



AURORA[®]

MODEL 384

END SUCTION FIRE PUMPS

INSTRUCTION, INSTALLATION, MAINTENANCE AND REPAIR MANUAL

NOTE! To the installer: Please make sure you provide this manual to the owner of the equipment or to the responsible party who maintains the system.


IMPORTANT NOTE TO INSTALLER:

This manual contains important information about the installation, operation and safe use of this product. This information should be given to the owner/operator of this equipment.

ATTENTION: SAFETY WARNINGS:

Read and understand all warnings before installation or servicing pump.

CALIFORNIA PROPOSITION 65 WARNING:

 **Warning:** This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

OPERATIONAL LIMITS: *

Maximum Operating Pressure: See UL Listings for max pressure by model.
Maximum Operating Temperature: 150°F (66°C)

Pumps are not to be operated outside the operating envelope as stated on the nameplate and the maximum case working pressure as published in the product catalog for the relevant model. Shaft couplings are selected for the maximum power output of the driver, however, the pump is not to be operated outside its normal limits.

All pumps are designed to allow 1/16" for corrosion. Should this value be exceeded, the pump should be taken out of service.

The 384 Pumps are not designed for use in potentially explosive atmospheres.

*See ASTM A126/ANSI B16.1 for pressure/temperature ratings of flanges.

ELECTRICAL SAFETY:

 **Warning:** Electrical Shock Hazard

All electrical connections are to be made by a qualified electrician in accordance with all codes and ordinances. Failure to follow these instructions could result in serious personal injury, death or property damage.

 **Warning:** Electrical Overload Hazard

Ensure all motors have properly sized overload protection. Failure to follow these instructions could result in serious personal injury, death or property damage.

 **Warning:** Sudden Start-Up Hazard

Disconnect and lock out power source before servicing. Failure to follow these instructions could result in serious personal injury, death or property damage.

HIGH TEMPERATURE SAFETY:

 **Warning:** Hot Surface Hazard

If pumping hot water, ensure guards or proper insulation is installed to protect against skin contact with hot piping or pump components. Failure to follow these instructions could result in serious personal injury, death or property damage.

HIGH PRESSURE SAFETY:
INSTALLATION

 **Warning:** Hot Surface Hazard

Some pump surfaces may be subject to elevated temperatures; there is no required operator contact necessary while the pump is operating.

 **Warning:** Spraying Water Hazard

When servicing pump replace all gaskets and seals. Do not reuse old gaskets or seals. Failure to follow these instructions could result in serious personal injury, death or property damage.

 **Warning:** High Pressure Hazard

Do not exceed the maximum pressure. Install properly sized pressure relief valves in system. Failure to follow these instructions could result in serious personal injury, death or property damage.



Warning: Expansion Hazard

Water expands when heated. Install properly sized thermal expansion tanks and relief valves. Failure to follow these instructions could result in serious personal injury, death or property damage.

Read and understand all safety warnings at the beginning of the manual before beginning installation or any repair work.

PUMP LOCATION. You probably have spent considerable time planning where your pump will be located. However, you may have overlooked some factor that may affect pump operation or efficiency.

The pump should be located as close to the liquid source as possible so that the suction line can be short and direct. It should be located in a clean, open area, where it is easily accessible for inspection, disassembly and repair. Pumps installed in dark, dirty areas or in cramped locations are often neglected, which can result in premature failure of both the pump and the driver.

The Aurora pump must be installed horizontally. Install isolating valves on each side of pump so pump maintenance can be performed without draining the system. Special mounting requirements may be required if the pump is to be mounted near a noise or vibration sensitive area.

These pumps are intended for use in applications where the water supply to the suction connection is permanently flooded. Operation of these pumps under static suction lift condition is strictly prohibited.

The installation must be evaluated to ensure that the net positive suction head available (NPSHA) meets or exceeds the requirements of NFPA 20.

FOUNDATION. The foundation for your pump must be sufficiently rigid to absorb any vibration and stress encountered during pump operation. A raised foundation of concrete is preferable for most floor mounted pumps. The raised foundation assures a satisfactory base, protects against flooding, simplifies moisture drainage, and facilitates keeping the area clean.

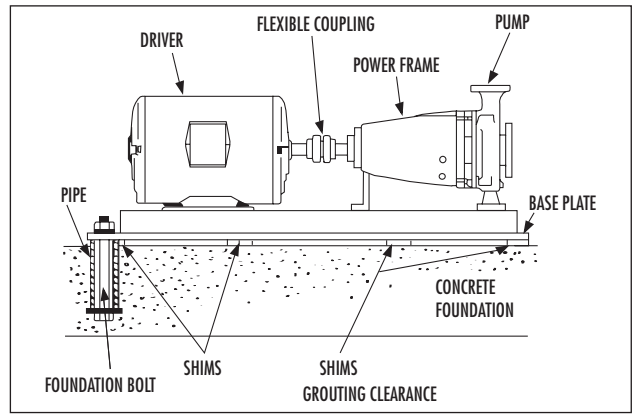


Figure 1. Foundation for Frame Mounted Pumps.

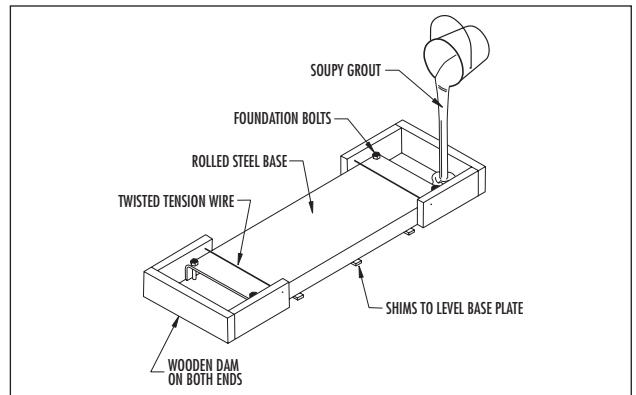


Figure 2. Grouting the Base for Frame Mounted Pumps.

Your pump should be firmly bolted to the foundation, whether it is a raised concrete base, steelwork wall, or structural member. The mounting bolts or lag screws should be accurately located per the applicable Aurora dimension sheet. Refer to Fig. 1.

LEVELING THE PUMP. Leveling the pump will require enough shims to support the base plate near the foundation bolts and at any points of the base plate carrying a substantial weight load. The shims should be large enough to allow a gap of 3/4" to 1-1/2" between the base plate and foundation for grouting.

