

**Wilfley**

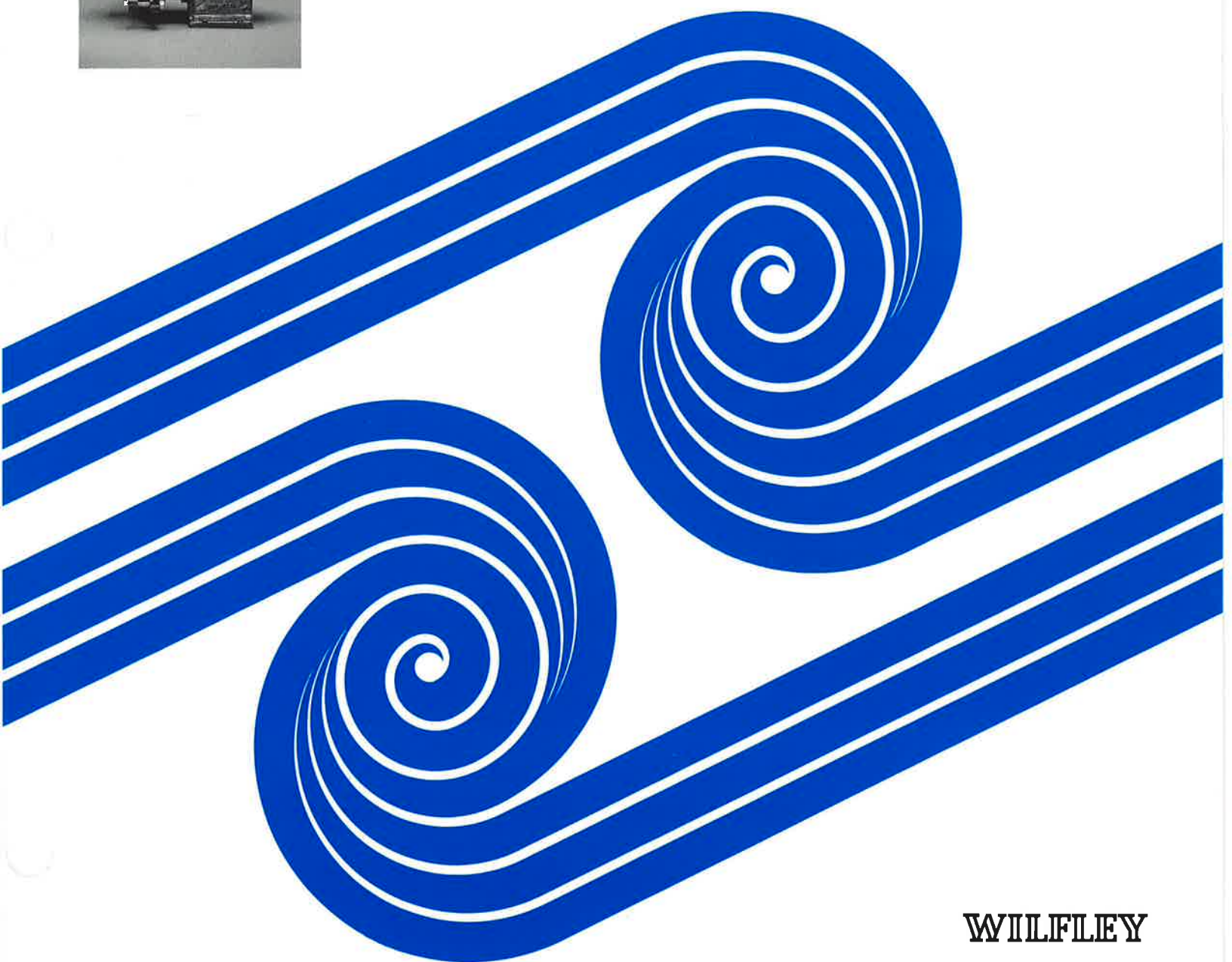
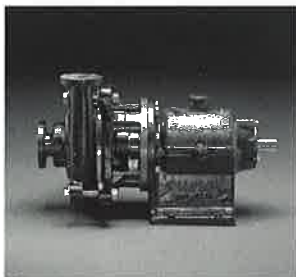
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**Centrifugal  
Acid  
Pump**

**Operating  
Handbook**

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**Model AF**



**WILFLEY**

# Model AF Operating Handbook

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For additional information about Wilfley Pumps, phone, fax or write our office in Denver, or the representative in your area. Please do not hesitate to contact us concerning any aspect of our pumps.

### WILFLEY

A. R. Wilfley & Sons, Inc./P.O. Box 2330/Denver, Colorado 80201

Telex: 054-543

Fax: 303-779-1277

1-303-779-1777

1-800-525-9930

## Spare Parts Ordering

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PLEASE INCLUDE THE SERIAL NUMBER OF YOUR PUMP WHEN ORDERING SPARE PARTS. WITH THIS NUMBER WE CAN DETERMINE AND DUPLICATE THE ORIGINAL CONFIGURATION AND MATERIALS OF YOUR PUMP.

To make part ordering easier, we have preassembled in our factory the replacement kits listed below and on the parts list. These kits are assembled to match your pump.

### #8000

#### **Recommended Spare Parts Kit:**

Except for gaskets, this kit contains the parts we recommend you have on hand to provide proper maintenance for your pump.

Several gasket kits, #8400 and #8450 should also be ordered. The spare parts kit is designed for one pump and should be altered when ordering stock for two or more pumps. The actual quantity of spare parts needed for a safe stock can be somewhat more or less depending on the severity of your pumping conditions.

### #8100

#### **Shaft and Thrust Drive Sleeve Assembly Kit:**

Bearings are pressed onto both the shaft and the thrust drive sleeve and locked into place. Assemblies are ready to install. The felt ring for the rear bearing cap-inner is included.

### #8400

#### **Gasket Kit:**

(Entire pump)

### #8450

#### **Gasket Kit:**

(Wetted end only)

Wetted end applies to the parts that are in contact with the solution being pumped.

These kits supply all the gaskets you will need when reassembling your pump. Several of these kits should be kept on hand.

### **Special Service**

Your Wilfley AF pumps may be returned to the factory, at any time, for complete overhaul and repair. Each pump is completely disassembled and worn or inoperable parts are replaced. All rebuilt pumps are subjected to the same testing procedures as newly constructed units.

Each pump is thoroughly inspected upon arrival. The tolerances and condition of each part is checked and only the parts that don't meet test requirements are replaced. We charge the standard price for parts and a minimal reassembly fee.

The utilization of this service provides you with almost instantaneous pump repair at an economical price. The units are overhauled and returned to you quickly.

Please contact A. R. Wilfley and Sons, Inc. or any of our representatives at any time, concerning our pumps or parts. You can be assured that we will do all within our power to ensure your complete satisfaction with Wilfley products.

### **Guarantee**

Wilfley guarantees your complete satisfaction. If our products or services fail to satisfy your needs please contact your local representative or A.R. Wilfley & Sons, Inc. directly for assistance.

## Safety Precautions

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Throughout this manual, references are made concerning pump configurations corresponding to specific frame sizes. We have provided detailed cutaways for both metal and plastic models to show general configurations. The frame size is embossed on the side of the frame.

### Special Service

Your Wilfley AF pumps may be returned to the factory, at any time, for complete overhaul and repair. Each pump is completely disassembled and worn or inoperable parts are replaced. All rebuilt pumps are subjected to the same testing procedures as newly constructed units.

For more information on rebuilding, contact A. R. Wilfley and Sons, Inc. at 1-303-779-1777.

Like all machinery, centrifugal pumps can be dangerous if used improperly. Any of the following list of misuses may result in a pump which does not function properly. A pump which does not function properly may be a hazard and could cause damage or injury.

For maximum safety and reliability use only factory supplied parts and closely follow all maintenance and operating recommendations and instructions.

Do not change the pumping conditions or installation of a Wilfley pump without consulting A. R. Wilfley & Sons, Inc. first to ascertain if the pump is capable of handling the new conditions and/or fluid.

It is not possible to list all the conceivable misuses of a centrifugal pump. Therefore, the following list is not meant to be complete and is provided only as a guide and as example of the types of misuse which can damage a pump and cause injury. The list will also give a good idea of the kinds of misuses which will void any and all warranties, if any.

1. Do not run a pump with the discharge valve closed.
2. Do not run a pump in the reverse direction.
3. Do not start a pump which is "windmilling" in the reverse direction due to fluid flowing back down the discharge pipe and into the suction pipe.
4. Do not continue to operate a pump where there are indications that something is rubbing, binding or knocking.
5. Do not continue to run a pump which gives an indication of overheating.
6. Do not operate a pump with the belt or coupling guard removed. Make sure the guard fits snugly around the belts or coupling so there are no openings.
7. Do not operate a pump if the governor weights are of different sizes.
8. Do not operate a pump that is vibrating, surging or making abnormal noise.
9. Do not work on a pump unless the drive system is locked out and the pump is disconnected from the drive system.
10. Do not connect the pump to the drive system without first checking to see that the drive system is running in the correct direction.
11. Check the factory alignment of the coupling or v belt drive before starting the pump.
12. Do not put a cold liquid in a hot pump or a hot liquid in a cold pump.
13. Do not hit a pump with any object.
14. Do not use worn or faulty parts.
15. Do not stick hands, arms, legs or any other objects into the discharge or intake or any other opening of a pump.
16. Do not weld attachments to the pump.
17. Do not apply external heat to the pump.
18. Do not lift the pump by its case.
19. Do not examine a pump without using proper eye and face protection.
20. Some materials deteriorate with time. If your pump has been out of service for more than 3 months, please contact A. R. Wilfley & Sons, Inc. for information concerning its suitability for service.

