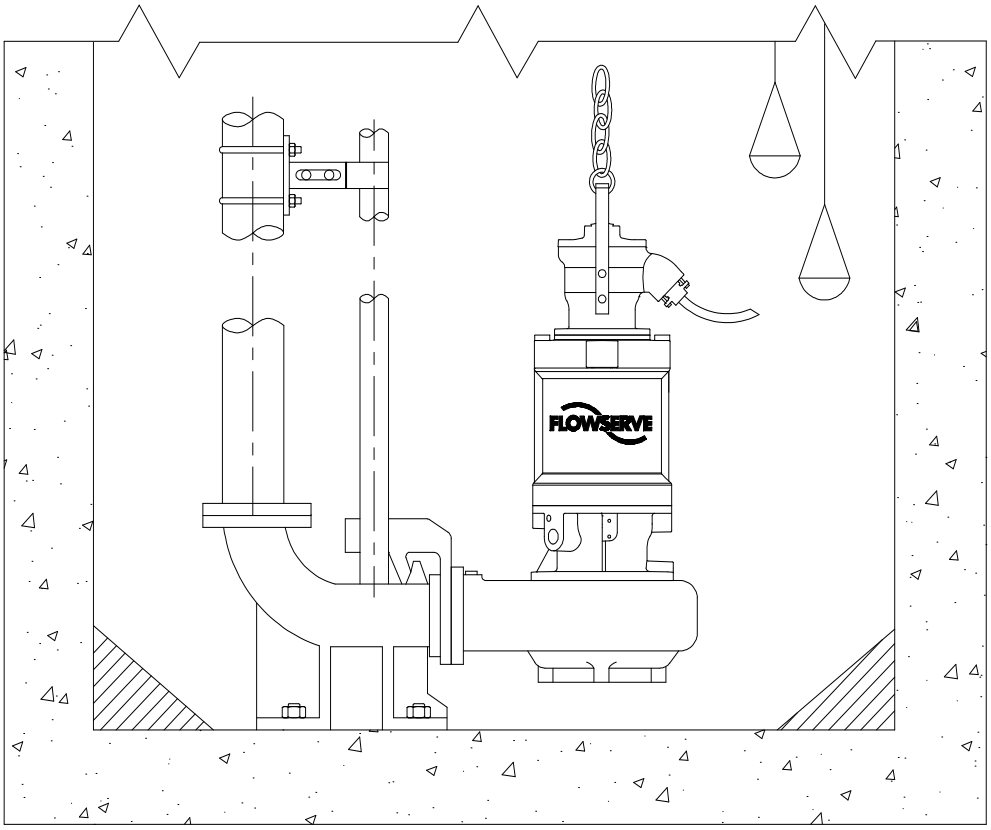
FLOWSERVE®

Pump Division



Type: MSX

Series 3, Non-Clog Submersible Pump

CENTRIFUGAL PUMPS

USER INSTRUCTIONS: INSTALLATION, OPERATION, MAINTENANCE

P/N 89155485

⚠ *These instructions should be read prior to installing, operating, using and maintaining this equipment.*

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FLOWSERVE Submersible Pump Start-Up/Warranty Registration

End User Information

Name _____

Address _____

City _____

State _____ Zip _____ Phone _____

Operator's Name _____

Model Number _____ HP _____

Serial Number _____

New / Replacement – Replaces _____ Mfr)

Describe Overall Condition of Pump(s) at Start-Up

_____

Pump(s) Storage - No. of Months _____
Indoors ____ Outdoors ____
Condition of Motor Cable _____
Were pump ends properly protected? Y / N If not, explain _____

Discharge Elbow and Guide Rail System

Upper guide rail bracket(s) bolted securely: Y / N
Slide rail base(s) properly bolted down: Y / N
Guide rails exactly vertical: Y / N
Base elbow exactly level: Y / N
Debris in bottom of station: Y / N
Liquid being pumped _____

Installation of Float Switches

Circle type of float arrangement: (Free Hanging) (Fixed to pipe)
Are float switches hanging free? Y / N
On cable fixed to pipe or rail, free length set at _____ ft.
Check/confirm that influent flow will not tangle floats: Y
Float Switch Location:

	Simplex	Duplex	
Pump off	_____	_____	ft. above top of pump
Pump on	_____	_____	ft. above off level
Lag pump on	_____	_____	ft. above on level
High level alarm	_____	_____	ft. above lag pump on

Control Panel

General condition at start-up _____

Manufacturer's identification No. _____

How is it mounted? _____

Approximate distance from pump _____ ft.

Is there a junction box in pit? Y / N Where? _____

Electrically connect the pump leads, float switches and power supply leads per instructions located in the control panel door.

Does panel include water-sensing relay(s)? Y / N
Make/Model of relay(s): _____

Confirm winding thermostat leads were correctly connected to appropriate relay in control box: Y / N
Confirm wiring was done correctly: Y / N

Pump Rotation Check

Check rotation by bumping the motor starter for rotation and viewing the impeller rotation through the discharge. Confirm that the correct rotation is clockwise when viewed from above. Y / N
Caution - Stand clear of pump when testing.

Meg OHM Check of Insulation

B-G _____ R-G _____ W-G _____

Install Pump in Pit

WARNING: Do not use pump power cables to lower pump.

Line Voltage
Power supply line voltage:
B-R _____ R-W _____ W-B _____
Power supply frequency: _____ Hz
See instruction manual if voltage variance exceeds 10%.

Average Pump Running at Rated COS
B _____ Amps R _____ Amps W _____ Amps

List Any Equipment Difficulties During Start-Up

Final Check

Is pump seated properly: Y / N
Do valves operate properly: Y / N

Nameplate Data

Phase _____ Hz _____ Voltage _____ RPM _____
Capacity _____ Head _____

Start-Up Information

Name	Present at Start-Up
Customer _____	Y / N
Contractor _____	Y / N
Consult. Eng. _____	Y / N
Representative _____	Y / N

Started by: _____
Firm: _____
Date: _____ Title: _____

I certify that the equipment has been inspected and is ready for permanent operation.

Signed: _____ Date: _____

This report must be submitted to Flowserve Pump Division to activate warranty.

Mail or Fax to:
Flowserve pump Division
5310 Taneytown Pike
Taneytown MD 21787
Attention: MSX Service Department

Fax 410-756-2615

WARNING: Consult Instruction Manual before performing any start-up functions listed above.

FOREWORD

Flowserve Pump Division products are the result of more than a century of progressive study and development. Advanced design, proper selection of materials and precision construction reflect this wide experience.

Flowserve Pump Division products are designed to give trouble-free, efficient operation with minimum maintenance and repair. This instruction book will familiarize management and operating personnel with pertinent details and procedures for the installation, operation and maintenance of these pumps.

The spaces below are for your identification of the equipment to which the book applies.

Unit Size	Serial No.	Identification No.

WARNING: THESE PUMPS (OR PROTOTYPES) HAVE BEEN SHOP TESTED AND FOUND SATISFACTORY FOR THE CONDITION FOR WHICH THEY WERE SOLD.

DO NOT OPERATE IN EXCESS OF THEIR RATED CAPACITY, SPEED, PRESSURE, AND TEMPERATURE. REFER TO MOTOR NAMEPLATE FOR APPLICABLE RATINGS

BE SURE THAT THE FOLLOWING GUIDELINES ARE MET WITH RESPECT TO AC POWER:

1. **SUPPLY POWER IS WITHIN 10% OF RATED VOLTAGE AT RATED FREQUENCY.**
2. **SUPPLY POWER IS WITHIN 5% OF RATED FREQUENCY AT RATED VOLTAGE.**
3. **COMBINED VARIATION IN VOLTAGE AND FREQUENCY IS WITHIN 10% (SUM OF ABSOLUTE VALUES) OF RATED VALUES.**

STUDY THIS INSTRUCTION BOOK

The descriptions and instructions contained within this manual cover the standard equipment design and many common variations. This manual does not cover all design details and variations, nor does it provide for every possible contingency that may be encountered. When information cannot be found in this manual, contact the nearest Flowserve Pump Division Representative.

Section I: Introduction and General Description

INTRODUCTION

The Flowserve Pump Division MSX Series 3 non-clog submersible pump is a volute-type centrifugal pump designed for handling sewage and industrial waste. The pump is driven directly by a motor. This pump is suitable for use in wet or dry pit applications.

MOTOR

The Flowserve Pump Division submersible motor is a three-phase, squirrel cage motor with a watertight stator housing designed specifically for the operation of Flowserve Pump Division non-clog pumps. The power supply cable is brought into the motor through a watertight cable gland. The rotor is impregnated under vacuum with a baked-on varnish to protect it against corrosion and is then dynamically balanced. The motor is constructed to meet the requirements of the ANSI/NFPA 70 (National Electric Code) Class 1, Division 1, Group C & D explosion proof service. However, only motors nameplated Class 1, Division 1, Group C & D are certified as explosion proof.

CAUTION: MOTORS NAMEPLATED CLASS 1, DIVISION 1, GROUP C & D MUST BE SERVICED BY CERTIFIED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL. SERVICE BY PERSONS OTHER THAN FLOWSERVE PUMP DIVISION PERSONNEL VIOLATES SAFETY REGULATIONS, NEGATES THE EXPLOSION PROOF CERTIFICATION AND VOIDS THE FACTORY WARRANTY.

Prior to installing or operating your MSX Series 3 pump, become familiar with the following:

1. NEMA Publication MG-1 (or latest release) Safety Standards for Construction and Guide for Selection Installation and Use of Electric Motors and Generators
2. The National Electric Code
3. Local codes and practices

COOLING SYSTEM

The MSX Series 3 motor has a self-contained, closed-loop cooling system, which makes it suitable for dry pit as well as wet pit applications. The cooling system circulates a cooling fluid (Propylene Glycol / water mixture) around the motor, then across a heat exchanger plate, transferring heat to the pumped fluid. The cooling system is designed to maintain the motor winding temperature below 275° F (135° C).

