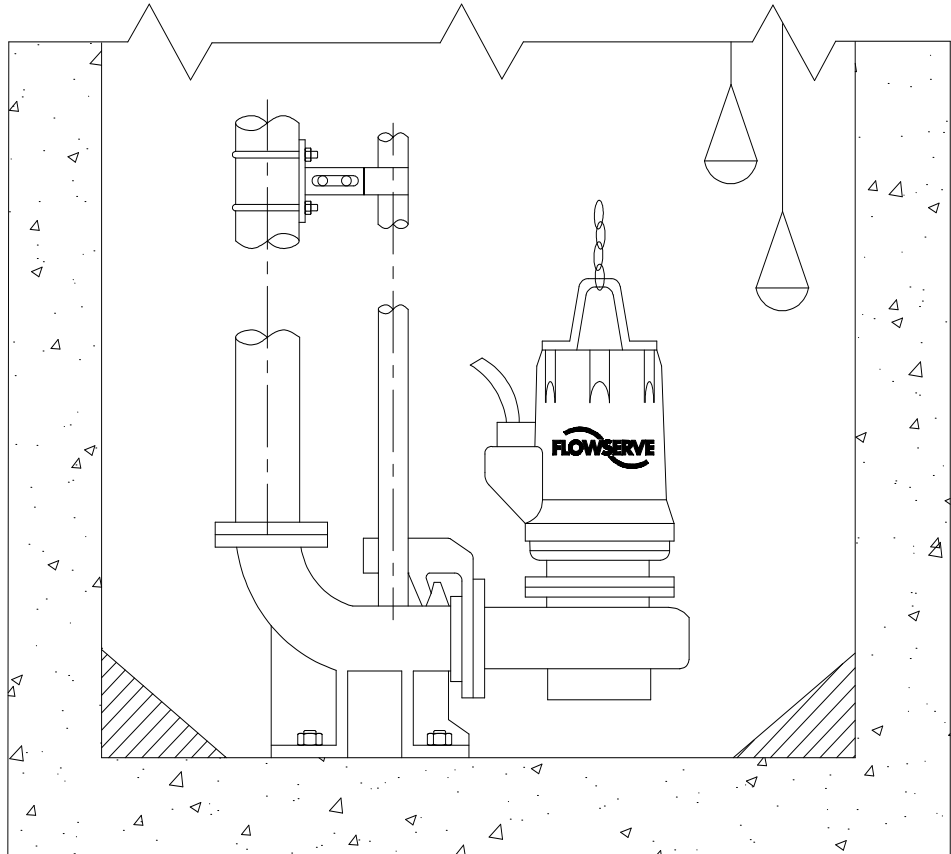




Pump Division



**Type: MSX**

Series 1/Barbarian, Non-Clog Submersible Pump

## CENTRIFUGAL PUMPS

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***USER INSTRUCTIONS:  
INSTALLATION, OPERATION, MAINTENANCE***

**P/N 81975302**



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

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# Submersible Pump Start-Up/Warranty Registration

<p><b><u>End User Information</u></b></p> <p>Name _____</p> <p>Address _____</p> <p>City _____</p> <p>State _____ Zip _____ Phone _____</p> <p>Operator's Name _____</p> <p>Model Number _____ HP _____</p> <p>Serial Number _____</p> <p>New / Replacement – Replaces _____ Mfr)</p>	<p><b><u>Pump Rotation Check</u></b></p> <p>Check rotation by laying the unit on its side, bumping the motor starter for rotation and viewing the impeller rotation. Confirm that the correct rotation is clockwise when viewed from above. Y / N</p> <p><b>Caution - Stand clear of pump when testing.</b></p>																				
<p><b><u>Describe Overall Condition of Pump(s) at Start-Up</u></b></p> <p>Pump(s) Storage - No. of Months _____</p> <p>Indoors _____ Outdoors _____</p> <p>Condition of Motor Cable _____</p> <p>Were pump ends properly protected? Y / N If not, explain _____</p>	<p><b><u>Meg OHM Check of Insulation</u></b></p> <p>B-G _____ R-G _____ W-G _____</p>																				
<p><b><u>Discharge Elbow and Guide Rail System</u></b></p> <p>Upper guide rail bracket(s) bolted securely: Y / N</p> <p>Slide rail base(s) properly bolted down: Y / N</p> <p>Guide rails exactly vertical: Y / N</p> <p>Base elbow exactly level: Y / N</p> <p>Debris in bottom of station: Y / N</p> <p><b>Liquid being pumped</b> _____</p>	<p><b><u>Install Pump in Pit</u></b></p> <p><b>WARNING: Do not use pump power cables to lower pump.</b></p> <p><b>Line Voltage</b></p> <p>Power supply line voltage: B-R _____ R-W _____ W-B _____</p> <p>Power supply frequency: _____ Hz</p> <p>See instruction manual if voltage variance exceeds 10%.</p> <p><b>Average Pump Running at Rated COS</b></p> <p>B _____ Amps R _____ Amps W _____ Amps</p>																				
<p><b><u>Installation of Float Switches</u></b></p> <p>Circle type of float arrangement: (Free Hanging) (Fixed to pipe)</p> <p>Are float switches hanging free? Y / N</p> <p>On cable fixed to pipe or rail, free length set at _____ ft.</p> <p>Check/confirm that influent flow <u>will not</u> tangle floats: Y</p> <p><b>Float Switch Location:</b></p> <table style="width:100%; border: none;"> <tr> <td></td> <td style="text-align: center;">Simplex</td> <td style="text-align: center;">Duplex</td> <td></td> </tr> <tr> <td>Pump off</td> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> <td>ft. above top of pump</td> </tr> <tr> <td>Pump on</td> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> <td>ft. above off level</td> </tr> <tr> <td>Lag pump on</td> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> <td>ft. above on level</td> </tr> <tr> <td>High level alarm</td> <td style="text-align: center;">_____</td> <td style="text-align: center;">_____</td> <td>ft. above lag pump on</td> </tr> </table>		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	<p><b><u>List Any Equipment Difficulties During Start-Up</u></b></p>  <p><b><u>Final Check</u></b></p> <p>Is pump seated properly: Y / N</p> <p>Do valves operate properly: Y / N</p>
	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																		
<p><b><u>Control Panel</u></b></p> <p>General condition at start-up _____</p> <p>Manufacturer's identification No. _____</p> <p>How is it mounted? _____</p> <p>Approximate distance from pump _____ ft.</p> <p>Is there a junction box in pit? Y / N Where? _____</p> <p>Electrically connect the pump leads, float switches and power supply leads per instructions located in the control panel door.</p> <p>Does panel include water-sensing relay? Y / N</p> <p>Make/Model of relay: _____</p> <p>Confirm winding thermostat leads were correctly connected to appropriate relay in control box: Y / N</p> <p>Confirm wiring was done correctly: Y / N</p>	<p><b><u>Nameplate Data</u></b></p> <p>Phase _____ Hz _____ Voltage _____ RPM _____</p> <p>Capacity _____ Head _____</p> <p><b><u>Start-Up Information</u></b></p> <table style="width:100%; border: none;"> <thead> <tr> <th style="text-align: center;">Name</th> <th style="text-align: center;">Present at Start-Up</th> </tr> </thead> <tbody> <tr> <td>Customer _____</td> <td style="text-align: center;">Y / N</td> </tr> <tr> <td>Contractor _____</td> <td style="text-align: center;">Y / N</td> </tr> <tr> <td>Consult. Eng. _____</td> <td style="text-align: center;">Y / N</td> </tr> <tr> <td>Representative _____</td> <td style="text-align: center;">Y / N</td> </tr> </tbody> </table> <p>Started by: _____</p> <p>Firm: _____</p> <p>Date: _____ Title: _____</p> <p><b><i>I certify that the equipment has been inspected and is ready for permanent operation.</i></b></p> <p>Signed: _____ Date: _____</p>	Name	Present at Start-Up	Customer _____	Y / N	Contractor _____	Y / N	Consult. Eng. _____	Y / N	Representative _____	Y / N										
Name	Present at Start-Up																				
Customer _____	Y / N																				
Contractor _____	Y / N																				
Consult. Eng. _____	Y / N																				
Representative _____	Y / N																				
<p>This report must be submitted to Flowserve Pump Division to activate warranty.</p> <p><b>Mail or Fax to:</b>  <b>Flowserve pump Division</b>  <b>5310 Taneytown Pike</b>  <b>Taneytown MD 21787</b>  <b>Attention: MSX Service Department</b></p> <p><b>Fax 410-756-2615</b></p>	<p><b>WARNING: Consult Instruction Manual before performing any start-up functions listed above.</b></p>																				