## General Installation

### Inspection Upon Arrival

Your pump has been carefully inspected and tested prior to shipment to assure that it meets your requirements. Please inspect the pump upon arrival for any damage which may have occurred during shipment. Report any damage immediately to carrier. Leave all shipping covers attached to the pump unit until it is ready for installation. If installation is to be delayed more than 15 days, the pump shaft should be rotated by hand once a week to lubricate the bearings and prevent rusting.

### Choosing Pump Location

The following recommendations may be helpful when choosing the best location for your pump.

a. Locate the pump as close to the liquid source as practical so that the suction pipe is short and direct with a minimum of elbows, fittings and valves.

b. Place the pump in a location so that the unit is accessible for inspection during operation as well as for maintenance operations involving removal and disassembly.

### Foundation

The foundation should be sufficient to absorb any vibration and to form a permanent, rigid support for the sub-base. This is important in maintaining the correct alignment of the direct connected unit. A concrete foundation on a solid base is satisfactory. Foundation bolts of the proper size should be embedded in the concrete located by the outline drawing.

### Alignment

It is necessary to align the pump and motor after the complete unit has been leveled on the foundation and after the foundation bolts have been tightened. Explicit directions for checking and aligning the pump components may be found in the Hydraulic Institute Standard.

### Piping

Both suction and discharge pipes should be supported independently near the pump so that when the flange bolts are tightened no strain will be transmitted to the pump casing. Expansion joints should be installed where large temperature variations are involved, with a pipe anchor used between the pump and the expansion joint.

### Discharge Piping

A check valve and a gate valve are often installed in the discharge line. The check valve is used to prevent fluid from flowing back through the pump while it is shut down. The gate valve blocks the discharge line during maintenance.

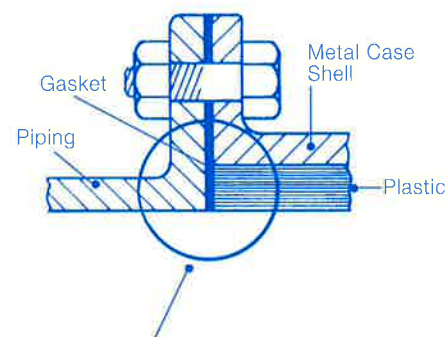
### Suction Piping

Care should be taken in sizing and locating suction piping to prevent cavitation.

### Special-Plastic Pump

Gaskets on the intake and discharge connections of plastic pumps should cover the entire flange to the inside diameter of the plastic lining. The companion piping flange should also come to this diameter to prevent leaking past the plastic lining.

### Intake and Discharge Connections



Critical Seal Area—Gasket must be compressed providing a positive seal between the pipe flange and plastic. This is to keep corrosive liquid from reaching the critical area between the plastic and metal case shell.



# Operating and General Servicing Recommendations

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## Pre-starting Recommendations

Please perform the following operations before attempting to start the pump.

- a. Visually check all main and auxiliary piping to insure that all connections have been properly made.
- b. Check voltage, fuse, starter amperage ratings and frequency on the motor nameplate against the electrical supply characteristics.
- c. Visually inspect all electrical connections to the motor and the control circuit.
- d. CHECK THE ROTATION OF THE MOTOR BY MOMENTARILY STARTING THE MOTOR WITH THE MOTOR DISCONNECTED FROM THE PUMP ASSEMBLY. DIRECTION OF ROTATION MUST BE AS SHOWN BY THE ARROW ON THE PUMP CASE AND THE DIRECTION OF ROTATION PLATE ON THE TOP OF THE FRAME. STARTING OR RUNNING PUMP BACKWARDS WILL CAUSE DAMAGE TO INTERNAL PARTS.

## Starting

Before starting the pump, it is advisable to have the pump casing and the suction line filled with liquid. However, because no rubbing components are contained in this pump such as seals or packing, no damage will result if started dry. It is normal to have the discharge valve closed when the pump is started since much less horsepower is required under these conditions. **DO NOT OPERATE THE PUMP IN A DEADHEADED (NO-FLOW) CONDITION.**

## Shutdown

Close the suction valve and discharge valve, then stop the pump.

## General Servicing

Your Wilfley Model AF pump is designed to provide long and trouble-free service with a minimum of maintenance. It is recommended that the pump be inspected at regular intervals and it is also suggested that a service record be kept for the pump.

## Motor

Please refer to the manufacturer's motor manual for recommended service instructions. It is recommended that the motor be well ventilated when in operation.

## Pump Storage

If the pump is inoperative for a long period of time, it is recommended that the pump be flushed and drained to minimize corrosion. It is also advisable to drain the lines and case if there is a possibility of freezing.

## General Repair and Part Replacement Instructions

### Periodic Servicing

The following table contains recommended service checks which should be performed on a periodic basis.

	<i>After First Run-Up</i>	<i>Every Week</i>	<i>Every 6 Months</i>
Flow, pressure and temperature (a)	●	●	
Gaskets	●	●	
Visual (b)	●	●	
Noise/vibration	●	●	
Lubrication (c)			●

a. Flow, Pressure and Temperature: All flow, pressure and temperature gauges should be monitored to insure that the pump is operating within specified limits. If the frame bearing temperatures are monitored, this temperature should not exceed 220°F. (104°C)

b. Visual: Periodic visual inspection should be made of the pump and its installation. The following items should be secure and in good order:

1. All mounting supports and attaching points.
2. All external nuts, bolts, and fittings.
3. All suction and discharge piping.

c. Lubrication: We recommend that grease be used sparingly on bearings. Grease should be clean and of sufficient quality to provide adequate lubrication. For operating and bearing temperatures up to 220°F (104°C) use a grade number 2 (or better) lithium base grease. For higher temperatures, consult your local lubrication engineer or A. R. Wilfley and Sons, Inc.

Please do not overgrease. Extensive damage can result from overgreasing. High operating temperatures due to excess amount of grease, can cause premature bearing failure. Bearing movement (front bearing only) can be retarded, damaging the bearing housing and affecting proper pump operation.

**NOTE:** Frame 5 pumps are equipped with pipe nipples that come down and out from the frame. They act as vents and should be open during greasing and for the first few minutes of running after greasing.

### General

The section views for each type of Model AF pump show the parts in their proper relationship and should be used as guides for disassembly and reassembly. Before disassembling the unit, thoroughly drain fluid out of the case and expeller cavities. Disassemble only to the extent necessary to repair.

### Inspection

Visually inspect all metal and plastic parts for cracks, fractures, burns, scoring, excessive wear or other visually detectable faults. Check seals and gaskets for cuts, tears, deterioration and loss of resilience. Replace as required.

### Parts Handling and Cleaning

Always use the proper tools for the job. Wash all metallic parts with solvent. Do not allow parts to remain in solvent for an extended period of time. Protect each part from contamination. If parts are not to be reinstalled in a short time, protect them from rust and corrosion.

### Special Disassembly Instructions

#### Bearings:

Bearings should not be removed from the shaft or thrust drive sleeve unless replacement is certain. BEARING CLEANLINESS IS A MUST.

#### Plastic Impellers:

Special care should be taken in removing plastic impellers from the pump shaft.

The plastic is relatively brittle and can be damaged by the strain of a pry bar and the shock of a hammer blow. A special impeller wrench is available to assist in removal.

# Pump Assembly Instructions

## General

The pump assembly instructions, highlighted in bold blue type, are divided into seven subassemblies and one final assembly. Each subassembly is preceded by suggestions for individual part inspection. The final assembly combines the subassemblies.

Disassembly is in the reverse order. Permanently attached items such as name tags and serial number plates do not require replacement and should never be removed.

Pump cut-a-ways, parts lists and ordering instructions can be found on pages 10 through 17. Individual cut-a-ways fold out for easy reference.

## I. Thrust Drive Sleeve Assembly

### Inspection

#### a. Thrust Drive Sleeve (Item 38):

Check that the drive end of the sleeve is smooth and free of rust. The front flange of the drive sleeve should not be significantly gouged from the governor weights and the spring bolt holes should not show excessive wear.

#### b. Thrust Drive Sleeve Bushings (Item 38A):

Visually check the outer bushing for cracks or nicks. Tap the flange end of the sleeve in the palm of your hand, and check for carbon flakes. Any sign of flakes indicates chipping of the bushing and the bushing should be replaced.

#### c. Rear Bearing(s) (Item 22):

There should be no signs of rusting or contamination by dirt, chips, or metal particles. When slowly rotated, there should be no points of drag, hangup, looseness or ability to wiggle or cock.

#### d. Bearing Caps (Items 17, 18, 19, 20):

Bearing cap sealing faces and inner bores should be clean and free of burrs. The rear bearing cap-outer is in contact with the rear bearing(s) and is subject to wear. If the thrust drive sleeve moves laterally more than 1/32" (0.8 mm)(indicates bearing movement), the rear bearing cap-outer should be replaced.