Recommended Cooling Fluid: Dow Dowfrost HD (30% Propylene Glycol/70% Water).

CAUTION: THE OPERATION OF THE COOLING SYSTEM IS DEPENDENT UPON THE USE OF THE PROPER COOLING FLUID. THE USE OF A NON-APPROVED COOLING FLUID WILL INCREASE THE INTERNAL TEMPERATURE OF THE MOTOR, WHICH MAY RESULT IN PRODUCT DAMAGE AND WILL VOID THE FACTORY WARRANTY.

CAUTION: THE USE OF FLOWSERVE PUMP DIVISION REPLACEMENT PARTS IS CRITICAL TO THE PROPER OPERATION OF THIS COOLING SYSTEM. PRECISE TOLERANCES, METALLURGY, MANUFACTURING PROCESSES AND HEAT TREATMENT ARE IMPORTANT FACTORS IN THE DESIGN OF EACH COMPONENT AND THE SERVICE IT WILL PROVIDE. THE USE OF NON-OEM PARTS MAY RESULT IN PRODUCT DAMAGE AND WILL VOID THE FACTORY WARRANTY AND EXPLOSION PROOF CERTIFICATION.

BARRIER SYSTEM

A second fluid is used to provide a barrier between the conductive cooling fluid and the electrical components of the motor. The barrier fluid is a synthetic non-conductive oil that allows for seal failure detection by means of conductivity sensors in the barrier chamber of the bearing housing.

Recommended Barrier Fluid: Royal Purple Barrier Fluid GT22.

MOTOR THERMAL PROTECTION

The motor winding is protected by three thermal switches installed in series with normally closed contacts. The contacts will open when the winding temperature within the motor exceeds 275° F (135° C). The thermal switches must be wired into the motor starter inside the control panel such that the motor automatically shuts down in the event of overheating; see Figure 4: Motor Connection Diagram (page 16). Observe the amperage rating of the thermal contacts at the connected voltage.

WARNING:	**FAILURE TO PROPERLY CONNECT THE MOTOR THERMAL SWITCHES MAY RESULT IN PERSONAL INJURY OR PRODUCT DAMAGE AND WILL VOID THE FACTORY WARRANTY AND EXPLOSION PROOF CERTIFICATION.**

CABLE

The motor is supplied with cable available in 35, 50, 75 and 100 foot (10.5, 15, 23, 30.5 m) lengths. The cable jacket is suitable for extra hard usage and meets the requirements of Type W, G or SOOW per ANSI/NFPA 70 Article 400.

MECHANICAL SEAL

The motor is equipped with three mechanical seals designed to prevent the entrance of the pumped liquid and coolant into the motor cavity. The lower mechanical seal prevents the pumped liquid from entering the bearing housing (filled with cooling fluid). The upper tandem mechanical seals prevent contamination of the barrier chamber by the pumped liquid or the cooling fluid and prevent the fluids from coming into contact with the bearings and the motor winding. Mechanical seal failure is indicated by the moisture detection sensors in the barrier chamber of the bearing housing.

MOISTURE DETECTION SENSORS

Moisture detection sensors located in the barrier chamber of the bearing housing will detect failure of the mechanical seals by measuring the electrical conductivity of the fluid in the chamber. Contamination of the barrier fluid with the pumped liquid will cause the conductivity to increase. The alarm sensor must be wired into an approved moisture detection sensor relay to illuminate a light on the pump motor control panel with increased conductivity of the fluid. The unit should be taken off-line for service with illumination of the light. The shutdown sensor must be wired into an approved moisture detection sensor relay to trigger an automatic motor shutdown with increased conductivity of the fluid.

WARNING:	**FAILURE TO PROPERLY CONNECT THE MOISTURE DETECTION SENSORS MAY RESULT IN PERSONAL INJURY OR PRODUCT DAMAGE AND WILL VOID THE FACTORY WARRANTY AND EXPLOSION PROOF CERTIFICATION.**

CAUTION: **THE LEAKAGE DETECTION CIRCUITS FOR MOTORS NAMEPLATED CLASS 1, DIVISION 1, GROUP C & D MUST BE SUPPLIED FROM AN ISOLATED SECONDARY CIRCUIT: 30 Vrms; 42 Vpk; 0.5 ma MAX.**

CAUTION: **FAILURE TO INSPECT AND REPLACE THE SEALS AS NECESSARY MAY RESULT IN LEAKING OF PUMPED FLUID INTO THE MOTOR HOUSING RESULTING IN DAMAGE TO THE MOTOR AND POSSIBLE ELECTRIC SHOCK.**

BEARINGS

MSX Series 3 pumps are equipped with back-to-back, tapered roller thrust bearings and single-row, ball line bearings. Both line and thrust bearings are regreasable.

Recommended Grease: Mobile Infinitec 152

IMPELLER AND WEARING RINGS

The pump impeller is of the enclosed non-clog type capable of passing solids of limited size. The impeller hub is keyed to the shaft and held in position by an impeller screw and impeller washer. A radial wearing ring is supplied on the casing. Radial impeller wearing rings are available as an option.

SECTION II: Pre-Installation Instructions

Inspect the equipment and check it against the shipping manifest immediately upon receipt. EXAMINE THE CRATE AND WRAPPING BEFORE DISCARDING. Parts or accessories are sometimes wrapped individually or fastened to the crate. Report any damage or shortage to the transportation company's local agent.

HANDLING

To prevent damage to the pumping unit, it is absolutely necessary that the unit be handled carefully. Lifting of the pumping unit must only be accomplished by using the lifting bail bolted to the motor. Check the torque (refer to chart on page 25) on the lifting bail bolts prior to lifting the unit. Lifting must be done slowly and continuously, avoiding jerks. When using cranes or lifting devices, take care to avoid bumping, walls, floors, etc.

During handling of the motor, the bending radii of the motor power supply and signal cable leading out of the motor cable junction box **MUST NOT FALL BELOW 4 TIMES THE CABLE DIAMETER.**

CAUTION: DO NOT LIFT THE MOTOR OR PUMPING UNIT BY THE POWER SUPPLY CABLES.

STORAGE

General

Submersible pump units need special preparations for storage. The power cable must be protected from direct exposure to sunlight and the open ends must be sealed against moisture.

The lower mechanical seal may leak a small amount of the cooling fluid onto the top shroud of the impeller during long periods of storage. This can be expected until the pump has been operated, giving the seals an opportunity to wear in. Excessive leaking (more than a few drops) should be reported to your local Flowserve Pump Division Service Center, as it may indicate a problem with the mechanical seals. If there is excessive leaking, the situation should be resolved prior to installing your pump.

Short Term (Less Than 6 Months)

When it is necessary to store a pump for a short time before it can be installed, place it in a dry location and protect it from moisture. When protective flanges are bolted to suction and discharge flanges at the factory, they should not be removed until the unit is ready for installation. Rotate the shaft a minimum of 5 revolutions every two weeks to keep the bearings coated and to minimize the effects of brinelling.

Long Term (More Than 6 Months)

More thorough precautions are required if the pump is scheduled to be stored for an extended period of time. The following is the procedure:

1. The storage area should be a clean, dry location not subject to rapid changes in temperature, light (no direct light) or humidity, and relatively free of ground transmitted vibration due to heavy construction and/or machinery. A temperature range of 40° to 120° F (5° to 50° C) with non-condensing humidity is recommended.
2. Drain water from the pump casing, rotate the pump rotor once in the proper direction and blow the liquid end dry with air.
3. Coat the interior surfaces of the liquid end with rust inhibitor by brushing, spraying or fogging. Rotate the pump shaft one turn in the proper direction while coating.
4. Coat all threaded openings with rust inhibitor and plug. Coat machined surfaces of exposed flanges with rust inhibitor and then cover with fiberboard or wood flange covers. Desiccant bags should be secured to the covers prior to putting them in place and must not contact metal surfaces.
5. Coat exposed, unpainted, machined surfaces with a rust inhibitor.
6. Cover the entire pump with a clear plastic sheet for protection from dust, dirt, moisture, etc. and to allow for visual inspection. The cover should be open near the top to allow for ventilation.

7. Rotate the pump shaft a minimum of 5 revolutions every two weeks to keep the bearings coated with lubricant and to minimize the effects of brinelling.
8. Prior to start-up or installation, a Flowserve Pump Division Representative should be hired to inspect all equipment to determine if any damage or deterioration of parts has occurred and that the equipment is in "as shipped" condition.

PRIOR TO INSTALLATION

Inspect the pump. The winding insulation should be checked prior to installation; see Section III Insulation Testing. Any significant change in the insulation resistance should be investigated with a Flowserve Pump Division Representative.

MANUFACTURER'S SERVICE

We recommend that the services of a Flowserve Pump Division Service Engineer or Flowserve Pump Division Authorized Representative be employed for start-up of pump equipment. The purchaser is then afforded the opportunity to receive adequate and authoritative instructions, validating the Flowserve Pump Division warranty.

SECTION III: Installation

GENERAL

Use the lifting bail bolted to the motor for handling the pumping unit. Exercise care in slinging and handling the unit. Observe the minimum cable bending radius given below.

CAUTION: THE COOLING FLUID LEVEL AND QUALITY IN THE MOTOR MUST BE CHECKED BEFORE THE UNIT IS OPERATED; see Section III, Motor Filling.

CAUTION: FLOWSERVE PUMP DIVISION RECOMMENDS THAT THE MOTOR WINDING INSULATION BE CHECKED ONCE THE UNIT IS IN PLACE AND PRIOR TO APPLYING POWER TO THE UNIT; see Section III, Insulation Testing.

