assembly	3-2
008	Bearing Sleeve	3-3
009	Bearing	3-3
009D	Bearing (Drive End)	3-2
011	Clamp Washer	4-1
012	Clamp Bolt	4-1
013	Cover Plate	6-6
015	Cover Plate Bolt	4-2
017	Cover Plate Liner	6-9
018	Cover Plate Liner – Throatbush Type	6-12
023	Cover Plate Liner Set Screw or Stud	6-13
024	End Cover	2-3
025	Shim Set	2-4
026	Frame Plate Liner Stud	6-12
027	End Cover Set Screw	2-3
028	Expeller	5-11
029	Expeller Ring	5-8
029R	Expeller Ring (Rubber Lined)	5-21
032	Frame Plate	4-2
034	Frame Plate Bolt	4-2
036	Frame Plate Liner	6-12
039	Frame Plate Stud	4-2
040	Frame Plate Liner Insert Bolt	—
041	Frame Plate Liner Insert	6-6
044	Gland	5-1
045	Gland Bolt	5-1
046	Grease Retainer	2-2
049	Impeller – Eight Vane Closed	—
051	Impeller – Two Vane Open	—
052	Impeller – Three Vane Open	—
056	Impeller – Four Vane Open	—
058	Impeller – Six Vane Open	—
060	Intake Joint	1-5
061	Labyrinth Locknut	2-6
062	Labyrinth	2-6

<b>Basic Part</b>	<b>Section &amp; Page</b>
<b>Number Part Name</b>	<b>Number</b>
063 Lantern Ring	5-6
064 Impeller O-Ring	6-4
067 Neck Ring	5-6
070 Shaft Key	6-23
073 Shaft	3-2
075 Shaft Sleeve	5-15
078 Stuffing Box	5-1
079 Expeller Ring Stud	5-22
083 Throatbush	6-6
085 Cotter	6-8
089 Bearing Seal	2-7
090 Shaft Seal	5-22
108 Piston Ring	2-6
109 Shaft Sleeve O-Ring	5-18
110 Volute Liner	6-6
111 Packing	5-1
117 Shaft Spacer	5-1
118 Lantern Restrictor	5-1
122 Seal Ring	6-6
124 Volute Liner Seal	6-4
125 Volute Liner Seal	6-4
126 Gland Clamp Bolt	5-1
127 Impeller – Five Vane Open	—
132 Discharge Joint	1-5
137 Impeller – Three Vane Closed	—
138 Grease Cup Adaptor	5-11
145 Impeller – Four Vane Closed	—
147 Impeller – Five Vane Closed	—
179 Shaft Sleeve Spacer	5-21
191 Impeller – Eight Vane Open Torque Cyclo	—
217 Impeller O-Ring	6-4
239 Release Collar	5-6
241 Lip Seal Gland	5-22
— Grease Fitting	3-4

#### PUMP ASSEMBLY TOOLS LIST

301 Piston Ring Compressor	—
302 Lifting Tube or FPLI Lifting Beam	6-24
303 Locating Nut	6-24
304 Volute Lifting Beam	5-3
305 “C” Spanner	2-6
306 Shaft Wrench	6-23
307 Lifting Plate	—
310 Stuffing Box and Expeller Ring	—
Lifting Beam	6-24
311 Shaft Lifting Nut	3-3

A SHAFT WRENCH (306) is supplied with each pump. Other tools listed are not required, though will facilitate pump disassembly/assembly. Contact the factory for price and availability

#### WARMAN PATENTS

To assure optimum performance of Warman pumps and to protect our customers from unknowledgeable, and hence dubious, attempts by others to produce apparent replacement parts for Warman pumps, the following is advised.

Various Warman pump parts are patented under active U.S.A. patents. There may be more Warman pump patent applications pending. Any attempt by others to produce pump parts which are patented by Weir Slurry Inc. will result in vigorous prosecution by Weir Slurry Inc. to the fullest extent that U.S.A. patent law allows.

# PUMP STORAGE PROCEDURES

The storage procedures listed below are to be followed by the purchaser. This is required in order to maintain Weir Slurry Group Inc.'s standard warranty while new or unused pumps are sitting idle for long periods.

## **SHORT-TERM STORAGE PROCEDURE** **For Period of 18 Months or Less**

1. Indoor storage is recommended, especially for elastomer lined pumps.
2. Protect the equipment from temperature and humidity extremes and exposure to excessive dust, moisture and vibration.
3. Rotate the shaft several turns every three to five weeks.
4. Every six months purge the labyrinth with grease to prevent dirt and/or moisture contamination of the bearings.
5. Protect rubber lined pumps from heat, light and exposure to ozone.
6. The suction and discharge flange openings are to be covered unless connected to piping.
7. All external machined surfaces are factory coated with a rust preventative prior to shipment. Maintain the protective coating on these surfaces with Kendall Seal N Sound or a comparable product.
8. For outdoor or excessively unfavorable environment, cover the equipment with some type of protective tarpaulin that will allow proper air circulation.
9. Prior to start-up, inspect the packing to insure that it is satisfactory.
10. Maintain written documentation of labyrinth purging and shaft rotation intervals to be made available to Weir International upon request for warranty validation.

## **LONG-TERM STORAGE PROCEDURE** **For Periods Greater Than 18 Months, But Less than 36 Months**

### **Pumps**

1. Prior to storage, thoroughly drain pumps of any and all water.
2. Indoor storage is required.

3. Protect the equipment from temperature and humidity extremes, and exposure to excessive dust, moisture and vibration.
4. Rotate the shaft several turns every three to five weeks.
5. Every six months purge the labyrinth with grease to prevent dirt and/or moisture contamination of the bearings.
6. Protect rubber lined pumps from heat, light and exposure to ozone.
7. The suction and discharge flange openings are to be covered unless connected to piping.
8. All external machined surfaces are factory coated with a rust preventative prior to shipment. Maintain the coating on these surfaces during storage.
9. For outdoor or excessively unfavorable environment, cover the equipment with some type of protective tarpaulin that will allow proper air circulation.
10. Prior to start-up, inspect the packing to insure that it is satisfactory. After a storage period of 18 months or longer, repacking with fresh dye formed packing is required at customer expense.
11. Maintain written documentation of labyrinth purging and shaft rotation intervals to be made available to Weir upon request.

### **Accessories**

Consult the original manufacturer for specific recommendations on gear drives, electric motors, mechanical seals, etc. Depending on length of storage period, addition of rust inhibitors to oil, connection of space heaters or other requirements may exist to ensure the factory warranty remains valid.

For storage period greater than 36 months, please contact Weir Minerals.



# BEARING ASSEMBLY INSTRUCTIONS

## BEARING ASSEMBLIES ASC, B, C, CAM, D, DAM, DSC, E, EAM, ESC, F, FAM, FG, G, GAM, AND GH

### SIZES ASC, B, C, CAM, D, DAM, DSC, E, EAM, ESC, F, FAM, FG, G, GAM, AND GH

This section contains information for pump designs designated as indicated above and as shown in *Figure 2-1*. The pump bearing configuration consists of opposing tapered roller bearings.

If your pump is newer than 1975 and is of the DD, EE, FF, GG, N, P, Q, R, RS, S, SH, T, TH, or U designation. (Refer to Section 3 for complete information.)

#### **! IMPORTANT !**

Please read before beginning any bearing assembly work. **NOTE - Labyrinth locknut has left hand threads.**

### GENERAL NOTES

When you install new bearings, clean bearing housing, end covers, shaft, etc. so that no foreign material or old grease remains in it. Any lubricant that you add must be absolutely clean. To assure this, the following is suggested.

1. Always keep the cover on grease can so that no dirt can enter.
2. Be sure the instrument with which you take the grease from the can is clean. Avoid using a wooden paddle, but rather use a steel blade or putty knife that can be wiped off smooth and clean.
3. In cases where a grease gun is used to introduce grease into bearing chamber, observe the same caution regarding the cleanliness of the gun, especially the nozzle and the grease fittings.
4. Quantities shown may need to be adjusted based on observations made during normal operation. For reference purposes, one shot from a standard grease gun is approximately one gram.

### ROLLER BEARING CLEANLINESS

More than 90% of all roller bearing failures are due to dirt that has found its way into the bearing, either due to carelessness before or during assembly or by the user after the unit has been placed in operation.

Dirt is made up of diamond hard particles which, when mixed with the lubricants, make a lapping compound. Thus, the revolving acting of the rollers in operation will gradually grind away the original close tolerance of the bearing and destroy the accuracy and efficiency.

The critical period in the life of a bearing occurs when it leaves the stockroom for the assembly bench, because it is going to be removed from its box and protective covering. From this point on, the bearing is at the mercy of the person handling it.

When handling bearings it is very important to have clean hands and clean tools. Keep plenty of clean rags available and use them often. Do not use waste paper, as the lint and short strands adhere too readily to oil surfaces. Keep hands and work area wiped clean.

### OIL LUBRICATED OR FILLED BEARING ASSEMBLIES

Specific instructions for oil lubricated bearing assemblies identified with a "Y" part number suffix are found in manual supplement "BA6". The same for oil filled assemblies with a "K" or "KH" suffix are found in supplement number "BA4". Review this information completely before attempting repairs.

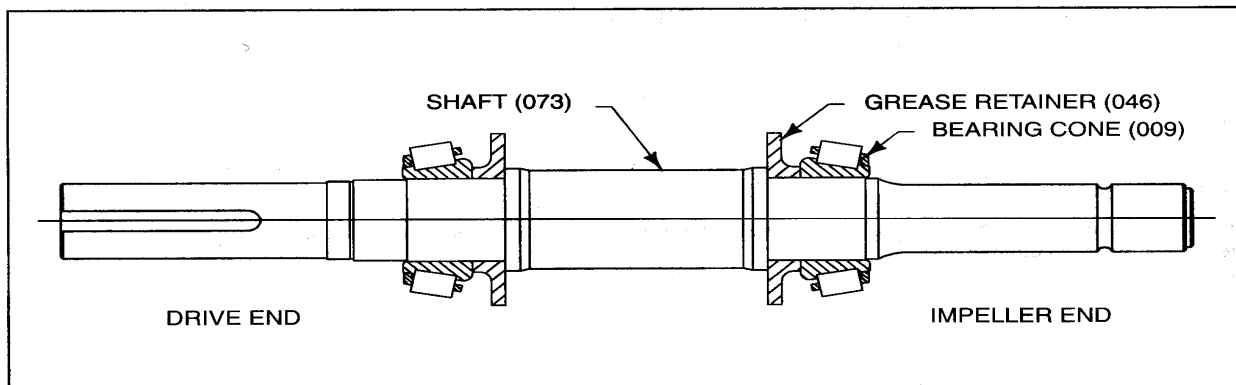


Figure 2-1 • Fitting Grease Retainers and Bearing Cones

#### BEARING ASSEMBLY – FITTING GREASE RETAINERS AND BEARING CONES (Figure 2-1)

1. Apply oil or light grease to the bearing lands on SHAFT(073).
2. Slide on one GREASE RETAINER (046) with the flange against the shaft shoulder.
3. Fit the cone of BEARING (009) to shaft with large diameter against retainer. It is advisable to preheat bearing cone. (Preheat should not exceed 210°F.) Weir suggests using an induction heater or oven to heat the bearings.

With the shaft in a horizontal position, the heated cone can be slipped on and pressed or tapped up to grease retainer.

4. Fit the other grease retainer and bearing cone as described above. It is important to locate both grease retainers hard against shoulders, and locate bearings hard against the grease retainers. You should check this again after bearings cool. Grease retainer should not rotate once the bearing is properly sealed.
5. Spray bearings with dewatering fluid to remove all moisture.

#### BEARING ASSEMBLY – FITTING IMPELLER END BEARING CUP TO HOUSING (Figure 2-2)

1. Apply oil or light grease to bore at each end of BEARING HOUSING (004).
2. Press, or carefully tap with mallet, cup of BEARING (009) into one end of bearing housing until the cup is slightly below the end face of housing.

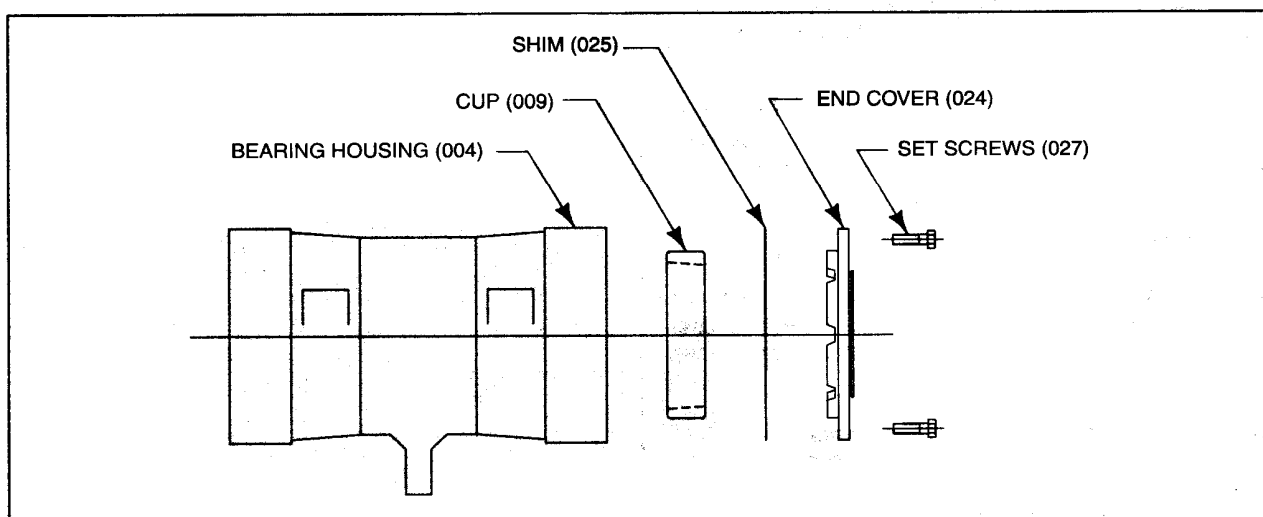


Figure 2-2 • Fitting Impeller End Bearing Cup to Housing

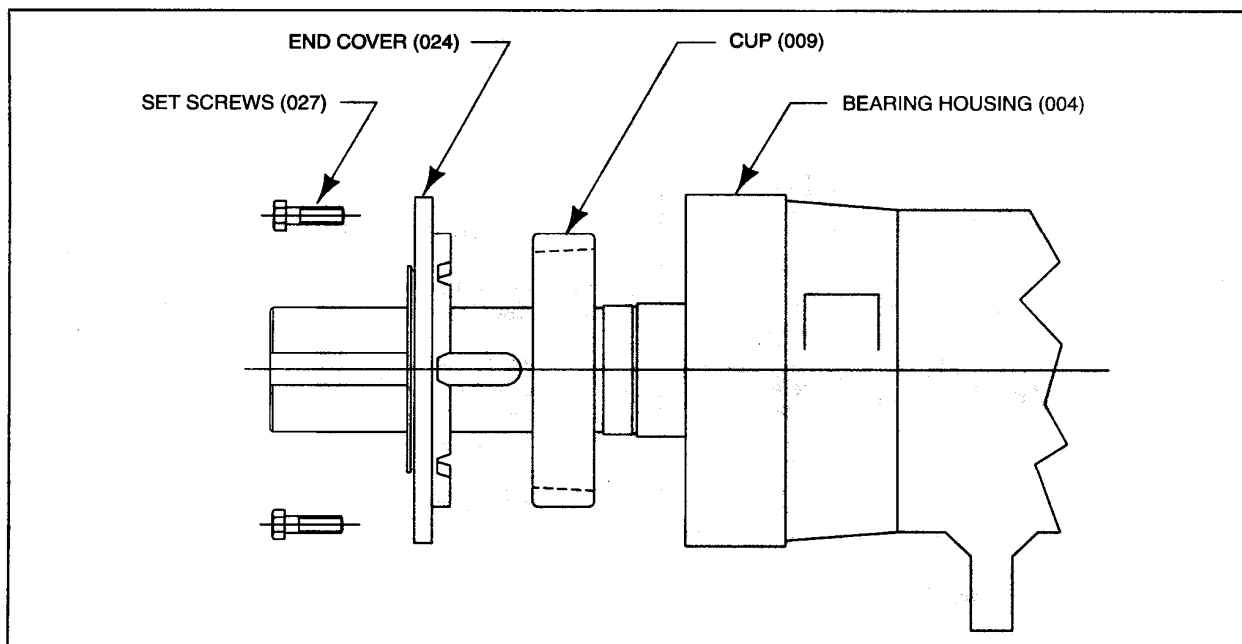


Figure 2-3 • Fitting Shaft to Bearing Housing

Bearing housing is symmetrical and bearing cup can be fitted to either end. **The small diameter of the cup should face out.** For single row taper roller bearings, cups and cones are not matched in sets, and may be interchanged. Assembly will be easier if you support the housing in a vertical position.

3. Place END COVER (024) with one SHIM (025) in housing and insert END COVER SCREWS (027). Use one thick shim only for sealing purposes, usually 0.018" to 0.020".
4. Tighten screws evenly. End cover will push bearing cup into correct position.

#### FITTING SHAFT TO BEARING HOUSING (Figure 2-3)

For assemblies up to C size this procedure can be carried out with housing in horizontal position. For larger sizes, it is advisable to assemble in vertical position so that bearings will fit up concentrically.

1. Obtain recommended type and quantity of grease per bearing. (Refer to Table 1-2).
2. Work this grease by hand into the bearing on the shaft to fill space between cone, rollers, and roller cage. Spread remainder of grease between bearing and grease retainer shown in Figure 2-1.
3. Repeat with other bearing.
4. Fit shaft with threaded (impeller) end into housing.
5. Press or tap remaining bearing cup into housing.

6. Place END COVER (024) into housing and insert END COVER SCREWS (027). Do not use shims at this stage; they will be used later as shown in Figure 2-5.
7. While manually rotating shaft slowly, gradually tighten screws until bearing cup has been pushed right up to bearing cone. The shaft should barely rotate and bearings should have virtually no end play.

#### **! CAUTION !**

**Do not over-tighten screws. Damage to the bearings may result.**

#### GAP MEASUREMENT (AT DRIVE END)

1. Measure the gap between end cover flange and housing face with feeler gauges as shown in Figure 2-4. Providing screws have been tightened evenly, this measurement method is usually satisfactory.
2. Remove the end cover.
3. Select SHIMS (025) of a total thickness equal to the gap measurement (obtained above) plus regular end play as shown in Table 2-2.
4. Fit shims, replace end cover, and insert end cover bolts. Temporarily install bolts to within approximately 1/8" of fully tightened position.

#### **NOTE**

Any other method of determining required thickness of shims may be used provided the final true end play between the bearings is obtained as shown in Table 2-2.

An alternate method of obtaining the correct end play is to install all shim supplied in the shim set under the drive end cover. One shim should be installed under the impeller end cover for searching. End play can then be checked and shims removed until the correct end play is achieved.

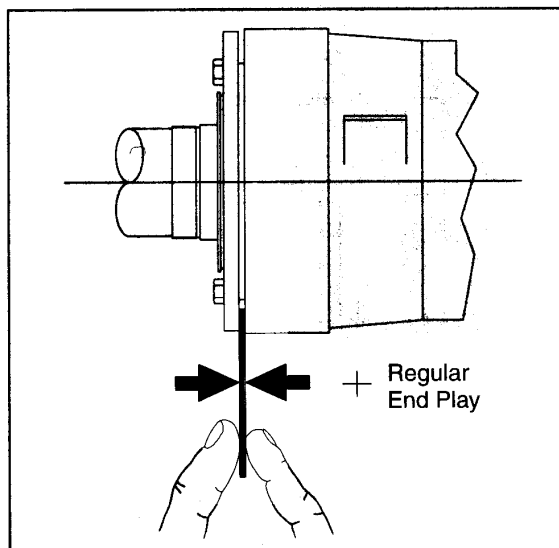


Figure 2-4 • Gap Measurement

COLOR	SHIM THICKNESS (in inches)
RED	.002
GREEN	.003
TAN	.004
BLUE	.005
TRANSPARENT	.0075
BROWN	.010
PINK	.015
YELLOW	.020
WHITE	.025

Table 2-1 • End Cover Shim Thickness

## NOTE

The END COVER SHIMS (025) are color coded by thickness. Table 2-1 below gives the thickness of the various colors. Some bearing assemblies are fitted with brass shims. In this case it may be necessary to measure the shims to determine their thickness.

## ADJUSTMENT OF BEARING CUP (\*Best Method)

With shims inserted, you must now move the drive end bearing cup back to the end cover to provide bearing end play.

1. Press or gently tap the shaft at threaded (impeller) end until bearing cup at opposite end has moved back to the loosely fitted end cover (see Figure 2-5). Be careful not to damage thread.
2. Tighten end cover bolts of loosely fitted end cover evenly to move the bearing cup into correct position. Both bearing cups should now be tight against their respective end covers and correct end play obtained.

SIZE	* END PLAY (COLD)	
ASC	.002" - .004"	(.050 - .102 mm)
B	.004" - .006"	(.102 - .152 mm)
C, CAM	.004" - .006"	(.102 - .152 mm)
D, DAM, DSC	.005" - .007"	(.127 - .178 mm)
E, EAM, ESC	.007" - .009"	(.178 - .229 mm)
F, FAM, FG	.010" - .012"	(.254 - .305 mm)
G, GAM, GH	.014" - .016"	(.356 - .406 mm)

Table 2-2 • Table of Regular End Play

\* For bearing assembly part numbers ending in "SYN", end play range should be set to the maximum value indicated in above chart plus .002" minus .000" (+0,05 / - 0,00 mm).

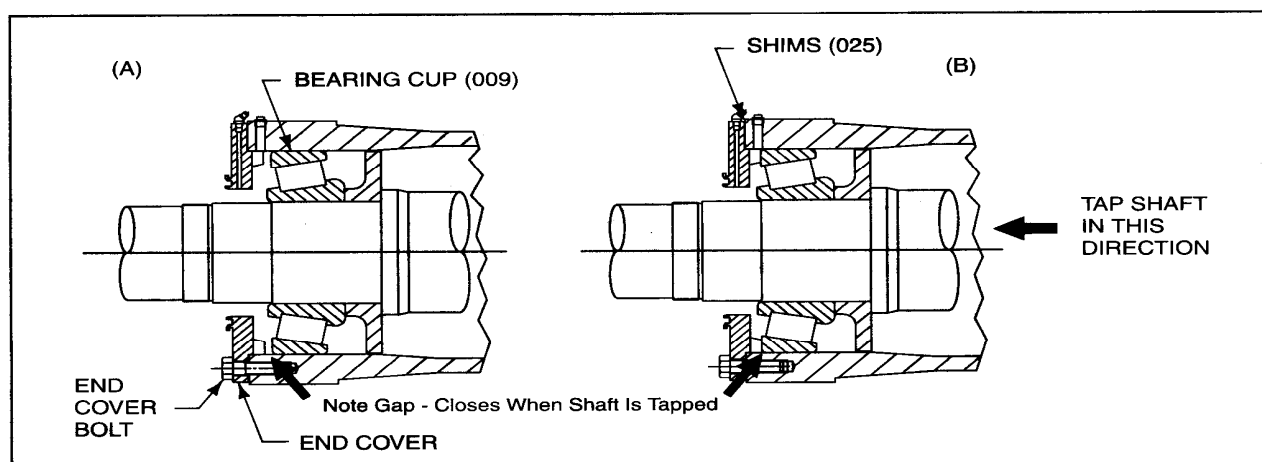


Figure 2-5 • Adjustment of Bearing Cup

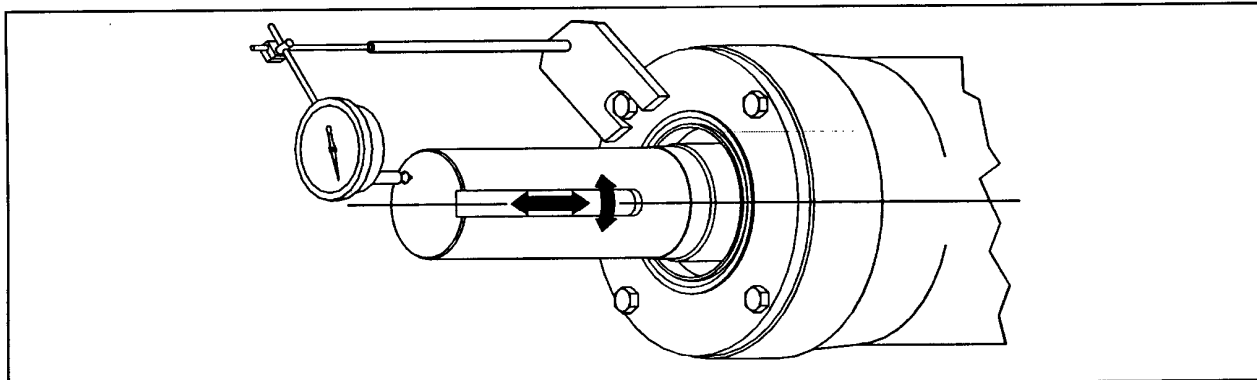


Figure 2-6 • End Play Measurement

### BEARING ASSEMBLY – END PLAY MEASUREMENT

Having moved the drive end bearing cup back to the end cover as shown in *Figure 2-5(B)* and fully tightened all screws, it is now necessary to measure the actual end play in the bearing assembly.

**Sizes – ASC, B, C, CAM, D, DAM, DSC, E, EAM, ESC**

1. Set up bearing assembly in horizontal position with housing held firmly. Hold in bench vice if possible.
2. Attach a mounting bracket with a dial indicator micrometer securely to the housing by means of one screw (027). Position dial actuating pin against end of shaft.
3. Manually rotate the shaft and push it hard backward and forward several times to establish a consistent dial reading. Note total movement.

**Sizes – F, FAM, FG, G, GAM, GH**

1. Due to size and weight, it is best to place the bearing assembly in a vertical position as shown in *Figure 2-7*, impeller end up. Support the assembly at the lower end cover with shaft free. The whole assembly must be located in a position where it can be reached by a hoist.
2. Hold the shaft tightly and screw on the SHAFT LIFTING NUT (311).
3. Attach mounting bracket with dial indicator as described above or use a magnetic base with an extension.
4. Move shaft up and down by lifting the whole assembly off the support by means of the hoist and then lowering it back onto the support. The bearing housing should be rotated to ensure an accurate reading. Observe maximum and minimum readings on dial indicator. Repeat several times until readings become consistent. Note total movement.

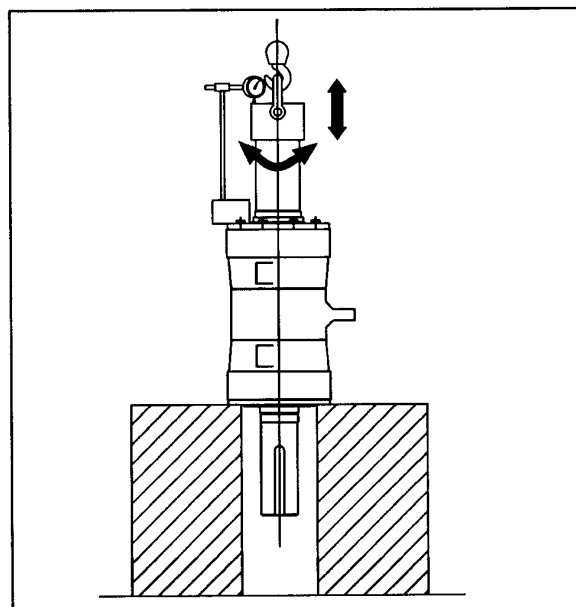


Figure 2-7 • Checking End Play

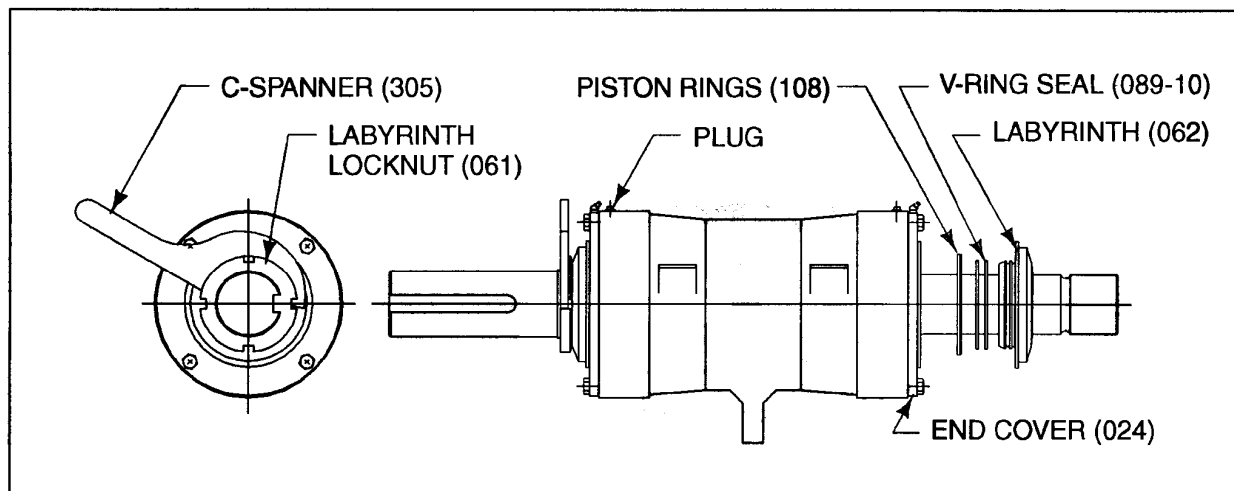


Figure 2-8 • Fitting Labyrinths, Piston Rings and Locknuts

#### ALL SIZES

If the end play is outside the regular limits indicated in *Table 2-2*, shims must be added or removed as required (at drive end):

If shims have to be removed, reposition end cover and tighten screws after removal of shims.

If shims have to be added, follow procedure for fitting shims and moving bearing cup back to end cover as shown in *Figure 2-5(B)*. After readjusting endplay with shims, measure the actual play again with the dial indicator.

#### BEARING ASSEMBLY TYPE "-10" – FITTING LABYRINTHS, V-RINGS, PISTON RINGS AND LOCKNUT (Figure 2-8)

#### FOR PUMPS MANUFACTURED FROM JUNE 1, 1990 TO PRESENT

The Type "-10" bearing assembly incorporates a v-ring seal (see *Figure 2-10*) in combination with piston rings. This positive contact seal improved on the piston ring/labyrinth design with regard to keeping contaminants out of the bearings. These bearing assemblies use a labyrinth with a profile matching the bearing end cover and are identified with a "-10" suffix on the part number. Any older unit can be retrofitted to the current design so long as both the labyrinth and bearing end cover are replaced with "-10" parts. In some cases a change in release collar is needed as well. Failure to do so will prevent free rotation of the shaft upon reassembling.

#### NOTE

Pumps supplied after November 1, 1990 may have 'hook' piston rings supplied (see *Figure 2-9*). These are hooked together in Step 1 below and do not require compression described in Step 4

1. Smear PISTON RINGS (108) with bearing grease and fit into the grooves of each LABYRINTH (062-10). Position ring grooves diametrically opposite.

#### NOTE

Some DAM and all FAM or GAM assemblies have a different style of labyrinth at the two ends of the bearing assembly. Check Pump Components Diagrams for specific details.

2. Refer to *Figure 2-10* for correct placement of v-ring seal in labyrinth or end cover, depending on site.
3. Slide labyrinths over shaft and push into end cover until piston ring prevents further entry.

#### NOTE

Position piston ring gaps away from main grease feed hole in end cover.

4. Compress rings, then push labyrinths into end cover and against bearing cone.
5. Fit LABYRINTH LOCKNUT (061) to drive end and tighten with C-SPANNER (305). **NOTE – Labyrinth locknut threads are left handed.**
6. Fit SQUARE HEAD PIPE PLUGS to bearing housing and GREASE FITTINGS to the end covers.
7. Pump grease into each end cover to flush labyrinth. BEARING ASSEMBLY now takes Warman Basic Part Number 005 and should be ready for installation.

# **BEARING ASSEMBLY – FITTING LABYRINTHS, PISTON RINGS, AND LOCKNUT (Figure 2-8)**

## **FOR PUMPS MANUFACTURED PRIOR TO JUNE 1, 1990**

1. Smear PISTON RINGS (108) with bearing grease and fit two rings to the grooves of each LABYRINTH (062). Position ring gaps opposite each other.

### **NOTE**

Some DAM and all FAM or GAM bearing assemblies have different types of labyrinths at either end. See component diagram for specific details.

2. Slide labyrinths over shaft and push into end cover until piston ring prevents further entry.
3. Compress rings and push labyrinths into bearing end covers.
4. Thread LABYRINTH LOCKNUT (061) on shaft drive end and tighten using C-SPANNER (305). **Threads are left handed.**
5. Fit GREASE FITTINGS to end covers and pipe plugs to inboard bearing housing. (Refer to Figure 1-2).

The BEARING ASSEMBLY now takes Warman Part Number (005) and should be ready for installation.

### **NOTE**

Sizes ASC, B, C, CAM, CSC, D, DAM, DSC, E, EAM, ESC, F, FAM, FG, G, GAM and GH were revised in 1981 to include a new purge fitting arrangement similar to the arrangement used on Sizes DD, EE, FF, GG, N, Q, R, RS, S, SH, TH and U.

Refer to Figure 1-3c for design prior to 1981.

If the bearing assembly is shown in Figure 1-3a or 1-3b, note that it is equipped with a grease purge fitting located in the end covers. In addition, there is a pipe plug just inboard of the grease purge fitting at each end of the bearing housing.

This plug should be removed only for inserting bearing lubricant (based on judgment and experience, and guideline from Table 1-1). Use only recommended, clean grease.

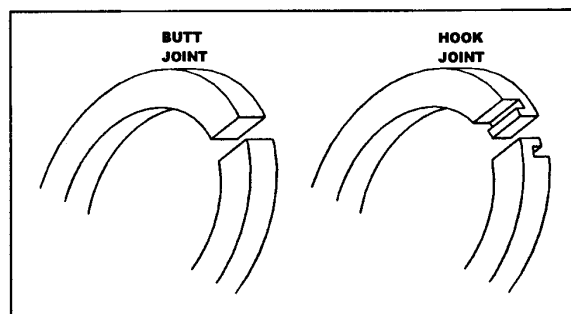


Figure 2-9 • Piston Ring Seals

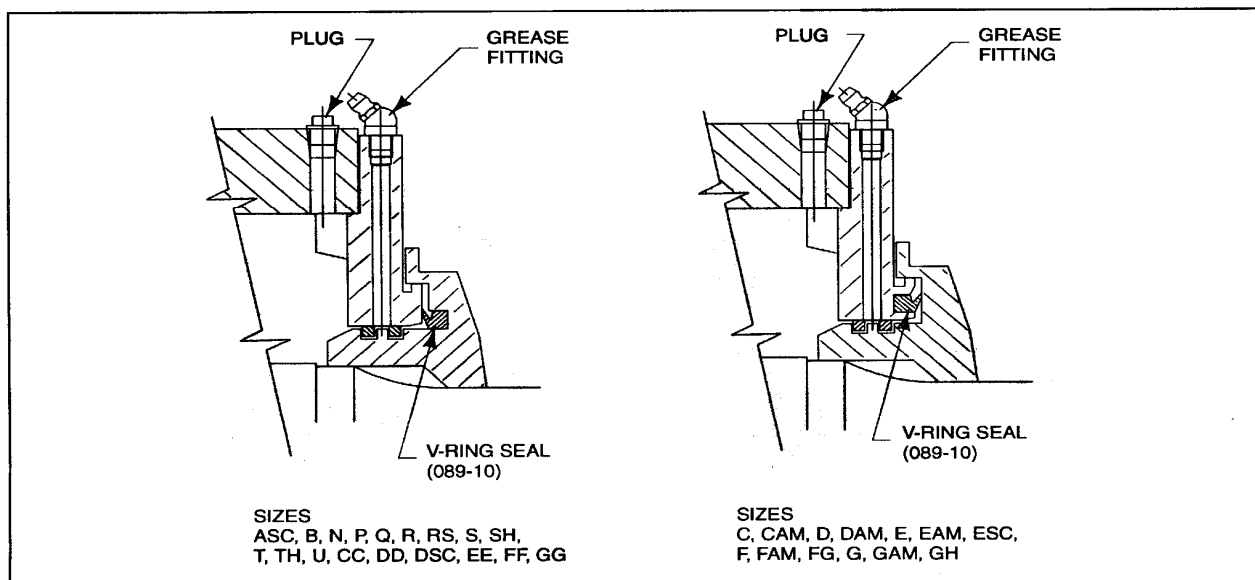


Figure 2-10 • V-Ring Seals

# BEARING ASSEMBLY INSTRUCTIONS

## BEARING ASSEMBLIES N, P, Q, R, RS, S, SH, T, TH, U, CC, DD, EE, FF, AND GG

### SIZES N, P, Q, R, RS, S, SH, T, TH, U, CC, DD, EE, FF, AND GG

The information provided in this section pertains to bearing assemblies built from 1976 to present. See *Figure 3-1* for bearing configuration.

