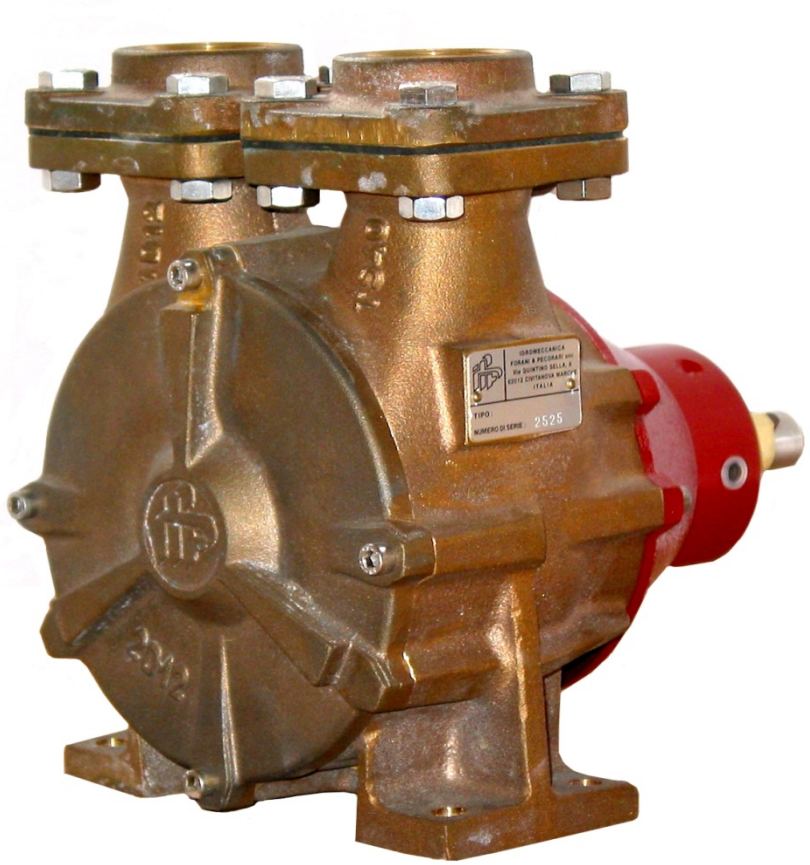
Installation, Operating & Maintenance Instructions for

FP

TS SERIES REGENERATIVE PUMPS

PLEASE READ THESE INSTRUCTIONS CAREFULLY



Failure to observe the recommended procedures may result in damage to equipment and personal injury, and may also invalidate the supplier's warranty

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Let's Solve Water

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1. Checking your FP pump on delivery

Your FP pump left our works in perfect condition. We wish to ensure that it reaches you in the same condition, and that it provides you with long and trouble-free service. **On receiving your FP pump,** please make the following preliminary checks:

a. Check that the pump model number conforms to your order

b. TS-series pumps are normally built to rotate clockwise, viewed from the drive (shaft) end. If you have specified opposite rotation, check that this is stated on the delivery paperwork.

c. Check that the details on the plate of the electric motor correspond to your power supply (volts/number of phases/HZ).

d. Check that no damage has occurred in transit. Check for loose nuts/bolts and for missing parts. Did you order any accessories or spare parts? Are they all there?

e. Check electrically driven base plate-mounted units visually for alignment of motor and pump, and turn the pump over by hand. Removing the fan cover from the motor and turning the motor fan can do this. The pump should rotate freely. Stiffness or uneven movement should be investigated.

REPORT IMMEDIATELY TO THE SUPPLIER ANY DAMAGE, OR MISSING OR INCORRECT PARTS. DELAY IN NOTIFICATION MAY CAUSE PROBLEMS IN DEALING WITH CLAIMS UNDER WARRANTY

2. Principle of operation of a regenerative pump

Regenerative pumps (also known as 'side channel', 'liquid ring', or sometimes as 'turbine' pumps) use a rapidly rotating multi-vane impeller to create a rotating ring of water. Designs differ in detail: the one shown here is typical.

