



## *USER INSTRUCTIONS*

### **Worthington<sup>®</sup> MVX centrifugal pumps**

Vertical, solids handling, wet-pit pumps

PCN=26999979 01-16 (E). Original instructions.

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***Installation  
Operation  
Maintenance***



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

***Experience In Motion***

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# 1 INTRODUCTION AND SAFETY


## 1.1 General

 ***These instructions must always be kept close to the product's operating location or directly with the product.***

Flowserve products are designed, developed and manufactured with state-of-the-art technologies in modern facilities. The unit is produced with great care and commitment to continuous quality control, utilizing sophisticated quality techniques, and safety requirements.

Flowserve is committed to continuous quality improvement and being at service for any further information about the product in its installation and operation or about its support products, repair and diagnostic services.

These instructions are intended to facilitate familiarization with the product and its permitted use. Operating the product in compliance with these instructions is important to help ensure reliability in service and avoid risks. The instructions may not take into account local regulations; ensure such regulations are observed by all, including those installing the product. Always coordinate repair activity with operations personnel, and follow all plant safety requirements and applicable safety and health laws and regulations.

 ***These instructions must be read prior to installing, operating, using and maintaining the equipment in any region worldwide. The equipment must not be put into service until all the conditions relating to safety noted in the instructions, have been met. Failure to follow and apply the present user instructions is considered to be misuse. Personal injury, product damage, delay or failure caused by misuse are not covered by the Flowserve warranty.***

## 1.2 CE marking and approvals

It is a legal requirement that machinery and equipment put into service within certain regions of the world shall conform with the applicable CE Marking Directives covering Machinery and, where applicable, Low Voltage Equipment, Electromagnetic Compatibility (EMC), Pressure Equipment Directive (PED) and Equipment for Potentially Explosive Atmospheres (ATEX).

Where applicable the Directives and any additional Approvals cover important safety aspects relating to machinery and equipment and the satisfactory provision

of technical documents and safety instructions. Where applicable this document incorporates information relevant to these Directives and Approvals. To confirm the Approvals applying and if the product is CE marked, check the serial number plate markings and the Certification. (See section 9, *Certification*.)

## 1.3 Disclaimer

***Information in these User Instructions is believed to be complete and reliable. However, in spite of all of the efforts of Flowserve Corporation to provide comprehensive instructions, good engineering and safety practice should always be used.***


Flowserve manufactures products to exacting International Quality Management System Standards as certified and audited by external Quality Assurance organizations. Genuine parts and accessories have been designed, tested and incorporated into the products to help ensure their continued product quality and performance in use. As Flowserve cannot test parts and accessories sourced from other vendors the incorrect incorporation of such parts and accessories may adversely affect the performance and safety features of the products. The failure to properly select, install or use authorized Flowserve parts and accessories is considered to be misuse. Damage or failure caused by misuse is not covered by the Flowserve warranty. In addition, any modification of Flowserve products or removal of original components may impair the safety of these products in their use.

## 1.4 Copyright

All rights reserved. No part of these instructions may be reproduced, stored in a retrieval system or transmitted in any form or by any means without prior permission of Flowserve.

## 1.5 Duty conditions

This product has been selected to meet the specifications of your purchase order. The acknowledgement of these conditions has been sent separately to the Purchaser. A copy should be kept with these instructions.


 ***The product must not be operated beyond the parameters specified for the application. If there is any doubt as to the suitability of the product for the application intended, contact Flowserve for advice, quoting the serial number.***


If the conditions of service on your purchase order are going to be changed (for example liquid pumped, temperature or duty) it is requested that the user seeks the written agreement of Flowserve before start up.


## 1.6 Safety


### 1.6.1 Summary of safety markings


These User Instructions contain specific safety markings where non-observance of an instruction would cause hazards. The specific safety markings are:


 **DANGER** This symbol indicates electrical safety instructions where non-compliance will involve a high risk to personal safety or the loss of life.

 This symbol indicates safety instructions where non-compliance would affect personal safety and could result in loss of life.

 This symbol indicates “hazardous and toxic fluid” safety instructions where non-compliance would affect personal safety and could result in loss of life.

 **CAUTION** This symbol indicates safety instructions where non-compliance will involve some risk to safe operation and personal safety and would damage the equipment or property.

 This symbol indicates explosive atmosphere. It is used in safety instructions where non-compliance in the hazardous area would cause the risk of an explosion.

 This symbol is used in safety instructions to remind not to rub non-metallic surfaces with a dry cloth; ensure the cloth is damp. It is used in safety instructions where non-compliance in the hazardous area would cause the risk of an explosion.

**Note:** This sign is not a safety symbol but indicates an important instruction in the assembly process.


### 1.6.2 Personnel qualification and training

All personnel involved in the operation, installation, inspection and maintenance of the unit must be qualified to carry out the work involved. If the personnel in question do not already possess the necessary knowledge and skill, appropriate training and instruction must be provided. If required the operator may commission the manufacturer/supplier to provide applicable training.


Always coordinate repair activity with operations and health and safety personnel, and follow all plant safety requirements and applicable safety and health laws and regulations.


### 1.6.3 Safety action


*This is a summary of conditions and actions to prevent injury to personnel and damage to the environment and to equipment. For products used in potentially explosive atmospheres section 1.6.4 also applies.*


 **DANGER** NEVER DO MAINTENANCE WORK WHEN THE UNIT IS CONNECTED TO POWER

 **GUARDS MUST NOT BE REMOVED WHILE THE PUMP IS OPERATIONAL**

 **DRAIN THE PUMP AND ISOLATE PIPEWORK BEFORE DISMANTLING THE PUMP**  
The appropriate safety precautions should be taken where the pumped liquids are hazardous.


 **FLUORO-ELASTOMERS (When fitted.)**  
When a pump has experienced temperatures over 250 °C (482 °F), partial decomposition of fluoro-elastomers (example: Viton) will occur. In this condition these are extremely dangerous and skin contact must be avoided.

 **HANDLING COMPONENTS**  
Many precision parts have sharp corners and the wearing of appropriate safety gloves and equipment is required when handling these components. To lift heavy pieces above 25 kg (55 lb.) use a crane appropriate for the mass and in accordance with current local regulations.

 **APPLYING HEAT TO REMOVE IMPELLER**  
There may be occasions when the impeller has either been shrunk fit on to the pump shaft or has become difficult to remove due to products of corrosion.

If you elect to use heat to remove the impeller, it must be applied quickly to the impeller boss. **TAKE GREAT CARE!**

Before applying heat ensure any residual hazardous liquid trapped between the impeller and pump shaft is thoroughly drained out through the impeller keyway to prevent an explosion or emission of toxic vapor. This must be carried out with the shaft in the vertical position. On some pump sizes a cavity exists in the impeller bore so on occasions a significant volume of liquid may drain out.

 **THERMAL SHOCK**  
Rapid changes in the temperature of the liquid within the pump can cause thermal shock, which can result in damage or breakage of components and should be avoided.

**HOT (and cold) PARTS**

If hot or freezing components or auxiliary heating supplies can present a danger to operators and persons entering the immediate area action must be taken to avoid accidental contact. If complete protection is not possible, the machine access must be limited to maintenance staff only, with clear visual warnings and indicators to those entering the immediate area. Note: bearing housings must not be insulated and drive motors and bearings may be hot.

***If the temperature is greater than 80 °C (175 °F) or below -5 °C (23 °F) in a restricted zone, or exceeds local regulations, action as above shall be taken.***

**HAZARDOUS LIQUIDS**

When the pump is handling hazardous liquids care must be taken to avoid exposure to the liquid by appropriate siting of the pump, limiting personnel access and by operator training. If the liquid is flammable and/or explosive, strict safety procedures must be applied.

***Gland packing must not be used when pumping hazardous liquids.***

**CAUTION PREVENT EXCESSIVE EXTERNAL PIPE LOAD**

Do not use pump as a support for piping. Do not mount expansion joints, unless allowed by Flowserve in writing, so that their force, due to internal pressure, acts on the pump flange.

**CAUTION NEVER RUN THE PUMP DRY**

**CAUTION ENSURE CORRECT LUBRICATION**  
(See section 5, *Commissioning, startup, operation and shutdown.*)

**CAUTION ONLY CHECK DIRECTION OF MOTOR ROTATION WITH COUPLING ELEMENT DISENGAGED.**

Starting in reverse direction of rotation will damage the pump.

**CAUTION START THE PUMP WITH OUTLET VALVE PARTLY OPENED**

(Unless otherwise instructed at a specific point in the User Instructions.)

This is recommended to minimize the risk of overloading and damaging the pump motor at full or zero flow. Pumps may be started with the valve further open only on installations where this situation cannot occur. The pump outlet control valve may need to be adjusted to comply with the duty following the run-up process. (See section 5, *Commissioning start-up, operation and shutdown.*)

**CAUTION INLET VALVES TO BE FULLY OPEN WHEN PUMP IS RUNNING**

Running the pump at zero flow or below the recommended minimum flow continuously will cause damage to the pump and mechanical seal.

**CAUTION DO NOT RUN THE PUMP AT ABNORMALLY HIGH OR LOW FLOW RATES**  
Operating at a flow rate higher than normal or at a flow rate with no back pressure on the pump may overload the motor and cause cavitation. Low flow rates may cause a reduction in pump/bearing life, overheating of the pump, instability and cavitation/vibration.

**1.6.4 Products used in potentially explosive atmospheres**

Measures are required to:

- Avoid excess temperature
- Prevent build up of explosive mixtures
- Prevent the generation of sparks
- Prevent leakages
- Maintain the pump to avoid hazard

The following instructions for pumps and pump units when installed in potentially explosive atmospheres must be followed to help ensure explosion protection. Always observe the regional legal Ex requirements.

**1.6.4.1 Scope of compliance**

Use equipment only in the zone for which it is appropriate. Always check that the driver, drive coupling assembly, seal and pump equipment are suitably rated and/or certified for the classification of the specific atmosphere in which they are to be installed.

Where Flowserve has supplied only the bare shaft pump, the Ex rating applies only to the pump. The party responsible for assembling the pump set shall select the coupling, driver and any additional equipment, with the necessary Certificate establishing it is suitable for the area in which it is to be installed.

The output from a variable frequency drive (VFD) can cause additional heating affects in the motor and so, for pumps sets with a VFD, the Certification for the motor must state that it is covers the situation where electrical supply is from the VFD. This particular requirement still applies even if the VFD is in a safe area.

**1.6.4.2 Avoiding excessive surface temperatures**


If an explosive atmosphere exists during the installation, do not attempt to check the direction of rotation by starting the pump unfilled. Even a short run time may give a high temperature resulting from contact between rotating and stationary components.

Where there is any risk of the pump being run against a closed valve generating high liquid and casing external surface temperatures, fit an external surface temperature protection device.

Avoid mechanical, hydraulic or electrical overload by using motor overload trips, temperature monitor or a power monitor and make routine vibration monitoring checks.

In dirty or dusty environments, make regular checks and remove dirt from areas around close clearances, bearing housings and motors.


**1.6.4.3 Preventing the build-up of explosive mixture**

 ENSURE THE PUMP IS PROPERLY FILLED AND VENTED AND DOES NOT RUN DRY  
Ensure the pump and relevant suction and discharge pipeline system is totally filled with liquid at all times during the pump operation, so that an explosive atmosphere is prevented. In addition it is essential to make sure that seal chambers, auxiliary shaft seal systems and any heating and cooling systems are properly filled.


If the operation of the system cannot avoid this condition, fit an appropriate dry run protection device (for example liquid detection or a power monitor).

To avoid potential hazards from fugitive emissions of vapor or gas to atmosphere the surrounding area must be well ventilated.

**1.6.4.4 Preventing sparks**

 To prevent a potential hazard from mechanical contact, the coupling guard must be non-sparking.

To avoid the potential hazard from random induced current generating a spark, the base plate must be properly grounded.


 Avoid electrostatic charge: do not rub non-metallic surfaces with a dry cloth; ensure cloth is damp.

Correct coupling alignment must be maintained.

**Additional requirement for metallic pumps on non-metallic base plates**

When metallic components are fitted on a non-metallic base plate they must be individually earthed.

**1.6.4.5 Preventing leakage**

 The pump must only be used to handle liquids for which it has been approved to have the correct corrosion resistance.

Avoid entrapment of liquid in the pump and associated piping due to closing of suction and discharge valves, which could cause dangerous excessive pressures to occur if there is heat input to the liquid. This can occur if the pump is stationary or running.

Bursting of liquid containing parts due to freezing must be avoided by draining or protecting the pump and ancillary systems.

Where there is the potential hazard of a loss of a seal barrier fluid or external flush, the fluid must be monitored.

If leakage of liquid to atmosphere can result in a hazard, install a liquid detection device.

**1.6.4.6 Maintenance to avoid the hazard**

 CORRECT MAINTENANCE IS REQUIRED TO AVOID POTENTIAL HAZARDS WHICH GIVE A RISK OF EXPLOSION

***The responsibility for compliance with maintenance instructions is with the plant operator.***

To avoid potential explosion hazards during maintenance, the tools, cleaning and painting materials used must not give rise to sparking or adversely affect the ambient conditions. Where there is a risk from such tools or materials, maintenance must be conducted in a safe area.

It is recommended that a maintenance plan and schedule is adopted. (See section 6, *Maintenance*.)

**1.7 Safety labels summary**

**1.7.1 Nameplate**

For details of nameplate, see the *Declaration of Conformity*, or separate documentation included with these User Instructions.

### 1.7.2 Safety labels

<b>FLOWSERVE</b>		<b>WARNING</b>	J218JZ250
<b>ESSENTIAL PROCEDURES BEFORE STARTING:</b>			
<p>INSTALL AND OPERATE EQUIPMENT IN ACCORDANCE WITH THE INSTRUCTION MANUAL SUPPLIED SEPARATELY.</p> <p>ENSURE GUARDS ARE SECURELY IN PLACE.</p> <p>ENSURE CORRECT DIRECTION OF ROTATION.</p>	<p>ENSURE ALL EXTERNAL CONNECTIONS TO THE PUMP / SHAFT SEALING AND DRIVER ARE CONNECTED AND OPERATIONAL.</p> <p>FULLY PRIME UNIT AND SYSTEM. DO NOT RUN UNIT DRY.</p>	<p>FAILURE TO FOLLOW THESE PROCEDURES MAY RESULT IN PERSONAL INJURY AND / OR EQUIPMENT DAMAGE</p>	

<b>FLOWSERVE</b>		<b>WARNING</b>	J218JZ268
<p>ENSURE UNIT ON A FIRM FOUNDATION AND THAT COUPLING FACES ARE IN CORRECT ALIGNMENT PRIOR TO AND AFTER BOLTING BASEPLATE DOWN AND FIXING PIPEWORK. SEE MANUAL FOR TOLERANCES.</p> <p>S'ASSURER QUE LE GROUPE ELECTROPOMPE EST FERMEMENT INSTALLE SUR SON MASSIF. VERIFIER LE LIGNAGE DE L'ACCOUPLMENT AVANT ET APRES FIXATION DU SOCLE ET DE LA TUYAUTERIE. VOIR LES TOLERANCES D'ALIGNMENT SUR LA NOTICE</p>			
		<p>PUMP MUSS AUF FESTEM FUNDAMENT STEHEN. KUPPLUNGSHÄLFEN KORREKT AXIAL AUSRICHTEN. DANN PUMPE AUF GRUNDPLATTE FESTSPANNEN UND ANSSCHLUSSLEITUNGEN BEFESTIGEN. TOLERANZEN S. BEDIENUNGSANLEITUNG.</p> <p>ZORG DAT POMPEENHEID OP EEN STEVIGE ONDERGROND OPGESTELD STAAT EN DAT KOPPELING CORRECT UITGELIJNT IS ZOWEL VOOR-ALS NADAT DE GRONDPLAAT MET BOUTEN IS VASTGEZET EN DE LEIDINGEN GEINSTALLEERD ZIJN. ZIE HANDLEIDING VOOR TOELAABARE SPELINGEN.</p>	
CDC: 603 604 610 612 621 623 624			

#### Oil lubricated units only:

<b>FLOWSERVE</b>		<b>WARNING</b>	J218JZ262
<p>WARNING</p> <p>WAARSCHUWING</p>	<p>THIS MACHINE MUST BE FILLED WITH OIL BEFORE STARTING</p> <p>CETTE MACHINE DOIT ÊTRE REMPLIE D'HUILE AVANT LA MISE EN MARCHÉ</p> <p>DIESE MASCHINE IST VOR DEM STARTEN MIT ÖL ZÜ FÜLLEN</p> <p>DEZE MACHINE MOET VOOR HET STARTEN MET OILIE GEVULD WORDEN</p>		
CDC: 603 604 610 612 621 623 624			

### 1.8 Specific machine performance

For performance parameters see section 1.5, *Duty conditions*. When the contract requirement specifies these to be incorporated into User Instructions they should be kept with this document. In cases where performance data has been supplied separately to the purchaser the same should be obtained and retained with these User Instructions if required.

### 1.9 Noise level

Attention must be given to the exposure of personnel to the noise, and local legislation will define when guidance to personnel on noise limitation is required, and when noise exposure reduction is mandatory. This is typically 85 to 90 dBA reference OSHA Standard 1910.95(a).

The usual approach is to control the exposure time to the noise or to enclose the machine to reduce emitted sound. You may have already specified a limiting noise level when the equipment was ordered, however if no noise requirements were defined, then attention is drawn to the following table to give an indication of equipment noise level so that you can take the appropriate action in your plant.

Pump noise level is dependent on a number of operational factors, flow rate, pipework design and acoustic characteristics of the building, and so the values given are subject to a 3 dBA tolerance and cannot be guaranteed.

Similarly the motor noise assumed in the “pump and motor” noise is that typically expected from standard and high efficiency motors when on load directly driving the pump. Note that a motor driven by an inverter may show an increased noise at some speeds.

If a pump unit only has been purchased for fitting with your own driver then the “pump only” noise level should be combined with the noise level for the driver obtained from the supplier. Consult Flowserve or a noise specialist if assistance is required in combining the values.

It is recommended that where exposure approaches the prescribed limit, then site noise measurements should be made.

The values are in sound pressure level  $L_{pA}$  at 1 m (3.3 ft) from the machine, for “free field conditions over a reflecting plane”.

For estimating sound power level  $L_{WA}$  (re 1pW) then add 17 dBA to the sound pressure value.

**Note:**

Typical motor noise levels may be obtained from a motor manufacturer’s data/catalogue to provide the average expected motor noise values at no load for reference only and are not guaranteed. The values could vary depending upon the test and surrounding conditions. The combined noise level of the pump and the motor will likely exceed the motor only values. It is to be noted that adding motors with similar noise levels increases the total noise level. Therefore, the dB correction to motor only values is required to obtain the combined noise levels of motor and the pump. Actual on-site noise measurement by experts is recommended and safety measures are to be taken accordingly.

## 2 TRANSPORT AND STORAGE

### 2.1 Consignment receipt and unpacking

Immediately after receipt of the equipment it must be checked against the delivery and shipping documents for its completeness and that there has been no damage in transportation. Any shortage and or damage must be reported immediately to Flowserve and received in writing within one month of receipt of the equipment. Later claims cannot be accepted.




**Note:** Check any crates, boxes and wrappings for any accessories or spare parts which may be packed separately with the equipment or attached to side walls of the box or equipment.

Each product has a unique serial number. Check that this number corresponds with that advised and always quote this number in correspondence as well as when ordering spare parts or further accessories.

## 2.2 Handling

Boxes, crates, pallets or cartons may be unloaded using fork lift vehicles or slings dependent on their size and construction.

## 2.3 Lifting

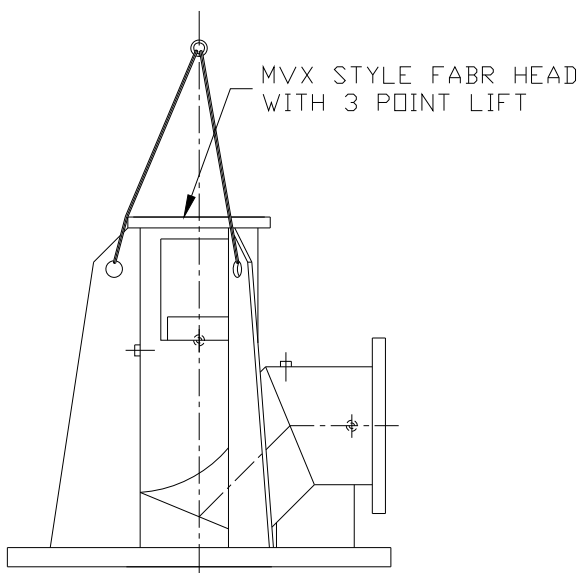
 Equipment in excess of 25 kg (55 lb) should be lifted by mechanical means. Fully trained personnel must carry out lifting, in accordance with local regulations.

Before lifting the driver alone, refer to the manufacturer's instructions.

