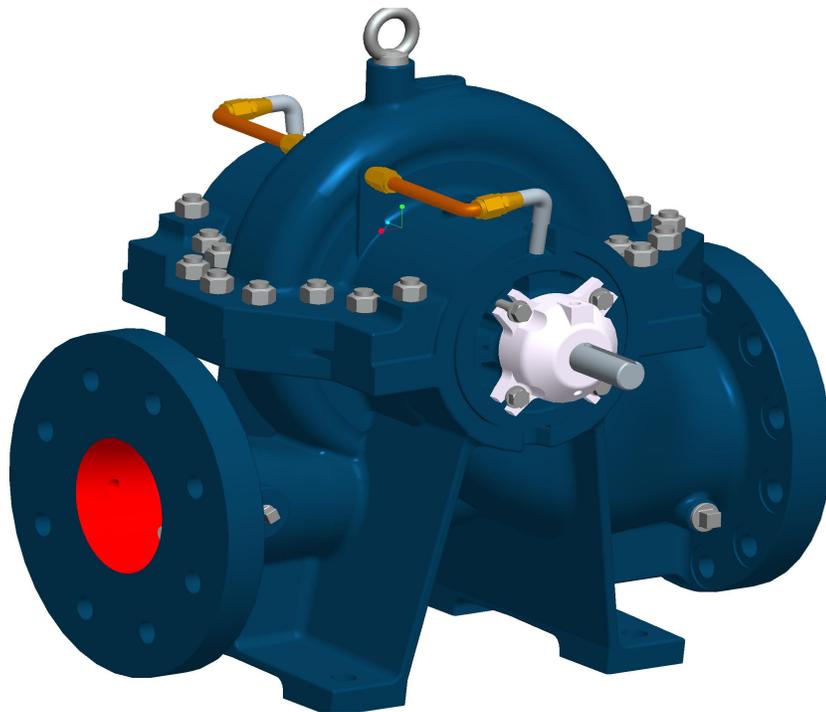


**INSTRUCTION ON
INSTALLTION,
OPERATION &
MAINTENANCE
FOR KIRLOSKAR PUMP
TYPE FM-UL**





CONTENTS

SR. NO.	TABLE OF CONTENTS	PAGE NO
1.0	INTRODUCTION	3
2.0	INSTALLATION	5
3.0	OPERATION	9
4.0	TECHNICAL DATA	13
5.0	MAINTENANCE	16
6.0	OVERHAULING	20
7.0	CROSS-SECTIONAL DRAWINGS	24
8.0	GENERAL OUTLINE DIMENSIONS	27



1. INTRODUCTION

1.1 GENERAL

The pumps covered by this manual, when correctly installed and maintained, will give long and reliable service. It is essential therefore that the instructions given here are followed at all times.

1.2 WARRANTY

Refer to your Sales Contract for coverage.

1.3 PUMP IDENTIFICATION

An identification plate is attached to the body of all pumps and contains the following minimum information:

PUMP TYPE, SERIAL No., CAPACITY, SPEED, HEAD.

Additional information may also be given covering impeller details, materials used, sales order line number etc. Reference should be made to this data when reading the manual.

1.4 HEALTH & SAFETY

1.4.1 GENERAL

I. QUALIFICATION AND TRAINING OF PERSONNEL

Personnel responsible for the installation, commissioning, operation and maintenance of this pumpset must be adequately qualified for their respective tasks. Scope of responsibility must be defined by the operator and appropriate supervision provided. The operator should also ensure that the contents of this manual are fully understood by the personnel.

II NON-COMPLIANCE WITH SAFETY INSTRUCTIONS

Non-compliance with safety instructions may produce a risk to personnel as well as to the environment and the pumpset, and result in loss of any right to claim damages.

Risks may include:

Failure of the pump-set.

Exposure of people to electrical, mechanical and chemical hazards.

c) Endangering the environment by releasing hazardous substances.

III COMPLIANCE WITH SAFETY AT WORK REGULATIONS

When operating the pumpset, the instructions contained in this manual, the relevant national accident prevention regulations and any other service and safety instructions issued by the operator are to be observed.

IV UNAUTHORISED ALTERATIONS AND FITTING OF SPARE PARTS

Modifications should not be carried out without consultation with Kirloskar Brothers limited (KBL). In the interests of safety and reliability only fit spare parts supplied by KBL. Failure to comply in these respects could affect warranty.

V. UNAUTHORISED USE

Pumpset performance and reliability can only be guaranteed providing that it is used in the manner and for the purpose for which it was intended.

1.4.2 SPECIFIC RECOMMENDATIONS

1.4.2.1 Your safety and that of others must always be the first consideration when working on machines. Safety is a matter of understanding the operations being undertaken and the potential dangers. Be on your guard at all times.

WARNING! The following health and safety recommendations must be strictly observed.

- (1) Whilst this pumpset has been designed to be safe under normal operating conditions, there are potential hazards, which the operator should be aware of. These can include: rotating components; electrical potentials; high temperature exhaust surfaces and gases (where diesel driven); and hazardous fluids.



- (2) When lifting the unit ensure that all lifting equipment has a safe working load rating, suitable for the operation. Only perform lifting operations using suitably trained personnel, and in line with instructions contained in this manual.
- (3) Persons working on the unit should always wear suitable protective clothing and footwear. Loose, frayed or baggy clothing and light footwear can be extremely dangerous. Clothing impregnated with oil or similar can constitute a health hazard through prolonged contact with the skin and may also create a fire risk. Wear protective goggles and gloves when handling battery acid.
- (4) Liquids used with some pumpsets are harmful if taken internally or come into contact with unprotected skin or eyes. In the event of an accident, obtain qualified medical assistance immediately.
- (5) Certain components (e.g. gaskets) may contain asbestos or other materials whose fibres can be harmful if inhaled. Always use suitable masks or respirators during maintenance or other operations where there is a risk of inhalation of fibrous dust.
- (6) Always ensure that all guards supplied are correctly installed following any maintenance operation.
- (7) Ensure that the pumpset is not run outside its operational limits. This can put the unit under excessive loads and cause breakdown.
- (8) When working on electric motor driven pumpsets take care to see that the isolator is in the "OFF" position, and a conspicuous notice is displayed warning that the unit is under repair. If a major overhaul is being carried out it is advisable to have a qualified electrician temporarily disconnect the unit.

1.4.2.2 PUMP HAZARDS

- (1) Ensure that the pump has no air in the suction line and casing. The pump rotating components rely on the liquid being pumped for cooling and lubrication. A failure to prime could result in pump failure.
- (2) Pump operation with insufficient lubrication to the bearings could result in overheating and seizure, with potentially catastrophic results.
- (3) Where soft packed sealing is used it is essential that a small leakage is present. Over tightening of the gland will result in damage to the packing, scoring of the shaft or sleeves and bearing seizure.
- (4) Ensure that all pressure has been released before working on the unit.
- (5) Always check that the drive shafts are correctly aligned following installation. Failure to do so could result in reduced life or a possible failure of the coupling, or bearings. (See Section 2.7).

1.4.2.3 HAZARDS RELATED TO ENGINE DRIVEN PUMPSETS

- (1) When working with gaseous fuels, ensure that the area is well ventilated and avoid naked flames, smoking, sparks etc. A Carbon Dioxide fire extinguisher should be kept close at hand.
- (2) Parts of the package, in particular, the exhaust system and engine surfaces can become very hot during and after operation and can cause severe burns.
- (3) Beware of the danger of scalding when removing cooling system pressure caps and hoses, or draining engine oil. Allow the system to cool first, then remove caps slowly.