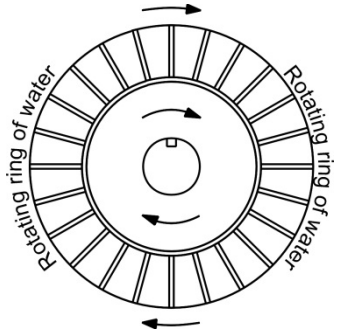


Figure 1

The impeller passes through a close fitting baffle that interrupts the rotating ring of water. Low pressure develops where the impeller emerges from the baffle, and water is drawn in through the inlet port.

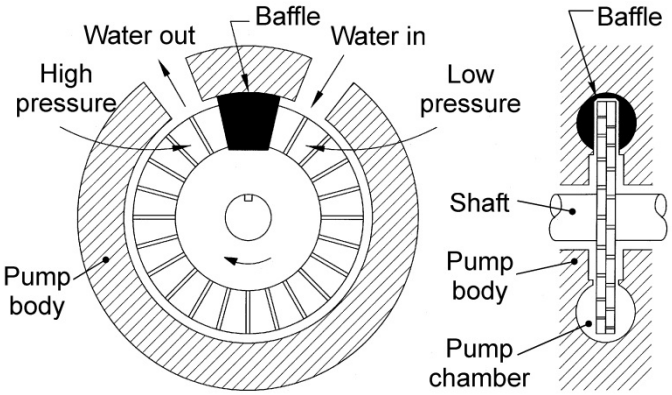


Figure 2

As the impeller rotates, it creates turbulance in the water, forcing it to follow the motion of the impeller. As the impeller re-enters the baffle, high pressure develops and the water is forced out of the discharge port.

Regenerative pumps can develop high heads at relatively low rotating speeds. Unlike centrifugal pumps, they can handle considerable amounts of entrained air without losing their prime. Some regenerative pump designs are capable of substantial self-priming lifts.

As the discharge is restricted and the flow decreases, the developed pressure increases and more power is absorbed. (A centrifugal pump behaves in the opposite way: absorbed power decreases as flow decreases and pressure rises).

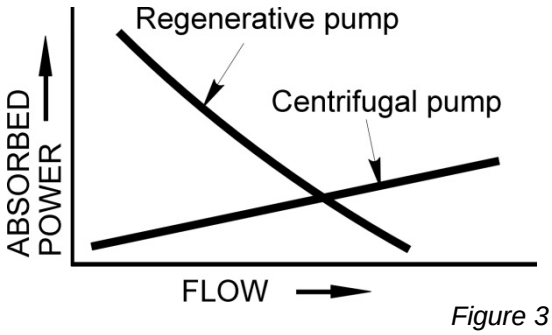


Figure 3

Regulating the rate of flow.

The rate of flow may be varied by means of a valve in the **discharge** line. Never throttle the inlet line. The recommended maximum and minimum flow rates are indicated by the ends of the performance curve published by the manufacturer.

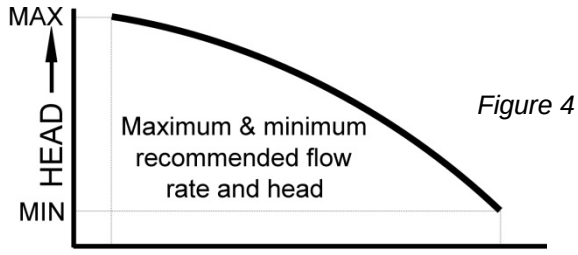


Figure 4

A ..... must be maintained if the flow rate is reduced for an extended period to zero, or near zero, the liquid in the pump casing will heat up, and the pump will eventually suffer damage.

The maximum recommended flow rate should not be exceeded, or the pressure in the inlet may fall to the point where cavitation occurs, leading to loss of efficiency, vibration, noise, and eventual damage.