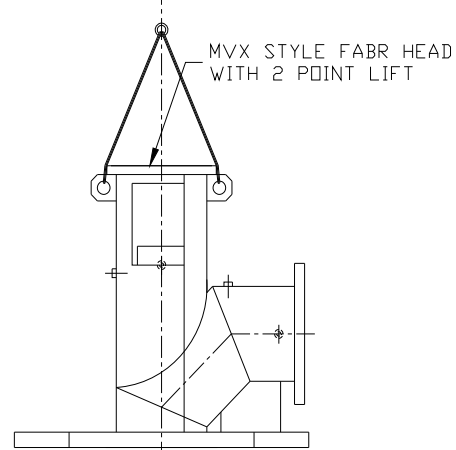
### 2.3.1 Lifting of fabricated discharge heads with or without the pump

For pumps supplied with a fabricated discharge head use a 2 point or 3 point method of lifting as shown in the details provided in 2.3.1.1 and 2.3.1.2. This method is applicable to the lifting of discharge heads with or without the pump.

#### 2.3.1.1 Three point lifting of fabricated discharge head types (with or without pump attached)



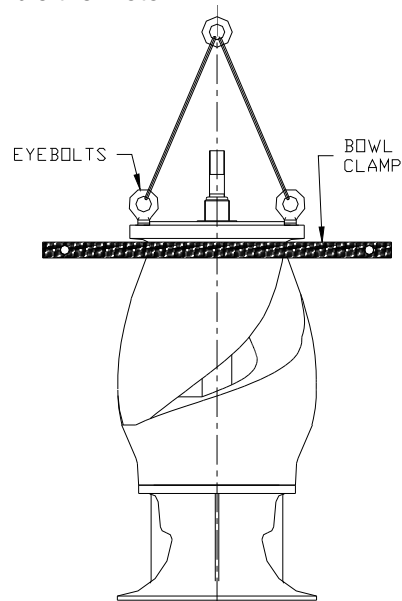
#### 2.3.1.2 Two point lifting of fabricated discharge head (with or without pump attached)



#### 2.3.2 Lifting of bowl assembly only

Install suitable eyebolts in the upper flange of the bowl assembly and center the lifting hook for lifting and lowering the assembly. If the pump cannot be lifted and installed fully assembled then bowl and column pipe clamps may be required for field assembly. A typical installation procedure would be:

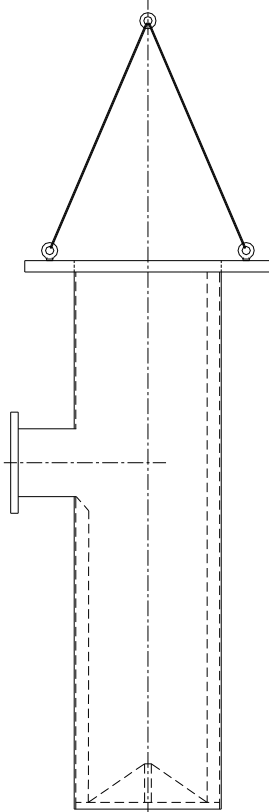
- Lower the bowl assembly until the bowl assembly clamp extensions rest on the foundation (use appropriate supports).
- Build the very first section of the column piping, and lower the entire assembly to assemble the next column section.
- Continue to build until it is ready for discharge head assembly.
- Install the discharge head.
- Assemble the motor.



*Example: Lifting of bowl assembly*

**2.3.3 Lifting of suction barrel**

A suction barrel is always supplied separately and has to be installed into the sump first. Install eyebolts on the flange of the suction barrel and attach slings and straps to bring the suction barrel to a vertical position. Move the barrel for installation. Provide hand support to prevent the suction barrel from swaying during movement.

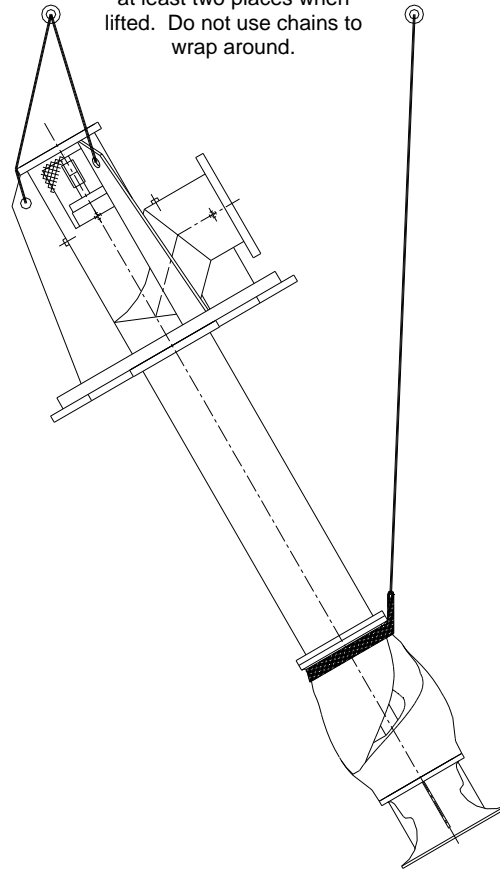


*Example: Lifting of suction barrel*

**2.3.4 Lifting of fully assembled pumps**

If the pump is fully assembled, it has to be adequately strapped and supported in at least two places before it can be lifted from the shipping crate and moved to the installation site. See details shown. Same rules are applicable when the pump is pulled out from the sump and moved to another location.

Pump must be supported in at least two places when lifted. Do not use chains to wrap around.



CAUTION

Two (2) cranes required for handling.



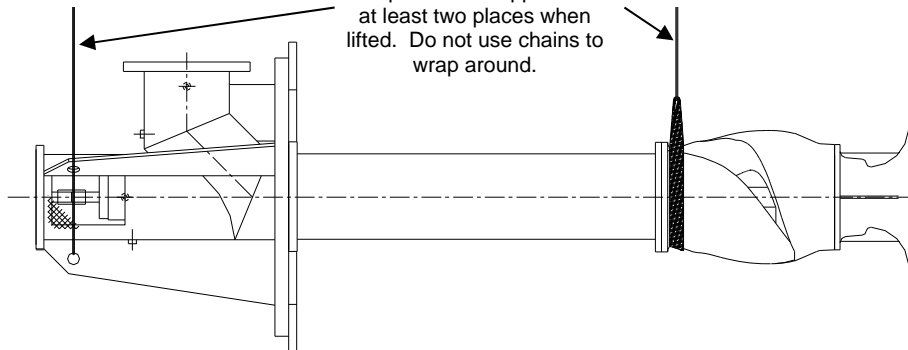
CAUTION

Examples shown here are for illustration only. Sections 2.3.1 to 2.3.4 provide general lifting instructions for the design variations shown. Your pump(s) may vary in weight, length and physical appearances from the types shown here. Hence fully trained personnel must carry out all lifting in accordance with local regulations.



Therefore, before lifting is attempted, exercise caution to prevent any injuries or loss of life.

Pump must be supported in at least two places when lifted. Do not use chains to wrap around.



## 2.4 Storage



Store the pump in a clean, dry location away from vibration. Leave piping connection covers in place to keep dirt and other foreign material out of pump. Turn the pump at frequent intervals to prevent brinelling of the bearings and the seal faces, if fitted, from sticking.

### 2.4.1 Inspection before storage

- a) Inspect the preservative coating/painted surfaces on the various parts. Touch up the areas, if necessary.
- b) Inspect all covers over pump openings and piping connections. If found damaged, remove the covers and inspect interiors of the opening for any deposits of foreign materials or water.
- c) If necessary, clean and preserve the interior parts as noted above to restore the parts to the "as shipped" condition. Replace covers and fasten securely.
- d) Exercise caution with pumps exposed to weather. Containers are not leak proof. Parts may be coated with a residual amount of protective coating, which will wash away if exposed to the elements.



Driver storage instructions should be checked for special care that may be required.

### 2.4.2 Short term storage (up to 6 months)

Follow the steps given in section 2.4.1. Select a storage space so that the unit will not be subjected to ground transmitted vibration, excess moisture, extreme weather conditions, corrosive fumes, or other harmful conditions. All boxes marked for inside storage must be stored indoors.

All equipment must be placed on skids or blocks to prevent contact with the ground and surface contaminants. Equipment must be adequately supported to prevent distortion and bending. When selecting a storage area the following should be taken into consideration:

- a) The deterioration of the equipment will be proportionate to the class of storage provided.
- b) The expenses involved in restoring the equipment at time of installation will be proportionate to the class of storage provided.

### 2.4.3 Long term or extended storage

If a situation arises for a long-term storage, (more than 6 months) please contact Flowserve for special storage instructions and warranty related information.

## 2.5 Recycling and end of product life

At the end of the service life of the product or its parts, the relevant materials and parts should be recycled or disposed of using an environmentally acceptable method and local regulations. If the product contains substances which are harmful to the environment, these should be removed and disposed of in accordance with current regulations. This also includes the liquids and or gases in the "seal system" or other utilities.



Make sure that hazardous substances or toxic fluids are disposed of safely and that the correct personal protective equipment is used. The safety specifications must be in accordance with the current regulations at all times.

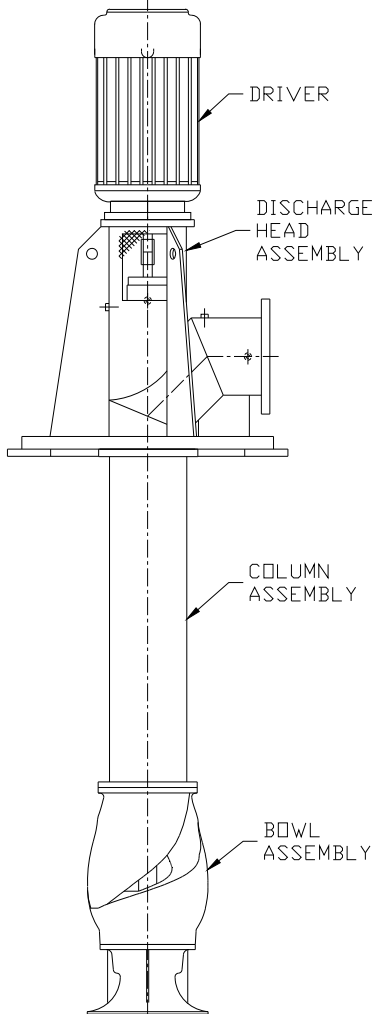
### 3 DESCRIPTION

Should questions arise concerning the pump, Flowserve will require the complete serial number to be of assistance. The serial number is stamped on a metal nameplate affixed to the discharge head assembly. The driver will have a separate nameplate attached to it. If you are requesting information on the driver, please provide both the driver serial number and the pump serial number to the Flowserve representative.

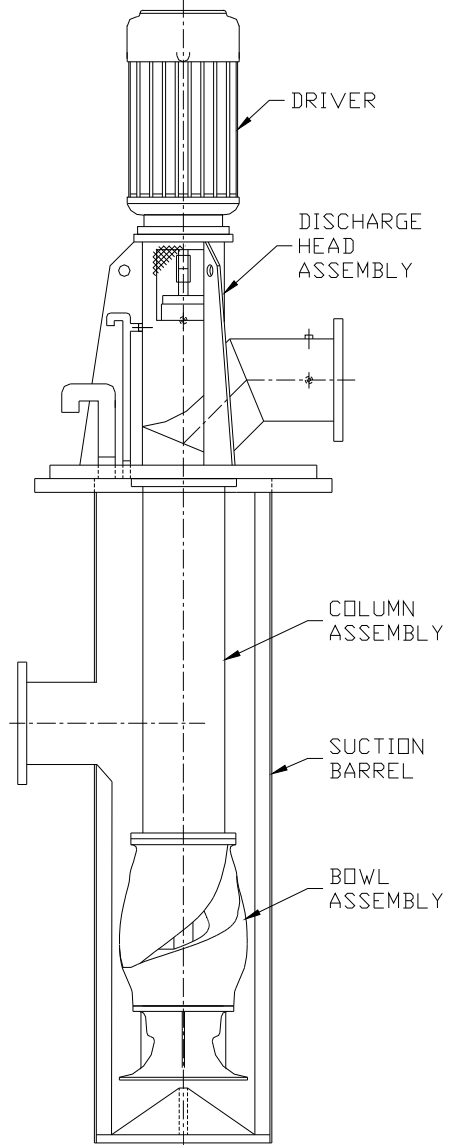
### 3.1 Configuration

MVX pumps are engineered pumps of the Wet pit type and can be installed in an open wet well or in a suction barrel. Most pumps are built with customer specific features and for applications in wastewater pumping stations, storm water service or industrial applications. The pumps vary in size and length and are usually provided with an enclosed shaft design for a dirty liquid service.

#### 3.1.1 Open wet well type



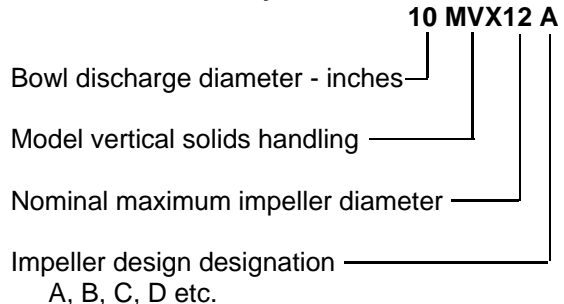
#### 3.1.2 Suction barrel type



### 3.2 Nomenclature

The pump size/serial number will be engraved on the nameplate typically as below. The nameplate is attached to the discharge head assembly.

#### 3.2.1 Bowl assembly nomenclature



The nomenclature above is the general guide to the MXV configuration description. Identify the actual pump size and serial number from the pump nameplate. The driver will have a separate nameplate.

**3.2.2 Discharge head nomenclature**

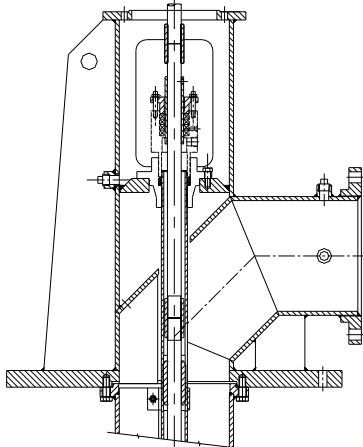
The above ground MXV discharge heads are designed specifically for the application. They are similar to the HFL type discharge head used on our VTP product line except that it contains a splitter vane on the back side of the enclosing tube to prevent the accumulation of solids around the tube.

The below ground MXV heads utilize the UF type fabricated head as used on our VTP product line.

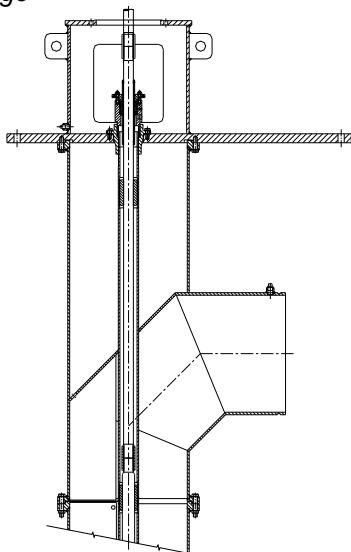
**3.2.2.1 Types of discharge heads**

Typical discharge head types. Details (a) and (b).

a) *Standard above ground discharge head*



b) *UF type fabricated head with below ground discharge*



**Note:**

The discharge heads shown in section 3.2.2.1 (a) and (b) are for illustration only. The shaft and coupling arrangements vary. For the actual configuration of the pump that has been purchased, please refer to the drawings supplied with the pump or order specific sectionals from Flowserve.

**3.3 Design of major parts**

**Note:**

Refer to section 8 for assembly reference numbers (Euro pump numbers).

**3.3.1 Drivers**

A variety of drivers may be used, however, electric motors are most common. For the purposes of this manual, all types of drivers can be grouped into two categories:

a) *Hollow shaft drivers:* where the head shaft extends through a tube in the center of the rotor and is connected to the driver by a clutch assembly at the top of the driver.

b) *Solid shaft drivers:* where the rotor shaft is solid and projects below the driver-mounting base. This type driver requires an adjustable coupling for connecting to the pump.

**3.3.2 Discharge head assembly**

(See also section 3.2.2.1)

The discharge head supports the driver and bowl assembly as well as supplying a discharge connection in most cases.

A shaft sealing arrangement is located in the discharge head to seal the shaft at its exit from the liquid chamber. The shaft seal will be either a mechanical seal assembly or a tube packing box with an enclosed line shaft. The shaft sealing arrangement also contains the injection port for clean water flush or oil drip lube of the line shaft and bowl bearings.

A splitter vane is provided on the backside of the elbow in the discharge head to preclude the accumulation of stringy material on the enclosing tube.

**3.3.3 Column assembly**

The column assembly consists of column pipe, which connects the bowl assembly to the discharge head and carries the pumped fluid to the discharge head; shaft, connecting the pump shaft to the driver; and the bearings required for the particular unit. Standard column pipe is of flanged-type construction with an axial splitter vane along its entire length. The splitter van prevents the accumulation of solids within the column pipe.

The column assembly is of enclosed line shaft type construction which includes an enclosing tube around the line shaft and utilizes clean water or oil drip lube to lubricate the line shaft bearings. The enclosing tube is tensioned by turning the tube tension nut located in the discharge head assembly.

The shafts are threaded or key coupled with thrust stud design or clamp ring design.

Typical sectional drawings can be found in section 8. See sectional drawings supplied with the pump for exact column assembly details for your order. The size and configuration vary depending upon the specific order requirements and application criteria.

**3.3.4 Bowl assemblies**

The bowl assembly consists of an impeller, bowl, and suction bell. Liquid is drawn into the suction bell where it is directed into the impeller. The impeller is rigidly mounted on the pump shaft which rotates and imparts energy to the fluid. The bowl captures the increased pressure energy and directs the fluid into the column pipe.

The bowl is arranged with multiple passages spaced evenly to provide for a balanced radial load on the impeller. The passages and annulus around the impeller are designed to minimize clogging.

**3.3.5 Impellers and rings**

The impeller is a solids handling type capable of passing trash and solids of limited size. The impeller hub is keyed to the shaft and retained with an impeller cover plate and retaining cap screw(s) to prevent its backing off.

A pair of replaceable wearing rings (optional) between the rotating impeller and the stationary suction head are provided for impeller and suction bell wear resistance.

A replaceable impeller back ring and restriction bushing between the rotating impeller and stationary bearing housing are provided to reduce the back pressure on the lower bearing housing shaft lip seal to protect it from the ingress of contaminants in the pumped liquid.

**3.3.6 Bearings**

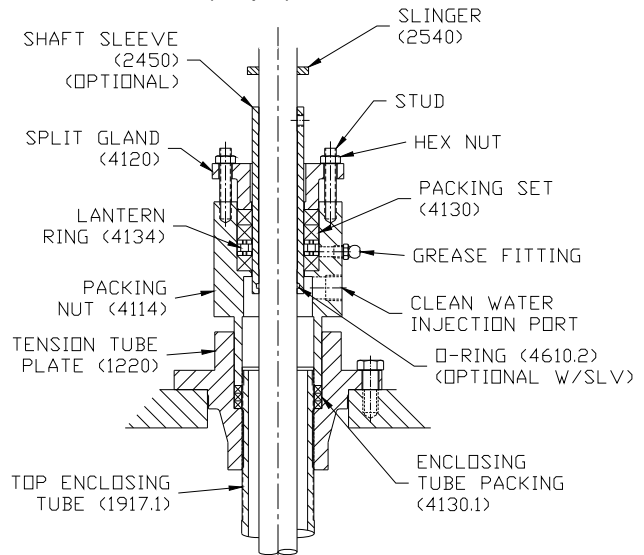
The lower bowl bearings and the upper connector line shaft bearings are lubricated by clean water or oil drip lube that is injected below the stuffing box packing (or mechanical seal).

**3.3.7 Stuffing box**

MXV pumps are fitted with low pressure stuffing boxes fitted to an enclosing tube tensioning assembly. This type of stuffing box is suitable for working pressures up to 6.0 bar (87 psi). Refer to stuffing box User Instructions for specifications.

**3.3.7.1 Packed box seal**

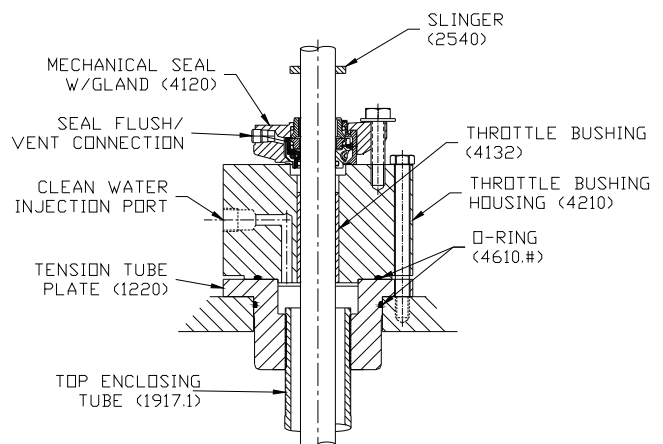
This type of packing box is fitted to an enclosing tube tensioning assembly and is suitable for pressures less than 6.0 bar (87 psi).



