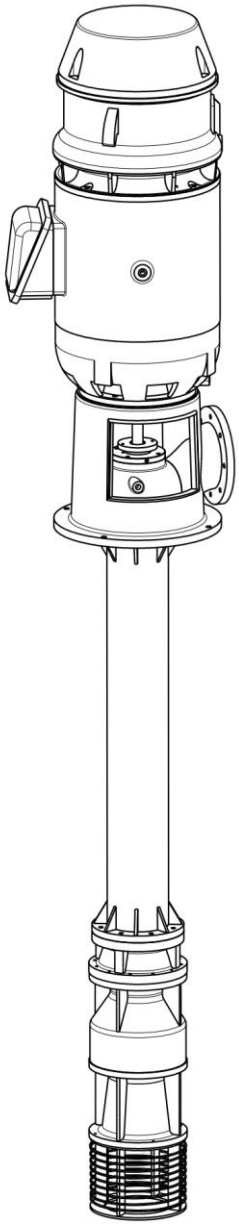
MOMTAZ PUMP CO.
Private Joint Stock

VERTICAL TURBINE PUMPS

USER MANUAL

Installation, Operation, Maintenance



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1. INTRODUCTION

1.1. General

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

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 is not covered by the MomtazPump guaranty**.**

1.2. Disclaimer

Information in these user manual is believed to be complete and reliable. However, in spite of all of the efforts of MomtazPump company to provide comprehensive instructions, good engineering and safety practice should always be used.

MomtazPump manufactures products according to internationally approved quality standard levels. 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 MomtazPump 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 MomtazPump parts and accessories is considered to be misuse. Damage or failure caused by misuse is not covered by the MomtazPump guaranty. In addition, any modification of MomtazPump products or removal of original components may impair the safety of these products in their use.

1.3. Copyright

1.4. Duty conditions

This product has been selected to meet the specifications of your purchase order. 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 Momtaz Pump for advice, quoting the serial number.

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

2. SAFETY

2.1. 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.

2.2. Safety action

This is a summary of conditions and actions to prevent injury to personnel and damage to the environment and to equipment.

- 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
- 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
- Do not use pump as a support for piping.
- Ensure correct lubrication
- Start the pump with outlet valve partly opened, 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.
- Never run the pump dry
- 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.
- 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.
- The surface temperature on the pump is influenced by the temperature of the liquid handled. The operator is responsible to ensure that the specified maximum liquid temperature is not exceeded.
- 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.

3. TRANSPORT AND STORAGE

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 MomtazPump and received in writing within one month of receipt of the equipment. Later claims cannot be accepted.

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.

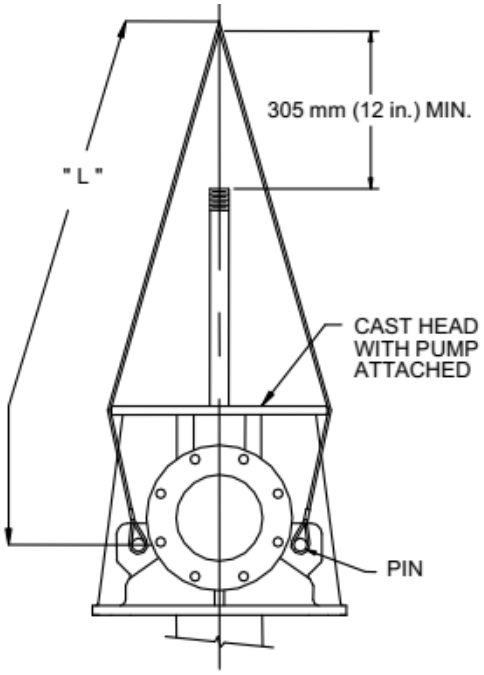
3.1. Handling

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

3.2. Lifting

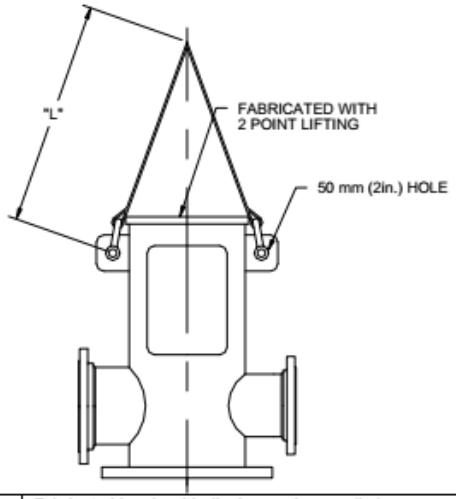
Equipment in excess of 25Kg (55lbs) should be lifted by mechanical means. Fully trained personnel must carry out lifting, in accordance with local regulations.

