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Introduction

The HD Series pumps have been certified to the requirements of the ATEX Directive 94/9/EC for use in Category II, Group 2 G applications. Read this manual before operating or working on the HD Series pumps. If additional information is required to facilitate operation or maintenance, contact the authorized Tuthill distributor shown at the back of this service manual.

HD Series pumps have been designed and manufactured to provide years of service under normal operating conditions. Illustrations used in this manual are for reference purposes only. Consult the factory or an authorized Tuthill distributor for proper part identification.

When ordering replacement parts, provide as much detail as possible to ensure correct parts are provided. Details should include the full model number (typically 12-13 digits but can be 18 digits), serial number, name of part, part number (if known), and part material.

Service Manual # 71 for the HD Series pumps is available at www.tuthillpump.com. The materials furnished for each pump are selected to suit individual applications.

WARNING

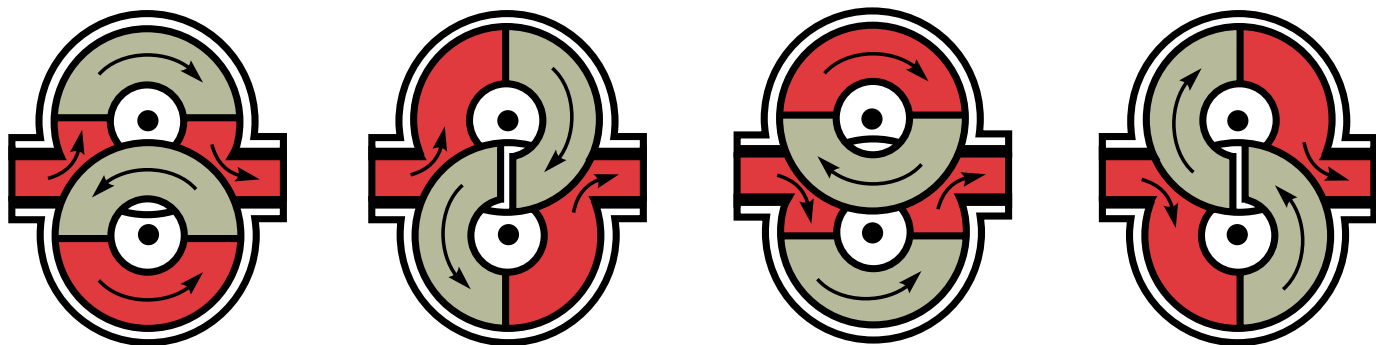
Failure to follow these instructions could result in serious bodily injury or death. Do not attempt to work on any Tuthill pump installation before completing the steps below. Disconnect the drive so that it cannot be started while work is being performed. Review the Material Safety Data Sheet (MSDS) applicable to the liquid being pumped to determine its characteristics and the precautions necessary to ensure safe handling. Vent all pressure within the pump through the suction or discharge lines.

All Tuthill pumps contain residual hydraulic oil from the factory production test. Determine if this is compatible with the fluid you are pumping. If the fluid is incompatible, then the pump must be fully flushed prior to use. If the pump is to be operated at elevated temperatures, the pump should be brought up to operating temperatures gradually. Rapid or sudden introduction of liquids at elevated temperatures into the cold liquid chamber of the pump could cause damage to pump externals, seals or other internal parts. Pumps can run dry provided provisions are made for the mechanical seal if one is used. Failure to comply with this could cause severe damage to the mechanical seal parts. Pump needs to be earthed separately to avoid a buildup of electro-static charge.

General Description

The design of the Tuthill Industrial Series incorporates externally timed impellers that are supported in the fluid chamber by double row, ball bearings located out of the product stream. This design enables the industrial Series to handle highly viscous abrasive slurries, corrosive acids or suspended solids without degradation, aeration or contamination of the product.

Pumping Principle



Here is How it Works

Rotating impellers develop a vacuum at inlet, drawing material into the cavity...positive action of the impellers displaces material, forcing discharge at pump outlet. Ports are always open; sealing action between impellers and housing prevents fluid flow return.

HD Models

Material of Construction	Size	Max Speed	Max. Capacity		Max. Pressure		Weight		Port Size (Internal NPT)
			USGPM	LPM	PSI	BAR	LB	KG	
Ductile Iron	30A	450	24.7	93	150	10.3	100	45	1-1/2" Top 1-1/2" Front
	2A	450	67.5	256	150	10.3	250	113	2" Top 2" Front
	3A	450	135	511	150	10.3	270	122	3" Top 3" Front
	70A	450	67.5	256	450	27.5	280	127	3" Top 2" Front
	120A	450	135	511	450	27.5	300	136	4" Top 3" Front
	330	450	337	1276	450	27.5	550	249	5" Top 4" Front
	600	450	666	2523	450	27.5	900	408	6" Right 6" Left
Stainless Steel	30A	450	24.7	93	150	10.3	100	45	Same As Above
	2A	450	67.5	256	150	10.3	250	113	Same As Above
	3A	450	135	511	150	10.3	270	122	Same As Above
	70A	450	67.5	256	450	27.5	280	127	Same As Above
	120A	450	135	511	450	27.5	300	136	Same As Above
	330	450	337	1276	450	27.5	550	249	Same As Above
	600	450	666	2523	450	27.5	900	408	Same As Above

HD Process Pump Numbering System

1	2	3	4	5	6	7	8	9	10	11	12	13
DIGITS 1 & 2		01-INDUSTRIAL DUTY (ID)			05 – INDUSTRIAL DUTY (ID) Only Models with **			02-STANDARD DUTY (SD) Ductile Iron Only		04-STANDARD DUTY (SD) Stainless Steel Only		
DIGITS 3 & 4		05 – Model 30						01 – Model 5A				
		14 – Model 2A						02 – Model 10				
		16 – Model 70A**						03 – Model 16				
		29 – Model 3A						05 – Model 25A				
		31 – Model 120A**						14 – Model 65				
		75 – Model 330**						26 – Model 125A				
		91 – Model 600**										
DIGITS 5 & 6		04 – 316 Stainless Steel (01, 04 & 05 Models)										
		09 – Ductile Iron (01, 02 & 05 Models)										
DIGIT 7		0 – Internal NPT (Std. on ID models)										
		1 – External NPT (Standard on SD models)										
DIGIT 8		0 – No Relief Valve										
		1 – Relief Valve (Available on all SD models & ID models 30, 2A, 3A, 70A, 120A)										
DIGITS 9 & 10		01 – Hot Clearance										
		02 – Special Shaft Material										
		05 – Special Packing										
		06 – Special Packing Configuration										
		08 – Mechanical Seals										
		09 – Special Bushings										
		10 – Special Clearances										
		13 – Steam Jacket/Tracing										
		19 – Special Ports (Flanged, etc.)										
		21 – Tutriding										
		26 – Interference Fit Gears										
		27 – Special U-Cup/Lip Seals										
28 - Miscellaneous												
DIGITS 11 & 12		01, 02, Etc. (Serialized at the factory)										
DIGIT 13 (If Required)		D – Double Lobe (Available on ID models only)										
		T – PTFE housing and faceplate bushings (SD Models)										

Temperature Limits of HD Process Pump Materials

[illegible]

Note: Viton and PTFE oil seals can be used in place of standard oil seals upon request. PTFE and Gore-Tex gaskets can be used in place of standard seals upon request.

WARNING

Failure to follow these instructions could result in serious bodily injury or death. Do not attempt to work on any Tuthill pump installation before completing the steps below. Disconnect the drive so that it cannot be started while work is being performed. Review the Material Safety Data Sheet (MSDS) applicable to the liquid being pumped to determine its characteristics and the precautions necessary to ensure safe handling. Vent all pressure within the pump through the suction or discharge lines. All Tuthill pumps contain residual hydraulic oil from the factory production test. Determine if this is compatible with the fluid you are pumping. If the fluid is incompatible, then the pump must be fully flushed prior to use. If the pump is to be operated at elevated temperatures, the pump should be brought up to operating temperatures gradually. Rapid or sudden introduction of liquids at elevated temperatures into the cold liquid chamber of the pump could cause damage to pump externals, seals or other internal parts. Pumps can run dry provided provisions are made for the mechanical seal if one is used. Failure to comply with this could cause severe damage to the mechanical seal parts. Pump needs to be earthed separately to avoid a buildup of electro-static charge.

Installation

For optimum pump performance the suction line must be at least as large as the corresponding pump port. It should be as short as possible in order to avoid excessive pressure drops and must be airtight. Locate the pump as close to the source of supply as conditions permit, and if possible, below the level of the liquid in the reservoir. When necessary to locate the pump in a pit, provisions should be made to safeguard against flooding. When handling high viscosity liquids, the speed of the pump must be reduced and the size of the inlet lines increased to prevent cavitation. Refer to the NPSHr data for the pump.

Pumps should be filled with liquid at installation. The placement of a strainer on the suction side of the pump will restrict any solids or abrasives from entering the pump, which could cause internal damage. Under no conditions should the pump be used to support external piping loads (weight or expansion). Piping and other equipment should be independently supported. Piping strain can result in misalignment, hot bearings, worn couplings, vibration, etc. It is important that the piping used be clean and free of chips and scales.

The discharge line must be designed with the maximum pressure rating of the pump in mind. Excessive pressure could cause damage to your motor and/or pump. If a pressure relief valve has not been supplied with the pump, some other means of pressure protection must be utilized. This could include in-line safety valves, pressure shutdown switches or other similar devices. Pumps are positive displacement pumps and must be used in conjunction with a pressure relief mechanism.

Every pump installation should have a good foundation. Its structure should be sufficiently strong to hold the pump rigid and to absorb any strain or shock that may be encountered. The installation should be leveled, checked for proper piping alignment, and then fastened securely.

The alignment should be rechecked after the pump's temperature has reached its operating temperature. Direct drive through a traditional flexible coupling is recommended. However, do not expect the coupling to compensate for misalignment. Contact the coupling manufacturer to determine the maximum amount of misalignment that the coupling can be subjected to. Never operate the pumps without all the guards in place.

Direction of Flow

Tuthill Industrial Process Pumps may be operated in either direction. The direction of flow is dependent on the direction of rotation of the pump drive shaft. When facing the drive shaft of the pump, a clockwise rotation provides a top suction port and a bottom discharge port. This applies to Model 30A, 2A, 3A, 70A, 120A, 330 Pumps (Pages 10, 12 & 14).

Model 600 Pumps are equipped with a vertical shaft arrangement (Page 22, 24, & 26). On these models a clockwise drive shaft rotation will provide a left hand suction port and a right hand discharge port. Flow would be from left to right when facing the drive shaft.

Packing Adjustment

WARNING

Packing is designed to leak. Therefore, when pumping hazardous liquids, a mechanical seal is recommended to minimize any potential source of leakage that could result in a hazardous condition.

All packings must leak to perform properly. Their purpose is to control leakage—not to prevent it. The slight leakage along the shaft provides proper lubrication to the packing. Pump packings have a lubricant, which acts as a primary sealant for the start-up and break-in phases, during which this lubricant acts to reduce friction. Once the pump is on the line, external lubrication must be supplied to the packing to keep it running properly and to attain longer life. If external lubrication is not supplied, the lubrication in the packings will bleed out due to heat generation. Heat is a primary cause of packing failure. Pumps with packing will require periodic adjustment. To accomplish this, gently and evenly tighten the packing gland nuts, which will further compress the packing. Do not over-tighten. Packing is designed to keep leakage to a slight weep. Normally 2-3 drops per minute is acceptable. If excessive leakage persists after complete adjustment, consider re-packing the stuffing box or using another packing type.

Lubrication Requirements

- Faceplate Bearings- The faceplate bearings are greased. Grease should be added to faceplate bearings when oil is changed. Add grease through fitting until new grease can be seen exiting under lip seal where shaft enters bearing. Bearings are designed to provide a minimum L10 life of 15,000 hours at maximum speed and pressures conditions.
- Housing Bushing- Housing bushings are fully lubricated by the pumped fluid and are maintenance free.
- Gear Case Bearings- Bearings are designed to provide a minimum L10 life of 15,000 hours at maximum speed and pressures conditions and are splashed lubricated.

Lubrication Instructions for Tuthill Process Pumps

The oil in the gear case of the process pumps is “Lubriplate” APG9 a trade name of Fiske Brothers Refining Company – Toledo, Ohio.

