



Pump Division



Model: VCT

VERTICAL CENTRIFUGAL PUMPS

***USER INSTRUCTIONS:
INSTALLATION, OPERATION AND
MAINTENANCE for self lubricated pump***

User Instructions No. MX0301 - 07/03 (E)

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1 INTRODUCTION AND SAFETY

1.1 General



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

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

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

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



These instructions should be read entirely prior to installing, operating, using and maintaining the equipment in any region worldwide. The equipment must not be put into service until all the conditions relating to safety noted in the instructions, have been met.

1.2 CE marking and approvals

It is a legal requirement that machinery and equipment put into service within certain regions of the world shall conform with the applicable CE Marking Directives covering Machinery and, where applicable, Low Voltage Equipment, Electromagnetic Compatibility (EMC), Pressure Equipment Directive (PED) and Equipment for Potentially Explosive Atmospheres (ATEX), American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers (IEEE), International Electrotechnical Commission (IEC), National Electrical Manufacturers Association (NEMA), National Fire Protection Association (NFPA).

1.3 Disclaimer

Information in these User Instructions is believed to be reliable. In spite of all the efforts

of Flowserve Corporation to provide sound and all necessary information the content of this manual may appear insufficient and is not guaranteed by Flowserve as to its completeness or accuracy.

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

1.4 Copyright

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

1.5 Duty conditions

This product has been selected to meet the specifications of your purchaser order. The acknowledgement of these conditions has been sent separately to the Purchaser.




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


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


1.6 Safety


1.6.1 Summary of safety markings


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

 **DANGER** This symbol indicates electrical safety instructions where non-compliance would affect personal safety.

 This symbol indicates safety instructions where non-compliance would affect personal safety.

 This symbol indicates safety instructions where non-compliance would affect protection of a safe life environment.

 This symbol indicates safety instructions where non-compliance would affect the safe operation or protection of the pump unit.

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

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

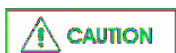
1.6.2 Personnel qualification and training

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

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

1.6.3 Safety action

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

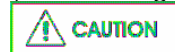
 **LEVELED FOUNDATION PLATE**
 Foundation plate or suction barrel flange must be leveled within 0.050mm (0.002 in.) as maximum variation which is indispensable for operation free of trouble.
 Use a rectified long bar in order to support precision level across the foundation plate (side-to-side) and levelling all directions every 45 degrees. Foundation plate must be verified before and after pour the grouting.


 **PREVENT EXCESSIVE EXTERNAL PIPE LOAD**

- a) Do not use pump as a support for piping. Piping must be independently supported and must not be drawn into position with flange bolting. Pipe strains on the pump can be a definite source of trouble, resulting in possible misalignment, excessive wear, vibration and even broken shafts.
- b) If expansion joint is used, employ tie rods of adequate strength (i.e. size for 1-1/2 times shut off pressure).
- c) Ensure pump and piping is flushed before use .

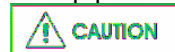
 **ENSURE CORRECT LUBRICATION**

When external water source or oil is needed for lubrication-see General Arrangement Drawing. (See drawings attached)


 See section 5.3, *Direction of rotation* before connecting the motor to the electrical supply.

 **START THE PUMP WITH OUTLET VALVE PART OPENED 30%.**

(Unless otherwise instructed at a specific point in the user instructions, see section 5, *Commissioning, start up, operation and shutdown.*) This is recommended to minimize the risk of overloading and damaging pump motor at full or zero flow. The pump outlet control valve may need to be adjusted to comply with the duty following the run-up process.


 **DO NOT RUN THE PUMP AT ABNORMALLY HIGH OR LOW FLOW RATES**

Operating at a flow rate higher or lower than normal may overload the motor and cause cavitation, instability and vibration.

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

 **HAZARDOUS LIQUIDS**

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

 **HANDLING COMPONENTS**

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

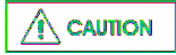


LIFTING DEVICES

Mounted on individual parts are intended for lifting the individual part only. Lifting slings must not put excessive side thrust on the lifting device.



GUARDS MUST NOT BE REMOVED WHILE THE PUMP IS OPERATIONAL



LIFTING ROTOR

Lifting rotor must be setting before start up the pump, according nameplate. See point 5.5



FLUORO-ELASTOMERS (When fitted.)

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



HANDLING COMPONENTS

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

1.6.4 Products used in potentially explosive atmospheres



Measures are required to:

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

The following instructions for pumps and pump units when installed in potentially explosive atmospheres must be followed to help ensure explosion protection. Both electrical and non-electrical equipment must meet the requirements of European Directive 94/9/EC.

1.6.4.1 Scope of compliance



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

Where Flowserve has supplied only the bare shaft pump, the Ex rating applies only to the pump. The

2 TRANSPORT AND STORAGE

party responsible for assembling the pump set shall select the coupling, driver and any additional equipment, with the necessary CE Certificate/ Declaration of Conformity establishing it is suitable for the area in which it is to be installed.

1.6.4.6 Preventing leakage



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

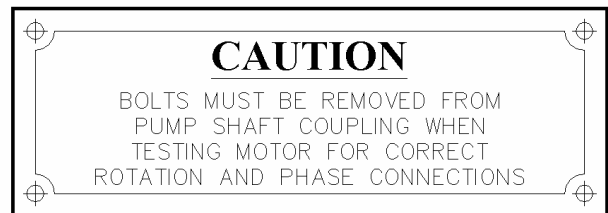
1.7 Nameplate and warning labels

1.7.1 Nameplate

Every pump has a name plate made in stainless steel with information regarding operating condition as capacity, total dynamic head, rotational speed, specific gravity, rotor setting, power consumption and serial number.

1.7.2 Warning labels

A stainless steel plate is attached to discharge head requesting removing coupling bolts before checking motor rotation and avoid damage to the equipment.



1.8 Specific machine performance

For performance parameters see data sheet and performance curve in this User Instructions.

1.9 Noise level

When pump noise level exceeds 85 dBA attention must be given to prevailing Health and Safety Legislation, to limit the exposure of plant operating personnel to the noise. The usual approach is to control exposure time to the noise.

Pump noise level is dependent on a number of factors - the type of motor fitted, the operating capacity, pipework design and acoustic characteristics of the building.

2.1 Consignment receipt and unpacking

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

Check any crate, boxes or wrappings for any accessories or spare parts that may be packed separately with the equipment or attached to side walls of the box or equipment.

Each product has a unique serial number. Check that this number corresponds with that advised and always quote this number in correspondence as well as when ordering spare parts or further accessories. For Flowserve contact see point 11.4

2.2 Handling

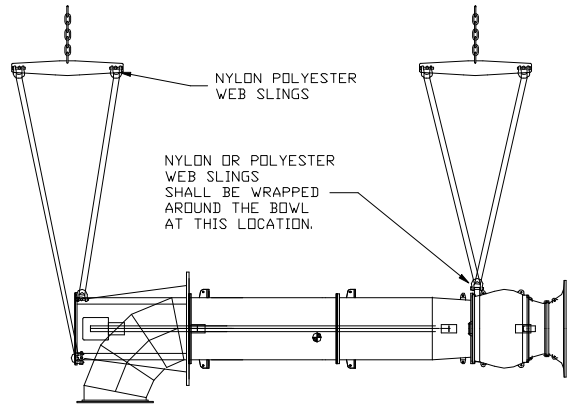
Boxes, crates, pallets or cartons may be unloaded using fork-lift vehicles or slings dependent on their size and construction.

2.3 Lifting

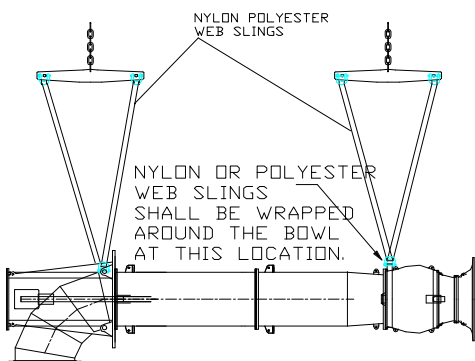
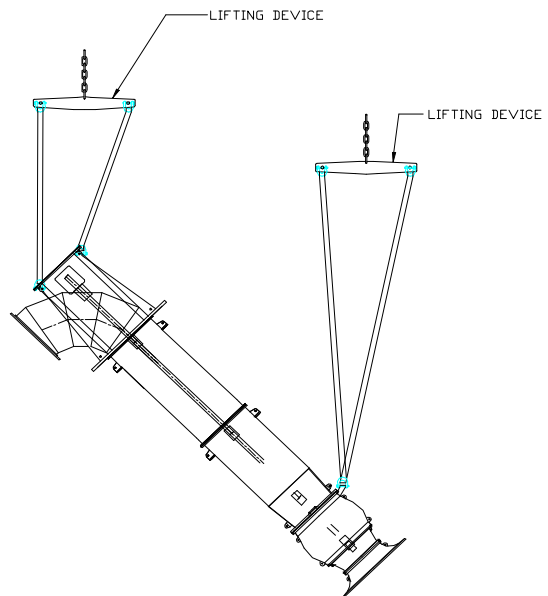


To avoid distortion, the pump unit should be lifted as shown. All lifting should be done using the lifting points that have been provided. (See the outline drawing for location, size configuration and for total equipment weight.) Arrange any slings, chains or cables so that the weight is distributed uniformly. Use spread bars when necessary to avoid undue pressure on light sheet metal parts.

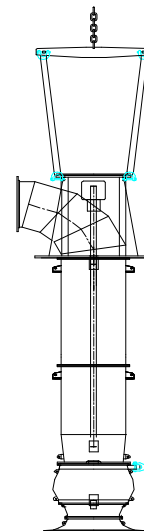
If lifting lugs are provided on discharge head baseplate lift it as shown.



For installing pump handle the pump as follow:



If lifting lugs are provided in the top of discharge head , lift it as follow.





Fully trained personnel must carry out lifting, in accordance with local regulations. The driver and pump weights are recorded on their respective General Arrangement Drawing.

2.4 Storage



Store the pump in a clean, dry location away from vibration. Equipment stored in horizontal position must be placed upon enough skids or wood blocks to prevent contact with ground and surface contaminants. Leave piping connection covers in place to keep dirt and other foreign material out of pump casing.

Renew the preservative coating in areas where it has been rubbed off or scraped including internal areas and replace covers on openings.

Touch up the areas has been chipped or scraped.

Twice a month 180° rotation of pump is needed in order to decrease shaft distortion due to horizontal storage.

Longer storage periods (more than 5 months), it is required to create and store the pump fully disassembled when it has rubber bearings in order to prevent rubber bearings deformation. Contact Flowserve's representative when longer than 5 months storage will be done (See section 10)

2.5 Recycling and end of product life

At the end of the service life of the product or its parts, the relevant materials and parts should be recycled or disposed of using an environmentally acceptable method and in accordance with local regulations. If the product contains substances that are harmful to the environment, these should be removed and disposed of in accordance with current local regulations.



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

3 PUMP DESCRIPTION

3.1 Name nomenclature

The pump size will be engraved on the nameplate as exemplar below:

65 APM

Where:

Nominal size: **65**

Pump type: **APM**

The typical nomenclature above is the general guide. Identify the actual pump size and serial number from the pump nameplate. Check that this agrees with the applicable certification provided.