If your pump was built prior to the year 1976, refer to Section 2 for complete assembly instructions.

### **! IMPORTANT !**

Read before beginning any bearing assembly work.

### GENERAL NOTES

When installing new bearings, clean bearing housing, end cap, shaft, and all details entering into the assembly so that no dirt, protective coating, or grease adheres to it.

Do not wash out the factory applied lubricant which the bearing is greased with. The manufacturer used a high grade non-acid lubrication, free from all chemicals and impurities that might cause corrosion. Any lubricant that you add must be absolutely clean. To assure this, the following procedures are recommended.

1. Always keep the cover on grease can so that no dirt can enter.
2. Be sure the instrument with which you take the grease from the can is clean. Avoid using a wooden paddle. Use a steel blade or putty knife that can be wiped off smooth and clean.
3. In cases where a grease gun is used to introduce grease into bearing chamber, observe the same caution regarding the cleanliness of the gun – especially the nozzle and the grease fittings.
4. Quantities shown may need to be advised based on observations made during normal operation. For reference purposes, one shot from a standard grease gun is approximately one gram.

### ROLLER BEARING CLEANLINESS

More than 90% of all roller bearing failures are due to dirt that has found its way into the bearing, either due to carelessness before or during assembly, or by the user after the unit has been placed in operation.

Dirt is made up of diamond hard particles which, when mixed with the lubricants, make a lapping compound. Thus, the revolving action of the rollers in operation will gradually grind away the original close tolerance of the bearing and destroy the accuracy and efficiency.

The critical period in the life of a bearing occurs when it leaves the stockroom for the assembly bench, because it is going to be removed from its box and protective coating. From this point on, it is going to be at the mercy of the person handling it.

When handling bearings, it is very important to have clean hands and clean tools. Keep plenty of clean rags available and use them often. Do not use waste paper, as the lint and short strands adhere too readily to oil surfaces. Keep hands and work area wiped clean.

### NOTE

Each bearing arrangement on these pump shafts is a complete assembly, and the parts (cones, cup and spacer) must be assembled as a unit and not mixed or interchanged with parts from other assemblies.

### OIL LUBRICATED OR FILLED BEARING ASSEMBLIES

Specific instructions for oil lubricated bearing assemblies identified with a "Y" part number suffix are found in manual supplement "BA6". The same for oil filled assemblies with a "K" or "KH" suffix are found in supplement number "BA4". Review this information completely before attempting repairs.



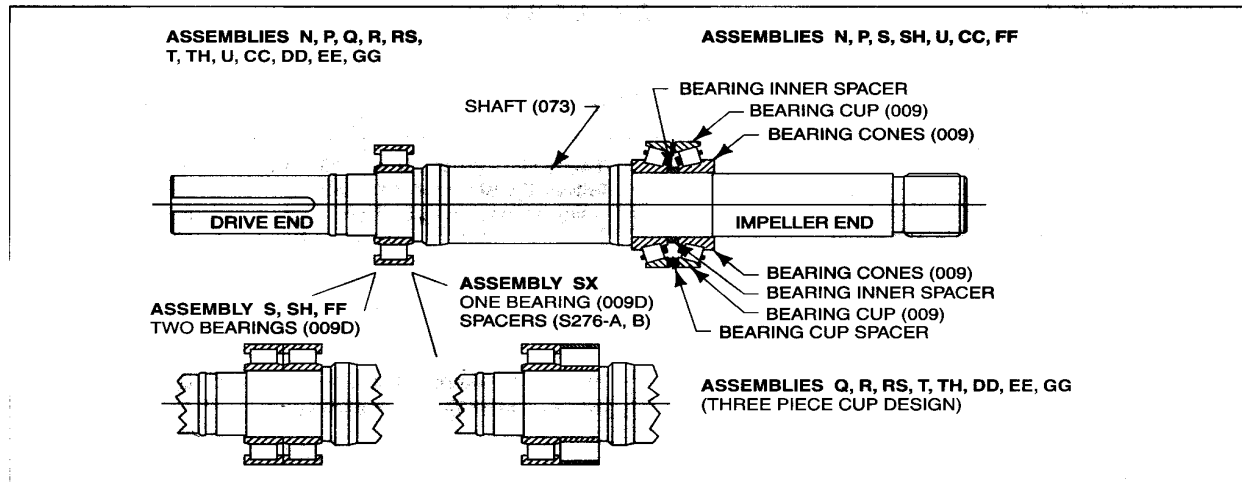


Figure 3-1 • Fitting Drive and Impeller End Bearing Assemblies

## BEARING ASSEMBLY

### FITTING OF DRIVE END INNER RING BEARING AND IMPELLER END BEARING (Figure 3-1)

1. Inspect the bearing journals of the shaft (073) for burrs, removing any with fine emery cloth before proceeding. Apply oil or light grease to the journals.
2. It is recommended to preheat the bearing inner races and cones. (Preheat should not exceed 210°F.) Weir suggests using an induction heater or oven to heat the bearings. See note regarding match numbers in Item 4 before proceeding.
3. Fit inner race of BEARING (009D) to drive end of shaft against shoulder.

For Bearing Assemblies S, SH, and FF, fit two inner races to drive end of shaft against shoulder.

On certain applications, for S frame pumps, only one drive end bearing is fitted. In this case, fit BEARING INNER SPACE against the shaft shoulder, then fit one (1) drive end bearing (009D) inner race on the shaft. This is designated as an "SX" frame.

With the shaft in vertical position, slip on the heated inner race or cones, and press or tap up to the shoulder.

4. Turn shaft end for end (impeller end up). Fit one cone of BEARING (009) with large diameter against shaft shoulder as shown in Figure 3-1.

Bearings (009) are provided with spacers and, as such, are preset assemblies. The spacers are furnished to size for each bearing assembly to provide the correct fitted end play. Components are **not** interchangeable with similar assemblies. Each component bears an identifying serial number engraved on it. **All parts with the same serial number must be kept together.**

The cup(s) and cones are further identified with a match number after the serial number (usually "-A" or "-B"). During installation the cones must be matched to the cup, or in the case of a three piece cup, the correct section. It is the fitment between the cones and cup(s) that determine the bearing inner spacer width, and in turn the final end play of the assembly. Thus, it is critical matching numbers are closely observed.

Some small preset assemblies are not marked with serial numbers or match marked, but are **still not interchangeable**.

Fit the cone spacer of BEARING (009) on the shaft against smaller end of cone as shown in Figure 3-1. For bearing assemblies using a one piece cup, check for the correct match number, if applicable, and fit the cup over the cone. With those having a three piece cup, match the cup to the cone, if applicable, and place over the cone. Follow up with the cup spacer and the remaining cup.

5. Fit the second cone of BEARING (009) on the shaft with the smaller end of the bearing against the spacer. It is important that the cones and spacer are located hard against one another and against the shaft shoulder.
6. Spray the bearing with dewatering fluid to remove all moisture.
7. Manually work recommended grease into bearing from both sides until grease appears through holes in the cup. Refer to Table 1-2 for recommended quantities.

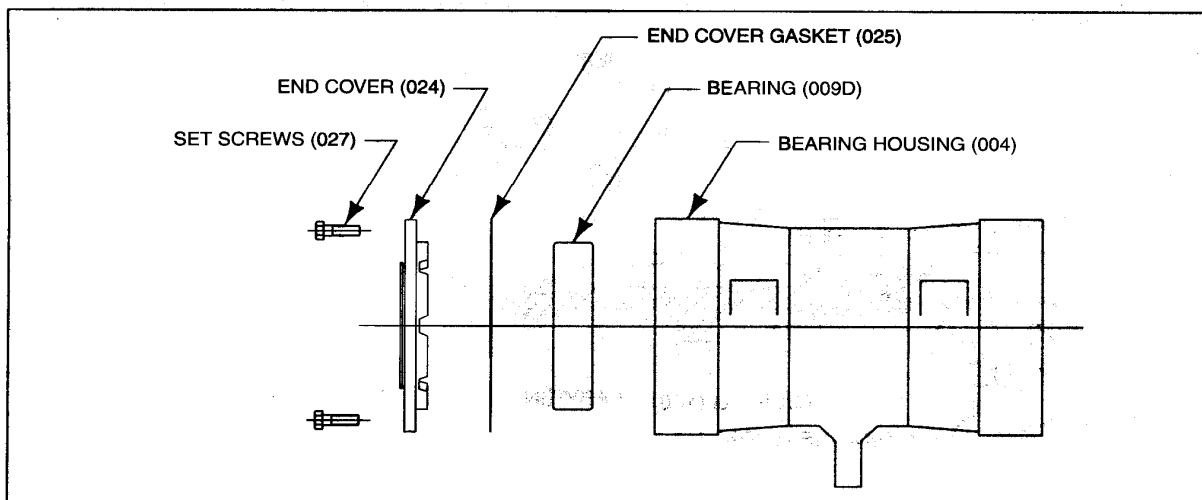


Figure 3-2 • Fitting Drive End Outer Bearing to Housing

#### FITTING OF DRIVE END OUTER BEARING TO HOUSING (Figure 3-2)

1. Apply light grease or oil to drive end bore (marked DRIVE END) of BEARING HOUSING (004).
2. Stand housing with drive end up. Fit outer BEARING (009D) and evenly tap it with a soft hammer against housing shoulder. For S, SH & FF assemblies, fit two outer rings of BEARINGS (009D). Certain S assembly applications have only one drive end bearing. Fit and tap in the OUTER BEARING SPACER before fitting the single outer bearing ring. This is designated as an "SX" assembly.
3. Work recommended bearing grease into bearing(s) in housing, applying a liberal amount inside bearing(s). Leave the space between the grease retaining shoulder in housing and the bearing half empty. Refer to Table 1-2 for recommended quantities.
4. Lightly grease inside surfaces of END COVER (024).
5. Place end cover with END COVER GASKET (025) in housing, insert END COVER SCREWS (027), and tighten evenly.

#### FITTING SHAFT TO BEARING HOUSING (Figure 3-3)

1. Place bearing housing on two wooden blocks with fitted end cover down as shown in Figure 3-3. Clean and lightly grease bearing bore.
2. Screw SHAFT LIFTING NUT (311) onto the impeller end of shaft, and by means of a hoist, lift shaft carefully into housing. Tap bearing until it rests against the bearing housing shoulder.

3. For T and TH assemblies, fit the BEARING SLEEVE (T008) into bearing housing and tap until it rests against bearing cup.
4. Lightly grease inside surfaces of END COVER (024).
5. Place END COVER with END COVER GASKET (025) into the housing. Insert END COVER SCREWS (027), and tighten evenly.

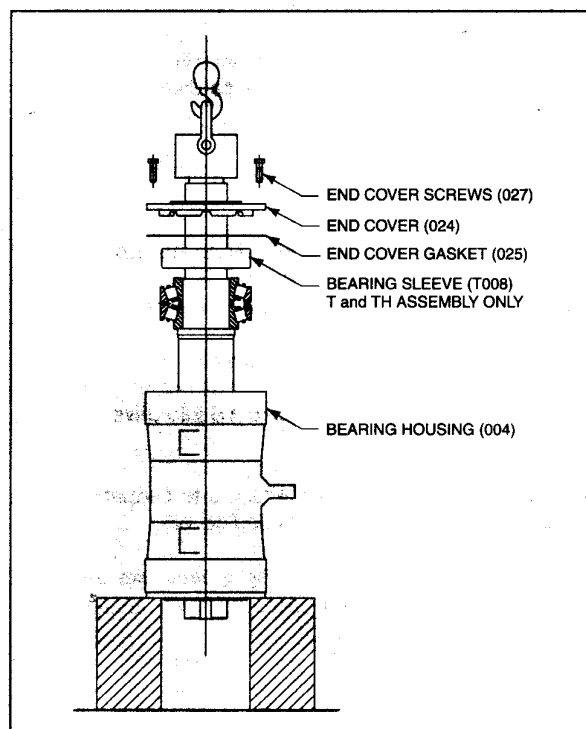
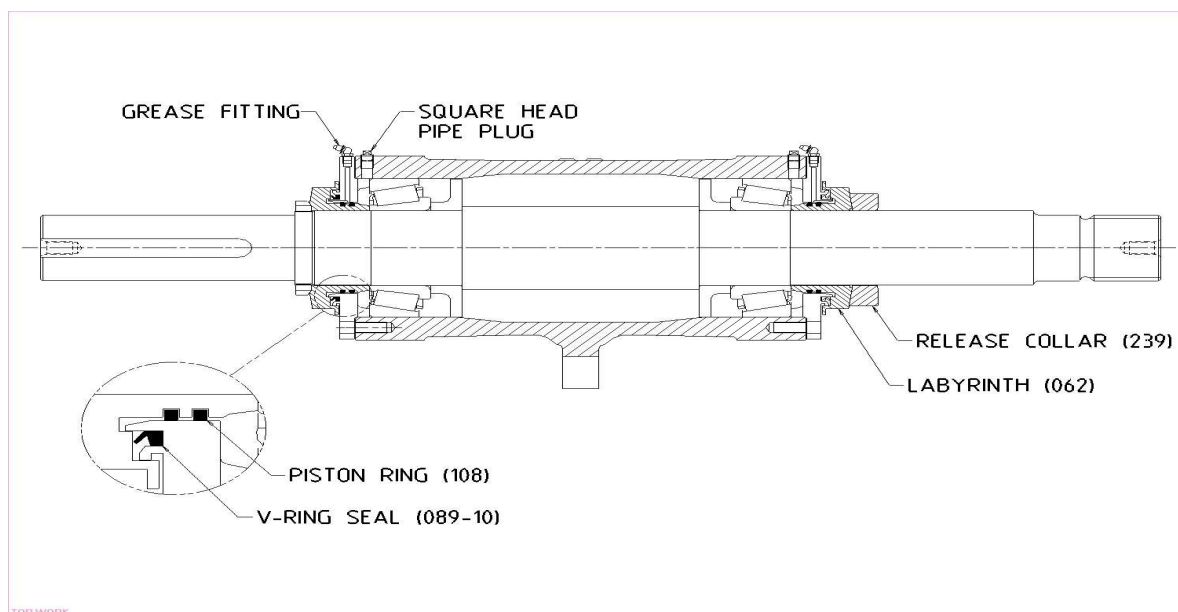


Figure 3-3 • Fitting Shaft to Bearing Housing



**Figure 3-4 Fitting Labyrinths, V-Rings, Piston Rings and Locking Screws**

#### FITTING LABYRINTHS, PISTON RINGS, AND LOCKING SCREWS (Figure 3-4)

##### NOTE

Pumps supplied after November 1, 1990 may have 'hook' style piston rings supplied (see Figure 2-8). These are hooked together in Step 1 below and do not require compression as described in Step 3 below.

1. Smear PISTON RINGS (108) with grease and fit two rings to the grooves of each LABYRINTH (062) and (062D). Position piston ring gaps diametrically opposite.
2. Fit V-RING SEAL (089-10) into groove in each labyrinth. (Refer to Figure 1-3a.)
3. Slide labyrinths over shaft. Note the LABYRINTH (062D) is fitted to the drive end. Push labyrinths into end cover until it is tight against the piston ring.
4. Compress rings, then push labyrinths into end covers.
5. Fit two SOCKET HEAD SCREWS into drive end labyrinth and lock to shaft.
6. Fit SQUARE HEAD PIPE PLUGS to bearing housing and GREASE FITTINGS to end covers.
7. Slowly rotate shaft and pump grease into each end cover to flush labyrinth.

The BEARING ASSEMBLY now takes Warman part number 005 and should be ready for installation.

#### CHECKING BEARING FITTED END PLAY

Although bearing assemblies are fitted together and require no adjustment, we strongly recommend the fitted end play be checked against values as tabulated below.

BEARING ASSEMBLY FITTED END PLAY		
N005	.0020" - .0045"	(.050 - .110 mm)
P005, CC005	.0030" - .0062"	(.074 - .159 mm)
Q005, DD005	.0040" - .0065"	(.102 - .165 mm)
R005, RS005, EE005	.0040" - .0080"	(.081 - .152 mm)
S005, SH005 FF005	.0024" - .0070"	(.061 - .178 mm)
T005, TH005, GG005	.0065" - .0090"	(.165 - .229 mm)
U005	.0075" - .0122"	(.191 - .312 mm)

*Table 3-1 • Bearing Assembly Fitted End Play*

Before measuring the fitted end play, it is necessary to have pressure against the labyrinth (impeller end) while testing. This ensures that the bearing cone (impeller end) remains in its correct position on the shaft, and the end play, whatever it may be, will remain constant. Perform the following procedure:

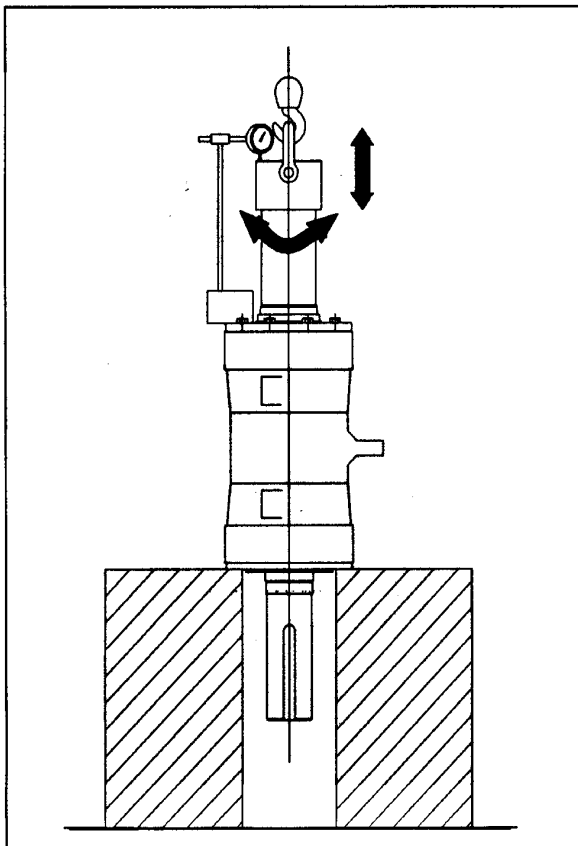
1. For S, SH, FF, T, TH, GG and U bearing assemblies only, join the three segments of RELEASE COLLAR (239) with its socket head cap screws and tighten securely. Refer to Section 5, pages 6 and 7 for complete release collar installation and disassembly instructions.

2. Fit the tapered side of the assembled release collar against the labyrinth.
3. Slip a piece of tube over the shaft, against the release collar, hold tightly and screw the SHAFT LIFTING NUT (311) on the impeller thread. If the release collar is not used on your assembly, the tube will go up directly against the labyrinth. This will prevent axial movement of the thrust bearing.

#### NOTE

The release collar (when required) must be fitted; otherwise the angled bearing surface on the labyrinth may be damaged.

4. Stand assembly, impeller end up, on two wooden blocks. The whole assembly must be located in a position where it can be reached by a hoist.
5. Attach a dial indicator to the assembly so the relative axial movement between shaft and housing can be measured. It is suggested that a dial indicator with a magnetic base is used. The base can be clamped to the bearing end cover and the stem of the dial indicator positioned on top of the SHAFT LIFTING NUT (311).



**Figure 3-5 • Checking End Play**

6. Move the shaft up and down by lifting the whole assembly off the support by means of the hoist, then lowering it back onto the support. Observe maximum and minimum readings in dial indicator. Repeat several times until readings become consistent. Note total movement and check that it is within values given in *Table 3-1*. If the total movement is outside these limits, review the assembly procedure. More often the total end play is excessive and can be traced to gaps between bearing components or the shaft shoulder. Disassemble the unit, press bearings further on the shaft, and reassemble. If end play is less than the minimum, which is unlikely, ensure you are exerting sufficient force on the shaft. If there is no change the bearing spacers must be checked for proper match numbers. Replace the entire bearing set if end play remains under the minimum required.

# FRAME ASSEMBLY INSTRUCTIONS

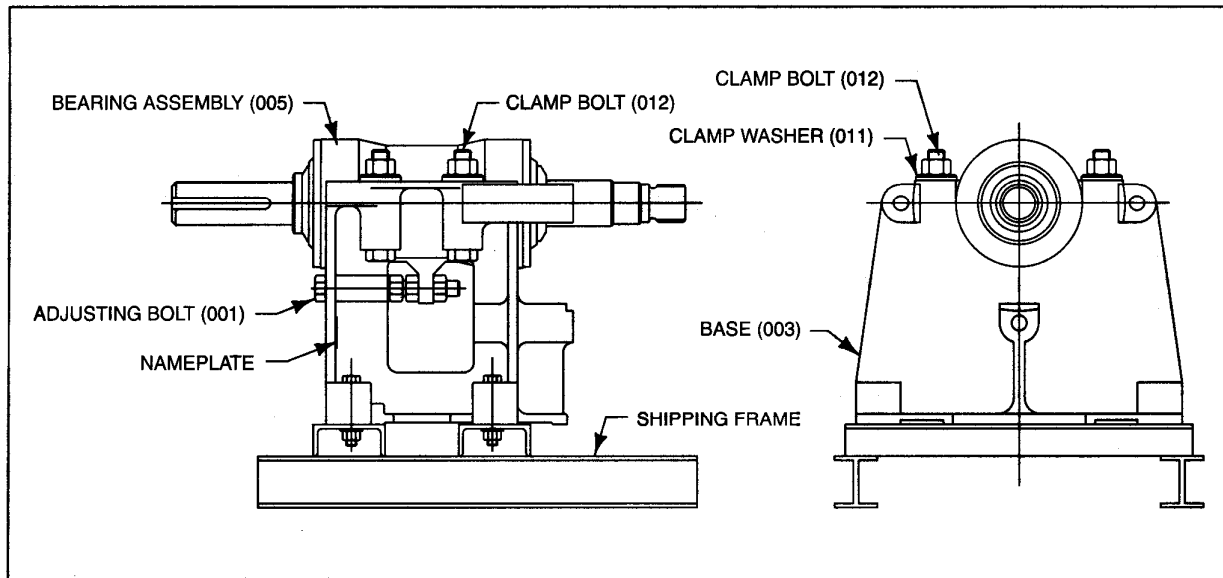


Figure 4-1 • Fitting Bearing Assembly to Base

## FITTING BEARING ASSEMBLY TO BASE (Figure 4-1)

### NOTE

Apply an anti-seize lubricant to threads and nuts of any bolts or studs used in the assembly to facilitate later removal.

1. Insert ADJUSTING SCREW (001) in BASE (003) from outside. Screw on one nut and fully tighten. Then screw on two additional nuts with two flat washers in between. These nuts are to be left loose and maximum distance apart.
2. Apply grease to the machined surfaces (bearing housing support cradle) in the base.
3. Lower the BEARING ASSEMBLY (005) onto the base. Line up machined surfaces of housing with surfaces in base. Check that the bearing housing lug fits over the adjusting screw in base and is also between nuts and washers.
4. Fit CLAMP BOLTS (012) through base from underneath. Drop CLAMP WASHER (011) over each bolt (domed side up) and screw on nuts.

Fully tighten "A" side clamp bolts as shown in Figure 6-18.

The "B" side bolts should not be tightened yet. Leave these bolts snug to maintain alignment and to allow axial movement.

5. Grease shaft protruding from labyrinth at impeller end. This application of grease will assist fitting and removal of shaft components and prevent moisture damage to the shaft.
6. Fit two pieces of timber to the underside of the base or use the appropriate shipping frame as shown in Figure 4-1 to prevent the pump from tipping forward during assembly of the wet end.

Check that the base is at sufficient height from the floor to allow assembly of wet end parts.

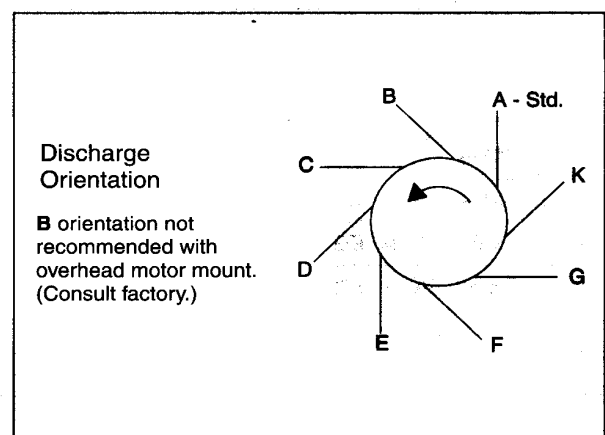


Figure 4-2 • Discharge Orientation Options When Facing Suction Side

### FITTING FRAME PLATE AND COVER PLATE BOLTS

1. Fit FRAME PLATE Adapter (380) used on most XU Pumps prior to fitting frame plate to base, making certain that the frame plate shoulder has engaged with the corresponding BASE RECESS. Except for a few smaller sizes, all pumps have provisions for locating the discharge at 45° increments from true vertical. (Refer to Figure 4-2.) Due to their size, the 20/18 TUAHP and 16/14 TUAHP pumps allow only the "C" and "G" discharge orientation.
2. Insert FRAME PLATE STUDS (039) or FRAME PLATE BOLTS (034), depending on the pump being certain that the largest diameter end is closest to the frame plate. (Refer to Figure 4-3.) Fit nuts and tighten to torque value on Table 4-1.

On some pumps, the frame plate is bolted externally (studs are used). In other pumps, bolts are used and are inserted from inside the frame plate.

3. For rubber lined pumps only, fit COVER PLATE BOLTS (015) through frame plate bosses, screw on nuts, and tighten fully.

### PUMPS FITTED WITH MECHANICAL SEALS

When installed, review the seal manufacturer's instructions for seal removal and installation prior to proceeding. Shaft concentricity is of particular importance.

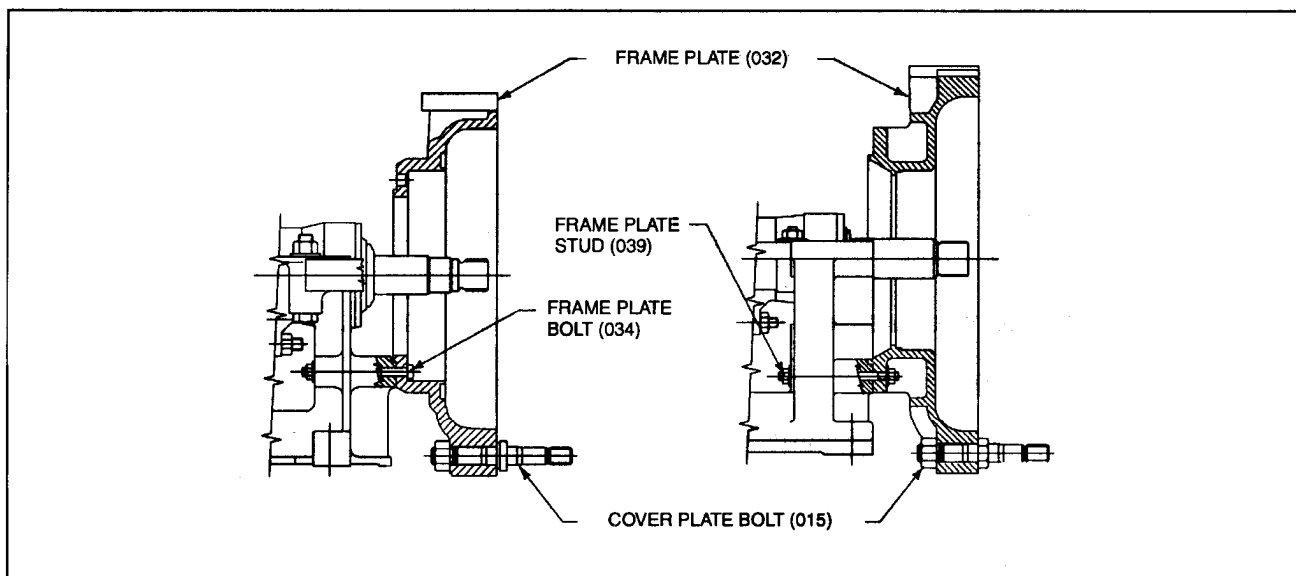


Figure 4-3 • Fitting Frame Plate and Cover Plate Bolts

BOLT	SIZE	TORQUE Ft Lb/Nm
B039, A034	1/2	40/54
C039, N039, P039	5/8	80/109
D039, D034, DH034, DG039	3/4	130/176
E039, EU039, E034, EG039	1	190/258
F039, FH039, F034, S039, RS039, S034, FG034, FG039	1-1/4	380/516
FAM039, G039, T039, ST039, G034, GD039	1-3/4	750/1017
GAM039, H039, H034, TU034, U034	2-1/2	1000/1356
J039	3-1/2	3000/4068

Table 4-1 • 034 and 039 Bolt Torquing Table

# GLAND SEAL ASSEMBLY

Depending on the application, a variety of pump shaft seals are available:

- Stuffing Box Gland
- Centrifugal Seal, Metal Expeller Ring
- Centrifugal Seal, Rubber Expeller Ring
- Centrifugal Seal with Restricted Water Assist
- Mechanical Seal

## NOTE

Apply an anti-seize lubricant to threads and nuts of any bolts or studs used. Apply also to the bare shaft before installing the shaft sleeve or spacer. Avoid contact with elastomer components as most lubricants are petroleum based.

## GLAND ASSEMBLY

**FITTING STUFFING BOX, LANTERN RESTRICTOR, PACKING GLAND, SHAFT SLEEVE, SHAFT SPACER, AND SHAFT SLEEVE O-RING.**

## PUMPS

20 AL	50 BL	75 CL
100 DL	150 EL	200 EM
200 FM	250 FL	250 EL
1.5/1 BAH	2/1.5 BAH	3/2 CAH
4/3 CAH	4/3 DAH	6/4 DAH
6/4 EAH	8/6 EAH	8/6 FAH
12/10 GAH	14/12 GAH	3/2 DHH
3/2 QHH	4/3 EHH	6/4 EAHP
8/6 FAHP		

Refer to *Figure 5-1* for the following assembly procedures:

1. Place the STUFFING BOX (078) flat on bench (gland side up).
2. Place the LANTERN RESTRICTOR (118) small diameter down so it rests on retaining lip in gland recess.
3. Stand the SHAFT SLEEVE (075) on end and place it through the lantern restrictor.
4. Fit PACKING RINGS (111). Make sure the packing rings are the correct length to fill annulus. The packing rings must be flattened separately, with joints staggered.
5. Assemble the GLAND (044) halves by inserting GLAND CLAMP BOLTS (126), fully tightening them. Place the gland into the stuffing box, pushing it down to compress packing rings. Insert GLAND BOLTS (045) and just snug nuts to hold shaft sleeve.
6. Fit the SHAFT SLEEVE O-RING (109) onto the bearing shaft and slide up to the labyrinth.
7. Insert assembled stuffing box into frame plate, tapping into position with a mallet. Locate the stuffing box with the water connection at top.

The shaft sleeve will probably remain forward. It should be pushed back to the labyrinth and shaft sleeve o-ring.

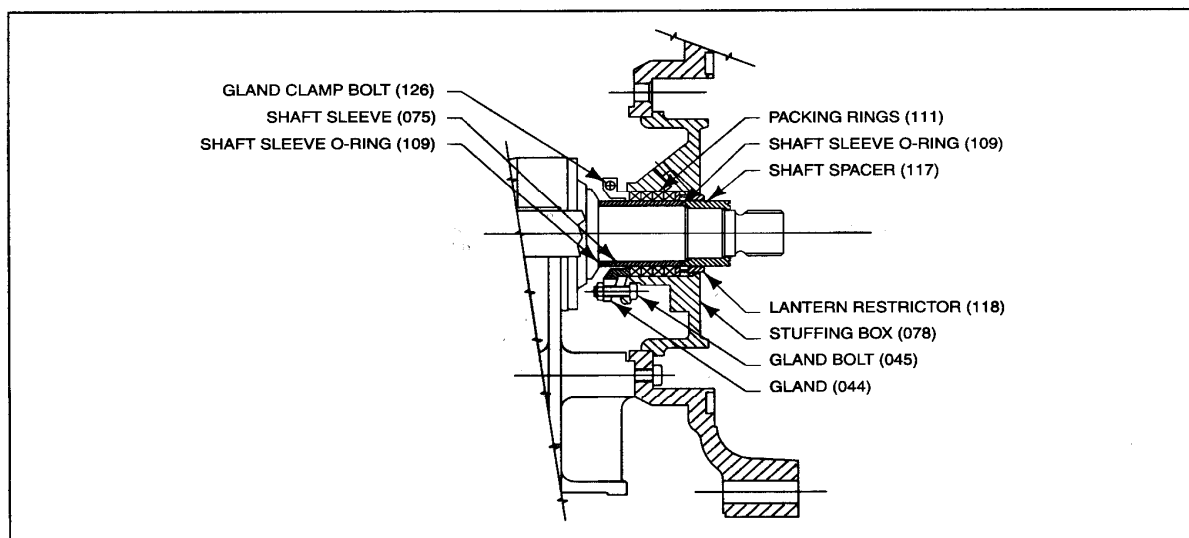


Figure 5-1 • Fitting Stuffing Box, Lantern Restrictor, Packing Gland, Shaft Sleeve, Shaft Spacer and Shaft Sleeve O-Ring

8. Fit the second SHAFT SLEEVE O-RING (109) onto the bearing shaft and push it into the recess in the end face of the shaft sleeve.
9. Place SHAFT SPACER (117) onto the bearing shaft and press tight to the shaft sleeve.
10. Liberally coat the shaft thread with anti-seize lubricant.

#### **PUMP – 8/6 SAHP**

The procedure is the same as that described above, with the following exceptions to step 6:

- a. Join the three segments of the RELEASE COLLAR (239) using its socket head cap screws. Complete Release Collar installation and disassembly instructions are provided later in this section of the manual. Tighten up the cap screws securely. Fit the RELEASE COLLAR (flat face out) on the bearing shaft and slide up the labyrinth.
- b. Slide the SHAFT SLEEVE SPACER (179) onto the bearing shaft and slide up to the release collar.
- c. Fit another shaft SLEEVE O-RING (109) on the shaft and slide it up to the flat face of spacer.

#### **PUMPS – 10/8 FAH, 10/8 GAH, 12/10 FAH, 14/12 FAH**

1. Place the STUFFING BOX (078) flat on a bench (gland side up).
2. Place the LANTERN RESTRICTOR (118) small diameter down so it rests on retaining lip in gland recess.
3. Stand the SHAFT SLEEVE (075) on end and place it through the lantern restrictor.
4. Fit PACKING RINGS (111). Make sure the packing rings are the correct length to fill annulus. The packing rings must be flattened separately with joints staggered.
5. Assemble the GLAND (044) halves by inserting GLAND CLAMP BOLTS (126), fully tightening them. Place the gland into the stuffing box, pushing it down to compress the packing rings. Insert GLAND BOLTS (045) just snugging the nuts enough to hold the shaft sleeve.
6. Fit a SHAFT SLEEVE O-RING (109) onto the bearing shaft and slide up to labyrinth.

7. Join the three (3) segments of the RELEASE COLLAR (239) using its socket head cap screws. Complete Release Collar installation and disassembly instructions are covered on pages 5-6 and 5-7 of this manual. Tighten up the socket head cap screws securely. Fit release collar (flat face out) onto the bearing shaft and slide up to the labyrinth.