Oil specifications are as follow

Viscosity at 100°F: 816 SSU	Viscosity at 212°F: 86 SSU
API Gravity: 26.5	Flash Point: 39°F
Fire Point: 440°F	Extreme Pressure Additives
Any 90-weight gear oil may be substituted if equivalent to above	
The grease used in the faceplate ball bearing of the Industrial Series pump is “Lubriplate” 1200-2	

Grease specifications are as follows

Lithium Base	N.L.G.I. #2
Work Penetration: 280	A.S.T.M. Dropping Point: 450°F
Minimum Oil Viscosity at 100°F: 950SSU	Water resistant with rust and corrosion inhibitors added
Any #2 bearing grease may be substituted if equivalent to above	

The following charts on lubrication requirements are offered as a guide only. Common sense approach to preventative maintenance must be exercised for best pump service life. Ambient conditions (temperature, humidity, dust, etc.) can alter schedule.

Model No.	Gearcase Capacity - CC	First Oil Change – Hrs.	Subsequent Change – Hrs.	Total Grease Capacity Per Pump - CC
30A	500	500	3000	30
2A & 3A	1900	500	3000	35
70A & 120A	250	500	3000	165
330	1000	500	3000	140
600	1250	500	3000	100
Above standard lubricants are adequate for operating temperatures between –100°F and +350°F				

If temperature exceeds 350°F, use the following.

- Oil Specification: Lubriplate APG 250 or equal
- Bearing Grease: 930-AA or equal

Inspection and Repair

Should it be necessary to remove the pump from service for periodic inspection of components and/or a major repair, the following steps should be taken. See following pages for exploded pump views and instructions.

WARNING

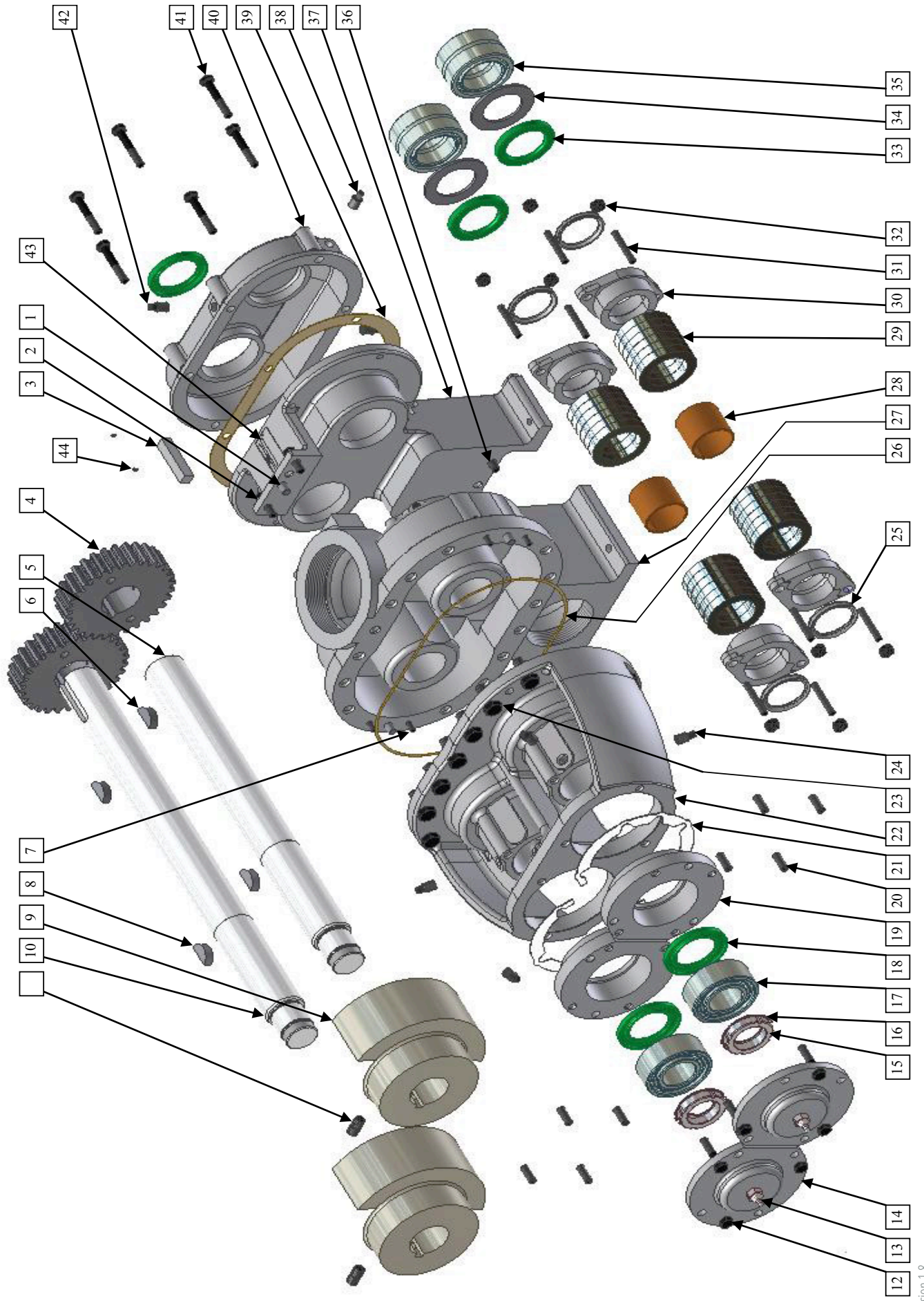
Failure to follow these instructions could result in serious bodily injury or death. Do not attempt to work on any Tuthill pump installation before completing the steps below. Only authorized personnel who are familiar with the repair of mechanical products should perform the necessary repair work. You must familiarize yourself with the entire contents of this manual prior to performing any work.

Disconnect the drive so that it cannot be started while work is being performed.

Review the Material Safety Data Sheet (MSDS) applicable to the liquid being pumped to determine its characteristics and the precautions necessary to ensure safe handling.

Vent all pressure within the pump through the suction or discharge lines. Ensure that the pump has cooled to a safe temperature prior to performing any work on the pump.

70A, 120A, and 330 Pumps Isometric Drawing (Models Starting w/ 05 & Packing)



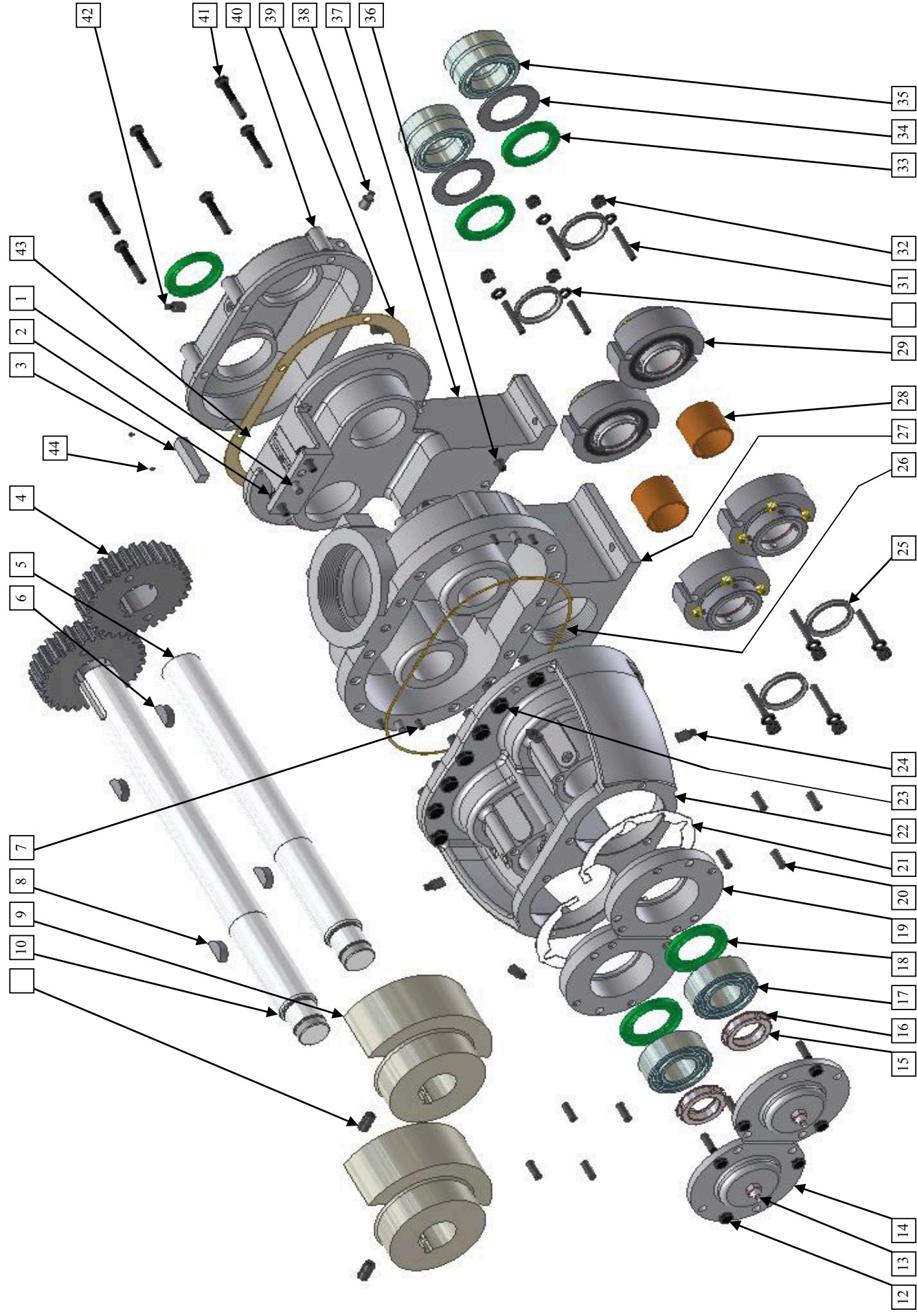
General Parts List for 70A, 120A, and 330 Pumps

Item #	Description	Qty
1	Dowel Pin	4
2	Cap Screw	2
3	Square Key	1
4	Timing Gears	2
5	Driven Shaft	1
	(Armco 17-4PH)	
6	Gear Key	2
7	Cap Screw	*
8	Impeller Key (CI)	2
	Impeller Key (SS)	
9	Impellers (CI) S.L.	2
	Impellers (CI) D.L.	
	Impellers (SS) S.L.	
	Impellers (SS) D.L.	
10	Drive Shaft	1
	(Armco 17-4PH)	
11	Set Screw (CI)	4
	Set Screw (SS)	
12	Hex Head Bolt	6
13	Grease Fitting	2
14	Bearing Cover	2
15	Lock Nut	2
16	Lock Washer	2
17	Ball Bearing	2
18	Lip Seal	2
19	Bearing Carrier	2
20	Set Screw	*
21	Shim -----.002"	As Req.
	Shim -----.005"	As Req.
	Shim -----.015"	As Req.

Item #	Description	Qty
22	Faceplate (CI)	1
	Faceplate (SS)	
23	Hex Head Bolt	*
24	Pipe Plug (CI)	8
	Pipe Plug (SS)	
25	V-Ring	4
26	Gore-Tex Gasket	1
27	Impeller Housing (CI)	1
	Impeller Housing (SS)	
28	Housing Bushings	2
	(CI) DU Bushing	
	(SS) Carbon Bushing	
29	Packing	4 sets
30	Packing Gland (CI)	4
	Split Glands for (SS)	8
31	Stud	8
32	Nut (CI)	8
	Nut (SS)	
33	Lip Seal	3
34	Spacer	2
35	Roller Bearing	2
36	Cap Screw	2
37	Bearing Housing	1
38	Pipe Plug (CI)	2
	Pipe Plug (SS)	
39	Gear Case Gasket	1
40	Gear Case Cover	1
41	Cap Screw	6
42	Vented Pipe Plug	1
43	Nametag	1
44	Drive Screw	2

Note: * Exact quantities will vary depending upon actual pump model. (CI) are Cast Iron pumps that will have corresponding steel and/or ductile iron components. (SS) are Stainless Steel pumps that will have corresponding stainless steel components. Recommended spare parts are in bold text. When ordering spare parts please specify pump model, serial number, part number & part name.