3.2 Design of major parts

3.2.1 Bowl.

The pump has its main part in the bowl which conducts liquid from impeller to column pipe and converts to pressure the velocity added by the impeller.

3.2.2 Impeller

The impeller is semi-open type and it is dynamically balanced

3.2.3 Shaft

The large diameter stiff shaft, supported by bearings is accurately machined.

3.2.4 Bearings and lubrication

Bearings are fitted as standard and are lubricated by pumped liquid.

3.2.5 Suction bell

This piece approaches liquid to impeller eye in optimum way.

3.2.6 Stuffing box housing

The stuffing box contains packing which controls leakage thru pump shaft passage.

3.2.7 Driver

The driver is normally an electric motor. Different drive configurations may be fitted such as internal combustion engines, turbines, hydraulic motors etc. driving via couplings, belts, gearboxes, drive shafts etc.

3.2.8 Accessories

Accessories may be fitted when specified by the customer on data sheet or purchase order.

3.3 Performance and operating limits

This pump has been selected to meet the specifications of your purchase order for more details see attachment in this User Instructions.

4 INSTALLATION



Equipment operated in hazardous locations must comply with the relevant explosion protection regulations.

4.1 Location

The pump should be located to allow room for access, ventilation, maintenance and inspection

with ample headroom for lifting it. Refer to the general arrangement drawing for the pump set.

4.2 Part assemblies

Motor is typically supplied loose. It is the responsibility of the installer to ensure that the motor is assembled to the pump and lined up as detailed in section 4.5.2 and 5.5

4.3 Foundation

CAUTION The foundation should be sufficiently substantial to absorb vibration and to form a permanent, rigid support for the pump. The mass of the foundation it is considered that foundation has an infinite mass since there will not be resonance between pump mass and foundation mass.

The combined resonant frequency of the pump, motor, foundation and discharge piping has been calculated to be sufficiently removed from the rotational speed so that no vibration amplification will occur. This analytical model has been based upon the following:

- A). A rigid foundation support system that has a stiffness of at least 2.5×10^5 lb/ft. It has been assumed that the pump foundation provides no lateral deflection to the combined assembly.
- B). An assumed discharge piping stiffness has been used to simulate the effect of the discharge piping.

Non-compliance with the provision of correct foundation and installation may lead to failure of the pump and, as such, would be outside the terms of the warranty.

4.4 Grouting

After levelling foundation plate, soleplate or suction barrel flange at 0.050mm (0.002 in.) maximum, using a straight bar which cross the sole plate side-to-side and a precision level device. Pour the grouting in order to fill the cavity below the foundation plate. It is important that a non-shrink type of grout be used. Ordinary cement, sand and water mixtures tend to shrink as the water evaporates, often leaving the underside of the foundation plate insufficiently supported. It is recommended that grouting be performed by a qualified grouting contractor. If in any doubt, see attachment in this user instructions or please contact your nearest service centre.

Grouting provides solid contact between the pump unit and foundation, prevents lateral movement of running equipment and dampens resonant vibrations.

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

4.5 Alignment

4.5.1 Thermal expansion

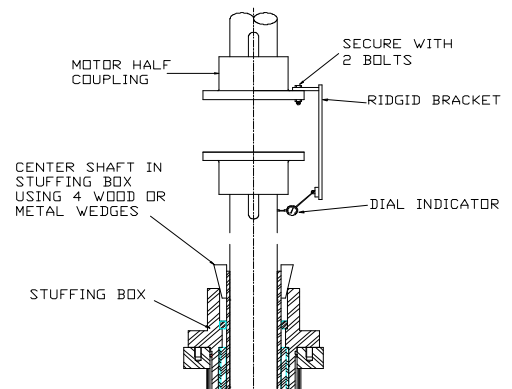
CAUTION The pump and motor will normally have to be aligned at ambient temperature and thermal expansion occurs after running at operating temperature. After eight hours of operation shut down and check the alignment immediately.

4.5.2 Alignment method

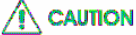
DANGER Ensure pump and driver are isolated electrically and the half couplings are disconnected.

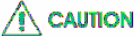
CAUTION The alignment MUST be checked to ensure successful operation using dial indicators as follow:

- a) Before mounting the motor check rotation (see point 5.3).
- b) Support driver vertically, shaft facing down and thoroughly clean the shaft and mounting faces.
- c) Install motor half coupling with its key and split ring on motor shaft, pull it down to seat firmly against the split ring.
- d) Install pump half coupling and adjusting nut.
- e) Using a dial indicator mounted to the driver half coupling, rotate driver shaft to take readings from the pump shaft, and move the driver as necessary to align driver and pump shaft within 0.002" (0.03 mm) total indicator run out and tighten driver mounting fasteners.(see Rotor setting point 5.3)
- f) Refer to driver manufacturer's manual for driver operating instructions and lubrication. (See point 10.2)



4.6 Piping

 Protective covers are fitted to the discharge flange, pipe connections and suction head, to prevent foreign bodies entering during transportation and installation. Ensure that these covers and shipping brace are removed from the pump before connecting any pipes.

 Never use the pump as a support for piping.

Maximum forces and moments allowed on the pump flanges vary with the pump size and type (see general arrangement drawing for specific values). To minimize these forces and moments that may, if excessive, cause misalignment, vibration and the possible failure of the pump, the following points should be strictly followed:

- Prevent excessive external pipe load, design piping system to minimize pump nozzle loads.
- Permit no excessive strain on the pump discharge flange
- Never draw piping into place by applying force to pump flange connections
- Provide expansion joints with tie rods of suitable strength (sized for 1 ½ times shut off pressure).
- Discharge valve should be located at least one pipe diameter from face of pump discharge flange.
- Special considerations and provisions must be made to avoid the chance of water-hammer during pump operation and start up pump.


 Ensure piping is flushed before use.


4.7 Final shaft alignment check


After connecting piping to the pump, rotate the shaft several times by hand to ensure there is no binding and all parts are free.


Recheck the coupling alignment, as previously described, to ensure no pipe strain. If pipe strain exists, correct piping, see point 4.5.2

4.8 Electrical connections


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

4.8.2  It is important to be aware of the potentially explosive areas where compliance is an additional requirement for making electrical connections.


4.8.3  **DANGER** The motor must be wired up in accordance with the motor manufacturer's instructions in this user instructions including any temperature, earth leakage, current and other protective devices as appropriate. The identification nameplate should be checked to ensure the power supply is appropriate.

4.8.4  A device to provide emergency stopping must be fitted.

4.8.5 The controller/starter electrical details will also be supplied within the controller/starter when applied.

4.8.6  See section 5.3, *Direction of rotation* before connecting the motor to the electrical supply.

5 COMMISSIONING, START-UP, OPERATION AND SHUTDOWN

 **These operations must be carried out by fully qualified personnel.**

5.1 Pre-commissioning procedure

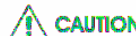
5.1.1 Lubrication

Determine the mode of lubrication of the pump-motor set and supply it.

5.2 Motor lubricants

See Motor's manual and motor outline in attachment in these User Instructions for motor **lubrication** details before any start up or test.

5.3 Direction of rotation

 Ensure the pump motor is given the same rotation as the pump direction arrow marked on the pump nameplate and Outline Drawing.

Some vertical motors are required to have non reverse couplings (non reverse device), to avoid pump-motor back spinning do to water column flow back during shutdown.

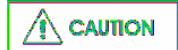
However the device is designed to support the forces developed by the pump, when the water is flowing back, which is increase gradually, the device is not expected to support the motor torque, which is suddenly applied as a shock a would damage the pins or ratchet plate teeth; Base on this, the motor must never be started against the ratchet pins, to avoid pins or ratchet plate damage

and as in consequence, catastrophic failure to the top parts of the motor.

If the phase sequence of the incoming motor power cables is not positively known and the motor is to be “bumped” for rotation check, the ratchet pins must be removed from the pin carrier, to avoid the expected damage to the non reverse device.

The pins removal is under customer or motor installer responsibility.

Whenever the dismantling of couplings is necessary, the use of witness marks will assure a balanced condition when assembly is complete.



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

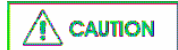
It is recommended that records be kept of the steady state uncoupled vibration and bearing temperatures to use for comparison with coupled and loaded conditions, and to provide a data base for judging the motor's performance in the future. These records should be permanently retained for reference.

5.4 Guarding



Guarding is supplied fitted to the pump set. If this has been removed or disturbed ensure that all the protective guards around the pump coupling and exposed parts of the shaft are securely fixed.

5.5 Rotor Setting

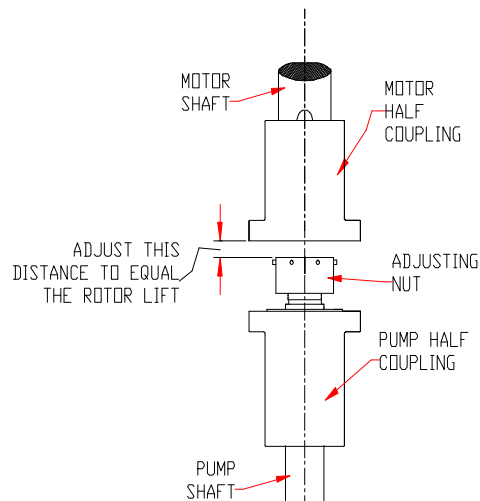


Before pump start up, it is required adjust the impeller setting and avoid rubbing between impeller and impeller liner which can damage severely the pump, Rotor setting is specified on pump nameplate and pump outline drawing.

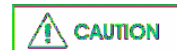
Follow next procedure in order to adjust the rotor setting:

- Fit motor half coupling on motor shaft.
- Fit split ring on motor shaft and move motor half coupling until it covers the split ring.
- Fit pump half coupling on the pump top shaft.
- Fit adjusting nut on the pump top shaft.
- Adjust separation between adjusting nut and motor half coupling at rotor setting specified on nameplate; Use feeler gages.

- Turn motor half coupling so bolt holes will line up with the bolt holes in the pump half coupling
- Insert two of the coupling bolts and tighten progressively until secure, thereby closing the gap above the adjusting nut and raising rotor to running position.
- Insert the remaining bolts and tighten them securely.
- Check for free rotation of driver and pump shaft. (See coupling detail in section 8)
- If mechanical seal is supplied, the set screws of drive collar must be tighten in this moment.



