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# INSTALLATION OPERATION AND MAINTENANCE MANUAL FOR SINTECH VERTICAL MIXED FLOW AND AXIAL FLOW PUMPS

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## WARRANTY

1. SINTECH PRICISION PRODUCTS LIMITED warrants products of its own manufacture only against defects in materials and workmanship under normal use and service for one year from the date of installation, commissioning but not more than eighteen months from the date of shipment from factory which ever is earlier.
2. Our liability in respect of any complaint is limited to replacing part / parts only to the extent that such replacement / repair are attributable to or arise solely from facility workmanship or defective material.
3. Accessories and component not manufactured by SINTECH are warranted only to the extent of the original manufacture's warranty.
4. No allowance will be made for repairs or alteration affected without specific written authorization from SINTECH.
5. The equipment as manufactured by SINTECH is precision machinery. Proper care can give a lifetime of **satisfactory service. Guarantee of performance and warranties** are based on the use of original equipment manufactured (OEM) parts. SINTECH takes no responsibility, when alteration none authorized design changes and / or none OEM replacement parts are incorporated.
6. This warranty is void unless purchases provides proper storage, installs and maintains the equipment in accordance with manufactures instructions.
7. Under the terms of this warranty SINTECH will not be responsible nor liable for-
  - (a) Consequential special looser damages.
  - (b) Equipment condition caused by fair wear and tear, abnormal conditions of use, accident, misuse or neglect of equipment.
  - (c) Labor charges, loss or damage resulting from supplying defective parts or improper repairs by unauthorized person.
  - (d) Damage caused by abrasive materials, chemicals, scale deposit, corrosion, lighting, improper voltage or mishandling.
  - (e) Labor charges for installation or removal or reinstallation of equipment.

Immediately on receipt a complete inspection and accounting against the packing list should be made and accompanying boxes and crates. \_All material is shipped FOB our factory or our vendor's shipping point unless other contractual arrangements are made under these terms; any claim for loss or damage in transit should be made to the delivering freight casing and copy to shipping party.

## NOTE:-

**AS PER THE COMPANY'S POLICY OF CONTINUOUS IMPROVEMENT,**  
**THE SPECIFICATIONS & DATA GIVEN IN THIS MANUAL ARE SUBJECT TO**  
**CHANGE FROM TIME TO TIME WITHOUT NOTICE.**

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## **SINTECH AXIAL FLOW PUMPS AND MIXED FLOW PUMPS**

There are various method of installing axial flow pumps and mixed flow pumps. This general instruction can be adopted to cover any special installation problem by using sound mechanical judgment.

When size permit the pumps are shipped completely assembled ready to set on foundation, for large size the pump bowl unit driver tubing shaft tapered column section straight column section are discharge elbow are shipped disassembled and should be assembled in sequence as suggested below.

### **Instruction For Erection Operation & Maintenance of Vertical Mixed flow and axial flow pumps**

#### **Introduction:**

These vertical mixed flow and axial flow pump are manufactured to close tolerances and rigid Specification. Hence Proper erection and maintenances are equally important to ensure trouble free service.

This manual covers important guidelines and instructions on erection, operation and maintenance. This instruction should be followed carefully failing which may result in the unsatisfactory performance/ damage to the pump.

Only mechanical aspects are detailed in this manual. Civil and electrical engineering details are to be finalized by client.

#### **This manual covers instruction for vertical mixed flow and axial flow pumps pump with following constructional features:**

- 1. Self water lubricated pump.**
2. External forced water lubricated pump.
3. Oil Lubricated pumps.
4. Delivery above ground level.
5. Delivery below ground level.
6. Grease lubricated anti friction thrust bearing.
7. Oil lubricated Mitchell type thrust bearing.

8. Solid shaft motor drive.
9. Hollow shaft motor drive.
10. Right angle gear drive
11. Belt drive

## **2. Pre Requisites for satisfactory working:**

For satisfactory operation, the pump must work under specific condition given below:

- A) The pump handles the liquid as specified in the order.
- B) The pumps operate at the duty point specified in the order.
- C) Minimum submergences is kept as shown in the outline dimension drawing supplied against the order.
- D) Operating & maintenance instruction are followed as given in this manual.
- E) Load of delivery pipe and other accessories such as sluice valve, reflux valve do not come directly on motor stool or pump column.
- F) The erection is carried out by the experienced skilled personal.

Prior confirmation must be taken from the manufacture /supplier, if the pump is to be used for the condition other than specified in the order.

## **3. PUMP HOUSE LAYOUT.**

The layout of pump station involves consideration of:

### **3.1 Water inlet to the sump:**

The water inlet to the sump is to be located as to make provision to avoid.

- 1.1 Turbulence
- 1.2 High velocity
- 1.3 Silt deposition
- 1.4 Air entrainment

Difference between the levels of inlet source and sump water level and sump dimension for satisfactory operation of pump, Please refer fig 1, 2, 3&4

### **3.2 Suction sump:**

The sump should be so designed as to provide:

#### **3.2.1 Enough water storage capacity to avoid:**

- 2.1.1 Sudden fluctuations in water levels.
- 2.1.2 Kinematics disturbances at the bell mouth such as turbulence, eddies, vortices etc.
- 2.1.3 Air entrainment.

### **3.2.2. Low water velocity:**

The maximum water velocity in sump should not exceed one meter per second in any case normally this is achieved by-----

- 2.2.1 Drawing the water from the source in the direction opposite to that of the source of flow.
- 2.2.2 Looping the flow drawn.
- 2.2.3 Baffling the flow passages.
- 2.2.4 Avoiding difference in the level of source of water and sump water. For this the intake pipes or channels of enough cross- sectional are to be provided.

### **3.2.3 Minimum or No silt deposition:**

As far as possible silt deposition should not be permitted in the sump.. however where deposition is unavoidable the maximum deposition level should be maintained at least one diameter length below at the end of the bell mouth (in case of strainer).

### **3.2.4 Individual flow pattern:**

Where one sump is having more than one pump set every pump should have its individual flow pattern undisturbed by the other. While locating the pump in the sump, Minimum distances from walls floor and adjacent pipes as given by manufactures should be maintained.

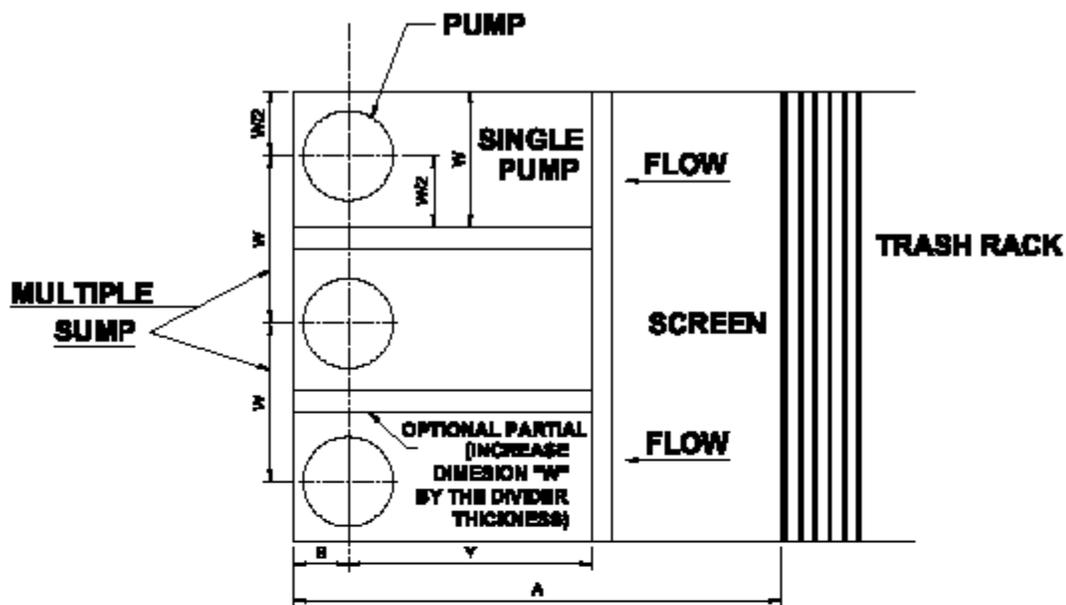
### **3.2.5 Pump submergence:**

The lowest water level in the sump should keep the lowest bowl submerged in order to avoid air entering the bell mouth & forming vortices. How ever submergence depends upon the pump capacity. The minimum submergence to be kept is shown in the outline drawing supplied against the order. The maximum level in the sump should be lower than the pump floor level i.e. during the floods.