POWER CABLE

Pay special attention to the power supply cables during installation. Where the power supply cables are subject to chafing and vibration, fasten them in wooden blocks or protect them by means of cable guards.

CAUTION: DO NOT BEND THE CABLE TO A RADIUS BELOW 4 TIMES THE CABLE DIAMETER.

CAUTION: DO NOT LIFT THE UNIT BY THE POWER CABLES.

CAUTION: PER ANSI/NFPA 70 (NEC) SECTION 400-9, POWER CABLES MAY NOT BE SPLICED DURING INITIAL INSTALLATION. SPLICES FOR NON-EXPLOSION PROOF MOTORS OCCURRING AFTER INITIAL INSTALLATION MUST CONFORM TO ANSI/NFPA 70 400-9.

CAUTION: POWER CABLES FOR MOTORS CERTIFIED AS EXPLOSION PROOF PER ANSI/NFPA 70 MUST BE CONTINUOUS PER SECTION 501-11. NO CABLE SPLICES ARE PERMITTED.

CAUTION: POWER CABLES ARE TO BE REPLACED ONLY WITH AN APPROVED POWER CABLE PURCHASED FROM FLOWSERVE PUMP DIVISION. POWER CORD REPLACEMENT WITH A NON-APPROVED POWER CABLE WILL VOID THE FACTORY WARRANTY AND NEGATE THE EXPLOSION PROOF CERTIFICATION.

LOCATION OF EQUIPMENT

The pump should be located to allow an overhead crane or lifting device with sufficient capacity to lift the entire unit. In wet pit applications, the suction eye of the pump must be located far enough above the bottom of the wet pit to allow for the maximum rated solid size to pass under the pump; i.e., a pump rated for 4-inch (100 mm) solids must have at least a 4-inch (100 mm) clearance between the bottom of the well and the suction eye of the pump.

SITE PREPARATION

Flowserve Pump Division MSX Series 3 pumps can be installed in a permanent well via a guide rail system or they can also be installed in dry pit applications with the use of a suction base and permanent discharge piping.

Foundation

The foundation should be of sufficient strength to absorb vibration (i.e., at least five times the weight of the pump unit) and to form a permanent, rigid support for the suction base. A concrete foundation on a solid base should be satisfactory.

Pump manufacturers can calculate, or determine by test, the natural frequency of the pump assembly, including pump and driver. However, in a field installation, the vibrating structure comprises, in addition to the pump assembly, the foundation, the mounting, the piping and supports. The natural frequency of the vibrating structure is determined by the stiffness of the total structure and by its equivalent mass. The

structure's natural frequency may therefore differ significantly from the natural frequency of the pump alone.

In the absence of any specific information, the pump manufacturer will assume that the piping is installed rigidly and anchored close to the pump connections. It will also be assumed that the hold-down bolts are securely embedded in a concrete foundation of infinite mass and rigidity.

The system designer must give this proper consideration and must ensure that the natural frequency of the vibrating structure, as defined above, does not fall within the pump operating speed range. He must also be aware of the much lower stiffness of fabricated system structures, relative to concrete, and the problems associated with calculating stiffness of unconventional and composite structures.

Foundation bolts of the specified size should be embedded in concrete and located according to the Elevation Drawing.

Grouting

The purpose of grouting is to prevent lateral shifting of the equipment supports and not to take up irregularities in the foundation. Only non-shrinking grout with a 6000 psi (41.4 MPa) compressive strength in 72 hours should be used. Flowserve Pump Division recommends the following procedure for grouting:

1. Build a wooden form around the outside of the base to contain the grout. In some cases the form is placed tightly against the lower edge of the base and in other cases it is placed a slight distance from the edge of the pump base.

2. Saturate the top of the rough concrete foundation with water, if required, before grouting. Add grout until the entire area under the pump base is filled. A stiff wire should be used to work the grout and release any air pockets.

3. After the grout is poured, the exposed surfaces should be covered with wet burlap to effect slow curing and prevent cracking. When the grout has set (about 48 hours), remove the forms and smooth the exposed surface if desired. The grout should be allowed to cure at lease 72 hours before dynamically loading.

CAUTION: IF LEVELING NUTS ARE USED ON THE FOUNDATION BOLTS TO LEVEL THE BASE, THEY MUST BE BACKED OFF AS FAR AS POSSIBLE PRIOR TO GROUTINGTHE BASE IN PLACE. SHIM NEAR THE FOUNDATION BOLTS, BACK OFF THE LEVELING NUTS AND TIGHTEN THE FOUNDATION BOLTS. TO DO OTHERWISE WILL SIGNIFICANTLY LOWER THE STRUCTURAL NATURAL FREQUENCY AND RESULT IN SEPARATION OF THE BASE FROM THE GROUT.

GUIDE RAIL INSTALLATION

A guide rail installation must be a double, round guide rail system; see Figure 1: Guide Rail System.

1. Install anchor bolts in the bottom of the wet well for the discharge elbow/base. Install the discharge elbow/base – see grouting instructions above. Secure the base with hex nuts and washers.
2. Cut the guide rail pipe to length. The CUSTOMER SUPPLIED guide rail pipe is galvanized or stainless steel, 2 or 3-inch round, Sch 40 pipe. Install the guide rails over the tapered plugs on the discharge elbow/base.
3. Place tapered plugs of the upper guide rail bracket in the guide rail pipes and position the upper guide rail bracket so that the guide rail pipes are plumb. Secure the upper guide rail bracket to the top of the well.

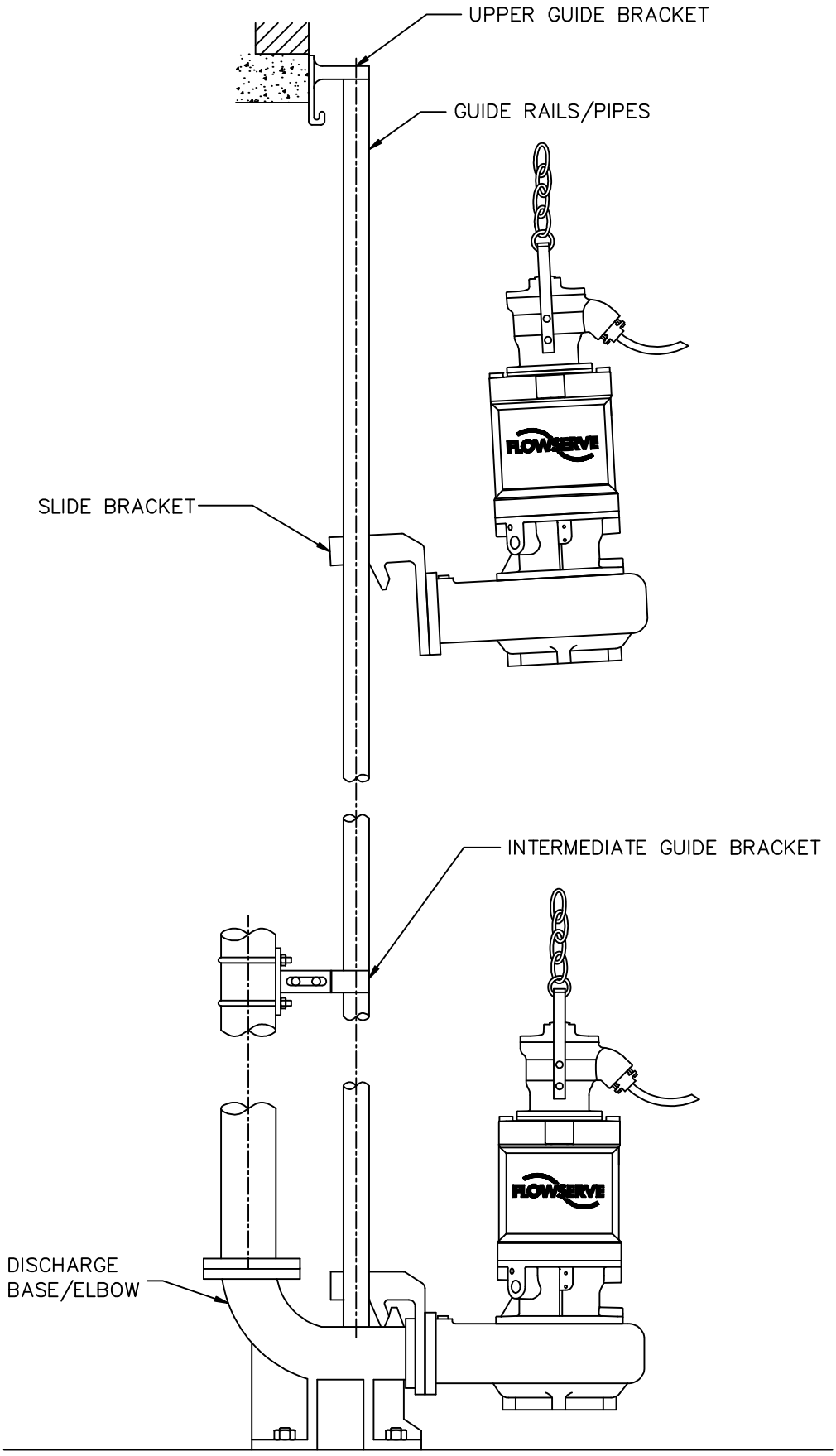


Figure 1: Guide Rail System

DRY PIT INSTALLATION

Piping Strains

Satisfactory operation cannot be maintained when the piping imposes a force on the pump. Misaligned piping flanges can spring and pull a pump out of position when their bolts are drawn up. Flanges must have flat faces and be brought squarely together before the bolts are tightened. To avoid breaking the flanges when tightening the bolting, mating pipe flanges should also have flat faces and full face gaskets should be used. Suction and discharge pipes, and associated equipment, should be supported and anchored near, but independent of the pump so that no strain will be transmitted to the pump casing.