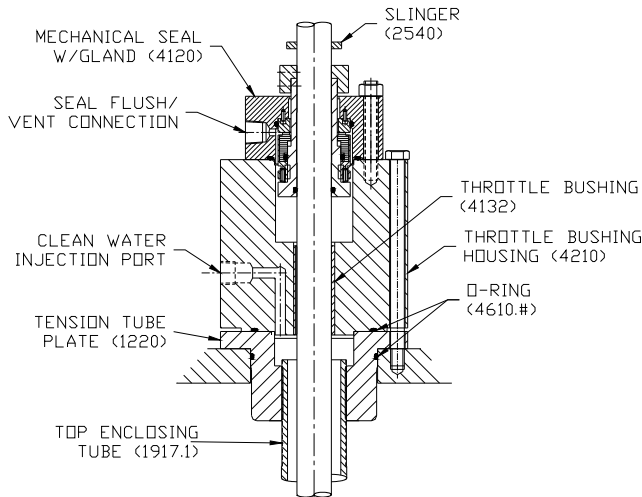
*Example: packed box*

**3.3.7.2 Mechanical shaft seal**

MXV pumps can also be fitted with a variety of mechanical seals. The requirement to fit the mechanical seal is to be provided at the time of contract.



*Example: outboard split mechanical seal*



*Example: cartridge mechanical seal*

### 3.3.8 Accessories

Accessories may be fitted when specified by the customer.

### 3.4 Performance and operation limits

This product has been selected to meet the specifications of the purchase order. See section 1.5.

The following data is included as additional information to help with the installation. It is typical and factors such as temperature, materials and seal type may influence this data. If required, a definitive statement for your particular application can be obtained from Flowserve.

#### 3.4.1 Operating limits

Pumped liquid temperature limits *	5 °C (40 °F) to +65 °C (150 °F)
Maximum ambient temperature *	Up to +40 °C (104 °F)
Maximum pump speed	Refer to the nameplate

\* Subject to written agreement from Flowserve. Special designs and materials may be available for pumps operating above and below these specified limits. Contact Flowserve for upgrade options available for your specific application.

## 4 INSTALLATION

Always check the equipment is suitable for the atmosphere and location it is required to be operated within.

### 4.1 Location

When equipment has been in storage for greater than 6 months, a complete inspection should be conducted in accordance with section 2.4.3.

#### 4.1.1 Inspection prior to installation

Six months prior to the scheduled installation date, a Flowserve representative is to be employed to conduct an inspection of the equipment and the facility.

If any deterioration of equipment is noticed, the Flowserve representative may require a partial or complete dismantling of the equipment including restoration and replacement of some components.

### 4.2 Preparation

The pump should be located to allow room for access, ventilation, maintenance and inspection with ample headroom for lifting and should be as close as practicable to the supply of liquid to be pumped.

Refer to the general arrangement drawing for the pump dimensions and details.

#### 4.2.1 General installation check-list

The following checks should be made before starting actual installation:

- Make sure that motor nameplate ratings and the power supply system match correctly.
- Check the sump depth and pump length match up.
- Check the liquid level in the sump.
- Check the installation equipment to be sure that it will safely handle the pump weight and size.
- Check all pump connections (bolts, nuts etc.) for any shipping and handling related problems.



**CAUTION**

Always support shafting in at least three places when lifting or installing. No installation should be attempted without adequate equipment necessary for a successful installation.

**Note:**

On hollow shaft drivers, check the clutch size against the shaft size, which must go through the clutch.

**Note:**

On solid shaft drivers, check the motor shaft size against the coupling bore size.



**CAUTION**

Apply thread lubricant sparingly to male shaft threads only at the time of making up shaft connection. Excess lubricant should be avoided.



**CAUTION**

Always check motor rotation before connecting driver to pump. Reverse rotation due to improper motor direction can cause extensive damage to the pump.

### 4.3 Foundation/anchor bolts



**CAUTION**

There are many methods of installing pump units to their foundations. The correct method depends on the size of the pump unit, its location and vibration limitations. Non-compliance with the provision of correct foundation and installation may lead to failure of the pump and, as such, would be outside the terms of the warranty.

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 pump support. This is important in maintaining the alignment of the unit. 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.

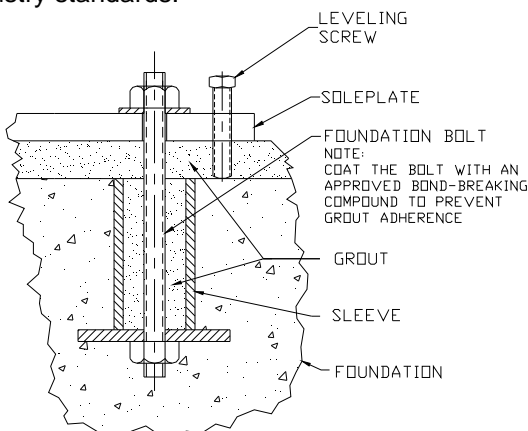
In the absence of any specific information, the pump manufacturer will assume that the piping is installed rigidly and anchored close to the pump connections. It will also be assumed that the hold-down bolts are securely embedded in a concrete foundation of infinite mass and rigidity.

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. One 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.

When a suction barrel is supplied the suction barrel or a separate soleplate must provide permanent, rigid support for the pump and motor.



All foundation/anchor bolt recommendations should be verified by prevailing industry standards.

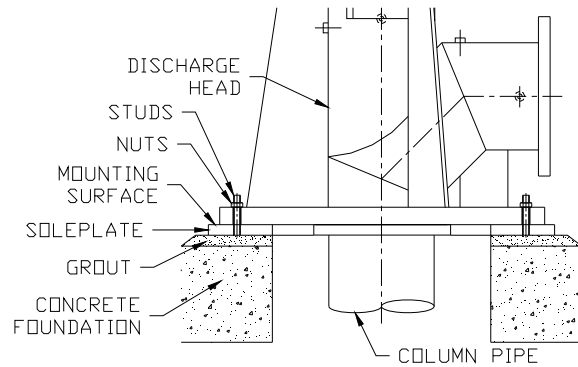


*Detail of a typical foundation bolt, grouted*

### 4.3.1 Leveling of pumps mounted on a soleplate and the soleplate is grouted

Most pumps are mounted on a separate plate known as a soleplate. In such cases, the soleplate shall be set with a master level or a precision machinist's level. The top mounting surface of the soleplate needs to be leveled to within **0.42 mm/m (0.005 in./ft)**. Accurate leveling and grouting of the soleplate is very important. Record the leveling data for future reference. Grout the soleplate and allow to set at least 72 to 80 hours (cure as required).

Before the pump is lowered into the pit recheck the soleplate for level. The post-grout cure level criteria is a maximum of **0.67 mm/m (0.008 in./ft)**. Soleplates that settle unevenly and/or beyond this specified tolerance shall be corrected. Correction of level may include removal and regrouting or field machining of the soleplate mounting surface. Align the discharge head bolt holes with the soleplate mounting holes, install the hold down studs and nuts and torque the nuts to the required level.



*Example of pump mounted on a soleplate*

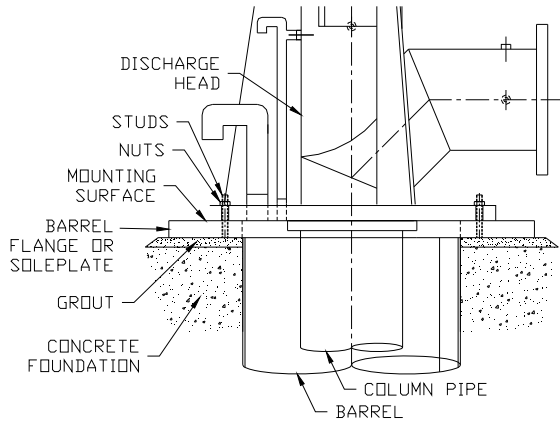
### 4.3.2 Leveling of pumps with a suction barrel

The suction barrel is first lowered into the pit and aligned with the anchor bolts. The suction barrel flange is leveled by using a master level or a precision machinist's level. Levels should be taken on the equipment mounting surfaces. The suction barrel flange mounting surface needs to be leveled to within **0.42 mm/m (0.005 in./ft)** using leveling screws, wedges or shims and then grouted. Also check the barrel ID for plumb to within **1.25 mm/m (0.015 in./ft)**. Accurate leveling and grouting of the barrel is very important. Record the barrel leveling and ID plumb data for future reference. Grout the barrel and allow to set at least 72 to 80 hours (cure as required).

Before the pump is lowered into the barrel recheck the barrel mounting surface for level. The post-grout cure level criteria is a maximum of **0.67 mm/m (0.008 in./ft)**.



Barrel mounting surfaces that settle unevenly and/or beyond this specified tolerance shall be corrected. Correction of level may include removal and regrouting or field machining of the barrel mounting surface. Align the discharge head bolt holes with the barrel mounting holes, install the hold down studs and nuts and torque the nuts to the required level.



*Example of a pump installed with a suction barrel*

#### 4.4 Grouting

Where applicable, grout in the foundation bolts. After adding pipe work connections and re-checking the coupling alignment, the mounting plate/soleplate should then be grouted in accordance with good engineering practice. If in any doubt, please contact Flowserve service center for advice.

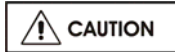
Grouting provides solid contact between the pump unit and foundation that prevents lateral movement of running equipment and dampens resonant vibrations. Care should be taken to ensure maximum surface contact with grout between the pump soleplate, suction barrel (if supplied) and foundation (i.e. there should be no voids).

Only non-shrinking grout with a 41.4 MPa (6 000 psi) compressive strength in 72 hours should be used.

Flowserve recommends the following procedure for grouting:

- a) Build a wooden form around the outside of the pump support to contain the grout. The form is usually placed a slight distance from the edge of the support.
- b) 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, including the space between any foundation bolts and pipe sleeves. A stiff wire should be used to work the grout and release any air pockets.
- c) 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 least 72 hours before dynamically loading.



If levelling nuts are used on the foundation bolts to level the base, they must be backed off as far as possible prior to grouting the base in place. Shim near the foundation bolts, back off the levelling nuts and tighten the foundation bolts to ~10% of their final torque value. To do otherwise will significantly lower the structural natural frequency and result in separation of the base from the grout.



Foundation bolts should only be fully tightened after the grout has been cured. After the grout has fully cured remove any leveling shims or wedges and back off any leveling screws. Then tighten foundation bolts to their final torque value. This will allow the soleplate to be supported by the grout and not by point-loaded leveling devices.

#### 4.5 Lifting and assembly

Motors may be supplied separately from the pumps. It is the responsibility of the installer to ensure that the motor is assembled to the pump and aligned as detailed in section 4.6. Discharge head, column piping and the pump assembly are supplied either separately or as fully assembled depending upon the pump size and weight. If the parts are shipped separately, it is the customer's responsibility to install and align the pump with driver to the satisfaction of Flowserve's installation instructions.

##### 4.5.1 Installation of pumps that are shipped unassembled

###### 4.5.1.1 Lifting

See lifting methods in section 2.3.

###### 4.5.1.2 Equipment and tools required for installation of unassembled pumps

The following list covers the principal tools/items required for installation:

- a) Two (2) mobile cranes capable of hoisting and lowering the pump and/or motor.
- b) Two (2) steel clamps of suitable size.
- c) Two (2) sets of chain tongs and cable sling for attaching to the pump and motor lifting eyes.
- d) Pipe clamp for lifting bowl assembly and the column pipe. Approximately 4.5 m (15 ft) of 19 mm (3/4 in.) diameter rope may be required.
- e) General purpose hand tools, pipe wrenches, end wrenches, socket set, screwdrivers, Allen wrenches, wire brush, scraper and fine emery cloth.
- f) Thread sealing compound designed for stainless steel and light machinery oil.

**Note:** Parts and accessories may be placed inside shipping containers or attached to skids in individual packages. Inspect all containers, crates and skids for attached parts before discarding.

**4.5.1.3 Uncrating and cleaning of unassembled pump**

- a) Clean the parts of any dirt, packing material and other foreign matter.
- b) Flush the pump inside and outside with clean water. Clean all machined surfaces.
- c) Remove any rust spots found on the machined surfaces with fine emery cloth.
- d) Clean all threaded connections and any accessory equipment.

**CAUTION** Lineshaft when shipped separately should be left in the crate to avoid damage or loss of straightness.

**4.5.1.4 Installing the bowl and column assembly**

- a) Sump and piping should be thoroughly cleaned of all loose debris before starting installation.
- b) Check all bolts for tightness.
- c) Do not lift or handle the bowl assembly by the pump shaft.
- d) Position lifting equipment so it will center over the foundation opening.
- e) Prepare the foundation and anchor bolt attachment as indicated in section 4.3
- f) Check for axial clearance or endplay and record that number for future reference (while bowls are in a horizontal position you should be able to push or pull the pump shaft indicating axial clearance).
- g) Carefully lift the bowl assembly with suitable straps or clamps. (See section 2.3 for lifting and safety rules.)
- h) Lower the bowl assembly into the sump or barrel. Set clamp or holding device that is attached to bowls on a flat surface. This is to stabilize bowl assembly and reduce possibility of cross threading the shaft.
- i) Proceed to install the column assembly (refer to specific column pipe drawings).

**4.5.1.5 Installation of discharge head**

Choose one of the following discharge head type installation procedures that is appropriate to the pump configuration that has been purchased. The standard MXV design utilizes an enclosing tube design. Section 4.5.1.5.2 is provided for reference only in the event an MXV is ever provided for product lubrication.

**4.5.1.5.1 Installation of discharge head with the enclosing tube**

**Note:** Pump head may be shipped with the sealing housing installed. For ease of assembly and to prevent damage, we recommend removing the housing before putting the head on the pump.

- a) Attach the top enclosing tube to the column enclosing tube and tighten (left hand threads).
- b) Lift the discharge head over shaft and enclosing tube then lower carefully into place. (See section 2.3 for recommended lifting methods and safety instructions.) Be sure, not to bend the shaft. Fasten the top column flange to bottom of head.
- c) The shaft must be centered in the discharge head.

(See section 4.5.3 for coupling installation on solid shaft drivers and section 4.3.1 and 4.3.2 for pump leveling details.)

**4.5.1.5.2 Installation of discharge head with product lubrication**

**Note:** Pump head may be shipped with the sealing housing installed. For ease of assembly and to prevent damage, we recommend removing the housing before putting the head on the pump.

- a) Lift discharge head over shaft and lower carefully into place. (See section 2.3 for recommended lifting methods and safety instructions.) Be sure not to bend the shaft. Fasten the top column flange to bottom of head.
- b) The shaft must be centered in the discharge head.

(See section 4.5.3 for coupling installation on solid shaft drivers and section 4.3.1 and 4.3.2 for pump leveling details.)

**4.5.2 Installation of pumps that are shipped fully assembled**

**4.5.2.1 Lifting**

See lifting methods in section 2.3.

**4.5.2.2 Equipment and tools required for installation of a fully assembled pump**

- a) Mobile crane capable of hoisting and lowering the entire weight of the pump and motor.
- b) Cable slings for attaching to the pump and motor lifting eyes.
- c) Ordinary hand tools: pipe wrenches, end wrenches, socket set, screwdrivers, Allen wrenches, wire brush, scraper and fine emery cloth.
- d) Thread sealing compound designed for type of connection and light machinery oil.

**Note:** The single most common cause of pump vibration is from a bent shaft. Shafting is straightened to stringent tolerances prior to shipping and great care must be exercised in its handling.

Always support shafting in at least three places when lifting or installing.

**CAUTION** Parts and accessories may be placed inside shipping containers, or attached to skids in individual packages.

Inspect all containers, crates and skids for attached parts before discarding.

Lifting heavy objects is dangerous. Use of appropriate tools and procedures is a must.

#### 4.5.2.3 Uncrating and cleaning of a fully assembled pump

- Clean the parts of all dirt, packing material and other foreign matter.
- Flush the pump inside and outside with clean water.
- Clean all machined surfaces. Remove any rust spots found on the machined surfaces with fine emery cloth.
- Clean all threaded connections and any accessory equipment.

#### 4.5.2.4 Installing the fully assembled pump

See sections 4.3.1 and 4.3.2 for pump leveling details.

Position lifting equipment so it will center over the foundation opening.

**CAUTION** Sump and piping should be thoroughly cleaned of all loose debris before starting installation.

- Lift the pump to a vertical position.
- Position pump over sump or suction barrel.
- Align the discharge of the pump with external piping then lower onto its soleplate.
- If a stuffing box and a hollow shaft driver are included, attach the head shaft to the pump shaft (left hand threads).
- If a mechanical seal is included install the seal per the seal manufacturer's instructions.

If the pump includes a suction barrel (can), follow the procedure as listed below. (See lifting instructions in section 2.3.)

- Install the suction barrel first with the barrel ID plumb to within **1.25 mm/m (0.015 in./ft)**. If the suction barrel is provided with a mounting flange the flange mounting surface needs to be leveled

to within **0.42 mm/m (0.005 in./ft)** using leveling screws, wedges or shims. When level and plumb tolerances have been met grout the mounting flange and bolts, if provided, directly to the foundation.

- If a soleplate is used, level to within **0.42 mm/m (0.005 in./ft)** using leveling screws, wedges or shims then recheck and recheck the barrel ID for plumb. When level and plumb tolerances have been met, grout the soleplate and suction barrel in place.
- Check to ensure suction barrel is free of debris and other foreign material.
- Install the pump.

#### 4.5.3 Installation of couplings on solid shaft drivers

**Note:** If the pump purchased is supplied with a solid shaft driver, one of the following coupling arrangements between the driver and the pump shaft is applicable. Choose the procedure appropriate to the coupling arrangement required.

**CAUTION** Clean threads on pump shaft and on adjusting nut. Check for burrs and nicks.

All burrs, nicks and rust must be removed from all mating parts of flanged coupling and pump before installation. Failure to remove all burrs, nicks and rust may result in misalignment causing pump to fail.

#### 4.5.3.1 Installation of adjustable flanged coupling WA/PA.

- The key [6700.#] for the driver shaft keyseat should be a snug or tight fit in the shaft keyseat, and a sliding fit in the keyseat of the driver half coupling [7200.1].
- The key with pin assembly [6700.#] should be a sliding fit in pump shaft keyseat and a snug or tight fit in pump half coupling [7200.2] keyseat.
- Side clearance of keys in keyseats should be checked with a feeler gauge. Clearance for WA/PA coupling should not exceed 0.076 mm (0.003 in.) for a snug fit or 0.127 mm (0.005 in.) for a sliding fit. These are maximum allowable clearances. Closer fits are preferred, if possible. It may be necessary to file-dress keys to obtain proper fit.
- Insert the key assembly [6700.#] with pin into pump half of coupling [7200.2] putting the pin in the hole in keyseat. The key should not extend below coupling.
- Lubricate pump coupling half and key assembly with light oil and slide it onto pump shaft [2130] with flange up. Slide it past threads.

- f) Lubricate adjusting nut [2909] with light oil and thread it onto pump shaft [2130] (left hand threads) with male register down. Thread it on until top of shaft and top of nut are even.
- g) Uncrate and lift driver to allow access to drive shaft.



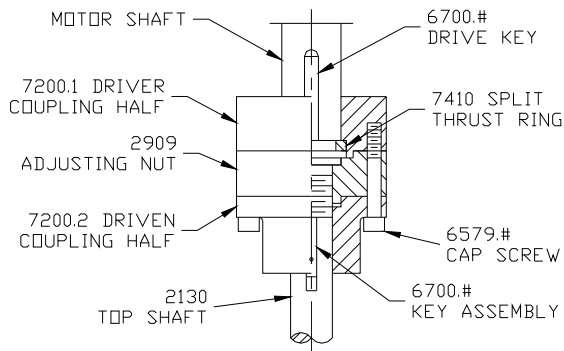
The driver must be set on supports capable of carrying the entire weight of the driver before proceeding to step (h). Failure of supports could cause damage to the motor, injury or loss of life.

- h) Clean and check driver shaft. Remove any burrs.
- i) Check the fit of the straight key and split thrust rings [7410] in their respective keyseats. (Refer to paragraph (a) regarding fit of the straight key.)
- j) Install straight key into keyseat. The bottom of the key must be above the top of circular keyseat for the split thrust rings.
- k) Lubricate driver half coupling lightly and slide it onto driver shaft. Slide bottom of coupling above the top of the keyseat for split thrust rings.
- l) Install split thrust rings into circular keyseat and slide the coupling down over them.
- m) Tighten the coupling bolts as follows.

Coupling bolts tightening torques		
Coupling size	Flange diameter mm (in.)	Torque Nm (lb.in.)
1 & 2	112 & 137 (4.4 & 5.4)	121.5 (1 075)
3, 4 & 5	156, 188, & 213 (6.1, 7.4, & 8.4)	237.0 (2 100)
6	251 (9.9)	424.0 (3 750)

Torque values are for standard fasteners lubricated with a high stress lubricant (such as, graphite and oil, Molybdenum disulfide, etc.). For stainless steel bolts, multiply listed torques by 0.80.

- n) Proceed with the driver installation.

