# GOULDS PUMPS

Installation, Operation, and Maintenance Manual Model VJC



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# **Introduction and Safety**

## Safety



#### WARNING:

- The operator must be aware of the pumpage and take appropriate safety precautions to prevent physical injury.
- Risk of serious injury or death. If any pressure-containing device is over-pressurized, it can explode, rupture, or discharge its contents. It is critical to take all necessary measures to avoid over-pressurization.
- Risk of death, serious personal injury, and property damage. Installing, operating, or maintaining the unit using any method not prescribed in this manual is prohibited. Prohibited methods include any modification to the equipment or use of parts not provided by ITT. If there is any uncertainty regarding the appropriate use of the equipment, please contact an ITT representative before proceeding.
- Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.
- Risk of serious personal injury or property damage. Dry running may cause rotating parts within the pump to seize to non-moving parts. Do not run dry.
- Never operate the pump below the minimum rated flow, when dry, or without adequate submergence.
- Running a pump without safety devices exposes operators to risk of serious personal injury or death. Never operate a unit unless appropriate safety devices (guards, etc.) are properly installed. See specific information about safety devices in other sections of this manual.
- Risk of death, serious personal injury, and property damage. Heat and pressure buildup can cause explosion, rupture, and discharge of pumpage. Never operate the pump with suction and/or discharge valves closed.
- Never operate the pump when the strainer is clogged.
- Precautions must be taken to prevent physical injury. The pump may handle hazardous and/or toxic fluids. Proper personal protective equipment should be worn. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.
- If the pump or motor is damaged or leaking, electric shock, fire, explosion, liberation of toxic fumes, physical harm, or environmental damage may result. Do not operate the unit until the problem has been corrected or repaired.



#### CAUTION:

Failure to observe the instructions contained in this manual could result in personal injury and property damage, and may void the warranty. Read this manual carefully before installing and using the product.

Risk of injury and/or property damage. Operating a pump in an inappropriate application can cause over pressurization, overheating, and/or unstable operation. Do not change the service application without the approval of an authorized ITT representative.

#### NOTICE:

Save this manual for future reference and keep it readily available.

For information about how to transport and store the pump, see Transportation and Storage in the Installation, Operation and Maintenance manual.

### Safety terminology and symbols

#### About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

- Personal accidents and health problems
- Damage to the product
- Product malfunction

#### **Hazard levels**

Hazard level		Indication
	DANGER:	A hazardous situation which, if not avoided, will result in death or serious injury
	WARNING:	A hazardous situation which, if not avoided, could result in death or serious injury
	CAUTION:	A hazardous situation which, if not avoided, could result in minor or moderate injury
NOTICE:		<ul> <li>A potential situation which, if not avoided, could result in undesirable conditions</li> <li>A practice not related to personal injury</li> </ul>

#### **Hazard categories**

Hazard categories can either fall under hazard levels or let specific symbols replace the ordinary hazard level symbols.

Electrical hazards are indicated by the following specific symbol:



#### **Electrical Hazard:**

These are examples of other categories that can occur. They fall under the ordinary hazard levels and may use complementing symbols:

- · Crush hazard
- · Cutting hazard
- Arc flash hazard

#### The Ex symbol

The Ex symbol indicates safety regulations for Ex-approved products when used in atmospheres that are potentially explosive or flammable.

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### **Environmental safety**

#### The work area

Always keep the pump station clean to avoid and/or discover emissions.

#### **Recycling guidelines**

Always recycle according to these guidelines:

- 1. If the unit or parts are accepted by an authorized recycling company, then follow local recycling laws and regulations.
- 2. If the unit or parts are not accepted by an authorized recycling company, then return them to the nearest ITT representative.

#### Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

- Dispose appropriately of all waste.
- Handle and dispose of the pumped fluid in compliance with applicable environmental regulations.
- Clean up all spills in accordance with safety and environmental procedures.
- Report all environmental emissions to the appropriate authorities.

#### **Reference for electrical installation**

For electrical installation requirements, consult your local electric utility.

### User health and safety

#### Safety equipment

Use safety equipment according to the company regulations. Use this safety equipment within the work area:

- Helmet
- Safety goggles (with side shields)
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection

#### The work area

Observe these regulations and warnings in the work area:

- Always keep the work area clean.
- Pay attention to the risks presented by gas and vapors in the work area.
- Avoid all electrical dangers. Pay attention to the risks of electric shock or arc flash hazards.

#### Product and product positioning requirements

Observe these requirements for the product and the product positioning:

• Never operate a pump unless safety devices are installed.

#### **Electrical connections regulations**

Electrical connections must be made by certified electricians in compliance with all international, national, state, and local regulations.

Observe these guidelines and warnings for electrical connections:

- Make sure that the product is isolated from the power supply and cannot be energized by mistake. This guideline also applies to the control circuit.
- Make sure that the thermal contacts are connected to a protection circuit according to the product approvals, and that they are in use.

#### **Precautions before work**

Observe these safety precautions before you work with the product or are in connection with the product:

• Provide a suitable barrier around the work area, for example, a guard rail.

