MOTOR P=60HP N=2900RPM FLANGE A-450

ø 55 H7

B-160 HFH

ø32 H7
m6

10

ø 35 G7
j6

9

ø 33

8

ø 35 j6

7

6

5

4

3

3/16" 12-NS-3-LH
CCW threading

ø 45

3

ø 139,7 (5")

2

1

18

17

16

15

14

13

12

11

185

400

ø 168,3 (6")

365

ΗΛΕΚΤΡΟΚΙΝΗΤΗΡΑΣ
P = 75 HP
N = 2900 RPM
ΦΛΑΝΤΖΑ A-550

ΣΧ.13885/Α4

Εγινε μετατροπή τών αντλιών από 8BHC/Z=4 σέ 8BHC/Z=5
καί ηλεκτρ/ρα απο 60HP/2900 σε 75HP/2900 μέ τήν Π-72

QUANTITY	PART NAME	ITEM	Material	Drawing Numb DIN	Pattern	Weight kp
	Flexible Coupling	18				
	Motor Stool	17				
	Ball Bearing Adaptor Flange	16				
	Ball Bearing Adaptor	15				
	Non-Reverse Rachet	14				
	Ball Bearing	13				
	Thrust Bearing	12				
	Discharge Branch	11				
	Shaft Nut	10				
	Distance Washer	9				
	Lub Tubing	8				
	Stuffing Box Gland	7				
	Stuffing Box Packing	6				
	Stuffing Box Bearing	5				
	Stuffing Box Casing	4				
	Top Shaft	3				
	Upper Column Pipe	2				
	Upper Column Shaft	1				

	1997	DATE	NAME	SIGN
STUD				
DRAWN	25-6		A.S.G	
PATTERN				
CHECKED	25-6		P.I.V	
SCALE	1:1			

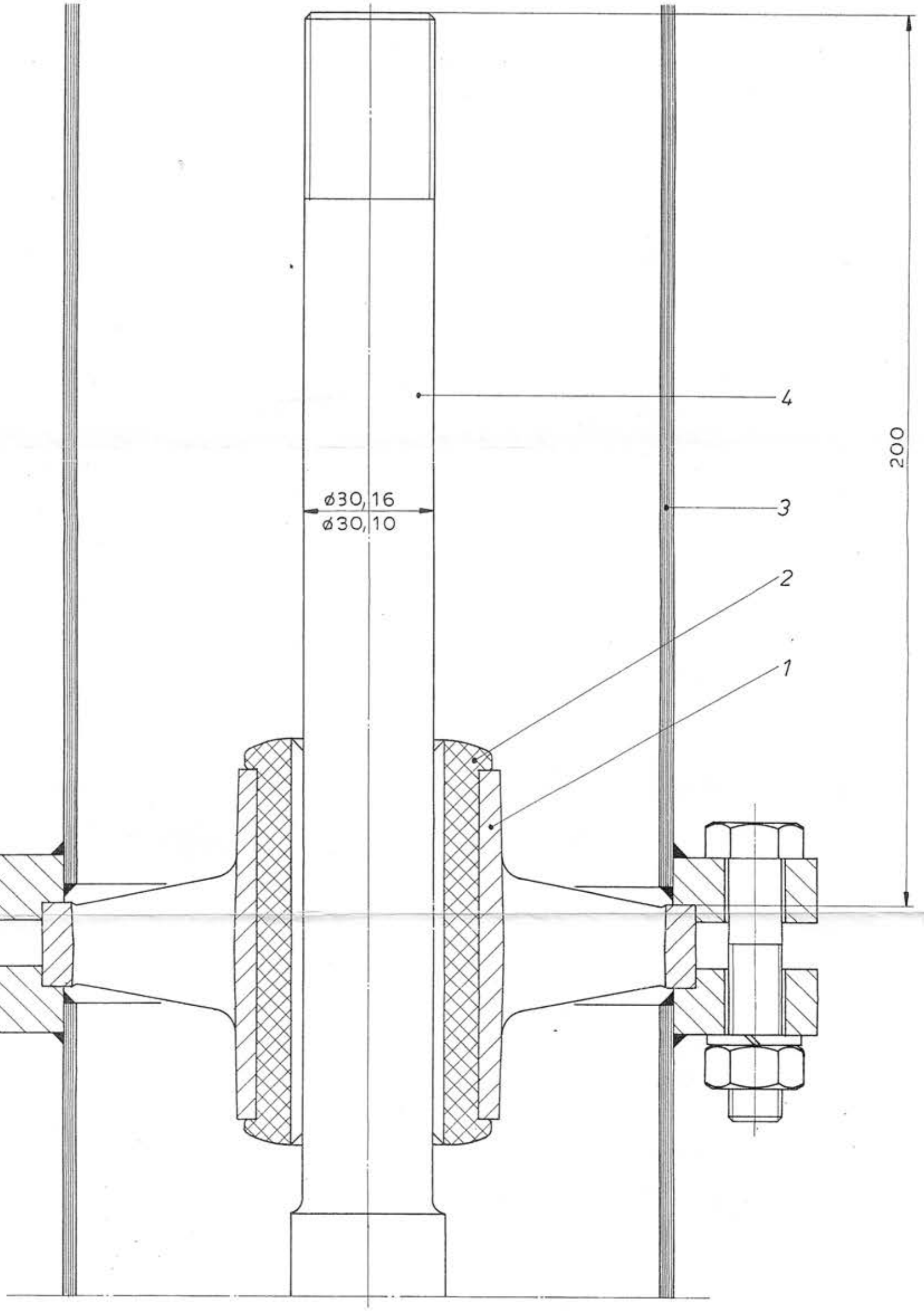
PUMP
DWP
8BHC/Z=5

General view of pump upper part

DP
DRAKOS POLEMIS INC
PUMP MANUFACTURES
KRYONERI ATTIKI

DRAWING NUMBER
13671/A0

Superceded By
Supercedes



QUANTITY	PART NAME	ITEM	Material	Drawing Numb DIN	Pattern Number	Weight kp
	Intermediate Column Shaft	4				
	Intermediate Column Pipe	3				
	Column Shaft Bearing	2				
	Bearing Retainer	1				

	1997	DATE	NAME	SIGN
STUD.				
DRAWN	26-6		A.S.G	
PATTERN				
CHECKED	26-6		P.I.V	

PUMP
DWP
8BHC/Z=5

DP
DRAKOS POLEMIS INC
PUMP MANUFACTURES
KRYONERI ATTIKI

SCALE 1:1

General view of the bearing retainer

DRAWING NUMBER 13672/A3

Superceded By

Superceds

ITT

Goulds Pumps

Installation, Operation, and Maintenance

Model VIT

Engineered for life

Table of Contents

Introduction and Safety

Safety

WARNING:

- The operator must be aware of safety precautions to prevent physical injury.
- Any pressure-containing device can explode, rupture, or discharge its contents if it is over-pressurized. Take all necessary measures to avoid over-pressurization.
- Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment. This includes any modification to the equipment or use of parts not provided by ITT. If there is a question regarding the intended use of the equipment, please contact an ITT representative before proceeding.
- Installation, Operation, and Maintenance manuals clearly identify accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal.
- Do NOT change the service application without the approval of an authorized ITT representative.
- NEVER operate the pump below the minimum rated flow, when dry, or without adequate submergence.
- NEVER operate the pump without safety devices installed.
- NEVER operate the pump with the discharge valve closed.
- NEVER operate the pump when the strainer is clogged.

Safety message levels

Definitions

Safety message 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
Electrical Hazard:	The possibility of electrical risks if instructions are not followed in a proper manner
NOTICE:	• A potential situation which, if not avoided, could result in an undesirable result or state • A practice not related to personal injury

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. The following safety equipment should be used 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.
- Never operate a pump unless a coupling guard is installed.
- Never force piping to make a connection with a pump.
- Never start a pump without the proper submergence.
- Never run a pump below the minimum rated flow or with the discharge valve closed.

Electrical connections regulations

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

Observe the following 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 applies to the control circuit as well.
- Make sure that the thermal contacts are connected to a protection circuit according to the product approvals, and that they are in use.

Earthing (grounding)

All electric equipment must be earthed (grounded). This rule applies to pumps and mixers as well as monitoring equipment.

Precautions before work

Observe the following safety precautions before working with the product or 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.
- Make sure that the equipment is properly insulated when operating at extreme temperatures.
- 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 has been thoroughly cleaned.
- Make sure that there are no poisonous gases within the work area.
- Make sure that a first-aid kit is close at hand.
- Disconnect and lock out power before servicing.
- Check the explosion risk before welding or using electric hand tools.

Precautions during work

Observe these safety precautions when you work with the product or are in connection with 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.
- Do not exceed the maximum working pressure of the pump.
- Do not open any vent or drain valve or remove any plugs while the system is pressurized. Ensure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.
- Never operate a pump without a coupling guard that has been correctly installed.

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.

General guidelines

WARNING:

Installation, Operation, and Maintenance manuals clearly identify accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal.

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:

- All work on the product must be carried out by certified electricians and ITT-authorized mechanics. Special rules apply to installations in explosive atmospheres.
- All users must know about the risks of electric current and the chemical and physical characteristics of the gas and/or vapor present in hazardous areas.
- The maintenance operation for Ex approved products must be made in conformity to the international or national standards (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:

- The product may be used only 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 without the proper submergence.
- 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 warranty

Coverage

ITT undertakes to remedy these faults in products sold by 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, please contact your ITT representative.

Transportation and Storage

Receive the unit

1. Inspect the package for damaged or missing items upon delivery.
2. Note any damaged or missing items on the receipt and freight bill.
3. File a claim with the shipping company if anything is out of order.

Unpack the unit

1. Remove packing materials from the unit.

   Dispose of all packing materials in accordance with local regulations.
2. Inspect the unit to determine if any parts have been damaged or are missing.
3. Contact your ITT representative if anything is out of order.

Pump handling

WARNING:

- Make sure that the pump cannot roll or fall over and injure people or damage property.
- These pumps use ceramic silicon carbide components. Do not drop the pump or subject it to shock loads as this can damage the internal ceramic components.

NOTICE: Use a forklift truck or an overhead crane with sufficient capacity to move the pallet with the pump unit on top. Failure to do so can result in equipment damage.

Lifting methods

WARNING:

- Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points. Lifting devices such as eyebolts, slings, and spreaders must be rated, selected, and used for the entire load being lifted.
- The pump and the components can be heavy. Make sure to use proper lifting methods, and wear steel-toed shoes at all times. Failure to do so can result in physical injury or equipment damage.
- Do not attach sling ropes to shaft ends.

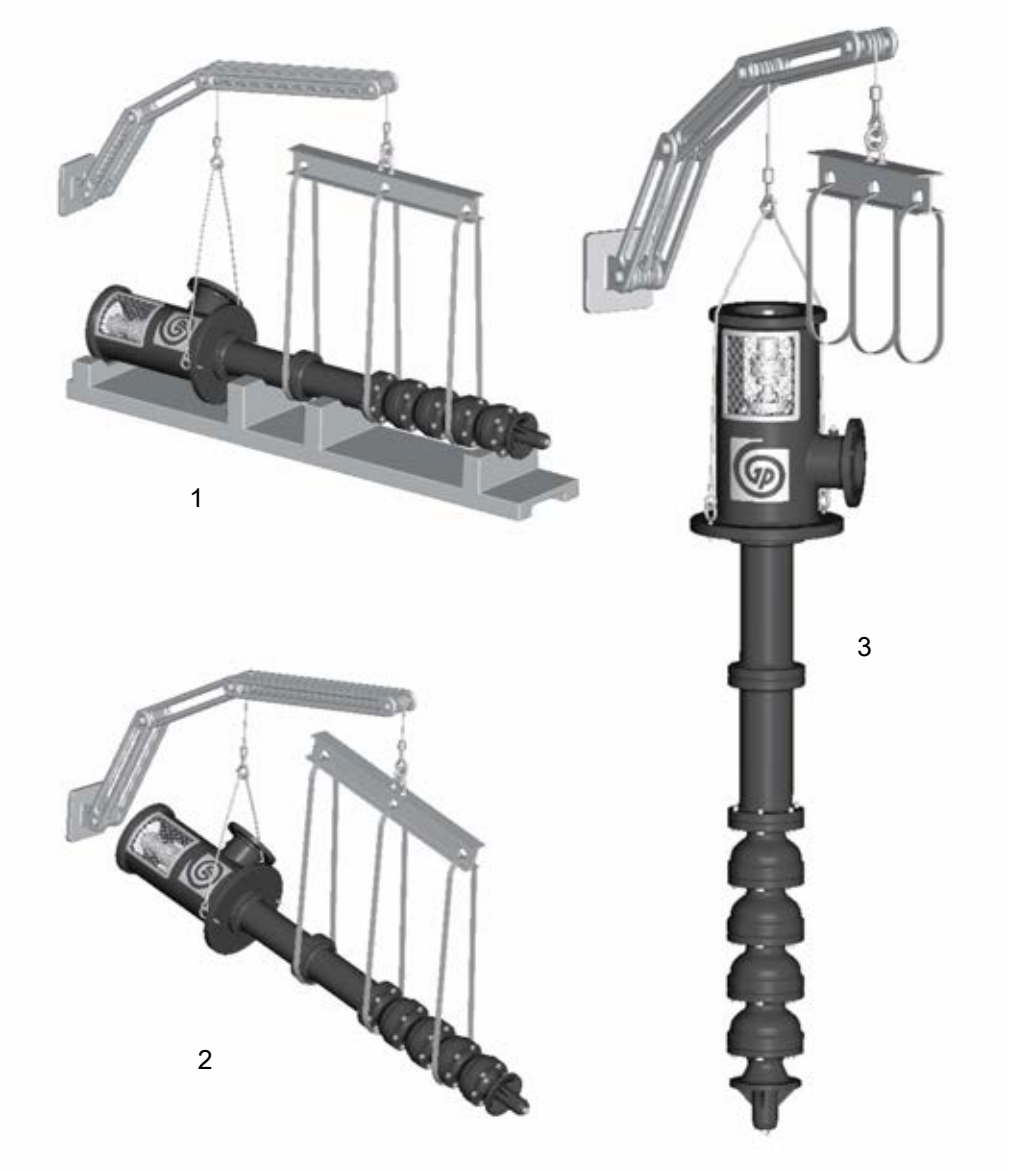
Table 1: Methods

Pump type	Lifting method
A fully-assembled pump	Use suitable lifting devices attached to the lifting lugs on the discharge head or suitable eye bolts through the discharge-head base flange.
A partially-assembled pump	Use suitable lifting devices attached to the component or sub-assembly lifting lugs or suitable eye bolts through the component flanges.
A disassembled pump	Use suitable lifting devices attached to the component lifting lugs or suitable eye bolts through the component flanges.

Examples

1. Horizontal position
2. Vertical position

Figure 1: VIT lifted from horizontal to vertical (for pumps up to 15 feet [4.6 meters] in length)



1. Horizontal position
2. Intermediate position
3. Vertical position

Figure 2: VIT lifted from horizontal to vertical (for pumps up to 30 feet [9.1 meters] in length)

Pump storage requirements

Requirements

Vertical pumps require proper preparation for storage and regular maintenance during storage. The pump is considered in storage when it has been delivered to the job site and is awaiting installation.

For specific requirements for storing motors, gearheads, and engines, contact the equipment manufacturer.

Storage preparation

Condition	Proper preparation
Indoor storage area (preferred)	• Pave the area. • Clean the area. • Drain the area and keep it free from flooding.
Outdoor storage area (when indoor storage is not available)	• Observe all indoor storage requirements. • Use weather-proof coverings such as flame-resistant sheeting or tarpaulins. • Place coverings in a manner that maximizes drainage and air circulation. • Tie coverings down to protect the pump from wind damage.
Placement of pumps and component parts	• Place the pump on skids, pallets, or shoring higher than 6 in. (15 cm) from the ground for good air circulation. • Sort to permit easy access for inspection and/or maintenance without excessive handling.
Stacking of pumps or component parts	• Make sure that racks, containers, or crates bear the full weight of pumps or parts to prevent distortion. • Keep identification markings readily visible. • Immediately replace any cover you remove for internal access.
Rotation of the pump and bowl assembly shaft	• Rotate the pump and bowl assembly shaft counterclockwise once a month, at a minimum. • Never leave the shaft in a previous position or in the extreme raised or lowered lateral position. • Make sure that the shaft rotates freely.
Controlled storage facilities	• Maintain an even temperature of 10°F (6°C) or higher above the dew point. • Keep the relative humidity to less than 50%. • Make sure that there is little or no dust.
Uncontrolled storage facilities (may have uneven temperatures, higher humidity, and/or dusty conditions)	• Inspect the pump periodically to make sure that all preservatives are intact. • Seal all pipe threads and flanged pipe covers with tape.

When pump is not in regular operation

If a pump has been installed, but is not in regular operation for an extended period of time, such as during a seasonal shutdown, operate it for at least 15 minutes every two weeks, if possible.

Prepare the pump for long-term storage

For storage periods over six months, you must follow the pump storage requirements and this procedure:

1. Inspect the lube-oil and seal-flush piping and either fill the piping with rust-preventative oil, or recoat the piping periodically in order to prevent corrosion.
2. Place 10 lbs (4.5 kg) of moisture-absorbing desiccant or 5.0 lbs (2.3 kg) of vapor-phase inhibitor crystals near the center of the pump.
3. If the pump is assembled, place an additional one pound (0.5 kg) in the discharge nozzle and securely fasten the nozzle to the discharge elbow.
4. Install a moisture indicator near the perimeter of the pump.
5. Cover the pump with black polyethylene with a minimum thickness of 6.0 mil (0.15 mm), and seal it with tape.
6. Provide a small ventilation hole approximately 0.5 in. (12.0 mm) in diameter.
7. Provide a roof or shed shelter to protect the pump from direct exposure to the elements.

Product Description

General description

The Model VIT pump is a vertical, industrial, turbine-type pump designed to meet a wide range of applications.

This pump has these capabilities:

- Capacities up to 70,000 gpm (15,900 m3/h)
- Heads up to 4,500 ft. (1,372 m)
- Power up to 5,000 hp (3,730 kW)

Bowl assembly

The bowl construction is flanged for accurate alignment and ease of assembly and disassembly. Impellers are either open or enclosed, depending on the design requirements. For temperatures over 180°F (82°C) and in the larger size bowls, impellers are keyed to the shaft. Low NPSH first-stage impellers are available for special applications.

Column

Flanged column construction provides positive shaft and bearing alignment, and also eases assembly and disassembly. The lineshaft is supported within the column with the use of bearing retainers that are spaced to provide vibration-free operation and to ensure long bearing and shaft wear.

Discharge head

The discharge head is designed to support the pump and to align the driver to the pump. Driver support windows provide access to seal piping and allow for easy adjustment of seals and couplings.

Thrust pot

A thrust pot is an option that is used when the driver is not designed to carry the axial pump thrust.

Drivers

Solid shaft drivers are used with most industrial applications. The rigidity of the rotor enhances vibration-free operation when mechanical seals are used.

You can use hollow shaft drivers in applications that specify packing or an enclosed lineshaft.

Nameplate information

Important information for ordering

Every pump has a nameplate that provides information about the pump. The nameplate is located on the discharge head.

When you order spare parts, identify this pump information:

- Model
- Size
- Serial number
- Item numbers of the required parts

  Item numbers can be found in the spare parts list.

Nameplate types

Nameplate	Description
Pump	Provides information about the hydraulic characteristics of the pump.
ATEX	If applicable, your pump unit might have an ATEX nameplate affixed to the pump, the baseplate, or the discharge head. The nameplate provides information about the ATEX specifications of this pump.

Discharge head nameplate

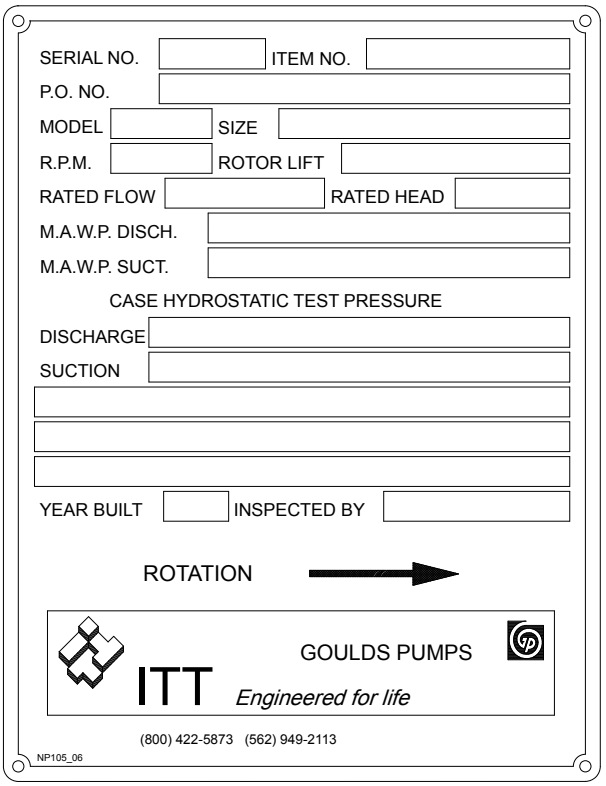


Table 2: Explanation of discharge head nameplate

Nameplate field	Explanation
SERIAL NO.	Serial number of the pump
ITEM NO.	Customer's pump item number
P.O. NO.	Customer's purchase order number
MODEL	Pump model
SIZE	Size of the pump
R.P.M.	Rated pump speed, revolutions per minute
ROTOR LIFT	Axial lift of the pump shaft and impellers
RATED FLOW	Rated pump flow, gpm (m^3/hr)
RATED HEAD	Rated pump head, ft (m)
M.A.W.P. DISCH.	Maximum allowable working pressure, psi (kg/cm^2)
M.A.W.P. SUCT.	N/A
DISCHARGE	Discharge head hydrostatic test pressure, psi (kg/cm^2)
SUCTION	N/A
YEAR BUILT	Year the pump was built
INSPECTED BY	Quality control identification stamp

ATEX nameplate

Nameplate field	Explanation
II	Group 2
2	Category 2
G/D	Pump can be used when gas and dust are present
T4	Temperature class

NOTICE: Make sure that the code classifications on the pump are compatible with the specific environment in which you plan to install the equipment. If they are not compatible, do not operate the equipment and contact your ITT representative before you proceed.

Installation

Preinstallation

Inspect the sub-base

1. If an optional sub-base is furnished, remove it from the pump discharge head when it is shipped assembled.
2. Completely clean the underside of the sub-base.

   You might need to coat the underside of the sub-base with an epoxy primer which you can purchase as an option.
3. Remove the rust-preventative solution from the machined topside with an appropriate solution.

Concrete foundation requirements

Requirements

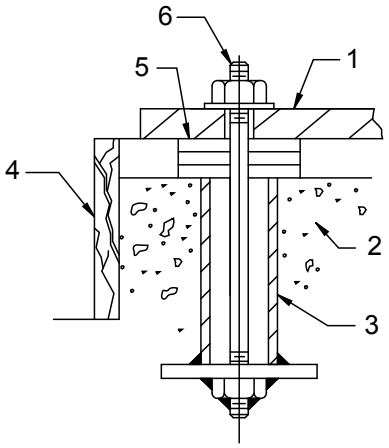
Make sure that you meet these requirements when you prepare the pump foundation:

- The foundation must be able to absorb any vibration.
- The foundation must be able to form a permanent and rigid support for the pumping unit.
- The foundation must be of adequate strength to support the complete weight of the pump and driver, plus the weight of the liquid that passes through it.

Typical installation

A typical installation has these characteristics:

- Bolts with a pipe sleeve that is two and a half times the size of the bolt diameter embedded in the concrete
- Properly sized
- Located in accordance with the dimensions given in the example drawing
- Enough space inside the pipe sleeves to allow the final position of the foundation bolts to align with the holes in the sub-base flange



1. Sub-base, or discharge head base flange
2. Foundation
3. Sleeve
4. Dam
5. Shims
6. Anchor bolt

Figure 3: Example of a typical installation

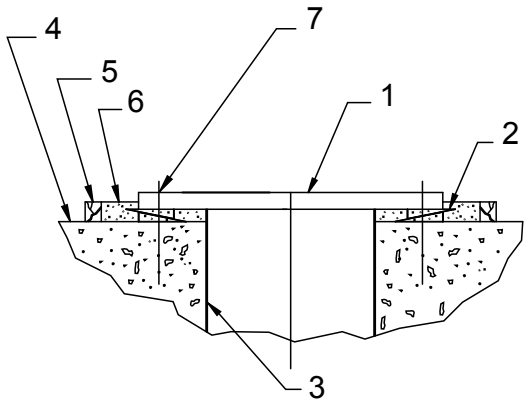
Install the sub-base on a concrete foundation

CAUTION:

You must earth (ground) all electrical equipment. This applies to the pump equipment, the driver, and any monitoring equipment. Test the earth (ground) lead to verify that it is connected correctly.

1. Remove water and debris from the anchor bolt holes and sleeves prior to grouting.
2. For sleeve-type bolts, fill the sleeves with packing or rags to prevent grout from entering.
3. Carefully lower the sub-base onto the foundation bolts and hand-tighten the bolt nuts.
4. Use a machinist's level to level the sub-base or a machine surface of the discharge head using leveling wedges.

   In order to ensure an accurate reading, check that the surface being leveled is free from all contaminants, such as dust.



1. Sub-base
2. Levelling wedges
3. Floor sleeve (optional)
4. Foundation
5. Dam
6. Grout
7. Centerline anchor bolt

5. Level the sub-base in two directions at 90° on the machined surface.

Table 3: Levelness tolerances

Commercial	API
0.005 inches per foot (0.127 mm per meter)	0.001 inches per foot (0.025 mm per meter)

Grout the sub-base

Non-shrink grout is recommended for this procedure.

1. Inspect the foundation for dust, dirt, oil, chips, and water.
2. Remove any contaminants.

   Do not use oil-based cleaners since they do not bond well with grout. Refer to the instructions from the grout manufacturer.
3. Build a dam around the foundation.
4. Thoroughly wet the foundation.
5. Pour grout to a minimum thickness of 0.375 in. (9.520 mm) between the sub-base and concrete foundation, up to the level of the dam.
6. Remove any air bubbles from the grout as it is poured by either puddling, using a vibrator, or pumping the grout into place.
7. Allow the grout to set at least 48 hours.

8. Tighten the foundation bolts.

Install the pump on a structural-steel foundation

1. Locate the pump directly over - or as near as possible to - the main building members, beams, or walls.
2. Bolt the discharge-head mounting flange, or sub-base to the support in order to avoid distortion, prevent vibration, and retain proper alignment.
3. Level the sub-base or discharge head using shims.

Piping checklists

General piping checklist

Precautions

CAUTION:

- Never draw piping into place by using force at the flanged connections of the pump. This can impose dangerous strains on the unit and cause misalignment between the pump and driver. Pipe strain adversely affects the operation of the pump, which results in physical injury and damage to the equipment.
- Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.

NOTICE:

Flange loads from the piping system, including those from the thermal expansion of the piping, must not exceed the limits of the pump. Discharge head deformation can result in contact with rotating parts, which can result in excess heat generation, sparks, and premature failure.

Piping guidelines

Guidelines for piping are given in the Hydraulic Institute Standards available from the Hydraulic Institute at 9 Sylvan Way, Parsippany, NJ 07054-3802. You must review this document before you install the pump.

Checklist

Check	Explanation/comment	Checked
Check that all piping is supported independently of, and lined up naturally with, the pump flange.	This helps to prevent: • Strain on the pump • Misalignment between the pump and the drive unit • Wear to the pump bearings, seal, and shafting	
Check that only necessary fittings are used.	This helps to minimize friction losses.	
Do not connect the piping to the pump until: • The grout for the discharge-head base flange or sub-base has hardened. • The hold-down bolts for the pump have been tightened.	—	
Make sure that all the piping joints and fittings are airtight.	This prevents air from entering the piping system or leaks that occur during operation.	
If the pump handles corrosive fluids, make sure that the piping allows you to flush out the liquid before you remove the pump.	—	

Check	Explanation/comment	Checked
If the pump handles liquids at elevated temperatures, make sure that the expansion loops and joints are properly installed.	This helps to prevent misalignment due to thermal expansion of the piping.	
Make sure that all piping components, valves and fittings, and pump branches are clean prior to assembly.	—	

Discharge-piping checklist

Checklist

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the discharge line.	The isolation valve is required for: • Priming • Regulation of flow • Inspection and maintenance of the pump	
Check that a check valve is installed in the discharge line, between the isolation valve and the pump discharge outlet.	The location between the isolation valve and the pump allows inspection of the check valve. The check valve prevents damage to the pump and seal due to the back flow through the pump, when the drive unit is shut off. It is also used to restrain the liquid flow.	
If increasers are used, check that they are installed between the pump and the check valve.	—	
If quick-closing valves are installed in the system, check that cushioning devices are used.	This protects the pump from surges and water hammer.	
If increasers are used, they must be of the eccentric type.	This prevents air from collecting at the top of the discharge pipe.	

Install a partially-assembled pump

Pumps 20 feet (6 meters) or less in length are usually shipped partially assembled, with the exception of these parts:

- Driver
- Packing
- Mechanical seal with piping
- Coupling assembly, spacer or non-spacer type

Refer to the Certified Pump Outline Drawing for the location of the anchor-bolt holes.

1. If a sub-base is supplied, install it.
2. Clean the sub-base and the bottom of the discharge head base.
3. Attach shackles to the discharge hand lifting lugs or thread two eye bolts through the bolt holes in the mounting flange.
4. Hoist the unit into position over the foundation.

   Make sure that the shackles, eye bolts, and sling are rated to handle in excess of the pump weight. See the outline drawing.
5. Carefully guide the unit so that it does not strike the sides of the sub-base or foundation.
6. Lower the unit until the discharge-head flange engages and rests firmly on the sub-base or foundation, then secure it with the capscrews provided.
7. When a lineshaft is shipped separately, complete these steps:

a) Check that the average total runout does not exceed 0.005 in. TIR (0.127 mm) for every 10 ft. (3 m).

   The shaft must be within tolerance prior to installation.

b) Remove the stuffing box, if it is installed, and carefully slide the shaft through the top column of the bearing retainer and bearing.

c) Thread the shaft into the coupling after you replace the stuffing box or seal housing.

Install the bowl assembly

WARNING:

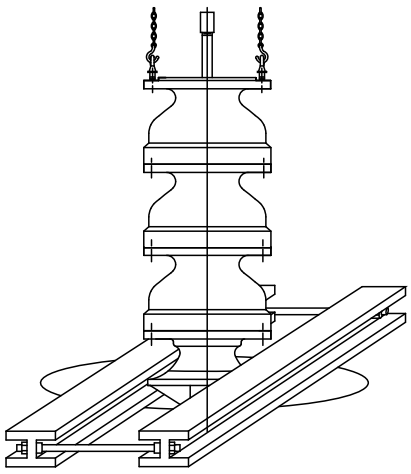
Do not work under a heavy and suspended object unless there is a positive support and safeguards that will protect you if a hoist or sling fails.

CAUTION:

- Do not attempt to lift the bowl assembly by the pump shaft. This can result in damage to the pump shaft.
- Do not drop any foreign object into the bowl assembly. This can cause serious damage to the pump and any downstream components. Any foreign object dropped into the bowl assembly must be retrieved before you continue with assembly.

1. Check that all capscrews are tight and turn the pump shaft by hand to make sure it turns freely.
2. Remove all accumulated dust, oil, or other foreign material from the external surfaces.
3. Place two I-beam supports across the baseplate opening that are strong enough to safely support the weight of the entire pump assembly.

   Connect these I-beams with threaded rods and nuts so you can clamp them firmly together for the portion to be supported.



4. Place a suitable hoist or derrick over the baseplate opening with the hook in the center.
5. Install two threaded eye bolts through the discharge bowl bolt holes 180º apart.
6. Attach a sling to the eye bolts and hoist it into position over the foundation opening.
7. Carefully lower the bowl assembly, guiding the unit so it does not strike the sides of the opening, until the discharge bowl flange rests firmly on the I-beam supports.
8. Place a cover over the discharge bowl opening to prevent the entrance of dirt or other foreign matter until you are ready to install the column assembly.

Install the threaded coupling

If you have a keyed coupling, see the Install the column section of this manual.

CAUTION:

Use Molykote Dow-Corning or an equivalent for all galling material such as 316 stainless steel.

Shaft threads are left hand.

1. Coat the threads with a light coat of oil for a non-galling material, or Molykote for galling material.
2. Install the threaded coupling onto the pump shaft by threading it on for one-half its length.

   You can insert a fine wire in the drill hole at the center of the coupling that serves as a gauge in order to determine when the coupling is correctly positioned on the pump shaft.
3. Remove the wire.

Column installation

This section describes how to install the two lineshaft options available for the column assembly:

- Open lineshaft
- Enclosed lineshaft

Install the open lineshaft

CAUTION:

Use Molykote Dow-Corning or an equivalent for all galling material such as 316 stainless steel.

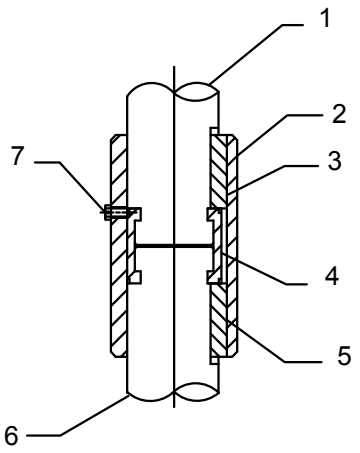
The bearing retainer is integral with the column. The top flange of the column has a male register and the bottom flange of the column has a female register.

1. Check the headshaft and lineshaft for straightness.

   The average TIR should be less than 0.0005 in. (0.013 mm) per ft. (0.305 m) and not exceed 0.005 in. (0.127 mm) for every 10 ft. (3 m).
2. Apply a thin film of oil to the lineshaft.
3. Install the coupling:

   Shaft threads are left hand.

If your lineshaft coupling is...	Then...
Threaded	1. Apply a thin film of oil to the coupling threads if it is a non-galling material. Use a suitable anti-seize if the coupling is a galling material. 2. Manually start the thread until you feel resistance. Use a fine wire inserted in the drill hole at the center of the coupling as a gauge to determine when the coupling is correctly positioned on the shaft. 3. Remove the wire after you install the coupling. 4. Complete the joint using a pair of pipe wrenches, one on top of the pump shaft and the other on the coupling. 5. Run the upper lineshaft into the coupling and hand-tighten. Do not apply wrenches on the bearing journal surfaces. For an illustration of the threaded coupling, see the VIT-FF product lube in the Parts List chapter.

If your lineshaft coupling is...	Then...
Keyed	1. Insert the key into the pump shaft. 2. Lower the sleeve over the pump shaft, to approximately 1.0 in. (25.4 mm) below the top of the shaft. 3. Lower the lineshaft until it touches the pump shaft. 4. Insert the split ring into the grooves of the pump shaft and lineshaft. 5. Raise the sleeve until it covers the split ring. 6. Insert the key into the lineshaft. 7. Raise the sleeve to the top of the key. 8. Secure the sleeve to the split ring with a lock screw and lock wire.  1. Lineshaft 2. Sleeve 3. Key 4. Split ring 5. Key 6. Pump shaft 7. Lock screw/lock wire

4. Attach the column to the bowl assembly:
   a) Lower the column over the lineshaft, taking care as the shaft passes through the lineshaft bearing, until the column flange engages the top-bowl flange register.
   b) Attach a sling to the eyebolts and to the hoist hook.
   c) Hoist the column section over the bowl assembly.
   d) Lower the column over the lineshaft until the column flange engages the discharge-bowl flange register.
   e) Insert as many capscrews through both flanges as possible and gradually tighten them in diametrically-opposite pairs.
5. Lift the bowl and column assembly high enough to allow for the removal of the I-beam supports.
6. Install and tighten the remaining capscrews.
7. Place the bowl and column assembly on the foundation:
   a) Lift the entire assembly by the column pipe eyebolts and remove the supports.
   b) Slowly lower the bowl and column assembly.
   c) Place the supports on the foundation and continue to lower the assembly until the upper column flange comes to rest on the supports.
8. If required, install the coupling and lineshaft to the protruding end of the lineshaft.
9. Assemble the next column section, or top column:
   a) Make sure that the bottom-column register engages the top-column register.

b) Secure the columns with capscrews and hex nuts until all column and lineshaft sections required for the proper pump setting are assembled.
c) Tighten the capscrews into the hex nuts gradually and uniformly.

Install the enclosed lineshaft

CAUTION:
Do not use automotive oils.

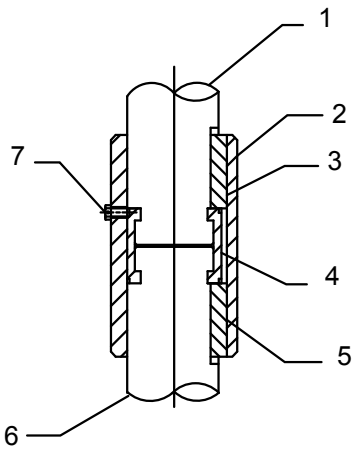
Pump lineshafts are connected with either threaded or keyed couplings. This section describes both procedures.