Discharge heads with pump attached are recommended to be lifted by using pins suitable with that head size (refer to below figures).



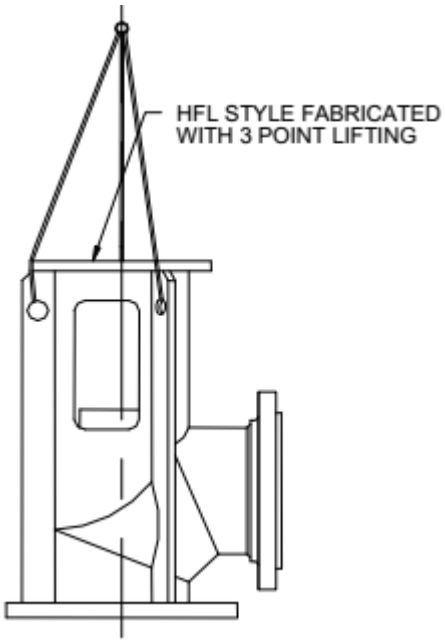
	Cast heads with discharge size mm (in.)				
	100 (4)	150 (6)	200 (8)	250 (10)	300 (12)
Pin Dia.	25 (1)	32 (1.25)	32 (1.25)	32 (1.25)	38 (1.5)
L	1220 (48)	1370 (54)	1370 (54)	1520 (60)	1520 (60)

"L" is approximate length

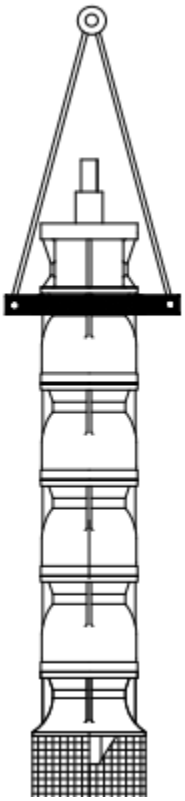


	Fabricated heads with discharge size mm (in.)		
	100-200 (4-8)	250-600 (10-24)	700-900 (28-36)
Pin Dia.	32 (1.25)	38 (1.50)	44 (1.75)
Weight	<2300 (5000)	<4500 (10000)	<6800 (15000)

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



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

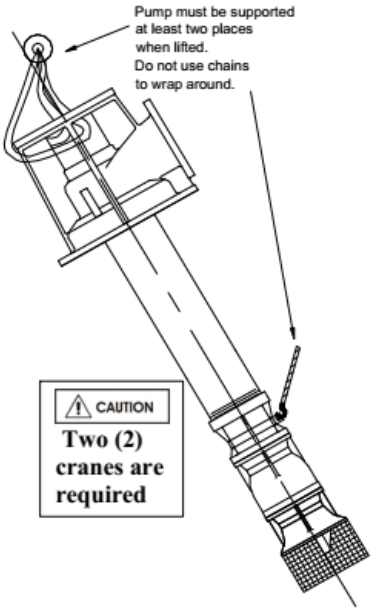


Lifting of bowl assembly only

If the pump is fully assembled, it has to be adequately strapped and supported at least two places before it can be lifted from the shipping crate and moved to the installation site. See details shown.

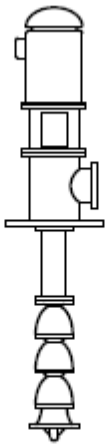
3.3. Storage

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 casing. Turn the pump at frequent intervals to prevent brinelling of the bearings and the seal faces, if fitted, from sticking.

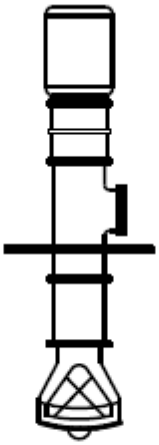


4. DESCRIPTION

Most pumps are built with customer specific features and for applications such as water pumping stations, deep wells, and industrial applications. The pumps vary in size, impeller types and length, and type of discharge head used. All of vertically suspended turbine pumps classified as VS1 to VS7 types are designed and manufactured by MomtazPump.