- Make sure that all safety guards are in place and secure.
- Allow all system and pump components to cool before you handle them.
- Make sure that you have a clear path of retreat.
- Make sure that the product cannot roll or fall over and injure people or damage property.
- Make sure that the lifting equipment is in good condition.
- Use a lifting harness, a safety line, and a breathing device as required.
- Make sure that the product is thoroughly clean.
- Make sure that there are no poisonous gases within the work area.
- Make sure that you have quick access to a first-aid kit.
- Disconnect and lock out power before servicing.
- Check the explosion risk before you weld or use electric hand tools.

#### **Precautions during work**

Observe these safety precautions when you work with the product or are in connection with the product:



#### CAUTION:

Failure to observe the instructions contained in this manual could result in personal injury and property damage, and may void the warranty. Read this manual carefully before installing and using the product.

- Never work alone.
- Always wear protective clothing and hand protection.
- Stay clear of suspended loads.
- Always lift the product by its lifting device.
- Beware of the risk of a sudden start if the product is used with an automatic level control.
- Beware of the starting jerk, which can be powerful.
- Rinse the components in water after you disassemble the pump.

#### Clean chemicals from the eyes

- 1. Hold your eyelids apart forcibly with your fingers.
- 2. Rinse the eyes for at least 15 minutes.
- Use an eyewash or running water.
- 3. Seek medical attention.

#### Clean chemicals from the body

- 1. Remove contaminated clothing.
- 2. Wash the skin with soap and water for at least one minute.
- 3. Seek medical attention, if required.

# Safety regulations for Ex-approved products in potentially explosive atmospheres

#### **Description of ATEX**

The ATEX directives are a specification enforced in Europe for electrical and non-electrical equipment. ATEX deals with the control of potentially explosive atmospheres and the standards of equipment and protective systems used within these atmospheres. The relevance of the ATEX requirements is not limited to Europe. You can apply these guidelines to equipment installed in any potentially explosive atmosphere.

#### **Guidelines for compliance**



#### WARNING:

Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.

If there are any questions regarding these requirements, the intended use, or if the equipment requires modification, contact an ITT representative before you proceed.

#### **Personnel requirements**

ITT disclaims all responsibility for work done by untrained and unauthorized personnel. These are the personnel requirements for Ex-approved products in potentially explosive atmospheres:

- (Ex) All work on the product must be carried out by certified electricians and ITT-authorized mechanics. Special rules apply to installations in explosive atmospheres.
- (ξx) Any maintenance for Ex-approved products must conform to international and national standards (for example IEC/EN 60079-17).

#### Product and product handling requirements

These are the product and product handling requirements for Ex-approved products in potentially explosive atmospheres:

- Only use the product in accordance with the approved motor data stated on the nameplates.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Never start a pump with a closed suction valve or blocked suction line.
- Before you start working with the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.
- Make sure that thermal contacts are connected to a protection circuit according to the approval classification of the product.
- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Make sure that the equipment is properly maintained:
  - Monitor the pump components and the end temperature of the liquid.
  - Maintain proper bearing lubrication.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that have been provided by an authorized ITT representative.

#### Equipment for monitoring

For additional safety, use condition-monitoring devices. Condition-monitoring devices include but are not limited to these devices:

- Pressure gauges
- Flow meters
- · Level indicators
- Motor load readings

- Temperature detectors
- Bearing monitors
- Leak detectors
- PumpSmart control system

### **Product approval standards**

#### **Regular standards**



#### WARNING:

Use of equipment unsuitable for the environment can pose risks of ignition and/or explosion. Ensure that the code classifications on the pump are compatible with the specific environment in which the equipment is to be installed. If they are not compatible, do not operate the equipment and contact an ITT representative before proceeding.

All standard products are approved according to CSA standards in Canada and UL standards in USA. The drive unit degree of protection follows IP68. See the nameplate for maximum submersion, according to standard IEC 60529.

### **Product warranty**

#### Coverage

ITT undertakes to remedy faults in products from ITT under these conditions:

- The faults are due to defects in design, materials, or workmanship.
- The faults are reported to an ITT representative within the warranty period.
- The product is used only under the conditions described in this manual.
- The monitoring equipment incorporated in the product is correctly connected and in use.
- All service and repair work is done by ITT-authorized personnel.
- Genuine ITT parts are used.
- Only Ex-approved spare parts and accessories authorized by ITT are used in Ex-approved products.

#### Limitations

The warranty does not cover faults caused by these situations:

- Deficient maintenance
- Improper installation
- · Modifications or changes to the product and installation made without consulting ITT
- Incorrectly executed repair work
- Normal wear and tear

ITT assumes no liability for these situations:

- · Bodily injuries
- Material damages
- Economic losses

#### Warranty claim

ITT products are high-quality products with expected reliable operation and long life. However, should the need arise for a warranty claim, then contact your ITT representative.

# **Model VJC installation check sheet**

[]	Inspect pump for shipping damage. Note the damage on the receipt and freight bill. Make a claim to transportation company.
[]	Study Installation, Operation and Maintenance Manual (IOM) prior to operation.
[]	Check for free operation of pump shaft. Adjust the impeller if binding is found. Refer to IOM in Seals (page 21) 1c.
[]	Connect the pump to foundation and piping. Piping must not add any strain to the pump.
[]	Disconnect the coupling or V-belt, and check the rotation of motor. (Incorrect pump rotation will critically damage pump). Reconnect driver.
[]	Attach coupling guard and all other safety devices.
[]	Open the discharge valve to prime the pump. If oil, air, or water leaks from the column pipe or fittings, close the discharge valve and determine the cause of the leak before operating of the pump.
[]	Run the pump at proper speed and hydraulic operating point.