See the Certified Pump Outline Drawing for the number of column and shaft sections required.

1. Check the headshaft and lineshaft for straightness.

   The average TIR should be less than 0.0005 in. (0.013 mm) per ft. (0.305 m) and not exceed 0.005 in. (0.127 mm) for every 10 ft. (3 m).
2. Install the coupling:

If your lineshaft coupling is...	**Then...**
Threaded	1. Apply a thin film of oil to the coupling threads if it is a non-galling material. Use a suitable anti-seize if the coupling is a galling material. 2. Manually start the thread until you feel resistance. Use a fine wire inserted in the drill hole at the center of the coupling as a gauge to determine when the coupling is correctly positioned on the shaft. 3. Remove the wire after you install the coupling. 4. Complete the joint using a pair of pipe wrenches, one on top of the pump shaft and the other on the coupling. 5. Run the upper lineshaft into the coupling and hand-tighten. Do not apply wrenches on the bearing journal surfaces. For an illustration of the threaded coupling, see the VIT-FF product lube in the Parts List chapter.
Keyed	1. Insert the key into the pump shaft. 2. Lower the sleeve over the pump shaft, to approximately 1.0 in. (25.4 mm) below the top of the shaft. 3. Lower the lineshaft until it touches the pump shaft. 4. Insert the split ring into the grooves of the pump shaft and lineshaft. 5. Raise the sleeve until it covers the split ring. 6. Insert the key into the lineshaft. 7. Raise the sleeve to the top of the key. 8. Secure the sleeve to the split ring with a lock screw and lock wire.

If your lineshaft coupling is...	Then...
	 1. Lineshaft 2. Sleeve 3. Key 4. Split ring 5. Key 6. Pumpshaft 7. Lock screw/lock wire

3. Attach a small, adjustable, pipe-vise type of lifting device to a section of enclosing tube.

   If such a device is not available, use a piece of light manila line, fastened to the tubing by a clove hitch or a double-half hitch.
4. Raise up and then lower the enclosing tube over the first length of shaft attached to the bowl.
5. Apply an anti-sieze compound to the matching threads of the pump-top screw bearing and securely tighten.
6. Install the first length of column pipe over the tube:
   a) Install two eyebolts diametrically opposite each other in the upper flange of the bottom column.
   b) Attach a sling to the eyebolts and to the hoist hook.
   c) Hoist the column section over the bowl assembly.
   d) Lower the column over the enclosing tube until the column flange engages the discharge-bowl flange register.
   e) Insert as many capscrews through both flanges as possible and gradually tighten them in diametrically-opposite pairs.
7. Lift the entire assembly by the column pipe eyebolts and remove the supports.
8. Slowly lower the bowl and column assembly.
9. Place the supports on the foundation and continue to lower the assembly until the upper column flange comes to rest on the supports.
10. Pour one quart of light turbine oil into the top tubing section and screw the tube bearing into the top length until it bottoms, ready to receive the next length of tubing assembly.
11. Install the lineshaft coupling onto the projecting end of the shaft.

If your lineshaft coupling is...	Then...
Threaded	1. Install it on the projecting end of the lineshaft for half the length of the coupling. 2. Repeat this step until all joints are installed.
Keyed	1. Install it onto the projecting end of the shaft as described in step 2. 2. Repeat this step until all joints are installed.

Install the discharge head

CAUTION:

- Do not bump or scrape the shaft protruding above the column. This could result in a bent or damaged shaft.
- Packed stuffing boxes are not allowed in an ATEX-classified environment.
- The mechanical seal used in an Ex-classified environment must be properly certified. Prior to startup, make sure that all areas that could leak pumped fluid to the work environment are closed.

NOTICE:

Make sure that the eyebolts or slings are rated to handle more than the pump weight.

Mechanical seals are shipped separately. If the seal housing is assembled to the discharge head, remove the seal before you begin this procedure.

For the enclosed lineshaft option, only perform steps 3 and 4 in this procedure:

1. If the stuffing box is assembled to the head, remove it and all attached piping.
2. Remove the coupling guard:
   a) Attach shackles to the discharge head lifting lugs, or thread two eyebolts in the head driver-support mounting holes diametrically opposite each other.
   b) Hoist the discharge head over the protruding headshaft.
3. Orient the discharge head in the required position:
   a) Lower the head while you center the vertical hole with the headshaft that protrudes above the column.

      Stop when the discharge head engages the column.
   b) Install the capscrews and secure the discharge head to the column.
   c) Tighten the capscrews gradually in diametrically-opposite pairs.
4. Lift the pump assembly high enough to allow for the removal of the supports.
5. Install and tighten the remaining capscrews until all capscrews are uniformly tight.
6. Hoist the bowl, column, and head assembly and remove the supports.
7. Lower the bowl, column, and head assembly until the discharge-head mounting flange engages the anchor bolts or the sub-base.
8. Secure the discharge head to the foundation or the sub-base.

Stuffing box installation

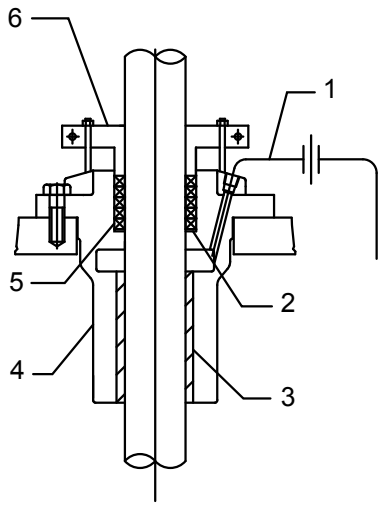
CAUTION:

- Make sure the split gland fits squarely in the stuffing box. A split gland that is not properly seated can cause uneven compression of the packing and damage to the shaft or sleeve.
- Packed stuffing boxes are not allowed in an ATEX-classified environment.

Stuffing box types

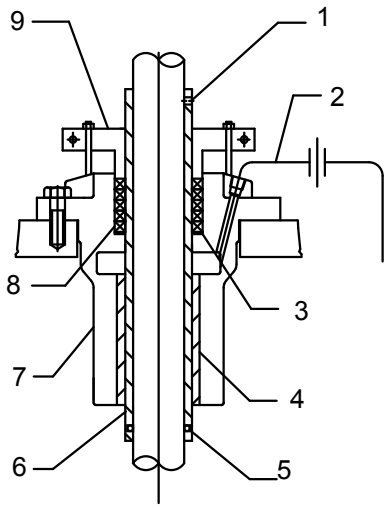
The stuffing box installation has three types:

- Type A
- Type B
- Type C



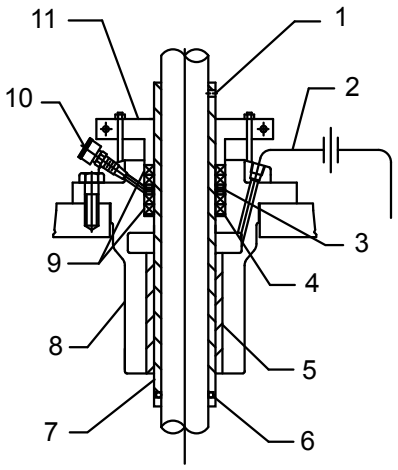
1. Bypass line
2. Packing washer
3. Bearing
4. Packing box
5. Packing rings
6. Split gland

Figure 4: Type A stuffing box



1. Setscrew
2. Bypass line
3. Packing washer
4. Bearing
5. O-ring
6. Sleeve
7. Packing box
8. Packing rings
9. Split gland

Figure 5: Type B stuffing box



1. Setscrew
2. Bypass line
3. Lantern ring
4. Packing washer
5. Bearing
6. O-ring
7. Sleeve
8. Packing box
9. Packing rings
10. Grease cup
11. Split gland

Figure 6: Type C stuffing box

Install the type A and B stuffing boxes

The style B stuffing box is the same as style A with the exception that it has a shaft sleeve with an O-ring.

1. Lubricate the O-ring and the shaft threads.
2. Slip the sleeve onto the shaft and carefully rotate it counterclockwise while you gently push down until the O-ring is clear of the shaft threads.
3. Locate the sleeve on the shaft and secure it with setscrews.
4. Position the gasket on the discharge head.
5. Slide the stuffing box down over the shaft and into position on the gasket.
6. Secure the stuffing box with capscrews.
7. If the packing washer is provided, insert it into the stuffing box.

   The packing washer is not required on shaft sizes 2.19 in. (55.63 mm) and larger.
8. Grease the packing rings for easier installation.
9. Install the packing rings:
   a) Twist each of the five packing rings sideways in order to easily get them around the shaft.

      You can set the sixth ring aside until the packing is adjusted for leakage after the first startup.
   b) Start the first ring into the stuffing box.
   c) Use your fingers to position the entire ring in the stuffing box.
   d) Tap each ring down using a split wooden bushing and push the packing ring down firmly until it seals on the shaft and bore of the stuffing box.
   e) Stagger the ring joints 90° apart.

      You can use the split gland as a tamper for the top ring.
10. Install the split gland and thread the nuts on the split gland studs.
11. Finger-tighten the nuts.
12. If an optional bypass line is furnished, attach it to the tube fitting in the stuffing box.

Final adjustment of the stuffing box must be made at pump start up. This final adjustment applies to all stuffing box styles. A properly packed stuffing box needs to be loose enough to allow you to turn the shaft.

Install the type C stuffing box

The style C stuffing box is provided with a shaft sleeve, O-ring, lantern ring, and grease cup.

1. Lubricate the O-ring and the shaft threads.
2. Slip the sleeve onto the shaft and carefully rotate counterclockwise while you gently push down until the O-ring is clear of the shaft threads.
3. Locate the sleeve on the shaft and secure it with setscrews.
4. If the packing washer is provided, insert it into the stuffing box.

   The packing washer is not required on shaft sizes 2.19 in. (55.63 mm) and larger.
5. Grease the packing rings for easier installation.
6. Install the packing rings:
   a) Twist each of the five packing rings sideways in order to get them around the shaft easily.

      You can set the sixth ring aside until the packing is adjusted for leakage after the first startup.
   b) Start the first ring into the stuffing box.
   c) Use your fingers to position the entire ring in the stuffing box.
   d) Tap each ring down using a split wooden bushing and push the packing ring down firmly until it seals on the shaft and bore of the stuffing box.
   e) Stagger the ring joints 90° apart.

      You can use the split gland as a tamper for the top ring.
   f) Insert the lantern ring into the stuffing box so that it aligns with the lubrication passage in the stuffing box.
   g) Install two packing rings and stagger the ring joints 90° apart.
7. Install the split gland and thread the nuts on the split gland studs.
8. Finger-tighten the nuts.
9. Attach a bypass line to the tube fitting in the stuffing box.
10. Grease the stuffing box:
    a) Thread a grease cup into the stuffing box.
    b) Fill the grease cup with a high grade of grease.
    c) After the stuffing box is completely assembled, apply grease to the lantern ring by turning the grease-cup cap several turns.

Final adjustment of the stuffing box must be made at pump start up. This final adjustment applies to all stuffing box styles. A properly packed stuffing box needs to be loose enough to allow you to freely turn the shaft.

Mechanical seal options

Pumps are shipped without mechanical seals installed. If they are not, then refer to the mechanical seal manufacturer's installation instructions.

These are the mechanical seal options for this pump:

- Cartridge mechanical seal
- Conventional inside component mechanical seal
- Conventional outside component mechanical seal
- High-pressure seal
- Dual mechanical seal

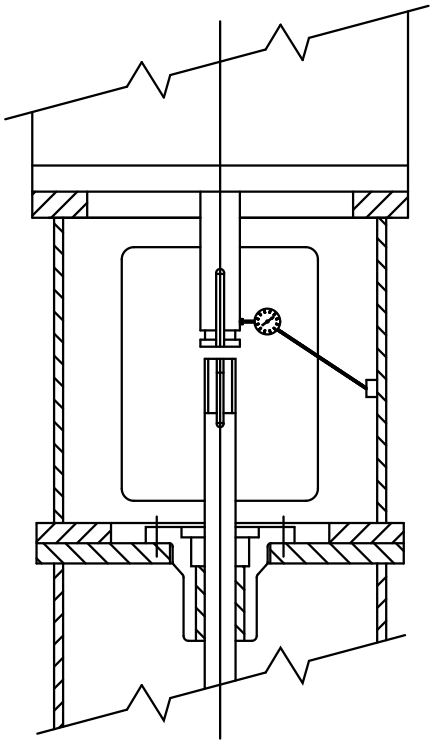
Install the mechanical seal

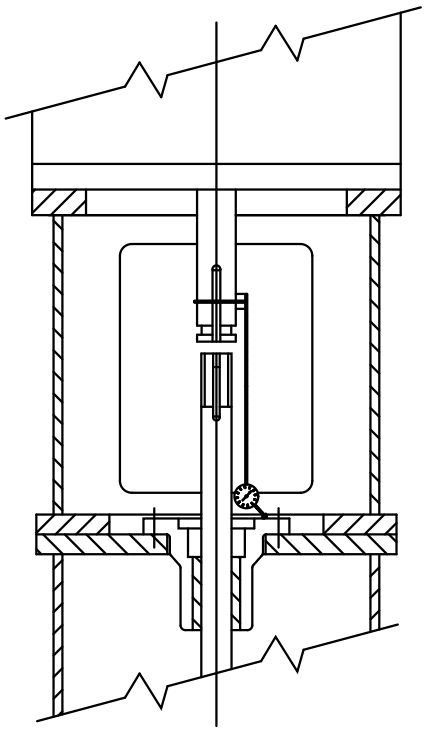
NOTICE:

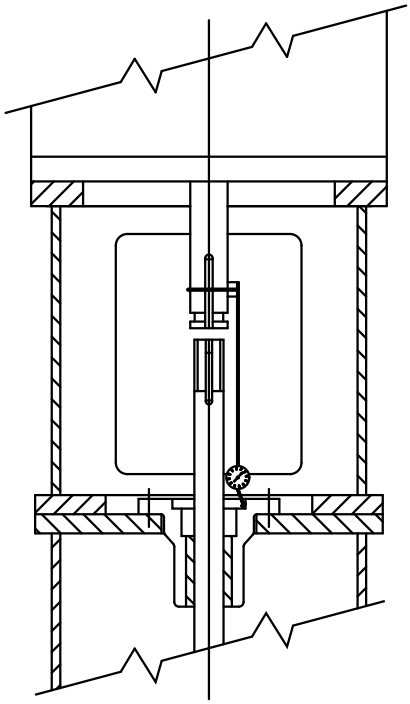
- Do not bump carbon inserts against the shaft as they can chip, crack, or break.
- Do not overtighten the capscrews on the gland. This can distort the seal seat and cause seal failure.
- Do not remove the seal spacer or eccentric washer, adjust the seal, or tighten the setscrews until after you adjust the impellers.
- Reset the seal after you adjust the impeller.

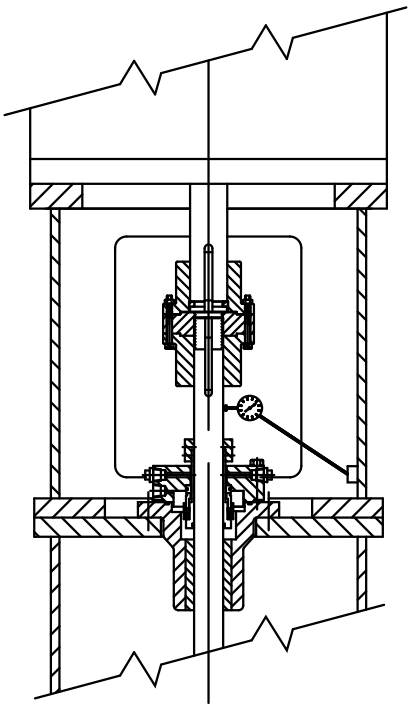
1. Install the O-ring or gasket between the seal housing and seal:
   a) Install the seal over the shaft and ease it into position against the face of the seal box.
   b) Take care when you pass the sleeve and O-ring over the keyways or threads in order to avoid damage to the O-ring.
2. Position the seal gland on the discharge-head seal housing and secure it with capscrews (or nuts for studs).
3. Tighten the capscrews gradually and uniformly in a criss-cross pattern, taking two or three passes.
4. Install all seal piping as required.
5. Before you make the final connections of the sealing-liquid pressurizing lines, make sure the seal housing and all sealing-liquid lines are flushed free of dirt, scale, and other particles.
6. Install the driver and coupling.
7. Take these flatness and concentricity measurements:

Runout of driver shaft	**Procedure**
Concentricity of driver shaft	1. Install the dial indicator as shown, with the base attached to the motor support. 2. Rotate the driver shaft by hand while you read the dial. Make sure that the runout does not exceed NEMA standards, 0.002 in. (0.05 mm) maximum TIR. 3. If the indicator reads higher than 0.002 in. (0.05 mm) TIR, loosen the four driver hold-down bolts and relocate the driver on the motor base register. 4. Obtain the desired position. 5. Tighten the hold-down bolts and repeat the indicator reading.

Runout of driver shaft	Procedure
	
Flatness of the seal housing	For this measurement, remove the mechanical seal if the dial indicator stylus cannot rotate 360° on the top surface of the seal gland. 1. Remove the lower coupling components and attach the base of the dial indicator to the driver shaft. 2. Place the stylus at the top surface of the seal gland, or at the top surface of the seal housing. 3. Rotate the driver shaft slowly 360°. 4. Check that the face of the seal housing is square with the shaft to within 0.002 in. (0.05 mm) TIR.

Runout of driver shaft	Procedure
	
Concentricity of the seal housing	This measurement requires that you remove the mechanical seal. 1. Install the dial indicator as shown. 2. Rotate the driver shaft by hand and run the indicator in the inside-machined surface of the seal housing to determine the concentricity. 3. If the indicator reads higher than 0.004 in. (0.10 mm) TIR, loosen the four driver hold-down bolts and relocate the driver on the motor base register. 4. Obtain the desired position. 5. Tighten the hold-down bolts and repeat the indicator reading.

Runout of driver shaft	Procedure
	
Concentricity of the head shaft	1. Reinstall the mechanical seal if it was removed for the flatness or concentricity measurement. 2. Install the coupling assembly and adjust the impeller. 3. Attach the base of the dial indicator on the discharge head or driver support. 4. Place the stylus on the shaft between the top of the seal and the bottom of the pump coupling. 5. Rotate the driver shaft slowly 360°. 6. Check that the shaft runout is within 0.004 in. (0.10 mm) TIR, or as required by specification. 7. Drill and dowel the pin in three places to secure the driver to the motor base after you obtain the required runouts.

Runout of driver shaft	Procedure
	

8. Position and install the drive collar of the seal by tightening the setscrews using the instructions from the mechanical seal manufacturer.
9. Save the seal spacer or eccentric washer.

   You can use these in order to hold the correct seal spacing in the event that you have to remove the seal. You must loosen the seal setscrews to re-adjust the impellers.
10. Seals that use half-dog-point setscrews might require that the shaft be spot faced or drilled in order to provide a secure placement:
    a) Cover the seal and seal housing.
    b) Remove the setscrews one at a time from the collar and spot face or drill the shaft and then tighten the setscrews into position.
    c) Remove any metal chips in order to avoid damage to the seal.

Assemble a single inside-mounted mechanical seal

Single inside-mounted mechanical seals have these characteristics:

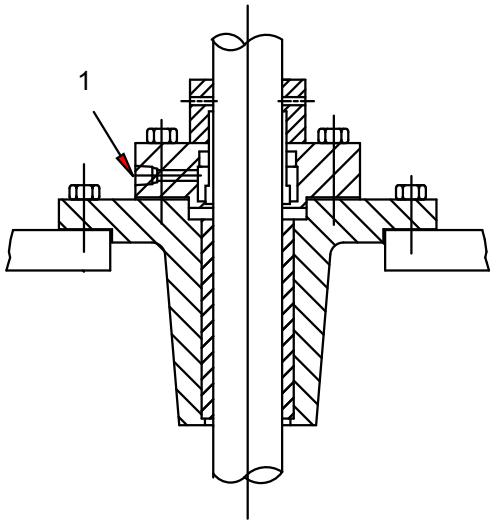
- They are cartridge seals.
- They have glands and sleeves.
- They are assembled as a unit by the seal manufacturer.

Follow the special instructions from the seal manufacturer in the event that non-cartridge seals are installed.

Assemble the seal:

If the seal is...	Then...
An O-ring type	Assemble the complete unit over the shaft. Use care when you pass the sleeve and O-ring over the keyways or threads to avoid damaging the O-ring.

If the seal is...	Then...
A Teflon wedge-ring type	1. Remove the sleeve collar and Teflon wedge ring. 2. Assemble them separately after the sleeve is in position. 3. Tighten the collar on the threads to seal the Teflon wedge around the shaft.



1. Bypass to suction

Assemble a single outside-mounted mechanical seal

These seals are provided in two sub-assemblies:

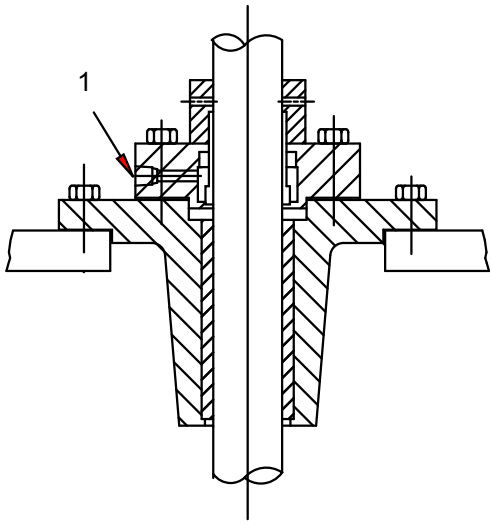
- Stationary unit
- Rotary unit

1. Install the stationary unit, which is the seal-gland assembly.

   The stationary unit will face up.
2. Install the rotary unit and take care not to disengage the rotary parts.

   Installation becomes difficult when the rotary unit parts become disengaged.

   IMPORTANT: Do not tighten the setscrews or adjust the seal until the impellers are adjusted.
3. Adjust the seal:
   a) Refer to the spring gap which is stamped on the collar and shown on the seal assembly drawing.
   b) Tighten the setscrews so that the compression ring is maintained at the same distance from the collar at all points.
   c) Before you start the pump, make sure that the spring gap and the distance from the face of the stuffing box to the collar are the same as shown on the seal assembly drawing.



1. Bypass to suction

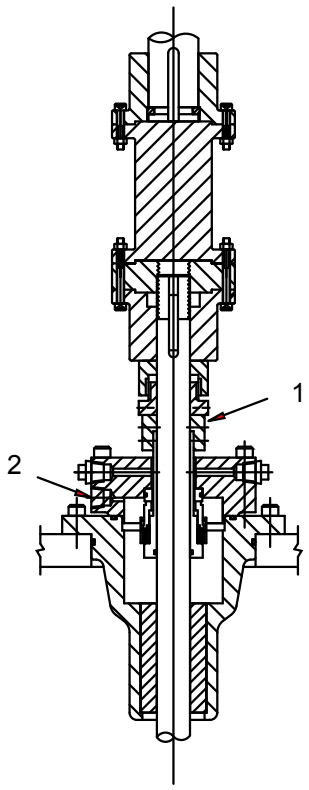
Install the high-pressure seal

High-pressure seals have these characteristics:

- Usually cartridge seals
- Shipped assembled and ready for installation
- Are either single or dual seals

Mechanical seals on pumps with over 1200 psi (85 kg/cm^2) gauge discharge pressure, or a pressure level specified by the seal manufacturer, are normally fitted with backup rings. These rings are installed after the seal installation, between the drive collar of the seal and the bottom of the flanged-pump coupling.

1. Install the backup ring:
   a) Thread the bottom backup ring into the top backup ring until it bottoms out.
   b) Slide the backup ring assembly over the shaft and position it on the seal.
2. Install the spacer coupling and the driver.
3. Set the seal into position.
4. Check the TIR on the headshaft above the mechanical seal.
5. Adjust the backup ring assembly.



1. Back-up rings
2. Bypass to suction

Install the dual mechanical seals

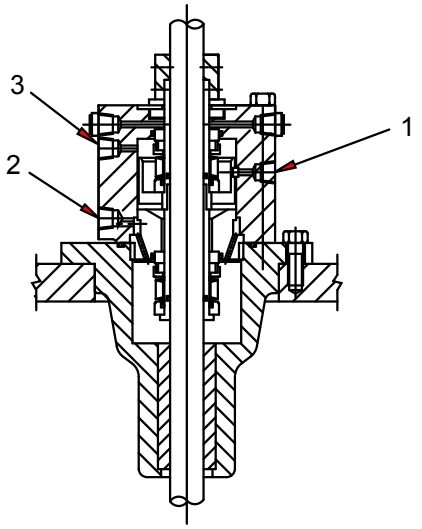
Dual seals are cartridge seals that are shipped assembled. This procedure only applies if a non-cartridge-type seal is furnished, and there are no instructions provided by the seal manufacturer.

1. Scribe a mark on the shaft or sleeve that is flush with the face of the seal housing.

   Use this reference mark to set the seal to the seal assembly.
2. Install the inner insert face:
   a) Lubricate the stuffing-box bore and OD of the inner (or lower) stationary insert.
   b) Protect the inner insert face with a soft and clean material, such as gasketing or sheet rubber.
   c) Install the inner insert face into the bottom of the seal housing with hand pressure only.
   d) If the insert includes a holding pin, make sure that the pin is aligned with the slot or hole in the bottom of the seal housing.
3. Carefully place the gland ring and outer stationary insert over the shaft.
4. Lubricate the shaft or sleeve before you install any of the rotary unit parts.
5. Install the seal collar, or collars, on the shaft or sleeve:
   a) Locate the collar so that it aligns with the reference mark you created in step 1 and to the setting dimension given on the seal assembly drawing.
   b) Tighten the setscrews to lock the collar to the shaft or sleeve.
6. Install the remaining rotary unit parts on the shaft or sleeve in the proper sequence and complete the assembly of equipment.
7. If it is provided, install the shaft packing on the shaft or sleeve individually.

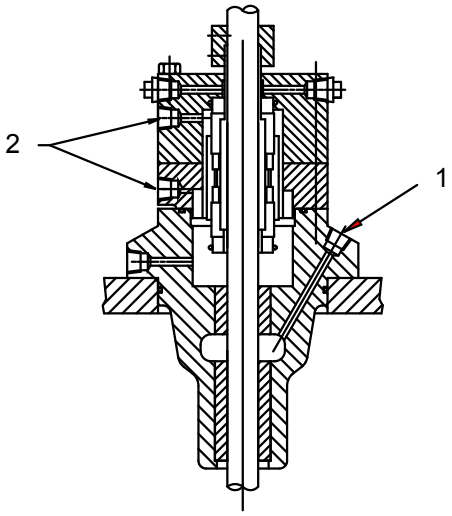
   Use care to avoid nicks or damage that can cause the seal to leak.
8. Seat the gland ring and gland gasket against the face of the seal housing:
   a) Tighten the nuts or bolts evenly and firmly.
   b) Make sure that the gland ring is not cocked.

c) Tighten the nuts or bolts just enough to seal at the gland ring gasket.



1. Connection to external seal lubrication
2. Bypass to suction
3. Connection to external seal lubrication

Figure 7: Tandem-mounted seal (dual unpressurized)

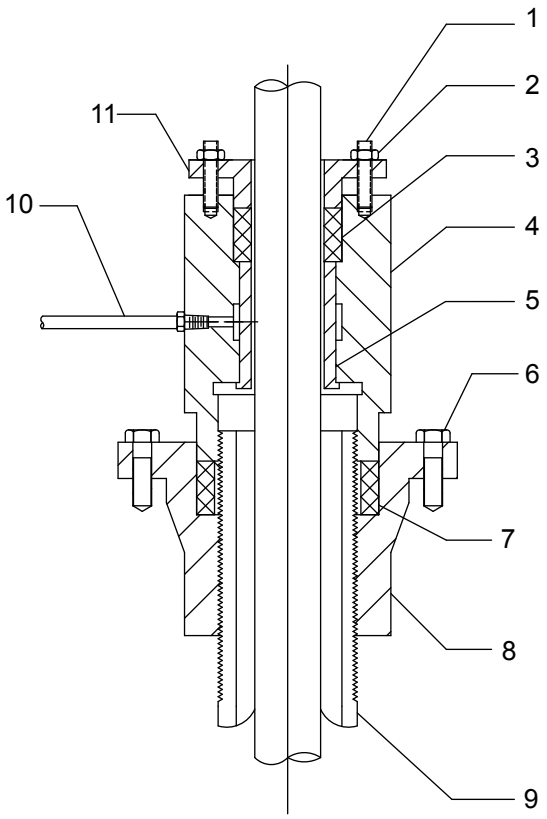


1. Bypass to suction
2. Connection to external seal lubrication

Figure 8: Double-mounted seal (dual pressurized)

Install the tube tension plate

1. Lubricate the tube threads and the underside of the tension-plate flange with a thread compound.
2. Thread the tension plate onto the enclosing tube nipple manually until its shoulder rests on the discharge head.



1. Stud
2. Hex nut
3. Packing
4. Tension nut
5. Bearing
6. Capscrew
7. Packing rings
8. Tension plate
9. Tube nipple
10. Line assembly water flush
11. Gland

Figure 9: Tension plate - water flush

Tension the enclosing tube

The enclosing tube sags from its own weight as it is installed and must be pulled tight (tensioned) to make it straight. This section describes two methods you can use to tension the tube:

- Direct pull method is more precise and is preferred.
- Wrenching method is given as an alternate.

The correct tension is equal to the weight of the enclosing tube plus 10%. Weights per unit length for each tube size are given in this table. Multiply by the total length of the tube to determine the total weight.

Table 4: Tube weight

Tube diameter in inches (millimeters)	Weight in pounds (kilograms) per foot of length
1.25 (31.75)	2.99 (1.36)
1.50 (38.10)	3.63 (1.65)
2.00 (50.80)	5.02 (2.28)
2.50 (63.50)	7.66 (3.47)
3.00 (76.20)	10.25 (4.65)
3.50 (88.90)	12.50 (5.67)
4.00 (101.60)	14.98 (6.80)

Tube diameter in inches (millimeters)	Weight in pounds (kilograms) per foot of length
5.00 (127.00)	20.78 (9.43)
6.00 (152.40)	28.57 (12.96)

Tension the enclosing tube using the direct pull method

This method requires the use of a dynamometer scale and an adapter fitting to grip the tube. A tube tension adapter is available through the factory.

1. Use a hoist to pull the upper end of the tube in order to obtain the predetermined tension value.
2. With the tension plate installed manually but not tightened, thread the special fitting onto the top of the tube to full engagement.
3. Attach the dynamometer scale to the fitting, and connect the upper end of the scale to the hoist hook.
4. Operate the hoist hook to apply the required tension.

   This pulls the tension plate off the discharge head.
5. Manually thread the tension plate in order to reset it.
6. Release the tension from the hoist.
7. Remove the dynamometer scale and special fitting.

Tension the enclosing tube using the wrenching method

If a dynamometer scale is not available, you can tension the tube by wrenching the tube-tension plate.

1. Make up a spanner wrench to straddle the projecting threaded tube end and engage the tube-tension plate capscrew holes by two lugs.
2. Torque the tension plate to take all the slack out of the shaft tubing and induce a reasonable amount of tension by turning the tension plate counterclockwise.

   For tubing 2.50 in. (63.50 mm) and larger, a man's full strength on a 3 ft. (0.9 m) lever arm is sufficient. For smaller sizes, you must utilize less pull.

   Do not turn the tension plate clockwise to align the holes in the tension plate and discharge head.

Install the tension nut

CAUTION:

Be sure that the top of the enclosing tube does not interfere with the tension nut.

1. Install the capscrews in the tension plate.
2. Pour one pint of oil down the oil tube.
3. Install the packing in the tension plate.
4. Thread the tension nut and tighten it firmly against the packing.
5. Perform these steps if a packed-type tension nut is used for water flush:
   a) Install the packing and packing gland.
   b) Secure the packing and the packing gland with a stud and nut and finger tighten.
   c) Install the line assembly and connect it to the flush liquid supply.
6. If the top of the tube interferes with the tension nut, determine the distance:

If the tube is...	Then...
Too short	Replace the tube with a longer tube of the correct length.
Too long	Cut the tube to the correct length and re-thread it.

7. Reinstall and re-level the pump.

Install a solid-shaft driver

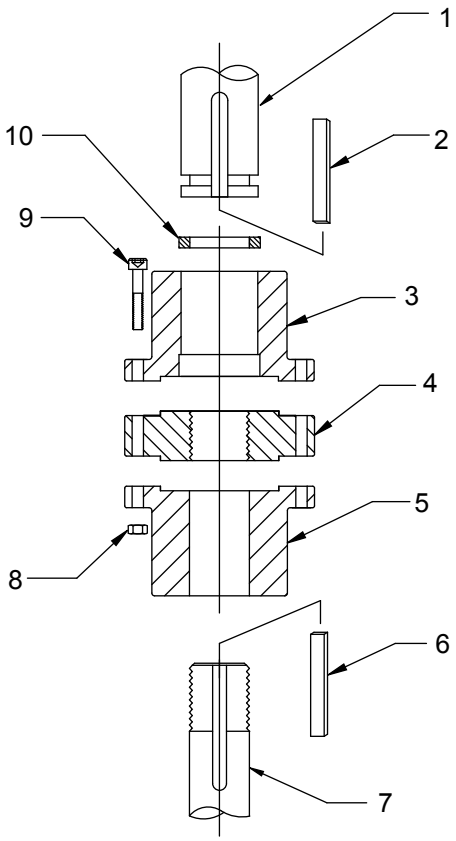
WARNING:

- When installing in a potentially explosive environment, make sure that the motor is properly certified.
- Do not test the motor for direction of rotation when it is coupled to the pump. If the pump rotates in the wrong direction, serious damage to the pump, motor, and personnel will result.
- Do not work under a heavy and suspended object unless there is a positive support and safeguards that will protect you if a hoist or sling fails.

NOTICE:

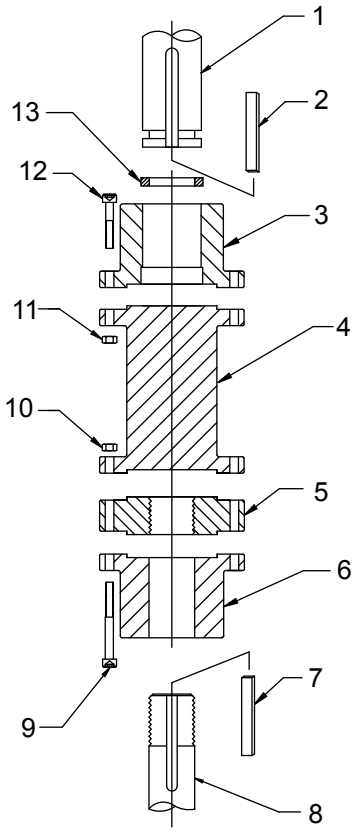
- When the pump is supplied with a thrust pot, do not secure the driver to the discharge head until after the thrust pot and flexible coupling are installed. A separate supplement for thrust pots will be furnished as required.
- Read and follow the motor manufacturer's instructions before lubricating the motor bearings. Excessive lubrication can cause the bearings to overheat and fail prematurely.

The coupling between the driveshaft and the discharge-head shaft can either be a non-spacer type or a spacer type. The spacer type is used on pumps furnished with a mechanical seal to permit servicing of the seal without the removal of the driver.



1. Driveshaft
2. Driver key, supplied by motor vendor
3. Driver hub
4. Adjusting plate
5. Pump hub
6. Pump key
7. Headshaft
8. Hex nut
9. Capscrew
10. Split ring

Figure 10: Non-spacer type coupling



1. Driveshaft
2. Driver key, supplied by motor vendor
3. Driver hub
4. Spacer
5. Adjusting plate
6. Pump hub
7. Pump key
8. Headshaft
9. Capscrew
10. Hex nut
11. Hex nut
12. Capscrew
13. Split ring

Figure 11: Spacer-type coupling

1. If a driver support is furnished and not installed, perform these steps:
   a) Hoist the driver support and inspect the mounting surfaces and register.
   b) Clean these surfaces thoroughly.
   c) Install the driver support on the discharge head and secure it with capscrews.
2. Attach a sling to the lifting lugs of the driver and hoist the motor.
3. Inspect the mounting surface, register, and shaft extension, and then clean these surfaces thoroughly. If any burrs are found, remove them with a smooth mill file.
4. Orient the motor-conduit box in the required position:
   a) Align the motor-mounting holes with the mating-tapped holes on the discharge head.
   b) Lower the motor until the registers engage and the motor rests on the discharge head.
   c) Secure the motor with capscrews.
5. On drivers with a non-reverse ratchet or pins, manually turn the driver shaft clockwise when viewed from the top, until the non-reverse ratchet or pins fully engage.
6. Lubricate the motor bearings according to the instructions on the lubrication plate attached to the motor frame.
7. Make temporary electrical connections according to the tagged leads or the diagram attached to the motor.