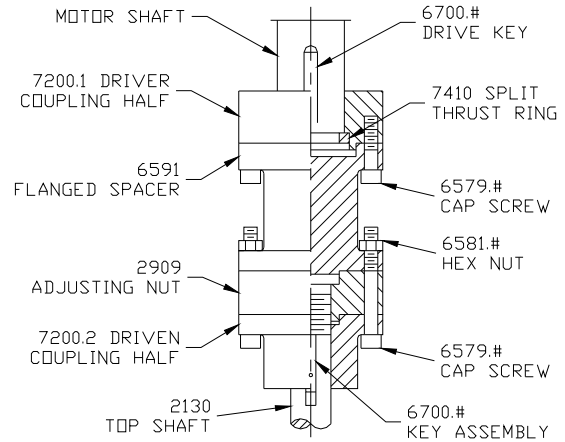


Type WA/PA coupling detail

#### 4.5.3.2 Installation of adjustable flanged spacer coupling WSA/PSA

Follow procedure from (a) to (l) as listed in section 4.5.3.1.

- a) Bolt spacer [6591] to the driver half coupling [7200.1] using the short set of socket head cap screws [6579.#]. The male register should be pointing down. Tighten all cap screws evenly to the bolt torques as listed in 4.5.3.1 in item (m).
- b) Proceed with the driver installation.



Type WSA/PSA coupling details

#### 4.5.4 Installation of drivers

Note:

Drivers will come with either hollow shaft or solid shaft as specified on the order/contract.

Choose the correct installation procedure from the following paragraphs.

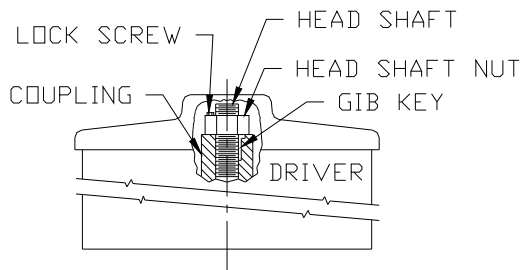


Reverse rotation with the pump shaft connected can cause extensive damage to the pump. Always check rotation before connecting driver to pump.

##### 4.5.4.1 Installation of hollow shaft driver

- a) Clean driver mounting flange on discharge head and check for burrs or nicks on the register and mounting face. Oil lightly.
- b) Remove driver clutch.
- c) See (j) regarding installation of motor guide bushing, if required.
- d) Lift driver and clean mounting flange, checking for burrs and nicks.
- e) Center motor over pump and rotate to align mounting holes.  
**Electric motors:** rotate junction box into desired position.  
**Gear drives:** rotate input shaft into desired position.
- f) Lower carefully into place making certain that the female register on the driver mates over the male register on the pump.
- g) Bolt driver to discharge head.

- h) Check the driver manufacturer's instruction manual for special instructions including lubrication instructions and follow all "startup" directions.
- i) Electric motors should be checked for rotation at this time. Make certain the driver clutch has been removed. Make electrical connections and "bump" motor (momentarily start, then stop) to check rotation. **DRIVER MUST ROTATE COUNTERCLOCKWISE** when looking down at top end of motor. To change the direction of rotation on a three-phase motor, interchange any two line leads. To change direction of rotation on a two phase motor, interchange the leads of either phase
- j) Some motors will be supplied with a "lower guide bushing" or "steady bushing" which is installed at the bottom of the motor to stabilize the shaft at this point. Some motor manufacturers mount this guide bushing before shipping while others will ship the guide bushing with instructions for field mounting.
- k) Check the packing slip to see if a guide bushing is required, if so, determine if the bushing is already mounted or not and proceed accordingly. Refer to motor instruction manual.
- l) Carefully install drive clutch on driver making sure that it fits down properly.
- m) Clean threads on top of head shaft and head shaft nut. Lubricate male threads lightly. Install head shaft.
- n) Install gib key in clutch and shaft. This must be a sliding fit and may require filing and dressing. Do not force.
- o) Thread adjusting nut down on shaft until it bears against clutch. (Threads on 43 mm (1.68 in.) and larger head shaft adjusting nuts are left-handed and all others are right handed). Do not thread nut further at this time. See impeller adjusting instructions in section 5.3.



**4.5.4.2 Installation of solid shaft driver without jacking screws**

**CAUTION** When lowering the motor and driver half of coupling onto pump, do not let pump half of the coupling touch the driver half of the coupling.

Before bumping motor make sure coupling halves are not touching and that the driver can rotate freely, without rotating the pump

Driver half coupling must be in proper position so the circular key will not come out.

- a) Clean driver mounting flange on discharge head and check for burrs or nicks on the register and mounting face. Oil lightly.
- b) Center motor over pump and rotate to align mounting holes.  
**Electric motors:** rotate junction box into desired position.  
**Gear drives:** rotate input shaft into desired position.
- c) Lower driver carefully into place making certain that the female register on the driver mates over the male register on the pump.
- d) Bolt driver to discharge head.
- e) Check driver manufacturer's instructions for special instructions including lubrication instructions and follow all "startup" instructions.
- f) Electric drivers should be checked for rotation at this time. Make electrical connections "bump" motor (momentarily start, then stop) to check rotation. **DRIVER MUST ROTATE COUNTERCLOCKWISE** when looking down at top end of motor. To change the direction of rotation on a three-phase motor, interchange any two line leads. To change direction of rotation on a two-phase motor, interchange the leads of either phase.
- g) See impeller adjustment instructions (section 5.3) before bolting the pump and driver half of the coupling together.

**4.5.4.3 Installation of solid shaft driver with jacking screws**

- a) Clean driver mounting flange on discharge head and check for burrs or nicks on the register and mounting face. Oil lightly.
- b) Center motor over pump and rotate to align mounting holes.  
**Electric motors:** rotate junction box into desired position.  
**Gear drives:** rotate input shaft into desired position.
- c) Lower driver carefully into place. Mount the dial indicator base on the O.D. of the motor half coupling. Set the indicator on the pump shaft, position the dial to zero being careful that the indicator is in direct line with one of the jackscrews. Record this reading then rotate the motor shaft and indicator 180 degrees. Record this reading being careful to note plus or minus values.

Take the difference of the two readings and using the jackscrews move the motor one-half of the difference. Repeat this step until the T.I.R. reading is a maximum of 0.051 mm (0.002 in.). Then repeat this step for the set of jack screws located 90 degrees to the first set. Once all readings are within 0.051 mm (0.002 in.), tighten motor bolts and check for any movement in readings.

- d) Check driver manufacturer's instructions for special instructions including lubrication instructions and follow all "startup" instructions.
- e) Electric drivers should be checked for rotation at this time. Make electrical connections and "bump" motor (momentarily start, then stop) to check rotation. DRIVER MUST ROTATE COUNTER-CLOCKWISE when looking down at top end of motor. To change the direction of rotation on a three-phase motor, interchange any two line leads. To change direction of rotation on a two-phase motor, interchange the leads of either phase.
- f) See impeller adjustment instructions (section 5.3) before bolting the pump and driver half of the coupling together.

## 4.6 Initial alignment

### 4.6.1 Thermal expansion

**CAUTION** The pump and motor will normally have to be aligned at ambient temperature and should be corrected to allow for thermal expansion at operating temperature.

### 4.6.2 Preparation before alignment

To ensure proper alignment the following items are very important.

- a) All machined mating surfaces (such as the mating flanges of pump and motor) must be clean and free of burrs and nicks.
- b) Exterior strain must not be transmitted to the pump. The most common cause of trouble is forcing the piping to mate with the pump. It is recommended that flexible connectors be installed in the piping adjacent to the pump.
- c) All threads should be checked for damage and repaired if necessary. Lubricate all threaded connections with a suitable thread lubricant (an anti-galling compound).

### 4.6.3 Alignment methods

**DANGER** Ensure pump and driver are isolated electrically and the half couplings are disconnected.

**CAUTION** The alignment MUST be checked.

Although the pump may have been aligned at the factory it must be checked and adjusted during field installation. If necessary, align the motor to the pump, not the pump to the motor.

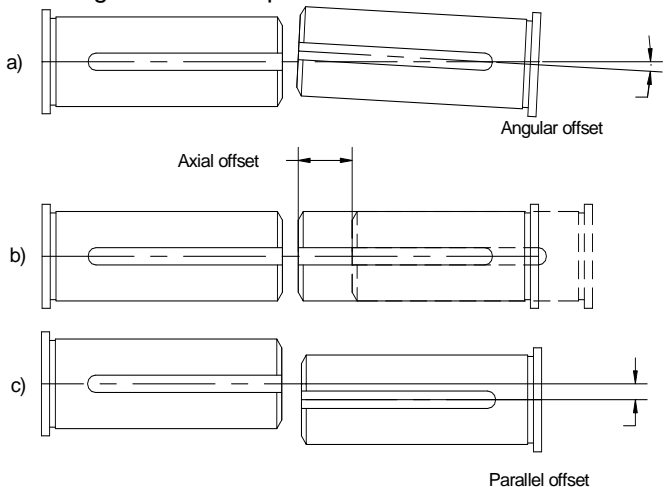
**Note:** The motor assembly may also have to be adjusted in the horizontal direction to line up the driver and driven shaft centers. Alignment screws are provided on larger units to lock the motor assembly in its final aligned position.

See section 5.3.2 for final coupling alignment for solid shafts.

**Note:** Before bumping motor make sure that the coupling halves are not touching and that the driver can rotate freely without rotating the pump. Driver half coupling must be in proper position so the circular key will not come out.

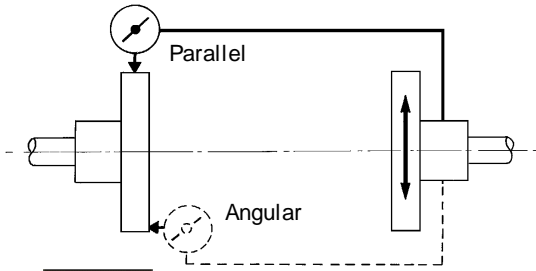
### 4.6.4 Angular and parallel misalignment

**CAUTION** Check the direction of pump rotation before the coupling is fully connected. The power supply to the driver to be connected only after the final alignment is complete.



- a) **Angular offset:** the median lines of shaft intersect between the two shafts.
- b) **Axial offset:** another offset is the displacement of one or both of the shafts. A typical example is thermal expansion.
- c) **Parallel offset:** the median lines run parallel. The maximum allowable parallel offset depends on the size of coupling and is indicated in the instruction manual of manufacturer of coupling.

For couplings with narrow flanges use a dial indicator as shown in the detail to check both parallel and angular alignment.



**Note:** Pumps with thick flanged non-spacer couplings can be aligned by using a straight-edge across the outside diameters of the coupling hubs and measuring the gap between the machined faces using feeler gauges, measuring wedge or calipers.

The alignment of the unit should be checked again after 200 service hours.

### 4.7 Piping

**CAUTION** Protective covers are fitted to the pipe connections to prevent foreign particles or objects entering the pump during transportation and installation. Ensure that these covers are removed and any items inside the pump are removed from the pump before connecting pipes.

#### 4.7.1 Pipe work and sump velocities

In order to minimize friction losses and hydraulic noise in the pump and pipe work it is good practice to choose discharge pipe work that is one or two sizes larger than the pump suction and discharge.

Typically, main pipe velocities should not exceed 3 m/s (9 ft/sec) in the discharge line. The intake design for the pump should follow the guidelines of ANSI-HI 9.8 - latest edition.

Take into account that the available NPSH must be higher than the required NPSH of the pump. The NPSH margin should follow the guidelines of ANSI-HI 9.6.4 - latest edition.

**CAUTION** Never use the pump as a support for piping.

#### 4.7.2 Maximum forces and moments allowed on MXV pump flanges

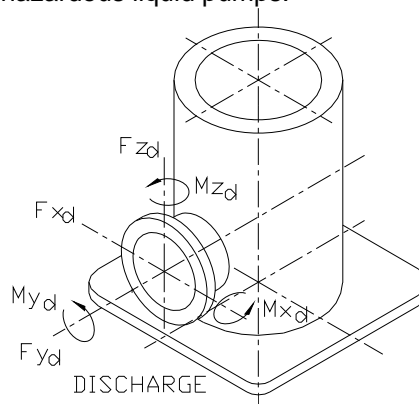
(See table 4.7.2.1.)

Maximum forces and moments allowed on the pump flanges vary with the pump size and type. To minimize these forces and moments that may, if excessive, cause misalignment, hot bearings, worn couplings, vibration and possible failure of the pump casing. The following points should be strictly followed:

- Prevent excessive external pipe load.
- Never draw piping into place by applying force to pump flange connections.
- Do not mount expansion joints so that their force, due to internal pressure, acts on the pump flange.

**CAUTION** Ensure piping and fittings are flushed before use.

**!** Ensure that the piping arrangement has been provided to flush the pump before removal in cases of hazardous liquid pumps.



**4.7.2.1 Table of maximum forces and moments allowed on MXV pump discharge flange**

Head type	Forces and moments	Discharge head size mm (in.)								
		255 (10)	305 (12)	355 (14)	400 (16)	460 (18)	508 (20)	610 (24)	760 (30)	915 (36)
MXV	$F_{xd}$	2.94 (660)	3.34 (750)	3.56 (800)	4.23 (950)	4.90 (1 100)	5.34 (1 200)	6.01 (1 350)	7.12 (1 600)	8.46 (1 900)
	$F_{yd}$	3.65 (820)	4.00 (900)	4.45 (1 000)	5.12 (1 150)	5.79 (1 300)	6.23 (1 400)	7.12 (1 600)	8.46 (1 900)	9.79 (2 200)
	$F_{zd}$	2.45 (550)	2.67 (600)	2.89 (650)	3.34 (750)	4.00 (900)	4.45 (1 000)	4.90 (1 100)	5.56 (1 250)	6.23 (1 400)
	$M_{xd}$	2.75 (2 030)	3.05 (2 250)	3.18 (2 350)	3.66 (2 700)	4.06 (3 000)	4.47 (3 300)	5.42 (4 000)	6.50 (4 800)	7.60 (5 600)
	$M_{yd}$	1.34 (990)	1.49 (1 100)	1.56 (1 150)	1.83 (1 350)	2.03 (1 500)	2.51 (1 850)	2.71 (2 000)	3.25 (2 400)	3.80 (2 800)
	$M_{zd}$	2.09 (1 540)	2.30 (1 700)	2.37 (1 750)	2.71 (2 000)	3.05 (2 250)	3.39 (2 500)	4.07 (3 000)	4.88 (3 600)	5.70 (4 200)

**Units: force (F) in kN (lbf); moments (M) in kNm (lbf-ft).** Loads shown are maximum allowable for standard construction. Contact Flowserve if higher values are required or temperatures are higher than ambient.

### 4.7.3 Auxiliary piping

#### 4.7.3.1 Drains

Normal pump leaks and gland leakage should be drained through a separate piping arrangement or back into the sump/suction barrel.

#### 4.7.3.2 Pumps fitted with gland packing

The external clean water flush liquid is allowed to flow through the gland packing below the injection pressure and drained out of the pump back into the sump/suction barrel. The piping plans and flush supply are to be selected based on the application and operating parameters.

#### 4.7.3.3 Pumps fitted with mechanical seals

The external clean water flush liquid is carried into the seal chamber with adequate pressure to both flush down the enclosing tube and to lubrication the mechanical seal. The piping plans and flush supply are to be selected based on the application and operating parameters.

### 4.7.4 Final checks

After connecting the piping to the pump, rotate the shaft several times by hand to ensure no pipe strain. If pipe strain exists, correct piping.

## 4.8 Electrical connections



**DANGER**

Electrical connections must be made by a qualified Electrician in accordance with relevant local national and international regulations.



It is important to be aware of electromagnetic compatibility when wiring up and installing equipment on site. Attention must be paid to ensure that the techniques used during wiring/installation do not increase electromagnetic emissions or decrease the electromagnetic immunity of the equipment, wiring or any connected devices. If in any doubt contact Flowserve for advice.



**DANGER**

The motor must be wired up in accordance with the motor manufacturer's instructions (normally supplied within the terminal box) including any temperature, earth leakage, current and other protective devices as appropriate. The identification nameplate should be checked to ensure the power supply is appropriate.



A device to provide emergency stopping should be provided near the pump.

For electrical details on pump sets with controllers see the separate wiring diagram.



**CAUTION**

See section 5.4, *Direction of rotation*, before connecting the motor to the electrical supply.

## 4.9 Final shaft alignment check

After connecting piping to the pump, rotate the shaft several times by hand to ensure there is no binding and all parts are free. Recheck the coupling alignment, as previously described, to ensure no pipe strain. If pipe strain exists, correct piping.

## 4.10 Protection systems

The following protection systems are recommended particularly if the pump is installed in a potentially explosive area or is handling a hazardous liquid. If in doubt, consult Flowserve.

If there is any possibility of the system allowing the pump to run against a closed valve or below minimum continuous safe flow a protection device should be installed to ensure the temperature of the liquid does not rise to an unsafe level.

If there are any circumstances in which the system can allow the pump to run dry, or start up empty, a power monitor should be fitted to stop the pump or prevent it from being started. This is particularly relevant if the pump is handling a liquid that can produce any explosive vapor.

If leakage of product from the pump or its associated sealing system can cause a hazard it is recommended that an appropriate leakage detection system is installed.

To prevent excessive surface temperatures at the bearings, it is recommended that temperature and/or vibration monitoring is done on a regular basis.

## 5 COMMISSIONING, STARTUP, OPERATION AND SHUTDOWN



**CAUTION**

These operations must be carried out by fully qualified personnel. Turn off power supply for safety while pump commissioning is in progress.

### 5.1 Pre-commissioning procedure

The gland packing is to be grease lubricated and clean flush water supply to be in place. Flush piping to be checked for leaks. Mechanical seals to be checked for leaks. The flush flow and pressure should be compared to that indicated in section 5.2.2.3.



- a) Pumps with the enclosing tubes and oil-lubed bearings must be filled with the proper lubricant to avoid running dry and to guarantee acceptable performance of the pump. A separate oil tank is attached to the pump. (See detail in section 5.2.3.)
- b) Check the direction of rotation of the pump (Coupling spacer dismantled). Should be counter clockwise when viewed from the driver end.
- c) The pump rotor and the shaft seal must be in correct axial position.
- d) Check the readiness of all auxiliary systems (seal system, lubrication system etc.,) for startup.
- e) All pipe work, including the internal and the auxiliary pipe work, must be connected correctly and must be absolutely tight. Check the tightness of all connections of the auxiliary pipe work. The discharge valve shall be closed or partially open as required.
- f) Turn the pump by hand, if required with the help of a lever, to check the free rotation of the rotor. The rotor must turn uniformly and noiselessly. Some resistance may be felt due to the friction in the bearings and seals.
- g) Check the readiness of the driver for startup. Refer to the manual for the driver to be sure that all precautions are in place to energize the motor.

## 5.2 Pump lubricants

Other than the stuffing box lubrication, mechanical seal and/or lineshaft lubrication, the pump will not require further periodic lubrication. If the pump will be started after a longer storage period, the bearings should be first flushed and cleaned by using a suitable cleaning agent. It is not necessary to remove the oil sprayed for short or long-term storage as this will mix up thoroughly with the lubrication oil.

**Note:** Re-checking the motor lubrication should be in accordance with the motor manufacturer's user instructions supplied separately with the pump.

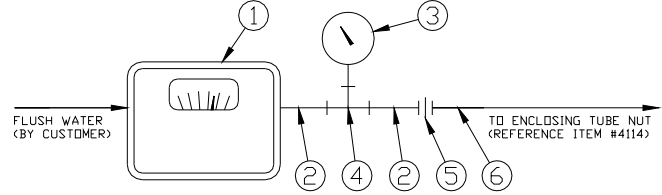
### 5.2.1 Enclosed shaft lubrication

MXV pumps with the enclosed shafting are lubricated by clean water flush or by a dedicated oil supply system. Clean water injection is the preferred method.

### 5.2.2 Clean water flush

Enclosed lineshaft bearings are lubricated by external clean water source, which is fed to the tension nut by a pressure injection system. It is important that the water supply source is large enough to provide the recommended lubrication.

### 5.2.2.1 Bearing flush schematic



### 5.2.2.2 Supplied components

Ref	Quantity	Name of part	Material
1	1	[Range to suit] lpm (gpm) flow monitor	Brass/nylon body; SST internals
2	2	½ in. pipe nipple	Brass
3	1	Pressure gauge <sup>1</sup>	Aluminum/brass
4	1	½ x ¼ x ½ in. pipe tee	Brass
5	1	½ in. pipe union	Brass
6	1	½ in. pipe nipple	Brass

Note 1: it is recommended that the gauge scale range exceeds the approximate pressure required by at least 25 %.

### 5.2.2.3 Flush water requirements

Lower bearing size	43 mm (1.69 in.)	68 mm (2.69 in.)	82 mm (3.25 in.)	95 mm (3.75 in.)	127 mm (5.00 in.)
Bearing flush flow lpm (gpm)	3.8 (1.0)	5.7 (1.5)	7.6 (2.0)	7.6 (2.0)	9.5 (2.5)
Approx pressure required bar (psi)	Refer to General Arrangement drawing for value <sup>2</sup>				

Note 2: the approximate pressure required is a function of the number and size of lower bowl and connector bearings used. It is calculated in accordance with Flowserve MXV ESM page 66.02.010.

