# INSTALLATION, OPERATING AND MAINTENANCE MANUAL

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# FOREWORD

1. Petrorahanpump is the result of advanced design based on over 35 years experience. It will give trouble-free, efficient operation with minimum maintenance and repair.

2. This instruction manual will familiarise both management and operating personnel with important details and correct procedures for the installation, operation and maintenance of your pump. The information in this manual is for the standard pump and any common deviations when possible. The manual does not cover all design details and variation, nor does it provide for every possible contingency, which may be encountered. When information can not be found in this manual; contact your sailor or Petrorahanpump sales office or service center.

3. On receipt of the pump, the packing case and its contents should be examined as detailed in section 1.

4. Before lifting the pump, please read the appropriate information detailed in section 1.

5. Before placed the pump in storage.
Please read the appropriate information detailed in section 1.

6. Should there be any doubt regarding the suitability or the installation of the pump, the nearest Petrorahanpump service center, or the main office at Isfahan should be consulted.

7. It is important to make a correct identification of a pump before carrying out any maintenance, or before consulting pumps. Identification is obtained form a nameplate Secured to the pump body. An example of a typical nameplate is shown in fig 1. The pump number should always be quoted.

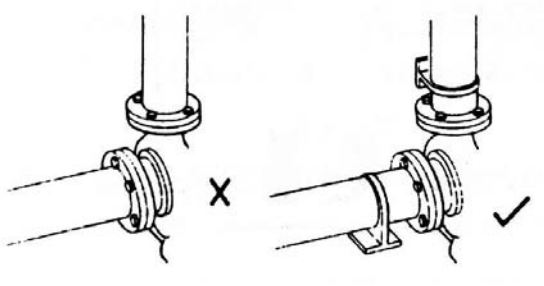
8. To ensure continued satisfactory operation, replacement parts to the original design specification should be obtained from Petrorahanpump.

# SAFETY

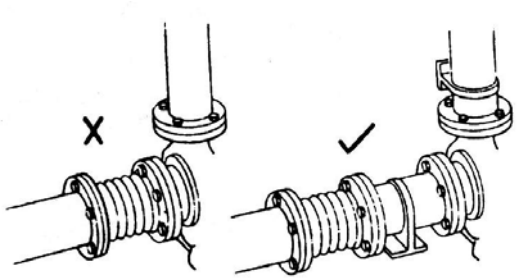
THIS IS A SUMMARY OF CONDITIONS AND ACTIONS TO PREVENT INJURY TO PERSONNEL AND DAMAGE TO EQUIPMENT.

(1) PREVENT EXCESSIVE EXTERANL PIPE LOADS.

- Do not use pump as a support Piping.



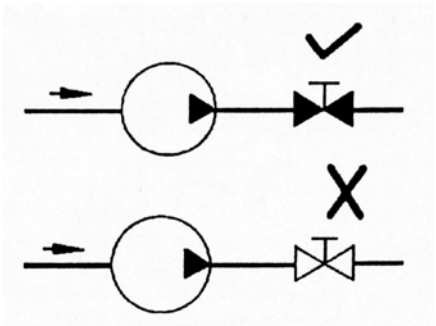
- Do not mount expansion joints so that their force, due to internal pressure, Acts on the pump flange.



(2) NEVER CHECK DIRECTION OF MOTOR ROTATION UNLESS COUPLING ELEMENT/PINS HAVE BEEN REMOVED.

- Starting in reverse direction of rotation
  Will damage the pump.

(3) ALWAYS START WITH OUTLET VALVE CLOSED.



- Starting the pump with the outlet valve open at full flow will overload the pump motors and may cause damage.

(4) ENSURE CORRECT LUBRICATION LEVELS ARE MAINTAINED.

(5) NEVER RUN THE PUMP DRY.

- Suction/inlet valves to be fully open when pump is running.
- Running the pump with no pumpage or below the recommended minimum flow continuously will cause the shaft packing or mechanical seal to run hot and burn within a short time.

(6) NEVER DO MAINTENANCE WORK WHILST THE UNIT IS CONECTED TO POWER.

(7) NEVER APPLY HEAT TO REMOVE IMPELLER.

- Trapped lubricant or vapor could cause an explosion.

**Nameplate details**

1. Vendor's size and model number
2. Pump serial number
3. Capacity
4. Pumping Head
5. Speed
6. Impeller Diameter
7. Project number
8. E.motor Power
9. Voltage
10. Current
11. Viscosity
12. Density

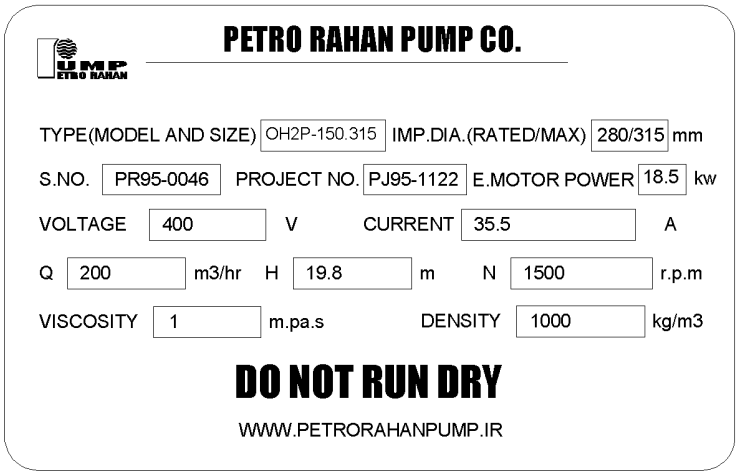



Fig1 Name plate of the pump
Dimension: 120mm x 75mm

## SAFETY

1.1 We have ensured, so far as is reasonably practical, that our equipment has been designed and constructed to be safe and without risk to health when properly used. Provided that the recommendations contained in this manual are carefully adhered to, we cannot foresee circumstances where, our equipment will present a health or safety hazard.

## THERMAL SHOCK

1.2 Rapid changes in the temperature of the liquid within the pump can cause thermal shock, which can result in damage or breakage of components. Thermal shock should be avoided, particularly so, where the material of the pump is not resistant to such loading.

1.3 If there is any doubt as to the suitability of the pump for the application intended, contact Petrorahanpump for advice, quoting the pump serial number.

# DESCRIPTION

## INTRODUCTION

1.4 Pump design

The pump is horizontal single stage overhung centerline single volute centrifugal type (type OH 2) and of back pull - out design the bearing bracket with delivery cover, mechanical seal impeller can be removed without disconnecting the suction or discharge piping or moving drive.

Two openings on the pressure casing are available for auxiliary piping according to API plans (Fig 1.1):

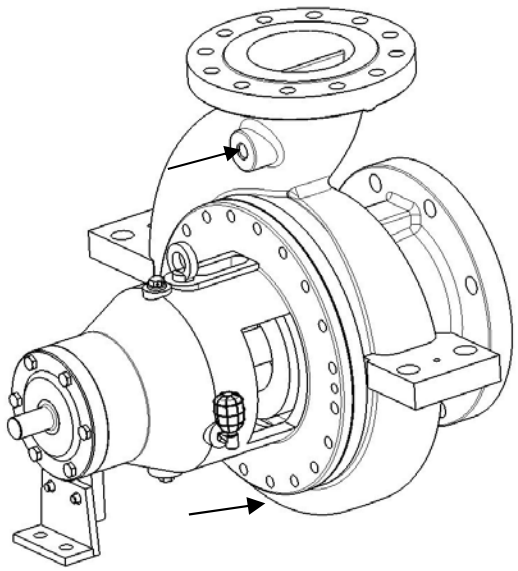


Fig 1-1: Location of opening & Auxilary piping

1.5 Pump Construction

Angular contact ball bearings in arrangement (back to back) are built into the bearing bracket for carrying the axial thrust. Cylindrical roller bearing is used for carrying the redial thrust. Bearing lubrication arrangement is hydrocarbon oil lubrication with the lubricating fluid oil.

1.6 Pump rating

Table 1.1-Basic pump working pressure and temperature rating

| | |
|---|---|
| MAXIMUM ALLOWABLE WORKING PRESSURE | 10 Bar |
| HYDROSTATIC TEST PRESSURE | 15 Bar |
| MAXIMUM ALLOWABLE TEMPERATURE | 80 °C |

Table 1.2-Preferred and allowable operating range (see also the performance curves)

| | | |
|---|---|---|
| Preferred operating range | Qmin= 160 m3/h | Qmax= 220 m3/h |
| Allowable operating range | Qmin= 40 m3/h | Qmax= 230 m3/h |

1.7 For ease of maintenance, the pump is constructed so that pipe connectors do not have to be disturbed when internal maintenance is required (fig 1-2).

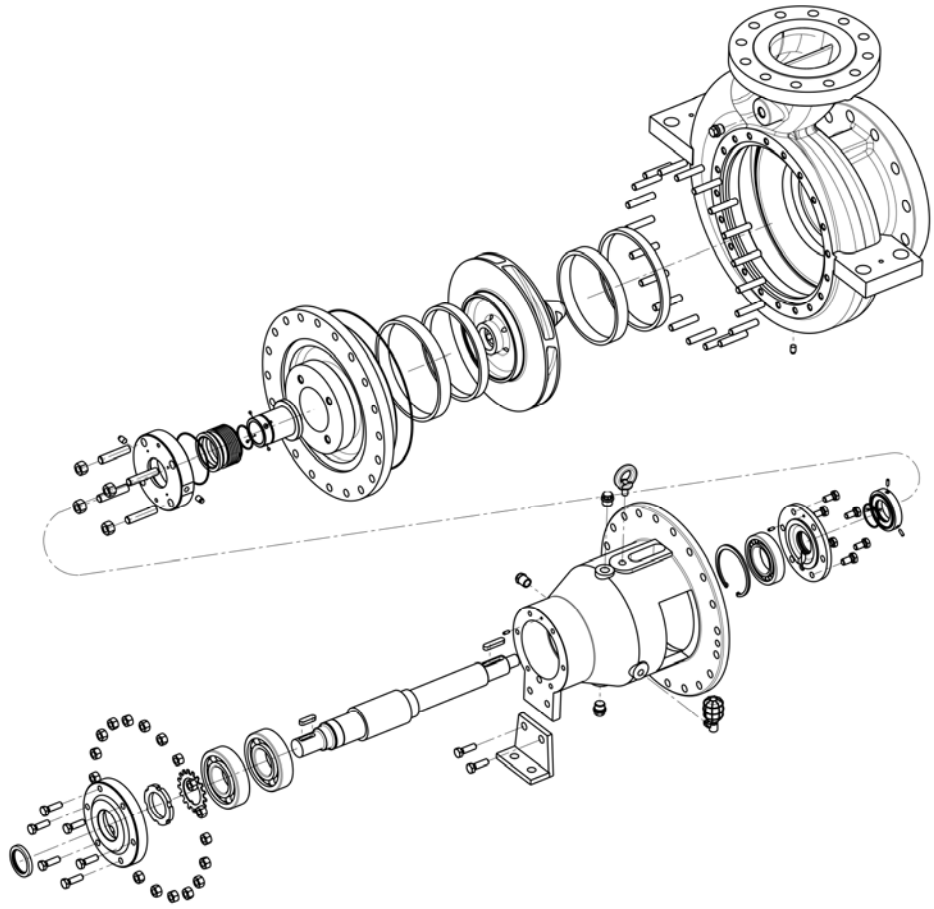


Fig 1-2 Pump Maintenance

1.8 The main components of the pump are:

1.8.1 Pump casing.

1.8.2 Impeller.

1.8.3 Shaft.

1.8.4 Bearing housing and bearing carrier.

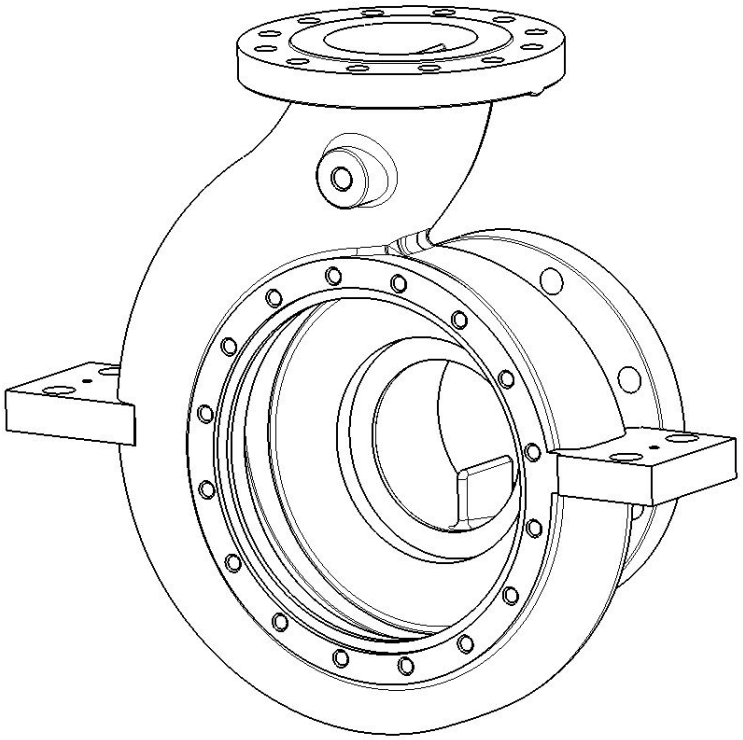
1.8.5 Bearings.

1.8.6 Mechanical seal housing.

1.8.7 Mechanical seal.

PUMP CASING

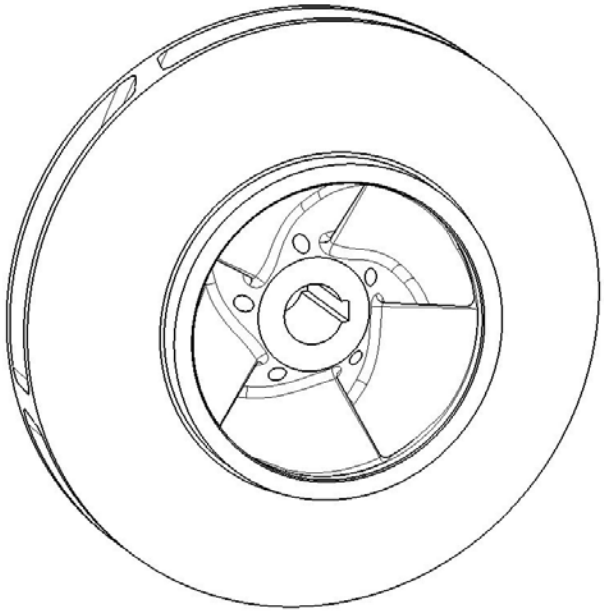
1.9 The pressure and temperature rating of the pump depends upon the material form which the pump and flanges have been manufactured. Consult Petrorahanpump for values. The pump casing is designed with a horizontal centerline end inlet and a vertical centerline top outlet which makes it self venting .The thick-section casing is built to withstand large branch loads (consult Petrorahanpump for values) and has ample corrosion allowance.