8. Fit a second SHAFT SLEEVE O-RING (109) onto the shaft sleeve and slide it against the release collar.
9. Insert the assembled stuffing box into the frame plate, tapping into position with a mallet. Locate the stuffing box with the water connection at top. The shaft sleeve must be pushed up against the release collar.
10. Slide the SHAFT SPACER (FAM117) onto the shaft and under the SHAFT SLEEVE (075).
11. Place a second SHAFT SLEEVE O-RING (109) into the recess in the end face of the shaft sleeve.
12. Place a second SHAFT SPACER (G117) over the first and push up to the sleeve.
13. Liberally coat the shaft thread with anti-seize lubricant.

#### **NOTE**

All the o-rings, in their respective grooves, will be compressed and fully covered by these metallic parts when the impeller is screwed onto the shaft.

#### **PUMP – 16/14 GAH**

1. Fit a SHAFT SLEEVE O-RING (G109) into the labyrinth groove.
2. Join the RELEASE COLLAR (239) using its socket head cap screws. Complete Release Collar installation and disassembly instructions are covered on pages 5-6 and 5-7 of this manual. Tighten up the socket head cap screws securely. Fit the release collar (conical face out) onto the bearing shaft and slide up to the labyrinth.
3. Fit a second SHAFT SLEEVE O-RING (G109) next to collar.
4. Install SHAFT SPACER (GAM117) (flange first) on the shaft. Then mount a SHAFT SLEEVE O-RING (H109) in the groove of the SHAFT SPACER (GAM117).
5. Finally, fit in order, a SHAFT SLEEVE (075), a SHAFT SLEEVE O-RING (H109), and a SHAFT SPACER (H117) on the bearing shaft.

#### **NOTE**

All the o-rings, in their respective grooves, will be compressed and fully covered by these metallic parts when the impeller is screwed onto the bearing shaft.



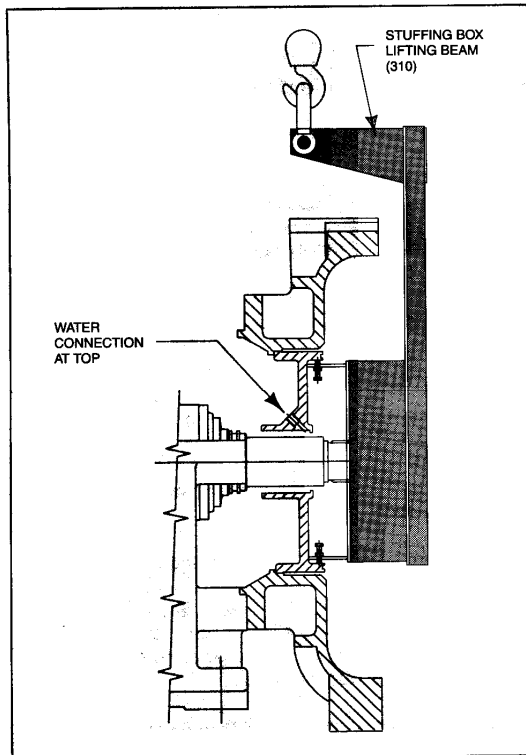


Figure 5-2 • Lifting Beam and Stuffing Box

6. Place the LANTERN RESTRICTOR (118) (small diameter out) freely over sleeve and push against the bearing housing.
7. Attach the STUFFING BOX LIFTING BEAM (310) to the STUFFING BOX (078) on opposite side of the lugs using the three jacking screws provided. Make sure that the water connection in the stuffing box is in line with the lifting beam as shown in *Figure 5-2*.
8. Lift the stuffing box by the lifting beam using a hoist. Insert stuffing box into frame plate tapping into position with a mallet.
9. Assembly of all gland parts in stuffing box will be carried out in the following manner after all other parts of the pump have been assembled:
  - a. Slide the LANTERN RESTRICTOR (118) inside the stuffing box, placing it against the retaining lip.
  - b. Slide the first PACKING RING (111) against the lantern restrictor. Check to ensure the packing ring is of correct length to fill annulus completely.
  - c. Fit the remaining packing rings to almost completely fill the annulus (stagger packing joints and flatten each ring).
  - d. Assemble GLAND (044) halves over shaft sleeve with gland neck toward stuffing box, insert GLAND CLAMP BOLTS (126), and fully tighten. Push

GLAND ASSEMBLY into the stuffing box to compress packing rings. Insert GLAND BOLTS (045) and just snug the nuts to hold shaft sleeve. (Final adjustment will be made when testing the pump.).

10. Liberally coat shaft thread with anti-seize lubricant.

**PUMPS – 1.5/1 CHH, 4/3 RHH, 4/3 RAHP, 8/6 GHH, 8/6 RAH, 16/14 TUAH, 300 RSL, 350 SL, 400 STL, 16/14 TUAHP, 450 STL, 500 STL, 550 TUL, 650 TUL, 650 UL**

1. Place STUFFING BOX (078) flat on a bench with the land side up.
2. Place LANTERN RESTRICTOR (118) with the small diameter down into the gland recess, resting it on retaining lip.
3. Stand shaft sleeve (076) (long) on end through lantern restrictor.
4. Fit PACKING RINGS (111). Make sure the packing rings are the correct length to fill annulus. The packing rings must be flattened separately, and joints must be staggered.
5. Assemble GLAND (044) halves, insert GLAND CLAMP BOLTS (126), and fully tighten. Place gland in stuffing box and push down to compress packing rings. Insert GLAND BOLTS (045) and just snug nuts sufficiently to hold shaft sleeve.
6. Fit the RELEASE COLLAR O-RING (109) (except 1.5/1 CHH, 4/3 RHH, 4/3 RAHP, 6/4 RAHP, 8/6 RAH, 300 RSL) on shaft and slide up to labyrinth.
7. Join the three (3) segments of RELEASE COLLAR (239) with its socket head cap screws and tighten up securely. Complete Release Collar installation and disassembly instructions are covered on pages 5-6 and 5-7 of this manual. Fit release collar (flat face out) on shaft up to labyrinth.
8. Fit SHAFT SLEEVE O-RING (109) in end of shaft sleeve.
9. Insert assembled stuffing box in frame plate and tap into position with a mallet. Locate stuffing box with water connection at top. The shaft sleeve must be pushed up against release collar.
10. Liberally coat shaft thread with anti-seize lubricant.

#### NOTE

All the o-rings, in their respective grooves, will be compressed and fully covered by these metallic parts when the impeller is screwed onto shaft.

**PUMPS – 6/4 FHH, 6/4 SHH, 8/6 THH,  
10/8 TAH, 10/8 TAPH, 12/10 TAAH, 12/10 TAH,  
14/12 TAAH, 14/12 TAH, 16/14 TAAH**

1. Place STUFFING BOX (078) flat on bench (gland side up).
2. Place LANTERN RESTRICTOR (118) (small diameter down) in gland recess to rest on retaining lip.
3. Stand SHAFT SLEEVE (076) on end through lantern restrictor.
4. Fit PACKING RINGS (111). Packing rings must be of the correct length to fill annulus, flatten separately, and joints must be staggered.
5. For models 12/10 TAAH and 16/14 TAAH only, fit PACKING RETAINER (259) into stuffing box behind packing rings.
6. Assemble GLAND (044) halves, insert GLAND CLAMP BOLTS (126), and fully tighten. Place gland in stuffing box and push down to compress packing rings. Insert GLAND BOLTS (045) and just snug nuts sufficiently to hold shaft sleeve.
7. Fit RELEASE COLLAR O-RING (109) (except 6/4 FHH) on shaft and slide up to labyrinth.
8. Join the three (3) segments of RELEASE COLLAR (239) (except 6/4 FHH) with its socket head cap screws and tighten up securely. Complete Release Collar installation and assembly instructions are covered on pages 5-6 and 5-7 of this manual. Fit release collar (flat face out) on shaft up to labyrinth.
9. Fit SHAFT SLEEVE SPACER O-RING (109) in end of SHAFT SLEEVE SPACER (179) and SHAFT SLEEVE (076).

**NOTE**

6/4 FHH use F075 short shaft sleeve and FG117 shaft spacer in place of FG076 long shaft sleeve.

10. Slide SHAFT SLEEVE SPACER (179) on shaft tight against locking collar.
11. Insert assembled stuffing box in frame plate and tap into position with a mallet. Locate stuffing box with water connection at top. The shaft sleeve must be pushed up against the shaft sleeve spacer.
12. Liberally coat shaft thread with anti-seize lubricant.

**NOTE**

All the o-rings, in their respective grooves, will be compressed and fully covered by the metallic parts when the impeller is screwed onto shaft.

**PUMPS – 10/8 STAH, 12/10 STAH, 14/12 STAH, 300 SL**

1. Place STUFFING BOX (078) flat on bench (gland side up).

2. Place LANTERN RESTRICTOR (118) (small diameter down) in gland recess to rest on retaining lip.
3. Stand SHAFT SLEEVE (076) (long) on end through lantern restrictor.
4. Fit PACKING RINGS (111). Packing rings must be of correct length to fill annulus, flattened separately, and joints must be staggered.
5. Assemble GLAND (044) halves, insert GLAND CLAMP BOLTS (126), and fully tighten. Place gland in stuffing box and push down to compress packing rings. Insert GLAND BOLTS (045) and just snug nuts sufficiently to hold shaft sleeve.
6. Fit O-RING (CSC 210) on shaft and slide up to labyrinth.
7. Join the three (3) segments of RELEASE COLLAR (239) with its socket head cap screws and tighten up securely. Complete Release Collar installation and disassembly instructions are covered on pages 5-6 and 5-7 of this manual. Fit release collar (flat face out) on shaft up to labyrinth.
8. Fit O-RING (CSC 210) in end of shaft sleeve.
9. Insert assembled stuffing box in frame plate and tap into position with a mallet. Locate stuffing box with water connection at top. The shaft sleeve just be pushed up against the release collar.
10. Liberally coat shaft thread with anti-seize lubricant.

**NOTE**

All the o-rings, in their respective grooves, will be compressed and fully covered by these metallic parts when the impeller is screwed onto shaft.

**PUMPS – 20/18 TAAH, 20/18 TAAH**

1. Place STUFFING BOX (078) flat on bench (gland side up).
2. Place LANTERN RESTRICTOR (118) (small diameter down) in gland recess to rest on retaining lip.
3. Stand SHAFT SLEEVE (076) on end through lantern restrictor.
4. Fit PACKING RINGS (111). Packing rings must be of correct length to fill annulus, flattened separately, and joints must be staggered.
5. Assemble GLAND (044) halves, insert GLAND CLAMP BOLTS (126), and fully tighten. Place gland in stuffing box and push down to compress packing rings. Insert GLAND BOLTS (045) and just snug nuts sufficiently to hold shaft sleeve.
6. Fit O-RING (109) on shaft and slide up to labyrinth.

7. Join the three (3) segments of RELEASE COLLAR (239) with its socket head cap screws and tighten up securely. Complete Release Collar installation and disassembly instructions are covered on pages 5-6 and 5-7 of this manual. Fit release collar (flat face out) on shaft up to labyrinth.
8. Fit O-RING (109) in end of shaft sleeve.
9. Attach the STUFFING BOX LIFTING BEAM (310) to the STUFFING BOX (078) on opposite side of the lugs using the three jacking screws provided. Make sure that the water connection in the stuffing box is in line with the lifting beam as shown in *Figure 5-2*.
10. Lift the stuffing box by the lifting beam using a hoist. Insert stuffing box into frame plate tapping into position with a mallet.
11. Insert assembled stuffing box into frame plate, tapping into position with a mallet. Locate stuffing box with water connection at top. The shaft sleeve must be pushed up against the release collar.
12. Liberally coat shaft thread with anti-seize lubricant.

**NOTE**

All the o-rings, in their respective grooves, will be compressed and fully covered by these metallic parts when the impeller is screwed onto shaft.

## GLAND ASSEMBLY

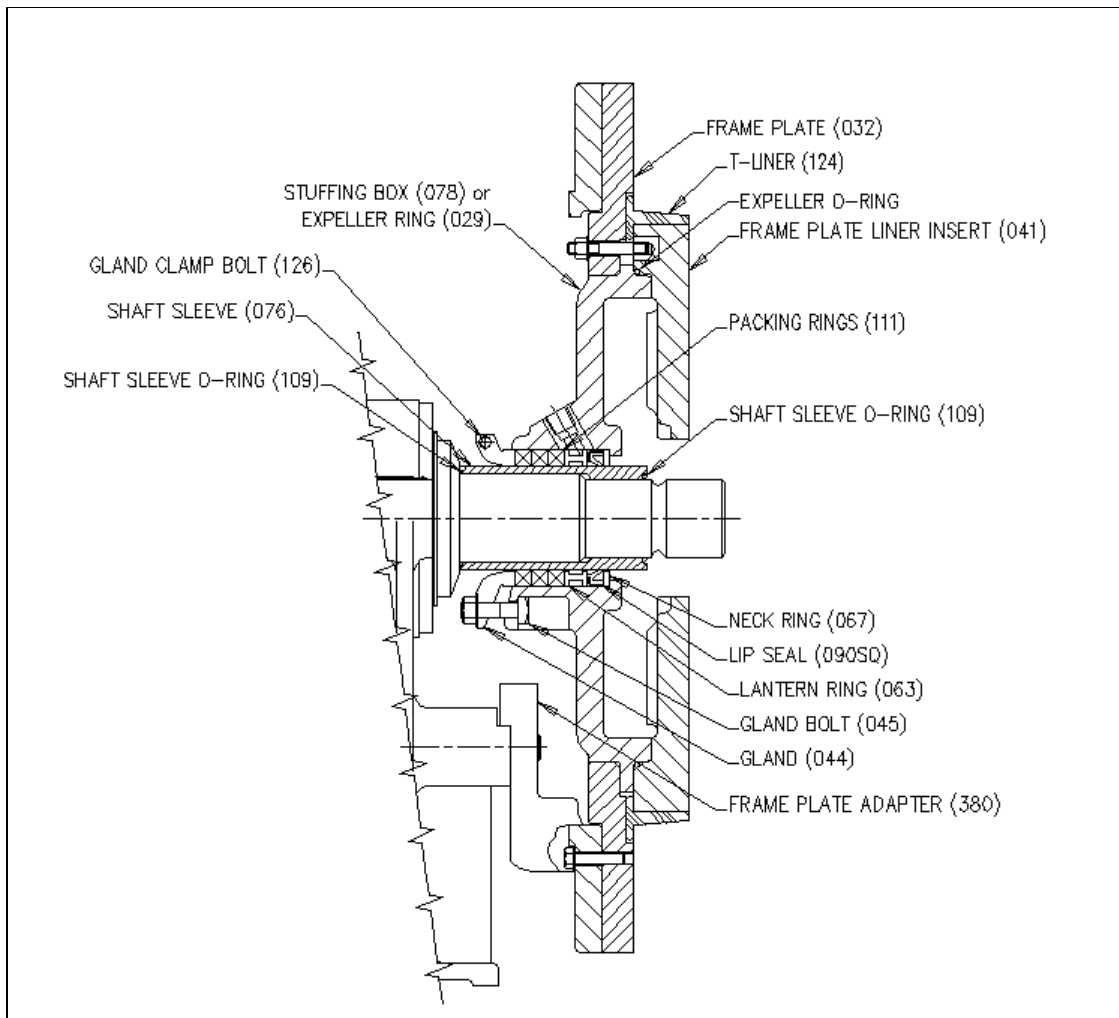
**FITTING STUFFING BOX/EXPELLER RING, NECK RING, LIP SEAL, LANTERN RING, SHAFT SLEEVE, PACKING, GLAND, SHAFT SLEEVE O-RING, FRAME PLATE LINER INSERT, ADAPTER PLATE**

**PUMPS – 3X3CXU, 4X4CXU, 4X4DXU, 6X5DXU, 6X5EXU, 8X6EXU, 8X6FXU, 10X8EXU, 10X8FXU, 12X10EXU, 12X10FXU, 14X12FXU**

Refer to *Figure 5-3* for the following assembly procedures:

1. Place FRAME PLATE LINER INSERT (041) flat on bench, screw and tighten studs in the tapped holes provided.

2. Place T-LINER (124) over frame plate liner insert.
3. Place EXPELLER O-RING onto STUFFING BOX (078) or EXPELLER RING (029) pilot.
4. Lower stuffing box/expeller ring into pilot of the frame plate liner insert.
5. Lower FRAME PLATE (032) onto stuffing box/expeller ring and fully tighten using the four frame plate liner insert studs. **Note: Frame plate orientation to gland water. Supply for discharge position.**
6. Drop NECK RING (067) into gland recess so it rests on the retaining lip.



**Figure 5-3: Stuffing Box/Expeller Ring, Gland, Packing, Lantern Ring, Lip Seal, Neck Ring, Shaft Sleeve and Shaft Sleeve O-Ring**

7. Place the LIP SEAL (090SQ) so it rests on the neck ring. Check lip seal is positioned correctly, so it is activated by internal pressure. A small amount of oil will assist in assembly of the seal.
8. Drop LANTERN RING (063) so it rests on lip seal.
9. Stand SHAFT SLEEVE (076) on end and place chamfered end of shaft sleeve through lantern ring, lip seal and neck ring.
10. Fit PACKING RINGS (111) make sure the packing rings are the correct lengths to fill annulus. Assemble the packing rings with joints staggered 180°. Assemble GLAND (044) halves, insert GLAND CLAMP BOLTS (126), and fully tighten. Place gland into the stuffing box, pushing it down to compress the packing rings. Insert GLAND BOLTS (045) and snug nuts sufficiently to hold shaft sleeve. Fit SHAFT SLEEVE O-RING (109) onto the bearing shaft and slide up to the labyrinth.
11. Mount gland assembly onto bearing shaft and bolt frame plate to FRAME PLATE ADAPTER (380).
12. Insert assembled stuffing box/expeller ring into frame plate adapter, tapping into position with a mallet. Locating the stuffing box with the water connection at the top.

The shaft sleeve will probably remain forward. It should be pushed back to the labyrinth and shaft sleeve o-ring.

#### **NOTE**

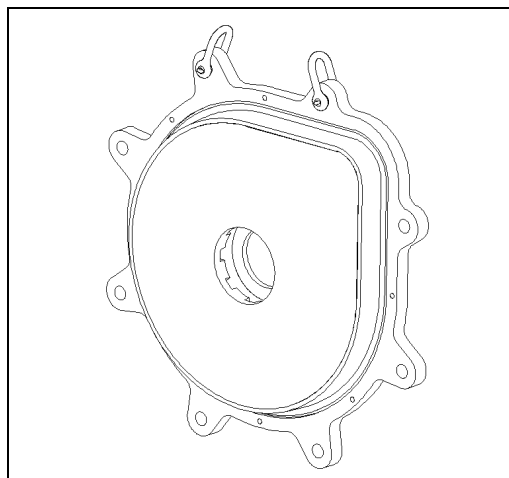
Slowly rotating the bearing shaft will help with the assembly of the shaft sleeve over the shaft.

#### **Pump – 3 X 3**

- a. Being that the gland assembly weights less than 50 lbs. A hoist is not necessary for lifting.

#### **Pump – 4 X 4, 6 X 5**

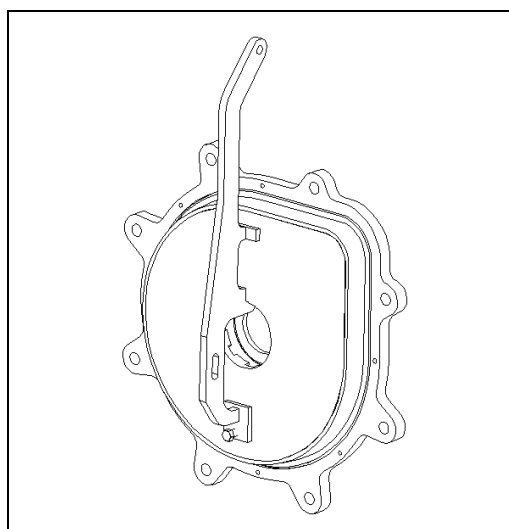
- a. Attach two chain shackles through the top ears on the frame plate. Lift the gland assembly using a hoist. Refer to *Figure 5-4*.
- b. Shaft sleeve and shaft sleeve o-ring should be pushed back to the labyrinth.



**Figure 5-4**

#### **Pump – 8 X 6, 10 X 8, 12 X 10, 14 X 12**

- a. Attach the FRAME PLATE LINER INSERT LIFTING BEAM (302) to the frame plate liner insert. Lift the gland assembly using the hoist. (Refer to *Figure 5-5*.)



**Figure 5-5**

- b. Shaft sleeve and shaft sleeve o-ring should be pushed back to the labyrinth.
14. Fit second SHAFT SLEEVE O-RING (109) onto the bearing shaft and push it into the recess in the end face of the shaft sleeve.
15. Liberally coat the shaft thread with anti-seize lubricant.

- ❖ If LANTERN RESTRICTOR (118) were being used, the lantern restrictor would replace steps 2 through 4.

#### **Pump – 3 x 3 XU**

The procedure is the same as that described above, with the following exceptions to step 12

- a) Lower CASING ADAPTER (380) onto stuffing box/expeller ring and fully tighten using the four-frame plate liner insert stud.

#### **Pump – 14 x 12 XU**

The procedure is the same as that described above, with the following exceptions to step 8.

- a) Join the three segments of the RELEASE COLLAR (239) using its socket head cap screws. Complete installation and disassembly are provided later in this section of the manual. Tighten up the cap screws securely. Fit the release collar (flat face out) on the bearing shaft and slide up to the labyrinth.

#### **NOTE**

All the o-rings, in their respective grooves, will be compressed and fully covered by these metallic parts when the impeller is screwed onto the shaft.

# RELEASE COLLAR

## INSTALLATION AND DISASSEMBLY

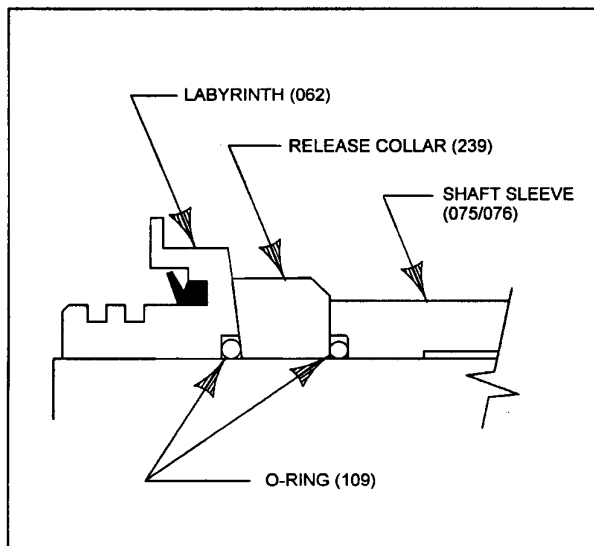


Figure 5-6 Release Collar Side Show

### RELEASE COLLAR (239) INSTALLATION PROCEDURE

1. Check to ensure that the RELEASE COLLAR O-RING (109) has been installed on the shaft and slid up to the labyrinth.
2. Install the release collar with the tapered side toward the labyrinth and the flat side toward the shaft sleeve (see Figure 5-6).

#### NOTE

The flat faces of the shaft sleeve and release collar fit together. The 7 degree taper on the labyrinth face and the 7 degree taper on the release collar fit together.

3. It may be necessary to disassemble the three segments of the release collar to install it on the shaft. It is important to reassemble the segments with the punch marks together as shown in Figure 5-7. This will ensure the segments fit properly.

#### **! CAUTION !**

Do not reuse the socket head cap screws after they have once been installed in a release collar. Full fastener strength cannot be obtained from a used fastener. Obtain new, unused screws. If 316 SS fasteners are removed they should be replaced with Grade 5 of the same size.

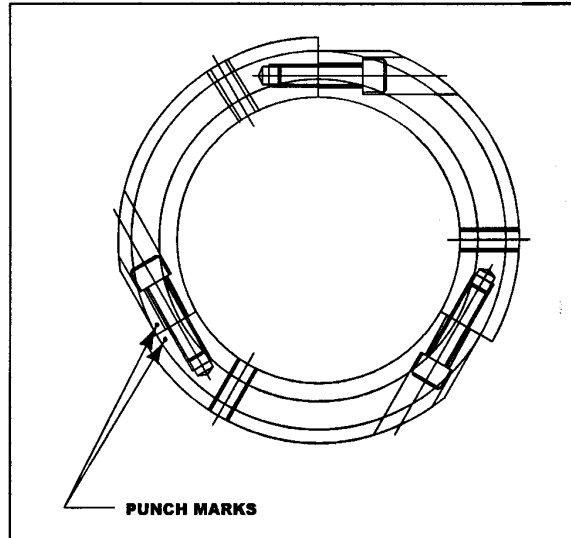


Figure 5-7 Release Collar End View

4. It is very important that the bolts holding the segments together be torqued properly. Socket head cap screws are supplied with the release collars and should be tightened as shown in Table 5-1. Pumps manufactured after September 1, 1994 are supplied with Grade 5 socket head cap screws. All others have 316 SS fasteners. Apply "Loctite 222 Screwlock" or similar product to threads. Replace all used screws with Grade 5 fasteners.

#### **!! WARNING !!**

**FAILURE TO PROPERLY TORQUE RELEASE COLLAR FASTENERS COULD RESULT IN THE FASTENERS LOOSENING OR FAILING, CONSEQUENTLY RESULTING IN SEVERE DAMAGE TO EQUIPMENT OR PERSONAL INJURY.**

5. Fill the recess of the socket head cap screws and pusher holes with silicone or other suitable sealant to prevent moisture from contacting these fasteners and fouling the threads.

Release collar installation is now complete.

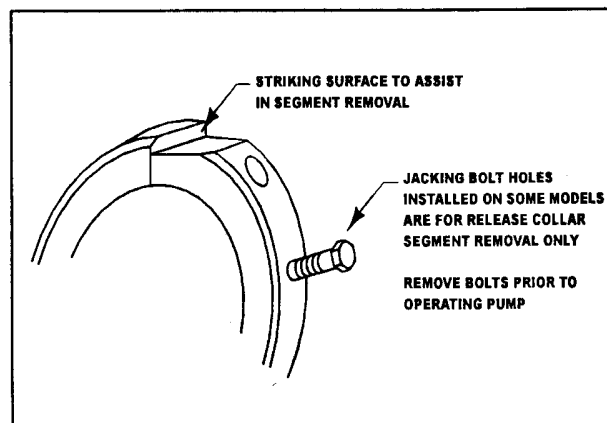
### RELEASE COLLAR (239) REMOVAL

1. Remove sealant or other material in heads of socket head cap screws. Be certain to achieve full engagement of the Allen wrench into the socket head.

2. Remove the three bolts holding the release collar together and install Grade 5 or better bolts into the threaded pusher holes in each segment shown in *Figure 5-8*. Do not use the socket head cap screws just removed as pusher bolts if they are 316 SS as their softer properties may cause them to strip during the subsequent removal procedure.
3. Alternately tighten the jacking bolts against the shaft to force the segments out. A ledge has been provided on the end of each segment to allow the use of a timber and mallet to assist in the removal process.

**! CAUTION !**

Do not apply heat to or attempt to cut the segments from the shaft. Heat may damage either the bearing or the shaft.



*Figure 5-8 Release Collar Jacking Bolt*

RELEASE COLLAR PART NUMBER	SOCKET HEAD CAP SCREW SIZE	FASTENER MATERIAL	
		316 SS	GRADE 5
		RECOMMENDED Ft Lb/Nm	
FAM239, FG239-1, FH239, S239	3/8-16 UNC-2B x 1.50 LG	21/29	26/36
G239, GH239, T239	1/2-13 UNC-2B x 2.50 LG	45/62	65/89
H239	5/8-11 UNC-2B x 2.50 LG	72/98	130/177
U239	M20 X 100	130/176	200/271

*Table 5-1 • Release Collar Socket Head Cap Screw Torque Recommendations*



# CENTRIFUGAL SEAL ASSEMBLY

## METAL EXPELLER RING

Two styles of centrifugal seals using a metal expeller ring and packing are available. The first uses grease lubrication to provide a true "waterless" shaft seal. In some instances, the grease cup is removed and a minimal amount of water is injected into the packing for both lubrication and improved sealing ability. The second seal arrangement uses a restricted seal water flush through a close fitting, non-metallic lantern restrictor.

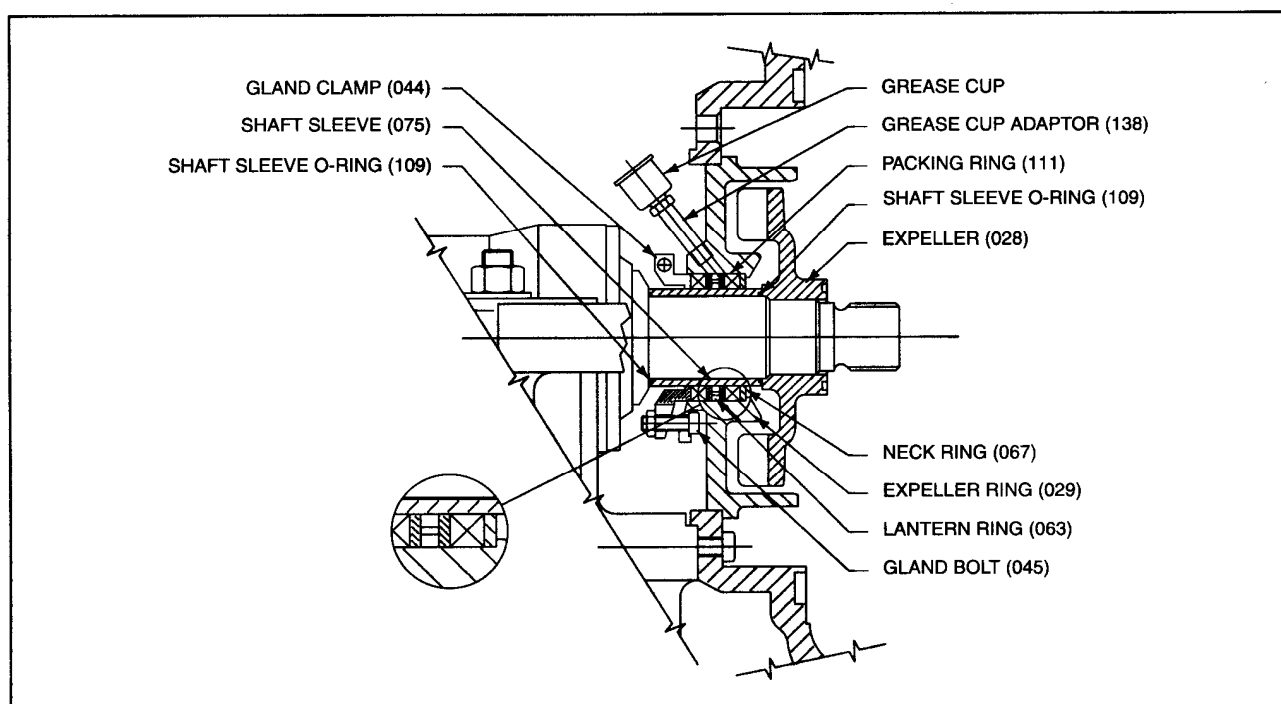
### GREASE LUBRICATED CENTRIFUGAL SEAL

**FITTING EXPELLER RING, NECK AND LANTERN RINGS, (METAL EXPELLER RING) PACKING, SHAFT SLEEVE, SHAFT SLEEVE (O-RING, AND EXPELLER).**  
(REFER TO FIGURE 5-9)

**PUMPS – 20AL, 50 BL, 75 CL, 100 DL,  
150 EL, 200 FM, 250 FL, 300 RSL, 1.5/1 BAH,  
2/1.5 BAH, 3/2 CAH, 4/3 DAH, 6/4 DAH,  
6/4 EAH, 8/6 FAH, 12/10 GAH, 14/12 GAH,  
1.5/1 CHH, 3/2 DHH, 3/2 QHH, 8/6 RAH**

1. Place EXPELLER RING (029) flat on bench (gland seal up).
2. Drop NECK RING (067) into gland recess so it rests on the retaining lip.

3. Stand SHAFT SLEEVE (075) on end and place through neck ring.
4. Fit the following items, in turn:
  - a. One PACKING RING (111) of correct length to fill annulus.
  - b. Grease LANTERN RING (063) and press down to flatten first ring.
  - c. Remaining packing rings (stagger packing joints and flatten each ring) to almost completely fill the annulus.
5. Assemble GLAND (044) halves, insert GLAND CLAMP BOLTS (126), and fully tighten. Place gland into expeller ring, pushing it down to compress the packing rings. Insert GLAND BOLTS (045) and snug nuts sufficiently to hold shaft sleeve.
6. Fit SHAFT SLEEVE O-RING (109) on shaft and slide up to labyrinth. Apply anti-seize lubricant to exposed shaft, including threads.
7. Insert assembled expeller ring into frame plate, tapping into position with a mallet. Locate expeller ring with the grease inlet at top.



**Figure 5-9 Centrifugal Seal Assembly - Metal Expeller Ring with Grease Lubrication**

The shaft sleeve will probably remain forward. It should be pushed back to the labyrinth and o-ring.

8. Fit second SHAFT SLEEVE O-RING (109) and push into recess in the end face of the shaft sleeve.
9. Place EXPELLER (028) onto the shaft and press up to the shaft sleeve.
10. Assembly of gland lubricating parts is done after all other parts of pump have been assembled.

Fit GREASE CUP ADAPTOR (138) and GREASE CUP to expeller ring as shown in *Figure 5-9*. Fill cup with recommended grease and screw down the cap to charge lantern ring. Refill cup. (*Refer to Section 1, page 12 for recommended grease.*)

**PUMPS – 4/3 CAH, 4/3 EHH, AND 4/3 RHH,  
8/6 EAH, 200 EM, 250 EL**

The procedure is the same as that described above, with the following exceptions to Step 8 for pumps supplied prior to January 1, 1990:

- a. Slide SHAFT SPACER (117E) onto the shaft against shaft sleeve.
- b. Fit SHAFT SPACER O-RING (109) into the spacer groove.

**PUMP – 6/4 FHH**

The procedure is the same as that described above with the following addition to Step 6:

- a. Slide SHAFT SPACER (179) onto the shaft up to the labyrinth.
- b. Fit another SHAFT SLEEVE O-RINGS (109) onto the shaft and slide it up to the flat face of the spacer.

**PUMPS – 10/8 FAH, 12/10 FAH, 14/12 FAH**

1. Fit SHAFT SLEEVE O-RING (G109) onto the shaft and slide it up to the labyrinth face.
2. Join the three (3) segments of RELEASE COLLAR (239) with its socket head cap screws and tighten securely. Complete Release Collar installation and disassembly are covered on pages 5-9 and 5-10 of this manual. Fit RELEASE COLLAR (flat face out) onto the shaft and slide it up to labyrinth.
3. Slide SHAFT SLEEVE O-RING (109) onto the shaft up to release collar. Apply anti-seize lubricant to exposed shaft, including threads.
4. Slide SHAFT SLEEVE (075) onto the shaft up to the release collar.
5. Slide SHAFT SPACER (FAM117) onto the shaft and under shaft sleeve.

6. Fit LANTERN RING (063), followed by NECK RING (067), freely over sleeve, and push both against bearing housing.
7. Attach EXPELLER RING LIFTING BEAM (310) to EXPELLER RING (029) on opposite side of lugs using three jacking screws provided, and insure that the grease inlet in the expeller ring is in line with the lifting beam.
8. Lift the expeller ring with the lifting beam by means of a hoist. Insert expeller ring in the frame plate, tapping into position with a mallet. Locate with the grease inlet at top.
9. Assembly of all gland parts in the expeller ring will be carried out in the following manner after all other parts of the pump have been assembled:
  - a. Slide NECK RING (067) inside expeller ring against retaining lip.
  - b. Fit one PACKING RING (111) of correct length to fill annulus and slide it against the neck ring.
  - c. Slide LANTERN RING (063) and press to flatten first ring.
  - d. Fit remaining packing rings to almost completely fill the annulus. Stagger packing joints and flatten each ring.
  - e. Assemble GLAND (044) halves over shaft sleeve with gland neck toward expeller ring, insert GLAND CLAMP BOLTS (126), and tighten fully. Push the gland into the expeller ring to compress packing rings. Insert GLAND BOLTS (045) and tighten nuts until snug.
  - f. Fit GREASE CUP ADAPTOR (138) and GREASE CUP to expeller ring. Fill cup with recommended grease and screw down cap to charge lantern ring. Refill cup. (*Refer to Section 1, page 12 for recommended grease.*)

10. Fit second SHAFT SLEEVE O-RING (109) and push it into recess in the end face of the shaft sleeve.
11. Place EXPELLER (028) on shaft, slide over shaft spacer, and press up to shaft sleeve.