5.6 Starting the pump

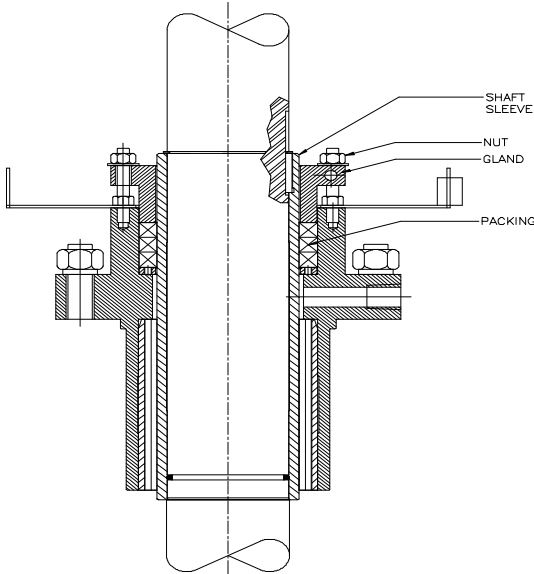


- CLOSE the outlet valve, two –speed motor operator with valve opening and slow closing. Generally 15/45 second timing works satisfactorily for most pump systems. 15 second to open , 45 second to close totally the valve. A single speed valve motor, most economical, at 60 second should be satisfactory.
- PRE-OPEN pump valve to 30 degrees with motor interlocked to start and stop position. The system can be primed or unprimed. If unprimed, system downstream should be fully opened and vented while hold valve to 30 degrees until system is stabilized, motor reaches rated speed and / or discharge piping is completely full.
- On Fully Prime System using a 15/45 second valve operator. Start pump and valve simultaneously.

- d) Check outlet pressure.
- e) Check outlet capacity.
- f) Check vibration at rated capacity. Note that vibration at different capacity than rated capacity could be bigger.
- g) Check motor current.

5.7 Running the pump

5.7.1 Pumps fitted with packed gland



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

The gland must be adjusted evenly to give visible leakage and concentric alignment of the gland to avoid excess temperature. If no leakage takes place the packing will begin to overheat. If overheating takes place the pump should be stopped and allowed to cool before being re-started. When the pump is re-started, check to ensure leakage is taking place at the packed gland.

The pump should be run for 30 minutes with steady leakage and the gland nuts tightened by 10 degrees at a time until leakage is reduced to an acceptable level, normally a minimum of 120 drops per minute is required. Bedding in of the packing may take another 30 minutes.

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

Never run gland packing dry or too tight, even for a short time.

5.7.2 Pumps fitted with mechanical seal

Mechanical seals will be adjusted to pump shaft tighten collar set screws and moving set pieces after rotor setting was done according point 5.5; Any slight initial leakage will stop when the seal is run in.

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

External flush or quench should be started before the pump is run and allowed to flow for a period after the pump has stopped.

Never run a mechanical seal dry, even for a short time. (See mech. seal IOM manual)

5.7.3 Normal vibration levels, alarm and trip

Alarm and trip values are given in attachment in these User Instructions. Measuring vibration at regular intervals will then show any deterioration in pump or system operating conditions.

5.8 Stopping and shutdown

- a) Close the outlet valve until 30 degrees.
- b) Stop the pump motor.
- c) Continue closing the outlet valve.

5.9 Emergency shutdown

In the event of power failure, water from system will flow in reverse through the pump while the pump discharge valve must be slowly closing. The pump and motor are designed so that no damage will occur from turning at speeds until 140% of rated speed which will be generated by the operating head in the pipe discharge system.

6 MAINTENANCE

6.1 General

It is the plant operator's responsibility to ensure that all maintenance, inspection and assembly work is carried out by authorized and qualified personnel who have adequately familiarized themselves with the subject matter by studying this manual in detail. (See also section 1.6.2.)

Any work on the machine must be performed when it is at a standstill. It is imperative that the

procedure for shutting down the machine is followed, as described in section 5.8.

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

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

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

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

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

Do not spray air or compressed inert gas on skin.

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

Never use air or compressed inert gas to clean clothes.

Before working on the pump, take measures to prevent an uncontrolled start. Put a warning board on the starting device with the words: **"Machine under repair: do not start"**.

With electric drive equipment, lock the main switch open and withdraw any fuses. Put a warning board on the fuse box or main switch with the words: **"Machine under repair: do not connect"**.

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

6.2 Maintenance schedule



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

- Any auxiliary systems installed must be monitored, if necessary, to ensure they function correctly.
- Gland packings must be adjusted correctly to give visible leakage and concentric alignment

of the gland follower to prevent excessive temperature of the packing or follower.

- Check for any leaks from gaskets and packings. The correct functioning of the shaft seal must be checked regularly.
- Check that the duty condition (capacity, head, voltage, current, etc.) is in the design operating range for the pump and record them.
- Check vibration to confirm satisfactory operation.
- Check dirt and dust is removed from areas around pump and motor.
- Check coupling alignment and re-align if necessary.

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

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

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

6.2.1 Routine inspection (daily/weekly)



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

- Check operating behaviour. Ensure vibration is normal.
- Check that there are no abnormal fluid or lubricant leaks (static and dynamic gasket or packing) and that any sealant systems (if fitted) are full and operating normally.
- Check that shaft seal leaks are within acceptable limits.
- Check the level and condition of motor lubricant. Check running hours since last recharge or complete lubricant change.
- Check any auxiliary supplies (if fitted) are functioning correctly.



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

6.2.2 Periodic inspection (six monthly)



- Check foundation bolts for security of attachment and corrosion.
- Check pump running records for hourly usage to determine if there is some operating change.
- The coupling should be checked for correct alignment (If necessary).



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

6.2.3 Re-lubrication



Refer to the motor manual and any associated equipment for periodic checks needed.

6.3 Spare parts

6.3.1 Ordering of spares

Flowserve keep records of all pumps that have been supplied. When ordering spares the following information should be quoted:

- 1) Pump serial number
- 2) Pump size
- 3) Part name – taken from sectional drawing in attachment.
- 4) Part number – taken from sectional drawing in attachment.
- 5) Number of parts required

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

If over size or under size parts are required (liked to wear rings) a sketch is required with indication of diameter dimension required.

To ensure continued satisfactory operation, replacement parts to the original design specification should be obtained from Flowserve.

Any change to the original design specification (modification or use of a non-standard part) will invalidate the pump's safety certification. For Flowserve contact see section 10 at the end of these user instructions.

6.3.2 Storage of spares

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

6.4 Recommended spares and consumable items

For start up purposes:

- 1 - complete set of packing
- 1 - set of gaskets and o rings

For 2 years operation:

- 1 - set of bearings
- 1 - set of packing
- 1 - shaft sleeve
- 1 - set of gaskets
- 1 – set of casing wear rings

- (optional:
- 1 - impeller wear rings)

For 4 years operation:

- 1 - set of bearings
- 1 - sets of gland packing
- 1 - shaft sleeves
- 1 - set of gaskets
- 1 - set of casing wear rings
- 1 - impeller

- (optional:
- 1 - impeller wear rings)

6.5 Tools required

Any special tool is required to maintain these pumps.

6.6 Fastener torques

6.6.1 Flange mating

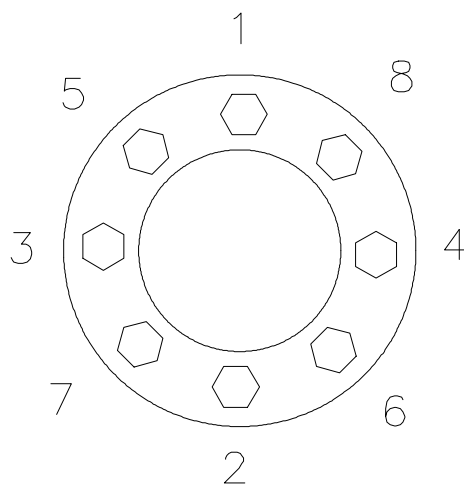
Surfaces shall be thoroughly cleaned. Assemble joint and hand tighten all fasteners to insure uniform metal-to-metal contact of the mating surfaces.

6.6.2 Using the proper size torque wrench

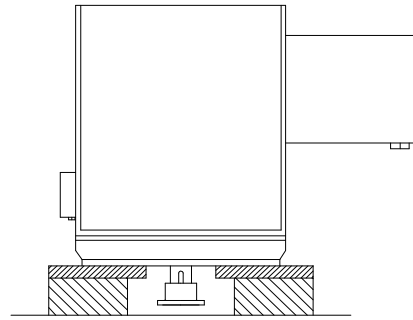
(Work in ¼ to ¾ of wrench scale) Pretorque fasteners with an even steady pull to approximately 1/3 of the torque value in the sequence specified below. Repeat sequence increasing torque to approximately 2/3 of the specified value. Finally repeat sequence for the specified torque.

6.6.3 start with any bolt

Identify as (1) and location designated as 0°, bolt (2) will be at 180°, bolt (3) at 270°, and bolt (4) at 90°. Using counterclockwise rotation, tighten bolt (5), (see figure below , where number of bolts are only as example) and continue rotation until all bolts have been tightened.



Bolt size	Torque Nm (lb•ft)
M 16 (5/8 in.)	84 (62)
M 20 (3/4 in.)	165 (120)
M 24 (7/8 in.)	285 (210)
M 27 (1 in.)	375 (275)
M 30 (1 1/8 in.)	540 (400)
M 36 (1 3/8 in.)	900 (660)
M 42 (1 5/8 in.)	1 410 (1 040)
M 48 (1 7/8 in.)	2 060 (1 500)



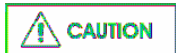
6.7 Renewal clearances

As wear takes place between the impeller and casing ring the overall efficiency of the pump set will decrease. To maintain optimum efficiency it is recommended that rings are replaced and the impeller renovated when the radial clearance detailed in attachment in this User Instructions is 1.5 bigger than new clearance.

6.8 Disassembly



Refer to section 1.6, *Safety*, before dismantling the pump; All numbers in parenthesis () correspond to the part numbers on the Sectional drawing.



Before dismantling the pump for overhaul, ensure genuine Flowserve replacement parts are available. Refer to sectional drawing in attachment for part numbers and identification.

6.8.1 Maintenance

6.8.1.1 Dismantling procedure

WARNING.- Do not attempt any maintenance, inspection, repair or cleaning in the vicinity of rotating equipment. Such action could result in personal injury to operating personnel.

- Break and tag motor circuit breaker. **Disconnect the motor leads.**
- Remove coupling guards from “windows” in discharge head (1371) and motor support.
- If mechanical seal is supplied, loose set screws from the drive collar (in this way, the shaft and seal sleeve will have free movement).
- Disconnect coupling halves (7210-7220) taking precautions not to allow the pump rotor to fall as the coupling bolts are removed, turn opposed bolts alternately.
- Remove the motor bolting. Lift off the motor from the discharge head (1371) and place it on blocking on the floor.

- Remove pump half coupling (7210) with key from upper shaft (2130).
- Remove bolting holding split gland (4120) to stuffing box (4110) and remove split gland. Remove stuffing box packing (4120).

6.8.1.2 Removing the pump

This pump is best removed from the system to carry out complete strip down, next procedure is for short pumps which can be removed completely assembled. Longer pumps should be removed from the pit removing sections at time.

- Using the overhead hoist, lift the complete pump from the pit until the suction head (1130) is about two feet above the pit opening. With the pumping element suspended in a vertical position ring a sling (provided by customer) around the casing (1170) as showed in figure of point 2.3, Using both overhead hoist, maneuver the pump into a horizontal position.
- Using both overhead hoist, lower the pump onto wood blocking on the floor

NOTE

At not time should the whole pump be lifted or supported by the casing or column lugs. At not time should the pump rotated or supported on the suction head.