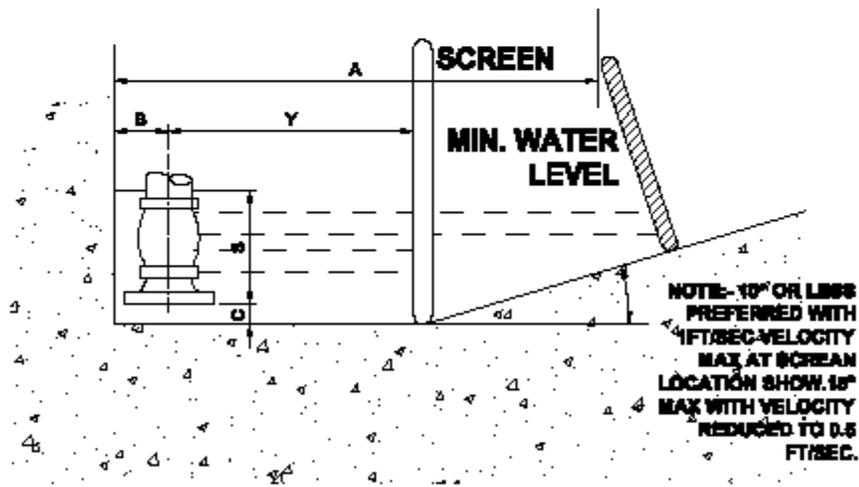
### **3.3. Pump house Requirement:**

These cover mainly the following aspects

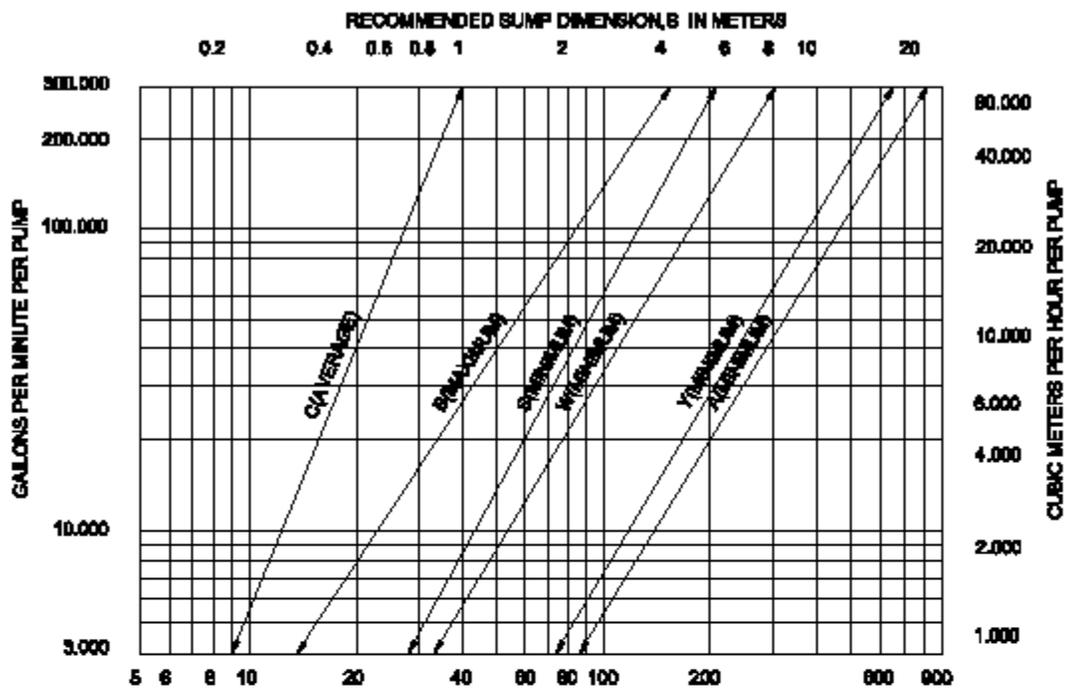
- 3.1 Strength of the building.
- 3.2 Sufficient floor area for working and overhauling
- 3.3 Sufficient head room for erection
- 3.4 Ventilation.
- 3.5 Provision for store room.



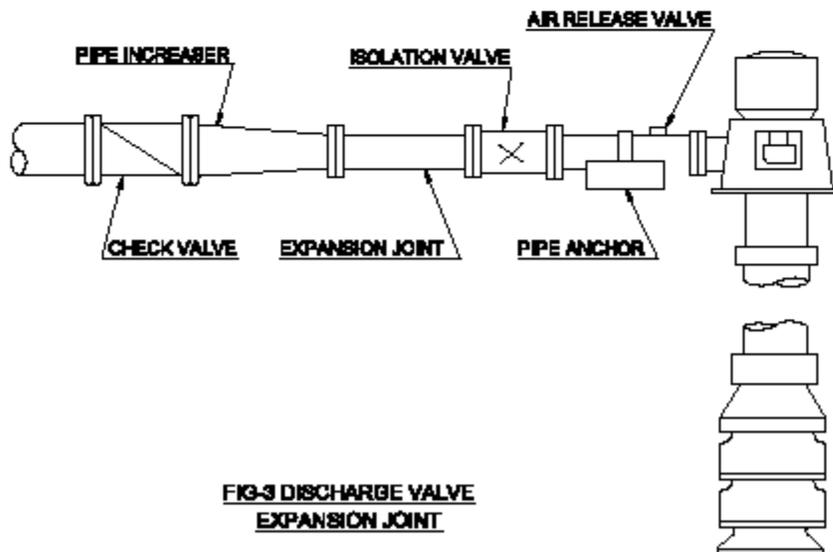
SUMP DIMENSION,  
PLAN VIEW, WET  
PIT TYPE PUMPS.



**FIG-1 SUMP DIMENSIONS, ELEVATION  
VIEW WET PLT TYPE PUMPS.**



RECOMMENDED SUMP DIMENSION, S IN METERS  
 FIG-2 SUMP DIMENSIONS VERSUS FLOW.