**PUMP – 16/14 GAH**

1. Fit SHAFT SLEEVE O-RING (G109) in the labyrinth groove.
2. Join the split RELEASE COLLAR (239) with its socket head cap screws and tighten up securely. Complete Release Collar installation and disassembly are covered on pages 5-9 and 5-10 of this manual. Fit collar (conical face out) onto shaft and slide up to labyrinth.

3. Fit a second SHAFT SLEEVE O-RING (G109) next to collar. Apply anti-seize lubricant to exposed shaft, including threads.
4. Fit a SHAFT SLEEVE O-RING (H109) into the groove of SHAFT SPACER (GAM117), then slide the spacer (flange first) onto the shaft.
5. Finally fit, in turn, a SHAFT SLEEVE (H075) and SHAFT SLEEVE O-RING (H109) onto the shaft.

**NOTE**

All the o-rings in their respective grooves will be compressed and fully covered by these metallic parts when the impeller is screwed onto the shaft.

6. Fit LANTERN RING (063), followed by NECK RING (067), freely over sleeve, and push both against bearing housing.
7. Attach EXPELLER RING LIFTING BEAM (310) to EXPELLER RING (029) onto the opposite side of lugs using three jacking screws provided, and insure that the grease inlet in the expeller ring is in line with the lifting beam.
8. Lift the expeller ring with lifting beam by means of a hoist, and insert the expeller ring into the frame plate. Tap into position with a mallet. Locate with grease inlet at top. For safety purposes it is desirable to attach a bar across the face of the expeller ring using a bolt at either end. Fit the bolt through one of the frame plate liner insert bolt holes. Remove the bar after the shaft packing and gland are installed.
9. After assembly of all other parts of the pump has been completed, carry out assembly of all gland parts in the expeller ring in the following manner:
  - a. Slide neck ring (067) inside expeller ring against retaining lip.
  - b. Fit PACKING RING (111) of correct length to fill annulus and slide against neck ring.
  - c. Slide LANTERN RING (063) into expeller ring and press to flatten first packing ring.
  - d. Fit the remaining packing rings to almost completely fill the annulus. Stagger packing joints and flatten each ring.
  - e. Assemble GLAND (044) halves over shaft sleeve with gland neck toward expeller ring, insert GLAND CLAMP BOLTS (126), and fully tighten. Push into the expeller ring to compress packing rings. Insert GLAND BOLTS (045) and tighten nuts until snug.
  - f. Fit GREASE CUP ADAPTOR (138) and GREASE CUP to expeller ring. Fill cup with recommended grease and screw down cap to charge lantern ring.

Refill cup. (Refer to Section 1, page 12 for recommended grease.)

10. Fit second SHAFT SLEEVE O-RING (109) and push it into recess in end face of shaft sleeve.
11. Place EXPELLER (028) on shaft, slide over shaft spacer, and press up to shaft sleeve.

**PUMPS – 8/6 GHH, 16/14 TUAH, 10/8 GAH, 20/18 TUAH, 350 SL, 400 STL, 450 STL, 500 STL, 550 TUL, 650 TUL, 650 UL**

1. Fit a SHAFT SLEEVE O-RING (109) into the labyrinth groove.
2. Join the split RELEASE COLLAR (239) with socket head screws and tighten securely. Complete Release Collar installation and disassembly instructions are covered on pages 5-9 and 5-10 of this manual. Fit collar (flat face out) onto the shaft and slide up to the labyrinth.
3. Fit a second SHAFT SLEEVE O-RING (109) next to the collar. Apply anti-seize lubricant to exposed shaft including threads.
4. Slide SHAFT SLEEVE (075) onto the shaft. Fit SHAFT SLEEVE O-RING (109) and push into recess in end face of shaft sleeve.
5. Follow instructions given in steps 6-12 for Frame 16/14 GAH.

**PUMPS – 6/4 SHH, 8/6 THH, 10/8 TAH, 12/10 TAH, 14/12 TAH**

1. Fit a SHAFT SLEEVE O-RING (109) into the labyrinth groove.
2. Join the SPLIT RELEASE COLLAR (239) with its socket head cap screws and tighten securely. Complete Release Collar installation and disassembly instructions are covered on pages 5-9 and 5-10 of this manual. Fit collar (conical face out) onto the shaft and slide up to labyrinth (omit this step for the 6/4 SHH). Apply anti-seize lubricant to exposed shaft, including threads.
3. Slide SHAFT SLEEVE SPACER (179) onto the shaft and slide up against labyrinth.
4. Fit a second SHAFT SLEEVE O-RING (109) onto the shaft and slide up against the shaft sleeve spacer.
5. Slide SHAFT SLEEVE (075) onto the shaft and up against the shaft sleeve spacer.
6. Slide LANTERN RING (063), then NECK RING (067), onto the shaft.

7. Attach EXPELLER RING LIFTING BEAM (310) to EXPELLER RING (029) onto opposite side of lugs using three jacking screws provided, and make certain the grease inlet in the expeller ring is in line with the lifting beam.
8. Lift the expeller ring with lifting beam by means of a hoist, and insert the expeller ring into the frame plate. Tap into position with a mallet. Locate with grease inlet at top. For safety purposes, it is desirable to attach a bar across the face of the expeller ring using a bolt at either end. Fit the bolt through one of the frame plate liner insert bolt holes. Remove the bar after the shaft packing and gland are installed.
9. After assembly of all other parts of the pump has been completed, carry out assembly of all gland parts in the expeller ring in the following manner:
  - a. Slide NECK RING (067) inside expeller ring against retaining lip.
  - b. Fit one PACKING RING (111) of correct length to fill annulus and slide against neck ring.
  - c. Slide grease filled LANTERN RING (063) into expeller ring and press to flatten first packing ring.
  - d. Fit remaining packing rings to almost completely fill the annulus. Stagger packing joints and flatten each ring.
  - e. Assemble GLAND (044) halves over shaft sleeve with gland neck toward expeller ring, insert GLAND CLAMP BOLTS (126), and fully tighten. Push into expeller ring to compress packing rings. Insert GLAND BOLTS (045) and tighten nuts until snug.
  - f. Fit GREASE CUP ADAPTOR (138) and GREASE CUP to expeller ring. Fill cup with recommended grease and screw down to cap to charge lantern ring. Refill cup. (*Refer to Section 1, page 12 for recommended grease.*)
  - g. Fit second SHAFT SLEEVE O-RING (109) and push it into recess in end face of shaft sleeve.
11. Place EXPELLER (028) onto the shaft and press up to the shaft sleeve.

**PUMPS – 10/8 STA, 12/10 STA,  
14/12 STA, 300 SL**

1. Fit a SHAFT SLEEVE O-RING (CSC 210) into labyrinth groove.
2. Join the split RELEASE COLLAR (239) with its socket head cap screws and tighten securely. Complete Release Collar installation and disassembly are on pages 5-9 and 5-10 of this manual. Fit collar (flat face out) onto the shaft and slide up to the labyrinth.

3. Fit a second SHAFT SLEEVE O-RING (CSC 210) next to collar.
4. Slide SHAFT SLEEVE (075) onto the shaft. Fit SHAFT SLEEVE O-RING (109) and push into recess in end face of shaft sleeve.
5. Follow instructions given in Steps 6-12 for Frame 16/14 GAH.

**RESTRICTED FLOW CENTRIFUGAL SEAL**

**FITTING METAL EXPELLER RING, LANTERN RESTRICTOR, PACKING, SHAFT SLEEVE, SHAFT SLEEVE O-RING, AND EXPELLER. (REFER TO FIGURE 5-10)**

**NOTE**

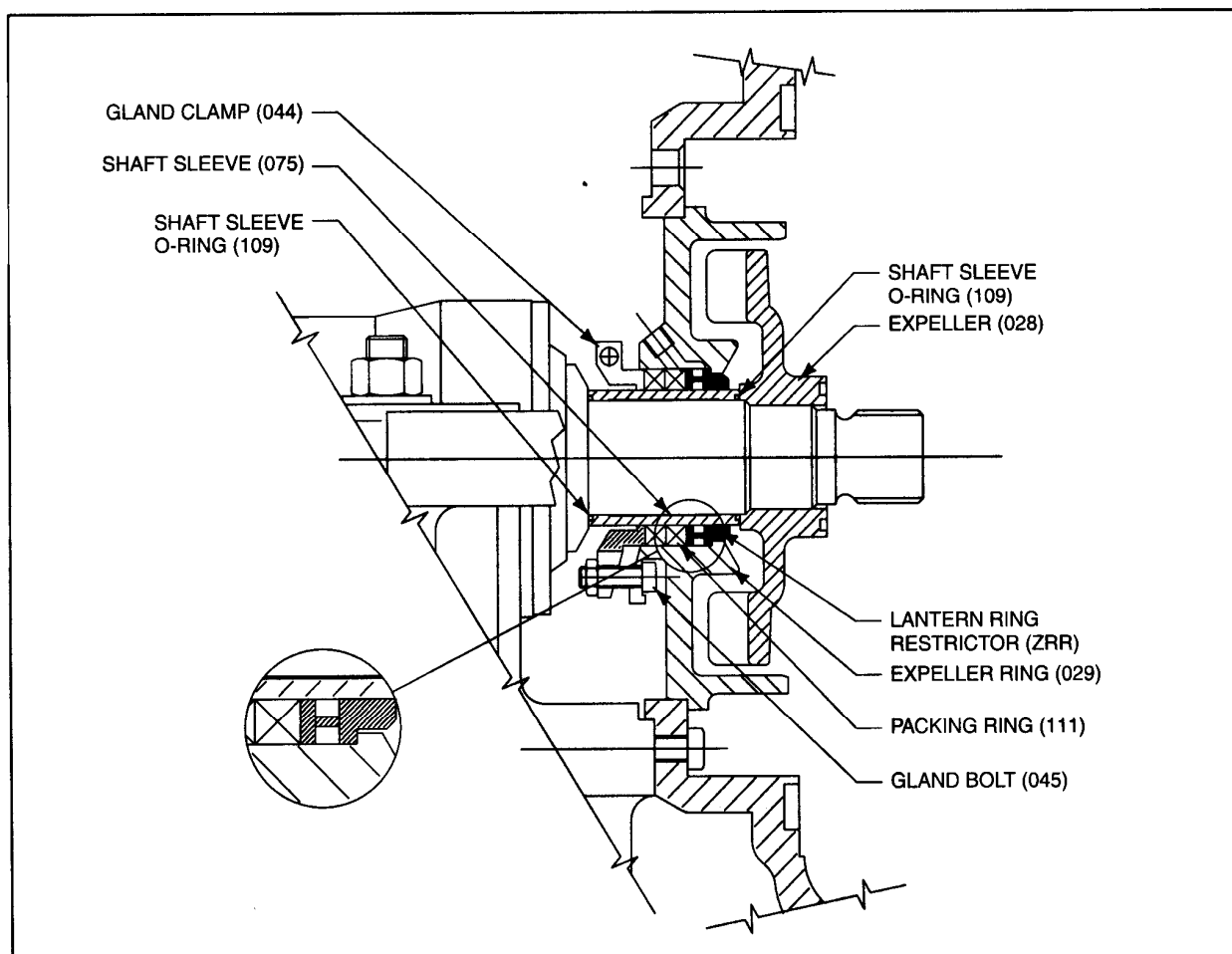
Assembly of water connection will be done after all other parts of the pump have been assembled.

Both seal water flow and pressure should be regulated to the values shown on the arrangement drawing for the pump. Excessive flow or pressure will necessitate over-compressing the packing, resulting in reduced packing and shaft sleeve wear life.

It may be necessary to modify the gland seal water port on field installed retrofits to this seal. This is done to allow sufficient flow to the lantern ring restrictor. Consult the factory for details.

**PUMPS – 20AL, 50 BL, 75 CL, 100 DL,  
150 EL, 200 FM, 250 FL, 300 RSL, 1.5/1 BAH,  
2/1.5 BAH, 3/2 CAH, 4/3 DAH, 6/4 DAH,  
6/4 EAH, 8/6 FAH, 12/10 GAH, 14/12 GAH,  
1.5/1 CHH, 3/2 DHH, 3/2 QHH, 8/6 RAH**

1. Place EXPELLER RING (029) flat on bench (gland side up).
2. Drop LANTERN RESTRICTOR (ZRR) into gland recess so it rests on the retaining lip.
3. Stand SHAFT SLEEVE (075) on end and place through lantern restrictor.
4. Fit two packing rings to almost completely fill the annulus. Stagger packing joints and flatten each ring.
5. Assemble GLAND (044) halves, insert GLAND CLAMP BOLTS (126), and fully tighten. Place gland into expeller ring, pushing it down to compress the packing rings. Insert GLAND BOLTS (045) and snug nuts sufficiently to hold shaft sleeve, but do not over-tighten.
6. Fit SHAFT SLEEVE O-RING (109) on shaft and slide up to labyrinth. Apply anti-seize lubricants to exposed shaft, including threads.
7. Insert assembled expeller ring into frame plate, tapping into position with a mallet. Locate expeller ring with the water inlet at top.



**Figure 5-10 Restricted Flow Centrifugal Seal**

8. Fit second SHAFT SLEEVE O-RING (109) and push into recess in the end face of the shaft sleeve.
9. Place EXPELLER (028) onto the shaft and press up to the shaft sleeve.

**PUMPS – 4/3 CAH, 4/3 EHH, 4/3 RHH,  
8/6 EAH, 200 EM, 250 EL**

The procedure is the same as that described above, with the following exceptions to Step 8 for pumps supplied prior to January 1, 1990:

- a. Slide SHAFT SPACER (117E) onto the shaft against shaft sleeve.
- b. Fit SHAFT SPACER O-RING (109) into the spacer groove.

**PUMP – 6/4 FHH**

The procedure is the same as that described above with the following addition to Step 6:

- a. Slide SHAFT SPACER (179) onto the shaft up to the labyrinth.
- b. Fit another SHAFT SLEEVE O-RING (109) onto the shaft and slide it up to the flat face of the spacer.

**PUMPS – 10/8 FAH, 12/10 FAH, 14/12 FAH**

1. Fit SHAFT SLEEVE O-RING (G109) onto the shaft and slide it up to the labyrinth face.
2. Join the three (3) segments of RELEASE COLLAR (239) with its socket head cap screws and tighten securely. Complete Release Collar installation and disassembly instructions are covered on pages 5-9 and 5-10 of the manual. Fit RELEASE COLLAR (flat face out) onto the shaft and slide it up to labyrinth.
3. Slide SHAFT SLEEVE O-RING (109) onto the shaft up to release collar. Apply anti-seize lubricant to exposed shaft, including threads.
4. Slide SHAFT SLEEVE (075) onto the shaft up to the release collar

5. Slide SHAFT SPACER (FAM117) onto the shaft and under shaft sleeve.
6. Fit LANTERN RESTRICTOR (ZRR) freely over sleeve, and push flat side against bearing housing.
7. Attach EXPELLER RING LIFTING BEAM (310) to EXPELLER RING (029) on opposite side of lugs using three jacking screws provided, and insure that the water inlet in the expeller ring is in line with the lifting beam. (Refer to Figure 5-11.)
8. Lift the expeller ring with the lifting beam by means of a hoist. Insert expeller ring in the frame plate, tapping into position with a mallet. Locate with the water inlet at the top. For safety purposes, it is desirable to attach a bar across the face of the expeller ring using a bolt at either end. Fit the bolt through one of the frame plate liner insert bolt holes. Remove the bar after the shaft packing and gland are installed.

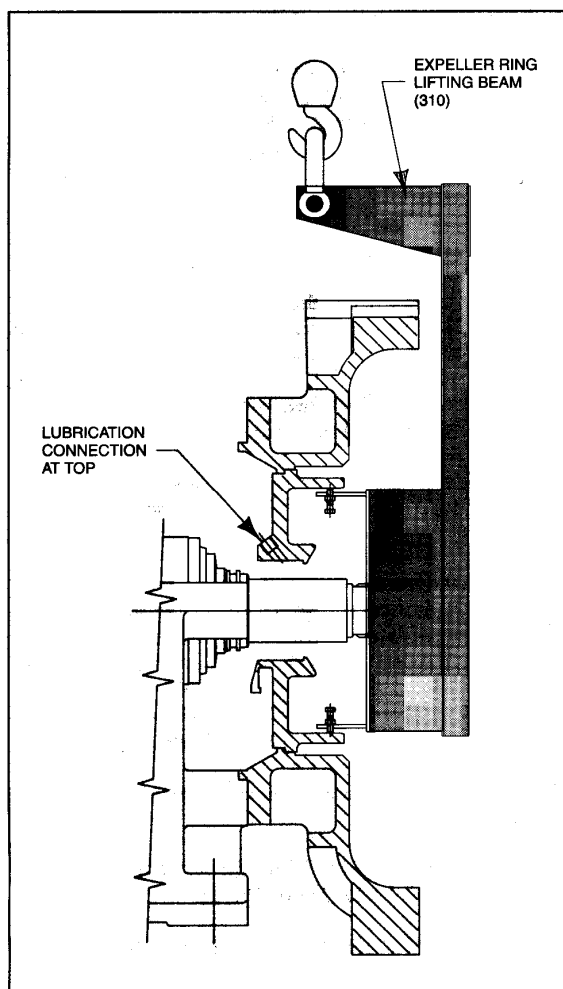


Figure 5-11 Use of Expeller Ring Lifting Beam

9. Assembly of all gland parts in the expeller ring will be carried out in the following manner after all other parts of the pump have been assembled.
  - a. Slide LANTERN RESTRICTOR (ZRR) inside expeller ring against retaining lip.
  - b. Fit two packing rings to almost completely fill the annulus. Stagger packing joints and flatten each ring.
  - c. Assemble GLAND (044) halves over shaft sleeve with gland neck toward expeller ring, insert GLAND CLAMP BOLTS (126), and tighten fully. Push the gland into the expeller ring to compress packing rings. Insert GLAND BOLTS (045) and tighten nuts until snug.
10. Fit second SHAFT SLEEVE O-RING (109) and push it into recess in the end of the shaft sleeve.
11. Place EXPELLER (028) on shaft, slide over shaft spacer, and press up to shaft sleeve.

#### PUMP – 16/14 GAH

1. Fit SHAFT SLEEVE O-RING (G109) in the labyrinth groove.
2. Join the split RELEASE COLLAR (239) with its socket head cap screws and tighten up securely. Complete Release Installation and disassembly instructions are covered on pages 5-9 and 5-10 of the manual. Fit collar (conical face out) onto shaft and slide up to labyrinth.
3. Fit a second SHAFT SLEEVE O-RING (G109) next to collar. Apply anti-seize lubricant to exposed shaft, including threads.
4. Fit a SHAFT SLEEVE O-RING (H109) into the groove of SHAFT SPACER (GAM117), then slide the spacer (flange first) onto the shaft.
5. Finally fit, in turn, a SHAFT SLEEVE (H075) and SHAFT SLEEVE O-RING (H109) onto the shaft.

#### NOTE

All the o-rings, in their respective grooves, will be compressed and fully covered by these metallic parts when the impeller is screwed onto the shaft.

6. Fit LANTERN RESTRICTOR (ZRR) freely over sleeve, and push flat side against bearing housing.
7. Attach EXPELLER RING LIFTING BEAM (310) to EXPELLER RING (029) onto the opposite side of lugs using three jacking screws provided, and insure that the water inlet in the expeller ring is in line with the lifting beam. (Refer to Figure 5-11)

8. Lift the expeller ring with lifting beam by means of a hoist, and insert the expeller ring into the frame plate. Tap into position with a mallet. Locate with water connection at top. For safety purposes, it is desirable to attach a bar across the face of the expeller ring using a bolt at either end. Fit the bolt through one of the frame plate liner insert bolt holes. Remove the bar after the shaft packing and gland are installed.
9. After assembly of all other parts of the pump has been completed, carry out assembly of all gland parts in the expeller in the following manner:
  - a. Slide LANTERN RESTRICTOR (ZRR) inside expeller ring against retaining lip.
  - b. Fit the packing rings to almost completely fill the annulus. Stagger packing joints and flatten each ring.
  - c. Assemble GLAND (044) halves over shaft sleeve with gland neck toward expeller ring, insert GLAND CLAMP BOLTS (126), and fully tighten. Push into the expeller ring to compress packing rings. Insert GLAND BOLTS (045) and tighten nuts until snug.
10. Fit second SHAFT SLEEVE O-RING (109) and push it into recess in end face of shaft sleeve.
11. Place EXPELLER (028) on shaft, slide over shaft spacer, and press up to shaft sleeve.

**PUMPS – 8/6 GHH, 16/14 TUAH, 10/8 GAH  
20/18 TUAH, 350 SL, 400 STL, 450 STL,  
500 STL, 550 TUL, 650 TUL, 650 UL**

1. Fit a SHAFT SLEEVE O-RING (109) into the labyrinth groove.
2. Join the split RELEASE COLLAR (239) with socket head cap screws and tighten securely. Complete Release Collar installation and disassembly instructions are covered on pages 5-9 and 5-10 of the manual. Fit collar (flat face out) onto the shaft and slide up to the labyrinth.
3. Fit a second SHAFT SLEEVE O-RING (109) next to the collar. Apply anti-seize lubricant to exposed shaft, including threads.
4. Slide SHAFT SLEEVE (075) onto the shaft. Fit SHAFT SLEEVE O-RING (109) and push into recess in end face of shaft sleeve.
5. Follow instructions given in Steps 6-12 for Frame 16/ 14 GAH.

**PUMPS – 6/4 SHH, 8/6 THH,  
10/8 TAH, 12/10 TAH, 14/12 TAH**

1. Fit a SHAFT SLEEVE O-RING (109) into the labyrinth groove.
2. Join the SPLIT RELEASE COLLAR (239) with its socket head cap screws and tighten securely. Complete Release Collar installation and disassembly instructions are covered on pages 5-9 and 510 of the manual. Fit collar (conical face out) onto the shaft and slide up to labyrinth (omit this step for the 6/4 SHH). Apply anti-seize lubricant to exposed shaft, including threads.
3. Slide SHAFT SLEEVE SPACER (179) onto the shaft and slide up against labyrinth.
4. Fit a second SHAFT SLEEVE O-RING (109) onto the shaft and slide up against the shaft sleeve spacer.
5. Slide SHAFT SLEEVE (075) onto the shaft and up against the shaft sleeve spacer.
6. Fit LANTERN RESTRICTOR (ZRR) freely over sleeve.
7. Attach EXPELLER RING LIFTING BEAM (310) to EXPELLER RING (029) onto opposite side of lugs using three jacking screws provided, and make certain the water inlet in the expeller ring is in line with the lifting beam. (*Refer to Figure 5-11*)
8. Lift the expeller ring with lifting beam by means of a hoist, and insert the expeller ring into the frame plate. Tap into position with a mallet. Locate with water connection at top. For safety purposes, it is desirable to attach a bar across the face of the expeller ring using a bolt at either end. Fit the bolt through one of the frame plate liner insert bolt holes. Remove the bar after the shaft packing and gland are installed.
9. After assembly of all other parts of the pump has been completed, carry out assembly of all gland parts in the expeller ring in the following manner:
  - a. Slide LANTERN RESTRICTOR (ZRR) into expeller ring against retaining lip.
  - b. Fit two packing rings to almost completely fill the annulus. Stagger packing joints and flatten each ring.
  - c. Assemble GLAND (044) halves over shaft sleeve with gland neck toward expeller ring, insert GLAND CLAMP BOLTS (126), and fully tighten. Insert GLAND BOLTS (045) and tighten nuts until snug.
10. Fit second SHAFT SLEEVE O-RING (109) and push it into recess in end face of shaft sleeve.
11. Place EXPELLER (028) onto the shaft and press up to the shaft sleeve.

**PUMPS – 10/8 STAH, 12/10 STAH,  
14/12 STAH, 300 SL**

1. Fit a SHAFT SLEEVE O-RING (CSC 210) into labyrinth groove.
2. Join the split RELEASE COLLAR (239) with its socket head cap screws and tighten securely. Complete Release Collar installation and disassembly instructions are covered on pages 5-6 and 5-7 of the manual. Fit collar (flat face out) onto the shaft and slide up to the labyrinth.
3. Fit a second SHAFT SLEEVE O-RING (CSC 210) next to collar.
4. Slide SHAFT SLEEVE (075) onto the shaft. Fit SHAFT SLEEVE O-RING (109) and push into recess in end face of shaft sleeve.
5. Follow instructions given in Steps 6-12 for Frame 16/14 GAH.

**"HS" HIGH SEAL CENTRIFUGAL SEAL**

This manual does not contain instructions specific to the Warman "HS" centrifugal shaft seal. Refer to manual supplement "M8", along with the specific pump component diagram for guidance.

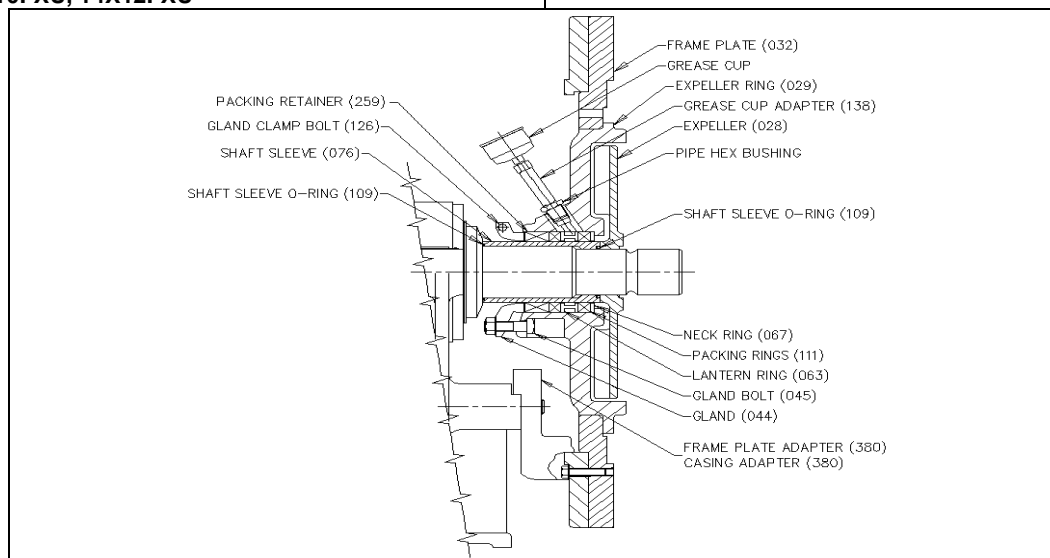
**GREASE LUBRICATED CENTRIFUGAL SEAL**

**FITTING EXPELLER RING, NECK RING, LANTERN RING, PACKING, SHAFT SLEEVE, ADAPTER PLATE, SHAFT SLEEVE O-RING AND IMPELLER O-RING**

**PUMPS – 3X3CXU, 4X4CXU, 4X4DXU, 6X5DXU,  
6X5EXU, 8X6EXU, 8X6FXU, 10X8EXU, 10X8FXU, 12X10  
EXU, 12X10FXU, 14X12FXU**

Refer to *Figure 5-12* for the following assembly procedures:

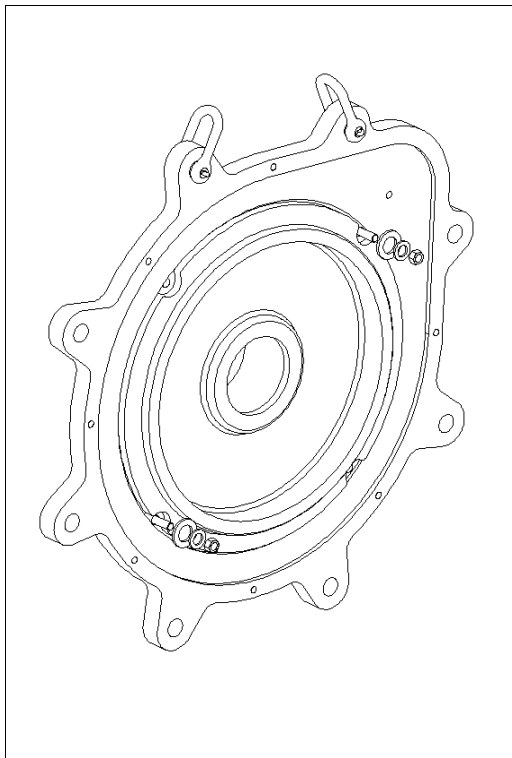
1. Place EXPELLER RING (029) flat on bench (gland seal up)
2. Drop NECK RING (067) into gland recess so it rests on the retaining lip.
3. Stand SHAFT SLEEVE (075) on end and place chamfered end of shaft sleeve through the neck ring.
4. Fit the following items in turn:
  - a. One PACKING RING (111) of correct length to fill annulus.
  - b. Grease LANTERN RING (063) and press down to flatten first ring.
  - c. One PACKING RING (111) of correct length to fill annulus.
  - d. Grease PACKING RETAINER (259) and press down to flatten second ring. (if applicable)
5. Assemble GLAND (044) halves, insert GLAND CLAMP BOLTS (126), and fully tighten. Place gland into expeller ring, pushing it down to compress the packing rings. Insert GLAND BOLTS (045) and snug nuts sufficiently to hold shaft sleeve.
6. Fit SHAFT SLEEVE O-RING (109) on shaft and slide up to labyrinth. Apply anti-seize to exposed shaft, including the threads.
7. Mount expeller ring assembly to bearing shaft and bolt frame plate to FRAME PLATE ADAPTER (380)



**Figure 5-12: Centrifugal Seal Assembly - Metal Expeller Ring with Grease Lubrication**



8. Using two studs, hex nuts and two sizes of flat washers, bolt the frame plate and expeller ring together. **Note: the larger flat washer must capture the expeller ring / stuffing box as shown in Figure 5-14.** Attach two chain shackles through the top ears on the frame plate. Lift the expeller ring assembly using a hoist. (Refer to Figure 5-13)



**Figure 5-13**

**NOTE**

Slowly rotating the bearing shaft will help with the assembly of the shaft sleeve over the shaft.

**Pump – 3 X 3**

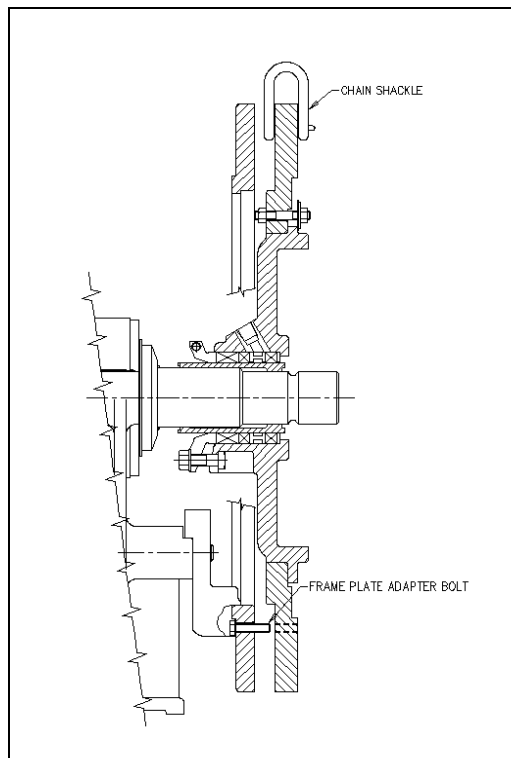
- a. Being that the expeller ring assembly weighs less than 50 lbs., A hoist is not necessary for lifting. Slide expeller ring assembly onto bearing shaft and tap into position with a mallet. Attach the two frame plate adapter bolts.

**Pump – 4 X 4, 6 X 5**

- a. Slide expeller ring assembly onto bearing shaft and tap into position with a mallet. Attach the two frame plate adapter bolts. Remove chain shackles.

**Pump – 8 X 6, 10 X 8, 12 X 10, 14 X 12**

- a. Slide expeller ring assembly onto bearing shaft until the chain shackles butt up against the frame plate adapter. Remove chain shackles and tap into position with a mallet. Attach the two frame plate adapter bolts. (Refer to Figure 5-14)



**Figure 5-14**

9. Fit second SHAFT SLEEVE O-RING (109) and push it into recess in the end of the shaft sleeve.
10. Place EXPELLER (028) on shaft, slide over bearing shaft and press up to shaft sleeve.
11. Assembly of gland lubricating parts is done after all other parts of pump have been assembled.
12. Fit GREASE CUP ADAPTER (138), grease cup and pipe hex bushing to expeller ring as shown in Figure 5-4. Fill cup with recommended grease and screw down the cap to charge lantern ring. Refill cup (refer to section 1 page 12 for recommended grease).

**Pump – 3 x 3 XU**

The procedure is the same as that described above with the following exceptions to step 7

- a. Mount the gland assembly to the CASING ADAPTER (380). Because of the small size it is not necessary to bolt the expeller ring and casing adapter together.

### **Pump – 14 x 12 XU**

The procedure is the same as that described above with the following exceptions to step 6:

- a. Join the three segments of the RELEASE COLLAR (239) using its socket head cap screws. Complete installation and disassembly are provided earlier in this section of the manual. Tighten up the cap screws securely. Fit the release collar (flat face out) on the bearing shaft and slide up to the labyrinth.

#### **NOTE**

All the o-rings, in their respective grooves, will be compressed and fully covered by these metallic parts when the impeller is screwed onto the shaft.

# CENTRIFUGAL SEAL ASSEMBLY

## RUBBER EXPELLER RING

**FITTING EXPELLER RING, SHAFT SEAL, GLAND STUDS, GLAND SHAFT SLEEVE, SHAFT SLEEVE O-RING, AND EXPELLER – (Figure 5-15).**

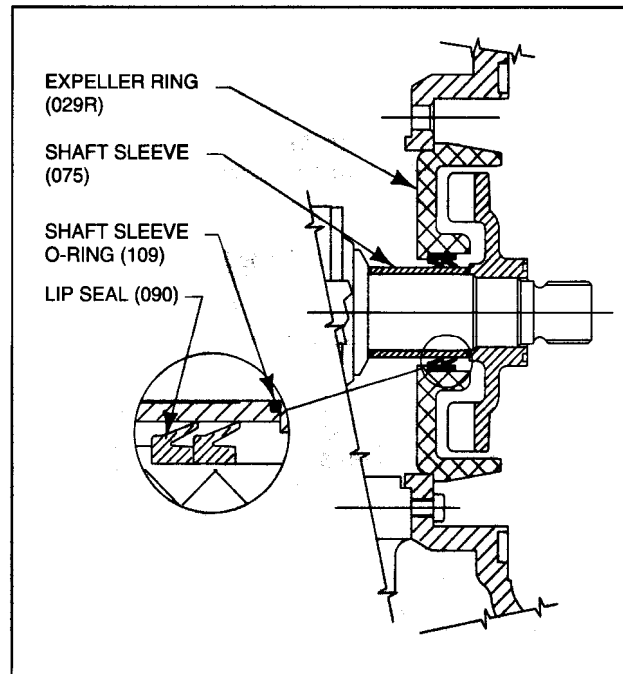
**PUMPS – 1.5/1 BAH, 2/1.5 BAH, 3/2 CAH  
4/3 CAH, 20 AL, 50 BL, 75 CL**

1. Place EXPELLER RING (029R) flat on bench.
2. Insert two (2) SHAFT SEALS (090) lip side up into inside diameter of expeller ring. To ease fitting, smear outside diameter of seals with liquid soap or rubber lubricant.
3. Fit SHAFT SLEEVE O-RING (109) onto shaft and slide up to the labyrinth. Apply anti-seize lubricant to exposed shaft, including threads.
4. Slide SHAFT SLEEVE (075) onto the shaft.
5. Fit a second SHAFT SLEEVE O-RING (109) and push into the recess in the end face of the shaft sleeve.