1.10 An integral foot support is used for Maximum resistance to misalignment and Distortion from pumping loads

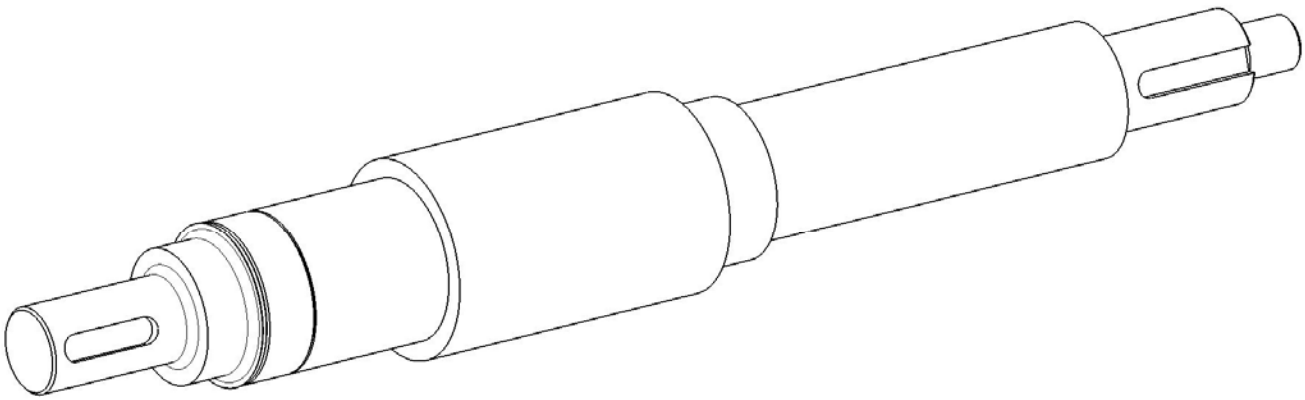
IMPELLER

1.11 The impeller is closed and it can be Semi open or fully open with wear plate for liquid in high viscosity.



SHAFT

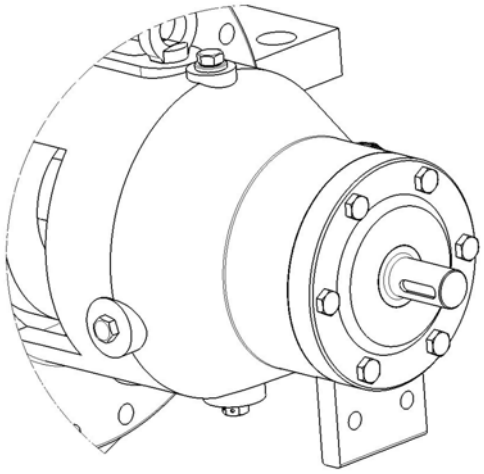
1.12 The large diameter stiff shaft, mounted on bearing, has a keyed drive end carries the dynamic shaft seals and impeller. A shaft Sleeve splash guards or driptray, may be fitted as option.



## BEARING HOUSING AND BEARING

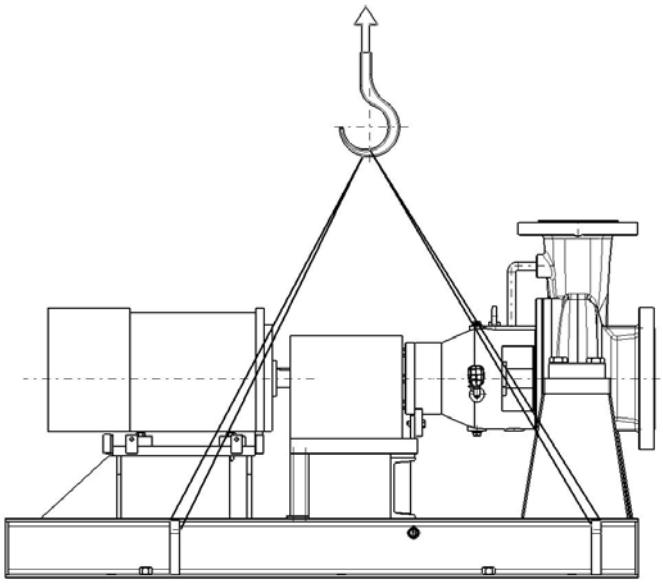
## CARRIER

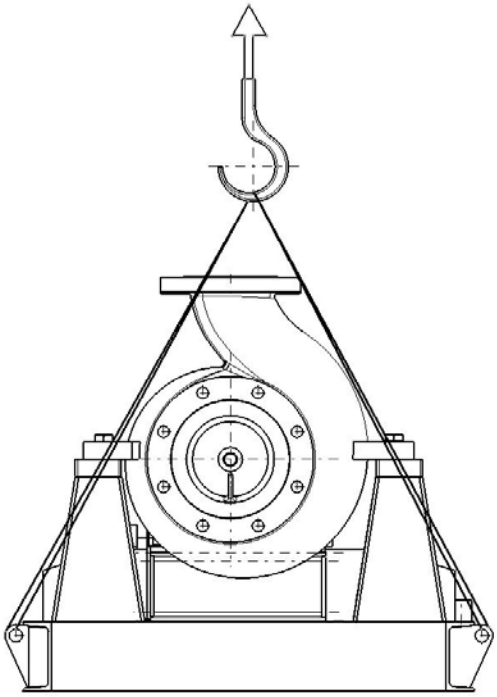
1.13 The bearing housing carries the pump end bearing and locates the bearing carrier which carries the drive end angular contact thrust bearing .The bearing carrier is attached to the bearing housing by three screws. Two grease nipples enable grease lubricated bearing to be replenished between Major maintenance intervals. For oil lubricated bearing a sight glass enables the oil level to be viewed. Additional lubrication and cooling Option may be fitted.



## HANDLING

1.14 Handing of the pump unit should be as Shown.





# SECTION 2- INSTALLATION

## 2.1 storage

Check upon arival:
This pump was thoroughly inspected at the factory prior to shipment to ensure its conformity with all specifications. Check for any damage occurred during shipping.

Long term storage:
If the pump must be stored for a period of time prior to installation, number of precautions should be taken to prevent damage. The pump and its components, as shipped from the factory, are adequately protected for indoor storage prior to installation, with the following precautions:

1. Water must be prevented from accumulating in the pump. Note that the plywood covers installed over the suction and discharge nozzles for shipping are not watertight and will leak if exposed to prolonged moisture. If water accumulated in the pump freezes, the pump will be seriously damaged.
2. To prevent condensation of atmospheric moisture in the pump installed packages of crystal silica gel in the suction and discharge openings.
3. All openings in the pump must be tightly sealed.
4. The pump should be located to permit free air circulation around it.
5. Rotate the pump shafts by hand, at least ten revolutions in the proper direction of rotation as indicated once a week.
6. If the equipment is stored longer than one year, it will be necessary to disassembly the bearing bracket and inspect the bearings.

## 2.2 Foundation, installing and leveling a common base plate

The pump unit should be installed on a sturdy foundation. Usual for such foundations is:
A concrete foundation slab.
A rigid metal frame assembly.

A concrete foundation slab is most suitable, as distortion of such a slab is very unlikely. This method is the most frequently used. The foundation should be designed and dimensioned sufficient to carry the weight of the pump unit and, also, to fully absorb the vibrations that occur when the pump is in full operation.
Also area for anchor bolts according to dimension (main general arrangement) drawing shall be empty inside equipped concrete.
By adjusting the Plates, set the pump unit level. When doing so, adjust the height of the pump unit so that there is a 20 - 40 mm gap between the base plate and the lower surface. The surface of metal plates shall be aligned together. And then base plate shall be set on that plates. And anchor bolts adjust on the base plate. And then perform adjustments between pump and foundation and piping. After assure from upon stages, do grouting over the anchor bolts. After drying concrete, fit the nuts to the anchor bolts and tighten these finger-tight. unless aligned pump , shims can use between base plate and metal plates. After finishing stages, other links such as suction and discharge for package can assembly. Tightening bolts shall be do as crosswise and equally. Grouting also should be do in empty places on base plate.

NOTE: Foundations, out of a material other than concrete, contact PETRO RAHAN SERVICE Department.

2.3 Erection

When placing the skid onto the foundation, the skid should be hoisted according to the Directions given in "Transport".
Take care that the floor on which the skid is to be placed, is sufficiently strong to carry the weight of the unit and is sufficiently rough so that the concrete that is poured afterwards will be able to obtain a proper bond with the floor.
Before pouring concrete to fill the space between skid and floor, the floor should be kept Moist during a considerable period, in order to saturate the floor with water so that it will Soak as less water as possible from the concrete that is to be poured, which would Affect the final result .The period during which the floor is to be kept wet varies, Depending on the age of the floor, between 12-24 hours. As a guideline it can be taken that a floor that is less than one month old should be kept wet for about 12 hours, a Floor that is older than one month should be kept wet for about 24 hours.

FOUNDATION BOLTS

2.4 Foundation bolts are use to anchor the Base plate to the supporting foundation and come in various types as shown in fig 2-1.

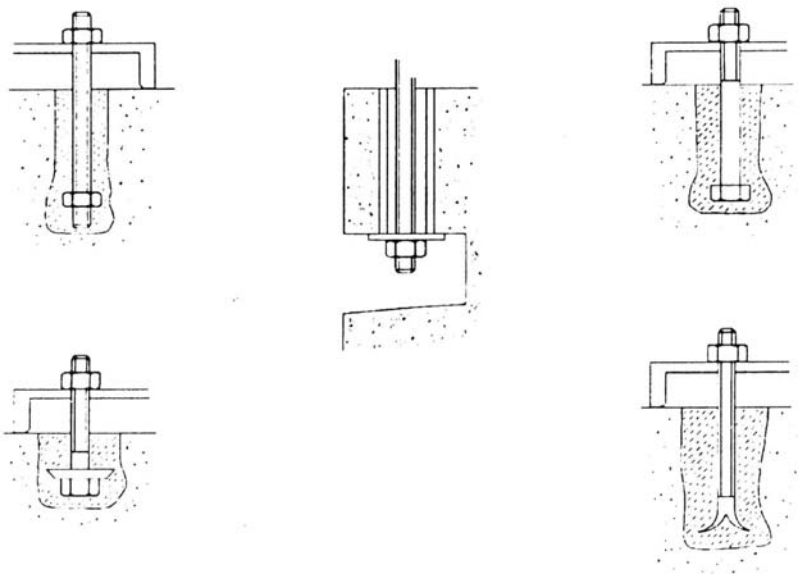


Fig 2-1. Typical foundation bolts and their installation (<u>For all this types, bolt size must be M12).</u>

LEVELLING

2.5 Leveling is achieved by using packing Pieces and shims fitted either side of the Foundation bolts before pouring the grouts see fig 2-2 It is also allow to use jack bolt.

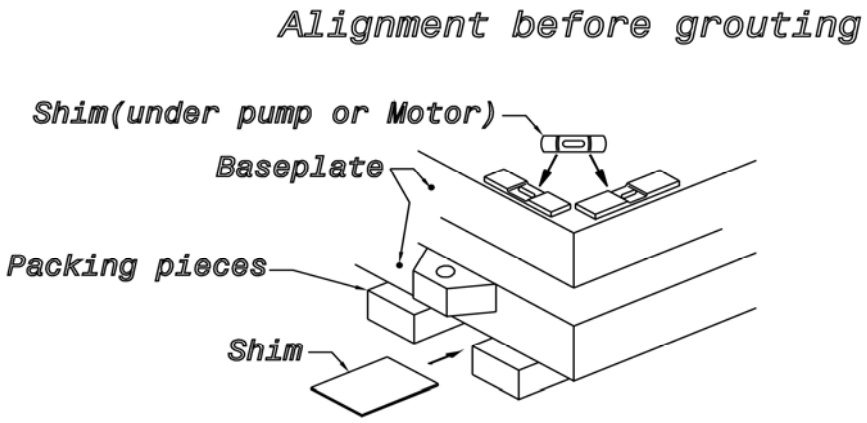



Fig 2-2. With the pump and driver correctly aligned, the grout can be poured

ALIGNMENT

THERMAL EXPANSION

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

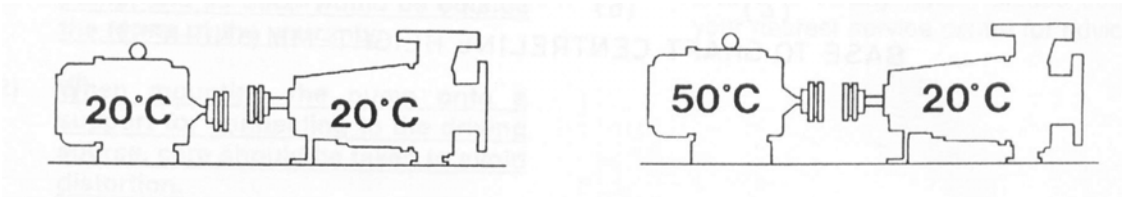



Fig 2-3 Alignment allowance example - high motor operating temperature

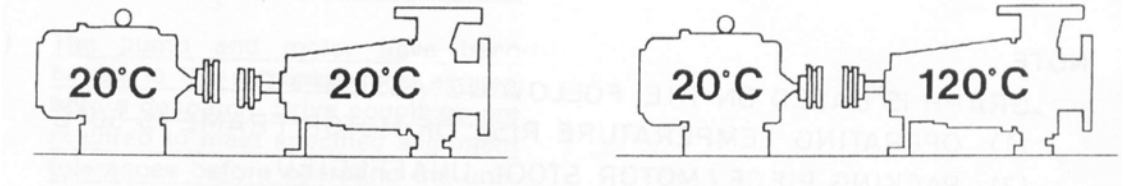



Fig 2-4 Alignment allowance example - high pump liquid temperature

To prevent excessive stress on the driver and pump bearings, the coupling, and shafts, it is necessary to conduct the following alignment procedure prior to initial start- up, and there after at any time pump or driver is serviced.

1) Mount a pair of dial indicators so that one read the angular run out between the two shafts. And the other reads the concentric run out. While this maybe done using standard dial indicator extensions, it is recommended that a set of yokes can be used. These yokes are constructed so that fork on one yoke engages the other yoke. Thus allowing both shafts to be easily turned in unison.

2) Rotate the shafts in unison, and read the total indicator run out on the dial indicators.

Reposition the units on the base plate, using shims as necessary, to achieve angular and concentric alignment within the tolerances.

3) For detail and for the allowed run out values follow the coupling instruction manual

4) Note that thermal expansion of the driver may cause the shaft to rise as the units reach their normal operating temperatures, thus affecting the concentric alignment.

5) When the units are properly aligned, tighten the mounting bolts, then double – check the alignment. Do not dowel the driver in place in until after checking the alignment at normal operating temperature.

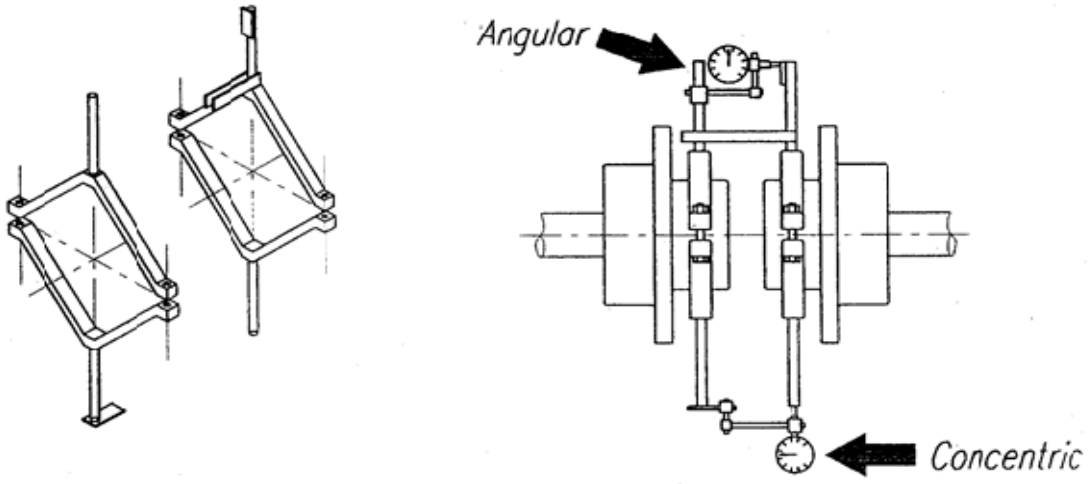
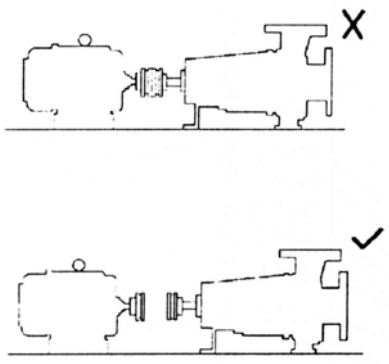


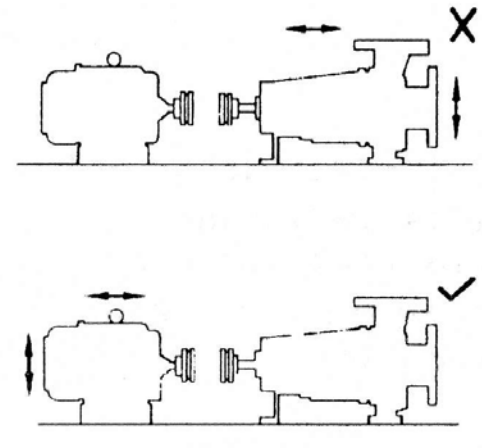

Figure 2-5 Shafts alignment

ALIGNMENT METHODS

2.7 Ensure the pump and motor half coupling are disconnected.



2.8 Align the motor to the pump, not the pump to the motor. Alignment is achieved by adding or removing shims form under the motor feet and moving motor horizontally as required.