# **Nameplate information**



#### Figure 1:

All VJC pumps carry the same Goulds nameplate, shown in Fig. 1. This nameplate provides information about the pump's hydraulic characteristics.

#### ATEX nameplate



#### Figure 2: ATEX nameplate

Nameplate field	Explanation
11	Group 2
2	Category 2
G/D	Pump can be used when gas and dust are present
Τ4	Temperature class



#### WARNING:

Use of equipment unsuitable for the environment can pose risks of ignition and/or explosion. Ensure that the code classifications on the pump are compatible with the specific environment in which the equipment is to be installed. If they are not compatible, do not operate the equipment and contact an ITT representative before proceeding.

# General

### Introduction

This instruction manual is intended to assist those involved with the installation, operation and maintenance of Goulds' SPD slurry pumps. It is recommended that this manual be thoroughly reviewed prior to installing or performing any work on the pump or motor.

## Importance of instructions

The design, material, and workmanship incorporated in the construction of Goulds' pumps makes them capable of giving long, trouble-free service. The life and satisfactory service of any mechanical unit, however, is enhanced and extended by periodic inspection and careful maintenance. This Instruction Manual was prepared to assist operators in understanding the construction and correct methods of installing, operating, and maintaining these pumps. Study thoroughly Sections *General* (page 10), *Installation Instructions-Vertical Pumps* (page 11), *Starting a vertical pump* (page 17), *Operating and Maintenance Instructions* (page 19), and carefully follow the instructions for installation and operation. Sections V, VI, VII and VIII are answers to trouble and maintenance questions.

Keep this instruction manual handy for reference. Further information can be obtained by contacting the Slurry Pump Division, East Centre St., Ashland, PA 17921 or your local representative.

## **Special warnings**

Goulds' Slurry Pump Division will not be liable for any damages or delay caused by failure to comply with the provisions of this Instruction Manual. This pump is not to be operated at speeds, working pressures, discharge pressures, or temperatures higher than, nor used with liquids other than stated in the original order acknowledgement, without written permission of the Slurry Pump Division, Goulds Pumps, Inc.

## **Receiving and inspection - shortages**

Care should be taken when unloading any Goulds' pump. If shipment is not delivered in good order and in accordance with the bill of lading, note the damage and shortage on both the receipt and freight bill. Make any claims to the transportation company promptly. Instruction sheets on various components as well as the Instruction Book for the pump are included in the shipment. Do not discard.

### Preservation and storage

Gould's Slurry Pump Division's normal domestic shipping and storage preparation is suitable for protecting the pump during shipment in covered trucks. It also provides protection during covered storage at the job-site and for a short period between installation and start-up. One approach is to provide special preservatives and wrapping before shipment. However, after installation, the protective wrappings will have to be removed. Therefore, application of preservatives after installation is considered good practice. Hand rotation of the shaft is recommended every 30 days to prevent damage to the bearings.

If the pump is to be idle and exposed to the elements for an extended period, either before or after installation, special precautions are required. Preservative treatment of bearings and machined surfaces will be required. Also, driver and coupling manufacturers should be contacted for long term storage procedures.

# **Installation Instructions-Vertical Pumps**

# Location of pump

The unit should be located in a clean, dry area free from flooding. The area should provide adequate space for maintenance and repair, considering complete disassembly and handling of equipment. The unit should be positioned to provide the most efficient pipeline system.

### **Pump support**

The pump support must be sufficiently substantial and level to give rigid support to the pump and to absorb vibration.

The bolts which secure the pump to the foundation should be 1/8 in. less in diameter than the holes in the pump frame (size is shown on the certified dimension drawing).



**CAUTION:** Provision must be made to support discharge piping independently from the pump to prevent excessive loads and maintain pump-driver alignment.

# **Discharge piping**

Short pipelines and a minimum of elbows and fittings result in the least amount of pipe friction during discharge. Excessive friction losses result in insufficient head.

The pumps are not designed to carry loads imposed by the weight of the pipeline. The pipe must be supported independently near the pump to prevent any strain being transmitted to the pump.

Arrangements should be made to keep the pump from back-spinning severely during shutdown. On a long discharge line, a non-slam check valve should be installed.

## Sump

The sump must be screened to prevent any foreign objects from falling into the sump and damaging the pump. The openings in the screening should be smaller than the openings in the pump impeller.

## **Direct connect - alignment**



WARNING: Before beginning any alignment procedure make sure driver power is locked out.

The points at which alignment are checked and adjusted are:

- Initial Alignment is done prior to operation when the pump and the driver are at ambient temperature.
- Final Alignment is done after operation when the pump and driver are at operating temperature.

NOTICE: Proper alignment is the responsibility of the installer and user of the unit.

Accurate alignment of the equipment must be attained. Trouble free operation can be accomplished by following these procedures.