- (4) Rectify all water, oil or fuel leaks immediately and clean up any spillage.
- (5) Before carrying out any work on the pumpset confirm that the fuel and electrical supplies to the engine are isolated correctly, and that there is no danger that it can be started. A conspicuous notice should be placed on the unit warning others that the unit is under repair.

1.4.2.4 PUMPSETS FITTED WITH ELECTRONIC COMPONENTS

CAUTION Damage can occur to the internal components when electric welding or high voltage "Megger" tests are carried out. Electronic components should always be disconnected before carrying out any work of this kind.

2. INSTALLATION

2.1 RECEIVING PUMP

On receipt of pump, a visual check should be made to determine if any damage has occurred in transit. Typical points to look for, are:

- a Broken or cracked equipment e.g. baseframe, motor, pump feet and flanges.
- b Bent shafts.
- c Damaged motor end bells, bent eyebolts or damaged boxes.
- d Missing items.

Loose parts are often wrapped individually and/or fastened to the equipment. If any damage or losses have occurred notify KBL and the transit company immediately.

When unloading pump, only lift using the lifting eyes on the baseframe or support frame. **DO NOT USE THE LIFTING POINTS ON THE PUMP OR MOTOR**

Pump and motor shafts are in alignment when shipped, however the alignment must be re-checked before use.

2.2 TEMPORARY STORAGE

If the pump is not to be installed immediately it should be stored in a clean, dry area, with protection from moisture, dust, dirt and foreign bodies. In particular, the following action should be taken:

- a Ensure the bearings are packed with the recommended grease, to prevent moisture from entering around the shaft.
- b Remove the glands, packing and lantern rings from the stuffing box, where soft packed sealing is used.
- c Check that the pump suction and discharge ports are covered to prevent foreign objects entering.
- d If, for a short period only, the pump has to be stored outside it should be covered to protect it from the effects of the weather.
- e Every 6 weeks, rotate the pump shaft to prevent bearing pitting.

2.3 PREPARATION

Before installing the pump, clean the suction and discharge flanges thoroughly and remove the protective coating from pump shafts, where applicable.



If the pump has been in storage and prepared in the manner as above, the bearing grease should be removed, the bearings cleaned (using an approved cleaning fluid) and then re-lubricated following the procedure detailed in Section 4. It is strongly recommended that this work is carried out by KBL (see Section 1.5). This is a chargeable service; however, pump warranty will be protected.

2.4 LOCATION

The pump should be installed as near to the liquid source as possible, with the shortest and most direct suction pipe practical.

Allow sufficient accessibility for inspection and maintenance, and ample headroom should be allowed for the use of an overhead crane or hoist sufficiently strong to lift the unit.

Where pumps are electric motor driven, power source electrical characteristics should be appropriate for those shown on motor data plate.

2.5 FOUNDATION

The foundation should be sufficiently substantial to absorb vibrations and rigid enough to avoid any twisting or misalignment. As a rough guide it should be 300 mm wider on all sides with the weight at least 1-1.5 times as heavy as the pumpset. Depth should be sufficient to achieve the necessary weight and deep enough to accommodate drilling pockets for fixing bolts.

$$\text{Min. Foundation depth (m)} = \frac{W}{2400 \times B \times L}$$

W (kg) = total weight of pump set; 2400 (kg/m³) = concrete density;
B (m) = foundation width; L (m) = foundation length

A suitable concrete mixture by volume is 1:2:3 (Cement: Sand: Aggregate) with a maximum 100mm slump, and a 28 day compressive strength of 27,000 N/mm². The foundation should be reinforced with layers of 150mm square No.8 gauge steel wire fabric, or equivalent, horizontally placed 150mm apart.

Loose bolt type anchors should be checked for tightness periodically, as there is a tendency to loosen off with vibration. Chemical type anchors are a suitable alternative.

2.6 INSTALLATION OF BASEFRAMES

Foundation concrete should be poured without interruption to within 12 to 40 mm of the finished height. The top surface should be well scored and grooved, before the concrete sets, to provide a bonding surface for the grout. The foundation should be allowed to cure for several days before the baseframe is shimmed and grouted.

Chemical Anchor type foundation bolts are recommended as these are less inclined to loosen off in service, and generally simplify installation. Manufacturer's instructions for installation and final torque figures should be rigorously followed. Allow enough bolt length for grout, shims, lower baseframe flange, nuts and washers. Fixing bolt diameter should be the largest capable of being inserted through the baseframe fixing holes.

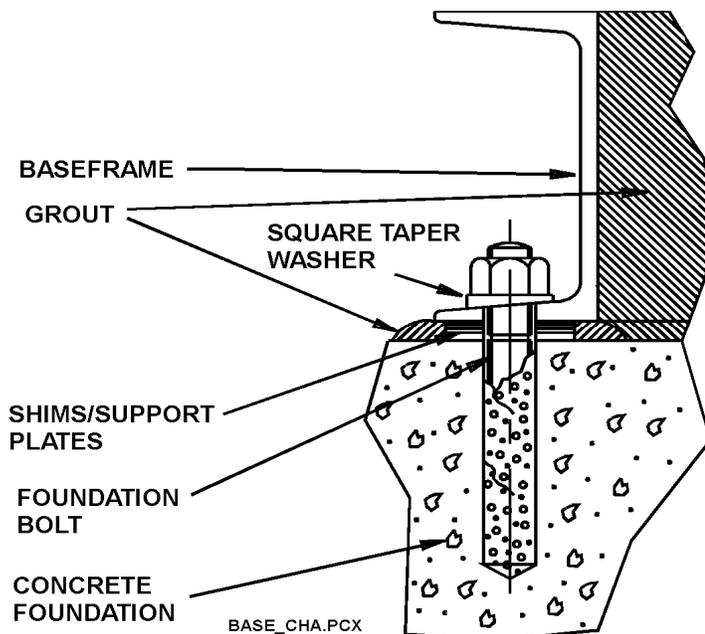
For installation purposes, baseframes can generally be provided:

Channel Section

Follow the appropriate installation procedure.

INSTALLATION FOR CHANNEL SECTION BASEFRAMES

Position pumpset and mark through baseframe fixing bolt holes. Move pumpset to one side and drill pockets for fixings. Install fixing anchors in line with manufacturer's instructions. Reposition pumpset using blocks and shims under the base for support either side of foundation bolts, and midway between the bolts, to locate the base approximately 25mm above the concrete foundation with the studs extending through the holes in the baseframe.



Add or remove shims under the base to level the pump-shaft in the case of horizontally mounted pumpsets; or to position the pump-shaft as near plumb vertical as possible in the case of vertically mounted pumpsets. The baseframe itself does not have to be level.

Torque down fixing nuts tight against the baseframe and observe pump and motor shafts or coupling hubs for alignment.

Note, square tapered washers should be used on the channel section flanges, to ensure that the fixing bolts are not bent.

Grout baseframe in completely using non-shrink grout and allow it to dry thoroughly before attaching piping to pump (24 hours is sufficient time with the approved grouting procedure).

The suction and discharge piping should be installed after the pumpset, ensuring that no pipe strain is placed on either flange, and that both pump and pipe flanges are square to each other

GROUTING PROCEDURE

Grouting compensates for uneven foundations, distributes weight of unit and prevents shifting. Use an approved, non-shrinking grout as follows:

Soak top of concrete foundation thoroughly, then remove surface water. Completely fill baseframe with grout.

After grout has thoroughly hardened check foundation bolts and re-tighten if necessary, then re-check alignment.

Approximately 14 days after the grout has been poured or when the grout has thoroughly dried, apply oil based paint to the exposed faces of the grout to prevent air and moisture from coming into contact.

2.7 ALIGNMENT PROCEDURE

(Excluding Cardan Shafting)

The pump driver, if supplied, is correctly aligned on its baseframe at the factory. A certain amount of deformation of the baseframe is possible during transit and it is therefore essential to check alignment, prior to final grouting.