If flow rate cannot be measured directly, it can be estimated from pressure readings taken at the pump inlet and discharge ports. If necessary, fit pressure gauges for this purpose. The difference in pressure readings when the pump is running can be converted into a figure for total head:

1 bar differential pressure = 14.6lb/sq.in
= 1 kg/cm^2
which is equivalent to a total head of
10.2 metres of fresh water, *or*
9.9 metres of seawater

The 'total head' may be estimated without pressure measurements. It consists of the static lift (i.e. vertical distance between water levels at source and discharge), with an additional head allowance for pressure loss due to pipe friction, including extra losses due to bends & fittings in the pipe work.

The total head figure you arrive at should lie between the maximum and minimum recommended head values indicated at the top (left) and bottom (right) ends of the performance curve, shown in schematic form in *figure 4.* A figure for the flow rate at the measured or calculated head may then be read from the performance graph.

If you are in any doubt about the head or pressure generated by FP pumps, or about the head or pressure they require to operate satisfactorily, please consult your pump supplier.

3. FP bronze regenerative pumps: scope of use

FP pumps are intended for use with sea or fresh water at normal ambient temperatures.

Specific gravity

The power absorbed by the pump at a given speed of rotation is directly proportional to the specific gravity of the liquid. The manufacturer's performance curves relate to fresh water (SG = 1.0). No correction is normally necessary for seawater (SG = 1.04).

Corrosion

FP regenerative pumps are built with wetted parts in bronze for resistance to seawater corrosion. They are not suitable for handling acids, alkalis or other chemicals. Check with your pump supplier before using an FP pump to handle any liquid other than fresh water or sea water.

Abrasion

With clean water running through them, FP regenerative pumps will give long service with very little attention. Solid materials such as sand or silt in suspension will accelerate wear on the working surfaces of the pump, which depend on close tolerances, and on the mechanical shaft seal, which may need to be replaced at intervals. The pump casing and the impeller will also be worn by the continual passage of abrasive particles, and may eventually need to be replaced. Substantial amounts of solid material in suspension will cause rapid wear and may clog the internal passages of the pump.

To minimise wear, flush the pump out thoroughly with clean fresh water when it is not in use.

Precautions against freezing

If the pump is to be shut down for an extended period, first flush it out thoroughly with clean water. Then drain the pipework and pump casing, to avoid any risk of damage from freezing in cold weather. Drain the pipework from its lowest point , to ensure that there are no remaining pockets of liquid.

WARNING

FP REGENERATIVE PUMPS ARE SUITABLE FOR PUMPING FRESH WATER OR SEAWATER.

THESE PUMPS ARE NOT INTENDED FOR USE WITH PETROL, BENZINE, GASOLINE OR OTHER LIGHT FRACTION PETROLEUM FUELS OR SOLVENTS, AND THEY MUST NOT BE USED FOR THIS PURPOSE

4. Installing your FP pump

a Locate the pump on a firm horizontal base, close to the liquid source. Fasten the pump securely to the base.

Electrically driven pumps must be installed in a well-ventilated space, to ensure an adequate flow of air around the motor. Ensure that there is adequate access, so that maintenance work can be performed without difficulty.

Alignment of long-coupled units: see page 10.

A qualified electrician should carry out all electrical installation work.

TS-series regenerative pumps may be installed with suction lift up to 4 metres. Suction lift is the vertical distance from the level of the water source to the centre line of the pump inlet port. Do not exceed this recommended maximum suction lift; if a higher suction lift is required, contact your pump supplier.

Bilge pumps must be located well above the anticipated maximum bilge water level

PUMP SPEED IS CRITICAL TO SELF-PRIMING PERFORMANCE – SEE PUMP DATA SHEET FOR INFORMATION ON SPEED/PRIMING TIME. A PUMP SPEED OF 1000 RPM IS THE MINIMUM REQUIRED FOR SATISFACTORY SELF-PRIMING.

b The inlet line should be as short as possible, with a bore at least as large as the nominal bore of the pump inlet port. Use rigid or reinforced pipe that will not deform or collapse under suction conditions.