2.9 For coupling with narrow flanges, use a dial indicator gauge as shown in fig 2-6. The alignment values are maximums for continuous service.

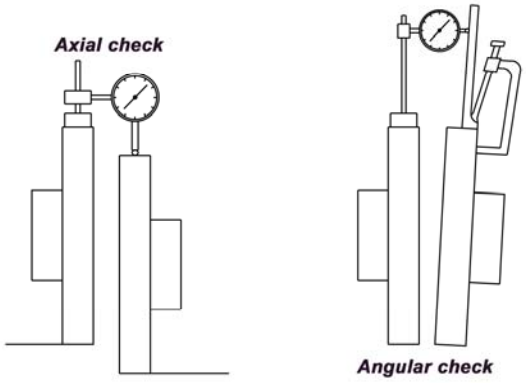



Fig 2-6

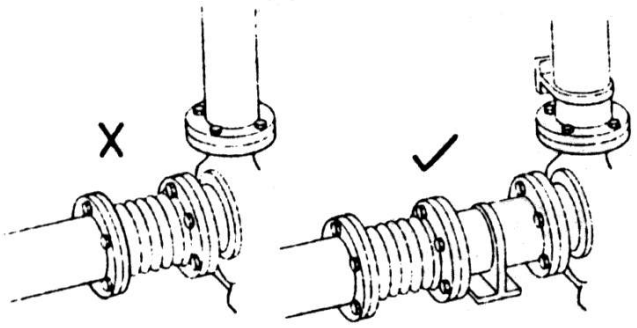
# PIPEWORK

## GENERAL

2.10 NPSHa (net positive suction head available) must exceed NPSHr (Net positive suction head required) as shown on the pump performance curve: evaluate pipe work friction losses and velocities.

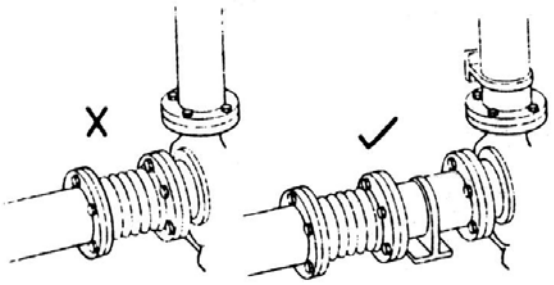
2.11 Maximum forces and moments allowed on the pump flanges vary with the pump size and type. To minimize these forces and moment, which may cause misalignment, hot bearing, Worn couplings, Vibration and the possible failure of the pump casing, the following points should be strictly followed.

2.11.1 Prevent excessive external pipe load.

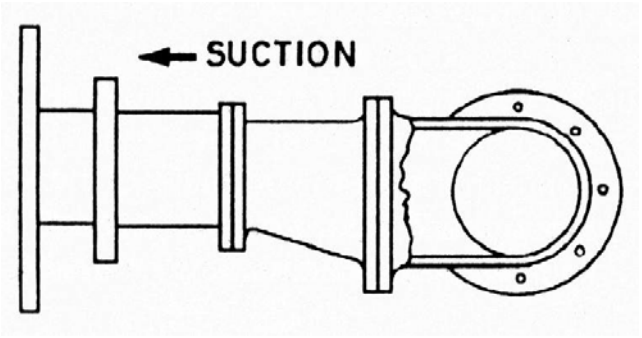



2.11.2 Never draw piping into place by applying force to pump flange connections.

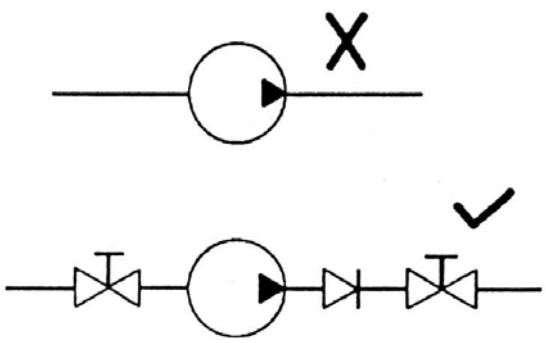
2.11.3 Do not mount expansion joints so that their force, due to internal pressure, acts on the pump flange.




2.11.4 The inlet pipe should be one or two sizes larger than the pump inlet bore and pipe bends should be as larger a radius as possible. On suction lift the pipe should be inclined up towards the pump inlet with eccentric reducers incorporated to prevent air lock. On positive suction, the inlet piping must have a constant fall towards the pump.



2.12 Fit isolator and non-return valves for ease of maintenance. Never throttle pump on suction side and never place a valve directly on the pump suction nozzle.



The non-return valve should be located as shown above and protects the pump from excessive backpressure and hence reverse rotation when the unit is stopped.

2.13 Suction piping and fittings should be flushed before using. Do not use elbows close to the pump suction flange; allow a minimum of two-pipe diameter of straight suction between the elbow and suction inlet. Suction strainers, when used, should have a net 'free area' of at least three times the suction pipe area.

2.14 piping for corrosive liquids should be arranged to allow pump flashing before removal of a unit.

## FINAL PIPING CHECK

After connecting the piping to pump:

2.15 Rotate shaft several times by hand to be sure that there is no binding and all parts are free.

2.16 check alignment, per the alignment procedure outlined previously to determine absence of pipe strain. If pipe strain exists, correct piping.

## PIPING RECOMMENDATION

The suction and discharge piping should be as short and direct as possible. To minimize head loss caused by pipe friction, the piping should be a size larger than the pump nozzles, and should have a minimum number of bends or elbows. The last section of pipe leading into the pump should always be a straight section with a length equal to at three times the diameter of the pipe. This will reduce the turbulence at the suction nozzle and help the pump to operate at its design efficiency.

The suction pipe must always be set up in such a manner to prevent the formation of air or vapor pockets. If the pump is located above the suction source, the suction pipe must follow a steady upward path, with no downward section that would create air pockets.

Another way to prevent air pockets is to avoid using symmetrical taper reducers in horizontal section of the suction pipe. symmetrical taper reducers allows an air pocket to from in the pipe.This air pocket should be prevented by Using eccentric taper reducers where the pipe size is reduced.

The piping must not be drawn into position by the flange bolts. Both pipes must be independently supported as close as possible to the pump, to prevent them from transferring forces on the pump nozzles.

If the temperature of the pumped fluid is more than 50`C above ambient temperature, provide an expansion joint in each pipe, to prevent thermal expansion or contraction from imposing unnecessary stress on the pump nozzles.

Valves should be installed in both the suction and discharge pipes, so the pump can be completely isolated from the system when not in operation. If the pump is operated against a static head, a check valve should be installed in the discharge pipe between the pump and the gate or butterfly valve. This will prevent the pump from being turned in reverse rotation by hydraulic pressure in the event of sudden failure of the driver.

It is recommended that a temporary suction strainer should be installed in the suction pipe to prevent any foreign matter from being drawn into the pump on initial start-up or following any repair work on the suction system. The strainer should be cone shaped with a net area equal to four times the cross sectional area of the suction pipe. If possible the suction strainer should be installed in a vertical section of pipe with a downward direction of flow, to minimize the probability of debris falling back in to the system when the screen is removed from cleaning. The strainer should be mounted in a spool piece, and pressure gauge should be installed for monitoring the pressure drop across the screen installed.

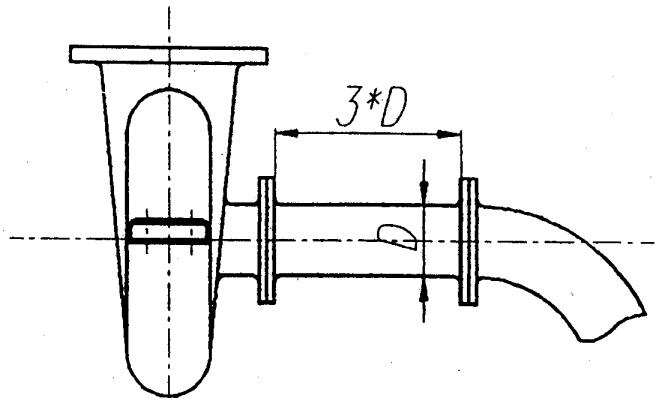



**Figure 2-7 Suction piping – straight pipe**

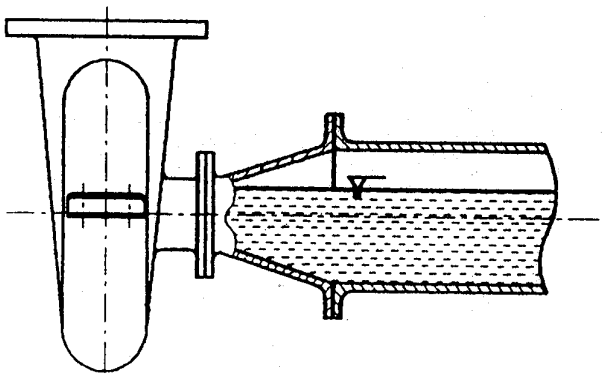


**Figure 2-8 Suction piping – symmetrical taper reducer**

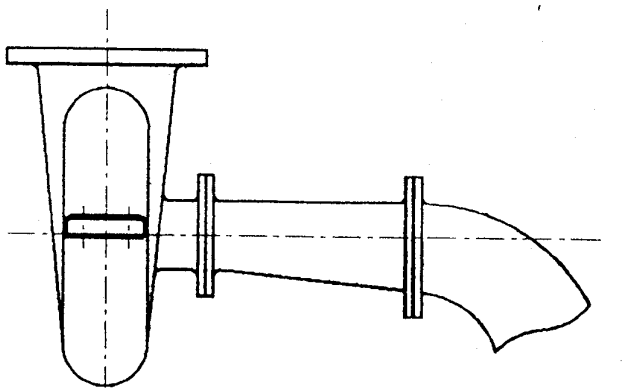


**Figure 2-9 Suction piping – eccentric taper reducer**

## AUXILIARY PIPING

Pump is equipped with openings for auxiliary piping system. Openings are plugged with plugs. Which conform to DIN 910. Position of opening of openings is shown on fig 1.1. Depending on the installation, auxiliary piping may be required for any or all of following:

1. Auxiliary process fluid piping
- vent and drain lines
- balance lines
- product flushing lines
- lines for injection of external fluids
- cyclone separator lines

2. Cooling water piping

Seal chamber shall be connected in a self-venting way.

Piping and tubing shall be cleaned with a suitable solvent.

## MECHANICAL SEALS

### 2.17 General safety notes

Any person being involved in assembly, disassembly, and start up, operation and maintenance of the PETRO RAHAN PUMP Mechanical Seal must have read and understood this operating manual and in particular the safety notes. We recommend the user to have this confirmed.
PETRO RAHAN PUMP Mechanical Seals are manufactured on a high quality level and they keep a high working reliability .yet, if they are not operated within their intended purpose or handled inexpertly they may cause risks.
The machine has to be set up in such a way that seal leakage can be led off and disposed properly and that any personal injury caused by spurting product in the event of seal failure is avoided.
Any operation mode that affects the operational safety on the mechanical seal is not permitted.
Unauthorized modifications or alternations are not permitted as they affect the operational safety of the mechanical seal.
PETRO RAHAN PUMP mechanical seals must be installed, operated, maintained, removed or repaired by authorized, trained and instructed personnel only.
The responsibilities for the respective jobs to be done have to be determined clearly and observed in order to prevent unclear competencies from the point of security.

Any work to be done on the mechanical seal is generally permitted when the seal is neither operating nor pressurized.
Warning
Seal that have been used with hazardous substances must be properly cleaned so that there is no possible danger to people or to the environment.
Apart from the given in this manual the general regulations for worker's protection and those for prevention of accidents have to be observed.

Instructions for worker's protection

Warning!
If the medium to be sealed and/or the supply liquid is objected to the dangerous substances regulation, the instructions for handling dangerous substances and the accident prevention regulations have be observed.
Medium to be sealed and/or supply medium may escape if the seal fails. Injury of persons and environment may be prevented by the user providing for splash protection and wearing safety goggles. Care has to be taken by the user for proper disposal of leakage. The user has to control these measures.
The user has to check what effects a failure of mechanical seal might have and what safety measures have to be taken to prevent personal injury or damage to the environment.
Note on explosion protection
In case this mechanical seal is operated in potentially explosive atmosphere the corresponding additional operating manual has to be observed by all means. If required this manual could be ordered from PETRO RAHAN PUMP.
The respective probation as to explosion protection for the provided temperature class must be carried out during the conformity assessment of the machine, into which the mechanical seal is installed, by the machine manufacture and/or the end user.

Emissions

A mechanical seal is a dynamical seal that cannot to be free of leakage due to physical and technical reasons. Seal design, manufacture tolerances, operating conditions, running quality of machine, etc. mainly define the leakage value. In fact, compared to other sealing systems there is few leakage. If the barrier pressure falls below the pressure in the machine the medium to be sealed may penetrate through the sealing gap, contaminating the barrier fluid. For the operation of M.S. We recommended a
Regular control of the barrier pressure and change of the barrier fluid.
During the running in phase of M.S the quantity of leakage may increase.
If the leakage amount dose not decreases or if there are other malfunctions the mechanical seal has to be shut down, removed and choked for reasons of safety.
The leakage may accrue in liquid or gaseous form. Its aggressiveness is equivalent to that of the barrier medium. Leakage of mechanical seal at outboard side has to be drained and disposed properly.
Components which may get in contact with the leakage have to be corrosion – resistant or have to be adequately protected.
If the medium to be sealed and/or the supply liquid is subjected to the hazardous substances regulation, the instructions for handling dangerous substances, and the accident prevention regulations have ne observed.

## SERVICING

Maintenance

A correctly operated mechanical seal needs low maintenance. Wear parts, however, have to be replaced, if necessary.
A duly operation includes a regular check of the following parameters:
Temperature of the supply fluid (max 60 °C at out let port of the mechanical seal)
Quantity of the supply fluid Leakage (drainage) rate of the mechanical seal
An inspection of the mechanical seal should be carried out during a revision of the complete plant. We recommend having this inspection be performed by responsible PETRO RAHAN PUMP personnel.
If the mechanical seal is removed during a revision of the plant the sliding faces should be refinished at the manufacturer and both, elastomeric seal rings and spring should be replaced.
Directives in case of failure try to define the kind of failure and record it.

In the event of excessive leakage, note changes in the leakage amount and switch the machine off if necessary.
If constant amount is leaking in a steady flow, the mechanical seal is damaged
In the event of an inadmissible temperature rise, the machine has to be stopped for safety reasons.
If there is a malfunction which you cannot correct on your own or if the cause of malfunction is not clearly recognizable please immediately contact to PETRO RAHAN PUMP.
During the warranty period the PETRO RAHAN PUMP mechanical seal must only be disassembled with approval of the manufacturer or when a representative is present.

Reconditioning (repair)

If reconditioning is necessary, the complete seal should be sent to the manufacturer, as this is best way to find out which components can be reconditioned or which parts must be replaced in order to ensure an optimum tightness.
If for compelling reasons, a reconditioning has to be carried out on site (e.g.no. spare seal on stock, long transport, problems with customs) the seal may be repaired in clean room by trained personnel of the user under the direction PETRO RAHAN PUMP mechanics).