- Install slings (provided by customer) around discharge head at the upper/lower flanges and ring to and overhead hoist. Remove bolting holding discharge head to outer column (6579). Remove discharge head off over coupling end of upper shaft (2130) and place on blocking on the floor. Remove “gasket eliminator” (See point 10.3) material from mating surfaces or discharge head and outer column.
- Rig outer column (1350) to an overhead hoist. Remove the bolting (6579) from between outer column and casing (1170). Remove outer column off over coupling end of upper shaft (2130) and place on blocking on the floor. Remove “gasket eliminator” material from mating surfaces of outer column and casing.

NOTE

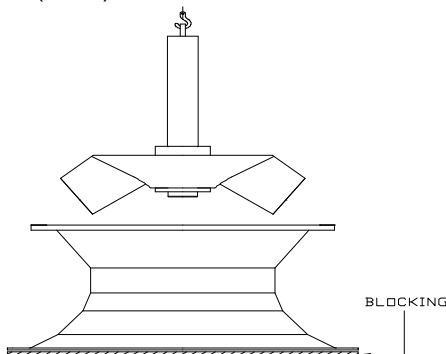
As outer column (1350) is being removed from upper shaft (2130), the blocking under exposed portion of upper shaft will have to be removed and reinstalled under exposed portion of upper shaft.

- e) Install sling along upper shaft (2130) and rig to an overhead hoist. Remove the bolting between the gib key and shaft coupling (7238). Remove split ring (7415) from groove in pump end shaft (2110). Slide shaft coupling up on upper shaft until the shaft coupling key in upper shaft is exposed. Remove both gib key and shaft coupling key in upper/pump end shaft (2110). Using the overhead hoist, lift and place upper shaft on horses and block to prevent rolling and dropping. Remove shaft coupling (7238) from lower end of upper shaft.
- f) Install a sling in exposed upper flange of casing (1170) and rig to overhead hoist. Install a sling around suction head (1130) and rig to auxiliary hoist. Using both hoists, lift the pump assembly from blocking and carefully maneuver into a vertical position until assembly is suspended vertically from the rigging attached to the eyebolts in casing (1170) upper flange. At no time should the pump rotated or supported on the suction head.
- g) Remove the casing to suction head bolting (6579). Using the rigging attached to casing (1170) upper flange. Lift and remove casing off over upper end of pump end shaft. Remove "gasket eliminator" (See point 10.3) from mating surfaces of casing and suction head (1130).

NOTE

Take care when removing the casing (1170) so as not to damage bearings (3312)

- h) Install eyebolts and slings (not provided) into upper end of the pump end shaft (2110) and rig to overhead hoist, Remove pump end shaft and impeller (2262) as a unit from the suction head (1130).

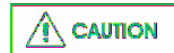


- i) Remove the four socket head caps crews (6579) with lockwasher from the split lock collar (2531). Block up the impeller (2262). Place a block of wood over the top of the pump shaft (2110) and tap until lock collar is completely clear of the impeller. Remove the lock collar (2110) and withdraw the pump shaft , with key (6710) from the impeller, Place pump shaft on horses and block to prevent rolling.

6.8.1 Multistage pumps

Described procedure is applicable for pumps with two or more stages which will be disassembly and assembly at same way, see figure 8.1.3 page 22

6.9 Examination of parts



Used parts must be inspected before assembly to ensure the pump will subsequently run properly. It is recommended replace all gaskets, "O" rings, bearings and wear rings during overhaul. In particular, fault diagnosis is essential to enhance pump and plant reliability.

1. Wire brush and clean all pump parts. Inspect parts for wearing, corrosion, and erosion. Inspect the impeller (2262) and casing (1170) for cracks.

2. Indicate each section of shaft on rollers or V-blocks for runout.

A. Indicate each section of shaft on "V" blocks or rollers for total indicated runout (TIR). The shaft shall be supported by two "V" blocks (rollers) near the ends of the shaft at the bearing and/or coupling areas of approximately the same diameter. The TIR of the rollers ("V blocks) shall not exceed .0005 E inches per foot, with a maximum variation of 0.005". The shaft journals or journals sleeves must be round to within .001 inch at the support areas on the "V" blocks or rollers.

B. Total indicator readings should be taken at every bearing and coupling area and/or every 12 inches between long bearing spans. Record distances from end of shaft to each TIR measurement. TIR measurements are to be taken every 90 degrees around the shaft.

C. Maximum allowable TIR is .001 inch X total length of shaft in feet. Shaft that exceed the limit can be straightened by either cold straightening or heat straightening. Refer to Flowserve Engineered Pump Division for heat straightening procedure.

3. Journal sleeves (3420).

Inspect journal sleeves. If journal sleeves are worn, they can be removed and sliding sleeves from shafts. Install new journal sleeve onto shaft and locate sleeve on its key.

4. Bearings (3320)

A. Removal

Remove setscrews from bearings. Bearing can be removed by pressing the old bearing out of its respective fit in the stuffing box extension (4110) and casing (1170). If this is not practical, bearing must be machined until disappear it

B. Assembly

Chill rubber bearing and fit into place or press bronze bearing into its fit.

If graphite bearings are supplied, they can be installed using a constant hydraulic press in dry, but, it is recommended that bushings should be dipped in water solvent or kerosene for easier installation.

Chill carbon bearing using nitrogen or refrigerator is a good option too.

CAUTION

WHEN INSTALLING THE “CUTLESS RUBBER BEARING” (3300- 3320) DO NOT CHILL TO LESS THAT 0F. AS THE RUBBER PORTION OF THE BEARING WILL DETACH FROM ITS RESPECTIVE METAL BACKING.

Install new setscrews in bearings and apply “loctite” (screw lock grade) to the threads.

NOTE

If used holes for bearing setscrews cannot be located when installing the bearings, then new holes will have to be drilling to spot the bearings to ensure securing to the bearing in their proper location with setscrew.

5.-Renew “O” rings (4610) and packing (4120) during reassembly procedure.

6.10 Assembly

To assemble the pump consult the sectional drawings, see section 8, *Parts list and drawings*.

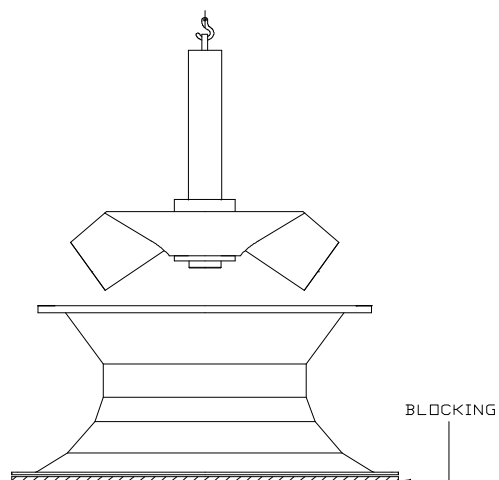
Ensure threads, gasket and O-ring mating faces are clean. Apply thread sealant to thread fittings. Threaded fittings torque should be periodically checked to assure that it is at the recommended value and be sure fittings are not loose.

6.10.1 Wear rings

- a) Impeller rings (when fitted) should be slipped onto the impeller and pressed down to the shoulder. (Do NOT use a steel hammer to knock them into position).
- b) Drill and tap 3 holes approximately 120° apart into the diametral mating faces of the ring and impeller and insert set screws. (The existing tapped holes from the removed impeller ring cannot be re-used).
- c) Case wear rings must be fitted onto casing (Do NOT use a steel hammer to knock them into position) and locate set screws approximately 120° apart (The existing tapped holes from the removed set screws cannot be re-used).
- d) Check the running clearance between impeller and casing ring against value indicated in attachment in these User Instructions.

6.10.2 Reassembly

- a) Place pump shaft (2110) on horses and block to prevent rolling. Install impeller key (6710) in machined groove of pump shaft (2110). Install impeller (2262) on shaft.
- b) Install split lock collar (2531), plus four cap screw / tabwashers. Tighten the cap screws to a final torque and bend the tab of the washer.
- c) Install the eyebolt (not provided) into coupling end pump shaft (2110) and rig to an overhead hoist. Raise pump shaft with impeller intact, to a vertical position.
- d) Be sure suction head (1130) assembly is properly supported, in a vertical position, blocking on the floor. Carefully place pump shaft with impeller, into suction head (1130) until impeller vanes are resting against inner wall of suction head.



- e) Using eyebolts with washer/nuts (not provided), rig casing (1170) upper flange to overhead hoist. Raise casing to a vertical position directly over pump shaft. Apply a layer of “gasket eliminator” (See point 10.3) to upper flange of suction head (1130). Carefully lower casing over end of pump shaft until casing is resting in position on suction head. Install casing to suction head bolting (6579) and torque. Do not unhook rigging attached to eyebolts in casing upper flange.

NOTE

Be sure case bearing (3312) was fitted previously into case and during assembly bearings do not “Hang –up” when passing over shafts.

- f) Using rigging attached to eyebolts in casing (1170) upper flange. Lift pump assembly slightly and install sling (provided by customer) around lower portion of the casing. Rig sling to an auxiliary hoist. Using both hoist lift pump assembly from blocking and maneuver into a horizontal position on blocking on the floor.

NOTE

At no time should the pump assembly be rotated on the suction head (1130) or strikes the floor or other object.

- g) Be sure casing and pump shaft are properly positioned on blocking on the floor (horizontally leveled).
- h) Install sling along upper shaft (2130) and rig to an overhead hoist. Install shaft coupling (7238) over lower end of upper shaft. Slide shaft coupling beyond keyway for shaft coupling key. Lift upper shaft in a horizontal position taking care that shaft coupling (7238) does not drop off upper shaft. Place upper shaft into position as close as possible to pump shaft (2110) without hitting them together. Install split ring halves (7415) which locks the upper shaft to pump end shaft. Install shaft coupling keys into keyways of both shafts. Slide shaft coupling down over keys and split ring until the shaft coupling comes in contact with gib key. Install the socket screw bolting between shaft coupling and key. Tighten and torque.

NOTE

Upper shaft (2130) must be supported on blocking before removing rigging from overhead hoist (do not hung it).

- i) Using the overhead hoist, lift the outer column (1350) from blocking on the floor in a horizontal position. Apply layer of “gasket eliminator” to upper flange of casing (1170). Install outer column over coupling end of upper shaft and

into position against upper flange of casing. Install bolting between outer column and casing and torque them.

NOTE

Blocking under upper shaft (2130) will have to be removed and reinstalled as outer column (1350) is being installed.

- j) Install slings (provided by customer) through “windows” of the discharge head (1371) and rig to an overhead hoist. Lift the discharge head from blocking on the floor in a horizontal position. Apply a layer of “gasket eliminator” on upper flange of outer column (1350). Install discharge head over coupling end of upper shaft and into position on outer column. Install bolting between discharge head and outer column and torque them.
- k) Install “O” ring (4610) and stuffing box extension journal sleeve (4610) over upper end of upper shaft (2130) and position on key (6733) and retaining ring at the sleeve end.
- l) Rig and install stuffing box extension (4110) on discharge head. Install stuffing box extension to discharge head bolting and torque them.
- m) Install chains or slings (provided by customer) through big lifting lugs in discharge head (1371) and around casing (1170) and rig to an overhead hoist. Using both hoists, carefully raise the unit to a vertical position over the pit, taking care not to rotate or support the assembly on suction head (1130). Remove sling around casing. Lower unit into pit unit until the discharge head flange rests on the soleplate (6140) and bolting.
- n) Check pump / motor direction of rotation as described on point 5.3
- o) If mechanical seal is supplied, install seal box and seal cartridge – without tight set screws of drive collar
- p) Install pump half coupling, adjusting nut and motor with its half coupling and make alignment according point 4.5.2
- q) Adjust rotor setting according point 5.5
- r) Install back ring (4132), packing (4120) and packing gland, see point 5.7.1 (if mechanical seal is supplied, tight set screws of drive collar)
- s) Install auxiliary piping and wiring. Install air release valve (if used). Install coupling guards on “windows” in the pump discharge head.