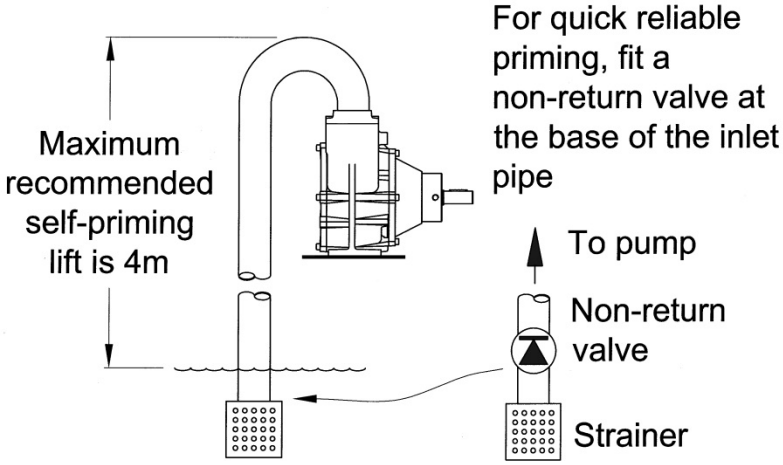


Figure 5

c Fit an **inlet strainer** if there is any risk of solid material entering the pump. The strainer should be of a suitable material, with approx. 2mm mesh size, and with an open area at least 2.5 times the cross-sectional area of the inlet pipework. The strainer should be inspected and cleaned regularly.

d The discharge line should preferably be of the same bore as the pump discharge port. If a smaller diameter discharge line is used, flow will be reduced. If the discharge pipe run is long, increase the pipe bore to minimise friction losses. Seek advice from your pump supplier if necessary.

e Align rigid pipework accurately with the pump ports, to ensure that the pump head is not distorted or damaged.

f For ease of maintenance, fit full bore isolating valves (e.g. ball valves) on either side of the pump.

g With electrically driven units, the use of a proper electrical starter is strongly advised. A starter will:

- ✦ provide a safe, waterproof switch enclosure, e.g. to IP55 'hose protected' specification.
- ✦ prevent accidental restarts after power failure.
- ✦ protect the motor with a correctly set thermal overload cut-out; a fuse protects only the wiring.
- ✦ withstand the heavy starting current of the motor, preventing arcing and rapid contact wear.

Ask your pump supplier for details of a suitable electrical starter for your FP pump.

SEA COCKS MUST BE FITTED FOR SAFETY IN INLET & DISCHARGE PIPEWORK PASSING THROUGH THE HULL OF THE VESSEL

5. Starting the pump

a Fill the pump body with water. Check carefully for leaks in the inlet pipework: air leaks may prevent the pump from priming.

b With electrically driven versions, start the motor briefly to check that the pump is rotating in the correct direction. (See para1b)

To alter the direction of rotation of a 3-phase motor, reverse any 2 power connections in the terminal box. For a single-phase motor, reverse the polarity of the start winding in relation to the main winding. If in doubt, obtain the help of a qualified electrician.

c Open the inlet and discharge valves fully. Start the motor. Allow an interval for the pump to prime itself. The time required for self-priming increases with the height of suction lift. With a high suction lift, the pump may take a minute or two to exhaust the air from the inlet line and prime itself. Once the pump has primed, the discharge valve may be adjusted to obtain the required flow.
If the flow is poor or non-existent, check carefully for air-leaks in the inlet pipework, adequate water supply, correct direction of rotation of the motor, and possible obstructions in the inlet and discharge pipework. Check that the discharge valve is open: if the pump cannot displace air through the discharge pipework it will be unable to prime itself.

d The flow may be regulated by throttling the discharge line. Do not close the discharge valve completely while the pump is running. Some flow must be permitted to prevent heating of the water in the pump casing.

ESSENTIAL PRECAUTIONS

- **DO NOT RUN THE PUMP DRY**

  Shaft seal damage is likely to result from a lack of liquid in the pump casing. Protection against dry running of electrically driven pumps can be provided in the form of level switches, probes, or electronic motor-load detectors. Ask the advice of your pump supplier if necessary.

