



FAIRBANKS NIJHUIS®

MODELS D5430, D5730, D2430
M, MT, MV, MVS, W, WD AND CWD SERIES

**SUBMERSIBLE
SOLIDS HANDLING PUMPS
STANDARD LOCATION AND
UL/CSA LISTED MODELS**

INSTALLATION, OPERATION AND MAINTENANCE 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.

INTRODUCTION

Read this manual completely before assembly or installation is started. Failure or neglect to properly install, operate or maintain your pump may result in personal injury, property damage or unnecessary damage to the pump.

CALIFORNIA PROPOSITION 65 WARNING:

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

SAFETY

The installation, use and operation of this type of equipment is affected by various Federal, State and Local Laws, Underwriters Laboratories (UL) and the regulations concerning OSHA. Compliance with such laws relating to the proper installation and safe operation of this type of equipment is the responsibility of the equipment Owner and all necessary steps should be taken by the Owner to assure compliance with such laws before operating the equipment.

The Motor supplied on this order is UL and for frame sizes 210, 250, 320, 360 and 365 is CSA Listed for Hazardous Locations Class I, Division 1, Group C and D, when used with normal line current. When the motor is built with inverter duty insulation, the pump may be used in variable frequency drive applications.

Do not attempt to service the pump until the electrical power has been disconnected and it has been verified that the pump cannot start. Because many installations utilize automatic starting equipment, the pump unit may start at any time without warning. Proper precautions should be taken to avoid injury as a result of automatic starting of the equipment.

This product has been designed specifically for operation in water or sewage. Do not use with other liquids without first consulting the factory.

Do not attempt to try to clean the pump with bare hands. The pumped material may contain items that may present health hazards such as needles, and other sharp objects. Always wear heavy puncture resistant gloves.

Before attempting to service this pump:

Familiarize yourself with this manual.

Disconnect or lock out the power source to insure the pump will not start.

Confirm power source disconnect with appropriate electrical test equipment.

Close the discharge valve, and if present, the suction valve.

After the pump has been installed, make certain that the pump and all piping connections are tight and are properly supported prior to start-up and operation.

Certain procedures in disassembly and assembly require parts be heated to high temperatures. Heat resistant gloves must be worn when handling heated parts. Heated parts can cause severe personal injury.

STORAGE OF PUMPS

If the equipment is not to be immediately installed and operated, the following instructions should be adhered to as a minimum.

Consider a unit in storage when:

It has been delivered to the jobsite and is awaiting installation.

It has been installed but operation is delayed pending completion of plant construction.

There are long (30 days or more) periods between operation cycles.

The plant (or facility) is shut down.

NOTE: Improper storage could result in product failures or restoration not covered by warranty.

If the pumps and motors are not immediately installed and operated, vertically store them in a clean, dry, well-ventilated area, free from vibration, moisture, and rapid or wide variations in temperature. Rotate the motor shaft by hand several revolutions every 4 weeks to ensure the bearing and seal components are coated with oil for protection against corrosion.

Keep ends of power and control cables clean and dry, do not submerge in water or sewage. Doing so will result in permanent damage.

GENERAL

The Model D5430, D5730 and D2430 pumps consist of several components. The following is a list of those major parts or component assemblies and a brief description of their design and function.

Impellers All Models 5430, 5730, 2430

The impeller is a balanced solids-handling type made of close-grained cast iron. The impeller is a one piece, single suction, enclosed radial flow design with well-rounded leading vanes and then tapered toward the trailing edge for a circular flow pattern. The waterways through the impeller have extremely smooth contours, devoid of sharp corners, so as to minimize rags, stringy or fibrous material from catching or clogging. The impeller is balanced and secured to the shaft by means of a bolt and key. The arrangement is such that the impeller cannot be loosened from torque in either forward or reverse rotation.

Volute/Sliding Bracket (Pull-Up) (D5430, D5730, D2430 M, MT, MV, MVS)

The volute is matched to the impeller and made of close-grained cast iron. The volute is of one-piece constant velocity, equalizing pressure design with smooth fluid passage large enough to pass any size solid that can pass through the impeller and shall include a flanged discharge connection.

The sliding bracket assembly is a part of the pumping unit, constructed so that when lowered onto the discharge base/elbow, the knifing action of the vertical metal-to-metal seal provides a self-cleaning, solids-handling, UL listed, non-sparking assembly.

Guide Rail Brackets (Pull-Up) (D5430, D5730, D2430 M, MT, MV, MVS)

An upper guide bracket is supplied to support and align the guide rails (supplied by others). When specified, an intermediate guide bracket is supplied for additional support.

Discharge Base (Pull-Up)

A rigid discharge base-elbow, designed to support the total weight of the pumping unit, is provided. The base is to be bolted to the foundation with appropriate anchor bolts in full contact with grout. The 90 degree elbow having a 125 lb. ANSI flange discharges vertically (MVS discharges horizontally).

Fits and Hardware

The volute and fronthead are manufactured with concentric shoulder fits to assure accurate alignment. All bolts, nuts and capscrews are stainless steel and are of the hex-headed type.

Motor

Motors are suitable for application in gases, where vapor or gas ignition temperatures are higher than the operating temperatures shown on the motor nameplate. The motors have a rated maximum operating skin temperature of 160° C. The Fairbanks Nijhuis® solids handling submersible motors are UL Listed for use in Class I, Division 1, Group C and D Hazardous Locations in air or submerged in water or sewage.

Motors up to and including 50 hp are designed for standard use with either 230V or 460V three-phase service depending on the nameplate rating. Standard motors larger than 50 hp are 460V only. On special order other voltages are available. All motor ratings are noted on the motor nameplate, and are based on operating in a 40° C ambient temperature. Insulation may be Class F, Class H or inverter duty as noted on the motor nameplate.

The standard motors have duty ratings for any one of three operating conditions: continuous duty in air, continuous duty submerged and short time duty in air (one-hour duty in air for 210 frame motors, and 15 minutes for 250 and larger frame motors). For a more detailed discussion of these conditions, see the section on Operation. The 250 Frame and larger motors have an optional water jacket construction, and are then rated for continuous operation in air.

The motor is mounted directly on the pump volute, and the pump impeller is installed on the motor shaft. For those motors with the optional water jackets, cooling water is provided continuously by the circulator, without any external piping or connections. (Optional external water source cooling is available.) All motor housing joints are equipped with long rabbet fits and O-ring seals. The housing and the water jacket are made of close grain cast iron. The motor shaft and all external nuts and bolts are stainless steel.

Motors have single row, upper radial ball bearing. The 210 frame uses a single row, lower thrust ball bearing. The 220 frame uses a single row roller ball radial and thrust bearing. The 250 through 490 frame motors incorporate double row, lower thrust ball bearings. All bearings are grease lubricated for life (except 210 frame, which is oil lubricated).

The motor shaft is sealed with two mechanical seals, mounted in a tandem arrangement, and with an oil chamber between them. For UL Listed, the inner seal has a carbon rotating face and a ceramic stationary face

(optional seal faces are available for the inner seal). The outer seal has a reaction bonded silicone carbide stationary face and a tungsten carbide rotating face. The O-rings for both the inner seal and outer seal stationary faces are Viton®.

For standard location 210 through 365 frames the internal seal has Carbon/Ni-resist seal faces; the external seal, Carbon-Ceramic faces (optional seal materials are available). Remaining seal components are stainless steel and Buna-N. For 400 through 445 frames the inner seal is Ni-resist/Carbon seal faces; the external seal Silicon/Tungsten faces. For the 490/495 frame, the inner seal is Tungsten/Carbon seal faces; the outer seal is Silicon/Tungsten.

Since all mechanical seals must seep moisture to provide lubrication to the sealing faces, two moisture detector probes have been installed in the seal chamber. This system monitors the quantity of water in the oil chamber. When a mixture of 25 to 30% of water to oil is reached, the moisture controller will signal that it is time to change the oil. O-ring sealed fill and drain plugs are included for ease of changing oil in the oil chamber.

Thermostats in the motor windings are standard, and protect the motor from excessive winding temperatures. Power and control cables are epoxy-potted into the cover to prevent moisture from intruding into the motor. For additional protection of maintenance and operation personnel, it is highly recommended that the motor power circuitry have ground fault interruption capabilities.

Solids Handling: The term solids handling is commonly applied to centrifugal pumps designed for the municipal sewage market. Pumps referred to as solids handling are specially designed to accommodate the pumping of solids by providing larger than normal passage ways through the impeller and volute, minimizing the number of impeller vanes and volute cut-waters. In addition, the leading edges of the impeller vanes and the volute cutwater are well rounded to promote the shedding of long fibrous material. These features make solids handling pumps more resistant to plugging from the accumulation of solids in the pump than a pump of conventional design. However, no pump can ever be described as being completely resistant to clogging.

When the content of the pumpage includes large amounts of fibrous solids which cannot be removed prior to the pump, the sump design should be of the nature to allow the pumps to be run at near full speed, drawing down the sump and cycling the pumps on and off as required. This is particularly true during low flow periods when solids tend to settle out and accumulate at the bottom of the sump and in the suction piping. Low speed and low velocity pumping can even cause plugging in a vertical leg of the discharge piping. Reduced pump speed and low suction velocities must be avoided to reduce the tendency to clog. The sump and suction piping design should be of the "self-cleaning" design to avoid the accumulation of solids at these locations.

INSTALLATION

When unpacking the unit, check for concealed damage. Claims for damage must be made at the receiving end through the delivery carrier. Damage cannot be processed from the factory.

Piping

All piping connections must be made with the pipe in a rigid supported state, and without the need to apply vertical or side pressure to obtain alignment of the piping with pump flange.

For all "W" and "WD" style units, all piping should be independently supported so that neither mechanical nor hydraulic pipe strain exists.

Discharge Piping

Discharge pipe should be as direct as possible with a minimum of valves to reduce pipe friction losses. A check valve and closing valve should be installed in the discharge line. The check valve, between the pump and closing valve, prevents reverse rotation in the event of power failure. The closing valves are used to isolate the pump for repairs.

Suction Piping

Suction pipe on "WD" pumps must be air tight and sloped upward to the pump flange to avoid air pockets which will impair satisfactory pump operation.

Prior to lifting the unit, check to ensure all hooks, cables, chains and hoists are of adequate strength and size. Refer to the Pump Data Section of this manual for approximate pump weights.

Lifting mechanism capability should not exceed two times the weight of the pump.

Lifting mechanism sheave shall have a diameter large enough so as to not crimp or severely bend the lifting cable. Small diameter or angle type sheaves could cause cable failure.

Do not lift by the power or control cable. Damage will result.

Control Cable Terminal Connections									
Control Device	Frame	Lead Color Code							
		Black	Blue	White	White/Black	Red	Red /Black	Orng	Grn
Thermostats	210 – 400	P2	N/A	P1	N/A	N/A	N/A	N/A	Grd
	440/445	P2	N/A	P1	N/A	N/A	N/A	N/A	Grd
	490/495	P2	N/A	P1	N/A	N/A	N/A	N/A	Grd
Moisture Detector	210 – 400	N/A	N/A	N/A	N/A	W2	N/A	W1	Grd
	440/445	N/A	N/A	N/A	N/A	W1	N/A	W2	Grd
	490/495	N/A	N/A	N/A	N/A	W2	N/A	W1	Grd
Optional Bearing RTD	250 – 365	N/A	R3	N/A	R2	N/A	N/A	N/A	Grd
	440/445	N/A	R1	N/A	R2	N/A	R3	N/A	Grd
	490/495	N/A	R1	N/A	R2	N/A	R3	N/A	Grd

Power leads connect the motor to the power supply.

Control leads connect thermostats, moisture detectors and optional thrust bearing RTD controls.

The cable cannot be spliced.

All electric controls and motor starting equipment must be located outside the hazardous area unless they are approved for hazardous locations.

The disconnect switch must be opened and locked out before any work is done on the motor-pump unit. Failure to take this precaution can result in serious injury or death.

The current through the thermostat shall not exceed the limits below:

Alternating Current		
Volts	Continuous Amperes	In Rush Amperes
110-120	3.0	30.0
220-240	1.5	15.0
440-480	0.75	7.5
550-600	0.60	6.0

Thermostats must be connected in the circuit and must be operative. Running the motor with inoperative thermostats will void the warranty. Thermostat contact rating 120-600VAC, 360 VA maximum.

Moisture detectors must be connected and functional. Operation of the pump without operative moisture detectors will void the warranty.

The direction of rotation should be checked before the pump is put in operation. Remove the volute handhold cover (or suction elbow cleanout cover.) The correct rotation of the pump is indicated by an arrow cast on the volute. While looking into the cleanout opening, “bump” start the motor to observe rotation.

Do not put hands or any item in cleanout to determine direction of rotation. To do so will cause serious personal injury.

Bump start is generally accomplished on three-phase motors by engaging and immediately disengaging the power switch. It is seldom necessary to engage the power source for more than one second to determine motor rotation.

Note the direction of impeller rotation. If the impeller rotates opposite the arrow on the pump volute, reverse any two of the three power leads and motor rotation will be reversed. (On 440 frame motors two “sets” of power leads must be reversed.)

Both motor mechanical seals are lubricated and cooled by the oil in the oil chamber. Oil chamber is filled at the factory prior to shipment.

Installation 5430, 5730 and 2430 M, MT, MV or MVS

Install the top guide bracket. Plumb the guide rails from the top guide bracket to locate the pump discharge base/elbow and assure proper alignment of the guide rails. Failure to do so will result in the pump discharge not properly seating against the discharge elbow, and could cause binding of the pump as it is raised and lowered in the sump.

Lower the base elbow onto the anchor bolts.

Level the base elbow using metal shims or metal wedges spaced close enough to give uniform support and stability. When level and perpendicular, tighten the anchor bolt nuts snugly, but not too firmly.

After leveling, the base elbow is to be grouted in place with a good quality non-shrinking grout. Leveling devices are to be removed or backed off and the pump base elbow tightened solidly against the grout bed. All pockets and/or holes left by removal of leveling devices are to be filled with grout.

Install the discharge piping tightening all bolts and check for pipe strain.

Install the guide rails, provided by others, (2" or 3" galvanized or stainless steel pipe) to the base elbow.