The motor must rotate counterclockwise when viewed from the top. See the arrow on the pump nameplate. If the motor does not rotate counterclockwise, change the rotation by interchanging any two leads (for three phase only). For single-phase motors, see the instructions from the motor manufacturer.

If motor shaft-end-play adjustment is required, check it using a dial indicator before you connect the pump coupling to the solid-shaft motor. Consult the applicable motor manufacturer instruction manual for detailed information on motor shaft end play.

Install the coupling hub

1. Apply a thin film of oil on the pump key and insert the key into the headshaft keyway seat.
2. Gently lower the pump half of the coupling hub onto the headshaft.
3. Thread the adjusting plate onto the headshaft until it is flush with the top of the headshaft.
4. Apply a thin film of oil to the driver key and insert the key into the drive-shaft keyway seat.
5. Place the driver half of the coupling hub onto the drive shaft with the key and slide it up the drive shaft until the annular groove is exposed.
6. Install the split ring in the groove and slide the driver half of the coupling hub down over the split ring to capture it.
7. If the pump is supplied with an adjustable spacer coupling, install the spacer between the headshaft and the drive shaft hubs.
8. Secure with capscrews and hex nuts.

Impeller adjustment

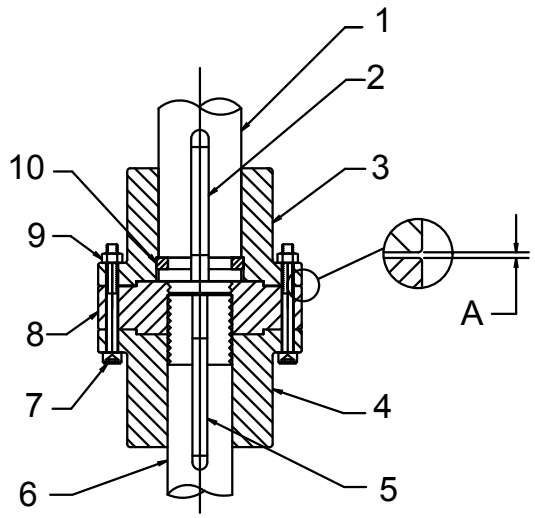
NOTICE:

- When a mechanical seal is provided, make sure it is not secured to the shaft during impeller adjustment. The shaft must move up or down within the seal assembly.
- For pumps that handle liquids between -50°F to 200°F (-45°C to 93°C), you can make impeller adjustments under ambient conditions. For liquids in excess of this range, make any impeller adjustments after the pump reaches the temperature of the liquid. In situations where this is not feasible due to safety considerations, or impossible due to external ice buildup in cryogenic applications, refer to the factory for specific instructions.
- Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in sparks and heat generation.

Example figures

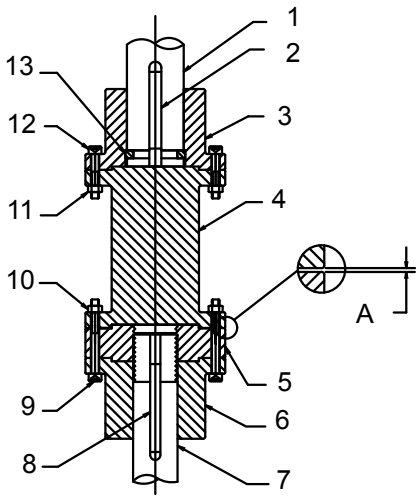
Impeller adjustment is identical for all drivers. Adjust the impeller by turning the adjusting plate.

At location A in thesetwo figures, measure the impeller adjustment before you tighten the coupling capscrews:



1. Driveshaft
2. Driver key, supplied by the motor vendor
3. Driver hub
4. Pump hub
5. Pump key
6. Headshaft
7. Capscrew
8. Adjusting plate
9. Hex nut
10. Split ring

Figure 12: Adjustable coupling (Type A)



1. Driveshaft
2. Driver key, supplied by motor vendor
3. Driver hub
4. Spacer
5. Adjusting plate
6. Pump hub
7. Headshaft
8. Pump key
9. Capscrew
10. Hex nut
11. Hex nut
12. Capscrew
13. Split ring

Figure 13: Spacer coupling (Type AS)

Adjust the impeller for a solid-shaft driver

IMPORTANT: The determination of the driver-shaft end-play can be critical and should be added to the impeller setting noted in this topic. For larger pumps over 8.00 in. (20.32 cm), this amount might not be sufficient. Refer to the pump outline drawing for details.

When impellers are reset, you must also reset the seal.

Complete these steps based on your impeller type:

If your impeller is an...	Then...
Open impeller	1. With the impellers touching the bottom of the bowls, turn the adjusting plate towards the driver hub or spacer to obtain a 0.015 in. (0.381 mm) clearance between the adjusting plate and driver hub or spacer for the first 10 ft. (3 m) of column. 2. Add 0.010 in. (0.254 mm) for each additional 10 ft. (3 m) of column. For example, if the total pump length is 50 ft. (15 m), set the open impellers at 0.055 in. (1.397 mm). 3. Align the adjusting plate with the pump hub, and tightly draw the coupling flanges together with capscrews and nuts. 4. Set the seal: a. Securely tighten all setscrews in the collar. b. Remove the spacer between the gland plate and the collar. c. Retain the spacer for future resetting of the seal.
Enclosed impeller	1. Obtain the impeller setting from the Certified Pump Outline Drawing. 2. Align the adjusting plate with the pump hub, and tightly draw the coupling flanges together with capscrews and nuts. 3. Set the seal: a. Securely tighten all setscrews in the collar. b. Remove the spacer between the gland plate and the collar. c. Retain the spacer for future resetting of the seal.

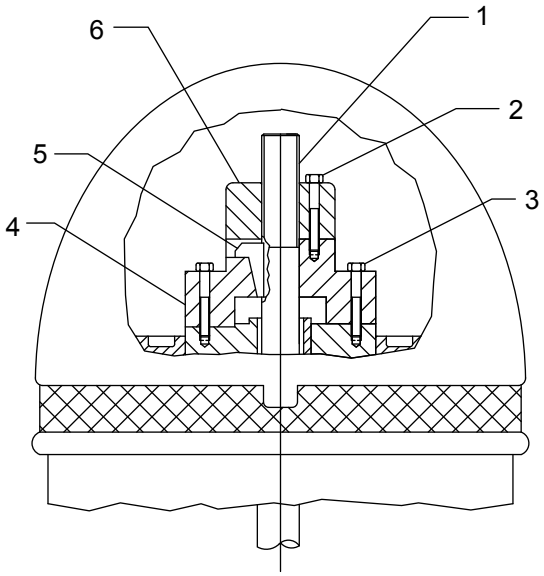
Install a hollow-shaft driver

WARNING:

Do not work under a heavy and suspended object unless there is a positive support and safeguards that will protect you if a hoist or sling fails.

IMPORTANT: When a pump is supplied with a thrust pot, do not secure the driver to the discharge head until after the thrust pot and flexible coupling are installed.

This figure shows the driving mechanism of all hollow-shaft drives. The drive shaft extends up through the quill or hollow shaft of the motor (or gear drive) and is held in place by an adjusting nut. This adjusting nut carries all the static and hydraulic thrust of the impellers and shaft, and also provides the adjustment for the impeller clearances:

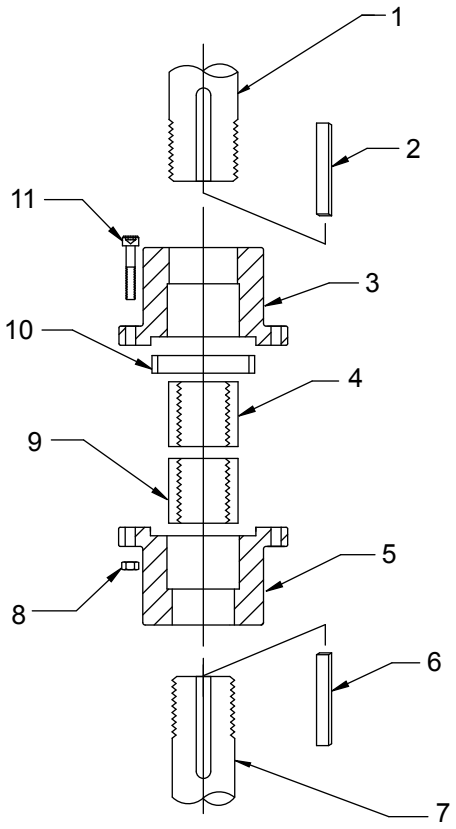


1. Drive shaft
2. Capscrew adjusting nut
3. Hold-down bolt
4. Drive coupling
5. Gib key
6. Adjusting nut

This procedure refers to either a VHS-type electric motor or hollow-shaft type gear drive.

1. If a driver support is furnished and not installed, perform these steps:
   a) Hoist the driver support and inspect the mounting surfaces and register.
   b) Clean these surfaces thoroughly.
   c) Install the driver support on the discharge head and secure it with capscrews.
2. Inspect the driver:
   a) Attach a sling to the lifting lugs of the driver and hoist the motor.
   b) Inspect the mounting surface, register, and shaft extension.
   c) Clean these surfaces thoroughly.
   d) If any burrs are found, remove these burrs with a smooth mill file and thoroughly clean afterward.
3. Orient the motor-conduit box in the required position:
   a) Align the motor-mounting holes with the mating-tapped holes on the discharge head.
   b) Lower the motor until the registers engage and the motor rests on the discharge head.
   c) Secure the motor with capscrews.
4. On drivers with a non-reverse ratchet or pins, manually turn the driver shaft clockwise when viewed from the top, until the non-reverse ratchet or pins fully engage.
5. Lubricate the motor bearings according to the instructions on the lubrication plate attached to the motor case.
6. Remove the drive coupling and hold-down bolts.
7. Screw the adjusting nut loosely onto the end of the drive shaft.
8. Clean the drive shaft thoroughly and attach a light line below the nut.
9. Lower the drive shaft through the motor-quill shaft and examine closely for dirt or burrs between the shaft ends.
10. Raise the drive shaft and adjusting nut assembly to allow room to install the rigid-flanged coupling.

Assemble the type AR rigid-flanged coupling



1. Drive shaft
2. Driver key
3. Drive hub
4. Ring-threaded
5. Pump hub
6. Pump key
7. Headshaft
8. Hex nut
9. Ring-threaded
10. Ring-alignment
11. Capscrew

1. Disassemble the coupling:
   a) Check that all components are clean and no foreign matter is lodged in any of the machined recesses or registers.
   b) Insert the driver key into the drive shaft keyway and slide the driver hub onto the drive shaft.
   c) Position the hub so that the threaded shaft end is exposed enough to allow for the mounting of threaded sleeves on the shaft end.

      To ease the assembly, you can temporarily secure the hub in this position using tape or a rope.
   d) Screw the threaded ring onto the driver shaft until the ring extends beyond the shaft end between 0.06 in. and 0.09 in. (1.52 mm and 2.29 mm).

      This ensures that the driver and pumpshaft ends will not contact each other when the coupling is completely assembled.
2. Insert the pump key into the pumpshaft keyway and slide the pump hub onto the pumpshaft.

   Position the hub so that the threaded shaft end is exposed.
3. Screw the threaded ring onto the pumpshaft until the ring extends beyond the shaft end between 0.06 in. and 0.09 in. (1.52 mm and 2.29 mm).
4. Slide the pump hub towards the threaded ring until the threaded ring is fully seated in its register in the hub.

Hold the hub in this position.

5. Insert the alignment ring into the register in the pump hub.
6. Slide the driver hub towards the pump hub until the driveshaft threaded ring is fully seated in the register in the driver hub.
7. Insert all the coupling hub capscrews and hex nuts and hand-tighten only.
8. Measure the gap between the coupling hub faces.

   In a properly assembled coupling, the gap will be between 0.014 in. and 0.026 in. (0.35 mm and 0.66 mm). This ensures that the threaded rings are properly clamped.

   If the gap is not correct:

   a) Disassemble the coupling.
   b) Check that all parts are clean and free of foreign matter.
   c) Reassemble the coupling.

      The alignment ring will be compressed between the coupling hubs.
9. Tighten all coupling hub capscrews.

Complete the hollow-shaft driver installation

CAUTION:

Never check the motor rotation with the drive coupling in place. The bore clearance between the drive coupling and the pump shaft OD is close enough that if the motor spins while this shaft is stationary, then galling and locking together is likely to occur.

1. Remove the sling and see if the drive shaft centers inside the driver quill within 0.010 in. (0.25 mm).

   If it does not, this indicates misalignment. Perform these steps:

   a) Check to see if you have a bent drive shaft, burrs, or foreign matter between the shaft ends or any of the mounting flanges:
      - Driver-to-driver support
      - Driver support to discharge head
      - Discharge head to sub-base or foundation
   b) Check to see if the sub-base and discharge head are level.

      If it is not, shim between the sub-base and the discharge head in order to correct the problem.
   c) Check the concentricity of the motor-to-motor stand to discharge head.
2. Connect the electricity and check that the motor rotation is counterclockwise when viewed from the top.

   See the arrow on the pump nameplate. If the motor does not rotate counterclockwise and you have a three-phase motor, change the rotation by interchanging any two leads. For single-phase motors, refer to the instructions from the motor manufacturer.
3. Install the motor-drive coupling:

   a) Insert ratchet pins if you are using a non-reverse ratchet.
   b) Match the coupling lugs with the corresponding holes in the motor.
   c) Pull down the hold-down bolts evenly.
   d) Make sure that the drive coupling is properly seated in the register fit.
4. Fit the gib key into the keyway so that there is a snug, but sliding, fit.

   Make sure that you can remove the key with gentle leverage using a screwdriver.
5. Make sure that the gib key is not so high that it prevents the adjusting nut from seating on the drive coupling.
6. Install the adjusting nut and hand tighten.

Adjust the impeller for a hollow-shaft driver

NOTICE:

- If your hollow-shaft driver has a mechanical seal, you must disengage it prior to impeller adjustment.
- Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in sparks and heat generation.

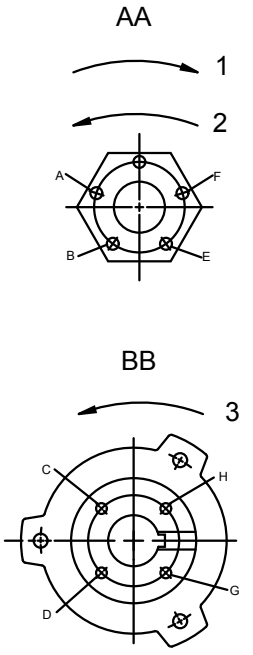
This procedure applies to the open and enclosed impeller:

1. Make sure that the shafting is all the way down and that the impellers are resting on their seats.
2. Turn the adjusting nut in a counterclockwise direction to lift the shaft until the impellers just clear their seats and the shaft turns freely by hand.

   This removes all deflection from the shaft.
3. Align hole A in the adjusting nut and hole C in the motor coupling.

   If you are careful, you can reach an initial impeller clearance between 0.001 in. to 0.003 in. (0.02 mm to 0.07 mm) depending on the shaft size and thread data shown in this table:

Shaft size	Thread	Vertical movement in 1/20th turns - adjusting nut
¾ in. (19 mm)	¾-16 LH	0.003 in. (0.076 mm)
1 in. (25 mm)	1-12 LH	0.004 in. (0.10 mm)
1 3/16 in. (30 mm)	1-12 LH	0.005 in. (0.12 mm)
1½ in. (38 mm)	1-10 LH	0.005 in. (0.12 mm)
1 11/16 in. (42 mm)	1-10 LH	0.005 in. (0.12 mm)
1 15/16 in. (49 mm)	1-10 LH	0.005 in. (0.12 mm)
2 3/16 in. (55 mm)	1-10 LH	0.005 in. (0.12 mm)
2 7/16 in. (62 mm)	1-10 LH	0.005 in. (0.12 mm)
2 11/16 in. (68 mm)	1-8 LH	0.006 in. (0.15 mm)



1. Lower impeller
2. Raise impeller
3. Correct impeller rotation

4. Insert a capscrew into hole B provided that these are the nearest-matching holes for counterclockwise rotation of the adjusting nut.
5. Turn the adjusting nut counterclockwise until holes B and D line up.

Table 5: Normal impeller clearances

Impeller type	Distance/size	Clearance
Open	First 10 ft (3 m) of column	0.015 in. (0.381 mm)
	Each additional 10 ft (3 m) of column	0.010 in. (0.254 mm)
Enclosed	Bowl sizes up to 8 in. (20.32 cm)	0.12 in. (3.05 mm)
	Bowls larger than 8 in. (20.32 cm)	0.1875 in. (4.750 mm)

Set up the lubrication system

1. Connect the solenoid valve, if provided, and the oil lines.
2. Fill the oil reservoir with oil.
3. Check the lubricator feed and make sure that the oil reservoir is flowing freely.

   In the case of a solenoid valve, temporary power connections are required.
4. Set the proper drops per minute on the regulator as this table shows:

   The shaft is the headshaft (OD). The adjustment is a manual adjustment on the regulator valve.

Shaft size in inches	Shaft size in millimeters	Drops per minute per 100 feet (30.48 meters) of shaft
0.75 to 1.00	19 to 25 mm	8
1.19 to 1.94	30 to 50 mm	16
2.19 and larger	55 mm and larger	20

Installation and startup checklist

Use this checklist in conjunction with the standard instruction manual furnished with the equipment. Initial each completed item or write N/A if the item is not applicable. After you complete this checklist, forward a copy to the VPD field service for entry into the quality assurance records. Use a separate checklist for each individual pump.

Part 1: System and installation inspections

Check	Checked
Check that the pump foundation is level to within 0.005 in. per ft. (0.0123 cm per m) of diameter. For API units, the level requirement is 0.001 in. per ft. (0.003 cm per m) of diameter.	
Check that the foundation can handle the weight and loading of the pump.	
Check that the foundation is properly grouted using a high quality non-shrink grout.	
Check that all the anchor bolts are tight.	
Check that the discharge piping is properly supported and that there is no excess nozzle loading on the discharge flange.	
On units with flexible or expansion joints attached to the pump discharge, check that tie rods are in place and properly installed.	
Check these items for all valves: • Operate freely • Properly installed for the direction of flow • Have the proper pressure	
Check where the pumped fluid is going and that the system is properly lined up for the test.	
Check that the pumped fluid supply will be continuously available for the duration of the test. It is very important that the initial run is at least ten minutes in duration in order to completely flush the pump.	

Check	Checked
If possible, check the cleanliness of the pumped fluid and piping. If you are present during the installation, check that the sump, barrel, and piping are clean.	

Part 2: Pump assembly pre-start inspections

Check	Checked
Verify that the drivers are properly lubricated before start-up. On drives with grease-lubricated motor bearings, insist that the motor vendor grease them on-site. Lubrication information is located on special motor tags or in the motor manuals.	
Determine the allowable number of cold/hot starts with the motor vendor. The general rule of thumb is two cold or one hot start per hour. Exceeding the recommended starts breaks down the motor insulation and can cause failure. Megger the motor if possible.	
Before you couple the driver to the pump, verify the proper rotation of the driver by bumping it. The proper rotation for vertical pumps is counterclockwise when viewed from above. Run the pump uncoupled to check that the driver runs smooth and sounds normal. • For VHS motors, remove the driveshaft if a coupling is provided, and the steady bushing and driver coupling if one is not provided. • On drivers with NRRs. remove the rachet pins, if possible. Otherwise, rotate the drive coupling clockwise until the pin stops tight against the rachet plate. If a customer refuses to allow you to check the rotation, have the customer sign and date this checklist before you proceed.	
After you verify the proper rotation of the driver, you can couple the pump to the driver. • On VSS units with a flanged coupling except for the AR type, set the impeller lift. • On VHS units, set the impeller lift using the adjusting nut on top of the motor after you make up the threaded or AR coupling. See either the pump nameplate or the outline drawing for the specific impeller lift required for an individual pump.	
Check the alignment on pumps that are equipped with jacking bolts since they require that the motor be physically aligned to the pump. Special alignment of the pump to the motor is not usually required since all components are equipped with register fits.	
Use a dial indicator in order to check that the shaft runout above the sealing element is not excessive: • Packing limit is a maximum of 0.008 in. (0.020 cm) • Mechanical seal limit is a maximum of 0.005 in. (0.0123 cm) For API, the maximum is 0.002 in. (0.005 cm)	
On units with seals, check these items: • Check that the seal rotates freely. • Check that the seal spacers are removed. • Check that the seal piping is properly installed.	
On water-lubricated, enclosed lineshaft units, check these items: • Check the water PSI and flow rate. • Check the solenoid valve and its connection for proper operation.	
On oil-lubricated, enclosed lineshaft units, check these items: • Check that the oil tank is completely full and allow the oil to drip overnight prior to start-up. • Check the solenoid valve and its connection for proper operation. • Check the oil tank and refill.	

Part 3: Unit startup

Check	Complete
After you complete all of the checks in Parts 1 and 2, conduct a start-up meeting with customer in order to discuss the actual procedures they might require during start-up and commissioning. Also, verify with the customer that their system is ready for pumped fluid.	
When the system is ready, push the start button and adjust the discharge valve in order to meet the design point (if required).	

Check	Complete
Watch for signs of trouble. The unit must run at least ten minutes in order to flush out the pump and system.	
Verify that the unit runs smoothly with no unusual noise, vibration, or over heating.	
Run the unit for one hour in order to test the system.	

Measurements

Reading	Value
Impeller lift	
Shaft runout	
Megger	
Vibration	

Commissioning, Startup, Operation, and Shutdown

Preparation for startup

Hazard statements

WARNING:

- Failure to follow these precautions before you start the pump will lead to serious personal injury and equipment failure.
- DO NOT operate the pump below the minimum rated flows or with the discharge valves closed. These conditions can create an explosive hazard due to vaporization of pumped fluid and can quickly lead to pump failure and physical injury.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- Operating the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment.

Precautions

NOTICE:

- Verify the driver settings before you start the pump.
- Make sure that the warm-up rate does not exceed 2.5°F (1.4°C) per minute.

You must follow these precautions before you start the pump:

- Flush and clean the system thoroughly to remove dirt or debris in the pipe system in order to prevent premature failure at initial startup.
- Bring variable-speed drivers to the rated speed as quickly as possible.
- Run a new or rebuilt pump at a speed that provides enough flow to flush and cool the close-running surfaces of the stuffing-box bushing.
- Run a new or rebuilt pump at a speed that provides enough flow to flush and cool the close-running surfaces of the stuffing-box or seal-housing bearing.
- If temperatures of the pumped fluid will exceed 200°F (93°C), then warm up the pump prior to operation. Circulate a small amount of fluid through the pump until the casing temperature is within 100°F (38°C) of the fluid temperature.
- Rubber bearings must be wet prior to startup if the non-submerged (dry column) length is greater than 50 ft (15 m). You can only use clean water or clean sea water.

At initial startup, do not adjust the variable-speed drivers or check for speed governor or over-speed trip settings while the variable-speed driver is coupled to the pump. If the settings have not been verified, then uncouple the unit and refer to instructions supplied by the driver manufacturer.

Prepare for startup

WARNING:

- For the VSS motor, do not check the motor rotation unless the motor is bolted to the pump and the driver hub is disconnected from the pump hub.
- For a VHS motor, do not check the motor rotation unless the motor is bolted to the pump and the drive coupling is removed.
- Do not test the motor for direction of rotation when it is coupled to the pump. If the pump rotates in the wrong direction, serious damage to the pump, motor, and personnel will result.

Consult the applicable manufacturer instructions for detailed information for the prime mover (electric motor, engine, or steam turbine), coupling, drive shaft, gear-head, or mechanical seal.

1. Confirm that you have completed these procedures:
   a) Connected the driver to a power supply.
   b) Verified that the driver rotates counterclockwise when viewed from above.
   c) Checked the alignment between the pump and driver.
   d) Adjusted the impeller.
   e) Attached the mechanical-seal lock collar to the shaft.
2. Verify that the mechanical seal is properly lubricated and that all piping to the seal is connected.
3. Verify that all cooling, heating, and flushing lines are operating and regulated.
4. Verify that all connections to the driver and starting device match the wiring diagram.
5. Verify that the voltage, phase, and frequency on the motor nameplate agree with the line current.
6. Rotate the shaft manually to make sure that the impellers are not binding.
7. Verify that the driver bearings are properly lubricated and check the oil level in the housing.
8. Verify that the auxiliary seal components are properly vented.
9. Inspect the discharge-piping connection and pressure gauges for proper operation.
10. For the enclosed lineshaft construction, turn on the oil drip or water flush for a minimum of five minutes.
11. For oil-lubricated lineshafts, set the sight feed dripper for the number of drops per minute as directed in this table:

Lineshaft size (OD)	Drops per minute per 100 ft. (39 m) of shaft
¾ to 1 in. (19 mm to 25 mm)	8
$1\ ^{3}/_{16}$ to $1\ ^{15}/_{16}$ in. (30 mm to 49 mm)	16
$2\ ^{3}/_{16}$ in. and larger (55 mm and larger)	20

Pump priming

CAUTION:

- The pump must be properly vented through the discharge head connections. This is important for liquids with suction pressures close to their vapor pressures. Vent piping must continuously rise back to the source so that liquid cannot collect in the vent line.
- Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.

NOTICE:

Net positive suction head available ($NPSH_A$) must always exceed NPSH required ($NPSH_R$) as shown on the published performance curve of the pump.

Requirements

- The minimum submergence must always be as indicated on the Certified Pump Outline Drawing.
- Never run the pump dry as this can cause the rotating parts within the pump to gall and seize to the stationary parts.
- The parts are lubricated by the liquid being pumped unless the enclosed linshaft option is purchased to lubricate the lineshaft bearings with a clean fluid.

Start the pump

CAUTION:

- Observe the pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down the pump and resolve the issue.

Before you start the pump, you must perform these tasks:

- Open any recirculation or cooling lines.

1. Fully close or partially open the discharge valve, depending on system conditions.
2. Start the driver.
3. Slowly open the discharge valve until the pump reaches the desired flow.
4. Immediately check the pressure gauge to ensure that the pump quickly reaches the correct discharge pressure.
5. If the pump fails to reach the correct pressure, perform these steps:
   a) Stop the driver.
   b) Confirm the minimum submergence.
   c) Restart the driver.
6. Monitor the pump while it is operating:
   a) Check the pump for bearing temperature, excessive vibration, and noise.
   b) If the pump exceeds normal levels, then shut down the pump immediately and correct the problem.
   A pump can exceed normal levels for several reasons. See Troubleshooting for information about possible solutions to this problem.
7. Repeat steps 5 and 6 until the pump runs properly.

Pump operation precautions

General considerations

CAUTION:

- Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side since this can result in decreased performance, unexpected heat generation, and equipment damage.
- Do not overload the driver. Driver overload can result in unexpected heat generation and equipment damage. The driver can overload in these circumstances:
  - The specific gravity of the pumped fluid is greater than expected.
  - The pumped fluid exceeds the rated flow rate.
- Make sure to operate the pump at or near the rated conditions. Failure to do so can result in pump damage from cavitation or recirculation.

Operation at reduced capacity

WARNING:

Never operate any pumping system with a blocked suction and discharge. Operation, even for a brief period under these conditions, can cause confined pumped fluid to overheat, which results in a violent explosion. You must take all necessary measures to make sure that this condition is avoided.

CAUTION:

- Avoid excessive vibration levels. Excessive vibration levels can damage the bearings, stuffing box or seal chamber, and the mechanical seal, which can result in decreased performance.
- Avoid increased radial load. Failure to do so can cause stress on the shaft and bearings.
- Avoid heat build-up. Failure to do so can cause rotating parts to score or seize.
- Avoid cavitation. Failure to do so can cause damage to the internal surfaces of the pump.

Operation under freezing conditions

NOTICE:

Do not expose an idle pump to freezing conditions. Drain all liquid that is inside the pump and the cooling coils. Failure to do so can cause liquid to freeze and damage the pump.

Mechanical seal leaks

NOTICE:

The mechanical seal used in an Ex-classified environment must be properly certified. Prior to startup, make sure that all areas that could leak pumped fluid to the work environment are closed.

Occasional leaks

If the seal leaks slightly at start-up, allow a reasonable amount of time for the seal to adjust itself. Fluids with good lubricating qualities normally take longer to adjust than fluids with lesser lubricating qualities. When a seal starts out with a slight leak and the leak decreases while running, it indicates leaks across the seal faces. Run the pump continuously in order to eliminate this issue.

Continuous leaks

When immediate leaks occur and remain constant, even during operation, it usually indicates either secondary seal (shaft packing) damage, or seal faces that are warped or cracked. See Troubleshooting for probable causes.

Stuffing box leaks

CAUTION:

Packed stuffing boxes are not allowed in an ATEX-classified environment.

Normal leaks

With the pump in operation, there should be some leaking at the stuffing box packing. The correct leak rate is a rate which keeps the shaft and stuffing box cool. This rate is approximately one drop per second. Check the temperature of the leaked fluid as well as the discharge head.

Decreased leaks

If the pump runs hot and the leaks begin to decrease, stop the pump and allow it to cool down. Loosen the packing gland in order to allow the packing to resume leaking. After pump has cooled, restart pump and run it for 15 minutes. Then check the leaks. If the leak exceeds two drops per second, adjust the packing.

Shut down the pump

WARNING:

The pump can handle hazardous and toxic fluids. Identify the contents of the pump and observe proper decontamination procedures in order to eliminate the possible exposure to any hazardous or toxic fluids. Wear the proper personal protective equipment. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks. You must handle and dispose of pumped fluid in compliance with the applicable environmental regulations.

1. Slowly close the discharge valve.
2. Shut down and lock the driver to prevent accidental rotation.
3. If the driver is not equipped with a non-reverse ratchet (NRR), be certain that the unit is completely stopped before you restart the pump.

Lubricate the thrust pot during a shutdown period

1. Completely immerse the bearings in oil.

   This helps to avoid oxidation of the anti-friction bearings during shutdown periods lasting longer than one week.
2. Fill the oil reservoir until the oil runs over the oil retainer tube and down the shaft.

Before startup, drain the oil to its required level.

Maintenance

Maintenance schedule

Maintenance inspections

A maintenance schedule includes these types of inspections:

- Routine maintenance
- Routine inspections
- Three-month inspections
- Annual inspections

Shorten the inspection intervals appropriately if the pumped fluid is abrasive or corrosive or if the environment is classified as potentially explosive.

Routine maintenance

Perform the following tasks whenever you perform routine maintenance:

- Lubricate the bearings on pumps supplied with thrust pots.
- Inspect the packing or mechanical seal.

Routine inspections

Perform the following tasks whenever you check the pump during routine inspections:

- Check for unusual noise, vibration, and bearing temperatures.
- Check the pump and piping for leaks.
- Analyze the vibration.

Three-month inspections

Perform the following tasks every three months:

- Check that the foundation and the hold-down bolts are tight.
- Check the packing if the pump has been left idle, and replace as required.

Annual inspections

Perform the following inspections one time each year:

- Check the pump capacity.
- Check the pump pressure.
- Check the pump power.

If the pump performance does not satisfy your process requirements, and the process requirements have not changed, then do the following:

1. Disassemble the pump.
2. Inspect it.
3. Replace worn parts.

Adjust and replace the packing

CAUTION:

Do not over-tighten the stuffing box. Excessive pressure can wear out packing prematurely and seriously damage the shaft.

NOTICE:

Packed stuffing boxes are not allowed in an ATEX-classified environment.

Adjust the packing when one of the following conditions occurs:

- The leakage rate exceeds two drops per second.
- There is overheating or no leakage.

Adjust the packing when leaking is excessive

Perform this procedure if leaks exceed two drops per second.

1. With the pump in operation, tighten the gland nuts one-quarter turn.
2. Before you make any more adjustments, check to see if the packing has equalized against the increased pressure by making sure the leakage has decreased to a steady state.

   If the leaks decrease to two drops per second, then you are finished. If the leaks continue to exceed two drops per second, continue to the next step.
3. Shut down the pump.
4. Allow the packing to compress enough so that the gland is about to contact the upper face of the stuffing box.
5. Remove the split gland, add one extra packing ring, and readjust.
6. If this fails to reduce the leak to two drops per second, then remove all packing rings and replace them with new rings:
   a) Remove the packing with the aid of a packing hook.
   b) If a lantern ring is provided, remove it by inserting a wire hook in the slots of the ring and pull it from the stuffing box.
   c) Thoroughly clean the stuffing box of all foreign matter.
7. If the replacement packing is in the form of a continuous coil or rope, cut it into rings before installing:
   a) Tightly wrap one end of the packing material around the top shaft like one coil spring.
   b) Cut through the coil with a sharp knife.

   See Installation for details about how to properly reinstall the stuffing box.

Adjust the packing when there is overheating or no leaks

CAUTION:

If there are no leaks or the stuffing box overheats, do not back off the gland nuts while the pump is running. This causes the entire set of packing rings to move away from the bottom of the box without relieving pressure of the packing on the shaft.

A small amount of leaking is required in order to prevent overheating.

1. Stop the pump and allow the packing to cool.
2. Restart the pump.
3. Repeat these steps until two drops of liquid per second comes through.
4. If this fails to fix the problem, then you must replace the packing.

Thrust pot lubrication guidelines

Flushing the oil reservoir

Flush the oil reservoir in order to remove all grit particles in the oil reservoir sump. Use the same type of oil to flush the reservoir as specified for lubrication. Always keep a supply of turbine oil on-hand.

NOTICE:

Pumps are shipped without oil. Oil-lubricated anti-friction bearings must be lubricated at the job site.

Oil levels

Pump status	Oil level
Not operating	At or lower than 1/8 in. to 1/4 in. (0.635 to 0.3175 mm) from the top of the oil sight gauge. Never operate the pump when the oil in the sight gauge is not at the required level.
Operating	Lower than the required level as indicated on the oil sight gauge.

Changing the oil

The frequency with which you change the oil depends on the severity of the environment. When the oil in the sight gauge is a dark brown color, it is time for an oil change. However, for a longer bearing life, it is recommended that you change the oil every six months. Be sure to flush the oil reservoir with each oil change.

Disassembly

Disassembly precautions

WARNING:

- Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, open vent or drain valves, or disconnect the piping.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- The pump and the components can be heavy. Make sure to use proper lifting methods, and wear steel-toed shoes at all times. Failure to do so can result in physical injury or equipment damage.
- The pump can handle hazardous and toxic fluids. Identify the contents of the pump and observe proper decontamination procedures in order to eliminate the possible exposure to any hazardous or toxic fluids. Wear the proper personal protective equipment. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks. You must handle and dispose of pumped fluid in compliance with the applicable environmental regulations.

NOTICE:

Make sure that all replacement parts are available before you disassemble the pump for overhaul.

Disassemble the head and column

WARNING:

Never try to lift the entire pump assembly by the lifting lugs or eyebolts furnished for the driver only. Always lift the pump with shackles through the lifting lugs or with eyebolts inserted through the flanges.

1. If equipped with mechanical seals, loosen the setscrews that fasten the seal to the pump shaft so that the pump shaft can slide up or down within the seal.
2. Remove the necessary components:

If the pump is...	Then remove...
Gear-driven	The driveshaft between the gear and the prime mover.
Electric-motor driven	The electrical connections at the conduit box and label the electrical leads so they can be reassembled correctly.

3. Uncouple the driver, or gear box, from the pump shaft and mounting flanges, and then lift off by the lifting lugs or eyebolts as furnished.
4. Disconnect the discharge head from the discharge piping.
5. Remove all hold-down bolts and integral piping.
6. Remove the coupling, packing box, or mechanical seal.
7. Continue with disassembly down to the bowls as described in the next section.

Bowl disassembly

The bowl assembly is composed of these parts:

- Suction bell
- Intermediate bowls
- Top bowl
- Impellers and securing hardware
- Bearings
- Pump shaft

Turbine bowl impellers are secured to the shaft by either a taper collet or a key and split-thrust ring. Follow only the procedures that apply to your particular construction. These types of impeller attachment can apply to any vertical pump less than 18 in. (46 cm) in diameter.

NOTICE:

Mark the components in sequence to aid reassembly.

Disassemble the taper collet bowl

1. Remove the capscrews that secure the top bowl to the intermediate bowl.
2. Slide the top bowl off the pump shaft.
3. Pull the shaft out as far as possible and strike the impeller hub using a collet driver or equivalent, sliding along the pump shaft to drive the impeller off the taper collet.
4. After the impeller is freed, insert a screwdriver into the slot in the taper collet, spread it, and remove the taper collet.
5. Slide the impeller off the pump shaft.
6. Repeat these steps until the bowl assembly is completely disassembled.

Disassemble the keyed bowl

1. Remove the capscrews that secure the top bowl to the intermediate bowl.
2. Slide the top bowl off the pump shaft.
3. Remove the capscrews and the split-thrust ring from the pump shaft.
4. Slide the impeller off the pump shaft and remove the key.

   NOTICE:

   If the impeller is seized to the shaft, then strike the impeller with a fiber mallet and drive the impeller off the pump shaft.