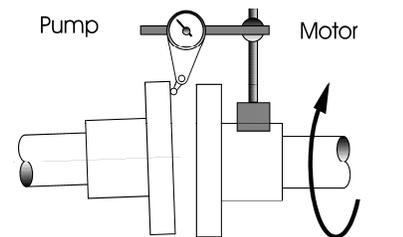
A flexible coupling will only compensate for a small amount of misalignment and should not be used to compensate for excessive misalignment of the pump and driver shafts. Inaccurate alignment results in vibration and excessive wear on the bearings, sleeve or shaft, and wear rings.

There are three forms of misalignment:

- I. Angular
- II. Parallel
- III. Axial

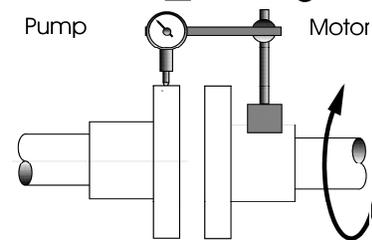
2.7.1 ANGULAR - shafts with concentric axes but not parallel.

To check for angular alignment, mount a dial gauge on either flange and rotate it against the other flange close to its edge. The variation in reading should generally be within 0.08mm, unless coupling details state otherwise.



2.7.2 PARALLEL - shafts with axes parallel but not concentric.

To check for parallel alignment, mount a dial gauge on either hub and rotate it against the outer diameter of the other hub. Alignment is ideally correct when there is no variation in the reading. Check coupling details for specific limits.



In both Angular and Parallel Alignment adjustments can be made by shimming under the driver mounting feet. After each adjustment, it is necessary to recheck all features of alignment.

2.7.3 AXIAL - the distance between the shaft ends should be correct.

Axial alignment should be checked last and can be achieved by moving the coupling hubs relative to the shafts. The distance between the shaft ends (DBSE) should be as stated on the General Assembly (GA) drawing, or in the coupling data.

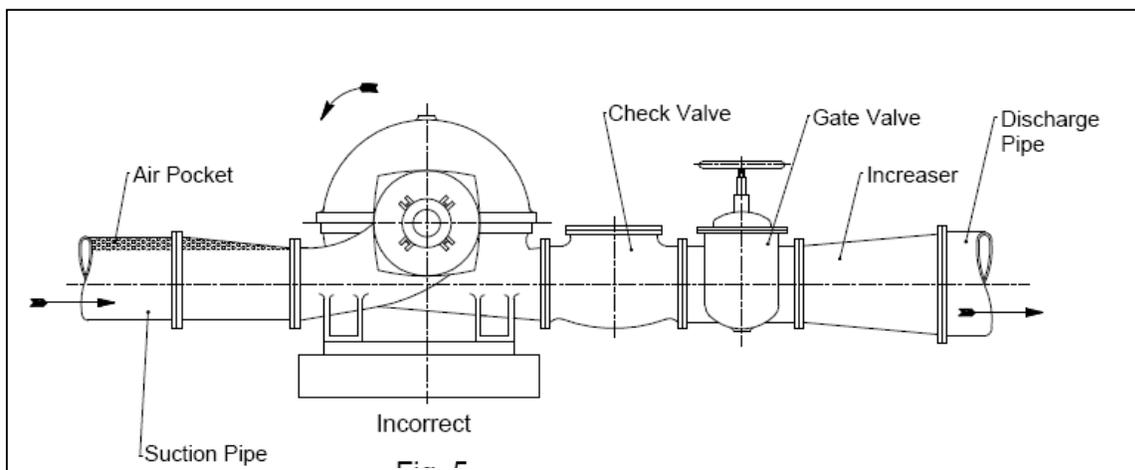
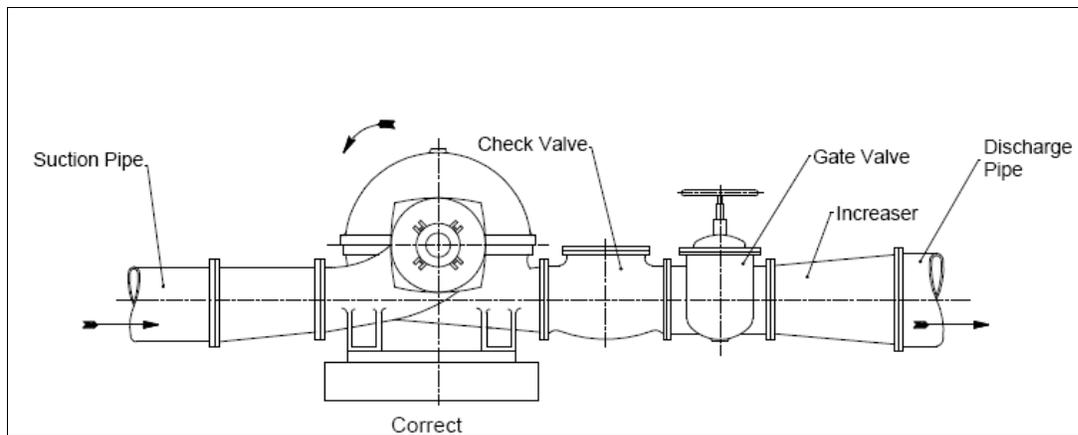
Alignment should be performed after the baseframe has been properly set and grout has dried thoroughly according to instructions. Final alignment should be made by shimming the driver only.

2.8 SUCTION & DISCHARGE PIPING

The following precautions should be observed during installation:

In the case of channel section and folded metal baseframes without side flanges, piping should be run to the pump. Do not move pump to pipe, this could make final alignment impossible.

Both suction and discharge piping should be supported independently and close to the pump so that no strain is transmitted to the pump when the flange bolts are tightened. Use pipe hangers or other supports at intervals necessary to provide support. When expansion joints are used in the piping system, they must be installed beyond the piping supports closest to the pump.



Install piping as straight as possible, avoiding unnecessary bends. Where necessary, use 45° or long sweep 90° fitting to decrease friction losses.

Make sure that all piping joints are air tight. Provide pipe expansions when hot fluids are to be pumped. Where reducers are used, eccentric reducers are to be fitted in suction lines and straight taper reducers in discharge and vertical lines. Undulations in the pipe runs are also to be avoided. Failure to comply with this may cause the formation of air pockets in the pipework and thus prevent the correct operation of the pump.

The suction pipe should be as short and direct as possible, and should be flushed clean before connecting to the pump. Where suction lift is not very high, it is advisable to use a foot valve. Horizontal suction lines must have a gradual rise to the pump.

The discharge pipe is usually preceded by a non-return valve or check valve and a discharge gate valve. The check valve is to protect the pump from excessive back pressure and reverse rotation of the unit and to prevent back flow into the pump in case of stoppage or failure of the driver. The discharge valve is used in priming, starting and when shutting down the pump.

The use of butterfly valves in suction lines is not recommended, however if unavoidable there should be a distance of at least 5 pipe diameters between the valve and the pump inlet flange.

FM FIREPUMP INSTALLATIONS



Enriching Lives

- Table 2-20 The diameter of the suction pipe, discharge pipe and gate valve should not be less than that shown in the Table.
- Para. 3-1.2 The horizontal centrifugal fire pump in horizontal or vertical position should not be used where a static suction lift is involved.

3. OPERATION

3.1 BEFORE STARTING (After Installation or Maintenance)

Before initially starting the pump, make the following inspection:

The unit baseframe must be grouted (where applicable), and bolted to the foundation.

Make sure all rotating parts are found to be free when turned by hand.

Ensure motor is correctly wired to its starting device. Check that the voltage, phase and frequency on the motor nameplate are correct for the line circuit.