# FOREWORD

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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.

<p><b>WARNING:</b> THESE PUMPS (OR PROTOTYPES) HAVE BEEN SHOP TESTED AND FOUND SATISFACTORY FOR THE CONDITION FOR WHICH THEY WERE SOLD.</p> <p>DO NOT OPERATE IN EXCESS OF THEIR RATED CAPACITY, SPEED, PRESSURE, AND TEMPERATURE. REFER TO MOTOR NAMEPLATE FOR APPLICABLE RATINGS</p> <p>BE SURE THAT THE FOLLOWING GUIDELINES ARE MET WITH RESPECT TO AC POWER:</p> <ol style="list-style-type: none"><li>1. SUPPLY POWER IS WITHIN 10% OF RATED VOLTAGE AT RATED FREQUENCY.</li><li>2. SUPPLY POWER IS WITHIN 5% OF RATED FREQUENCY AT RATED VOLTAGE.</li><li>3. COMBINED VARIATION IN VOLTAGE AND FREQUENCY IS WITHIN 10% (SUM OF ABSOLUTE VALUES) OF RATED VALUES.</li></ol>
---

## 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 1 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, which must be partially submerged in the pumped fluid during operation.

**CAUTION: MOTOR COOLING IS ACCOMPLISHED BY HEAT TRANSFER FROM THE MOTOR HOUSING TO THE PUMPED FLUID. CONTINUOUS OPERATION WITH THE MOTOR ABOVE THE PUMPED LIQUID (NOT SUBMERGED) MAY CAUSE THE MOTOR TEMPERATURE TO RISE AND MAY TRIP THE THERMAL DISCONNECTS.**

**CAUTION: THE RECOMMENDED MINIMUM SUBMERGENCE FOR CONTINUOUS OPERATION OF MSX PUMP UNITS ARE AS SHOWN ON THE GENERAL ARRANGEMENT DRAWING.**

### **MOTOR**

The Flowserve Pump Division submersible motor is a three-phase, squirrel cage motor with a watertight stator housing designed specifically for the submerged operation of Flowserve Pump Division non-clog pumps. The power 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 1 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

### **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. Observe the amperage rating of the thermal contacts at the connected voltage.

<p><b>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.</b></p>
---

## MOISTURE DETECTION SENSOR

A moisture detection sensor located in the oil chamber of the bearing housing will detect failure of the lower mechanical seal by measuring the electrical conductivity of the fluid in the oil chamber. Contamination of the oil with the pumped liquid will cause the conductivity to increase. The 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.

<b>WARNING:</b> <b>FAILURE TO PROPERLY CONNECT THE MOISTURE DETECTION SENSOR MAY RESULT IN PERSONAL INJURY OR PRODUCT DAMAGE AND WILL VOID THE FACTORY WARRANTY AND EXPLOSION PROOF CERTIFICATION.</b>
--

**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.**

**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; 60 Vpk; 0.5 ma MAX.**

## 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, GW or SOOW per ANSI/NFPA 70 Article 400.

## MECHANICAL SEAL

The motor is equipped with two mechanical seals designed to prevent the entrance of the pumped liquid into the motor cavity. The lower mechanical seal prevents the pumped liquid from entering the oil-filled bearing housing. The upper mechanical seal prevents the pumped liquid from coming into contact with the bearings and the motor windings. Lower mechanical seal failure is indicated by a moisture detection probe in the oil-filled bearing housing.

## BEARINGS

MSX Series 1 pumps are equipped with double-row, angular contact thrust and single-row, deep-groove ball line bearings. The line and thrust bearings are lubricated for life with grease.

## 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 between the impeller and the casing. A radial impeller wearing ring is available as an option.

## **SECTION II: Pre-Installation Instructions**

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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 24) 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 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 CABLE.**

### **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 barrier 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 with grease and to minimize the effects of false 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 grease and to minimize the effects of false 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 resistance 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**

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### **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 OIL LEVEL AND QUALITY IN THE BEARING HOUSING MUST BE CHECKED BEFORE THE UNIT IS OPERATED; see Section III, Bearing Housing Oil 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 cables during installation. Where the power 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 (NEC) SECTION 400-9.**

**CAUTION: POWER CABLES FOR MOTORS CERTIFIED AS EXPLOSION PROOF PER ANSI/NFPA 70 (NEC) 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 CABLE REPLACEMENT WITH A NON-APPROVED POWER CABLE WILL VOID THE FACTORY WARRANTY AND NEGATE THE EXPLOSION PROOF CERTIFICATION.**

**CAUTION: A CABLE CHANGE ON A MOTOR WITHOUT A JUNCTION BOX AND A TERMINAL BOARD MUST BE PERFORMED BY AUTHORIZED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL. REMOVAL OF THE CABLE GLAND(GROMMET) OR 2-INCH NPT PLUG 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. 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; see Elevation Drawing.