**NOTE:** The front bearing cap-outer and the pump bracket is manufactured as one unit on the Frame 0.

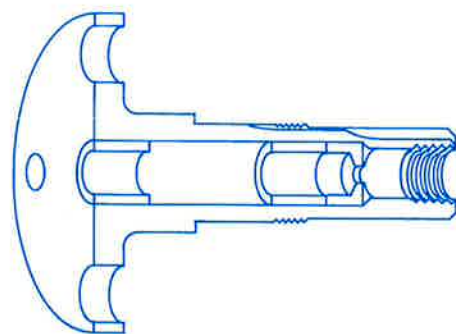
### Assembly:

Place bearing cap grease seal or felt rings (Items 17A, 18A, 19A, 20A) into grooves in the bore of bearing caps and lubricate generously.

**NOTE:** The front bearing cap-outer contains two felt rings on all frames except the Frame 0, it contains only one. Both rear bearing caps on the Frame 5 pumps use rubber seals which are pressed into the cap with the open end containing the spring facing the bearing.

Slide the thrust drive sleeve spacer into the flange end of the drive sleeve bore with the open side of the spacer forward. Press the thrust drive sleeve bushings into the sleeve, one being pressed down against the spacer bushing and the second until it is flush with the bottom of the chamfer at the flange end of the sleeve. Screw the thrust drive sleeve plug (Item 38C) into the rear of the sleeve.

## Thrust Drive Sleeve Section

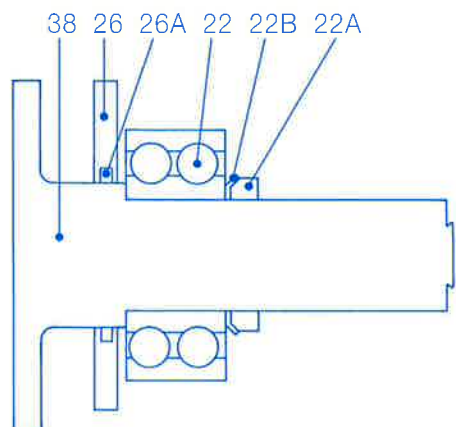


Stand the thrust drive sleeve on the flange end and slip the rear bearing cap-inner over the top of the sleeve. Heat the rear thrust bearing(s) in a clean fluid or on a bearing heater to 220-260°F (104°-127°C) and then immediately place onto the shaft.

Frames 0, 1 and 2 use a single double row bearing. Frame 3 and 4 have two single row bearings with a spacer in between. Frame 5 is composed of a thrust bearing and a radial bearing individually mounted.

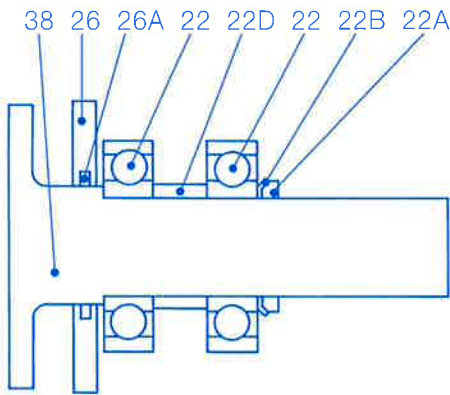
**NOTE:** It is important that any partially shielded bearings be positioned on the shaft to receive proper lubrication.

Frame 0, 1 and 2

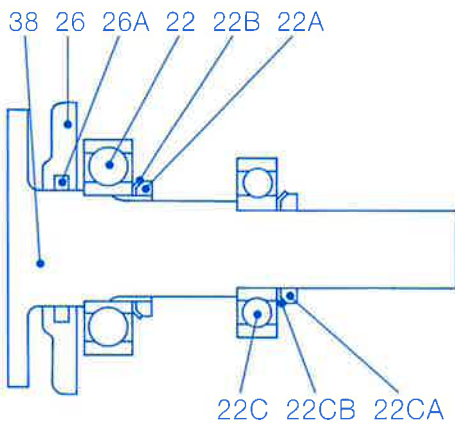




Frame 3 and 4



Frame 5



After the bearings have had a chance to cool, slip the rear bearing lockwasher (Item 22B) onto the shaft and screw on the rear bearing locknut (Item 22A). Securely tighten the rear bearing locknut and bend down one of the prongs on the lockwasher into a slot on the locknut in order to keep it from loosening. Check the bearings for free rotation and be sure that they are firmly locked into place on the thrust drive sleeve.

## II. Shaft Assembly

### Inspection

a. Shaft (Item 13): The shaft must be free of corrosion or chemical attack and excessive scoring. The rear end of the shaft which rides in the thrust drive sleeve must be perfectly smooth in order to insure easy slippage. The shaft must not be bent.

b. Front Bearing (Item 16): As in the rear bearing, the front bearing must be clean and rotate smoothly. (See Section 1-c page 6).

### Assembly:

The front bearing is a thrust bearing and should be mounted in the proper direction. On most bearings the work "Thrust" is stamped on either the inner or outer race. The bearing should be placed on the shaft so that the word "Thrust" faces the rear if it is stamped on the inner race and faces forward if stamped on the outer race. If the word "Thrust" does not appear on the races, consult bearing manufacturer for proper installation.

Heat the front bearing similarly to the rear bearing and immediately slide it onto the shaft. After it has cooled, fit the front bearing lockwasher (Item 16B) and the front bearing locknut (Item 16A) onto the shaft. Tighten the locknut securely and bend a prong of the lockwasher into a groove in the locknut to secure it in place. Check the bearing for free rotation and make sure that it is firmly in place. Lubricate the bearing with enough grease to cover all of the ball bearings but do not overgrease.

## III. Governor Sleeve Assembly

### Inspection:

Visually inspect the nose of the governor weights for excessive wear. Make sure that the weights are the same size and weight as those removed.

### Assembly:

Attach the governor weight (Item 28) to the governor sleeve (Item 24) with pins (Item 20) and lock into place with cotter pins (Item 29A). Make sure that the governor weights pivot freely without binding.

## IV. Case Plate Assembly

### Inspection:

a. Stationary Seal Ring Housing (Item 12): The stationary seal ring housing gasket face must be smooth and free of dents and corrosive attack.

b. Stationary Seal Ring Inspection (Item 11): The face of the stationary seal ring must be perfectly smooth and scratch free. The seal rings rub for a few seconds during starting and stopping. When the pump is stopped, the clearance between the shaft sleeve (Item 14) and the front bearing cap (Item 17), indicates the amount of wear left in the seal rings. When the difference between the two parts is less than 1/32" (0.8 mm), the seal rings should be replaced.

c. Case Plate Labyrinth Ring (Item 67): Check that both sealing faces are smooth and corrosion free. Check for wear or scoring in the labyrinth ring groove itself. The maximum clearance between the impeller and the labyrinth ring groove should not exceed 0.030" (0.75 mm) with a 2" discharge or smaller and 0.035" (0.9 mm) in pumps with a 3" discharge or larger. Scoring in the labyrinth ring usually indicates either an hydraulic or mechanical problem.

d. Case Plate (Item 5): The case plate should be inspected for unusual wear or corrosive attack. Replace if necessary. Carefully inspect the gasket surfaces for scratches, dents, or cracks.

#### **Assembly:**

Place case plate front face down on a flat surface. Lightly lubricate the case plate labyrinth ring gasket (Item 67A)\* and place on the rear face of the case plate. (New gaskets should always be used). Insert the labyrinth ring through the case plate bore and then place lightly lubricated stationary seal ring housing gasket (Item 12A)\* onto the rear labyrinth ring face. Place the stationary seal ring into the stationary seal ring housing with the chamfer facing outward, then place stationary seal ring housing onto the rear of the labyrinth ring. Bolt the assembly together but leave nuts finger tight. The nuts will be tightened after the seal rings have been aligned.

\*Important: Proper gasket thickness is critical to maintaining pump tolerances. All AF gaskets are .032 in. (0.8 mm) thick and will compress approximately 10%.

## **V. Impeller**

### **Inspection:**

a. Impeller (Item 8): Check the outside ring of the impeller intake for scoring as well as the rear ring which fits into the labyrinth ring. Any scoring usually means that the impeller is turning out of true or else the case or labyrinth ring is cocked. Check wear in case or labyrinth ring for an indication or reason for wear. Make sure that all expeller vanes are clear.

b. Rotary Seal Ring (Item 9): The rotary seal ring must have a perfectly smooth and scratch-free chamfered face.

### **Assembly:**

Coat the impeller hub with a nonseizing agent. Lightly lubricate a new rotary seal ring gasket (Item 10A)\* and place on the impeller. Slide the rotary seal ring onto the impeller with chamfer facing outward. The rotary seal ring is compressed between the shoulder on the impeller and the shaft sleeve (Item 19) during operation so it should protrude slightly beyond the end of the impeller. This is to ensure that the rotary seal ring makes contact with the shaft sleeve gasket (Item 14 A)\*.

## **VI. Case**

### **Inspection:**

a. Case (Item 3): Inspect for excessive or abnormal wear.

b. Case Wear Ring (Item 4): The case wear ring should also be inspected for unusual wear.

### **Assembly:**

On pumps with a 2 1/2" discharge or less, the case wear ring is press-fitted on the inside of the case. Pumps with a 3" discharge or greater have a case wear ring that requires a gasket and is slip-fitted on the outside of the case.

## **VII. Frame**

### **Inspection:**

The bearing cavities must be completely clean and free of all rust, corrosion, burrs and nicks. Carefully check the front bearing housing for ridges made by the sliding radial bearing. Also, check the sealing surfaces for the bearing caps. They should be clean of all rust and burrs.