CAUTION: PIPE COUPLINGS WHICH ARE NOT AXIALLY RIGID ARE SOMETIMES USED IN THE DISCHARGE AND/OR SUCTION PIPING TO AVOID TRANSMITTING ANY PIPING STRAINS CAUSED BY SYSTEM PRESSURE, THERMAL EXPANSION, OR PIPE MISALIGNMENT. SUCH PIPE COUPLINGS ALLOW TRANSMITTAL TO THE PUMP, A FORCE EQUAL TO THE AREA OF THE EXPANSION JOINT TIMES THE PRESSURE IN THE PIPING. THESE FORCES CAN HAVE A SIGNIFICANT MAGNITUDE AND IT IS IMPRACTICAL TO DESIGN THE PUMP CASING, SUPPORT, ETC., TO WITHSTAND THEM. CONSEQUENTLY, WHEN PIPE COUPLINGS LACK AXIAL RIGIDITY, A SUITABLE PIPE ANCHOR MUST BE INSTALLED BETWEEN IT AND THE PUMP. ALTERNATELY, ADEQUATE RESTRAINING DEVICES SHOULD BE USED AND PROPERLY ADJUSTED TO PREVENT THESE FORCES FROM BEING TRANSMITTED TO THE PUMP.

Suction Piping

Experience has shown that the major source of trouble in centrifugal pump installations, other than misalignment, is traceable to a faulty suction line. The utmost attention must be given to this portion of the installation to ensure that the pump receives hydraulically stable flow. The suction piping should be direct as possible and its length held to a minimum. If a long suction line is required, increase the pipe size to reduce friction losses. Then gradually reduce the pipe size in steps before entering the pump. The piping should be run without having high spots and should have a continual rise toward the pump. This prevents air pockets which inevitably cause trouble. Clean out all debris from the suction line and wet well prior to operating the pumps.

Care should be exercised to keep the suction piping air tight and sealed against leakage. An isolation valve is recommended in the suction line if a positive head exists above the top of the casing. Isolation valves on suction and discharge lines are recommended to facilitate future inspection and repairs.

Discharge Piping

A check valve and a gate valve are normally installed in the discharge line. The check valve is normally placed between the pump and the gate valve to protect the pump from any excessive back pressure and reverse rotation which may be caused by water running back through the pump casing during a driver or power failure. Any reverse flow through the pump or excessive back pressure should be kept to an absolute minimum. The check valve will also prevent suspended solids from accumulating in the casing and will increase wearing ring life.

Instrumentation

A compound pressure gauge should be connected to the suction and a pressure gauge connected to the discharge side of each pump. Mount the gauges at a convenient location as they are necessary for any adequate check on pump performance.

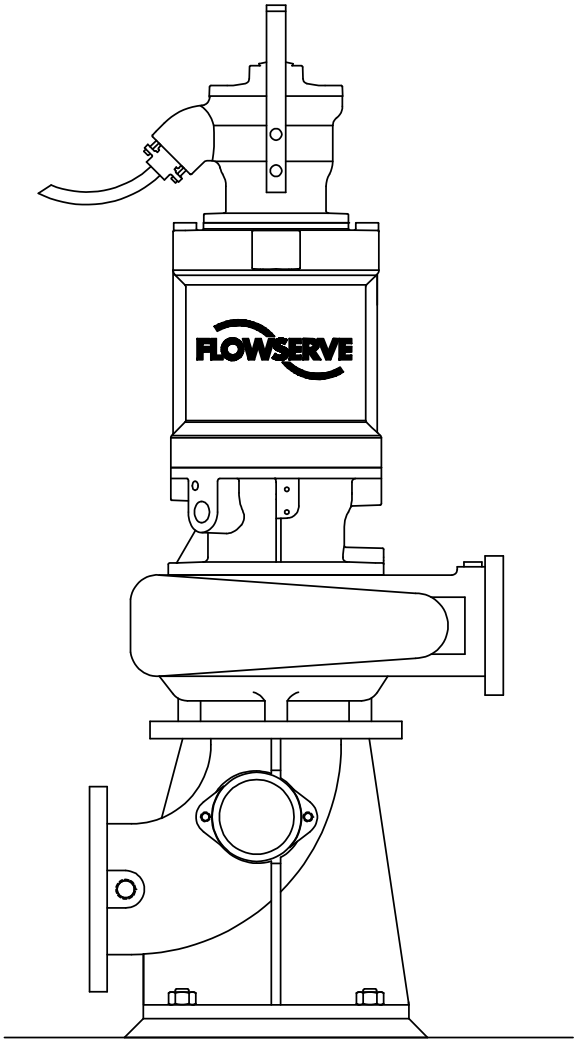


Figure 2: Dry Pit Installation

FLOAT SWITCHES

In wet pit applications, customer supplied float switches are typically used to control the starting and stopping of the pump(s) based on the fluid level of the well. The switches hang freely from a bracket mounted to the frame of the wet well. The float switches should be located such that they will not tangle with each other or with the discharge piping. Either of these situations may give erroneous signals.

A typical arrangement for a float switch control system for a wet well is shown in Figure 3: Float Switch Installation. The four switches are as follows: 1) Pump(s) off; 2) Lead pump on; 3) Lag pump on (for arrangements with two or more pumps); 4) High level alarm. There could be additional lag pump switches depending on the number of pumps in the system.

CAUTION: THE SYSTEM SHOULD BE DESIGNED TO MINIMIZE THE NUMBER OF STARTS. THE FREQUENCY OF RESTARTS SHOULD NOT EXCEED RECOMMENDATIONS BY NEMA MG-10, TABLE 7.

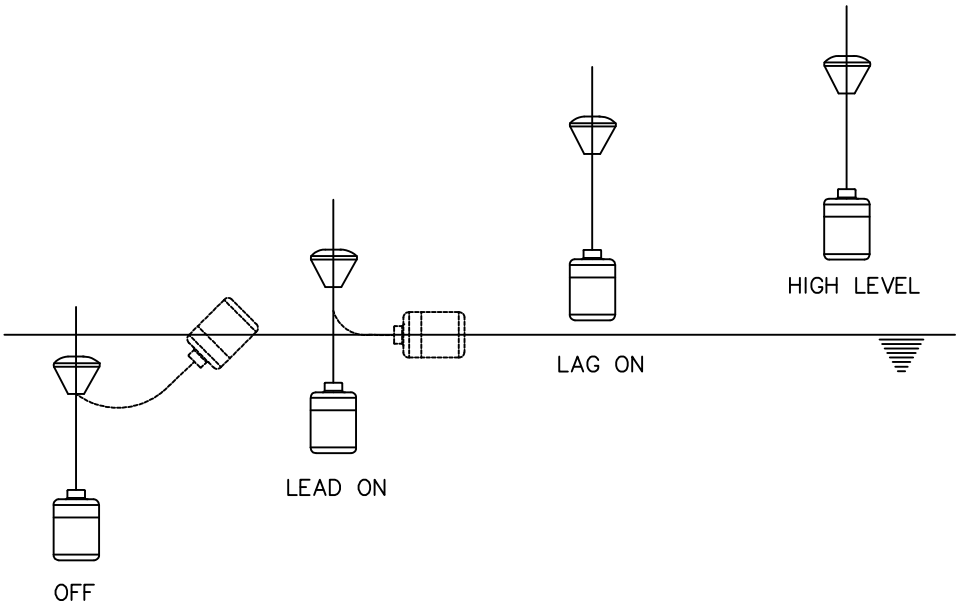


Figure 3: Float Switch Installation

ELECTRICAL

CAUTION: FOLLOW LOCAL PRACTICES AND THE NATIONAL ELECTRIC CODE WHEN CONNECTING EQUIPMENT.

Motor Power Wiring

Electrical power is supplied to the motor through the power supply cable(s) leading out of the pump stator junction box. Each motor is supplied with standard 35 foot (10.5 m) power cable(s) (50, 75 and 100 foot cables are also available). The motor rated voltage can be found on the pump/motor nameplate. The motor is connected to the power cable(s) at the factory according to Figure 4: Motor Connection Diagram. Installation and operation instructions for power service at other voltages may vary from those listed in this manual. Contact Flowserve Pump Division directly for variations in installation and performance at other voltages.

Most Series 3 MSX Pumps are furnished multiple power cables to meet the ampacity ratings as required by ANSI/NFPA 70 (NEC). Multiple power cables must always be connected in parallel such that all the White (W) power leads are connected to the same phase (example T1) at the control panel terminal block; and likewise, all the Red (R) power leads are connected to a unique phase (T2), and all the Black (B) power leads are connected to a unique phase (T3).

Note that some MSX pumps will also have a separate cable for control wires. Control cables will always have conductors of a smaller wire size (AWG) than power cables. Refer to supplemental instructions for specific wiring instructions as applicable.

WARNING: ALWAYS CONNECT MULTIPLE POWER CABLES IN PARALLEL. FAILURE TO HEED THIS WARNING MAY CAUSE SERIOUS PERSONAL INJURY.