#### **Alignment checks**

#### Initial Alignment (Cold Alignment)

- Before Mounting Baseplate To ensure alignment can be attained.
- After Mounting Baseplate To ensure no changes have occurred during the mounting process.
- After Connecting Piping To ensure pipe strains haven't altered alignment. If changes have occurred, alter piping to remove pipe strains on pump flanges.

#### **Final Alignment (Hot Alignment)**

 After First Run - To obtain correct alignment when both pump and driver are at operating temperature. Thereafter, alignment should be checked periodically in accordance with plant operating procedures.

#### Alignment criteria

Disconnect coupling halves before proceeding with the alignment. Check for parallel and angular alignment with either the Dial Indicator Method or the Straight- Edge Method outlined below.



Figure 3: Direct connect alignment

The faces and outside diameters of the coupling halves must be square and concentric with the bores. Good alignment is achieved when the dial indicator readings, for both parallel and angular misalignment, are 003in. (.076mm) Total Indicated Reading (T.I.R.) or less when the pump and driver are at operating temperature (Final Alignment). Fig. 2 provides a picture of what to look for.

Setup

1. Mount two dial indicators on one of the coupling halves (X) so that hey contact the other coupling half (Y), see Fig. 3.





#### Figure 4: Dial indicator setup

2. Check setting of indicators by rotating coupling half X to ensure indicators stay in contact with coupling half Y but do not bottom out. Adjust indicators accordingly.

#### **Measurement techniques**

- 1. To ensure accuracy of indicator readings, always rotate both coupling halves together so indicators contact the same point on coupling half Y. This will eliminate any measurement problems due to runout on coupling half Y.
- 2. Take indicator measurements with driver hold-down bolts tightened. Loosen hold-down bolts prior to making alignment corrections.
- 3. Take care not to damage indicators when moving driver during alignment corrections.

#### **Alignment Procedure**

A check for both angular and parallel alignment must be completed and the necessary adjustments be made to obtain the .003in. (.076mm) T.I.R. stated in the alignment criteria.

#### Angular alignment

A unit is in angular alignment when indicator A (Angular Indicator), Fig 3, does not vary by more than .003in. (.076mm) as measured at four points on the coupling periphery goo apart at operating temperature. There are two methods outlined below which are acceptable to achieve the desired alignment.

#### Method 1 - Dial Indicator Method

For the following steps, refer to Fig. 4.

- 1. Zero indicator A at position 1 of coupling half Y. Mark this position on both flanges.
- 2. Rotate both flanges 180° to position 3. Observe needle and record reading.
- 3. Negative Reading The coupling halves are further apart at position 3 than position 1. Positive Reading The coupling halves are closer at position 1 than position 3.



#### Figure 5: Directions of viewing coupling. View from top of pump.

- 4. The angular alignment should not be a problem. If, however, .003" (.076mm) T.I.R. or less is not attainable check the motor and motor mount for perpendicularity to their respective centerlines.
- 5. Repeat steps 1-4 substituting position 2 for position 1 and position 4 for position 3. Use the same marks made on the coupling from positions 1 and be sure to turn the coupling halves together.

#### Method 2 - Feeler Gauge Method

For the following steps refer to Fig. 4.

- 1. Insert a feeler gauge at position 1 at the periphery of the couplings. Mark this position on both flanges.
- 2. Record the largest gauge size which fits snugly between the two flanges.
- 3. Rotate both flanges to position 3 180°.
- 4. Insert a feeler gauge at position 3 at the periphery of the couplings.
- 5. Record the largest gauge size which fits snugly between the two flanges.
- 6. Calculate the difference between the readings at positions 1 and 3. The difference should not be greater than .003in. (.076mm). If, however, .003in. (.076mm) T.I.R. or less is not attainable check the motor and motor mount for perpendicularity to their respective centerlines.
- 7. Repeat steps 1-6 substituting positions 2 and 4 for positions 1 and 3 respectively. Use the same marks made on the coupling from position 1 and be sure to turn the coupling halves together.

#### Parallel alignment

The unit is in parallel alignment when indicator P (Parallel Indicator) does not vary by more than .003in. (.076mm) as measured at four points on the coupling periphery 900 apart at operating temperature. There are two methods outlined below which are acceptable to achieve the desired alignment.

Method 1 - Dial Indicator Method

Tip: Since the coupling halves are

For the following steps, refer to Fig. 4.

- 1. Zero indicator P at position 1 of coupling half Y. Mark this position on both flanges.
- 2. Rotate both flanges 180° to position 3. Observe needle and record reading.
- Negative Reading The coupling half Y is shifted toward position 1. If the value is greater than .003in. (.076mm), shift the motor accordingly.
   Positive Reading The coupling half Y is shifted toward position 3. If the value is greater than .003" (.076mm), shift the motor accordingly.
- 4. Repeat steps 1-3 until indicator P reads .003in. (.076mm) or less.
- 5. Once the ideal alignment is reached, repeat steps 1-4 substituting position 2 for position 1 and position 4 for position 3.

#### Method 2 - Straight-Edge Method

For the following steps refer to Fig. 4.