Confirm correct direction of motor rotation prior to coupling to pump. Check by starting motor and switching off immediately, observing rotation is the same as the arrow direction on the pump casing.

Check the alignment between pump and motor.

Check bearing lubrication is provided (see lubrication section). Also check driver lubrication.

If the pump has soft packed sealing, check that the stuffing box has been packed.

Close drain valves. Ensure that the pump is primed. Never run the unit dry. The liquid in the pump serves as a lubricant for close running fits within the pump and the pump may be damaged if operated dry. Pumps may be primed by using an ejector, exhaustor or vacuum pump. If a foot valve is used in the suction line, the pump may be primed by venting and filling the casing with liquid. Vent and drain plugs are provided either in the casing, or in external pipework.

Suction pipework should have been flushed clean during installation. Failure to do this is a common reason for commissioning failures.

3.2 STARTING

Close valve in discharge line. Open fully all valves in the suction line.

Turn on seal water to the stuffing box where external pipe supplied.

Prime the pump and start the pump driver.

When the pump is operating at full speed, open the discharge valve slowly.

Do not operate the pump for prolonged periods with a closed discharge valve, so as to avoid overheating.

The pump should be shut down at once and the trouble corrected if the pump is running at its rated speed and found to have any of the following defects:

- a No liquid delivered.
- b Not enough liquid delivered.
- c Not enough pressure.
- d Loss of liquid after starting.
- e Excess vibration.
- f Motor runs hot.
- g Pump bearing overheating.



3.3 RUNNING

While the pump is running, a periodic inspection should be made of:

Bearings Check the bearings for temperature, which should not normally exceed 158°F, after running in period.

- a) Stuffing Box (if Soft Packed) - Ensure there is sufficient leakage to lubricate the packing.
- b) Suction and discharge gauge readings (if fitted).

3.4 STOPPING

- a) Slowly close delivery valve, then shut down driving unit in accordance with manufacturer's instructions.
- b) Shut off external sealing liquid supply to relieve stuffing box pressure, where fitted.
- c) Successful operation of the pump depends on accurate coupling alignment. It is recommended that the alignment is re-checked after the preliminary run.

TABLE 1

FAULT FINDING CHART (for Electric Motor driven sets)



Enriching Lives

PROBABLE CAUSES	POTENTIAL FAULT OR DEFECT										REMEDIAL ACTION (See Table 2)	
	No liquid delivered Insufficient liquid delivered Liquid delivered at low pressure Loss of liquid after starting Excessive vibration Motor runs hot Excessive noise from pump cavitation Bearings or stuffing gland overheats											
Pump not primed	<input type="checkbox"/>											1
Speed too low	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>									2
Speed too high						<input type="checkbox"/>	<input type="checkbox"/>					3
Air leak on suction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>							4
Air or gas in liquid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>							5
Discharge head too high (above rating)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>						6
Suction lift too high	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>					7
Not enough suction head for hot liquid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>					8
Inlet pipe not sufficiently submerged	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>					9
Liquid viscosity greater than rating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>		<input type="checkbox"/>				10
Liquid density greater than rating						<input type="checkbox"/>		<input type="checkbox"/>				11
Insufficient net inlet head	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>					12
Impeller plugged up	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>				13
Wrong direction of rotation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>					14
Excessive wear ring clearance		<input type="checkbox"/>	<input type="checkbox"/>									15
Damaged impeller		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>					16
Rotor binding					<input type="checkbox"/>	<input type="checkbox"/>						17
Defect in motor						<input type="checkbox"/>						18
Voltage/frequency lower than rating			<input type="checkbox"/>			<input type="checkbox"/>						19
Lub. oil dirty or contaminated								<input type="checkbox"/>				20
Foundation not rigid					<input type="checkbox"/>							21
Misalignment of pump/driver					<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>				22
Bearing worn					<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>				23
Rotor out of balance					<input type="checkbox"/>			<input type="checkbox"/>				24
Bent or damaged pump shaft					<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>				25
Impeller undersize		<input type="checkbox"/>	<input type="checkbox"/>									26
Air leak in stuffing box		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								27



TABLE 2 REMEDIAL ACTIONS

FAULT	CAUSES	REMEDY
1	Pump not primed - lack of prime- incomplete priming	Fill pump and suction pipe completely with liquid.
2	Speed too low	Check whether motor is directly across-the-line and receiving full voltage. Frequency may be too low. Motor may have an open phase.
3	Speed too high.	Check voltage on motor.
4	Air leak in suction.	If pumped liquid is water or non-explosive, find leak using flame around flanges. For such liquid as gasoline, suction line can be tested by
5	Air or gas in liquid.	May be possible to over rate pump to the point where it will provide adequate pressure despite condition.
6	Discharge head too high	Check pipe friction losses. Larger piping may correct condition. Check that valves are fully open.
7	Suction lift too high.	If no obstruction at inlet, check for pipe friction losses. Static lift may be too great, measure with vacuum gauge while pump
8	Not enough suction head for liquid	Consult KBL
9	Inlet pipe not submerged enough.	If inlet cannot be lowered, chain a board to suction pipe. It will be drawn into eddies, smothering the vortex.
10	Viscosity of liquid greater than rating	Use large driver. Consult supplier for recommended size.
11	Liquid heavier than rating.	Use larger driver. Consult supplier for recommended size.
12	Insufficient net inlet head.	Increase positive suction head on pump by lowering pump.
13	Impeller plugged up or partially choked.	Dismantle pump and clean impeller.
14	Wrong direction of rotation.	Check motor rotation with directional arrow on pump casing.
15	Excessive wear ring clearance.	Dismantle, inspect and replace if necessary.
16	Damaged impeller.	Inspect impeller. Replace if damaged, or vane sections are badly eroded.
17	Rotor binding.	Check deflection of rotor. Check bearings for damage or excessive wear.
18	Defects in motor.	Check any motor defects. The motor may not be ventilated properly due to a poor site location.
19	Voltage and/or frequency lower than rating	The voltage and frequency of the electrical current may be lower than that for which the motor was rated. Consult supplier for correct supply.
20	Lubricating oil/grease dirty, or contaminated.	Clean bearings and bearing housings as per instructions and re-lubricate.
21	Foundation not rigid.	Check if foundation bolt nuts are drawn tight against base. Check the foundations comply with the recommendations in instructions.
22	Misalignment of pump and driver	Realign pump and driver.
23	Bearing worn.	Check bearings for damage and excessive wear. Any irregularities will cause a drag on the shaft.
24	Rotor out of balance	Check for causes. Consult supplier.
25	Shaft bent.	Check deflection of rotor. Total indicator run-out should not exceed 0.05mm on shaft and 0.1mm on impeller wear ring surface.
26	Impeller too small.	Check with supplier to see if a larger impeller can be used, otherwise cut pipe losses or increase speed or both, but be careful not to overload.
27	Air leak in stuffing box.	Increase seal lubricant pressure to above atmosphere.
OTHER	Head lower than rating.	Machine impeller O/D to size advised by supplier.
	Foot valve too small or partially obstructed.	Area through ports of valve should be at least as large as area of suction pipe - preferably 1½ times. If strainer is used, net clear area should be 3
	Obstruction of liquid passages.	Dismantle pump and inspect passages of impeller and casing. Remove obstruction.
	Defective packing.	Replace packing and sleeves if badly worn.

**4. TECHNICAL DATA****4.1 DIRECTION OF ROTATION**

Pumps are supplied with clockwise direction of rotation when viewed from coupling end.

The direction of rotation can be reversed easily without changing any part.