5. Repeat these steps until the bowl assembly is completely disassembled.

Remove the turbine bowl and impeller wear rings

1. Remove the setscrews or grind off the tack weld if the rings are furnished with those locking methods.
2. Use a diamond-point chisel in order to cut two V-shaped grooves on the bowl or impeller wear ring approximately 180° apart.

   Use extreme care not to damage the wear ring seat.
3. With a chisel or drift punch, knock the end of one half of the ring in, and pry the ring out.
4. On high-alloy materials such as chrome steel, set up the bowl or the impeller in a lathe and machine the wear ring off, using extreme care not to machine or damage the ring seat.

Remove the bowl, suction bell, and lineshaft bearings

NOTICE:

Bowl bearings are press fit. Do not remove the bowl bearings unless replacement is necessary.

1. Using an arbor press and a piece of pipe or sleeve with an outside diameter slightly smaller that the diameter of the bowl or lineshaft bearing housing bore, press the bearing off.
2. Remove the suction bell bearing by setting the suction bell in a lathe and machining the bearing off.

   The suction bell bearing can also be removed using bearing pullers to pull the bearings out.

Pre-assembly inspections

Guidelines

Before you assemble the pump parts, make sure you follow these guidelines:

- Inspect the pump parts according to the information in these pre-assembly topics before you reassemble your pump. Replace any part that does not meet the required criteria.
- Ensure that the parts are clean. Clean the pump parts in solvent to remove oil, grease, and dirt.

NOTICE: Protect machined surfaces while you clean the parts. Failure to do so may result in equipment damage.

Replacement guidelines

Casing check and replacement

Inspect the casing for cracks and excessive wear or pitting. Thoroughly clean gasket surfaces and alignment fits to remove rust and debris.

Impeller replacement

This table shows the criteria for replacing the impeller parts.

Impeller parts	When to replace
Impeller vanes	• When grooved deeper than 1/16 in. (1.6 mm), or • When worn evenly more than 1/32 in. (0.8 mm)
Vane edges	When you see cracks, pitting, or corrosion damage
Keyway and bores	When you see damage

Gaskets, O-rings, shims, and seats replacement

- Replace all gaskets, O-rings, and shims at each overhaul and disassembly.
- Inspect the seats. They must be smooth and free of physical defects. To repair worn seats, skin cut them in a lathe while maintaining dimensional relationships with other surfaces.
- Replace parts if seats are defective.

Bearing retainer check

Check the bearing retainer for deformation and wear.

Shaft checks

- Check the shafts for straightness and excessive wear on the bearing surfaces.
- Check the deflection of shafts. The average total runout should not exceed 0.010 in. (0.25 mm) TIR for every 10 ft. (3 m) of shaft length.

Mechanical seal checks

On pumps equipped with a mechanical seal, check that the shaft or sleeve is free of pits, burrs, or sharp edges to prevent cutting or improper sealing of the seal O-rings. Remove any burrs and sharp edges by polishing with a fine emery cloth.

Impeller and bowl checks

Visually check impellers and bowls for cracks and pitting. Check all bowl bearings for excessive wear and corrosion.

Reassembly

Install the turbine bowl and impeller wear ring

1. Place the chamfered face of the bowl or impeller wear ring towards the ring seat and press the ring into the seat.
2. Use an arbor press or equivalent and make sure the ring is flush with the edge or the wear ring seat.

Install the bowl, suction bell, and lineshaft bearings

Make sure you have an arbor press or equivalent for pressing the bearings.

1. Press the bearing into the retainer.
2. Press the bearing into the suction bell.

   The top of the bearing should protrude above the suction hub equal to the depth of the counter bore in the sand collar.
3. Press the bearings into the intermediate bowl and the top bowl.
4. Place the bowl with the flange downward and press the bearing through the chamfered side of bowl hub until the bearing is flush with the hub.

Install the taper collet bowl assembly

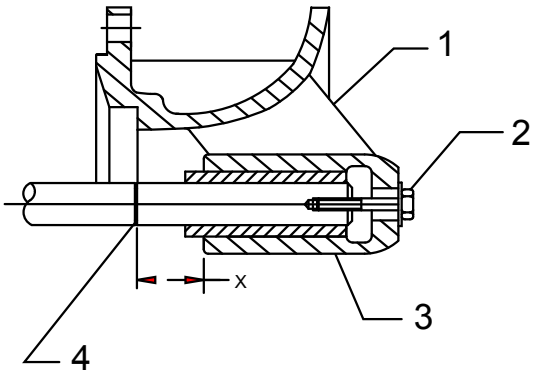
WARNING:

Wear protective gloves and use appropriate eye protection to prevent injury when handling hot parts.

1. Apply a thin film of turbine oil to all mating and threaded parts.
2. If the pump is equipped with a sand collar, then perform these steps:
   a) If the sand collar is not assembled to the shaft, then heat the sand collar until it slips over the shaft and quickly position it so that the top of the sand collar is even with the locating groove before it cools.

      The sand collar is attached to the shaft with a shrink fit. The shaft is machined with a 0.01 in. (0.25 mm) groove to locate the sand collar. The large diameter of the counterbore of the sand collar goes toward the suction bell bearing.
   b) Slide the end of the pump shaft with the sand collar into the suction bell bearing until the sand collar rests against the suction bell.
   c) Skip the next step and proceed to installing the impellers.
3. If the pump is not equipped with a sand collar, then locate the pump shaft with respect to the suction bell:
   a) Insert the pump shaft into the suction bell bearing until it bottoms out.
   b) Pull the shaft out until the distance between the groove on the shaft and the top of the suction bell hub, and not the top of the bearing, is correct for the particular pump.

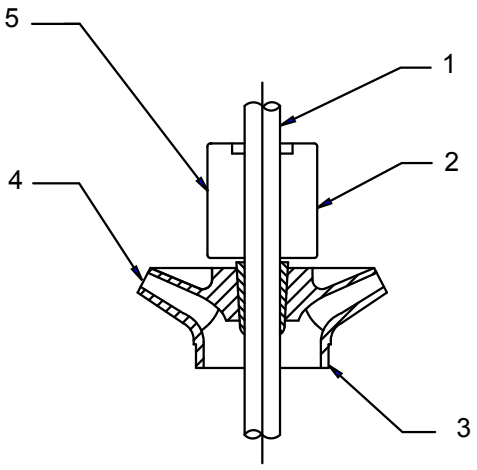
      Use the X dimension in the Pump shaft dimensions table in the Maintenance chapter.



1. Suction bell
2. Capscrew screwed into the tapped hole in the shaft with washers, as required
3. Suction bell hub
4. 0.01 in. (0.25 mm groove)

c) Hold the shaft in this position by inserting a capscrew with a washer into the hole in the end of the suction bell and then into the threaded hole in the end of the shaft.

4. Install the impeller:
   a) Slide the first impeller over the shaft until it seats on the suction bell.
   b) Insert a screwdriver into the slot in the taper collet, spread the slot, and slide the collet over the pump shaft.
   c) Hold the impeller against the bowl and slide the collet into the impeller hub.
5. Hold the shaft with a capscrew and washer against the suction bell and drive the taper collet into place with a collet driver.



1. Shaft
2. Collet
3. Impeller
4. Location to hold impeller against the bowl and drive collet into impeller hub
5. Collet driver assembly position

6. After collet is in place, recheck the X dimension.
7. Slide the intermediate bowl onto the shaft and secure it with the capscrews provided.
8. Repeat preceding procedure for number of stages required.
9. Remove the capscrew and washer and make sure of the following:
   - The shaft rotates freely without dragging or binding.
   - There is adequate lateral end play.

Install the keyed bowl assembly

1. Install the key into the keyway of the pump shaft, slide the impeller over the shaft, and position the impeller on the key.
2. Install a split-thrust ring on the pump shaft groove and secure it to the impeller with capscrews.
3. Slide an intermediate bowl over the pump shaft and secure it to the suction bell with capscrews.
4. Repeat these steps for the number of stages required.

Pump shaft setup dimensions

The size of the pump is stated on the nameplate and on the Certified Pump Outline Drawing.

Pump size	X dimension (inches)	X dimension (millimeters)
4D	1.31	33.27
6A	1.37	34.80
6D	1.37	34.80
6J	1.37	34.80
7A	1.37	34.80
8A	1.37	34.80
8D	1.37	34.80
8J	1.37	34.80
9A	1.37	34.80
10A	1.75	44.45
10D	1.75	44.45
10J	1.75	44.45
10L	2.12	53.85
11A	2.12	53.85
12D	2.25	57.15
12J	2.12	53.85
14D	2.75	69.85
14H	2.75	69.85
14J	2.75	69.85
16D - Bell	1.75	44.45
16D - Bowl	2.75	69.85
18H	2.75	69.85
20H	0.87	22.10
28T	4.50	114.30
36T	6.25	158.75

Troubleshooting

Operation troubleshooting

Symptom	Cause	Remedy
Pump does not start.	The electrical circuit is open or not complete.	Check the circuit and make any necessary corrections.
	The impellers are binding against the bowls.	Reset the impeller adjustment. See Installation for details.
	The electric driver is not receiving enough voltage.	Make sure that the driver is wired correctly and receiving full voltage.
	The motor is defective.	Consult an ITT representative.
The pump is not delivering liquid.	The bowl assembly is not submerged enough.	Adjust the liquid level in the sump as necessary.
	The suction strainer is clogged.	Remove the obstructions.
	There is an obstruction in the liquid passage.	Pull the pump and inspect the impeller and bowl.
	The discharge head is not properly vented.	Open the vent.
The pump is not producing the rated flow or head.	The impellers are not rotating fast enough.	Make sure that the driver is wired correctly and receiving full voltage.
	The impellers are rotating the wrong direction.	Make sure the impellers are spinning counterclockwise when viewed from above. Check the engagement of the motor coupling.
	The total pump head is too high.	Check the pipe friction losses. Use larger discharge piping.
	The liquid passages are partially obstructed.	Inspect the impellers and bowls and remove any obstructions.
	There is cavitation.	Insufficient NPSH is available.
	The impellers are too high (semi-open construction only).	Reset the impeller adjustment. See Installation for details.
There is not enough pressure.	The impellers are not rotating fast enough.	Make sure that the turbine is receiving full steam pressure.
	The liquid passage is obstructed.	Inspect the impellers and bowls and remove any obstructions.
	The impellers are rotating the wrong direction.	Make sure the impellers are spinning counterclockwise when viewed from above. Check the engagement of the motor coupling.
	The impellers are too high (semi-open construction only).	Reset the impeller adjustment. See Installation for details.
The pump starts and then stops pumping.	Excessive power is required.	Use a larger driver. Consult an ITT representative.
	The pump is pumping a higher viscosity or different specific gravity liquid than it was designed to handle.	Test the liquid for viscosity and specific gravity. Consult an ITT representative.
	Critical parts have experienced mechanical failure.	Check the bearings, wear rings, and impellers for damage. Any irregularities in these parts will cause a drag on the shaft. Replace any damaged parts as necessary.
	The impellers are rotating too fast.	Check the frequency on the motor.
	The pump and driver are misaligned.	Realign the pump and driver.
	The discharge head is not properly vented.	Open the vent.

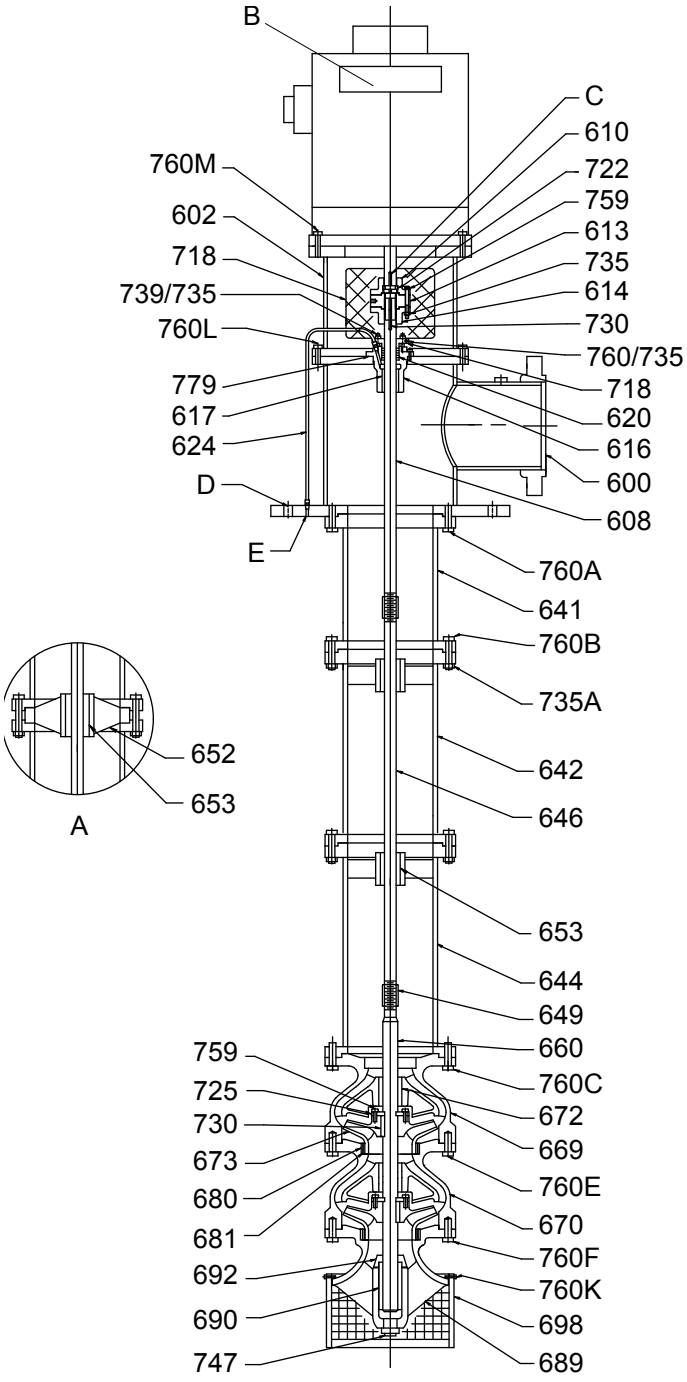
Symptom	Cause	Remedy
The pump requires excessive power.	The impellers are damaged.	Inspect the impeller for damage and replace it if necessary.
	A foreign object is lodged between the impeller and the bowl.	Remove the object.
	The liquid is heavier than expected.	Check the specific gravity and viscosity.
	The liquid viscosity is too high or the pumped fluid is partially freezing.	Check for both conditions. They can cause drag on the impeller. Consult an ITT representative.
	The bearings are defective.	Replace the bearings and check the shaft or shaft sleeve for scoring.
	The stuffing-box packing is too tight.	Release the gland pressure and retighten. Keep the leakage flowing. If there is no leakage, then check the packing, sleeve, or shaft. See Maintenance for details.
The pump is noisy.	The pump is cavitating.	Increase the liquid level in the sump.
	The shaft is bent.	Straighten as necessary.
	Rotating parts are binding, loose, or broken.	Replace parts as necessary.
	The bearings are worn.	Replace the bearings.
	The discharge head is not properly vented.	Open the vent.
The pump is vibrating excessively.	One of these conditions might exist: • The coupling is misaligned. • The shaft is bent. • The impellers are not balanced. • The bearings are worn. • There is cavitation. • There is strain on the discharge piping. • There is resonance.	Determine the cause by using a vibration frequency analyzer or by disassembling the pump. A complex problem might require the assistance of an ITT representative.
	The driver shaft is not adjusted properly.	Readjust the driver. See Installation for details.
There is excessive leakage from the stuffing box.	The packing is defective.	Replace any packing that is worn or damaged.
	The wrong kind of packing was used.	Consult an ITT representative.
The stuffing box is overheating.	The packing is too tight.	Release the gland pressure and retighten. Keep the leakage flowing. If there is no leakage, then check the packing, sleeve, or shaft. See Maintenance for details.
	The packing is not lubricated.	Release the gland pressure and replace any packing that is burned or damaged. Regrease the packing as necessary.
	The wrong grade of packing was used.	Consult an ITT representative.
	The stuffing box was improperly packed.	Repack the stuffing box.
The packing wears out too fast.	The shaft or shaft sleeve is worn or scored.	Remachine or replace any parts as necessary.
	There is insufficient leakage across the packing.	Repack the stuffing box and make sure that the packing is loose enough to allow some leakage.
	The stuffing box was improperly packed.	Repack the stuffing box properly, making sure that all old packing is removed and the stuffing box is clean.
	The wrong grade of packing was used.	Consult an ITT representative.

Symptom	Cause	Remedy
The mechanical seal leaks.	The seal faces are not flat due to the gland bolts being too tight, causing warpage of the gland and insert.	Remove the gland bolts and then reinstall them properly.
	The shaft packing has been chipped during installation.	Replace the packing.
	One of these conditions exists: • The carbon insert is cracked. • The insert face or seal ring was chipped during installation.	Remove the mechanical seal, inspect, and replace as necessary.
	The seal faces are scored from foreign particles between the faces.	Install a strainer, and then filter or cyclone the separator as required to filter out any foreign particles.
The seal squeals during operation.	There is an inadequate amount of liquid at the seal faces.	A bypass flush line is necessary. If a bypass line is already in use, then enlarge it to produce more flow.
Carbon dust is accumulating on the outside of the gland ring.	There is an inadequate amount of liquid at the seal faces.	Bypass the flush line. If a bypass line is already in use, then enlarge it to produce more flow.
	Liquid film is flashing and evaporating between the seal faces and leaving residue, which is grinding away the carbon.	Consult an ITT representative.
The seal leaks but nothing appears to be wrong.	The seal faces are not flat.	Relap or replace the seal faces.
The seal is wearing out too quickly.	Product is abrasive, causing excessive seal face wear.	Determine the source of the abrasives and install a bypass flushing to prevent abrasives from accumulating in the seal area. Install a cyclone separator as necessary.
	Abrasives are forming due to the process liquid cooling and crystallizing or partially solidifying in the seal area.	Install a bypass flush line to hold the liquid temperature around the seal above the crystallization point.
	The seal is running too hot.	Check for possible rubbing of the seal components. Recirculation or a bypass line may be necessary.
	The wrong kind of seal was used.	Consult an ITT representative.

Parts Listings and Cross-Sectional Drawings

VIT FF product lube

This image shows the VIT-FF with motor support (two-piece head construction):



This pump has these features:

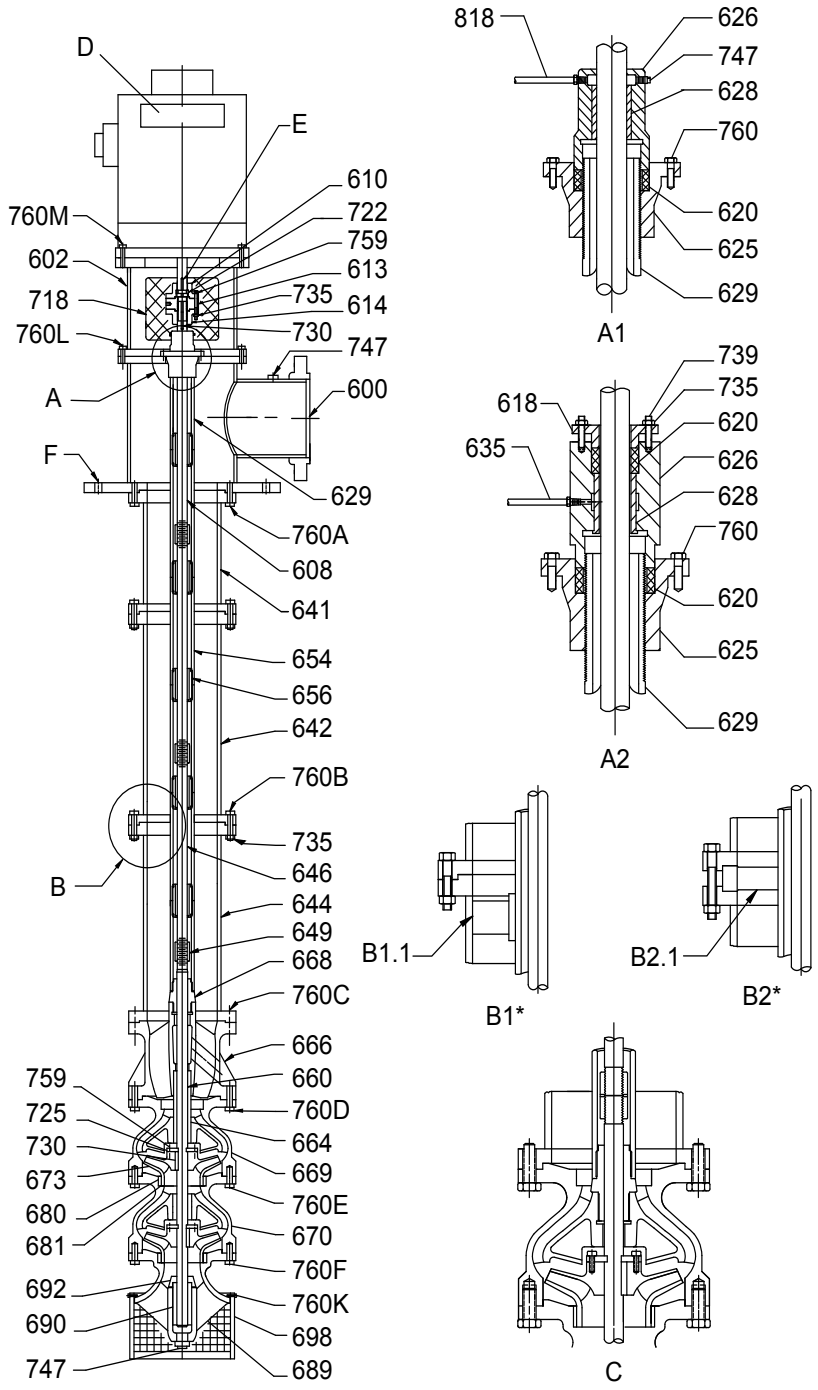
- Flanged adjustable coupling
- Standard stuffing box

- Flanged column with integral bearing retainer and lineshaft bearing
- Bowl assembly:
  - Keyed impellers
  - Bowl and impeller wear rings
  - Strainer (basket type)

Label	Part name
A	Optional, on duplicate pumps
B	VSS motor
C	Motor key, supplied by the motor vendor
D	Mounting holes
E	Bypass, return to sump
600	Head
602	Motor support
608	Headshaft
610	Hub motor
613	Adjusting plate
614	Pump hub
616	Stuffing box
617	Bearing
620	Packing
624	Bypass line assembly, tube and fitting
641	Top column
642	Intermediate column
644	Bottom column
646	Lineshaft
649	Lineshaft coupling
652	Bearing retainer
653	Lineshaft bearing
660	Pump shaft
669	Top bowl
670	Intermediate bowl
672	Bowl bearing
673	Impeller
680	Bowl wear ring
681	Impeller wear ring
689	Suction bell
690	Suction bearing
692	Sand collar
698	Basket type strainer
718	Coupling guard
722	Retaining ring
725	Thrust ring
730	Key

Label	Part name
735	Hex nut
739	Stud
747	Pipe plug
759	Socket head capscrew
760	Capscrew
760A	Column/head capscrew
760B	Column/column capscrew
760C	Column/bowl capscrew
760E	Bowl/bowl capscrew
760F	Bowl/bell capscrew
760K	Strainer capscrew
760L	Support head capscrew
779	Gasket

VIT FF enclosed lineshaft



Label	Part name
A	Tension plate, oil lube and water flush
A1	Tension plate – oil lubricated
A2	Tension plate – water flushed
B	Tube stabilizer
B1	Tube stabilizer
B1.1	Integral tube stabilizer (welded to column)

Label	Part name
B2	Tube stabilizer
B2.1	Tube stabilizer (optional on duplicate pumps)
C	32 in. (81 cm) and larger bowl assembly (with flush only)
D	VSS motor
E	Motor key, supplied by motor vendor
F	Mounting holes
600	Head
602	Motor support
608	Headshaft
610	Hub motor
613	Adjusting plate
614	Pump hub
618	Gland
620	Packing
625	Tension plate
626	Tension nut
628	Bearing
629	Tube nipple
635	Line assembly, water flush
641	Top column
642	Intermediate column
644	Bottom column
646	Lineshaft
649	Lineshaft coupling
654	Enclosed tube
656	Bearing tube
660	Pump shaft
664	Bearing throttle
666	Discharge bowl
668	Bearing adapter
669	Top bowl
670	Intermediate bowl
673	Impeller
680	Bowl wear ring
681	Impeller wear ring
689	Suction bell
690	Suction bearing
692	Sand collar
698	Basket type strainer
718	Coupling guard
722	Retaining ring

Label	Part name
725	Thrust ring
730	Key
735	Hex nut
739	Stud
747	Pipe plug
759	Socket head capscrew
760	Capscrew
760A	Column/head capscrew
760B	Column/column capscrew
760C	Column/bowl capscrew
760D	Bowl/discharge bowl capscrew
760E	Bowl/bowl capscrew
760F	Bowl/bell capscrew
760K	Strainer capscrew
760L	Support head capscrew
760M	Motor/support capscrew
818	Lubricator assembly
Stabilizers provided: • Every 10 ft. (3 m) up to 40 ft. (12 m) of column • Every 40 ft. (12 m) over 40 ft. (12 m) of column	

Local ITT Contacts

Regional offices

Region	Address	Telephone	Fax
North America (Headquarters)	ITT - Goulds Pumps Vertical Products Operation 3951 Capitol Avenue City of Industry, CA 90601–1734 USA	+1–562–949–2113	+1–562–695–8523
Asia Pacific	ITT Industrial Process 10 Jalan Kilang #06-01 Singapore 159410	+65–627–63693	+65– 627–63685
Europe	ITT - Goulds Pumps Millwey Rise Industrial Estate Axminster, Devon, England EX13 5HU	+44–1297–630250	+44–1297–630256
Latin America	ITT - Goulds Pumps Camino La Colina # 1448 Condominio Industrial El Rosal Huechuraba – Santiago 8580000 Chile	+562–544–7000	+562–544–7001
Middle East and Africa	ITT - Goulds Pumps Achileos Kyrou 4 Neo Psychiko 115 25 Athens Greece	+30–210–677–0770	+30–210–677–5642

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www.ittindustrialproducts.com/feedbacksurvey.html

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Contact Us

Goulds Pumps has offices, warehouses and manufacturing facilities worldwide, while doing business in over 100 countries in the Americas, Europe, the Middle East and Asia Pacific. To find your nearest distributor, use our convenient Sales and Service Locator found on our Web site.

Visit our Web site for the latest version of this document and more information
www.gouldspumps.com

ITT - Goulds Pumps Vertical Products Operation
3951 Capitol Avenue
City of Industry, CA 90601-1734
USA
Tel. (562) 949-2113
Fax (562) 695-8523

VENDOR LITERATURE COVER SHEET

Vendor Name: Pompe Garbarino S.p.A.

Equipment Description: Pump, Vertical, 27CMH, 50m

STDN Part Number: SD004111-250

Manufacturer Part Number: MU 40-200 VS

Liquid: Seawater
SG: 1.025
Temperature: 11.5/26 deg. C

DUTY

Capacity: 27 m3/hr Normal
Head: 50 m (Water Column)
Speed: 2900 RPM
Installed Power: 15 KW

MATERIALS
Casing/Impeller, Column Line, and Shaft/Sleeves: SAF 2205.
Foundation Plate: 316L SS

Motor frame: carbon steel.

MOTOR

Manufacturer: ABB

IEC / CE stamped and rated.
Motor Power minimum 1.1 times absorbed power.
No. Poles: 2
Frame: VI
RPM: 2900
Power: 15 KW
400 V, 50 Hz, 3 phase.
Insulation Class F.
IP55

POMPE
GARBARINO S.p.A.

INSTALLATION , USE AND MAINTENANCE MANUAL

THIS MANUAL IS TO BE READ BY ALL PERSONNEL OPERATING THE MACHINE

Data, drawings and technical characteristics are the sole property of

" POMPE GARBARINO S.p.A. "

CUSTOMER : SEVERN TRENT DE NORA
ORDER : D005499
HULL : LAVRION V-CCP
PUMP TYPE : MU 40-200 VS
SERVICE : SEAWATER PUMPS
JOB : 470389

N. 470389MG01

N. 470389 DS 01 /A

Pompe Garbarino S.p.A

OFFER N. 04107-2-rev. DATE 14.07.04 pag. 2

VERTICAL CENTRIFUGAL PUMP TYPE: MU 40-200 VS

Q.ty 3 Item:

Liquid		: sea water
Specific gravidity	kg./dm3	: 1.025
Viscosity	CPS	: 1
Temperature	°C	: 11.5/26
DUTY		
Capacity	m3/h	: 27
Head	m.c.l.	: 50
Speed	RPM	: 2900
Pump efficiency	%	: 50
Absorbed power	Kw.	: 7.6
Max. absorbed power	Kw.	: 11
Installed power	Kw.	: 15
Rotation (view from motor)		: C.W.
CONSTRUCTION		
Pump	type	: MU 40-200 vertical
Impeller	n./type	: 1/closed
Coupling	type	: elastic
Seal	type	: seal ring
Bearing*	type	: ball/bushing
Lubrication		: grease/pumped liquid
LENGTH (with filter)	mm.	: 5.350
A Min. submergence	mm.	: 300
MATERIALS		
Casing/Impeller		: SAF 2205
Column line		: SAF 2205
Shaft/Sleeves		: SAF 2205
Foundation plate/motor frame		: S.S. 316 L / C.STEEL

MOTOR: Electric Constructor: ABB

Frame: VI N.Poles: 2 RPM: 2900 Power Kw: 15

Volts: 400 Hz.: 50 Insul.: cl.F. Prot.: IP55

Type: I.E.C. Tropical.: NO EEXD: NO

ACCESSORIES	MATERIALS
Foundation plate	1) S.S. 316L
Foundation bolts	2) S.S. 316L
Strainer / Delivery flange DN 2" Ansi 150 RF	3) S.S. 316L / SAF 2205

PUMP NET PRICE each €.

EL. MOTOR NET PRICE each €.

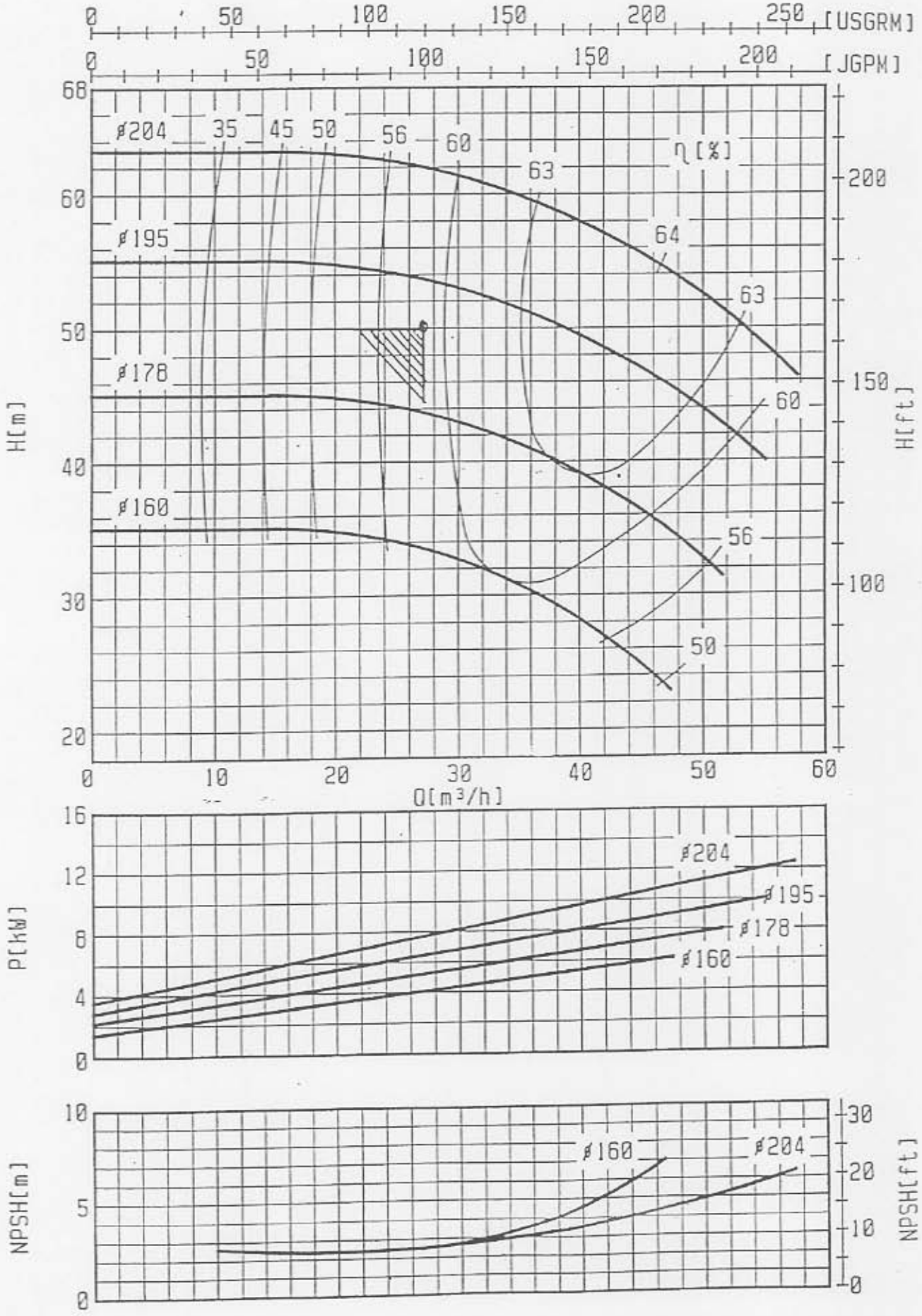
NET PRICE FOR ORDER PUMP+MOTOR each €.