- 1. Place a straight edge across the two coupling flanges at position 1 and mark the spot on both flanges.
- 2. Adjust the motor so that the straight-edge rests evenly on both flanges (within .003in. .076mm).
- 3. Rotate both flanges 90° to positions 2 and repeat steps one and two.
- 4. The unit will be in parallel alignment when the straight edge rests evenly (within .003in. . 76mm) on the coupling periphery at both positions along the periphery.

NOTICE: Care must be taken to have the straight edge parallel to the axis of the shafts.

*TIP:* Since the coupling halves are disconnected, this would be a good time to check the motor rotation to see if it is in the proper direction.

### V-belt drive -alignment

Well designed and properly installed v-belt drives are capable of running for years without maintenance. There are a few points that should be checked periodically.

- 1. Sheave Alignment Alignment must be maintained for full power transmission, minimum vibration, and long drive life. A dial indicator can be used to check runout on the periphery and face of each sheave. A straight edge can be used to check the alignment of the pump and drive sheaves in the vertical direction, See Fig. 6 page 6.
- 2. Belt Installation When installing new belts, shorten center distance between sheaves so that belts can be placed on the sheave without the use of force. Never "roll" or "pry" the belts into place, as this could damage the belt cords.
- 3. Check Belt Fit Regardless of the belt section used, the belt should never be allowed to bottom in the groove. This will cause the belts to lose their wedging action and slippage can occur. Sheaves or belts that permit such a condition to occur should be changed.
- Maintain Proper Belt Tension Proper tension is essential for long belt life. Improper tension could cause belt fatigue and/or hot bearings. The general method for tensioning belts is given below, and should satisfy most drive

requirements.

Step 1: Reduce the center distance so that the belts may be placed over the sheaves and in the grooves without forcing them over the sides of the grooves. Arrange the belts so that both belt spans have approximately the same sag between the sheaves. Apply tension to the belts by increasing the center distance until the belts are snug, see Fig.5.



#### Figure 6: V-belt tension positions

Step 2: Operate the drive a few minutes to seat the belts in the sheave grooves. Observe the operation of the drive under its highest load condition (usually starting). A slight bowing of the slack side of the drive indicates proper tension. If the slack side remains taut during the peak load, the drive is too tight. Excessive bowing or slippage indicates insufficient tension. If the belts squeal as the motor begins operation or at some subsequent peak load,

they are not tight enough to deliver the torgue demanded by the drive machine. The drive should. be stopped and the belts tightened.

Step 3: Check the tension on a new drive frequently during the first day by observing the slack side span. After a few days of operation the belts will seat themselves in the sheave grooves and it may become necessary to readjust so that the drive again shows a slight bow in the slack side.

Other methods of determining proper belt tension can be obtained from the drive manufacturer.

5. Use Belt Guards - Belt guards protect personnel from danger and the drive from contamination. Inspect periodically to assure that belts do not rub against guard.



WARNING: Do not operate the pump without the proper drive guard in place. Failure to observe this warning could result in personal injury to operating personnel.

6. Keep Belts Clean - Dirt and grease reduce belt life. Belt dressing affects performance only temporarily and is never recommended. Maintaining a clean drive is a better idea. If any questions arise pertaining to the drive limitations, consult the manufacturer.

## Factors that may disturb alignment



CAUTION: The unit should be checked periodically for alignment. If the unit does not stay in line after being properly installed, the following are possible causes:

- Settling or spring of the foundation. 1.
- Wear of bearings. 2.
- 3.
- Pipe strains distorting or shifting the machine. Spring of the base plate due to heat treated from an adjacent heat source. 4.
- Shifting of the building structure due to variable loading or other causes. 5.
- Loose nuts or bolts on the pump or driver assembly 6



Figure 7: V-belt drive alignment

# Starting a vertical pump

## **Pump support**

Before starting a new pump, check the pump supports and piping to be certain that they conform to the specifications in the "Installation Instructions" section.

# **Bearing lubrication**

The bearing housing must have adequate lubrication. The bearing housing is properly filled with grease before shipment. Under normal conditions relubricate monthly or after 500 hours of operation, whichever occurs first. See Section *Lubrication* (page 20) for grease type and amount.

## Shaft rotation

The pump shaft must turn without any binding or rubbing. By manually turning the rotating element, only the uniform frictional drag of the bearings should be felt. If the pump does not turn freely, it should be checked to determine the cause of binding.

## **Correct driver rotation**

The direction of rotation of the driver must be checked before it can be coupled with the pump. The direction of rotation of the pump is indicated in a prominent location. For pumps with impellers threaded on the shaft, reverse rotation would back the shaft from the impeller thread.



#### WARNING:

Incorrect rotation could result in considerable damage to the pump.

• Lockout power to the driver before checking the motor rotation.

# **Bearing housing seals**

The bearing housing seals may generate some heat until broken in. Oil may be applied to them if the heat becomes excessive at the time the pump is started.

## Priming

The pump must be completely primed before operation. The pump must not be started unless the liquid level is above the impeller.

## **Special warning**

At the shutoff point, with no water flow, the horsepower delivered to the pump is rapidly converted into heat. A great danger exists from possible explosion! Use the check sheet to prepare the pump for operation.



**CAUTION:** Immediately observe pressure changes. If the discharge pressure is not quickly attained - stop the driver, reprime and attempt to restart.