4.2 BEARING DETAILS

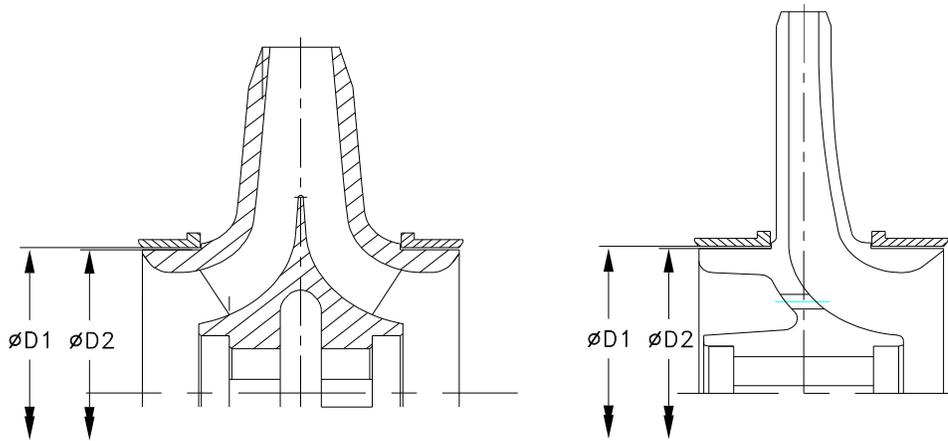
Single Stage Pump Model	Bearing Module	Ball Bearing Reference No. (DE & NDE)
FR08BD	1	6306
FR08BE		
FR12CF		
FR12CG		
FR10DE		
FR10BD	2	6309
FR10BE		
FR12BD		
FR12BE		
FR12BF		
FR15BE		
FR12DF		
FR15DF		
FR25DA		
FR10EA		
FR10ED		
FR12EE		
FR15ED		
FR15EE		
FR20DD		
FR20DE		
FR20ED		
FR25EA		
FR25ED		
FR15FE		
FR20FD		
FR20FE		
FR20FF		

Two Stage Pump Model	Bearing Module	Ball Bearing Reference No. (DE & NDE)
FR12XD	B70	6411
FR12YD		
FR15XE		
FR15XF		
FR15YE		

4.3 WEAR RING DETAILS



Enriching Lives



Pump Type	Fig. No.	D1 Tol.H7.		D2 Tol.c9.		Diametral Clearances	
		Min.	Max	Min.	Max	Min	Max
FR08BD	1	120.000	120.035	119.733	119.820	0.180	0.302
FR08BE	1	120.000	120.035	119.733	119.820	0.180	0.302
FR10BD	1	150.000	150.040	149.690	149.790	0.210	0.350
FR10BE	1	150.000	150.040	149.690	149.790	0.210	0.350
FR12BD	1	175.000	175.040	174.670	174.770	0.230	0.370
FR12BE	1	175.000	175.040	174.670	174.770	0.230	0.370
FR12BF	1	175.000	175.040	174.670	174.770	0.230	0.370
FR15BE	1	180.000	180.040	179.670	179.770	0.230	0.370
FR12CF	1	145.000	145.040	144.690	144.790	0.210	0.350
FR12CG	1	145.000	145.040	144.690	144.790	0.210	0.350
FR10DE	1	145.000	145.040	144.690	144.790	0.210	0.350
FR12DF	1	175.000	175.040	174.670	174.770	0.230	0.370
FR15DF	1	185.000	185.046	184.645	184.760	0.240	0.401
FR20DD	1	224.000	224.046	223.625	223.740	0.260	0.421
FR20DE	1	224.000	224.046	223.625	223.740	0.260	0.421
FR25DA	1	224.000	224.046	223.625	223.740	0.260	0.421
FR10EA	1	150.000	150.040	149.690	149.790	0.210	0.350
FR10ED	1	150.000	150.040	149.690	149.790	0.210	0.350
FR12EE	1	185.000	185.046	184.645	184.760	0.240	0.401
FR15ED	1	185.000	185.046	184.645	184.760	0.240	0.401
FR15EE	1	185.000	185.046	184.645	184.760	0.240	0.401
FR20ED	1	245.000	245.046	244.605	244.720	0.280	0.441
FR25EA	1	245.000	245.046	244.605	244.720	0.280	0.441
FR25ED	1	245.000	245.046	244.605	244.720	0.280	0.441
FR15FE	1	225.000	225.046	224.625	224.740	0.260	0.421



FR20FD	1	245.000	245.046	244.605	244.720	0.280	0.441
FR20FE	1	245.000	245.046	244.605	244.720	0.280	0.441
FR20FF	1	245.000	245.046	244.605	244.720	0.280	0.441
FR12XD	2	240.000	240.072	239.465	239.580	0.420	0.607
FR12YD	2	240.000	240.072	239.465	239.580	0.420	0.607
FR15XE	2	240.000	240.072	239.465	239.580	0.420	0.607
FR15XF	2	240.000	240.072	239.465	239.580	0.420	0.607
FR15YE	2	240.000	240.072	239.465	239.580	0.420	0.607

* For FR12XD, FR12YD, FR15XE, FR15XF, FR15YE Tolerance is H8b9

4.4 IMPELLER DETAILS

All single stage models have enclosed type double entry radial flow impellers.

All single stage models have enclosed type single entry radial flow impellers.

4.5 STUFFING BOX DETAILS

Champion Style – 3116 – Graphite cotton greasy packing is used in the standard supply.

Pumps are supplied with soft packed stuffing boxes with seal lubrication via external copper pipe work. Refer section 5.4 and the following table while carrying out maintenance:

Pump Type	No. of Rings	Packing Ring Size(mm)	Approx. length of one ring(mm)
FR08BD FR08BE FR12CF FR12CG FR10DE	4	10 x 10	175
FR12DF FR15DF	4	10 x 10	230
FR20DD FR20DE	4	10 x 10	280
FR10BD FR10BE FR12BE FR12BF FR12BD FR15BE FR15ED FR15EE	4	12 x 12	230
FR20FD FR20FE FR20FF	4	12 x 12	280
FR08ED FR10EA FR10ED FR12EE	2	12 x 12	230
FR15FE	2	12 x 12	280
FR12XD FR12YD FR15XE FR15XF FR15YE	3	12 x 12	305



5. MAINTENANCE

5.1 ROUTINE MAINTENANCE

This section gives details of routine preventative maintenance. Where repair or major overhaul is required please contact KBL Service at the addresses shown in section 1.5.

5.1.1. GENERAL

Routine maintenance is essential to maintain the plant in a serviceable condition, and a sound insurance against enforced inopportune shutdown. A high degree of cleanliness of equipment and surrounding areas should be maintained during all maintenance procedures.

5.1.2 FREQUENCY OF INSPECTIONS

A general guide is shown in Table 3.

Depending on operation and environmental conditions together with a comparison of previous inspections, the frequency may be altered to maintain satisfactory operation of the plant to suit established operating procedures.

5.2 LUBRICATION

GREASE LUBRICATED BEARINGS

Bearings are initially lubricated during manufacture or re-assembly. The re-greasing interval depends upon the running speed of the unit:

TABLE 3 BEARING RE-GREASING INTERVALS

PUMP RUNNING SPEED	RE-GREASING INTERVAL	AMOUNT OF GREASE
1450 RPM	5000 HOURS	50 GRAMMES
2950 RPM	3000 HOURS	50 GRAMMES

To recharge the bearings with fresh grease, use grease gun through the two lubricating nipples.

DO NOT APPLY LUBRICANT WHEN PUMP IS RUNNING.

Every 10,000 hours or 2 years remove bearings from pump, de-grease, thoroughly clean, recharge with fresh grease and refit in accordance with re-assembly instructions.

Recommended grease: -

Speed	Lubricant recommended
1450 rpm.	IOCL SERVOGEM-3 or equivalent.
2900 rpm.	IOCL SERVOGEM-2 or equivalent.