REV. A	FIRMA	DATA
EMESSO	Z.E.	01/10/04
VERIFICATO	Z.E.	01/10/04
APPROVATO		01/10/04

* Ball bearing thrust lubricated with lubricator
Column line bearing lubricated with pumped liquid

POMPE GARBARINO S.p.A. Acqui T.	POMPA CENTRIFUGA MONOSTADIO *SINGLE STAGE CENTRIFUGAL PUMP* DIN 24255	CURVE *CURVES* MU92026/0

POMPA TIPO *PUMP TYPE*	MU 40-200	GIRI/MIN. *R.P.M.*	2900	ps = 1 kg/dm³ v = 1 mm²/s



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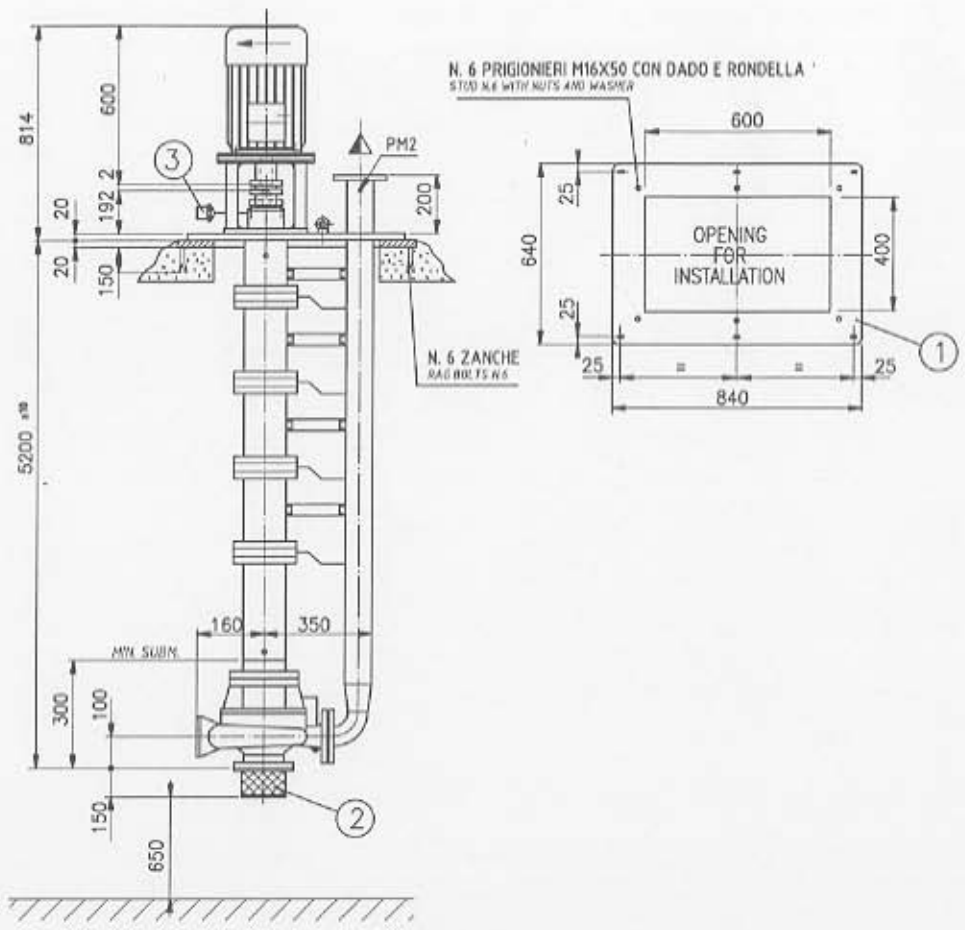
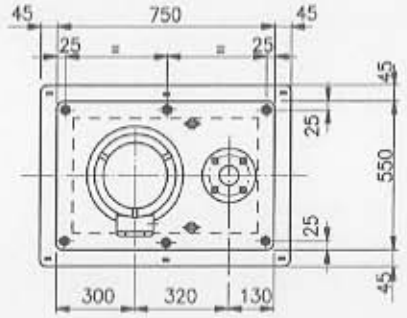




CLIENTE *CUSTOMER*	SEVERN TRENT DE NORA		POMPA TIPO *PUMP TYPE*
IMPIANTO/COSTR. *PLANT/HULL*	LAVRION V-CCPP		MU 40-200 VS
COMM.CLIENTE *JOB*	D004111		QUANTITA' *QUANTITY* 3
ORDINE *ORDER*	D005499		MOTORE ELETT. *ELECTRIC MOTOR*
CONTRASSEGNO *ITEM*			COSTR. *M.F.R.* ABB
NS. COMMESSA *OUR JOB*	470389		TIPO *TYPE* M2QA160MB2
SERVIZIO *SERVICE*	SEAWATER PUMPS		POTENZA kW *POWER kW* 15
FL.ASPIRAZIONE *SUCTION FLANGE*	FL.MANDATA *DISCHARGE FLANGE*		V/f/Hz/IP *V/ph/Hz/IP* 400/3/50/55
DN	DN 2" (50)		GIRI/MIN. *R.P.M.* 2900
SERIE *SERIES*	SERIE *SERIES* ANSI 150 RF		PESO MOTORE *MOTOR WEIGHT* kg 122
DIAM.ESTERNO *EXTERNAL DIAM.*	DIAM.ESTERNO *EXTERNAL DIAM.* 152		PESO LANTERNA *MOTOR LANTERN WEIGHT* kg 33
DIAM.CENT.FORI *HOLES CENTER DIAM.*	DIAM.CENT.FORI *HOLES CENTER DIAM.* 121		PESO BASE *BASE WEIGHT* kg 59
NOFORI/DIAM. *NOHOLES/DIAM.*	NOFORI/DIAM. *NOHOLES/DIAM.* 4/19		PESO TUBI E ALBERI *COLUMN-SHAFT-PIPE WEIGHT* kg 277
TENUTA AD ANELLO ☒ *SEALING RING*	PORTATA *CAPACITY* m /h³ 27		PESO POMPA *PUMP WEIGHT* kg 32
TENUTA BADERNA ☐ *SOFT-PACKING SEAL*	PREVALENZA *HEAD* × m 50		PESO C/PIASTRA *COUNTER PLATE WEIGHT* kg 47
TENUTA MECCANICA ☐ *MECHANICAL SEAL*	SUPPORTI INTERM. *INTERM. BUSHES* Q.ty 4		PESO TOTALE *TOTAL WEIGHT* kg 570

× ALLA GIRANTE
× AT IMPELLER

LISTA CONNESSIONI
CONNECTIONS LIST

POS	SERVIZIO *SERVICE*	DN *SIZE*	RATING	NOTE
PM2	ATTACCO PER MANOMETRO *PRESSURE GAUGE CONNECTION*	G 1/4"		TAPPATO *PLUGGED*

LISTA ACCESSORI
ACCESSORIES LIST

POS	DESCRIZIONE *DESCRIPTION*	MATERIALI/NOTE *MATERIALS/NOTES*	Q.TA' *Q.TY*
1	CONTROPIASTRA *COUNTER PLATE*	AISI 316 L	1
2	FILTRO *STRAINER*	AISI 316 L	1
3	INGRASSATORE AUTOMATICO *AUTOMATIC GREASER*	-	1

Tolleranze generali misure non lavorate ISO 2768-c *General tolerances for machined measures ISO 2768-c*	
Misure nominali *Nominal measure* Oltre / *over*	Fino a / *to*
0,5	6
6	30
30	120
120	400
400	1000
1000	2000

Tolleranze *Tolerances*: ± 0.3 | ± 0.5 | ± 0.8 | ± 1.2 | ± 2 | ± 3

POMPE GARBARINO
Acqui Terme - ITALY

ANN. DAL N./DELETE FROM No	EMESSO/PREPARED	VERIFICA/CHECKED	APPROV./APPROVED
SOST. IL N./SUBSTITUTES No		B.R.	E.M.
TAGLIA POMPA/PUMP SIZE Vs 24	COMMESSA JOB 470389		

DISEGNO D'INGOMBRO E/POMPA TIPO MU 40-200 VS

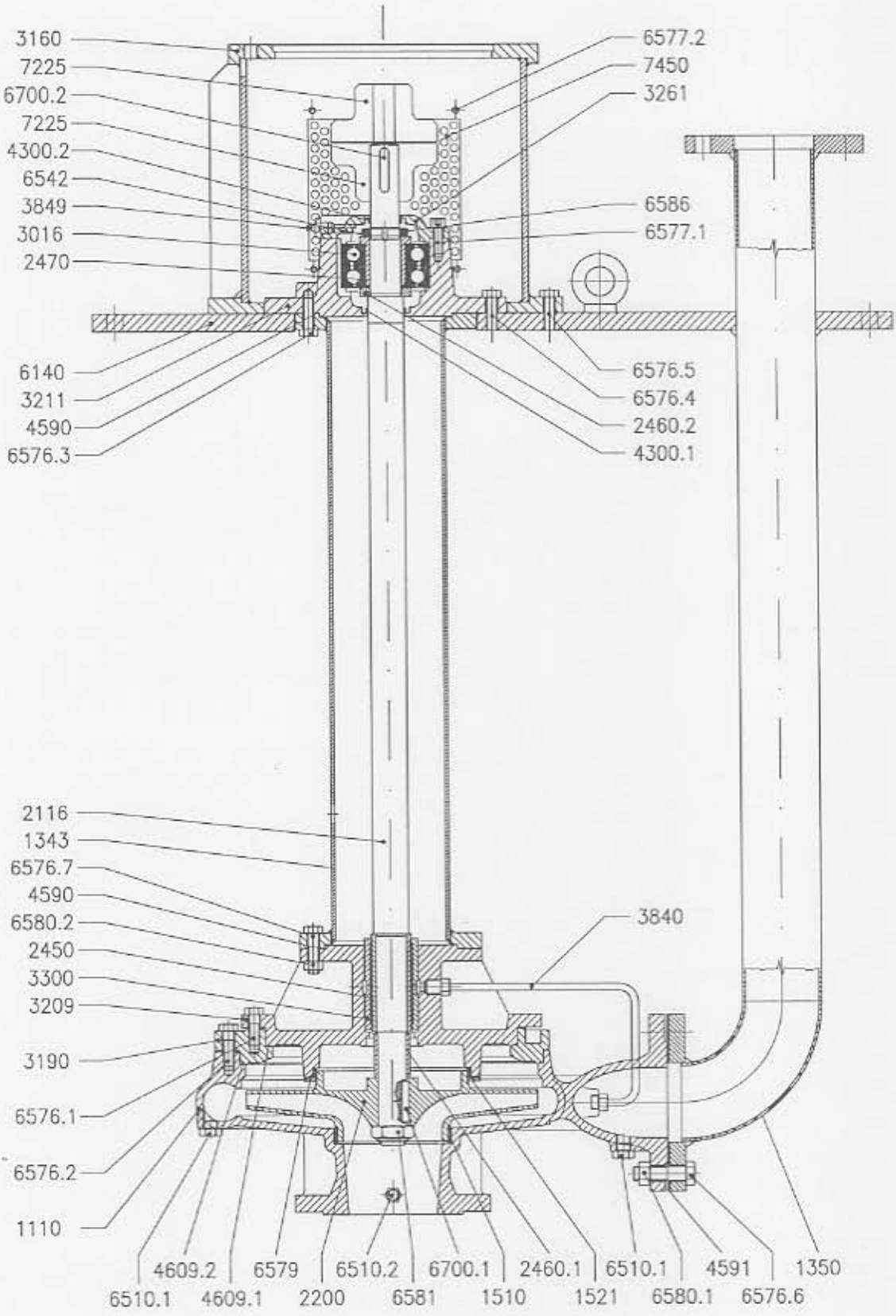
GENERAL ARRANGEMENT E/PUMP TYPE MU 40-200 VS

SERVICE SEAWATER PUMPS

DATA *DATE* 01/10/04

SCALA *SCALE* *NOT IN SCALE DWG*

DIS. N° *No DWG* 14452



N. 4703895201

ELENCO PARTI COMPONENTI TAB. N. 659.
COMPONENT LIST TAB. N. 659

POMPE GARBARINO S.p.A.
Acqui T.

POS.	MODIFICHE		DATA	VIST.
MAT.	PESO kg.	ANNULL. DAL N.	SOST. IL N.	
DIS.	VIST.	DATA 08/04/03		

	FIRMA SIGNATURE	DATA DATE
EMESSO PREPARED		08/04/03
VERIFICATO CHECKED		08/04/03
APPROVATO APPROVED		08/04/03

POMPA CENTRIFUGA TIPO MU-VS

E/P MU 90 - 200 VS

Centrifugal Pump type MU-VS

SCALA —

MODELLO N. 659

DIS. N. 13261-S

POMPE GARBARINO S.p.A.	Lista Parti *Part List*	No Distinta *Parts List No*	No Sezione *Section No*	No Tabella *Table No*
		VUMU.659	13261-S	659

POMPA TIPO / Pump type **MU** 40-200 **VS**

N. 470389 D01

Versione TENUTA AD ANELLO
Version SEAL RING

Pos.	Descrizione / *Description*	No	Note	Mat.
1110	Corpo pompa *Pump Casing*	1		
1343	Tubo guida portante lato pompa *Column, pump side*	1		
1350	Tubo premente *Column pipe*	1		
1510	Anello di usura del corpo lato aspirante *Casing wear ring,suction side*	1		
1521	Anello di usura *Wear ring*	1		
2116	Albero della pompa VS *VS pump shaft*	1		
2200	Girante *Impeller*	1		
2450	Camicia d'albero *Shaft sleeve*	1		
2460.1	Bussola distanziatrice *Spacer sleeve*	1		
2460.2	Bussola distanziatrice *Spacer sleeve*	1		
2470	Bussola di centraggio *Centering sleeve*	1		
3016	Cuscinetto obliquo a sfere *Single row angular contact ball bearing*	2		
3160	Lanterna del motore *Motor stool*	1		
3190	Anello di riduzione *Reduction ring*	1		
3209	Sopporto lato pompa *Bearing housing pump side*	1		
3211	Sopporto lato comando *Bearing housing drive side*	1		
3261	Coperchio del sopporto lato comando *Bearing cover, drive side*	1		
3300	Cuscinetto a boccola *Bearing bush*	1		
3840	Condotto di lubrificazione *Lubricating pipe*	1		
3849	Ingrassatore a sfera dritto *Straight ball greaser*	1		
4300.1	Anello di tenuta sull'albero rotante *Radial shaft seal*	1		
4300.2	Anello di tenuta sull'albero rotante *Radial shaft seal*	1		
4590	Guarnizione piana *Gasket*	2		
4591	Guarnizione piana per flange *Gasket for flange*	1		
4609.1	Corda O-ring *O-Ring string*	1		
4609.2	Corda O-ring *O-Ring string*	1		
6140	Piastra di appoggio *Support plate*	1		
6510.1	Tappo filettato a testa esagonale *Hexagon head screw plug*	2		
6510.2	Tappo filettato a testa esagonale *Hexagon head screw plug*	1		

Data	Rev.	Descrizione	Emesso	Verificato	Approvato
08/04/03	0	EMISSIONE			

POMPE GARBARINO S.p.A.	Lista Parti *Part List*	No Distinta *Parts List No* VUMU.659	No Sezione *Section No* 13261-S	No Tabella *Table No* 659

POMPA TIPO / Pump type **MU** 40-200 **VS**

N. 4703895201

Versione TENUTA AD ANELLO
Version SEAL RING

Pos.	Descrizione / *Description*	No	Note	Mat.
6542	Rosetta di sicurezza per ghiera a tacche *Lockwasher for locknut*	1		
6576.1	Vite a testa esagonale *Hexagon screw*	-		
6576.2	Vite a testa esagonale *Hexagon screw*	-		
6576.3	Vite a testa esagonale *Hexagon screw*	6		
6576.4	Vite a testa esagonale *Hexagon screw*	4		
6576.5	Vite a testa esagonale *Hexagon screw*	4		
6576.6	Vite a testa esagonale *Hexagon screw*	-		
6576.7	Vite a testa esagonale *Hexagon screw*	6		
6577.1	Vite a testa cilindrica esagono incassato *Hexagon socket head screw*	4		
6577.2	Vite a testa cilindrica esagono incassato *Hexagon socket head screw*	8		
6579	Vite a testa svasata piana con intaglio *Slotted countersunk flat head screw*	-		
6580.1	Dado esagonale *Nut*	-		
6580.2	Dado esagonale *Nut*	6		
6581	Dado esagonale autobloccante della girante *Impeller heavy selflocking nut*	1		
6586	Ghiera a tacche *Locknut*	1		
6700.1	Linguetta *Key*	1		
6700.2	Linguetta *Key*	1		
7225	Semigiunto elastico di trasmissione *Half coupling*	2		
7450	Coprigiunto *Coupling guard*	2		

Data	Rev.	Descrizione	Emesso	Verificato	Approvato
08/04/03	0	EMISSIONE			

POMPE GARBARINO S.p.A.	DATI TECNICI	DOC. N. DTVS002	
		POMPE VS	PAG. 1/1

TABELLA LUBRIFICAZIONE — POMPE VS
LUBRICATION TABLE — PUMPS VS

Parti da lubrificare : **CUSCINETTI POS. 3016**
Lubricated parts : *BEARINGS POS. 3016*
Tipo lubrificante : **GRASSO**
Lubricant type: *GREASE*
Tipo di lubrificazione : **INGRASSATORE**
Lubrication type : *GREASER*

Temperatura cuscinetti (°C) *Bearings temperature (°C)*	Tipo di grasso *Grease type*	Grassi suggeriti *Recommended greases*		Q.tà totale *Total q.ty* g	Primo cambio *First change* ore *hours*	Frequenza dei cambi *Change frequency* ore *hours*	Durata massima carica *Charge maximum life* mesi *months*
		Produttore *Manufacturer*	Denominazione *Name*				
<50	NLGI 2	A SHELL	ALVANIA EP LF2	Q Vedi tabella sotto *See below table*	300	5000	12
		B MOBIL	MOBILITH SHC220				
		C BP	MM EP2				
> 50	NLGI 3	D SKF	LGMT 3		300	3000	6
		E SHELL	ALVANIA R3				
		F API	PGX - 3				

Caratteristiche fisiche dei grassi *Greases phisical characteristics*		Tipi di grasso *Grease type*					
		A	B	C	D	E	F
Densità *Density*	kg/dm³	0.86	0.87	0.88	0.89	0.89	0.89
Punto di goccia *Dropping point*	°C	180	250	175	180	185	185
Penetrazione *Penetration*	mm/10	267	280	265÷295	220 ÷ 250	220 ÷ 250	220 ÷ 250
Viscosità olio base *Base oil viscosity*	mm²/s	15.6					

Quantità totale grasso – *Grease total quantity*

Taglia - *Size*	TIPO POMPA-*PUMP TYPE*	Q
MU 24	25-160 / 25-200 / 32-160 / 32-200 / 32-250 / 40-160 / 40-200 / 40-250 / 50-160 / 50-200 / 50-250 / 65-160 / 65-200 / 80-160	25g
MU 32	40-315 / 65-250 / 65-315 / 65-400 / 80-200 / 80-250 / 80-315 / 100-200 / 100-250 / 100-315 / 125-250	30g
MU 42	80-400 / 100-400 / 125-315 / 125-400 / 150-250 / 150-315 / 150-400 / 200-250 / 250-250	50g
MU 55	150-500 / 200-315 / 200-500 / 250-315 / 250-400	80g

Il primo cambio e la frequenza dei cambi sono riferiti alle ore effettive di lavoro.
First change and change frequency are related to real working hours.

REV.	DATA	DESCRIZIONE	EMESSO	VERIFICATO	APPROVATO
0	25/11/02	EMISSIONE	CAROSIO	CAROSIO	MONACI

POMPE
GARBARINO S.p.A.

CE

INSTALLATION, OPERATING AND MAINTENANCE MANUAL

PUMP TYPE

MU-VS MCA-VS

ISO 9001

Certification No. 38329

ANSI · RAB
EMS
QMS
ACCREDITED

Member of CISQ Federation
RINA
ISO 9001:2000
Certified Quality System

POMPE GARBARINO S.p.A.
Via Marenco, 44
15011 Acqui Terme (AL)
ITALY

CONTENTS

1 GENERAL

This operating instruction manual is intended to facilitate the familiarisation with the pump and to better exploit its specific use. Prior to install and operate, following instructions are to be carefully read.
This manual contains installation, start up, maintenance procedures and operating safety prescriptions. It forms integral part of the equipment; therefore it shall be carefully preserved and kept close to the operation site for an easy access of trained personnel.

Pump is to be operated according to the contractual data-sheet. Pompe Garbarino declines the responsibility against improper use and unauthorised modifications.

The present manual reflects the technical status of the equipment at the time of its acquisition and it will not be updated with future design modifications/improvements.
Special arrangements and manufacturing variation can differ from the descriptions of this manual. Drawings are to be considered as indicative and are not binding. When available always use attached documentation.
For any additional information or queries, please do not hesitate to contact Pompe Garbarino (info@pompegarbarino.it).

2 SAFETY

Safety prescriptions indicated in this manual shall always comply during any intervention on the equipment in addition to the inner regulations of the Company and the existing National standards in force in terms of accident prevention.

Customer is responsible of the compliance with all existing local safety standards. Non-observance of outlined safety instructions may jeopardise the safety of personnel, environment and equipment itself.

2.1 Prescriptions

You shall always follow below listed instructions:

- Use the pump only according to the specifications detailed in the data sheet.
- Interventions are to be carried out by authorised personnel only.
- Ascertain on first aid and fire fighting devices location.
- Do not work when pipes are under pressure
- Intervention on the machine shall be carried out only with power shut-off.
- In case of hot liquid, operate only after pump is cooled off.
- Always reset safety protections

2.2 Dangers

Customer/operator must provide all necessary safety guards and signs in case temperature of fluid handled be such so as to pose a hazard or in case of toxic/and or explosive liquids.
Some pump components may under particular circumstances cause dangers:

- lubricants: eyes / skin irritation
- plastic/rubber parts: fumes in case of overheating
- paint fumes during working.

2.3 Simbols

The safety instructions contained in this manual whose non-observance might cause hazards to persons and equipment are specially indicated with following signs:

General danger

Voltage danger

Liquid pressure

3 GUARANTEE

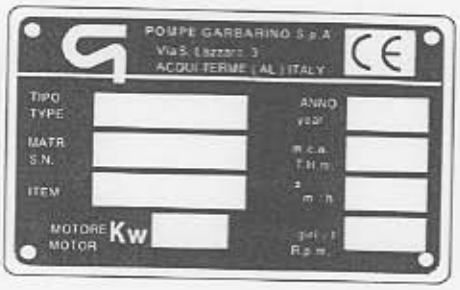
Pompe Garbarino grants a warranty period of 12 months of operation, but not exceeding 18 months from delivery date. Guarantee covers defective parts exclusively, the sole supply of replacing spares and does not include dismantling, reassembling and freight costs. For those components not manufactured by Pompe Garbarino, sub-supplier guarantee conditions shall apply.
Guarantee invalidates in case pump be modified or altered without authorisation or in case of use of parts other than the original ones.
Any other clause specially agreed in the purchase order deletes and supersedes above stated conditions.

4 DESIGNATION

Each pump is delivered with a designation plate showing following data:

- Model
- Serial number
- Tag/Item
- Year of manufacture
- Differential head in *meters water column* (m.w.c.– m.c.a.– m.c.l.)
- Capacity (m^3/h)
- Motor power (kW)
- Motor speed (rpm)

Serial number identifies every single pump. You shall use it as reference for any communication with Pompe Garbarino.



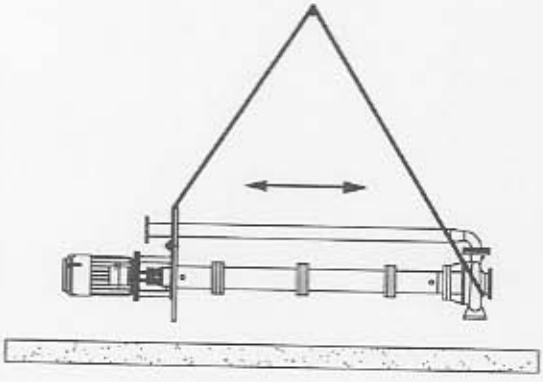
5 HANDLING AND STORAGE

5.1 Handling

Handling of the machine shall be carried out by qualified and authorised personnel only.
Before starting, check whether packing or pump show any particular handling instructions.
Use crane, ropes, slings and lifting means suitable to the weight and dimensions of the pump.

Due to the length of the pump, improprer handling operation can cause distorsion to the column and to line-shaft.

Pump must be moved horizontally as per following picture. Do not lift the pump with fork truck, use always mobile crane and lifting ropes.



5.2 Storage

Pump is to be stored in a closed and dry room. Connections must be plugged and the unit covered with waterproof material.
If stored outdoor, let the pump inside its packing and provide a suitable waterproof cover.

5.3 Preservation for long lasting storage

When the unit is put into storage for more than 6 months, use suitable rust preventers to preserve inner metal components.
Spray preservers through suction flange, especially in the area of wear rings.

After the treatment, suction and discharge bores as well as all other connections must be plugged. All surfaces of the pump can be oiled or greased against corrosion.

Once a month rotate the pump shaft by hand in the working direction.

To perform this operation is possible to turn the impeller through the suction nozzle or the coupling.

6 GENERAL DESCRIPTION

General aspects common to various pump families are hereinafter described. Refer to specific documentation and manual particular paragraphs for a peculiar pump description.

6.1 Noise

Motor Size	Noise pressure level dBA			
	Pump + motor			
	50 Hz		60 Hz	
	2 poles	4 poles	2 poles	4 poles
80	65	53	69	57
90	72	57	75	61
100	73	59	77	63
112	73	59	77	63
132	73	65	77	69
160	81	68	84	72
180	81	75	84	79
200	83	75	87	79
225	87	77	91	81
250	87	77	91	81
280	87	80	91	84
315	87	81	91	85

Above data are average indicative values measured above ground at 1 meter distance according to curve A - ISO R 1680. Tolerance 3 dBA must be considered. Data can vary depending on the motor brand and on specific pump application.

6.2 Special versions

Vertical pump can be different from standardard configuration in casa of special application.

6.2.1 Various driving units

For pumps driven by any other type of motor (hydro, compressed air, hydraulic) also refer to attached specific instructions and to the indications listed on general arrangement drawing.

6.2.2 Explosion proof – ATEX version

Upon specific request of Customer, pump can be manufactured with explosion-proof motor for use in hazardous area. Group, temperature class and

protection type of the motor are selected according to the information given by Client.

Prior to install the pump in a hazardous area, make sure it is suitable for the specific explosive atmosphere.

For European market machinery for hazardous area must be conform to EU Directive 94/9/9EC (ATEX Directive). ATEX pumps are identified by Ex symbol stamped on nameplate. For these pumps refer also to the additional instruction enclosed in this manual.

Maintenance operation on explosion proof motors must be performed following relative instruction manual.

7 DESIGN CHARACTERISTICS

7.1 General

Vertical line-shaft pump with side discharge, baseplate and external motor driven.
Operating sectors: industrial, chemical, petrochemical, power plants.
Liquids handled: fresh water, sea water, steam condensate, oil, chemical and petrolchemical products, waste water, others.
Materials, construction and arrangement changes according to the specific application.

7.2 Designation

MU	32	-	160	VS
1	2		3	4

1	Pump type: MU = closed impeller MCA = open impeller
2	Casing delivery nozzle
3	Impeller nominal diameter
4	Vertical Sump pump

MU-VS pumps are destined for use with clean or lightly contaminated liquid.
MCA-VS pumps are destined for use with dirty liquid with high content of solid, even of big dimension.
Difference between the two type of pumps are only in the casing and impeller arrangement; column, line-shaft, drive arrangement are similar.
Pump with same designation can be different in performance, materials, lenght and components. For comunication to Pompe Garbarino use always designation and serial number.

7.3 Size

Gr	Size	Gr	Size.
24	MU 25-160 MU 25-200 MU 32-160 MU 32-200 MU 32-250 MU 40-160 MU 40-200 MU 40-250 MCA 50-125 MCA 50-140 MU/MCA 50-160 MU 50-200 MU 50-250 MU 65-160 MU 65-200 MU/MCA 80-160	42	MCA 80-335 MU 80-400 MCA 100-280 MCA 100-335 MU 100-400 MU 125-315 MU 125-400 MU 150-250 MCA 150-280 MU 150-315 MCA 150-335 MU 150-400 MU 200-250
32	MU 40-315 MCA 50-200 MCA 50-250 MCA 50-280 MU 50-315 MU 65-250 MU 65-315 MU 65-400 MU/MCA 80-200 MU/MCA 80-250 MCA 80-280 MU 80-315 MU/MCA 100-200 MU/MCA 100-250 MU 100-315 MU 125-250 MCA 150-250	55	MU 150-500 MU 200-315 MU 200-500 MU 250-250 MU 250-315 MU 250-400

Each group (24-32-42-55) has common components for high interchangeability and easy maintenance. See following paragraphs for details.

7.4 Construction details

Pump Centrifugal, single stage, vertical line-shaft with side discharge.
Casing Radially split, volute casing with flanged nozzle. Bottom suction and side discharge.
Impeller. MU-VS pump: overhung closed impeller with balancing holes. MCA-VS pumps: overhung open impeller with balancing back rigs.
Wear rings. (Only for MU-VS pumps) Fitted on casing and pump cover. MCA-VS pumps have not wear rings.
Support. The line-shaft is supported by thrust double ball bearings (7000 series) on drive end and by radial bushings along the line-shaft (the number of bushings depends by the pump lenght). Bushings are in special materials selected for the specific application.
Shaft seal. Radial lip seal, gland packing or mechanical seal (standard DIN 24960 or special type).
Motor stool. High strength design for low motor vibration. Opening is provided for checking and

maintenance operation. Standard material carbon steel, other materials on demand.

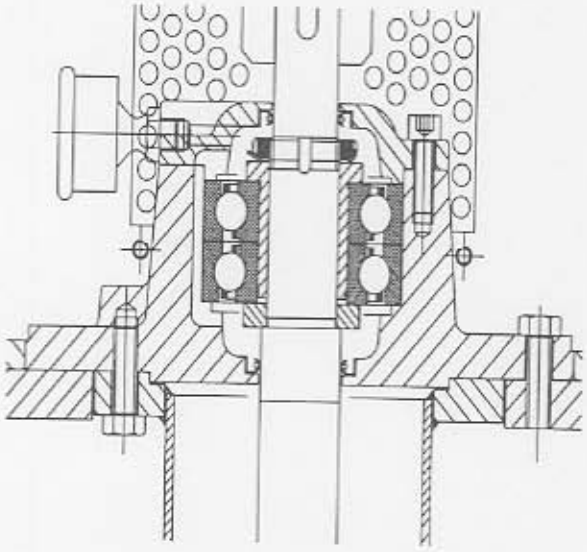
Baseplate. Heavy carbon steel baseplate for pump support. Other materials on demand. Circular flange baseplate (according to UNI/DIN NP 10-16, ANSI 150-300) for tank nozzle installation.

Material of each parts can change on the basis of specific pump application. Check data-sheet for details.

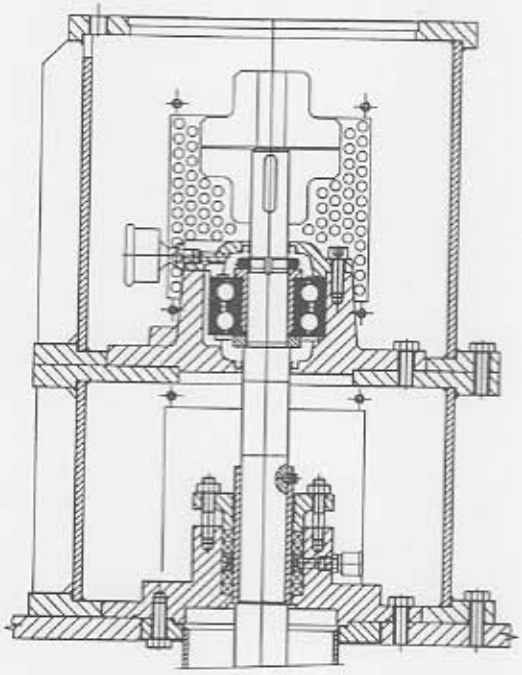
7.5 Shaft seal

7.5.1 Radial lip seal

The shaft seal is made with a radial lip seal installed at the top of column. Material is selected according to the pumped liquid (NBR, Viton, EPDM, Teflon).



7.5.2 Soft packing



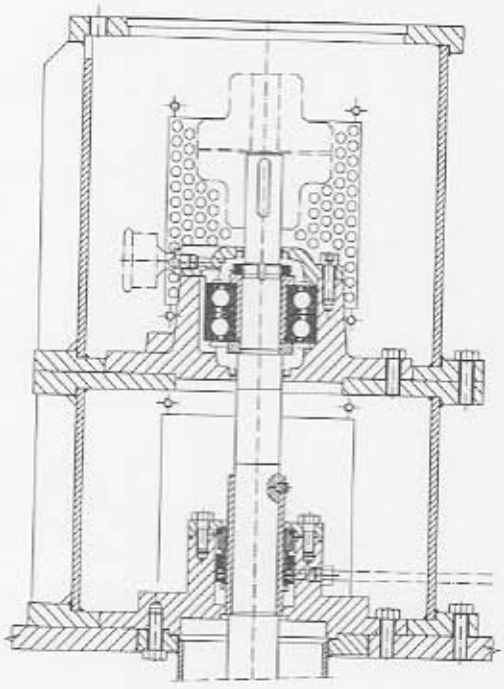
Shaft sealing is obtained by means of compression of various packing rings of specific material fitted into the stuffing box. Shaft is protected by sleeve. Is possible to adjust compression by tightining the nuts of packing cover. Excessive compression can cause overheating of the stuffing box and fast wear of the sleeve.

Usually soft-packing is grease lubricated by mean of external nipple for manual regreasing or by automatic greaser (in this case refer to specific instruction for its adjustment).

7.5.3 Single mechanical seal DIN 24960

Usually mechanical seal is installed when hermetic sealing of vapours/gas is required or when the pump is installed on a pressurized tank.

A mechanical seal consists of two surfaces: one stationary and one rotating, sliding face to face. Liquid sealing is also obtained with o-ring between the static part (seat) and its housing and with rubber bellow or o-ring between rotating part and shaft. One or more springs assure the contact between the two faces.



Single mechanical seal is a DIN 24960 type. So is possible to install on the pump every mechanical seals compliant with this standard.
The big range of applications brings to various design features and materials of the mechanical seals, but the operating principle remains the same.
Mechanical seal need continuos liquid lubrication to avoid overheating of the faces. Lubrication liquid can be the same pumped liquid only if it is clean. In this case pump is already arranged with lubrication tubing between delivery pipe and seal housing. On the cases strainer or cyclon can be used on lubrication line.
In case of dirty pumped liquid, lubrication of mechanical seal must be done with external clean water. See general arrangement drawing for indication about flow and pressure.

Mechanical seal always need liquid lubrication

7.5.4 Special mechanical seals

Pump can be equipped with special mechanical seals, i.e. double with fluid barrier, single cartridge type, single with water/steam quench and so on.
Refer to the general arrangement drawing for connection and to specific documentation.

8 Bearings and bushings

8.1 Bearings

Pumps have thrust double ball bearings (7000 series) on drive end above the baseplate.
Bearings are grease lubricated by means of a grease nipple or a Stauffer greaser.

Bearings and grease quantity			
Gr	Size	Bearings	Grease (g)
24	MU 25-160 MU 25-200 MU 32-160 MU 32-200 MU 32-250 MU 40-160 MU 40-200 MU 40-250 MCA 50-125 MCA 50-140 MU/MCA 50-160 MU 50-200 MU 50-250 MU 65-160 MU 65-200 MU/MCA 80-160	2×7308	50
32	MU 40-315 MCA 50-200 MCA 50-250 MCA 50-280 MU 50-315 MU 65-250 MU 65-315 MU 65-400 MU/MCA 80-200 MU/MCA 80-250 MCA 80-280 MU 80-315 MU/MCA 100-200 MU/MCA 100-250 MU 100-315 MU 125-250 MCA 150-250	2×7309	60
42	MCA 80-335 MU 80-400 MCA 100-280 MCA 100-335 MU 100-400 MU 125-315 MU 125-400 MU 150-250 MCA 150-280 MU 150-315 MCA 150-335 MU 150-400 MU 200-250	2×7312	95
55	MU 150-500 MU 200-315 MU 200-500 MU 250-250 MU 250-315 MU 250-400	2×7316	160

For regreasing intervals see maintenance chapter.

8.2 Bushings

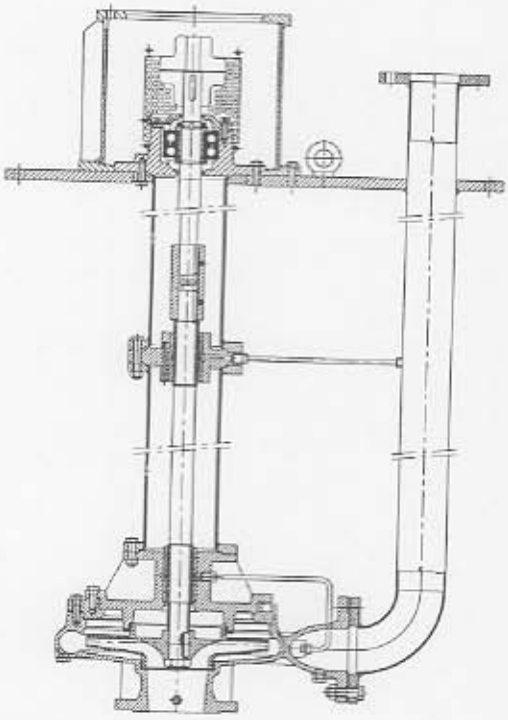
Since the pump has considerable length, line shaft has several radial supports done by bushing (plain bearing). Bushings materials are selected in the basis of pumped liquid, temperature, solid suspended and so on.
Bushings are mounted into the intermediate supports and in casing support and their number change according to the pump length. Shaft is

protected from sliding wear by mean a sleeve in special stainless steel.
Shaft bushings need always lubrication to avoid overheating and fast wear of the material. Lubrication system is selected according to the specific pump application in order to give the best pump realibilty. For any details refer to the general arrangement drawing.

8.3 Lubrication by pumped liquid

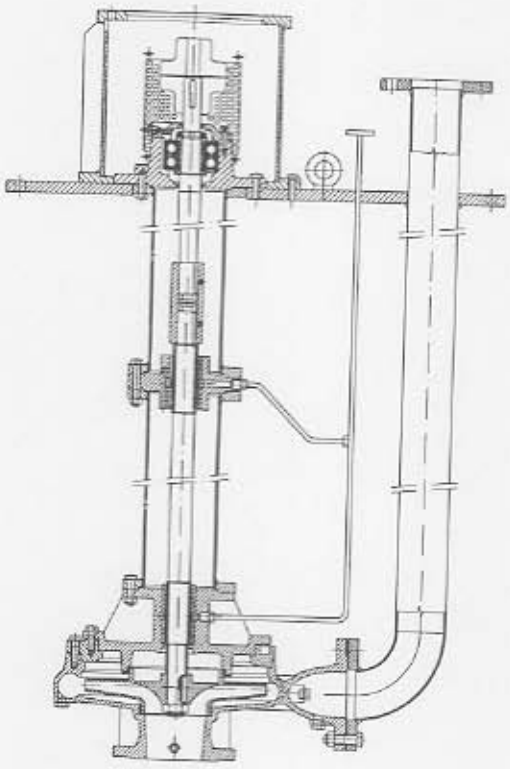
When pump is used for transfer clean liquid, the same pumped liquid lubricates the bushings. Each bushing is connected to the discharge pipe with lubrication tubing. Lubrication liquid is then drained to the tank through the drain hole of the column (bottom side).

Dirty liquids or suspended solids cause fast wear of the bushings. Since lubrication system is selected only on the basis of customer technical documentation, is important to check the liquid on site before pump start-up.