70A, 120A, and 330 Pumps Isometric Drawing (Models Starting w/ O5 & Tuffseals)



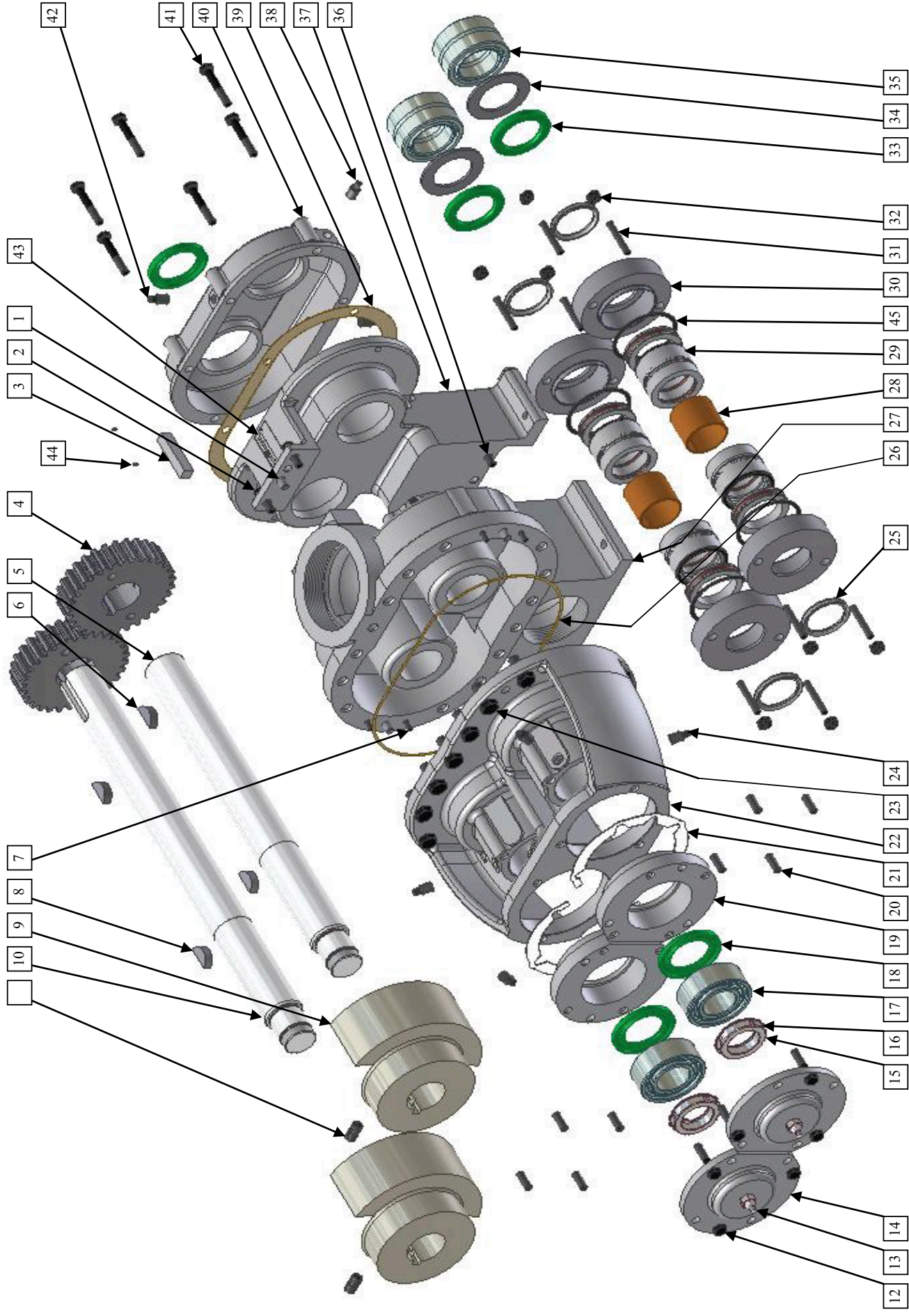
General Parts List for 70A, 120A, and 330 Pumps

Item #	Description	Qty
1	Dowel Pin	4
2	Cap Screw	2
3	Square Key	1
4	Timing Gears	2
5	Driven Shaft	1
	(Armco 17-4PH)	
6	Gear Key	2
7	Cap Screw	*
8	Impeller Key (CI)	2
	Impeller Key (SS)	
9	Impellers (CI) S.L.	2
	Impellers (CI) D.L.	
	Impellers (SS) S.L.	
	Impellers (SS) D.L.	
10	Drive Shaft	1
	(Armco 17-4PH)	
11	Set Screw (CI)	4
	Set Screw (SS)	
12	Hex Head Bolt	6
13	Grease Fitting	2
14	Bearing Cover	2
15	Lock Nut	2
16	Lock Washer	2
17	Ball Bearing	2
18	Lip Seal	2
19	Bearing Carrier	2
20	Set Screw	*
21	Shim -----.002"	As Req.
	Shim -----.005"	As Req.
	Shim -----.015"	As Req.

Item #	Description	Qty
22	Faceplate (CI)	1
	Faceplate (SS)	
23	Hex Head Bolt	*
24	Pipe Plug (CI)	8
	Pipe Plug (SS)	
25	V-Ring	4
26	Gore-Tex Gasket	1
27	Impeller Housing (CI)	1
	Impeller Housing (SS)	
28	Housing Bushings	2
	(CI) DU Bushing	
	(SS) Carbon Bushing	
29	Tuffseal	4
31	Stud	8
32	Nut (CI)	8
	Nut (SS)	
33	Lip Seal	3
34	Spacer	2
35	Roller Bearing	2
36	Cap Screw	2
37	Bearing Housing	1
38	Pipe Plug (CI)	2
	Pipe Plug (SS)	
39	Gear Case Gasket	1
40	Gear Case Cover	1
41	Cap Screw	6
42	Vented Pipe Plug	1
43	Nametag	1
44	Drive Screw	2
45	Washer	8

Note: * Exact quantities will vary depending upon actual pump model. (CI) are Cast Iron pumps that will have corresponding steel and/or ductile iron components. (SS) are Stainless Steel pumps that will have corresponding stainless steel components. Recommended spare parts are in bold text. When ordering spare parts please specify pump model, serial number, part number & part name.

70A, 120A, and 330 Pumps Isometric Drawings (Models Starting w/ O5 & Mech. Seals)



General Parts List for 70A, 120A, and 330 Pumps

Item #	Description	Qty
1	Dowel Pin	4
2	Cap Screw	2
3	Square Key	1
4	Timing Gears	2
5	Driven Shaft	1
	(Armco 17-4PH)	
6	Gear Key	2
7	Cap Screw	*
8	Impeller Key (CI)	2
	Impeller Key (SS)	
9	Impellers (CI) S.L.	2
	Impellers (CI) D.L.	
	Impellers (SS) S.L.	
	Impellers (SS) D.L.	
10	Drive Shaft	1
	(Armco 17-4PH)	
11	Set Screw (CI)	4
	Set Screw (SS)	
12	Hex Head Bolt	6
13	Grease Fitting	2
14	Bearing Cover	2
15	Lock Nut	2
16	Lock Washer	2
17	Ball Bearing	2
18	Lip Seal	2
19	Bearing Carrier	2
20	Set Screw	*
21	Shim -----.002"	As Req.
	Shim -----.005"	As Req.
	Shim -----.015"	As Req.
22	Faceplate (CI)	1
	Faceplate (SS)	

Item #	Description	Qty
23	Hex Head Bolt	*
24	Pipe Plug (CI)	8
	Pipe Plug (SS)	
25	V-Ring	4
26	Gore-Tex Gasket	1
27	Impeller Housing (CI)	1
	Impeller Housing (SS)	
28	Housing Bushings	2
	(CI) DU Bushing	
	(SS) Carbon Bushing	
29	Mechanical Seal	4
30	Mech. Seal Gland (CI)	4
	Mech. Seal Gland (SS)	4
31	Stud	8
32	Nut (CI)	8
	Nut (SS)	
33	Lip Seal	3
34	Spacer	2
35	Roller Bearing	2
36	Cap Screw	2
37	Bearing Housing	1
38	Pipe Plug (CI)	2
	Pipe Plug (SS)	
39	Gear Case Gasket	1
40	Gear Case Cover	1
41	Cap Screw	6
42	Vented Pipe Plug	1
43	Nametag	1
44	Drive Screw	2
45	Seal Gland Gasket	4

Note: * Exact quantities will vary depending upon actual pump model. (CI) are Cast Iron pumps that will have corresponding steel and/or ductile iron components. (SS) are Stainless Steel pumps that will have corresponding stainless steel components. Recommended spare parts are in bold text. When ordering spare parts please specify pump model, serial number, part number & part name.

Disassembly & Reassembly for 70A, 120A, & 330 Pumps

Minor Disassembly for Fluid Chamber Inspection

1. Remove all burrs on drive shaft with a file or emery paper. Also check for any deposit of paint. Special care should be taken around the keyway and beveled corner on the drive shaft. These two areas are normally where burrs occur. Burrs or paint will cause an obstruction in the bushing area.
2. Drain oil from gear case by removing lower drain plug (38). Remove six cap screws (41) on face of gear case cover (40).
3. Remove gear case cover by sliding over shafts.
4. If the timing gears (4) are a slip fit on the shafts. Check that the gears have the correct timing marks before removal. If necessary, mark them again. Remove the gears by loosening the setscrews. There are two in each gear. Then slide gears off drive end of shaft. If gear keys are sheared a gear puller may be required. NOTE: Mark gears so that in reassembly the gears may be remounted on the shafts from which they were removed. Remove two gear keys.(6)
5. If interference fitted (IF) timing gears (4) are furnished. Check that the gears have the correct timing marks before removal. If necessary, mark them again. IF gears do not have setscrews. First attempt to remove them can be made with a standard gear puller. If the gear puller was not successful in removing the gears, heat the gear OD with a torch and use a hydraulic jack to remove the gears.

NOTE: Mark gears so that in reassembly the gears may be remounted on the shafts from which they were removed. Remove two gear keys.(6)

WARNING

Wear heat-resistant gloves when handling hot components.

6. **A.** If Packing is used (reference assembly on page 10). Remove packing gland nuts (32) and slide packing gland (30) out of the way. Then remove packing (29) from both seal chambers in the impeller housing. If pump is equipped with mechanical seals, see below for general instructions and refer to the seal instructions that were shipped with the pump. Also, reference Page 34 for additional packing information. **B.** If Tuffseals are used (reference assembly on page 12). Loosen Tuffseal set screws that lock the cartridge seal's collar onto the shaft, on the impeller housing side. Also, reference Page 35 for additional Tuffseal information. **C.** If mechanical seals are used (reference assembly on page 14). Remove pipe plugs (24) from impeller housing stuffing boxes. This allows access to the mechanical seal set screws holding the seal to the shaft. Mark the shaft where the mechanical seal is so that the correct seal working length can be referenced upon re-assembly. Then loosen the mechanical seal set screws. Loosen the mechanical seal gland nuts (32) and allow the mechanical seal gland to be loose on the housing. Thus, when the shafts are pulled out of this area when removing the faceplate assembly the gland will not fall off. Allow it to hang loosely on the studs. Also, reference Page 35 for additional mechanical seal information.
7. Remove hex head bolts (23) on outboard side of faceplate. Make note on which side the drive shaft is located for reassembly. Remove entire faceplate assembly by sliding away from impeller housing.

CAUTION

Faceplate assembly will be heavy and not balanced. Use proper lifting methods. This assembly includes the impellers and shafts installed in the faceplate. DO NOT DISTURB the bearing carrier (19) on the bearing bridge on the faceplate. These caps hold the adjustment of the clearance of the impellers in relation to the fluid chamber. If further disassembly is required, refer to major disassembly instructions.

Fluid Chamber Check Points

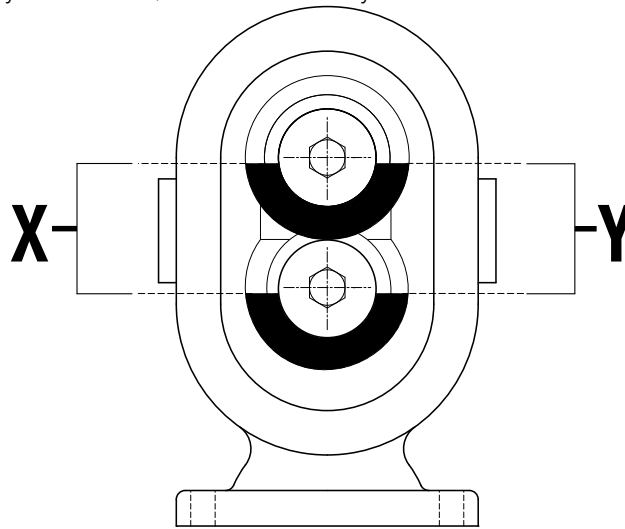
Procedure No. 1 - Check for twisted shaft

1. Place faceplate group upright in vise.

CAUTION

Use soft jaws to prevent damage to the gasket seal surfaces. Tighten jaws on sides of bearing bridge.