Disassembly / removal

- Stop the machine as instructed; allow cool, depressurizing it and ensuring that pressure cannot build up again.
- Work on the M.S is only permitted when the machine is at
- Depressurize and shut off (or drain) the supply of the M.S
- There must be no product on the M.S (if necessary drain the machine and rinse it out)
- Isolate the machine to prevent it starting up unexpectedly
- Observe the safety notes (safety data sheets)

When removing, please observe by all means:
- Current accident prevention
- Regulation for handling hazardous substances

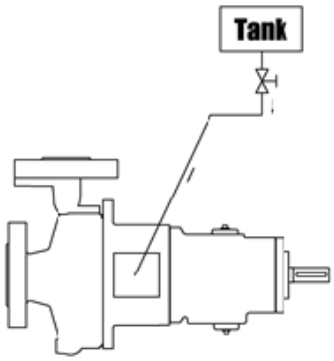
Seals that have been used with hazardous substances must be properly cleaned so that there is no possible danger to people or to the environment.
The packaging used to transport the seal must:
- Be identified with the relevant hazard symbol
- Include the safety data sheet for the product and/or supply medium.

If the medium to be sealed builds deposit s or tends to solidify during cooling down or standstill of the machine the suffering box has to flushed with suitable clean liquid. The flow and the liquid should be determined by the user considering the resistance of the seal materials.
The order of disassembly to remove the mechanical seal out of the machine depends on the design of the machine and should be determined by the machine manufacturer.
During removal of the mechanical seal the machine auxiliaries have to be used in accordance with the instructions of the manufacturer.
Disassemble the machine until you can reach the seal cartridge.

2.18 The design of the single internal seal housing with conical housing provides excellent liquid circulation around the seal and will not normally require a separate flash. Single seals requiring re-circulation will normally be provided with auxiliary piping from pump casing already Fitted. Symbols which Petrorahanpumppumps Work on seal connections are as follows:

Q - Quench at top
F - Flash
D - Drain outlet
BI - Barrier fluid in
BO - Barrier fluid out doublep seals

2.19 single seals, which have a supply to the Auxiliary quench connection in the seal housing, require connection to supply. The Supply may be from a liquid flow, low pressure Steam or static pressure from a header tank.




2.20 Double seals require a barrier liquid compatible with the pumped liquid. With back-to-back double seals. The barrier liquid should be at a minimum pressure of 1 bar above the maximum pressure on the pump side of the inner seal. The barrier liquid pressure must not exceed limitations of the seal on the atmospheric side. For toxic service the Barrier liquid supply and discharge must be in a safe area.

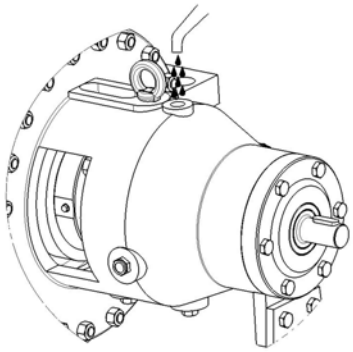
2.21 special seals may require modification to auxiliary piping described above. Consult Petrorahanpump if not sure of correct method or arrangement.

2.22 For pumping hot liquids, to avoid seal damage, the flush supply must be maintained on completion of pumping.

## OIL LUBRICATED BEARINGS

### GENERAL

2.23 Fill bearing housing with correct grade of Oil to the correct level



## MOTOR

### GENERAL

2.24 The motor must be wired up in accordance with the motor manufacturer's instructions. The identification nameplate should be checked to ensure the power supply is appropriate.

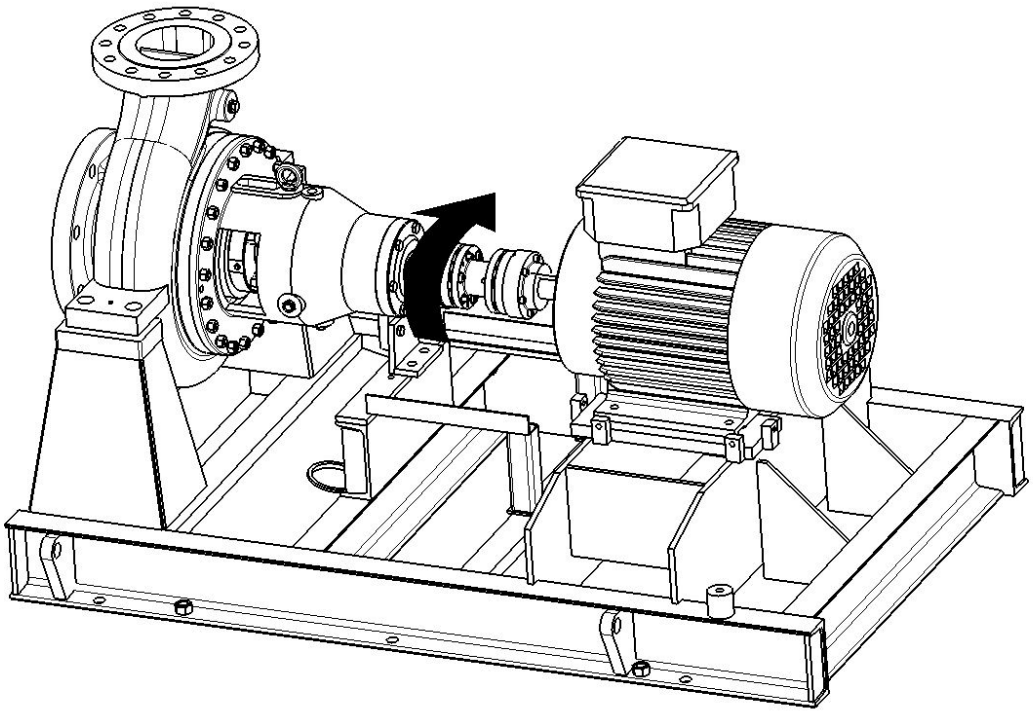
CAUTION…

Serious damage can result if the pump is run, for even a short period of time, in the wrong direction of rotation.

NOTE

The pump is shipped with the coupling spacer removed.

2.25 Ensure the direction of rotation of the motor is correct before fitting the coupling spacer. Direction of rotation must correspond to the arrow on the bearing the housing.



## SECTION3 - COMMISSIONING AND OPERATION

### a. Pre-starting instruction

1. Clean up the unit, and check all the piping to verify that it is properly installed. If possible, install a suction strainer (see Piping recommendations).

2. Check all bolted flanged connections are sure they are tight, and make certain that all external connections have been made and function properly.

3. Be certain that the driver is properly installed in accordance with the instructions provided by the manufacture.

4. Check the shaft alignment. Refer to the alignment instructions, Verify that the coupling is properly installed.

5. Energize the driver motor MOMENTARILY to ascertain the direction of rotation.

6. If the pump is equipped with mechanical seal, make certain that it has been properly set.

7. Make certain that adequate lubrication is provided (see lubricating oil recommendations). In sub-freezing temperatures, the oil should be pro -heated, to ensure that the bearings will receive adequate lubrication at start-up.

### b. Starting procedure

1. Test and make available any signals, interlock system, and any other protective devices incorporated in the pumping system.

2. Check the pump for rotational freedom, by removing the coupling guards from the base plate and turning the pump coupling slowly by hand.

3. With the discharge valve closed, slowly open the pump suction valve to allow the pumped fluid to enter the pump casing.

4. If the pump is located below the level of liquid to be pumped, it will prime it self.

5. If the pump is located above the level of the liquid to be pumped, an ejector or other means must be provided to evacuate the air or vapor from pump casing.

6. Open all ancillary inlet and outlet isolating valves to cooling systems.

7. Ensure that the mechanical seal is serviceable.

8. Check if the casing and suction piping completely filled with liquid. Rotating parts within the pump may be seriously damaged if the pump operates dry.

9. Open the seal injecting valves and vents the seal to ensure that liquid is presents the circulation system so the seal will not run dry.

10. If the pumping fluid is very hot. Allow sufficient time for the pump casing to heat to within 100 F of the pumped fluid temperature before starting the driver.

11. Switch on the driving electric motor.

12. Check pressure in the discharge pipe.

**c. Protection of pump:**

For safe and reliable operation of pump, the following protection is necessary:

1. Too low pressure on the suction side. When too low pressure is reached, pump must be switched off.

2. Valve on the suction side closed. Start of pump is forbidden.
3. Valve on the discharge side closed. Opening of the vale must be controlled by pressure switch or time relay.

4. Start of pump when run in reverse mode. Start of pump is forbidden (interlocked)

5. Operation by empty discharge line. First filling must be controller by partially closed discharge valve.

**d. Stopping the pump:**

1. Slowly close the delivery-isolating valve until zero flow is obtained.

2. Switch off the driver.

3. Close all auxiliary-cooling systems.

**e. Extended shutdown**

If the pump is to be unused for a period of time after installation, there are several precautions to be observed:

1. If the pump is exposed to freezing temperatures when not in operation, care must be taken to prevent liquid from freezing within the pump .The pump casing should be drained, by removing the plug in the bottom of the casing. Or by blowing the liquid out with air. Also drain all cooling jackets to prevent the coolant from freezing and damaging the pump.
2. If possible the pump should be started once every tow weeks and run for 20 or 30 minutes. This will keep the bearings lubricated and will prevent condensation from accumulating in the pump casing.
3. After the pump has been stopped for more than 30 days, turn the shaft by hand once a week to lubricate the bearings if normal starting is not possible.

**f. Routine operational procedures**

1. Periodically check the level of lubricating oil.
2. Check the oil level at the constant level oilier and fill it necessary.
3. Monitor the oil and bearing temperature.
4. Monitor the suction and discharge gauges to verify that the pump is operating correctly. If at any time these gauges indicate zero or low pressure, the pump must be stopped immediately.
5. Periodically check for leakage on mechanical seal. Excessive leakage indicates worn or damaged seal faces-repair or replacement is necessary.
6. Periodically check tightening of flanges and other connections.

**g. Lubricating oil recommendations**

For bearing lubrication oils with properties according to table 3.1 can be selected. Two of possible vendors is listed in the table.(5-1)Oil must be change every 8000 operating hours or every year. After first filling the oil must be changed after 200 operating hours.

| Oil Temperature range | Viscosity at 40`C mm2/s(CST) | ISO-VG group | shell | Mobil |
|---|---|---|---|---|
| Up to 40`C | 11-35 | VG 32 | Tellus oil c 22<br>Tellus oil c 32 | Mobil DTE 13<br>Mobil DTE 24<br>Mobil DTE oil light |
| 30 – 70 `C | 25 - 50 | VG 46 | Tellus Oil C 32<br>Tellus Oil C 46 | Mobil DTE 15<br>Mobil DTE 25<br>Mobil DTE oil Medium |
| 60-100`C | 40 - 75 | VG 68 | Teller oil C 46<br>Teller oil C 68 | Mobil DTE 26<br>Mobil DTE oil Heavy Medium |

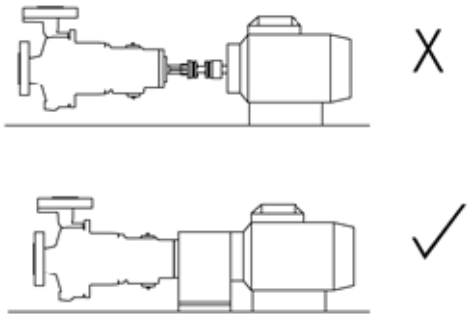
**Table 3.1 – lubrication oil recommendations**

**SADID & PARS & BEHRAN products can be used instead of ISO VG grou**

## SAFETY

### GENERAL

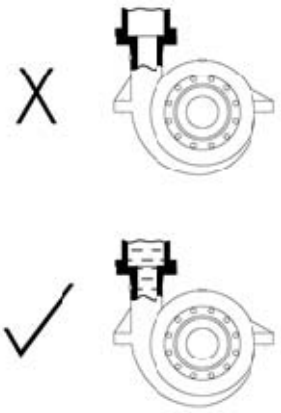
3.1 Ensure all protective guards are secured in position.



## PRIMING

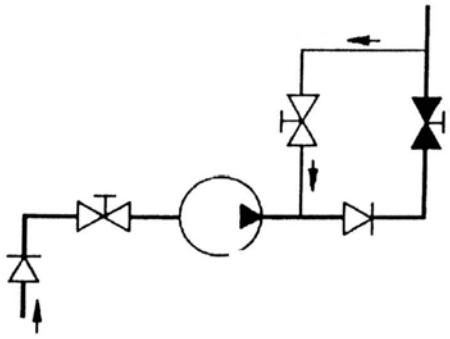
### GENERAL

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



3.3 Priming may be carried out with an ejector, vacuum pump interceptor or other equipment, or by simple flooding from inlet source.

3.4 when in service, pumps using inlet pipes with foot valves may be primed by passing liquid back from the outlet pipe trough the pump.



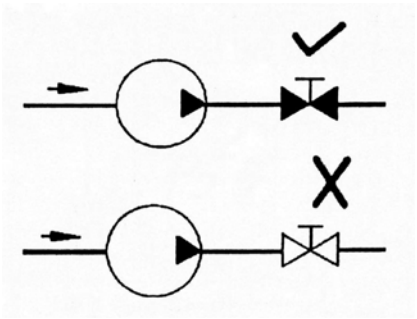
## STARTING

GENERAL

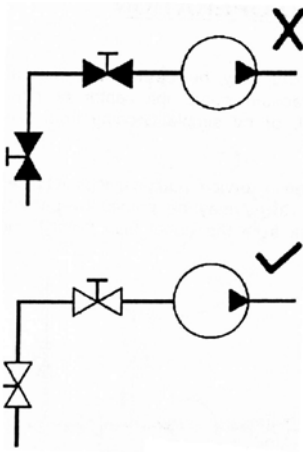
3.5 To start the pump:

3.5.1 ensure flashing and/or cooling liquid supplies are turned ON, before starting pump.

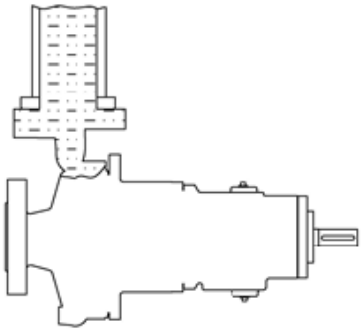
3.5.2 CLOSE the outlet valve.



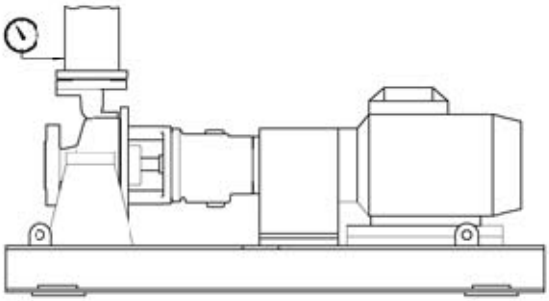
3.5.3 OPEN all inlet valves.



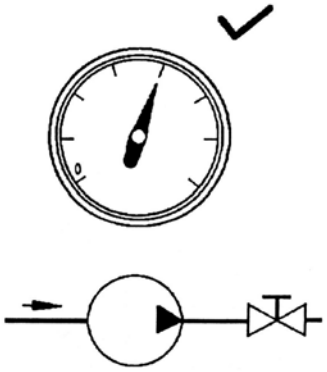
3.5.4 Prime the pump.



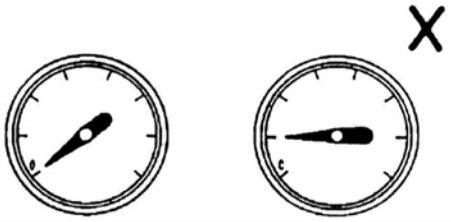
3.5.5 Starts motor and check outlet Pressure.