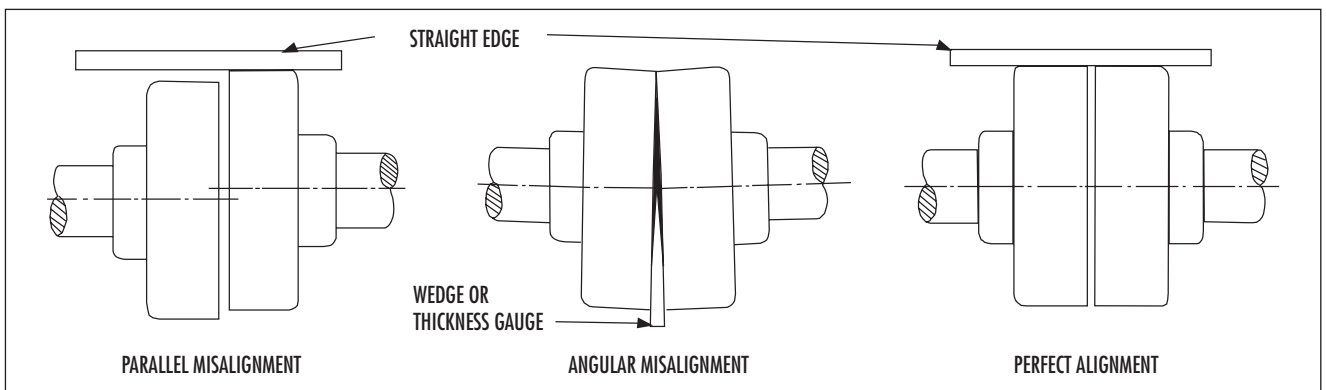


Figure 3. Flexible Coupling Alignment.

Warning: Lifting Hazard

The motor and pump assembly may be very heavy. Use extreme caution and safe lifting equipment during the lifting procedure. Failure to follow these instructions could result in serious personal injury, death or property damage.

IMPORTANT: The pump base must be set level to avoid any mechanical difficulties with the pump or motor. The 384 pump was properly aligned, if supplied with a motor, at the factory. However, since the pump base is flexible, it may spring and twist during shipment. Do not pipe the pump until it is realigned. Realign the base after piping is completed and after the pump is grouted in and bolted down. NOTE: It may be necessary to readjust the alignment from time to time while the unit and foundation are new. Realignment will prevent premature bearing failure, excessive vibration or shaft failure.

Ensure that proper hydronic accessories such as pressure relief valves, thermal expansion tanks and flow/pressure control devices are installed in the system. Consult the responsible party for your system to ensure these devices are installed and of the proper size.

GROUTING THE INSTALLATION. Grouting the base plate prevents lateral movement of the base plate and improves the vibration absorbing characteristics of the foundation by increasing its mass. A wooden dam should be constructed around the base plate to contain the grout while it is being poured. The dam can be built tight against the base plate or slightly removed from it as desired. Refer to Fig. 2. The entire base plate should be completely filled with nonshrinkable type grout. The grout should be puddled frequently to remove any air bubbles from the grout.

ROTATION. Pump rotation is clockwise when viewed from the back of the motor. An arrow is also located on the pump to show the direction of rotation.

Warning: Sudden Start-Up Hazard

Disconnect and lock out power source before servicing. Failure to follow these instructions could result in serious personal injury, death or property damage.

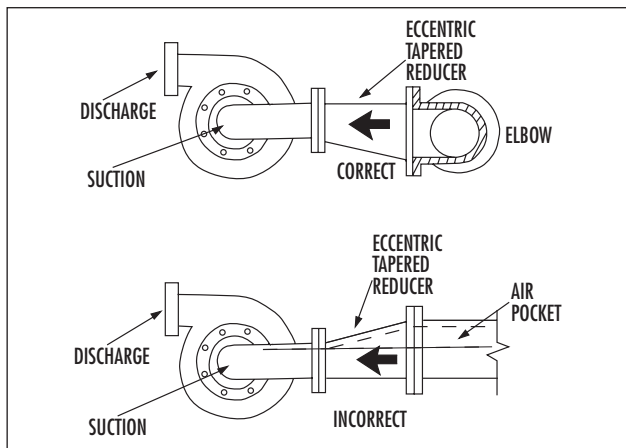


Figure 4. Installation of Tapered Reducers.

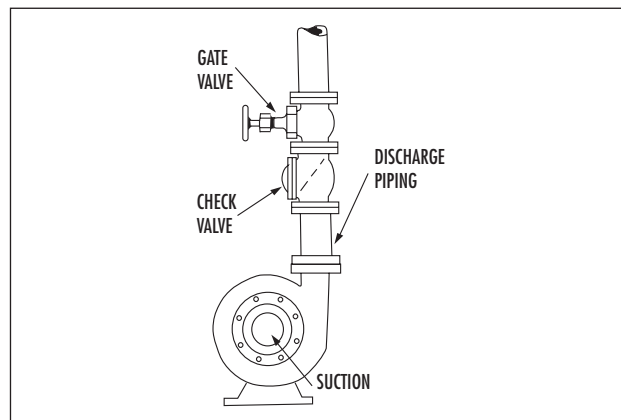


Figure 5. Gate Valve and Check Valve.

INITIAL ALIGNMENT OF THE FLEXIBLE COUPLING.

The pump and driver were accurately aligned at the factory. However, it is impossible to maintain this alignment during shipping and handling. Therefore it will be necessary for you to realign the pump and driver. Flexible couplings are not universal joints. They should not be used to compensate for misalignment of the pump and motor shafts. Their function is to transmit power from the driver to the pump while compensating for thermal expansion and shaft end movement. The coupling faces should be far enough apart so that they do not make contact when the motor shaft is forced to the limit of the bearing clearance toward the pump shaft.

In order to properly align the coupling, you will need a taper gauge or set of feeler gauges and a straight edge.

There are two types of misalignment encountered with flexible couplings: angular misalignment, in which the shafts are not parallel, and parallel misalignment where the shafts are parallel but not on the same axis.

To check angular alignment, insert a feeler gauge or taper gauge at any four places 90-degrees apart around the coupling halves. Insert shims under the driver feet until the same reading is obtained at all four check points. The pump and driver will then be in angular alignment.

To check parallel alignment, a straight edge should be held against the edges of the coupling halves at any four places 90° apart around the coupling. The straight edge should be parallel to the pump and driver shafts at all times. Insert shims until the straight edge lies flat against both coupling halves at all four checkpoints. The pump and driver will then be in proper parallel alignment. Refer to Fig. 3.

For fine alignment, 3500 RPM operation, for all other coupler types.

A dial indicator should be used when greater alignment accuracy is required. Use the following alignment tolerances unless specified otherwise by the coupling manufacturer. On sleeve type couplings make sure there is at least 1/8" end clearance between the sleeve and the two coupling halves.

To check angular misalignments, mount the dial indicator base to the coupling half, and position the dial indicator button on the front or rear face of the opposite coupling half. Set the dial to zero, rotate both coupling halves together, making sure the indicator button always indicates off the same spot. Misalignment values within 0.004 inches TIR per inch of coupler radius is permissible.

To check parallel misalignment, mount the dial indicator base to one coupling half, or shaft, and position the dial indicator button on the outside diameter of the opposite coupling half. Set the dial to zero. Rotate both coupling halves together, making sure the indicator button always indicates off the same spot. Misalignment within 0.004 inches TIR is permissible.



Warning: Coupling Failure

Do not operate pump with coupling out of alignment. Ensure final coupling alignment according to coupling manufacturer's instructions. Coupling, pump or driver failure may occur. Failure to follow these instructions could result in serious personal injury or death and property damage.

Pumps are supplied by the manufacturer with adequate guards for the coupling. The installer is to ensure that any additional guarding required shall be compliant with EN 953.

PIPING:

SUCTION PIPING. The suction piping should be short and direct with as few elbows and fittings as possible to keep head loss (from friction) at a minimum. A horizontal suction line should have a gradual rise to the pump, and pass under any interfering piping. The suction pipe diameter must be at least the diameter specified by NFPA 20. All joints must be tight to maintain prime on the pump.