2. Install carbon steel gear keys on an angle. Angle is to hold gears from sliding down on shaft.
3. Slide proper timing gear on drive shaft, revolving shaft to align key with gear keyway, taking precautions that the timing marks are face out and aligned. There are two punch marks appearing on the gear on the drive shaft and one punch mark on the mating tooth on the driven shaft.
4. Turn impellers to the position shown below. If the dimension X is the same as dimension Y, then there is no shaft damage. If there is a variation, then the shaft is twisted or the impeller keys may be sheared. Disassemble in accordance with major disassembly instructions. If the impeller keys are sheared, then install new keys and recheck for twisted shaft.



Procedure No. 2 - Install new gears

- Place faceplate group in vise and install keys as in Procedure No. 1
- Slide gear on driven shaft, aligning keyway of gear with woodruff key on shaft
- Position impellers as shown in the sketch in Procedure No. 1 with dimension X the same as dimension Y
- Slide timing gear on drive shaft and align keyway in gear with woodruff key in shaft and mesh gears
- Recheck dimension X and dimension Y to be certain that they are the same
- Mark gears as indicated in Procedure No. 1 and slide gears off shafts and follow minor reassembly instructions

Procedure No. 3 - Install new bushings

- Disassemble in accordance with minor disassembly instructions
- Press worn bushing from impeller housing and gear case and press new bushings in impeller housing
- Press bronze bushings in gear case and remove expansion plug in gear case cover
- Press out worn bushings and press new bushings in gear case cover.

CAUTION:

If impeller housing bushing is steel backed PTFE, do not ream

- Check gearcase lip seals and bearings for damage. Replace parts as necessary

Reassemble in Accordance with Minor Reassembly Instructions

1. Apply grease to gasket seal surface on impeller housing. Then press gasket in place. Grease is used to hold gasket in position
2. **A.** If Packing is used (reference assembly on page 10). Place packing glands in seal chambers in housing. Also, reference Page 34 for additional packing information. **B.** If Tuffseals are used (reference assembly on page 12). Make sure the Tuffseal on the impeller housing side is ready to accept the shafts and that the collar set screws are unscrewed enough so that the shafts can slide through the collars easily. Also, reference Page 35 for additional Tuffseal information. **C.** If mechanical seals are used (reference assembly on page 14). Make sure the mechanical seal bodies in the impeller housing stuffing boxes are ready to accept the shafts and that the seal set screws are unscrewed enough so that the shafts can slide through the seals easily. Also, reference Page 35 for additional mechanical seal information.
3. After checking for burrs, insert shafts through housing bushing, packing glands/mechanical seals/Tuffseals and gear case bushings. V-rings should also be installed while inserting the shafts. Be aware that the V-rings need to be slid onto the shafts because of their snug fit.

Note: Insert drive shaft in the same position as when disassembled.

4. Tighten cap screws, which hold the faceplate in place.
5. Install carbon steel gear keys in shaft keyways.
6. Slip proper timing gear on driven shaft.
7. Slip timing gear on the drive shaft, rotating shaft to align key with gear keyway, taking precautions that the timing marks are face out and aligned. There are two punch marks appearing on the gear on the drive shaft and one punch mark on the mating tooth on the driven shaft.
8. Spin the pump drive shaft several times to be certain that there is no interference from incorrect timing.
9. Apply grease to gasket seal surface on gear case. Press gasket in place. The same gasket is used on both impeller housing and gear case.
10. Slide gear case cover over shafts, being certain that drive shaft bore in cover is properly positioned in relation to drive shaft.

CAUTION

Take care in sliding lip of oil seal over drive shaft. If proper care is not taken, the lip will be damaged and oil leakage will result.

11. Tighten six cap screws holding gear case cover in place.
12. **A.** If Packing is used (reference assembly on page 10). Install new packing in seal chambers and tighten packing gland nuts to finger tightness. If pump is equipped with mechanical seals, install them according to the seal instructions and reference 12c for general instructions. Also, reference Page 34 for additional packing information. **B.** If Tuffseals are used (reference assembly on page 12). Use the seal spacers to set the right collar location. After setting the end clearances, tighten the gland nuts and then collar set screws to lock the seal collar onto the shaft. Finally, turn the spacers away from the collar so they will not interfere with it during operation. Also, reference Page 35 for additional Tuffseal information. **C.** If mechanical seals are used (reference assembly on page 14). Position the mechanical seal body axially on the shaft using the previous mark that was made during disassembly. After setting the end clearances, tighten the seal set screws to the shaft. Install the mechanical seal gland back into the impeller housing stuffing box and tighten the gland nuts (32). Re-install the pipe plugs (24). Also, reference Page 35 for additional mechanical seal information.
13. Install the drainpipe plug.
14. Remove oil level plug and fill gear case with lube oil (see lube oil chart, page 8/9) to the oil level hole.
15. Install and tighten fill plug and oil level plug.
16. Spin the assembled pump several times to be certain that there is no interference from incorrect timing. If no interference is apparent, then the pump is ready to be put back in service.

Major Disassembly Instructions

The first seven steps are the same as in the minor disassembly procedure. The major disassembly involves the disassembly of the faceplate group.

8. Place faceplate group in a vise.

CAUTION

Use soft vise jaws to prevent damage to gasket seal surface.

9. **A.** If Packing is used (reference assembly on page 10). Remove packing gland nuts (32) and slide packing gland (30) out of the way. Then remove packing (29) from both seal chambers on faceplate. If pump is equipped with mechanical seals, refer to the seal instructions that were shipped with the pump. Also, reference Page 34 for additional packing information. **B.** If Tuffseals are used (reference assembly on page 12). Loosen Tuffseal set screws that lock the cartridge seal's collar onto the shaft. Also, reference Page 35 for additional Tuffseal information. **C.** If mechanical seals are used (reference assembly on page 14). Remove pipe plugs (24) from impeller housing stuffing boxes. This allows access to the mechanical seal set screws holding the seal to the shaft. Mark the shaft where the mechanical seal is so that the correct seal working length can be referenced upon re-assembly. Then loosen the mechanical seal set screws. Loosen the mechanical seal gland nuts (32) and allow the mechanical seal gland to be loose on the housing. Thus, when the shafts are pulled out of this area the gland will not fall off. Allow it to hang loosely on the studs. Also, reference Page 35 for additional mechanical seal information.
10. Remove six bearing hex head bolts (12).
11. Remove the two bearing covers (14).
12. Remove the two faceplate bearing locknuts (15).
13. Slide impeller and shaft assembly out through the fluid chamber side of faceplate.
14. Remove the two ball bearings (17) from the bearing bridge on faceplate.
15. Check condition of lip seals (18) and replace if required.
16. Remove the two setscrews (11) from each impeller hub.
17. Press shafts through impellers by placing impeller and shaft assembly in press with threaded stub shaft up.
18. Remove woodruff impeller keys.

Reassembly

1. **A.** Install impellers onto shafts [For non-galling impellers (ductile iron)]. Apply lubricant to shaft end on which impeller fits (White lead is recommended). Slip impeller on shaft from the threaded stub shaft end. Install stainless steel woodruff impeller key. Align keyway in impeller with woodruff impeller key. Press impeller into proper position, and install setscrews as tight as possible. The dimensions shown below are given from the shoulder on the shaft to the nearest flat face on the hub of the impeller.
- B.** Install impellers onto shafts [For galling impellers (Stainless Steel)]. Impellers must be shrunk on the shafts, due to galling properties of the material. Heat impellers to 500-550°F for 1/2 - 2 hours. Quickly assemble shaft and impeller with keys in place into proper position according to the dimensions from above. Allow cooling.

CAUTION

Wear heat-resistant gloves when handling hot components.

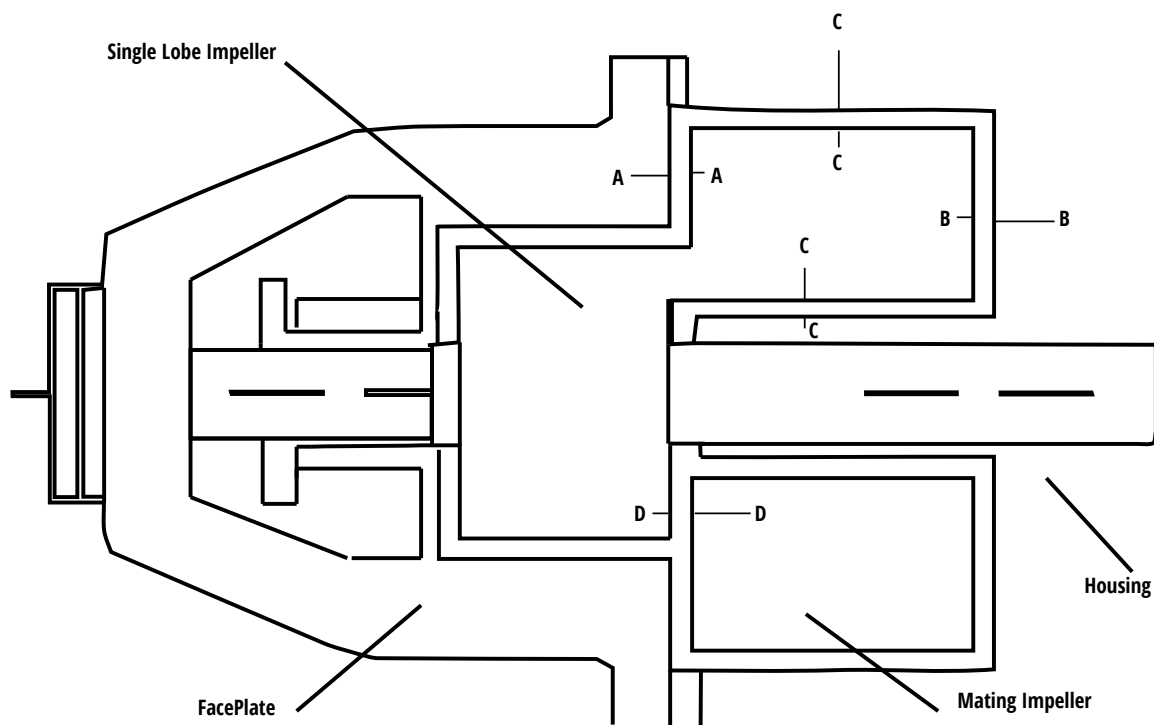
Pump Size	Impeller Location (inches)
70A & 120A	5.677 – 5.690
330	6.942 – 6.955

2. Install lip seals (18) in faceplate (22), in bottom of bearing bores on bearing bridge (19).
3. Install faceplate bearings (17) in bearing bores. Before installation, pack bearings with grease.
4. **A.** If Packing is used (reference assembly on page 10). Insert packing (29) and glands (30) in seal chambers on faceplate. Also, reference Page 34 for additional packing information. **B.** If Tuffseals are used (reference assembly on page 12). Install Tuffseals onto impeller stuffing boxes. Use the gland washers (45) and nuts (32) to hand tighten the seal glands to the stuffing boxes. Do not fully tighten the nuts. Also, reference Page 35 for additional Tuffseal information. **C.** If mechanical seals are used (reference assembly on page 14). Press in the stationary seal seat into the mechanical seal gland if replacing the seal or re-use the existing one. Have the seal bodies and seal glands nearby as those will have to be slipped onto the shafts as one is assembling the shafts through the impeller faceplate. Loosen the pipe plugs (24) so one will have access to the mechanical seal set screws in order to set the correct working height of the seal. Also, reference Page 35 for additional mechanical seal information.
5. Insert impeller and shaft assemblies, threaded portion first, through stuffing box, packing/mechanical seal body and seat, Tuffseals, seal gland, and inner race of faceplate bearing. Secure assemblies in this position by tightening the faceplate bearing lock nuts (15). V-rings (25) should also be installed while inserting the shafts. Be aware that the V-rings need to be slid onto the shafts because of their snug fit.
6. Insert bearing cover (14) in place and tighten bearing hex head bolts (12). The impeller and shaft assemblies are now secure in the faceplate.
7. Check the clearance with a feeler gauge, between the machine face of the faceplate and the flat surface on the lobe of the impeller. This setting clearance will vary with the material of construction and pumping temperature. See chart below for the proper setting clearance. This clearance is checked by revolving the impeller and shaft 360°, while checking the clearance at multiple positions. All other clearances are automatically set if this clearance is correct.

Chamber Clearances

Faceplate gaskets compress to approximately .003 - .004 inches when pump bolts are tightened.
For impeller assembly settings and resultant clearances, see below.