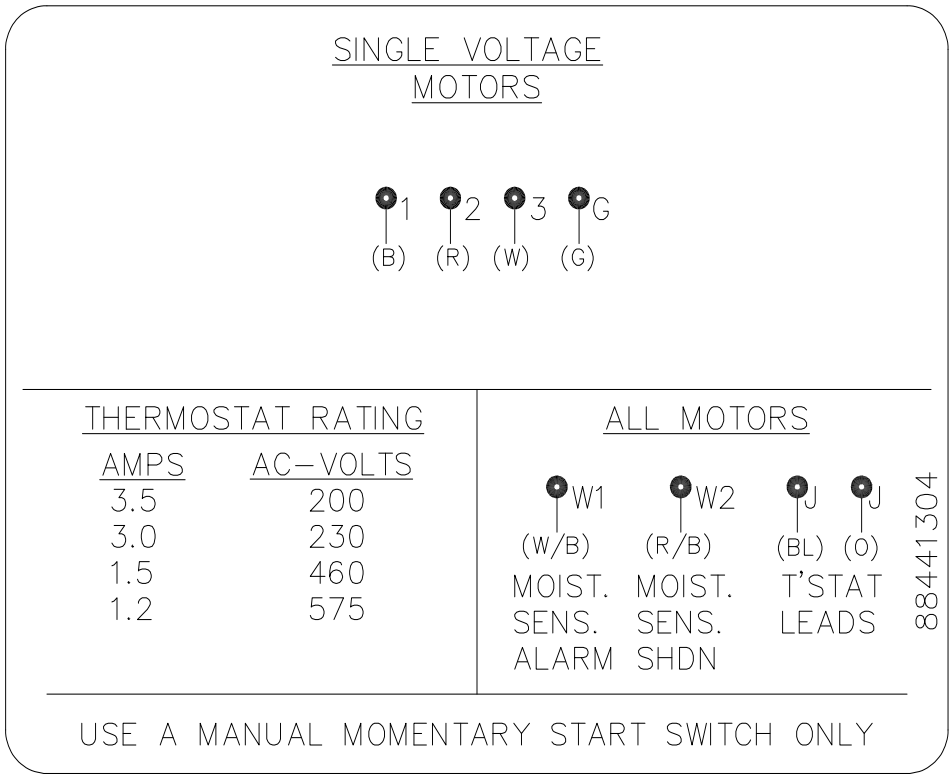


Figure 4: Motor Connection Diagram

Checking Rotation

After connection of the electric service and prior to installing the unit, the rotation must be checked. Incorrect rotation will result in poor performance of the unit and can cause damage to the pump. Check rotation by bumping the motor starter for rotation and viewing the impeller rotation through the discharge; a flashlight may be required. The correct rotation is clockwise when viewed from the top.

CAUTION: ENSURE THE PUMP'S STABILITY ON A LEVEL SURFACE. LOOSLY STRAP THE MOTOR LIFTING BAIL TO AN OVERHEAD LIFTING DEVICE TO PREVENT TIPPING. DO NOT BUMP THE MOTOR WHILE THE UNIT IS SUSPENDED FROM CHAINS, AS IT COULD HAVE A CONSIDERABLE REACTION FORCE.

WARNING: DO NOT PLACE HANDS, LOOSE ARTICLES OF CLOTHING, ETC. NEAR THE PUMP DISCHARGE. WEAR SAFETY GOGGLES. FAILURE TO HEED THIS WARNING MAY CAUSE SERIOUS PERSONAL INJURY.

If the pump rotation is wrong, make sure that the power is off and interchange the L1 and L2 motor lead connections at the control panel. Verify the pump rotation direction before you continue.

Insulation Testing

Flowserve Pump Division recommends that the motor winding insulation be checked once the unit is in place and prior to applying power to the unit. If the insulation resistance of the motor winding and power supply cable is to be tested, use an instrument designed for this purpose (500 VDC). To measure the insulation resistance, use to following procedure:

1. Disconnect all leads of the power supply cable and clean them carefully.
2. Measure the insulation resistance between one cable core and ground. All other cable leads are kept away from ground during this procedure.
3. The insulation resistance of the new motor measured at the factory exceeds 500 mega-ohms (connected to frame). If the test results in an insulation value less than 6 mega-ohms, contact Flowserve Pump Division.

WARNING: **WINDINGS AND POWER SUPPLY CABLES WILL, DURING INSULATION TESTING, BE CAPACITIVELY CHARGED TO THE TEST VOLTAGE.**

THE BARE CABLE ENDS MUST NOT BE TOUCHED DURING THE TEST AND BEFORE THE WINDINGS AND CABLE BARE CONDUCTORS HAVE BEEN DISCHARGED.

AFTER COMPLETION OF THE TEST, DISCHARGE THE CABLES BY APPLYING THE CABLE BARE CONDUCTORS TO THE PROTECTIVE GROUND CONNECTION.

Current and Voltage Imbalance

Upon installation, the amount of current imbalance should be calculated. The pump should be operated while submerged to simulate normal operating conditions and the current imbalance should be calculated as described below. Current imbalance between phases should not exceed 4%. The current imbalance is defined as follows:

Imbalance = (max current - average current of the three phases) / average current of the three phases

The current imbalance will further increase any imbalance in the line voltage. It is advisable to find the "most even" balance by changing the phase connections of the motor in a clockwise order until the smallest difference is obtained.

An imbalanced voltage of more than one percent will result in an even larger imbalanced current and excessive heat generation. The motor should be derated according to NEMA MG-1, 14.35 in order that the winding temperature not affect the life of the motor.

Motor Overload Protection

A motor overload relay with an approved heater element is to be used. Overload protection and grounding should be in accordance with the National Electric Code and also be consistent with sound local practices.

Protection Against Inadmissible Starting Frequency

Flowserve Pump Division recommends protecting the motor from frequent restarting via a time delay relay. The frequency of restarts should not exceed recommendations by NEMA MG-10, Table 7.

If additional starts are required, it is recommended that none be made until all conditions affecting operation have been thoroughly investigated and the motor is checked for excessive heating. The number of starts should be minimized in order to maintain the life of the motor.

MOTOR THERMAL PROTECTION

The motor winding is protected by three thermal switches installed in series with normally closed contacts. The contacts will open when the winding temperature within the motor exceeds 275° F (135° C). The thermal switches must be wired into the motor starter within the control panel such that the motor automatically shuts down in the event of overheating; see Figure 4: Motor Connection Diagram. Observe the amperage rating of the thermal contacts at the connected voltage.

WARNING: **FAILURE TO PROPERLY CONNECT THE MOTOR THERMAL SWITCHES MAY RESULT IN PERSONAL INJURY OR PRODUCT DAMAGE AND WILL VOID THE FACTORY WARRANTY AND THE EXPLOSION PROOF CERTIFICATION.**

MOISTURE DETECTION SENSORS

Moisture detection sensors located in the barrier chamber of the bearing housing will detect failure of the mechanical seals by measuring the electrical conductivity of the fluid in the chamber. Contamination of the barrier fluid with the pumped liquid will cause the conductivity to increase. The alarm sensor must be wired into an approved moisture detection sensor relay to illuminate a light on the pump motor control panel with increased conductivity of the fluid. The unit should be taken off-line for service with

illumination of the light. The shutdown sensor must be wired into an approved moisture detection sensor relay to trigger an automatic motor shutdown with increased conductivity of the fluid. Refer to Figure 4: Motor Connection Diagram.

WARNING	**FAILURE TO PROPERLY CONNECT THE MOISTURE DETECTION SENSOR MAY RESULT IN PERSONAL INJURY OR PRODUCT DAMAGE AND WILL VOID THE FACTORY WARRANTY.**

CAUTION: THE LEAKAGE DETECTION CIRCUIT FOR MOTORS NAMEPLATED CLASS 1, DIVISION 1, GROUP C & D MUST BE SUPPLIED FROM AN ISOLATED SECONDARY CIRCUIT: 30 Vrms; 42 Vpk; 0.5 ma MAX.

COOLING SYSTEM FILLING

Your pump will require 7-20 gallons (28-80 liters) of cooling fluid (Propylene Glycol – water mixture, 30% - 70% respectively) depending on the frame size of the motor (see table). In the event that fluid leaks onto the pump or into the environment, it should be cleaned and disposed of according to the Material Safety Data Sheet.

Motor Frame Size	Gallons of Cooling Fluid
36	7
37	12
38	20

Remove the plugs at the top of the cooling jacket (take care not to damage the o-rings on the washers). Begin filling through the port marked with an F using a funnel or nozzle. Fill the pump until the coolant level reaches the bottom of the vent port. Replace the plugs and be sure to compress the o-rings.

Note that your pump is shipped from the factory with the cooling system filled.

CAUTION: DURING OPERATION, THE COOLING FLUID WILL INCREASE IN TEMPERATURE AND PRESSURIZE THE COOLING SYSTEM. PRIOR TO DRAINING THE COOLING FLUID, THE PUMP SHOULD BE ALLOWED TO COOL. THE COOLING SYSTEM SHOULD BE OPENED CAREFULLY AS THE COOLING FLUID COULD STILL BE PRESSURIZED.

BARRIER SYSTEM FILLING

Your pump will require .50-1.30 gallons (1.9-5 liters) of barrier fluid (Royal Purple Barrier Fluid GT22) depending on the frame size of the motor (see table). In the event that fluid leaks onto the pump or into the environment, it should be cleaned and disposed of according to the Material Safety Data Sheet.

Motor Frame Size	Gallons of Barrier Fluid
36	.50
37	.75
38	1.30

Remove the NPT plug marked BFF on the side of the bearing housing. This plug is located above a large NPT drain plug. Add the barrier fluid using a funnel or nozzle through this port and replace the plug.

Note that your pump is shipped from the factory with the barrier system filled.

SECTION IV: Operation

The following procedures outline the most important steps involved in pump operation. Any procedure modification due to particular installation peculiarities should conform to good engineering practices.

MOTOR COOLING

Flowserve Pump Division MSX Series 3 non-clog submersible pump is driven directly by a motor. Flowserve Pump Division MSX Series 3 pumps have an internal cooling system, which makes them suitable for use in either wet or dry pit applications.

MINIMUM SUBMERGENCE

The recommended minimum submergence for wet pit applications is to the top of the casing. This is to prevent air entrapment through the hydraulic end of the pump, which will affect performance and could damage the unit.