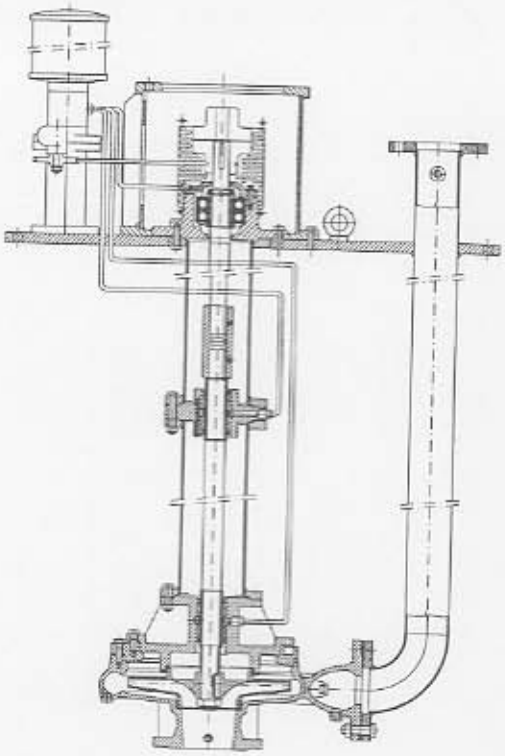
8.4 External lubrication

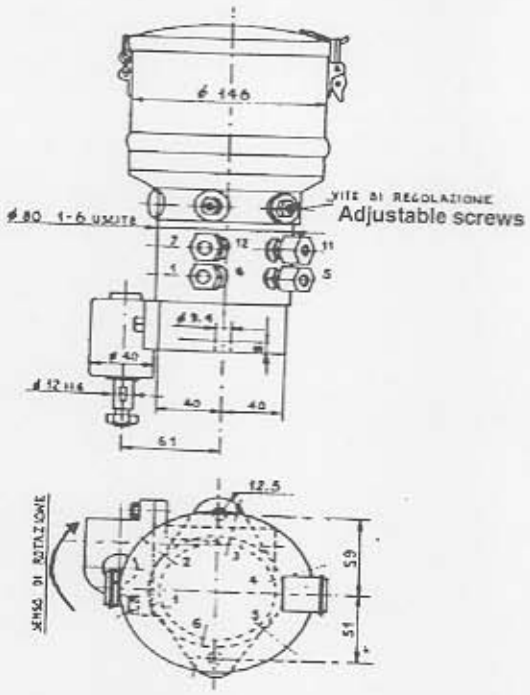
External lubrication is selected when pump is used with dirty liquids. Lubrication must be done with clean water (industrial quality) at ambient temperature. Pump is provided with a connection (threaded or flanged according to the Client requirements) on the baseplate.



Lubrication liquid flow and pressure is indicated on general arrangement drawing.
Lubrication line must have filter (suggested 100 micron) and then pressure gauge just before pump connection, in order to check pressure supply.
External lubrication must be actived only when the pump is running. With very contaminated liquids, is suggested to start external lubrication before pumps start (1-2 minutes) and then to stop it after the pump shut-down (again for 1-2 minutes). This practise allows sediments removing from bushings.

8.5 Greaser pump lubrication





Factory setting	
ball bearing line	½ max flow = 2 screw turns
bushings lines	max flow = 4 screw turns

With dirty liquid and if no external water source is available, pump is equipped with automatic greaser pump. Greaser pump is installed on the motor stool and is driven by pulley and belt by the pump coupling. Greaser pump is connected to the bushings by indipendent lubrication lines. Lubricant flow of each line can be adjusted on the grease pump by mean of regulation screws.

Greaser pump FKG20 type BK030491X	
piston diameter	7 mm
reduction ratio	1:1200
max flow/stroke	0.2 cm3 (4 screw turns)
pressure	max 50 bar
outlets	max 12
flow regulation	1 screw turn = ¼ max flow = 0.025 cm3

Greaser pump has 4 kg grease reservoir that must be periodically refilled. Refilling intervals depend on the number of lubrication lines and pump rotational speed (see lubrication instruction).
Greaser pump is connected also to the pump ball bearing for lubrication.
Greaser pump is factory set and need only reservoir grease filling before start-up.

Bushings lines are set to max flow for safety reason. If during pump operation consumption of grease is too high, is possible to reduce the flow for the bushing line to ½ max flow and for ball bearing line to ¼ max flow. Do not reduce grease flow under this limit.
With grease lubrication bushings are protected from dirty liquid by bottom and top radial lip seals. Also the radial lip seals keep grease inside the housing. Seals are mounted in such a way to evacuate excess of grease.

8.6 Lubrication by automatic greaser

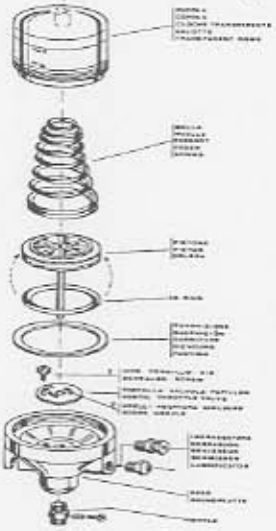
In case of pumps with small length, is possible to lubricate the bushings by automatic spring greaser. It is mounted above the baseplate and connected to the bushing by mean of stainless steel tubing.
Capacity of cup is 100 cc and flow is adjustable with the following operation:

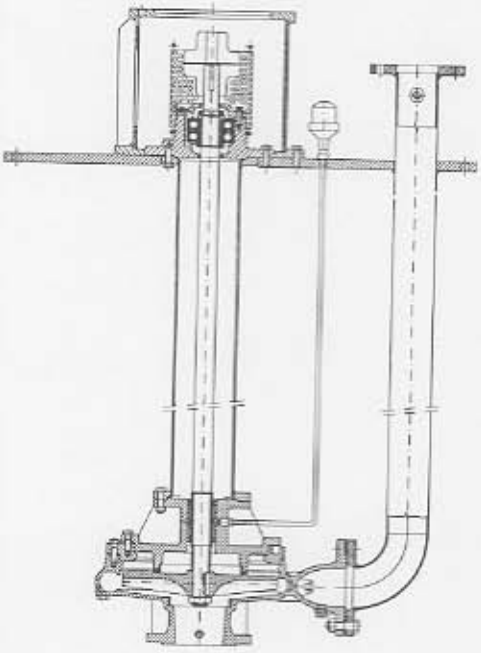
1. Remove transparent cup
2. Loose screw pos. 1
3. Turn disk throttle valve to reduce free passage
4. Tighten screw pos. 1
5. Reassembly the greaser

For greaser with standard yellow spring select grease according to table:

Ambient temperature	Grease
-23°C to +4°C	NLGI 1
+5°C to +55°C	NLGI 2

With grease lubrication bottom and top radial lip seals protect bushings from dirty liquid and keep grease inside the housing. Seals are mounted in such a way to evacuate excess of grease.





9 INSTALLATION

9.1 General

For vertical pumps, installation is fundamental for trouble-free working and good performance

Defective design of the tank and the pump installation can cause entrainment of air, uneven velocity distribution in suction, turbolence, and cavitation. All this conditions cause vibration, noise and low reliabily of the pump.

Tank design must be done considering following aspects.

9.2 Minimum submergence and bottom clearance

Pump needs a minimum submergency to avoid vortex formation or cavitation condition. Minimum submergence depends on operating condition of the pump i.e. flow, speed, liquid temperature. Refer to the general arrangement drawing for submergence datum. In case of missing drawing, refer to the table.

Suction flange of pump must be at minimum distance (gap) from bottom floor of the tank. This gap assures low velocity of liquid in the pump inlet and avoids turbolence.

If strainer is installed on pump suction, gap from bottom can be reduce to half the data indicated in previous table. Always refer to the general arrangement drawing.

Minimum submergence (mm)				
Gr	Size		Sub.	Gap
24	MU 25-160 MU 25-200 MU 32-160 MU 32-200 MU 32-250 MU 40-160 MU 40-200 MU 40-250 MU 50-160 MU 50-200 MU 50-250 MU 65-160 MU 65-200 MU 80-160	MCA 50-125 MCA 50-140 MCA 50-160 MCA 80-160	300	100
32	MU 40-315 MU 50-315 MU 65-250 MU 65-315 MU 65-400 MU 80-200 MU 80-250 MU 80-315 MU 100-200 MU 100-250 MU 100-315 MU 125-250	MCA 80-200 MCA 80-250 MCA 50-200 MCA 50-250 MCA 50-280 MCA 80-280 MCA 100-200 MCA 100-250 MCA 150-250	400	200
42	MU 80-400 MU 100-400 MU 125-315 MU 125-400 MU 150-250 MU 150-315 MU 150-400 MU 200-250	MCA 80-335 MCA 150-280 MCA 100-280 MCA 100-335 MCA 150-335	500	300
55	MU 150-500 MU 200-315 MU 200-500 MU 250-250 MU 250-315 MU 250-400		600	400

9.3 Discharge pipe

Discharge pipelines must be at least equal or bigger than nominal diameter of pump nozzle.
For pipe size take into consideration following fluid velocity limits:

- discharge flow 3 m/s

To avoid deposits in the pipes, at least a velocity of 1 m/s is necessary.
The pipes should be anchored in close proximity to the pump and should be connected without trasmitting any stresses or strains to nozzle. The pump must not bear the weight of the pipelines to avoid vibrations. Check that loads on the pump flanges do not exceed permissible forces and moments indicated for each type of pump.
Pipes must be tightened in such a way to avoid vibrations or displacements during operation.
Delivery pipe lay-out must be designed in order to permit free easy lifting from tank.
Thermal expansions of long pipelines must be compensated by appropriate measures (i.e. expansion bends).
Adapters to larger diameter pipes must be concentric for top discharge port, eccentric for side discharge port.
A minimum rising slope of 2% should be observed for horizontally laid pipes.
Install a pressure gauge connected to the pipe or directly fitted to the pumps.
A check valve should be fitted so as to prevent the pump from over-pressures due to water hammering.
Install also a gate valve downstream the check valve.

9.4 Baseplate anchoring

Baseplate anchoring greatly affects pump vibration and noise. Pay much attention to avoid distorsion of pump baseplate and overload of delivery pipe

During installation pump delivery flange must remain closed and duly protected. For pump lifting use only eyebolts mounted on baseplate. Do not use eyebolts of motor.

9.5 Steel structure

We suggest installing the pump on a steel counterplate and not directly on supporting beams to have plain surface. Supporting surface should be flush, plain and clean.

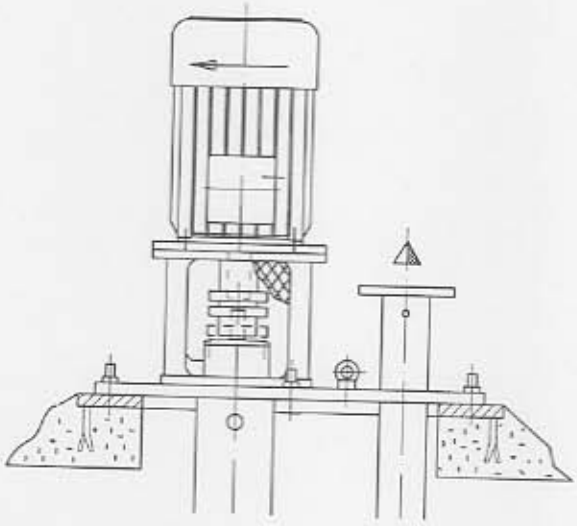
- Place pump on supporting structure centering the holes or the stud bolts.
- Level it up with the aid of a spirit level. Metal shims should be fitted in close proximity of the anchor holes.
- Tighten screws or bolts according to torque wrench setting data given below.

Torque wrench setting (Nm)				
Class →	5.6	6.8	8.8	10.9
M 16	75	140	170	240
M 18	120	220	250	340
M 20	145	310	330	460
M 24	250	480	570	800

9.6 Concrete foundation

Steel counterplate must be grouted on the tank opening in order to couple pump baseplate. Counterplate will have stud bolts positioned in the same position of baseplate holes. Much type of counterplates can be used, but opening dimension as per general arrangement drawing and flat support surface must be realized.
If counterplate is provided with the pump, check dimension on general arrangement drawing.

- place the pump on the counterplate
- use a spirit level to level the baseplate using metal shims. Shims must be inserted close to the foundation bolts, to the right and left side.
- tighten foundation bolts according to torque wrench settings given above.



9.7 Connecting the piping

Delivery pipe layout must be designed such a way to permit easy pump removing from tank.

Before connecting thoroughly clean the pipes. Possible welding slags should be carefully removed

- Check pipe flange alignement with pump flange. The face-to-face surfaces must be perfectly parallel, center-lined and their clearance suitable for type of gasket to be fitted. Following are flange alignment indication for pratical use:
  - ➢ free passage of bolts through flange holes
  - ➢ distance between flanges egual to gasket thickness ±0.5 mm

- Center the gaskets between the flanges
- Tighten flanges bolts/tie rods
- Loosen baseplate anchoring bolts to check eventual stresses caused by pipes. In case adjust pipes alignement.
- Retighten bolts connecting pump baseplate.

9.8 Auxiliary connections

Dimensions and location of auxiliary connections are indicated on pump installation drawing.

9.9 Connection to power supply

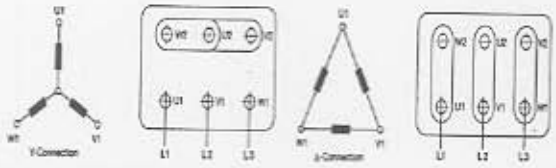
Trained personnel only according to following instructions must do connection to the power supply and national standards in force.

Connect to power supply when power is off

For motors above 15 kW, provide a star-delta starting. This starting can be possible only for those motors with delta winding at rated voltage. Starting connection must be star type and then changed over in delta. Starting absorbed current reduces to 1/3.
Check data and type of connection specified on motor identification plate. Connection varies according to motor winding and power supply according to following table:

Line Voltage (V)	Winding voltage (plate data)					
	220/380 220 Δ	380/660 380 VΔ	500 Δ	500 Y	660 Δ	660 Y
220	Δ					
380	Y	Δ				
500			Δ	Y		
660		Y			Δ	Y

Make sure that terminals be connected according to below scheme.



9.9.1 Earthing

Motor frame shall be ground connected. When the connection is missing, connect ground cable to one anchoring screw of motor.

9.9.2 Motor protection

Provide a motor protection thermal switch to prevent motor from eventual overload. The breaker shall be set for an operating current equal or less than 1.15 times the rated current.
This device ensures a global protection against slow overloads. When it is necessary to reduce reaction time or detect a momentary load or follow the temperature evolution, thermal protection probes must be installed in the windings.

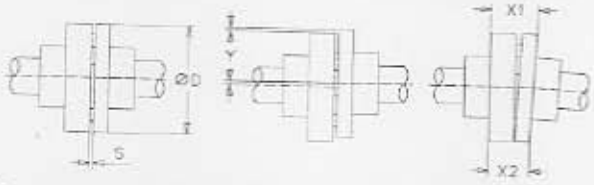
9.10 Coupling alignment

Even if pump and motor are delivered assembled, you shall always check the alignment of the coupling.

The alignment determines proper functioning of the unit and long life of the various components.
Coupling tolerance values hereinafter indicated refer to type of coupling usually employed. For all other couplings installed according to customer request see attached documentation.
Even if motor stool help to obtain coupling alignment, a check of radial, axial and angular misalignment must be always done before start-up.

9.10.1 Misalignments

Improper coupling hubs alignment can be axial, parallel and angular. Actually misaligning is always determined by a combination of these three types.



X1 = max measurement X2 = min measurement

FLEXIBLE COUPLINGS TYPE RUSTEEL A/AD			
Coupling	Axial	Parallel	Angular
Ø D (mm)	S (mm)	Y (mm)	X1-X2 (mm)
80	2÷2,5	0,2	0,5
100	2÷2,5	0,2	0,5
130	2÷2,5	0,2	0,5
150	3÷4	0,25	0,8
180	3÷4	0,3	0,8
220	3÷4	0,3	1
260	3÷4	0,35	1

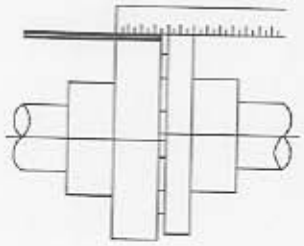
Radial and axial permissible deviations depend on the type and size of coupling installed. Values as reported here below are valid even for spacer couplings.

9.10.2 Alignment procedure

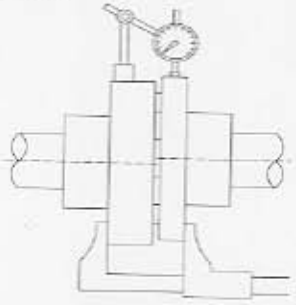
Aligning can be done by one of following outlined methods.

Straightedge, Feeler gauge and caliper gauge.
Place the straightedge on half coupling circumference pump side and measure the parallel misaligning by using the feeler gauge. Use

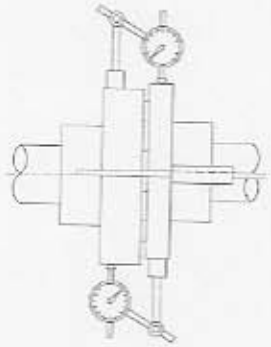
the caliper to verify the axial distance and angular aligning.



Dial gauge and caliper gauge Place the dial gauge on the pump half coupling and measure the parallel deviations of the motor half coupling. Verify angular and axial alignments by means of the caliper gauge.



Double dial gauge and caliper gauge. Verify the parallel and angular alignment by placing the dial gauge and caliper gauge on the two coupling halves. A caliper must check axial distance.



Laser. For use and installation of a laser aliner, see Manufacturer instructions.

Follow below instructions to align pump coupling.

1. Place the coupling halves on the shaft in case they have not been installed yet.
2. Place the motor without completely tightening bolts.
3. Verify the axial distance between both coupling halves adjusting their position. Fix the half-couplings to the shafts with the grub screws.
4. Verify parallel alignment. A little gap between motor flange and motor stool is available to correct radial misalignment.
5. Verify angular alignment. To correct angular alignment insert metal shims under motor flange. Shims must be placed near the bolts.
6. Tight the motor bolts.

10 START UP/SHUT DOWN

10.1 Checks before start-up

Before pump start-up check that all indications given in the present document have been duly observed

1. Visual check of the pump unit. Check if all the external screws are securely tight (baseplate anchor bolts, pump/motor jacking screws, coupling guard screws, etc). Baseplate must be correctly installed on the sump/tank opening, without any distorsion/tension due to the anchor bolts tightening.
2. Check connection of pump nozzle with delivery pipe.
3. Check presence of pressure gauge on the delivery side of pump. Pressure gauges are important to check pump performance during running.
4. Check electrical connections of the motor and the cable glands
5. Check by hand free rotation of the shaft after coupling guard removing. Coupling guard must be replaced before pump starting.
6. Check coupling alignment. Coupling guard must be replaced before pump starting.

If automatic greaser pump is installed:

7. Fill the reservoir with grease
8. Check belt tension
9. Note that grease outlets are factory set. To change outlets setting see specific Instruction.

If external flushing for bushings/mechanical seal/packing is required:

10. Check if flushing line is properly installed and ready to use.

If automatic spring greaser is installed:

11. Fill the greaser through the nipple
12. Unlock screw to permit spring action
13. Note that spring greaser is factory set. To change grease flow, see specific Instruction.

14. Check that all protections of rotating units be properly and securely installed.
15. Check liquid level in the tank with pump minimum submergence.

16. Make sure plant and operators are ready for the start up
17. Start and stop motor for a few seconds and check direction of rotation.

10.2 Start up

1. *If external flushing is required*: open flushing line valve and make sure flow is present.
2. Close delivery valve.
3. Switch the motor briefly on and off and check if the rotation is correct with the direction arrow (CW-clockwise from top view).
4. Start the pump.
5. Check the pressure gauge to see when the pressure becomes stable. If pressure does not increase, stop the pump and repeat the start-up after some minutes.
6. Open delivery valve to regulate pump head.

Overheating caused by prolonged running with discharge valve closed can damage the pump

10.3 Shutdown

Switching motor power supply off shall shut down pump.
During shutdown discharge valve can either be open or closed. In case no check valve is installed in the discharge line, close the discharge valve to prevent pump from the effect of water hammer.
In the event of no check valve on delivery pipe, shaft can freely rotate in the opposite direction. Avoid restarting the pump during this phase.
If liquid can freeze due to low ambient temperature and pump is shut-down for prolonged time, tank must be complety drained to avoid damage to pump.

11 ADJUSTING AND OPERATION CHECKING

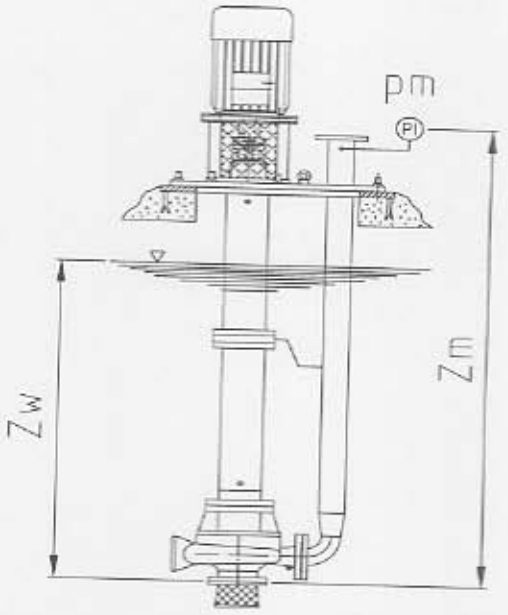
Hereinafter you will find all main checks to be carried out after pump starting. Causes of eventual faults and remedies are detailed in par. 14.

11.1 Total head

The flow rate delivered by the pump is function of the total head developed according to the pump characteristic curve.
After start up, check total head corresponds to rated duty.
For raw calculation read values indicated on the manometer on discharge line and apply following formula:

$$H = \frac{10{,}2\, p_m}{\gamma} + z_m - z_w$$

H = differential head (m)
γ = specific gravity (kg/dm^3)
p_m = discharge pressure (bar)
z_m = vertical distance between pressure gauge and pump suction (m)
z_w = vertical distance between free liquid level and pump suction (m)



In case pump head is lower than the nominal one, close the discharge valve slowly until duty point is reached.
Pressure losses greater than project ones determine a pump develops head bigger than the nominal one. In this case to obtain correct head it is necessary to modify the plant to reduce pressure losses or install bigger impeller.

11.2 Vibration/Noise

Steady state pump shall be without vibrations or anomalous noise. Stop pump immediately in case such anomalies may occur and remove the cause.

11.3 Motor power

When pump is steady running power consumption shall not exceed motor rated power.
Using pump characteristic curve you may calculate pump brake power if you know pump head. Brake power shall be lower than motor rated power.
Since absorbed power is related to pump flow, always check real and duty capacity.

11.4 Temperatures

During normal running conditions ball bearings temperature shall not exceed 90°C.

11.5 Minimum flow

Prolonged running with null flow rate can damage the pump

Pump needs a minimum flowrate to avoid overheating of pumped inside the casing and overload of bottom bushing. If no indication is present on the pump data-sheet, take as minimum flow indicatively the 25% of flowrate at best efficiency point.

12 MAINTENANCE

12.1 Recommendations

Repair and maintenance work to the pump must only be carried out by trained personnel and shall be governed by the instructions given in the present manual.

Maintenance to the pump must be carried out with power supply off.

Pumps handling liquids posing health hazards must be decontaminated.

Do not operate on rotating units or under pressure.

12.2 Lubrication

Use high quality mineral grease with antioxidant, corrosion proof and antifoaming characteristics.
Grease type must be selected according to the lubrication system of the pump:

1. *Ball bearing lubrication by nipple*
   - bearing temp ≤ 50°C NLGI 2
   - bearing temp > 50°C NLGI 3

Grease lubrication intervals (working hours)			
Bearings temp.	First regreasing	Following regreasing	Max. grease duration
≤ 50 °C	300 h	1500 h	1 year
> 50	300 h	1000 h	6 year

2. *Greaser pump*
   - only NLGI 2

Grease reservoir recharge frequency (h)				
Grease outlets	Centrifugal pump speed (rpm)			
	1450	1750	2900	3500
1	650	540	325	270
2	325	270	160	160
3	215	180	110	90
4	160	135	80	70
5	130	110	65	55
6	110	90	55	45

3. *Automatic spring greaser*
   - ambient temp -23°C/+4°C NLGI 1
   - ambient temp +5°C/+55°C NLGI 2

Regreasing intervals are much dependent to operating condition of the pump. Check grease level of the automatic greaser to determine regreasing intervals.

12.2.1 Grease characteristics

Penetration index (ASTM D217-67 T)			
NLGI	1	2	3
Penetration at 25° ($mm \times 10^{-1}$)	310-340	265-295	220-250

Merely as an indication find herebelow a list of recommended grease:

CASTROL	SPHEEROL
IP	ATHESIA EP
CHEVRON	DURALIT
MOBIL	MOBILUX EP
ESSO	BEACON EP
SHELL	ALVANIA EP
BP	ENERGREASE LS EP

An excessive grease quantity can cause ball bearings overheating

12.3 Dismantling and reassembly - General indications

Before start dismatling make sure the pump cannot be powered on accidentally and close all shut-off valves in the discharge lines.
Thrust bearing, radial lip seal, soft packing or mechanical seal can be replaced without removing pump from tank.
For detailed dismantling procedure, refer to instructions in par.15.
Reassembly is affected in reverse order to dismantling with same procedure. During reassembly following prescriptions are advisable:

- use plastic or wooden hammers preferably; when using steel hammers, interpose always wood piece
- bearings shall be fitted on the shaft after heating at 80-90°C. Do not use hammer on the bearings.

12.4 Components revision

Pump shall be periodically completely dismantled to check components. When damaged, replace them only with original spares.

12.4.1 General check

Check inner parts status. Remove eventual deposits and scaling by using water or specific solvents.
Check coupling rubber elements or flexible membrane.
Gaskets can be reused only if not damaged.

12.4.2 Bearing

Check radial lip seals and in case replace them.
Dismantle the bearings and clean them thoroughly with solvents or specific detergents. When damaged, oxidated, blue cloured, or noisy bearings are to be replaced.

Do not disperse scraps in the environment

Any impurity shall be removed by using suitable solvent.
Complete regreasing must be done before bearing re-assembly.

12.4.3 Bushings

Check bushing surface. If any marks are present, change bushing with new one.
Check clearance between bushing and housing. In normal condition max allowable clearance is 0.5 mm. Small clearance can be required if pump has vibration during working.

12.5 Tightening torques

During pump reassembly screws shall be tightened according to following indications.

TIGHTENING TORQUES (Nm)			
M 8	20	M 20	350
M 10	40	M 24	600
M12	70	M 30	1200
M14	110	M 35	2000
M16	170	M 36	2100
M 18	250		

12.6 Spare parts

Use original spare parts only

Using original Pompe Garbarino spare parts can only ensure pump reliability and long life.
When ordering spare parts please always indicate following data:

- Pump type
- Serial number
- Cross section drawing number
- Pos. Number and part designation
- Required quantity

When available always use cross-sectional drawing included in the technical documentation.

13 DISPOSAL

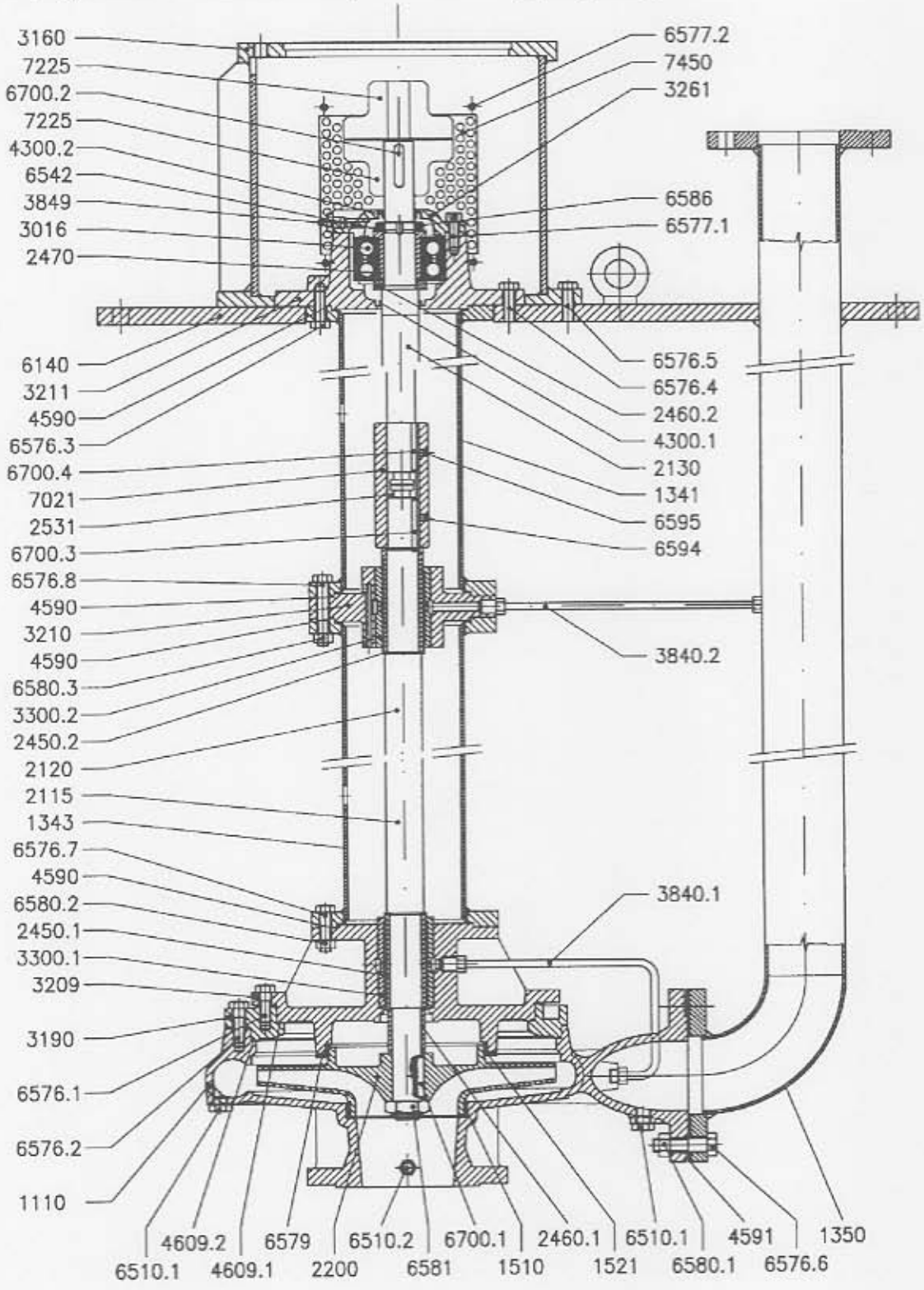
Materials employed when manufacturing the pump do not pose health hazards; therefore they do not need peculiar procedure for disposal.
If the pump was used for handling liquids posing health hazards, adequate decontamination shall be provided according to relevant laws.
Collect waste lubricant that shall be delivered to specialized and authorized disposal Companies.
Dismantle the pump and select the various components to facilitate differentiated disposal.
For materials of construction refer to pump data sheet and relevant technical documentation.
Scraps shall be delivered to specialized Companies against issuing of regular invoice.
We recommend conserving the pump nameplate to be produced together with the invoice.

14 TROUBLE SHOOTING

A	B	C	D	E	F	G	H	I	L	M	CAUSE	ACTION
											Pump does not start	
											No flow	
											Unsufficient flow rate	
											Unsufficient discharge pressure	
											Pump is vibrating and noisy	
											Motor is overloaded	
											Bushings quick worn out	
											Increase in bearing temperature	
											Ball bearings quick worn out	
		•	•	•	•						Air intake at suction; vortex presence	Check minimum submergence
•											Motor defective or not powered	Check power connection and motor.
•											Impeller is blocked because of erroneous reassembly	Dismantle the pump and reassembly the rotor properly. Check gap between impeller and cover
•											Impeller or bushings seizure	Dismantle the pump and check
		•									Required plant head is bigger than pump max head	Pump does not suitable for the application
		•	•	•	•						Cavitation	Check suction condition and NPSH available.
		•									Reverse rotation	For three phase motors, interchange two of the phases.
		•	•	•							Rotation speed too low	Check power frequency. Increase speed (hydraulic, air powered motors, turbine)
			•								Required plant head bigger than project one	Revise plant. Increase speed (combustion, hydraulic, air powered motors, turbines) Increase impeller diameter
					•	•					Required plant head lower than design one	Check plant head. Reduce impeller diameter. Decrease speed (combustion, hydraulic, air powered motors, turbines)
		•	•								Clogged pipelines or valves	Check and clean
•		•	•		•						Impeller clogged	Remove and clean
		•	•		•						Strainer clogged	Check and clean
			•	•		•					Actual viscosity higher than design one	Check viscosity with steady running pump
						•					Specific gravity higher than design one	Partially shut adjusting valve
					•			•	•		Coupling misaligned	Check and align
					•						Misalignment of delivery flange with pipe	Check flange alignment, pipes fastening, baseplate anchoring
					•						Baseplate not properly installed	Loose bolts one by one and check if vibrations decrease. Insert metal shims around the bolts to eliminate baseplate distorsion
					•			•			Pump ball bearings/bushings worn out	Check and replace
					•						Motor bearings worn out	Check and replace
						•					Low power voltage	Check and adjust
					•		•	•	•		Defective reassembly	Check and correct
							•				Flow rate too low	Increase flow rate
								•	•		Insufficient or unsuitable lubricant	Check and top up
							•				Insufficient lubrication liquid flow	Check and adjust
							•				Dirty lubrication liquid	Change type of lubrication. Contact After Sales Department
							•				Empty grease reservoir	Refill grease reservoir

15 CROSS SECTIONAL DRAWINGS

15.1 Pump type MU-VS – Radial seal ring – Lubrication by pumped liquid

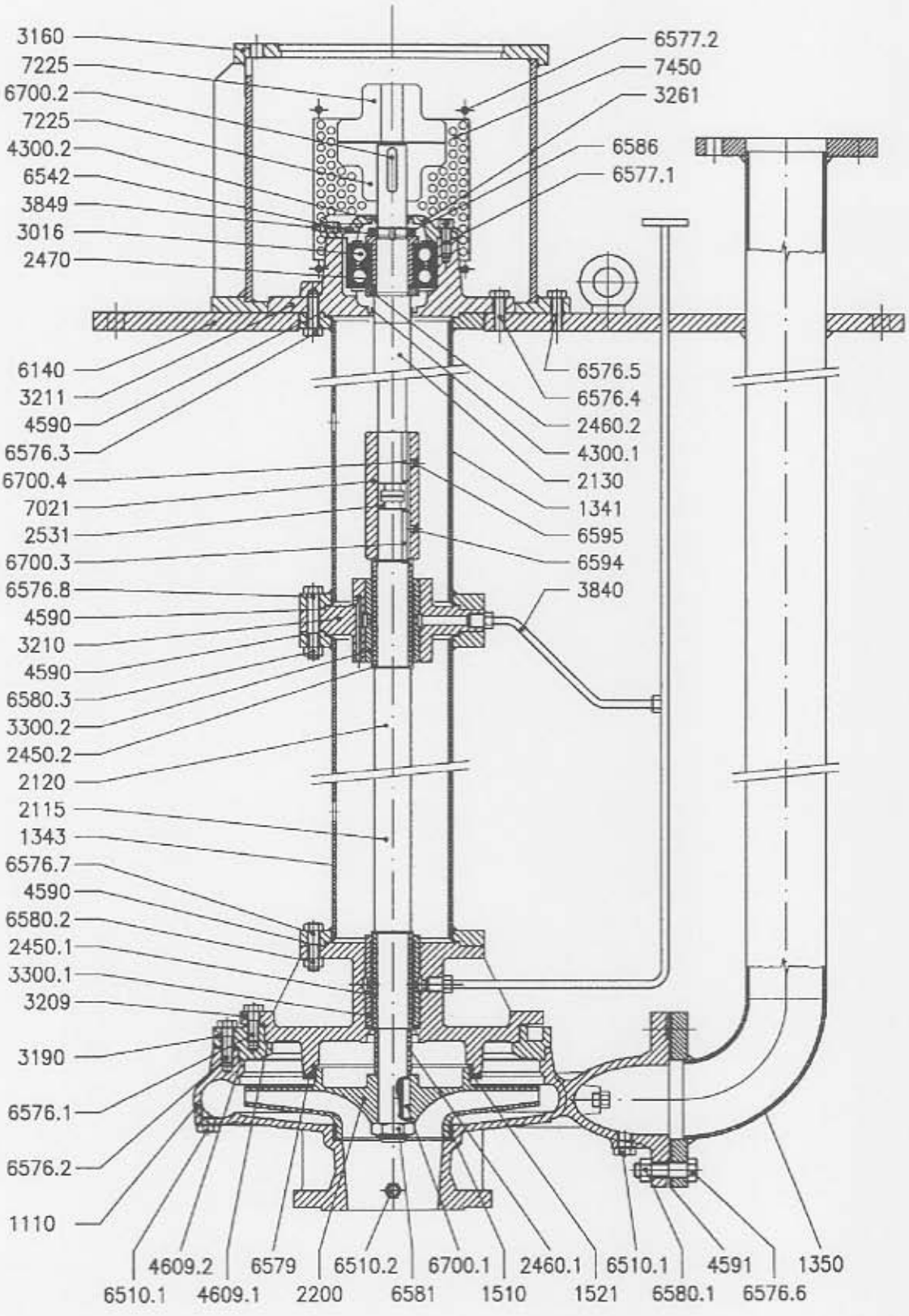


Section No 09801-S/B Part list Tab. No 439/B

1110	Pump Casing	1
1341	Support column	n
1343	Column, pump side	1
1350	Column pipe	1
1510	Casing wear ring, suction side	1
1521	Casing wear ring in casing cover	1
2115	Vertical pump shaft	1
2110	Pump shaft	1
2120	Intermediate shaft	n-1
2130	Top shaft	1
2200	Impeller	1
2450.1	Shaft sleeve	1
2450.2	Shaft sleeve	n
2460.1	Spacer sleeve	1
2460.2	Spacer sleeve	1
2470	Centering sleeve	1
2531	Retaining ring, split	n
3016	Single row angular contact ball	2
3160	Motor stool	1
3190	Reduction ring	1
3209	Bearing housing pump side	1
3210	Bearing housing intermediate	n
3211	Bearing housing drive side	1
3261	Bearing cover, drive side	1
3300.1	Bearing bush	1
3300.2	Bearing bush	n
3840.1	Lubricating pipe	1
3840.2	Lubricating pipe	n
3849	Straight ball greaser	1
4300.1	Radial shaft seal	1
4300.2	Radial shaft seal	1
4590	Gasket	2n+2
4591	Gasket for flange	1
4609.1	O-ring	1
4609.2	O-ring	1
6140	Support plate	1
6510.1	Hexagon head screw plug	2
6510.2	Hexagon head screw plug	1
6542	Lockwasher for locknut	1
6576.1	Hexagon screw	-
6576.2	Hexagon screw	-
6576.3	Hexagon screw	6
6576.4	Hexagon screw	4
6576.5	Hexagon screw	4
6576.6	Hexagon screw	-
6576.7	Hexagon screw	6
6576.8	Hexagon screw	6n
6577.1	Hexagon socket head screw	4
6577.2	Hexagon socket head screw	8
6579	Slotted countersunk flat head screw	-
6580.1	Nut	-
6580.2	Nut	6
6580.3	Nut	6n
6581	Impeller heavy selflocking nut	1
6586	Locknut	1
6594	Hexagon socket set screw flat point	n
6595	Hexagon socket setscrew dog point	n
6700.1	Key	1
6700.2	Key	1
6700.3	Key	n
6700.4	Key	n
7021	Intermediate coupling	n
7225	Half coupling	2
7450	Coupling guard	2