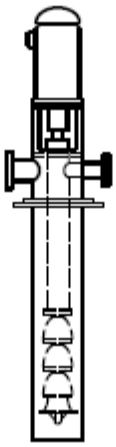
Pump type VS1



Pump type VS2

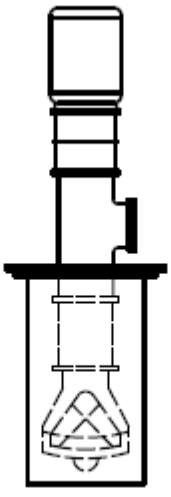
Pump type VS5

Pump type VS3



Pump type VS6

Pump type VS4



Pump type VS7

4.1. Design of major parts

4.1.1. 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.

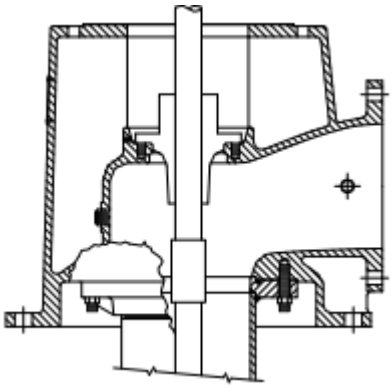
b) Solid shaft drivers: where the rotor shaft is solid and projects below the driver-mounting base. This type driver requires an adjustable coupling for connecting to the pump.

4.1.2. Discharge Head Assembly

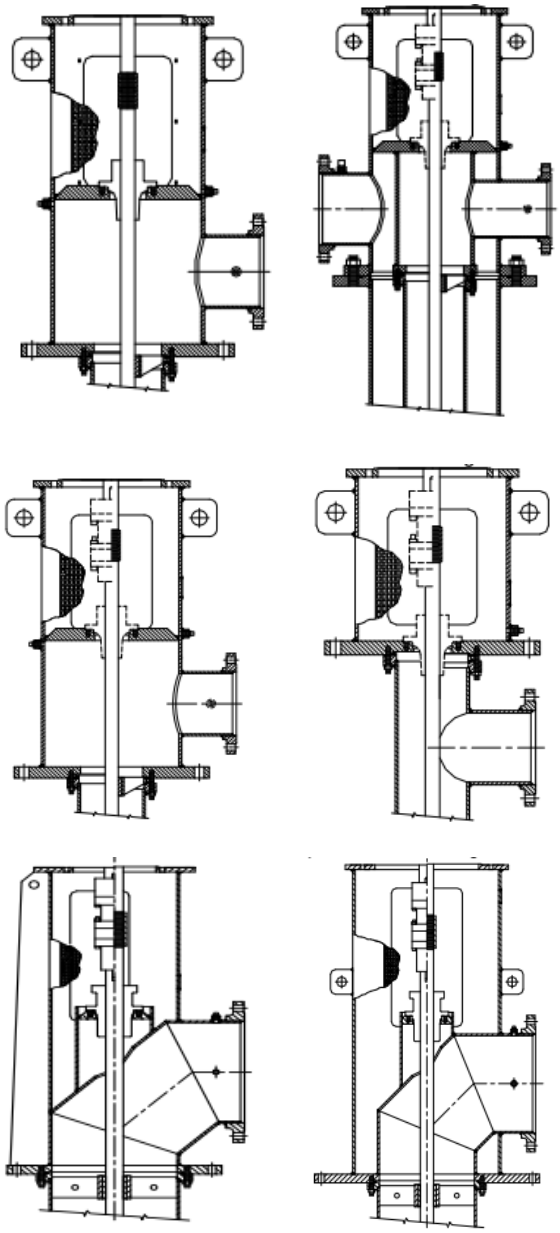
The discharge head supports the driver and bowl assembly as well as supplying a discharge connection in most cases.

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 usually be a stuffing box with an open lineshaft.

Typical discharge head types are shown in following figures.



cast discharge head



fabricated discharge head types

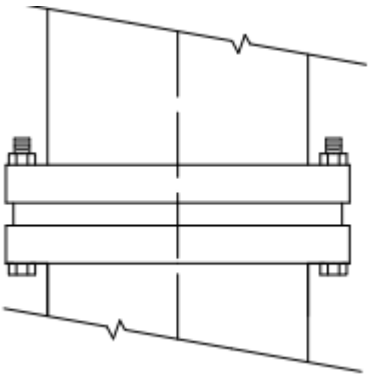
The discharge heads shown above are for illustration only. The shaft and coupling arrangements vary. For the actual configuration of the pump that has been purchased, please refer to the drawings supplied with the pump.