INCREASERS & REDUCERS. For installations where pump suction flange is smaller than system piping: Eccentric reducers should be installed directly at the suction nozzle, with the taper at the bottom to prevent air pockets from forming. Straight taper reducers should never be used in a horizontal suction line because of the air pocket that is formed at the leg of the reducer and the pipe. Refer to Fig. 4.

For installations where pump suction flange is larger than system piping: Either concentric or eccentric reducers can be used, and should be installed directly at the suction nozzle.

DISCHARGE PIPING. Discharge piping should also be short and direct with as few elbows and fittings as possible to keep head loss (from friction) at a minimum. The discharge pipe diameter must be at least the diameter specified by NFPA 20.

DISCHARGE VALVES. The discharge piping must include a check valve and an indicating isolation valve. The check valve should be located between the isolation valve and the pump. If an increaser (or reducer) is used in the discharge piping, the increaser (or reducer) should be installed between the pump nozzle and the check valve. The check valve protects against a reverse flow of the liquid if the driver fails. Refer to Fig. 5.

PRESSURE RELIEF VALVE. All End Suction Fire Pump Models are provided with a pressure relief valve by the pump manufacturer to prevent an over pressure condition. For rotodynamic pumps, these valves are to set in the field at a point between the duty pressure and shut-off pressure to prevent a no-flow condition. For rotary positive displacement pumps, the pressure relief valve is factory set to 10% above the duty pressure and sealed with a safety wire, and are not to be field adjusted.

SPECIAL CONSIDERATIONS FOR DIESEL ENGINES:

ENGINE FLUIDS. Many diesel engines are shipped dry and must have lubricating oil and coolant added prior to start-up. It is the installer's responsibility to assure that all fluid levels are correct to avoid damage to the engine.

DIESEL ENGINE WIRING. The End Suction Fire Pump controller must be wired to the diesel engine's junction box. This is usually a simple matter of connecting like-numbered terminals of each with the correct wire gauge size. Refer to panel manufacturer's wiring diagram.

The electric solenoid valve in the diesel engine cooling loop piping must be wired to the engine junction box. Either red wire goes to terminal 1; the other red wire goes to terminal 11; the green wire is grounded to the engine block.

Engines may have 12-volt or 24-volt systems, but all batteries furnished are 12-volt. Since dual battery sets are required by N.F.P.A. 20, two batteries are furnished for 12-volt systems and four batteries are furnished for 24-volt systems.

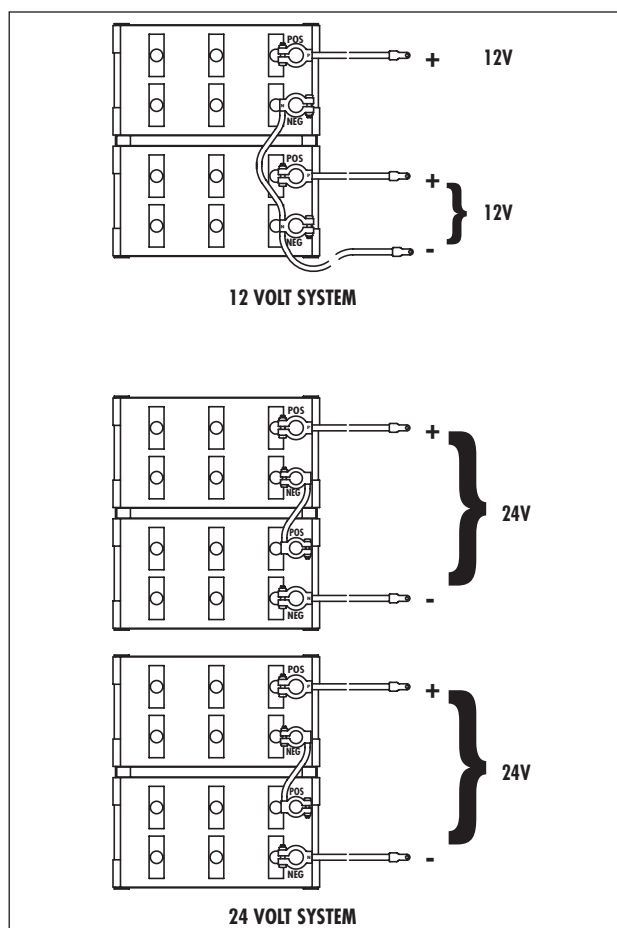


Figure 6. Battery Cable Arrangements.

Aurora's standard battery racks are designed to keep the batteries elevated off the floor for housekeeping purposes. They must be placed on a suitable level surface as close to the diesel engine as possible. Each rack holds two batteries; one rack is required for 12-volt systems and two racks for 24-volt systems. If two racks are used, they are to be placed side-by-side and not stacked.

Electrolyte is not furnished by Aurora Pump; it must be procured locally (approximately 16 quarts per battery).

Electrolyte must be added and the batteries charged at a low rate for at least 24 hours prior to start-up. It is recommended for safety reasons that the batteries be filled with electrolyte only after being placed in their permanent positions in the pump room.



Danger: Can Cause Blindness or Severe Burns

Batteries contain sulphuric acid electrolyte. This is a highly **CORROSIVE POISON**. They also produce a mixture of hydrogen and oxygen gasses which will **EXPLODE** if ignited.

WHEN WORKING ON OR NEAR BATTERIES, MIXING OR POURING ACID SOLUTIONS, ALWAYS WEAR PROTECTIVE CLOTHING AND PROTECT EYES WITH SAFETY GOGGLES. KEEP SPARKS, FLAMES AND CIGARETTES AWAY.

KEEP BATTERIES AND ACID OUT OF THE REACH OF CHILDREN.

If acid contacts skin or eyes, flush affected parts with clean water immediately and repeat for 15 minutes. Then seek prompt medical attention.

If acid is taken internally, call medical help immediately. Drink large quantities of water, milk or milk of magnesia, beaten eggs or vegetable oil.

Acid spilled on clothing, workbench or floor may be neutralized with baking soda or ammonia solutions, in metallic containers.

Use only glass, ceramic or acid resisting plastic vessels. Never discard used containers before they have been rinsed clean, then puncture them to prevent further use.

When charging batteries, keep area well ventilated and bar general access. Connect/disconnect batteries only when charge is switched off. Make sure tools cannot short circuit battery terminals. Keep vent caps on battery during charging.