(n : is the number of e Bearing Housing Intermediate)

15.2 Pump type MU-VS – Radial seal ring – Lubrication by external liquid

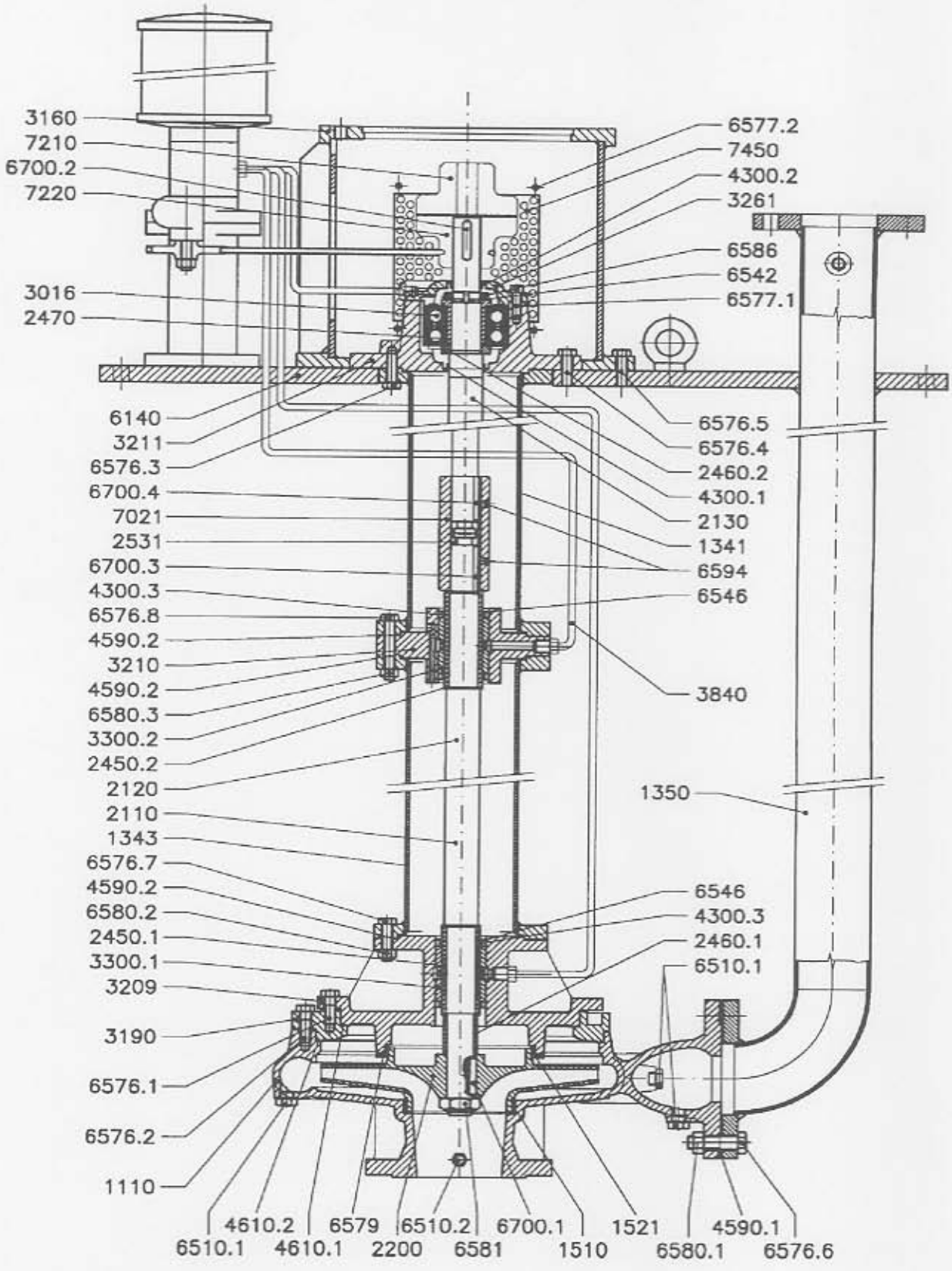


Section No S/UVXXER01A Part list Tab. No 676

1110	Pump Casing	1
1341	Support column	n
1343	Column, pump side	1
1350	Column pipe	1
1510	Casing wear ring, suction side	1
1521	Casing wear ring in casing cover	1
2115	Vertical pump shaft	1
2120	Intermediate shaft	n-1
2130	Top shaft	1
2200	Impeller	1
2450.1	Shaft sleeve	1
2450.2	Shaft sleeve	n
2460.1	Spacer sleeve	1
2460.2	Spacer sleeve	1
2470	Centering sleeve	1
2531	Retaining ring, split	n
3016	Single row angular contact ball	2
3160	Motor stool	1
3190	Reduction ring	1
3209	Bearing housing pump side	1
3210	Bearing housing intermediate	n
3211	Bearing housing drive side	1
3261	Bearing cover, drive side	1
3300.1	Bearing bush	1
3300.2	Bearing bush	n
3840	Lubricating pipe	n+1
3849	Straight ball greaser	1
3851	Stauffer	1
4300.1	Radial shaft seal	1
4300.2	Radial shaft seal	1
4590	Gasket	2n+2
4591	Gasket for flange	1
4609.1	O-ring	1
4609.2	O-ring	1
6140	Support plate	1
6510.1	Hexagon head screw plug	2
6510.2	Hexagon head screw plug	1
6542	Lockwasher for locknut	1
6576.1	Hexagon screw	-
6576.2	Hexagon screw	-
6576.3	Hexagon screw	6
6576.4	Hexagon screw	4
6576.5	Hexagon screw	4
6576.6	Hexagon screw	-
6576.7	Hexagon screw	6
6576.8	Hexagon screw	6n
6577.1	Hexagon socket head screw	4
6577.2	Hexagon socket head screw	8
6579	Slotted countersunk flat head screw	
6580.1	Nut	-
6580.2	Nut	6
6580.3	Nut	6n
6581	Impeller heavy selflocking nut	1
6586	Locknut	1
6594	Hexagon socket set screw flat point	n
6595	Hexagon socket setscrew dog point	n
6700.1	Key	1
6700.2	Key	1
6700.3	Key	n
6700.4	Key	n
7021	Intermediate coupling	n
7225	Half coupling	2
7450	Coupling guard	2

(n : is the number of Intermediate Bearing Housing)

15.3 Pump type MU-VS – Radial seal ring – Lubrication by greaser pump

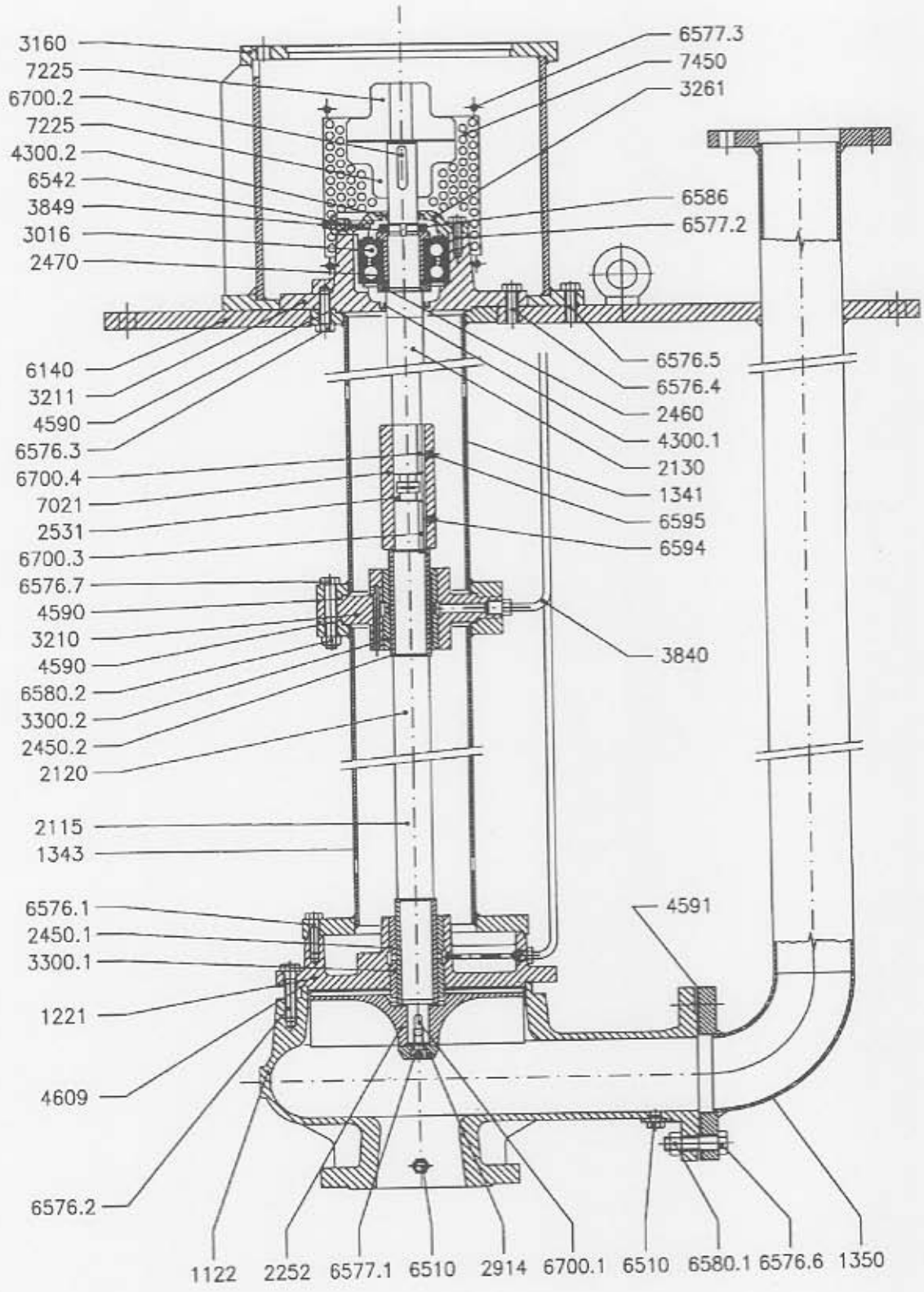


Section No 11344-S/A Part list Tab. No 554/A

1110	Pump Casing	1
1341	Support column	n
1343	Column, pump side	1
1350	Column pipe	1
1510	Casing wear ring, suction side	1
1521	Casing wear ring in casing cover	1
2110	Pump shaft	1
2120	Intermediate shaft	n-1
2130	Top shaft	1
2200	Impeller	1
2450.1	Shaft sleeve	1
2450.2	Shaft sleeve	n
2460.1	Spacer sleeve	1
2460.2	Spacer sleeve	1
2470	Centering sleeve	1
2531	Retaining ring, split	n
3016	Single row angular contact ball	2
3160	Motor stool	1
3190	Reduction ring	1
3209	Bearing housing pump side	1
3210	Bearing housing intermediate	n
3211	Bearing housing drive side	1
3261	Bearing cover, drive side	1
3300.1	Bearing bush	1
3300.2	Bearing bush	n
3840	Lubricating pipe	n+2
4300.1	Radial shaft seal	1
4300.2	Radial shaft seal	1
4300.3	Radial shaft seal	2n+2
4590.1	Gasket	1
4590.2	Gasket	2n+2
4610.1	O-ring	1
4610.2	O-ring	1
6140	Support plate	1
6510.1	Hexagon head screw plug	2
6510.2	Hexagon head screw plug	1
6542	Lockwasher for locknut	1
6546	Internal circlip for bores	2n+2
6576.1	Hexagon screw	-
6576.2	Hexagon screw	-
6576.3	Hexagon screw	6
6576.4	Hexagon screw	4
6576.5	Hexagon screw	4
6576.6	Hexagon screw	-
6576.7	Hexagon screw	6
6576.8	Hexagon screw	6n
6577.1	Hexagon socket head screw	4
6577.2	Hexagon socket head screw	8
6579	Slotted countersunk flat head screw	2
6580.1	Nut	-
6580.2	Nut	6
6580.3	Nut	6n
6581	Impeller heavy selflocking nut	1
6586	Locknut	1
6594	Hexagon socket set screw flat point	2n
6700.1	Key	1
6700.2	Key	1
6700.3	Key	n
6700.4	Key	n
7021	Intermediate coupling	n
7225	Half coupling	2
7450	Coupling guard	2

(n : is the number of Intermediate Bearing Housing)

15.4 Pump type MCA-VS – Radial seal ring – Lubrication by external liquid

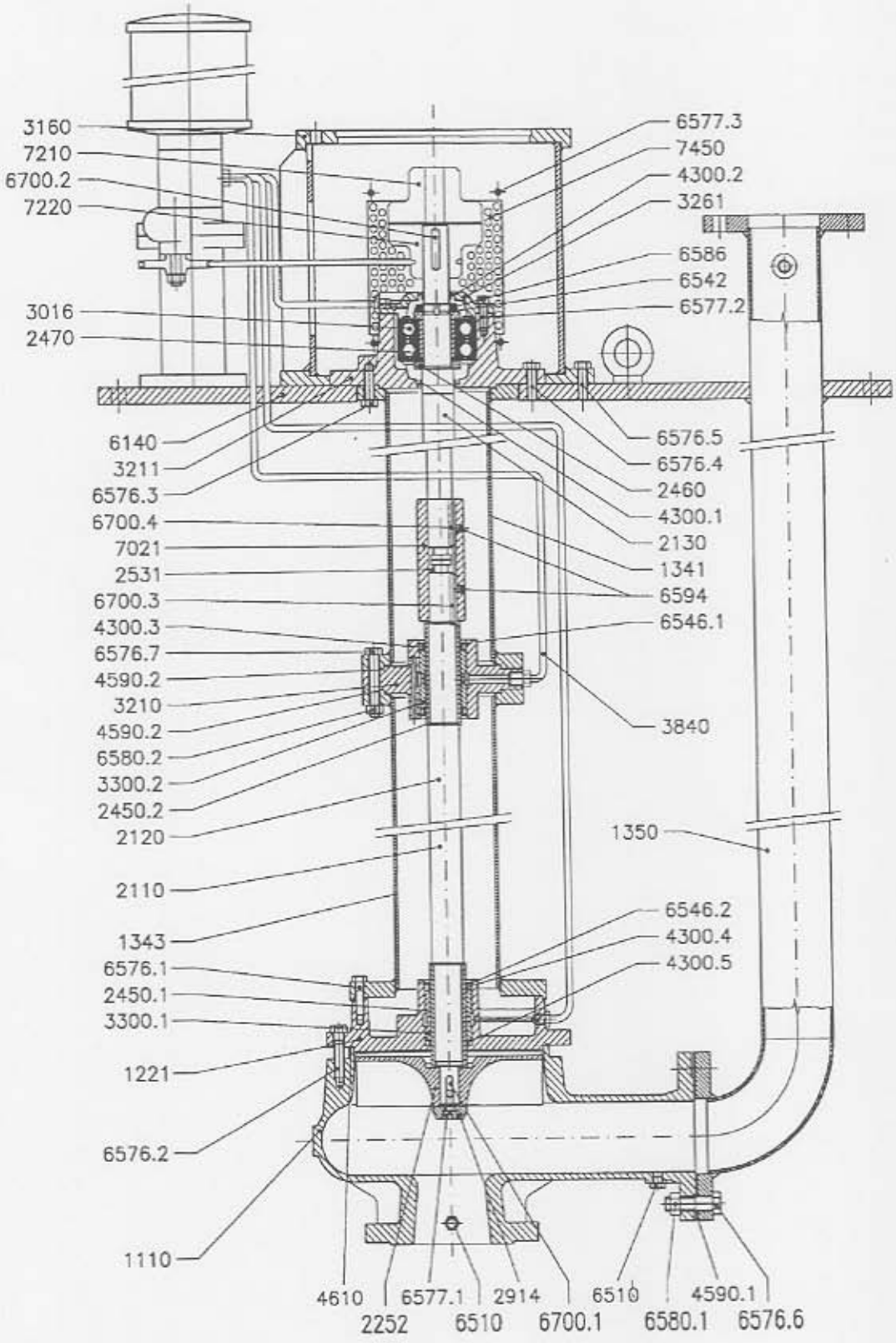


Section No 11090-S/B Part list Tab. No 539/B

1122	Pump casing without feet	1
1221	Casing cover	1
1341	Support column	n
1343	Column, pump side	1
1350	Column pipe	1
2115	Vertical pump shaft	1
2120	Intermediate shaft	n-1
2130	Top shaft	1
2252	Radial flow impeller open	1
2450.1	Shaft sleeve	1
2450.2	Shaft sleeve	n
2460	Spacer sleeve	1
2470	Centering sleeve	1
2531	Retaining ring,split	n
2914	Impeller hub cap	1
3016	Single row angular contact ball	2
3160	Motor stool	1
3210	Bearing housing intermediate	n
3211	Bearing housing drive side	1
3261	Bearing cover, drive side	1
3300.1	Bearing bush	1
3300.2	Bearing bush	n
3840	Lubricating pipe	1
3849	Straight ball greaser	1
4300.1	Radial shaft seal	1
4300.2	Radial shaft seal	1
4590	Gasket	2n+1
4591	Gasket for flange	1
4609	O-Ring string	1
6140	Support plate	1
6510	Hexagon head screw plug	2
6542	Lockwasher for locknut	1
6576.1	Hexagon screw	-
6576.2	Hexagon screw	-
6576.3	Hexagon screw	6
6576.4	Hexagon screw	4
6576.5	Hexagon screw	4
6576.6	Hexagon screw	-
6576.7	Hexagon screw	6n
6577.1	Hexagon socket head screw	1
6577.2	Hexagon socket head screw	4
6577.3	Hexagon socket head screw	8
6580.1	Nut	-
6580.2	Nut	6n
6586	Locknut	1
6594	Hexagon socket set screw flat point	n
6595	Hexagon socket set screw dog	n
6700.1	Key	1
6700.2	Key	1
6700.3	Key	n
6700.4	Key	n
7021	Intermediate coupling	n
7225	Half coupling	2
7450	Coupling guard	2

n : is the number of Intermediate Bearing Housing

15.5 Pump type MCA-VS – Radial seal ring – Lubrication by greaser pump



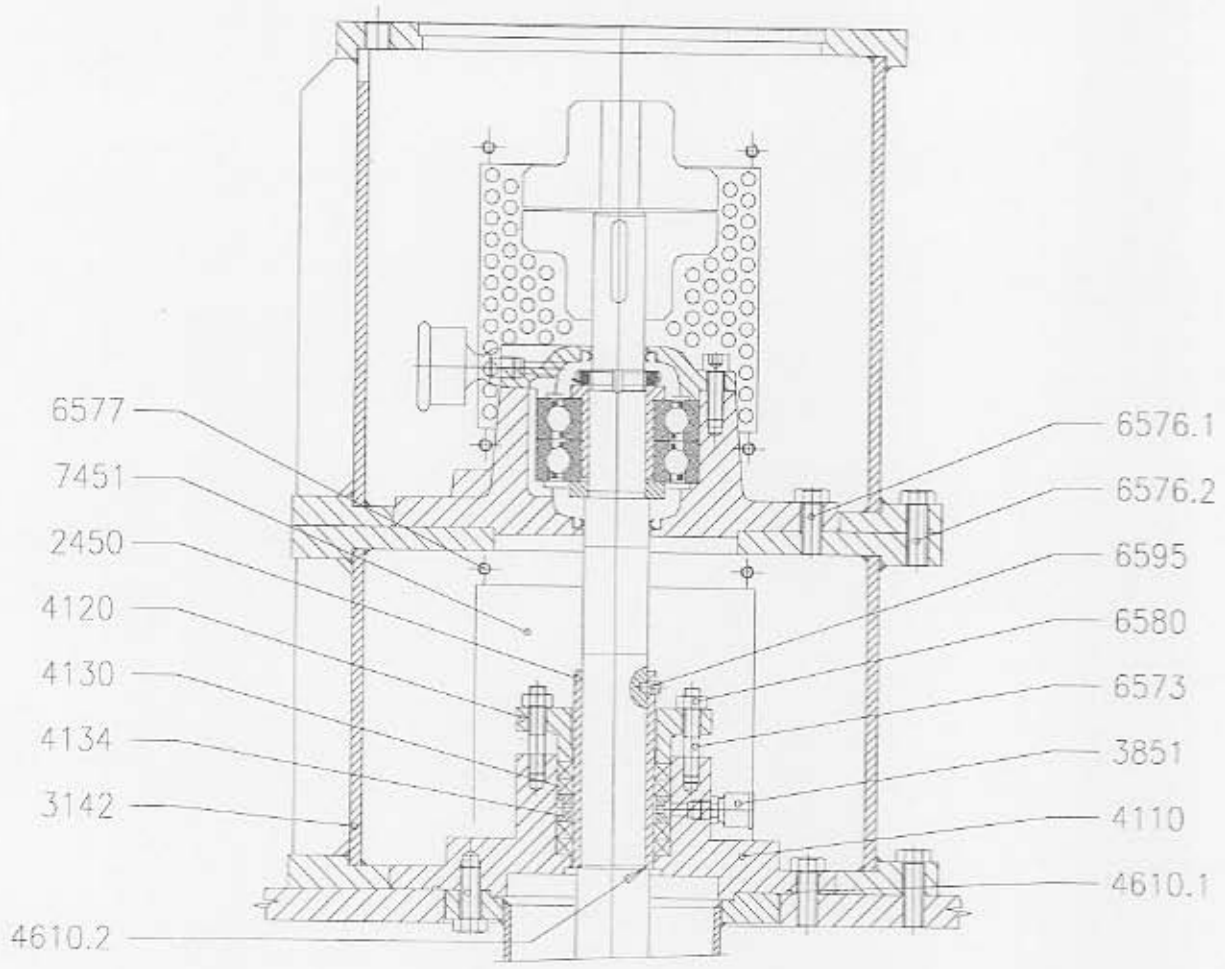
Section No 11345-S/A Part list Tab. No 555/A

1110	Pump casing	1
1221	Casing cover	1
1341	Support column	n
1343	Column, pump side	1
1350	Column pipe	1
2110	Pump shaft	1
2120	Intermediate shaft	n-1
2130	Top shaft	1
2252	Radial flow impeller open	1
2450.1	Shaft sleeve	1
2450.2	Shaft sleeve	n
2460	Spacer sleeve	1
2470	Centering sleeve	1
2531	Retaining ring,split	n
2914	Impeller hub cap	1
3016	Single row angular contact ball	2
3160	Motor stool	1
3210	Bearing housing intermediate	n
3211	Bearing housing drive side	1
3261	Bearing cover, drive side	1
3300.1	Bearing bush	1
3300.2	Bearing bush	n
3840	Lubricating pipe	n+2
4300.1	Radial lip seal	1
4300.2	Radial lip seal	1
4300.3	Radial lip seal	2n
4300.4	Radial lip seal	1
4300.5	Radial lip seal	1
4590.1	Gasket	1
4590.2	Gasket	2n+1
4610	O-Ring	1

6140	Support plate	1
6510	Hexagon head screw plug	2
6542	Lockwasher for locknut	1
6546.1	Internal circlip for bores	2n
6546.2	Internal circlip for bores	1
6576.1	Hexagon screw	-
6576.2	Hexagon screw	-
6576.3	Hexagon screw	6
6576.4	Hexagon screw	4
6576.5	Hexagon screw	4
6576.6	Hexagon screw	-
6576.7	Hexagon screw	6n
6577.1	Hexagon socket head screw	1
6577.2	Hexagon socket head screw	4
6577.3	Hexagon socket head screw	8
6580.1	Nut	-
6580.2	Nut	6n
6586	Locknut	1
6594	Hexagon socket set screw flat point	2n
6700.1	Key	1
6700.2	Key	1
6700.3	Key	n
6700.4	Key	n
7021	Intermediate coupling	n
7210	Half coupling drive side	1
7220	Half coupling pump side	1
7450	Coupling guard	2

n : is the number of Intermediate Bearing Housing

15.6 Pumps type MU-VS/MCA-VS – Soft packing version

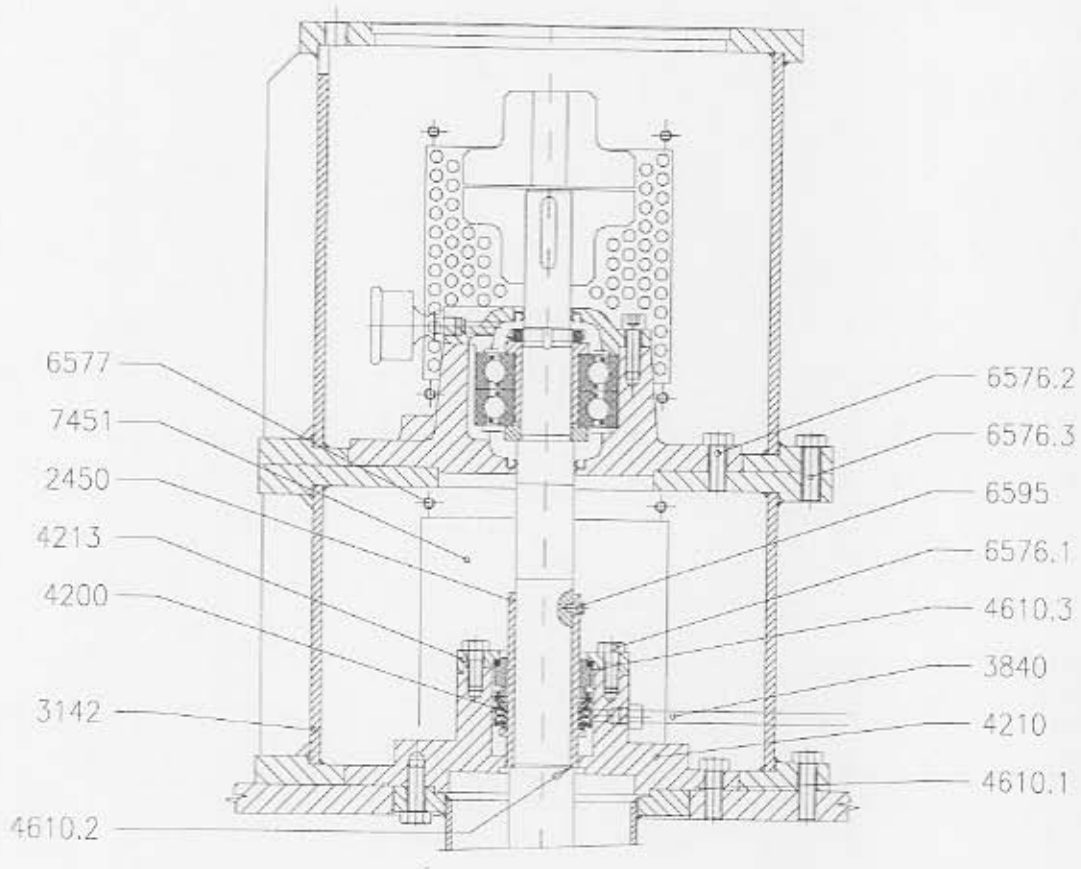


Section No 10729-S Part list Tab. No 513

2450	Shaft sleeve	1
3142	Thrust bearing lantern	1
3851	Stauffer	1
4110	Stuffing box housing	1
4120	Stuffing box gland	1
4130	Gland packing	4
4134	Lantern ring	1
4610.1	O-ring	1
4610.2	O-ring	1

6573	Medium metal end stud	2
6576.1	Hexagon screw	4
6576.2	Hexagon screw	4
6577	Hexagon socket head	8
6580	Nut	2
6595	Hexagon socket set	1
7451	Motor stool guard	2

15.7 Pumps type MU-VS MCA-VS – Mechanical seal version



Section No 10728-S Tab. No 512

2450	Shaft sleeve	1
3142	Thrust bearing lantern	1
3840	Lubricating pipe	1
4200	Mechanical seal	1
4210	Housing for mechanical seal	1
4213	Cover plate for mechanical seal	1
4610.1	O-ring	1
4610.2	O-ring	1
4610.3	O-ring	1
6576.1	Hexagon screw	4
6576.2	Hexagon screw	4
6576.3	Hexagon screw	4
6577	Hexagon socket head screw	8
6595	Hexagon socket set screw dog point	1
7451	Motor stool guard	2

16 DISMANTLING

MU-VS – Seal ring – Lubrication by pumped liquid (Drawing No 09801-S/A)
MU-VS – Seal ring – Lubrication by external liquid
MU-VS – Seal ring – Lubrication by greaser pump (Drawing No 11344-S)

Thrust bearing dismantling
Thrust bearing can be replaced without removing pump from tank.
1. Remove screws 6576.5 and motor stool 3160 with motor.
2. Unscrew grub screw and remove half coupling 7225
3. Remove key 6700.2 from shaft end.
4. Unscrew screws 6577.1 and then remove bearing cover 3261
5. Unlock lockwasher 6542 and unscrew locknut 6586
6. Extract sleeve 2470 with bearing 3016, spacer 2460.2 from bearing housing 3211
7. Remove bearing 3016 from sleeve 2470
8. Extract radial lip seal 4300.2 from bearing cover 3261

Complete dismantling
For the complete dismantling pump must be removed from tank. Follow previous points from 1 to 7. Then:
9. Remove the lubricating pipes 3840.1-3840.2
10. Remove bolts 6576.6-6580.1, screws 6576.2 then remove casing 1110
11. Remove selflocking nut 6581, impeller 2200, shaft key 6700.1 and spacer sleeve 2460.1
12. Remove screws 6576.1 and reducer ring 3190
13. Remove bolts 6576.7-6580.2 and bushing housing 3209
14. Extract shaft sleeve 2450.1 from shaft 2115
15. Remove bolts 6576.8-6580.3 and column pipe 1343
16. Remove intermediate bushing housing 3210
17. Remove next column pipe 1343
18. Unscrew the grub screws 6594, shift the intermediate coupling 7021 towards baseplate, remove slip ring 2531, key 6700.3 and separate shaft 2115. Remove intermediate coupling 7021, key 6700.4 and sleeve 2450.2 from shafts.
19. Repeat previous points 15-16-17 for all the intermediate column pipes 1343 and shafts 2120
20. Remove screws 6576.3, top column pipe 1341 and last intermediate shaft 2120 and motor shaft 2130
21. Remove screws 6576.4 and separe bearing 3211 from baseplate 6140
22. Extract bushings 3300.1-3300.2 from intermediate housings 3210 and bushing housing 3209
23. Extract radial lip seals 4300.1 from bearing housing 3211
24. Remove screws 1521 and then wear ring 6579
25. Extract wear ring 1510 from casing 1110

Pump type MCA-VS – Radial seal ring – Lubrication by external liquid (Section No 11090-S/B)
Pump type MCA-VS – Radial seal ring – Lubrication by greaser pump (Section No 11345-S/A)

Thrust bearing dismantling
Thrust bearing can be replaced without removing pump from tank.
1 Remove screws 6576.5 and motor stool 3160 with motor.
2 Unscrew grub screw and remove half coupling 7225
3 Remove key 6700.2 from shaft end.
4 Unscrew screws 6577.2 and then remove bearing cover 3261
5 Unlock lockwasher 6542 and unscrew locknut 6586
6 Extract sleeve 2470 with bearing 3016, spacer 2460 from bearing housing 3211
7 Remove bearing 3016 from sleeve 2470
8 Extract radial lip seal 4300.2 from bearing cover 3261

Complete dismantling
9 For the complete dismantling pump must be removed from tank. Follow previous points from 1 to 7. Then:
10 Remove the lubricating pipes 3840
11 Remove bolts 6576.6-6580.1, screws 6576.2 then remove casing 1122
12 Unscrew grub screw 6577.1 and then remove the impeller hub cap 2914, impeller 2252, shaft key 6700.1

13 Remove screws 6576.2, screw 6576.1 and casing cover 1221
14 Extract shaft sleeve 2450.1 from shaft 2115
15 Remove bolts 6576.7-6580.2 and column pipe 1343
16 Remove intermediate bushing housing 3210
17 Remove next column pipe 1343
18 Unscrew the grub screws 6594, shift the intermediate coupling 7021 towards baseplate, remove slip ring 2531, key 6700.3 and separate shaft 2115. Remove intermediate coupling 7021, key 6700.4 and sleeve 2450.2 from shafts.
19 Repeat previous points 15-16-17 for all the intermediate column pipes 1343 and shafts 2120
20 Remove screws 6576.3, top column pipe 1341 and last intermediate shaft 2120 and motor shaft 2130
21 Remove screws 6576.4 and separe bearing 3211 from baseplate 6140
22 Extract bushings 3300.1-3300.2 from intermediate housings 3210 and casing cover 1221
23 Extract radial lip seals 4300.1 from bearing housing 3211

Pumps type MU-VS MCA-VS – Soft packing version (Section No 10729-S)

Soft packing rings replacement

1. Unscrew nuts 6580
2. Move up the stuffing box gland 4130
3. Remove gland-packing rings 4130.

Pumps type MU-VS MCA-VS – Mechanical seal version (Section No 10728-S)

Mechanical seal dismantling

1. Remove thrust bearing following previous indication
2. Unscrew screws 6576.1 and remove seal cover 4213 with seal seat inside
3. Unscrew hexagon socket set screw dog point 6595 and shift up sleeve 4213 together with mechanical seal 4200

NOTES – MAINTENANCE REPORT

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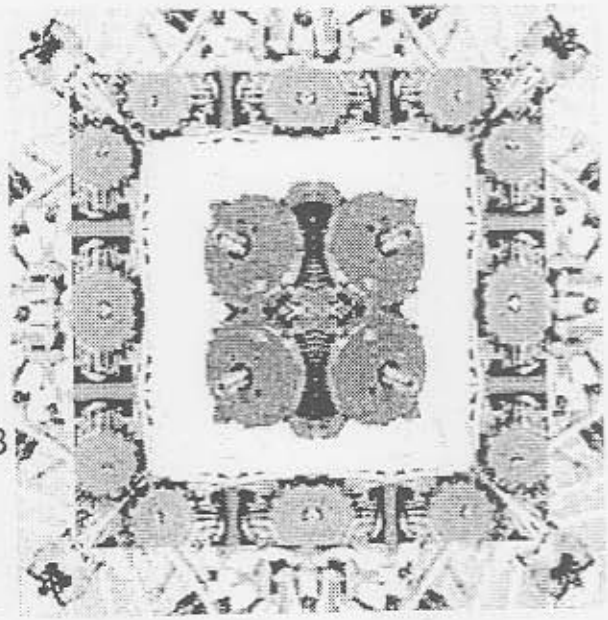
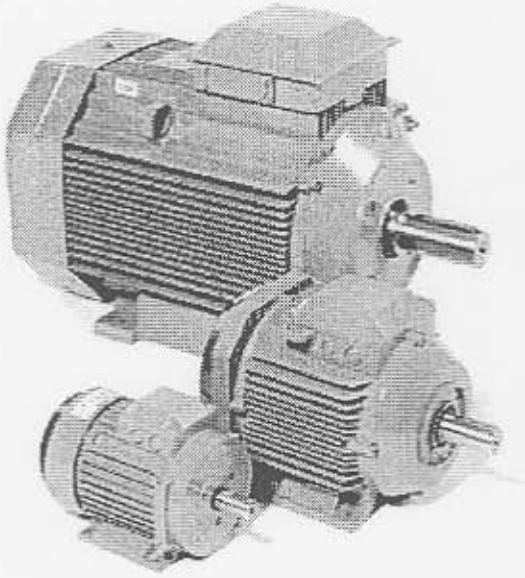
Manual MNVS001

Machine Instructions

M3000





ABB

Example of the Declaration of Conformity given by ABB Motors.