MODEL MATERIAL CLEARANCES		A IMPELLER SETTING (SIDE)		B RESULTING SIDE CLEARANCE (OPPOSITE SIDE)		C ON RADII		D RESULTING PASS OVER	
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
Models: 70A & 120A									
Non-Gall	Standard	.0020	.0025	.0025	.0080	.0040	.0060	.0005	.0045
	Hot	.0060	.0065	.0065	.0120	.0080	.0100	.0035	.0075
Gall	Standard	.0065	.0070	.0070	.0125	.0080	.0100	.0035	.0075
	Hot	.0105	.0115	.0105	.0165	.0120	.0140	.0060	.0110
Model: 330									
Non-Gall	Standard	.0040	.0045	.0045	.0100	.0060	.0080	.0015	.0065
	Hot	.0090	.0100	.0090	.0150	.0110	.0130	.0050	.0110
Gall	Standard	.0105	.0115	.0105	.0165	.0120	.0140	.0060	.0120
	Hot	.0155	.0165	.0155	.0215	.0170	.0190	.0100	.0160



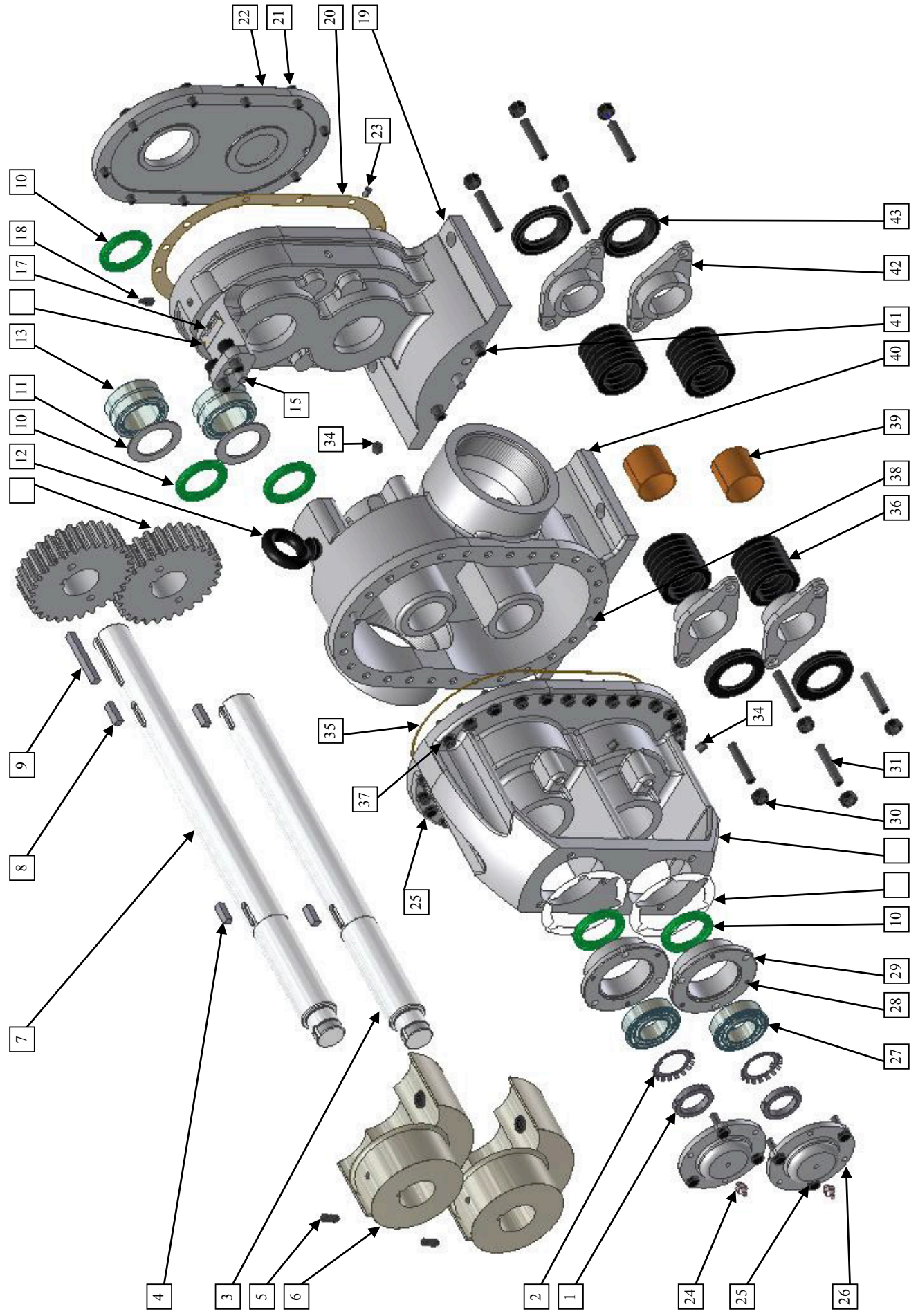
8. If the impellers are properly set on the shaft to dimensions from step 1, then the initial setting clearance will always be too large. Thus, to move the impeller to the proper setting, add shims between bottom of bearing bore and the bearing outer race. The following shims are available:

- Red .002"
- Blue .005"
- Pink .015"

9. Grease faceplate bearings thru fittings on bearing caps.

10. For the remaining reassembly procedure, refer to steps 1 - 16 in Minor Reassembly Instructions.

600 Pumps Isometric Drawing with Packing (Models Starting w/ 05)



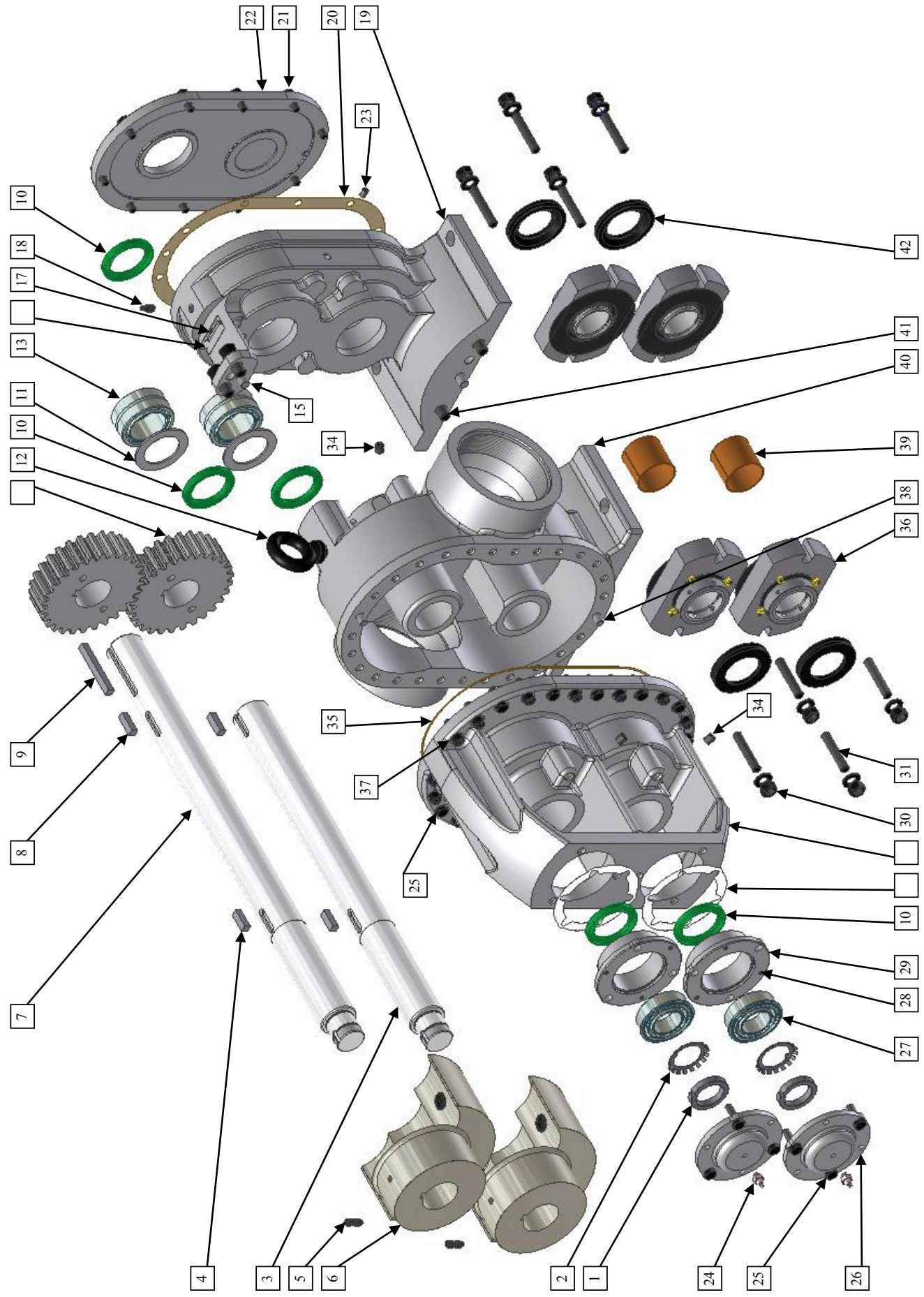
General Parts List for Model 600 Pumps

Item #	Description	Qty
1	Lock Nut	2
2	Lock Washer	2
3	Driven Shaft	1
	(Armco 17-4PH)	
4	Impeller Key (CI)	2
	Impeller Key (SS)	
5	Set Screw	4
6	Impellers (CI) S.L.	2
	Impellers (CI) D.L.	
	Impellers (SS) S.L.	
	Impellers (SS) D.L.	
7	Drive Shaft	1
	(Armco 17-4PH)	
8	Gear Key	2
9	Key	1
10	Lip Seal	5
11	Bearing Spacer	2
12	Eye Bolt	1
13	Roller Bearing	2
14	Timing Gear	2
15	Dowel Pin	2
16	Nametag	1
17	Drive Screw	2
18	Vented Pipe Plug	1
19	Gear Case	1
20	Gear Case Gasket	1
21	Hex Head Bolt	10
22	Gear Case Cover	1
23	Pipe Plug	2
24	Grease Fitting	2
25	Hex Head Bolt	16

Item #	Description	Qty
26	Bearing Cover	2
27	Ball Bearing	2
28	Set Screw	6
29	Bearing Carrier	2
30	Nut (CI)	8
	Nut (SS)	
31	Stud	8
32	Shim ----- .002"	As Req.
	Shim ----- .005"	As Req.
	Shim ----- .015"	As Req.
33	Faceplate (CI)	1
	Faceplate (SS)	
34	Pipe Plug (CI)	8
	Pipe Plug (SS)	
35	Gore-Tex Gasket	1
36	Packing	4 sets
37	Cap Screw	16
38	Dowel Pin	2
39	Housing Bushings	2
	DU Bushing (CI)	
	Carbon Bushing (SS)	
40	Impeller Housing (CI)	1
	Impeller Housing (SS)	
41	Cap Screw	4
42	Packing Gland (CI)	4
	Split Glands for (SS)	8
43	V-Ring	4

Note: (CI) are Cast Iron pumps that will have corresponding steel and/or ductile iron components. (SS) are Stainless Steel pumps that will have corresponding stainless steel components. Recommended spare parts are in bold text. When ordering spare parts please specify pump model, serial number, part number & part name.