### **SITE PREPARATION**

Flowserve Pump Division MSX Series 1 wet well pumps can be installed in a permanent well via a guide rail system or on a fabricated stand so that they are transportable. A guide rail installation can be either with a single, square guide rail or with a double, round guide rail system; see Figure 1: Guide Rail System.

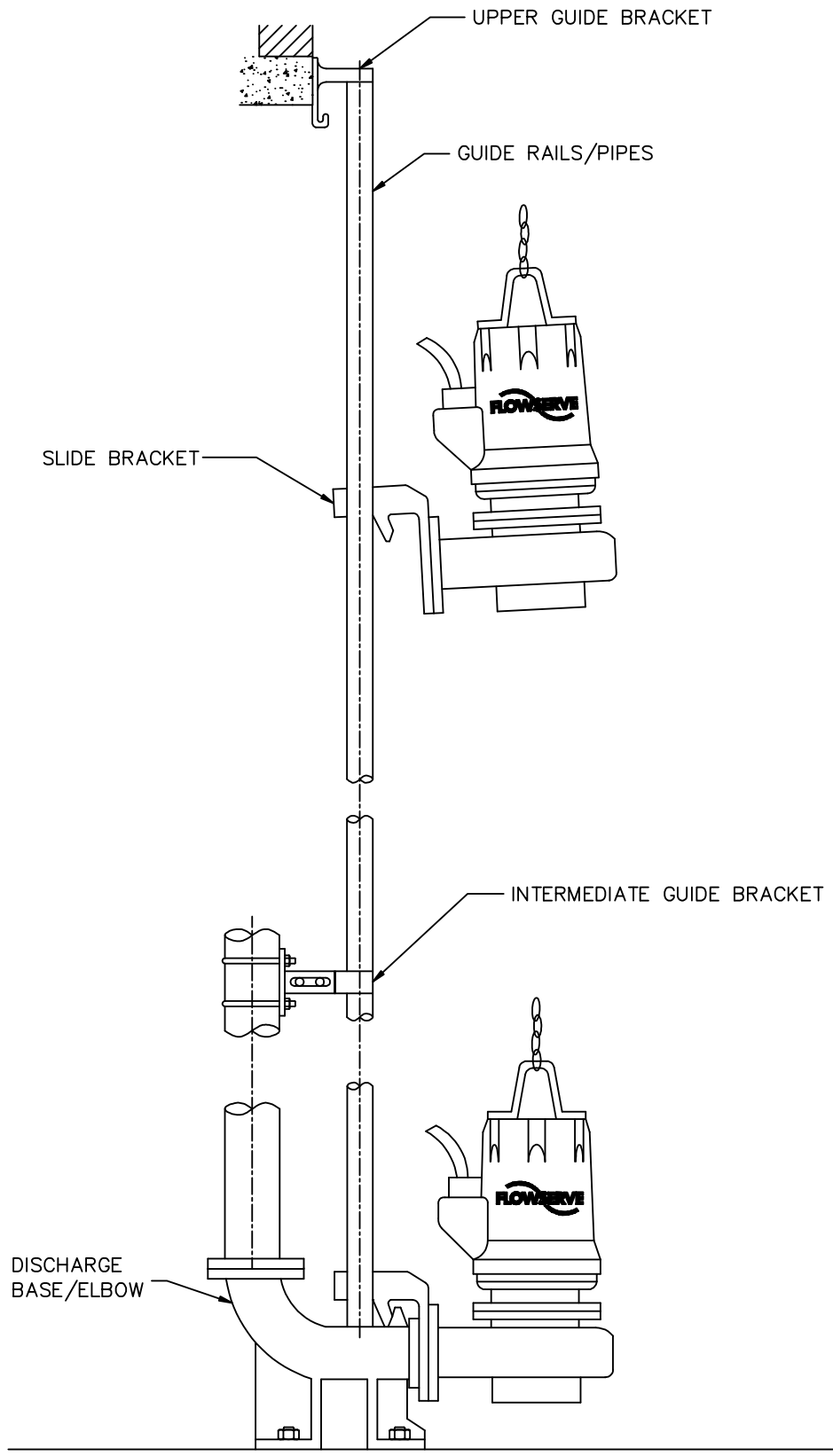


Figure 1: Guide Rail System

## Foundation

The foundation should be of sufficient strength to absorb vibration (at least five times the weight of the pump unit) and form a permanent, rigid support for the pump. Foundation bolts of the specified size should be embedded in concrete and located according to the Elevation Drawing. Flowserve Pump Division recommends that the piping be installed rigidly and anchored close to the pump connections and that the anchor bolts are securely embedded in a concrete foundation of adequate mass and rigidity.

## GUIDE RAIL INSTALLATION

1. Install anchor bolts in the bottom of the wet well for the discharge elbow/base. Install the discharge elbow/base. Secure the base with hex nuts and washers.
2. Cut the guide rail pipe(s) to length. The CUSTOMER SUPPLIED guide rail pipe is 1 1/2-inch galvanized or stainless steel square tubing (single rail systems) or galvanized or stainless steel, 2-inch round, Sch 40 pipe (double rail systems). Install the guide rail(s) over the tapered plug(s) on the discharge elbow/base.
3. Place tapered plug(s) of the upper guide rail bracket in the guide rail pipe(s) and position the upper guide rail bracket so that the guide rail pipe(s) are plumb. Secure the upper guide rail bracket to the top of the well.

## PEDESTAL MOUNTING

Pumps intended for portable use are supplied with a transportable stand. Either flexible hose with quick disconnect couplings or rigid piping can be attached to the discharge; see Figure 2: Transportable Stand.