3.5.6 If pressure is satisfactory, slowly OPEN outlet valves.



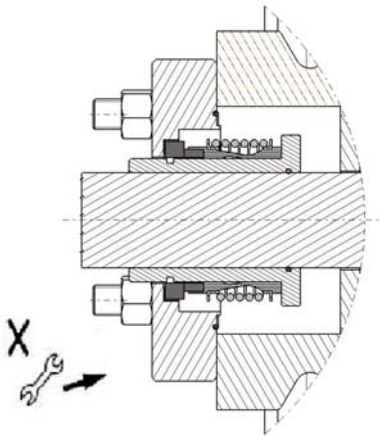
3.5.7 If NO pressure, or LOW pressure, STOP the pump. Refer to section 4 for fault diagnosis.



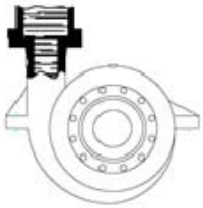
## RUNNING

### MECHANICAL SEAL

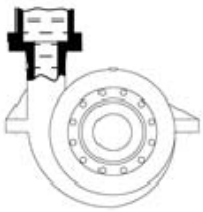
3.6 Mechanical seals require no adjustment any slight initial leakage will stop when the seal is run it. If the temperature adjacent to the seal Face rises during run it, stop the pump and allow to cooling before re-start.




3.7 Before pumping dirty liquids, run the pump in using clear liquid to safeguard the seal face.

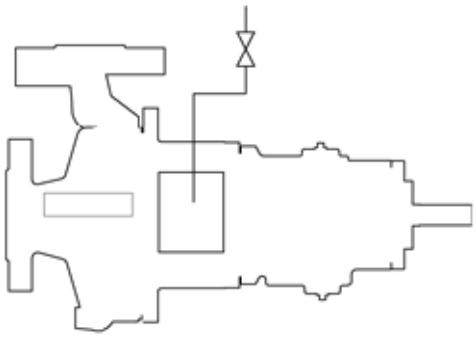


*Dirty liquid*



*Clean liquid*

3.8 For external flush or quench, start the flush or quench supply before the pump is run and allow to flow for a period after the pump is stopped.



## STOPPING

### GENERAL

3.9 To stop the pump proceed as follows:

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

3.9.2 Stop the pump.

3.9.3 Switch off flushing and/or cooling liquid supplies.

3.9.4 For prolonged shutdowns and especially when ambient temperatures are likely to drop to below 0deg C, the pump and any cooling and flushing arrangements must be drained or otherwise protected.

## SECTION 4 – OPERATING DIFFICULTIES

### GENERAL

4.1 This section gives information on fault diagnosis and possible remedies to operating difficulties. The matrix details a list of possible symptoms to which the probable cause or causes may be ascertained by reading off the cause alongside the black spot.

4.2 Enter the table at the symptom(s) and then read off possible causes of trouble opposite black spots.

TABLE 4-1 FAULT DIAGNOSIS MATRIX

| SUCTION TROUBLES | PUMP DOES NOT DELIVER WATER ⇓ | INSUFFICIENT CAPACITY DELIVERED ⇓ | INSUFFICIENT PRESSURE DEVELOPED ⇓ | PUMP LOSES PRIME AFTER STARTING ⇓ | PUMP REQUIRES EXCESSIVE POWER ⇓ | MECHANICAL SEAL LEAKS EXCESSIVELY ⇓ | MECHANICAL SEAL HAS SHORT LIFE ⇓ | PUMP VIBRATES OR IS NOISY ⇓ | BEARINGS HAVE SHORT LIFE ⇓ | PUMP OVERHEATS AND SEIZES |
|---|---|---|---|---|---|---|---|---|---|---|
| | SYMPTOMS | | | | | | | | | |
| Pump not primed. | ● | | | | | | | | | ● |
| Pump or suction pipe not completely filled with liquid. | ● | ● | | ● | | | | ● | | |
| Suction lift too high. | ● | ● | | ● | | | | ● | | |
| Insufficient margin between suction pressure and vapour pressure. | ● | ● | | | | | | ● | | ● |
| Excessive amount of air or gas in liquid. | | ● | ● | ● | | | | | | |
| Air or vapour pocket in suction line. | ● | ● | | ● | | | | | | |
| Air leaks into suction line. | | ● | | ● | | | | | | |
| Air leaks into pump through mechanical seal, sleeve joints, casing joint or pipe lugs. | | ● | | ● | | | | | | |

| | SYMPTOMS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | PUMP OVERHEATS AND SEIZES | | | | | | | | | |
| | BEARINGS HAVE SHORT LIFE ⇓ | | | | | | | | | |
| | PUMP VIBRATES OR IS NOISY ⇓ | | | | | | | | | |
| | MECHANICAL SEAL HAS SHORT LIFE ⇓ | | | | | | | | | |
| | MECHANICAL SEAL LEAKS EXCESSIVELY ⇓ | | | | | | | | | |
| | PUMP REQUIRES EXCESSIVE POWER ⇓ | | | | | | | | | |
| | PUMP LOSES PRIME AFTER STARTING ⇓ | | | | | | | | | |
| | INSUFFICIENT PRESSURE DEVELOPED ⇓ | | | | | | | | | |
| | INSUFFICIENT CAPACITY DELIVERED ⇓ | | | | | | | | | |
| | PUMP DOES NOT DELIVER WATER ⇓ | | | | | | | | | |
| | ⇓ | | | | | | | | | |
| Foot valve too small. | | ● | | | | | | ● | | |
| Foot valve partially clogged. | | ● | | | | | | ● | | |
| Inlet of suction pipe insufficiently submerged. | ● | ● | | ● | | | | ● | | |
| **SYSTEM TROUBLES** | | | | | | | | | | |
| Speed too low. | ● | ● | ● | | | | | | | |
| Speed too high. | | | | | ● | | | | | |
| Total head of system higher than head of pump. | ● | ● | ● | | | | | | | |
| Total head of system lower than pump design head. | | | | | ● | | | | | |
| Specific gravity of liquid different from design. | | | | | ● | | | | | |
| Viscosity of liquid differs from that for which designed. | | ● | ● | | ● | | | | | |
| Operation at very low capacity. | | | | | | | | ● | | ● |
| Operation at high capacity. | | | | | ● | | | ● | ● | |
| **MECHANICAL TROUBLES** | | | | | | | | | | |
| Misalignment due to pipe strain. | | | | | ● | ● | ● | ● | ● | ● |
| Improperly designed foundation. | | | | | | | | ● | | |
| Shaft bent. | | | | | ● | ● | ● | ● | ● | |
| Rotating part rubbing on stationary part internally. | | | | | ● | | | ● | ● | ● |
| Bearings worn | | | | | | ● | ● | ● | ● | ● |
| Wearing ring surfaces worn. | | ● | ● | | ● | | | | | |
| Impeller damaged or eroded. | | ● | ● | | | | | ● | | |
| Leakage under sleeve due to joint failure. | | | | | | ● | | | | |
| Shaft sleeve worn or scored or running off centre. | | | | | | ● | ● | | | |
| Mechanical seal improperly installed. | | | | | ● | ● | ● | | | |
| Incorrect type of mechanical seal for operating conditions. | | | | | ● | ● | ● | | | |
| Shaft running off centre because of worn bearings or misalignment. | | | | | | ● | ● | ● | ● | ● |

| | SYMPTOMS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | PUMP OVERHEATS AND SEIZES | | | | | | | | | ⇓ |
| | BEARINGS HAVE SHORT LIFE | | | | | | | | ⇓ | |
| | PUMP VIBRATES OR IS NOISY | | | | | | | ⇓ | | |
| | MECHANICAL SEAL HAS SHORT LIFE | | | | | | ⇓ | | | |
| | MECHANICAL SEAL LEAKS EXCESSIVELY | | | | | ⇓ | | | | |
| | PUMP REQUIRES EXCESSIVE POWER | | | | ⇓ | | | | | |
| | PUMP LOSES PRIME AFTER STARTING | | | ⇓ | | | | | | |
| | INSUFFICIENT PRESSURE DEVELOPED | | ⇓ | | | | | | | |
| | INSUFFICIENT CAPACITY DELIVERED | ⇓ | | | | | | | | |
| | PUMP DOES NOT DELIVER WATER ⇓ | | | | | | | | | |
| Impeller out of balance resulting in vibration. | | | | | | ● | ● | ● | ● | ● |
| Abrasive solids in liquid pumped. | | | | | ● | ● | ● | | | |
| Internal misalignment of parts preventing seal ring and seat from mating properly. | | | | | | ● | ● | | | |
| Mechanical seal was run dry. | | | | | | ● | ● | | | |
| Internal misalignment due to improper repairs causing impeller or inducer to rub. | | | | | | ● | ● | | | |
| Excessive thrust caused by a mechanical failure inside the pump. | | | | | | | | ● | ● | ● |
| Excessive grease in ball bearings. | | | | | | | | ● | ● | |
| Lack of lubrication for bearings. | | | | | | | | ● | ● | |
| Improper installation of bearings (damage during assembly, incorrect assembly, wrong type of bearing etc). | | | | | | | | ● | ● | |
| Dirt getting into bearings. | | | | | | | | ● | ● | |
| Rusting of bearings due to water getting into housing. | | | | | | | | ● | ● | |

## SECTION 5 – PREVENTIVE MAINTENANCE

### MAINTENANCE SCHEDULE

5.1 A preventive maintenance schedule can extend the life of your pump. Our specialist service personnel can help control maintenance records and provide condition monitoring for temperature and vibration to locate potential problems and so prevent them occurring.

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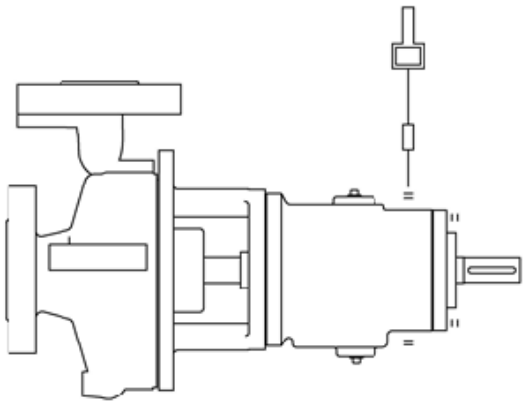
### ROUTINE INSPECTION

5.2 Examine the pump as follows:

5.2.1 check operating behavior; ensure noise, vibration and bearing temperatures are normal

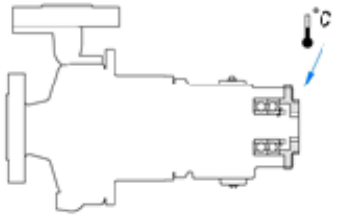
| **Speed of Rotation ,n** | **Maximum r.m.s values of the vibration Velocity for the shaft centerline height h1** | |
|---|---|---|
| | h1<225mm | h1>225mm |
| min$^{-1}$ | mm/s | mm/s |
| n<1800 | 2.8 | 4.5 |
| 1800<n<4500 | 4.5 | 7.1 |

table is based on ISO 2372 and ISO 2373.

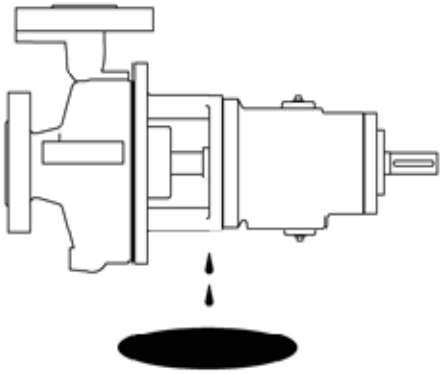


5.2.1.1 Vibration limites severity for horizontal pumps with multivane impellers

For ring oiled or splash systems, oil sump tempraure be low 82°c.During shop testing.
The sump oil temperature rise shall not exceed 39°c.




5.2.2 Check that there are no abnormal Fluid or lubricant leaks (static and dynamic seals).



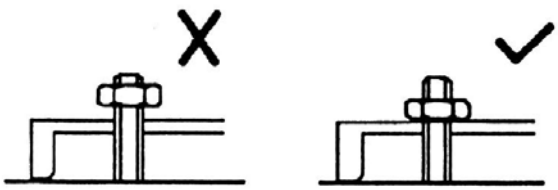
5.2.3 Check that shaft seal leaks are within acceptable limits.

5.2.4 Check; through oil level sight glass, the level and condition of oil lubricant. On grease lubricated pump, check running hours since last recharge of grease or complete grease change.

6 MONTH INSPECTION

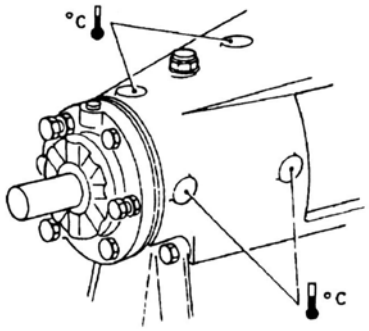
5.3 In addition to routine inspection requirements, carry out the following checks:

5.3.1 Check foundation bolts for security of attachment and corrosion.



5.3.2 Check the pump capacity, pressures and power. If pump performance does not satisfy the latest process requirements and these have not changed, investigate pump for worn parts.

5.3.3 Check pump-running records for hourly usage to determine if bearing lubricant requires changing .The normal interval between oil or grease change is 4000 operating hours.Higher temperatures foroperating temperature around 100°C the oil should be changed every three mounths.




5.3.4 Check lubricant and bearing temperature analysis. This can be useful in optimizing lubricant change intervals. A maintenance schedule log is provided in section 6 to record temperature and vibration levels.

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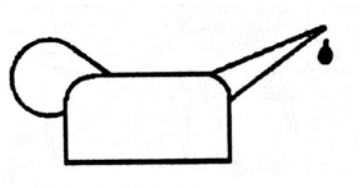
LUBRICATION

OIL LUBRICATED BEARINGS CAUTION…

Oil lubricated units are supplied without oil and must be filled before starting the pump.

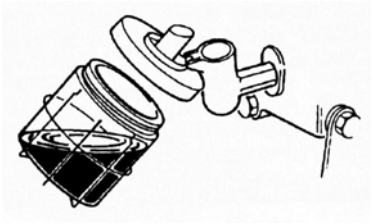


5.4 For oil lubricated bearings, the bearing housing must be filled with the correct oil to half way up the sight glass.You can determine the specification of oil by provided instruction in 5-10.

5.5 There are two methods of filling the bearing housing with oil:

5.5.1 Unscrew the oil filler/breather and fill through the orifice.

5.5.2 Hinge back the constant level oiler and unscrew its glass dome. Fill the dome with oil and screw back in position, then swing the dome back to its operating position.



NOTE

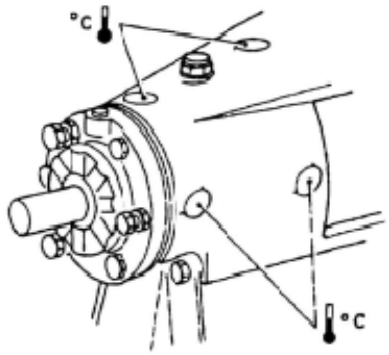
Fill to the correct oil level. Too low a level and the bearing will wear Faster.Too high a level and the bearing will run hot.

5.6 It may be necessary to top up the oil level between oil changes. Normal intervals are 4000 operating hours between lubricant changes. For pumps on hot service for in severely damps or corrosive atmosphere, the oil will require changing more frequently. Lubricant and bearing temperature analysis can be useful in optimizing lubricant change intervals.

| BEARING OIL TEMPERATURE deg C | DIN/ISO VG | SAE No | VISCOSITY AT 40 deg C | | |
|---|---|---|---|---|---|
| | | | CST | SSU | $mm^2$ $S\text{-}S^{-1}$ |
| -15 to 50 | 15 | 5W | 14 | 75 | 15 |
| 50 to 65 | 32 | 10W | 32 | 150 | 32 |
| | 46 | | 46 | 225 | 46 |
| 65 to 80 | 68 | 20 | 65 | 300 | 68 |
| 80 to 95 | 100 | 30 | 100 | 470 | 100 |
| | 150 | | 151 | 700 | 150 |

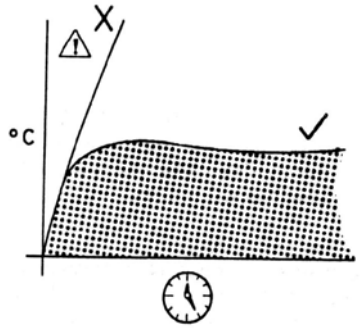
TABLE 5-1 OIL VISCOSITY TO TEMPRETURE

5.7 The lubricating oil should be a high quality oil having oxidization and foam Inhibitors, or synthetic oil. The index of viscosity should generally be ISO VG 32, 46 or 68, depending on the bearing temperature. The bearing temperature can normally be determined at the condition monitoring points provided, after a period of two hours operation.