If the guide rails are over 20 feet in length, an intermediate guide bracket is used. Install the "u"-bolt around the discharge pipe near the top of the lower section of guide rail, and hand tighten the bolts to the bracket. Slip the rubber bushings down inside the guide rails and tighten with the spreader bolts. Tighten the "u"-bolt nuts securing the bracket to the discharge pipe. Lower the top rails onto the intermediate guide bracket.

Install the top guide bracket over the guide rails inserting the rubber bushings into the guide rails and tighten with the spreader bolts. Shim between the back of the top guide bracket and the well curb to obtain strain-free vertical positioning of the guide rails.

Tighten the bolts of the retainer bracket support to the well curb.

Attach one end of a suitable lifting cable or chain to the metal motor bail with the other end attached to a suitable lift or hoist.

With an adequate hoist, lower the pump onto the guide rails and into the wet pit. The location of the hoist should be in a position so that the centerline of the pump pull up bracket guide is within 1/2" of the centerline of the guide rails.

The pump is self-connecting to the base elbow. No bolting or other fastening is required. Check to ensure there is proper seating between the pump discharge flange and the base elbow flange. If not, raise the pump partially back up the guide rails and again lower onto the base below.

Install the controls per the control manufacturer's recommendations.

Wire the motor protection devices.

All electric controls and motor starting equipment must be located outside the hazardous area unless they are approved for hazardous locations.

The disconnect switch must be opened and locked out before any work is done on the motor-pump unit. Failure to take this precaution can result in serious injury or death.

Installation 5430, 5730, 2430 W

Attach one end of a suitable lifting cable or chain to the metal motor bale or lifting harness with the other end attached to a suitable lift or hoist.

With an adequate hoist, lower the pump into the wet pit.

Connect the discharge piping tightening all bolts and eliminate any pipe strain.

Install the controls per the control manufacturer's recommendations.

Wire the motor and motor protection devices.

Installation 5430, 5730 and 2430 WD

The pump should be installed as near the wet well as possible so that a short direct suction pipe can be used to keep suction losses at a minimum. Total net position suction head available (NPSHA), which includes suction lift and pipe friction losses, must be greater than the net positive suction head required (NPSHR) by the pump. Discharge piping should be direct and with as few elbows and fittings as possible.

Pump should be located in an area that will permit periodic inspection and maintenance. Head and access room should be provided.

Lower the unit onto the foundation and position the base so the anchor bolts are aligned in the middle of the holes in the base.

Set the base on metal shims or metal wedges placed directly under the part of the base carrying the greatest weight, and spaced close enough to give uniform support and stability.

Adjust the metal shims or wedges until level or vertical as appropriate. Make sure that all shims or wedges fit firmly between the foundation and the base.

If leveling nuts are installed on the anchor bolts and are used for alignment, follow the same procedure as with shims or wedges. Support the base with additional shims or wedges if necessary. Make sure that all nuts and shims are in firm contact with the base. Tighten the foundation bolts snugly, but not too firmly.

The unit should be grouted using a high grade non-shrinking grout. The base is designed to be completely filled with grout.

Damaging vibration may result if the baseplate is not solidly in contact with the grout bed.

Do not fill the pipe sleeves with grout. If leveling nuts are used, make sure they are not imbedded in grout. Provide access in the grout to the leveling nuts so that they can be backed off after the grout has cured.

Allow the grout to fully cure before backing off the leveling nuts (if used) or removal of shims, and firmly tightening the foundation bolts.

All piping connections must be made with the pipe in a rigid support state, and without the need to apply vertical or side pressure to obtain alignment of the piping with pump flange.

All piping should be independently supported near the pump so that pipe strain will not be transmitted to the pump casing. The weight of the piping and of the contained liquid must be considered in support design. Suction and discharge piping should be one or two sizes larger than the pump flange sizes, especially where the piping is of considerable length. Any flexible joints installed in the piping must be equipped with tie rods to absorb piping axial thrust.

Suction pipe must be air tight and sloped upward to the pump flange to avoid air pockets which will impair satisfactory pump operation. The discharge pipe should be as direct as possible with a minimum of valves to reduce pipe friction losses.

A check valve and closing valve should be installed in the discharge line. The check valve, between the pump and closing valve, prevents reverse rotation in the event of power failure. Closing valves are used for priming and to isolate the pump for repairs. The pump must never be throttled by the use of a valve in the suction line.

In addition to the primary piping connections, your pump may require connections to the water jacket (if external water source is used), and suction and discharge pressure gauges. All of these connections should now be made.

These auxiliary pipe lines must be kept clean for satisfactory pump operation and pump life.

Wire the motor protection devices.

OPERATION

5430, 5730, 2430 M, MT, MV, MVS, W or WD

It is important that the motor be operated within the limits of its rating. Carefully note the "Duty" block on the motor nameplate. One of the following ratings will be on the motor nameplate:

If the Duty cycle reads "Cont. Submerged," it is required that the motor be continuously submerged.

If the Duty cycle reads "Continuous in Air," it may be run non-submerged at its rated load. "Continuous in Air" units can also run submerged at its rated load.

If the Duty cycle reads "Continuous in Air, Jacketed," it may be run non-submerged at its rated load.

A Duty cycle of "Short Time in Air 15 Min." requires the following:

The capacity of the pump should be selected to be greater than the maximum flow into the wet well. Under maximum flow conditions, the pump must draw-down the sump from the top of the motor to the bottom flange on the motor within 15 minutes.

A Duty cycle of "Short Time in Air 1 Hour" requires the following (210 frame only):

The capacity of the pump should be selected to be greater than the maximum flow into the wet well. Under maximum flow conditions, the pump should draw-down the sump from the top of the motor to the bottom flange on the motor within 1 hour.

The power frequency shall not vary by more than +/-5%, and the voltage by more than +/-10% of the nameplate data. Voltage deviation from the nameplate ratings will have an effect on pump speed and, therefore, on pump performance. The pump will deliver the rated head and capacity only when running at the rated speed.

Note: Voltage should not vary from phase to phase by more than 2% without derating the motor's horsepower rating. Damage may occur to the motor if operated with more variation.

Proper voltage is required or permanent damage to the motor may occur. Check to ensure input voltage is the same as the motor rated voltage.

NOTE: Pumps should not be operated for extended periods of time (no more than 2-3 days) with the moisture indicator light on.

All Pumps

Make sure the moisture detection system is operational at all times.

Make sure both the suction (if required) and discharge valves are open.

Observe all caution, warning and danger tags that may be attached to the equipment.

Never run the pump longer than 15 minutes without liquid in the volute as close running fits within the pump are lubricated by the liquid. This condition may result in pump seizure, and/or seal damage.

Because of tight internal clearances these pumps should not run against a closed valve, unless approved by the factory.

Under no circumstances should any flammable liquids be pumped.

Starting the Pump

5430, 5730, 2430 M, MT, MV, MVS or W

Be sure the pump is submerged properly and that the liquid level exceeds the minimum operating level recommended.

Refer to the motor nameplate for operation limits before proceeding.

The pump requires no special procedures or adjustments before starting, except to check for rotation. The control system should be set to ensure no more than 10 across the line starts per hour on the 210 through the 365 frame motors, and 1 across the line start per hour on the 400 frame and larger motors.

Start the unit.

Immediately after the pump has been started, check the following:

Observe the unit for any unusual noise or vibration.

The voltage should be within +/- 10% of the rated nameplate voltage across each phase. There should be no more than 2% variation between the average voltage and each leg.

The amp reading of each phase should be less than the rated nameplate amps.

Observe the unit for proper pressure and flow output.

Continue to observe the unit's operation for at least the next four hours.

For any problems, consult the "Troubleshooting" section of this manual.

5430, 5730, 2430 WD

The pump must be primed to initial start up and the prime must be maintained through subsequent start-stop cycles. The priming procedure is different for positive and negative suction head systems and the following procedures should be followed:

Positive suction head:

- open vent on the highest point on the pump casing.

- open all suction valves.

- allow the liquid to flow from the vent hole until all air bubbles are vented, then close the vent.

Negative suction head:

- install an ejector or vacuum pump on the vent on the highest point on the pump casing.

- open the suction valve.

- start ejector or vacuum pump.

- allow liquid to flow until a continuous flow is exhausted from the ejector, then close the valve to the vent.

Refer to the motor nameplate for operation limits before proceeding and check pump rotation.

The control system should be set to ensure no more than 10 across the line starts per hour on the 210 through 365 frame motors, and 1 across the line start per hour on the 400 frame and larger motors.

For motors with water jackets that utilize an external water source, ensure water is flowing to the water jacket. Refer to the Technical Data section for cooling water flow requirements.

After the pump is primed and the external cooling water is running, if required, start the unit.

Immediately after the unit has started, check the following:

Observe the unit for any unusual noise or vibration.

The voltage should be within +/- 10% of the rated nameplate voltage across each phase. There should be no more than 2% variation between the average voltage and each leg.

The amp reading of each phase should be less than the rated nameplate amps.

Observe the unit for proper pressure and flow output.

Continue to observe the unit's operation for at least the next four hours.

For any problems, consult the "Troubleshooting" section of this manual.

Stopping the Pump

Pump stations are usually designed to have the pumps started and stopped automatically. Since this is a function of station design, the operators should be familiar with the systems operating parameters. The general procedure to shut down the pump is as follows:

Disconnect the electrical motor.

If the pump is to be removed for repair, close the suction and discharge valves.

Seasonal Operating Instructions

If the pump is located in an area that is subject to below freezing temperatures and will not be operated enough to prevent freezing, it should be drained to prevent damage to the casing. Particular attention should be made to jacketed units using an external water source.

TROUBLESHOOTING

Insufficient Pressure or Flow	Solution
Wrong direction of rotation.	Reverse any two motor lead connections.
Impeller running clearance too great.	Reset impeller clearance.
Speed too low.	Check driver voltage and electrical source.
Impeller passage partially plugged.	Clean impeller passages.
Insufficient net positive suction head.	Raise wet well level.
Air in liquid.	De-aerate liquid. Increase submergence to prevent vortexing.
Impeller damaged.	Check and repair or replace.
Impeller diameter too small.	Replace impeller with larger diameter. Check driver hp.
The following for "WD" Models only	
Suction lift too high.	Reduce suction line losses.
Insufficient suction line submergence.	Increase submergence.
Air leaks into suction piping or gaskets.	Check flange connections for proper seal. Tighten connections.
Excessive Power Consumption	Solution
Pump too much liquid.	Change system. Reduce pump speed. Trim impeller.
Speed too high.	Check driver speed and voltage.
Improper line voltage or frequency.	Check driver voltage. Change power source or driver.
Incorrect diameter impeller.	Determine correct impeller diameter and replace or trim impeller.
Shaft bent.	Replace shaft.
Specific gravity or viscosity of liquid pumped is too high.	Reduce pump capacity.
Vibration or Noise	Solution
Pipe strain.	Improperly supported or aligned. Check pipe supports adjust or realign.
Wrong rotation.	Reverse any two motor lead connections.
Pumps too much liquid and exceeds NPSHR.	Increase system head. Reduce pump speed. Trim impeller.
Shaft bent.	Replace shaft.
Pump running at shut-off position.	Open discharge valve. Check for obstructions.
Air in liquid.	Increase submergence.
Impeller passages plugged.	Clean impeller passages.
Overheating	Solution
Shaft bent.	Replace shaft.
Insufficient submergence.	Increase submergence.
Rotating element binds.	Determine cause and correct.
Water cooling line plugged. (External water source only.)	Clean cooling water line. Provide clean source of liquid.
Water jacket passageways restricted.	Clean water jacket.
Excessive load.	Increase system head. Check for mechanical interference.
Excessive cycles.	Change level controls, change system.
Excessively high or low voltage.	Correct voltage source.
Liquid Level Above High Limit	Solution
Excessive flow to wet well.	Reduce influent. Increase pump capacity.
Solids collecting around the pump suction reducing pump capacity.	Remove solids accumulation.
Controls improperly set on the high level.	Reset controls.
Improper sump design.	Correct sump design.
Pump has been inoperative temporarily and excess water has accumulated in wet well.	Operate pump to reduce level. (If a higher than normal water level has existed and was not witnessed, it can easily be detected by examining the sump for a scum line above the normal high level limit.)

MAINTENANCE

General

With proper application of the pump/motor unit and proper installation of all the protective devices, no periodic maintenance of the equipment is necessary.

Should the moisture detector indicate intrusion of moisture, the pump should be shut-down as soon as possible. Oil should be drained from the motor by removing the oil cavity inspection plug. With the motor in position with the inspection plug hole at the top, refill the seal chamber with oil and place the unit back in service. (In some cases, the seal faces require time to seal properly and some water may have passed by the seal faces into the seal oil chamber causing an alarm to signal.)

Note that all mechanical seals must seep to provide lubrication to the rotating faces. This is trapped in the oil chamber between the inner and outer seals. During the initial run-in period, new seals may seep enough to cause the moisture alarm to go off. This is normal, change the oil and put the unit back into service.

Should a malfunction be indicated by the motor protection devices or observed in the operation of the pump, the pump should be removed, serviced and the cause of the problem corrected.

Motor overheating may be caused by an accumulation of foreign material collecting on the outside of the motor housing. For non-jacketed motors, the outside of the motor housing should be cleaned. In the case of jacketed motors, it may also be necessary to wash the internal and external surfaces of the cooling jacket and the stand pipe tube.

The water jacket is supplied with two taps, one labeled "in" and the second "out." Before removing the jacket for cleaning, try cleaning out the cooling cavity by flushing water through the "out" tap and out the "in" tap. Reinstall the unit and test for overheating by running the unit.

Pump Removal

Thread teather rope through the grab link.

Pull teather rope and chain tight.

Lower the grab link completely to the bottom of the pump chain.

Let teather rope and lifting cable go slack. Tighten up on lifting cable until grab link engages chain.

Lift pump from pit.

Pump Installation

Use the hook only.

Engage pump chain into hook.

Lift pump from floor, position over pit and lower pump to installation with pump base.

Pull teather rope tight and let hook fall free.

Pull hook out of pit.

Pump Disassembly

Prepare the pump for disassembly according to the following procedures:

Disconnect and lock out the power to the motor.

Check with appropriate electrical test equipment to ensure the motor cannot be accidentally started.

Remove the pump and motor from the sump.

If pump/motor inspection, maintenance or repair must be performed at another location, disconnect the motor leads at the controller.