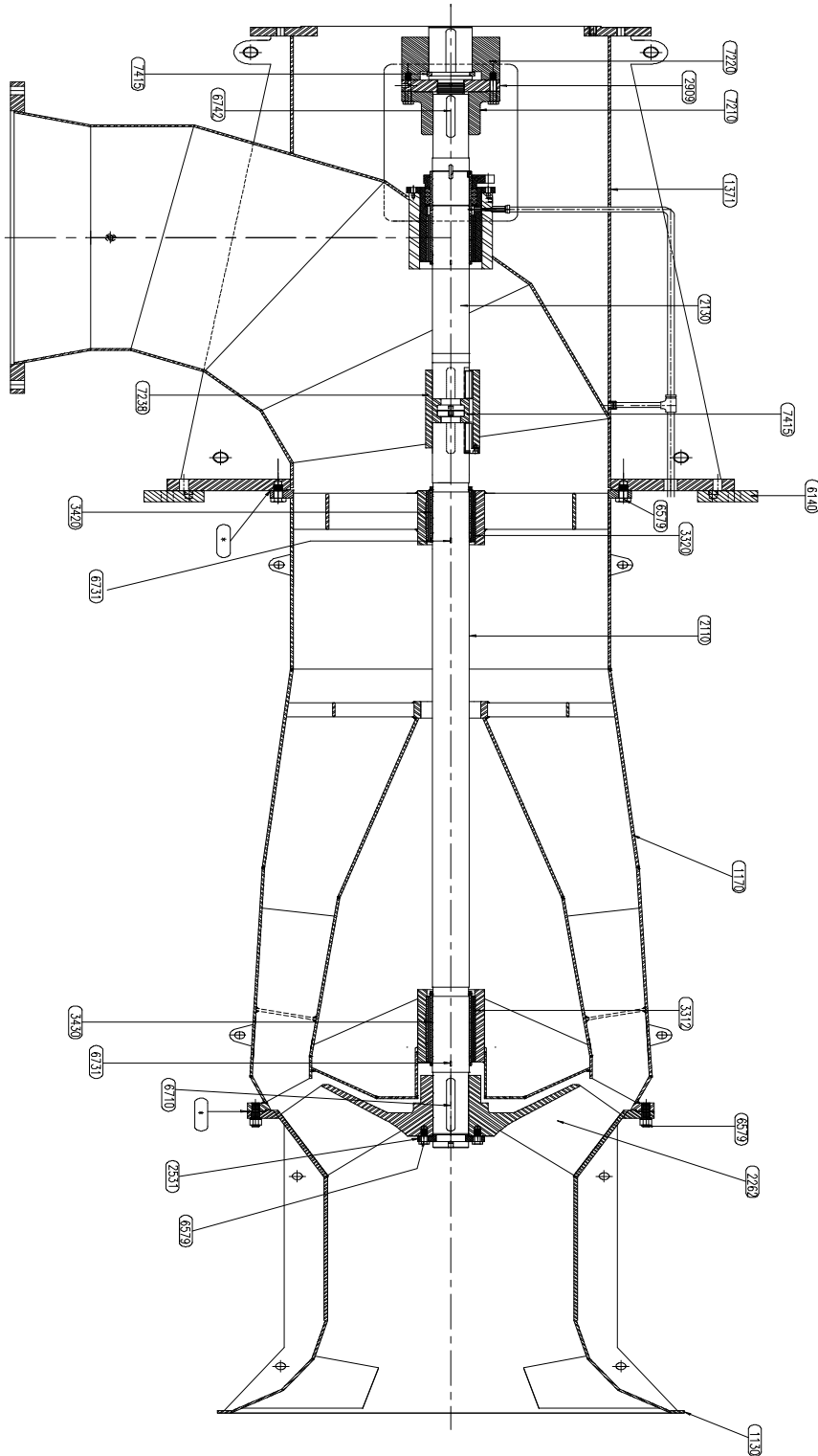
7 FAULTS; CAUSES AND REMEDIES

Trouble	Cause	Remedy
Insufficient Capacity	Speed to low	Check power supply to motor for correct voltage.
	Wrong rotation	Reconnect motor leads
	Foreign material in impeller, casing, diffusion vanes, and/or discharge head nozzle	Dismantle pump and remove any foreign material
	Mechanical defects: Impeller damaged. Share impeller key.	Dismantle pump and check
	Insufficient supply of water to be pumped	Determine proper level of water in sump and proper pump submergence.
Pump vibrates	Loose mounting or coupling bolts.	Tighten bolts
	Broken or worn pieces	Inspect and replace same
	Coupling misalignment	Check alignment and correct
	Cavitation	Determine proper level of water in sump and proper pump submergence
	Foreign material in impeller causing unbalance.	Dismantle pump and remove foreign material.
	Mechanical defects: Shaft bent. Bearing worn.	Dismantle pump and replace part or parts causing vibration
Pump overloads driver	Speed to high	Check power supply for correct frequency
	Pump bearing Seize or rotating element binds	Check rotor setting. Dismantle pump and replace parts causing rubbing, seizures or binding.
Pump stops abruptly	Pump binding at running fits	Dismantle pump and correct
Stuffing box overheats	Stuffing box packed too tight	Repack stuffing box with new packing per "Stuffing Box Packing" instructions.
	Insufficient Leakage in packing	Loosen gland nuts and retighten finger tight or until proper leakage is obtained
Excessive Gland Leakage	Packing not seated	Gland not tighten evenly loosen nuts and tighten evenly. (see "Stuffing Box Packing" instructions)
	Worn Packing	Replace packing
Pump is noisy	Cavitation	Determine proper level of water in sump and proper pump submergence
	Loose parts	Tighten or replace defective parts
	Noise in driver	Check driver IOM manual

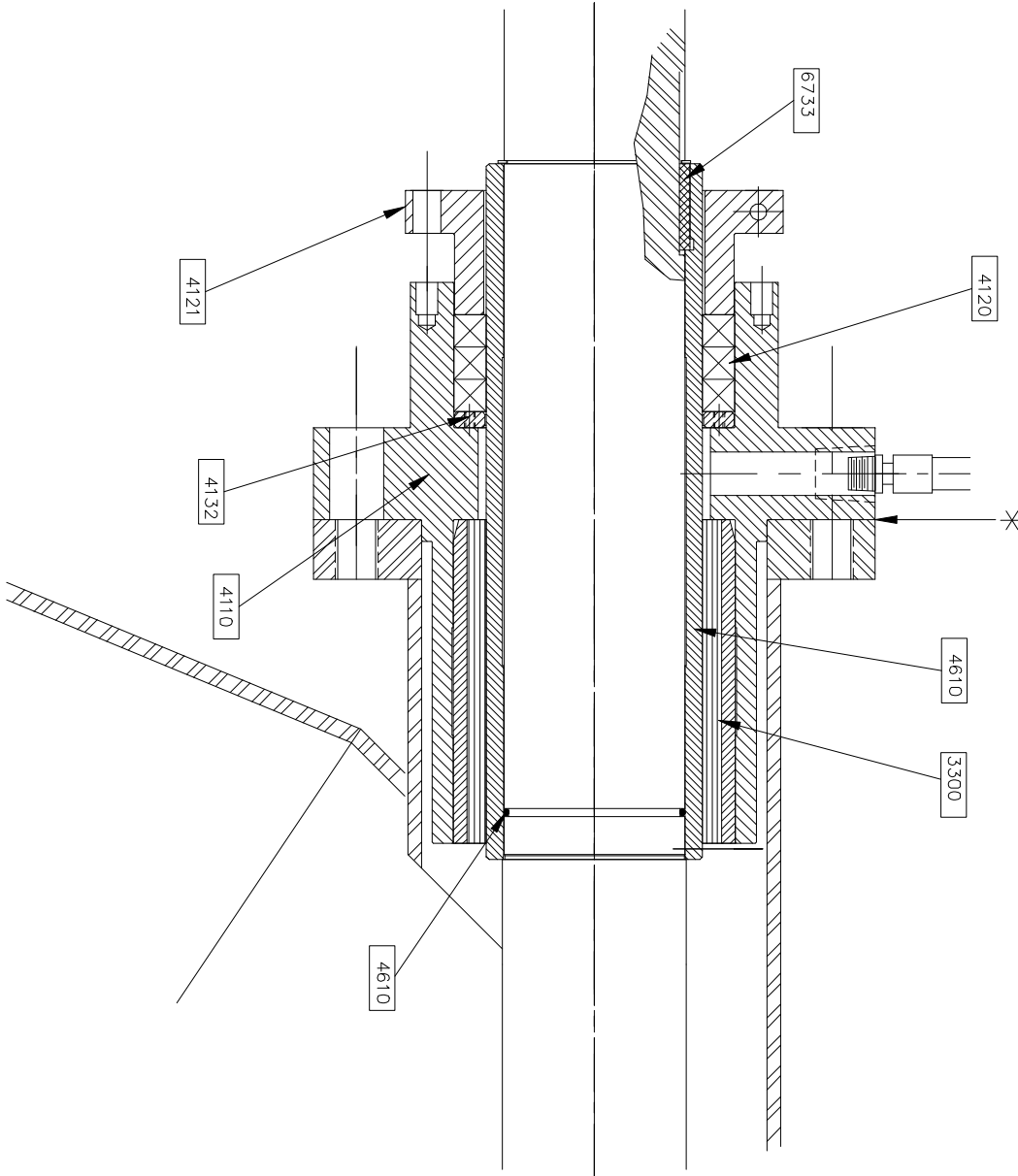
Refer to driver manufacturer's instruction manual for trouble shooting of driver