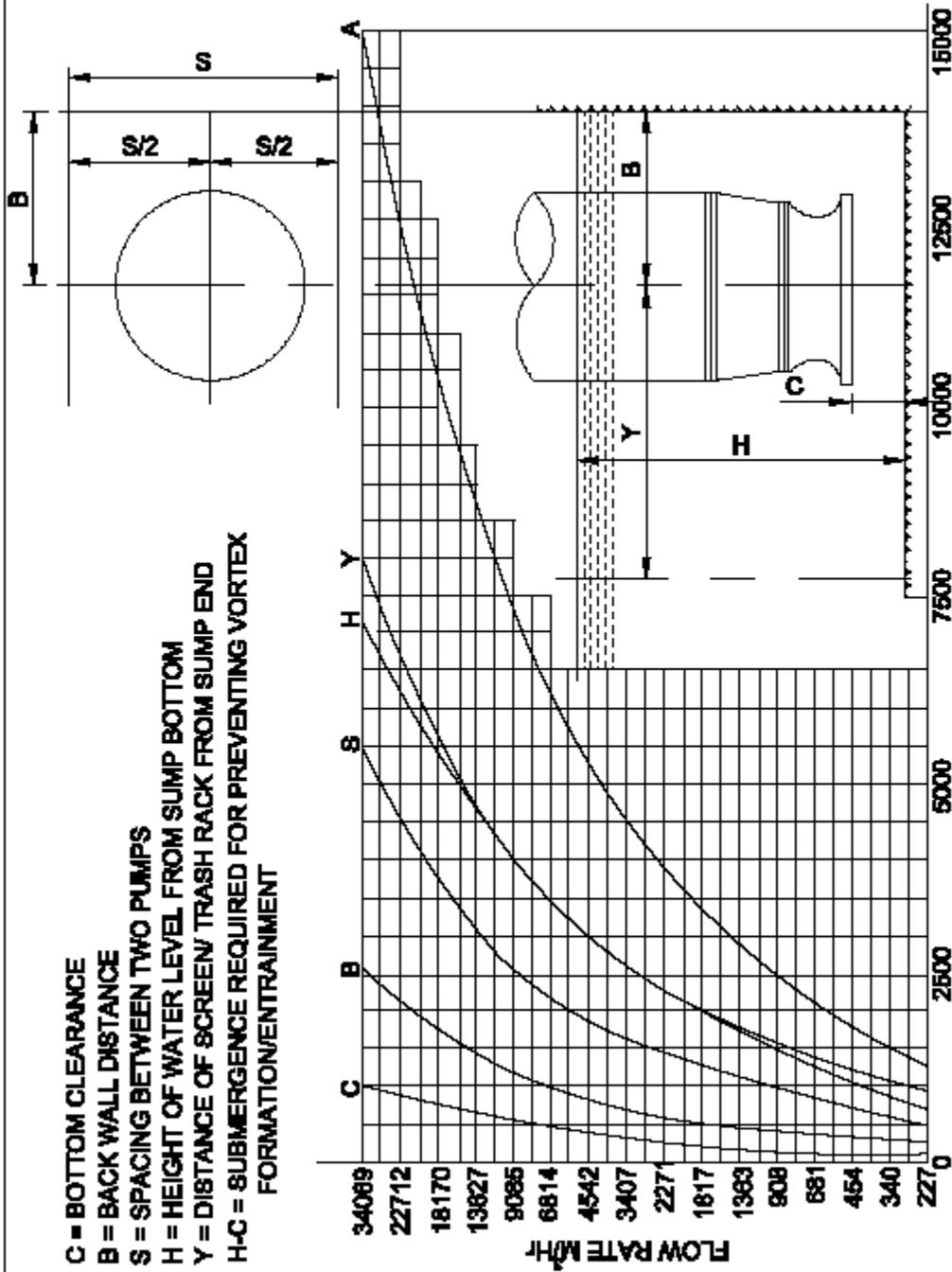


Fig-4:- Recommended sump Dimension-mm  
 Sump Dimensions vs. flow.

### **3.4. Drawing:**

Before proceeding with instruction for pump erection laid down in following pages. it is advisable to study the drawing of vertical turbine pump/fig 5, 6,7,8,9 & 10 which cover all part and their assembly as well as name of all parts. This will make easier to understand the erection procedure.

### **5. Storage and handling:**

#### **A. On receiving the material:**

(To avoid damages during transit the pump is supplied in partially assembled condition)

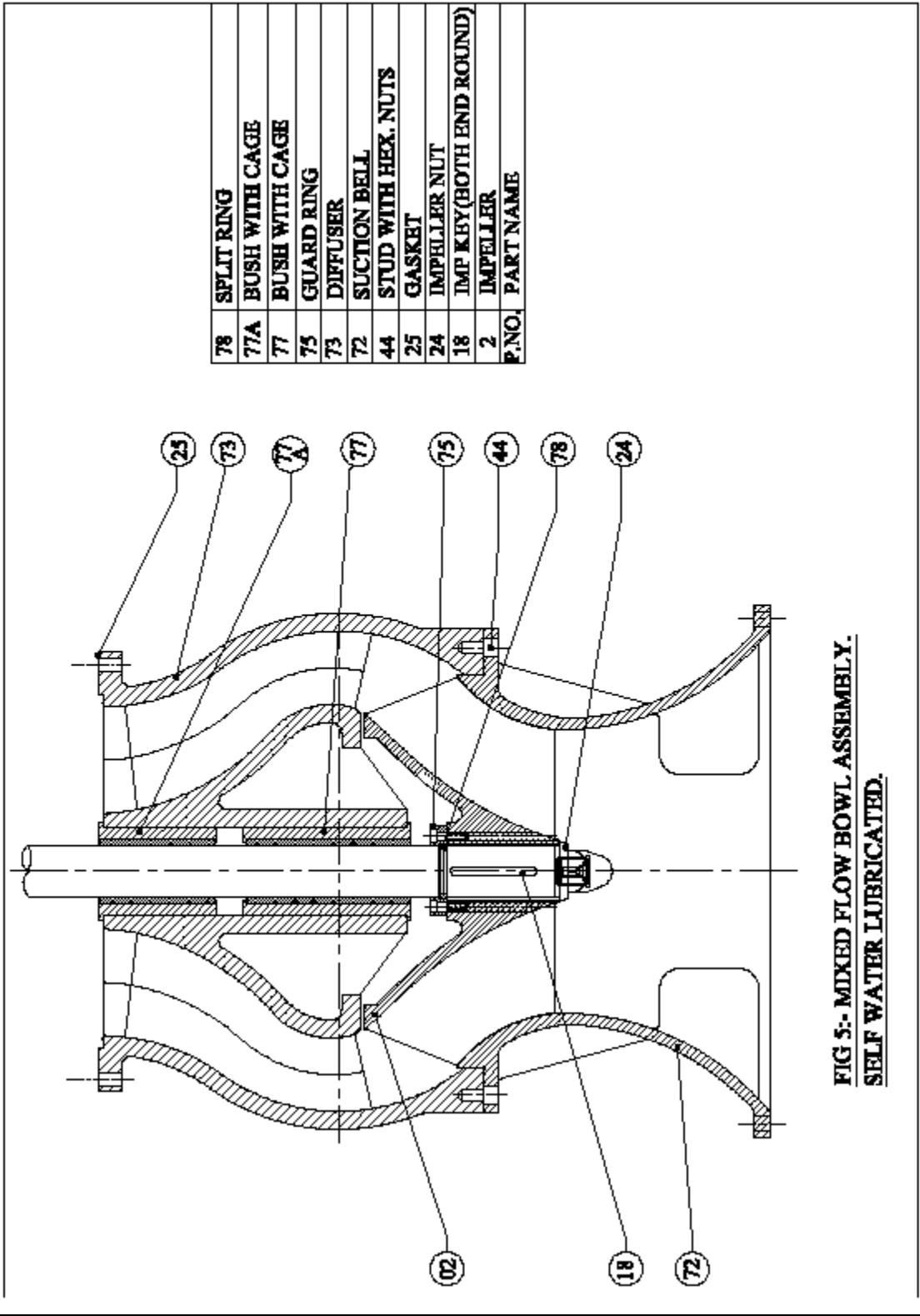
1. Check that all packages are intact and that open parts are not damaged in transit.
2. Open the packing & check content of each packing against delivery note packing list.
3. Check specifically line shaft and verify that these are not bent and are in good condition.
4. Report immediately discrepancies, if any to the supplier.
5. Unless the pump is to be installed immediately repack the material in respect vie cases after the content have been verified.
6. Do not open the package again unless ready for erection.

#### **B. Storage:**

(a) Storing place should be adequately clean. Store room should have sufficient space for movement and stacking of material. The floor of the store room should be hard and plain.