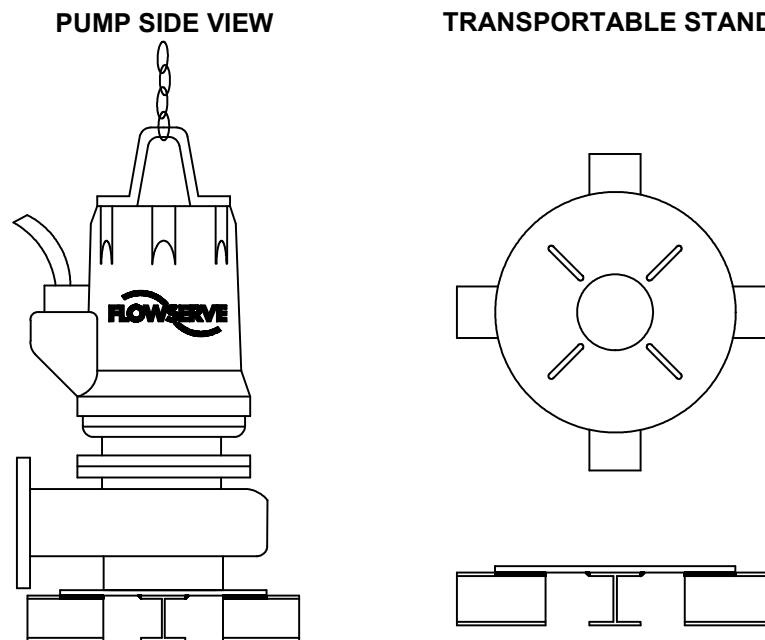


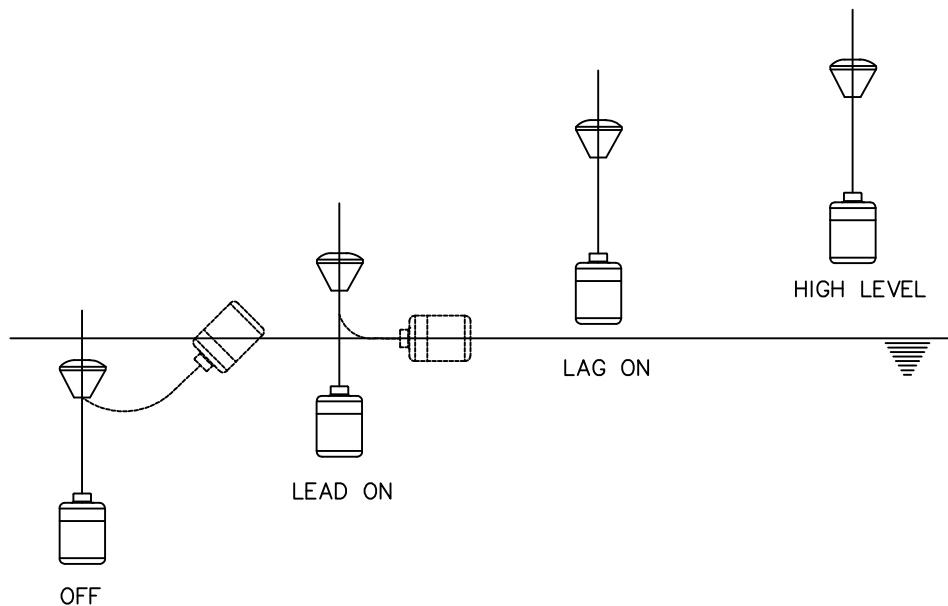
Figure 2: Transportable Stand

## FLOAT SWITCHES

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 are not in direct line with the flow into the wet well, and 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.**

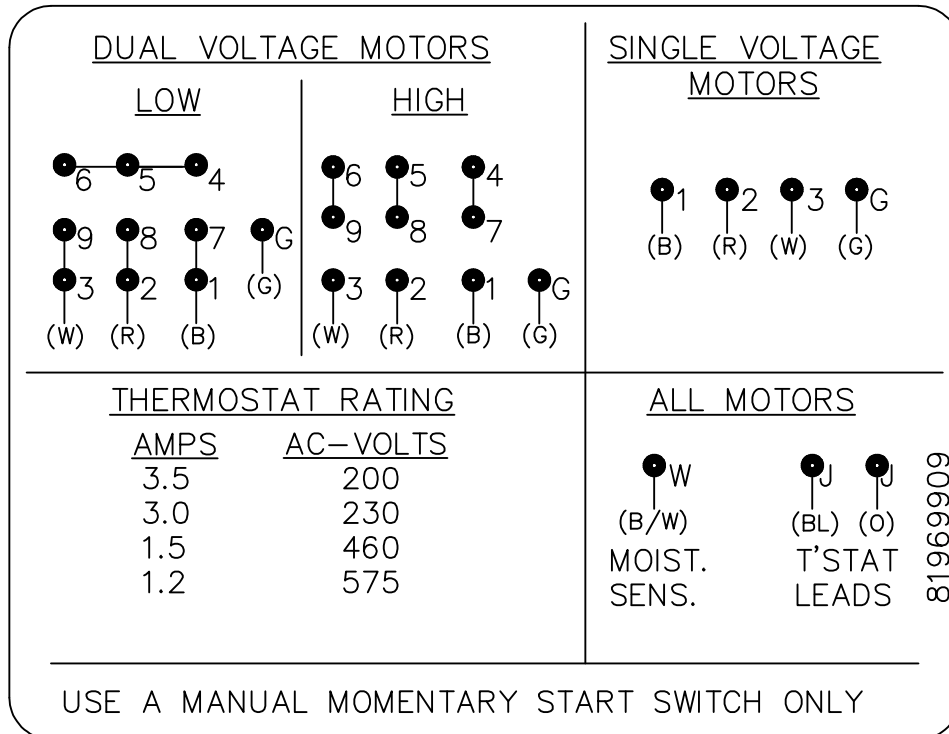
### Motor Power Wiring

Electrical power is supplied to the motor through the power supply cable leading out of the pump stator junction box. Each motor is supplied with a standard 35 foot (10.5 m) power cable (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 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.

## Dual Voltage Motors

Dual voltage motors are connected at the factory according to the purchase order and are labeled with the voltage connection. A change in voltage requires rewiring of the motor. Motors capable of having the voltage changed in the field require an optional junction box with a terminal board.

**CAUTION:** A VOLTAGE CHANGE ON A MOTOR WITHOUT A JUNCTION BOX AND TERMINAL BOARD MUST BE PERFORMED BY PERSONS QUALIFIED AND AUTHORIZED BY FLOWSERVE PUMP DIVISION. AUTHORIZATION CAN BE OBTAINED BY ATTENDING A FLOWSERVE PUMP DIVISION SERVICE SCHOOL FOR MSX PUMPS. REMOVAL OF THE CABLE GLAND(GROMMET) OR 2-INCH NPT PLUG WILL VOID THE FACTORY WARRANTY AND NEGATE THE EXPLOSION PROOF CERTIFICATION.



**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 laying the unit on its side, bumping the motor starter for rotation and viewing the impeller rotation. The correct rotation is clockwise when viewed from the above.

**CAUTION:** USE BLOCKS TO PREVENT THE UNIT FROM ROLLING AS IT IS BUMPED. DO NOT BUMP THE MOTOR WHILE THE UNIT IS SUSPENDED BY CHAINS AS IT COULD HAVE A CONSIDERABLE REACTION FORCE.

**WARNING:** DO NOT PLACE HANDS, LOOSE ARTICLES OF CLOTHING, ETC. NEAR THE SUCTION EYE. 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 the 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 megohms (connected to frame). If the test results in an insulation value less than 6 megohms, 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:

$$\text{Imbalance} = (\text{max current} - \text{average current of the three phases}) / \text{average current of the three phases}$$

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. Motors of this type are capable of making the following starts:

1. Two starts in succession, coasting to rest between starts, with the motor initially at ambient temperature.
2. One start with the motor initially at a temperature not exceeding its rated load operation temperature.

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.

<b>WARNING:</b>	<b>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.</b>
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## MOISTURE DETECTION SENSOR

A moisture detection sensor located in the oil chamber of the bearing housing will detect failure of the lower mechanical seal by measuring the electrical conductivity of the fluid in the chamber. Contamination of the oil with the pumped cooling fluid will cause the conductivity to increase. The 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.