8 PARTS LIST AND DRAWINGS

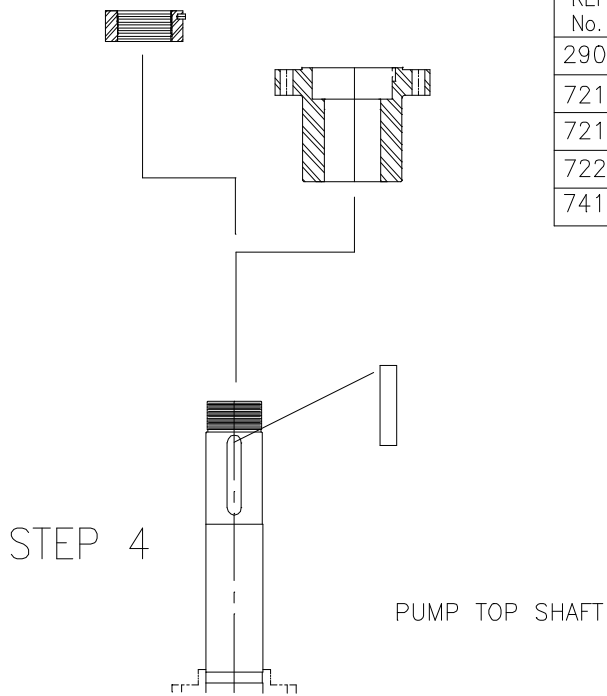
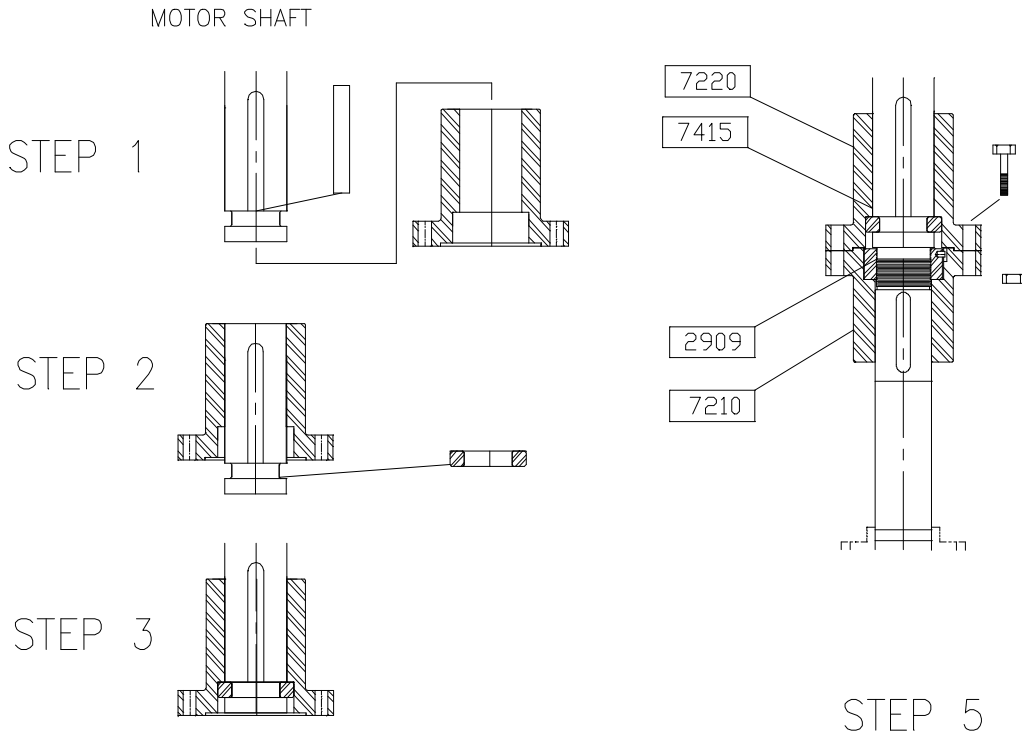
8.1 Typical sectional drawing



8.1.1 Stuffing box typical sectional drawing



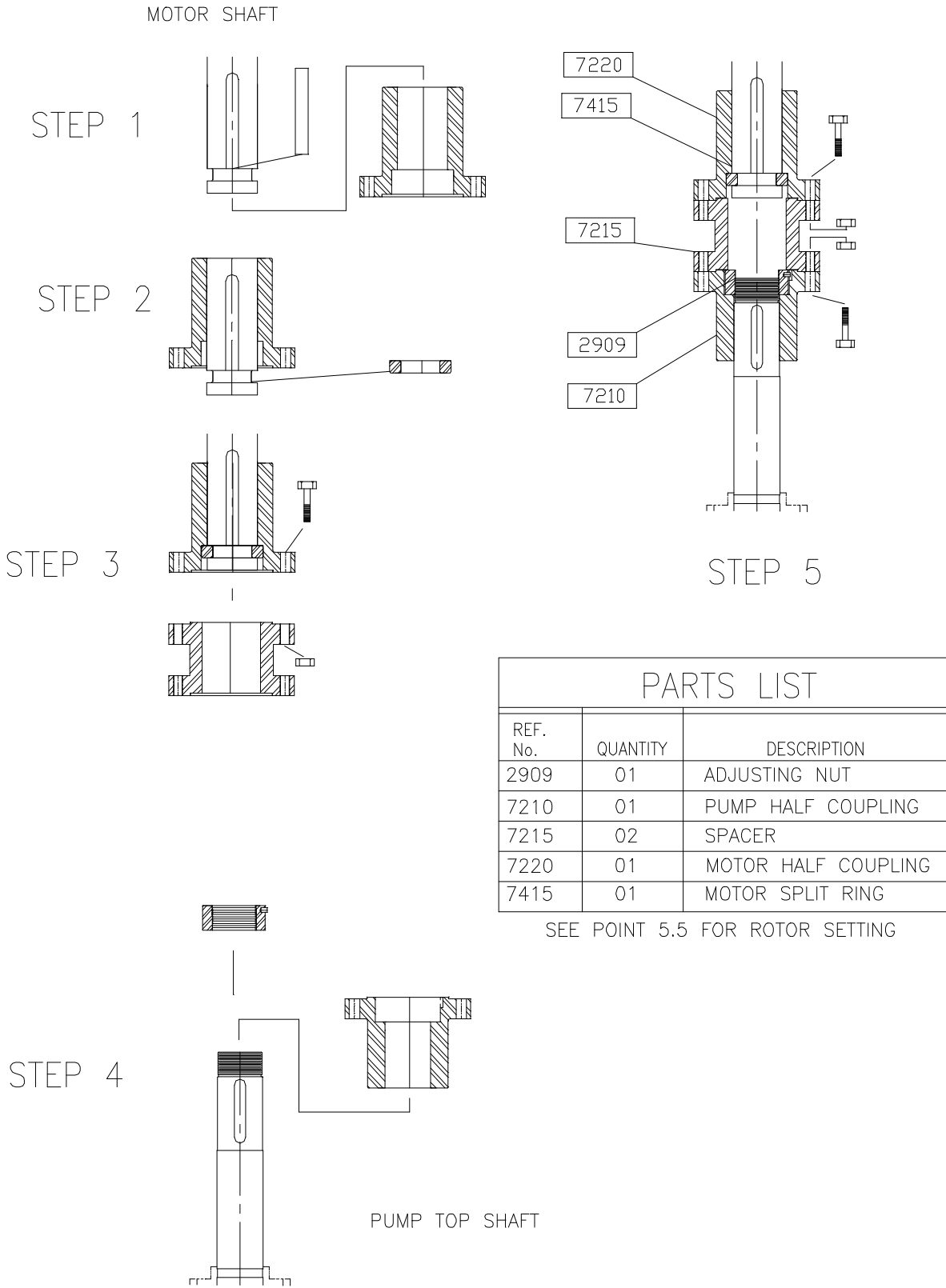
8.1.2 Coupling assembly drawing



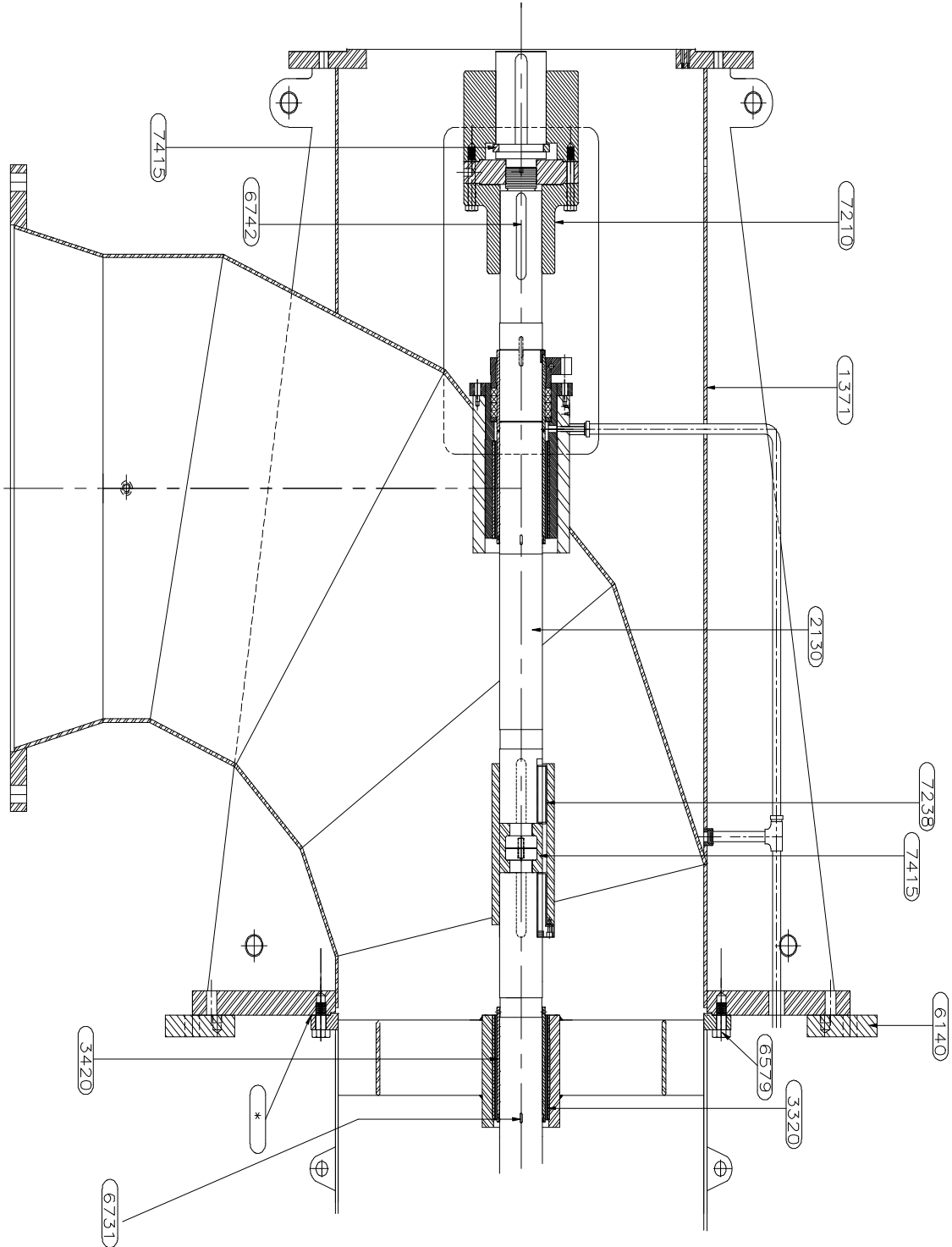
PARTS LIST		
REF. No.	QUANTITY	DESCRIPTION
2909	01	ADJUSTING NUT
7210	01	PUMP HALF COUPLING
7215	02	SPACER
7220	01	MOTOR HALF COUPLING
7415	01	MOTOR SPLIT RING