Remove the capscrews holding the motor to the volute.

Remove the motor and impeller assembly from the volute.

Store the motor in a clean, dry place if no motor repair is required.

Remove the impeller capscrew and impeller washer.

Remove the impeller and the impeller key from the motor shaft.

The impeller has a straight bore fit, with a close tolerance. It may be necessary to use a wheel puller or similar device.

Note the location and number of shims placed between the impeller hub (or circulator if provided) and the shaft shoulder.

Care should be taken not to damage the impeller when using a puller or similar device. Attach the puller or other equipment at the impeller vane area only, do not use the impeller shroud.

Do not try to remove the shaft from the motor or disassemble any part of the motor.

If the impeller or fronthead wear rings require replacement, refer to the wear rings section of this manual.

Note: It is not necessary to remove the volute from the fronthead unless those items require service.

If the fronthead must be removed, remove the capscrews and remove from the volute. Remove the cleanout over and gasket, if provided.

Motor Disassembly

The motor requires no periodic service, with the exception of changing the mechanical seal oil every 4000 hours of operation, not to exceed one year. Motor bearings are lubricated for life.

UL Listing requirements do not permit disassembly or repairs of the motor by the owner, except for the replacement of the outer seal or the cable assembly. Motors must be returned to the factory or an authorized Fairbanks Nijhuis UL Listed Qualified Service Center.

Cover/Cable Removal

With the motor in a vertical position remove the cover capscrews, loosening slowly to allow any pressure to escape.

Break the seal between the cover and the housing.

Lift cover, turn over, and secure to housing with one cover capscrew.

Remove the terminal board nuts and lead wires.

Lower Mechanical Seal Removal

Drain oil from seal chamber through the inspection plug, and properly dispose of oil.

Remove the rotary seal body clamp by removing the two locking screws on the UL Listed models. Remove the seal retaining ring and seal protective cup, seal spring retainer and spring on standard models.

Remove the rotating portion of the seal.

Remove the gland capscrews.

Remove the gland.

Remove the stationary portion of seal from the gland.

Water Jacket Removal

On the 250 frame motors, first remove the water jacket retaining ring by spreading it with a blunt screwdriver. On 320 and larger frame motors, remove the jacket capscrews and retainers. Match-mark the water jacket and motor. Remove the jacket by tapping on the lugs at the bottom end of the jacket. Flush the outside of the motor. Remove both O-rings and clean the O-ring grooves. Check and clean the cooling water inlet and outlet passages from any obstructions. Pay particular attention to cleaning of the stand pipe tubes. If necessary, remove the motor from the volute to inspect and clean the water circulator, and the water channels in the back of it. Flush and clean the water jacket.

For reassembly, proceed in the reverse order. Installation of new O-rings is recommended after each disassembly. Realign the water jacket and motor to the match-mark(s), by rotation of the jacket in a counter-clockwise direction.

Never attempt to disassemble the motor without first allowing it to cool down. Residual heat in the motor windings can cause high temperatures and pressures within the motor. Escaping hot gas or oil may cause serious personal injury.

Motor Assembly

Outer Mechanical Seal and Gland Installation

Inspect the shaft.

Buff out all nicks that could cut the seal elastomer.

Use caution while buffing to avoid creating flat spots on the shaft under the elastomer. Wipe the shaft clean with a soft cloth. Keep the material out of the oil cavity.

Clean the machined surfaces.

Clean the oil cavity.

Install the gland O-ring on the gland.

Run a small bead of 515 Loctite® Form-a-Gasket around the face of the lower bearing housing.

Install the gland and install the gland capscrews/bolts.

Lubricate the O-ring on the stationary seal face with a water based rubber lubricant (P-80 or equal) and install it in the gland. Be sure the correct side (polished side) is facing up. Extreme care is to be taken not to damage the stationary seal face, and when installed, it is level and perpendicular to the shaft. It is recommended to measure down to at least three points on the seal face, at 120 degrees from each other. These dimensions should not vary more than 0.003".

Lubricate the inner diameter of the elastomer body of the rotating seal with a water based rubber lubricant (P-80 or equal).

Install the rotating portion of the seal. Be sure not to damage the seal when it passes over the step on the shaft.

Install the retaining clamp, secure with the two locking screws on UL Listed models.

On standard models, install the seal spring, seal protective cup and outer mechanical seal retaining ring, compressing the spring until the retaining ring seats into its groove.

Through the fill port on the side of the housing, fill the oil cavity with the recommended amount of oil. Replace plug.

Cover Cable Assembly

Install the cover O-ring onto the cover.

Connect the control and power cable lead wires to the terminal board.

Run a small bead of 525 Loctite® Form-a-Gasket around the motor housing or to the top motor housing (on 320 and 360 frames) to seal it to the cover.

Place the cover onto the motor housing or top motor housing and bolt up.

Pump Assembly

The following step-by-step instructions for assembly of the pump are essentially the reverse order of the instructions for disassembly.

Prepare the pump for assembly according to the following procedures:

Thoroughly clean all parts to remove all oil, grease and any foreign material.

Inspect all parts including the motor shaft for wear or damage and replace if required.

Gaskets should not be reused and should always be replaced.

If the impeller or fronthead wear rings are being replaced, or if the pump is to be retrofitted for wear rings, refer to the Wear Rings section of this manual. Always use factory parts.

Thoroughly clean the impeller bore, the end of the shaft, the shaft and keyway.

Inspect and measure the impeller bore, the shaft fit diameter, the key and the keyway for wear.

Note: Measure in several locations along the length of the fit.

If wear is noticed and the clearance between the shaft and the impeller exceeds 0.003" anywhere along the length of the impeller bore, contact the factory for instructions for rework or replacement of the components.

Install the impeller key in the motor shaft. Replace the shaft shims and if provided the circulator. Slide the impeller in place, making sure it fits firmly against the shaft shims or circulator.

With the impeller washer in place, install the impeller capscrew and tighten securely.

If the volute and fronthead have been removed proceed as follows:

Use new cleanout cover gaskets and install the cleanout cover.

Install a new volute gasket and install the fronthead on the volute. Secure with capscrews.

Install the motor with impeller in the volute and securely tighten the capscrews holding the motor to the volute.

Check the impeller/fronthead clearance as follows:

Measure the clearance between the impeller face and the suction head. Record this value.

If the clearance is not between the values shown below, remove the impeller and shim between the impeller hub and shaft until the proper clearance is obtained.

Pump	Nominal Clearance
2" thru 5" D5431-D5434	.010-.020
4" D5435	.0075-.015
6" and 8" D5433-D5435	.015-.025
10" D5435	.020-.030
5" thru 8" D5436	.020-.030
All D5700 Series	.030-.040
All D2400 Series	.025-.035

After the proper clearance has been obtained remove the impeller capscrew.

Apply 3 or 4 drops of Loctite® No. 609 to the capscrew threads.

With the impeller washer in place, install the capscrew and torque.

Install the motor/impeller assembly in the volute and tighten the capscrews.

Note: Allow the Loctite® to cure before starting the pump.

The pump assembly is complete.

Return the unit to the sump and resume operation.

Wear Rings

Replacing Existing Wear Rings

If the pump is equipped with wear rings and replacement is required, refer to Removal below.

If this pump is to be fitted with wear rings, and was not originally so equipped, contact the factory for correct dimensions.

To prevent possible serious personal injury, protective eye glasses should be worn while working on this equipment.

Removal

If the wear ring requires replacement it can be removed by heating it to 350-400°F to break the Loctite® bond.

Installation

If the wear rings are to be replaced they should be replaced with genuine Fairbanks Nijhuis wear rings. Install the wear rings as follows:

Apply a bead of Loctite® No. 290 completely around the middle of the impeller wear ring and fronthead wear ring fit, and press the wear rings into place.

To ensure proper bonding, thoroughly clean all mating parts with solvent to remove all grease, oil, dirt, etc.

To avoid distortion and ensure proper installation, be careful to press the wear rings evenly and completely in place. They should firmly fit against the corresponding impeller or fronthead shoulder at the bottom of the wear ring fit.

Moisture Detection Cavity Oil Capacities

Frame Size	One Port	Two/Three Port
210	19 oz.	28 oz.
250	22 oz.	38 oz.
320	52 oz.	74 oz.
360	48 oz.	71 oz.
365	N/A	71 oz.
400	N/A	71 oz.
440	N/A	62 oz.
490	N/A	174 oz.

External Cooling Water Requirements

Frame Size	Flow Rate
250	3 GPM
320	6 GPM
360	10 GPM
365	10 GPM
400	15 GPM
440	25 GPM
490	30 GPM

Technical Data

Motor Frame	Impeller Screw Torque
210	60
250	60
320	200
360	300
440	300

Anything over 12" refer to factory.

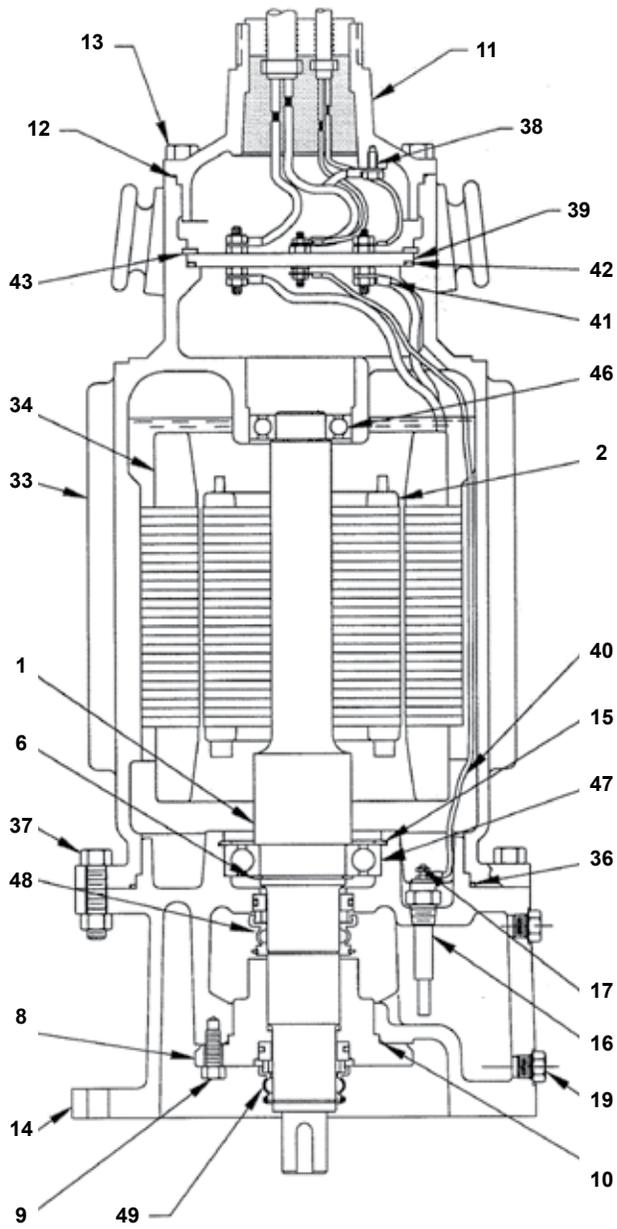
MATERIAL SPECIFICATIONS

ITEM	DESCRIPTION	MATERIAL	SPECIFICATION
1	Shaft, Motor	SST	A582 Type 416
2	Rotor	—————	—————
3	Locknut	Steel	Commercial
4	Lockwasher	Steel	Commercial
5	Washer, Precision	Steel	Commercial
6	Retaining Ring, Bearing	Steel	Commercial
7	Spacer	SST	18-8
8	Gland, Seal	Cast Iron	A48 CL30
9	Capscrew, Gland Seal	SST	AISI Type 316
10	O-ring, Gland Seal	Rubber	BUNA-N
11	Cover, Cable Assembly	—————	—————
12	O-ring, Cover	Rubber	BUNA-N
13	Capscrews, Cover	SST	AISI Type 316
14	Lower Bearing Housing	Cast Iron	A48 CL30
15	Retaining Ring, Bearing	Steel	Commercial
16	Moisture Detectors	—————	Commercial
17	Resistor	—————	—————
18	Pipe Plugs, Water Seal	Cast Iron	Commercial
19	Inspection Plug	SST	18-8
20	Circulator	SST	A167 Type 304
21	Water Jacket	Cast Iron	A48 CL30
22	Retaining Ring, Water Jacket	SST	Commercial
23	O-ring, Upper Jacket	Rubber	BUNA-N
24	O-ring, Lower Jacket	Rubber	BUNA-N
25	Stand Tube	SST	AISI Type 316
26	Retainer, Jacket	SST	AISI Type 316
27	Capscrew, Jacket	SST	AISI Type 316
28	Capscrew, Handhole Cover	SST	AISI Type 316
29	Motor Housing, Top	Cast Iron	A48 CL30
30	Capscrews, Top Housing	SST	AISI Type 316
31	Bail, Lifting	SST	AISI Type 316 or 17-4 PH
32	Capscrews, Bail	SST	AISI Type 316
33	Motor Housing	Cast Iron	A48 CL30
34	Stator	—————	—————
35	Hole Cover	Steel	Commercial
36	O-ring, Housing	Rubber	BUNA-N
37	Capscrew, Housing	SST	AISI Type 316
38	Ground Screw	—————	Commercial
39	Terminal Board Assembly	—————	—————
40	Leads, Moisture Detector	—————	—————
41	Insulator, Shrink Tube	Polyolefin	Commercial
42	O-ring, Term Board	Rubber	BUNA-N
43	Retaining Ring, Term Board	Steel	Commercial
44	Cover, Lower Bearing	Cast Iron	A48 CL30
45	Capscrew, Lower Bearing Cover	SST	AISI Type 316
46	Bearing, Radial	Steel	Commercial
47	Bearing, Thrust	Steel	Commercial
48	Inner Mechanical Seal	—————	—————
49	Outer Mechanical Seal	—————	—————
50	Cover, Handhole	Cast Iron	A48 CL30
51	O-ring, Handhole Cover	Rubber	BUNA-N