Drop point: 180° C min

5.3 BEARINGS – GENERAL

These instructions do not supersede any information issued by the bearing manufacturers, to whom application should be made for more comprehensive literature.

Care and maintenance of bearings is a matter of ensuring that they are:

1. Correctly lubricated at intervals.
2. Removed, cleaned and refitted with care.
3. Tools used and work areas should be clean.

To remove a bearing, use correctly suited withdrawal equipment. If other means are not available, a



hammer and soft metal drift may be used to tap evenly around the circumference of the inner ring.

CAUTION: Damage can be caused by exerting force against the outer ring of a ball bearing.

Ball bearings should not be dismantled.

Clean bearings thoroughly with an approved fluid.

Dry the bearings with dry compressed air. Do not spin a clean dry bearing. All the cleaning fluid must be removed from the bearing since it might damage the lubricating properties of the grease.

Inspect the bearing for wear, fractures, cracks, corrosion or other damage which may necessitate bearing replacement.

Work approximately 30 grams of grease into both sides of bearing immediately after drying and inspecting, to prevent corrosion.

Check that the bearing, shaft and housing are clean and undamaged.

When fitting the bearing on the shaft, the use of a soft drift and hammer should be avoided if possible. The drift could shed flakes of metal into the bearing. If a lock nut is used to "push-home" the bearing then a special hook or "C" spanner must be used to turn it. A drift and hammer applied to one slot would cause damage to the nut and introduce flakes of metal into the bearing. The tab washer should not be in place during this procedure since there is a risk of shearing off the inner tab. The nut should be removed when the bearing is fully pushed home then the tab washer placed in position and the nut refitted.

In general soaking bearings in a hot oil bath prior to fitting to the shaft is recommended.

After assembly and when the bearing housings are in position, the bearing housing cavity incorporating the grease nipple should be fully charged with the recommended grease leaving the cavity on the other side of the bearing free of grease.



5.4 SOFT PACKED SEALING

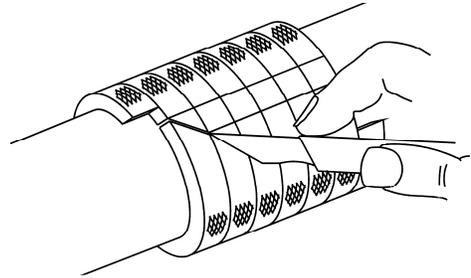
Some pumps are supplied with soft packed stuffing boxes with seal lubrication via external nylon or copper pipework. Refer to Table 5 and the following when carrying out maintenance:

GLAND PACKING REPLACEMENT

Isolate pump driver, close all valves and relieve any liquid pressure. Remove gland follower, gland packing, lantern ring and split bush or neck ring (where fitted). A screw type packing ring extractor will aid removal but take care not to damage the stuffing box. During removal take careful note of the order and position of the parts so that the reverse procedure can be carried out for re assembly. Various different arrangements of sealing are employed on the Thrustream range of pumps with the following combinations of parts being three variations (refer to specific sectional drawing for actual arrangement):

- 1) Soft packing + lantern ring
- 2) Split bush + lantern ring + soft packing
- 3) Neck ring + 2 off lantern rings + soft packing

Clean and inspect all components for wear and surface finish. If satisfactory, cut new rings diagonally at 45° as shown in Figure 4.4.1. using a dummy shaft of the same diameter as the pump shaft. Refer to the appropriate table at the end of this manual for details of number and lengths.



SOFT PACKING INSERTION

5.4.1. Soft packing + lantern ring

Insert the first packing ring and tap to the bottom of the stuffing box. Each following ring should be installed in the same manner ensuring that the cut in each packing ring is rotated approximately 120° to the last.

Install the lantern ring in the appropriate position aligning with the lubrication connection. Make due allowance for the lantern ring to be pushed deeper into the stuffing box during adjustment.

5.4.2. Split bush + lantern ring + soft packing

Install the split bush and push to the bottom of the stuffing box followed by the lantern ring. Check that the lantern ring aligns with the lubrication connection.

5.4.3. Neck ring + 2 off lantern rings + soft packing

Install the neck ring and push to the bottom of the stuffing box followed by the lantern ring. Check that the lantern ring aligns with the lubrication connection.

Insert the first packing ring and tap it down to the lantern ring. Install the following ring in the same manner ensuring that the cut in the packing ring is rotated approximately 120° to the first. Install the second lantern ring followed by the last packing ring.



FINAL RE-ASSEMBLY

The last packing ring should never protrude beyond the stuffing box face thus allowing the gland follower to 'start' in the stuffing box. If this is not the case, then dismantle and check that the correct number of rings has been used and that they have seated correctly.

Bring the gland follower up squarely against the last packing ring and finger tightens the securing nuts evenly.

Turn the shaft to ensure that no binding is taking place.

Pressurize the stuffing box, ensuring there is no trapped air. The gland should start to leak heavily almost immediately. If it does not, stop the pump immediately and investigate.

GLAND FOLLOWER ADJUSTMENT

After the pump has been running for 10 minutes at full pressure, adjust the follower nuts by one sixth of a turn every 10 minutes until there is a small leakage only. This leakage is essential to ensure packing is lubricated.

TABLE 4 ROUTINE MAINTENANCE CHART

Every Week	Visually check for leaks. Check for vibration. Hand test bearing housing for any sign of temperature rise. Adjust gland as necessary to maintain slight leakage.
Every Month	Check bearing temperature with a thermometer.
Every 3 Months	Check running hours and consult re-lubrication interval chart. Check grease lubricated bearings for saponification - i.e. signs of any deposits, oil separation and undue hardening and softening of grease.
Every 6 Months	Check running hours and consult re-lubrication interval chart. Check soft packed gland packing, where fitted, and replace if necessary. Check shaft or shaft sleeve for scoring. Check alignment of pump and motor. Check holding down bolts for tightness. Check coupling for wear.
Every Year	Check rotating element for wear. Check wear ring clearances. Clean and re-grease bearings. Check running hours and consult re-lubrication interval chart.



6. OVERHAULING

With normal daily operating spell, the pump will be due for overhaul after about 5000 working hours. This work should be done by skilled personnel. Please refer to the cross sectional drawing while dismantling and reassembling the pump. Please also refer to chart given at end of this booklet.

6.1 DISMANTLING PROCEDURE (Single Stage Pumps):

1. Remove drain plug (60100) and drain the pump.
2. Remove all casing main joint nuts (58001) and dowel pins (61100). Remove copper flushing piping.
3. Insert a screw driver or peg bar into the slots between the Upper half (12200) and Lower half (12300) casing and separate the halves, lifting off the upper half casing.
4. Tap the stuffing box inserts (97900) with a soft headed hammer to break the seal between the stuffing box insert and lower half casing and lift the rotating element out of the lower half.
5. Remove four hex. head screws (57100) from each bearing housing (24001 & 24002) and remove the bearing housings from the bearings.
6. Remove bearing retaining nut (33600) and lock washer (41500) from the outboard end of the shaft and using a puller remove the bearing [260] from the shaft. Remove the drive end bearing [260] in the same manner.

NOTE : Retaining nut and lock washer are not used on the drive end bearing.

7. Remove shoulder rings [19900] from the shaft. Remove oil seals [50000] from the supporting frame [22000].
8. Remove four nuts [50002] from each supporting frame [22000] off the shaft, working glands [22300] off the shaft at the same time.
9. Slide stuffing box inserts [97900] off the shaft. Remove packing [43000], lantern rings [22700] and stuffing box spacer rings [20700] from each stuffing box insert.
10. Remove casing rings [19000] from the impeller [15900].
11. a. Clockwise rotation : Unscrew shaft sleeve [31000] from the non-drive end and slide it off the shaft.
b. Anti-clockwise rotation : Unscrew shaft sleeve [31000] from the drive end and slide it off the shaft.
12. Remove impeller [15900], slide back impeller key [32000] and remove the other shaft sleeve [31000] from the drive end. Remove impeller key.
1. 13. In case of two stage pumps before removing the impellers put the mark of first stage and second stage impellers so that while reassembling, the impellers may not be interchanged.