5.8 The bearing temperature may be allowed to rise to 50deg C above ambient, but should not exceed 82 deg C (API 610 limit). A continuously rising temperature, or an abrupt rise, indicate a fault.

5.9 pumps, which handle high temperature liquids, may require their bearings to be cooled to prevent bearing temperature exceeding their limits. Ambient temperature, airflow and bearing size are important secondary influences on bearing temperature.




5.10 When selecting the oil the following aspects should be considered.

Bearing life maybe extended by selecting an oil whose viscosity $\nu$ at the operating temperature is somewhat higher than $\nu_1$ however, since increased viscosity raises the bearing operation temperature there is frequently a practical limit to the lubrication improvement which can be obtained by this means.

If the viscosity ratio $K = \nu / \nu_1$ is less than 1 an oil containing EP additives is recommended and if $K$ is less than 0.4 an oil with such additieves must be used . An oil with EP additives may also enhance operational reliability in cases where $K$ is greater than 1 and medium and large size roller bearings are concerned. It should be remembered that only some EP additives are benefical, however (see also under “load carrying ability”.)

For exceptionally low or high speeds for critical loading conditions, or for unusual lubricating conditions please consult AEPC.

Example:

A bearig having a bore diameter d=340mm and outside diameter D=420mm is required to operate at a speed n=500r/min .since dm=0.5(d+D), dm=380mm.From diagram 2 the minimum kinematic viscosity $\nu_1$ required to give adequate lubrication at the operating temperature is 13 mm2/s. From diagram 3, assuming

that the operating temperature of the bearing is 70°c, an oil having a viscosity $\nu$ at the refrence temperature of 40°c of at least 39 mm2/s will be required.

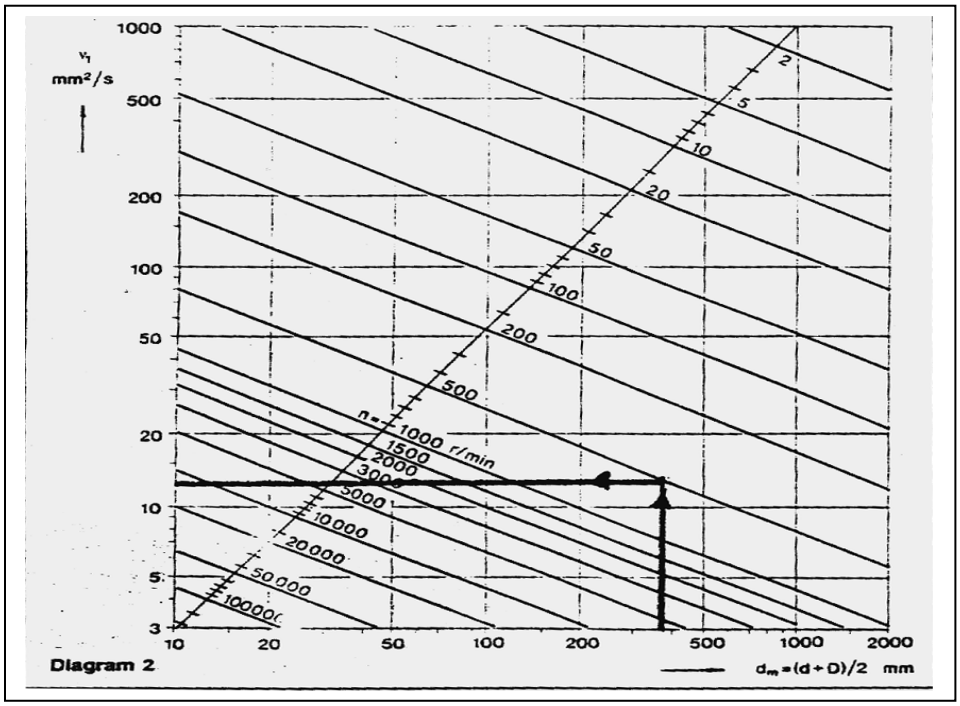


Diagram 2

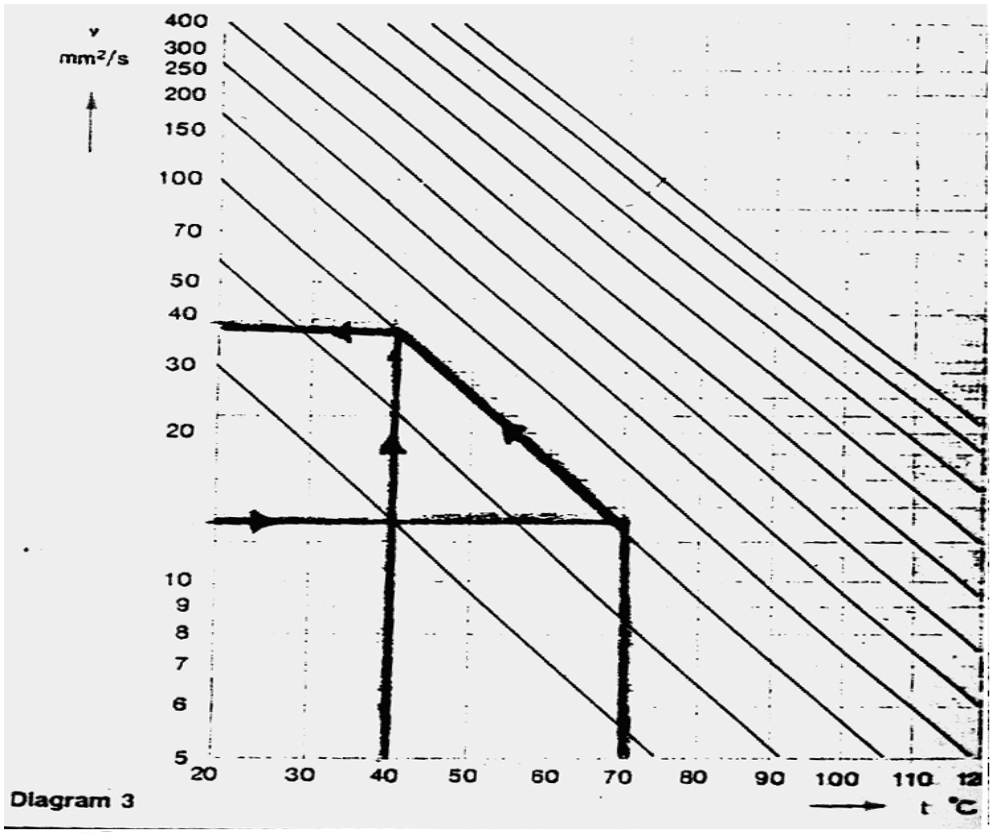


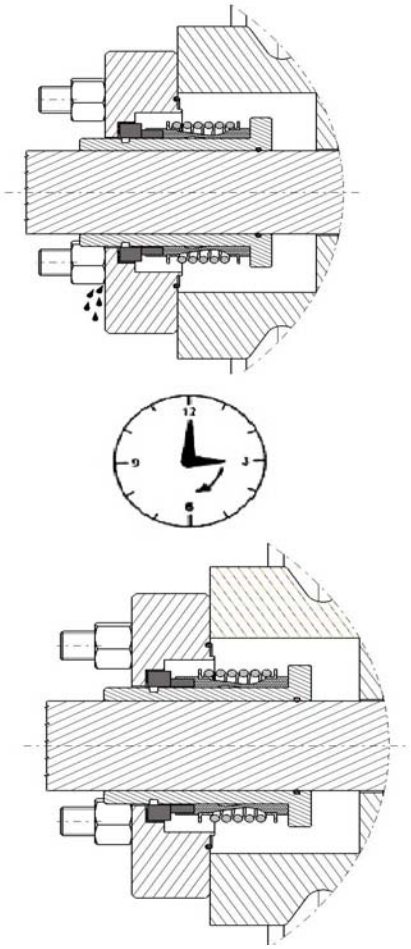
Diagram 3

# TABLE 5-2 RECOMMENDED OIL LUBRICANTS

| CENTRIFUGAL PUMP LUBRICATION | | | | OIL COMPANIES AND LUBRICANTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OIL | Viscosity mm²/s 40 deg C | Temperature maximum deg C | Designation according to DIN51502 ISO VG | BP | DEA | Elf | Esso | Mobil | Q8 | Shell | Texaco | Wintershall (BASF Group) |
| Splash Lubrication | 32 | 65 | HL/HLP 32 | BP Energol HL32<br>BP Energol HLP32 | Anstron HL32<br>Anstron HLP32 | OLNA 32<br>HYDRELEF 32<br>TURBELF SA32<br>ELFOLNA DS32 | TERESSO 32<br>NUTO H32 | Mobil DTE OIL LIGHT<br>Mobil DTE13<br>Mobil DTE 24 | Q8 Verdi 32<br>Q8 Haydn 32 | Shell Tellus 32<br>Shell Tellus 37 | Rando Oil HD32<br>Rando Oil HD-AZ-32 | Wiolan HN32<br>Wiolen HS32 |
| | 68 | 80 | HL/HLP 68 | BP Energol HL68<br>BP Energol HLP68 | Anstron HL68<br>Anstron HLP68 | TURBELF SA68<br>ELFOLNA DS68 | TERESSO 68<br>NUTO H68 | Mobil DTE Oil Heavy Medium<br>Mobil DTE 26 | Q8 Verdi 68<br>Q8 Haydn 68 | Shell Tellus 01 C 68<br>Shell Tellus 01 68 | Rando Oil 68<br>Rando Oil HD C-68 | Wiolan HN68<br>Wiolen HS68 |
| Force Feed Lubrication | 46 | - | HL/HLP 46 | BP Energol HL46<br>BP Energol HLP46 | Anstron HL46<br>Anstron HLP46 | TURBELF SA 46<br>ELFOLNA DS 46 | TERESSO 46<br>NUTO H46 | Mobil DTE Oil Medium<br>Mobil DTE 15 M<br>Mobil DTE 25 | Q8 Verdi 46<br>Q8 Haydn 46 | Shell Tellus 01 C 46<br>Shell Tellus 01 46 | Rando Oil 46<br>Rando Oil HD B-46 | Wiolan HN46<br>Wiolen HS46 |

MECHANICAL SEALS

5.11 The seal and any auxiliary flushing should be examined frequently for correct operation. A mechanical seal should give a long period of service with no attention. Any slight initial leakage will be eliminated when the seal is run it.



COUPLING

5.12 The coupling should be inspected regularly and checked for correct alignment and worn driving elements.

SECTION 6 – DISMANTLING AND ASSEMBLY

**a. pump isolation**

WARNING! Before the pump is dismantled in any way or removed from the system, the nature of the pumped liquid must be ascertained, and the pump isolated and drained as detailed below. Ensure that the electrical supply is physically disconnected or isolated and locket out. Follow all applicable national /site safety procedures and take all necessary precautions to avoid hazards to personnel or equipment.

1. Isolated the pump from the system by closing the valves on the suction and discharge side.
2. Switch off all powers and disconnect or isolated the machine electrically.
3. Disconnect all auxiliary piping.
4. Drain the pump& cooling jacket.

**b. Impeller disassembly**

1. Block mechanical seal according to the mechanical seal manual.
2. Remove the coupling guards, disconnect and remove the spacer
3. Connect bearing bracket to the crane; use lifting eyebolt
4. Disconnect the bearing bracket from the base plate.
5. Remove all nuts off the studs
6. With two jack screws M 12 push volute casing off the bearing bracket
7. Carefully remove the bearing bracket (with delivery cover, mechanical seal and impeller) out of the volute casing and from the base plate, use the crane
8. Join the delivery cover with bearing bracket with four auxiliary screws and nuts though holes for bolts
9. Transport the unit to proper place for servicing
10. Remove impeller nut, on opposite end of the shaft use special tool
11. Remove impeller the shaft.

**C.Impeller assembly**

1. Set impeller key in its groove

2. Lubricate impeller, impeller rings and shaft with grease.

3. Mount impeller with piece of wood and hammer, support opposite end of shaft during impeller assemblin
4. Clean groove in impeller nut.
5. Grease the threads on the shaft with antifriction heat resistant paste. The paste used by pump vendor was molycote 1000. (OPTIONAL)
6.Tight impeller nut with proper wrench, on opposite shaft end use special tool (fig 6.1)
7.Check the impeller redials run out at wear ring or wear ring position (fig.6.3)
8.Transport the unit in the vicinity of the volute casing, which is mounted into the piping system
9. Clean sealing surfaces.
10.Set O-RING on it place without any lubricant. For each assembling use new gasket.
11. Lubricate impeller wear rings
12. Disassemble the auxiliary screws
13. Carefully assemble unit into the volute casing and studs
14.Grease contact surface of studs nuts and contact surface of the delivery cover flange with adequate antifriction past on basis MoS2 or other. The past used by pump vender was molycote 1000
15. Use a calibrated torque wrench and tight all according to standard tables.
16. Assemble all remain plugs and auxiliaries
17. Open breather and screws plug
18. Fill the bearing bracket with prescribed adequate oil
19. Close the breather and screws plug
20. Free the mechanical seal

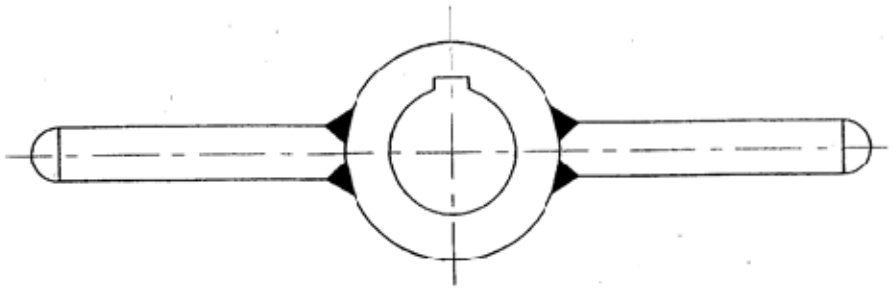


**Figure 6-1 Shaft blocking tool**

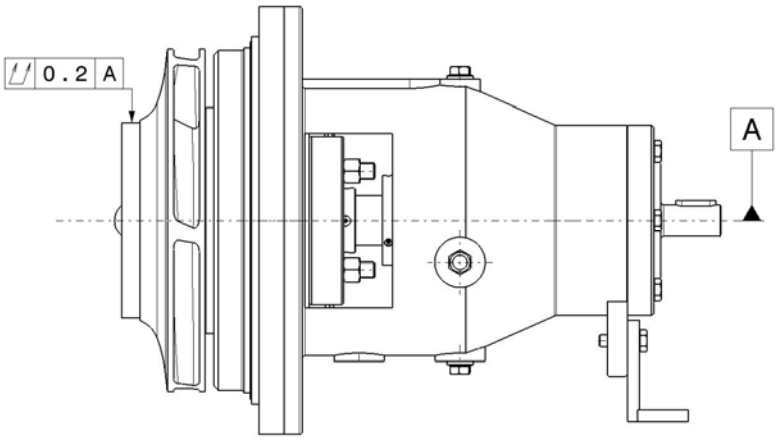



**Figure 6-2 Checking of impeller radial runout**

### d. Mechanical seal disassembly

Follow step 1 to 11 of the section 6.b. (impeller disassembly).
1. Put complete bearing bracket assembly in vertical position.
2. Remove auxiliary screws from point 5 in section 6.b.
3. Carefully loosen the connection between mechanical seal and shaft.
4. Hang complete assembly on the wire rope. (fig.6.3)
5. With two jack screws M 16 push the delivery cover (with mechanical seal) off the bearing bracket.
6. Pull up slowly and carefully complete bearing bracket and remove it.
7. Remove nuts from studs and disassembly mechanical seal cartridge.