- **DO NOT PUMP WATER CONTAINING SUBSTANTIAL AMOUNTS OF SOLID MATERIAL IN SUSPENSION**

  Your FP pump is designed to handle clean water, although small quantities of fine suspended solids can be passed without difficulty. Abrasive solids will accelerate wear, leading to decreased performance, seal leaks and eventual failure.

  Fit an inlet strainer to protect the pump against the entry of large solid objects.

- **NEVER RESTRICT THE INLET TO THE PUMP WHILE IT IS RUNNING**

  This will lead to low inlet pressure, causing loss of efficiency, cavitation, vibration, noisy running and eventual damage to pump and bearings.

- **IF THE PUMP IS TO BE SHUT DOWN FOR AN EXTENDED PERIOD**

  Drain the pipework and casing, to eliminate any risk of freezing in cold weather. If necessary, flush the pump through with clean water first, to prevent build-up of deposits on internal surfaces.

- **TO AVOID THE EXPENSE AND INCONVENIENCE OF A PROLONGED SHUTDOWN…**

  Keep a spare shaft seal. If the pump is part of an essential process, and extended down-time cannot be tolerated, consider keeping a reserve pump unit on standby. Your pump supplier will do his best to respond promptly, but you can avoid the need for emergency despatches by keeping essential spare parts to hand.

Maintenance

Check regularly that the pump runs smoothly, delivers the required water flow and pressure, and does not leak. Investigate leaks, noisy running, vibration or inadequate flow or pressure without delay, to minimise the risk of pump damage or failure.

A comprehensive repair service is available if required: ask your pump supplier for details.

6.1 Manual Clutch - Models TS40 (1½"), TS50 (2"), TS65 (2½")
Fitting & maintenance - refer to diagram and Parts List

a Remove plastic plugs from tapped holes at left & right of bearing housing end.

b Fit clutch collar over bearing housing end with tapped holes uppermost

c Fit guide pivots through collar slots into tapped holes in bearing housing and tighten down firmly. Grease guide pivots to ensure smooth running in collar slots.

d Place heavy washer (thrust plate) over shaft end into recess in clutch collar.

e Ensure shaft key is in position. Grease shaft. Push pulley and bearing assembly on to shaft and tap home with a mallet

NOTE: Clutch cone bore to face outwards.

f Grease the 3 stainless steel rods with heavy graphited grease. Insert the rods into the 3 holes on the clutch boss.

Ordinary bearing grease is unsuitable: Use e.g.

Esso Cazar K2, Molykote BR2

g Line up twin keys on boss with key ways in clutch cone and push cone on.

h Place spring and spring cover over clutch cone boss, and insert spacer through spring cover. Compress spring and fit lock washer & bolt.

i Tighten down firmly.

j Grease stainless steel ball and drop into tapped boss in clutch collar. Grease spring and drop above ball. Screw clutch lever into tapped boss until a satisfactory operating position is reached. Tighten lever lock nut.

NOTE: Ball will drop into detent position on bearing housing front when lever is screwed in to correct depth.

IMPORTANT NOTE

THE CLUTCH IS SELF-ADJUSTING AND REQUIRES LITTLE MAINTENANCE ITSELF. BUT IT HAS TO BE REMOVED BEFORE SOME PUMP MAINTENANCE OPERATIONS CAN TAKE PLACE. THE CLUTCH WILL BE EASIER TO TAKE APART IF IT IS REMOVED AND DISMANTLED AT INTERVALS OF ABOUT 1500 HOURS RUNNING TIME, AND RE-FITTED WITH LIGHT GREASING WHERE INDICATED ABOVE.

Dismantling the clutch

a Remove the clutch securing bolt from the end of the shaft.

b Withdraw the spacer, cover & spring

c Withdraw the clutch cone. Inspect it for wear on the outer surface of the cone and on its mating surface inside the pulley.