4.1.3. Column Assembly

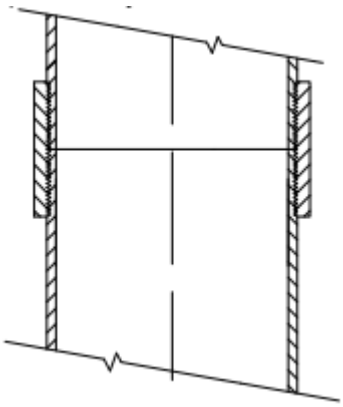
The column assembly consists of column pipe, which connects the bowl assembly to the

discharge head and carries the pumped fluid to the discharge head. Typical column assemblies are:

a) flanged column assembly



b) threaded column assembly



The column supports shaft assembly that is of open lineshaft construction type which utilizes the fluid being pumped to lubricate the lineshaft bearings.

See sectional drawings supplied with the pump for exact column assembly details as per the order. The size and configuration vary depending upon the specific order requirements and application criteria.

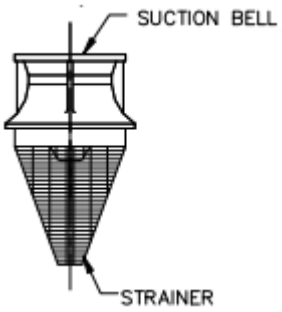
4.1.4. Bowl Assemblies

The bowl assembly consists of impellers rigidly mounted on the pump shaft coupled to an electric motor. Impellers are cast wheels with multiple diffuser vanes and maybe coated to meet the hydraulic requirements.

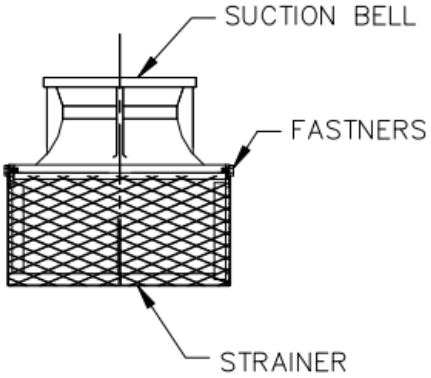
4.1.5. Suction Strainers

Strainers are used to prevent foreign particles from entering the pump. The type of strainers and the mesh size depends on the application. Examples are shown below. Strainers are fastened directly to the suction bell.

a) Cone type (bolt on) strainer



b) Bolt on strainer



4.1.6. Impellers

Pumps are supplied with enclosed, or semi open impeller types. Impellers are low, medium and high capacity type designed for maximum coverage of all pump applications. Impellers are cast and machined to match each order and to provide required surface finish to achieve hydraulic characteristics. Impellers are

dynamically balanced and held in position on the shaft by a tapered lock collet or split ring and key.

4.1.7. Stuffing Box

Pumps are fitted with stuffing boxes. Stuffing boxes are normally adequate for working pressures up to 20.7 bar (300 psi). Refer to the pump drawings provided in the pump final book to figure out about the exact type of stuffing box applied to your pump.

4.1.8. Shaft Couplings

Different types of shaft coupling arrangements are used according to the specific requirements of each purchase order. Refer to the pump drawings provided in the pump final book to figure out about the exact type of couplings applied to your pump.

5. INSTALLATION

5.1. Location

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.

When equipment has been in storage for greater than 6 months, prior to the scheduled installation date, a MomtazPump representative is to be employed to conduct an inspection of the equipment and the facility. If any deterioration of equipment is noticed, the MomtazPump representative may require a partial or complete dismantling of the equipment including restoration and replacement of some components.

5.2. Preparation

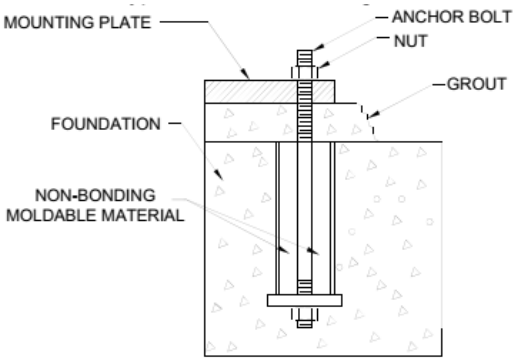
The following checks should be made before starting actual installation.

a) Make sure that motor nameplate ratings and the power supply system match correctly.
b) Check the sump depth and pump length matchup.
c) Check the liquid level in the sump.
d) Check the installation equipment to be sure that it will safely handle the pump weight and size.
e) Check all pump connections (bolts, nuts etc.) for any shipping and handling related problems
f) Always check motor rotation before connecting driver to pump. Reverse rotation due to improper motor direction can cause extensive damage to the pump

5.3. Foundation/Anchor Bolts

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 guaranty.