SEE POINT 5.5 FOR ROTOR SETTING

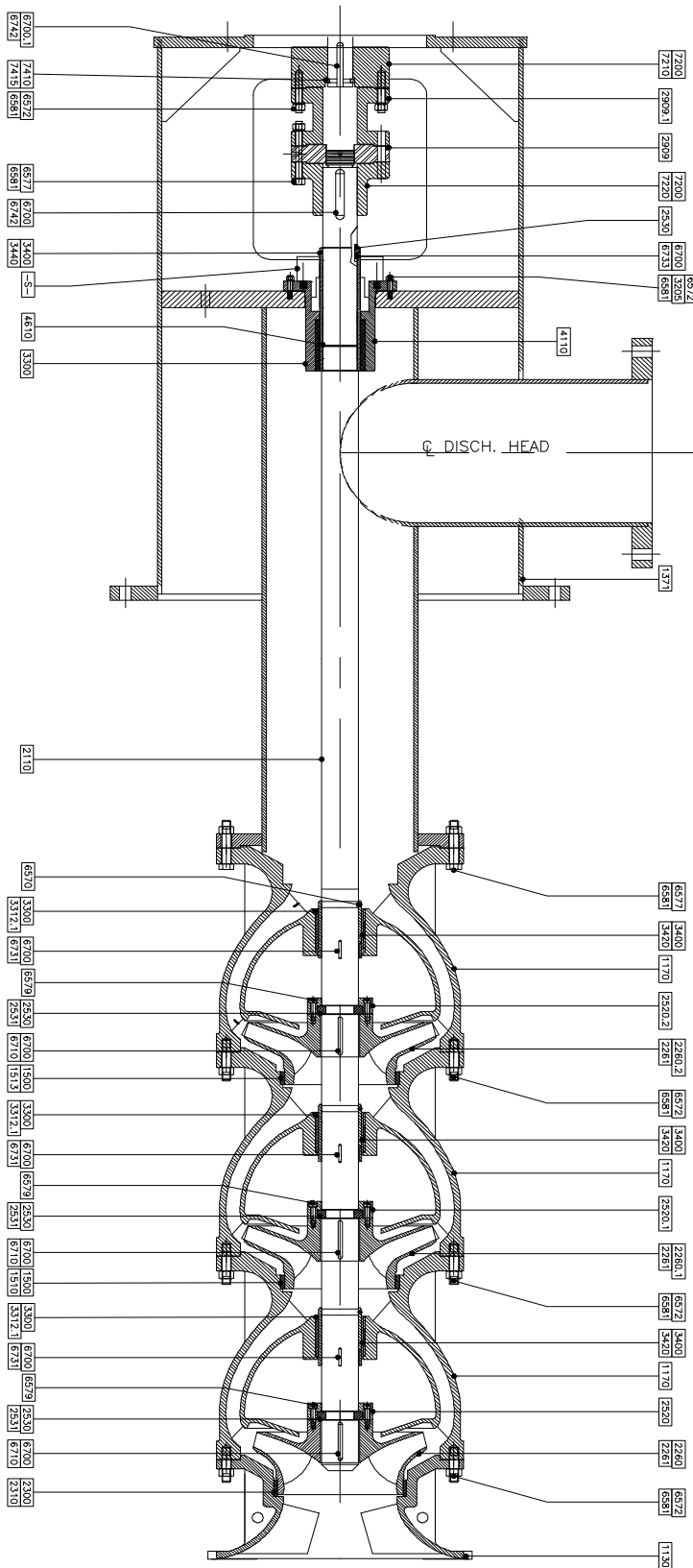
8.1.3 Coupling assembly with spacer drawing



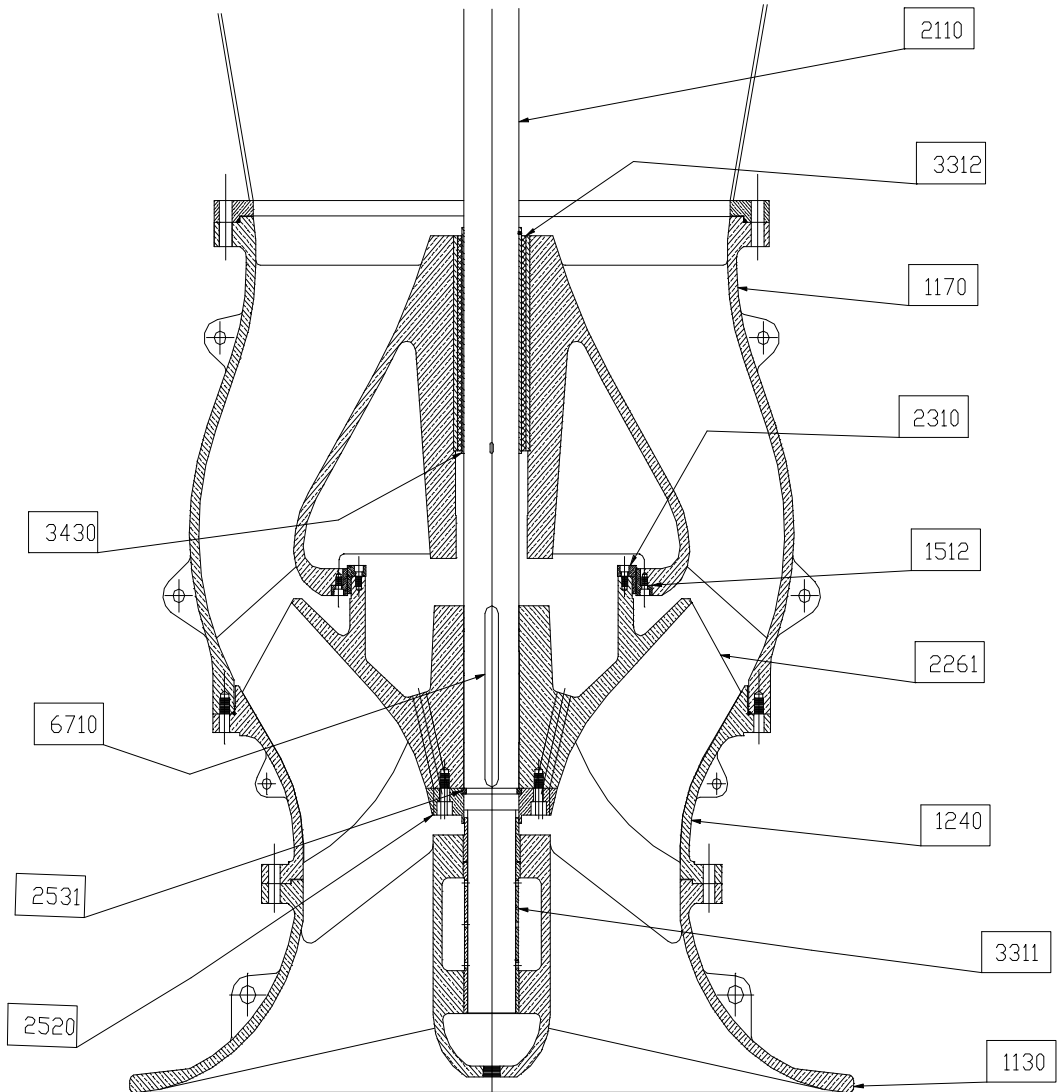
8.1.4 Discharge typical sectional drawing



8.1.5 Typical cross sectional drawing of multistage pump



8.1.6 Suction bell with bearing



PART	DESCRIPTION
1130	SUCTION BELL
1170	TOP CASE
1140	IMPELLER CASE
1512	CASE WEAR RING
2110	PUMP SHAFT
2261	IMPELLER

PART	DESCRIPTION
2310	IMPELLER WEAR RING
2520	THRUST COLLAR
2531	SPLIT RING
3311	SUCTION BELL BEARING
3430	SHAFT SLEEVE

When suction bell bearing is provided, it is permanently lubricated with water resistant grease (Shell retinax AM, Alvania EP-2 or Mobil grease special) which does not require change during operation.

When pump would be removed for overall maintenance and suction bell bearing would be inspected and re-installed then the cavity into the suction bell must be filled with clean and new grease.

8.2 Parts list

BILL OF MATERIALS	
ITEM	PART DESCRIPTION
1170	CASING
2262	IMPELLER
4110	STUFFING BOX
2110	SHAFT-PUMP
2130	SHAFT-UPPER
4121	SPLIT GLAND
6579	CAP SCREWS-LOCK COLLAR TO IMPELLER
4132	RING,BACK UP-STUFFING BOX
7415	MOTOR SPLIT RING
3430	SLEEVE LOWER-CASING
4610	SLEEVE, STUFFING BOX
2531	SPLIT RING
3312	BEARING-LOWER CASING
3300	BEARING-STUFFING BOX
1130	SUCTION HEAD
6140	SOLEPLATE
4610	"O" RING -SLEEVE
1371	DISCHARGE HEAD
4120	RINGS-PACKING
7220	COUPLING-MOTOR HALF
7210	COUPLING-PUMP HALF
2909	ADJUSTING NUT
7238	SLEEVE-SHAFT COUPLING
6710	KEY-IMPELLER
6731	KEY-SLEEVE LOWER CASING
6733	KEY-SLEEVE STUFFING BOX
6742	KEY- COUPLING - PUMP HALF
*	GASKET ELIMINATOR: LOCTITE 515

8.3 General arrangement drawing

The typical general arrangement drawing and any specific drawings required by the contract will be sent to the Purchaser separately and a copy will be included in this User Instructions.

9 CERTIFICATION

Certificates, determined from the contract requirements will be provided separately.

10 SUPPLEMENTARY INFORMATION

10.1 Long term storage

During extended periods of storage prior to installation and from the time of installation until commercial operation, precautions must be taken to protect the pump from deterioration. The various parts of the pump are protected prior to shipment by applying varying grades of preservative and paint. However, during shipment and handling, the preservatives are subjected to conditions that can cause their removal. Also during extended periods of time, the preservatives may deteriorate. The following procedures should be followed to prevent deterioration of the pump during the extended storage period. These procedures may also be supplemented by the experience of the person(s) performing the tasks.

Vertical pumps are shipped assembled when weight, length and bearing material permit. When the pump length exceeds approximately 30 feet and/or when carbon bearings are furnished, the pump is shipped in subassemblies. The motor driver and auxiliary accessories are packed separately.

Upon arrival at the storage site, each unit and accompanying crating should be visually inspected for shipping damage, any of which should be reported to Flowserve.

All material shall be placed in a location protected against weather, floods and traffic damage while in storage. All items should be stored in an accessible area, where air can circulate around them fully and completely. Indoor storage facilities should be provided by the contractor or user, with accessories prepared in accordance with this procedure.

All of the components should remain in their original shipping crates (if applicable). All handling should be done with slings only and with extreme care. The customer should inspect all units every 30 days.

Recommendations given herein are made with the strict understanding that Flowserve will incur no cost resulting from Long Term Storage Procedures. Flowserve also relinquishes any responsibility for any damage or malfunction incurred to the unit at the time of installation due to inadequate preservation by the Customer.

It should be noted that unless otherwise agreed to, full responsibility and costs associated with the storage and inspection of this equipment rests with the customer.

WARNING !!!

Failure to follow this procedure will jeopardize the integrity of equipment, and may contribute to poor performance, abnormalities and associated problems when equipment is installed and operated.