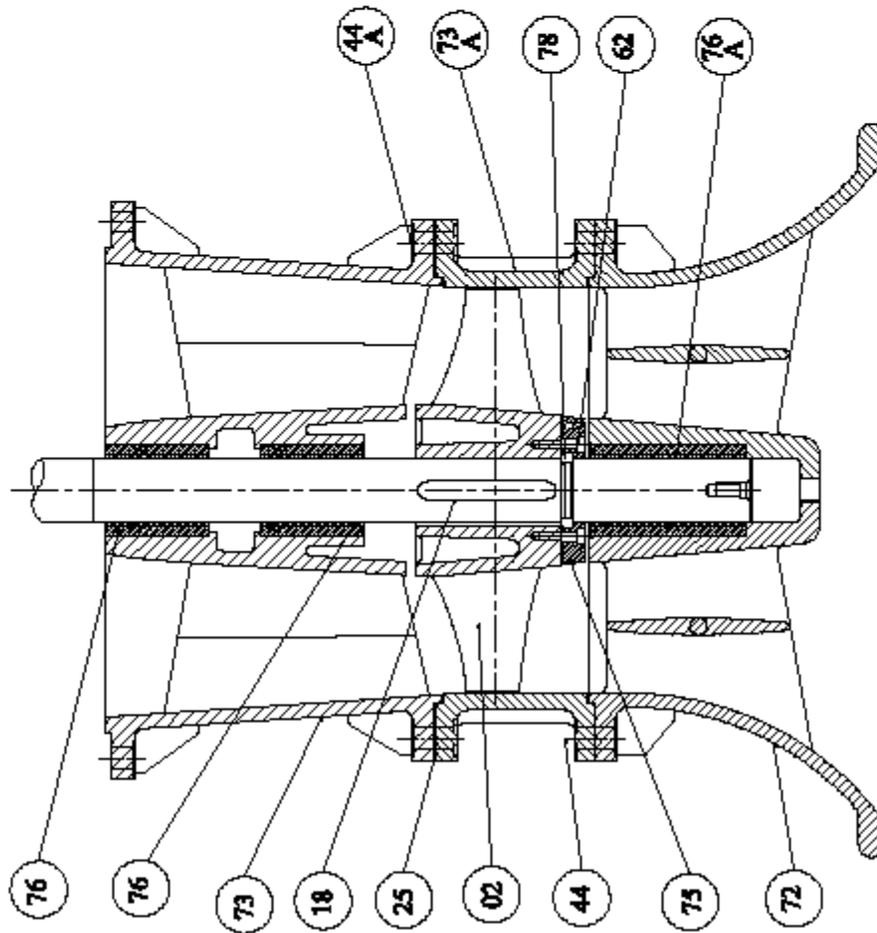
(b) Do not place the package one cover other inconveniently. Keep the parts on wooden logs and properly leveled.

(c) Keep the parts in the proper sequence so that during erection they can be taken out in an orderly fashion.



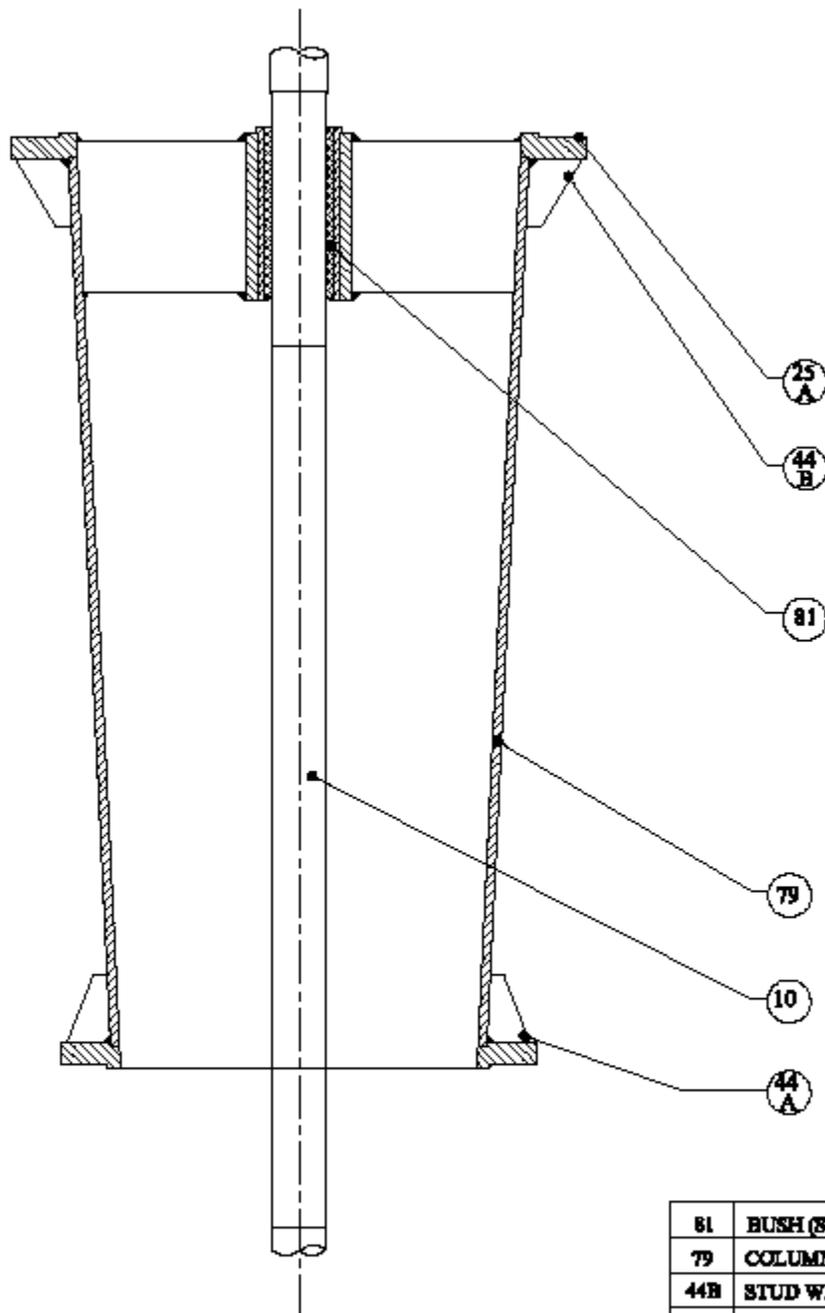
78	SPLIT RING
77A	BUSH WITH CAGE
77	BUSH WITH CAGE
75	GUARD RING
73	DIFFUSER
72	SUCTION BELL
44	STUD WITH HEX. NUTS
25	GASKET
24	IMPELLER NUT
18	IMP KBY(BOTH END ROUND)
2	IMPELLER
	P.NO.
	PART NAME