600 Pumps Isometric Drawing (Models Starting w/ 05 & Tuffseals)



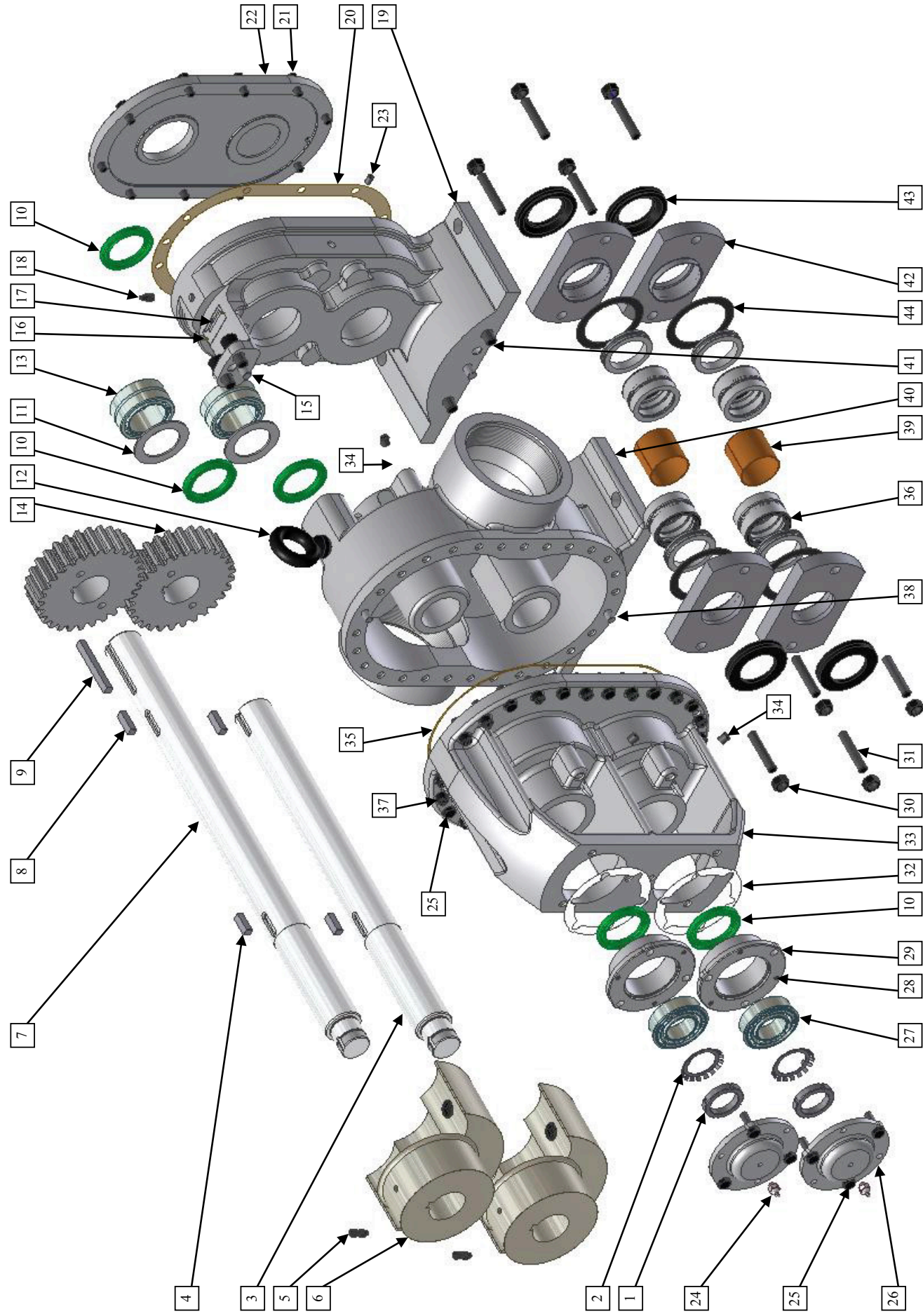
General Parts List for Model 600 Pumps

Item #	Description	Qty
1	Lock Nut	2
2	Lock Washer	2
3	Driven Shaft	1
	(Armco 17-4PH)	
4	Impeller Key (CI)	2
	Impeller Key (SS)	
5	Set Screw	4
6	Impellers (CI) S.L.	2
	Impellers (CI) D.L.	
	Impellers (SS) S.L.	
	Impellers (SS) D.L.	
7	Drive Shaft	1
	(Armco 17-4PH)	
8	Gear Key	2
9	Key	1
10	Lip Seal	5
11	Bearing Spacer	2
12	Eye Bolt	1
13	Roller Bearing	2
14	Timing Gear	2
15	Dowel Pin	2
16	Nametag	1
17	Drive Screw	2
18	Vented Pipe Plug	1
19	Gear Case	1
20	Gear Case Gasket	1
21	Hex Head Bolt	10
22	Gear Case Cover	1
23	Pipe Plug	2
24	Grease Fitting	2
25	Hex Head Bolt	16

Item #	Description	Qty
26	Bearing Cover	2
27	Ball Bearing	2
28	Set Screw	6
29	Bearing Carrier	2
30	Nut (CI)	8
	Nut (SS)	
31	Stud	8
32	Shim -----.002"	As Req.
	Shim -----.005"	As Req.
	Shim -----.015"	As Req.
33	Faceplate (CI)	1
	Faceplate (SS)	
34	Pipe Plug (CI)	8
	Pipe Plug (SS)	
35	Gore-Tex Gasket	1
36	Tuffseal	4
37	Cap Screw	16
38	Dowel Pin	2
39	Housing Bushings	2
	DU Bushing (CI)	
	Carbon Bushing (SS)	
40	Impeller Housing (CI)	1
	Impeller Housing (SS)	
41	Cap Screw	4
42	V-Ring	4

Note: (CI) are Cast Iron pumps that will have corresponding steel and/or ductile iron components. (SS) are Stainless Steel pumps that will have corresponding stainless steel components. Recommended spare parts are in bold text. When ordering spare parts please specify pump model, serial number, part number & part name.

600 Pumps (Models Starting w/ O5 & Mech. Seals)



General Parts List for Model 600 Pumps

Item #	Description	Qty
1	Lock Nut	2
2	Lock Washer	2
3	Driven Shaft	1
	(Armco 17-4PH)	
4	Impeller Key (CI)	2
	Impeller Key (SS)	
5	Set Screw	4
6	Impellers (CI) S.L.	2
	(CI) D.L.	
	(SS) S.L.	
	(SS) D.L.	
7	Drive Shaft	1
	(Armco 17-4PH)	
8	Gear Key	2
9	Key	1
10	Lip Seal	5
11	Bearing Spacer	2
12	Eye Bolt	1
13	Roller Bearing	2
14	Timing Gear	2
15	Dowel Pin	2
16	Nametag	1
17	Drive Screw	2
18	Vented Pipe Plug	1
19	Gear Case	1
20	Gear Case Gasket	1
21	Hex Head Bolt	10
22	Gear Case Cover	1
23	Pipe Plug	2
24	Grease Fitting	2
25	Hex Head Bolt	16

Item #	Description	Qty
26	Bearing Cover	2
27	Ball Bearing	2
28	Set Screw	6
29	Bearing Carrier	2
30	Nut (CI)	8
	Nut (SS)	
31	Stud	8
32	Shim -----.002"	As Req.
	Shim -----.005"	As Req.
	Shim -----.015"	As Req.
33	Faceplate (CI)	1
	Faceplate (SS)	
34	Pipe Plug (CI)	8
	Pipe Plug (SS)	
35	Gore-Tex Gasket	1
36	Mechanical Seals	4
37	Cap Screw	16
38	Dowel Pin	2
39	Housing Bushings	2
	(CI) DU Bushing	
	(SS) Carbon Bushing	
40	Impeller Housing (CI)	1
	Impeller Housing (SS)	
41	Cap Screw	4
42	Mech. Seal Gland (CI)	4
	Mech. Seal Gland (SS)	4
43	V-Ring	4
44	Seal Gland Gasket	4

Note: (CI) are Cast Iron pumps that will have corresponding steel and/or ductile iron components. (SS) are Stainless Steel pumps that will have corresponding stainless steel components. Recommended spare parts are in bold text. When ordering spare parts please specify pump model, serial number, part number & part name.

WARNING

Failure to follow these instructions could result in serious bodily injury or death. Do not attempt to work on any Tuthill pump installation before completing the steps below. Disconnect the drive so that it cannot be started while work is being performed. Review the Material Safety Data Sheet (MSDS) applicable to the liquid being pumped to determine its characteristics and the precautions necessary to ensure safe handling. Vent all pressure within the pump through the suction or discharge lines. All Tuthill pumps contain residual hydraulic oil from the factory production test. Determine if this is compatible with the fluid you are pumping. If the fluid is incompatible, then the pump must be fully flushed prior to use. If the pump is to be operated at elevated temperatures, the pump should be brought up to operating temperatures gradually. Rapid or sudden introduction of liquids at elevated temperatures into the cold liquid chamber of the pump could cause damage to pump externals, seals or other internal parts. Pumps can run dry provided provisions are made for the mechanical seal if one is used. Failure to comply with this could cause severe damage to the mechanical seal parts. Pump needs to be earthed separately to avoid a buildup of electro-static charge.

Disassembly & Reassembly for Model 600 Pumps

Minor Disassembly For Fluid Chamber Inspection

1. Remove all burrs on drive shaft with a mill file or emery paper. Also check for deposit of paint. Special care should be taken around the keyway and beveled corner on the drive shaft. These two areas are normally where burrs appear. Burrs or paint will cause an obstruction in the bushing area.
2. Drain oil from gear case by removing lower drainpipe plug. Remove cap screws (23) on face of gear case cover.
3. Remove gear case cover (22) by sliding over shafts.
4. If the timing gears (14) are a slip fit on the shafts. Mark gears so that in reassembly the gears may be remounted on the shafts from which they were removed. Remove the gears by loosening the setscrews. There are two in each gear. Then slide gears off drive end of shaft. If gear keys are sheared a gear puller may be required. Remove two woodruff gear keys (8).
5. If interference fitted (IF) timing gears (14) are furnished. Mark gears so that in reassembly the gears may be remounted on the shafts from which they were removed. IF gears do not have setscrews. First attempt to remove them can be made with a standard gear puller. Check that the gears have the correct timing marks before removal. If necessary, mark them again. If the gear puller was not successful in removing the gears, heat the gear OD with a torch and use a hydraulic jack to remove the gears.

WARNING

Wear heat-resistant gloves when handling hot components.

6. **A.** If Packing is used (reference assembly on page 22). Remove packing gland nuts (30) and slide packing gland (42) out of the way. Then remove packing (36) from both seal chambers in the impeller housing. If pump is equipped with mechanical seals, see below for general instructions and refer to the seal instructions that were shipped with the pump. Also, reference Page 34 for additional packing information. **B.** If Tuffseals are used (reference assembly on page 23). Loosen Tuffseal set screws that lock the cartridge seal's collar onto the shaft, on the impeller housing side. Also, reference Page 35 for additional Tuffseal information. **C.** If mechanical seals are used (reference assembly on page 25). Remove pipe plugs (34) from impeller housing stuffing boxes. This allows access to the mechanical seal set screws holding the seal to the shaft. Mark the shaft where the mechanical seal is so that the correct seal working length can be referenced upon re-assembly. Then loosen the mechanical seal set screws. Loosen the mechanical seal gland nuts (30) and allow the mechanical seal gland to be loose on the housing. Thus, when the shafts are pulled out of this area when removing the faceplate assembly the gland will not fall off. Allow it to hang loosely on the studs. Also, reference Page 35 for additional mechanical seal information.
7. Remove hex head bolts (25) on outboard side of faceplate. Make note on which side the drive shaft is located for reassembly. Remove entire faceplate by sliding away from impeller housing.

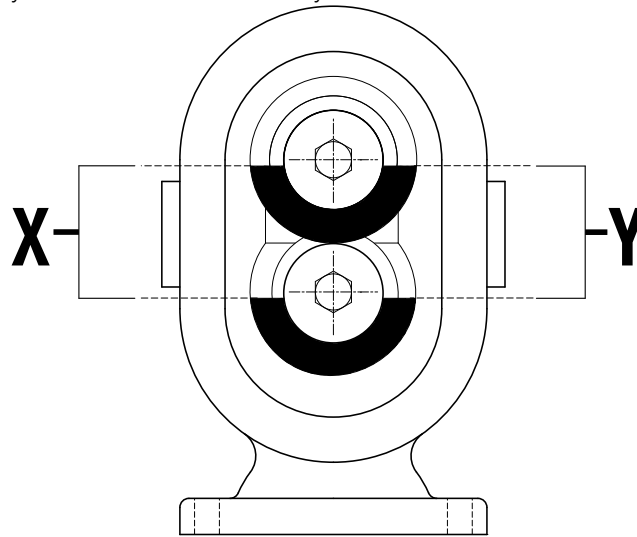
CAUTION

Faceplate assembly will be heavy and not balanced. Use proper lifting methods. This assembly includes the impellers and shafts installed in the faceplate. Do not disturb the bearing covers (26) on the bearing bridge on the faceplate. These covers hold the adjustment of clearance of the impeller in relation to the fluid chamber. If further disassembly is required, refer to major disassembly instructions.

Fluid Chamber Check Points

Procedure No. 1 - Check for twisted shaft

1. Place faceplate group upright in vise. Caution: Use soft jaws to prevent damage to the gasket seal surfaces. Tighten jaws on sides of bearing bridge.
2. Install carbon steel gear keys on an angle. Angle is to hold gears from sliding down on shaft.
3. Slide proper timing gear on drive shaft, revolving shaft to align key with gear keyway, taking precautions that the timing marks are face out and aligned. There are two punch marks appearing on the gear on the drive shaft and one punch mark on the mating tooth on the driven shaft.
4. Turn impellers to the position shown below. If the dimension X is the same as dimension Y, then there is no shaft damage. If there is a variation, then the shaft is twisted or the impeller keys may be sheared. Disassemble in accordance with major disassembly instructions. If the impeller keys are sheared, install new keys and recheck for twisted shaft.