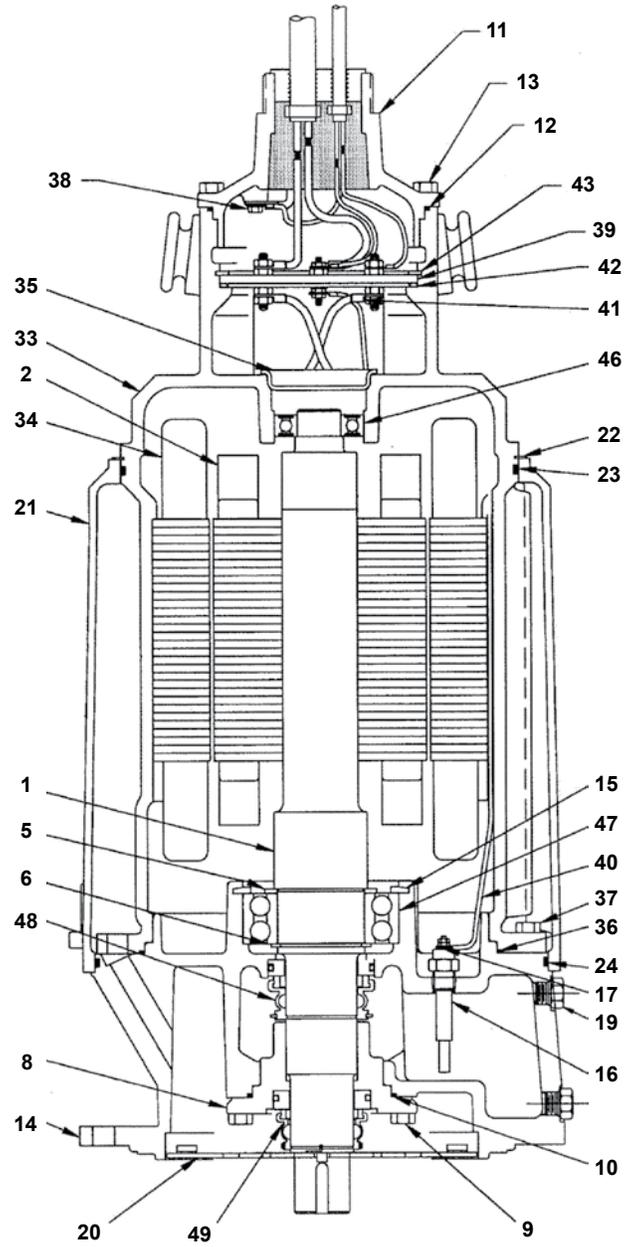
Notes:

All material specifications are ASTM unless otherwise noted.
Optional O-ring and mechanical seal materials are available.

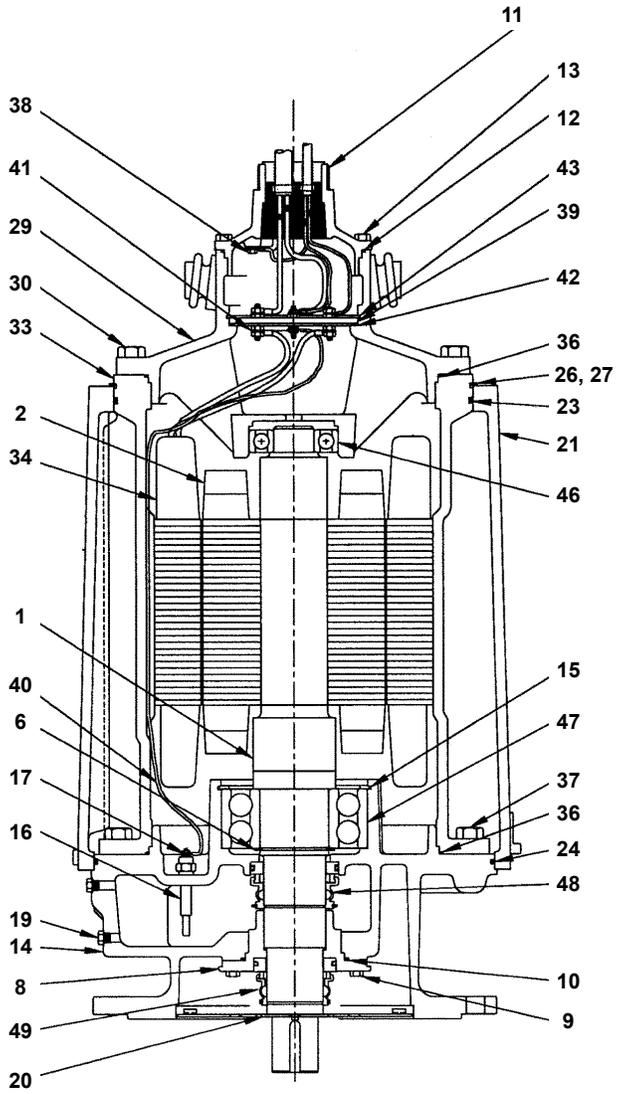
210 FRAME



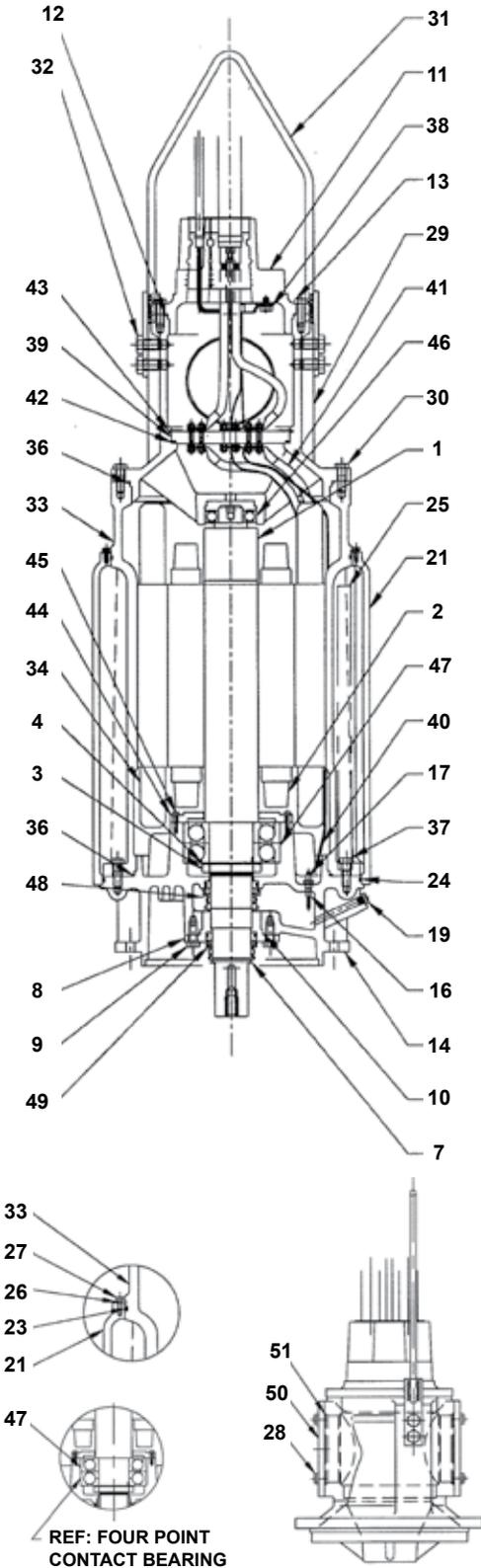
250 FRAME SHOWING OPTIONAL WATER JACKET



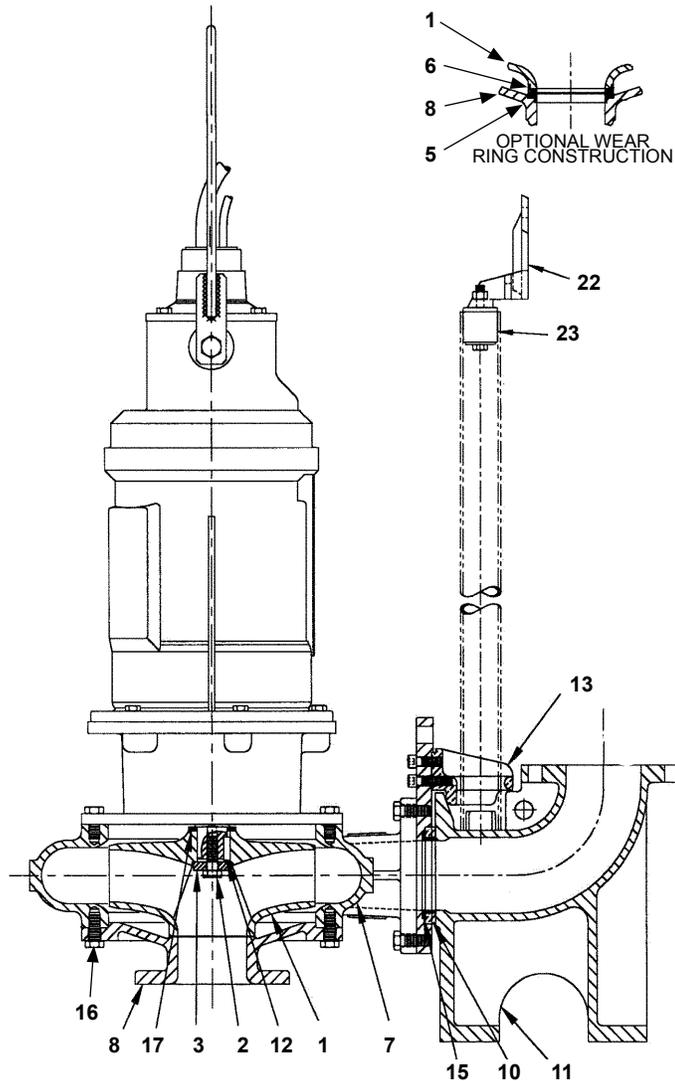
320, 360 AND 365 FRAME
 SHOWING OPTIONAL WATER JACKET



400, 440, 445 AND 490 FRAME
 SHOWING OPTIONAL WATER JACKET



D5430MT THROUGH 365 FRAME



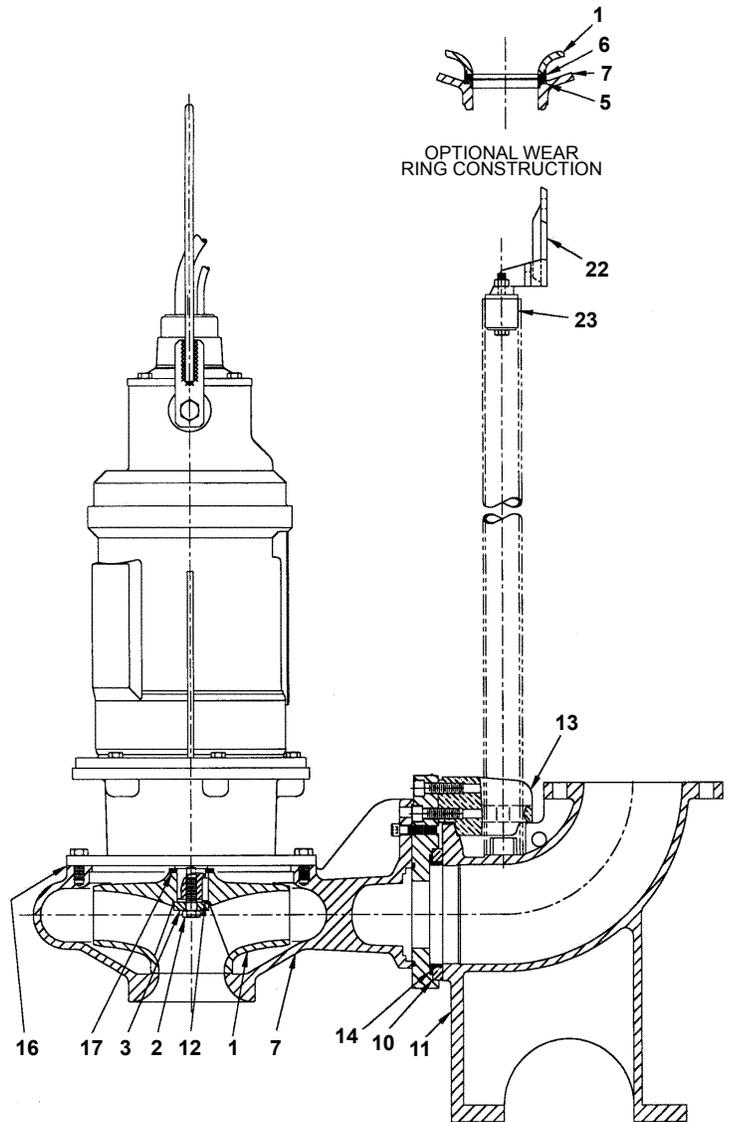
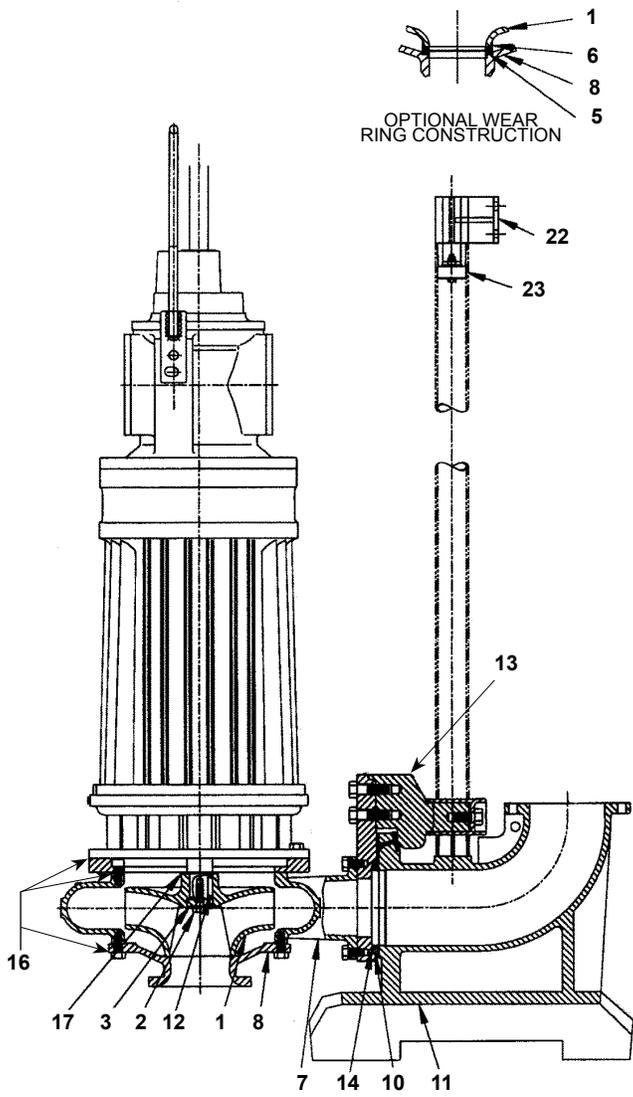
D5430, 5730 AND 2430 M&W PARTS IDENTIFICATION LIST