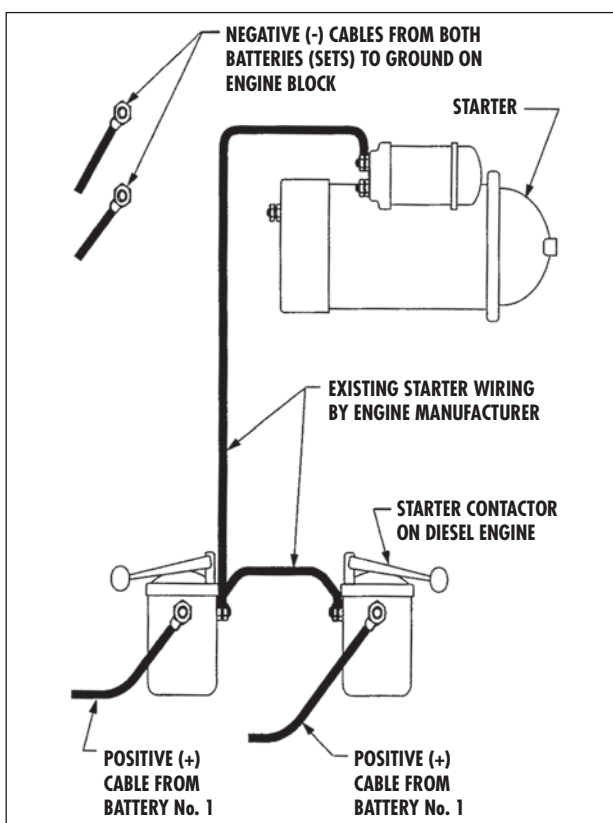


Figure 7. Starter and Contactor Connections.

The positive battery terminal of each battery (or pair of batteries for 24-volt systems) is connected to one of the engine's starter contactors. The negative terminals are to be connected to the engine block or other suitable ground. Aurora Pump's standard battery cable wire gauge sizes are selected for a maximum 10-foot circuit length (5-foot cables). Longer cables will require heavier gauge wire to be used.

Power wiring to the engine's jacket water heater must be completed only after it has been assured that there is sufficient coolant in the engine. Most heaters are continuously energized when wiring is connected and will burn out the heating element if no water is present. This failure is not covered by warranty. Refer to engine manufacturer's data sheet for correct voltage of the heater.

DIESEL ENGINE COOLING LOOP PIPING. The cooling loop system diverts a small amount of water from the pump discharge through the engine's heat exchanger to help control the operating temperature of the engine. Prior to start-up, it is recommended that this piping be checked for damage or displacement that might have occurred during shipment.

During normal operation, the top two valves of the cooling loop (in the by-pass line) are to be closed, and the lower two valves (in the pressure regulated line) are to be open. Failure to observe this may result in overpressurization of the heat exchanger when the pump is started, causing damage to the engine.

Piping from the engine's heat exchanger to a drain is to be provided by the installer. It is important to use the recommended size piping to reduce back pressure and avoid overpressurizing the heat exchanger.

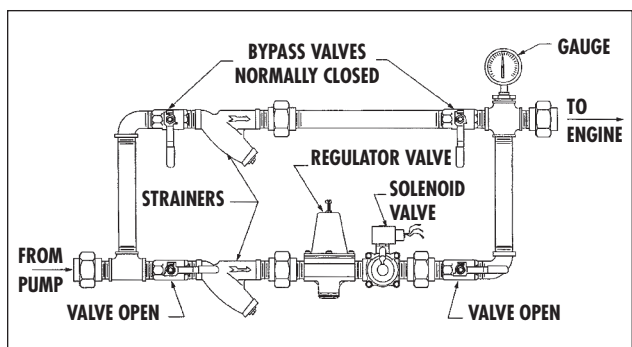


Figure 8. Cooling Loop Showing Normal Position Of Valves.

A length of PVC tubing is provided by Aurora to be connected to the petcock in the cooling loop piping in order to vent the system and visually verify the flow of water through the heat exchanger.

DIESEL ENGINE FUEL SYSTEM. The fuel tank should be installed so that the supply outlet is at the same elevation as the engine's fuel pump. Since the unit base is usually elevated as described earlier, this may require that the fuel tank is likewise elevated. The means of elevating the tank is the responsibility of the installer. Substituting the legs furnished with the tank with pipes of greater length is not a recommended method of elevating the tank.

All fuel fittings shown in Figure 9 are shipped loose for field installation. They are to be assembled as shown in Figure 9 to be consistent with Figure A-8-4.6 of N.F.P.A. Pamphlet 20. Installation may vary at the discretion of the installer with the approval of the local authority having jurisdiction. Note that some sections of common piping needed to complete this installation are not furnished by Aurora and must be procured locally.

Tube fittings are provided to allow the use of 5/8" O.D. tubing for the fuel supply and return lines (the tubing itself is NOT furnished by Aurora). If hard piping is used, these tube fittings are simply to be discarded.

Diesel fuel is not furnished by Aurora and must be procured locally prior to start-up.

DIESEL MUFFLER AND EXHAUST SYSTEM. A commercial grade muffler and flexible connector are furnished as standard on diesel End Suction Fire Pumps. If necessary, additional fittings needed for connecting these to the engine are also provided.

Commercial grade mufflers have NPT connections on 3" and 3-1/2" sizes, slip-on (automotive type) connectors for 4", 5" and 6" sizes, and 125# ANSI flanged connections for larger sizes.

Optional residential grade mufflers have NPT connections on 3" and 3-1/2" sizes; ANSI 125# flanges on 4" and larger sizes.

Piping, elbows and other components required to route the exhaust to the outside are not provided by Aurora. It is suggested that the building contractor or on-site engineers design and install the remainder of the exhaust system.

Mufflers are sized by Aurora to allow the engine to operate at its rated speed with nominal back pressure. However, if more than 25 feet of additional piping and/or more than four 90-degree elbows are required to complete the system, it is

important to contact the factory for re-evaluation of the system with respect to back pressure. A larger muffler and piping may be required to allow the engine to operate properly.

The flexible connectors furnished by Aurora are intended for use as a vibration control device and cannot be substituted for elbows in the piping system. It is recommended that the flexible connector be placed as close to the engine's exhaust outlet as possible. The muffler and piping must be supported to prevent strain on any diesel engine component.

START-UP AND FIELD ACCEPTANCE TEST:

GENERAL. The following is a general outline for starting and field testing End Suction Fire Pump systems. It is recognized that requirements and methods may vary depending on local customs and practices. Those involved in End Suction Fire Pump sales MUST fully understand all local requirements and N.F.P.A. Pamphlet 20. A general method to follow is outlined below.

Be specific and complete when ordering End Suction Fire Pumps and accessories so that all necessary and correct items are on hand for the start-up. Trouble cannot be tolerated on the day of the field acceptance test.

Visit the jobsite after delivery of the equipment to verify that all components ordered have been received and are correct for the installation.

Visit the jobsite again after installation to assure that the components have been correctly assembled and installed.

After the installation is complete and the End Suction Fire Pump system is pressurized and checked by the contractor, the following items must be verified:

1. Coupling has been properly aligned.
2. Motor has been "bumped" to check for proper rotation.
3. Diesel engine (where applicable) has been properly serviced, necessary fluids added, batteries filled and charged, jacket water heater operating.

INITIAL TEST. The following steps are basic for an initial test of the End Suction Fire Pump system:

1. Close the valves on all discharge outlets.
2. Open the suction valve.
3. Having read the controller manual and gained an understanding of its operation, set the End Suction Fire Pump controller to "manual". The Jockey pump panel should be set to the "off" position.
4. With the controller door closed, start the End Suction Fire Pump.
5. Adjust the packing to allow approximately 60 drops per minute to flow from each packing box. Further adjustment may be required later, so a recheck upon completion of the test is advised.