### e. Mechanical seal assembly

WARNING! Mechanical seal must be blocked during the installation mechanical.
1. Remove all sharp edges and repair all mechanical damages from the parts.
2. Clean all parts with white spirit and any dry them with compressed air.
3. Lubricate “O” ring between mechanical seal and delivery cover with dish washing liquid.
4. Put “O” ring in its groove.
5. Put delivery cover on the plate. (fig.6.3)
6. Lubricate contact surface of mechanical seal cartridge with silicon grease
7. Set carefully mechanical seal cartridge on its place.
8. Grease contact surface of stud’s, nuts and mechanical seal gland with adequate antifriction paste on the basis MoS2 or other. The paste used by PETRO RAHAN PUMP was molycote 1000.
9. Use a calibrated torque wrench and tight all nuts.
10. Lubricates both “O” rings with dish washing liquid and put them in their grooves

11. Mount pin.
12. Mount eye bolt M10 on the end of shaft if it hasn't been already done.
13. Hang complete bearing bracket on the steel wire (fig 6.3)
14. Lubricate "O" ring between mechanical seal and shaft with dish washing liquid put in its groove.
15. Lubricate shaft mechanical seal sleeve with dish washing liquid.
16. lower complete bearing bracket very slowly and carefully down and center it by hand.
17. Insert four auxiliary screws and tighten item.
18. Tighten mechanical seal rotation parts on the shaft.
19. Reblock the mechanical seal.

Further step follows section 5.c. (impeller assembly).

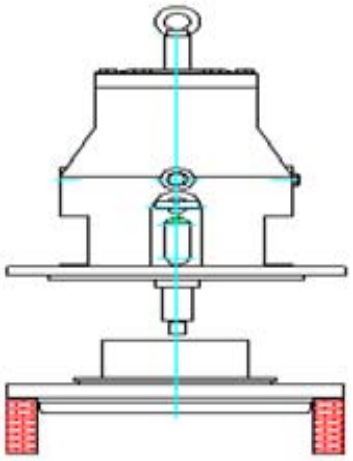


**Figure 6-3 Mechanical seal disassembling / assembling**

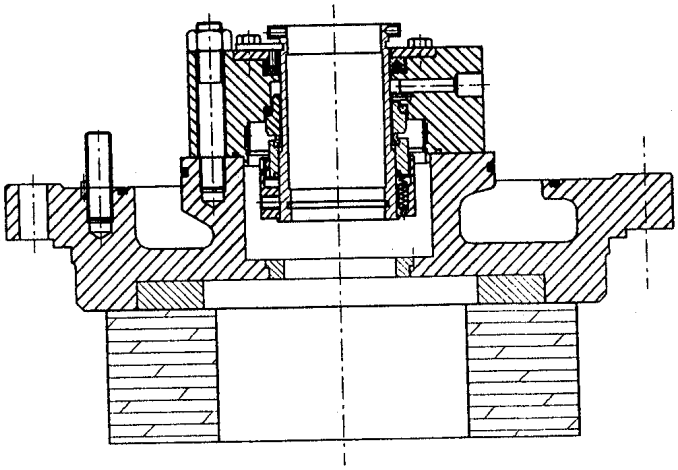


**Figure 6-4 Mechanical seal assembling**

### f. Bearings disassembly

1. Follow steps in section 6.b. (impeller disassembly) and 6.d. (Mechanical seal disassembly)
2. remove constant level oilier
3. remove deflector from pump side.
4. remove bearing cover screws on both sides.
5. remove bearing covers
6. loosen lock washer and. remove bearing nut on pump side.
7. remove breather and screws plug
8. put bearing bracket in vertical position (fig.6.5)
9. press shaft out of bracket with hydraulic press or carefully tap of the shaft using a soft face hammer
10. remove a cir clip
11. remove outer ring of roller bearing with cage assembly
12. remove both axial bearing with standard pulled .
13. remove inner ring of redial roller bearing.

### g. Bearing assembly

1. Clean all parts in with spirit dry them in compressed air.
2. Heat the angular contact ball bearings in oil bath to 210 `C
3. Put shaft in vertical position and mount the oil ring
4. Mount first and then second bearing in back to back – “O” arrangement
5. Calm the bearing to ambient temperature
6. Tight them with lock washer and bearing nut (fig 6.7)
7. Heat the inner ring of redial cylinder roller bearing in oil bath to 210`C
8. Mount the inner ring (shaft in vertical position )
9. Put the oil ring in its groove
10. Mound the circlip in its groove in bearing bracket
11. Put the bearing bracket in vertical position.
12. Grease outer ring of redial bearing and assemble it in the bearing bracket (fig 6.6)
13. Mount shaft assembles in bearing bracket. Use wire with permanent. Magnet for proper positioning oil ring
14. Clean the contact surfaces bearing bracket and of bearing covers with triclorethilene and removed all the possible remains old glue
15. Lubricate the contact surfaces of bearing cover with adequate glue. The glue used by pump vendor was lectate 510(Associated component details )
16. Before mounting the cover lubricate holes for screws with grease
17. Mount the cover on the bearing bracket ant tighten screws
18. Repeat the same procedure with cover on the other side of the bearing bracket
19. Lubricated O ring with silicon grease and put it in its grooved in the deflector
20. Lubricated shaft and deflector with silicon grease
21. Mount deflector on shaft
22. Tight deflector with three screw
23. The same procedure is valid for the second deflector
24. Put ventilator key in its groove
25. Grease shaft and ventilator and mount it, use a piece of wood; opposite side of shaft shall be supported during the ventilator mounting
26. Mount cir clip
27. Mount the ventilator cap
28. Mount screws with spring washers and tighten them
29. Mount constant level oilier , use the same glue as for the covers
30. Check the shaft radial run out on place of the mechanical seal further step follows 6.e. (Mechanical seal assembly).

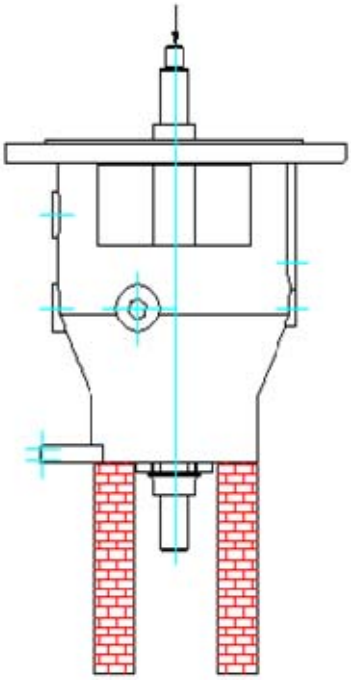


**Figure6-5 rotor disassembling**

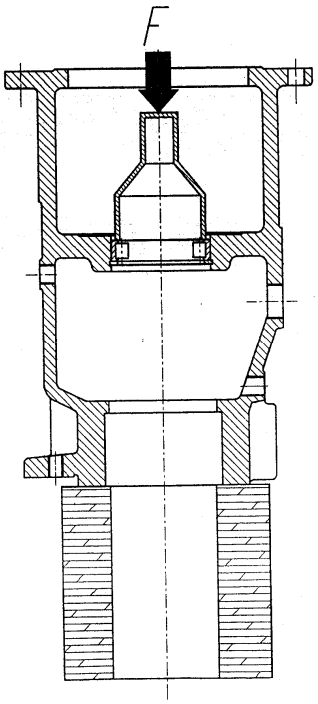



**Figure 6-6 assembling & disassembling of outer ring of radial bearing**

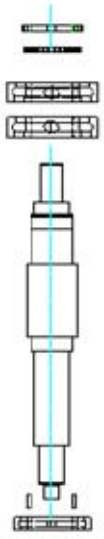


**Figure 6-7: assembling and disassembling of bearings on shaft**

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## DISMANTLING

WARNING

THE PETRO RAHAN PUMP PUMP MAY HAVE PUMPED HAZARDOUS OR TOXIC LIQUIDS: SKIN AND EYE PROTECTION ARE THEREFORE ESSENIAL. THE LIQUID MUST BE HANDLED AND DISPOSED: OF BY CONFORMING WITH ENVIROMMENTAL LEGISLATION.

NOTE

Before dismantling the pump for overhaul, ensure quality Petrorahanpump pumps replacement parts are available.

GENERAL

6.1 all of methods in this section refer to Fig 6-1.

BACK PULL-OUT CARTRIDGE REMOVAL

6.2 To remove the pull-out cartridge proceed as follows:

6.2.1 Isolate power supply to driver motor.

6.2.2 Shut off all valves controling the flow to and from the pump.

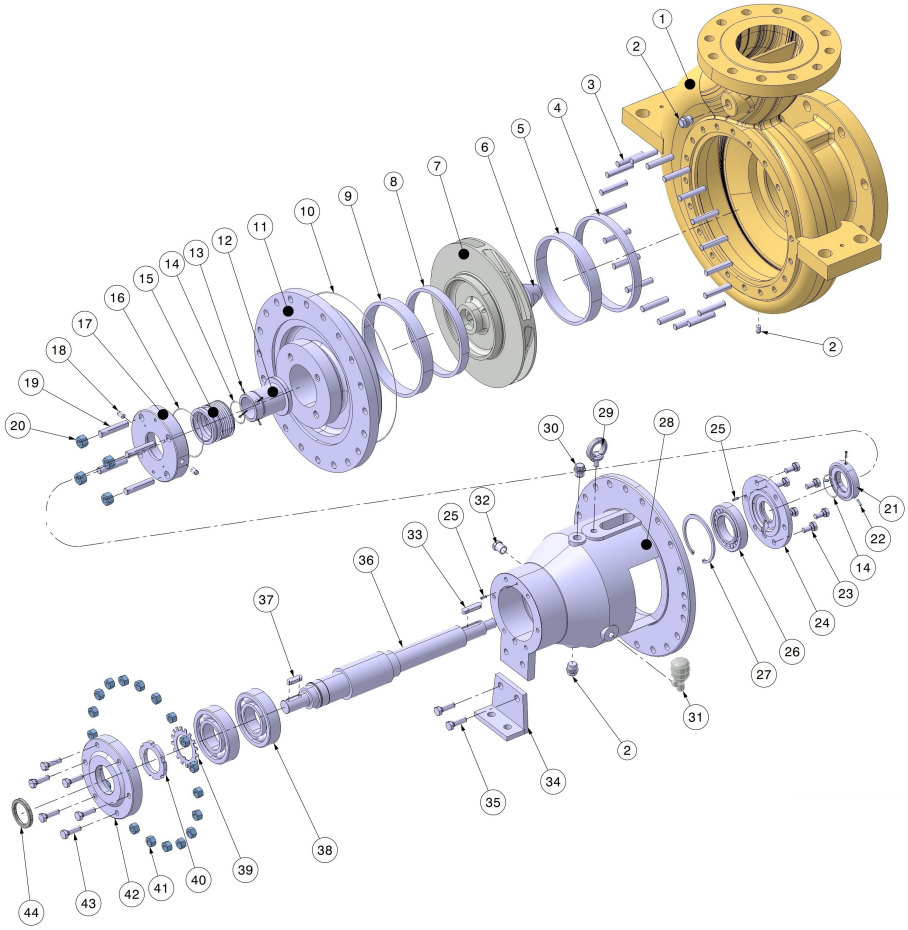
6.2.3 Disconnect all auxiliary pipes and tubes where applicable.

6.2.4 Remove coupling guards and disconnect coupling.6.2.5 if oil lubricated frame, drain oil removing magnetic drain plug and washer (fig 8-2 items 5 and 4).

6.2.5 If oil lubricated frame, drain oil by removing magnetic drain plug and washer.

NOTE

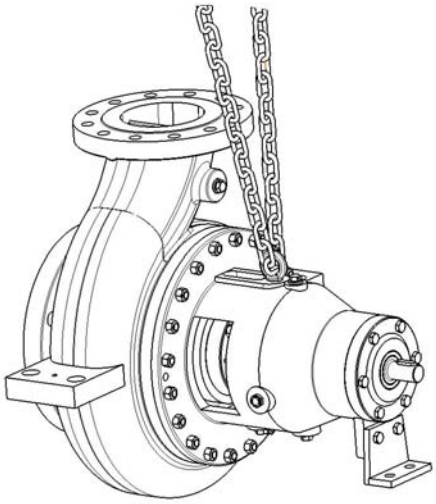
Oil analysis can help determine the cause of bearing failure. Keep oil if bearing failure is suspected



| Item | Part Name | Part No. | Qty. | Material | Description |
|---|---|---|---|---|---|
| 44 | Radial Shaft Seal | 37 | 1 | SKF(HMS5-RG) | Φ68xΦ50x8 |
| 43 | Bolt (Bearing Housing) | 53.01 | 6 | St.(Hardened) | M12x40 |
| 42 | Bearing Cover (Ball Bearing) | 09.01 | 1 | GG 25 | |
| 41 | Nut (Casing) | 54.03 | 1 | St. | M14 |
| 40 | Lock Nut | 54.01 | 1 | St. | KM12 |
| 39 | Lock Washer | 56 | 1 | St. | MB12 |
| 38 | Bearing (Angular Contact) | 08.01 | 2 | SKF | 7312 B |
| 37 | Key (Coupling) | 52.01 | 1 | AISI 304 | 40x12x8 |
| 36 | Shaft | 06 | 1 | A 276 | Gr 420 |
| 35 | Bolt (Bearing Housing Bracket) | 53.02 | 2 | St.(Hardened) | M16x50 |
| 34 | Bearing Housing Bracket | 09 | 1 | St. | |
| 33 | Key (Impeller) | 52.03 | 1 | AISI 420 | 46x12x8 |
| 32 | Oil Level Indicator | 62 | 1 | | G 1/2 |
| 31 | Sight Glass | 63 | 1 | | G 3/8 |
| 30 | Plug(Oil Fill) | 57.01 | 1 | | G 1/2 |
| 29 | Eye Bolt | 53.03 | 1 | | M16 |
| 28 | Bearing Housing | 09 | 1 | GG 25 | |
| 27 | Circlip | 52.02 | 1 | Standard | D110x4 |
| 26 | Bearing (Roller type) | 08.02 | 1 | SKF | NU212 |
| 25 | Pin (Bearing Cover) | 51 | 2 | St. | Φ5.5x12 |
| 24 | Bearing Cover(Pump Side) | 09.02 | 1 | Ck 45 | |
| 23 | Bolt (Bearing Cover) | 53.04 | 6 | St.(Hardened) | M12x25/Gr 8.8 |
| 22 | Socket Screw (Deflector) | 53.05 | 3 | St.(Hardened) | M5x15/Gr 8.8 |
| 21 | Deflector | 16 | 1 | Ck 45 | |
| 20 | Nut (Gland) | 54.02 | 4 | AISI 304 | M16 |
| 19 | Screw (Gland) | 53.06 | 4 | AISI 304 | M16 |
| 18 | Plug (Gland) | 53.08 | 2 | AISI 316 | 3/8-NPT |
| 17 | Gland | 14 | 1 | AISI 316 | |
| 16 | O-Ring (Gland) | 34.02 | 1 | NBR | Φ2-ID110 |
| 15 | Mechanical Seal Package | 12 | 1set | | Burgman MG1-G60 EN12756(Φ65) |
| 14 | O-Ring (Sleeve) | 34.03 | 2 | NBR | Φ2-ID50 |
| 13 | Socket Screw(Shaft Sleeve) | 53.09 | 4 | AISI 304 | M8x6 |
| 12 | Shaft Sleeve | 07 | 1 | AISI 316 | |
| 11 | Casing Cover | 01.01 | 1 | A 216 | Gr WCB |
| 10 | O-Ring (Casing) | 34.04 | 1 | NBR | Φ2.5-ID343 |
| 9 | Wear Ring (Rear-Casing Cover) | 33.01 | 1 | AISI 420 | Hardened |
| 8 | Wear Ring(Rear-Impeller) | 33.04 | 1 | AISI 420 | Hardened |
| 7 | Impeller | 02 | 1 | AISI 304 | A351(Gr CF3) |
| 6 | Cap Nut (Impeller) | 54.04 | 1 | AISI 304 | |
| 5 | Wear Ring(Front-Impeller) | 33.04 | 1 | AISI 420 | Hardened |
| 4 | Wear Ring (Front-Casing Cover) | 33.03 | 1 | AISI 420 | Hardened |
| 3 | Screw (Casing) | 53.07 | 20 | St.(Hardened) | M14x55 |
| 2 | Plug (Casing Vent) | 57.03 | 3 | St. | G 1/2 |
| 1 | Casing | 01.02 | 1 | A 216 | Gr WCB |

Fig 6-8

6.2.3 Place hoist sling through bearing housing window.



6.2.4 Remove casing hex screws.

6.2.5 Remove back pullout bearing housing with impeller assembly from pump casing. Even tightening of the jacking screw will assist this.