**FITTING EXPELLER RING, SHAFT SEAL, GLAND STUDS, GLAND SHAFT SLEEVE, SHAFT SLEEVE O-RING, AND EXPELLER (RUBBER EXPELLER RING) – (Figure 5-16).**

**PUMPS – 100 DL, 150 EL, 200 FM, 250 FL,  
300 RSL, 4/3 DAH, 6/4 DAH, 6/4 EAH, 8/6 FAH**

1. Place EXPELLER RING (029R) flat on a bench with the gland side up as shown in *Figure 5-9*.
2. Fit two EXPELLER RING STUDS (079) into expeller ring tapped holes provided and tighten fully.
3. Insert three SHAFT SEALS (090) (lip down) into gland recess and push against retaining lip. To ease fitting, smear the outside diameter of seals with liquid soap or rubber lubricant.
4. Place LIP SEAL GLAND (241) into the expeller ring, fit nuts on studs, and tighten fully. (Gland adjustment is not required.)
5. Fit SHAFT SLEEVE O-RING (109) onto the shaft and slide up to labyrinth as shown in *Figure 5-16*. Apply anti-seize lubricant to exposed shaft, including threads.
6. Slide SHAFT SLEEVE (075) on shaft.
7. Fit a second SHAFT SLEEVE O-RING (109) and push into recess in end face of shaft sleeve.



**Figure 5-15 Assembly of Lip Seal Gland Components**

**PUMPS – 4/3 CAH, 8/6 EAH, 200 EM, 250 EL**

The procedure is the same as that described above, with the following exceptions to Step 7 for pumps supplied prior to January 1, 1990:

- a. Slide SHAFT SPACER (117E) onto the shaft against shaft sleeve.
- b. Fit SHAFT SPACER O-RING (109) into the spacer groove.

**PUMPS – 10/8 FAH, 12/10 FAH, 14/12 FAH,  
12/10 GAH, 12/10 GAH, 14/12 GAH,  
10/8 STAH, 12/10 STAH, 14/12 STAH,  
14/12 TAH, 20/18 TUAH, 300 SL,  
350 SL, 400 STL, 450 STL, 500 STL,  
550 TUL, 650 TUL, 650 UL**

These frames incorporate a LANTERN RING (063) or LANTERN RING (063)/NECK RING (067) to allow the introduction of grease lubrication to the lip seals. (See *Figure 5-17*) Pre-grease the lantern ring before installing between lip seals. Only two lip seals are used with this arrangement.

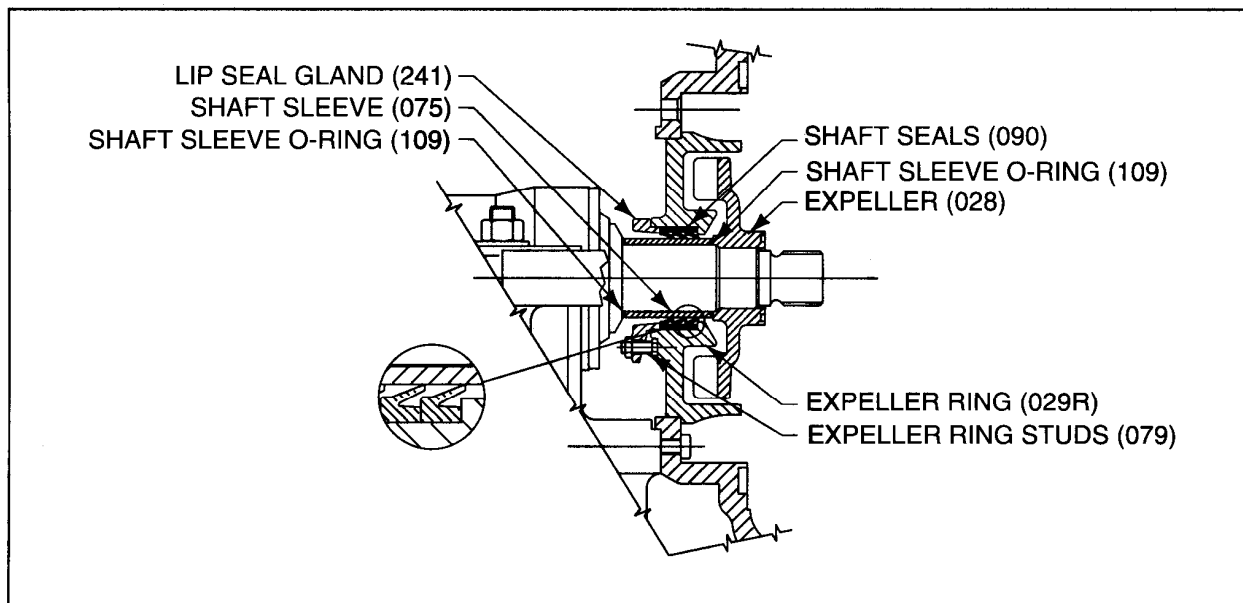
### ALL PUMPS

1. Insert assembled expeller ring over shaft sleeve into frame plate recess and tap into position with a mallet.
2. Place EXPELLER (028) on shaft and press up to shaft sleeve or spacer. Ensure vanes point toward expeller ring as shown in *Figure 5-16*.

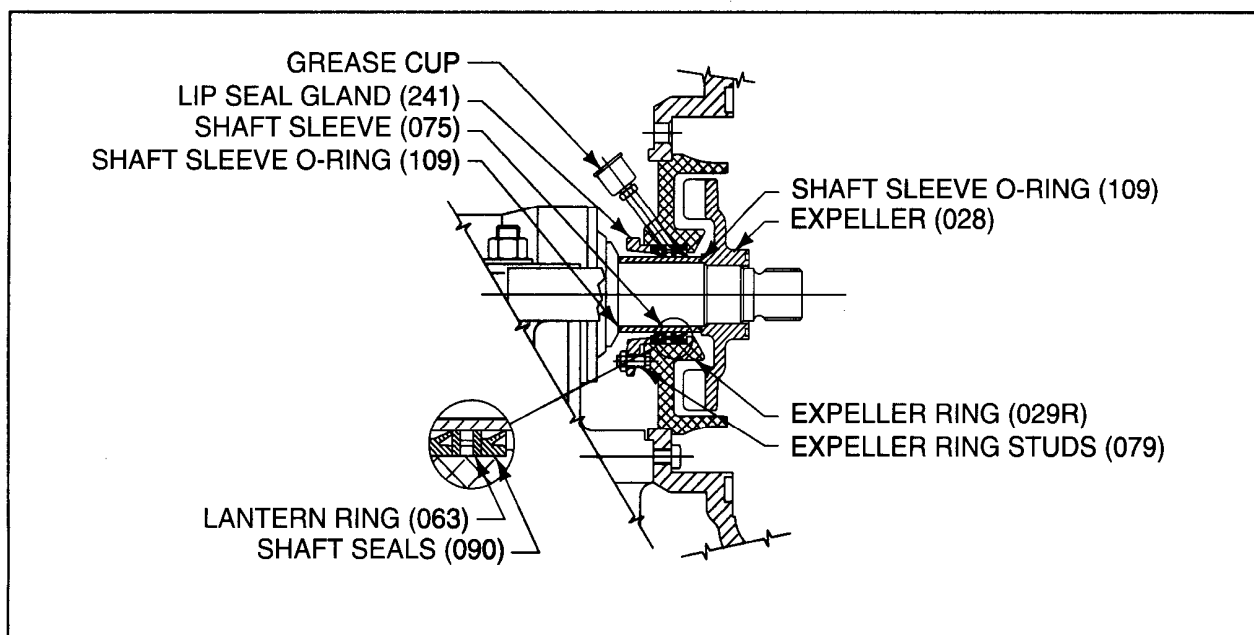
### MECHANICAL SEAL

Consult the seal manufacturer for installation and maintenance procedures on mechanically sealed pumps.

Do not attempt to remove or reinstall the mechanical seal without first reviewing the manufacturer's instructions. Damage to the seal faces can occur.



**Figure 5-16 Fitting of Expeller Ring, Shaft Seals, Gland Studs, Gland, Shaft Sleeve, Shaft Sleeve O-Ring and Expeller**



**5 -17 Fitting Expeller Ring, Shaft Seals, Lantern Ring, Gland Studs, Gland, Shaft Sleeve, Shaft Sleeve O-Ring and Expeller**

# MECHANICAL SEAL ASSEMBLY

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## PUMPS FITTED WITH MECHANICAL SEALS

When a mechanical shaft seal is involved, review the seal manufacturer's instructions, along with the specific component diagrams for the pump and shaft seal prior to proceeding. Seal faces are most vulnerable when exposed while handling. Protect the faces until just prior to installing the seal or immediately after removal.

Seal face adjustment varies with the type and manufacturer. Correct adjustment is critical to successful operation and to avoid damage to the seal faces. Leave seal faces apart or drive collar/set screws disengaged from the shaft sleeve until impeller adjustment is completed. Read the manufacturer's instructions completely. If there are any questions, contact the seal manufacturer or Weir Minerals for guidance

# PUMP LINER ASSEMBLY INSTRUCTIONS

## GENERAL NOTES

Warman pumps are available in a variety of liner configurations (metal lined, elastomer lined, or a combination of both). A few sizes are also available in an unlined configuration (AHU designation). This manual contains assembly instructions for all liner configurations. Refer to your pump components diagram to determine the applicable configuration.

For lined pumps locate your model number in *Table 6-1* below to determine the appropriate pump assembly section of the manual. For unlined pumps refer to *Section 6, Page 19*.

Do not use petroleum based lubricants on liner components. Use only mild hand soap if required.

PUMP MODEL		LINER CONFIGURATION	
		METAL	ELASTOMER
1.5/1	BAH	A	C
1.5/1	CHH	A	-
2/1.5	BAH	A	C
3/2	CAH	A	C
3/2	DHH, QHH	B	-
4/3	CAH	A	C
4/3	DAH	A	C
4/3	EHH, RHH, RAHP	B	D
6/4	DAH	B	D
6/4	EAH	B	D
6/4	EAHP, RAHP	B	D
6/4	FHH, SHH	B	-
8/6	EAH	B	D
8/6	FAH, RAH	B	D
8/6	FAHP, SAHP	B	D
8/6	GHH, THH	B	-
10/8	FAH	B	D
10/8	GAH, TAH	B	D
10/8	TAHP	B	D
12/10	FAH	B	D
12/10	GAH, STAH, TAH	B	D
12/10	TAHP	B	D

PUMP MODEL		LINER CONFIGURATION	
		METAL	ELASTOMER
14/12	FAH	B	G
14/12	GAH, STAH, TAH	B	G
14/12	TAHP	B	G
16/14	GAH	B	G
16/14	HAH, TAH, TUAH	B	G
16/14	TUAHP	B	G
20/18	TUAH	B	G
20/18	TUAHP	B	G
20	AL	A	C
50	BL	A	C
75	CL	A	C
100	DL	A	C
150	EL	A	C
200	EM, FM	B	D
250	EL, FL	B	F
300	RSL, SL	B	E
350	SL	B	G
400	STL	B	G
450	STL	B	G
500	STL	B	G
550	TUL	B	G
650	TUL, UL	B	G

A	=	METAL LINER	2 PARTS	Section 6 - Page 3
B	=	METAL LINER	3 PARTS	Section 6 - Page 6
C	=	ELASTOMER LINER	2 PARTS	Section 6 - Page 9
D	=	ELASTOMER LINER	3 PARTS HAVING INTEGRAL VOLUTE LINER SEAL	Section 6 - Page 11
E	=	ELASTOMER LINER	3 PARTS HAVING SEPARATE VOLUTE LINER SEAL	Section 6 - Page 13
F	=	ELASTOMER LINER	4 PARTS HAVING INTEGRAL VOLUTE LINER SEALS	Section 6 - Page 15
G	=	ELASTOMER LINER	4 PARTS HAVING SEPARATE VOLUTE LINER SEALS	Section 6 - Page 17

Table 6-1 • Liner Configuration Chart

Table 6-2 below lists recommended torque values for COVER PLATE BOLTS (015). These values should be followed on all pumps, but are critical for metal lined pumps to prevent possible damage to the volute liner due to over-tightening.

		MAXIMUM TORQUE	
PUMP MODEL		Ft-Lb	Nm
1.5/1	BAH	35	48
1.5/1	CHH	35	48
2/1.5	BAH	35	48
3/2	CAH	35	48
3/2	DHH, QHH	160	217
4/3	CAH	80	108
4/3	DAH	80	108
4/3	EHH, RHH	420	570
4/3	RAHP	1150	1500
6/4	DAH	160	217
6/4	EAH	160	217
6/4	EAHP, RAHP	1150	1500
6/4	FHH, SHH	420	570
8/6	EAH	160	217
8/6	FAH, RAH	160	217
8/6	FAHP, SAHP	1150	1500
8/6	GHH, THH	700	950
10/8	FAH	420	570
10/8	GAH, STAH, TAH	420	570
10/8	TAHP	1150	1500
12/10	FAH	420	570
12/10	GAH, STAH, TAH	420	570
12/10	TAHP	1150	1500
14/12	FAH	700	950
14/12	GAH, STAH, TAH	700	950
14/12	TAHP	1150	1500
16/14	GAH	1200	1500
16/14	HAH, TAH, TUAH	1200	1500
16/14	TUAHP	1628	2200
20/18	TUAH	2500	1500
20/18	TUAHP	2500	1500
20	AL	8	10
50	BL	21	28
75	CL	33	45
100	DL	33	45
150	EL	66	90
200	EM, FM	160	217
250	EL, FL	160	217
300	RSL, SL	240	325
350	SL	240	325
400	STL	590	800
450	STL	590	800
500	STL	1115	1500
550	TUL	1115	1500
650	TUL, UL	1115	1500

Table 6-2 • Torque Table for Cover Plate Bolts (015)

After completing liner installation the impeller must be adjusted. Refer to Impeller Clearance Adjustment near the end of this section.

All metal lined pumps (except unlined "AHU") incorporate MOLDED INTAKE JOINT RINGS (060) and DISCHARGE JOINT RINGS (132) between the pump liner projection and the adjacent piping flange. This is also true for all elastomer lined pumps except smaller sizes. Refer to your components diagram to see if they are not required.

# PUMP ASSEMBLY

## METAL LINERS - TWO PARTS

### FITTING SEAL RING, FRAME PLATE LINER INSERT, VOLUTE LINER SEALS, VOLUTE LINER, IMPELLER AND COVER PLATE

For two piece metal lined pumps, the volute liner and "front liner" (throatbush) are one piece. This applies for pump sizes **1.5/1 AH, 2/1.5 AH, 3/2 AH, 4/3 AH, 1.5/1 CHH, 20 AL, 50 BL, 75 CL, 100 DL, and 150 EL** pumps. (Refer to Figure 6-1.)

1. Fit VOLUTE LINER SEAL (124 or 125). The seal is one of two types:

- O-RING: VOLUTE FRAME SEAL (125): 1.5/1 AH, 2/1.5 AH, 3/2 AH, and 20 AL pumps. The seal is an o-ring and it is fitted at a later stage.
- C-SECTION – VOLUTE LINER SEAL (124): 1.5/1 CHH, 50 BL, 75 CL, 100 DL, 150 EL, and 4/3 AH pumps. The seal is a C-Section and is activated by internal pressure. Fit it (flat face in) into the frame plate groove. Use rubber contact cement if required.

2. Fit SEAL RING (122 or 109). This seal is also of two different types.

#### FOR 1.5/1 AH, 2/1.5 AH, and 3/2 AH PUMPS

Fit C-Section SEAL RING (122) onto rim of stuffing box or expeller ring. To aid in holding the seal in position during subsequent assembly steps, it is recommended that the seal be cemented to the stuffing box/expeller ring using rubber cement, (preferably of the dry contact type), with sufficient drying time allowed before contacting the two parts. Only apply the cement at four to six locations on bottom of the C-section in the seal, rather than all the way around. This will ensure that the seal is not unduly restrained during compression.

#### FOR 20 AL, 50 BL, 75 CL, 100 DL, 150 EL, and 1.5/1 CHH PUMPS

Fit O-RING SEAL (122 or 109) into groove around the perimeter of the stuffed box. If needed, use rubber cement as indicated above to hold o-ring in position during assembly.

3. Fit FRAME PLATE LINER INSERT (041) and IMPELLER.

#### NOTE

For most of the sizes listed the frame plate liner insert is NOT held with studs, but is held by a locating seat engaging with the frame plate -

(1.5/1 AH, 2/1.5 AH, 3/2 AH, 20 AL, 50 BL, 75 CL, 100 DL, and 150 EL) or by the volute liner (4/3 AH). Only the 1.5/1 CHH pump uses studs.

#### a. FOR 1.5/1 AH, 2/1.5 AH, 3/2 AH, 20 AL, 50 BL, 75 CL, and 100 DL PUMPS

- Obtain correct type of impeller as specified for the particular application. Rest the impeller, boss up, on a flat surface. Apply anti-seize lubricant to the impeller thread.

Place FRAME PLATE LINER INSERT (041) over impeller boss, then screw impeller on shaft. Make certain that the various seals have not shifted and that the locating seats on the back of the frame plate liner insert engage fully with the frame plate.

- Check CLAMP BOLTS (012) on side of base (See Figure 4-1) to ensure they are snug just enough to hold the bearing assembly horizontal, but not locked in place. Assuming shaft is bare, fit SHAFT KEY (070) in keyway and bolt SHAFT WRENCH (306) onto the shaft. If the pump is installed, remove v-belts or separate coupling hubs. While holding impeller with a bar between the vanes, turn shaft with wrench or v-belt pulley and tighten impeller on shaft. Do not over-tighten.

To hold the frame plate liner insert temporarily in its correct position, move the bearing assembly back by means of the nut on the ADJUSTING SCREW (001).

- Fit VOLUTE FRAME SEAL (125) – (O-Ring) over the rim of frame plate liner insert and next to the frame plate.

#### b. FOR 4/3 AH AND 150 EL PUMPS

- Obtain correct type of IMPELLER as specified for the particular application. Elastomer impellers require use of BOSS CAP (379). To keep it in position during assembly tape it to the impeller hub. Rest the impeller (boss up) on a flat surface. Apply anti-seize lubricant to the impeller thread.

Place FRAME PLATE LINER INSERT (041) over the impeller boss, then screw impeller onto the shaft. Make certain that the various seals have not shifted.



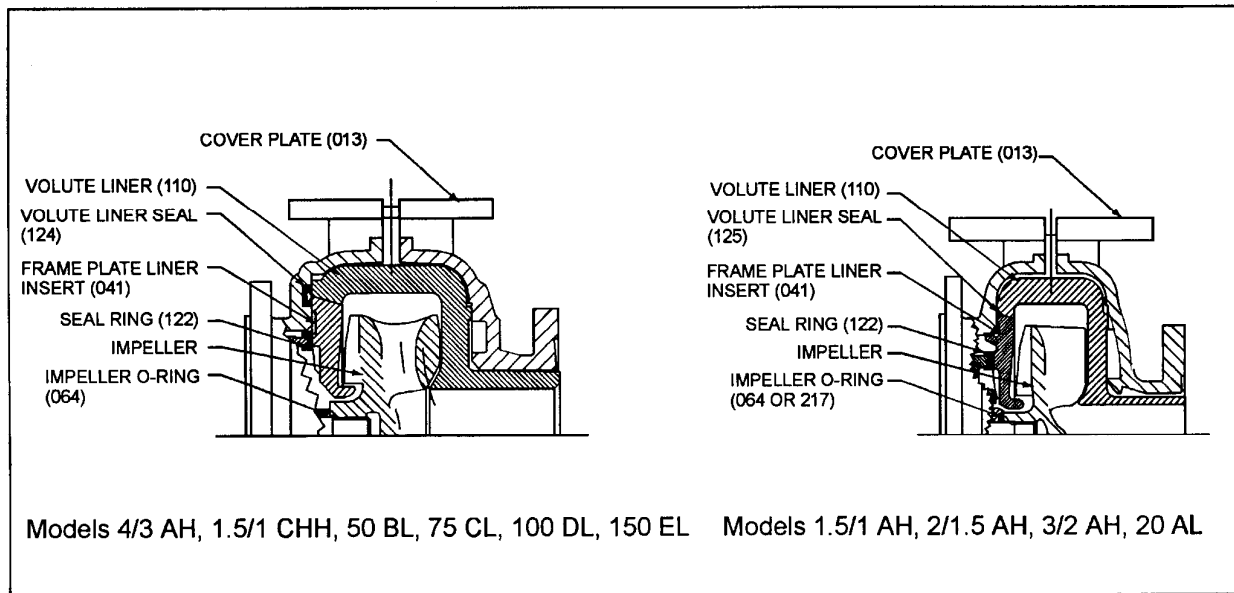


Figure 6-1 • Pump Assembly – Volute Liner Seal

- If the shaft is bare fit SHAFT KEY (070) in keyway and bolt SHAFT WRENCH (306) on shaft, over key. Hold shaft with wrench and, turning the impeller with a bar between vanes, tighten impeller on shaft. Do not over-tighten.

Check that CLAMP BOLTS (012) on recessed side of base are tight enough to hold the bearing assembly horizontal, but not to lock it. To hold the frame plate liner insert temporarily in its correct position, move the bearing assembly back by means of the nut on the ADJUSTING SCREW (001). The insert may be centered by hand if required.

c. **FOR 1.5/1 CHH PUMPS**

- Screw and tighten STUDS (026) into tapped holes in the frame plate liner insert.
- Place liner insert over shaft and align studs with holes in frame plate. Screw on nuts, but do not tighten completely.
- Obtain correct impeller and apply anti-seize to impeller threads. Engage impeller with shaft threads and hold with a bar between vanes while turning the pump shaft. Using SHAFT WRENCH (306) installed on shaft extension, tape with a mallet to tighten impeller. Ensure all shaft o-rings remain in place.

4. Fit VOLUTE LINER (110) as follows: For two piece metal lined pumps, the volute liner and "front liner" (throatbush) are one piece. Lift VOLUTE LINER (110) over impeller and push back into frame plate so that the taper of the frame plate liner insert

engages with the corresponding taper in the volute liner as shown in Figure 6-1.

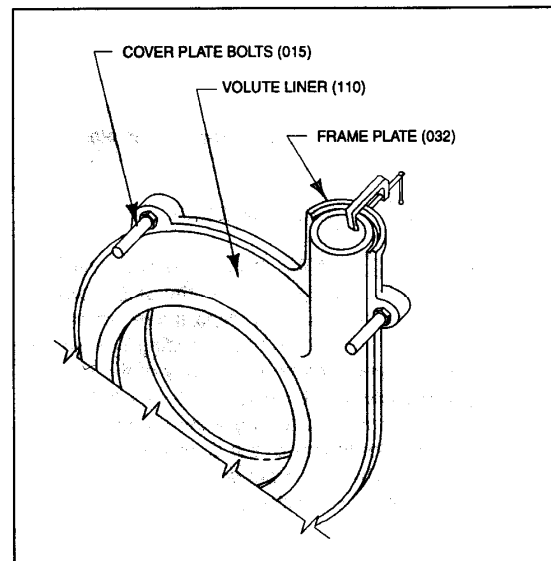


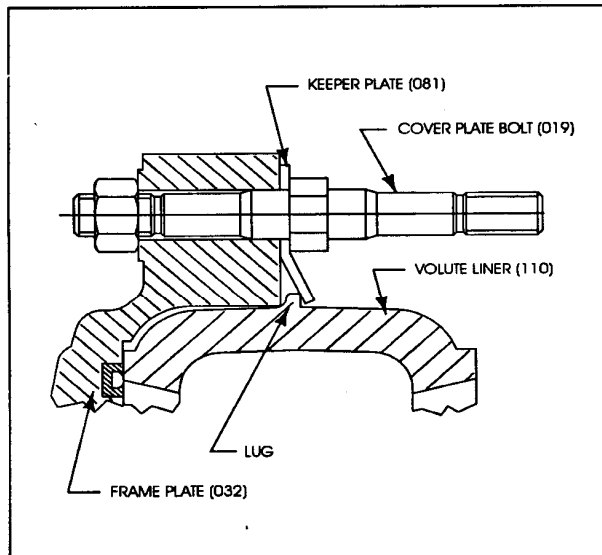
Figure 6-2 • Fitting Volute Liner and Throatbush

Make certain the volute frame seal has not shifted. To hold the volute liners temporarily in this position use a C-clamp. Clamp the volute liner discharge nozzle to the half flange of the frame plate as shown in Figure 6-2. For 150 EL pumps only reinstall (3) KEEPER PLATES (081) as shown in Figure 6-2a.

**!! WARNING !!**

**TO PREVENT INJURY, IT IS VERY IMPORTANT THAT THE VOLUTE LINER BE HELD FIRMLY DURING THE FINAL STAGES OF ASSEMBLY.**

5. Lift COVER PLATE (013) over volute liner and line up holes with cover plate bolts (015) already fitted in the frame plate. Screw nuts on cover plate bolts. Do not tighten. Remove C-clamp from volute liner and tighten all cover plate bolts evenly to the torque given in *Table 1*. For the 1.5/1 CHH only, tighten up frame plate liner insert studs completely.
6. Depending on the method used to assemble the gland components, complete the assembly of gland parts in the stuffing box or expeller ring by following the relevant instructions in the seal assembly section. For pumps fitted with Warman Mechanical Seals, assembly of the remaining parts and header tank, etc. should now be completed.
7. The pump is now ready for fitting of joint rings and impeller adjustment. (*Refer to Figure 6-24 for adjustment procedure.*)



**Figure 6-2a • Using Keeper Plate to Retain Volute**

# PUMP ASSEMBLY

## METAL LINERS – THREE PARTS

**FITTING FRAME PLATE LINER INSERT, VOLUTE LINER, SEAL RINGS, VOLUTE LINER SEALS, IMPELLER O-RING, IMPELLER AND COVER PLATE. IMPORTANT - READ INSTRUCTIONS FOR HANDLING VOLUTE ON PAGE 8 BEFORE PROCEEDING.**

1. Apply rubber cement in expeller or shaft spacer groove. Depending on pump type, fit either IMPELLER O-RING (064) or (217), or SHAFT SLEEVE O-RING (109) into the expeller as shown in *Figure 6-3*. Make sure that o-ring is held in position.
2. Fit SEAL RING (122). There are two different type seals.
  - a. The C-section type fits on the rim of the stuffing box or the metal expeller ring. Use rubber cement to hold the seal in position, avoiding the possibility of the seal shifting when the frame plate liner is attached.
  - b. The o-ring type fits an o-ring. Fit it in the groove in the rim of the stuffing box or the metal expeller ring. Use rubber cement to hold seal in position if needed.
3. Fit VOLUME FRAME SEAL (124). The seal is of C-section and it is actuated by internal pressure. Fit it (flat face in) into the frame plate groove. Use rubber cement to hold the seal in position, avoiding the possibility of the seal shifting when the frame plate liner is attached.
4. Fit FRAME PLATE LINER INSERT (041) and IMPELLER.

The frame plate liner insert has provisions to accommodate studs for mounting insert into frame plates. Proceed as follows:

1. Screw and tighten STUDS (026) into tapped holes provided in the frame plate liner inserts.
2. Suspend LIFTING TUBE (302) from a hoist. Stand the frame plate liner insert on edge and push the lifting tube into insert hole.

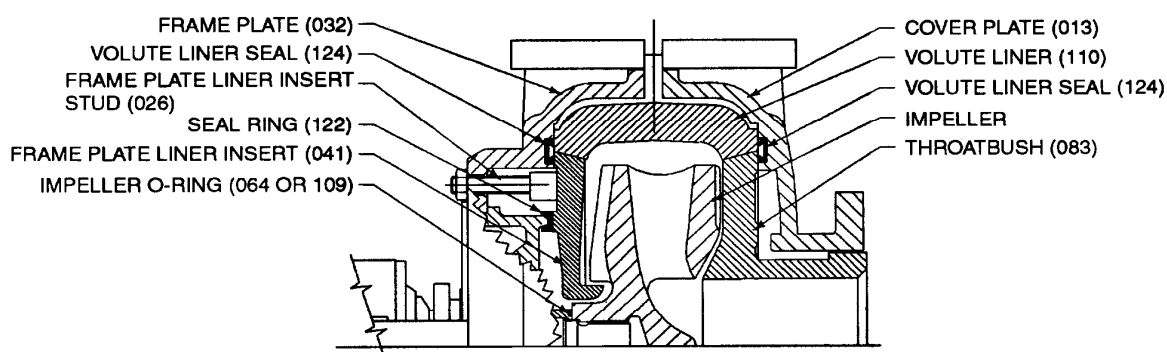
Lift tube along with the insert and slide the tube over shaft thread. Line up studs, or bolts, with holes and push liner insert against frame plate.

Make sure that the various seals have not shifted. Screw on nuts, but do not tighten, then remove lifting tube.

3. Check CLAMP BOLTS (012) on side of base (see *Figure 6-8*) to ensure they are just tight enough to hold the bearing assembly horizontal, but not to lock it. Assuming the shaft is bare, fit SHAFT KEY (070) in keyway and bolt SHAFT WRENCH (306) onto the shaft. If the pump is installed, remove v-belts or separate coupling hubs.

Hold the shaft and screw LOCATING NUT (303) on the shaft. The conical face will locate the frame plate liner insert in its correct position. Tighten up all studs on the insert, then remove locating nut.

4. Obtain correct type of IMPELLER as specified for particular pump application. Elastomer impellers require use of a BOSS CAP (379). To keep it in position during



*Figure 6-3 • Pump Assembly – Metal Liners (3 Parts)*

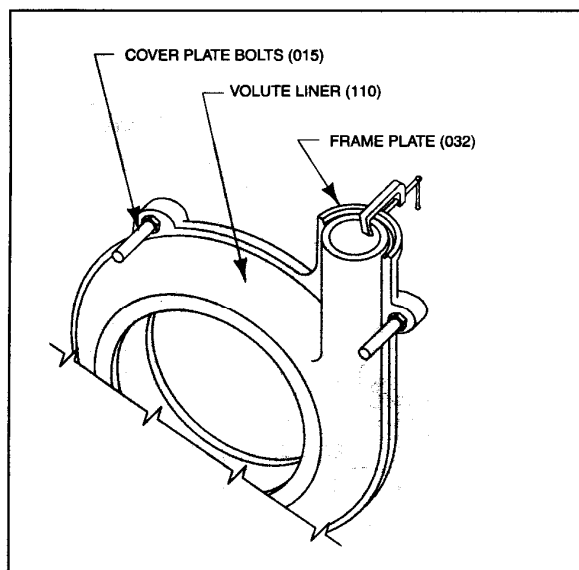


Figure 6-4 • Fitting Frame Plate and Volute

assembly tape it to the impeller hub. Rest impeller (boss up) on flat surface. Apply anti-seize lubricant to thread.

Lift impeller with hoist using a sling, cable or hook. Use a bar between vanes to hold impeller while turning shaft and tighten snugly. Do not over-tighten.

Make sure that the various o-rings on the shaft are not damaged during assembly and that they are fully covered by the corresponding sleeves, etc.

#### NOTE

The importance of this step cannot be over-emphasized. If seals are damaged, a leak will almost certainly occur, requiring a tear down to correct.

5. Fit VOLUTE LINER (110) and THROATBUSH (083).

Use LIFTING BEAM (304) and a hoist to lift VOLUTE LINER (110) off the floor. Use a C-clamp on the lower end of the lifting beam to ensure volute does not rotate during handling.

In large pumps, lugs are provided around the periphery of the liner. These lugs are positioned so three of the cover plate bolts line up with them. KEEPER PLATES are used to hold the volute in place as shown in Figure 6-5.

#### !! WARNING !!

**IT IS VERY IMPORTANT TO HOLD THE VOLUTE LINER FIRMLY IN PLACE DURING THE FINAL STAGES OF ASSEMBLY. FAILURE TO DO SO COULD RESULT IN PERSONAL INJURY OR DAMAGE TO THE PUMP.**

It is recommended that a C-clamp be placed on the discharge as shown in Figure 6-4 to ensure the volute remains in place during the remainder of the assembly.

This is particularly true for smaller sizes which do not have retaining lugs on the volute.

- a. Rest COVER PLATE (013) (intake flange down) on suitable supports so as to keep flange approximately one inch above floor.
- b. Fit VOLUTE LINER SEAL (124) with flange down into the groove in the cover plate.
- c. Lower THROATBUSH (083) into cover plate.
- d. Insert wedge-shaped COTTERS (085) through slots in the neck of the cover plate. Tap them carefully and evenly until throatbush is held firmly in cover plate.

#### NOTE

Large pumps may utilize four (4) studs instead of cotters to hold throatbush in position. Mark stud locations and matching holes in cover plate before lowering in place.

6. Fit COVER PLATE (013).

Lift cover plate, complete with throatbush, where applicable, over volute liner and line up holes with COVER PLATE BOLTS (015) already in frame plate.

Large cover plates are provided with radially tapped holes for eye bolts to facilitate lifting.

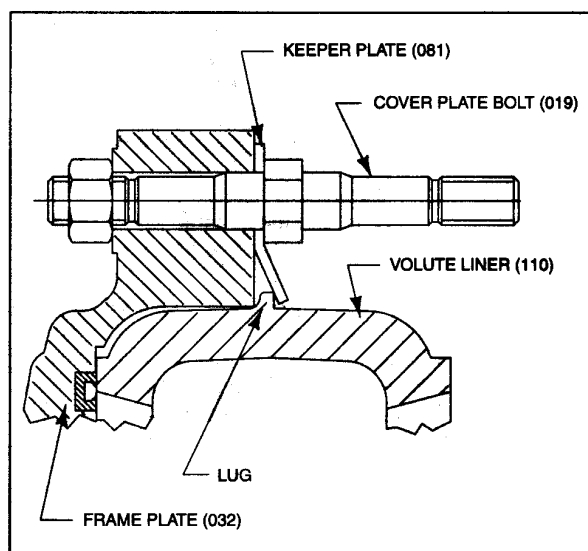


Figure 6-5 • Using Keeper Plate to Retain Volute

Screw nuts on cover plate bolts. Do not tighten. Remove throatbush cotters and C-clamp from volute liner, then tighten all cover plate bolts evenly according to the Torque Table 6-2.

Check all liner insert bolts for tightness and reinstall throatbush cotters.

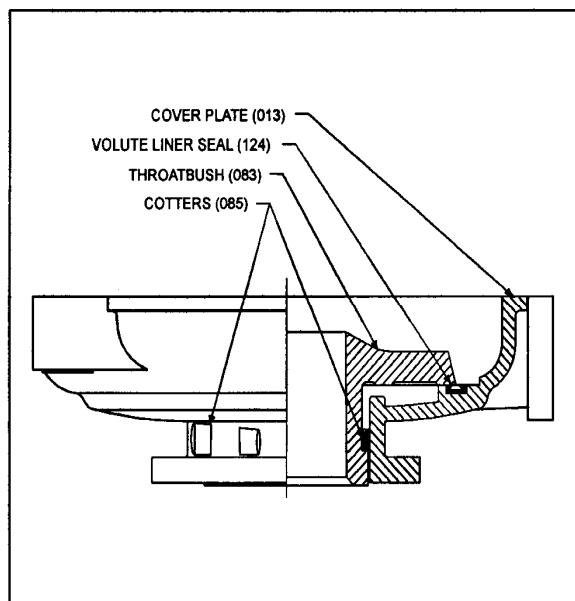


Figure 6-6 • Throatbush Cotter Location

## Lifting and Handling Large Metal Volute Liners

It is recommended that large volutes be handled horizontally until installation. If the volute is attached to a sturdy skid, use the skid for transporting it. Otherwise we recommend three heavy slings be placed through the volute at equal spacing with some padding placed between the sling and volute. This serves to protect the sling and prevent it from sliding around the volute while handling. The volute should be kept relatively close to the ground while transporting it.

Installation of large volutes is best handled with the aid of a lifting beam. (Refer to Figure 6-6a.) The lifting beam allows the volute to be picked up from the horizontal position and balanced vertically while being installed in the frame plate. Rig with an auxiliary sling or chain attached to a heavy "C" clamp at the discharge neck. This prevents any rotation of the volute from occurring while being handled regardless of orientation. The beam is installed in the horizontal position and then lifted to a vertical position. Do not remove the beam until the volute is securely attached to the pump frame plate.

A combination of slings and chains may be used to install the volute provided the slings are protected from sharp edges. The volute must also be properly balanced in a vertical position when handling.

When KEEPER PLATES (081) are not used on the larger volutes the cast lugs are drilled for bolts which are used to attach it to the frame plate. Do not over-tighten these.