6.2 ASSEMBLY PROCEDURE (Single Stage Pumps):

Module 1 and 2 pumps soft packed stuffing box. **Clockwise rotation.**

2. Wipe shaft [18000] with clean light oil. Screw shaft sleeve [31000] onto shaft at drive end per dimension "A" given on page.
3. Place impeller key [32000] into key way and tap milled-down end right home under sleeve.
4. Check the impeller for correct rotation [page 29] and slide onto shaft from non-drive end.
5. Screw second shaft sleeve [31000] onto shaft at non-drive end and lock up tight against impeller hub and first sleeve.



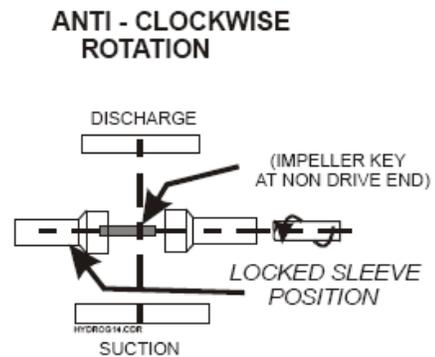
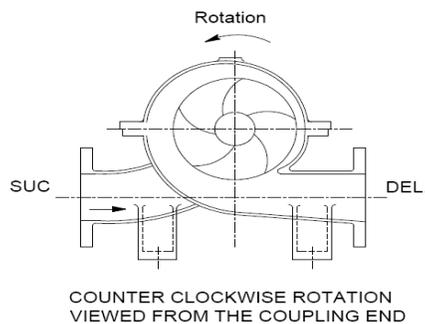
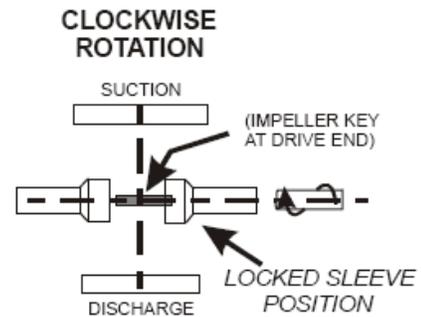
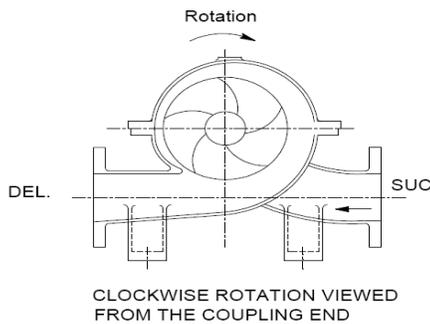
6. Slide the casing rings [19000] onto the impeller.
7. Block up mechanical seal flushing line in each insert [979] with st. steel pin and arald [page 26, Fig. 12].
8. Check "O" rings for cuts or flaws, discard if faulty. Lubricate and roll "O" ring into the groove in each insert [97900].
9. Slide inset [97900] over shaft with guide vane at top position.
10. Slide stuffing box spacer ring [20700] into insert bore and install stuffing box packing per instruction given on 6.3 slide gland [22300] and supporting frame [22000] onto the shaft simultaneously and secure supporting frame to each insert with four studs/nuts [58003/58002]. Secure and tighten gland with two studs/nuts [58200/58200] as described in the packing instructions.
11. Fit shoulder ring [19900] onto shaft, then press oil seal [50000] into insert.
12. Heat the ball bearing [26000] to approximately 100 °C [212 °F] using bearing hot plate or oil and water solution [10 to 15% soluble]. NOTE : Do not exceed temperature 120 °C [250 °F].
13. Slide the heated bearing onto the shaft upto shoulder ring [19900] [non-drive end]. Place locking washer [41500] onto shaft and screw bearing retaining nut [36000] using hook spanner. Lock up tight against bearings.
14. Cool the bearing to room temperature and coat both sides with recommended grease.
15. Coat the inside of the bearing housing [24002] with grease and slide into place over bearing. Secure bearing housing [24002] to the support frame [220] with four hex. head screws [57100].
16. At coupling end : heat the bearing [28000] to approximately 100 °C [212 °F] using bearing hot plate or oil and water solution. NOTE : Do not exceed 120 °C [250 °F].
17. Slide the heated bearing onto the shaft to about shoulder ring [19900] [coupling end].
18. Cool the bearing to room temperature and coat both sides with recommended grease.
19. Coat the inside of the bearing housing [24001] with grease and slide into place over bearing. Secure bearing housing [24001] to the support frame [22000] with four hex. head screws [57100].
20. Set the rotating element in the pump casing bottom half [12300]. Locate both insert tongues in their respective casing grooves. Locate pin 61002 and 61003 in their respective slots. Correct any excessive "O" ring buckling. Check that the impeller is centralized in the casing ± 2.5 mm and that there is no rubbing.
21. Install casing gasket [51900] with a light coat of commercial cup grease on both gasket surfaces. Carefully align the inner edge of the gasket with the insert "O" rings.
22. Lower the upper half casing [12200] into place and install casing joint nuts. NOTE : When installing upper half casing make sure that the "O" rings are not cut or pinched and that the gasket is hard against the "O" rings.
23. Insert casing joint dowels [61100] and drive them home. Tighten the joint nuts [500.1] per instructions on page 27.
24. Install stuffing box flushing piping [56000].
25. Rotate the shaft by hand to assure smooth turning and that it is free from rubbing or binding.

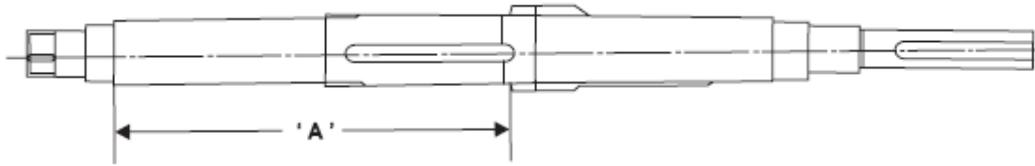
6.3 REVERSING ROTATION OF PUMPS (Single Stage Pumps):

Reversing rotation of pumps puts suction and discharge opening on opposite sides with respect to the coupling end.

Changes in assembly procedure –

1. Screw shaft sleeve [31000] onto shaft [18000] at non-drive end as per dimension "A" given in table below.
2. Place impeller key [32000] into key way and tap milled-down end right home under non-drive end shaft sleeves [soft packed].
3. Check impeller for correct rotation as shown in fig below and slide onto shaft from drive end.
4. Screw second shaft sleeve onto shaft at drive end and using hook spanner, lock up tight against the impeller hub.
5. From step 5 the assembly procedure is the same as for clockwise rotation pumps.