ABB

EC Declaration of Conformity

The Manufacturer :- *(Name and address of the manufacturer)*

hereby declares that

The Products :- *(Product identification)*

are in conformity with provisions of the following Council Directives :

Low Voltage Directive 73/23/EEC (amended by 93/68/EEC),

and, as components, with the essential requirements of the following :

EMC Directive 89/336/EEC (amended by 92/31/EEC and 93/68/EEC), regarding the intrinsic characteristics to emission and immunity levels,

and are in conformity with :

EN 60 034-1

Additional Information :-

By design, the machines, considered as components, comply with the essential requirements of

Machinery Directive 98/37/EEC provided that the installation be correctly realised by the manufacturer of the machinery (for example : in compliance with our Installation Instructions and EN 60 204 "Electrical Equipment of Industrial Machines").

Certificate of Incorporation (Directive 98/37/EEC, Art 4.2 and Annex II, Sub B) :

The machines above must not be put into service until the machinery into which they have been incorporated have been declared in conformity with the Machinery Directive.

Year of CE marking : CE00.

Signed by .....

Title .....

Date .....

Translations into other languages are available from ABB Motors.

Machine Instructions

NOTE!
These instructions must be followed to ensure safe and proper installation, operation and maintenance of the motor. They should be brought to the attention of anyone who installs, operates or maintains this equipment. Ignoring the instruction may invalidate the warranty.

Declaration of Conformity

Declarations of Conformity with respect to the Low voltage Directive 73/23/EEC amended by Directive 93/68 EEC are issued separately with individual machines.

The Declaration of Conformity also satisfies the requirements of a Declaration of Incorporation with respect to the Machinery Directive 98/37/EEC.

Validity

The instructions are valid for the following ABB electrical machine types, in both motor and generator operation.

series MT*, MBT*, MXMA, M2V*/M3V*, M2Q* series M2A*/M3A*, M2B*/M3B*, M2C*/M3C*, M2F*/M3F*, M2L*/M3L*, M2M*/M3M*, M2R*/M3R*,

in frame sizes 63 - 400.

(Additional information may be required for some machine types due to special application and/or design considerations.)

Putting into service (starting)

Reception check

Immediately upon receipt check the machine for external damage and if found, inform the forwarding agent without delay.

Check all rating plate data, especially voltage and winding connection (star or delta). The type of bearing is specified on the rating plate from size 112 and larger.

Remove transport locking if employed. Turn shaft by hand to check free rotation.

Motors equipped with roller bearings: Running the motor with no radial force applied to the shaft may damage the roller bearing.

Motors equipped with angular contact bearing:
Running the motor with no axial force applied in the right direction to the shaft may damage the angular contact bearing.

Motors equipped with regreasing devices:
When starting the motor for the first time, apply at least the specified quantity of grease until new grease is forced out of the grease outlet.
For details see section "Machines with relubrication system" on page 6.

Insulation resistance check

Measure insulation resistance before commissioning and when winding dampness is suspected.

Resistance, measured at 25°C, shall exceed the reference value, i.e. 10 M ohm (measured with 500 V dc Megger)

WARNING
Windings should be discharged immediately after measurement to avoid risk of electric shock.

Insulation resistance reference value is halved for each 20°C rise in ambient temperature.

If the reference resistance value is not attained, the winding is too damp and must be oven dried.
Oven temperature should be 90°C for 12-16 hours followed by 105°C for 6-8 hours.

Drain hole plugs, if fitted, must be removed during heating.

Windings drenched in seawater normally need to be rewound.

Direct-on-line or star/delta starting

The terminal box on standard single speed machines normally contains 6 winding terminals and at least one earth terminal.

Earthing must be carried out according to local regulations before the machine is connected to the supply voltage.

The voltage and connection are stamped on the rating plate.

Direct-on-line starting (DOL):
Y or Δ winding connections may be used.
eg 660 VY, 380 VΔ indicates Y-connection for 660 V and Δ-connection for 380 V.

Star/Delta starting (Y/Δ) :
The supply voltage must be equal to the rated voltage of the machine in Δ-connection.
Remove all connection links from the terminal block.

For two-speed, single phase and special machines, supply connection must follow the instructions inside the terminal box.

Terminals and direction of rotation

Direction of rotation is clockwise when viewing the shaft face at the machine drive end, when the line phase sequence L1, L2, L3 is connected to the terminals as shown in the figure 1.

To alter the direction of rotation, interchange the connection of any two line cables.

If the machine has a uni-directional fan, ensure that the direction of rotation is according to the arrow marked on the machine.

Use

Operating conditions
The machines are intended for use in industrial drive applications.
Normal ambient temperature limits are -25° to +40°C.
Maximum altitude 1000 m above sea level.

Safety considerations
The machine is intended for installation and use by qualified personnel, familiar with relevant safety requirements.

Safety equipment necessary for the prevention of accidents at the installation and operating site must be provided in accordance with the local regulations.

> WARNING
> Small motors with supply current directly switched by thermally sensitive switches can start automatically.

Points to observe
1. Do not use the machine to step on
2. The temperature of the outer casing of the machine may be hot to the touch during normal operation.
3. Some special machine applications require special instructions (e.g. using frequency converter supplies)
4. Lifting lugs must only be used for lifting the motor. They must not be used to lift the motor when it is attached to other equipment.

Handling

Storage
The machine should always be stored indoors, in dry, vibration free and dust free conditions.

Unprotected machined surfaces (shaft-ends and flanges) should protected with anti-corrosive paint.

It is recommended that shafts be rotated periodically by hand to prevent grease migration.

Anti condensation heaters, if fitted, should preferably be energised.

The characteristics of electrolytic capacitors, if fitted to single-phase motors, will require "reforming" following periods of storage exceeding 1-2 years.
Contact ABB Sales Office for details.

Transportation
Machines fitted with cylindrical-roller and/or angular contact bearings must be fitted with locking devices during transport.

Lifting
Lift the motor using the lifting lugs only.
The center of gravity of motors with the same frame may vary due to different outputs, mounting arrangements and auxiliary equipment.
Check that eyebolts or the lifting lugs integrated with the motor frame are undamaged before lifting. Damaged lifting lugs must not be used.
Lifting eyebolts must be tightened before lifting. If needed the position of the eyebolt must be adjusted with suitable washers.
Ensure that proper lifting equipment is used and that the sizes of the hooks are suitable for the lifting lugs.
Care must be taken not to damage auxiliary equipment and cables attached to the motor.

Machine weights
Total machine weight can vary within the same frame size (center height) depending on different output, mounting arrangements and added features.

The following table shows estimated maximum weights for machines in their basic versions as a function of frame material.

On machines weighing more than 25 kg, the actual weight is stated on the rating plate.

Frame size	Aluminium Weight kg	Aluminium Add. for brake	Cast iron Weight kg	Steel Weight kg
63	6	-	-	-
71	8	5	13	-
80	12	8	20	-
90	17	10	30	-
100	25	16	40	-
112	36	20	50	-
132	63	30	90	-
160	110	55	175	-
180	160	65	250	-
200	220	-	310	-
225	295	-	400	-
250	370	-	550	-
280	-	-	800	600
315	-	-	1300	1000
355	-	-	2300	2200
400	-	-	3500	3000

Installation

Cooling
Normal ambient temperatures should not exceed 40°C (marine standard 50°C) if standard performance is to be achieved. Check that the motor has sufficient airflow. Ensure that no nearby equipment or surfaces radiate additional heat to the motor. For more information about higher ambient temperatures and cooling, see "the Motor Guide" or contact ABB Sales Office.

Foundation
The purchaser bears full responsibility for preparation of the foundation.

Metal foundations should be painted to avoid corrosion.

Foundations must be even, and sufficiently rigid to withstand possible short circuit forces. They shall be dimensioned as to avoid the occurrence of vibration due to resonance.

Foundation studs
Bolt the foundation studs to the feet of the motor and place a 1-to-2 mm shim between the stud and the feet.

Align the motor directly using appropriate means.

Grout the studs with concrete, check alignment and drill holes for locating pins.

Drain holes
Always check that open drain holes face downward. Machines with closable plastic drain plugs are delivered with these open.
In extremely dusty environments, all drain holes should be closed.

Alignment
Correct alignment is essential to avoid bearing failures, vibrations and possible fractured shaft extensions.

Slide rails and belt drives
- Fasten the machine to the slide rails as shown in figure 2.
- Place the slide rails horizontally on the same level.
- Check that the machine shaft is parallel with driven, or driving, shaft.
- Any belt must be tensioned according to the supplier's instructions.

> WARNING
> Excessive belt tension will damage bearings and can cause shaft breakage.

Do not exceed the maximum belt forces (i.e. radial bearing loading) stated in the relevant product catalogues.

Connection

Normal machine design has the terminal box on top and cable entry possible from both sides.

As a special option, some machines are available with top mounted terminal boxes rotatable 4 x 90°, and some with side mounted terminal boxes.

Availability of these solutions is described in the product catalogues.

Unused cable entries must be closed.

As well as main winding and earthing terminals, the terminal box can also contain connections for thermistors, standstill heating elements, bimetallic, switches, or PT 100 resistance elements.

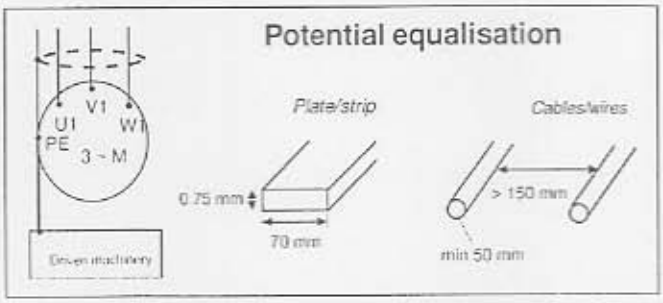
> WARNING
> Voltage may be connected at standstill inside the terminal box for heating elements or direct winding heating.

Connection diagrams for auxiliary elements are found inside the terminal box cover.

> WARNING
> The capacitor in single-phase motors can retain a charge that appears across the motor terminals, even when the motor has reached standstill.

In frequency converter applications motor frame external earthing must be used for equalising the potential between the motor frame and the driven machine, unless the two machines are mounted on the same metallic base. For motor frame sizes above IEC 280, use 0.75 x 70 mm flat conductor or at least two 50 mm² round conductors. The distance of the round conductors must be at least 150 mm from each other.

This arrangement has no electrical safety function; the purpose is to equalise the potentials. When the motor and the gearbox are mounted on a common steel fundament, no potential equalisation is required.



To comply with EMC-requirements, use only cables and connectors approved for this purpose. (See instruction for frequency converters.)

Assembly and dismantling

General
Dismantling and assembly of machines must be carried out by qualified personnel using only suitable tools and working methods.

Bearings
Special care should be taken with the bearings. These must be removed using pullers and fitted by heating or using special tools for the purpose. How to replace bearings is described in detail in a separate instruction leaflet available from ABB Sales Office.

Fitting coupling halves and pulleys
Coupling halves and pulleys must be fitted using suitable equipment and tools that do not damage the bearings.

Never fit a coupling half or pulley by hammering into place or remove it using a lever pressed against the body of the machine.

Mounting accuracy of coupling half :
check that the clearance **b** is less than 0,05 mm and that the difference **a1** to **a2** is also less than 0,05 mm. See figure 3.

Balancing

The rotor of the machine is dynamically balanced.

As standard, balancing has been carried out using **half key**, and the shaft is marked **with a RED tape**, with the text "Balanced with half key".
To avoid vibration the coupling-half or pulley must be balanced with half key after the keyway has been machined.

In the event of balancing **with full key** the shaft is marked **with a YELLOW tape**, with the text "Balanced with full key".
To avoid vibration the coupling-half or pulley must be balanced without a key after the keyway has been machined.

In case balancing **without key**, the shaft is marked **with a BLUE tape**, with the text "Balanced without key".

Maintenance and lubrication

General inspection

- Inspect the machine at regular intervals.
- Keep the machine clean and ensure free ventilation airflow.
- Check the condition of shaft seals (eg V-ring) and replace if necessary.
- Check the condition of connections and mounting and assembly bolts.
- Check the bearing condition by listening for unusual noise, vibration measurement, bearing temperature, inspection of spent grease or SPM bearing monitoring.

  * When changes of condition occur, dismantle the machine, check the parts and replace if necessary.

Lubrication

Machines with permanently greased bearings

Machines up to frame size 180 are normally fitted with permanently greased bearings of either Z or 2Z types. Bearing types are specified in the respective product catalogues and on the rating plate of each motor from size 112 and larger.

As a guide, adequate lubrication can be achieved for the following duration, according to L1 at ambient temperature of 25° C.
32 000 - 45 000 duty hours for 4 pole machines.[1]
16 000 - 26 000 duty hours for 2 and 2/4 pole machines.[1]

The shorter times apply to larger frame sizes.

[1] Depending on application and load conditions, see applicable product catalogue.
Hours of operation for vertical motors are half of the above values.

Machines with relubrication system

> **WARNING**
> Beware of all rotating parts!

Relubrication procedure:
- Remove grease outlet plug if fitted.
- Press fresh grease into the bearing until all old grease has been forced out
- Let the motor run 1-2 hours to ensure that all excess grease is forced out of the bearing. Close the grease outlet plug if fitted.

Regrease motors while running. If this is not possible, lubrication can be carried out while the machine is at a standstill. In this case, use only half the quantity of grease, then run the motor for a few minutes at full speed. When the motor has stopped, the remaining quantity of grease can be forced in until the old grease has been replaced.
After 1-2 running hours close the grease outlet plug (if fitted).

The grease outlet plug must be removed permanently with automatic lubrication.
If the machine is fitted with a lubrication information plate, follow the given values, otherwise use the values in table below.

ABB Motors policy is to have reliability as a vital issue in bearing lubrication intervals. That is why we follow the L1-principle (meaning that 99 % of the motors are sure to make the interval time). According to L1 policy the lubrication intervals are as follows:

Frame size	Amount of grease g/bearing	3600 r/min	3000 r/min	1800 r/min	1500 r/min	1000 r/min	500-900 r/min
	Ball bearings						
	Lubrication intervals in duty hours						
112	10	10000	13000	18000	21000	25000	28000
132	15	9000	11000	17000	19000	23000	26500
160	25	7000	9500	14000	17000	21000	24000
180	30	6000	8000	13500	16000	20000	23000
200	40	4000	6000	11000	13000	17000	21000
225	50	3000	5000	10000	12500	16500	20000
250	60	2500	4000	9000	11500	15000	18000
280	70	2000	3500	8000	10500	14000	17000
315	90	2000	3500	6500	8500	12500	16000
355	120	1200	2000	4200	6000	10000	13000
400	120	1200	2000	4200	6000	10000	13000
	Roller bearings						
	Lubrication intervals in duty hours						
160	25	3500	4500	7000	8500	10500	12000
180	30	3000	4000	7000	8000	10000	11500
200	40	2000	3000	5500	6500	8500	10500
225	50	1500	2500	5000	6000	8000	10000
250	60	1300	2000	4500	5700	7500	9000
280	70	1000	1700	4000	5300	7000	8500
315	90	1000	1700	3300	4300	6000	8000
355	120	400	1000	2000	3000	5000	6500
400	120	400	1000	2000	3000	5000	6500

Lubrication intervals for vertical machines are half of the above values.

The amount of grease stated in the table should be doubled if an automatic regreasing system is used.

The table values are based on the motor running at rated output in an ambient temperature of about + 25° (approx. 80°C bearing temperature). The values should be halved for 15°C increase in bearing temperature and may be doubled for 15°C decrease in ambient temperature.

> **WARNING**
> The maximum operating temperature of the grease and bearings must not be exceeded.

Higher speed operation, eg in frequency converter applications, or lower speed with heavy load will require shorter lubrication intervals. Consult ABB Sales Office in such cases.

Typically a doubling of speed will require a reduction of lubrication intervals to approx. 40 % of values tabulated above.

Suitability of bearings for high speed operation must be checked.

Lubricants

When regreasing, use only special ball bearing grease with the following properties:

- good quality grease with lithium complex soap and with mineral- or PAO-oil
- base oil viscosity 100-150 cST at 40°C
- consistency NLGI grade 2 or 3
- temperature range -30°C - +120°C, continuously.

Grease with the correct properties is available from all the major lubricant manufacturers.

The following (or similar) high performance grease can be used

- EssoUnirex N2 or N3
- Shell Albida EMS 2
- SKF LGHQ 3
- Mobil Mobilith SHC 100
- Klüber Kluberplex BEM 41-132
- BP Energrease LC2

NOTE!
Always use high speed grease for high speed machines and some other models, e.g. M2/M3_ 355 and 400 2-pole machines, where the speed factor is higher than 400 000 (calculated as Dm x n where Dm = average bearing diameter, mm ; n = rotational speed, rpm). The following, or similar, types of grease can be used:

- Kluber Asonic GHY 72
- Kluber Asonic HQ 72-102
- Shell Albida EMS 2
- Esso LT2
- Mobil Mobilith SHC 100

The following normal type of grease can be used if the regreasing interval is halved (these types of grease should not be used when bearing temperature is above 100 °C)

- Esso Beacon 2 or 3
- Shell Alvania RL2 or RL3
- SKF LGMT 2 or 3
- Mobil Mobilux 2
- Kluber Centoplex 2
- BP Energrease LS2

If the make of grease is changed and compatibility is uncertain, consult ABB Sales Office.
Highly loaded and/or slowly rotating bearings require EP-grease.
If the ambient temperature is below -25°C or above +55°C, or bearing temperature is above 110°C, consult ABB Sales Office regarding suitable grease.

> **WARNING**
> Grease can cause skin irritation and eye inflammation.
> Follow all safety precautions specified by the manufacturer.

Spare parts

When ordering spare parts, the full type designation and product code, as stated on the rating plate, must be specified.
If the machine is stamped with a serial manufacturing number, this should also be given.

Environmental requirements

Noise levels

Smaller machines have a sound pressure level not exceeding 70 dB(A).

The following table shows catalogue values of sound pressure levels at 1 m from the machines surface.

Frame size	Guideline sound pressure level, dB(A) 2 pole	4 pole	6 pole	8 pole
132	69	59	61	56
160	69	62	59	59
180	69	62	59	59
200	72	63	63	60
225	74	66	63	63
250	75	67	63	63
280	77	68	66	65
315	80	71	68	72
355	83	80	75	75
400	83	80	-	-

Values for specific machines can be found in the relevant product catalogues. Tolerance ± 3 dB(A).

The table values refer to 50 Hz sinusoidal supply conditions.

For 60 Hz sinusoidal supply, add 4 dB(A) to the above values.

For sound pressure levels with non-sinusoidal supplies, contact ABB Sales Office.

Sound pressure levels for all machines in the above frame sizes having separate cooling systems and for series M2F*/M3F*, M2L*/M3L*, and M2R*/M3R*, are indicated in separate Machine Instructions.

Rewinding

Rewinding should always be carried out by qualified repair shops.

Smoke venting and other special motors should not be rewound without first contacting ABB Motors.

These instructions do not cover all details or variations in equipment nor provide for every possible condition to be met in connection with installation, operation or maintenance. Should additional information required, please contact the nearest ABB Sales Office.

Motor trouble shooting chart
Your motor service and any trouble shooting must be handled by qualified persons with proper tools and equipment.

TROUBLE	CAUSE	WHAT TO DO
Motor fails to start	Blown fuses	Replace fuses with proper type and rating.
	Overload trips	Check and reset overload in starter.
	Improper power supply	Check to see that power supplied agrees with motor rating plate and load factor.
	Improper line connections	Check connections with diagram supplied with motor.
	Open circuit in winding or control switch	Indicated by humming sound when switch is closed. Check for loose wiring connections. Also, ensure that all control contacts are closed.
	Mechanical failure	Check to see if motor and drive turn freely. Check bearings and lubrication.
	Short circuited stator	Indicated by blown fuses. Motor must be rewound.
	Poor stator coil connection	Remove end bells, locate with test lamp.
	Rotor defective	Look for broken bars or end rings.
	Motor may be overloaded	Reduce load.
Motor stalls	One phase may be open	Check lines for open phase.
	Wrong application	Change type or size. Consult manufacturer.
	Overload	Reduce load.
	Low voltage	Ensure the rating plate voltage is maintained. Check connection.
	Open circuit	Fuses blown, check overload relay, stator and push buttons.
Motor runs and then dies down	Power failure	Check for loose connections to line, fuses and control.
Motor does not come up to speed	Not applied properly	Consult supplier for proper type.
	Voltage too low at motor terminals because of line drop	Use higher voltage or transformer terminals or reduce load. Check connections. Check conductors for proper size.
	Starting load too high	Check load motor is supposes to carry at start.
	Broken rotor bars or loose rotor	Look for cracks near the rings. A new rotor may be required, as repairs are usually temporary.
	Open primary circuit	Locate fault with testing device and repair.
Motor takes too long to accelerate and/or draws high amp	Excessive load	Reduce load.
	Low voltage during start	Check for high resistance. Adequate wire size.
	Defective squirrel cage rotor	Replace with new rotor.
	Applied voltage too low	Get power company to increase power tap.
Wrong rotation	Wrong sequence of phases	Reverse connections at motor or at switchboard.
Motor overheats while running underloaded	Overload	Reduce load.
	Frame or bracket vents may be clogged with dirt and prevent proper ventilation of motor	Open vent holes and check for a continuous stream of air from the motor.
	Motor may have one phase open	Check to make sure that all leads are well connected.
	Grounded coil	Locate and repair.
	Unbalanced terminal voltage	Check for faulty leads, connections and transformers.

TROUBLE	CAUSE	WHAT TO DO
Motor vibrates	Motor misaligned	Realign.
	Weak support	Strengthen base.
	Coupling out of balance	Balance coupling.
	Driven equipment unbalanced	Rebalance driven equipment.
	Defective bearings	Replace bearings.
	Bearings not in line	Line up properly.
	Balancing weights shifted	Rebalance motor.
	Contradiction between balancing of rotor and coupling (half key – full key)	Rebalance coupling or motor
	Polyphase motor running single phase	Check for open circuit.
	Excessive end play	Adjust bearing or add shim.
Scraping noise	Fan rubbing fan cover	Remove interference.
	Fan striking insulation	Clear fan.
	Motor loose on bedplate	Tighten holding bolts.
Noisy operation	Airgap not uniform	Check and correct bracket fits or bearing.
	Rotor unbalance	Rebalance.
Hot bearings general	Bent or sprung shaft	Straighten or replace shaft.
	Excessive belt pull	Decrease belt tension.
	Pulleys too far away	Move pulley closer to motor bearing.
	Pulley diameter too small	Use larger pulleys.
	Misalignment	Correct by realignment of drive.
Hot bearings ball	Insufficient grease	Maintain proper quality of grease in bearing.
	Deterioration of grease or lubricant contaminated	Remove old grease, wash bearings thoroughly in kerosene and replace with new grease.
	Excess lubricant	Reduce quantity of grease, bearing should not be more than 1/2 filled.
	Overloaded bearing	Check alignment, side and end thrust.
	Broken ball or rough races	Replace bearing, first clean housing thoroughly.

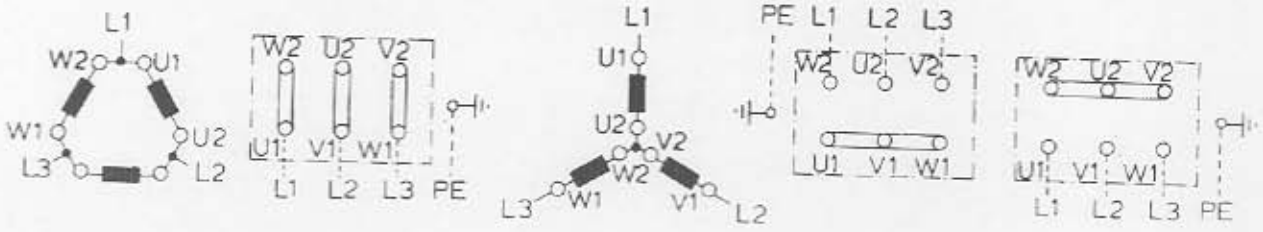


Figure 1. Connection diagram
Bild 1. Anschlußdiagram
Figure 1. Connection
Figura 1. Conexión
Figura 1. Collegamento
Figur 1. Anslutningdiagramm

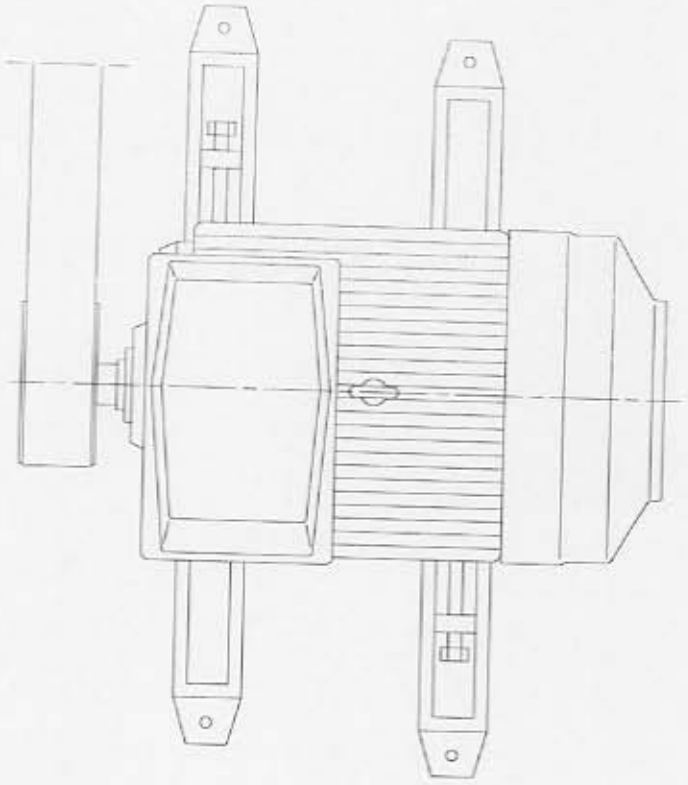


Figure 2. Belt drive
Bild 2. Riementrieb
Figure 2. Glissières et entraînements à courroie
Figure 2. Carriles tensores y correas
Figura 2. Slitte tendicinghia e pulegge
Figur 2. Remdrift
Kuva 2. Hihnakäyttö

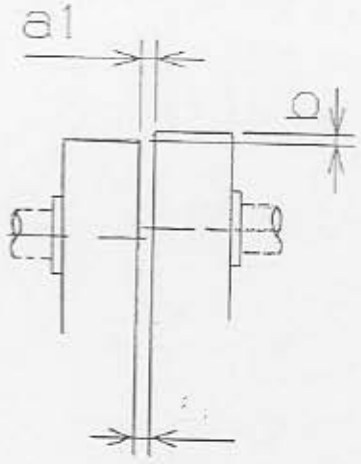
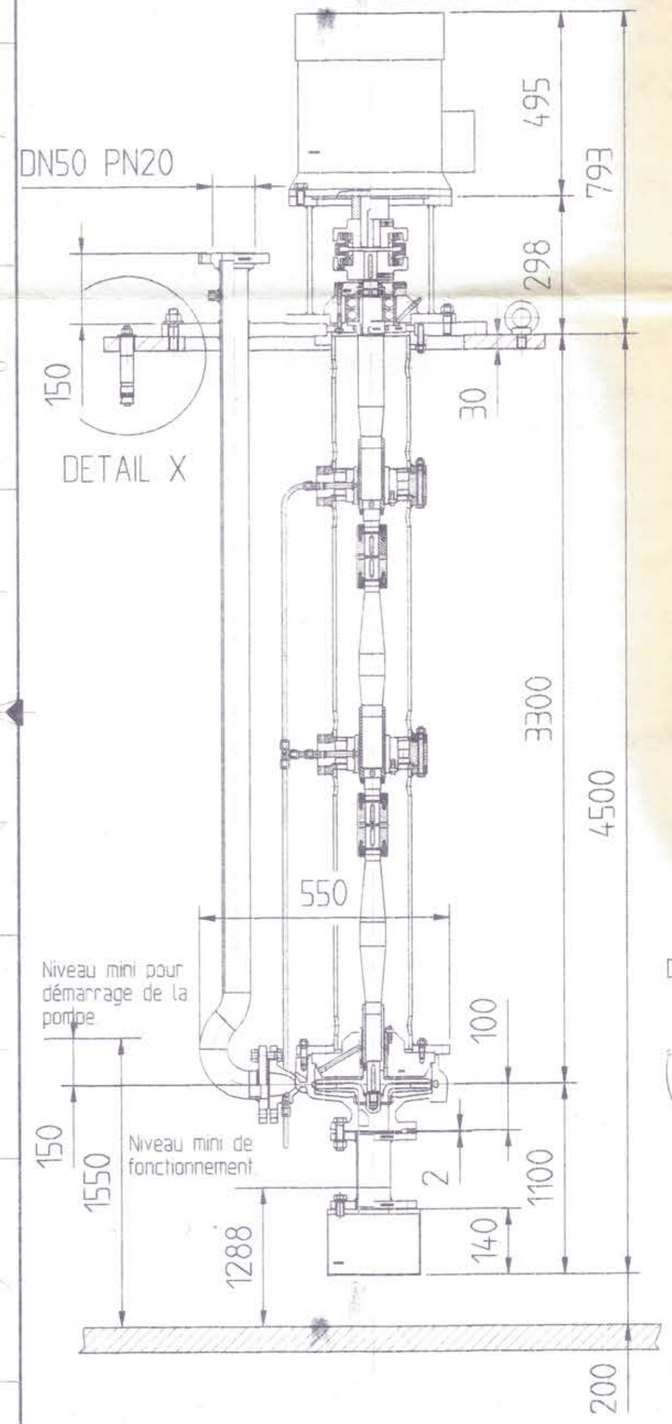


Figure 3. Mounting of half-coupling or pulley
Bild 3. Anbau von Kupplungshälften und Riemenscheiben
Figure 3. Montage des demi-accouplements et des poulies
Figura 3. Montaje de mitades de acoplamiento y poleas
Figura 3. Montaggio di semigiunti e pulegge
Figur 3. Montering av kopplinshalvor och drivskivor
Kuva 3. Kytkinpuolikkaan ja hihnapyörän asennus

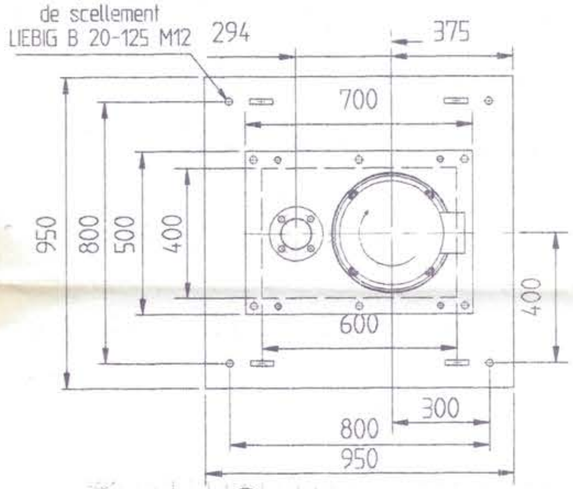
TOLERANCE OF THE DIMENSIONS						
Dimensions without tolerances	From	1	10	100	500	1000
	To	10	100	500	1000	2000
± Tolerances		±1	±2	±5	±10	±15

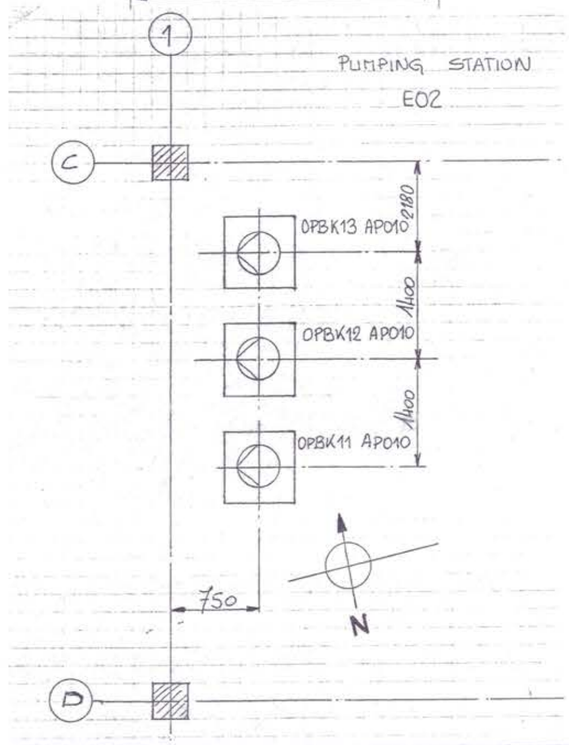
Moteur / Motor	AF2S
Type / Type	160 L 2
Vitesse / Synchronous speed	3000 Tr/mn (rpm)
Puissance / Power	15 Kw
Fréquence / Frequency	50 Hz
Tension / Voltage	400 V
Protection / Protection	IP55

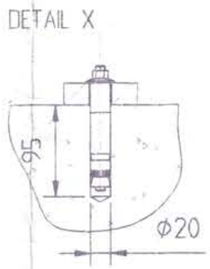


Brides suivant NF E 29 203

CONSTRUCTION COMPONENT NUMBER	
00 J15 B 009	0 PKB 11 AP 010
00 J15 B 010	0 PKB 12 AP 010
00 J15 B 011	0 PKB 13 AP 010







Nr	Date	OBSERVATIONS
3	06/01/98	UP TO DAY
2	11/97	UP TO DAY
1	07/97	Up to day

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OUTLING DRAWING

CNV 065-050-250

Dessiné BARTZMANN

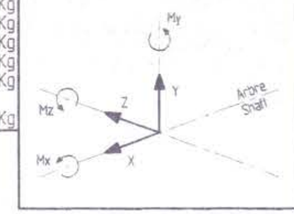
Vérifié

Date 18/07/1997

POMPES RUTSCHI — 67 Avenue de Pfastatt, 68110 ILLZACH

9.21.2128

Moteur / Motor	126 Kg
Pompe / Pump	400 Kg
Plaque de base / Ground plate	90 Kg
Accouplement / Coupling	3 Kg
Accessoires / Accessory	60 Kg
Poids total / Net weight	679 Kg



Admissible forces and moments working on the discharge branche 050

Forces et moments admissibles sur brides de refoulement DN 050

Fx (daN)	100
Fy (daN)	180
Fz (daN)	140
Mx (m.daN)	50
My (m.daN)	60
Mz (m.daN)	50

AS BUILT

REV	DATE	AUTH.	CHECK. BY	APPR. BY	MODIFICATIONS	STATUS
B	06.01.98	S.S	M.S	J.C	UP TO DAY	BPE
A	20/10/97	S.S	M.S	J.C	FIRST ISSUE	BPO

SCALE :

SIZE :A2

SUPPLIER NAME : POMPES RUTSCHI — 67 Avenue de Pfastatt, 68110 ILLZACH

Nr : R601952/953/954

SPECIFICATION Nr :J15

PUBLIC POWER CORPORATION

ATHENS GREECE

LAVRION COMBINED CYCLE BLOCK - 550 MW NET

CONTRACT N° DMKT - 162 / 99129

SEA WATER CHLORINATION TRANSFER PUMPS
0 PKB 11/12/13 AP010
EQUIPMENT ARRANGEMENT

GEC ALSTHOM — POWER GENERATION DIVISION — METKA S.A.

PGD-PPG
Nr LAV00MCTEJ15EA004

Customer number ***LAV00MPKBJ15EA004***

ISSUE REV. A B