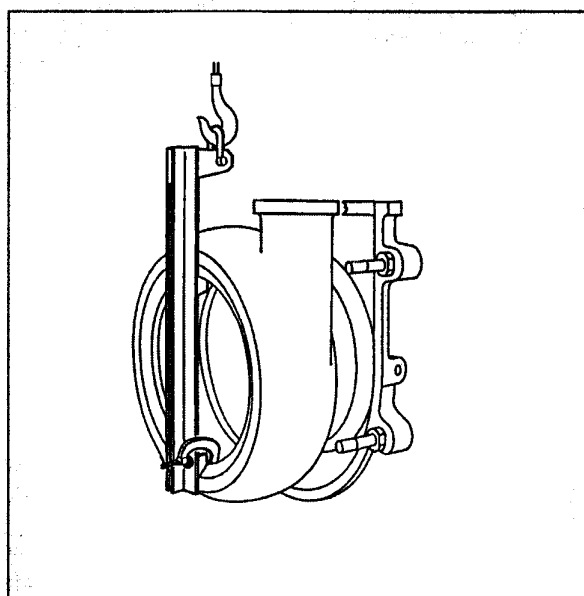


Figure 6-6a • Volute Lifting Beam Installation

# PUMP ASSEMBLY

## ELASTOMER LINERS – TWO PARTS

### FITTING FRAME PLATE LINER, COVER PLATE LINER, IMPELLER AND COVER PLATE

1. Apply some rubber cement in the expeller groove or haft spacer groove, and fit either IMPELLER O-RING (064) or (217) or, depending on the pump, SHAFT SLEEVE O-RING (109) into it. (See appropriate components diagram.) Make sure that the o-ring is held in position.
2. Fit FRAME PLATE LINER (036)
  - a. Screw and tighten STUDS (026) in tapped bosses provided in the frame plate liner.
  - b. Lift liner into position, line up studs with holes, and push liner into frame plate. Fit nuts onto studs.
3. Fitting IMPELLER.
  - a. Obtain correct type of impeller as specified for particular pump application. Rest the impeller (boss up) on a flat surface. **Note:** Elastomer impellers on pump sizes 4/3 CAH and larger must be fitted with the impeller boss cap (359). To keep it in position during assembly tape it to the impeller hub.

- b. Check CLAMP BOLTS (012) on side of base (See Figure 6-18) to ensure they are snug just enough to hold the bearing assembly horizontal, but not locked in place. Assuming shaft is bare, fit SHAFT KEY (070) in keyway and bolt SHAFT WRENCH (306) onto the shaft. If the pump is installed, remove v-belts or separate coupling hubs. While holding impeller with a bar between the vanes, turn shaft with wrench or v-belt pulley and tighten impeller on shaft. Do not over-tighten. Make sure the various o-rings on the shaft are not damaged during assembly.
4. Fit COVER PLATE LINER (017) and COVER PLATE (013).
  - a. Screw and tighten STUDS (023) into tapped bosses, when provided, on COVER PLATE LINER (017).

### **! CAUTION !**

Avoid solvent-based soap rubber lubricant, because it can affect the overall life and durability of natural rubber.

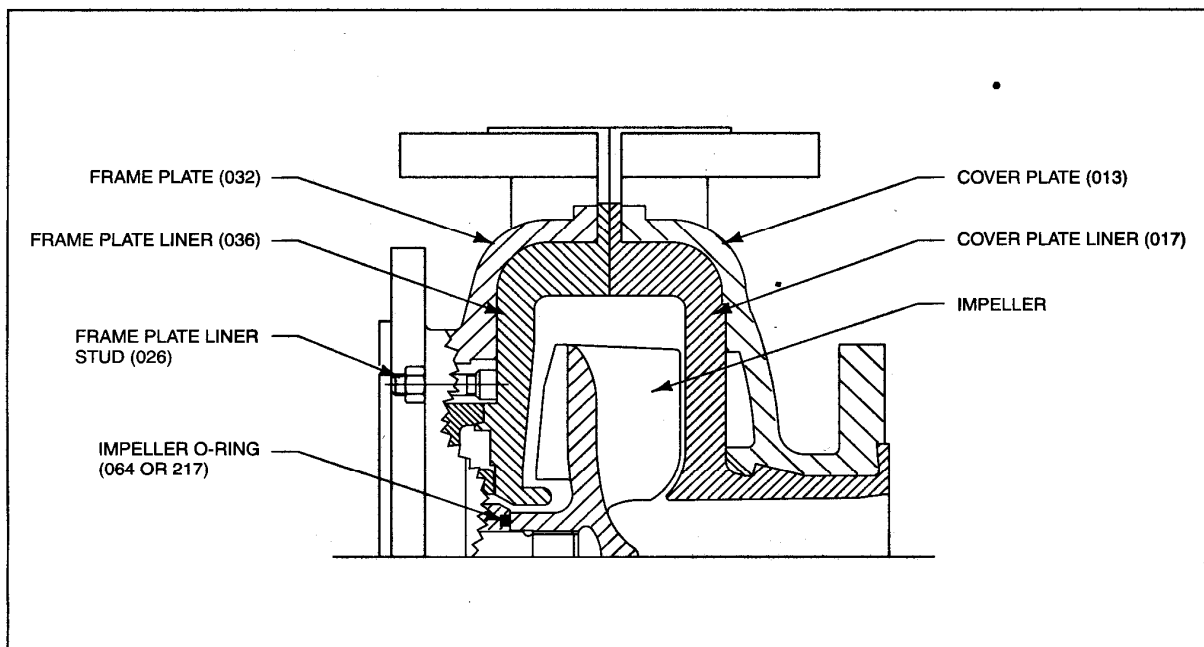


Figure 6-7 • Pump Assembly – Rubber Liners (2 Part)

- b. Place cover plate liner on floor (suction flange up). Apply a liberal amount of liquid soap or rubber lubricant on suction flange and inside suction neck of COVER PLATE (013).
- c. Place cover plate over liner, lining up studs with holes. Press cover plate down until liner is hard against cover plate. Insert a small tire iron between suction neck and liner and lift flange out. Fit nuts onto studs.
- d. Lift cover plate complete with liner and line up holes with COVER PLATE BOLTS (015) already in frame plate. Screw nuts on the cover plate bolts and tighten evenly to torque values given in *Table 6-2*.

**Pump Sizes 20 AL, 1.5/1 AH AND 2/1.5 AH (Rubber Lined Only)**

Place a rod which is the diameter of the discharge into the pump discharge during final casing assembly to ensure proper discharge diameter. This rod should be lubricated with a soap of non-petroleum origin and removed after the cover plate bolts have been properly tightened.

After completing assembly the impeller must be adjusted.  
(Refer to *Figure 6-24*.)

# PUMP ASSEMBLY

## ELASTOMER LINERS – THREE PARTS WITH INTEGRAL VOLUTE LINER SEALS

### FITTING FRAME PLATE LINER, COVER PLATE LINER, THROATBUSH, IMPELLER AND COVER PLATE

1. Apply some rubber cement in the expeller or shaft spacer groove and fit either IMPELLER O-RING (064) or (217) or, depending on pump, SHAFT SLEEVE O-RING (109) into it. (See appropriate components diagram.) Make sure that the o-ring is held in position.
2. Fit FRAME PLATE LINER (036).
  - a. Screw and tighten STUDS (026) into tapped bosses provided in frame plate liner.
  - b. Lift liner into position, line up studs with holes, and push into frame plate. Fit nuts onto studs.

#### NOTE

On 200 EM or FM or 8/6 RAH pump with the discharge at one of the 45° positions, an ADAPTOR RING (drawing number A14346) is bolted to the frame plate liner. Remove the adaptor ring from the old liner and replace it on the new liner before reassembly.

3. Fit IMPELLER.
  - a. Check CLAMP BOLTS (012) on side of base (See Figure 6-18) to ensure they are just tight enough to hold the bearing assembly horizontal, but not to lock it. Assuming the shaft is bare, fit SHAFT KEY (070) in keyway and bolt SHAFT WRENCH (306) onto the shaft. If the pump is installed, remove v-belts or separate coupling hubs.
  - b. Obtain correct type of impeller as specified for particular pump application. **Note:** Elastomer impellers must be fitted with the impeller BOSS CAP (359). To keep it in position during assembly tape it to the impeller hub. Apply anti-seize lubricant to the thread. Lift the impeller with a rope hoist, and screw it onto shaft. Use a bar between vanes and hold while turning shaft to tighten impeller. Be careful not to damage various o-rings on the shaft during assembly.
4. Fit COVER PLATE LINER (018), THROATBUSH (083), and COTTERS (085) or STUD (026) as shown in Figure 6-8.

If STUDS (026) are used on the throatbush or cover plate liner they must be installed before assembling to the cover plate.

Natural rubber (R) compounds are more flexible than materials such as polyurethane (U) or neoprene (S). Follow Steps e-h for materials other than natural rubber. Continue on with Step j for all materials.

- a. Place COVER PLATE (013) on floor resting on suction flange. If required install COVER PLATE LINER STUDS (023) in COVER PLATE LINER (018). Position liner in cover plate and tighten nuts on liner studs just until snug.
  - b. For throatbushes having studs, mark the relative location of one mating hole in the cover plate on the cover plate liner, and also on the back of the throatbush. Install studs in the throatbush and place two blocks of lumber in the suction opening of the cover plate. Lower throatbush onto supporting blocks and remove rigging. Align studs with holes in cover plate. Lift cover plate and remove blocking.
- For throatbushes without studs, use of supporting blocks will allow easy removal of rigging used for lifting. In this case alignment is not required.
- c. Apply a liberal amount of liquid soap or rubber lubricant on tapered edge of throatbush and lip seal of liner.

#### **! CAUTION !**

**Avoid solvent based soap lubricant, because they can affect overall life and durability of the liner material.**

- d. Using a tire iron or flat pry bar between liner and throatbush, pry up tapered edge of liner and force throatbush down against lip seal. Assist this action by stepping down on the area being worked while tapping the edge with a small mallet.
- e. For elastomer liners other than natural rubber, place COVER PLATE LINER (018) (outer flange down) on floor with a block in the center of sufficient height to finish flush or slightly above liner. Rest the THROATBUSH (083) (suction flange up) on the block.



- f. Apply a liberal amount of liquid soap or rubber lubricant on the tapered edge of the throatbush and on the lip seal of liner.
- g. If throatbush has studs, mark location of one with respect to mating hole in cover plate on throatbush and liner. Align throatbush studs with cover plate. Lift and tilt liner to engage lip seal over one-third of the throatbush diameter. Run a small tire iron with rounded edges between throatbush and liner, and lift lip seal to engage over the back of throatbush. Insure that the lip is properly set.

**! CAUTION !**

**Be careful during this operation not to damage or tear lip seal.**

- h. Lift COVER PLATE (013) (suction flange up) and fit over throatbush and liner.
- j. Insert COTTERS (085) through slots in neck of cover plate. Tap them carefully and evenly until throatbush is held firmly in cover plate. If studs are used on the throatbush install nuts and tighten until snug.

5. Fitting COVER PLATE (013).

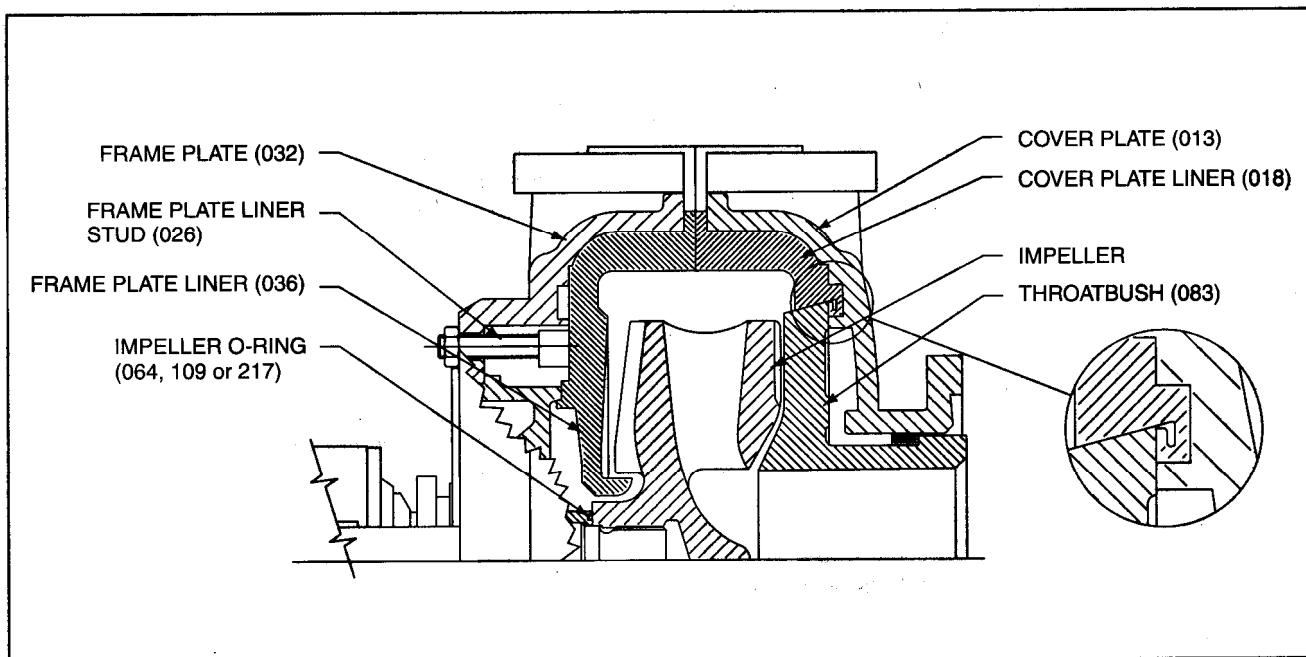
Lifting cover plate, complete with throatbush and liner, and line up holes with COVER PLATE BOLTS (015) already in frame plate.

**NOTE**

Large cover plates are provided with radially tapped holes for eye bolts to facilitate lifting.

Screw nuts on cover plate bolts and tighten evenly to torque values given in *Table 6-2*.

After completing assembly the impeller must be adjusted. (Refer to *Figure 6-21*.)



*Figure 6-8 • Pump Assembly – Rubber Liners (3 Part)*

# PUMP ASSEMBLY

## ELASTOMER LINERS – THREE PARTS WITH SEPARATE VOLUTE LINER SEALS

### FITTING FRAME PLATE LINER, COVER PLATE LINER, THROATBUSH, VOLUTE LINER SEAL, IMPELLER AND COVER PLATE.

1. Apply some rubber cement in expeller or shaft spacer groove. Fit either IMPELLER O-RING (064), (217) or, depending on pump, SHAFT SLEEVE O-RING (109) into it. See appropriate components diagram. Make sure that o-ring is held in position.
2. Fit FRAME PLATE LINER (036).
  - a. Screw and tighten STUDS (026) in tapped bosses provided in frame plate liner.
  - b. Lift liner carefully into position, line up studs with holes, and push into frame plate. Fit nuts onto studs. Do not over-tighten. Limit torque to 10 ft-lbs for studs .500" or less and 15 ft-lbs for those that are larger.
3. Fit impeller.
  - a. Check CLAMP BOLTS (012) on side of base (See Figure 6-18) to ensure they are just tight enough to hold the bearing assembly horizontal, but not to lock it. Assuming the shaft is bare, fit SHAFT KEY (070) in keyway and bolt SHAFT WRENCH (306) onto the shaft. If the pump is installed, remove v-belt or separate coupling hubs.

- b. Obtain correct type of impeller as specified for particular application. **Note:** Elastomer impellers must be fitted with a BOSS CAP (359). To keep it in position during assembly tape it to the impeller hub. Apply anti-seize lubricant to the thread. Lift impeller with a rope hoist and use a bar between vanes to hold impeller while turning the shaft. Be careful not to damage the various o-rings on the shaft during the assembly and ensure that the impeller boss cap remains in place.
4. Fit VOLUTE LINER SEAL (124).
 

Fit seal (124) into recess, flat side first, in cover plate. Rubber contact cement may be used to secure the seal into the recess during assembly.
5. Fit THROATBUSH (083).
  - a. Screw and tighten STUDS (274) into tapped bosses provided in throatbush (083).
  - b. Place COVER PLATE (013) on floor resting on suction flange. Lift throatbush carefully into position, line up studs with holes, and push into cover plate. Fit nuts onto studs. Ensure volute liner seal remains in place.

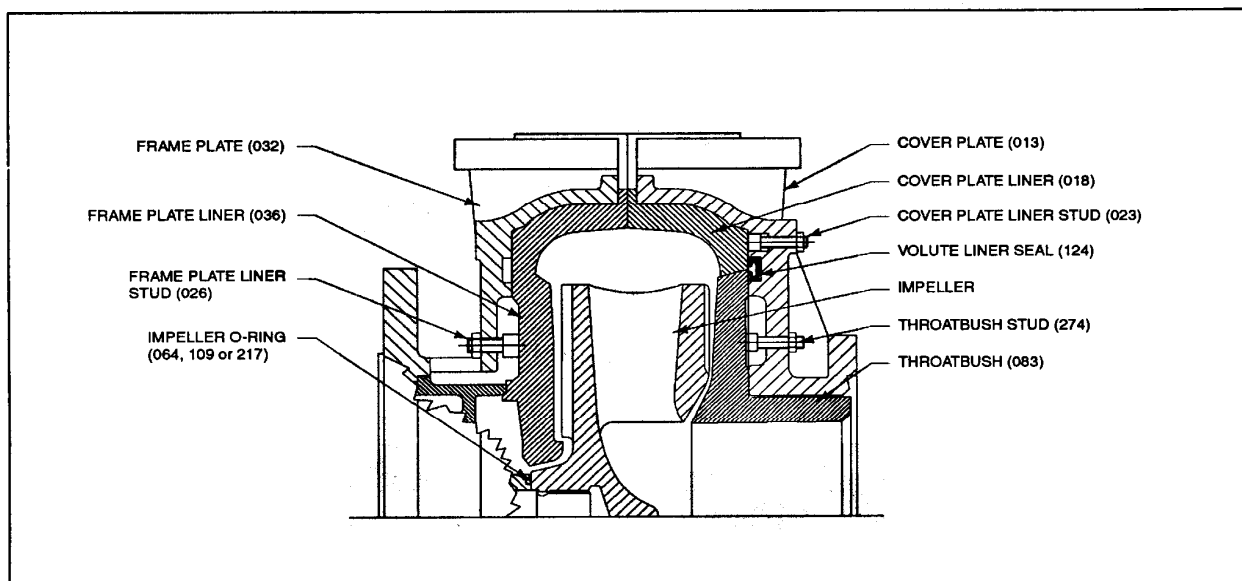


Figure 6-9 • Pump Assembly – Rubber Liners (3 Part) with Separate Volute Liner Seal

6. Fit COVER PLATE (018).

- a. Screw and tighten STUDS (023) in tapped bosses provided in cover plate liner.
- b. Apply a liberal amount of liquid soap or rubber lubricant on tapered edge of throatbush and cover plate liner.

**! CAUTION !**

**Avoid solvent based soap rubber lubricant, because it can affect the over-all life and durability of the liner.**

- c. Lift cover plate liner carefully into position, line up studs with holes and push into cover plate. Fit nuts onto studs.
7. Fit COVER PLATE (013). Lift cover plate, complete with throatbush and liner, and line up holes with COVER PLATE BOLTS (015) already in frame plate.

Screw nuts on cover plate bolts and tighten evenly. (Refer to Table 6-2 for torque values.) After completing assembly impeller must be adjusted. (Refer to Figure 6-21.)

# PUMP ASSEMBLY

## ELASTOMER LINERS – FOUR PARTS WITH INTEGRAL VOLUTE LINER SEALS

### FITTING FRAME PLATE LINER, COVER PLATE LINER, FRAME PLATE LINER INSERT, THROATBUSH AND IMPELLER.

1. Apply some contact cement in expeller or shaft spacer groove. Fit either IMPELLER O-RING (064), (217) or, depending on pump, SHAFT SLEEVE O-RING (109) into it. (See appropriate components diagram.) Make sure that o-ring is held in position.
2. Fit FRAME PLATE LINER (043), FRAME PLATE LINER INSERT (041), and LINER STUDS (026).
  - a. Screw and tighten STUDS (026) in tapped bosses provided in frame plate liner insert.
  - b. Position frame plate liner in frame plate. Use a clamp at discharge if required to hold in place.

### **! CAUTION !**

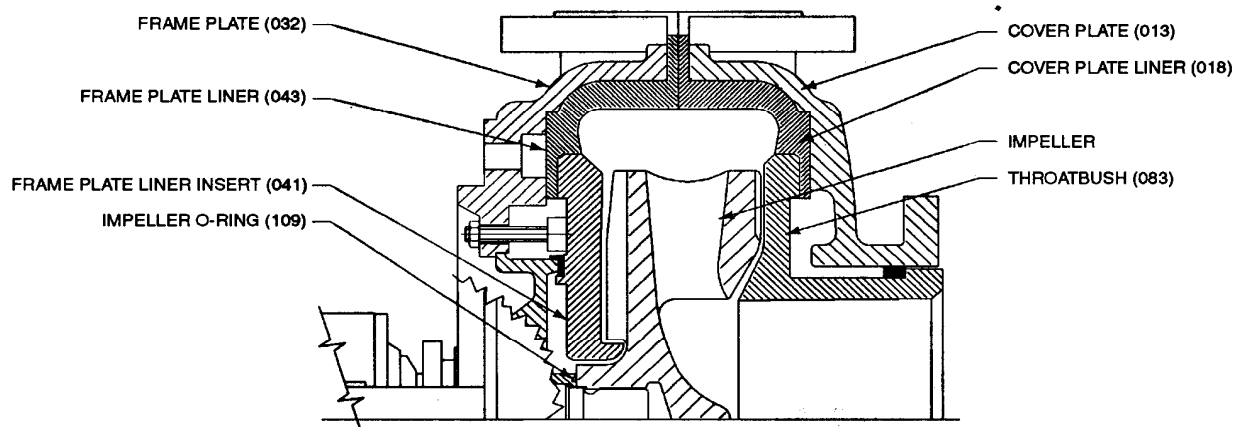
**Avoid solvent based soap solution such as Swarfega as a rubber lubricant, because it can affect the over-all life and durability of natural rubber.**

- c. Apply a liberal amount of liquid soap or rubber lubricant on mating edges of liner and liner insert. Lift insert up and into position. Fit nuts on studs.

Do not over-tighten. Limit torque to 10 ft-lbs. for studs .500" or less and 15 ft-lbs. for those larger.

3. Fit IMPELLER.
  - a. Check CLAMP BOLTS (012) on side of base (see Figure 6-18) to ensure they are just tight enough to hold the bearing assembly horizontal, but not to lock it. Assuming the shaft is bare, fit SHAFT KEY (070) in keyway and bolt SHAFT WRENCH (306) onto the shaft. If the pump is installed, remove v-belts or separate coupling hubs.
  - b. Obtain correct type of IMPELLER as specified for particular pump application. **Note:** Elastomer impellers must be fitted with a BOSS CAP (359). To keep it in position during assembly tape it to the impeller hub. Apply anti-seize lubricant to the thread. Lift the impeller with a rope hoist, and screw it onto shaft. Use a bar between vanes and hold while turning shaft to tighten impeller. Be careful not to damage the various o-rings on the shaft during assembly.
4. Fit COVER PLATE LINER (018), THROATBUSH (083), and COTTERS (085) or STUDS (026).

If STUDS (026) are used on the throatbush or cover plate liner they must be installed before assembling to the cover plate.



**Figure 6-10 • Pump Assembly – Rubber Liners (4 Parts) with Integral Volute Liner Seals**

Natural rubber (R) compounds are more flexible than materials such as polyurethane (U) or neoprene (S). Follow steps a-d for natural rubber components and steps e-h for other elastomer materials. Continue on with Step j for all materials.

- a. Place COVER PLATE (013) on floor resting on suction flange. If required, install COVER PLATE LINER STUDS (023) in COVER PLATE LINER (018). Position liner in cover plate and tighten nuts on liner studs just until snug.

- b. For throatbushes having studs, mark the relative location of one mating hole in the cover plate on the cover plate liner, and also on the back of the throatbush. Install studs in the throatbush and place two blocks of lumber in the suction opening of the cover plate. Lower throatbush onto supporting blocks and remove rigging. Align studs with holes in cover plate. Lift cover plate up and remove blocking.

For throatbushes without studs, use of supporting blocks will allow easy removal of rigging used for lifting. In this case alignment is not required.

- c. Apply a liberal amount of liquid soap or rubber lubricant on tapered edge of throatbush and lip seal of liner.

#### **! CAUTION !**

**Avoid solvent based soap lubricant, because they can affect overall life and durability of the liner material.**

- d. Using a tire iron or flat pry bar between liner and throatbush, pry up tapered edge of liner and force throatbush down against lip seal. Assist this action by stepping down on the area being worked while tapping the edge with a small mallet.

- e. Place COVER PLATE LINER (018) (flange down) on the floor with a block in the center of sufficient height to finish flush or slightly above liner. Rest the THROATBUSH (083) (suction flange up) on it.
- f. Apply a liberal amount of liquid soap or rubber lubricant on tapered edge of throatbush and on lip of liner. If throatbush has studs, mark location of one with respect to mating hole in cover plate on throatbush and liner. Align throatbush studs with cover plate.
- g. Lift and tilt liner to engage lip over one-third of the throatbush diameter. Run a small tire iron with rounded edges between throatbush and liner, and lift lip to engage over the throatbush tapered edge. Make certain that the lip is properly set. Be careful not to damage or tear the lip seal during this operation.
- h. Lift COVER PLATE (013) (suction flange up) and fit over throatbush and liner.
- i. Insert COTTERS (085) through slots in the neck of the cover plate. Tap them carefully and evenly until throatbush is held firmly in cover plate.

#### **NOTE**

Large pumps may utilize four STUDS (026) instead of cotters to hold throatbush in position. In this case install nuts and tighten snug.

5. Fit COVER PLATE (013).

Lift cover plate, complete with throatbush and liner, and line up holes with COVER PLATE BOLTS (015) already in frame plate.

Screw nuts on cover plate bolts and tighten evenly to torque values given in *Table 6-2*.

After completing assembly the impeller must be adjusted. (*Refer to Figure 6-21.*)

# PUMP ASSEMBLY

## ELASTOMER LINERS – FOUR PARTS WITH SEPARATE VOLUTE LINER SEALS

### FITTING FRAME PLATE LINER, COVER PLATE LINER, FRAME PLATE LINER INSERT, THROATBUSH, VOLUTE LINER SEALS AND IMPELLER.

1. Apply some heavy grease in expeller or shaft spacer groove. Fit either IMPELLER O-RING (064), (217) or, depending on pump, SHAFT SLEEVE O-RING (109) into it. (See appropriate components diagram.) Make sure that o-ring is held in position.
2. Fit volute liner seals (124) into recess in frame plate and cover plate. Contact cement may be used to secure the seals into the recess during assembly.
3. Fit FRAME PLATE LINER INSERT (041).
  - a. Screw and tighten STUDS (026) in tapped bosses provided in frame plate liner insert.
  - b. Lift FRAME PLATE LINER INSERT carefully into position, line up studs with holes, and push into frame plate. Fit nuts onto studs. Do not over-tighten. Limit torque to 10 ft-lbs. for studs .500" or less and 15 ft-lbs. for those that are larger. Ensure volute liner seal remains in place.

4. Fit FRAME PLATE LINER (043).

- a. Screw and tighten STUDS (040) in tapped bosses provided in frame plate liner.
- b. Apply a liberal amount of liquid soap or rubber lubricant on the 45° taper edge of the frame plate liner and frame plate liner.
- c. Lift liner and insert carefully in position, line up studs with holes, and push into frame plate. Fit nuts onto studs.

### **! CAUTION !**

**Avoid solvent based soap rubber lubricant, because it can affect the overall life and durability of the liner.**

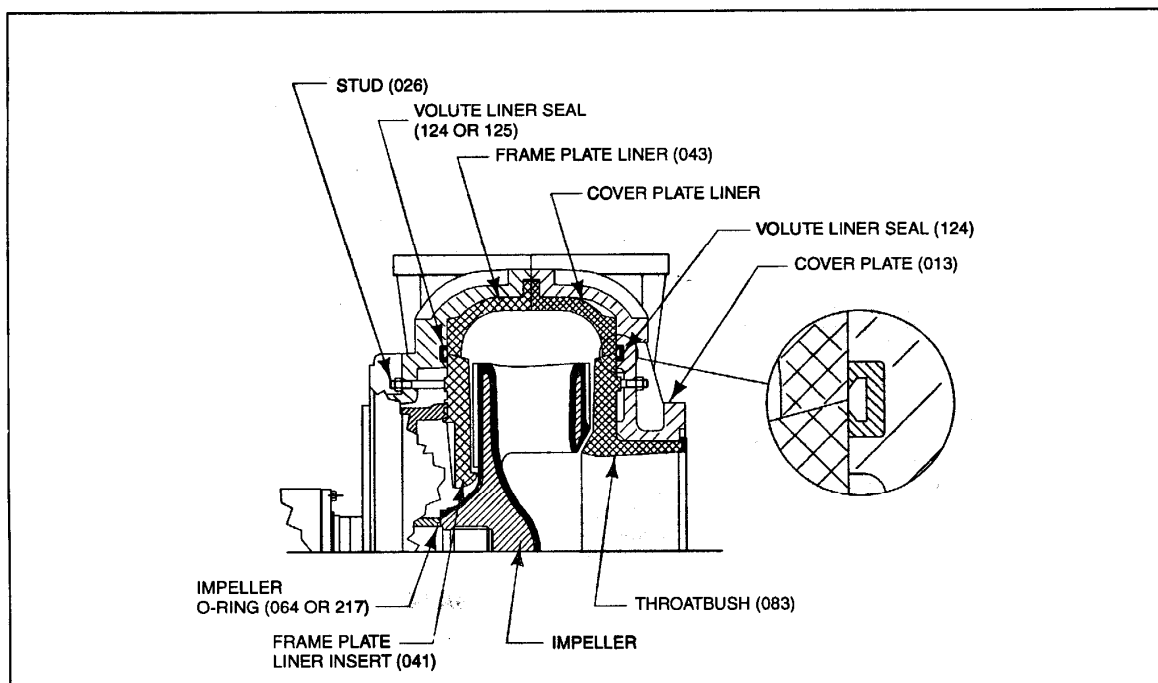


Figure 6-11 • Pump Assembly – Rubber Liners (4 Parts)



5. Fit IMPELLER.

- a. Check CLAMP BOLTS (012) on side of base (see *Figure 6-18*) to ensure they are just tight enough to hold the bearing assembly horizontal, but not to lock it. Assuming the shaft is bare, fit SHAFT KEY (070) in keyway and bolt SHAFT WRENCH (306) onto the shaft. If the pump is installed, remove v-belts or separate coupling hubs.
- b. Obtain correct type of IMPELLER as specified for particular application. **Note:** Elastomer impellers must be fitted with a BOSS CAP (359). To keep it in position during assembly tape it to the impeller hub. Apply anti-seize lubricant to the thread. Lift the impeller with a rope hoist, and screw it onto shaft. Use a bar between vanes and turn shaft to tighten impeller. Be careful not to damage the various o-rings on the shaft during assembly.

6. Fit THROATBUSH (083).

- a. Screw and tighten studs (274) in tapped bosses provided in THROATBUSH.
- b. Lift THROATBUSH carefully into position, line up studs with holes in COVER PLATE (013) and push into cover plate. Fit nuts onto studs. Ensure volute liner seal installed above remains in place.

7. Fit COVER PLATE LINER (018).

- a. Screw and tighten studs (023) in tapped bosses provided in cover plate liner.

- b. Apply a liberal amount of liquid soap or rubber lubricant on tapered edge of throatbush and cover plate liner.

- c. Lift cover plate liner carefully into position, line up studs with holes and push into cover plate. Fit nuts onto studs.

8. Fit COVER PLATE (013).

Lift cover plate, complete with throatbush and liner, and line up holes with COVER PLATE BOLTS (015) already in frame plate.

**NOTE**

Large cover plates are provided with radically tapped holes for eye bolts to facilitate lifting.

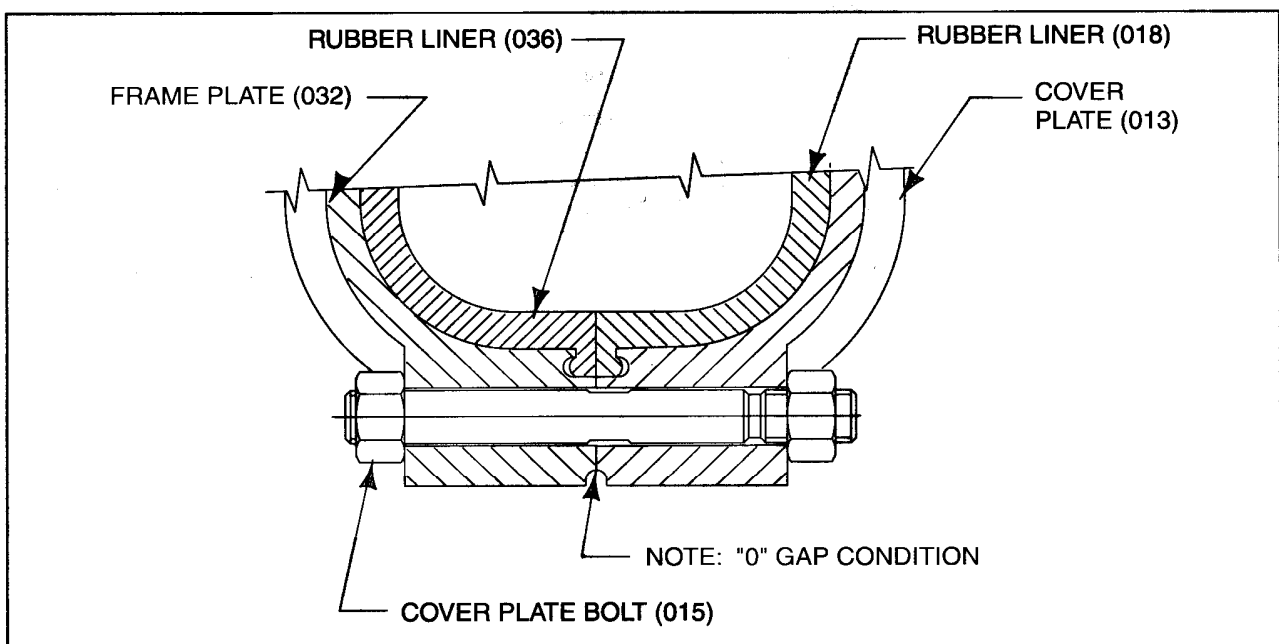
Screw nuts on cover plate bolts and tighten evenly. (Refer to *Table 6-1* for torque values.)

After completing assembly the impeller must be adjusted. (Refer to *Figure 6-21*.)

*Figure 6-10* shows the unique design feature of the Warman High Pressure Slurry Pump (designated by the suffix "AHP"). This design is also used on 500 STL and larger "L" series pump models.

**NOTE**

The secure interlocking of the RUBBER LINERS (036) or (043) and (018) by the integral grooves in the FRAME PLATE (032) and COVER PLATE (013), this feature provides a superior seal by restriction of the rubber from displacing.



*Figure 6-12 • AHP Liner Interlocking Features*



# PUMP ASSEMBLY

## UNLINED PUMPS

The Warman AHU series pump is designed to be an unlined counterpart to the heavy-duty AH series pump. Both use the same bearing assemblies, bases, seal components, and impeller. They also have the same suction and discharge flange center lines and hydraulic performance.

Maintenance of the AHU pump is identical to that of the AH pump except for the wear components. This section is intended to clarify which sections of this manual from the AH series are applicable, as well as explain difference unique to the unlined pump assembly techniques.

### AHU PUMP ASSEMBLY

#### FRAME ASSEMBLY – FITTING BEARING ASSEMBLY TO CRADLE

Refer to the frame assembly instructions outlined in Section 4 of this manual.

#### ADAPTOR PLATE ASSEMBLY – FITTING ADAPTOR PLATE TO BASE (Figure 6-13)

1. Fit ADAPTOR PLATE (032) to BASE (003). Make certain the adaptor plate shoulder has engaged with the corresponding locating diameter on the base.