CAUTION

THE CLUTCH SPRING WILL STILL BE UNDER HEAVY COMPRESSION WHEN THE BOLT THREADS BECOME DISENGAGED. RETAIN THE SPRING COVER SECURELY WHILE REMOVING THE BOLT

d Check for play in the pulley bearing by rotating/manipulating the pulley.

e Remove and clean the 3 stainless steel rods.

f Remove the pulley and bearing assembly from the shaft, and take out the circlips. Press out and inspect the bearing.

g Inspect the thrust washer for wear.

Reassembling the clutch

Follow the fitting instructions above

6.2 Dismantling the pump – refer to diagram and parts list

TO REPLACE THE SHAFT SEAL, IMPELLER OR BEARINGS, OR FOR OTHER INSPECTION AND MAINTENANCE WORK, FOLLOW THESE INSTRUCTIONS CAREFULLY TO ENSURE THAT YOUR FP-SERIES PUMP IS REPAIRED SAFELY AND WITHOUT DAMAGE. NOTE THE POSITION OF EACH PART AS IT IS REMOVED, TO ENSURE THAT RE-ASSEMBLY IS STRAIGHTFORWARD.

a Before starting work on your FP pump, isolate the electric motor from the power supply, and close the inlet and discharge valves fully. If the pump takes in sea water –

CLOSE THE INLET SEA COCK

Open the drain port in the pump casing.

b The pump casing must be separated from the rest of the installation before any further work can be done. This achieved by removing the pump casing bolts (normally 6) – see parts list and diagram.

If the pump is a long-coupled unit, with an oil-filled bearing housing, the oil should be drained now.
If preferred, the pump body may be left in place with the pipework attached.

c **Long-coupled units.** Remove the coupling guard. Release the mounting bolts securing the motor. Withdraw the motor together with the back half of the coupling. Release the mounting bolts securing the bearing housing of the pump. Withdraw the bearing housing, together with the impeller, from the pump body.

Close-coupled units. Release the mounting bolts securing the motor. Withdraw the motor, together with the impeller, from the body.

d To remove impeller – remove outer cover plate. Remove and check O-ring seal. Withdraw the front 'side plate', noting that it must be replaced in the same location (i.e. make sure you do not replace it with the rear 'side plate').

Hold the drive end of the shaft and remove the impeller nut. (To grip the shaft end of a close-coupled electric motor-pump unit, remove the motor fan cover and fan). Withdraw the impeller. If necessary use a puller, engaging it in the metric threaded holes. Make sure you do not lose the shaft key.

Withdraw the rear 'side-plate' (once again, make sure you replace it the same location). Check that the faces of the impeller and the matching side plates are not worn or damaged. Check the condition of the shaft and keyway.

(Models TS50 and TS65/18 – withdraw bronze spacer ring).

Carefully withdraw the rotating half of the mechanical seal from the shaft. Inspect the carbon face for wear or cracks. Pull the stationary half of the seal from its housing. Check the condition of the polished face and the rubber holding cup.

e To evaluate the condition of the bearings, rotate the shaft by hand. Check for lateral or axial play and for rough or uneven movement

f To remove the shaft and bearing assembly, first remove the retaining clip at one end of the bearing housing, then press the shaft and bearing assembly through the same end of the bearing housing.

g To remove the bearings, press each in turn off the shaft (each moves towards its respective shaft end).Note the position of the bearing shields and the slinger.

6.3 Reassembling the pump – refer to diagram and parts list

Follow the dismantling instructions carefully in reverse order. Note carefully the following points particularly:

a Press the bearings fully home to the shoulders on the shaft.

b Ensure that one bearing shield and circlip is correctly located in the bearing housing, before pushing in the shaft & bearing assembly. Push the shaft fully home, then replace the other bearing shield and circlip.

c Using grease sparingly, fit the stationary half of the mechanical shaft seal (ceramic ring and cup rubber) into the seal housing. Ensure that the polished ceramic face of the seal faces the impeller.