#### WARNING:

- This unit must never be used without prior installation of the safety guards for rotating parts as prescribed by O.S.H.A.
- Operation of this pump with the discharge valve closed for even brief periods of time is an unacceptable and dangerous practice. a great danger exists from possible explosion!
- Do not apply heat to the hub or nose of threaded impeller. danger of explosion.

# **Operating and Maintenance Instructions**

# Lubrication



**WARNING:** Operation of the pump without proper lubrication can result in overheating of the bearings, bearing failures, pump seizures and actual breakup of the equipment exposing operating personnel to possible injury.

The bearing housing is properly filled with grease before shipment. Under normal conditions, grease should be added monthly, or after 500 operating hours, whichever occurs first. Add .40 ounces to the inboard fitting and .80 ounces to the outboard fitting.

Use:

Shell	Alvania No. 2
Mobil	Mobilux EP No. 2
Texaco	Multifak No. 2
Sun Oil-Company	Prestige No. 42
American Oil Company	Amolith Grease No.2

When it becomes necessary to replace the bearing housing seals, the housing and the bearings should be flushed clean with a solvent and repacked with new grease. Overlubrication results in excessive bearing temperatures.

## **Maintained capacity**

The amount of liquid pumped will lessen as wear occurs between the faces of the impeller and suction liner. To maintain full pump capacity, the impeller clearance must be adjusted periodically. Each application is different and it is necessary to determine the amount of wear for a certain time period before setting up a schedule for adjustment.

- 1. Impeller Clearance Adjustment
  - 1. Shut the discharge valve to the pump.
  - 2. Loosen the thrust bearing housing locking stud nuts (370C). (Refer to *Disassembly of bearing housing and shaft assembly* (page 22), Fig 8.
  - 3. Tum impeller clearance adjusting bolts (3700/ccw) to move the bearing housing down until the impeller (101) touches the suction liner (1008). Tum the bolts to raise the bearing housing .06", which gives the recommended operating clearance. Make sure the impeller turns freely through the entire rotation.
  - 4. Tighten thrust bearing housing locking stud nuts and bolts (370C).
- 2. Conditions Requiring Adjustments
  - 1. Overheated thrust bearings may develop from uneven adjustment of the jam nuts. Check lubrication.
  - 2. Noise, vibration and wear may result from the impeller rubbing on the suction liner or casing wall. Adjust impeller clearance.
  - 3. Poor performance and wear may result from excessive impleller clearance at the suction side casing liner.

**NOTICE:** Lubricate adjusting studs for easy maintenance.

### Seals

The upper bearing housing seal may generate some heat until broken in. Oil may be applied to the seal if the heat it generates becomes excessive at the time the pump is started. Make sure the seal area is free of dust and dirt prior to starting.

### **Duplex thrust bearing replacement**

Duplex bearings are made up of two single row bearings manufactured with controlled relationship between the axial location of the inner and outer ring faces and are supplied as matched pairs or sets.

When it becomes necessary to replace a duplex bearing, both halves of the new bearing must be matched. Under no circumstances should a duplex bearing be made by using two single row bearings not specifically matched tor duplex use.

When replacing a duplex bearing, mount the two mated bearings back- to-back so that the stamped faces (high shoulders) of the outer rings are together.

In case of making replacements for bearings which have been installed and run, it is recommended that both halves be replaced. This avoids the dangers involved in attempting to match two bearings, one of which has unknown internal characteristics.

### Gaskets and o-ring seals

When making inspections or repairs, be sure to replace all gaskets and o-rings. Pumps will operate at reduced capacities if o-rings are not installed.

### Maintenance schedule

In general, a routine maintenance program can extend the life of your pump. Well maintained equipment will last longer and require fewer repairs.

**NOTICE:** You should keep maintenance records, this will help pinpoint potential causes of problems.

- 1. Routine Maintenance:
  - Bearing lubrication
  - · Seal monitoring
  - Vibration analysis
  - Discharge pressure
  - Temperature monitoring
- 2. Routine Inspections:
  - Check for unusual noise, vibration and bearing temperatures.
  - Inspect pump and piping for leaks.
- 3. Quarterly Inspections:
  - Check hold down bolts for tightness.
- 4. Yearly Inspections:
  - Check pump capacity, pressure and power.

If the pump performance does not satisfy your process requirements, the pump should be disassembled and inspected. Worn parts should be replaced.

# **Disassembly and Reassembly**



**WARNING:** Do not apply heat to the hub or nose of a threaded impeller. Danger of explosion.

## **Disassembly of a bottom suction pump - VJC**

- 1. Lock out power supply to motor.
- 2. Shut off valves controlling flow from the pump. Remove all auxiliary piping and tubing.
- 3. Remove pump.
- 4. Loosen v-belts or disconnect coupling. Remove either from shaft.
- 5. Remove motor and motor mount if a direct connected pump.
- 6. Unbolt and remove suction cover (182) and suction cover liner (1008).
- 7. With the shaft (122) clamped, tum the impeller (101) in the direction of normal rotation and unscrew from the shaft. To avoid damage to shaft, wrap tape around threads.
- 8. Unbolt studs, nuts and bolts (370 & 371H). Remove casing (100) with rubber gasket (211).
- 9. Unbolt nuts (370H) from throttle bushing (473) and remove from column pipe. Access to nuts is made through column pipe relief holes.
- 10. Slide shaft sleeve (126) from shaft (122).
- 11. Disassemble column pipe (192) and discharge pipe (195).
- 12. Remove nuts from bearing housing locking studs (370C). See Fig. 8.
- 13. Draw bearing housing and shaft assembly from the frame (228).