2. Insert ADAPTOR PLATE STUDS (039 or 034) to fasten adaptor plate to base. Make certain the large diameter end is closest to the adaptor plate.
3. Torque to values specified in *Table 4-1*.

#### GLAND SEAL (Figure 6-14)

#### FITTING STUFFING BOX, LANTERN RESTRICTOR, PACKING GLAND, SHAFT SLEEVE, SHAFT SPACER AND SHAFT SLEEVE O-RING

The assembly procedure for the gland seal in *Figure 6-14* is identical to the procedure described in Section 5.

#### CENTRIFUGAL SEAL ASSEMBLY – METAL EXPELLER RING (Figure 6-15)

#### FITTING EXPELLER RING, NECK AND LANTERN RINGS, PACKING, SHAFT SLEEVE, SHAFT SLEEVE O-RING, and EXPELLER

The assembly procedure for the centrifugal seal assembly in *Figure 6-15* is identical to that in Section 5.

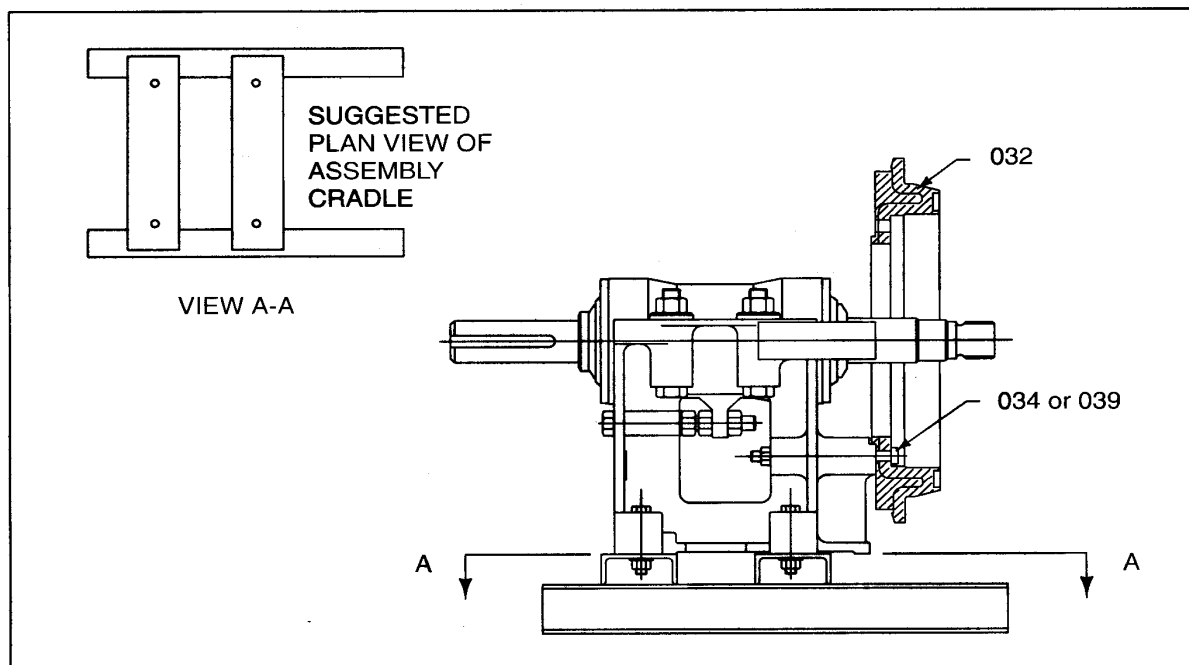


Figure 6-13 • Base Plate and Cradle

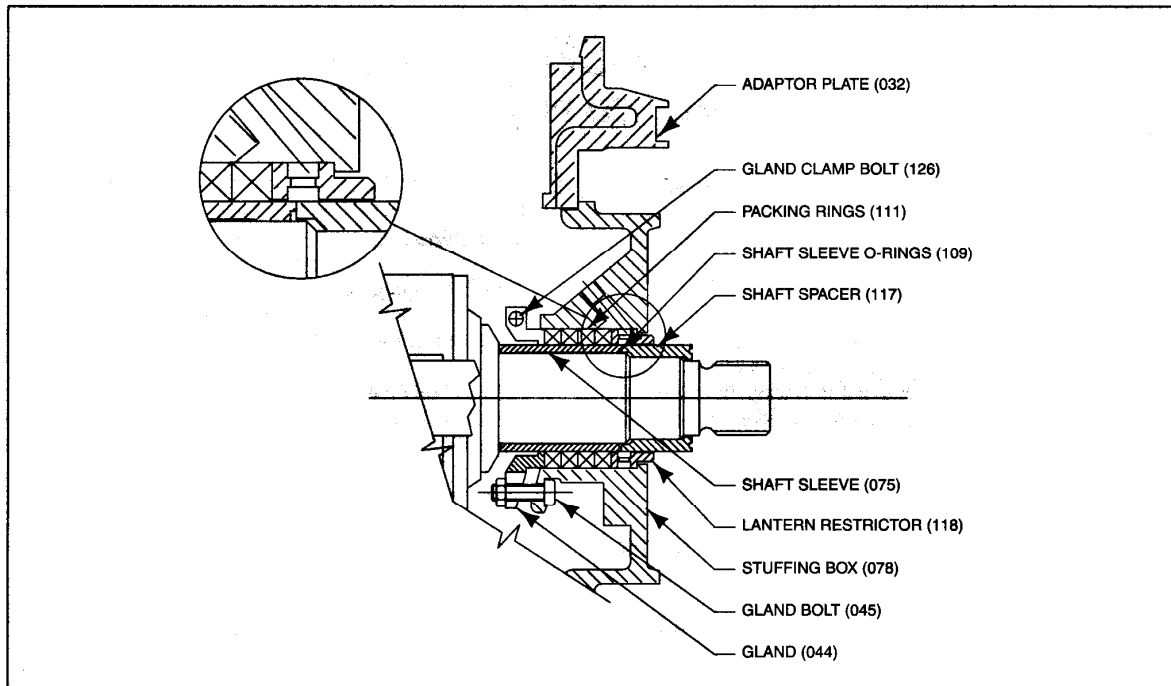


Figure 6-14 • Gland Assembly (AHU)

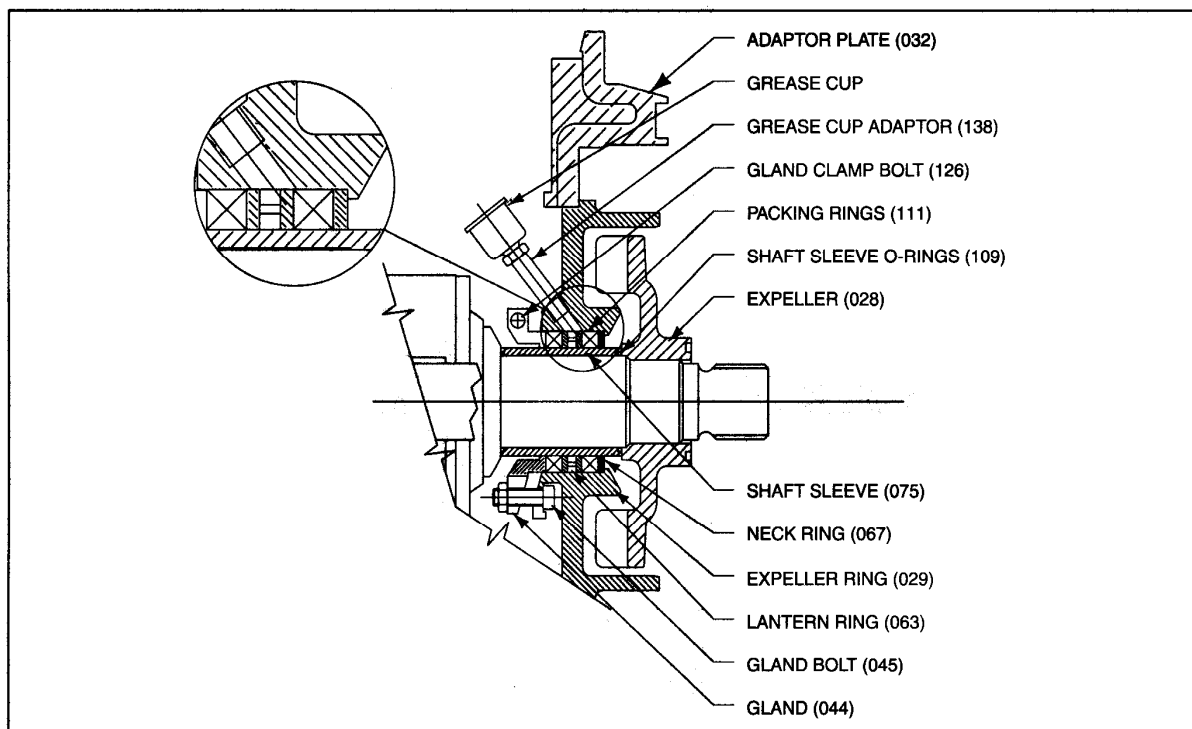
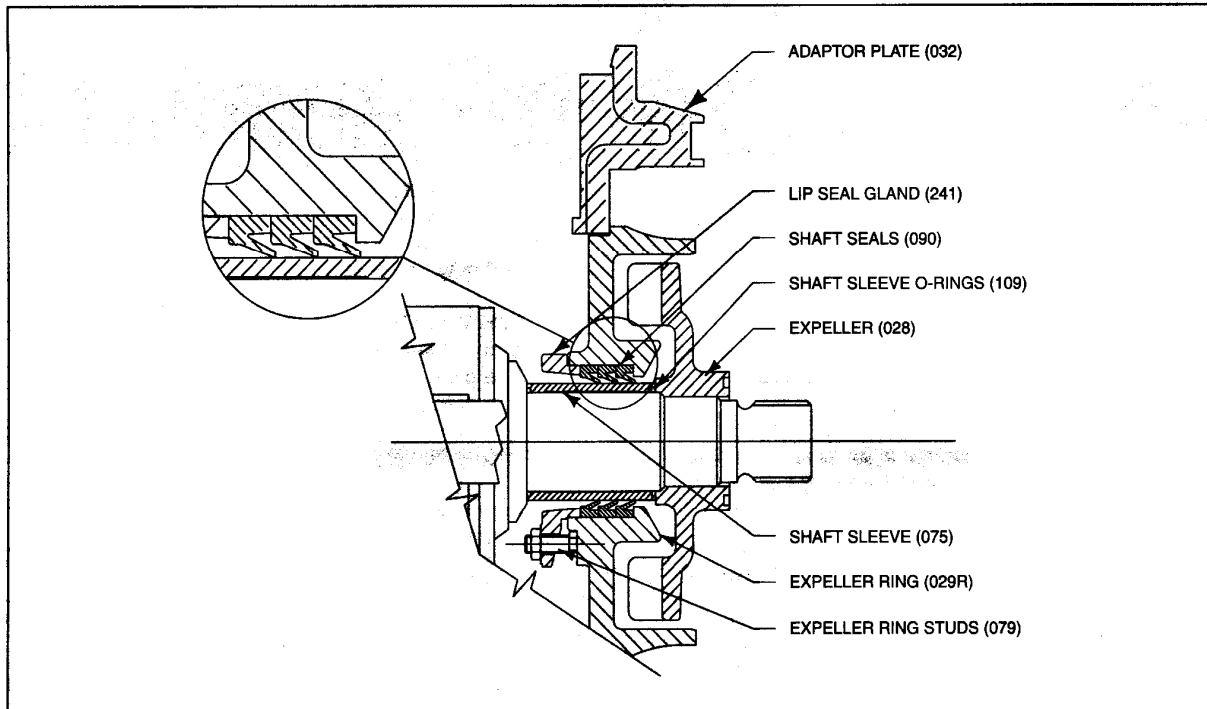
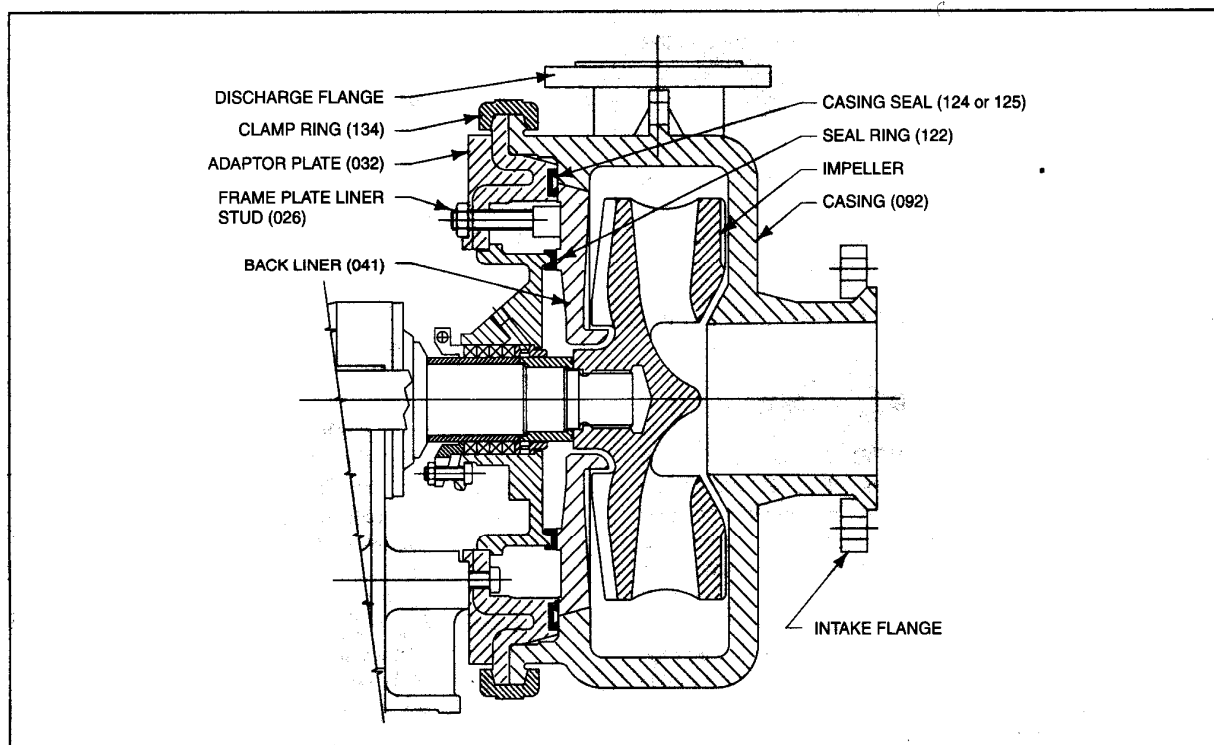


Figure 6-15 • Centrifugal Seal Assembly – Metal Expeller Ring (AHU)



*Figure 6-16 • Centrifugal Seal Assembly – Rubber Expeller Ring (AHU)*



*Figure 6-17 • Pump Assembly (AHU)*

**CENTRIFUGAL SEAL ASSEMBLY – RUBBER EXPELLER RING (Figure 6-16)****FITTING EXPELLER RING, SHAFT SEALS, GLAND STUDS, GLAND, SHAFT SLEEVE, SHAFT SLEEVE O-RING, and EXPELLER**

The assembly procedure for the rubber centrifugal seal shown in *Figure 6-16* is described in Section 5.

**PUMP ASSEMBLY****FITTING FRAME PLATE LINER INSERT, SEAL RING, CASING SEAL, IMPELLER O-RING, IMPELLER, and CASING (Refer to Figure 6-17)**

1. Apply some rubber cement in expeller or shaft spacer groove and fit IMPELLER O-RING (064 or 217) or, depending on pump model, SHAFT SLEEVE O-RING (109). Make certain that the o-ring is held in position.
2. Fitting SEAL RING (122).

The seal is a C-section type seal. Fit it to the rim of the stuffing box or the metal expeller ring. It is advisable to use rubber cement to hold this part in position, avoiding the possibility of shifting as the frame plate liner is attached.

3. Fitting CASING SEAL (124 or 125).

The casing seal is one of two types.

3/2 CAHU Pump:

The seal is an o-ring. It is fitted at a later stage in the assembly.

All other pumps:

The seal is a C-section type and is actuated by internal pressure. Fit the seal (flat face in) into the frame plate groove. It is advisable to use rubber cement to hold this part in position during assembly.

4. Fitting FRAME PLATE LINER INSERT (041) and IMPELLER.

**3/2 CAHU, 4/3 CAHU, 4/3 DAHU**

1. Obtain the correct type of IMPELLER as specified for the particular pump application. **Note:** Elastomer impellers have a BOSS CAP (359). To keep it in position during assembly tape it to the impeller hub. Rest the impeller (boss up) on a flat surface. Apply anti-seize lubricant to the impeller thread.
2. Check CLAMP BOLTS (012) on side of base (see *Figure 6-18*) to ensure they are just tight enough to hold the bearing assembly horizontal, but not to lock it. Assuming the shaft is bare, fit SHAFT KEY (070) in keyway and bolt SHAFT WRENCH (306) onto the

shaft. If the pump is installed, remove v-belts or separate coupling hubs. Slide the FRAME PLATE LINER INSERT over the shaft thread and temporarily hold it in place by hand. Holding the impeller with a bar placed between the vanes, and turning the shaft, snug up the impeller on the shaft. Do not over-tighten.

To hold the frame plate liner insert temporarily in its correct position, move the bearing assembly back by means of the nut on ADJUSTING SCREW (001). The insert may be centered by hand, if required.

3. Fit the VOLUTE FRAME SEAL (125) (o-ring type) over the rim of the frame plate liner insert and next to the frame plate. This procedure on applies for 3/2 CAHU pump only.

**ALL OTHER PUMP SIZES**

In these pumps the frame plate liner insert has provisions to accommodate studs for mounting of the inserts in the frame plates. The only exceptions are 3/2 CAHU, 4/3 CAHU and 4/3 DAHU pumps.

Proceed as follows:

1. Screw and tighten STUDS (026) in tapped holes provided in the frame plate liner insert. **Note:** that this step is not required on the 3/2 CAHU, 4/3 CAHU, and the 4/3 DAHU.
  2. Suspend LIFTING TUBE (302) from a hoist as shown in *Figure 6-19*. Stand the frame plate liner insert on edge and push the lifting tube into the insert hole. Lift the tube with the insert and slide the lifting tube over the shaft thread. Line up studs or bolts with the holes and push line insert against the adaptor plate.
- Check the various seals have not shifted. Screw on nuts (if required), but do not tighten them at this time. Remove the lifting tube from the assembly.
3. Check CLAMP BOLTS (012) on side of base (see *Figure 6-18*) to ensure they are just tight enough to hold the bearing assembly horizontal, but not to lock it. Assuming the shaft is bare, fit SHAFT KEY (070) in keyway and bolt SHAFT WRENCH (306) onto the shaft. If the pump is installed, remove v-belts or separate coupling hubs.

While holding the shaft with the wrench, screw LOCATING NUT (303) on the shaft. The conical face will locate the frame plate liner insert in its correct position. Tighten up all studs or bolts on the insert, and then remove the locating nut.

4. Obtain the correct type of IMPELLER as specified for the particular pump application. **Note:** Elastomer impellers have a BOSS CAP (359). To keep it in position during assembly tape it to the impeller hub. Rest the impeller (boss up) on a flat surface. Apply anti-seize lubricant to the thread.

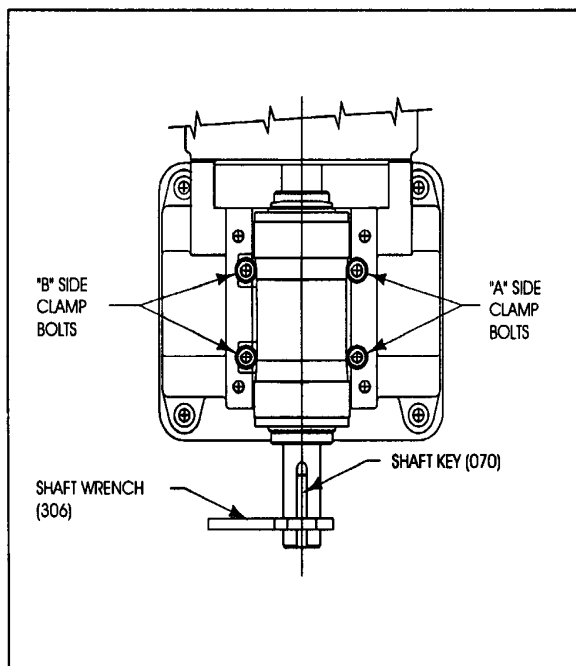


Figure 6-18 • Shaft Key and Clamp Bolts

Lift the impeller with a hoist, using rope or a hook, and screw the impeller on the shaft. Use a bar placed between vanes to hold the impeller, or secure with a sling attached to the hoist if an elastomer impeller is used, and rotate the shaft to tighten the impeller. Make certain that various o-rings on the shaft are not damaged during assembly and that they are fully covered by the various sleeves, etc.

5. Strike the shaft wrench with a mallet to firmly seat the impeller against the shaft sleeve.

#### FITTING CASING (092) and CLAMP RING (134).

1. Lift the casing with the appropriate lifting apparatus and position it against the adaptor plate. A liberal application of Never-Seize on these mating surfaces will ease disassembly.
2. Use a C-clamp or other device to ensure a tight fit between the mating surfaces. Be careful not to damage the taper for the clamp ring.
3. Install the clamp ring halves, making certain to fully seat the ring to the bottom of the taper. Use drift or rubber mallet as required. Use of Never-Seize on the taper will ease disassembly.
4. Insert the clamp ring bolt and washer. Torque to the value recommended in *Table 6-3*.
5. Use two piece intake and discharge flanges to connect pump flange to piping. Ensure the proper joint ring is used between flanges.

PUMP SIZE	RECOMMENDED MAX. TORQUE		CLAMP RING BOLT DIA.
3/2 CAHU	50 FT LBS	68 Nm	5/8
4/3 CAHU	50 FT LBS	68 Nm	5/8
4/3 DAHU	50 FT LBS	68 Nm	5/8
6/4 DAHU	60 FT LBS	82 Nm	3/4
6/4 EAHU	60 FT LBS	82 Nm	3/4
8/6 EAHU	110 FT LBS	150 Nm	1
8/6 FAHU	110 FT LBS	150 Nm	1
10/8 EMU	110 FT LBS	150 Nm	1
10/8 FMU	110 FT LBS	150 Nm	1
250 ELU	110 FT LBS	150 Nm	1
250 FLU	110 FT LBS	150 Nm	1

Table 6-3 • Recommended Torque for Clamp Ring Bolts

#### PUMP FITTED WITH MECHANICAL SEALS

When installed review the seal manufacturer's instructions for seal removal and installation prior to proceeding.

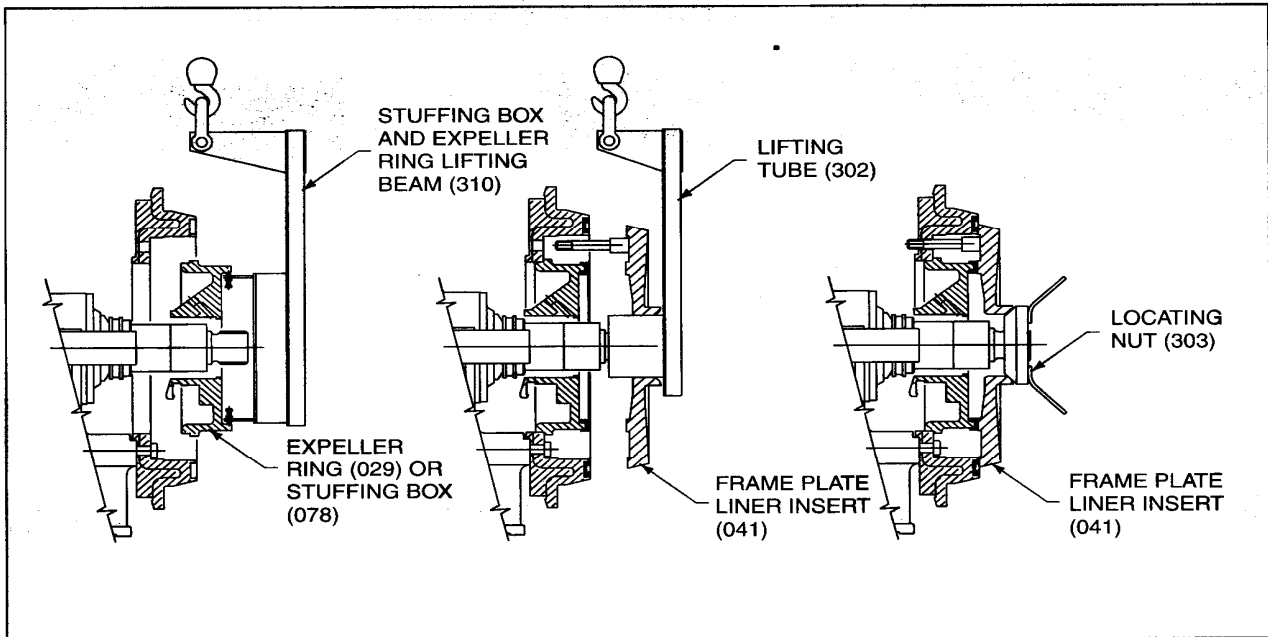


Figure 6-19 • Lifting Beam, Lifting Tube and Positioning Nut

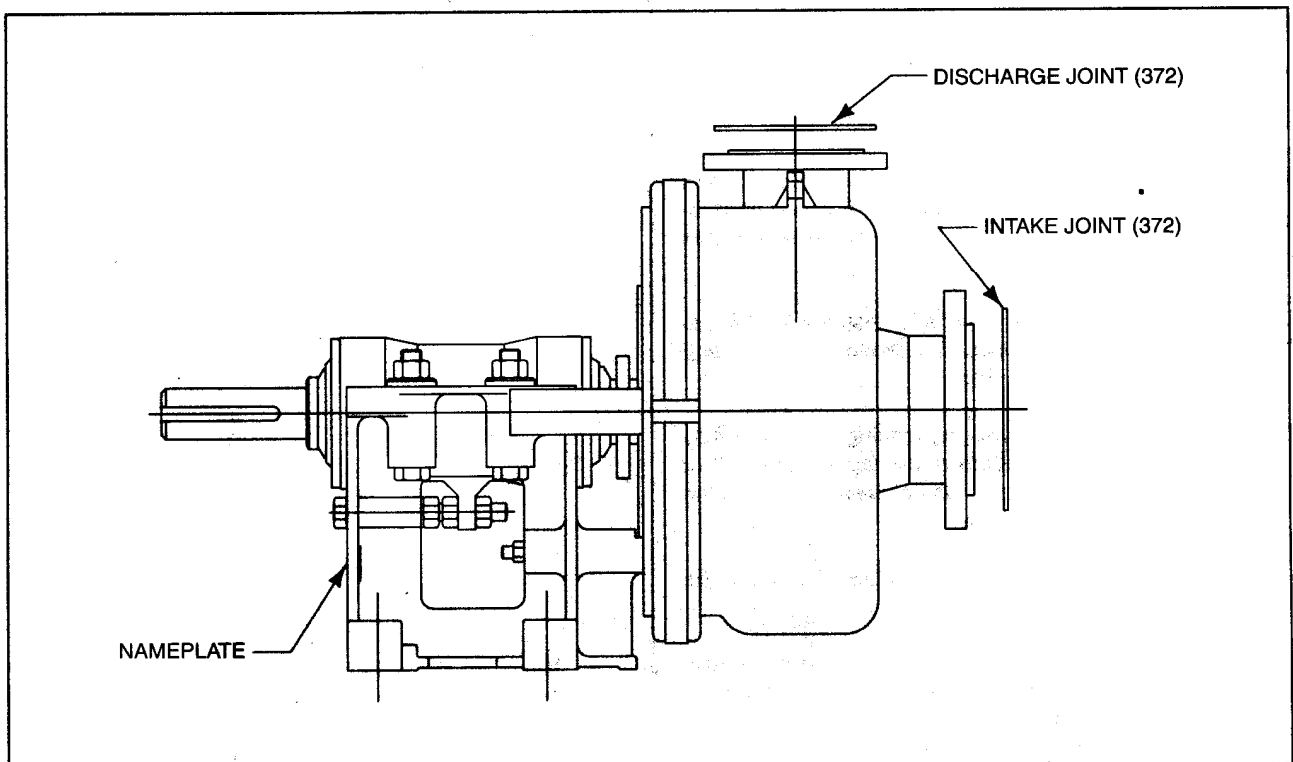


Figure 6-20 • Completed Assembly

The Warman XU series is designed to be a high efficiency counterpart to the AHU series pump. Both use the same bearing assemblies and bases. They also have the same suction and discharge flange centerlines, with the XU series having improved hydraulic performance.

Maintenance of the XU pump is identical to that of the AHU pump except for the wet end. This section is intended to clarify which sections of this manual from the AHU series are applicable, as well as explain differences unique to the XU pump assembly technique.

#### **XU PUMP ASSEMBLY**

##### **FRAME ASSEMBLY – FITTING BEARING ASSEMBLY TO CRADLE**

Refer to the frame assembly instructions outlined in Section 4 of this manual.

##### **FRAME PLATE ADAPTER ASSEMBLY – FITTING ADAPTER PLATE TO BASE (Figure 6-21)**

Fit FRAME PLATE ADAPTER (380) to BASE (003). Make certain the frame plate adapter shoulder has engaged with the corresponding locating diameter.

Insert ADAPTER PLATE STUD (039 or 034) to fasten frame plate adapter to base.

Torque to values specified in *Table 4-1*.

##### **GLAND SEAL (Figure 5-3)**

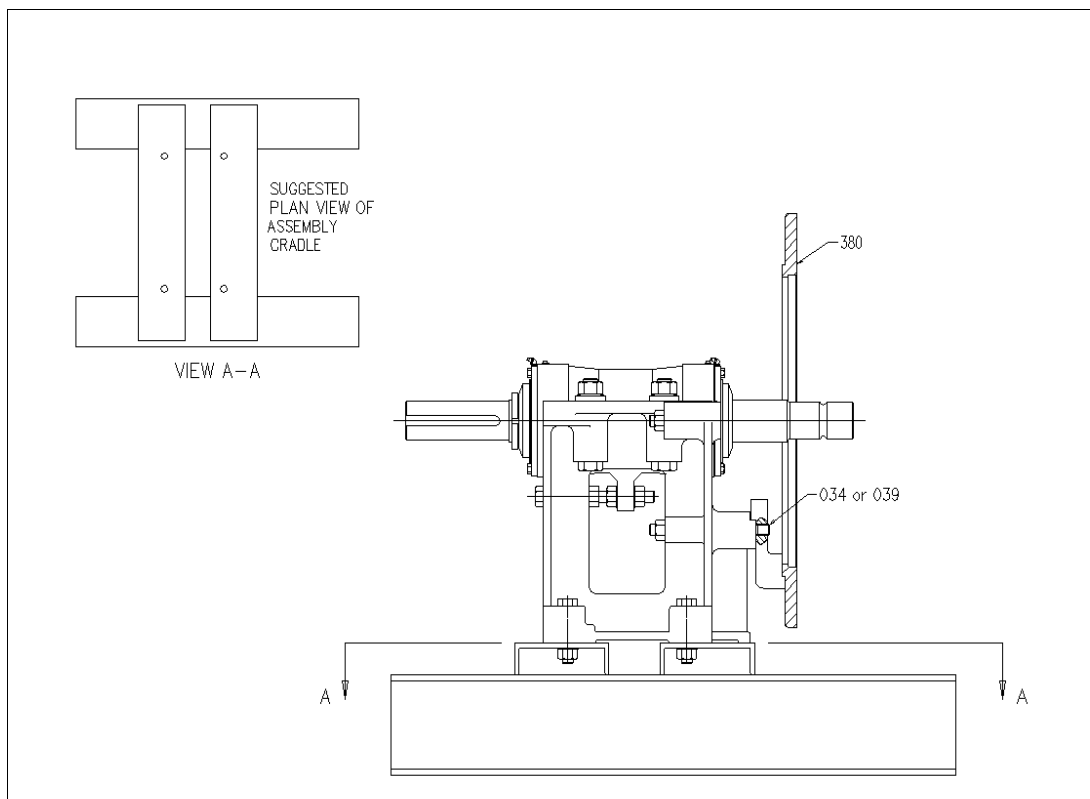
##### **FITTING STUFFING BOX, GLAND, PACKING, LANTERN RING, LIP SEAL, NECK RING, SHAFT SLEEVE AND SHAFT SLEEVE O-RING**

The assembly procedure for the gland seal in *Figure 5-3* is identical to the procedure described in section 5.

##### **CENTRIFUGAL SEAL ASSEMBLY – METAL EXPELLER RING (Figure 5-12)**

##### **FITTING FRAME PLATE, EXPELLER RING, NECK AND LANTERN RING, PACKING, PACKING RETAINER, SHAFT SLEEVE, SHAFT SLEEVE O-RING AND EXPELLER**

The assembly procedure for the gland seal in *Figure 5-12* is identical to the procedure described in section 5.



**Figure 6-21: Frame Plate Adapter and Base**

## **PUMP ASSEMBLY**

### **FITTING FRAME PLATE LINER INSERT, T-LINER, EXPELLER RING O-RING, IMPELLER O-RING, IMPELLER AND CASING** (*Figure 6-22*)

1. Apply some silicone in expeller or shaft sleeve groove and fit IMPELLER O-RING (064 or 109) or, depending on pump model, SHAFT SLEEVE O-RING (109). Make certain that the o-ring is held in position.

### **FITTING FRAME PLATE LINER INSERT (041)**

1. Fit T-Liner (124) around frame plate liner insert.
2. Lay the frame plate liner insert flat (expelling vanes down) on ground. Using the FRAME PLATE LINER INSERT LIFTING BEAM (302) or, depending on what size, hand lift over the shaft thread.
3. Be sure to screw and tighten studs in tapped holes provided in the frame plate liner insert after suspending the frame plate liner insert with T-liner.
4. Line up studs with the holes and push frame plate liner insert against adapter plate. Screw on nuts and tighten. Remove lifting beam from the assembly.

### **FITTING IMPELLER (147)**

1. Check CLAMP BOLTS (012) on side of base (see *Figure 6-18*) to ensure they are just tight enough to hold the bearing assembly horizontal, but not to lock it. Assuming the shaft is bare, fit SHAFT KEY (070) in keyway and bolt SHAFT WRENCH (306) onto the shaft. If the pump is installed, remove v-belts or separated coupling hubs.

2. Rest the impeller (hub up) on a flat surface. Apply anti-seize to the thread. Lift the impeller with a hoist, using a sling or hook, and screw the impeller on the shaft. Use a bar placed between vanes to hold the impeller, and rotate the shaft to tighten the impeller. Make certain that the various o-rings on the shaft are not damaged during assembly and that they are fully covered by the various sleeves, etc.
3. Strike the shaft wrench with a mallet to firmly seat the impeller against the shaft sleeve or expeller.