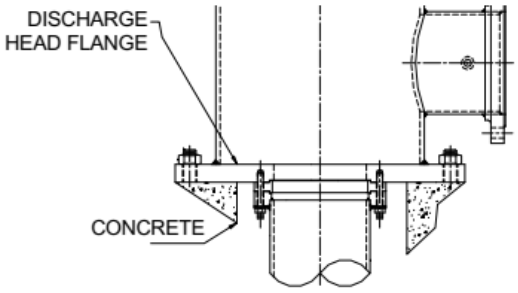
The foundation must consist of material that will afford rigid support to the discharge head and will absorb expected stresses that may be encountered in service. Concrete foundations should have anchor bolts installed in sleeves that allow alignment and have holes in the mounting plate as illustrated in the detail below. Sleeve should be filled with non-bonding moldable material after sleeve is set in place.



5.3.1. Leveling of Pumps Mounted on the Discharge Head Flange

Some pumps are installed directly by using the flange that comes as an integral part of the discharge head. The pump is lowered into the pit and aligned with the anchor bolts.

The mounting flange is shimmed to achieve required level by using a precision machinist's level. The pump is to be leveled to within 0.16 mm/m (0.002 in./ft). The data to be recorded for future reference. Anchor bolt nuts are tightened sufficient enough to hold down the pump in place.
Grout is poured and allowed to set for at least 72~80 hours (cure as required) before any further work is done on the pump.

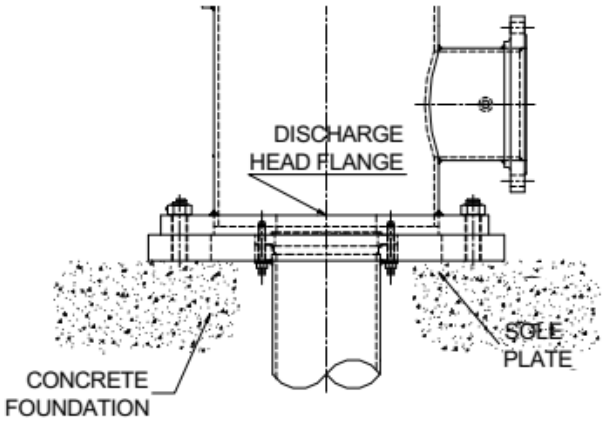


5.3.2. Leveling of Pumps Mounted on a soleplate and the soleplate is grouted

Some pumps are mounted on a separate plate known as soleplate. In such cases, the level shall be set with a master level or a precision machinist's level. The mounting surface needs to be leveled to within 0.16 mm/m (0.002 in./ft).

The level should not exceed 0.125 mm (0.005 in.) elevation difference taken on any two points on the individual soleplate. Accurate shimming and grouting of the soleplate is very important. Record the leveling data for future reference.

Grout the soleplate and allow to set at least 72~80 hours (cure as required) before the pump is lowered into the pit. Align the discharge head boltholes with the anchor bolts. Check and adjust the pump level to within 0.16 mm/m (0.002 in./ft) with respect to the soleplate and torque the nuts to the required level.



5.4. 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. 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 base, sole plate, suction can and foundation (no voids).

Foundation bolts should only be fully tightened after the grout has been cured.

5.5. 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.

5.5.1. Installation of Pumps

5.5.1.1. Equipment and tools required

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.

5.5.1.2. Uncrating and Cleaning of a Fully Assembled Pump

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

5.5.1.3. Installing the Fully Assembled Pump

Set up installation unit so that the lifting cable will be centered directly over the well or sump. Carefully lift the bowl assembly and suction barrel with a clamp. Lower the bowl assembly into the well or sump. Set the clamps 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.

a) Lift the pump to a vertical position.
b) Position pump over sump.
c) Align the discharge of the pump with external piping then lower onto the base. Level the entire pump.
d) If a stuffing box and a hollow shaft driver are included, attach the head shaft to the pump shaft.

6. COMMISSIONING, STARTUP, OPERATION AND SHUTDOWN

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

6.1. Pre-commissioning Procedure

a) Check the direction of rotation of the pump

b) The pump rotor and the shaft seal must be in correct axial position.

c) Check the readiness of all auxiliary systems for startup.

d) 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.

e) 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.

f) 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.

6.2. Impeller Adjustment

Proper impeller adjustment positions the impeller inside the bowl assembly for maximum performance.

The impellers must be raised slightly to prevent them from dragging on the bowls, but not raised too high so as to adversely affect hydraulic performance.