### **Assembly:**

**NOTE:** All threads are right-handed.

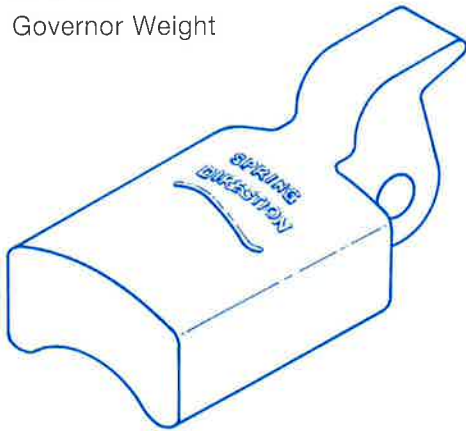
Insert the thrust drive sleeve assembly through the front side of the rear bearing housing. Slip the rear bearing cap-outer (Item 23) over the thrust drive sleeve. Install the rear bearing cap capscrews (Item 26B) with star lockwashers (Item 26C) through the rear bearing cap-outer and tighten into the rear bearing cap-inner.

Insert the shaft in the front end of the front bearing housing and through the front bearing cap-inner, governor sleeve assembly with the nose of the governor weights facing the rear, and into the thrust drive sleeve. Slip the front bearing cap-outer over the shaft. Use the front bearing cap screws (Item 18B) with star lockwashers (Item 18C) to attach the front bearing caps, tighten securely.

Line up the bolt holes in the governor sleeve with the hole in the shaft and tighten the sleeve onto the shaft with the governor sleeve cap screw (Item 24A).

Prior to attaching the governor spring sets, check the spring direction diagram of the governor weights.

Governor Weight



Attach the governor spring units (Item 25) to the governor sleeve flange using the governor sleeve cap screw, washers and nuts (Items 25A, 25B, 25C). The governor sleeve nuts are plastic lined. The governor springs are made up of individual leaves. The following table indicates the number of leaves and spring units for your pump.

	Units	Leaves in each unit
Frame 0	2	3
Frame 1, 2, 3	2	10
Frame 4, 5	4	10

**IMPORTANT:** Tighten the cap screws completely, then back off slightly (approximately 1/4 turn) until the cap screw and cap screw nut turn together when the cap screw is rotated; this will insure proper spring action.

**TEST:** Place a bar between the governor sleeve and the thrust drive sleeve, push the shaft forward and release to make sure that it moves freely.

**Final Assembly:**

Check to make sure that both the front and rear faces of the pump bracket (Item 15) are clear of any buildup. Fit the pump bracket onto the frame using the pump bracket cap screws (Item 15A). Coat the front end of the shaft with a non-seizing compound and install the shaft sleeve (Item 14) and lightly lubricated shaft sleeve gasket (Item 14A)\*. Fit the case plate assembly with stationary seal ring housing spout facing downward into the pump bracket. Check the assembly to be sure it fits properly into the pump bracket and it is perpendicular to the shaft.

Screw the impeller assembly onto the shaft. The impeller will be tightened upon pump start-up but it must be tightened initially to prevent a shock load. Care must be taken when tightening plastic impellers.

To avoid damage, an impeller wrench should be used. See page 5 for further instructions.

Place a new case plate gasket (Item 5A)\* around the case plate. Bolt the case (Item 3) with wear ring (Item 4) onto the pump bracket using case bolts with nuts and washers (Item 3A). Place a level onto the top flange of the case and rotate the case until it is completely level. Tighten securely.

**Seal Alignment:**

In order for the pump to seal properly upon shutdown, the seal rings must be aligned. Reach through the pump bracket and back the nuts off of the stationary seal ring housing so that the stationary seal ring housing is movable when the shaft is pushed forward but immobile when the shaft is released. Pry the shaft forward and snap it back two or three times in order to align the seals. Secure

stationary seal ring housing evenly by alternately tightening the nuts.

Check that the shaft slides forward and returns easily by prying the governor sleeve forward. With governor sleeve and shaft forward, turn the shaft and make sure that there is no rubbing or any roughness except for bearing friction.

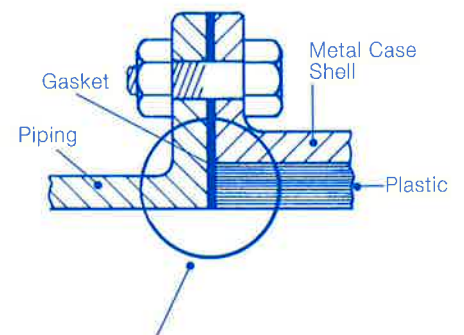
Place the frame cover (Item 20) and frame cover gasket (Item 20B) on the frame and secure with the frame cover cap screws (Item 20A).

Before starting the pump, please refer to the prestarting recommendations on page 4.

**Special-Plastic Pump**

Gaskets on the intake and discharge connections of plastic pumps should cover the entire flange to the inside diameter of the plastic lining. The companion piping flange should also come to this diameter to prevent leaking past the plastic lining.

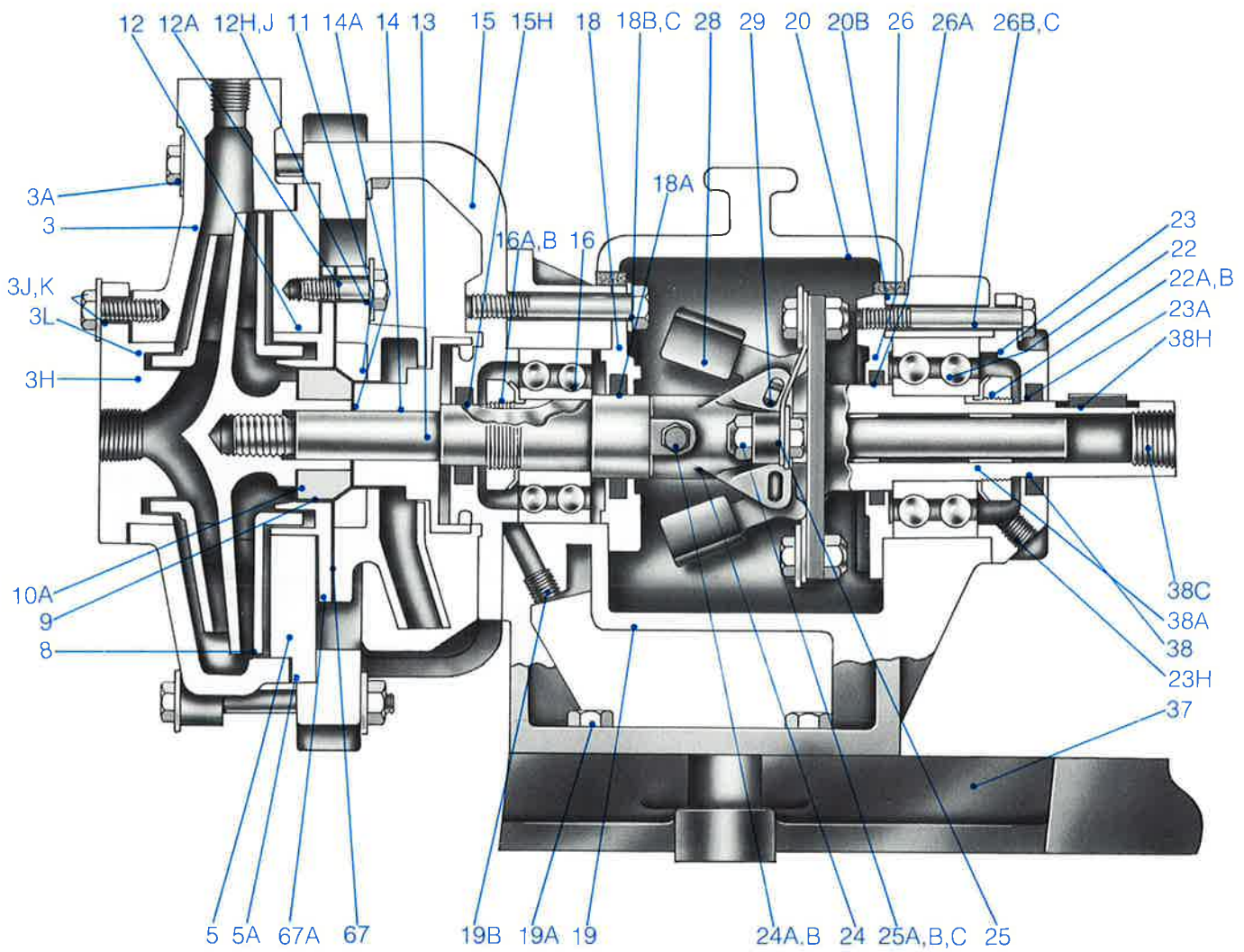
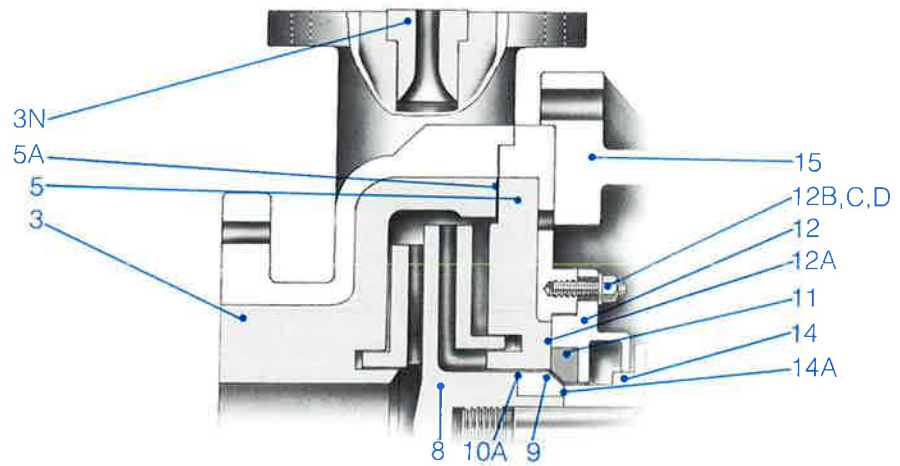
Intake and Discharge Connections



**Critical Seal Area**—Gasket must be compressed providing a positive seal between the pipe flange and plastic. This is to keep corrosive liquid from reaching the critical area between the plastic and metal case shell.