Also, failure to follow this procedure will invalidate any warranty on equipment.

CAUTION

AT NO TIME DURING STORAGE OR HANDLING IS THE PUMP TO BE ROTATED ON OR SUPPORTED BY THE SUCTION HEAD (Suction Bell)

NOTE

If pump is equipped with a mechanical seal and is stored or has not been run for 1 year or more, the seal must be removed before start-up and faces re-lapped to guard against the possibility of seal leakage. When reinstalling the seal, new "O" rings and gaskets must be used.

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INSPECTION UPON ARRIVAL

When the pump is received, it should be inspected for damage, other signs of rough handling and double check for missing pieces. Any damage or suspicion of missing pieces should be reported immediately to the carrier, Flowserve's Sales Representative and Factory's Customer Service department (or Flowserve's Project Management department from the factory that shipped equipment).

Inspect the preservative coating on the various parts. If necessary, renew the preservative in areas where it has been rubbed off or scraped.

Inspect all painted surfaces. If necessary, touch up the areas where paint has been chipped or scraped.

In some cases (and on some type of pumps), the rotor is shipped in a blocked position. Do not remove blocking until unit is to be installed. This will minimize bearing loads and rotor distortion.

Inspect all covers over pump openings and piping connections. If covers are damaged or loose, they are to be removed, and a visual inspection made of the accessible interior areas for accumulation of foreign materials or water. If necessary, clean and recoat the interior parts with preservative to restore the parts to the "as shipped" condition. Install or replace covers and fasten securely.

When selecting storage area, the following should be taken into consideration:

1. The deterioration of the equipment will be proportionate to the class/type of storage provided.
2. The expense involved in restoring the equipment at time of operation will be proportionate to the class/type of storage provided.

STORAGE PREFERRED (DRY)

GENERAL

If at all possible, the pump and its parts should be stored indoors in either the horizontal or vertical position where they will be protected from the elements. If it is not possible to store the pump and its components indoor precautions must be taken to protect them from the elements. When stored outdoors, the pump and its components should be protected from dirt, dust, rain, snow, or other suitable coverings.

All equipment stored in the horizontal position must be placed upon skids or blocks to prevent contact with the ground and surface contaminants. Equipment must be adequately supported to prevent distortion and bending. Also, periodic (twice a week) 180° rotation of pump's rotor is needed in order to decrease shaft distortion due to horizontal storage. When equipment is subjected to longer storage periods (more than 5 months), it is required to crate and store the pump's rotor fully disassembled, in order to prevent rubber bearing deformation (if applicable), shaft distortions, shaft couplings problems, and others. Please contact Flowserve's representative when longer than 5 months storage will be done.

Rubber parts such as spare o-rings have a shelf life of up to 3 years if stored in original heat sealed packing and adequately protected from air, light, ozone, radiation, excessive temperature (120 degrees F), contamination and physical damage.

If pump is stored vertically, rotor is to be lifted and blocked to dimension shown on rotor plate.

INSPECTION AND MAINTENANCE

1. Customer Inspection And Maintenance

The stored equipment is to be placed on a periodic inspection schedule by the customer.

NOTE:

The responsibility for setting up an inspection schedule rests with the customer and will be dependent upon the class/type of storage provided. It would be expected that, initially, inspection would occur weekly, then

depending upon the inspection reports being favorable or unfavorable, inspection would continue weekly, monthly, or quarterly, as may be determined. Inspection reports should be kept on file.

Each inspection should consist of a general surface inspection to assure that:

- a) Pump supports and rotor blocking are firmly in place.
- b) Pump covers over openings are firmly in place.
- c) Pump covering, plastic or tarps, are firmly in place. Any holes or tears must be repaired to prevent entrance of dirt or water.
- d) Pump covers are periodically removed from openings and interior accessible areas inspected. If surface rusting has occurred, clean and repaint or recoat with preservative.
- e) If rusting occurs on exterior surfaces, clean and repaint or recoat with preservative.
- f) Check individually wrapped parts for signs of deterioration. If necessary, renew preservative and wrapping.

2. Six Months Prior to Installation

Six months prior to the scheduled installation date, a Flowserve representative is to be employed to conduct an inspection. All costs involved during inspection, dismantling, restoration, replacement of parts and reassembly will be responsibility of the customer. The customer should supply all necessary labor, tools, and cranes. This inspection will include (not necessarily in its entirety) but not be limited to the following:

- a) An inspection of all periodic inspection records as kept on file by the customer, and all the inspection reports that have been compiled during the storage period.
- b) An inspection of the storage area to determine the "as stored" condition of the equipment prior to any protective covers being removed.
- c) An inspection of the equipment with protective covers and flange covers removed.
- d) Depending upon the length of time the equipment was stored, the class/type of storage provided (indoor, heated, unheated ground floor, concrete floor, out-of-doors, under roof, no roof, waterproof covering, on concrete, on ground) and as a result of the inspection of a, b, and c above, Flowserve representative may require a partial or complete dismantling of the equipment.
- e) Dismantling may necessitate restoration by painting preserved surfaces, and/or replacement of gaskets, "O" rings, packing or mechanical seal bearings.

Upon completion of the inspection, the Flowserve representative shall submit a report to the customer, and to the Manager of Customer Service, stating in detail the results of the inspection.

3. One Month Prior To Installation.

One month prior to installation of the equipment, a Flowserve representative is to be employed to conduct a final inspection. This final inspection will be made to assure that the requirements of the six-month inspection report were satisfactorily completed and that equipment is ready for installation.

Upon completion of this inspection, the Flowserve representative shall submit a final report to the customer, and to the Manager of Customer Service advising the results of the final inspection.

STORAGE NON-PREFERRED (WET)

GENERAL

It is not recommended that the pumping element be subjected to extended periods of submergence or wetting prior to start-up. However, it is recognized that, in some cases, a long period may lapse from installation until commercial operation.

If pump must be stored in a wet pit, the following inspection and maintenance procedures should be performed:

1. Rotor is to be lifted and blocked to dimension shown on rotor plate.
2. Provide circulation of water in sump (high pressure water nozzles, air hoses, etc.) and inject air into pump bell to agitate water. Take precautions that sump does not freeze.
3. Flush bearings with 18.93 to 37.85 L/Min. (5 to 10 GPM) of clean water for 30 minutes every 3 days. See general arrangement drawing for location of bearing injection pipe taps. Take precautions that pipes do not freeze.
4. Install sample metal strips (comparable to material in pump) in sump, and inspect weekly for marine growth, corrosion, etc. Take necessary action to alleviate problems.
5. Check sump for silt build-up, plugging of inlet screens and trash racks within one week of start-up.

START-UP

Prior to and during start-up, any requirement for the services of a Flowserve representative will revert to the original contract agreement for the equipment purchased.

DRIVERS

When Motor(s) are to be shipped by the seller, each motor shall be prepared for shipment in accordance with the Motor Manufacturers' shipping and/or storage procedures. The Motor(s) shall be handled with either forklift trucks or slings. The driver rotor should be blocked to relieve bearing loads. Storage must be indoors and dry. See the manufacturer's storage requirements.

10.2 Coupling alignment procedure

An alternative procedure for coupling alignment is as follow:

1. Determine type of bearings in motor. If motor has roller or ball bearings instead of sleeve guide bearings skip the next step.
2. If the motor guide bearings are sleeve types the motor shaft must be centered within the sleeve bearings and that center must be maintained while completing the coupling alignment procedure.
 - A). One method of centering the motor shaft in the sleeve guide bearings is to attach two dial indicators on magnetic bases from the face of the bearing cap or end bell at 90^o's to each other with the dial stems touching the shaft. Push the motor shaft as far as it will go in one direction, in line with one of the indicators, while holding the shaft as far as it will go zero the dial and pull the shaft back as far as it will go. Read the dial and set the shaft at ½ of the total travel. When the shaft is set, zero the dial and leave it set. Then do the same procedure to the opposite dial indicator. When that dial is set to zero, then, push the shaft until both dials read zero. At that point the shaft is centered.
 - B). To obtain accurate alignment numbers while rotating the motor shaft, set the motor shaft to the zero number on both dial indicators. Mount a third dial indicator from the motor coupling or shaft and read the pump shaft or the bore of the stuffing box ext. every 90^o's. Stop the motor shaft at each 90^o point and recenter the motor shaft to the zero point on the two dials touching the motor shaft and read the point. Do that at each point to be read on the shaft being aligned to.
3. Remove the packing gland follower and at least two rings of packing. The motor shaft must be centered within the stuffing box ext., within .002" using either adjustable parallels or snap

gauges and a micrometer. Small wooden wedges can be inserted between the shaft and the I.D. of the stuffing box to hold the shaft in place.

4. Follow step 2-B and bring the coupling (shaft) alignment to within .002" TIR. **DO NOT READ OFF OF THE PUMP COUPLING AS IT IS A SLIP FIT TO THE SHAFT**, Read the shaft! Once the alignment has been completed and the motor hold down bolts are tight, set the coupling lift using 4 coupling bolts. Set up a dial indicator and read the lower shaft runout below the pump coupling and above the stuffing box ext. You should read .005" or below. If you read higher than .005" uncouple the unit and rotate the motor coupling one bolt-hole, recouple, read the lower shaft runout again. Repeat until the lowest runout number is achieved and then complete the coupling procedure.

10.3 Gasket eliminator application.

Gasket eliminator is an anaerobic gel flange sealant Loctite 515 which is ready to use and cures at room temperature when it is isolated from air contact.

Gasket eliminator (Loctite 515) is used for sealing metal faces or flanges and provides resistance to pressure immediately after assembly of flanges.

10.3.1 Directions for use on stainless steel and other passive surfaces

For best performance surfaces should be clean and free of grease.

Apply an aerosol layer of Loctite 7649 primer over both surfaces to be joint in order to activate the surface

Apply Loctite 515 manually as cord way over one surface to be joint

Flanges should be tightened as soon as possible after assembly to avoid shimming.

10.3.2 Directions for use on carbon steel surfaces

For best performance surfaces should be clean and free of grease.

Apply Loctite 515 manually as cord way over one surface to be joint

Flanges should be tightened as soon as possible after assembly to avoid shimming.

11 OTHER RELEVANT DOCUMENTATION AND MANUALS

11.1 Supplementary User Instruction manuals

Supplementary instruction determined from the contract requirements for inclusion into User Instructions such as for a driver, instrumentation, controller, sub-driver, seals, sealant system, mounting component etc are included under this User instructions.

11.2 Change notes

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

11.3 Additional sources of information

Reference 1:

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

Reference 2:

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

Reference 3:

Pump Handbook, 2nd edition, Igor J. Karassik et al, McGraw-Hill Inc., New York, 1993.

Reference 4:

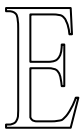
ANSI/HI 1.1-1.5
Centrifugal Pumps - Nomenclature, Definitions, Application and Operation.

10.4 CUSTOMER SERVICE INFORMATION SANTA CLARA OPERATION



Personal Assistance.

Lines atended from 8:30 a.m. to 6:30 p.m. (Central Standard time)
Monday to Friday



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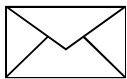
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