The impeller must be down against the bowl seat when starting impeller adjustment. When pumps are subjected to suction pressure, the pressure acting against the shaft tends to raise it. 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 impellers dragging. On the other hand, if the impellers appear to be dragging after the initial adjustment, the unit should be stopped and the impellers raised one step. Dragging impellers will increase the load significantly and can usually be heard and felt as increased vibration. A sharp rise in motor amperage will occur when impellers are dragging.

6.3. Direction of Rotation

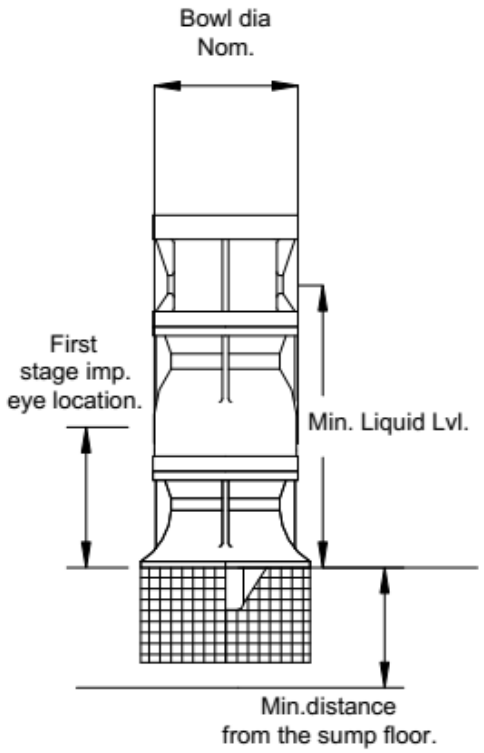
Ensure the pump is given the same rotation as specified or as marked on the pump/driver. Please contact MomtazPump representative, if you have any questions before the startup.

6.4. Priming and Axillary Supplies

Ensure the inlet pipe and pump casing are completely full of liquid before starting continuous duty operation.

6.4.1. Pump Submergence

Minimum submergence is required to prevent vortex formation. The submergence varies in general from 2 to 3 times the nominal bowl diameter and is always specific to each pump model. The submergence needed for adequate NPSH to the first stage impeller may be different from the general rule mentioned earlier. Location of the first stage impeller eye to be taken into account for minimum priming submergence. It is also equally important to take note of the minimum distance to be maintained to the suction bell from the sump floor (with or without strainer). Therefore, refer to the MomtazPump supplied general assembly drawing on minimum submergence or contact MomtzPump before the pump is started.



6.5. Starting the Pump

6.5.1. 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 impellers are 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.
d) Check all connections to the driver and control. Do not overfill the grease cavity. Over greasing can lead to overheating and premature failure of the thrust bearing.
e) Check that all piping connections are tight.
f) Check all foundation bolts for tightness.
g) Check all bolting connections for tightness (coupling bolts, gland bolts, driver bolts etc).
h) All guards must be secured in position prior to pump startup to prevent possible contact with rotating parts.

To ensure proper alignment three items are very important during installation and they are:

- All machined mating surfaces (such as the mating faces of the pump and motor) must be clean and free from burrs and nicks. These surfaces should be cleaned thoroughly with a scraper, wire brush and emery cloth if necessary and all nicks or burrs removed with a fine file
- Exterior strain must not be transmitted to the pump. The most common cause of trouble in this respect is forcing the piping to mate with the pump. It is recommended that flexible connectors be installed in the piping adjacent to the pump.
- All threads should be checked for damage and repaired if necessary. If filing is necessary, remove the part from the pump if possible, or arrange to catch all the filings so they do not fall onto other parts of the pump. Clean all threads with a wire brush and approved cleaning solvent, ends of shafts must be cleaned and any burrs removed since alignment depends on the shaft ends butting squarely. Lubricate all threaded connections with a suitable approved thread lubricant (an approved anti-galling compound should be used on stainless mating threads)

6.5.2. 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 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.

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 one half turn 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.

6.5.3. Open shaft lubrication before startup

Open lineshaft bearings are lubricated by the pumped fluid on short-coupled units less than 15 m (50 ft) long and usually do not require pre- or post-lubrication. All open lineshaft pumps where the static water level is more than 15 m (50 ft) below the discharge head should be adequately

pre-lubricated before startup. These units have a non-reverse ratchet on the driver to prevent backspin when turning off pump.

6.5.4. Initial Starting

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) OPEN all inlet valves.
c) Prime the pump & check lubrication system in operation (check the liquid level).
d) Ensure all vent connections are closed before starting.
e) Check the motor connections.
f) Start pre-lubrication liquid flow on pump if required.
g) 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 to determine the probable cause.