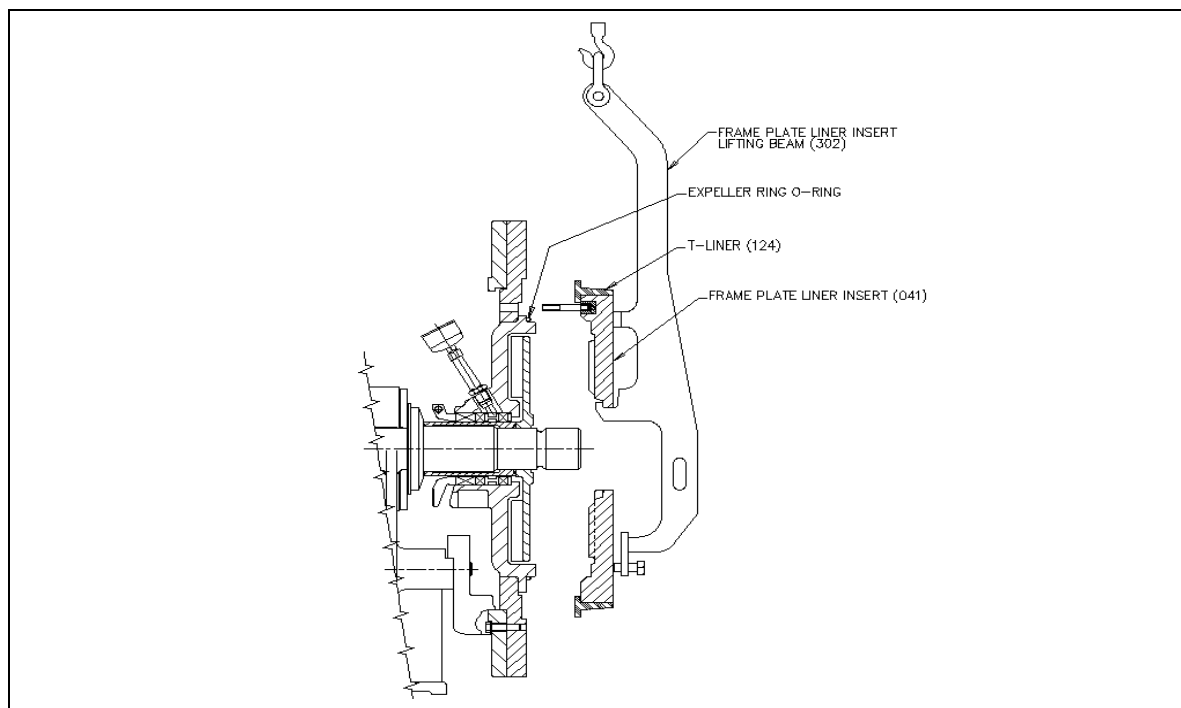
### **FITTING CASING (092)**

1. Screw and tighten studs in tapped holes provided in the casing. Lift the casing using the appropriate lifting lugs and position against adapter plate. A liberal application of silicone on the T-liner will ease assembly and disassembly. Tighten up all bolts
2. Use two piece intake and discharge flanges to connect pump flange to piping. Ensure the proper joint ring is used between flanges.

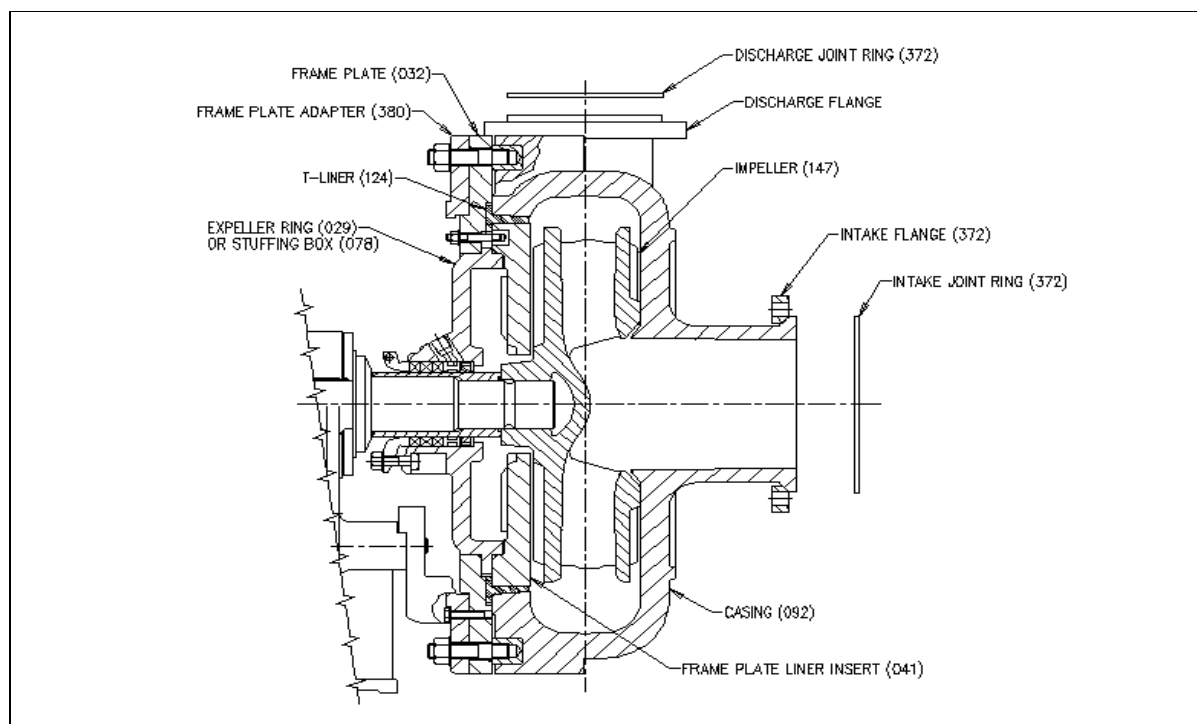
#### **NOTE**

Apply contact cement on intake and discharge joint rings to hold into place.





**Figure 6-22: Frame Plate Liner Insert Lifting Beam**



**Figure 6-23: Complete Assembly**

# IMPELLER CLEARANCE ADJUSTMENT

The following procedure describes a typical impeller clearance adjustment for a Warman pump. The flexibility inherent in Weir Slurry's pump design does allow other settings as may be desired to optimize specific operating conditions.

Pumps with recessed impellers do not rely on close running clearances with the liner. In such cases the impeller is normally adjusted back to keep shaft seal pressure at a minimum.

1. Loosen CLAMP BOLTS (012) on Side 'B' only, as shown in *Figure 6-18*, except on 8/6 AH or larger pumps, when such are fitted with mechanical seals. In this case loosen only the clamp bolt furthest from the pump shaft end. This will ensure the bearing assembly will not lift up on one end, resulting in possible damage to the mechanical seal faces. A maximum .010" rise at the bearing assembly drive end is allowed.
2. Rotate the shaft clockwise by hand and move the bearing assembly forward (toward cover plate) by tightening the rear nut on ADJUSTING SCREW (001) until the impeller starts to rub on the front liner as shown in *Figure 6-24*.
3. Release the nut just tightened by 1/3 turn (2 flats), then move the bearing assembly back by means of the front nut until the housing lug is secure against the rear nut.
4. Tighten CLAMP BOLTS (012) on side 'B' as shown in *Figure 6-18* per *Table 6-4*. Bolts on side 'A' were tightened earlier.

5. Tighten both adjustment screw nuts against housing lug.
6. Rotate the shaft and, if rubbing occurs, adjust the impeller back in the casing until the rubbing stops.

## NOTE

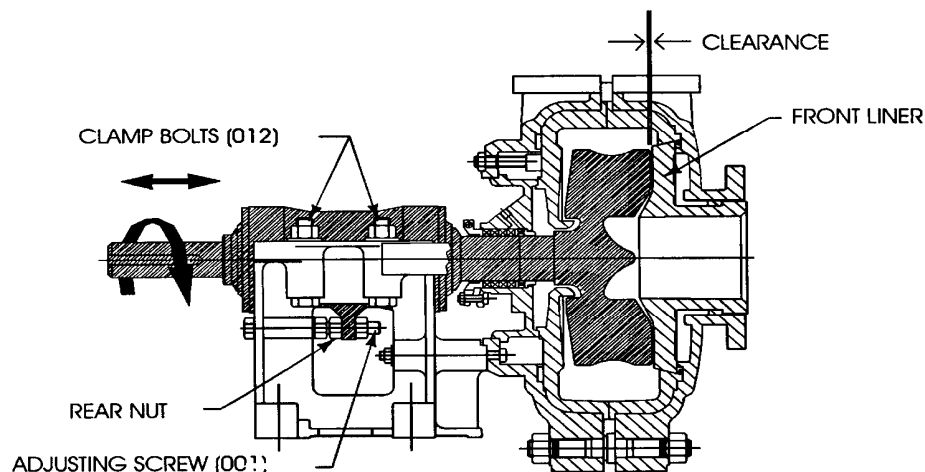
If the process fluid could cause expansion due to heat or swelling (in the case of a rubber lined pump), provide for additional clearance in the adjustment procedure to allow for these conditions.

On pumps fitted with a centrifugal shaft seal, forward impeller adjustment may increase seal area pressure. Thus on some applications it may be necessary to operate the pump with a slightly greater impeller clearance to ensure proper shaft sealing is achieved.

## ! CAUTION !

**Operation of a pump with the impeller rubbing against the liner may cause severe damage to the pump. Proper operating clearance must be checked prior to operating the pump.**

For model 20 AL pumps a combination single clamp bolt/adjusting cam is used for adjustment. Retighten nut once adjustment is complete.



**Figure 24 Impeller Clearance Adjustment**

**PUMP DISMANTLING**

Dismantling the pump is the reverse of the instructions given for assembly purposes, with the exception of removing the impeller on the larger pumps. It is recommended that assembly procedures be reviewed prior to beginning work.

To allow the impeller to be unscrewed easily, the RELEASE COLLAR (239) must be removed before the impeller is unscrewed. Release collars are only available on FAM bearing sizes and larger.

The procedure for removal of the release collar is included in Section 5 of this manual.

**!! WARNING !!**

**UNDER NO CIRCUMSTANCES SHOULD HEAT BE USED TO EXPAND OR CUT AN IMPELLER FROM THE SHAFT. PERSONAL INJURY COULD OCCUR AS A RESULT OF AN EXPLOSION.**

**NOTE**

Shaft wrench for inch frame pumps carries "m" suffix for metric shaft assemblies.

20/18 pump also requires FPL Lifting Beam U18314 if rubber lined.

BEARING ASSEMBLY SIZE	MAXIMUM TORQUE Ft Lb/Nm
ASC, B	8/10
C, CAM, CSC, CC, D, DAM, DSC, DD	33/45
E, EAM, EE, ESC, F, FAM, FF, FG	137/185
G, GAM, GH, GG	240/235
H	1115/1500
N	18/25
P, Q	33/45
R, RS, S, SH	137/185
T, TH	390/525
U	1115/1500

Table 6-4 • Bearing Housing Clamp Bolt Torque Table



# PUMP ASSEMBLY TOOLS

<u>PUMP MODEL</u>	<u>NUMBER</u>	<u>DESCRIPTION</u>	<u>PUMP MODEL</u>	<u>NUMBER</u>	<u>DESCRIPTION</u>
<b>TYPE 'AH' &amp; 'AHU'</b>			12/10 FAH	F301	Piston Ring Compressor
1.5/1 BAH	B301	Piston Ring Compressor	FAM10302	FPLI Lifting Tube	
	B305	C Spanner	FAM303	Locating Nut	
	B306	Shaft Wrench	G10304	Volute Lifting Beam	
2/1.5 BAH	B301	Piston Ring Compressor	F305	C Spanner	
	B305	C Spanner	F306	Shaft Wrench	
	B306	Shaft Wrench	F307	Lifting Plate	
3/2 CAH & CAHU	C301	Piston Ring Compressor	G310	Stuffing Box Lifting Beam	
	C305	C Spanner	S301	Piston Ring Compressor	
	C306	Shaft Wrench	G10302	FPLI Lifting Tube	
4/3 CAH & CAHU	C301	Piston Ring Compressor	G303	Locating Nut	
	C305	C Spanner	G10304	Volute Lifting Beam	
	C306	Shaft Wrench	S306	Shaft Wrench	
4/3 DAH & DAHU	D301	Piston Ring Compressor	S311	Lifting Plate	
	D305	C Spanner	G310	Stuffing Box Lifting Beam	
	D306	Shaft Wrench	T301	Piston Ring Compressor	
	D307	Lifting Plate	G10302	FPLI Lifting Tube	
6/4 DAH & DAHU	D301	Piston Ring Compressor	G303	Locating Nut	
	E4302	FPLI Lifting Tube	G10304	Volute Lifting Beam	
	E303	Locating Nut	T306	Shaft Wrench	
	E4304	Volute Lifting Beam	T311	Lifting Plate	
	D305	C Spanner	G310	Stuffing Box Lifting Beam	
	D306	Shaft Wrench	F301	Piston Ring Compressor	
	D307	Lifting Plate	FAM12302	FPLI Lifting Tube	
6/4 EAH & EAHU	E301	Piston Ring Compressor	FAM303	Locating Nut	
	E4302	FPLI Lifting Tube	G12304	Volute Lifting Beam	
	E303	Locating Nut	F305	C Spanner	
	E4304	Volute Lifting Beam	F306	Shaft Wrench	
	E305	C Spanner	F307	Lifting Plate	
	E306	Shaft Wrench	G310	Stuffing Box Lifting Beam	
	E307	Lifting Plate	S301	Piston Ring Compressor	
8/6 EAH & EAHU	E301	Piston Ring Compressor	G12302	FPLI Lifting Tube	
	F4302	FPLI Lifting Tube	G303	Locating Nut	
	F303	Locating Nut	G12304	Volute Lifting Beam	
	F4304	Volute Lifting Beam	S306	Shaft Wrench	
	E305	C Spanner	S311	Lifting Plate	
	E306	Shaft Wrench	G310	Stuffing Box Lifting Beam	
	E307	Lifting Plate	T301	Piston Ring Compressor	
8/6 FAH & FAHU	F301	Piston Ring Compressor	G12302	FPLI Lifting Tube	
	F4302	FPLI Lifting Tube	G303	Locating Nut	
	F303	Locating Nut	G12304	Volute Lifting Beam	
	F4304	Volute Lifting Beam	T306	Shaft Wrench	
	F305	C Spanner	T311	Lifting Plate	
	F306	Shaft Wrench	G310	Stuffing Box Lifting Beam	
	F307	Lifting Plate	G301	Piston Ring Compressor	
10/8 FAH	F301	Piston Ring Compressor	GAM14302	FPLI Lifting Tube	
	FAM12302	FPLI Lifting Tube	TH303	Locating Nut	
	FAM303	Locating Nut	H14304	Volute Lifting Beam	
	G8304	Volute Lifting Beam	G305	C Spanner	
	F305	C Spanner	G306	Shaft Wrench	
	F306	Shaft Wrench	G307	Lifting Plate	
	F307	Lifting Plate	H310	Stuffing Box Lifting Beam	
	G310	Stuffing Box Lifting Beam	T301	Piston Ring Compressor	
10/8 STAH	S301	Piston Ring Compressor	GAM14302	FPLI Lifting Tube	
	G12302	FPLI Lifting Tube	TH303	Locating Nut	
	G303	Locating Nut	H14304	Volute Lifting Beam	
	G8304	Volute Lifting Beam	T306	Shaft Wrench	
	S306	Shaft Wrench	T311	Lifting Plate	
	S311	Lifting Plate	H310	Stuffing Box Lifting Beam	
	G310	Stuffing Box Lifting Beam	G301	Piston Ring Compressor	
			G305	C Spanner	

<u>PUMP MODEL</u>	<u>NUMBER</u>	<u>DESCRIPTION</u>
18/16 GAH (cont.)	G306	Shaft Wrench
	G307	Lifting Plate
18/16 TUAH	T301	Piston Ring Compressor
	T306	Shaft Wrench
	T311	Lifting Plate
20/18 GAM	G301	Piston Ring Compressor
	U18302**	FPLI Lifting Tube
	U18304	Volute Lifting Beam
	G305	C Spanner
	G306	Shaft Wrench
	G307	Lifting Plate
	U18310	Stuffing Box Lifting Beam
20/18 TUAH	T301	Piston Ring Compressor
	U18302**	FPLI Lifting Tube
	TU303	Locating Nut
	U18304	Volute Lifting Beam
	T306	Shaft Wrench
	T311	Lifting Plate
	U18310	Stuffing Box Lifting Beam
<b>TYPE 'HH'</b>		
1.5/1 CHH	C301	Piston Ring Compressor
	C305	C Spanner
	C306	Shaft Wrench
3/2 DHH	D301	Piston Ring Compressor
	DH2302	FPLI Lifting Tube
	E303	Locating Nut
	DH2304	Volute Lifting Beam
	D305	C Spanner
	D306	Shaft Wrench
	D307	Lifting Plate
	Q301	Piston Ring Compressor
	DH2302	FPLI Lifting Tube
	E303	Locating Nut
	DH2304	Volute Lifting Beam
	Q306	Shaft Wrench
	E311	Lifting Plate
4/3 EHH	E301	Piston Ring Compressor
	F6302	FPLI Lifting Tube
	F303	Locating Nut
	F6306	Volute Lifting Beam
	E305	C Spanner
	E306	Shaft Wrench
	E307	Lifting Plate
	R301	Piston Ring Compressor
	F6302	FPLI Lifting Tube
	F303	Locating Nut
	F6304	Volute Lifting Beam
	E306	Shaft Wrench
	F311	Lifting Plate
6/4 FHH	F301	Piston Ring Compressor
	FH4302	FPLI Lifting Tube
	FAM303	Locating Nut
	G8304	Volute Lifting Beam
	F305	C Spanner
	F306	Shaft Wrench
	F307	Lifting Plate
	S301	Piston Ring Compressor
	FH4302	FPLI Lifting Tube
	FAM303	Locating Nut
	G8304	Volute Lifting Beam
	S306	Shaft Wrench
	S311	Lifting Plate

<u>PUMP MODEL</u>	<u>NUMBER</u>	<u>DESCRIPTION</u>
8/6 GHH	G301	Piston Ring Compressor
	GH6302	FPLI Lifting Tube
	GAM303	Locating Nut
	G12304	Volute Lifting Beam
	G305	C Spanner
	G306	Shaft Wrench
	G307	Lifting Plate
	GH310	Stuffing Box Lifting Beam
8/6 THH	T301	Piston Ring Compressor
	GH6302	FPLI Lifting Tube
	GAM303	Locating Nut
	G12304	Volute Lifting Beam
	T306	Shaft Wrench
	T311	Lifting Plate
	GH310	Stuffing Box Lifting Beam
<b>TYPE 'AHP'</b>		
6/4 EAHP	E301	Piston Ring Compressor
	E4302	FPLI Lifting Tube
	E303	Locating Nut
	E4304	Volute Lifting Beam
	E305	C Spanner
	E306	Shaft Wrench
	E307	Lifting Plate
6/4 RAHP	E301	Piston Ring Compressor
	E4302	FPLI Lifting Tube
	E303	Locating Nut
	E4304	Volute Lifting Beam
	R306	Shaft Wrench
	R311	Lifting Plate
8/6 FAHP	F301	Piston Ring Compressor
	F6302	FPLI Lifting Tube
	F303	Locating Nut
	F6304	Volute Lifting Beam
	F305	C Spanner
	F306	Shaft Wrench
	F307	Lifting Plate
8/6 SAHP	S301	Piston Ring Compressor
	F6302	FPLI Lifting Tube
	F303	Locating Nut
	F6304	Volute Lifting Beam
	S306	Shaft Wrench
	S311	Lifting Plate
10/8 GAHP	G301	Piston Ring Compressor
	G12302	FPLI Lifting Tube
	G303	Locating Nut
	G8304	Volute Lifting Beam
	G305	C Spanner
	G306	Shaft Wrench
	G307	Lifting Plate
	G310	Stuffing Box Lifting Beam
10/8TAHP	T301	Piston Ring Compressor
	G12302	FPLI Lifting Tube
	G303	Locating Nut
	G8304	Volute Lifting Beam
	T306	Shaft Wrench
	T311	Lifting Plate
	G310	Stuffing Box Lifting Beam
12/10 GAHP	G301	Piston Ring Compressor
	G10302	FPLI Lifting Tube
	G303	Locating Nut
	G10304	Volute Lifting Beam
	G305	C Spanner


<u>PUMP MODEL</u>	<u>NUMBER</u>	<u>DESCRIPTION</u>	<u>PUMP MODEL</u>	<u>NUMBER</u>	<u>DESCRIPTION</u>
12/10 GAHP (cont.)	G306	Shaft Wrench	75 CL (cont.)	C305	C Spanner
	G307	Lifting Plate		C306	Shaft Wrench
12/10 TAHP	G310	Stuffing Box Lifting Beam	100 DL	D301	Piston Ring Compressor
	T301	Piston Ring Compressor		D305	C Spanner
	G10302	FPLI Lifting Tube			D306 Shaft Wrench
	G303	Locating Nut		D307	Lifting Plate
	G10304	Volute Lifting Beam	150 EL	E301	Piston Ring Compressor
		T306 Shaft Wrench		E305	C Spanner
	T311	Lifting Plate		E306	Shaft Wrench
12/10 GAHPP	G310	Stuffing Box Lifting Beam		E307	Lifting Plate
	G301	Piston Ring Compressor	200 EM & EMU	E301	Piston Ring Compressor
	G10302	FPLI Lifting Tube		F6302	FPLI Lifting Tube
	G303	Locating Nut		F303	Locating Nut
	G10304	Volute Lifting Beam		F8304	Volute Lifting Beam
	G305	C Spanner		E305	C Spanner
	G306	Shaft Wrench	200 FM & FMU	E306	Shaft Wrench
	G307	Lifting Plate		E307	Lifting Plate
12/10 TAHPP	G310	Stuffing Box Lifting Beam		F301	Piston Ring Compressor
	G301	Piston Ring Compressor		F6302	FPLI Lifting Tube
	G10302	FPLI Lifting Tube		F303	Locating Nut
	G303	Locating Nut		F8304	Volute Lifting Beam
	G10304	Volute Lifting Beam		E305	C Spanner
		T306 Shaft Wrench		E306	Shaft Wrench
	T307	Lifting Plate		E307	Lifting Plate
14/12 GAHP	G310	Stuffing Box Lifting Beam	250 EL & ELU	E301	Piston Ring Compressor
	G301	Piston Ring Compressor		F6302	FPLI Lifting Tube
	G12302	FPLI Lifting Tube		F303	Locating Nut
	G303	Locating Nut		F8304	Volute Lifting Beam
	G12304	Volute Lifting Beam		E305	C Spanner
	G305	C Spanner		E306	Shaft Wrench
	G306	Shaft Wrench		E307	Lifting Plate
	G307	Lifting Plate	250 FL & FLU	F301	Piston Ring Compressor
14/12 TAHP	G310	Stuffing Box Lifting Beam		F6302	FPLI Lifting Tube
	T301	Piston Ring Compressor		F303	Locating Nut
	G12302	FPLI Lifting Tube		F10304	Volute Lifting Beam
	G303	Locating Nut		E305	C Spanner
	G12304	Volute Lifting Beam		E306	Shaft Wrench
	T306	Shaft Wrench		E307	Lifting Plate
	T311	Lifting Plate	300 RSL	R301	Piston Ring Compressor
20/18 HAHP	G310	Stuffing Box Lifting Beam		RS302	FPLI Lifting Tube
	H301	Piston Ring Compressor		RS303	Locating Nut
	U18302**	FPLI Lifting Tube		S30304	Volute Lifting Beam
	U18304	Volute Lifting Beam		E306	Shaft Wrench
	H305	C Spanner		F311	Lifting Plate
	H306	Shaft Wrench		S310	Stuffing Box Lifting Beam
	H307	Lifting Plate	300 SL	S301	Piston Ring Compressor
	U18310	Stuffing Box Lifting Beam		S302	FPLI Lifting Tube
20/18 TUAHP	T301	Piston Ring Compressor		S303	Locating Nut
	U18302**	FPLI Lifting Tube		S30304	Volute Lifting Beam
	TU303	Locating Nut		S306	Shaft Wrench
	U18304	Volute Lifting Beam		S311	Lifting Plate
	T306	Shaft Wrench		S310	Stuffing Box Lifting Beam
	T311	Lifting Plate	350 SL	S301	Piston Ring Compressor
	U18310	Stuffing Box Lifting Beam		S302	FPLI Lifting Tube
				S303	Locating Nut
<b>TYPE 'L', 'M'</b>				S35304	Volute Lifting Beam
20 AL	A301	Piston Ring Compressor		S306	Shaft Wrench
	A305	C Spanner		S311	Lifting Plate
	A306	Shaft Wrench	400 STL	S35310	Stuffing Box Lifting Beam
50 BL	B301	Piston Ring Compressor		S301	Piston Ring compressor
	B305	C Spanner		T302	FPLI Lifting Tube
	B306	Shaft Wrench		ST303	Locating Nut
75 CL	C301	Piston Ring Compressor		T40304	Volute Lifting Beam
				S306	Shaft Wrench

<u>PUMP MODEL</u>	<u>NUMBER</u>	<u>DESCRIPTION</u>	<u>PUMP MODEL</u>	<u>NUMBER</u>	<u>DESCRIPTION</u>
400 STL (cont.)	T311	Lifting Plate	12X10 EXU	E301	Piston Ring Compressor
	T40310	Stuffing Box Lifting Beam		E302	FPLI Lifting Beam
450 STL	S301	Piston Ring Compressor		E305	C Spanner
	T45302	FPLI Lifting Tube		E306	Shaft Wrench
	ST303	Locating Nut	12X10 FXU	F301	Piston Ring Compressor
	T45304	Volute Lifting Beam		F302	FPLI Lifting Beam
	S306	Shaft Wrench		F305	C Spanner
	T311	Lifting Plate		F306	Shaft Wrench
	T45310	Stuffing Box Lifting Beam	14X12 FXU	F301	Piston Ring Compressor
500 STL	S301	Piston Ring Compressor		F302	FPLI Lifting Beam
	ST40302	FPLI Lifting Tube		F305	C Spanner
	ST303	Locating Nut		F306	Shaft Wrench
	T50304	Volute Lifting Beam			
	S306	Shaft Wrench			
	T311	Lifting Plate			
	T45310	Stuffing Box Lifting Beam			
550 TUL	T301	Piston Ring Compressor			
	U18302	FPLI Lifting Tube			
	TU303	Locating Nut			
	U55304	Volute Lifting Beam			
	T306	Shaft Wrench			
	T311	Lifting Plate			
	T45310	Stuffing Box Lifting Beam			
650 TUL	T301	Piston Ring Compressor			
	TU302	FPLI Lifting Tube			
	TU303	Locating Nut			
	U65304	Volute Lifting Beam			
	T306	Shaft Wrench			
	T311	Lifting Plate			
	T45310	Stuffing Box Lifting Beam			
<b>Type XU</b>					
3X3 CXU	C301	Piston Ring Compressor			
	C305	C Spanner			
	C306	Shaft Wrench			
4X4 CXU	C301	Piston Ring Compressor			
	C305	C Spanner			
	C306	Shaft Wrench			
4X4 DXU	D301	Piston Ring Compressor			
	D305	C Spanner			
	D306	Shaft Wrench			
6X5 DXU	D301	Piston Ring Compressor			
	D305	C Spanner			
	D306	Shaft Wrench			
6X5 EXU	E301	Piston Ring Compressor			
	E305	C Spanner			
	E306	Shaft Wrench			
8X6 EXU	E301	Piston Ring Compressor			
	E302	FPLI Lifting Beam			
	E305	C Spanner			
	E306	Shaft Wrench			
8X6 FXU	F301	Piston Ring Compressor			
	F302	FPLI Lifting Beam			
	F305	C Spanner			
	F306	Shaft Wrench			
10X8 EXU	E301	Piston Ring Compressor			
	E302	FPLI Lifting Beam			
	E305	C Spanner			
	E306	Shaft Wrench			
10X8 FXU	F301	Piston Ring Compressor			
	F302	FPLI Lifting Beam			
	F305	C Spanner			
	F306	Shaft Wrench			



## Fault Finding Chart

FAULTS		SYMPTOMS									
		Discharge failure	Reduced discharge delivery	Insufficient pressure	Pump loses prime	Excessive horsepower required	Leakage from stuffing box	Packing has short life	Vibration and noise from pump	Short life of bearings	Overheating or seizure of pump
INTAKE	Pump not Primed.										
	Pump or intake pipe not completely filled with liquid.										
	Suction lift too high.										
	Insufficient margin between intake pressure and vapor pressure.										
	Excessive amount of air or gas in liquid.										
	Air pocket in intake line.										
	Air leaks into intake line.										
	Air leaks into pump through stuffing box.										
	Foot valve too small.										
	Foot valve partially clogged.										
	Intake pipe insufficiently submerged.										
	Blocked intake.										
SYSTEM FAULTS	Intake pipe diameter too small or length of intake pipe too long.										
	Speed too low.										
	Speed too high.										
	Wrong direction of rotation.										
	Total head of system higher than design head.										
	Total head of system lower than design head.										
	Specific gravity of liquid different from design.										
	Viscosity of liquid differs from that for which designed.										
	Operation at very low capacity.										
	Entrained air in pump. Pump hopper requires baffles.										
MECHANICAL FAULTS	Badly installed pipe line or gaskets partly blocking pipe.										
	Misalignment.										
	Foundations not rigid.										
	Shaft bent.										
	Rotating part rubbing on stationary part.										
	Bearings worn.										
	Impeller damaged or worn.										
	Casing gasket defective, permitting internal leakage.										
	Shaft sleeves worn or scored at the packing.										
	Packing improperly installed.										
	Incorrect type of packing or operating conditions.										
	Shaft running off-center because of worn bearings or misalignment.										
	Impeller out of balance, resulting in vibration.										
	Gland too tight, resulting in no flow of liquid to lubricate packing.										
	Foreign matter in impeller.										
	Dirt or grit in sealing liquid, leading to scoring shaft sleeve.										
	Excessive thrust caused by a mechanical failure inside the pump.										
	Excessive amount of lubrication in bearing housing causing high temperature.										
	Lack of lubrication.										
	Improper installation of bearings.										
	Dirt getting into bearings.										
	Rusting of bearings due to water getting into housing.										
	Expeller worn or blocked.										
	Excessive clearance at bottom of stuffing box, forcing packing into pump.										

 =Probable Faults

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## Recommended Slurry Pump Flushing Procedure

All slurry pumps must be flushed immediately after shutdown. Failure to do so can allow slurry to settle in the casing, build up in the suction or discharge piping and attach to the pump liners, impeller and / or seal components. Mechanically sealed pumps are especially susceptible to failure from solids build-up. Subsequent starts of the equipment can then tear liners, damage impellers, fail mechanical seals and damage piping components and their support structure.

If the solids in the casing cause the impeller to start in a bogged condition, excessive shaft deflection can occur, and may result in mechanical seal, bearing, and foundation failures. Piping and piping support structure and drive train damage can occur as well.

The exact procedure required in each installation will vary. The entire flushing process may take as little as 15 minutes for a small pump, but may take hours for a large pump. The desired end result is to have the pump completely filled with clear liquid and to not have damaged the pump or pumping system in any way during the flushing sequence.

The suction valve should be closed. It is assumed there is a drain valve located in the suction line between the pump and the suction valve.

Pump should not be rotating and the liquid in the pump should be stationary, not flowing in or out of the pump, prior to starting the flush procedure. The best position for the discharge valve during flushing is dependant on site conditions.

If there is a closed discharge valve in the system the vent valve between the pump and the discharge valve must be open. If there is no vent valve the discharge valve must be open.

If the discharge valve is closed and there is no vent valve, (or if the vent valve is closed) it is possible to create a vacuum or over pressurize the pump during the flush and drain sequence that could damage or displace the liners in the pump or damage other pump and piping components.

## Flushing

1. With the discharge vent or discharge valve open, open the drain valve on the suction line and drain the pump until slurry stops issuing from the drain valve. This leaves the bottom of the pump casing below the suction line full of slurry.
2. With the discharge vent or discharge valve open, close the drain valve and open the flush line to fill the pump completely. Minimum liquid level should be at least past the pump discharge flange.
3. With the discharge vent or discharge valve open, open the drain valve and drain the pump until liquid stops flowing.
4. Repeat this process until clear liquid comes out of the drain valve.

## Storage/not operating

5. Pumps not operating for any period of time and potentially exposed to process gasses should be filled completely with water to prevent gases from attacking metal components in the pump.
6. If the possibility exists the suction valve will leak and allow solids into the pump during idle periods, filling the pump discharge with clear water up to the height of slurry in the suction tank will help minimize solids leaking into the pump.
7. Regular checks should be made to ensure the liquid in the pump does not drain off. The discharge vent should be left open to prevent vacuum creation should liquid leak from the pump during the storage/not operating period.
8. It may be necessary to change the liquid in the pump during storage periods to prevent a buildup of acids or solids in the pump. Frequency required will be site condition dependant.

Cycle times for draining and filling the pump and pipe will vary depending on pump size and the piping system. Based on site conditions this flushing procedure should be modified as necessary to achieve the end goal of a clean undamaged pump and piping system full of clear water.

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## PUMP STORAGE PROCEDURE

Weir Minerals North America (WMNA) recommends all pumps be stored and operated indoors. Even if these procedures are followed, it is possible for operational and storage problems to arise due to environmental conditions the pump is subjected to. These problems must be corrected at the owner's expense prior to operation. WMNA will accept no responsibility for these problems. These provisions are applicable to WMNA proprietary items only. For the appropriate storage procedures for non-WMNA items refer to specific requirements from the manufacturer.

### PUMP STORAGE PROCEDURE

#### For Periods Less Than 24 Months

1. Prior to storage, thoroughly drain pumps, including trapped, difficult to drain water.
2. Protect the equipment from temperature and humidity extremes and exposure to excessive dust, moisture and vibration.
3. Rotate the shaft 10 turns once a month. Consult seal manufacturer's long term storage procedures for seal specific considerations prior to rotating the shaft.
4. For grease lubricated bearing assemblies purge the labyrinths with grease while turning the shaft to prevent dirt and/or moisture contamination of the bearings. This should be done every three to five weeks.
5. For oil-lubricated bearing assemblies, maintain the oil level at maximum level. Turn the shaft 10 times once a month to ensure that all rollers and parts of the bearing and housing are coated with oil. All breathers may have been removed and plugged for shipment and storage. If additional corrosion protection is desired or if storage conditions are severe, it may be necessary to install a desiccant breather in place of the plugs during storage. It is the equipment owner's responsibility to determine if site conditions are severe enough to warrant the use of a desiccant breather and to absorb the installation and operational cost for the desiccant breather.
6. If contractual requirements include a constant level oiler, oil level gauge or other accessory for the pump bearing assembly, it may not be installed for shipment and storage. Oiler ports may be plugged. It is the equipment owner's responsibility to install the oiler in a suitable time frame before operation to prevent damage to the bearing assembly due to air or water ingress from the oiler or oiler vents.
7. If all breather vents have been plugged it is common for oil lubricated bearing assemblies that experience temperature variations to have small leaks from the labyrinths during storage. These will stop when the breathers are installed and the equipment is operated. Reducing the temperature variations will reduce or eliminate this leakage.
8. If the pump is stored in severe conditions, it may be necessary to install a desiccant breather to prevent condensation in the bearing assembly. Consult factory for proper installation. It is the equipment owner's responsibility to determine if site conditions are severe enough to warrant the use of a desiccant breather and to absorb the installation and operational cost for the desiccant breather.
9. Protect rubber-lined pumps from heat, light and exposure to ozone.

**PUMP STORAGE PROCEDURE *continued***

10. The suction and discharge flange openings are to be covered unless connected to piping. If connected piping can carry corrosive gasses, pump should be stored full of clean water. Storage water should be changed as needed to prevent buildup of corrosive chemicals.
11. All external machined surfaces are factory coated with a rust preventative prior to shipment. Maintain the protective coating on these surfaces with Kendall Seal N Sound or a comparable product. Ensure that the rust preventing coating of the shaft drive end is maintained.
12. To prevent damage to packing; remove the packing rings and store in a cool dry location for use at a later time.
13. For excessively unfavorable environment, cover the equipment with a protective tarpaulin that will allow proper air circulation.
14. Change oil if moisture content in the oil exceeds the oil manufacturer's maximum allowed.
15. Maximum pump storage is limited to 24 months.

**PUMP STORAGE PROCEDURE**

**For Periods More Than 24 Months consult factory**

**PRIOR TO START-UP**

1. Repack pump with fresh packing.
2. Maintain written documentation of labyrinth purging and shaft rotation intervals to be made available to WMNA upon request for warranty validation.
3. Change oil if moisture content in the oil exceeds the oil manufacturer's maximum allowed.
4. Customer is responsible to hire a qualified WMNA service representative to inspect pump assembly. Any parts found to be not in as new condition due to long-term storage must be replaced. WMNA will not be responsible for any costs associated with replacement of parts or the cost of the parts themselves.
5. Please refer to Section 1 of the Warman Installation, Operation, and Maintenance Manual for additional details regarding pump operating information.

**ACCESSORIES**

Consult the original manufacturer for specific recommendations on gear drives, electric motors, mechanical seals, etc. Depending on length of storage period, addition of rust inhibitors to oil, connection of space heaters or other requirements may exist to ensure the factory warranty remains valid.

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