Item	Description
1	Impeller
2	Capscrew, Impeller
3	Washer, Impeller
4	Base
5	Wear Ring, Fronthead
6	Wear Ring, Impeller
7	Volute
8	Fronthead
9	Elbow, Suction
10	Ring, Flange
11	Base Elbow, Discharge
12	Key, Impeller

Item	Description
13	Bracket, Guide
14	Gasket, Elbow
15	Seal, Flange
16	Gasket, Volute
17	Shim, Impeller
18	Cover, Volute Handhole
19	Gasket, Volute Handhole Cover
20	Cover, Suction Elbow Handhole
21	Gasket, Suction Elbow Handhole Cover
22	Bracket, Upper Guide
23	Bushing, Upper Guide Bracket
24	Coupling, Discharge

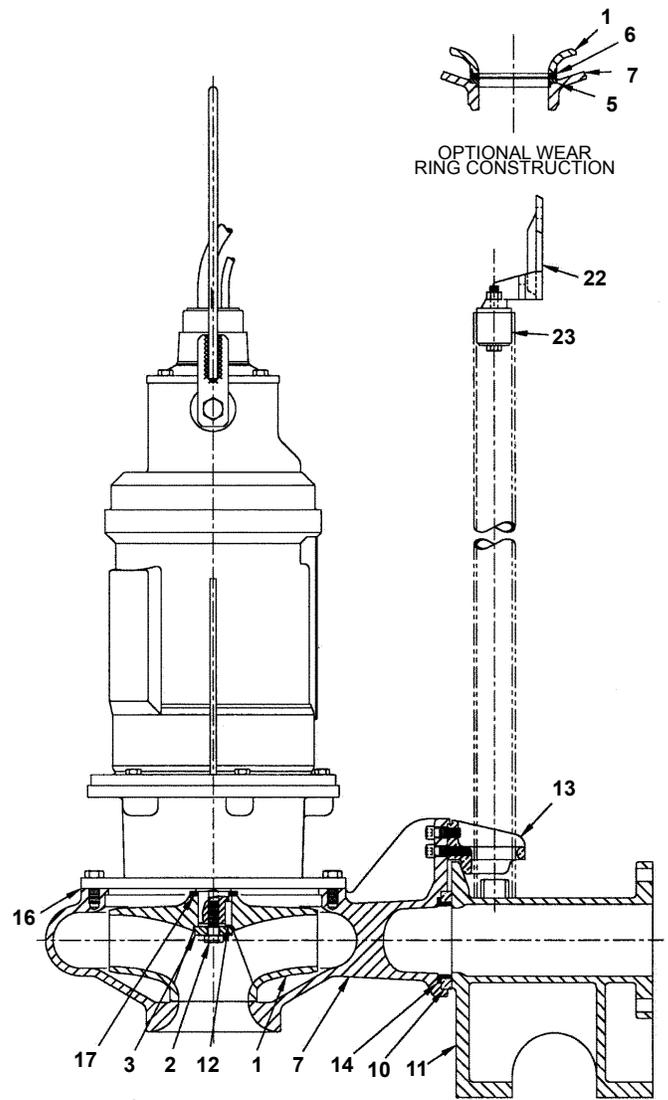
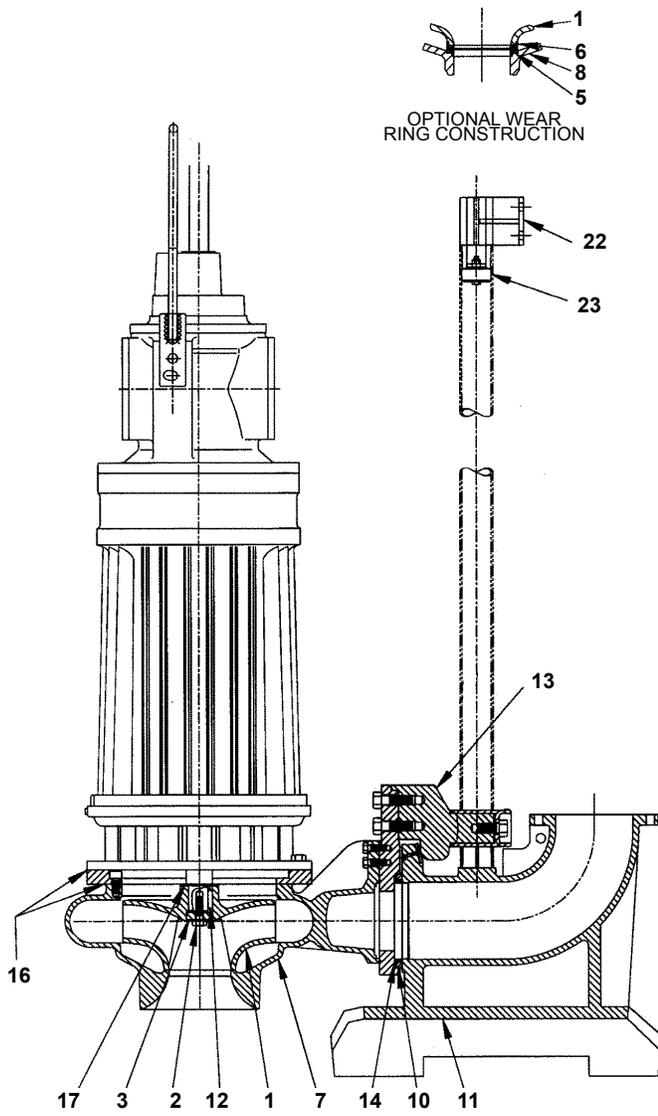
D5430MT 400, 440 AND 490 FRAME

D5430MV THROUGH 365 FRAME

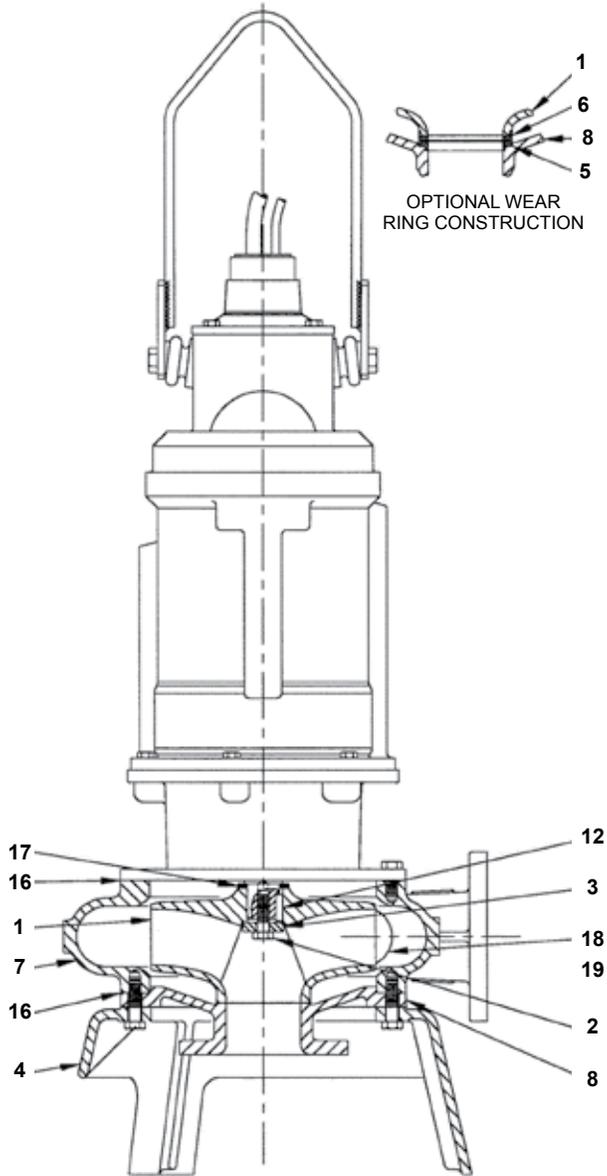


D5430MV 400, 440 AND 490 FRAME

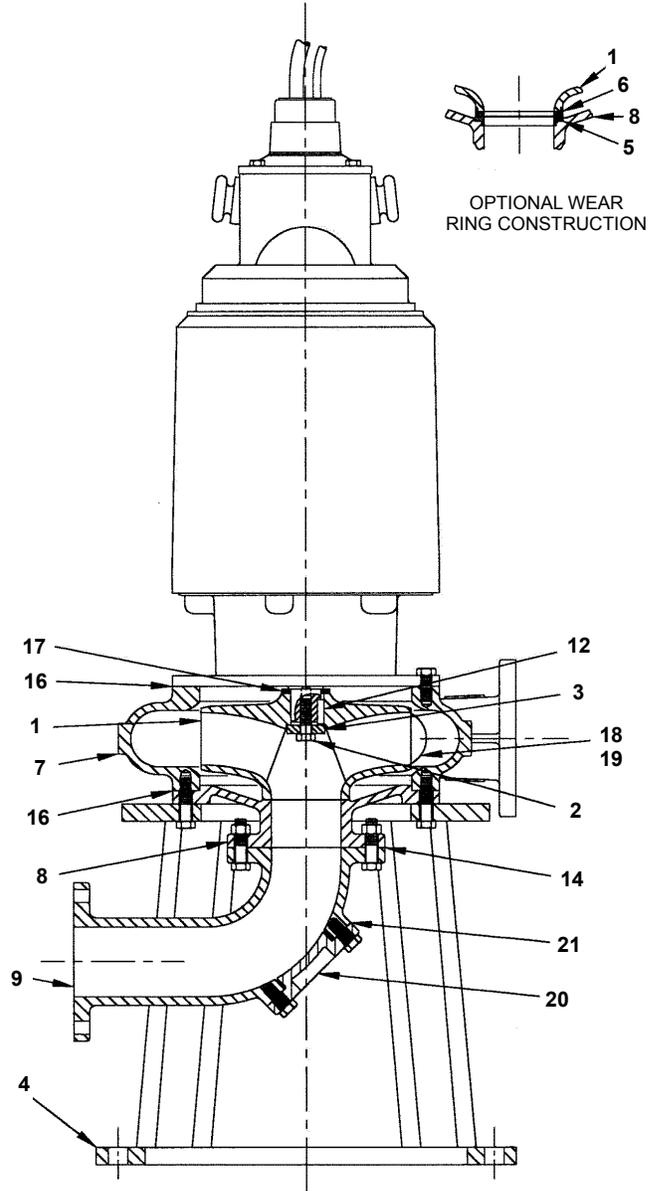
D5430MVS



D5430W

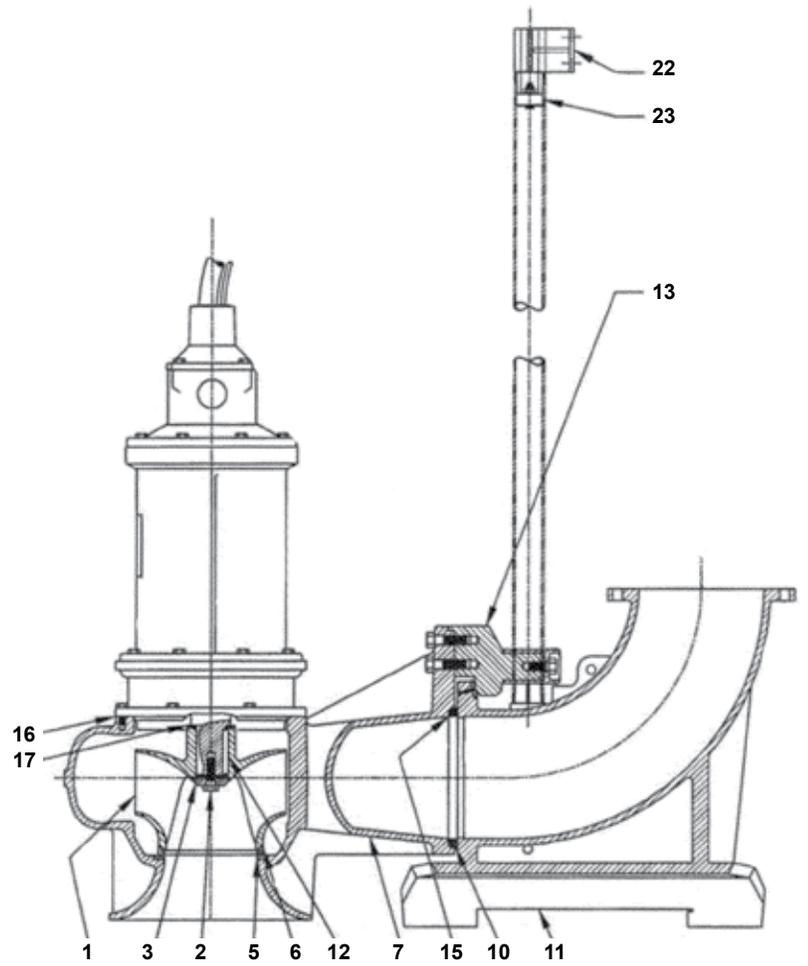
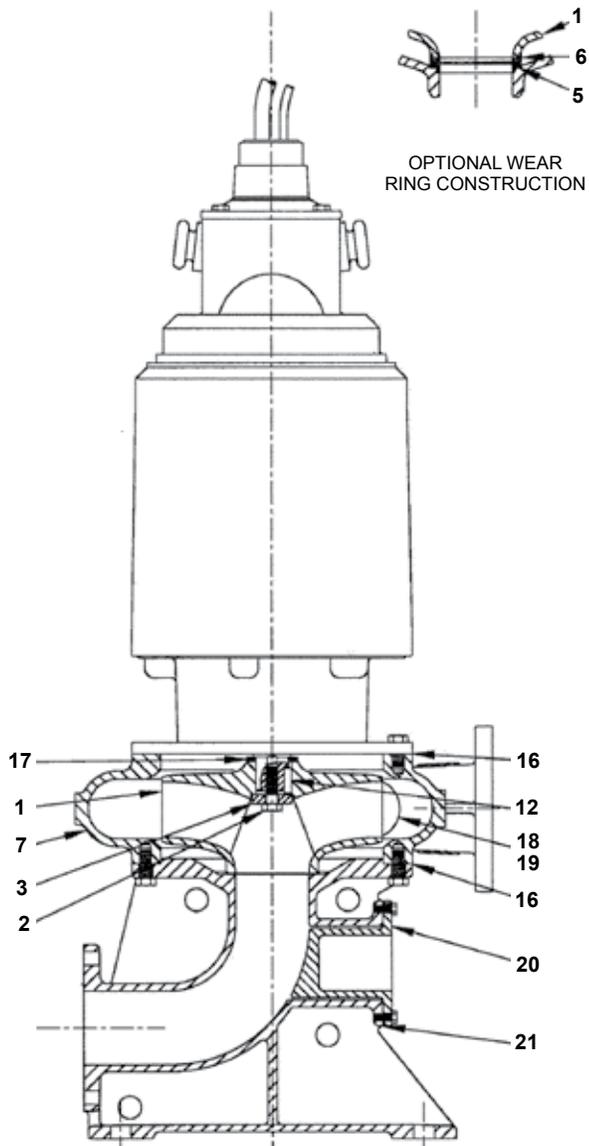