<b>WARNING</b>	<b>FAILURE TO PROPERLY CONNECT THE MOISTURE DETECTION SENSOR MAY RESULT IN PERSONAL INJURY OR PRODUCT DAMAGE AND WILL VOID THE FACTORY WARRANTY.</b>
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**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; 60 Vpk; 0.5 ma MAX.

## BEARING HOUSING OIL FILLING

In order to fill the bearing housing with oil, the pump and motor assembly should be in a vertical orientation. Remove the upper NPT pipe plug on the bearing housing and fill the chamber level with the NPT fitting with approximately 2 quarts (1.9 L) of an approved oil (see below). It is easiest to use a nozzle to fill the chamber, which will protrude through the NPT opening without blocking the entire opening. This allows for the air in the chamber to escape and will speed up the filling process. In the event that oil leaks onto the pump or into the environment it should be cleaned and disposed of according to the Material Safety Data Sheet.

Your pump was supplied with Chevron Lubricating Oil FM ISO 68, which is a biodegradable, light hydraulic oil which passes the acute aquatic toxicity (LC-50) criteria adopted by the U.S. Fish and Wildlife Service and the U.S. EPA. The oil is designed to give maximum protection in high performance industrial applications as well as in environmentally sensitive areas. This oil is not formulated with metal containing performance additives, which will persist in the environment in the event of a leak.

## DISCHARGE PIPING

A check valve is normally installed in the discharge line to protect the pump from any excessive backpressure and reverse rotation caused by water running back through the casing during a driver or power failure. Any such reverse flow through the pump or excessive backpressure should be kept to an absolute minimum.



## SECTION IV: Operation

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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 1 non-clog submersible pump is driven directly by a motor that must be partially submerged in the pumped fluid during operation.

**CAUTION: MOTOR COOLING IS ACCOMPLISHED BY HEAT TRANSFER FROM THE MOTOR HOUSING TO THE PUMPED FLUID. CONTINUOUS OPERATION WITH THE MOTOR ABOVE THE PUMPED LIQUID (NOT SUBMERGED) MAY CAUSE THE MOTOR TEMPERATURE TO RISE AND MAY TRIP THE THERMAL DISCONNECTS.**

**CAUTION: THE RECOMMENDED MINIMUM SUBMERGENCE FOR CONTINUOUS OPERATION OF MSX PUMP UNITS ARE AS SHOWN ON THE GENERAL ARRANGEMENT DRAWING.**

### REDUCED CAPACITY OPERATION

In general, Flowserve Pump Division MSX Series 1 non-clog pumps are designed for continuous operation within 25% 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 bearing housing is filled with oil 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: Bearing Housing Oil Filling.
2. 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. 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**

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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 (NEC) 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 CORD REPLACEMENT WITH A NON-APPROVED POWER CABLE WILL VOID THE FACTORY WARRANTY AND NEGATE THE EXPLOSION PROOF CERTIFICATION.**

**CAUTION: A CABLE CHANGE ON A MOTOR WITHOUT A JUNCTION BOX AND TERMINAL BOARD MUST BE PERFORMED BY AUTHORIZED FLOWSERVE PUMP DIVISION SERVICE PERSONNEL. REMOVAL OF THE CABLE GLAND(GROMMET) OR 2-INCH NPT PLUG 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 that 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 bearing

housing oil should be inspected at this time for quality. Reference replacing oil (refer to page 22) 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. Use lifting bail and chain to remove the pump from wet pit.
2. Transport pump to a Flowserve Pump Division approved service shop.

**CAUTION: TAKE PRECAUTIONS TO PROTECT THE PUMP DURING TRANSPORTATION.**

3. Remove 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 OIL, AND COULD DAMAGE THE MECHANICAL SEAL.**

4. Drain fluid from the oil chamber in the bearing housing.
5. Remove the impeller mounting screw. The screw was mounting using Loctite 2760 and may require heating to 400° F (204° C) for removal.
6. Remove the impeller and the impeller key. Note that upon removal of the impeller, the lower mechanical seal will be disengaged and residual oil may leak from the bearing housing.
7. Remove the wear ring(s) as necessary. Reference maintenance of wearing rings.

#### **Bearing Housing**

1. Drain cooling fluid from the oil chamber in the bearing housing.
2. Remove primary ring (rotating face) of the mechanical seal from the shaft.
3. Remove the adapter plate from the bearing housing. Take care not to damage the mating ring while removing the adapter plate. The mating ring (stationary face) of the mechanical seal should not be removed unless it is being replaced.
4. Remove primary ring of the upper mechanical seal by removing the snap ring on the shaft. 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 PUMPS.**

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. Replace upper mechanical seal.
2. Install the adapter plate onto the bearing housing.
3. Replace the lower mechanical seal.
4. Assemble the components of the rotating element. The impeller screw is locked in place using Loctite 2760. Mating surfaces must be thoroughly cleaned and dry prior to application of the Loctite compound.
5. Install the casing wearing ring.
6. 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**

To remove mechanical seals, follow the procedure below:

1. The impeller (lower seal) or snap ring (upper seal) must be removed in order to remove the primary ring (rotating face). The shaft should be lightly lubricated so that the bellows will slide off the shaft. It is recommended that a soft hand soap and water mixture or glycerin be used. Light mineral oil may be used sparingly with nitrite and fluorocarbons.

**CAUTION: DO NOT USE WASHING-UP LIQUID, LIQUID SOAP OR HAND CLEANING GELS. DO NOT USE HYDROCARBON-BASED OILS OR ANY GREASE (INCLUDING SILICONE GREASE) ON ANY BELLOWS.**

2. The seat/mating ring is removed by gently prying it from the gland plate (the adapter plate for the lower seal and the bearing housing for the upper seal).

## **Installation of Seals**

1. Inspect the primary seal and mating ring and wipe them clean.
2. Install the seal/mating ring in the gland plate (the adapter plate for the lower seal and the bearing housing for the upper seal) by gently pushing the ring and bellows into the bore. NOTE: IN ORDER TO APPLY EVEN PRESSURE AROUND THE ENTIRE MATING RING A SLEEVE SHOULD BE USED. Care must be taken not to damage the seal face during installation.
3. Clean and lightly lubricate the shaft. See the note above concerning which types of lubrication are acceptable with elastomer bellows.
4. Carefully slide the seal along the shaft far enough that the snap ring or impeller can be installed to hold the seal in place. The seal faces must meet perfectly or the seal will not perform properly.