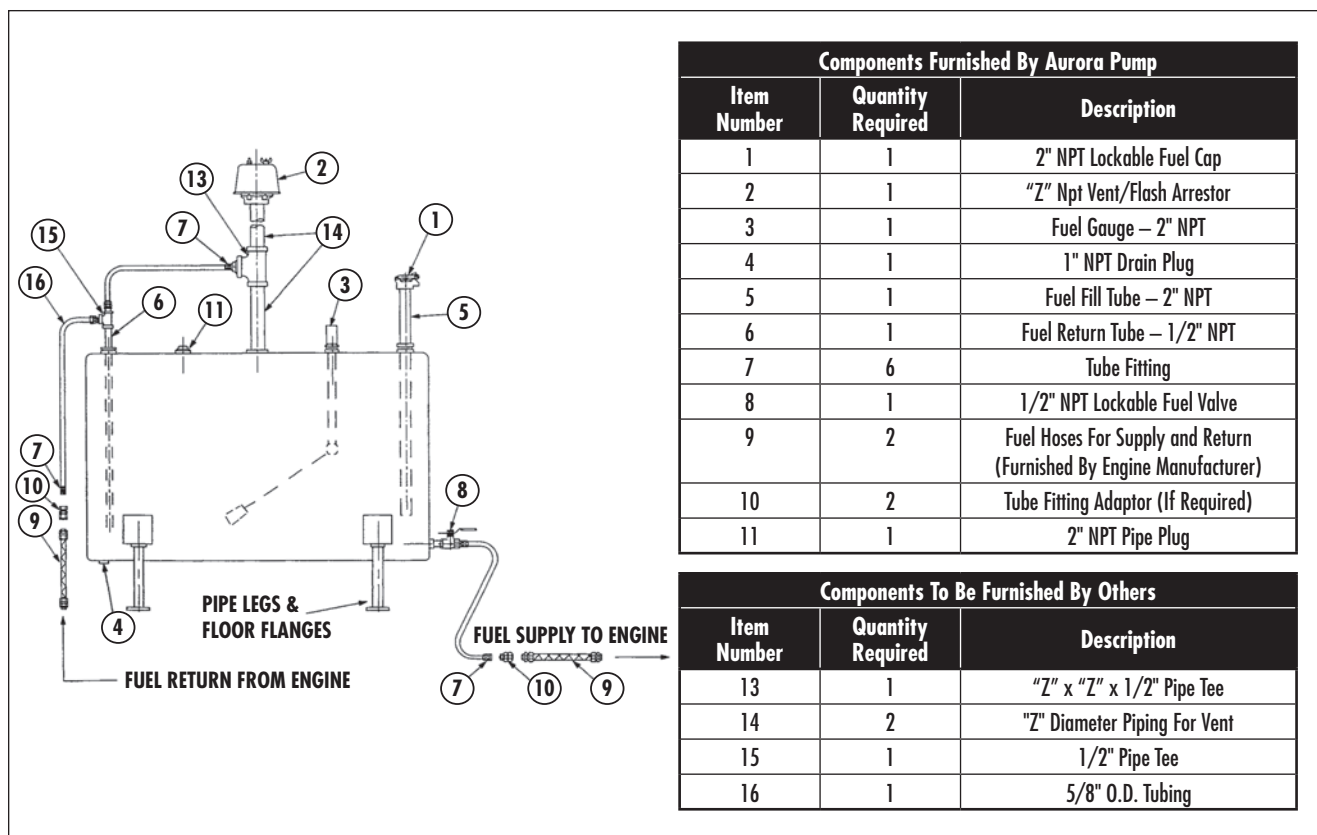


Figure 9. Diesel Fuel Tank and Fittings.

6. Close the relief valve completely for a brief period to verify that the shut-off pressure agrees with that on the certified factory test curve.
7. Adjust the casing relief valve (electric-driven units only) to allow enough flow to keep the pump cool.
8. Stop the End Suction Fire Pump.
9. Set the End Suction Fire Pump controller to the "automatic" position.
10. Slowly lower the system pressure with the control valve. The End Suction Fire Pump should start. Observe this starting pressure and adjust if necessary. (Adjustment procedure varies with controller manufacturer.) Stop the End Suction Fire Pump.

FIELD ACCEPTANCE TEST. Personnel on hand for the End Suction Fire Pump field acceptance test should include the controller representative, diesel engine service technician (if applicable), representatives of the insuring agency and local fire authority, as well as those responsible for building maintenance and supervision.

Equipment needed for the field acceptance test includes:

1. Calibrated ammeter.
2. Volt meter.
3. Tachometer.
4. Pitot tube & gauge.

5. Calibrated suction and discharge gauges with 1/4% accuracy. (Gauges furnished with the pump are 2%-3% accurate and could be troublesome for the field acceptance test.)
6. 50 feet of 2-1/2" hose for each connection on the hose manifold.
7. Play pipe with suitable nozzle for each hose.

While field acceptance tests vary by location, the following steps are usually taken. Additional operations may be required depending on the special needs in some territories.

1. A hose and play pipe are connected to each valve on the hose manifold.
2. The discharge valve leading to the building's fire system is closed.
3. The discharge valve leading to the hose manifold (or "test header") is opened.
4. The suction valve is opened.
5. All relief valves are closed.
6. One hose valve on the hose manifold is opened.
7. With the End Suction Fire Pump operating, the hose valve is adjusted for a flow of 500 GPM at the play pipe as indicated by the pitot tube. Refer to Table 1 to determine the pressure vs. flow for the size play pipe used for this test.

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Nozzle Pressure	GPM At Various Nozzle Sizes					
	1-1/8	1-1/4	1-3/8	1-1/2	1-5/8	1-3/4
10	100	130	160	195	235	285
20	160	203	245	290	348	410
30	206	254	308	366	430	498
35	222	275	332	395	464	538
40	238	294	355	423	496	575
45	252	311	377	448	525	610
50	266	328	397	473	555	643
55	279	344	417	496	582	675
60	291	360	435	518	608	716
62	296	366	442	526	618	728
64	301	371	449	535	628	732
66	305	377	456	543	637	739
68	310	383	463	551	647	750
70	315	388	470	559	656	761
72	319	394	477	567	666	772
74	323	399	483	575	675	783
76	328	405	490	583	684	793
78	332	410	496	590	693	803
80	336	415	502	598	702	814
85	347	428	518	616	723	839
90	357	440	533	634	744	863
95	355	452	547	651	765	887
100	376	464	562	668	784	910
105	385	476	575	685	804	932
110	394	487	589	701	823	954
115	403	498	602	717	841	976
120	412	509	615	732	859	997

Table 1. GPM At Various Nozzle Sizes.

8. By opening additional valves and measuring the flow equal to 500 GPM, readings of 1000 GPM, 1500 GPM, 2000 GPM, etc. can be determined.
9. Open the necessary hose valves to obtain the total rated flow. When this flow is assured, check and record the following data:
 - a. Suction gauge pressure
 - b. Discharge gauge pressure
 - c. RPM with tachometer
 - d. Voltage
 - e. Amps (on all legs)
10. Verify that the flow remained constant during the above data readings.
11. Adjust hose valves to achieve 150% of rated flow. Proceed as before and record the necessary data.
12. Repeat these steps as required by supervising authorities to obtain the desired number of points on the test curve.