D5439WD



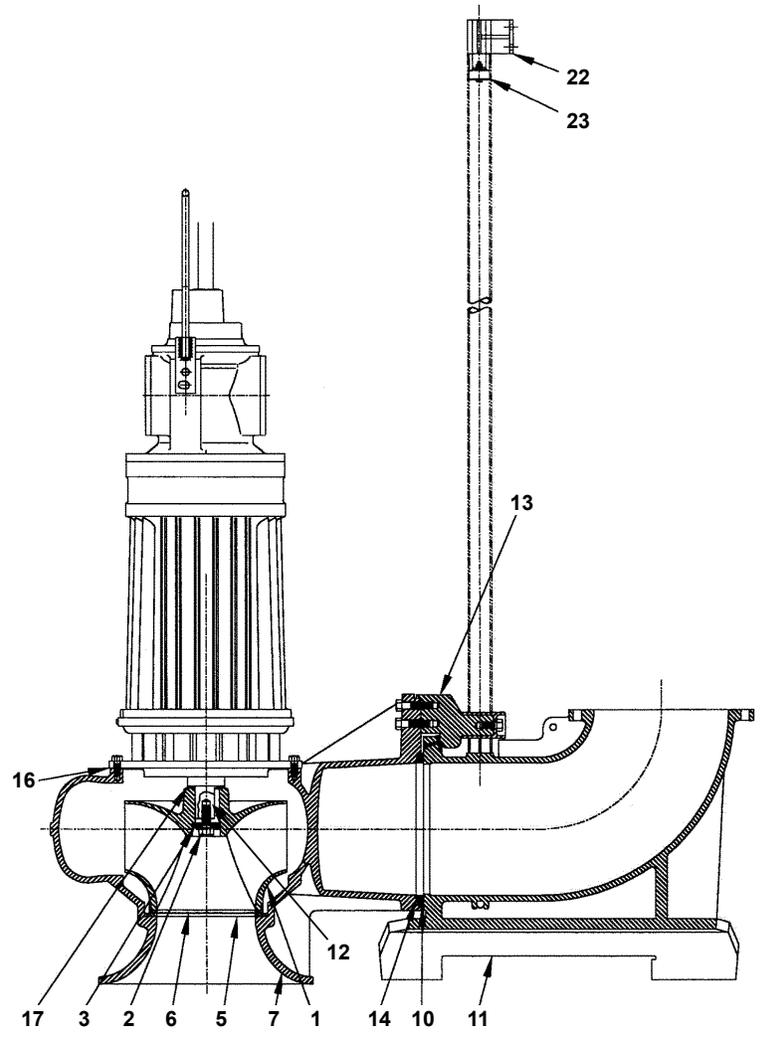
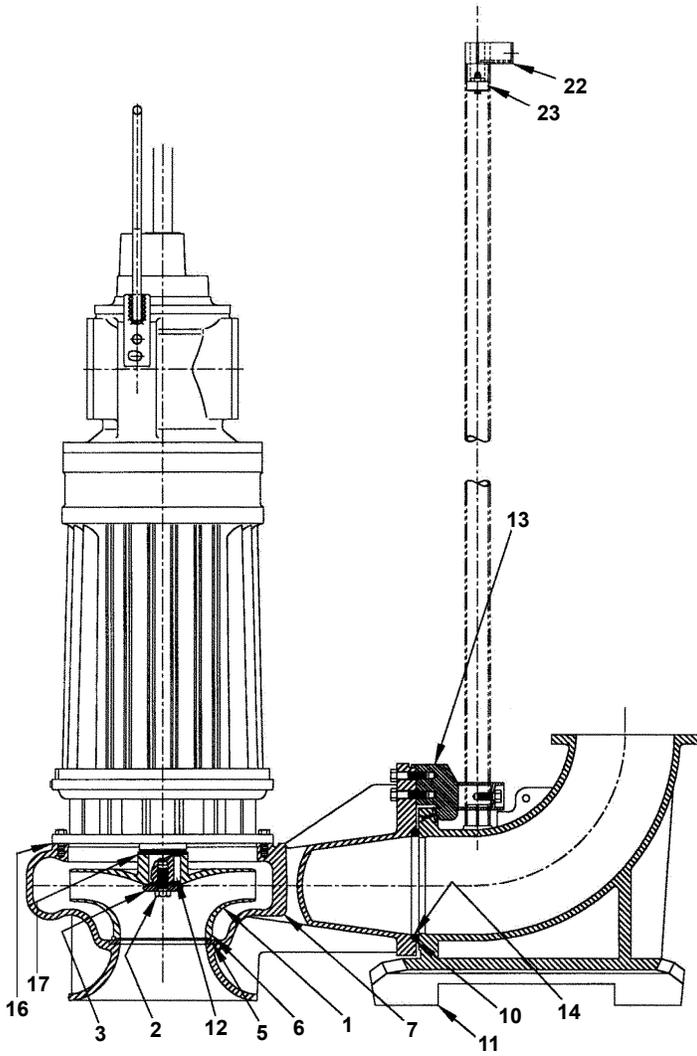
D5430CWD

D5731MV



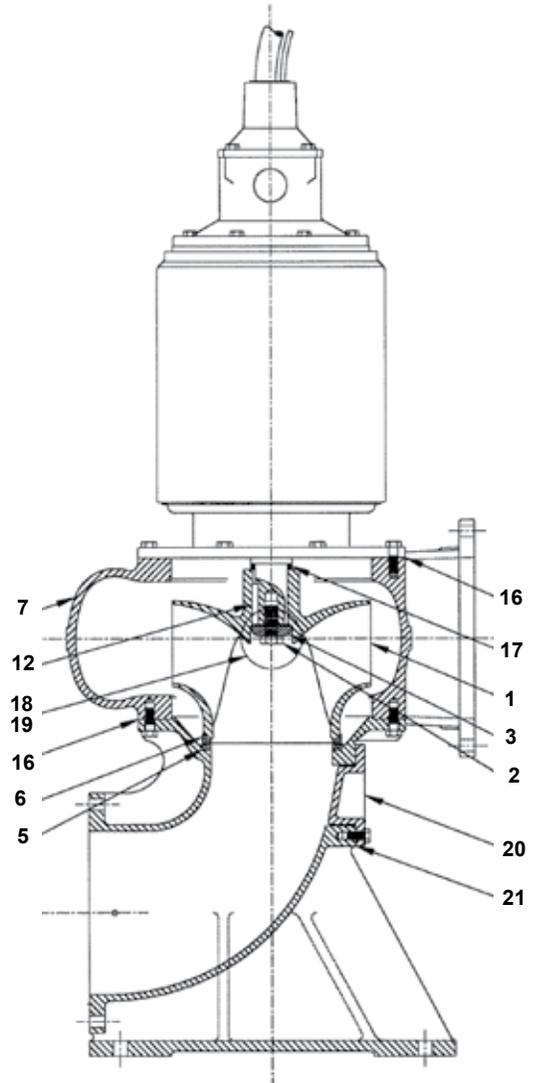
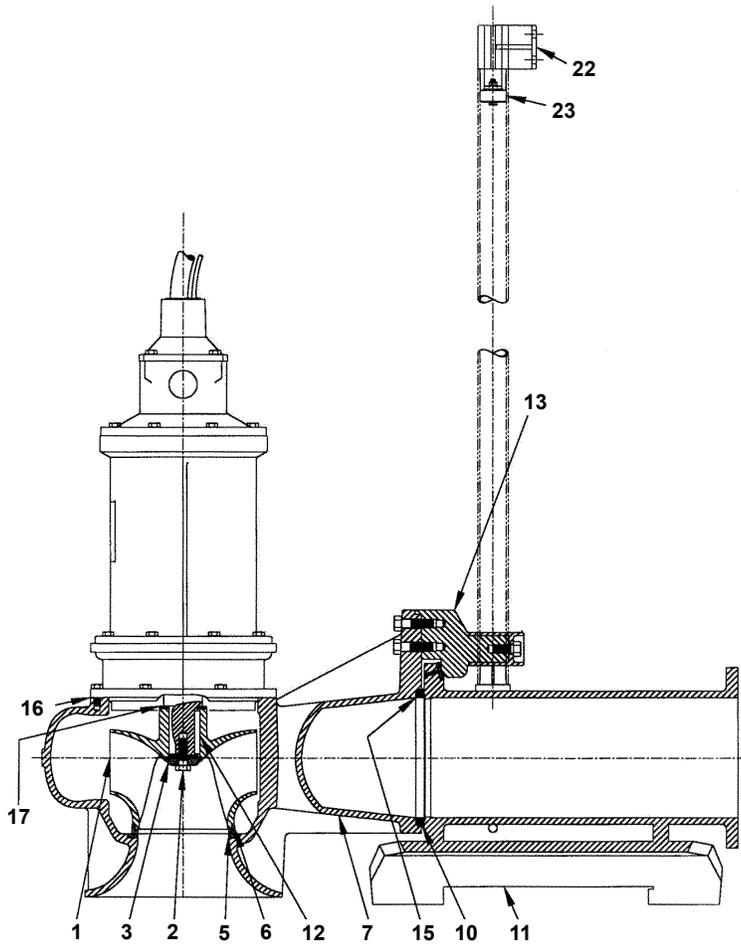
D5733MV

D5831MV



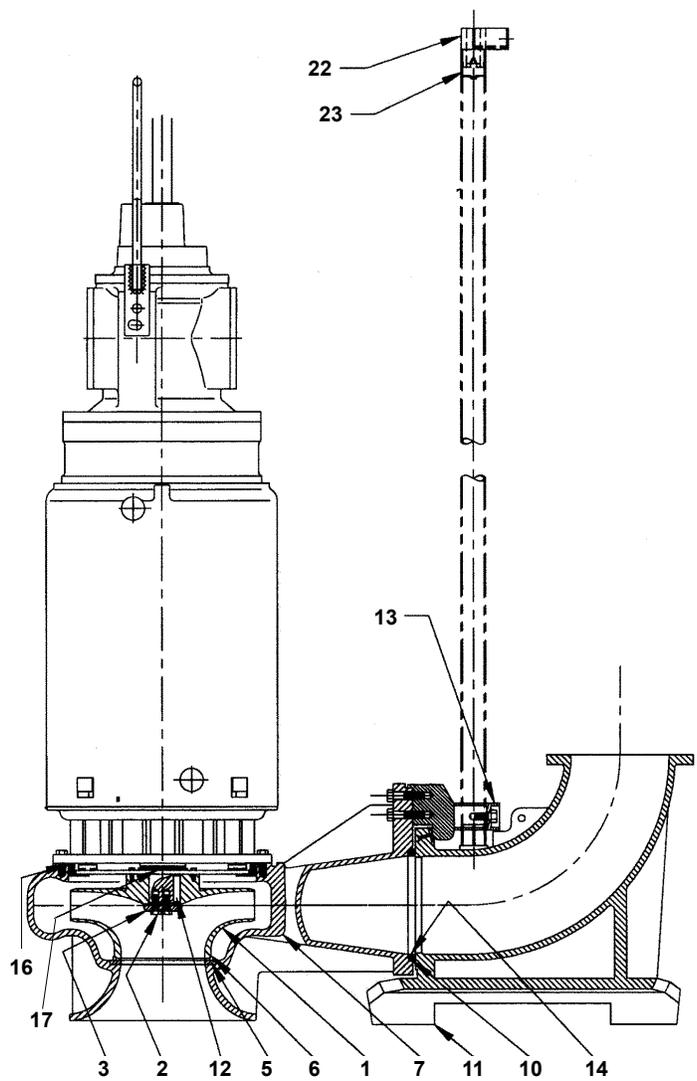
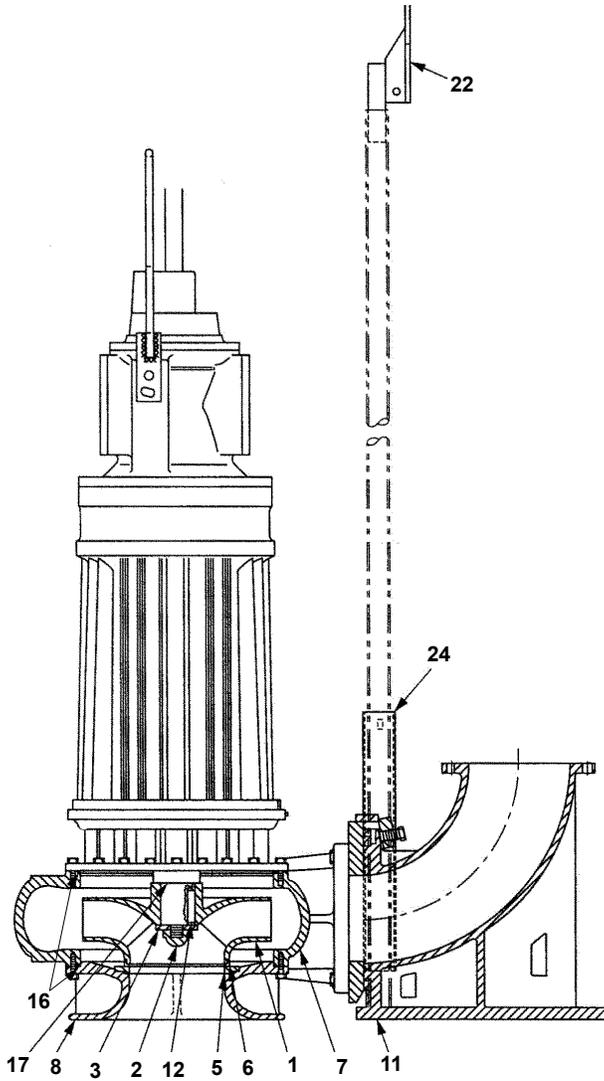
D5731MVS