**FIG 5-- MIXED FLOW BOWL ASSEMBLY.  
SELF WATER LUBRICATED.**



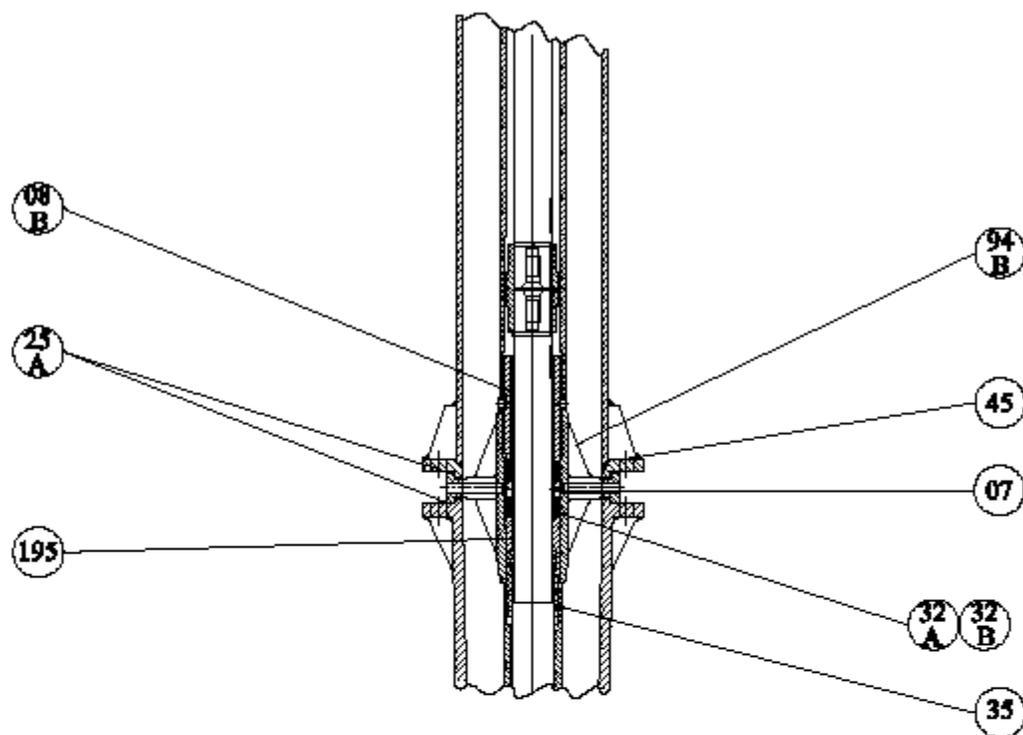
78	SPLIT RING (SET)
76A	RUBBER BUSH (SUCTION BELL)
76	RUBBER BUSH (DIFFUSER)
75	GUARD RING
73A	PROPELLER CASING
73	DISCHARGE BOWL
72	SUCTION BELL
62	ALLEN CAP SCREW
44A	BOLT WITH NUT & SP. WASHER
44	BOLT WITH NUT & SP. WASHER
25	GASKET
18	IMP KEY (BOTH END ROUND)
02	PROPELLER
P.NO.	PART NAME

**FIG 6:- AXIAL FLOW BOWL ASSEMBLY.**



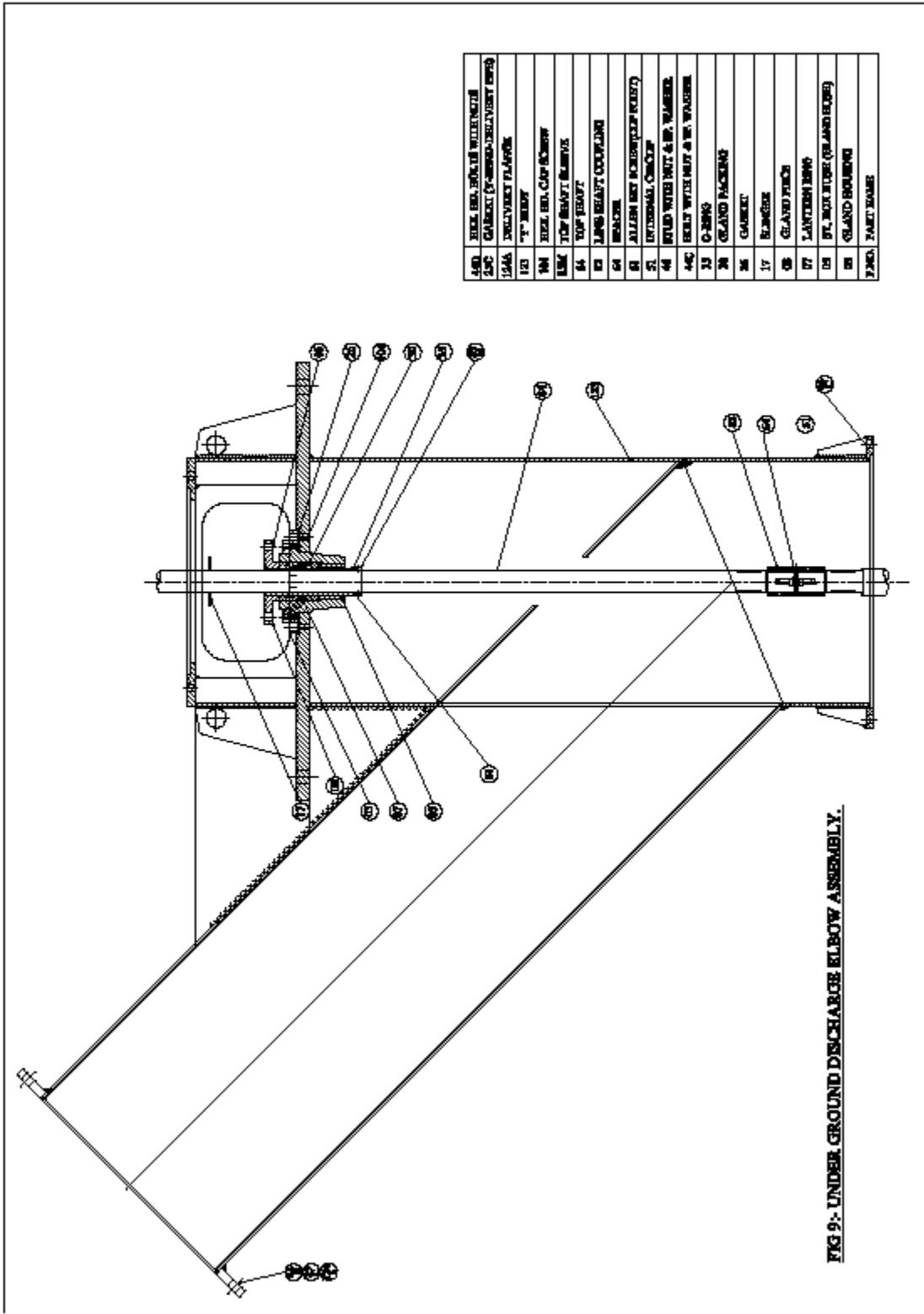
**FIG 7A:- COLUMN ASSEMBLY  
WATER LUBRICATED.**

81	BUSH (SPIDER)
79	COLUMN PIPE (TAPER)
44B	STUD WITH HEX. NUTS
44A	HEX BOLT WITH NUTS
25A	GASKET
10	PUMP SHAFT
P.NO.	PART NAME



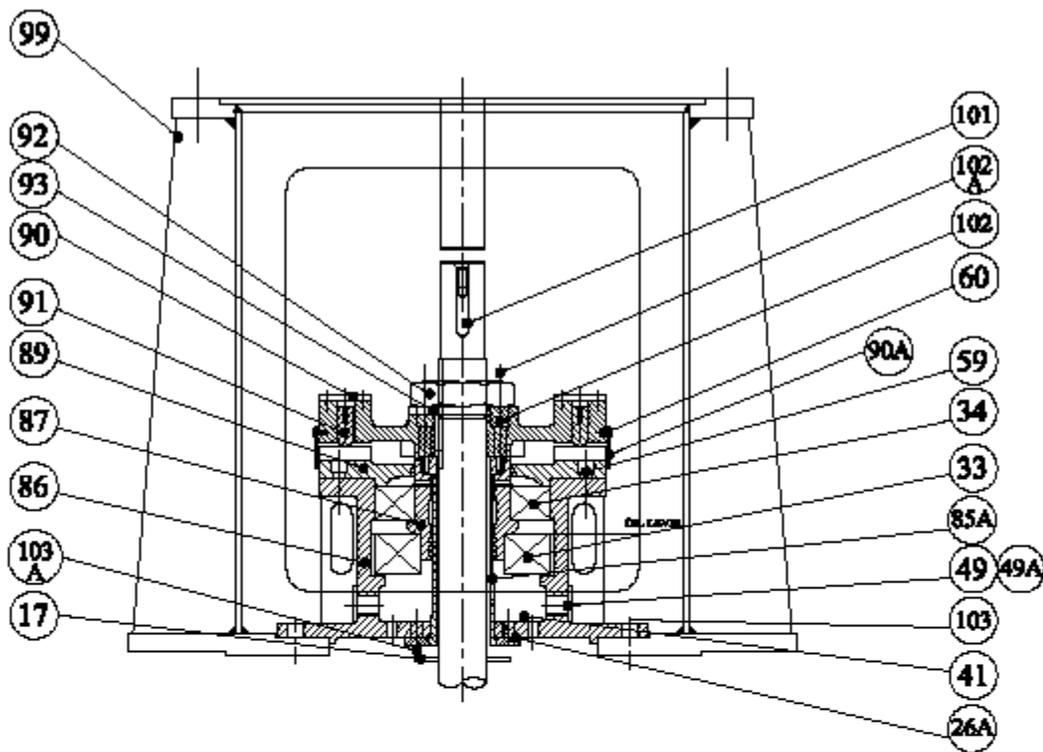
08B	TUBE CONNECTOR BRG.
25A	GASKET
195	THYROIDAL BUSH
94B	BOTTOM SPIDER
45	HEX. BOLTS WITH NUTS & SP. WASHER
07	LANTERN RING
32A	"U" TYPE CUP SEAL
35	"O" RING
<b>P.No.</b>	<b>PART NAME</b>