d Fit the rotating half of the mechanical seal over the shaft, with the carbon ring facing the ceramic ring of the stationary half. (Models TS50 and TS65/18 – replace bronze spacer ring)

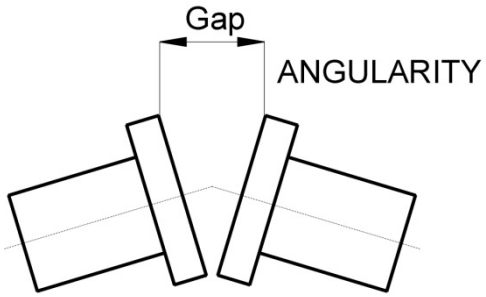
e With **long-coupled units**, carefully align the pump and motor while uniting both sides of the coupling, and before securing the motor and bearing housing bolts. See page 10.

f If the bearing housing is oil-lubricated refill with the correct lubricant. Use 10W40 multigrade of good quality **(e.g. Shell, Esso, or Castrol).**

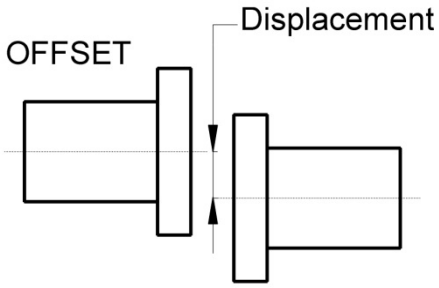
ALIGNMENT of long-coupled motor-pump units

Long-coupled pumps have been pre-aligned with the motor prior to shipment. If pump units receive rough treatment during shipment, they can become mis-aligned. The flexible coupling is not designed to compensate for mis-alignment. Improper alignment will cause vibration and premature bearing failure.

CHECK THE ALIGNMENT OF PUMP AND MOTOR BEFORE START-UP.



Check the angularity of the coupling faces



Check the angularity of the coupling faces

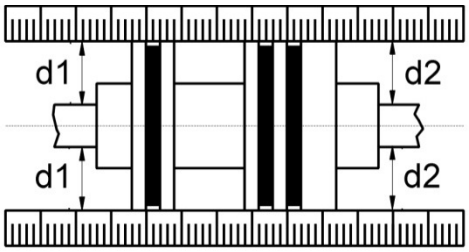
A final alignment check should be made after the baseplate has been grouted and set, and the foundation bolts have been tightened.

Couplings should be aligned within the following limits

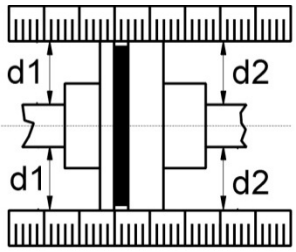
COUPLING TYPE	OFFSET	ANGULARITY
	Displacement	Gap
Short flexible coupling (3000 rpm)	0.05mm	0.04mm per 100mm coupling dia
Flexible spacer coupling (3000	0.07 per 100mm spacer length	0.04mm per 100mm coupling dia

Methods of checking alignment

Straight edge
Using a straight edge, check the distance from the shaft at several points on the circumference of the coupling. The distances **d1** and **d2** should each remain constant.



SPACER COUPLING



SHORT COUPLING

IMPORTANT NOTE
The straight edge method checks static coupling alignment, not shaft alignment. It relies for its accuracy on the accurate alignment of each coupling half on its shaft. The straight edge method is a useful preliminary check, but should not be seen as an effective final alignment method.

Dial gauge ("clocking")
There are several methods, using one or two dial gauges. The most accurate is the reverse indicator method, using two gauges, which overcomes errors due to `sag' of the gauge bars.

Optical methods
Several proprietary systems are available, such as the `OPTALIGN' system (INA Linear Systems). Mechanical errors are eliminated by optical alignment techniques. On request, your pump supplier can provide further information about suitable alignment methods, including allowances for THERMAL EXPANSION in high temperature duties.