### 5.2.2.4 Minimum water quality requirements

ph value	6.0 to 8.0
Maximum particle size	60 µm (0.002 in.)
Temperature range	2 to 40 °C (35 to 105 °F)

### 5.2.2.5 Wiring requirements

The flow monitor must be wired for pump shut down when bearing flush falls below the flow given above. Monitors are supplied with a factory set flow switch.



Refer to the flow monitor manual for wiring and switch details.

Failure to properly connect the bearing flush flow monitor may result in product damage and will void the factory warranty.

### 5.2.2.6 Operating requirements

Bearing flush water is required in order to prevent abrasive materials from damaging the bearings.

For wastewater service, continuous water flow through the injection port is required (during operation and standby). For extended shutdowns with constant submergence, the bearings must be flushed 15 minutes after final shutdowns and 15 minutes prior to restarts.

If submergence varies it is suggested the flush water remain on continuously. After a restart, continuous water flow through the injection port is required.

**5.2.2.7 Pre-lubrication of injection lubricated pumps**

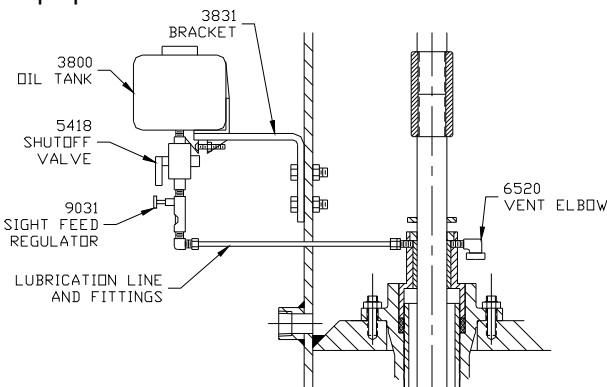
As a general rule, the liquid flow is to be started at least 15 minutes before the pump is started for the first time or in the event of pump not being in use for longer duration.

The injected lubricant flow should never be stopped for short 'off' periods. Adequate care should be taken to make sure that the flow is available and consistent for subsequent startups and operation. Injection pressure to be adjusted as recommended before the startup.

**5.2.3 Dedicated oil supply system**

The lubricating oil must be available and should be allowed to run into the enclosing tube in sufficient quantity to thoroughly lubricate all lineshaft bearings. The gravity flow system is the most commonly utilized system for oil.

The oil reservoir (example shown in detail below) must be kept filled with a good quality light turbine oil (about 30 cSt) at the operating temperature and adjusted to feed a minimum of 3 drops per minute per 15 m (49 ft) of column length, at never less than 5 drops per minute total.



**5.2.3.1 Pre-lubrication for oil supply system**

As a general rule, the oil must be allowed to flow by gravity at least 45 minutes before the pump is started for the first time or in case the pump was turned off for a longer duration. Adequate care should be taken to make sure that the flow is available and is consistent for subsequent startups.

**5.2.4 Enclosed shaft lubricants**

The following oils are recommended for enclosed lineshaft bearing lubrication under normal operating conditions. (See tables 5.2.4.1 and 5.2.4.2.)



It is recommended that detergent type oils not be used.

**5.2.4.1 Non-food grade lubricant oils**

Oil manufacturer	Trade name of the oil
Conoco Inc.	Conoco Diamond Class Turbine oil ISO -32
Exxon Company	Teresstic- GT 32
Mobil Oil Company	Mobile DTE-797- Grade-32
Shell Oil Company	Tellus-32, Tellus-37 or Turbo Oil T -32
Chevron Lubricants	Chevron Turbine Oil TR-32
BP	Energol HL-C 32
Texaco, Inc.	Texaco Regal (R&O)- 32

**5.2.4.2 Food grade lubricant oils**

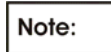
Oil manufacturer	Trade name of the oil
Exxon Company	Exxon-DTE-FM32
Mobil Oil Company	Mobile DTE-FM- Grade-32
Shell Oil Company	Cassida HF 32

If none of the above oils are available, an equivalent turbine oil (food or non-food grades as required) with matching properties shall be selected. Oils with a viscosity range of 30 cSt (mm<sup>2</sup>/s) to 37 cSt (mm<sup>2</sup>/s) at 40 °C (100 °F) with a minimum viscosity index of 90 are recommended.

The pour point of the oil must be in accordance with the lowest expected temperature of the bearing housing during a stop of the pump.

**5.2.5 Oil level**

The correct oil level is in the middle of the oil sight glass and shall be checked when the pump is not in operation. Periodically check if the lubricating oil is mixed with any condensed water. Careful opening of the oil drain during a stop of the pump will show any water.



After the initial start the level will decrease due to circulation of the oil through the bearings.



If the oil level is higher than specified, it could result in higher bearing temperatures resulting in poor lubrication.

**5.3 Impeller adjustment**

Proper impeller adjustment positions the impeller inside the bowl assembly for maximum performance. The impeller must be raised slightly to prevent it from dragging on the suction bell ring, but not raised too high so as to adversely affect hydraulic performance.

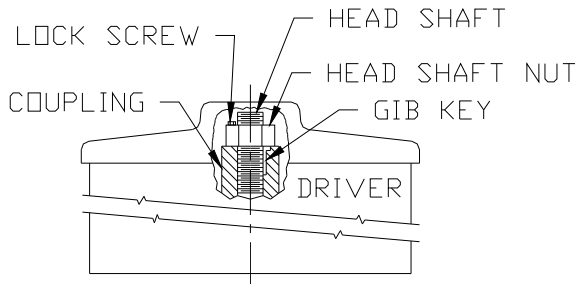
The impeller must be down against the suction bell ring when starting impeller adjustment. Make sure the shaft is down when starting to adjust the impellers.

If, after making the impeller adjustment, the pump does not deliver its rated capacity, the impellers can be lowered one step at a time until the lowest possible adjustment is achieved without the impeller dragging. On the other hand, if the impeller appear to be dragging after the initial adjustment, the unit should be stopped and the impeller raised one step. Dragging impeller will increase the load significantly and can usually be heard and felt as increased vibration. A sharp rise in motor amperage will occur when an impeller is dragging.

**5.3.1 Impeller adjustment for a hollow shaft driver**

Impeller adjustment when using hollow shaft drivers is as follows. (The driver canopy will have to be removed before beginning.)

- a) Install headshaft if not already in place.
- b) Install driver clutch in accordance with the driver instruction manual and bolt into place.
- c) Check shaft position. Lower shaft until there is a definite feel of metal contacting metal. This indicates the impeller is "on bottom" and in the correct starting position for impeller adjustment.
- d) Thread headshaft nut down (right hand threads) except 43 mm (1.7 in.) and larger sizes that have left hand threads, until impeller is just raised off their seat and the shaft will rotate freely.
- e) Check the pump nameplate for recommended impeller setting and running clearance information. In the absence of any nameplate documentation see the tables in section 5.3.1.1 and 5.3.1.2.



*Detail showing head shaft and lock screw arrangement*

**Note:**

If at any time during the life of this pump the pumping conditions or total pump length changes, contact the factory for recalculation of the impeller setting.

- f) Tighten the adjusting nut to match impeller setting recommended by Flowserve. See the tables in section 5.3.1.1 and 5.3.1.2.
- g) Using the locking cap screw provided, bolt the headshaft nut down and lock to the motor coupling using the lock screw. See the details of head shaft and lock screw arrangement under item (e) above.



Always lock headshaft nut by tightening the lock screw before starting driver. Failure to do so could result in damage to the pump and driver.

- h) If a mechanical seal is used, adjust the mechanical seal at this time.

**5.3.1.1 Impeller clearance settings**

Flowserve recommends the following impeller settings based on the pump sizes.

MXV impeller clearance	
Pump size	Impeller setting mm (in.)
10MVX12A/B & 12MVX13D	0.38 - 0.64 (0.015 - 0.025)
14MVX15A/B 16MVX17A/B & 16MVX20D 20MVX20A/B	0.51 - 0.76 (0.020 - 0.030)
20MVX27D 24MVX24A/B	0.64 - 0.89 (0.025 - 0.035)
24MVX33D	0.76 - 1.02 (0.030 - 0.040)

**Note:**

Shafts elongate due to the hydraulic thrust of the pump and the impellers must be compensated for this elongation. Shaft elongation varies for each model depending upon the size, shaft length, shaft diameter and impeller weight. Please see the documentation supplied along with the pump for exact impeller setting value matched for the specific pump that you have purchased.

**5.3.1.2 Head shaft nut adjustment**

Head shaft size mm (in.)	Threads per every 25 mm (1 in.) length of the shaft	Lateral adjustment mm (in.)	
		One complete turn of nut will result in shaft movement of:	Each face of nut
25 (1.0)	14	1.81 (0.071)	0.30 (0.012)
32 (1.25) 38 (1.50) 43 (1.69)	12	2.12 (0.083)	0.35 (0.014)
43 (1.69) 50 (1.94) 55 (2.19) 62 (2.44)	10	2.54 (0.100)	0.42 (0.017)
68 (2.69) 75 (2.94)	8	3.18 (0.125)	0.53 (0.021)

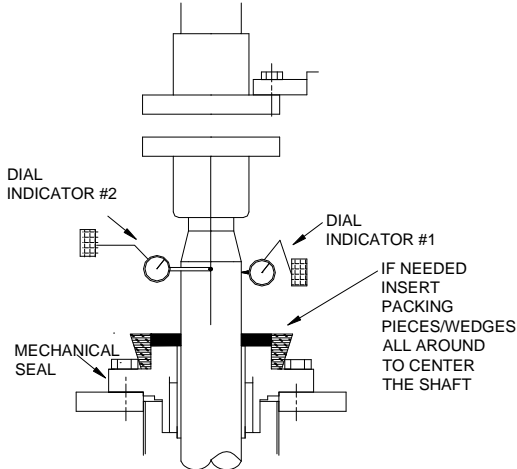
**5.3.2 Impeller adjustment for a solid shaft driver**

Impeller adjustment when using solid shaft drivers is accomplished in the adjustable flanged coupling located below the driver.

**5.3.2.1 Adjusting adjustable flanged coupling**

- a) Assemble coupling on pump shaft and driver shaft (if not installed earlier).
- b) Check motor direction of rotation.
- c) Check and write down Flowserve recommended impeller setting for final adjustment.

- d) Pump to motor alignment and final coupling.
1. Mount two magnetic indicator bases on the discharge head at 90 degrees to each other.
  2. Set the indicator tips on the shaft just above the seal and at 90 degrees to each other. (Usually parallel and perpendicular to the discharge nozzle).
  3. Push the shaft (parallel to discharge) back and forth (without bending shaft).
  4. Note and record the minimum and maximum indicator readings. Do the same procedure at 90 degrees to the discharge.



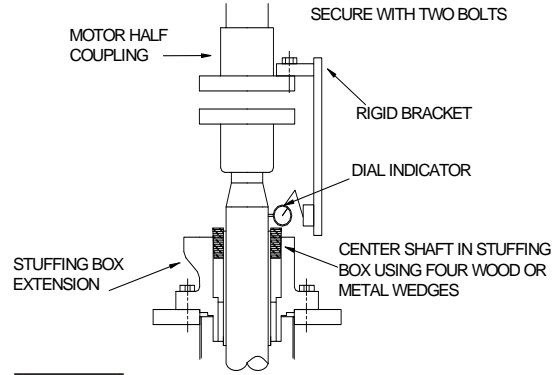
5. Set the shaft in the center of the maximum and minimum indicator readings for both directions. If the shaft will not stay in this position, use small wooden wedges between the shaft and seal bolts to hold the shaft. The indicators can now be removed.

**5.3.2.2 Alternate method for pump with packing**

- a) Using an inside micrometer, measure the space between the shaft and the packing box bore. Do this both parallel and perpendicular to the discharge nozzle.
- b) Using the wedges center the shaft so the measurements taken at 180 degrees to each other are within 0.10 mm (0.004 in.) of being equal.

**For pumps using motor jackscrews for alignment skip to step d).**

Mount the magnetic base on the drive half coupling (a band clamp may be necessary to hold base due to limited space). Position the tip of the indicator on the pump shaft just above the seal. Slowly rotate the driver shaft. Note and record the T.I.R. reading. If this reading is more than 0.25 mm (0.010 in.) for WA and WSA couplings or 0.15 mm (0.006 in.) for PA and PSA couplings, unbolt the drive and reposition the driver in the direction required to reduce the T.I.R. to within the allowable limits.



**Note:** If a register fit is used for alignment, driver will be able to be moved only ~0.25 mm (~0.010 in.). If enough movement is not obtainable then the male register can be filed to obtain acceptable T.I.R. readings. Go to step e).

- c) On pumps using jackscrews for motor alignment, mount the dial indicator base on the O.D. of the motor half coupling. Set the indicator on the shaft, position the dial to zero being careful that the indicator is in direct line with one of the jackscrews. Record this reading then rotate the motor shaft and indicator 180 degrees.

Record this reading being careful to note plus or minus values. Take the difference of the two readings and using the jackscrews move the motor one half of the difference. Repeat this step until the T.I.R. reading is a maximum of 0.05 mm (0.002 in.).

Then repeat this step for the set of jackscrews located 90 degrees to the first set. Once all readings are within 0.05 mm (0.002 in.) tighten motor bolts and check for any movement in readings.

- d) Set the impeller setting gap between the adjusting nut and the driver portion of the coupling. See impeller setting instruction above. Do not try to align the match marks on the pump half coupling with the driver half coupling. Rather just advance the adjusting nut to the next hole that will allow the cap screws to be installed.

**Note:** **DO NOT** try to align the marking on the nut with the other markings.

- e) Using 2 bolts of the coupling, at 180 degrees to each other, slowly raise pump half coupling until impellers are just lifted off the seat. (This can be gauged by trying to turn shaft by hand. At the point the impellers are lifted the pump will turn.) Be sure to lift both sides evenly.
- f) Measure the resultant gap between the motor half coupling and the adjusting nut.
- g) Find the difference between the original gap and the new gap. Add this difference to the original gap and reset the adjusting nut.

- h) Bolt the coupling together and tighten bolts by tightening opposite sides.
- i) Remove wooden wedges, if used. Mount magnetic base on pump and set the tip of indicator on the shaft just above the seal. Slowly rotate the shaft and note the T.I.R. reading.

Unless otherwise specified, the allowable T.I.R. readings are:

- WA and WSA couplings 0.10 mm (0.004 in.)
- PA and PSA couplings 0.05 mm (0.002 in.)

If the reading is larger than the allowable values specified above, unbolt the pump and rotate the driver portion of the coupling to a different hole and repeat steps (i) and (j) until acceptable readings are obtained.

- j) If a mechanical seal is used, adjust the mechanical seal at this time.

### 5.4 Direction of rotation



Ensure the pump is given the same rotation as specified or as marked on the pump/driver. Please contact Flowserve representative, if you have any questions before start-up.

To avoid dry running the pump must either be filled with liquid or have the flexible coupling disconnected before the driver is switched on.



If maintenance work has been carried out to the site's electricity supply, the direction of rotation should be re-checked as above in case the supply phasing has been altered.

### 5.5 Guarding

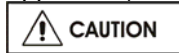


Guarding is supplied fitted to the pump set. Fasteners for guards must remain captive in the guard to comply with the Machinery Directive 2006/42/EC. When releasing guards, the fasteners must be unscrewed in an appropriate way to ensure that the fasteners remain captive. Whenever guarding is removed or disturbed ensure that all the protective guards are securely refitted prior to start-up.

### 5.6 Priming and auxiliary supplies



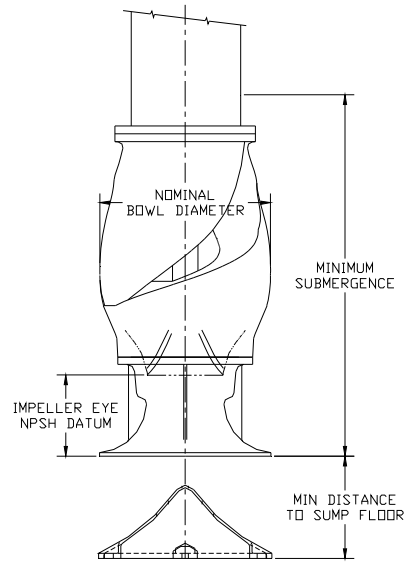
Ensure electrical, hydraulic, pneumatic, sealant and lubrication systems (as applicable) are connected and operational.



Ensure the pump bowl assembly is completely submerged in liquid to the minimum submergence level before starting continuous duty operation.

### 5.6.1 Pump submergence

Minimum submergence is required to prevent vortex formation.



The submergence varies in general from 1 to 2 times the nominal bowl diameter and is always specific to each pump model. The submergence needed for adequate NPSH to the impeller eye may be different from the general rule mentioned earlier. The location of the impeller eye must be taken into account for determining adequate NPSH. It is also equally important to take note of the minimum distance to be maintained to the suction bell from the sump floor. Therefore, refer to the Flowserve supplied general assembly drawing on minimum submergence or contact Flowserve before the pump is started.

### 5.7 Starting the pump

#### 5.7.1 Pre-starting checks

Before starting the pump the following checks should be made:

- a) Rotate the pump shaft by hand to make sure the pump rotates freely and the impeller is correctly positioned.
- b) Ensure that the electric motor has been properly lubricated in accordance with the instructions furnished with the driver.
- c) Ensure the electric motor has been checked for proper rotation. The pump must be disconnected from the driver at the coupling before checking. The electric motor must rotate counter-clockwise when looking down on the top of the driver.
- d) Check all connections to the driver and control.
- e) Do not overfill the grease cavity. Over greasing can lead to overheating and premature failure of a motor thrust bearing.
- f) Check that all piping connections are tight.
- g) Check all foundation bolts for tightness.

- h) Check all bolting connections for tightness (coupling bolts, mechanical seal gland bolts, driver bolts etc.). Make sure the head shaft adjusting nut is properly locked into position for hollow shaft driver.
- i) On pumps equipped with stuffing box, make sure the gland nuts are only finger tight.  
**Do not** tighten packing gland before starting.
- j) On pumps equipped with mechanical seals verify that the clean water flush will lubricate the seal chamber. Make sure the mechanical seal is properly adjusted and locked into place. Ensure that all seal spacers are in the running position prior to operation.
- k) All guards must be secured in position prior to pump startup to prevent possible contact with rotating parts.
- l) Lubricating liquid must be available and must run into the enclosing tube in sufficient quantity to thoroughly lubricate all line shaft bearings.

When adjusting the packing gland, bring both nuts down evenly and in small steps until the leakage is reduced as required. The nuts should only be tightened about 10 degrees at a time at 20 to 30 minute intervals to allow the packing to "run-in". Under proper operation, a packing set will last a long time. Occasionally a new ring of packing will need to be added to keep the box full.

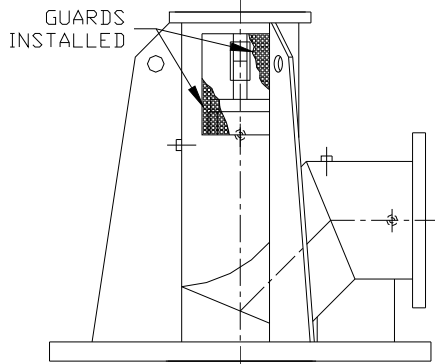
After adding two or three rings of packing, or when proper adjustment cannot be achieved, the stuffing box should be cleaned completely of all old packing and re-packed.

**5.7.3 Enclosed shaft lubrication before start-up**

Enclosed lineshaft bearings are lubricated by an extraneous liquid (usually clean water or oil).

Clean water flush is normally used and must be provided as indicated in section 5.2.2.

**5.7.1.1 Typical safety guards**



**CAUTION** After initial startup, pre-lubrication of the mechanical seal will usually not be required as enough liquid will remain in the seal chamber for subsequent startup lubrication.

**Note:** A screen guard is furnished on all pumps having exposed rotating shafts. This screen must be secured in place prior to pump startup to prevent possible contact with rotating parts. Typical arrangement is shown above.

**5.7.2 Stuffing box adjustment**

On the initial starting it is very important that the packing not be tightened excessively. New packing must be run in properly to prevent damage to the shaft or shaft sleeve and shortening of the packing life.

The stuffing box must be allowed to leak for proper operation. The proper amount of leakage can be determined by checking the temperature of the leakage, this should be cool or just lukewarm - NOT HOT - usually 40 to 60 drops per minute will be adequate.

If a dedicated oil lubrication system is use it must be provided as indicated in section 5.2.3. The oil reservoir must be kept filled with a good quality of light turbine oil (about 30 cSt (mm<sup>2</sup>/s) at operating temperature) and adjusted to feed 3 drops/minute for every 15 m (49 ft) of column.

**CAUTION** Commencement of lubrication supply before pump startup and after pump shutdown must follow the instructions given in section 5.2.2 and 5.2.3.

**5.7.4 Initial starting**

**CAUTION** Ensure flushing liquid supplies are turned ON before starting the pump.

- a) If the discharge line has a valve in it, partially open the discharge valve closest to the pump. The discharge valve is intended to add sufficient system resistance to the pump. Failure to maintain pump flow rates within the limits of the pump and motor could result in severe damage.
- b) Verify the pump bowl assembly is submerged in liquid with a suitable supply of liquid available to the sump or suction barrel.
- c) Check the clean water flush or lubrication system in operation (check the supply flow rate, pressure, liquid level, etc. as applicable).
- d) Ensure all vent connections are properly set to vent the column and head on startup.