**FIG-7B ENCLOSED LINE SHAFT  
OIL LUBRICATED FLANGED COLUMN**



148	SEAL, RING, WATER TIGHT
149	GASKET, O-RING, TIGHTENING RING
150	INFLUENT FLANGE
151	"T" BRIDG
152	SEAL, RING, CAP COVER
153	TOP SHAFT BEARING
154	TOP BEARING
155	LAMP BEARING COUPLING
156	BRACKET
157	ALLIUM RING ASSEMBLY (SEE 157)
158	OPTIONAL CHECKUP
159	WELD WATER TIGHT & W. WALKER
160	SEAL, WATER TIGHT & W. WALKER
161	O-RING
162	GASKET PACKING
163	GASKET
164	BRACKET
165	GLAND PINCH
166	LANTERN RING
167	BT, BOX TUBE (GLAND BEARING)
168	GLAND BEARING
169	PANEL NAME

**FIG 9:- UNDER GROUND DISCHARGE ELBOW ASSEMBLY.**



103A	HEX. HD CAP SCREW
103	HEX. HD CAP SCREW
102A	HEX. HD CAP SCREW
87	BRG. SLEEVE
86	BRG. HOUSING
93	GIB KEY
92	TOP ADJUSTING NUT
91	RATCHET PIN
90A	BELT (FOR RATCHET COVER)
90	RATCHET COVER.
89	RATCHET
17	SLINGER
P.NO.	PART NAME

102	ALLEN CAP SCREW
99	MOTOR STOOL
101	PUMP COUPLING KEY
85A	OIL SLBBVE(BEARING)
60	HEX HEAD CAP SCREW
59	ALLEN CAP SCREW
49A	OIL PLUG
49	OIL LEVEL INDICATOR
41	OIL DRAIN FLUG
34	HBARING
33	BEARING
26A	GASKET
P.NO.	PART NAME

**FIG 10:- THRUST STAND ASSEMBLY.**

### **C. Handling:**

1. All machined parts are coated with a special antirust coat. if any parts is found exposed clean it and apply a thick coating of grease or anti rust compound and then wrap it with wax paper to prevent further rusting .
2. Never try to drag any part or package of parts for any reason. Dragging sets in intrinsic vibration which distorts the accuracies parallelism etc of machined surface distortion of accuracies might cause serious functional and operation troubles.
3. Over hanging should be avoided as far as possible. While lifting the part by the ropes they should be properly balanced.
4. Transportation should be free from jerks long parts be handled without due supports.
5. Open parts must be transported on soft and well supported bedding to prevent scratches.

**Note:** Care must be exercised in handling of all parts particularly the shaft, column pipe enclosing tubes. They are machined to close tolerance and carefully, inspected at factory and if bent can cause trouble bent shaft or pipe should never be installed in the well.

### **3.6 Equipment and Tools-:**

1. Overhead Crane / chain Pulley Block:

The Crane/ chain pulley blocks should be of ample capacity to take the load of the complete. Pump. There should be a minimum clear height between foundation & top most position of pulley block as indicated on outline drawing supplied against the order to facilitate easy erection. The pulley block should have the lift of 5-6 meters and the hand chains provided should be long enough to operate it conveniently from the floor.

2. Chains & lifting hooks, shackles
3. Jute ropes crow bars and small pipes for leverage.
4. Light but accurate straight edge.
5. Spirit level having the accuracy of 0.02mm / meter.
6. Kerosene and thinner for cleaning of parts.
7. Threading compound to prevent rusting.
8. Feeler gauge and shims for adjustment of level.
9. "V" blocks and dial gauge with magnetic stand to check the trueness of the shaft etc.
10. Small wire brush for cleaning of thread of shaft and coupling.
11. Lubricant oil required for erection.

12. Special spanners and clamps for erection are generally supplied against specific order and depending upon type of pump supplied.
  - a. 2 pairs of clamps of column shaft.
  - b. One pair of clamps for shaft enclosing tubes.
  - c. One eye bolt for head shafts.
  - d. One set of clamps for line shafts.
  - e. One spanner for impeller nut.
  - f. One spanner for thread barrel coupling.
  - g. One spanner for line shaft
  - h. One spanner for nuts of thrust collar.
  - i. Two spanners for coupling shafts.

**Besides, above the erector must have the following standard tools equipment for smooth erection:**

1. Files triangular half round & flat.
2. Triangular scraper.
3. Two sets of standard or ring spanners
4. Adjustable spanner screw drivers of 300 mm (12") and 150 mm (6")
5. Steel rule tape.
6. Hand drill
7. Set of taps and dies up to 25mm (1")
8. Chisel machinist hammer, hacksaw vice etc.
9. Emery paper grease gun thin rolled sheets of brass 0.03 to 0.005 mm thickness for cutting shims

### **3.7 Foundation**

The foundation layout & design should be considered from the following aspects:

#### **1. Foundation**

- A. Foundation is required for sintech vertical pump. The foundation must be enough built to support the weight of the entire pump full of water and should be rigid enough to withstand and prevent vibration simple but substantial concrete foundation should be built around the well casing at the surface. The casing should not be extended above the top of the foundation and

space must be provided is the foundation to receive the projecting hub or pipe flange at the bottom of discharge head.

### **SUB BASE (SOLE PLATE) :**

Sub base and sole plate is common term in use to describe a general class of solid steel plates mounted in grout (or bolted to steel structures) at the pump foundation surface.

1. Remove the sub base from the pump discharge head when shipped assembled.
2. Completely clean the underside of sub base. It is sometimes necessary to coat the underside of the sub base with an epoxy primer.
3. Remove the rust preventive solution from the machined top side with an appropriate solution.

### **SITE WITH CONCRETE FOUNDATION:**

1. A pump house should have sufficient space for operation, maintenance and inspection.
2. Sub-base mounted pumps are manually grouted on a concrete foundation, which has been poured on a solid footing. The foundation must be able to absorb any vibration and to form a permanent, rigid support for the pumping unit.
3. The foundation must be of a sufficient Strength to support the complete weight of the pump plus the weight of liquid passing through it. A typical installation will have bolts with a pipe sleeve 2½ times the bolt diameter embedded in concrete. Bolts should be sized and located in accordance with the dimensions given in the certified pump outline drawing, if provided the pipe sleeve allows movement for the final positioning of the foundation bolts to conform to the holes in the sub-base flange. (fig.-11)
4. Remove water and / or debris from anchor bolt holes / sleeve prior to grouting. If sleeve type bolts are being used, fill the sleeve with packing or rags to prevent grout from entering.
5. Carefully lower the sub-base on to the foundation bolts hand tightens the nuts.
6. Leveling sub-base / sole plate may be done by several methods. Two common methods are :-
  - (A) Using level wedges (Shown in fig-12.).
  - (B) Leveling nuts on the anchor bolts regardless of the method, a machinist level must be used for leveling.