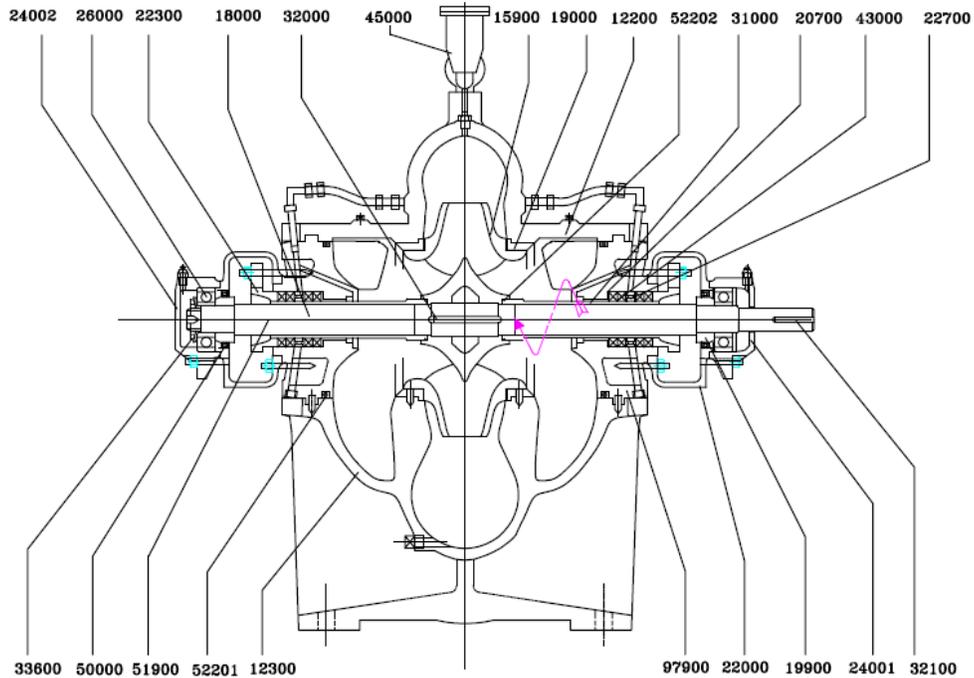




Pump Type	Dimension A
FR08BD, FR08BE	283
FR10BD, FR10BE	355
FR12BD, FR12BE, FR12BF	355
FR15BE	355
FR12CF, FR12CG	283
FR10DE	283
FR12DF	355
FR15DF	355
FR20DD, FR20DE	415
FR25DA	415
FR10EA, FR10ED	355
FR12EE	355
FR15EE, FR15ED	355
FR20ED	419
FR25EA, FR25ED	419
FR15FE	419
FR20FE, FR20FF, FR20FD	419



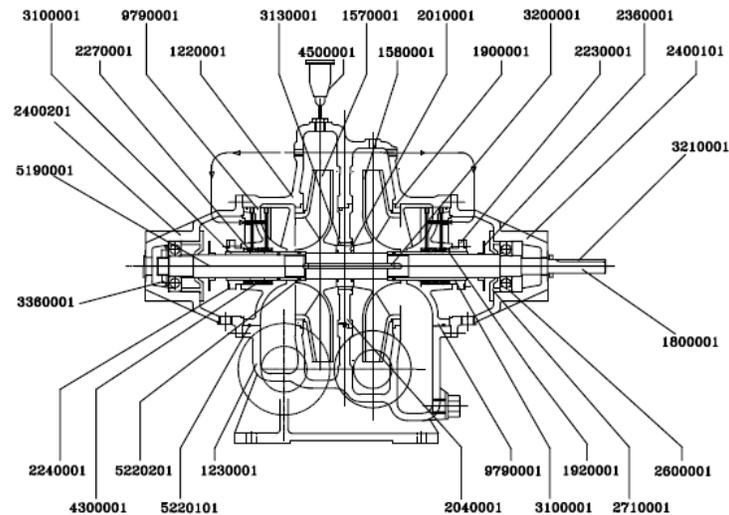
CROSS SECTIONAL ASSEMBLY OF FM/UL PUMPS (MODULE 1 & 2)



PART NO.	DESCRIPTION	MATERIAL DESCRIPTION	QTY
12200	UPPER HALF CASING	CI IS 210-FG 260	01
12300	LOWER HALF CASING	CI IS 210-FG 260	01
15900*	IMPELLER	LT BR IS 318-LTB2	01
18000*	SHAFT	CS IS 1570 - 45C8 HOT RLD	01
19000*	WEAR RING	LT BR IS 318-LTB2	02
19900	SHOULDER RING	CI IS 210-FG 200	02
20700	ST.BOX PACKING RING	MS IS 2062-Fe 410 W A	02
22000	ST.BOX COVER	CI IS 210-FG 260	02
22300*	GLAND	LT BR IS 318 -LT B2	02
22700*	LANTERN RING	LT BR IS 318-LTB2	02
24001	BEARING HOUSING DE	CI IS 210-FG 260	02
24002	BEARING HOUSING NDE	CI IS 210-FG 260	01
26000	BEARING	STEEL	01
31000*	SHAFT SLEEVE	LT BR IS 318-LTB2	02
32000*	IMPELLER KEY	CS IS 1570 - 45C8 HOT RLD	02
32100*	KEY FOR COUPLING	CS IS 1570 - 40C8 HOT RLD	01
33600*	LOCK NUT FOR BEARING	CS IS 1570 - 20C8 HOT RLD	01
43000*	GLAND PACKING	CHAMPION-3116 OR EQ	01
45000	AUTO AIR RELEASE VALVE	CI	01
50000*	OIL SEAL	NEO RBR ST SPRING	01
51900	GASKET	NON ASBESTOS	01
52201*	"O" RING FOR INSERT	NEOPRENE RUBBER	02
52202*	"O" RING FOR SLEEVE	NEOPRENE RUBBER	02
97900	INSERT	CI IS 210-FG 260	02



CROSS SECTIONAL ASSEMBLY OF FM/UL PUMPS (TWO STAGE)



PART NO.	DESCRIPTION	MATERIAL DESCRIPTION	QTY
12200	UPPER HALF CASING	CI IS 210-FG 260	01
12300	LOWER HALF CASING	CI IS 210-FG 260	01
15700*	IMPELLER I STAGE	LT BR IS 318-LTB2	01
15800*	IMPELLER II STAGE	LT BR IS 318-LTB2	01
18000*	SHAFT	CS IS 1570 - 45C8 HOT RLD	01
19000*	WEAR RING	LT BR IS 318-LTB2	02
19200	NECK RING	LT BR IS 318-LTB2	02
20100*	SPACER BETWEEN IMPELLER	LT BR IS 318-LTB2	01
20400*	INTERSTAGE RING	CI IS 210-FG 260	01
22300*	GLAND	LT BR IS 318 -LT B2	02
22400*	GLAND PLATE	ST ST ASTMA276-316 ANLD	02
22700*	LANTERN RING	LT BR IS 318-LTB2	02
23600*	WATER DEFLECTOR	ST ST ASTMA276-316 ANLD	02
24001	BEARING HOUSING DE	CI IS 210-FG 260	01
24002	BEARING HOUSING NDE	CI IS 210-FG 260	01
26000	BEARING	STEEL	02
27100	BEARING COVER	CI IS 210-FG 260	02
31000*	SHAFT SLEEVE	LT BR IS 318-LTB2	02
31300*	INTER STAGE BUSH	LT BR IS 318-LTB2	01
32000*	IMPELLER KEY	CS IS 1570 - 45C8 HOT RLD	01
32100*	KEY FOR COUPLING	CS IS 1570 - 40C8 HOT RLD	01
33600*	LOCK NUT FOR BEARING	CS IS 1570 - 20C8 HOT RLD	01
43000*	GLAND PACKING	CHAMPION-3116 OR EQ	01
45000	AUTO AIR RELEASE VALVE	CI	01
51900	GASKET	NON ASBESTOS	01
52201*	"O" RING FOR INSERT	NEOPRENE RUBBER	02
52202*	"O" RING FOR SLEEVE	NEOPRENE RUBBER	02
97900	INSERT	CI IS 210-FG 260	02



Maintenance Record

Date	Summary of maintenance & repairs done - replacement parts fitted etc.:
	Installed & Commissioned