If possible, the pump should be left running for approximately one 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.

If abrasives or debris are present, upon startup, the pump should be allowed to run until the pumpage is clean. Stopping the pump when handling large amounts of abrasives (as is sometimes present on initial starting) may lock the pump and cause more damage than the pump is allowed to continue operation.

6.5.5. Frequency of Lubrication

The characteristics of the installation and severity of service will determine the frequency of lubrication.

Lubricant and pump/motor bearing temperature analysis is useful in optimizing lubricant change intervals. The motor bearing temperature limitations should be considered for its lubrication requirements.

6.5.6. Normal vibration levels, alarm and trip

Pumps generally fall under classification of rigid support 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 pump or operating conditions. Measurements shall be taken at the pump/motor interface.

6.5.6.1. Typical allowable field vibration values for vertical turbine pumps

Motor rating kW (hp)	Vibration velocity-unfiltered	Vibration mm/sec (in./sec) rms
0.75-to 7.5 (1-10)	N	6.1 (0.24)
7.5 to 75 (10 -100)	N	6.1 (0.24)
75 to 750 (100 -1000)	N	6.1 (0.24)-7.1 (0.28)

N = Normal; Alarm = N X1.25; TRIP = N X 2.0.

6.5.7. 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.

6.6. Operating the Pump

Make sure that the pump is vented to enable all trapped air to escape. Under normal conditions after the pump is fully vented and primed, it should be unnecessary to re-vent the pump.

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 will 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.

Never run gland packing dry, even for a short time

6.7. Stopping and Shutdown

a) Close the outlet valve, but ensure that the pump runs in this condition for no more than a few seconds.
b) Stop the pump.
c) Switch off flushing and/or cooling /heating liquid supplies at a time appropriate to the process.

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

6.8. 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.

6.8.1. 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.

6.8.2. 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.

6.8.3. Pump speed

Changing pump speed effects flow, total head, power absorbed, $NPSH_R$, 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, $NPSH_A > NPSH_R$, and that noise and vibration are within local requirements and regulations.

6.8.4. Net positive suction head (NPSHA)

NPSH available ($NPSH_A$) is a measure of the head available in the pumped liquid, above its vapor pressure, at the pump suction branch. NPSH required ($NPSH_R$) is a measure of the head required in the pumped liquid, above its vapor pressure, to prevent the pump from cavitation. 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.

6.8.5. Pumped flow

Flow must not fall outside the minimum and maximum continuous safe flow shown on the pump performance curve and or data sheet.

7. MAINTENANCE

7.1. 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.

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 6.7.

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 6, *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. Put a warning board on the starting device with the words: ***"Machine under repair: do not start"***.

7.2. 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 safe operating range for the pump.

f) Check vibration, noise level and surface temperature at the bearings 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.

Our specialist 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 8, *Faults; causes and remedies*, for fault diagnosis.
b) Ensure equipment complies with the recommendations in this manual.

Contact MomtazPump if the problem persists.

7.2.1. 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.
e) Check any auxiliary supplies eg. heating /cooling (if fitted) are operating correctly.
f) Refer to the manuals of any associated equipment if routine checks needed.

7.2.2. Periodic inspection (every 6 Months)

a) Check foundation bolts for security of attachment and corrosion.
b) Check pump operation hours to determine if bearing lubricant shall be changed.
c) The coupling should be checked for correct alignment and worn driving elements.
d) Refer to the manuals of any associated equipment for periodic checks needed.

7.2.3. Re-lubrication

7.2.3.1. Pump lubrication

In general, Pumps that are product lubricated will not require further periodic lubrication. Bearing lubricant shall be checked at least twice a year in full time operation mode. A high quality industrial grade # 3 grease is recommended.

Stuffing box and mechanical seal needs flow of flush.

7.2.3.2 Driver lubrication

Refer to driver manufacturer's User Instructions.

7.2.4. Impeller re-adjustment

Ordinarily, impellers will not require re-adjustment if properly set at initial installation. All adjustments of the impellers will change the seal setting, therefore, the seal must be loosened from the shaft until the adjustment is completed and then reset.

7.2.5. Maintenance of the stuffing box

7.2.5.1. 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.

7.2.5.2. 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.

7.2.5.3. Replacing packing

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

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 are as follows.

Packing Dimensions		
Shaft size	Packing ring size	Outside diameter of packing
mm (in.)	mm (in.)	mm (in.)
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)

7.2.5.4. Startup 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.

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

7.3 Spare Parts

7.3.1 Ordering of spares

MomtazPump keep 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 BOM of the pump.