7. Trouble shooting

Problem	Possible cause	Action
● Motor fails to start when switched on	● Loose wiring ● Blown fuse ● No power in pump circuit ● Overload cut-out has tripped	● Check wiring ● Check cause, replace fuse ● Check supply ● Check cause, reset
● Motor hums but does not run. Overload trips out	● Pump jammed ● Start winding or capacitor failure in single-phase motor	● Disconnect power, turn pump by hand, investigate cause ● Check motor
● Motor runs, but no water flows	● No water in pump ● Pump has lost prime ● Air leak in inlet line ● No water supply ● Inlet or discharge line blocked ● Inlet or discharge valve closed	● Fill the pump with water Check drain plug ● Investigate cause: re-prime ● Check inlet line, port connections, drain plug & priming port ● Check water supply ● Check pipework ● Check valves
● Motor runs too hot to touch; smell of burning	● Motor overloading and not properly protected	● Check cause of overload; check thermal cut-out setting, check condition of motor
● Insufficient flow or pressure	● Discharge head too high ● Insufficient pump speed (engine-driven units) ● Pump running in reverse direction ● Inlet or discharge blockage	● Review installation, fit larger pump if necessary ● Adjust pulley ratios ● Check direction of rotation ● Check pipework, strainers

8. Warranty

We warrant that all new equipment sold by us is free from defects in material or workmanship. Our liability under this warranty is limited to making good any part or parts which shall within one year from the date when the equipment was delivered new to the purchaser be returned to us and which we are satisfied on our examination to have been defective in material or workmanship. Included in this warranty are the costs of labour incurred by us in making good any such part or parts.

This warranty is given on condition that:

i. we are notified in writing within fourteen days after such defects appear and the equipment or defective parts are returned to us as soon as reasonably practical or where this is not practical made available for inspection by us

ii. the equipment has in our judgement been correctly installed and normally used in accordance with the instructions provided for its installation and maintenance

iii. unless performance figures and performance tolerances have been stipulated by the purchaser and agreed by us at the time of ordering the equipment we shall be under no liability in the absence of any defect in material or workmanship for failure to obtain any particular performance

iv. if the equipment has in our judgement been altered taken apart repaired tampered with neglected damaged or used in any way so as adversely to affect its performance or condition we shall not be liable for any fault arising from its use

v. we shall not be liable for faults arising from the use of any spare or replacement parts not authorised or recommended by us

vi. any equipment or defective part replaced by us shall become our property

vii. the decision whether to repair or replace a defective part under warranty claim shall be at our discretion

viii. excluded from this warranty are any parts which need replacement due to normal wear and tear

ix. carriage to our works of any equipment or parts under warranty claim shall be the responsibility of and at the expense of the claimant

x. we accept no responsibility for loss or damage howsoever occasioned to customers' goods whilst such goods are in transit to or from ourselves or in the possession of or in transit to or from our agents

xi. we give no warranty in respect of equipment supplied by us except the foregoing warranty and without prejudice to the generality of the foregoing we shall be under no liability whether in contract or otherwise in respect of any defects in the goods or from any injury loss or damage resulting from such defects or from any work done in connection therewith and we shall not in any circumstances be liable for any consequential loss or damage suffered including any loss of use loss of contract or loss of profits. Our liability shall in no case exceed the value of the goods in relation to which the claim is made

xii. the purchaser acknowledges that the equipment is sold to him in consideration of payment of the price and of the undertaking on the part of the purchaser to

   a. observe all prudent trade practices in relation to installation and user so that the equipment is not used when it is in an unsafe condition for whatsoever reason

   b. ensure in so far as the equipment is incorporated into other equipment that such other equipment is in good working order and that such incorporation is in accordance with what the manufacturer would require

   c. ensure that his staff and all users of the equipment are adequately informed of their duties in relation to use of the equipment

   d. observe the Health & Safety at Work legislation as amended from time to time in relation to the equipment supplied so that we shall not be liable in any respect as a result of the purchaser's failure to observe the conditions a. to d. set out above

The foregoing warranty is given without prejudice to purchasers' statutory rights.