6.2.6 Remove pump casing gasket and discard. A replacement gasket will be required for assembly. Clean gasket-mating surface.

6.2.7 Secure the back pullout assembly on a clean workbench.

IMPELLER REMOVAL

WARNING…

NEVER APPLY HEAT TO REMOVE IMPELLER. TRAPPED OIL OR LUBRICANT MAY CAUSE AN EXPLOSION.

SEAL HOUSING AND SEAL REMOVAL

6.3 The Petrorahanpump pump is available with a complete range of quality mechanical seals and primary sealing technologies.The seal manufacture's instruction should be followed for dismantling and assembly, but the following guidance should assist most seal types.

6.4 To remove the seal housing and seals proceed as follows:

6.4.1 Remove the seal housing hex screws and seal cover screws (if separate seal cover fitted), to loosen the seal housing and slide the seal cover away.
6.4.2 Mark the position of the mechanical seals on the shaft then loosen the grub screws (for most mechanical seal).
6.4.3 Carefully pull off the seal housing/cover and mechanical seal rotating element/elements where fitted.

NOTES

(1) On non-cartridge seals the stationary seat remains in the seal housing /cover with its sealing member. Remove it only if it is to be replaced.

6.4.4 Remove shaft sleeve, if used on non-cartridge seals.

BEARING HOUSING DISMANTLING

6.5 To dismantle the bearing housing
Proceed as follows:

6.5.1 Pull off the pump half of coupling and remove coupling key.

6.5.2 Remove support foot by unscrewing hex screws.

6.5.3 Remove the pump side liquid flinger and/or labyrinth seals rotary half (depending on option fitted).

6.5.4 Remove bearing carrier hex screws and back off the hex nuts. Tighten bearing carrier hex screws evenly to initiate bearing carrier release.

6.5.5 Remove shaft assembly from the bearing housing by pulling it towards the coupling end.

6.5.6 Remove inner circlip, or locking ring if duplex bearing fitted.

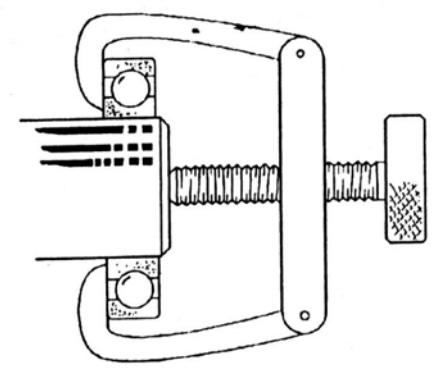
NOTE

Locking ring has a left-hand thread.

6.5.7 Remove drive side liquid flinger and/or labyrinth seal rotary half (depending on option fitted). Remove bearing carrier O-ring and bearing carrier.

NOTE

6.5.8 When pressing bearing off the shaft, use force on the inner race only. Do not re-use bearings removed but keep for inspection.



6.5.9 Remove pump side bearing.

6.5.10 Release the self locking drive side bearing not (6) and remove drive side bearing.

EXAMINTION

ADVICE

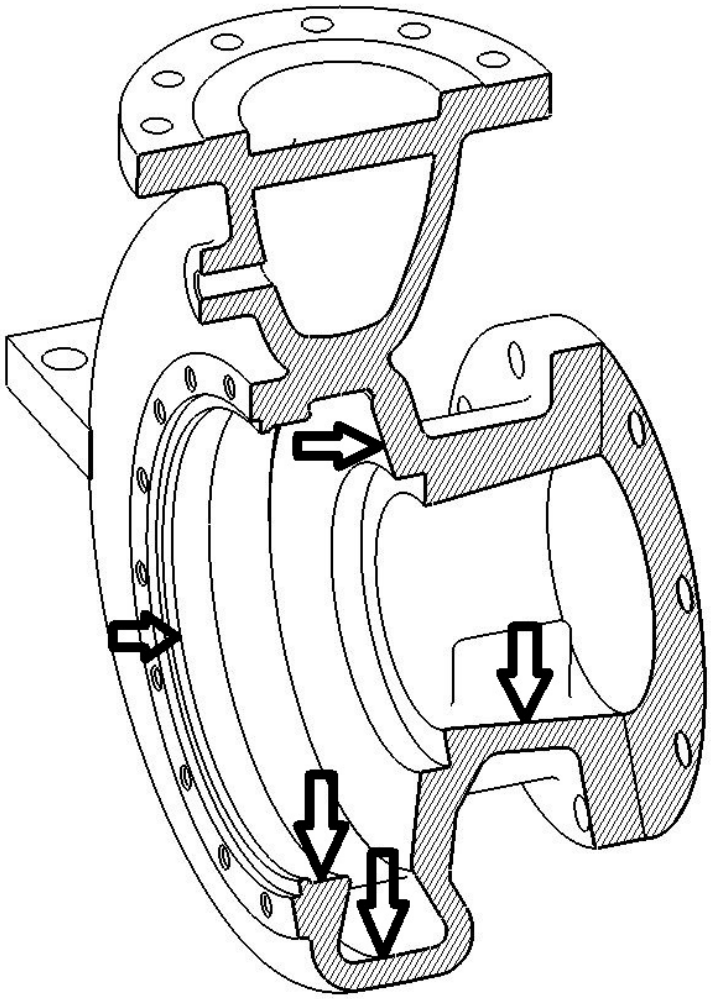
WHERE COMPLETE OVERHAUL OR CHANGE IN DUTY RATING IS DONE BY OUR SPECIALISED PERSONNEL.

GENERAL

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

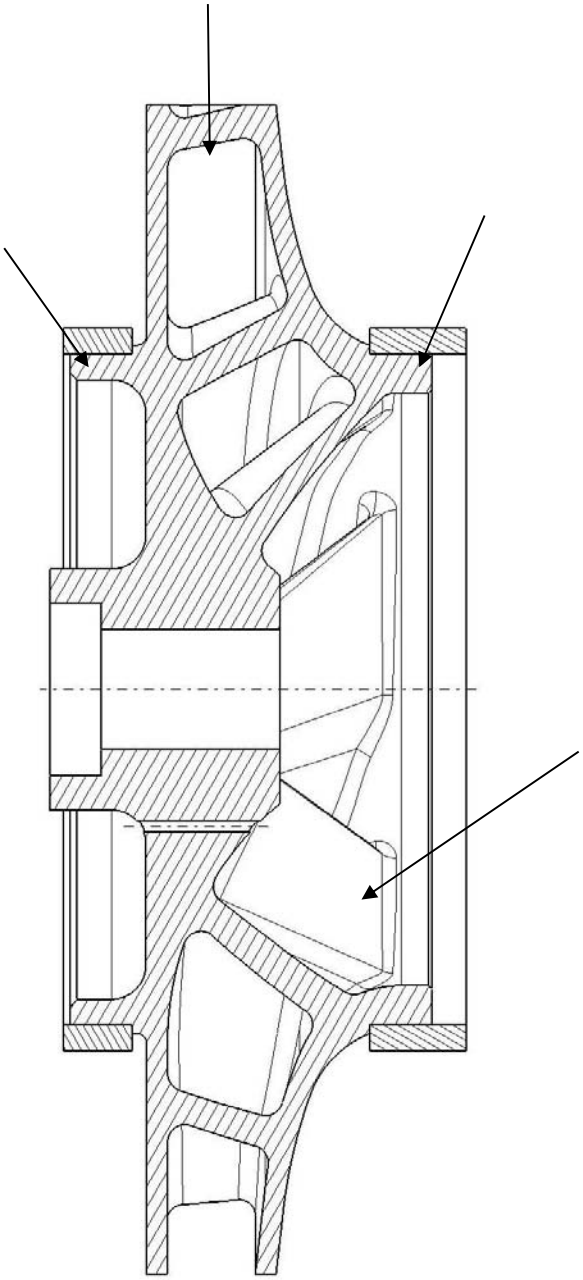
CASING AND SEAL HOUSING

6.7 Inspect for excessive wear or pitting and replace if greater than 3 mm. Inspect for any sealing surface irregularities.



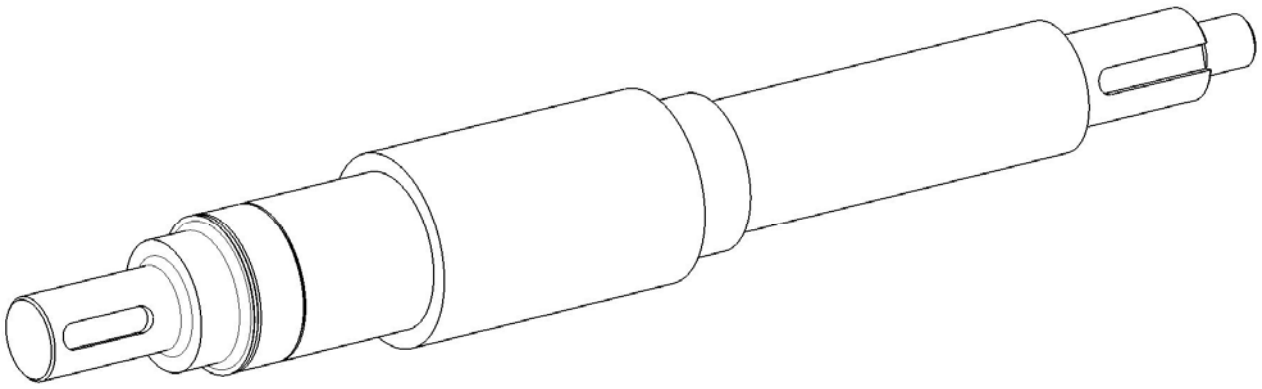
IMPELLER

6.8 Inspect vanes A for damage and replace impeller if grooved deeper than 1.5 mm or worn evenly more than 0.8 mm. Inspect pump out vanes B and replace impeller if worn more than 0.8 mm. Inspect leading and trailing edges C and replace impeller if corrosion, erosion or damage found.



SHAFT AND SLEEVE

6.9 Inspect shaft and sleeve for grooves or pitting and replace if found. Check shaft run outs are within 0.025 mm at the coupling end and 0.050 mm at the sleeve end.



GASKETS AND O-RINGS

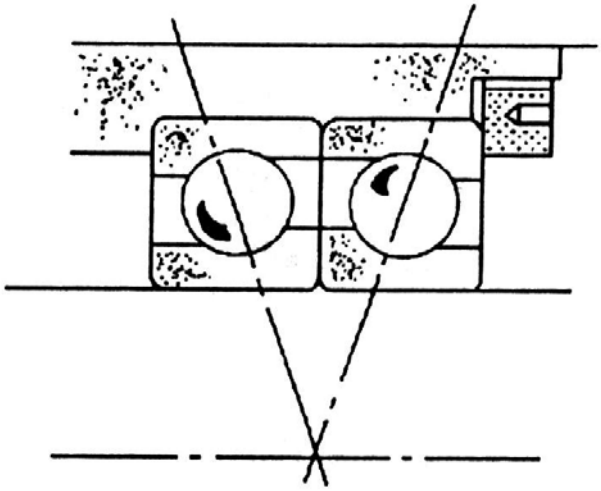
After dismantling, discard and replace gaskets and O-ring. New gaskets and O-rings should be of at least the same quality and thickness as the original to compress to the same standard.

BEARING AND BEARING ISOLATORS OR LIP SEALS

6.10 The oil, bearing and bearing isolators or lip seals are to be inspected for contamination and damage. If oil bath lubrication is utilized, these provide useful information on operating condition within the bearing housing. If bearing damage is not due to normal wear and the lubricant contains adverse contaminants, the cause should be corrected before the pump is returned to service. DO NOT RE-USE BEARINGS.

6.11 Due to the limited life of lip seals compared to the labyrinth seal option, lip seals should be replaced with new precision, double lip seals or retrofitted with COX labyrinth seals. Lip seals, like mechanical seals are not totally leak free devices when rotating. In mechanical seals the external emission is usually in from of vapor and is not visible. Oil from a bearing housing does not evaporate and may cause oil staining adjacent to the pump bearing.

BEARING HOUSING AND CARRIER



6.12 Inspect the bearing cartridge cirlip groove, ensure it is free from damage and that housing lubrication passages are clear replace grease nipples or the filter bearther (where fitted) if damage or clogged. On oil lubricated version, the oil level slight glass should be replaced if oil stained.

## ASSEMBLY

GANARAL

6.13 To assemble the Petrorahanpumppumps consult the exploded-view drawings in section 8 and note the following specific considerations. Numbers in parenthesed refer to item numbers detailed in section 8, fig 8-1 unless otherwise stated.

NOTE

Ensure threads, gasket and O-ring mating faces are clean. Apply thread sealant to Non-face sealing pipe thread fitting, e.g. constant level oiler utilized.

BEARING HOUSING AND ROTATING

ELEMENT ASSEMLY

6.14 Clean the inside of the bearing housing, bearing carrier and bores for bearings.

6.15 Attach bearing housing support foot using hex screws.

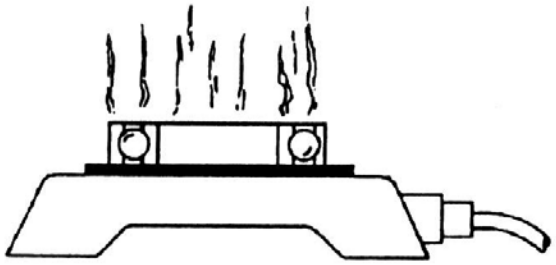
6.16 Press drive sides bearing on to shaft (the bearing inner races are an interference fit on to the shaft) if optional duplex bearings are to be fitted, these must be mounted back-to-back, as shown below.

NOTES

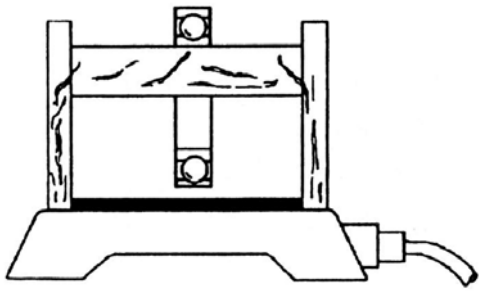
(1) The double row thrust bearing will not normally have a single filling slot, as such bearings are limited to taking thrust in only one direction. If such a bearing replacement is used. It must be positioned on the shaft so that the bearing-filling slot faces the impeller end of the shaft.

(2) One of the following methods is recommended for fitting the bearings onto the shaft.

6.17 Method 1: Use a hotplate, hot bath, oven or induction heater to heat the bearing race to expand it so it can easily be placed in position then allowed to shrink and grip the shaft.



6.18 Induction heating demagnetizes the bearing. It is important that the temperature is not raised above 100deg C.



6.19 Method 2: press the bearing onto the shaft using equipment that can provide a steady, even load to the inner race. Care is to be taken to avoid damage to the bearing and shaft.