### **NOTE:-**

When using a machinist level, it is important the surface being leveled is free of all contaminants, such as dust, to ensure accurate reading.

7. Level the sub-base in two directions at 90 degree on the machined surface. The levelness tolerance is 0.005 inches per foot for commercial and 0.001 inches per foot for API.

(C) Using level wedges (Shown in fig.-12)

- (D) Leveling nuts on the anchor bolts regardless of the method, a machinist level must be used for leveling

### **SUB-BASE GROUTING:-**

1. Inspect foundation for dust dirt, oil, chips, wolver etc and remove any contaminants. Do not use oil based cleanness as grout will not bond to them.
2. Build dam around the foundation (See fig.-12). Thoroughly wet foundation.
3. Pour grout between sub-base and concrete foundation, up to the level of dam. Remove air bubbles from grout as it is poured by pudding. Using a vibrator or pumping the grout in the place. Non shrink is recommended.
4. Allow grout to set at least 48 hours.
5. Tighten foundation bolts.

### **II. for Sump:**

The foundation lay out design should be considered from the following aspects.

#### **3.7.1 Dimensional Requirement:**

- 1.1 The location and grouting of the foundation bolts should be marked out as per location drawing which is supplied n advance. Pumps mounted on girders < the foundation bolt holes should come on the beam center.
- 1.2 The foundation opening should be large enough so that the bell mouth and outlet "T" will pass easily through the bore.

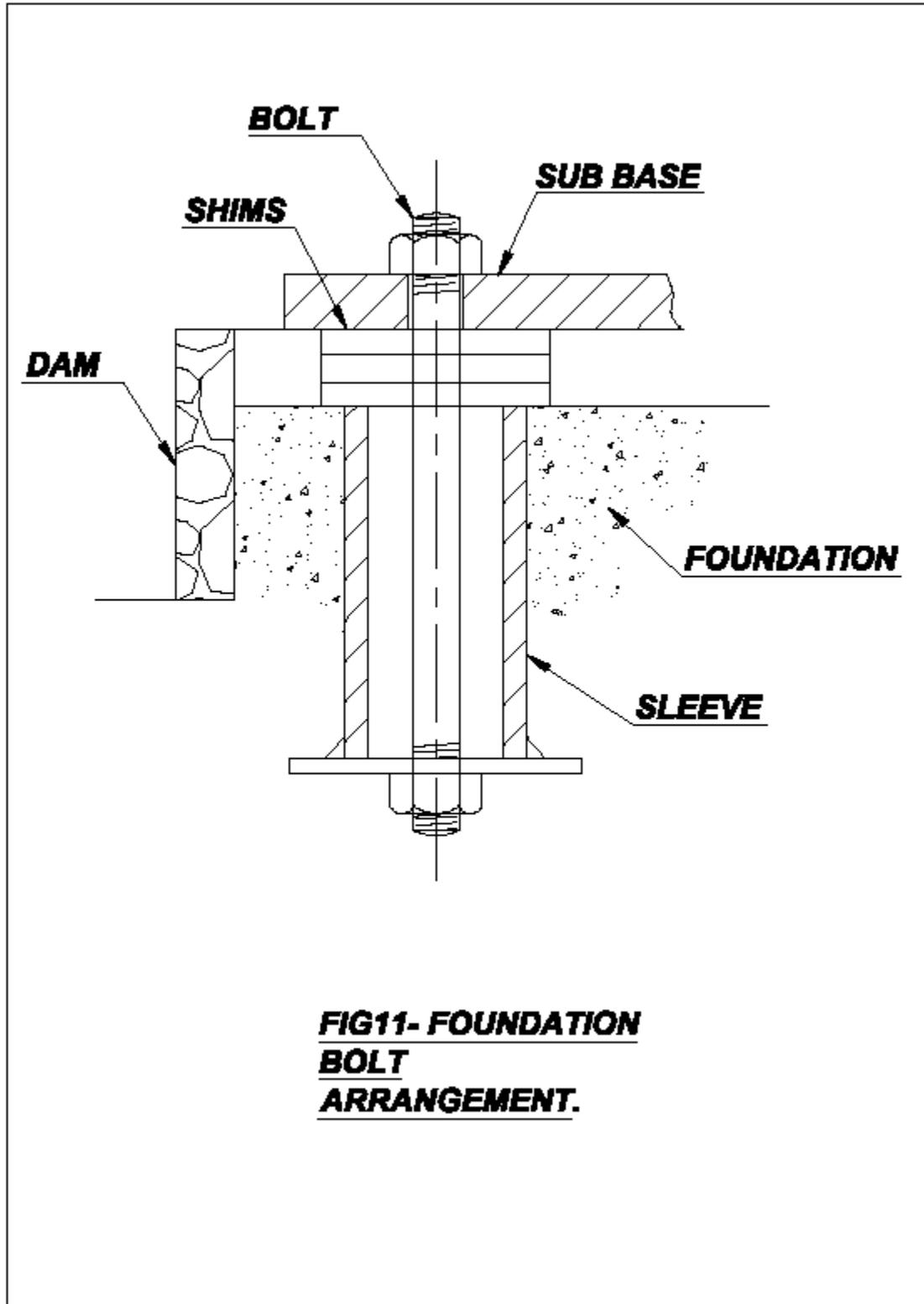
#### **3.7.2 Strength of foundation:**

- 2.1 The foundation should be sufficient strong to take load of motor Tea to absorb any vibration and to from a permanent rigid support. The weight of the pump is given in G.A drawing. The total load is borne by foundation plates/ base plate in order to take this load (including safety foundation plate should be welded to the reinforcement of the concrete. Foundation plates should not lose or form pockets with the parent foundation.
- 2.2 For the pumps mounted on girders, the foundation plates should be properly welded on girders should be firmly embedded in the walls of the house.