13. Finally, close all valves and record the above readings in Step 9 at shut-off (zero GPM) condition.

If a number of automatic and/or manual starts are to be demonstrated, this series of tests can now be conducted.

The Jockey Pump controller must be set to start the Jockey Pump at a pressure greater than that of the main End Suction Fire Pump. The following procedure may be used to accomplish this.

1. The main End Suction Fire Pump controller is set to the “off” position.
2. The Jockey Pump controller is set to the “automatic” position.
3. The system pressure is slowly reduced by opening the test valve until the Jockey Pump starts. Observe the pressure at which the Jockey Pump starts.
4. Allow the Jockey Pump to continue running until the system pressure rises enough to stop the pump automatically. Typically, there is a minimum of 10 psi between the “pump start” and “pump stop” pressure readings.
5. Adjust the set points in the Jockey Pump controller as necessary to achieve the desired results. As with the main End Suction Fire Pump controller, adjustment methods vary with controller manufacturer.

IMPORTANT:

Upon successful completion of the field acceptance test, the following points must be verified:

1. The discharge valve leading to the outside hose manifold should be closed.
2. The discharge valve leading to the building fire protection system should be opened.
3. The casing relief valve should be set to a pressure just below the shut-off pressure of the pump.
4. The main relief valve (if applicable) should be set to a pressure just above the maximum system pressure.
5. Both the End Suction Fire Pump and Jockey Pump controllers should be set to the “automatic” position.
6. Any alarm systems disabled during the tests should be reactivated.
7. The individual or authority responsible for maintaining the building’s fire protection system must be made aware of all settings and the operational condition of the system before leaving the site.

MAINTENANCE:

Your Aurora pump requires no maintenance other than periodic inspection, occasional cleaning and lubrication of bearings. The intent of inspection is to prevent breakdown, thus obtaining optimum service life. The liquid end of the pump is lubricated by the fluid being pumped and therefore does not require periodic lubrication.

LUBRICATION OF IMPELLER SHAFT BEARINGS:

Regreaseable bearings will require periodic lubrication and can be accomplished by using the zerk or lubrication fittings in the cartridge cap and power frame. Lubricate the bearings at regular intervals using a grease of high quality. Mixing of different brands of grease should be avoided due to possible chemical reactions between the brands which could damage the bearings. Accordingly, avoid grease of vegetable or animal base which can develop acids, as well as grease containing rosin, graphite, talc and other impurities. Under no circumstances should used grease be reused.

Overlubrication should be avoided as it may result in overheating and possible bearing failure. Under normal application, adequate lubrication is assured if the amount of grease is maintained at 1/3 to 1/2 the capacity of the bearing and space surrounding it.

In dry locations, each bearing will need lubrication at least every 4,000 hours of running time or every 6 to 12 months, whichever is more frequent. In wet locations (exposed to dripping water, to the weather, or to heavy condensation such as is found in unheated and poorly ventilated underground locations) the bearings should be lubricated at least after every 2,000 hours of running time or every 4 to 6 months, whichever is more frequent.

Use Chevron SRI, NLGI2.

Lubricate motor per motor manufacturer’s instructions.

GENERAL INSTRUCTIONS:

1. Keep this pump and motor properly lubricated.
2. Inspect the pump regularly for leaky seals of gaskets and loose or damaged components. Replace or repair as required.

ELECTRICAL WIRING. Normally, your pump will be supplied with an attached drive motor. The motor should be wired in accordance with the wiring diagram found on the motor nameplate. Be sure the voltage, frequency, and phase of your power supply corresponds with the nameplate data. It is advisable to provide a separate switch and overload protection for your pump motor to protect against power failure in some other area. Conversely, if the pump motor develops electrical problems, it will be isolated from other equipment.

PRESTARTING INSTRUCTION. The coupling halves should be connected. Prior to connection, however, the drive motor should be started to make sure the direction of rotation is the same as the direction indicated by the arrow on the pump casing.

When the pump is used in conjunction with electric motors and controls, these components must be in accordance with EN 60529 IP 22. Electrical equipment applied is to conform to the requirements of EN 50081 parts 1 or 2, and to EN 50082 parts 1 or 2, and the relevant parts of EN 6100 with regard to electromagnetic compatibility. Protection of the electrical assembly against electrostatic phenomena shall be per paragraph 5.2.2.2 of EN 809. General compliance of the

CAPSCREW TORQUE FOR COMMON BOLT DIAMETERS						
IN-POUNDS		FOOT-POUNDS				
1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"
85	180	27	43	65	130	230

Table 2. Torque Chart.

electrical assembly shall be per EN 60204-1. The installer shall ensure that any displays and control actuators are designed and installed in accordance with EN 894. The nature of the pumped liquid precludes the need for an emergency stop device; the pump can be shut down by normal means. Any electrical equipment shall be properly earthed.

Overall assembly shall be shown to comply with 98/37/EC Annex 1 paragraph 1.7.4 (f) by the final assembler with respect to noise and vibration.

Installation must comply with the Machinery Directive 98/37/EC as well as any other applicable national regulations in the member state of the installation. The final installation must not be put into service until it has been declared in conformity with the provisions of the Machinery Directive.

PUMP DISASSEMBLY: For frame mounted pumps, model 384.

Any disassembly/assembly procedures performed will require testing per NFPA 20 Table 14.5.2.3 after re-assembly has been completed prior to the pump being returned to service.

 **Warning: Sudden Start-Up Hazard**

Disconnect and lock out power source before servicing. Failure to follow these instructions could result in serious personal injury, death or property damage.

Read and understand all safety warnings at the beginning of the manual before beginning installation or any repair work.

1. Ensure the electrical power is locked out, the system pressure has been lowered to 0 psi and temperature of the unit is at a safe level before beginning any disassembly of the pump.
2. Isolate the pump from the system by closing the valves that should be located on both the suction and discharge of the pump. Loosen the drain plug at the bottom of the casing and drain the pump. The flush line assembly (optional 1, 3, 2 and 75) should be removed at this time.

Inspect removed parts at disassembly to determine if they can be reused. Ball bearings that turn roughly or show wear should be replaced. Cracked castings should never be reused. Scored or worn pump shafts should be replaced. Gaskets should be replaced at reassembly simply as a matter of economy. They are much less expensive to replace routinely than to replace singly as the need arises.

 **Warning: Hot Surface Hazard**

If pumping hot water, ensure guards or proper insulation is installed to protect against skin contact with hot piping or pump components. Failure to follow these instructions could result in serious personal injury, death or property damage.



Warning: High Pressure Hazard

The pump is rated at a maximum of 175 psi at 150°F. Do not exceed this pressure. Install properly sized pressure relief valves in system. Failure to follow these instructions could result in serious personal injury, death or property damage.



Warning: Spraying Water Hazard

When servicing pump replace all gaskets and seals. Do not reuse old gaskets or seals. Failure to follow these instructions could result in serious personal injury, death or property damage.

PACKING REMOVAL/REPLACEMENT ONLY:

- a. Remove capscrews (65), gland lamps (22) and gland halves (23).
- b. Use a flexible Packing Tool* with a hook attachment for removal of the packing, and a wood screw attachment for removal of the lantern ring. The lantern ring contains several holes for the packing tool.

* The Packing Tool can be purchased from industrial supply, or hardware stores. It is not considered a special tool.