REDUCED CAPACITY OPERATION

In general, Flowserve Pump Division MSX Series 3 non-clog pumps are designed for continuous operation within 65% to 130% of the best efficiency point at maximum RPM and impeller diameter. They are suitable for occasional or intermittent operation at capacities outside these limits; however, pump operation may be noisy and component life may be reduced.

These limitations are placed because the impellers have wide discharges and at other capacities, large radial reactions are encountered and flow recirculation may occur. This is an inherent design characteristic for pumps of this type.

In many cases, particularly in sewage pumping applications, reduced capacities are met by a reduction in pump speed and no throttling is used. Under these circumstances, the low-capacity applications are not nearly as critical because of lower pump speed and relatively lower pump operating heads.

For applications where pump operation at other capacities is anticipated contact the nearest Flowserve Pump Division Sales Representative.

PRELIMINARY TO STARTING

Read this instruction manual thoroughly before starting the unit. Make sure the following items are checked before starting:

1. Ensure that the motor is filled with cooling fluid and that the moisture detection sensor and thermal disconnects are functioning properly; see Section III: Moisture Detection Sensor, Section III: Motor Thermal Protection, and Section III: Cooling System Filling.
2. Check that all plugs are secure and that no fluid is leaking from the unit.
3. Check the direction of rotation of the driver. The arrow on the pump casing will show the correct rotation; see Section III: Checking Rotation.

STARTING

The procedure for starting the unit will vary somewhat with each installation; however, the following steps generally apply:

1. Verify that the pump rotor turns freely. If it is bound, do not operate the pump until the cause of the trouble is located.
2. If the pump is in a wet pit application, make sure the pump is submerged.
3. Start the driver.
4. If the discharge valve is closed, open the valve slowly as pressure is built up on the discharge side of the pump.
5. Monitor noise and power consumption for several hours. When starting a unit and after the starting current has faded, the ammeter may, for a short time, indicate a higher current than given on the motor data sheet.

STOPPING

Although the procedure for stopping may vary slightly with each installation, typically the driver is simply shut down.

SECTION V: Maintenance

CAUTION: DURING THE WARRANTY PERIOD, FACTORY APPROVAL MUST BE OBTAINED PRIOR TO MAKING REPAIRS. FAILURE TO GET APPROVAL WILL VOID THE WARRANTY.

WARNING: MOTORS NAMEPLATED CLASS 1, DIVISION1, GROUP C & D MUST BE SERVICED BY CERTIFIED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL. THIS INCLUDES, BUT IS NOT LIMITED TO SERVICE ON THE ROTOR, STATOR, BEARINGS, CABLE, CABLE GLANDS AND GROMMETS. SERVICE BY PERSONS OTHER THAN CERTIFIED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL VIOLATES SAFETY REGULATIONS, NEGATES THE EXPLOSION FROOF CERTIFICATION AND VOIDS THE FACTORY WARRANTY.

ALL MOTORS UNDER WARRANTY MUST BE SERVICED BY CERTIFIED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL. SERVICE BY PERSONS OTHER THAN CERTIFIED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL VOIDS THE FACTORY WARRANTY.

POWER CABLE

Pay special attention to the power supply cables during maintenance. Where the power supply cables are subject to chafing and vibrating, fasten them in wooden blocks or protect them by means of cable guards.

CAUTION: DO NOT BEND THE CABLES TO A RADIUS BELOW 4 TIMES THE CABLE DIAMETER.

CAUTION: DO NOT LIFT THE UNIT BY THE POWER CABLES.

CAUTION: PER ANSI/NFPA 70 (NEC) SECTION 400-9, POWER CABLES MAY NOT BE SPLICED DURING INITIAL INSTALLATION. SPLICES FOR NON-EXPLOSION PROOF MOTORS OCCURRING AFTER INITIAL INSTALLATION MUST CONFORM TO ANSI/NFPA 70 SECTION 400-9.

CAUTION: POWER CABLES FOR MOTORS NAMEPLATED CLASS 1, DIVISION 1, GROUP C & D MUST BE CONTINUOUS PER ANSI/NFPA 70 SECTION 501-11. NO CABLE SPLICES ARE PERMITTED. POWER CABLES ARE TO BE REPLACED ONLY WITH AN APPROVED POWER CABLE PURCHASED FROM FLOWSERVE PUMP DIVISION. POWER CABLE REPLACEMENT WITH A NON-APPROVED POWER CABLE WILL VOID THE FACTORY WARRANTY AND NEGATE THE EXPLOSION PROOF CERTIFICATION.

INSPECTIONS

Regular observations should be made of the pump operation to avert trouble. Whether or not you consider a log of these inspections necessary, the operator must be alert for irregularities in the operation of the pump(s). Any trouble symptoms, which are detected, should be reported immediately. Motor noise, power consumption, vibration, and pump output should be checked periodically. An abrupt change in any of the above is much more indicative of trouble than a consistently high reading.

Semiannual and Annual Inspection

Check for stable and smooth operation. Check the unit running records for hourly usage vs. power consumption, vibration and pump output to determine if internal inspection is required. The cooling fluid should be inspected for quantity and quality, and the barrier chamber should be inspected for signs of contamination at this time. Reference replacing fluids (refer to page 24) for inspection guidelines.

Complete Overhauls

Frequency of a complete overhaul depends upon the hours of operation of the pump, the severity of the conditions of service, the materials used in the pumping unit construction, and the care the pump receives in operation.

Do not open your unit for inspection unless there is definite evidence that the capacity has fallen off excessively or unless there is indication of trouble inside the pump or the motor.

PUMP DISMANTLING PROCEDURE

Care must be exercised in the dismantling operation. For convenience at re-assembly, lay out all parts in the order in which they are removed matchmarking to disassembly. Protect all machined faces against metal to metal contact and corrosion. Proceed as follows; reference Motor/Pump Sectional Drawing.

Impeller and Casing

1. Disconnect power from the motor.
   - In wet pit applications, use the lifting bail and chain to remove the pump from the wet pit.
   - In dry pit applications, drain the hydraulic end of the pump of any pumped fluids and detach the pump from the suction and discharge piping.
2. Remove the bolts holding the adapter plate to the pump casing. Draw out the pump rotating assembly complete with the motor. Set the motor on a mounting stage or wooden vee-blocks. Care must be taken in handling the unit.

CAUTION: DO NOT REMOVE THE BOLTS THAT HOLD THE BEARING HOUSING TO THE ADAPTER PLATE AS THIS MAY LEAK COOLING FLUID AND COULD DAMAGE THE MECHANICAL SEAL.

3. Remove the impeller mounting screw. The screw was mounted using Loctite 2760 and may require heating to 400° F (204° C) for removal.
4. Remove the impeller and the impeller key.
5. Remove the wearing ring(s) as necessary. Reference maintenance of wearing rings. (refer to page 23).

Draining Fluids

Cooling Fluid

1. Remove the vent plug on the top of the cooling jacket (marked with a "V").
2. Remove the 1/2" NPT plug from the bottom of the bearing housing and drain the cooling fluid.
3. Replace the plugs.

Barrier Chamber

1. Remove the large NPT plug from the side of the bearing housing and drain the barrier fluid.
2. Replace the NPT plug.

Bearing Housing

1. Drain cooling fluid from bearing housing.
2. Remove mating ring (rotating face) of the lower mechanical seal from the shaft.
3. The heat exchanger plate can be removed by removing the lower mechanical seal primary ring and using screwdrivers to gently pry from the groove at the outside diameter of the plate.

CAUTION: DO NOT REMOVE THE HEAT EXCHANGER PLATE FROM THE ADAPTER PLATE UNLESS THERE IS REASON TO BELIEVE THAT THE COOLING SYSTEM IS NOT FUNCTIONING PROPERLY.

CAUTION: THE HEAT EXCHANGER PLATE IS PART OF A PRESSURE VESSEL CONTAINING THE COOLING FLUID. THE O-RINGS MUST BE REPLACED ANY TIME THIS PART IS REMOVEDFROM THE ADAPTER PLATE. THE O-RING GROOVES SHOULD BE INSPECTED TO ASSURE THAT THE PLATE SEALS PROPERLY.

4. Remove the adapter plate from the bearing housing. Take care not to damage the primary ring while removing the adapter plate. The primary ring (stationary face) of the mechanical seal should not be removed unless it is being replaced.
5. Remove the oil impeller and key by removing the snap ring on its hub. Heat may be required to remove the oil impeller from the shaft. 30-60 seconds of heating via propane torch is normally sufficient to remove the oil impeller.
6. Remove the oil impeller cover plate.
7. Remove primary ring of the first upper tandem mechanical seal by removing the snap ring on the outside diameter.
8. Remove the three screws attaching the seal adapter to the bearing housing and remove the seal adapter containing the mating ring (stationary face) of the mechanical seal.
9. Remove primary ring of the second upper tandem mechanical seal by removing the snap ring on the outside diameter. The mating ring (stationary face) of the mechanical seal should not be removed unless it is being replaced.

CAUTION: BEARING REMOVAL OR INSTALLATION MUST ONLY BE DONE BY PERSONS QUALIFIED AND AUTHORIZED BY FLOWSERVE PUMP DIVISION. AUTHORIZATION CAN BE OBTAINED BY ATTENDING A FLOWSERVE PUMP DIVISION SERVICE SCHOOL FOR MSX SERIES 3 PUMPS.

CAUTION: LIFT THE STATOR HOUSING SEVERAL INCHES AND DETACH THE MOISTURE PROBE FROM THE EXTENSION WIRE BEFORE REMOVING THE STATOR HOUSING.

CAUTION: DO NOT LIFT THE UNIT BY THE POWER CABLES.