## **REPLACING OIL**

The oil in the bearing house should be inspected at yearly intervals, or sooner, depending on pump use. A small amount of oil should be drained from the bearing housing and examined. If the oil is clean, there is no need to replace it. If the oil is discolored or milky it should be drained and replaced with fresh oil. The oil should be checked again 2-3 weeks later. If the oil has become discolored or milky, the mechanical seal should be replaced. The replacement oil should be a low viscosity, environmentally friendly, hydraulic oil with additives for the following: oxidation stability, water separability, foam suppression and protection against wear, rust and corrosion. Flowserve Pump Division recommends the use of Chevron FM or equal hydraulic oil.

## **BEARINGS**

MSX Series 1 pumps are furnished with grease-lubricated bearings, which are sealed for life. 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 EP2 grease suitable for anti-friction bearing use. The grease contains rust and oxidation inhibitors. Flowserve Pump Division recommends using Mobil Infinitec 152.

## 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**

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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

### **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. Worn bearings

## **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

## **SECTION VII: Service Parts and Parts Replacement**

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### **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.

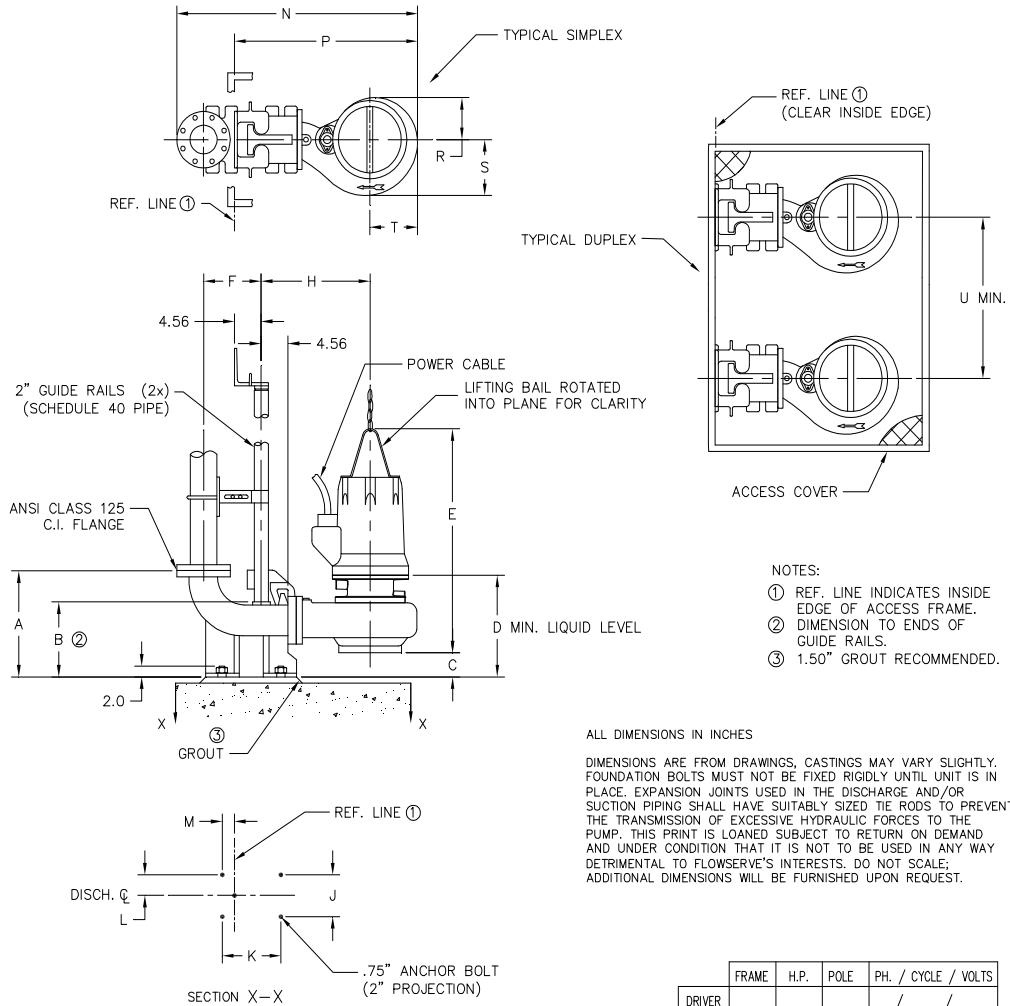
### **RETURNING PARTS**

All material returned to the factory must 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.