- c. Thoroughly clean the shaft sleeve (25) and packing cover (26) seal cavity. Thoroughly inspect the bore of the Pump Packing Cover (26) and the Shaft Sleeve (25) for wear or signs that replacement is needed.
- d. Place one ring of packing (28) into the packing cover (26). On successive rings of packing stagger the packing joints to prevent excessive leakage through the packing box. If a lantern ring (29) is used, place a second ring of packing (28) into the cover before installing lantern ring. Refer to Fig. 10.

CAUTION

There must be two (2) rings of packing in front of lantern ring (29) to assure proper alignment between the lantern ring and the sealing tube connection (3) in the cover (26). Install remaining packing rings (28). Each ring should be tapped firmly into place with a wood or metal bushing.

- e. Replace gland halves (23) and place gland clamps (22) over capscrews (65). Tighten capscrews (65) finger tight into either cover assembly (26).

NOTE: The slots in gland halves (23) should be diagonal to pump horizontal center line.

Proceed to Step 17 to return the pump to service.

3. Remove the coupling guard.
4. Loosen the set screws in both coupling halves and slide each half back as far as possible on its shaft. Then, remove the coupling insert.



Warning: High Pressure Hazard

Make certain that the internal pressure of the pump is relieved before continuing. Failure to follow the instructions could result in serious person injury, death, or property damage.

5. Remove the two foot support capscrews from the powerframe. Loosen, but do not remove the volute capscrews (5). Use capscrew in the jack screw holes to loosen the impeller subassembly from the volute.
6. Now remove the volute capscrews (5) and remove the impeller subassembly from the volute.



Warning: Lifting Hazard

The motor and pump assemblies may be very heavy. Use extreme caution and safe lifting equipment during the removal and assembly procedures. Failure to follow these instructions could result in serious personal injury, death or property damage.

7. Remove the impeller capscrew (9), washer (9A), gasket (9B), and capscrew seal (9C). Remove impeller (11).

8. Remove impeller key (12).

9. Remove the O-ring (10).

Remove the packing (and optional lantern ring)

10. Remove capscrews (65), gland lamps (22) and gland halves (23).

11. Unscrew capscrews (5) and remove cover assembly (26). The bore of the pump packing cover (26) should be checked for excessive wear.

12. Shaft sleeve (25) is a slip fit on the shaft and should be easily removed unless the pump has been in service for a long time. In this case it may be necessary to use a puller. Take care to prevent damaging the surface of the sleeve. Replace the sleeve if it is grooved from wear.

13. All packing (28) and lantern ring (29) (if used) must now be removed from the packing box, and the cavity thoroughly cleaned to allow new packing to fit properly.

14. Thoroughly clean the shaft sleeve (25) and packing cover (26) seal cavity.

15. Wear ring(s) (7 & 16) are pressed into their housings with an interference fit and must be removed with a puller if new rings are required.

PUMP REASSEMBLY:

1. Replace the shaft sleeve (25) or packing cover (26) if there is evidence of surface damage like pitting, corrosion, nicks or scratches.

2. Replace wear ring(s) (7 & 16) in casing (6) and cover (26). Rings should not be hammered into place. Use a press or clamp the parts in a bench vice using wooden blocks to protect the rings.



- Place one ring of packing (28) into the packing cover (26). On successive rings of packing stagger the packing joints to prevent excessive leakage through the packing box. If a lantern ring (29) is used, place a second ring of packing (28) into the cover before installing lantern ring. Refer to Fig. 10.

CAUTION

There must be two (2) rings of packing in front of lantern ring (29) to assure proper alignment between the lantern ring and the sealing tube connection (3) in the cover (26). Install remaining packing rings (28). Each ring should be tapped firmly into place with a wood or metal bushing.

- Slide the shaft sleeve (25) through the packing. Proceed to next step if only replacing packing.

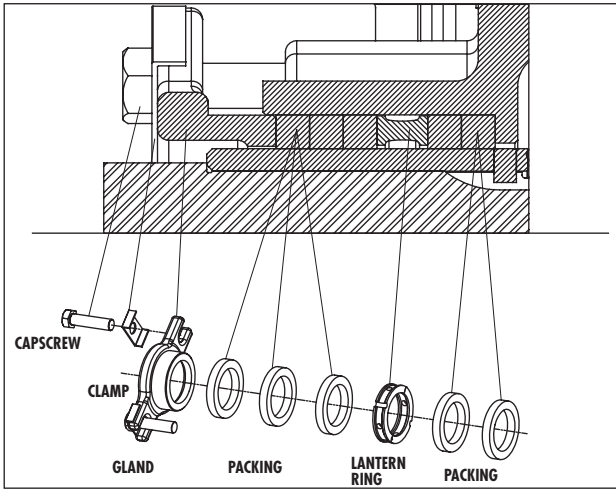


Figure 10. Packing.

- Replace gland halves (23) and place capscrews (65) through gland clamps (22). Tighten capscrews (65) finger tight into either cover assembly (26).
 - Slide Packing Cover Assembly onto shaft.
- NOTE: The slots in gland halves (23) should be diagonal to pump horizontal center line.
- Install O-ring (10).
 - Install a new impeller key (12).
 - Install impeller, impeller washer (9A), new impeller washer gasket (9B), capscrew seal and capscrew (9). Tighten capscrew per torque chart (see Table 2).

Warning: Lifting Hazard

The motor and pump assemblies may be very heavy. Use extreme caution and safe lifting equipment during the removal and assembly procedures. Failure to follow these instructions could result in serious personal injury, death or property damage.

- Install new casing gasket (8). Then install the pump assembly into the volute.
- Tighten volute capscrews (5) per torque chart (see Table 2).
- Install foot support capscrews (62) and tighten per torque chart (see Table 2).
- Install coupling and align.
- Install drain plugs, close drain valve.
- Replace all relief, cooling, flush lines (1, 3, 2, 75), or drain lines from the pump including compression connections (1 and 2) and tubing (3).
- Reinstall the coupling guard.
- Open isolation valves and inspect pump for leaks.
- Return pump to service.

Warning: Sudden Start-Up Hazard

Disconnect and lock out power source before servicing. Failure to follow these instructions could result in serious personal injury, death or property damage.

Warning: Rotating Component Hazard

Do not operate pump without all guards in place. Failure to follow these instructions could result in serious personal injury or death and property damage.

STARTING PUMP AFTER REASSEMBLY:

Do not start pump until all air and vapor has been bled and until making sure that there is liquid in the pump to provide the necessary lubrication for the packing.

When the pump is returned to service, additional care must be given to packing box to ensure a proper packing life. It is necessary to allow 60–120 drops leakage per minute through the packing for lubrication purposes. If the flow rate is other than this, the capscrews should be either loosened or tightened one quarter turn at a time to acquire the correct leakage (both capscrews must be turned equally to prevent cocking of the gland). It will take approximately ten minutes at any one gland setting before the leakage rate will stabilize. When in doubt, choose the greater leakage rate since overly tight packing will ruin not only the packing, but the sleeve as well.

POWER FRAME OR PUMP SHAFT DISASSEMBLY/REPLACEMENT:

Read and understand all safety warnings at the beginning of the manual before beginning installation or any repair work.