**CAUTION** Observe extreme caution when venting and or draining hazardous liquids. Wear appropriate protective clothing. Do not breathe toxic vapors. Do not breathe toxic vapors. Do not allow sparking, flames or hot surfaces in the vicinity of the equipment.

- e) Check the motor connections.
- f) Start the pump and observe the operation. If there is any difficulty, excess noise or vibration, stop the pump immediately and refer to the Trouble Shooting Chart (section 7) to determine the probable cause.



Do not run the pump with the outlet valve closed for a period longer than 30 seconds.

- g) Open the discharge valve as desired to operate the unit at its design conditions.
- h) Check complete pump and driver for leaks, loose connections, or improper operation.

If possible, the pump should be left running for approximately a half hour on the initial startup, this will allow the bearings, packing or seals, and other parts to “run-in” and reduce the possibility of trouble on future starts.

**5.7.5 Frequency and quantity of lubrication**

The characteristics of the installation and severity of service will determine the frequency and quantity of lubrication. Lubricant and driver bearing temperature analysis are useful in optimizing lubricant change intervals.

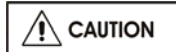
The motor bearing temperature limitations should be considered for its lubrication requirements. Refer to driver manufacturer’s user instructions supplied with the pump. If documents are not found contact Flowserve.



Never mix greases containing different bases, thickeners or additives.

**5.7.6 Normal vibration levels, alarm and trip**

Pumps generally fall under classification of rigidly supported machines within the International Rotating Machinery standard and maximum vibration levels are based on those standards



Alarm and trip values for installed pumps should be based on the actual measurements (N) taken on the pump in a fully commissioned (new) condition. Measuring vibration at regular intervals and recording will help to track any deterioration in the pump or operating conditions. Measurements shall be taken at the pump/motor interface.

**5.7.6.1 Typical allowable field vibration values for MXV - sumps or suction barrels**

Motor rating kW (bhp)	Vibration velocity - unfiltered	Vibration mm/s (in./sec) rms
below 25 (below 33)	N	7.6 (0.30)
25 to 75 (33 -100)	N	8.1 (0.32)
75 and up (100 and up)	N	8.6 (0.34)

N = Normal; Alarm = N x1.25; Trip = N x 2.0.

**5.7.7 Motor start/stop frequency**

Even though motors are normally suitable for at least two consecutive starts, it is recommended to restart only after coasting to rest between starts (minimum of 15 minutes gap), with the motor initially at ambient temperature. If more frequent starting is necessary, refer to driver manufacturer’s instructions or contact Flowserve with details.



The number of motor start and stops in any given time affects motor life.



If the motor is expected to experience multi starts in any given time, please refer to the driver’s User Instructions before the pump is put into operation.

**5.8 Operating the pump**

**5.8.1 Venting the pump**



Make sure that the pump is vented during startup to enable all trapped air to escape, taking due care with hazardous or hot liquids.

**5.8.2 Pumps fitted with packed glands**

If the pump has a packed gland, there must be some leakage from the gland. Gland nuts should initially be finger-tight only. Leakage should take place soon after the stuffing box is pressurized.

The gland must be adjusted evenly to give visible leakage and concentric alignment of the gland ring to avoid excess temperature. If no leakage takes place, the packing may begin to overheat.


If overheating takes place, the pump should be stopped and allowed to cool before being re-started. When the pump is re-started, check to ensure leakage is taking place at the packing gland.

If hot liquids are being pumped it may be necessary to loosen the gland nuts to achieve leakage.

The pump should be run for 30 minutes with steady leakage and the gland nuts tightened by 10 degrees at a time until leakage is reduced to an acceptable level, normally a minimum of 40-60 drops per minute is required.




Care must be taken when adjusting the gland on an operating pump. Safety gloves are essential. Loose clothing must not be worn to avoid being caught by the pump shaft. Shaft guards must be replaced after the gland adjustment is complete.


 The packing on MVX pumps with enclosed lineshaft lubrication is grease lubricated via a grease fitting. Never run gland packing unlubricated or dry, even for a short time.

**5.8.3 Pumps fitted with mechanical seal**

Mechanical seals require no adjustment after their initial setting unless the pump coupling is to be disconnected or adjusted. Any slight initial leakage will stop when the seal is run in.

Before pumping dirty liquids it is advisable to run in the pump mechanical seal using clean liquid to safeguard the seal face.

 An external clean water flush should be started before the pump is run and allowed to flow for a period after the pump has stopped.

 Never run a mechanical seal dry, even for a short time.

**5.8.4 Pump and motor bearing temperature**

MVX pumps are fitted with enclosed lineshaft bearings that are either clean water flush lubricated or drip feed oil lubricated. Hence they are isolated from the pumped product and surrounding atmosphere.


However if the motors are working in a potentially explosive atmosphere, temperature or vibration monitoring at the bearings is recommended.

Refer to the motor manufacturer’s operating instructions for recommended motor bearing lubrication, temperature monitoring and recommended alarm and trip settings.

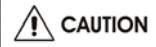
If motor bearing temperatures (such as thrust bearings) are to be monitored it is essential that a benchmark temperature is recorded at the commissioning stage and after the bearing temperature has stabilized.

It is important, particularly with grease lubrication, to keep a close watch on the bearing temperatures. After startup the temperature rise should be gradual, reaching a maximum after approximately 1.5 to 2 hours. This temperature rise should then remain constant or marginally reduce with time.

**5.9 Stopping and shutdown**

a)  Close the outlet valve, but ensure that the pump runs in this condition for no more than 30 seconds.

b) Stop the pump.  
c) Switch off flushing and or cooling/heating liquid supplies at a time appropriate to the process. (See sections 5.2.2.6 and 5.2.2.7.)

 For prolonged shutdowns and especially when ambient temperatures are likely to drop below freezing point, the pump and any flushing arrangements must be drained or otherwise protected.

**5.10 Hydraulic, mechanical and electrical duty**

This product has been supplied to meet the performance specifications of your purchase order. However it is understood that during the life of the product these may change. The following notes may help the user decide how to evaluate the implications of any change. If in doubt contact your nearest Flowserve office.

**5.10.1 Specific gravity (SG)**

Pump capacity and total head in meters (feet) do not change with SG, however pressure displayed on a pressure gauge is directly proportional to SG. Power absorbed is also directly proportional to SG. It is therefore important to check that any change in SG will not overload the pump driver or over-pressurize the pump.

**5.10.2 Viscosity**

For a given flow rate the total head reduces with increased viscosity and increases with reduced viscosity. Also for a given flow rate the power absorbed increases with increased viscosity, and reduces with reduced viscosity. It is important that checks are made with your nearest Flowserve office if changes in viscosity are planned.

**5.10.3 Pump speed**

Changing pump speed effects flow, total head, power absorbed, NPSH<sub>R</sub>, noise and vibration. Flow varies in direct proportion to pump speed, head varies as speed ratio squared and power varies as speed ratio cubed. The new duty, however, will also be dependent on the system curve. If increasing the speed, it is important therefore to ensure the maximum pump working pressure is not exceeded, the driver is not overloaded, NPSH<sub>A</sub> > NPSH<sub>R</sub> by a safe margin, and that noise and vibration are within local requirements and regulations.

**5.10.4 Net positive suction head (NPSH<sub>A</sub>)**

NPSH available (NPSH<sub>A</sub>) is a measure of the head available in the pumped liquid, above its vapor pressure, at the pump impeller leading suction vane tip.



NPSH required ( $NPSH_R$  or  $NPSH_3$ ) is a measure of the head required in the pumped liquid, above its vapor pressure, to prevent the pump head from dropping more than 3 % from its expected curve shape with adequate  $NPSH_A$ . It is important that  $NPSH_A > NPSH_R$ . The margin between  $NPSH_A > NPSH_R$  should be as large as possible. If any change in  $NPSH_A$  is proposed, ensure these margins are not significantly eroded. Refer to the pump performance curve to determine exact requirements particularly if flow has changed.

If in doubt please consult your nearest Flowserve office for advice and details of the minimum allowable margin for your application.

### 5.10.5 Pumped flow

Flow must not fall outside the minimum and maximum continuous safe flow shown on the pump performance curve and or data sheet. If not provided consult your nearest Flowserve office for MCSF and AOR values.

## 6 MAINTENANCE

### 6.1 General



It is the plant operator's responsibility to ensure that all maintenance, inspection and assembly work is carried out by authorized and qualified personnel who have adequately familiarized themselves with the subject matter by studying this manual in detail. (See also section 1.6.)

Any work on the machine must be performed when it is at a standstill. It is imperative that the procedure for shutting down the machine is followed, as described in section 5.9.

Guard fasteners must remain captive during dismantling of guards as described in section 5.5 to comply with the Machinery Directive 2006/42/EC.

On completion of work all guards and safety devices must be re-installed and made operative again.

Before restarting the machine, the relevant instructions listed in section 5, *Commissioning, start up, operation and shut down*, must be observed.

***Oil and grease leaks may make the ground slippery. Machine maintenance must always begin and finish by cleaning the ground and the exterior of the machine.***

If platforms, stairs and guard rails are required for maintenance, they must be placed for easy access to areas where maintenance and inspection are to be carried out. The positioning of these accessories must not limit access or hinder the lifting of the part to be serviced.

When air or compressed inert gas is used in the maintenance process, the operator and anyone in the vicinity must be careful and have the appropriate protection.

Do not spray air or compressed inert gas on skin.

Do not direct an air or gas jet towards other people.

Never use air or compressed inert gas to clean clothes.

Before working on the pump, take measures to prevent an uncontrolled start. I.e., a lockout should be placed on the starting device to indicate:

***"Machine under repair: do not start"***.

With electric drive equipment, lock the main switch open and withdraw any fuses. Put a warning board on the fuse box or main switch with the words:

***"Machine under repair: do not connect"***.

Never clean equipment with inflammable solvents or carbon tetrachloride. Protect yourself against toxic fumes when using cleaning agents.

### 6.2 Maintenance schedule

It is recommended that a maintenance plan and schedule is adopted, in line with these User Instructions, to include the following:

- a) Any auxiliary systems installed must be monitored, if necessary, to ensure they function correctly.
- b) Gland packings must be adjusted correctly to give visible leakage and concentric alignment of the gland follower to prevent excessive temperature of the packing or follower.
- c) Check for any leaks from gaskets and seals. The correct functioning of the shaft seal must be checked regularly.
- d) Check bearing lubricant level, and if the hours run show a lubricant change is required.
- e) Check that the duty condition is in the allowable operating range for the pump.
- f) Check vibration, noise level and surface temperature at the bearings and stuffing box to confirm satisfactory operation.
- g) Check dirt and dust is removed from areas around close clearances, bearing housings and motors.
- h) Check coupling alignment and re-align if necessary.

Flowserve authorized service personnel can help with preventative maintenance records and provide condition monitoring for temperature and vibration to identify the onset of potential problems.

If any problems are found the following sequence of actions should take place:

- a) Refer to section 7, *Faults; causes and remedies*, for fault diagnosis.
- b) Ensure equipment complies with the recommendations in this manual.
- c) Contact Flowserve if the problem persists.

A periodic inspection is recommended as the best means of preventing breakdown and keeping maintenance costs to a minimum.



Variation from initial performance is probably an indication of changing system conditions, wear, or impending breakdown of unit.

### 6.2.1 Routine inspection (daily/weekly)



The following checks should be made and the appropriate action taken to remedy any deviations:

- a) Check operating behavior; ensure noise, vibration and bearing temperatures are normal.
- b) Check that there are no abnormal fluid or lubricant leaks (static and dynamic seals) and that any sealant systems (if fitted) are full and operating normally.
- c) Check that shaft seal leaks are within acceptable limits.
- d) Check the level and condition of lubrication oil. On grease lubricated pumps, check running hours since last recharge of grease or complete grease change.
- e) Check any auxiliary supplies, i.e., pump bearing clean water flush are operating correctly.
- f) Refer to the manuals of any associated equipment if routine checks needed.

### 6.2.2 Periodic inspection (every 6 months)



- a) Check foundation bolts for security of attachment and corrosion.
- b) Check the stuffing box for free movement of the gland. Clean and oil the gland studs and nuts. Closely observe the stuffing box for excessive leakage which cannot be reduced by gland adjustment, and replace the packing as necessary.
- c) The coupling should be checked for correct alignment and worn driving elements.



Refer to the manuals of any associated equipment for periodic checks needed.

## 6.2.3 Re-lubrication

### 6.2.3.1 Pump lubrication

On MVX enclosed line shaft pumps, other than the continuous bearing clean water flush or oil drip lubrication through the injection port, the pump will not require further periodic lubrication.

### 6.2.3.2 Driver lubrication



Refer to driver manufacturer's User Instructions.

## 6.2.4 Impeller re-adjustment

The front impeller to wearing ring gap will require readjustment to compensate for wear. Wear will vary with each installation.

Adjustment is only necessary when the performance of the pump has deteriorated to a point considered, by the owner, to be objectionable.



All adjustments of the impeller will change the seal setting, therefore, the seal must be loosened from the shaft until the adjustment is completed and then reset.

### 6.2.4.1 Hollow shaft driver

Wear can be monitored by periodic end play checks of the rotor assembly. Prior to any extended period of operation, the rotor assembly end play should be measured.

This may be accomplished by first fully loosening the head shaft nut and then turning the nut down by hand until it contacts the motor coupling. Then further tighten the nut while counting turns until the shaft is as high as it will go. Record the number of turns of possible nut travel with new wear surfaces and compare periodic repetitions of this procedure. See section 5.3.1 for head shaft nut adjustment information.

### 6.2.4.2 Solid shaft driver

Wear can be monitored by periodic impeller setting checks of the rotor assembly. Prior to any extended period of operation, the impeller setting should be measured.

This may be accomplished by first uncoupling the motor and allowing the pump rotor to seat on the suction bell ring. Using two coupling bolts, at 180 degrees to each other, slowly raise pump half coupling until impellers are just lifted off the seat. (This can be gauged by trying to turn the shaft by hand. At the point the impellers are lifted, the pump will turn.) Be sure to lift both sides evenly.

Measure the resultant gap between the motor half coupling and adjusting nut and record this value. Compare periodic repetitions of this procedure.

Readjust the ring gap as specified in section 5.3.2.

### 6.2.5 Maintenance of the stuffing box

#### 6.2.5.1 General

Maintenance of the stuffing box will consist of greasing the box when required, tightening the packing gland occasionally as the leakage becomes excessive, and installing new packing rings or sets as required.

#### 6.2.5.2 Greasing the stuffing box

Under ordinary operation, once-a-month greasing of the stuffing box will be adequate. A high quality industrial grade # 2 grease is recommended; see the table below for typical brands and types.

Manufacturer	Grease types
Exxon	Unirex N2
BP	Energrease LS2
Mobil	Mobilux 2
Shell	Alvania No.2
Texaco	Multitak 20
Esso	Beacon 2

#### 6.2.5.3 Replacing packing

Remove gland and all old packing. If the box contains a lantern ring, remove this and all packing below it using two packing hooks.

Inspect shaft or sleeve for score marks or rough spots. Be sure by-pass holes (if supplied) are not plugged. Repair or replace badly worn shaft or sleeve.

If wear is minor, dress down until smooth and concentric. Clean box bore.

Oil inside and outside of replacement rings lightly and install in box, staggering joints 90 degrees. Be sure to replace lantern ring in proper position when used.

Replace gland and tighten nuts finger tight. The packing gland must never be tightened to the point where leakage from the packing is stopped.

A small amount of leakage is required for packing lubrication.

Packing ring sizes vary with the shaft diameter. Packing ring size information is as follows:

### Packing ring sizes

Packing dimensions mm (in.)		
Shaft size	Packing ring size	Outside diameter of packing
25 (1.00)	9.65 (0.38)	44.4 (1.75)
32 (1.25)	9.65 (0.38)	50.8 (2.00)
38 (1.50)	11.17 (0.44)	60.4 (2.38)
43 (1.69)	12.70 (0.50)	68.3 (2.68)
49 (1.93)	12.70 (0.50)	74.6 (2.93)
56 (2.20)	12.70 (0.50)	81.0 (3.19)
62 (2.44)	12.70 (0.50)	87.3 (3.43)
68 (2.68)	12.70 (0.50)	93.7 (3.69)
75 (2.95)	12.70 (0.50)	100.0 (3.93)
82 (3.22)	12.70 (0.50)	107.9 (4.24)
89 (3.50)	15.74 (0.62)	120.6 (4.74)
95 (3.75)	15.74 (0.62)	127.0 (5.00)
102 (4.00)	15.74 (0.62)	133.3 (5.24)
114 (4.50)	15.74 (0.62)	146.0 (5.74)

#### 6.2.5.4 Start-up with new packing

Check to see that the by-pass line (if used) is connected and the packing gland is loose. Start pump and allow it to run for 20 to 30 minutes. Do not tighten the gland during this "run-in" period even if leakage is excessive. Should the new packing cause excessive heating during "run-in", flush the shaft and packing box area with cold water or shut the pump down and allow to cool.



For all repair instructions please call Flowserve representative or customer service with the order number and unit details for specific repair instruction literature.

All repair work should be carried out by trained and authorized personnel only. Flowserve's written permission may be required for any disassembly/repair of the pump that is still under warranty.

### 6.3 Spare parts

#### 6.3.1 Ordering of spares

Flowserve keeps records of all pumps that have been supplied. When ordering spare parts we need the following information:

1. Pump type and pump size
2. Serial number of the pump
3. Number of the required spare parts
4. Reference number and name of the part as listed in the part list or in the sectional drawing (The pump size and serial number are as shown on the pump nameplate.)

To ensure continued satisfactory operation, replacement parts to the original design specification should be obtained from Flowserve. Any change to the original design specification (modification or use of a non-standard part) will invalidate the pump's safety certification.

**6.3.2 How to select recommended spares**

Generally a list of spare parts is supplied along with the pump that shows the parts that are included in each of the following two classes of recommended spares. If you do not find such documentation please contact Flowserve for the list.

**6.3.2.1 Class I minimum**

Suggested for domestic service when pump is handling clean non-corrosive liquids and where interruptions in service are not important.

**6.3.2.2 Class II average**

Suggested for domestic service when pump is handling abrasive or corrosive liquids and where some interruptions in continuity of service are not objectionable.

Please contact Flowserve Sales Representative in your area to review the spares best suited to meet your requirements.

**6.3.3 Storage of spare parts**

Spares should be stored in a clean dry area away from vibration. Inspection and re-treatment of metallic surfaces (if necessary) with preservative is recommended at 6 month intervals.

**6.4 Recommended spares and consumables**

A list of spares and consumables are generally included along with this User Instructions and other documents that you have received along with the pump and are made specifically to your order. In the event that the list is not found, please contact Flowserve with pump type and order number.

**6.5 Tools required**

A typical range of tools that will be required to maintain this pump are listed below.

- Open ended spanners/wrenches (standard size range)
- Socket spanners/wrenches (standard size range)
- Allen keys/wrenches
- Standard range of screw drivers
- Soft mallet

**Note:**

Other tools may be required depending on the accessories/special parts used per contract. Flowserve in general is not obligated to ship the tools with any pump shipped.