Procedure No. 2 - Install new gears

1. Place faceplate group in vise and install woodruff keys as in Procedure No. 1
2. Slide gear on driven shaft, aligning keyway of gear with woodruff key on shaft
3. Position impellers as shown in the sketch in Procedure No. 1 with dimension X the same as dimension Y
4. Slide timing gear on drive shaft and align keyway in gear with woodruff key in shaft and mesh gears
5. Recheck dimension X and dimension Y to be certain that they are the same
6. Mark gears as indicated in Procedure No. 1
7. Slide gears off shafts and follow minor reassembly instructions

Procedure No. 3 - Install new bushings

1. Disassemble in accordance with minor disassembly instructions.
2. Press worn bushing from impeller housing and gear case.
3. Press new bushings in impeller housing.
4. Press bronze bushings in gear case.
5. Remove expansion plug in gear case cover.
6. Press out worn bushings and press new bushings in gear case cover.
7. Check gear case lip seals and bearings for damage. Replace parts as necessary.

CAUTION

If impeller housing bushing is steel backed PTFE, do not ream.

Reassemble In Accordance With Minor Reassembly

1. Apply grease to gasket seal surface on impeller housing. Then press impeller-housing gasket in place. Grease is used to hold gasket in position.
2. **A.** If Packing is used (reference assembly on page 23). Place packing glands (42) in seal chambers of housing (40). Also, reference Page 34 for additional packing information. **B.** If Tuffseals are used (reference assembly on page 23). Make sure the TuffSeal on the impeller housing side is ready to accept the shafts and that the collar set screws are unscrewed enough so that the shafts can slide through the collars easily. Also, reference Page 35 for additional Tuffseal information. **C.** If mechanical seals are used (reference assembly on page 25). Make sure the mechanical seal bodies in the impeller housing stuffing boxes are ready to accept the shafts and that the seal set screws are unscrewed enough so that the shafts can slide through the seals easily. Also, reference Page 35 for additional mechanical seal information.
3. After checking for burrs, insert shafts, through housing bushing, packing glands/mechanical seals/Tuffseals and gear case bushings. V-rings (43) should also be installed while inserting the shafts. Be aware that the V-rings need to be slid onto the shafts because of their snug fit. Note: Insert drive shaft on same side as when disassembled.
4. Tighten cap screws, which hold faceplate in place.
5. Slip fit timing gears. Install carbon steel gear keys in shaft keyways. Slip proper timing gear on driven shaft. Then slip timing gear on drive shaft, revolving shaft to align woodruff key with gear keyway, taking precautions that the timing marks are face out and aligned. These marks are two center punch marks on the gear on the drive shaft and one center punch mark on the mating tooth cavity. Then turn pump drive shaft over several times to be certain that there is no interference from being out of time. Tighten setscrews on shaft. Then install locking setscrew.
6. Interference fitted timing gears. Make sure that gears are properly marked with the timing marks and that the bores and keyways are free of burrs. Repair as necessary. Heat the gears to 500°F-550°F in an oven for 40 minutes. Add keys to the drive and driven shafts.

WARNING

Wear heat-resistant gloves when handling hot components.

7. Install the timing gear on the driven shaft first, making sure that the timing marks are facing outward. Assure that the driven gear has cooled before installing the drive gear. Match the timing gears and install the drive gear. Rotate the shafts after the gear cools to assure the correct timing of the impellers.
8. If timing is correct, apply grease to gasket seal surface on gear case. Press gear case gasket in place.
9. Slide gear case cover over shafts, being certain that drive shaft bore in cover is properly positioned in relation to drive shaft. Then tighten cap screws holding gear case cover in place. CAUTION: Take care in slipping lip of oil seal over drive shaft. If proper care is not taken, the lip will be damaged and oil leakage will result.
10. **A.** If Packing is used (reference assembly on page 23). Install new packing in seal chambers and tighten packing gland nuts to finger tightness. If pump is equipped with mechanical seals, install them according to the seal instructions and reference 12c for general instructions. Also, reference Page 34 for additional packing information. **B.** If TuffSeals are used (reference assembly on page 23). Use the seal spacers to set the right collar location. After setting the end clearances, tighten the gland nuts and then collar set screws to lock the seal collar onto the shaft. Finally, turn the spacers away from the collar so they will not interfere with it during operation. Also, reference Page 35 for additional Tuffseal information. **C.** If mechanical seals are used (reference assembly on page 25). Position the mechanical seal body axially on the shaft using the previous mark that was made during disassembly. After setting the end clearances, tighten the seal set screws to the shaft. Install the mechanical seal gland back into the impeller housing stuffing box and tighten the gland nuts (32). Re-install the pipe plugs (24). Also, reference Page 35 for additional mechanical seal information.
11. Install drainpipe plug. Remove oil level plug. Fill gear case with lube oil (see lube chart on page 8&9) until oil comes out oil level hole. Then install and tighten fill plug and oil level plug.
12. Spin the assembled pump several times to be certain that there is no interference from incorrect timing. If no interference is apparent, the pump is ready to be put back in service.

Major Disassembly Instructions

The first seven steps are the same as in the minor disassembly procedure. The major disassembly involves the disassembly of the faceplate group.

- 8.** Place faceplate group in a vise. CAUTION: Use soft vise jaws to prevent damage to gasket seal surface.
- 9. A.** If Packing is used (reference assembly on page 23). Remove packing gland nuts (30) and slide packing gland (42) out of the way. Then remove packing (36) from both seal chambers on faceplate. If pump is equipped with mechanical seals, refer to the seal instructions that were shipped with the pump. Also, reference Page 34 for additional packing information. **B.** If TuffSealls are used (reference assembly on page 23). Loosen Tuffseal set screws that lock the cartridge seal's collar onto the shaft. Also, reference Page 35 for additional TuffSeal information. **C.** If mechanical seals are used (reference assembly on page 25). Remove pipe plugs (34) from impeller housing stuffing boxes. This allows access to the mechanical seal set screws holding the seal to the shaft. Mark the shaft where the mechanical seal is so that the correct seal working length can be referenced upon re-assembly. Then loosen the mechanical seal set screws. Loosen the mechanical seal gland nuts (30) and allow the mechanical seal gland to be loose on the housing. Thus, when the shafts are pulled out of this area the gland will not fall off. Allow it to hang loosely on the studs. Also, reference Page 35 for additional mechanical seal information.
- 10.** Remove six hex head bolts (25). Remove bearing covers (26). Press tines of lock washers (2) out of grooves on lock nut (1). Remove lock nut.
- 11.** Remove bearing carrier (29) and bearing (27). CAUTION: Note the shims that are placed between bearing carrier (29) and faceplate (33). If shafts and impellers are not replaced, these shims must be returned to the same position from which they were removed. Now slide impeller and shaft assembly out through the fluid chamber side of faceplate.
- 12.** Remove the two double row faceplate ball bearings (27) from the bearing carriers (29). Then remove lip seals (10) and check condition. Replace if required.
- 13.** If the shaft or impeller needs to be replaced, remove two set screws (5) from each impeller hub. Then press shafts through impellers by placing impeller and shaft assembly in press with threaded stub shaft up. Remove impeller keys (4).

Reassembly

- 1. A.** Install impellers onto shafts [For non-galling impellers (ductile iron)]. Apply lubricant to shaft end on which impeller fits (White lead is recommended). Slip impeller on shaft from the threaded stub shaft end. Install steel woodruff impeller key. Align keyway in impeller with woodruff impeller key. Press impeller into proper position, and install setscrews as tight as possible. The dimensions shown below are given from the shoulder on the shaft to the nearest flat face on the hub of the impeller. **B.** Install impellers onto shafts [For galling impellers (Stainless Steel)] Impellers must be shrunk on the shafts, due to galling properties of the material. Heat impellers to 500-550°F for 1 ½ -2 hours. Quickly assemble shaft and impeller with keys in place into proper position according to the dimensions from above. Allow cooling.

Pump Size	Impeller Location (inches)
600	8.018 – 8.033

WARNING

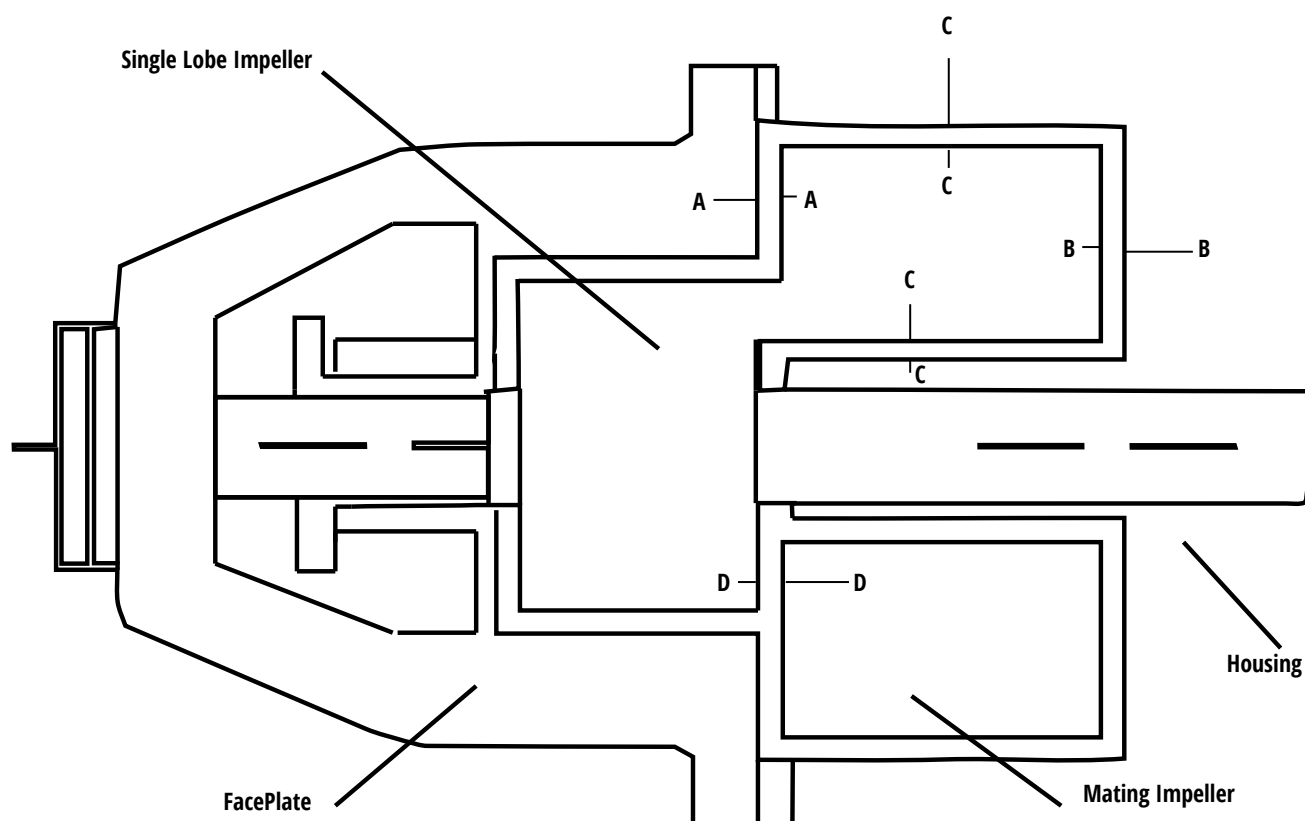
Wear heat-resistant gloves when handling hot components.

- 2.** Install lip seals (10) in faceplate (23), in bottom of bearing bores on bearing bridge.
- 3.** Install faceplate bearings (27) in bearing bores. Before installation, pack bearings with grease.
- 4. A.** If Packing is used (reference assembly on page 10). Insert packing (36) and glands (42) in seal chambers on faceplate. Also, reference Page 34 for additional packing information. **B.** If TuffSealls are used (reference assembly on page 12). Install Tuffseals onto impeller stuffing boxes. Use the gland washers and nuts (30) to hand tighten the seal glands to the stuffing boxes. Do not fully tighten the nuts. Also, reference Page 35 for additional Tuffseal information. **C.** If mechanical seals are used (reference assembly on page 14). Press in the stationary seal seat into the mechanical seal gland if replacing the seal or re-use the existing one. Have the seal bodies and seal glands nearby as those will have to be slipped onto the shafts as one is assembling the shafts through the impeller faceplate. Loosen the pipe plugs (34) so one will have access to the mechanical seal set screws in order to set the correct working height of the seal. Also, reference Page 35 for additional mechanical seal information.
- 5.** Insert impeller & shaft assemblies, threaded portion 1st, through stuffing box, packing/mechanical seal, body, seat, Tuffseals, seal gland, and inner race of faceplate bearing. V-rings should also be installed while inserting the shafts. Beware the V-rings (43) need to be slid onto the shafts because their snug fit. Secure assemblies in this position by tightening faceplate & bearing lock nuts (1).
- 6.** Insert bearing covers (26) in place and tighten bearing hex head bolts (25). The impeller and shaft assemblies are now secure in the faceplate.
- 7.** Check the clearance with a feeler gauge, between the machine face of the faceplate and the flat surface on the lobe of the impeller. This setting clearance will vary with the material of construction and pumping temperature. See chart below for the proper setting clearance. This clearance is checked by revolving the impeller and shaft 360° while checking the clearance at multiple positions. All other clearances are automatically set if this clearance is correct.