## GENERAL ARRANGEMENT DRAWING MSX SERIES 1 WET-PIT DOUBLE GUIDE RAIL



## GENERAL ARRANGEMENT DRAWING DIMENSIONAL DATA

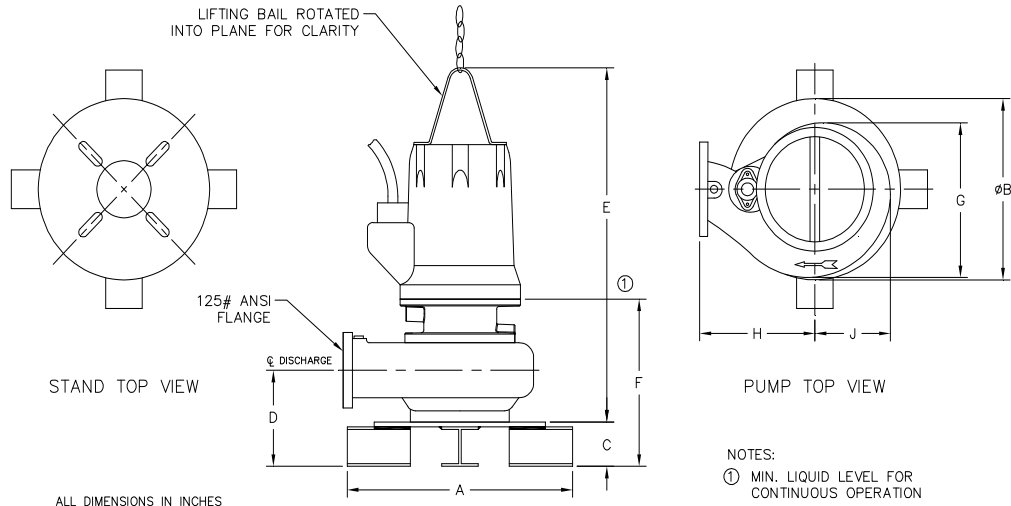
ALL DIMENSIONS IN INCHES

PUMP	MOTOR FRAME	DISCH SIZE	DIMENSIONS																	PUMP WEIGHT (lbs)	BASE WEIGHT (lbs)
			A	B	C	D	E	F	H	J	K	L	M	N	P	R	S	T	U		
3MSX7	11	3	16.87	12.06	5.12	17.38	32.00	9.44	15.96	7.75	9.88	3.88	1.75	35.41	26.59	6.00	6.65	6.07	19.30	325	92
		4	16.87	12.06	5.12	17.38	32.00	9.44	15.96	7.75	9.88	3.88	1.75	35.97	26.59	6.00	6.65	6.07	19.30	325	105
	12	3	16.87	12.06	5.12	17.38	34.38	9.44	15.96	7.75	9.88	3.88	1.75	35.41	26.59	6.00	6.65	6.07	19.30	440	92
		4	16.87	12.06	5.12	17.38	34.38	9.44	15.96	7.75	9.88	3.88	1.75	35.97	26.59	6.00	6.65	6.07	19.30	440	105
3MSX8	11	3	16.87	12.06	5.29	17.50	31.95	9.44	15.96	7.75	9.88	3.88	1.75	36.47	27.65	7.13	7.13	7.13	21.39	330	92
		4	16.87	12.06	5.29	17.50	31.95	9.44	15.96	7.75	9.88	3.88	1.75	37.03	27.65	7.13	7.13	7.13	21.39	330	105
	12	3	16.87	12.06	5.29	17.50	34.33	9.44	15.96	7.75	9.88	3.88	1.75	36.47	27.65	7.13	7.13	7.13	21.39	445	92
		4	16.87	12.06	5.29	17.50	34.33	9.44	15.96	7.75	9.88	3.88	1.75	37.03	27.65	7.13	7.13	7.13	21.39	445	105
3MSX9	12	3	16.87	12.06	5.31	17.50	34.31	9.44	15.96	7.75	9.88	3.88	1.75	36.76	27.94	7.42	7.42	7.42	22.26	456	92
		4	16.87	12.06	5.31	17.50	34.31	9.44	15.96	7.75	9.88	3.88	1.75	37.32	27.63	7.42	7.42	7.42	22.26	456	105
4MSX7	11	4	16.87	12.56	5.12	17.50	32.12	9.82	17.65	7.75	9.88	3.88	2.13	39.23	29.47	6.50	7.89	7.26	22.28	338	104
		6	17.75	13.63	6.00	18.38	32.12	11.00	17.65	9.50	11.00	4.75	3.87	41.52	29.47	6.50	7.89	7.26	22.28	338	138
	12	4	16.87	12.56	5.12	17.50	34.50	9.82	17.65	7.75	9.88	3.88	2.13	39.23	29.47	6.50	7.89	7.26	22.28	453	104
		6	17.75	13.63	6.00	18.38	34.50	11.00	17.65	9.50	11.00	4.75	3.87	41.52	29.47	6.50	7.89	7.26	22.28	453	138
4MSX9	12	4	16.87	12.56	4.37	17.00	34.75	9.82	17.14	7.75	9.88	3.88	2.13	38.71	28.95	6.54	7.94	7.26	22.41	473	104
		6	17.75	13.63	5.25	17.88	34.75	11.00	17.14	9.50	11.00	4.75	3.87	41.00	28.95	6.54	7.94	7.26	22.41	473	138
4MSX11	12	4	16.87	12.56	3.87	17.51	35.76	9.82	17.90	7.75	9.88	3.88	2.13	39.83	30.07	6.86	8.36	7.61	23.58	480	104
		6	17.75	13.63	4.75	18.39	35.76	11.00	17.90	9.50	11.00	4.75	3.87	42.12	30.07	6.86	8.36	7.61	23.58	480	138
6MSX9	11	6	17.07	14.45	4.48	18.18	33.44	11.00	20.40	9.50	11.00	4.75	3.38	45.55	33.50	7.40	9.55	8.54	26.50	350	146
		8	17.75	15.31	5.16	18.86	33.44	12.19	20.40	9.50	11.00	4.75	4.19	47.88	33.50	7.40	9.55	8.54	26.50	350	171
	12	6	17.07	14.45	4.48	18.18	35.82	11.00	20.40	9.50	11.00	4.75	3.38	45.55	33.50	7.40	9.55	8.54	26.50	465	146
		8	17.75	15.31	5.16	18.86	35.82	12.19	20.40	9.50	11.00	4.75	4.19	47.88	33.50	7.40	9.55	8.54	26.50	465	171
6MSX10	12	6	17.07	14.45	4.75	18.14	35.51	11.00	21.40	9.50	11.00	4.75	3.38	47.85	35.80	8.35	11.23	9.84	30.81	490	146
		8	17.75	15.31	5.43	18.82	35.51	12.19	21.40	9.50	11.00	4.75	4.19	50.18	35.80	8.35	11.23	9.84	30.81	490	171

ALL DIMENSIONS IN MILLIMETERS

PUMP	MOTOR FRAME	DISCH SIZE	DIMENSIONS																	PUMP WEIGHT (kg)	BASE WEIGHT (kg)
			A	B	C	D	E	F	H	J	K	L	M	N	P	R	S	T	U		
3MSX7	11	3	428.5	306.3	130.0	441.5	812.8	239.8	405.4	196.9	251.0	98.6	44.5	899.4	675.4	152.4	168.9	154.2	490.2	147	42
		4	428.5	306.3	130.0	441.5	812.8	239.8	405.4	196.9	251.0	98.6	44.5	913.6	675.4	152.4	168.9	154.2	490.2	147	48
	12	3	428.5	306.3	130.0	441.5	873.3	239.8	405.4	196.9	251.0	98.6	44.5	899.4	675.4	152.4	168.9	154.2	490.2	200	42
		4	428.5	306.3	130.0	441.5	873.3	239.8	405.4	196.9	251.0	98.6	44.5	913.6	675.4	152.4	168.9	154.2	490.2	200	48
3MSX8	11	3	428.5	306.3	134.4	444.5	811.5	239.8	405.4	196.9	251.0	98.6	44.5	926.3	702.3	181.1	181.1	181.1	543.3	150	42
		4	428.5	306.3	134.4	444.5	811.5	239.8	405.4	196.9	251.0	98.6	44.5	940.6	702.3	181.1	181.1	181.1	543.3	150	48
	12	3	428.5	306.3	134.4	444.5	872.0	239.8	405.4	196.9	251.0	98.6	44.5	926.3	702.3	181.1	181.1	181.1	543.3	202	42
		4	428.5	306.3	134.4	444.5	872.0	239.8	405.4	196.9	251.0	98.6	44.5	940.6	702.3	181.1	181.1	181.1	543.3	202	48
3MSX9	12	3	428.5	306.3	134.9	444.5	871.5	239.8	405.4	196.9	251.0	98.6	44.5	933.7	709.7	188.5	188.5	188.5	565.4	207	42
		4	428.5	306.3	134.9	444.5	871.5	239.8	405.4	196.9	251.0	98.6	44.5	947.9	701.8	188.5	188.5	188.5	565.4	207	48
4MSX7	11	4	428.5	319.0	130.0	444.5	815.8	249.4	448.3	196.9	251.0	98.6	54.1	996.4	748.5	165.1	200.4	184.4	565.9	153	47
		6	450.9	346.2	152.4	466.9	815.8	279.4	448.3	241.3	279.4	120.7	98.3	1054.6	748.5	165.1	200.4	184.4	565.9	153	63
	12	4	428.5	319.0	130.0	444.5	876.3	249.4	448.3	196.9	251.0	98.6	54.1	996.4	748.5	165.1	200.4	184.4	565.9	205	47
		6	450.9	346.2	152.4	466.9	876.3	279.4	448.3	241.3	279.4	120.7	98.3	1054.6	748.5	165.1	200.4	184.4	565.9	205	63
4MSX9	12	4	428.5	319.0	111.0	431.8	882.7	249.4	435.4	196.9	251.0	98.6	54.1	983.2	735.3	166.1	201.7	184.4	569.2	215	47
		6	450.9	346.2	133.4	454.2	882.7	279.4	435.4	241.3	279.4	120.7	98.3	1041.4	735.3	166.1	201.7	184.4	569.2	215	63
4MSX11	12	4	428.5	319.0	98.3	444.8	908.3	249.4	454.7	196.9	251.0	98.6	54.1	1011.7	763.8	174.2	212.3	193.3	598.9	218	47
		6	450.9	346.2	120.7	467.1	908.3	279.4	454.7	241.3	279.4	120.7	98.3	1069.8	763.8	174.2	212.3	193.3	598.9	218	63
6MSX9	11	6	433.6	367.0	113.8	461.8	849.4	279.4	518.2	241.3	279.4	120.7	85.9	1157.0	850.9	188.0	242.6	216.9	673.1	159	66
		8	450.9	388.9	131.1	479.0	849.4	309.6	518.2	241.3	279.4	120.7	106.4	1216.2	850.9	188.0	242.6	216.9	673.1	159	78
	12	6	433.6	367.0	113.8	461.8	909.8	279.4	518.2	241.3	279.4	120.7	85.9	1157.0	850.9	188.0	242.6	216.9	673.1	211	66
		8	450.9	388.9	131.1	479.0	909.8	309.6	518.2	241.3	279.4	120.7	106.4	1216.2	850.9	188.0	242.6	216.9	673.1	211	78
6MSX10	12	6	433.6	367.0	120.7	460.8	902.0	279.4	543.6	241.3	279.4	120.7	85.9	1215.4	909.3	212.1	285.2	249.9	782.6	222	66
		8	450.9	388.9	137.9	478.0	902.0	309.6	543.6	241.3	279.4	120.7	106.4	1274.6	909.3	212.1	285.2	249.9	782.6	222	78