D5731CWD DRY-PIT WITH COMBINATION BASE ELBOW SHOWN

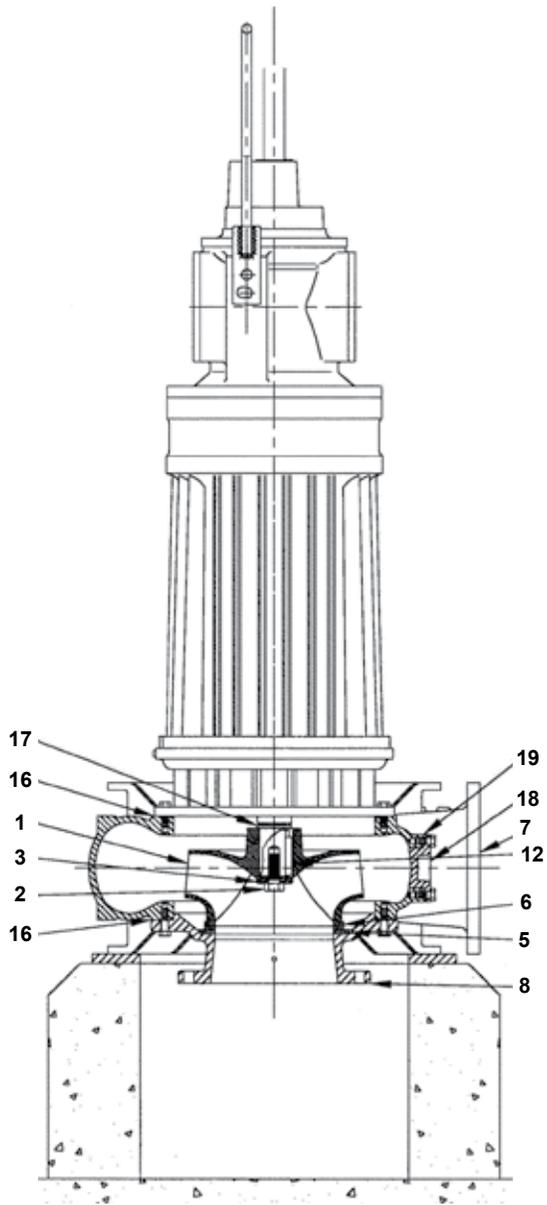


D2436M

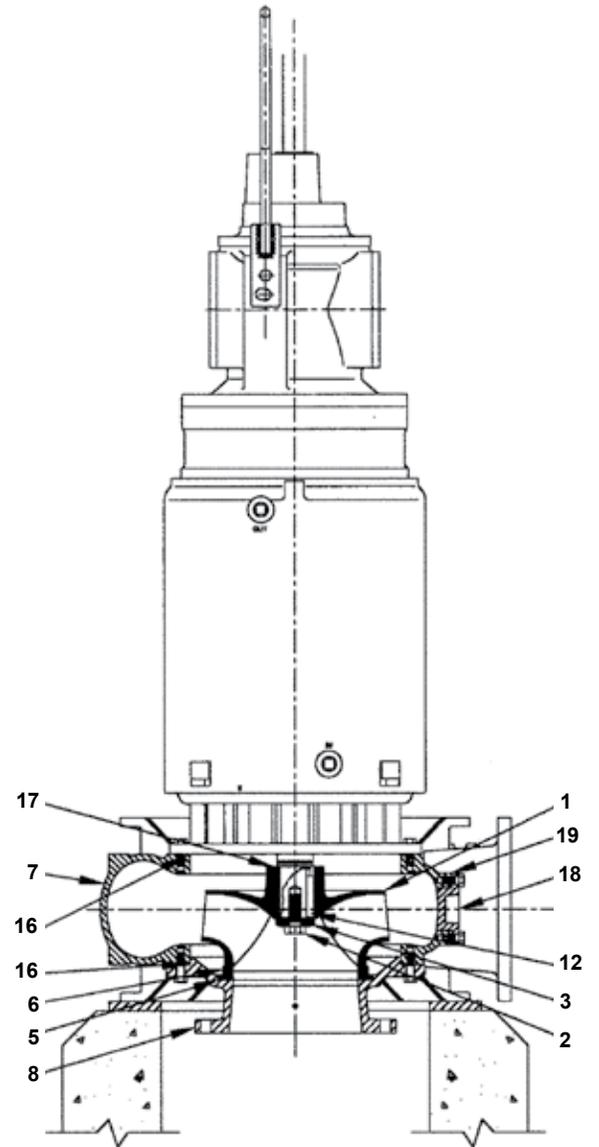
D2430MV



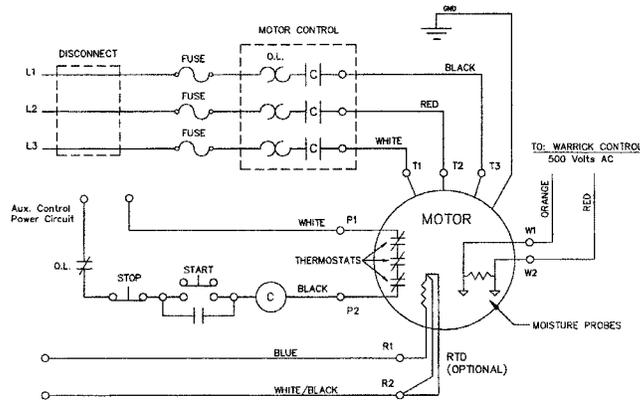
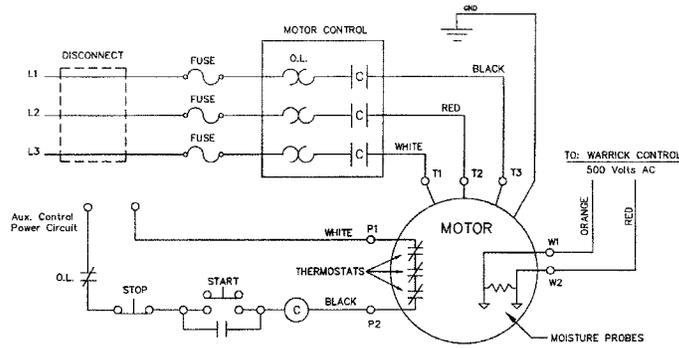
D2430W