**6.6 Fastener torques**

**6.6.1 Fastener torques for pump assembly**

Bolt torque values for class 2A and 2B lubricated threads							
Thread data		Material group					
		A 316 SS SAE J429 Grade 2	B ASTM B164 UNS NO4400	C Hastalloy C276	D ASTM A449 GRADE 5	E ASTM A193 Grade B7M	F SAE J429 Grade 8
Nominal diameter mm (in.)	Threads per 25 mm (in.)	Approximate yield stress – N/mm <sup>2</sup> (psi)					
		207 (30 000)	276 (40 000)	345 (50 000)	441 (60 000)	552 (80 000)	690 (100 000)
		Torque Nm (lbf•ft)					
6 (0.25)	20	4 (3)	5 (4)	5 (4)	7 (5)	9 (7)	12 (9)
8 (0.31)	18	7 (5)	8 (6)	11 (8)	14 (10)	17 (13)	21 (16)
10 (0.37)	16	9 (7)	14 (10)	16 (12)	20 (15)	27 (20)	34 (25)
11 (0.43)	14	16 (12)	20 (15)	25 (19)	31 (23)	42 (31)	53 (39)
12 (0.5)	13	23 (17)	31 (23)	39 (29)	47 (35)	62 (46)	78 (58)
15 (0.56)	12	27 (20)	45 (33)	75 (41)	66 (49)	89 (66)	111 (82)
16 (0.62)	11	41 (30)	60 (44)	54 (73)	88 (65)	118 (87)	149 (110)
19 (0.74)	10	81 (60)	101 (75)	127 (94)	149 (110)	203 (150)	257 (190)
22 (0.87)	9	122 (90)	163 (120)	203 (150)	258 (190)	312 (250)	420 (310)
25 (1.00)	8	190 (140)	244 (180)	312 (230)	366 (270)	488 (360)	610 (450)
29 (1.13)	7	271 (200)	352 (260)	448 (330)	529 (390)	705 (520)	882 (650)
29 (1.13)	7	271 (200)	366 (270)	461 (340)	556 (410)	732 (540)	923 (680)
32 (1.25)	7	366 (270)	488 (360)	610 (450)	746 (550)	990 (730)	1235 (910)
32 (1.25)	8	379 (280)	502 (370)	637 (470)	760 (560)	1 017 (750)	1275 (940)
35 (1.38)	6	434 (320)	570 (420)	719 (530)	855 (630)	1 140 (840)	1425 (1050)
35 (1.38)	8	461 (340)	610 (450)	760 (560)	922 (680)	1 221 (900)	1533 (1130)
38 (1.50)	6	556 (410)	746 (550)	936 (690)	1 126 (830)	1 506 (1 110)	1872 (1380)
38 (1.50)	8	597 (440)	800 (590)	990 (730)	1 194 (880)	1 587 (1 170)	1995 (1470)
41 (1.63)	5.5	719 (530)	963 (710)	1 207 (890)	1 438 (1 060)	1 927 (1 420)	2402 (1770)
41 (1.63)	8	773 (570)	1 031 (760)	1 302 (960)	1 560 (1 150)	2 076 (1 530)	2592 (1910)
44 (1.75)	5	882 (650)	1 180 (870)	1 479 (1 090)	1 778 (1 310)	2 375 (1 750)	2958 (2180)
44 (1.75)	8	971 (720)	1 302 (960)	1 628 (1 200)	1 940 (1 430)	2 592 (1 910)	
50 (2.00)	4.5	1 356 (1 000)	1 778 (1 310)	2 225 (1 640)	2 673 (1 970)		
50 (2.00)	8	1 478 (1 090)	1 968 (1 450)	2 470 (1 820)	2 958 (2 180)		
57 (2.25)	8	2 143 (1 580)	2 850 (2 100)				
63 (2.50)	8	2 970 (2 190)					

**Note:** Torque values shown are for standard fasteners lubricated with high stress lubricant such as graphite-oil, Molybdenum disulfide, etc.

**Note:** 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.

**6.6.2 Torques for couplings screws**

Coupling size #	Flange diameter mm (in.)	Nm (lbf•ft)
1 and 2	111 or 137 (4.4 or 5.4)	122 (90)
3 - 5	156, 187 213 (6.0, 7.4, 8.4)	237 (175)
6	250 (10.0)	424 (313)

Torque values are for standard fasteners lubricated with a high stress lubricant (such as graphite and oil, Molybdenum disulfide, etc.). For stainless steel bolts, multiply listed torques by 0.80.

**6.7 Setting impeller clearance**

Please see section 5.3 for specific instructions on impeller adjustment.

**6.8 Disassembly**

Refer to section 1.6, *Safety*, before dismantling the pump.

**CAUTION** Before dismantling the pump for overhaul, ensure genuine Flowserve replacement parts are available. Refer to sectional drawings for part numbers and identification.

Please take precaution during disassembly that there is no risk of explosion due to the nature of the materials/tools/equipment/method used. Wherever chemical and hazardous materials are involved, proper safety rules have to be followed to prevent any dangers to human lives. Contact Flowserve for guidance, or local regulatory agency for specific safety information.

**6.8.1 General**

Eventually repairs will have to be made, either to the pump or to the motor. When regular maintenance checks indicate that an overhaul is required, it should not be delayed.

Repairs will consist of removal of the unit and disassembly to the point necessary for replacement of worn parts.

Disassembly should be performed in a clean area with sufficient space to lay out the parts in order of disassembly. Cleanliness throughout repairs is important - remember this is a close tolerance, high speed machine and should be handled as such.

**CAUTION** Protect machined surfaces from burrs and scrapes, which will cause misalignment on reassembly.

To prevent injury due to electric shock or rotating equipment, the pump controls must be locked and tagged in the off position.

To prevent injury due to lethal liquids, gases and/or hot parts, before disassembly the pump must be isolated from the system, drained of liquids, vented of fumes and brought to room temperature.

**6.8.2 Motor/discharge head disassembly**

See section 8 for generic sectional drawings. Refer to other documentation for any specific job supplied sectional drawing.

- a) Close gate valve in discharge line.
- b) Lock out power supply to driver.
- c) Disconnect all electrical connections and tag.
- d) Disconnect any external auxiliary piping connections.

**Note:** Refer to cross sectional drawings for component illustrations.

- e) **Hollow shaft drivers:** Remove head shaft nut lock screw, unthread head shaft nut [right hand threads 25 mm (1 in.) to 38 mm (1 1/2 in.); left hand threads 43 mm (1 11/16 in.) and larger], remove gib key from driver clutch, remove driver clutch from driver as in driver instructions.

**Note:** On hollow shaft driver units, if the head shaft couples above the top enclosing tube remove the head shaft and shaft coupling (left hand threads).

- Solid shaft drivers:** Disconnect the driver shaft from the pump shaft by removing the socket head cap screws from the flanged coupling. This will allow the pump shaft and impellers to also drop down. If coupling has a spacer, remove the lower set of cap screws and nuts only.
- f) Remove bolts that attach driver to discharge head.
- g) Rig the motor to a suitable hoist and keep the lifting mechanism in ready state.
- h) Lift driver off pump and set on wooden supports. Be sure supports are high enough to clear shaft and shaft coupling (solid shaft driver).
- i) Disconnect discharge piping from pump.
- j) Remove the discharge head hold down bolts (or nuts).

- k) If the pump is of shorter length rig the discharge head along with the entire pump assembly (see section 2.3 for lifting) using a suitable hoist. (Check the building height clearance before lifting is attempted.)
  - Use eye bolts and hooks as necessary and get the lifting mechanism in ready state
  - Lift the entire pump assembly vertically until pump suction clears the base
- l) Lifting longer set pumps:
  - Remove stuffing box/mechanical seal completely. Protect the shaft against damage while lifting the discharge head
  - Lift the pump just enough to access the first column pipe flange connection
  - Support the entire pump just below the first column pipe joint
  - Disconnect the discharge head and lift
  - Now lift the pump again by using the column pipe flange and disconnect the first section of column piping
  - Remove the enclosing tube [1917.1, 1917], brackets [3831], lineshaft [2130, 2120], connector bearings [3050.1] and shaft couplings [7119] and repeat the process until all column piping is disassembled
  - Last step is to lift and remove the bowl assembly
- m) Cover opening in foundation.
- n) Lower pump components into a horizontal position on suitable supports and in a suitable area for disassembly.

**Note:**

If more than minor repairs are anticipated it is recommended that the unit be taken to a shop or other clear area with a smooth floor and overhead lifting equipment.

- o) Unthread the packing nut (left hand threads) and remove the packing from around the top enclosing tube. This packing will be tamped tight.
- p) Unbolt the lube packing box and remove.

**Note:**

Before proceeding further make sure the discharge head and bowl assembly are supported independently of each other.

**6.8.3 Flanged column disassembly**

- a) Remove the top column from discharge head. The nuts are located just under the discharge head.
- b) Remove the discharge head being careful not to damage or bend the shaft extending through the discharge head.

**Note:**

If more than one length of column pipe is involved each column pipe and shaft should be match marked to keep the shaft extensions the same during reassembly.

**CAUTION**

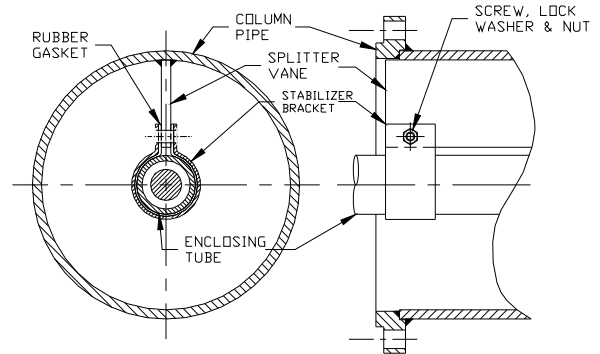
When using wrenches on shafting always place the wrenches on the same side of the shaft to avoid excess side strain on the shafting. Care should always be taken so that exposed lengths of shafting are not damaged or bent.

- c) Remove the top enclosing tube (left hand threads). Hold the lower tube and turn the upper tube. Leave the threaded line shaft bearing threaded into the lower tube to support the shaft.

**CAUTION**

Do not nick, dent or otherwise damage the ends of enclosing tube. This will result in damage to the pump.

- d) Remove the head shaft and coupling if a head shaft is used and if it has not been removed earlier (left hand threads).
- e) Remove the tube stabilizer if installed by unbolting it from the column splitter vane.



**Note:**

Tube stabilizers are installed on an as required basis for each order. Column sections may or may not contain a tube stabilizer.

- f) Remove the column pipe by unbolting it at the nearest joint from the top of the pump.
- g) Each time a length of column pipe is removed the enclosing tube and line shaft must also be disassembled. Locate the joint and unscrew (left hand threads) the enclosing tube from the line shaft bearing which acts as a bearing for the shaft and coupling for the enclosing tube. Leave the line shaft bearing threaded into the enclosing tube. (It is used to support the line shaft.) Slide the enclosing tube up to expose the line shaft coupling. The line shaft and coupling should be removed by holding the lower line shaft and turning the coupling (line shaft threads are left hand).
- h) Repeat steps (e), (f) and (g) for each piece of column pipe removed.

**Note:**

Maximum bearing spacing is 1.5 m (60 in.) on enclosed line shaft pumps. If column lengths are over 1.5 m (60 in.) there will be an additional line shaft bearing that must be disassembled during teardown. To check for an additional bearing, remove the tube and shaft from the column pipe. There is a bearing located at each joint.

- i) Refer to section 6.10 for reassembly.

**6.8.4 Bowl assembly/disassembly**

- a) Lay the bowl assembly in the horizontal position and block evenly.
- b) Measure the end play:
  - Push the shaft down until the impeller seats against the suction bell ring
  - Mark the shaft position
  - Pull the shaft up until the impeller hits the bowl assembly
- c) Record the distance travelled:  
End play = \_\_\_\_\_
- d) Remove the suction bell cap screws and remove the suction bell.
- e) Impeller removal:
  - Pull the shaft up so that the impeller seats against the bowl assembly
  - Loosen the impeller cap screw(s) 2-3 turns
  - Push the shaft away from the bowl then rapidly back to the bowl assembly to loosen the impeller. Repeat until the impeller is axially loose
  - Remove the cap screw and cover plate and then slide the impeller off of the shaft
  - Remove the straight key from the shaft
  - Pull the shaft out of the lower bowl bearings

**6.9 Examination of parts**



Used parts must be inspected for physical defects, wear corrosion and damage before assembly to ensure the pump will subsequently run properly. In particular, fault diagnosis is essential to enhance pump and plant reliability.

When repairing a bowl assembly that has been in service for several years, the physical condition or strength of all parts such as cap screws, bowls and bowl threads must be carefully checked.

When attempting to rework any part, extreme care must be taken to maintain alignment of mating parts and "as new" tolerances.

Before proceeding with assembly, thoroughly clean all bolts, nuts, threaded connections and mating faces. Clean up any burrs with a file or emery cloth.

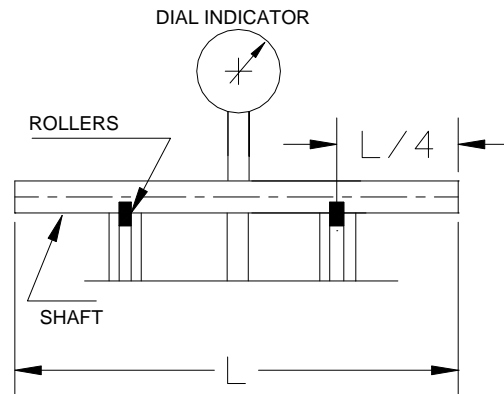


Cleanliness and proper lubrication are required to guarantee ease of re-assembly and proper pump operation.

**6.9.1 Examination of shaft/s**

Check the shafts for straightness, pitting and wear. Remove all burrs or nicks. Shaft damage is usually best corrected by replacing the shaft.

The lineshaft(s) must be straight to within 0.04 mm/m (0.0005 in./ft) of shaft length. The detail below shows the recommended method for checking shaft straightness. If the shaft is not straight, it must be straightened or replaced. If the deflection is gradual over a considerable length, the shaft can usually be straightened by supporting on two blocks straddling the crooked section and applying pressure to the high side to deflect the shaft in the opposite direction. If the shaft has a sharp crook (dog-leg), it is recommended that the shaft be replaced since the shaft will not always remain straight, even if satisfactorily straightened.



The pump bowl shaft must not have a runout in excess of 0.025 mm (0.001 in.) T.I.R. at the impeller end with respect to the bearing journals.



Even if a shaft is new or has been previously straightened, it is recommended that the shaft be re-checked at this point to ensure damage has not occurred in transit or handling.

**6.9.2 Examination of bearings**

Check all bearings for total clearance over the shaft. It is recommended that all bearings indicating visual wear be replaced. In addition, any bearings whose running clearance exceeds "as new" tolerances by more than 50 % should be replaced. (See table 6.9.2.1.)

**6.9.2.1 Shaft/bearing clearance**

Nominal shaft diameter mm (in.)	Line shaft bearing clearance max/min mm (in.)	Lower bowl bearing clearance max/min mm (in.)
31.8 (1.25)	0.127/0.241 (0.0050/0.0095)	N/A
42.9 (1.69)	0.196/0.322 (0.0077/0.0127)	0.114/0.216 (0.0045/0.0085)
49.2 (1.94)	0.216/0.343 (0.0085/0.0135)	N/A
61.9 (2.44)	0.267/0.394 (0.0105/0.0155)	N/A
68.3 (2.69)	N/A	0.140/0.241 (0.0055/0.0095)
74.6 (2.94)	0.267/0.394 (0.0105/0.0155)	N/A
82.5 (3.25)	N/A	0.157/0.269 (0.0062/0.0106)
95.2 (3.75)	N/A	0.178/0.305 (0.007/0.012)
127 (5.00)	N/A	0.279/0.406 (0.011/0.016)

Greene Tweed® lower bowl bearings are pressed into their respective bores. They must be machined on the inside diameter until the wall is thin enough to collapse for removal.

If the bearing bore of the housing is heavily scarred or corroded, the part should be replaced or reworked to provide a true bore for the bearing.

Replacement lower bowl bearings should be pressed into place by means of an arbor press. After pressing, the shaft seal bore area should be left open. These bearings will require machining of the bore after they have been pressed into the housing. Finish on the bearing surface must be smooth 3 µm (125 µin.).

Replacement bearings are designed to be pressed into housings so bores will shrink to "as new" tolerances. Measure the bore of bearings after pressing and ream as necessary to assure "as new" tolerances.

Worn upper bowl bearings may be removed by turning with a pipe wrench (left hand threads). Heating of the bearing may be required to weaken the Loctite.

Replacement upper bowl bearings should be threaded in by hand after coating the lower half of the male threads with Loctite 271. One half of the threads should remain above the face of the bowl flange and be free of Loctite.

**6.9.3 Inspection of bowl assembly**

When repairing a bowl assembly that has been in service for several years, the physical condition or strength of all parts such as cap screws, bowls and bowl threads must be carefully checked.

**CAUTION** When attempting to rework any part, extreme care must be taken to maintain alignment of mating parts and ensure "as new" tolerances.

The inspection, disassembly of bowl assembly requires expertise and tools to perform the job correctly. It is recommended to seek the services of Flowserve trained technicians to inspect and repair bowl assemblies. Replace any bowl component which shows excessive damage or wear.

**6.9.3.1 Inspection of enclosed impellers**

- Clear all passageways and check for signs of damage from abrasion or corrosion. Replace an impeller that shows signs of excessive wear.
- If the impeller does not have a lower wear ring the impeller may be machined to accept a wear ring to renew this surface. If the lower impeller wear ring is worn it may be replaced. See section 6.9.3.2 for assembly.
- If the impeller back ring is worn it may be pressed or machined off and replaced.

Please note that certain repairs may require special skills and it is recommended to contact a Flowserve authorized service center before attempting any such repairs.

See section 6.9.4 for wearing ring tolerance chart.

**6.9.3.2 Wear ring(s)**

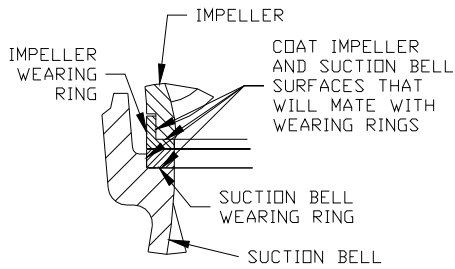
The suction bell is fitted with an axial wearing ring (plate) retained with Loctite 638. The impeller may be fitted with an optional wearing ring retained in place with a slight interference fit and Loctite 638.

Instructions for mounting of these rings are as follows:

- Thoroughly clean the impeller and suction bell seat and wearing ring surfaces to be coated with a suitable solvent.
- Let air dry.
- Coat the impeller and suction bell seat surfaces indicated below with Loctite 638.
- Heat the impeller ring to 150 °C (300 °F) to provide a nominal clearance to facilitate a "bonded shrink fit".
- The suction bell ring is designed with a nominal clearance fit, hence, heating or chilling if this ring is not required.
- Rotate the rings during assembly to assure full spreading over the whole bonding surface.



- g) Let the bond cure for at least 3 hours before handling the part.



The rings can be chilled, heated or machined off for removal.

Generally, it is recommended that the wear rings be renewed or overhauled when pump performance has decreased appreciably due to excessive wearing ring clearance.

**6.9.3.3 Back rings**

The bearing housing and the backside of the impeller are fitted with interference fit rings. The rings can be chilled, heated or machined on the bore or turn diameter until the wall is thin enough to collapse for removal.

Generally it is recommended that the back rings be replaced when the clearance exceeds 2.3 mm (0.090 in.) diametrically. (See section 6.9.4.2 for assembly tolerances.)

**6.9.4 Wearing ring chart for MXV impellers**

**6.9.4.1 Front wear rings**

The front impeller wear rings are designed to have a slight interference fit on the bore to have a “bonded shrink fit” during assembly as in section 6.9.3.2. The suction bell wear rings are designed to have a slight clearance fit on their turn. These rings are then installed using Loctite 638 on their turn and face fits as in section 6.9.3.2.

The clearance fit at assembly is a nose clearance and must be adjusted during the setting of the driver on the pump discharge head. See section 5.3 for the clearance settings and adjusting methods.

**6.9.4.2 Back rings**

Pump size	Clearance between back rings	Restriction bushing interference fit	Impeller back ring interference fit
	mm (in.)		
10MVX12	0.356 - 0.508 (0.014 - 0.020)	0.152 - 0.102 (0.006 - 0.004)	0.127 - 0.076 (0.005 - 0.003)
10MVX13	0.356 - 0.508 (0.014 - 0.020)	0.152 - 0.102 (0.006 - 0.004)	0.127 - 0.076 (0.005 - 0.003)
14MVX15	0.483 - 0.660 (0.019 - 0.026)	0.170 - 0.109 (0.0067 - 0.0043)	0.168 - 0.076 (0.0066 - 0.0030)
16MVX17	0.483 - 0.660 (0.019 - 0.026)	0.193 - 0.119 (0.0076 - 0.0047)	0.175 - 0.084 (0.0069 - 0.0033)
16MVX20	0.584 - 0.762 (0.023 - 0.030)	0.206 - 0.132 (0.0081 - 0.0052)	0.183 - 0.091 (0.0072 - 0.0036)
20MVX20	0.584 - 0.762 (0.023 - 0.030)	0.206 - 0.132 (0.0081 - 0.0052)	0.183 - 0.091 (0.0072 - 0.0036)
20MVX27	0.711 - 0.940 (0.028 - 0.037)	0.234 - 0.150 (0.0088 - 0.0059)	0.221 - 0.117 (0.0087 - 0.0046)
24MVX24	0.711 - 0.940 (0.028 - 0.037)	0.234 - 0.150 (0.0088 - 0.0059)	0.221 - 0.117 (0.0087 - 0.0046)
24MVX33	0.762 - 1.016 (0.030 - 0.040)	0.269 - 0.185 (0.0106 - 0.0073)	0.246 - 0.132 (0.0097 - 0.0052)

**6.9.5 Replacement parts**

Parts showing signs of damage, cracks or excessive wear should be replaced. Flowserve assumes no responsibility or liability for damages caused by the use and or failure of a pump which has been fitted with spare or repair parts not of our manufacture. Only genuine parts from Flowserve or an authorized distributor should be used.

**6.10 Assembly**

To assemble the pump consult the sectional drawings.

**Note:**

The pump that has been purchased may have order specific assembly and parts configurations. Specific cross sectional drawings that reflect the exact pump/parts details can be purchased from Flowserve. Contact Flowserve for drawings purchase and cost information.

It is recommended to call for trained Flowserve technicians for all your assembly needs.



Refer to seal manufacturer’s instructions for disassembly and re-assembly of mechanical seals.



Please take precautions during assembly process such that there is no risk of explosion due to the nature of the materials/tools/equipment/methods used. Wherever chemicals and hazardous materials are involved, proper safety rules must be followed to prevent any danger to human lives. Refer to applicable local regulatory agency requirements for specific safety information.