Figure 8: VJC suction end

# Disassembly of bearing housing and shaft assembly

1. Press inboard bearing (168C) off of shaft.

- 2. Remove deflector (123) and outboard end cover (109).
- 3. Remove bearing housing (134A) from bearing and slide off bottom of shaft.
- 4. Remove outboard bearing locknut (136) and lockwasher (382) and press outboard bearings (112C) off shaft.



Figure 9: VJC bearing housing

### Inspection and parts replacement guidelines

- 1. **Impeller:** Replace if impeller shows excessive erosion, corrosion, extreme wear or vane breakage. Hubs must be in good condition. Reduction in hydraulic performance may be caused by excessive impeller wear, especially along the suction liner mating surface. Replace if impeller adjustment is gone.
- 2. Suction Liner: Replace if impeller mating surface is worn flush.

- 3. **Shaft Sleeve:** Sleeve surface and throttle bushing must be smooth. If either are badly grooved or cut it must be replaced.
- 4. Casing Suction Cover: Replace if worn.
- 5. **Shaft:** Check for runout (.006in. max.) to see that shaft has not been bent. Bearing seats and oil seal area must be smooth and free of scratches or grooves. Shaft threads must be in good condition. Replace if necessary.
- 6. Bearings: Replace if worn, loose, or rough and noisy when rotated.
- 7. Oil Seals, 0-Rings, and Gaskets: Replace.
- 8. General: All parts must be clean before assembly. All burrs should be removed.

**NOTICE:** Standard bearing manufacturer fits and tolerance dimensions are used in the manufacture of spd vertical pumps.



WARNING: Do not apply heat to hub or nose of threaded impeller. Danger of explosion.

# Reassembly of bearing housing and shaft assembly

- 1. Clean shaft (122) thoroughly, checking for nicks or worn areas. Refer to Fig. 8.
- 2. Press outboard seal (332) into outboard end cover (109), positioning the seal so that the lip points upward when installed with the pump. Press inboard seal (333) into frame (228) with the lip pointing downward and secure with capscrews (370P).
- 3. Heat outboard bearings evenly using an oven, hot clean oil bath or other approved method. The use of a torch is not recommended. Heat to 230 to 250°F. Slide each bearing onto the shaft so that the wide side of the outer rings are together. Hold each bearing inner ring down toward the shaft shoulder. Allow the bearings to cool. Place a sleeve over the shaft and drive both inner rings together toward the shaft shoulder.
- 4. Position outboard bearing locknut (136) and lockwasher (382) against the bearing shoulder and tighten firmly only after the bearings are cool. Bend "tang" of lockwasher into slot in locknut after the nut has been tightened.
- 5. Hand pack outboard bearing with recommended grease (see *Lubrication* (page 20)). Mound a small amount of grease above the bearing to insure sufficient lubrication. Bearing cavity should be half filled with grease and then rotated to distribute
- 6. Insert bearing housing (134A) over the impeller end of shaft and pull over outboard bearing. Attach end cover (109) with o-ring (496). Tighten bolts evenly so outboard bearing seats proper1y. A gap of approximately .06in. should exist between the end cover flange and the bearing housing. This gap assures the bearing is tight into the bearing housing.
- 7. Press inboard bearing (168C) onto shaft until inner race seats onto shaft shoulder.
- 8. Hand pack inboard bearing fully with recommended grease (see *Lubrication* (page 20). Mound a small amount of grease above bearing to insure sufficient lubrication.

## Pump reassembly -- vertical bottom suction - VJC

- 1. Install o-ring (496A) onto bearing housing (134A).
- 2. Insert bearing housing and shaft assembly into frame (228).
- 3. Reassemble column pipe (192), frame (228), discharge pipe (195), casing (100), discharge elbow (315), and throttle bushing (473) as required.
- 4. Position bearing housing shaft assembly so that the shaft is as far into the water end as possible. This will assure proper placement of the impeller (101) on the shaft.
- 5. Install nuts on bearing housing locking studs (370C).
- 6. Slide shaft sleeve (126) onto shaft after coating shaft with an anti-seizing compound such as "Never Seez" or equal.

- 7. Remove protective tape from shaft threads.
- 8. Thread impeller (101) onto shaft (122). Make sure impeller contacts shaft sleeve (126).
- 9. Rotate shaft to assure that all parts are free.
- 10. Move impeller (101) by means of the impeller adjusting bolts toward the throttle bushing (473) as far as possible.
- 11. Attach suction liner (1008) to the suction cover (182). Apply a small amount of "Never Seez" in casing fit to facilitate removal.
- 12. Place o-ring on suction cover (182). Position suction cover and suction liner assembly into casing (100) and bolt it in place. Tighten all bolts evenly so that suction cover will not become misaligned.
- 13. Adjust impeller (101) using the adjusting bolts so that it rubs the suction liner (1008). Back off impeller approximately .06in., the recommended operating clearance. Do not cock the bearing housing (134A). Make sure the impeller turns freely through the entire rotation. Lock adjusting bolts in place.
- 14. Tighten bearing housing locking studs (370C).
- 15. Attach motor mount if direct connected pump.
- 16. Connect v-belt drive or coupling.
- 17. Follow procedure for installation of vertical pumps.