# Frame 0 Model AF



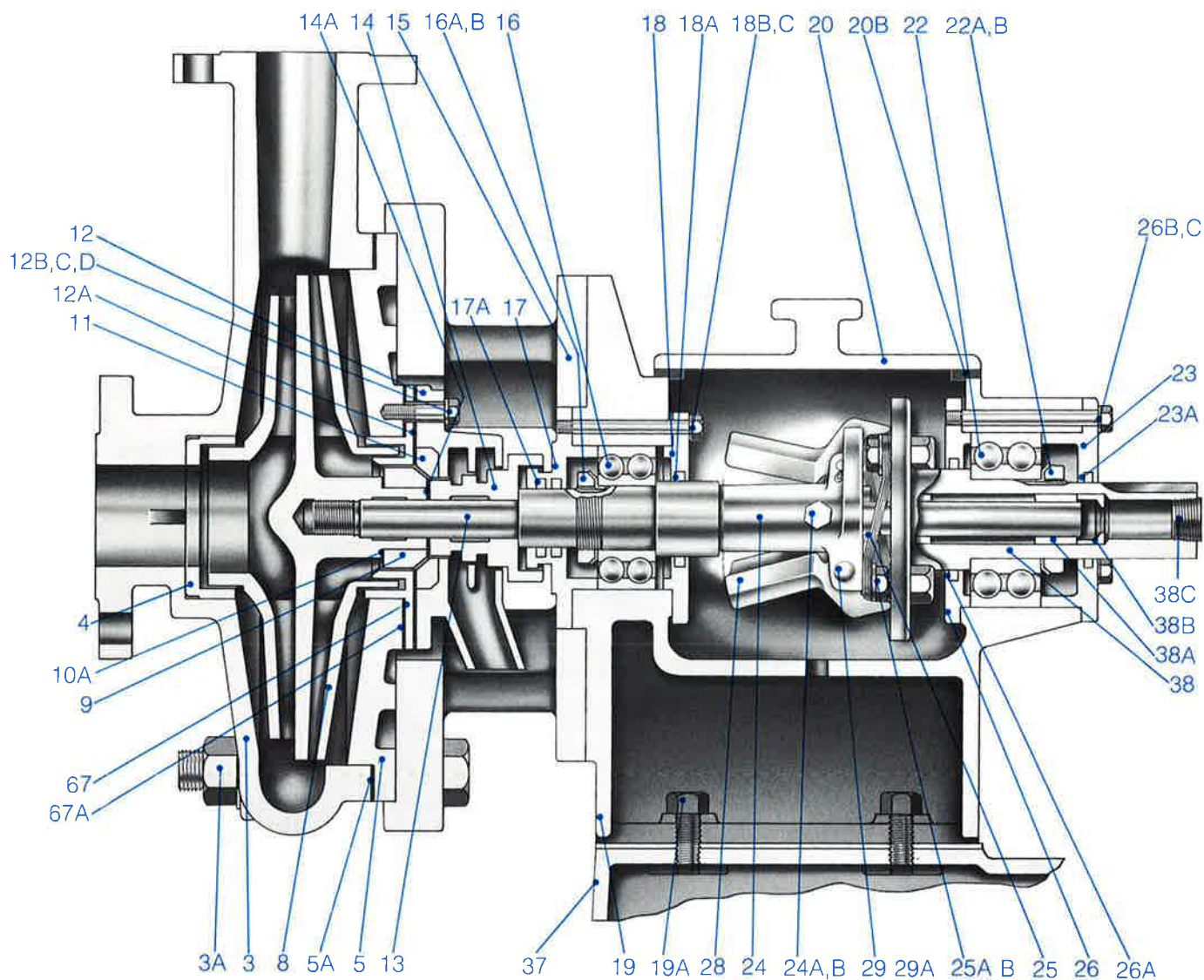
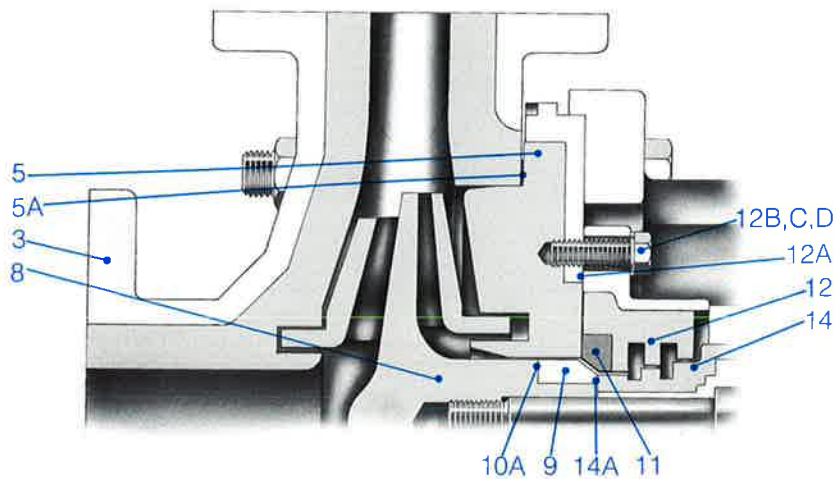
# Parts List and Recommended Spare Parts

Item Number	Number Required	Spare Parts Kit	Gasket Kit (Entire Pump)	Gasket Kit (Wetted End Only)	Case Plate Assembly	Governor & Thrust Drive Sleeve Assembly	Description
3	1	1					Case
3A	8						Case Bolt Assembly (includes case bolt, case bolt nut and two case bolt washers)
3H	1						Case Intake Connection
3J	3						Case Intake Connection Cap screw
3K	3						Case Intake Connection Cap screw washer
3L	1		1	1			Case Intake Connection Gasket
5	1	1			1		Case Plate
5A	1		1	1			Case Plate Gasket
67	1	1					Case Plate Labyrinth Ring
67A	1		1	1	1		Case Plate Labyrinth Ring Gasket
8	1	1					Impeller
9	1	1					Rotary Seal Ring
10A	1		1	1			Rotary Seal Ring Gasket
11	1	1			1		Stationary Seal Ring
12	1				1		Stationary Seal Ring Housing
12A	1		1	1	1		Stationary Seal Ring Housing Gasket
12H	3				3		Stationary Seal Ring Housing Cap screw
12J	3				3		Stationary Seal Ring Housing Cap screw Washer
13	1						Shaft
14	1						Shaft Sleeve
14A	1		1	1			Shaft Sleeve Gasket
15	1						Pump Bracket
15H	1		1				Pump Bracket Felt Ring
16	1	1					Front Bearing
16A	1						Front Bearing Locknut
16B	1						Front Bearing Lockwasher
18	1						Front Bearing Cap—Inner
18A	1		1				Front Bearing Cap Felt Ring—Inner
18B	4						Front Bearing Cap screw—Inner
18C	4						Front Bearing Cap screw Lockwasher—Inner
19	1						Frame
19A	4						Frame Cap Screw
19B	3						Frame Grease Plugs
20	1						Frame Cover
20A	2						Frame Cover Cap screw (Not Illustrated)
20B	1						Frame Cover Gasket
22	1	1				1	Rear Bearing
22A	1					1	Rear Bearing Locknut
22B	1					1	Rear Bearing Lockwasher
23	1					1	Rear Bearing Cap—Outer
23A	1		1			1	Rear Bearing Cap Felt Ring—Outer
23H	1					1	Rear Bearing Cap Grease Plug—Outer
24	1					1	Governor Sleeve
24A	1					1	Governor Sleeve Cap Screw
24B	1					1	Governor Sleeve Cap Screw Nut
25	1*					1	Governor Spring
25A	4					4	Governor Spring Cap Screw
25B	4					4	Governor Spring Cap Screw Nut
25C	4					4	Governor Spring Cap Screw Washer
26	1					1	Rear Bearing Cap—Inner
26A	1		1			1	Rear Bearing Cap Felt Ring—Inner
26B	3					3	Rear Bearing Cap Cap screw—Inner
26C	3					3	Rear Bearing Cap Cap screw Lockwasher—Inner
28	2					2	Governor Weight
29	2					2	Governor Weight Pin
37	1						Subbase
38	1	1				1	Thrust Drive Sleeve
38A	2					2	Thrust Drive Sleeve Bushing
38C	1					1	Thrust Drive Sleeve Plug
38H	1					1	Thrust Drive Sleeve Key