**6.10.1 Parts preparation**

Before proceeding with assembly, thoroughly clean all bolts, nuts, threaded connections and mating faces. Clean up any burrs with a file or emery cloth.

**Note:** Cleanliness and proper lubrication are required to guarantee ease of reassembly and proper pump operation.

Check the lineshaft for straightness and remove all burrs or nicks. The shaft must be straight to within 0.04 mm/m (0.0005 in./ft) of shaft length.

**Note:** Even if the shaft is new or has been previously straightened, recheck at this point to ensure damage has not occurred in transit or handling.

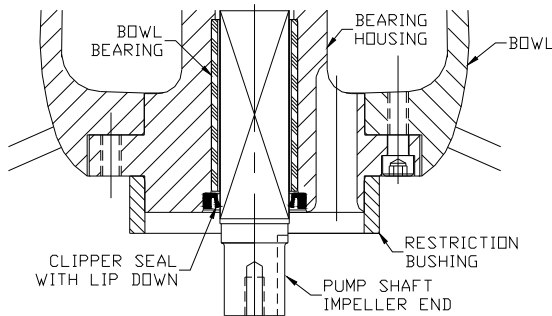
- h) Attach the suction bell to the lower bowl flange taking care to align the register fit. Insert and uniformly tighten the cap screws.
- i) Grasp the shaft and rotate by hand to check for binding. Measure the end play and verify it against the value recorded in section 6.8.4. If a significant reduction in end play is observed and the wearing ring has not been renewed, dismantle the bowl assembly and determine the cause.
- j) Screw the shaft coupling onto the shaft.
- k) Check all bolts and nuts for tightness.
- l) Proceed with pump assembly and installation per section 4.5.

**6.10.2 Pump reassembly**

- a) Verify that the bowl bearings are installed. The upper bowl bearing is threaded into the bowl top; the lower bowl bearing is pressed and machined in the bearing housing.
- b) Assemble the bearing housing into the lower portion of the bowl. Insert and uniformly tighten the cap screws.
- c) Insert the shaft into the bowl from the lower side. Align the shaft coating (bearing journals) with the bearings.

**CAUTION** Do not nick, crack or otherwise damage the bearing journals. This will result in damage to the pump.

- d) Remove the wire spring from the clipper seal lip and then lubricate the shaft seal OD and lip with light oil. Install the seal in the bearing housing with the lip facing the impeller.



- e) Place the impeller key in the key seat on the pump shaft. Coat the shaft with anti-seize compound.
- f) Slip the impeller over the shaft and key and seat in the taper or against the shoulder.
- g) Attach the cover plate and impeller screw to the shaft end to retain the impeller. The screw should be retained with Loctite 271 or equivalent. Torque the cap screw to the value listed in section 6.6.1.

## 7 FAULTS; CAUSES AND REMEDIES

### FAULT SYMPTOM

Pump overheats and seizes																	
↓	Bearings have short life																
↓	↓	Pump vibrates or is noisy															
↓	↓	↓	Mechanical seal has short life														
↓	↓	↓	↓	Mechanical seal leaks excessively													
↓	↓	↓	↓	↓	Pump requires excessive power												
↓	↓	↓	↓	↓	↓	Pump loses prime after starting											
↓	↓	↓	↓	↓	↓	↓	Insufficient pressure developed										
↓	↓	↓	↓	↓	↓	↓	↓	Insufficient capacity delivered									
↓	↓	↓	↓	↓	↓	↓	↓	Pump does not deliver liquid									
								<b>POSSIBLE CAUSES</b>				<b>POSSIBLE REMEDIES</b>					
<b>A. SYSTEM PROBLEMS</b>																	
●								●	●	Pump not submerged.				Check requirements/liquid level. Vent and/or prime.			
	●							●	●	Impeller not adjusted or loose on shaft.				See section 5.3 for proper impeller adjustment.			
	●							●	●	Suction lift too high or level too low.				Check $NPSH_A > NPSH_R$ , proper submergence, losses at strainers/fittings.			
●	●							●	●	Insufficient margin between suction pressure and vapor pressure.							
								●	●	Excessive amount of air or gas in liquid.				Check and purge pipes and system.			
								●		Line check valve backward/stuck.				Reverse chuck valve/free the valve.			
								●	●	Unit running backwards.				See start up instruction. Check motor phase/wiring			
	●							●	●	Air or vapor pocket in suction line.				Check suction line design for vapor pockets.			
								●	●	Air leaks into suction line.				Check suction pipe is airtight.			
	●							●	●	Intake strainer or impeller plugged or pump in mud or sand.				Start and stop several times or use line pressure if available to back flush or pull pump to clean.			
	●							●	●	Inlet of suction pipe insufficiently submerged.				Check out system design.			
								●	●	Speed too low.				Consult Flowserve.			
								●	●	Speed too high.				Consult Flowserve.			
								●	●	Total head of system higher than differential head of pump.				Check system losses or consult Flowserve.			
								●		Total system head is lower than pump design head.							
								●	●	Specific gravity of liquid different from design.				Check and consult Flowserve. Check the pump design for the type of liquid to be handled.			
								●	●	Viscosity of liquid differs from the designed.				Consult Flowserve.			
●	●									Operation at very low capacity.				Measure. Check minimum permitted. Consult Flowserve.			
	●	●								Operation at high capacity.				Measure value and check maximum permitted. Consult Flowserve.			
<b>B. MECHANICAL PROBLEMS</b>																	
●	●	●	●	●	●					Misalignment due to pipe strain.				Check the flange connections and eliminate strains using elastic couplings or a method permitted.			
		●								Improperly designed foundation / Loose fasteners.				Check setting of base plate. Tighten, adjust, grout base as required. Check fasteners and torque.			
	●	●	●	●	●					Shaft bent.				Check shaft run outs. Consult Flowserve.			
●	●	●				●	●			Rotating part rubbing on stationary part.				Check. Consult Flowserve, if necessary.			
●	●	●	●	●						Bearings worn.				Replace bearings.			

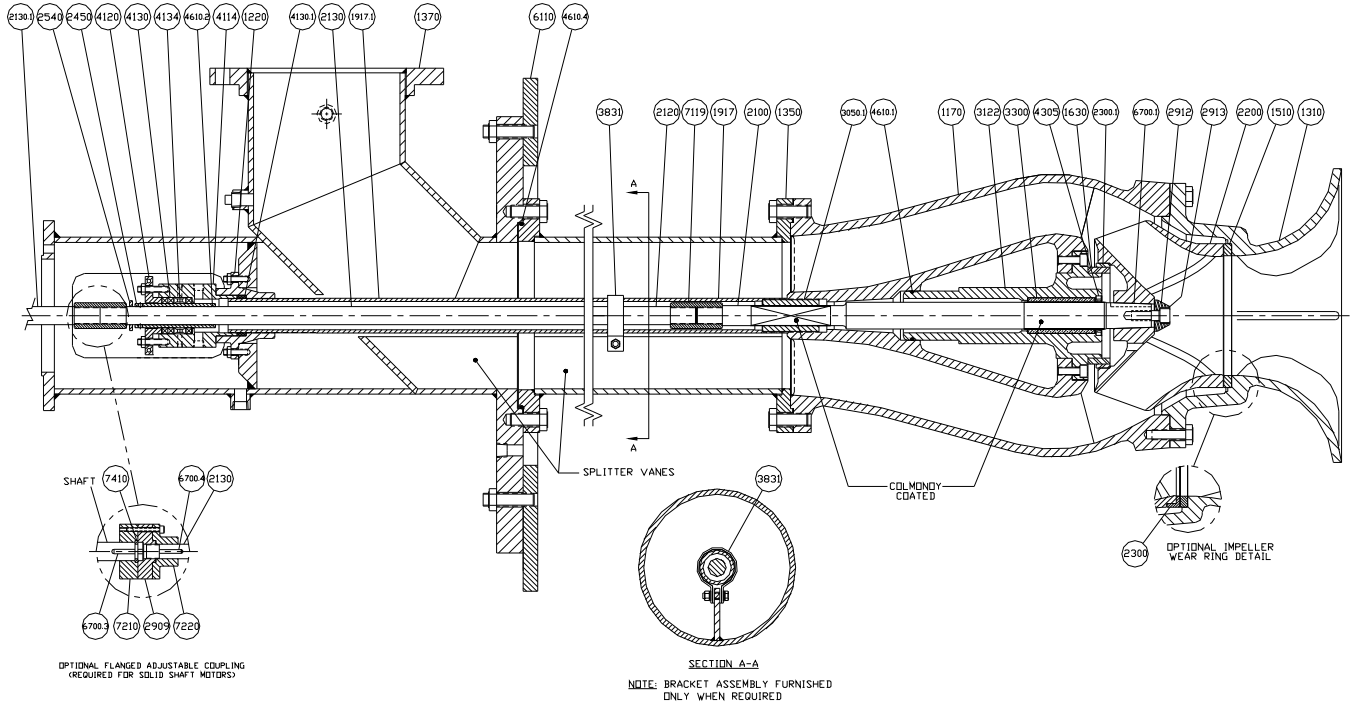
**FAULT SYMPTOM**

Pump overheats and seizes											
↓	Bearings have short life										
↓	Pump vibrates or is noisy										
↓	Mechanical seal has short life										
↓	Mechanical seal leaks excessively										
↓	Pump requires excessive power										
↓	Pump loses prime after starting										
↓	Insufficient pressure developed										
↓	Insufficient capacity delivered										
↓	Pump does not deliver liquid										
				●	●	●				Wearing ring surfaces worn.	Replace worn wear ring/surfaces.
	●				●	●				Impeller damaged or eroded.	Replace or consult Flowserve for an upgrade.
			●							Leakage under sleeve due to joint failure.	Replace joint and check for damage.
		●	●							Shaft sleeve worn, scored, or running off center.	Check and renew defective parts.
		●	●	●						Mechanical seal improperly installed.	Check alignment of faces/damaged parts/assembly
		●	●	●						Incorrect type of mechanical seal.	Consult Flowserve.
●	●	●	●							Shaft running off center because of worn bearings or misalignment.	Check misalignment and correct if necessary. If alignment satisfactory check bearings for excessive wear.
●	●	●	●							Impeller out of balance resulting in vibration.	Check. Consult Flowserve for problem resolution ideas.
	●	●	●	●						Solids/abrasive particles in liquid pumped.	
		●	●							Internal misalignment of parts preventing seal ring and seat from mating properly.	
		●	●							Mechanical seal was run dry.	Check mechanical seal/flush supply/pump and repair.
		●	●	●						Internal misalignment due to improper repairs causing impeller to rub.	Check method of assembly, possible damage or state of cleanliness during assembly. Check and consult Flowserve, if necessary.
●	●	●								Excessive thrust caused by a mechanical failure inside the pump.	Check wear condition of impeller, its clearances and liquid passages.
	●	●								Excessive grease in ball bearings.	Check method of re-greasing.
	●	●								Lack of lubrication for bearings.	Check hours run since last change of lubricant, the schedule and its basis.
	●	●								Improper installation of bearings (damage during assembly, incorrect assembly, wrong type of bearing etc.).	Check method of assembly, possible damage or state of cleanliness during assembly and type of bearing used. Remedy and consult Flowserve, if necessary.
	●	●								Damaged bearings due to contamination.	Check contamination source and replace bearings.
<b>C. MOTOR/ELECTRICAL PROBLEMS</b>											
		●			●	●	●	●		Wrong direction of rotation.	Reverse 2 phases at motor terminal box.
	●									Motor protector open.	Check nameplate for voltage and current rating. Replace faulty motor protectors.
						●				Line voltage not correct/faulty control box/wiring/low voltage.	Check wiring diagram.
	●									Blown fuse/breaker open/dead motor/short or loose connection.	Check/repair or replace fuses/breakers.
				●				●		Motor running on 2 phases only.	Check supply and fuses.
	●	●							●	Motor running too slow.	Check motor terminal box connections and voltage.

## 8 DRAWINGS AND PARTS LISTS

**Note:** Sectional drawings provided in this section are typical representations for the most common pump arrangements for the purposes of basic understanding of the equipment. The details shown may not reflect the specifics of the pump that has been purchased. Order-specific cross sectional drawings and parts list can be purchased from Flowserve separately. Contact Flowserve for ordering and pricing information on such.

### 8.1 10MVX12 and 10MVX13 typical wet pit pump sectional



#### 8.1.1 Parts list

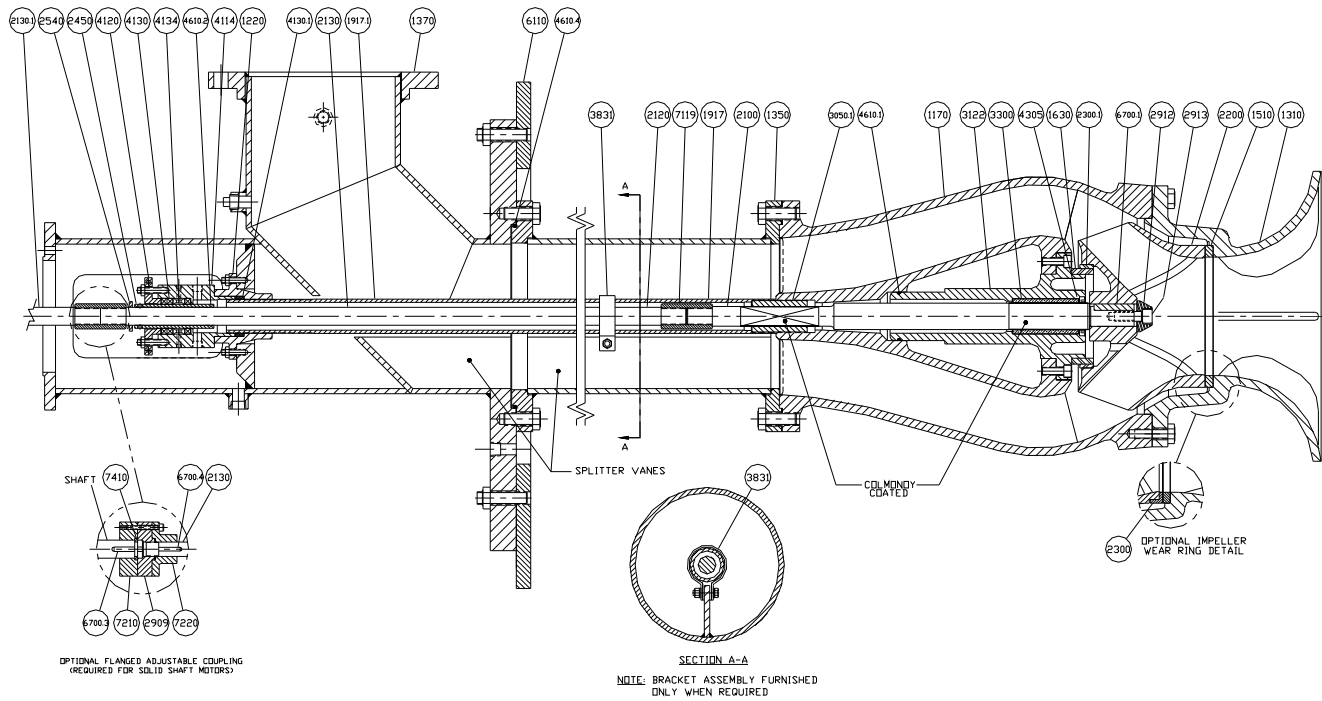
Stationary parts		
Ref	No of pieces	Description
1170	1	Bowl
1220	1	Tube tension plate
1310	1	Suction bell
1350	*	Column pipe
1370	1	Discharge head
1510	1	Suction bell wear ring
1630	1	Restriction bushing
1917	*	Enclosing tube
1917.1	1	Top enclosing tube
3050.1	*	Connector bearing
3122	1	Bearing housing (bowl)
3300	1	Bowl bearing
3831	*	Bracket
4114	1	Enclosing tube nut
4120	1	Packing gland - split
4130	Set	Packing
4130.1	Set	Packing
4134	1	Lantern ring
4305	1	Shaft lip seal
4610.1	1	Bearing housing O-ring
4610.4	1	Column pipe O-ring
6110	1	Pump soleplate

\* as required: see original material list

Optional flanged adjustable coupling (see lower left detail above) (required for solid shaft motors)		
Ref	No of pieces	Description
2130	1	Top line shaft
2909	1	Coupling adjusting nut
6700.3	1	Driver key
6700.4	1	Driven key
7210	1	Driver half coupling
7220	1	Driven half coupling
7410	1	Split thrust ring

Rotating parts		
Ref	No of pieces	Description
2100	1	Pump shaft
2120	*	Line shaft
2130	1	Top line shaft
2130.1	1	Head shaft
2200	1	Impeller
2300	1	Impeller wear ring (optional)
2300.1	1	Impeller back ring
2450	1	Packing box sleeve
2540	1	Deflector
2912	1	Impeller cover plate
2913	1	Impeller screw (retained with Loctite)
4610.3	1	Shaft sleeve O-ring
6700.1	1	Impeller key
7119	*	Shaft coupling

## 8.2 14MX15 and larger typical wet pit pump sectional



### 8.2.1 Parts list

Stationary parts		
Ref	No of pieces	Description
1170	1	Bowl
1220	1	Tube tension plate
1310	1	Suction bell
1350	*	Column pipe
1370	1	Discharge head
1510	1	Suction bell wear ring
1630	1	Restriction bushing
1917	*	Enclosing tube
1917.1	1	Top enclosing tube
3050.1	*	Connector bearing
3122	1	Bearing housing (bowl)
3300	1	Bowl bearing
3831	*	Bracket
4114	1	Enclosing tube nut
4120	1	Packing gland - split
4130	Set	Packing
4130.1	Set	Packing
4134	1	Lantern ring
4305	1	Shaft lip seal
4610.1	1	Bearing housing O-ring
4610.4	1	Column pipe O-ring
6110	1	Pump soleplate

\* As required: see original material list

Optional flanged adjustable coupling (see lower left detail above) (required for solid shaft motors)		
Ref	No of pieces	Description
2130	1	Top line shaft
2909	1	Coupling adjusting nut
6700.3	1	Driver key
6700.4	1	Driven key
7210	1	Driver half coupling
7220	1	Driven half coupling
7410	1	Split thrust ring

Rotating parts		
Ref	No of pieces	Description
2100	1	Pump shaft
2120	*	Line shaft
2130	1	Top line shaft
2130.1	1	Head shaft
2200	1	Impeller
2300	1	Impeller wear ring (optional)
2300.1	1	Impeller back ring
2450	1	Packing box sleeve
2540	1	Deflector
2912	1	Impeller cover plate
2913	1	Impeller screw (retained with Loctite)
4610.3	1	Shaft sleeve O-ring
6700.1	1	Impeller key
7119	*	Shaft coupling

### 8.3 General arrangement drawing

The typical general arrangement drawing and any specific drawings required by the contract will be sent to the Purchaser separately unless the contract specifically calls for these to be included into the User Instructions. If these drawings are supplied separately, the purchaser should retain those with the User Instructions.

And any copies of other drawings sent separately to the Purchaser should be obtained from the Purchaser and retained with these User Instructions.

## 9 CERTIFICATION

Certificates determined from the Contract requirements are provided with these instructions where applicable. Examples would be hydrostatic test and shop performance test curves and data. If provided, copies of these other certificates sent separately to the Purchaser should be retained along with these User instructions.

## 10 OTHER RELEVANT DOCUMENTATION AND MANUALS

### 10.1 Supplementary User Instructions

Supplementary instructions determined from the contract requirements for inclusion into user instructions such as for a driver, instrumentation, controller, sub-driver, seals, sealant system, mounting component, etc., are included in the Data Book. If further copies of these are required they should be obtained from the supplier for retention with these user instructions.

Where any pre-printed set of user instructions are used, and satisfactory quality can be maintained only by avoiding copying these, they are included at the end of these user instructions such as within a standard clear polymer software protection envelope.

### 10.2 Change notes

If any changes, agreed with Flowserve, are made to the product after its supply, a record of the details should be maintained with these User Instructions.

### 10.3 Additional sources of information

*Reference 1:*

NPSH for Rotodynamic Pumps: a reference guide, Europump Guide No. 1, Europump & World Pumps, Elsevier Science, United Kingdom, 1999.

*Reference 2:*

Pumping Manual, 9<sup>th</sup> edition, T.C. Dickenson, Elsevier Advanced Technology, United Kingdom, 1995.

*Reference 3:*

Pump Handbook, 4<sup>th</sup> Edition, Igor J. Karassik et al, McGraw-Hill Inc., New York, NY, 2007.

*Reference 4:*

Pumping Station Design, 3<sup>rd</sup> Edition, Robert L. Sanks, Butterworths, Stoneham, MA, 2006.

*Reference 5:*

ANSI/HI 1.1-1.5  
Centrifugal Pumps - Nomenclature, Definitions, Application and Operation.

*Reference 6:*

ANSI-HI 9.6.1  
Rotodynamic Pumps – Guideline for NPSH Margin

*Reference 7:*

ANSI-HI 9.8  
Rotodynamic Pumps – for Pump Intake Design

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**Your local Flowserve representative:**

*To find your local Flowserve representative please  
use the Sales Support Locator System found at  
[www.flowserve.com](http://www.flowserve.com)*

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