The pump size and serial number are as shown on the pump nameplate.

7.4. Disassembly

7.4.1. Pump disassembly instructions

a) Disconnect all cables/wires and cooling water pipe connections to the driver (if provided).
b) Carefully remove the flush or lubricant connections and remove any associated piping that would interfere with the dismantling.
c) Make sure that all the valves are shut completely to avoid any leaks or spills.
d) Disconnect the coupling halves (the driver & pump).
e) Disconnect the suction (if used) and discharge pipe connections to the discharge head.

f) Rig the motor to a suitable hoist and keep the lifting mechanism in ready state.
g) Remove the motor to discharge head bolting and remove the motor from the discharge head and place it on a safe and appropriate location.
h) If the pump is of shorter length (with or without can) rig the discharge head along with the entire pump assembly using a suitable hoist (check the building height clearance before the lifting is attempted)
i) Use eye bolts and hooks as necessary and get the lifting mechanism in ready state.
j) Lifting of short set pumps
    - Remove the fasteners at the discharge head /foundation/ soleplate
    - Lift the entire pump assembly by clamping at the discharge head.

k) Lifting of deep set pumps
    - Remove the fasteners at the foundation plate or soleplate
    - Remove stuffing box 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 column pipe flange and disconnect the first section of column piping
    - Remove the bearing retainers and shaft couplings and repeat the process until all column piping is disassembled
    - Last step is to lift and remove the bowl assembly

7.5. Examination of Parts

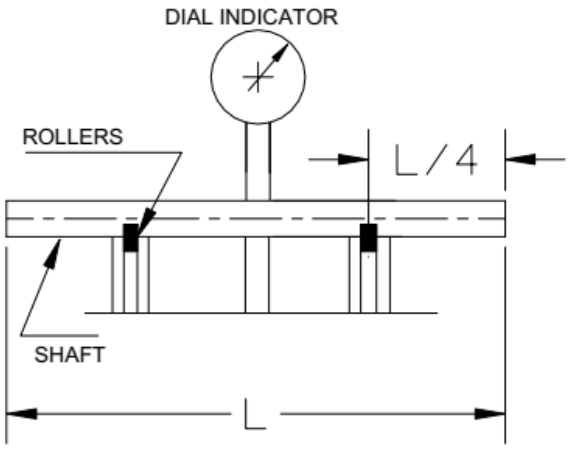
Used parts must be inspected before assembly to ensure the pump will subsequently run properly. In particular, fault diagnosis is essential to enhance pump and plant reliability.

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.

7.5.1. 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 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.



Even if the 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.

7.5.2. 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.

Rubber bearings should always be replaced when servicing a pump.

7.5.3. 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.

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 MomtazPump trained technicians to inspect and repair bowl assemblies.

7.5.3.1. Inspection of impellers

a) Clear all passageways and check for signs of damage from abrasion or corrosion. Replace an impeller that shows signs of excessive wear.
b) Check impeller running clearances against “as new” tolerances. If the clearances exceed the maximum tolerances shown by more than 50%, the new wear rings should be installed to obtain correct tolerances.
c) If the original unit was furnished with bowl and impeller wear rings, they may be pressed or machined off.

7.6. Assembly

To assemble the pump refer to the pump drawings. It is recommended to call for trained MomtazPump technicians for all your assembly needs.

8. 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	POSSIBLE CAUSES	POSSIBLE REMEDIES
										A. SYSTEM PROBLEMS	
●								●	●	Pump not submerged.	Check requirements/liquid level. Vent and/or prime.
		●				●		●	●	Impeller not adjusted or loose on shaft.	See PART/2-Section A7 for proper impeller adjustment.
		●						●	●	Suction lift too high or level too low.	Check NPSHa>NPSHr, 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. Consult Flowserve.
					●	●	●	●		Viscosity of liquid differs from the designed.	
●		●								Operation at very low capacity.	Measure. Check minimum permitted. Consult Flowserve.
	●	●			●	●				Operation at high capacity.	Measure value and check maximum permitted. Consult Flowserve.
										B. MECHANICAL PROBLEMS	
●	●	●	●	●	●					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.
					●		●	●		Wearing ring surfaces worn.	Replace worn wear ring/surfaces.

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	POSSIBLE CAUSES	POSSIBLE REMEDIES
		●					●	●		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.
										C. MOTOR/ELECTRICAL PROBLEMS	
		●			●	●	●	●		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.