\*



# Frame 1 and 2 Model AF



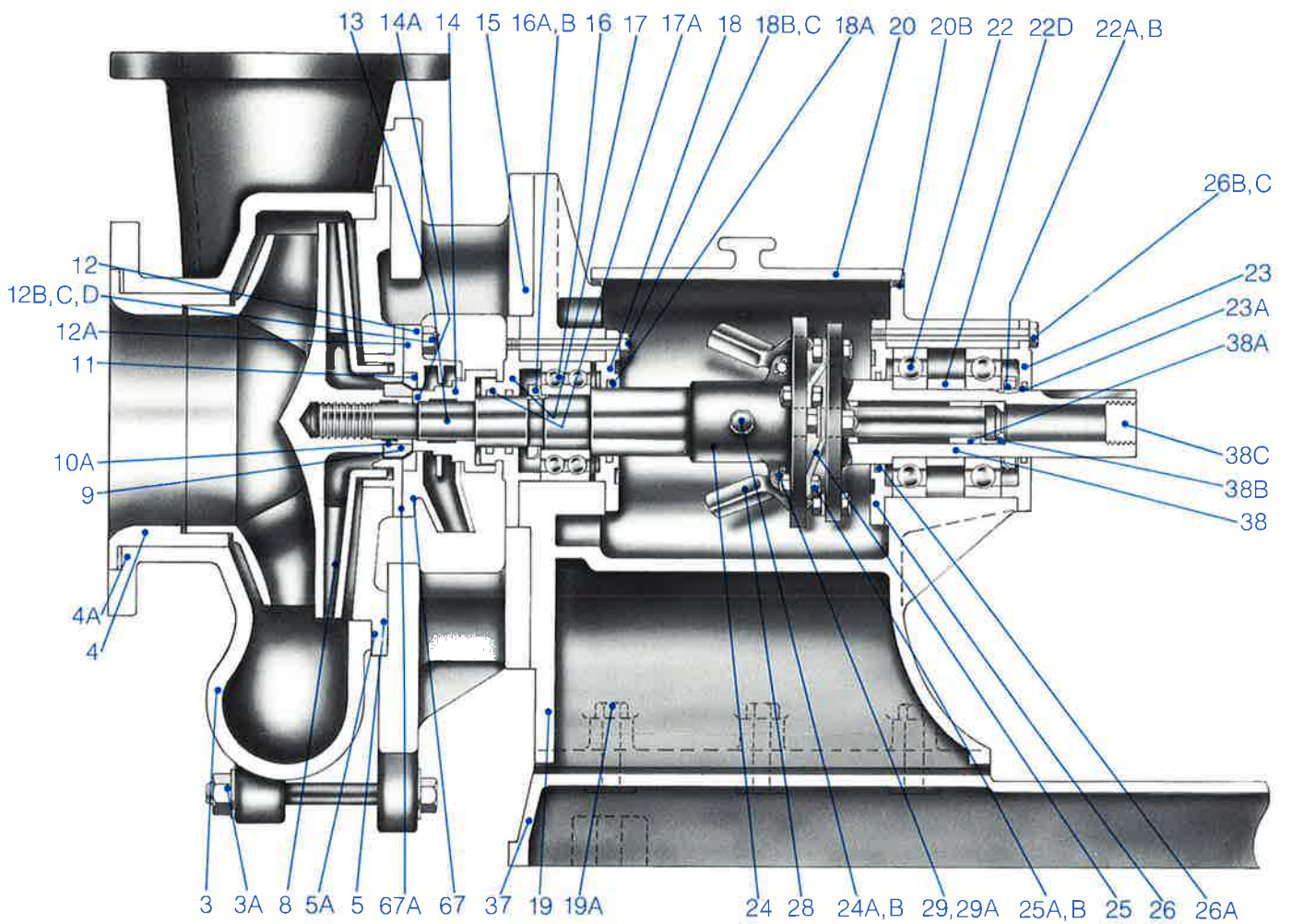
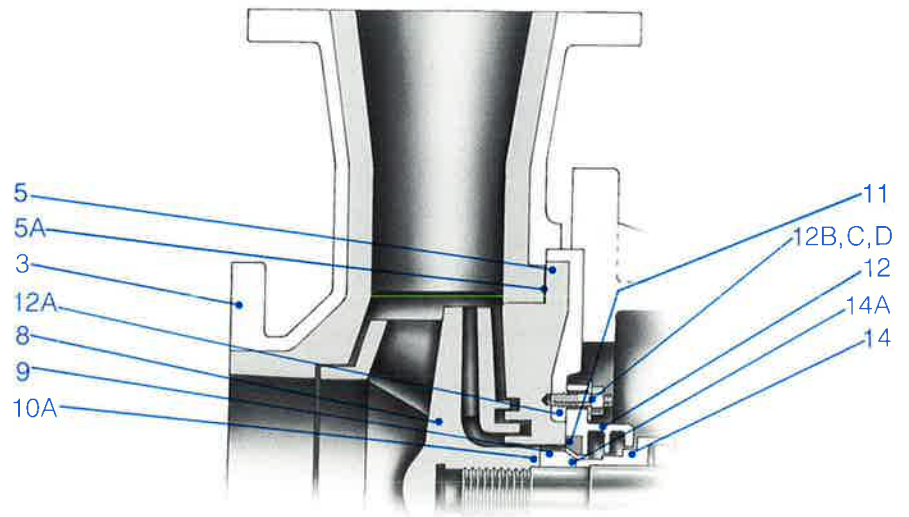
## Parts List and Recommended Spare Parts

Item Number	Number Required	Spare Parts Kit	Gasket Kit (Entire Pump)	Gasket Kit (Wetted End Only)	Case Plate Assembly	Governor & Thrust Drive Sleeve Assembly	Description
3	1	1					Case
3A	4						Case Bolt Assembly (includes case bolt, case bolt nut and two case bolt washers)
4	1	1					Case Wear Ring
4A	1		1	1			Case Wear Ring Gasket (If Required)
5	1	1			1		Case Plate
5A	1		1	1			Case Plate Gasket
67	1				1		Case Plate Labyrinth Ring
67A	1		1	1	1		Case Plate Labyrinth Ring Gasket (If Required)
8	1	1					Impeller
9	1	1					Rotary Seal Ring
10A	1		1	1			Rotary Seal Ring Gasket
11	1	1			1		Stationary Seal Ring
12	1				1		Stationary Seal Ring Housing
12A	1		1	1	1		Stationary Seal Ring Housing Gasket
12B	3*				3		Stationary Seal Ring Housing Stud Bolt
12C	3*				3		Stationary Seal Ring Housing Stud Bolt Nut
12D	3*				3		Stationary Seal Ring Housing Stud Bolt Washer
13	1						Shaft
14	1						Shaft Sleeve
14A	1		1	1			Shaft Sleeve Gasket
15	1						Pump Bracket
15A	6						Pump Bracket Cap Screw (Not Illustrated)
16	1	1					Front Bearing
16A	1						Front Bearing Locknut
16B	1						Front Bearing Locknut Washer
17	1						Front Bearing Cap—Outer
17A	2		2				Front Bearing Cap Felt Ring—Outer
18	1						Front Bearing Cap—Inner
18A	1		1				Front Bearing Cap Felt Ring—Inner
18B	3						Front Bearing Cap Screw
18C	3						Front Bearing Cap Screw Lockwasher
19	1						Frame
19A	4						Frame Cap Screw
19B	2						Frame Grease Plug (Not Illustrated)
19C	2						Frame Grease Relief Plug (Not Illustrated)
20	1						Frame Cover
20A	2						Frame Cover Cap Screw (Not Illustrated)
20B	1						Frame Cover Gasket
22	1	1				1	Rear Thrust Bearing
22A	1					1	Rear Thrust Bearing Locknut
22B	1					1	Rear Thrust Bearing Lockwasher
23	1					1	Rear Bearing Cap—Outer
23A	1		1			1	Rear Bearing Cap Felt Ring—Outer
24	1					1	Governor Sleeve
24A	1					1	Governor Sleeve Cap Screw
24B	1					1	Governor Sleeve Cap Screw Nut
25	1 **					1	Governor Spring
25A	2					2	Governor Spring Cap Screw
25B	2					2	Governor Spring Cap Screw Nut
26	1					1	Rear Bearing Cap Inner
26A	1		1			1	Rear Bearing Cap Felt Ring Inner
26B	3						Rear Bearing Cap—Cap Screw
26C	3						Rear Bearing Cap—Cap Screw Lockwasher
28	2					2	Governor Weight
29	2					2	Governor Weight Pin
29A	2					2	Governor Weight Pin Cotter
37	1						Subbase
38	1	1				1	Thrust Drive Sleeve
38A	2	2				2	Thrust Drive Sleeve Bushing
38B	1	1				1	Thrust Drive Sleeve Spacer
38C	1					1	Thrust Drive Sleeve Plug

\*Plastic Pump requires 4 of each part 12B, 12C, 12D

\*\* The governor spring consists of 2 units, each contains 10 leaves.