10. Remove the bolts on the lower bearing cover and lift the rotor assembly out of the bearing housing.

Carefully examine all individual parts, important joints and all wearing surfaces as the pump and rotor are dismantled. As a general rule, regardless of the performance of the unit, parts appreciably worn should be replaced if it is not intended to examine the pump until the next overhaul period. It is recommended that the mechanical seals and o-rings be replaced whenever the bearing house is disassembled.

PUMP ASSEMBLY

To assemble the pump, reverse the dismantling instructions previously described. Follow the mechanical seal and wearing ring instructions. Torque all assembly bolts and screws to the torque values listed at the end of this section. Assemble in the following order:

1. Verify the mating ring (stationary face) of the second upper tandem mechanical seal is installed properly in the bearing housing.
2. Assemble the rotor assembly into the bearing housing (make sure the lower cup and spacer are in the bearing housing).
3. Assemble the stator housing and cooling jacket onto the stator housing. Use the standpipe to properly align the stator housing on the bearing housing.

CAUTION: BE SURE TO CONNECT THE MOISTURE PROBES TO THE EXTENSION WIRES.

4. Replace the primary ring of the second upper tandem mechanical seal.
5. Replace the seal adapter containing the mating ring (stationary face) of the first upper tandem mechanical seal.
6. Replace the primary ring of the first upper tandem mechanical seal.
7. Replace the oil impeller cover plate by placing the supply tube in the bearing housing.
8. Place the oil impeller drive key on the shaft and install the oil impeller. Replace the snap ring below the hub of the impeller to secure it to the shaft.

9. Replace the adapter plate using the cooling fluid supply tube to assure the proper orientation. Inspect and replace the gasket between the adapter plate and the cover plate as necessary.

CAUTION: RE-ASSEMBLY OF THE COVER PLATE AND ADAPTER PLATE TO THE BEARING HOUSING REQUIRES ALIGNMENT OF THE PARTS BY THE COOLING FLUID SUPPLY TUBE. ALIGNMENT OF THESE PARTS IS CRITICAL TO THE FUNCTION OF THE COOLING SYSTEM.

10. If the heat exchanger plate was removed, replace it with new o-rings and install the lower mechanical seal primary ring.
11. Replace the lower mechanical seal.
12. Assemble the components of the rotating equipment. The impeller screws are locked in place using Loctite 2760. Mating surfaces must be thoroughly cleaned and dried prior to application of the Loctite compound. The screws must be replaced after being removed.
13. Install the casing wearing ring.
14. Install the rotating assembly in the casing.

MAINTENANCE OF CASINGS

The casing waterways should be kept clean and clear of rust. Whenever a unit is dismantled, clean the waterways of the casing.

MAINTENANCE OF WEARING RINGS

Generally, it is recommended that the wear rings be replaced or overhauled when pump performance has decreased appreciably due to excessive wearing ring clearance or when the diametrical clearance exceeds 0.010" (0.25 mm) per inch of ring diameter.

Removal of Wearing Rings

The casing wearing ring and impeller wearing ring (optional) are mounted using an interference fit. Removing these rings may require cutting or machining.

Mounting of Wearing Rings

Clean the ring and location where the ring is to be mounted thoroughly and examine them for physical defects, wear, corrosion, and damage. Chill the wearing ring and mount it in the casing. If the impeller wearing ring was furnished with the original unit, heat the wearing ring prior to mounting it in the impeller. Ensure that the wearing rings are fully seated.

MECHANICAL SEALS

Removal of Seals

In order to remove the lower mechanical seal, the following procedure must be followed:

1. The set screws on the mating ring should be backed off and the mating ring can be removed.
2. Remove the six screws attaching the seal head adapter to the adapter plate and remove the primary ring from the pump.

In order to remove the upper tandem mechanical seals, the following procedure must be followed:

1. Remove primary ring of the first upper tandem mechanical seal by removing the snap ring on the outside diameter. Pry/pull (backside of the snap ring location on the elastomer body) the primary ring from its location and slide it down the shaft.
2. Remove the three screws attaching the seal adapter to the bearing housing and remove the seal adapter containing the mating ring (stationary face) of the mechanical seal.
3. Remove primary ring of the second upper tandem mechanical seal by removing the snap ring on the outside diameter. Pry/pull (backside of the snap ring location on the elastomer body) the primary ring from its location and slide it down the shaft.
4. The second upper tandem mechanical seal mating ring can be removed one of two ways:

- Remove the rotating assembly from the bearing housing; see Pump Dismantling Procedure, Bearing Housing, and push the mating ring out of the bearing housing from the top.
- Tap the mating ring with a chisel until the ring breaks and remove the pieces. This will require flushing of the barrier chamber to remove any debris that entered it as a result of the breakage.

CAUTION: IT IS RECOMMENDED THAT THE MECHANICAL SEALS BE REPLACED WHENEVER THE BEARING HOUSING IS DISASSEMBLED.

Installation of Seals

To install the upper tandem mechanical seals, follow the manufacturer's instructions and the procedure listed below.

1. Thoroughly inspect the seal faces and the o-ring, bearing housing, and shaft surfaces with which the seal makes contact.

Second Upper Tandem Mechanical Seal

2. Lubricate the o-ring on the mating ring with a water based rubber lubricant or a light film of No. 2 lithium grease and install it in the bearing housing. Be sure that it is inserted notch-side first with the notch engaging the anti-rotation pin.
3. Lubricate the inside surface of the primary ring with a water based rubber lubricant or a light film of No. 2 lithium grease and slide the mechanical seal primary over the shaft with the snap ring mounted on the body. Gently compress the seal until the ridge on the inside of the body engages the appropriate groove in the shaft.

First Upper Tandem Mechanical Seal

4. Lubricate the o-ring on the mating ring with a water based rubber lubricant or a light film of No. 2 lithium grease and install it in the seal adapter. Be sure that it is inserted notch-side first with the notch engaging the anti-rotation pin.
5. Install the seal adapter assembly in the bearing housing. Secure with three socket head cap screws.
6. Lubricate the inside surface of the primary ring with a water based rubber lubricant or a light film of No. 2 lithium grease and slide the mechanical seal primary over the shaft with the snap ring mounted on the body. Gently compress the seal until the ridge on the inside of the body engages the appropriate groove in the shaft.

To install the lower mechanical seal, follow the manufacturer's instructions and the procedure listed below.

1. Thoroughly inspect the seal faces and the general condition of the mechanical seal prior to installing.
2. Install the mechanical seal primary and seal head adapter into the adapter plate. Secure with the machine screws (there should be 6 screws).
3. Slide the mechanical seal mating ring over the shaft and gently compress the mechanical seal.
4. Tighten the set screws evenly around the mating ring assembly. The back of the mating ring adapter should be flush with the impeller shaft shoulder. It may be necessary to use a sleeve-like tool to properly locate the back of the mating ring adapter.

REPLACING FLUIDS

The cooling fluid and barrier fluid in the bearing housing should be inspected at semiannual and annual intervals or sooner depending upon pump use. A small amount of each of the fluids should be drained from the motor and examined. If the fluids are clean, there is no need to replace them. If the fluids are discolored or milky, they should be drained and replaced with fresh fluid. The fluid(s) should be checked again 2-3 weeks later. If it again becomes discolored or milky the appropriate mechanical seal should be replaced. The replacement fluid must be a Flowserve Pump Division approved fluid. Contact an authorized service person for replacement fluids. See page 18 for cooling system filling and barrier system filling instructions.

CAUTION: THE OPERATION OF THE COOLING SYSTEM IS DEPENDENT UPON THE USE OF THE PROPER COOLING FLUID. THE USE OF A NON-APPROVED COOLING FLUID WILL INCREASE THE INTERNAL TEMPERATURE OF THE MOTOR, WHICH MAY RESULT IN PRODUCT DAMAGE AND WILL VOID THE FACTORY WARRANTY AND EXPLOSION PROOF CERTIFICATION.

BEARINGS

MSX Series 3 pumps are furnished with grease-lubricated bearings. Both line and thrust bearings are re-greasable. Proper grease lubrication is very important. Anti-friction bearings can be over-greased as well as under-greased. Any time maintenance is performed on the bearings, they should be repacked with grease and the bearing chamber should be filled approximately 75% full.

The bearings are to be lubricated with a premium quality Lithium-Complex NGLI EP2 grease suitable for greased-for-life, anti-friction bearing use. The grease contains rust and oxidation inhibitors and extreme pressure additives. The grease should have a viscosity of 14.1 cSt at 100° C and a minimum Timken OK load rating of 60 lbs. Flowserve Pump Division recommends using Mobile Infinitec 152.

Regreasing Bearings

Both the line and thrust bearings on the Series 3 MSX pump are regreasable through ports on the outside of the pump. Follow the procedure below to re-grease the bearings.

Special Preparation

Wet Pit

- Thoroughly clean the area around the 1/4" NPT plugs on the outside of the bearing housing and junction box.
- Remove the NPT plugs and replace them with the appropriate grease fittings.

Dry Pit

- No special preparations are necessary if grease fittings are already installed.
- If grease fitting are not installed, follow the wet pit procedure.

Greasing Procedure (applies to both wet and dry pit pumps)

1. Pump the specified grease into the bearings via the grease fittings.
2. Remove the grease fittings.
3. Operate the pump for approximately 5 minutes, allowing excess grease to flow out of the unit.
4. Replace NPT plugs for wet pit units or grease fittings for dry pit units.

RECOMMENDED TORQUES FOR THREADED FASTENERS

The following tables are provided as a guide for the proper assembly of fasteners. Torques are for NON-lubricated threads.

Hex Head Cap Screw

HH Cap Screw Diameter	Number Threads	Wrench Torque (lb-ft)
0.250	20	5
0.313	18	9
0.375	16	16
0.438	14	25
0.500	13	39
0.563	12	55
0.625	11	77
0.750	10	134
0.875	9	215
1.000	8	320
1.125	8	465
1.250	8	649
1.375	8	874
1.500	8	1147

Note: Assemble joints without Adding lubricant.