### VJC section drawing

Pumps manufactured with bearing assemblies C1- C4, CSA, & CSA use ball bearings.



Figure 10: VJC full sectional C1-C4, C5A, C6A bearing frames

Bill of material

Item	Qty	Part Name
100	1	Casing
1008	1	Suction Liner

101	1	Impeller
109 112C	1	End cover thrust bearing
122	1	Shaft
123	1	Deflector
126	1	Shaft sleeve
134A	1	Bag. housing
136	1	Bag. locknut
168C	1	Radial bearing
174A	1	Suction bell**
182	1	Suction cover
189	1	Floorplate**
192	1	Column pipe assembly
195	1	Discharge pipe assembly
211	1	Gasket
228	1	Frame
315	1	Discharge elbow
332	1	Grease seal
333	1	Grease seal
351	2	Gasket
351A	1	Gasket
382	1	Bag. lockwasher
400	1	Key coupling
412	1	o-ring
473	1	Throttle bushing
496	1	0-ring
496A	1	0-ring

Hardware below frame\* frame hardware

\* Threaded hardware below the frame is coated with loctite 242, or equal.

\*\* Floorplate and suction bell are optional

CS & CS bearing assemblies

NOTICE: Consult page 1 of pump bill of material for bearing size used in your pumps.

Pumps manufactured with bearing assemblies CS & CS use spherical roller bearings (item 168C) and tapered roller bearings (item 112C).



Figure 11: VJC bearing housing C5 and C6 frames

# **Check List for Locating Trouble**

## Insufficient capacity

- 1. Pump not primed, insure sump level is above casing.
- 2. Speed too low.
- 3. Total head higher than pump rating.
- 4. Suction lift too great or insufficient NPSH of system.
- 5. Impeller passages partially blocked.
- 6. Suction line partially blocked.
- 7. Wrong direction of rotation.
- 8. Mechanical defects: impeller worn or damaged; defective gasket causing leakage.

### Insufficient pressure

- 1. Speed too low.
- 2. Air in slurry.
- 3. Wrong direction of rotation.
- 4. Mechanical defects: impeller worn or damaged; defective gasket causing leakage.

### Motor overload

- 1. Speed too high.
- 2. Total head lower than pump rating (pump will attempt to pump too much water).
- 3. Slurry being pumped has higher specific gravity than that for which pump is rated.
- 4. Mechanical defects: shaft bent; worn bearings; worn impeller or other water end parts.
- 5. Slurry locked in and around impeller.
- 6. Pump running at high horsepower area of the pump curve (off of design point).
- 7. Rubbing or binding of rotating elements.

## **Pump vibration**

- 1. Foundation not sufficiently rigid.
- 2. Impeller partially blocked causing unbalance.
- 3. Misalignment.
- 4. Mechanical defects: shaft bent, worn bearings, impeller worn.

### Leak at column pipe

- 1. Worn impeller.
- 2. Discharge pressure greater than pump rating.
- 3. Worn bearings.
- 4. Speed too low.
- 5. Deteriorated o-rings or gaskets.
- 6. Poor pipe joints.

### Water hammer

Water hammer is a high pressure surge within a closed pipe system, created by a rapid change in the flow rate. Changes in the flow rate occur when there are sudden changes in the pump speed. The most common cause is the sudden opening or closing of a valve or flow control device. Extensive damage to the pump and pipeline is a result of water hammer.

# **Ordering Spare Parts**

### **Replacement parts procedure**

To ensure against possible long and costly down time periods, especially on critical services, it is advisable to have spare parts on hand.

Repair orders will be handled with a minimum of delay if the following directions are followed:

- 1. Give model number, size of pump, and serial number. These can be obtained from the nameplate on the pump.
- 2. Write plainly the name and part number of each part required. These names and numbers should agree with those on the bill of material.
- 3. Give the number of parts required.
- 4. Give complete shipping instructions.

### **Recommended spare parts**

The following are pump application categories and their recommended spare parts. Light Duty - Random mildly abrasive particles:

- 1 Shaft Sleeve
- 1 Gasket Set

Medium Duty - Light slurries up to 1.2 S.G. with moderately abrasive materials:

- 1 Impeller
- 1 Set Liners
- 1 Shaft Sleeve
- 1 Gasket Set
- 1 Set Bearings

Heavy Duty - Slurries over 1.2 S.G. with highly abrasive materials:

- 1 Casing
- Impeller
- Sets Liners
- · Bearing Assembly
- Shaft Sleeves
- Gasket Sets

Severe Duty - Key process equipment on heavy slurries over 1.2 S.G. with high heads and highly abrasive particles:

- Casing
- Impellers
- 2 Sets Liners
- Shaft Sleeves
- Gasket Sets
- 1 Spare Pump

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