# Frame 3 and 4 Model AF





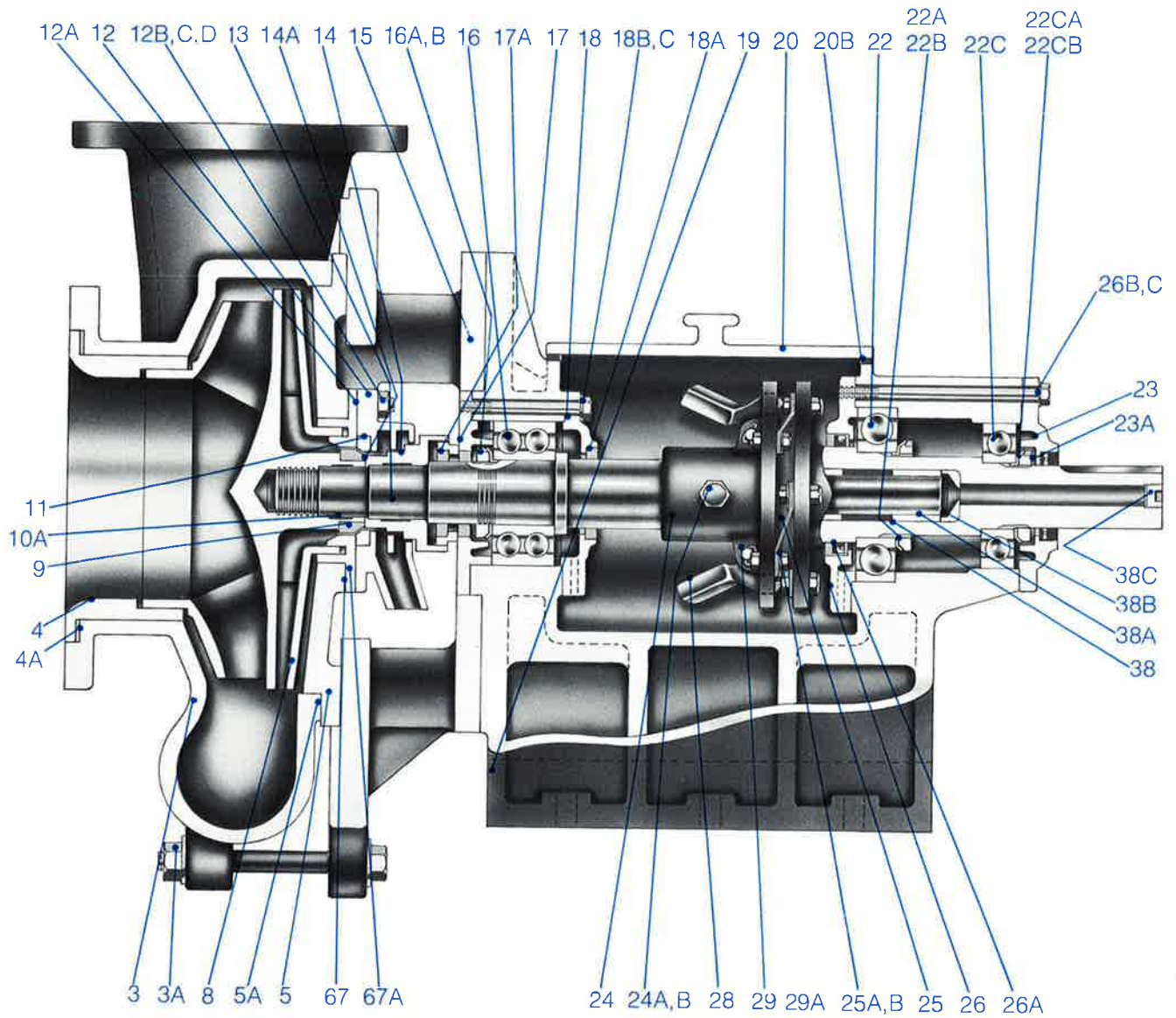
## Parts List and Recommended Spare Parts

Item Number	Number Required	Spare Parts Kit	Gasket Kit (Entire Pump)	Gasket Kit (Wetted End Only)	Case Plate Assembly	Governor & Thrust Drive Sleeve Assembly	Description
3	1	1					Case
3A	4						Case Bolt Assembly (includes case bolt, case bolt nut and two case bolt washers)
4	1	1					Case Wear Ring
4A	1		1	1			Case Wear Ring Gasket (If Required)
5	1	1			1		Case Plate
5A	1		1	1			Case Plate Gasket
67	1				1		Case Plate Labyrinth Ring
67A	1		1	1	1		Case Plate Labyrinth Ring Gasket (If Required)
8	1	1					Impeller
9	1	1					Rotary Seal Ring
10A	1		1	1			Rotary Seal Ring Gasket
11	1	1			1		Stationary Seal Ring
12	1				1		Stationary Seal Ring Housing
12A	1		1	1	1		Stationary Seal Ring Housing Gasket
12B	3*				3		Stationary Seal Ring Housing Stud Bolt
12C	3*				3		Stationary Seal Ring Housing Stud Bolt Nut
12D	3*				3		Stationary Seal Ring Housing Stud Bolt Washer
13	1						Shaft
14	1						Shaft Sleeve
14A	1		1	1			Shaft Sleeve Gasket
15	1						Pump Bracket
15A	6						Pump Bracket Cap Screw (Not Illustrated)
16	1	1					Front Bearing
16A	1						Front Bearing Locknut
16B	1						Front Bearing Locknut Washer
17	1						Front Bearing Cap—Outer
17A	2		2				Front Bearing Cap Felt Ring—Outer
18	1						Front Bearing Cap—Inner
18A	1		1				Front Bearing Cap Felt Ring—Inner
18B	3						Front Bearing Cap Screw
18C	3						Front Bearing Cap Screw Lockwasher
19	1						Frame
19A	4/6						Frame Cap Screw
19B	2						Frame Grease Plug (Not Illustrated)
19C	2						Frame Grease Relief Plug (Not Illustrated)
20	1						Frame Cover
20A	2						Frame Cover Cap Screw (Not Illustrated)
20B	1						Frame Cover Gasket
22	2	2				2	Rear Thrust Bearing
22A	1					1	Rear Thrust Bearing Locknut
22B	1					1	Rear Thrust Bearing Lockwasher
22D	1					1	Rear Bearing Spacer
23	1					1	Rear Bearing Cap—Outer
23A	1		1			1	Rear Bearing Cap Felt Ring—Outer
24	1					1	Governor Sleeve
24A	1					1	Governor Sleeve Cap Screw
24B	1					1	Governor Sleeve Cap Screw Nut
25	1**					1	Governor Spring
25A	4					4	Governor Spring Cap Screw
25B	4					4	Governor Spring Cap Screw Nut
26	1					1	Rear Bearing Cap Inner
26A	1		1			1	Rear Bearing Cap Felt Ring Inner
26B	3						Rear Bearing Cap—Cap Screw
26C	3						Rear Bearing Cap—Cap Screw Lockwasher
28	2					2	Governor Weight
29	2					2	Governor Weight Pin
29A	2					2	Governor Weight Pin Cotter
37	1						Subbase
38	1	1				1	Thrust Drive Sleeve
38A	2	2				2	Thrust Drive Sleeve Bushing
38B	1	1				1	Thrust Drive Sleeve Spacer
38C	1					1	Thrust Drive Sleeve Plug

\*Plastic Pump requires 4 of each part 12B, 12C, 12D.

\*\* The governor spring consists of 2 units for the Frame 3, and 4 units for the Frame 4, each contains 10 leaves.

# Frame 5 Model AF





## Parts List and Recommended Spare Parts

Item Number	Number Required	Spare Parts Kit	Gasket Kit (Entire Pump)	Gasket Kit (Wetted End Only)	Case Plate Assembly	Governor & Thrust Drive Sleeve Assembly	Description
3	1	1					Case
3A	4						Case Bolt Assembly (includes case bolt, case bolt nut and two case bolt washers)
4	1	1					Case Wear Ring
4A	1		1	1			Case Wear Ring Gasket (If Required)
5	1	1			1		Case Plate
5A	1		1	1			Case Plate Gasket
67	1				1		Case Plate Labyrinth Ring
67A	1		1	1	1		Case Plate Labyrinth Ring Gasket (If Required)
8	1	1					Impeller
9	1	1					Rotary Seal Ring
10A	1		1	1			Rotary Seal Ring Gasket
11	1	1			1		Stationary Seal Ring
12	1				1		Stationary Seal Ring Housing
12A	1		1	1	1		Stationary Seal Ring Housing Gasket
12B	3				3		Stationary Seal Ring Housing Stud Bolt
12C	3				3		Stationary Seal Ring Housing Stud Bolt Nut
12D	3				3		Stationary Seal Ring Housing Stud Bolt Washer
13	1						Shaft
14	1						Shaft Sleeve
14A	1		1	1			Shaft Sleeve Gasket
15	1						Pump Bracket
15A	6						Pump Bracket Cap Screw (Not Illustrated)
16	1	1					Front Bearing
16A	1						Front Bearing Locknut
16B	1						Front Bearing Locknut Washer
17	1						Front Bearing Cap—Outer
17A	2		2				Front Bearing Cap Oil Seal—Outer
18	1						Front Bearing Cap—Inner
18A	1		1				Front Bearing Cap Oil Seal—Inner
18B	3						Front Bearing Cap Screw
18C	3						Front Bearing Cap Screw Lockwasher
19	1						Frame
19A	6						Frame Cap Screw (Not Illustrated)
19B	2						Frame Grease Plug (Not Illustrated)
19C	2						Frame Grease Relief Plug (Not Illustrated)
20	1						Frame Cover
20A	2						Frame Cover Cap Screw (Not Illustrated)
20B	1						Frame Cover Gasket
22	1	1				1	Rear Thrust Bearing
22A	1					1	Rear Thrust Bearing Locknut
22B	1					1	Rear Thrust Bearing Lockwasher
22C	1	1				1	Rear Radial Bearing
22CA	1					1	Rear Radial Bearing Locknut
22CB	1					1	Rear Radial Bearing Lockwasher
23	1					1	Rear Bearing Cap—Outer
23A	1		1			1	Rear Bearing Cap Oil Seal—Outer
24	1					1	Governor Sleeve
24A	1					1	Governor Sleeve Cap Screw
24B	1					1	Governor Sleeve Cap Screw Nut
25	1*					1	Governor Spring
25A	4					4	Governor Spring Cap Screw
25B	4					4	Governor Spring Cap Screw Nut
26	1					1	Rear Bearing Cap Inner
26A	1		1			1	Rear Bearing Cap Oil Seal—Inner
26B	3						Rear Bearing Cap—Cap Screw
26C	3						Rear Bearing Cap—Cap Screw Lockwasher
28	2					2	Governor Weight
29	2					2	Governor Weight Pin
29A	2					2	Governor Weight Pin Cotter
37	1						Subbase (Not Illustrated)
38	1	1				1	Thrust Drive Sleeve
38A	2	2				2	Thrust Drive Sleeve Bushing
38B	1	1				1	Thrust Drive Sleeve Spacer
38C	1					1	Thrust Drive Sleeve Plug

\* The governor spring consists of 4 units, each contains 10 leaves.