Follow steps 1 – 14 from main pump disassembly procedure.

- Remove the power frame capscrews and bearing/shaft assembly from the packing cover. If replacing the shaft, continue to Step 16.

MODEL 384

16. Remove the grease fittings (43) from the power frame.
 17. Unscrew capscrews (48) and remove bearing cap (49). Remove O-ring (oil lubed only) and retainer ring (52).
 18. Slide out shaft (55) and bearings (53 and 54). Since bearings (53 and 54) are press fitted on the shaft, they will have to be pulled or pressed off the shaft. Remove grease seals (51) from frame (57) and bearing cap (49).
 19. Thoroughly clean the shaft (55), removing any oil or dirt.
4. Fasten bearing cap (49) in position with capscrews (48). Position slingers (47) on the shaft.
 5. Position bracket (35) on the frame (57) and secure with capscrews (5A). Tighten screws evenly to assure proper alignment.

Follow steps 1 through 18 from Pump Reassembly procedure to complete pump assembly.

Do not start pump until all air and vapor have been bled and until making sure that there is liquid in the pump to provide the necessary lubrication for the packing.

POWER FRAME REASSEMBLY:

Reassembly will generally be in reverse order of disassembly. If disassembly was not complete, use only those steps related to your particular repair program.

1. Press grease seals (51/51A) into frame (57), and bearing cap (49).
2. Press bearings (53 and 54) onto shaft (55). Snap retainer ring (52) into place.
3. Slide shaft (55) and bearings (53 and 54) into frame (57).

When the pump is returned to service, additional care must be given to packing box to ensure a proper packing life. It is necessary to allow 60–120 drops leakage per minute through the packing for lubrication purposes. If the flow rate is other than this, the capscrews should be either loosened or tightened one quarter turn at a time to acquire the correct leakage (both capscrews must be turned equally to prevent cocking of the gland). It will take approximately ten minutes at any one gland setting before the leakage rate will stabilize. When in doubt, choose the greater leakage rate since overly tight packing will ruin not only the packing, but the sleeve as well.

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WARRANTY

Seller warrants equipment (and its component parts) of its own manufacture against defects in materials and workmanship under normal use and service for one (1) year from the date of installation or start-up, or for eighteen (18) months after the date of shipment, whichever occurs first. Seller does not warrant accessories or components that are not manufactured by Seller; however, to the extent possible, Seller agrees to assign to Buyer its rights under the original manufacturer's warranty, without recourse to Seller. Buyer must give Seller notice in writing of any alleged defect covered by this warranty (together with all identifying details, including the serial number, the type of equipment, and the date of purchase) within thirty (30) days of the discovery of such defect during the warranty period. No claim made more than 30 days after the expiration of the warranty period shall be valid. Guarantees of performance and warranties are based on the use of original equipment manufactured (OEM) replacement parts. Seller assumes no responsibility or liability if alterations, non-authorized design modifications and/or non-OEM replacement parts are incorporated. If requested by Seller, any equipment (or its component parts) must be promptly returned to Seller prior to any attempted repair, or sent to an authorized service station designated by Seller, and Buyer shall prepay all shipping expenses. Seller shall not be liable for any loss or damage to goods in transit, nor will any warranty claim be valid unless the returned goods are received intact and undamaged as a result of shipment. Repaired or replaced material returned to customer will be shipped F.O.B., Seller's factory. Seller will not give Buyer credit for parts or equipment returned to Seller, and will not accept delivery of any such parts or equipment, unless Buyer has obtained Seller's approval in writing. The warranty extends to repaired or replaced parts of Seller's manufacture for ninety (90) days or for the remainder of the original warranty period applicable to the equipment or parts being repaired or replaced, whichever is greater. This warranty applies to the repaired or replaced part and is not extended to the product or any other component of the product being repaired. Repair parts of its own manufacture sold after the original warranty period are warranted for a period of one (1) year from shipment against defects in materials and workmanship under normal use and service. This warranty applies to the replacement part only and is not extended to the product or any other component of the product being repaired. Seller may substitute new equipment or improve part(s) of any equipment judged defective without further liability. All repairs or services performed by Seller, which are not covered by this warranty, will be charged in accordance with Seller's standard prices then in effect.

THIS WARRANTY IS THE SOLE WARRANTY OF SELLER AND SELLER HEREBY EXPRESSLY DISCLAIMS AND BUYER WAIVES ALL OTHER WARRANTIES EXPRESSED, IMPLIED IN LAW OR IMPLIED IN FACT, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Seller's sole obligation under this warranty shall be, at its option, to repair or replace any equipment (or its component parts) which has a defect covered by this warranty, or to refund the purchase price of such equipment or part. Under the terms of this warranty, Seller shall not be liable for (a) consequential, collateral, special or liquidated losses or damages; (b) equipment conditions caused by normal wear and tear, abnormal conditions of use, accident, neglect, or misuse of said equipment; (c) the expense of, and loss or damage caused by, repairs or alterations made by anyone other than the Seller; (d) damage caused by abrasive materials, chemicals, scale deposits, corrosion, lightning, improper voltage, mishandling, or other similar conditions; (e) any loss, damage, or expense relating to or resulting from installation, removal or reinstallation of equipment; (f) any labor costs or charges incurred in repairing or replacing defective equipment or parts, including the cost of reinstalling parts that are repaired or replaced by Seller; (g) any expense of shipment of equipment or repaired or replacement parts; or (h) any other loss, damage or expense of any nature.

The above warranty shall not apply to any equipment which may be separately covered by any alternate or special warranties.

PERFORMANCE: In the absence of Certified Pump Performance Tests, equipment performance is not warranted or guaranteed. Performance curves and other information submitted to Buyer are approximate and no warranty or guarantee shall be deemed to arise as a result of such submittal. All testing shall be done in accordance with Seller's standard policy under Hydraulic Institute procedures.

LIABILITY LIMITATIONS: Under no circumstances shall the Seller have any liability under the Order or otherwise for liquidated damages or for collateral, consequential or special damages or for loss of profits, or for actual losses or for loss of production or progress of construction, regardless of the cause of such damages or losses. In any event, Seller's aggregate total liability under the Order or otherwise shall not exceed the contract price.

ACTS OF GOD: Seller shall in no event be liable for delays in delivery of the equipment or other failures to perform caused by fires, acts of God, strikes, labor difficulties, acts of governmental or military authorities, delays in transportation or procuring materials, or causes of any kind beyond Seller's control.

COMPLIANCE WITH LAW: Seller agrees to comply with all United States laws and regulations applicable to the manufacturing of the subject equipment. Such compliance shall include: The Fair Labor Standards Acts of 1938, as amended; Equal Employment Opportunity clauses of Executive Order 11246, as amended; Occupational Safety and Health Act of 1970 and the standards promulgated thereunder, if applicable. Since compliance with the various Federal, State, and Local laws and regulations concerning occupational health and safety, pollution or local codes are affected by the use, installation and operation of the equipment and other matters over which Seller has no control, Seller assumes no responsibility for compliance with those laws and regulations, whether by way of indemnity, warranty, or otherwise. It is incumbent upon the Buyer to specify equipment which complies with local codes and ordinances.



AURORA®

800 Airport Road
North Aurora, Illinois 60542
630-859-7000
www.aurorapump.com