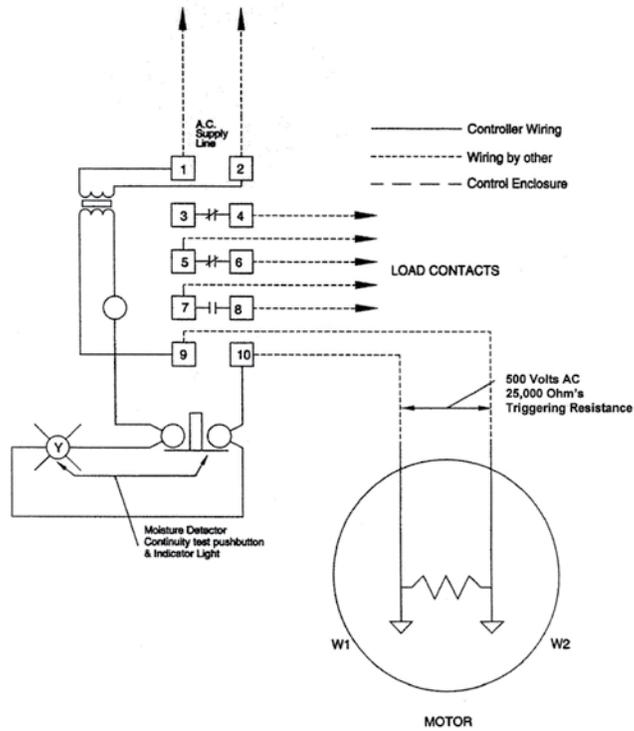
D2430WD



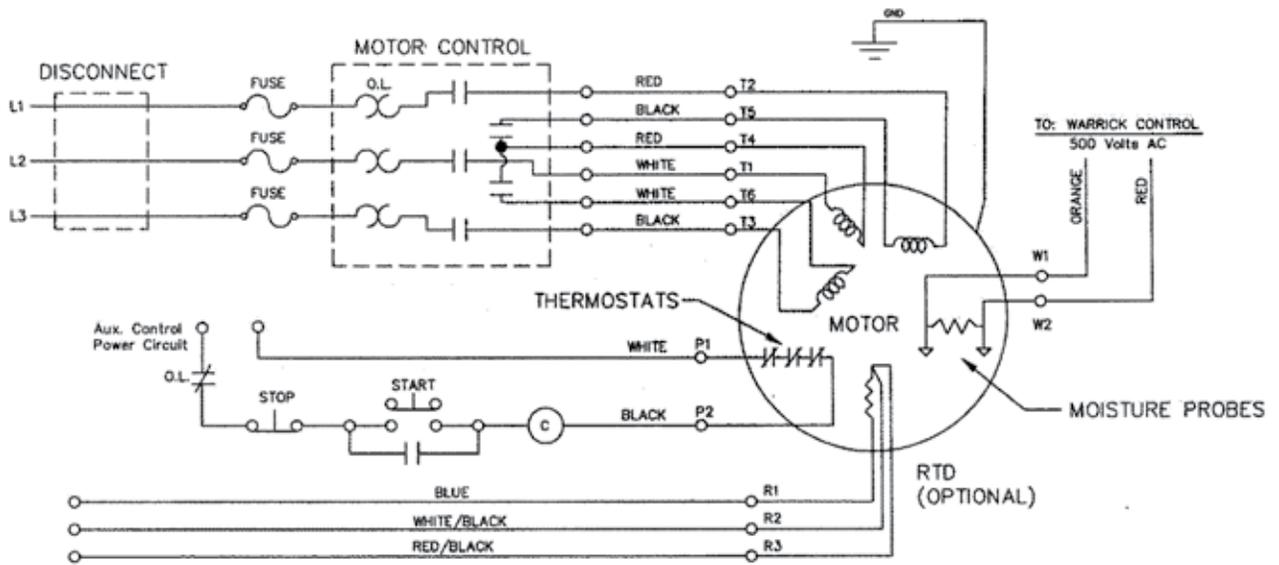
210, 250, 320, 360 AND 365 FRAMES



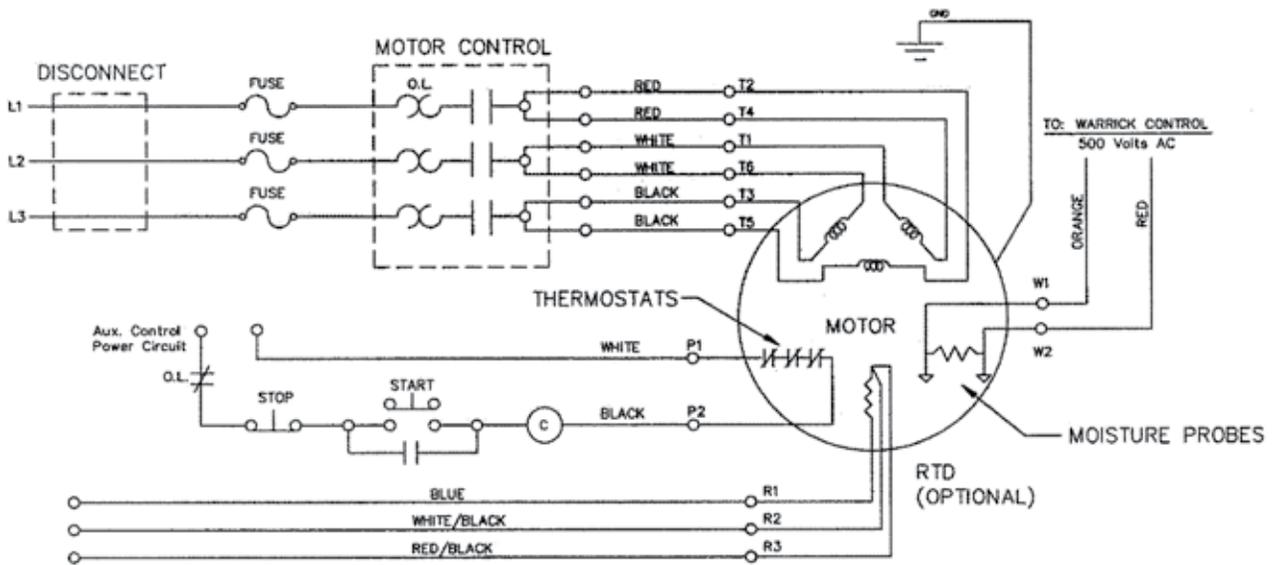
MOISTURE DETECTION CONTROLLER



440 AND LARGER FRAME

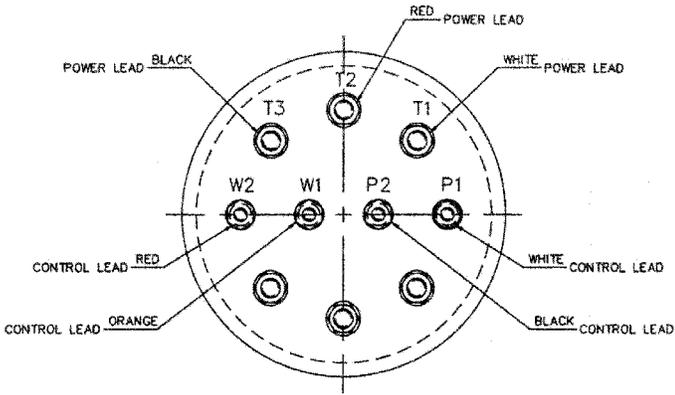


WYE-START DELTA RUN

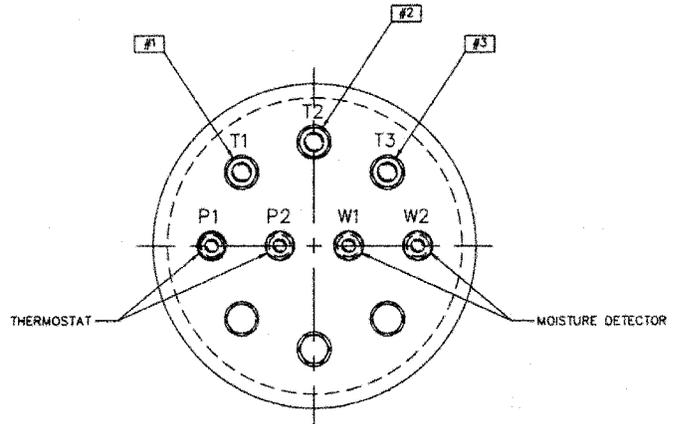


DELTA START DELTA RUN

TERMINAL BOARD CONNECTIONS 210-400 FRAME SINGLE VOLTAGE

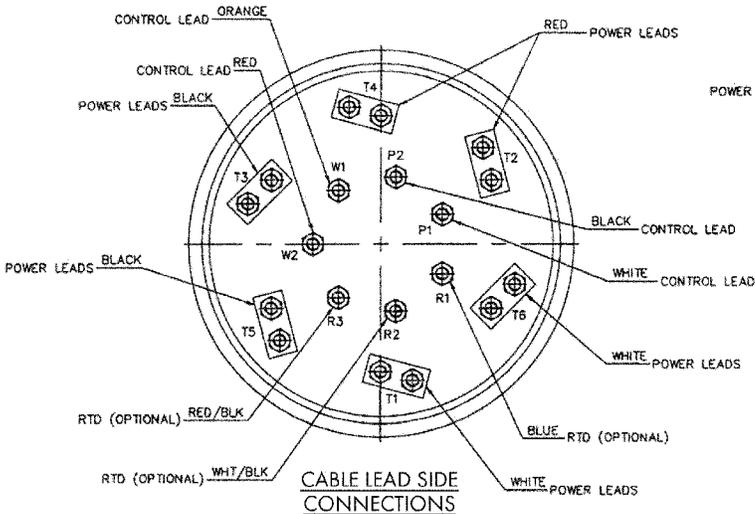


CABLE LEAD SIDE
CONNECTIONS

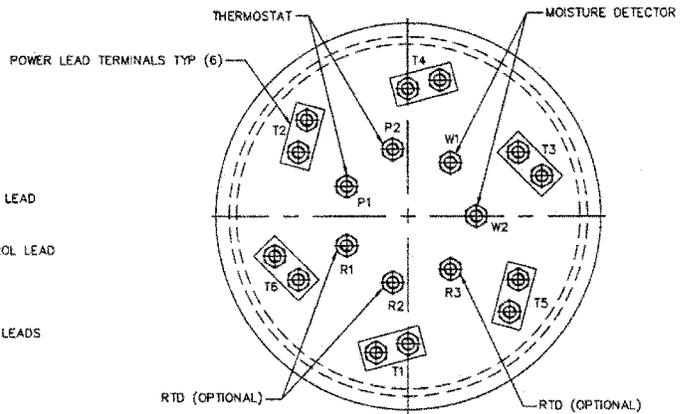


MOTOR LEAD SIDE
CONNECTIONS

TERMINAL BOARD CONNECTIONS 440-445 FRAME

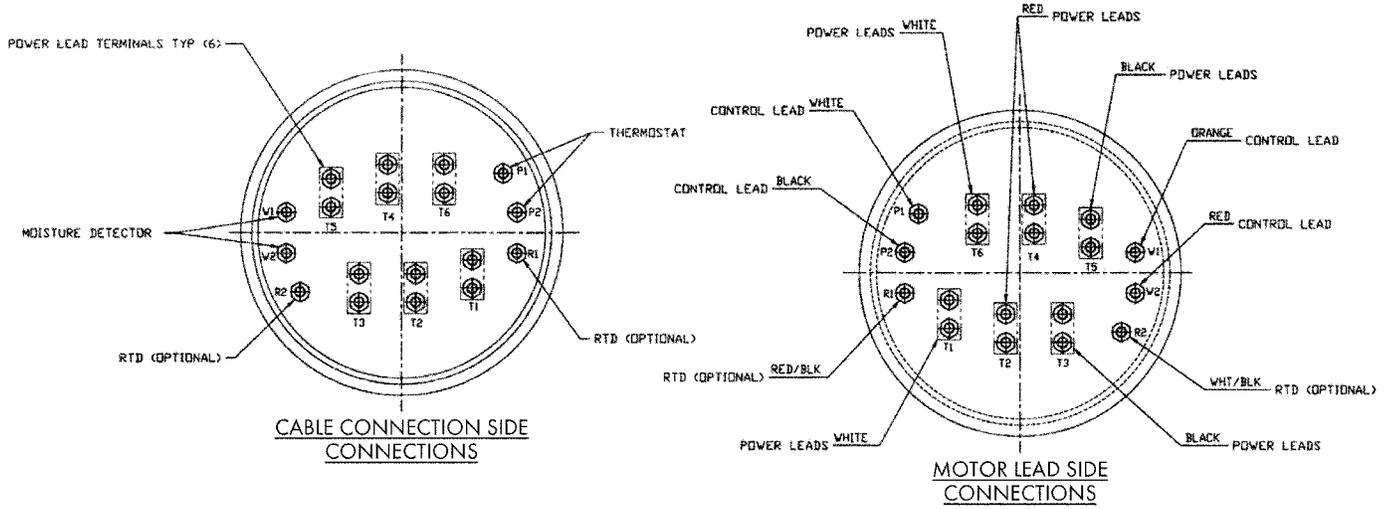


CABLE LEAD SIDE
CONNECTIONS

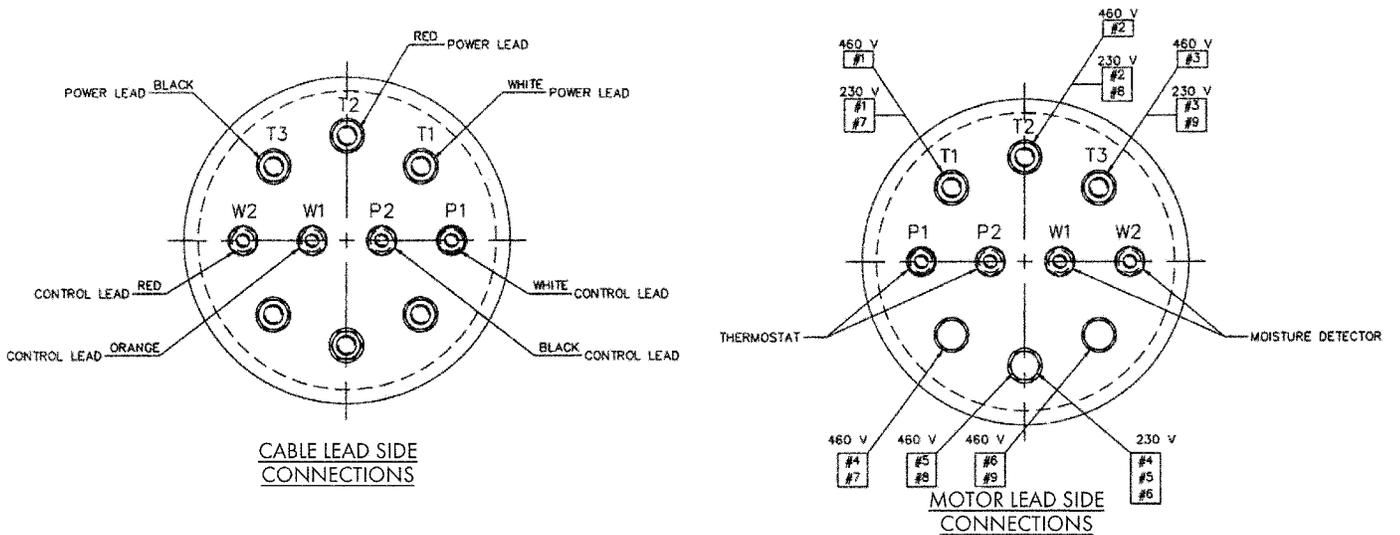


MOTOR LEAD SIDE
CONNECTIONS

TERMINAL BOARD CONNECTIONS 490 FRAME



TERMINAL BOARD CONNECTIONS 210-320 FRAME DUAL VOLTAGE



SUBMERSIBLE PUMP/MOTOR START-UP CHECKLIST

Contractor _____ Pump Serial Number _____
 Project Name _____ Pump Model Number _____
 Date of Shipment _____ Motor Serial Number _____

	Procedure	Yes	No	N/A	Comments
1.	Shipment Was there any damage in transit? (If so, has freight claim been filed?) Were all items received?				_____ _____
2.	Storage Has equipment been protected from the elements? Was equipment subject to flooding?				_____ _____
3.	Installation (All) Is grouting under base or elbow properly compacted? Is grouting of the non-shrink type? Have proper anchor bolts been used? Have the bolts been properly tightened? If motor is furnished with a water jacket and piped to external water source, what are flow & pressure readings? _____ GPM, _____ PSI. Installation (M or MV Pull-Up) Is fit between pull-up adapter and elbow correct? Are guide rails plumb and straight? Is power and control cable protected from possible damage? Installation (W) Has discharge been checked for pipe strain? Installation (W/D) Have both suction & discharge been checked for pipe strain?				_____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____
4.	Rotation Has the rotation of the drives been checked for correct rotation? Are moisture detectors wired into controls? Are thermostats wired into controls? Is motor wired to a continuous meggering device? Do controls have proper disconnect protection? Are heater coils correctly sized and installed properly? Are controls wired with an alarm that will promptly notify personnel if a problem develops?				_____ _____ _____ _____ _____ _____ _____
5.	System Has the system been checked to insure that it is free of foreign matter which could be damaging to the pump? Is liquid available to the pump? Has assurance been obtained from responsible parties that all piping is secure and that the routing of flow has been established and is correct? Are liquid levels properly set?				_____ _____ _____ _____
6.	Start-Up Has flow been established? Flow rate: _____ GPM Have gauge readings been taken? Suction pressure: _____ PSI Discharge pressure: _____ PSI Is excessive vibration present? What is recorded line voltage? _____ volts What is motor amp draw on each leg? 1.) _____ 2.) _____ 3.) _____				_____ _____ _____ _____ _____ _____
7.	Safety Have all safety labels been read and understood?				_____

Name _____ Date _____
 Name _____ Date _____

THIS PAGE INTENTIONALLY LEFT BLANK



5 YEAR WARRANTY

FAIRBANKS NIJHUIS SUBMERSIBLE PUMPS AND MOTORS FOR USE IN MUNICIPAL SEWAGE COLLECTION: PERMANENT INSTALLATION

Fairbanks Nijhuis Pump ("Seller") extends a five (5) year prorated limited warranty from date of shipment on submersible pumps and motors of its own manufacture against defects in materials and workmanship. The Buyer must give written notice of any alleged defect covered by this warranty within a reasonable time after the claim arises which time shall not exceed thirty (30) days. No claim made after the expiration of the warranty shall be valid. Seller does not warrant accessories of 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.

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.

This warranty shall run for a period of five (5) years from the date of shipment for pumps and motors, permanently installed, maintained and operated in accordance with the Fairbanks Nijhuis Pump Installation, Operation and Maintenance Manuals in use at the time of sale and as amended from time to time to the extent the Buyer has notice of such amendments. Warranty is void if moisture detectors and thermostats are not properly wired and if electrical cable between motor control panel and motor is spliced.

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. Underwriters Laboratories Listed motors must be repaired at a certified UL repair Facility, otherwise the UL Listing is void. 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.

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 parts, and labor to replace those parts, and is not extended to the product or any other component of the product being repaired.

THIS WARRANTY IS THE SOLE WARRANTY OF FAIRBANKS NIJHUIS PUMP AND FAIRBANKS NIJHUIS PUMP 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. This warranty does not apply to parts that fail due to abuse or normal wear (including, but not limited to impeller, wearing rings, seals and bearings). Under the terms of this warranty, Fairbanks Nijhuis Pump shall not be liable for: (a) consequential, incidental, collateral, special or liquidated losses or damages; (b) equipment conditions caused by normal wear and tear, abnormal conditions of use, improper operation, acts of God, 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 those authorized by Fairbanks Nijhuis Pump (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 expense of shipment of equipment or repaired or replacement parts; or (g) any other loss damage or expense of any nature. The liability of Fairbanks Nijhuis Pump shall in no event exceed the purchase price of the individual unit of equipment paid by the original Buyer.

The Buyer's exclusive remedy under this warranty shall be for Fairbanks Nijhuis Pump to repair or replace on an adjusted basis the parts failing due to defects in materials and/or workmanship. The Buyer will be invoiced for such repairs at the prorated percentage rate in the table below:

Repair Parts Price Factor

Months After Shipment	Sell Price Factor
0-18*	No Charge
Thru 36	.50
37 - 48	.70
49 - 60	.80

* Or not to exceed 12 months after installation, whichever comes first.

All repairs or service which are not covered by this warranty will be charged in accordance with standard prices in effect. In-shop labor for motor or pump repairs for the first 12 months after installation will be at no charge. After this period, labor charges for repair are the responsibility of the Buyer. Charges for removal, transportation, reinstallation and all associated additional cost, are not covered under warranty. Fairbanks Nijhuis Pump shall have the option, but shall not be obligated, to provide in lieu of repair a replacement for any equipment that is defective.

CONDITION TO WARRANTY WORK: If Buyer is in default (including, but not limited to, the failure of Buyer to maintain a current account with Seller) under the Order or any other agreement between Buyer and Seller, Buyer's rights under the warranty shall be suspended and the original warranty period will not be extended.

PERFORMANCE: Performance curves and other information submitted to Buyer are used to illustrate the general type and quality of the equipment and not to represent that the equipment will necessarily be of that type or nature. No warranty or guarantee shall be deemed to arise as a result of such submittal unless separately agreed to in writing by Fairbanks Nijhuis Pump.