## Pump System Troubleshooting

Problem	Test	Test Results	Indicates	Action to Take
No Flow or Low Flow	<b>1</b> Rotate motor shaft by hand with the shaft sleeve of the pump pried forward.	Rotates freely		Proceed to number 3
		Shaft won't turn, or rubbing noise.	Pump or motor failure.	Proceed to number 2
	<b>2</b> Remove coupling, rotate pump shaft by hand with shaft sleeve pried forward and motor shaft.	Pump shaft won't turn.	Pump Problem.	Remove pump & repair. Proceed to number 3
		Motor shaft won't turn.	Motor bearing problem.	Replace motor. Proceed to number 3
	<b>3</b> Start motor, check direction of rotation.	Rotation correct.		Proceed to number 4
		Rotation incorrect.	Motor wiring reversed.	Correct hookup.
	<b>4</b> Check pump shaft speed.	Pump speed OK.		Proceed to number 6
		Pump speed incorrect.		Proceed to number 5
	<b>5</b> If pump gearbox or V-belt driven-check motor speed.	Motor speed OK.	Sheaves or gear ratio wrong.	Correct speed ratio.
		Motor speed incorrect.	Wrong speed motor or low voltage.	Correct as required.
	<b>6</b> Install pressure gauges at pump inlet and discharge-pump not running.	Inlet pressure OK.		Proceed to number 7
		Inlet pressure low or missing.	Inlet valve closed or blocked.	Open valve or free blockage. Proceed to number 7
	<b>7</b> Start pump and motor-check inlet pressure.	Inlet pressure OK.		Proceed to number 8
		No inlet pressure.	Unit cavitating or not primed.	Bleed pump case. Check valves and piping.
		Low inlet pressure.	Inlet line restricted or air leaks in inlet piping, excessive vapors (low NPSH), foaming of fluid.	Use defoamer, eliminate air leaks. Correct NPSH problems.
	<b>8</b> Check discharge pressure and compare with head-flow curve.	Pressure at pump OK.	Faulty flow instrumentation.	Proceed to number 9
		Pressure higher than normal.	Discharge valve or piping blocked.	Correct blockage.
		Pressure lower than normal.	Excessive impeller clearance or impeller damage. (Could indicate excessive pump flow & delivery. Proceed to number 9.)	Remove pump & repair.
	<b>9</b> Check flow instrumentation vs. physical Measurement.	Measurements do not correspond	Instrumentation Error	Check valving, instrumentation and piping

## Pump System Troubleshooting

Problem	Test	Test Results	Indicates	Action to Take	
Noise & or Vibration	<b>1</b>	Visually check for loose or missing screws or bolts from coupling or tie-down points.	Bolt and screws OK. Loose or missing bolts.	Improper or incomplete assembly	Proceed to number 2 Replace and tighten bolts
		<b>2</b>	Rotate unit by hand with shaft sleeve pried forward.	Unit free and clear. Scraping, clunking or other unusual noise heard. or Unit won't turn free & easily.	
<b>3</b>	With unit running, monitor type & location of noise. Use stethoscope or screwdriver held against pump & motor housing over bearings.			Grinding, scraping, rubbing noise heard from pump only.	Impeller or expeller rubbing inside case.
		Scraping or rubbing noise heard from motor only.	Motor fan blades possibly loose or bent.	Consult motor manual.	
		Thumping or clicking noise or excessive vibration.	Bad bearings, damaged coupling or pump/motor misalignment.	Proceed to number 4	
<b>4</b>	Drop drive coupling. Push & pull pump & motor shafts in both radial & axial direction.	No shaft movements observed.	Bearing OK	Proceed to number 5	
		Shaft wiggles or moves.	Failed bearings.	Remove & repair. Proceed to number 6	
<b>5</b>	With coupling removed, turn on motor and listen for noise.	Motor quiet.		Proceed to number 6	
		Noisy	Motor failure	Remove & Replace	
<b>6</b>	Check pump and motor shaft alignment with dial indicator.	Axial alignment & squareness within .005-inch.	Correct alignment	Proceed to number 7	
		Axial alignment & squareness not within .005-inch.	Poor alignment	Align units.	
<b>7</b>	Remove shaft and thrust drive sleeve. Check for bearing wear.	Bearings operate smoothly.	Bearing OK	Recheck tests.	
		Bearings stick or have flat spots.	Bearing failure.	Remove bearings & replace.	

## Pump System Troubleshooting

Problem	Test	Test Results	Indicates	Action to Take
Motor Runs Hot or Throws Breaker	<b>1</b> With motor & pump not running, verify units rotate freely without noise or drag by hand. The shaft sleeve of the pump should be pried forward when rotating pump shaft.	Shaft turns freely-no noise		Proceed to number 2
		Shaft drag or noise heard	Mechanical Problem	Go to section on noise & vibration #1
	<b>2</b> Check breaker fuse size and motor nameplate rating.	Breaker fuse and motor rating correspond	Correct motor & fuse	Proceed to number 3
		Breaker fuse and motor rating do not correspond	Incorrect fuse	Install proper fuse
	<b>3</b> With motor & pump running, check pump & motor speed.	Speed & motor direction OK	Correct motor & frequency	Proceed to number 4
		Speed of pump wrong	Incorrect motor or frequency.	Correct motor
	<b>4</b> Measure pump output flow rate and/or discharge pressure	Flow and pressure correct		Proceed to number 5
		Flow too high (discharge pressure low)	Improper valving or system upset.	Correct system problems.
	<b>5</b> Measure motor amperage or HP.	Amperage (HP) OK.		Proceed to number 6
		Amperage (HP) too high.	Mechanical failure of pump or motor.	Go to section on noise & vibration #1
	<b>6</b> Measure motor voltage at motor and breaker.	Motor voltage OK.		Proceed to number 7
		Motor voltage low	Incorrect voltage	Correct voltage
	<b>7</b> Check motor fan cooling & air flow.	Good air flow, cool temperature.	Motor Problem.	Consult Motor Manual.
		No air flow.	Motor fan difficulty or shroud blocked.	Improve air flow, consult Motor Manual.

# Pump System Troubleshooting

Problem	Test	Test Results	Indicates	Action to Take
<p>Whenever leakage is encountered, before removing pump, visually determine when the leakage is occurring, while running, or when the pump is at a full stop. During these inspections you should try to determine the exact origin of the leak. Special attention should be given to the drain spout, which can be observed with an angled mirror. Once you have determined when the pump is leaking, refer to the guide below.</p>				
Leakage (normal running)	<b>1</b> Visually determine exact leakage point.	Leakage is down inside of drain spout.	Pump inlet pressure exceeds expeller capacity.	Check inlet pressure.
		Leakage comes from case or gasket area.	Excessive expeller wear, corrosion, or clearance. Damaged seal surface, gasket failure, or loose bolts.	Remove pump and use Disassembly Guide for Leakage. Section B. Remove pump and use Disassembly Guide for Leakage. Section C.
Leakage (pump at complete stop)	<b>1</b> Visually determine exact leakage point.	Leakage is down inside of drain spout.	Problem with check valve assembly.	Remove pump and use Disassembly Guide for Leakage. Section A.
		Leakage is from case or gasket area.	Damaged seal surface, gasket failure, or loose bolts.	Remove pump and use Disassembly Guide for Leakage. Section C.

## Disassembly Guide for Leakage

### A. Seal Malfunction

Parts Involved:  
Rotary Seal Ring  
Case Plate Assembly  
Shaft Sleeve Assembly

#### Disassembly Checks

1. Pry the shaft sleeve assembly forward and check for a smooth sliding action
2. Check governor weights for wear and freedom of movement
3. Check alignment of the rotary and stationary (case plate assembly) seal rings. Instructions for alignment are on page 9.
4. Disassemble pump and check all parts for wear

### B. Expeller System Malfunction

Parts Involved:  
Impeller/Expeller  
Case Plate Assembly

#### Disassembly Checks

1. Remove case and check expeller to case plate clearance.
2. Check to make sure the expeller vanes are clear and unplugged
3. Disassemble the wetted end of the pump and inspect all parts for damage or wear

### C. Gasket or Seal Surface Malfunction

Parts Involved:  
Case  
Case Bolts  
Case Plate Gasket  
Case Plate Assembly

#### Disassembly Checks

1. Check case bolt tightness and condition.
2. Case plate should fit tightly and be in good condition.
3. Sealing surfaces should be clean and smooth.
4. Gaskets should be in good condition, free of defects. We recommend each time a gasket seal is broken, the gasket be replaced