Chamber Clearances

Faceplate gaskets compressed to approximately .003 - .004 inches when pump bolts are tightened. Impeller assembly settings and resultant clearances see below.

MODEL 600 MATERIAL CLEARANCES		A IMPELLER SETTING (SIDE)		B RESULTING SIDE CLEARANCE (OPPOSITE SIDE)		C ON RADII		D RESULTING PASS OVER	
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
Non-Gall	Standard	.0060	.0065	.0065	.0120	.0080	.0100	.0035	.0085
	Hot	.0120	.0130	.0120	.0180	.0140	.0160	.0070	.0130
Gall	Standard	.0185	.0195	.0185	.0245	.0200	.0220	.0130	.0190
	Hot	.0245	.0255	.0245	.0305	.0260	.0280	.0170	.0230



8. If the impellers are properly set on the shaft to dimensions from step 1, then the initial setting clearance will always be too large. Thus, to move the impeller to the proper setting, add shims between bottom of bearing bore and the bearing outer race. The following shims are available:
 - Red .002"
 - Blue .005"
 - Pink .015"
9. Grease faceplate bearings thru fittings on bearing caps.
10. For the remaining reassembly procedure, refer to steps 1 - 16 in Minor Reassembly Instructions.

Packings

Installing Packings in Pumps

1. Remove all old packing using a packing hook. Clean stuffing box and shaft thoroughly and examine shaft for wear or scoring. Check bearings for wear as this can cause an eccentric shaft rotation resulting in excessive leakage. Packings will not act as a bearing. If shaft surface is worn, replace shaft or have seal surface area resurfaced.
2. Be certain the proper size packing is used. The following packing sizes will apply

Pump Model	Packing Size	Shaft Diameter	No. of Rings
70A & 120A	7/16" Square	1-7/8"	6
330	1/2" Square	2-1/4"	6
600	1/2" Square	2-1/2"	6

3. Always cut packings into separate rings. Never coil around shaft. (standard factory packings are pre-cut and pre-formed) If bulk packing is used cut each ring on a mandrel the same size as the pump shaft. Try rings in stuffing box to be certain that each ring fills the seal chamber and that there is no gap between packing joints.
4. Install one ring at a time, seating each ring independently. Use clean oil to lubricate shaft and inside of stuffing box. Joints should be staggered and kept at least 90° apart. Each individual ring should be firmly seated with a tamping tool. Never depend entirely on the gland to seat a set of packings. This practice will jam the last rings installed but leave the front rings loose. The result is excessive and rapid wear.
5. After last ring is installed, tighten gland nuts finger tight. Then start pump and take up nuts until leakage is decreased. Stopping leakage at this point will cause packing to burn. If temperature rises in seal area, back off on packing nuts as this indicates excessive gland pressure.
6. Allow packing to leak freely for at least one hour when starting up a newly packed pump. Take up gland nuts gradually, 1/16 turn every 5-10 minutes, until leakage stabilizes at about 3-5 drops per minute. If temperature in seal area increases, back off and start over.

Note: Replace packing when leakage cannot be controlled by further take-up of gland. Test results indicate that 70% of the wear occurs on the first two rings of packing nearest the gland. Rings next to the gland work the hardest. The rings in the bottom of the stuffing box serve to throttle some fluid pressure. On abrasive service the bottom ring takes most of the beating. Therefore, this ring should be a firm ring.

How to Pack for Abrasive Liquids

As used here "Abrasives" is a broad term intended to cover the problem of packing against slurries, congealing liquids and the likes. They cause the greatest damage to equipment, and present difficulties for packing. In general, this involves flush, purges and temperature control. Hard facing on the shaft seal surfaces, such as stellite or ceramic, are also recommended. When pumping slurries and abrasives an external source of clear or otherwise suitable liquid must be force fed at a pressure higher than that existing in the stuffing box. This differential pressure is in the area of 10-25 psi.

Suspended Solids

Solids which are suspended in liquids and which are an inherent part of their structure would include starch, clay slurry, muddy water and other similar slurries. This is best handled by an external flush of clear liquid through a lantern ring as shown. This arrangement will result in a small amount of product dilution and is controlled by the differential pressure in the seal chamber.

Installing Tuthill TuffSeal™ Cartridge Seals

1. Once pump is fully disassembled (shafts are removed from the impeller housing and faceplate) one can clean stuffing box and shafts thoroughly and examine shaft for wear or scoring. Check bearings for wear as this can cause an eccentric shaft rotation resulting in excessive leakage. If shaft surface is worn, replace shaft or have seal surface area resurfaced.
2. Install new Tuffseal Cartridge seals to the impeller housing and faceplate by fitting the studs into the seal gland slots. Then install the washers and nuts to hold the seal gland onto the stuffing box. These nuts should be tightened finger tight so that the seal assembly can move when the shafts are being installed.
3. During re-assembly, lubricate both of the seal's O-rings to and make sure the shafts are guided through the Tuffseal collar. Apply even pressure when pushing the shaft through the seal as to not damage the collar O-rings.
4. Once the entire pump is re-assembled, make sure the collar shoulder is seated against the seal spacers.
5. Tighten the seal gland nuts to secure the Tuffseal to the stuffing box.
6. After the pump's end clearance is set, then tighten the collar setscrews evenly to the shaft.
7. Rotate the spacers away from the collar so that they will not rub against any rotating component when the seal is operating.









Installing Mechanical Seals in Pumps(General)

1. Once pump is fully disassembled (shafts are removed from the impeller housing and faceplate) one can clean stuffing box and shafts thoroughly and examine shaft for wear or scoring. Check bearings for wear as this can cause an eccentric shaft rotation resulting in excessive leakage. If shaft surface is worn, replace shaft or have seal surface area resurfaced.
2. Install new stationary seal seat into the mechanical seal gland. Use a seal lubricant to aid in pressing the seat into the gland. Do not scratch or score the seal face during this process as it will result in a leak.
3. During re-assembly, make sure the mechanical seals and the glands are guided through the shafts as they are installed. Apply even pressure when pushing the shaft through the seal as to not damage the O-rings or seal bellows.
4. Once the entire pump is re-assembled, and the correct end clearance is set, reference the correct working length of the seal.
5. Mark the shaft, through the stuffing box access port, where the correct working length would be on the shaft.
6. Move the seal body to that mark and tighten the seal setscrews. This sets the correct working height of the mechanical seal. Please reference the seal's manual for the correct working height.
7. Install the seal gland and seal gland gasket to the stuffing box.
8. Tighten the nuts to the seal gland.

Torque For Shaft Locknuts

Industrial Models	Torque (ft-lbs.)
70A, 120A, 330, & 600	120 – 125

Torque For Faceplate Bolts

Pump Model	Screw Description	Type of Metal		Faceplate Qty. & Appearance	Applied Torque (ft-lbs)
600	½" Hex Head, 1 ½" LG. P104-1H	Note 1	10		70 - 75
	½" Socket Head, 1 ½" LG. P105-74	Note 2	4		70 - 75
	1/2" Socket Head, 11/8" LG P104-1S4	Note 3	14		30 - 35
330	½" Hex Head, 1 ¼ " LG. P104-4H	Note 1	8		70 - 75
	½" Socket Head, 1 ¼ " LG. P105-57	Note 2	4		70 - 75
70A & 120A	½" Hex Head, 1 ¼" LG. P104-4H	Note 1	13		70 - 75
	½" Hex Head, 1" LG. P104-2H	Note 1	1		70 - 75
	¼" Socket Head, 1 ½" LG. P105-78	Note 2	4		11 - 14

Note:

- SAE grade 5 steel (Min. tensile strength of 105,000 PSI heat-treated medium carbon)
- High carbon alloy, quenched and tempered (Min. tensile strength of 160,000 PSI)
- Grade 316 stainless steel

Serial Number Location

The serial number will be located on the pump nameplate. In addition, the serial number may be located on the impeller housing top port. Please furnish this number when ordering parts. Pumps with the built-in pressure relief valve must have a top suction port.

Common Causes of Pump Problems

Symptoms								Possible Causes	Suggested Solutions
Excessive Gland Leakage	Noisy	Excessive Heat	Wear	Starts, Then Loses Prime	Fails to Pump	Low Flow	Takes Too Much Power		
	X			X		X		Suction line high for vapor pressure of liquid	Reduce vacuum requirements
	X		X			X		Liquid too viscous for pump speed	Reduce pump speed
	X			X		X		Air leakage in suction piping	Tighten and seal all joints
				X	X			Suction pipe not immersed in liquid	Lengthen suction pipe or add liquid to supply tank
	X				X			Suction strainer clogged or of insufficient area	Clean strainer or use larger size
X	X	X	X				X	Misalignment between pump and driver	Re-align. Check coupling alignment with dial indicator
	X	X	X				X	Rotating elements binding	Disassemble and inspect
	X	X	X				X	Pipe strain on pump casing	Disassemble pipe and re-align before reassembling
	X					X		Relief valve chattering	Check setting and valve seating
X			X			X	X	Excessive system pressure	Check for obstructions in discharge line.
X		X					X	Stuffing box packed too tightly	Repack and adjust
						X		Pump speed too low	Check pump impeller speed
X						X		Pump parts worn	Have pump reconditioned or replace worn parts
						X	X	Obstruction in discharge line	Check discharge piping and valves for obstruction
					X			Wrong direction of rotation	Reverse motor
	X					X			
						X		Suction line sized too small	Increase suction piping size
								Torque control coupling not adjusted	Readjust coupling

Troubleshooting

No fluid is delivered

- Power is not on
- Net positive suction head available (NPSHa) is lower than required for the vapor pressure of the liquid pumped
- You should calculate NPSHa and redesign piping, if necessary
- There are leaks in suction line
- Direction of shaft rotation is incorrect
- Relief valve setting is too low (if the pump is equipped with a relief valve). Liquid is discharging through the by-pass port

Capacity is too low

- There are air leaks in suction line
- Suction losses are too high. The suction lift is too great or the suction line is too small or too long
- This can be detected by installing a vacuum gauge directly at the pump suction
- The maximum vacuum at the pump suction should never exceed 15" of mercury
- Vaporization caused by higher vacuums will generally result in capacity drop-off
- Redesign suction conditions
- Pump speed is too slow
- Strainer is too small or obstructed
- Suction pipe or port is not immersed in liquid deep enough
- Piping is improperly installed permitting an air pocket to form in the pump
- Increased clearances or wear in the pump will sometimes cause the pump to deliver an insufficient supply of liquid.

Pump works spasmodically.

- Leaky suction lines
- Suction conditions vary
- Air or vapor is in the liquid
- Problem: Excessive power draw
- Pressure is too high
- Liquid is more viscous than originally expected
- Suction or discharge line is obstructed
- There is insufficient horsepower
- There are mechanical defects
- Drive shaft and pump are misaligned
- Pump is binding due to incorrect clearance setting
- Pump shaft is bent
- Misalignment due to bad piping/poor installation causing strain or distortion

Pump is noisy

- Pump is cavitating due to inadequate suction conditions
- There is misalignment of coupling
- Coupling is set too close to pump
- There is vibration of the pump due to a worn or bent shaft
- There are air leaks on suction side of pump or air entrainment in the fluid

Pump leaks

- Bolts need tightening, allowing gaskets or O-rings to leak
- Gaskets or O-rings are damaged

Note: Packings are designed to leak. Leakage should be at a rate that will prevent excessive heating on the bracket at the packing area.

Material Returns

If it becomes necessary to return a pump to the factory, a Return Goods Authorization (RGA) must be obtained from either your local Authorized Distributor or our Alsip plant. No RGA can be issued until a completed Material Safety Data Sheet (MSDS) has been forwarded to our Alsip plant and return of the pump has been approved.

- Tuthill pumps are precision-built and must be handled with care
- Pumps must be drained of all fluid and the ports plugged to prevent foreign material from getting into the pump
- Pumps must be packaged securely to prevent damage while in transit

Warranty

Tuthill Pump Group warrants its products against defective material and workmanship for 90 days from the date of startup or one year from date of shipment from Tuthill's plant, whichever comes first. This warranty does not include products damaged by tampering, improper installation, abuse, or wear. Nor does it cover consequential damages, or other losses due to pump failure. Because of the unpredictable nature of fluids encountered, pumps are not warranted for any specific life.