Socket Head Cap Screw (Bumax 88 Impeller Bolt)

SH Cap Screw Diameter	Number Threads	Wrench Torque (lb-ft)
0.375	16	28
0.500	13	70
0.625	11	138

Notes:

Apply Loctite 2760 liberally to threads and shoulder face at assembly.

The torque values listed above are specifically for Bumax 88 high strength fasteners. Fasteners will show the “Bumax” name on bolt head.

CAUTION: FOR ASSEMBLY OF A JOINT ALWAYS FINGER-TIGHTEN ALL NUTS OR BOLTS FIRST. THEN CROSS-TIGHTEN EVENLY IN ABOUT THREE EQUAL STEPS TO DEVELOP FINAL TORQUE VALUES.

SECTION VI: Locating Trouble

Common troubles that may occur with your pump and potential causes are listed below. The operator can often avoid unnecessary expenses by careful consideration of the points below.

FAILURE TO DELIVER FLUID OR INSUFFICIENT CAPACITY

1. Pump not primed
2. Liquid level is too low in the wet pit
3. Speed is too low; check voltage and current of each phase of the motor
4. Discharge pressure required by the system is greater than design pressure
5. Waterways of impeller, casing and /or piping are partially clogged
6. Wrong direction of rotation
7. Valves not open
8. Insufficient net positive suction head
9. Excess amount of gas or air in the liquid
10. Mechanical defects: impeller damage, wearing ring gap worn excessively

INSUFFICIENT DISCHARGE PRESSURE

1. Speed is too low
2. Excessive amount of air or gases in liquid
3. Discharge pressure required by the system is greater than the design pressure
4. Liquid viscosity is higher than that for which the pump was designed
5. Waterway of impeller, casing and/or piping are partially clogged
6. Wrong direction of rotation
7. Mechanical defects: impeller damaged, wearing ring gap worn excessively

PUMP POWER CONSUMPTION TOO HIGH

1. Speed is too high
2. The liquid being pumped is of a higher specific gravity or viscosity than that for which the pump was designed.
3. Mechanical damage
4. Excessive solid concentration is causing binding at the wearing ring gap area
5. Bearings are over-greased
6. Pump capacity exceeds design capacity (system head is lower than design head)
7. Motor temperature exceeds design temperature

PUMP VIBRATES

1. Foundation not sufficiently rigid or foundation bolts loose
2. Impeller partially clogged, causing imbalance
3. Mechanical defects
    - Bent shaft
    - Rotating element rubbing on stationary part
    - Worn bearings
    - Impeller or driver rotor out of balance
    - Loose impeller nut
4. The critical frequency of the system including pump, piping and foundation is being excited
5. The pump is being operated too far away from capacities for which it was designed
6. Insufficient net positive suction head
7. Inadequate piping support
8. Pump is not properly seated on the discharge elbow (wet pit applications)

BEARING LIFE IS SHORT

1. Internal misalignment due to piping strain or improper foundation
2. Shaft bent or damaged
3. Improper installation of bearings
4. Lubricant contaminated
5. Excessive imbalance of the rotating assembly
6. Pump being operated too far away from capacities for which it was designed
7. Pump vibrating excessively
8. Motor temperature exceeds design temperature

MECHANICAL SEAL HAS SHORT LIFE OR LEAKS EXCESSIVELY

1. Shaft bent
2. Mechanical seal improperly installed
3. Incorrect type of mechanical seal for the application
4. Excessive vibration
5. Abrasive material in seal cavity
6. Mechanical seal was run dry
7. Seals are over- or under-compressed

MOTOR OVERHEATS

1. Fluid level in cooling system is low
2. Cooling fluid is contaminated
3. A non-approved cooling fluid is being used

SECTION VII: Service Parts and Parts Replacement

SERVICE PARTS

The severity of the conditions of service, the extent to which repairs can be carried out in the field and the number of units installed will determine, to a great extent, the minimum number of service parts which should be kept in stock at the site of the installation. It is suggested, as insurance against delays, that service parts be purchased when the order is placed or as soon after receiving the pump as possible.

A suggested spare parts list (priced if desired) can be furnished upon request.

The use of original Flowserve Pump Division replacement parts in the maintenance of your unit is recommended. Precise tolerances, metallurgy, manufacturing processes, and heat treatment are important factors in the design of each component and the service it will provide. Failure of any component can result in extensive damage to your unit.

CAUTION: WARRANTY WILL BE TERMINATED BASED ON THE INSTALLATION OF NON-OEM PARTS.

SERVICE PARTS STORAGE

Spare parts and parts of a dismantled pump unit should be stored separately.

HOW TO ORDER SPARE PARTS

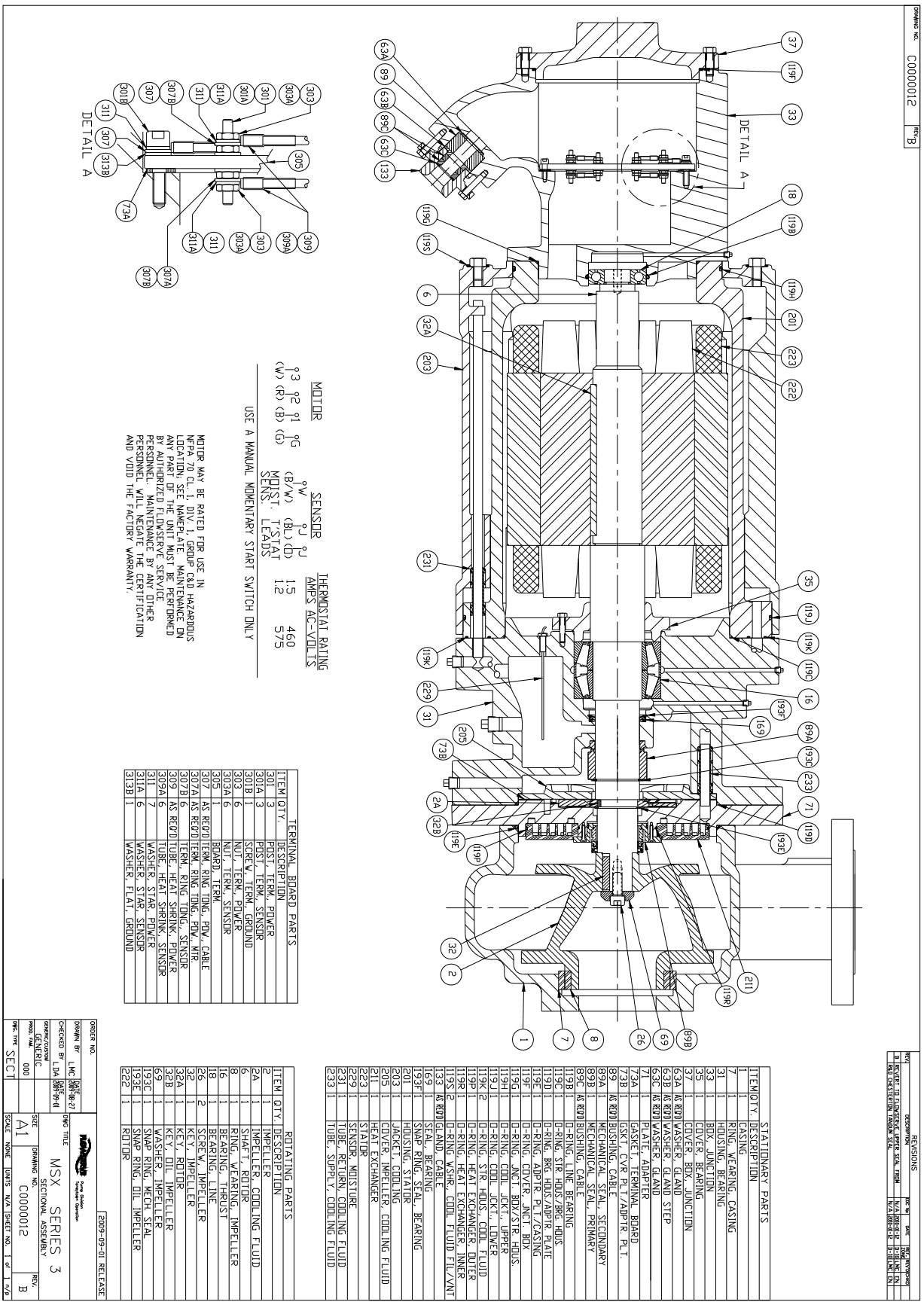
When ordering service parts the pump serial number and the size and type of pump must be given. Refer to the nameplate for this information. Give the name and number of the parts as listed on the spare parts list on the Sectional Drawing, the quantity required and, when possible, the complete symbol stamped on the old part. Orders for service parts should be sent to the nearest Flowserve Pump Division Sales Representative or Sales Office.

RETURNING PARTS

All material returned to the factory mast have a returned material (RM) tag attached. Consult the aforementioned sales office or factory from which the equipment was purchased for shipping instructions and RM tags. Unnecessary delays are avoided when parts or equipment are returned to the proper factory using the correct procedure.

1. When contacting the sales office or factory for return authorization, list the material to be returned and the reason for returning it.
2. Upon receipt of the RM tags, be sure to check the name and parts list, number of parts involved and the serial number of the equipment.
3. The RM tag must accompany the material shipped. Enclose it in the shipping container or attach it to the part being returned.
4. In cases where more than one part or box is returned, print or stencil your name, the name or each part and the RM tag number on each part or box and attach the tag to one of the parts. This will facilitate quick identification.
5 Articles being returned must be cleaned and free of sewage and carefully packed to prevent damage from handling or from exposure to weather.

SECTION VIII: Drawings



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