## GENERAL ARRANGEMENT DRAWING MSX SERIES 1 WET-PIT TRANSPORTABLE STAND - MOUNTED



ALL DIMENSIONS IN INCHES  
DIMENSIONS ARE FROM DRAWINGS, CASTINGS MAY VARY SLIGHTLY. THIS PRINT IS LOANED SUBJECT TO RETURN ON DEMAND AND UNDER CONDITION THAT IT IS NOT TO BE USED IN ANY WAY DETRIMENTAL TO FLOWSERVE'S INTERESTS. DO NOT SCALE; ADDITIONAL DIMENSIONS WILL BE FURNISHED UPON REQUEST.

	FRAME	H.P.	POLE	PH. / CYCLE / VOLTS
DRIVER				/ / /

### ALL DIMENSIONS IN INCHES

PUMP	MOTOR FRAME	DISCH SIZE	DIMENSIONS									STAND WEIGHT (lbs)	PUMP WEIGHT (lbs)	BASE WEIGHT (lbs)
			A	B	C	D	E	F	G	H	J			
3MSX7	11	3	25.00	19.00	4.66	8.54	32.00	16.92	12.65	9.44	6.07	67	325	392
	12	3	25.00	19.00	4.66	8.54	34.38	16.92	12.65	9.44	6.07	67	440	507
3MSX8	11	3	25.00	19.00	4.66	8.37	31.95	16.87	14.26	9.44	7.13	67	330	397
	12	3	25.00	19.00	4.66	8.37	34.33	16.87	14.26	9.44	7.13	67	445	512
3MSX9	12	3	25.00	19.00	4.66	8.35	34.31	16.85	14.84	9.44	7.42	67	456	523
4MSX7	11	4	25.00	19.00	4.66	8.54	32.12	17.04	14.39	11.13	7.26	67	338	405
	12	4	25.00	19.00	4.66	8.54	34.50	17.04	14.39	11.13	7.26	67	453	520
4MSX9	12	4	25.00	19.00	4.66	9.29	34.75	17.29	14.47	10.62	7.26	67	473	540
4MSX11	12	4	25.00	19.00	4.66	9.79	35.76	18.30	15.22	11.38	7.61	67	480	547
6MSX9	11	6	25.00	19.00	4.66	10.06	33.44	18.36	16.95	13.88	8.54	67	350	417
	12	6	25.00	19.00	4.66	10.06	35.82	18.36	16.95	13.88	8.54	67	465	532
6MSX10	12	6	25.00	19.00	4.66	9.79	35.51	18.05	19.58	14.88	9.84	67	490	557

### ALL DIMENSIONS IN MILLIMETERS

PUMP	MOTOR FRAME	DISCH SIZE	DIMENSIONS									STAND WEIGHT (kg)	PUMP WEIGHT (kg)	BASE WEIGHT (kg)
			A	B	C	D	E	F	G	H	J			
3MSX7	11	3	635.0	482.6	118.4	216.9	812.8	429.8	321.3	239.8	154.2	30	147	178
	12	3	635.0	482.6	118.4	216.9	873.3	429.8	321.3	239.8	154.2	30	200	230
3MSX8	11	3	635.0	482.6	118.4	212.6	811.5	428.5	362.2	239.8	181.1	30	150	180
	12	3	635.0	482.6	118.4	212.6	872.0	428.5	362.2	239.8	181.1	30	202	232
3MSX9	12	3	635.0	482.6	118.4	212.1	871.5	428.0	376.9	239.8	188.5	30	207	237
4MSX7	11	4	635.0	482.6	118.4	216.9	815.8	432.8	365.5	282.7	184.4	30	153	184
	12	4	635.0	482.6	118.4	216.9	876.3	432.8	365.5	282.7	184.4	30	205	236
4MSX9	12	4	635.0	482.6	118.4	236.0	882.7	439.2	367.5	269.7	184.4	30	215	245
4MSX11	12	4	635.0	482.6	118.4	248.7	908.3	464.8	386.6	289.1	193.3	30	218	248
6MSX9	11	6	635.0	482.6	118.4	255.5	849.4	466.3	430.5	352.6	216.9	30	159	189
	12	6	635.0	482.6	118.4	255.5	909.8	466.3	430.5	352.6	216.9	30	211	241
6MSX10	12	6	635.0	482.6	118.4	248.7	902.0	458.5	497.3	378.0	249.9	30	222	253

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P/N 81975302  
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