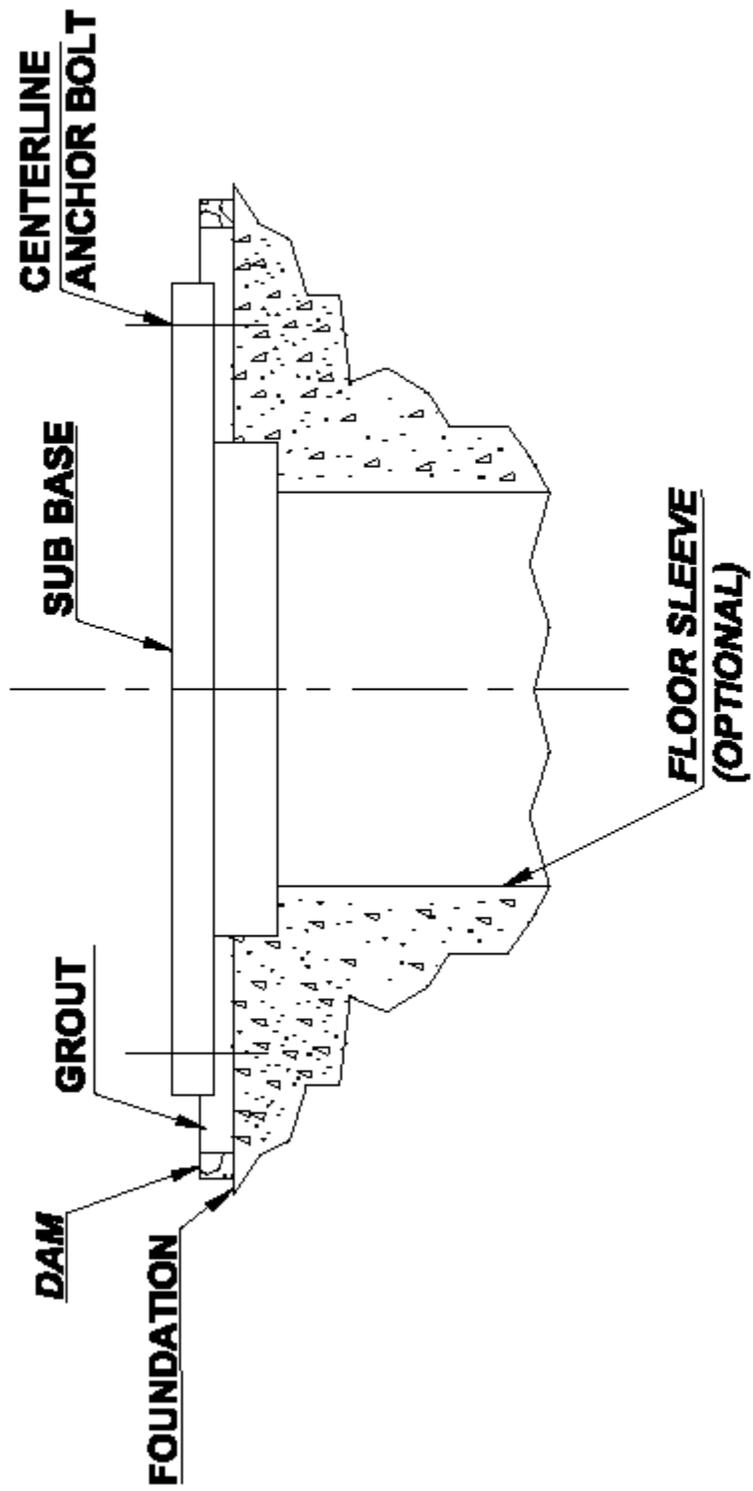
#### **3.7.3 Leveling the foundation:**

- 3.1 The guidelines about to check the level of the foundation plates individually and in combination.Fig.12

The top surface of the foundation plates should be leveled to the accuracy of 0.05 mm/ m all foundation plates should be adjusted for height leveled by putting shim below it. Other foundation plates should be leveled with respect to this foundation plates with help of straight edge and spirit level.



**FIG11- FOUNDATION  
BOLT  
ARRANGEMENT.**



**FIG-12 GROUTING  
AND LEVELING OF  
BASE PLATE.**

The straight edge used for checking the level should be long enough to cover the entire cross length of the foundation plates and it should not rest anywhere but on the machined surface of the foundation plates.

### **After pouring the concrete:**

- 3.2 Before allowing the concrete to set check the level of the foundation plates individually and in combination as there is a possibility of distortion while pouring the concrete.
- 3.3 After setting of the concrete recheck the level of the surface of foundation plates bring the sole plates in level to the accuracy of 0.05 mm/m by grinding or scraping if the distortion is taken place due to setting.
- 3.4 For the pumps mounted on girders, similar check about individual I and in combination level to be made before and after welding of the foundation plates to the girders.

(If the foundation plates procured by the client directly at their and then ensure that foundation plates are machined to close tolerance.)

### **3.5 Due to Resetting:**

After the installation is completed and the operation is commenced it is likely that the concrete supports suffer deformations due to resting. This can happen due to the internal stresses in the concrete which get relieved with time and due to operating condition. Hence frequent check is needed on the level of the foundation plates on which the entire pumps assembly is mounted and the alignment of the delivery pipe line and delivery "T" are not disturbed. During the readjustment of level or alignment of delivery flanges use of shims may be necessary. In such cases surface contact between the foundation plates shims and lower motor stool should be ensured.

#### **3.7.4 Connecting to the delivery pipe line:**

After mounting the lower motor stool on the foundation plates delivery pipe flange should perfectly match with flange of outline pipe. Alignment is not perfect it will disturb the pump. Due care should be taken to see that load of delivery piping and accessories such as sluice valve etc is not coming on pump column / motor stool separate firm support should be given to delivery pipe and accessories. For underground discharge elbow the opening should be large enough to permit passage of the discharge elbow. The pump can be supported at the base plate with I beam. In order to take the load of pump the foundation plate should be firmly grouted in the concrete or bolted with I beam it should not be loose.

#### **Note:**

When a belt driven pump is installed on beam or timbers the driver should always be parallel to the beam never at right angle.

## **4. INSTRUCTION FOR PUMP INSTALLATION:**

### **GENERAL**

Inspect or check report of well before starting installation of pump to standing at letter stage. Sintech pumps are designed for operation only with all parts in correct alignment. The well must be free of sand and casing per formation should not be closed the new pump should not be used to develop and test the tube well. Examine whether well is straight enough to permit the column shafting and bowl assembly to hang vertically in the well. Check well suitable diameter to accommodate the pump. Check the total depth of the well and water level.

The pump must be installed in the well or sump so that it is submerged in water. Check whether well is capable of delivery the quantity of water necessary to supply to pump. The pump should not be permitted to run otherwise serious damage may occur. The water must be free of gas from underground and be tested for purity. Air or gas in water may result in a result in reduced capacity or unbalanced condition that sets up vibration which may result in damage to pump. Completely remove oil from water surface by skimming as oil may damage rubber bearing in pump.

No Guarantee can be made by sintech

1. if pump handles liquid other than clear fresh non aerated water at a temperature not exceeding 30 c
2. If pump is handling sand or other material and is damage by erosion corrosion electrolysis or graphitization.
3. If the pump is installed in well which has and is of not sufficient diameter to provide proper clearance so that pump can hung free and plumb in well.
4. If section pressure at the lowest impeller drops below atmosphere pressure.
5. If motor or engine speed is slow for reason beyond control.

#### **4.1 INSTALLATION AND START UP CHECK LIST:**

1. Verify the pump foundation head sub base/sole plate is level within 0.005 inch per foot (0.375 mm per meter) of diameter note that on API units level requirement is 0.001 inch per foot (0.075 mm per meter) of diameter.
2. Inspect the foundation to determine whether it appears adequately designed to handle the weight and loading if the pump. Note that sintech does not design foundation and is not responsible for foundation failures.
3. Insure that the head sub base sole plate etc. is properly grouted using high quality non shrink grout. This can be verified by sounding the foundation.
4. Insure oil anchor bolt are tight.
5. Insure that discharge piping is properly supported and there is no excess nozzle loading on the discharge flange. Verify this by loosening and then checking freedom of flange bolting.
6. Insure that all valves operate freely and are properly installed for direction of flow also insure that they have the proper pressure rating.
7. Verify where the pump page is going and system is lined up for the test.
8. Verify that the pump page supply will be continuously available for the duration of test. it is very important that the initial rum is for at least ten minutes duration in order to completely flush the pump.
9. If possible verify the cleanliness of the pump page and piping. If on hand during installation insure that the sump well and piping are clean.
10. Verify that the drivers (motor, grease engine etc.) are properly lubricated before start up on drivers with grease lubricated motor bearing check and re grease motor bearing.
11. Determine the allowable number of cold/ not starts with the motor manufacturer / supplier. This very important especially during initial start up when number of start /stop have to be worked oil of the system and control. The general rule of thumb is two cold or one not start per hour. Exceeding the recommend start break downs the motor insulation and can cause failure.
12. Prior to coupling the driver to the pump verify proper rotation of the driver by 'bumping' it. Note that the proper rotation for our vertical pump is CCW when viewed from top. In additional to verifying rotation run uncoupled to insure that the driver runs smooth and sounds normal. Note that on units with VHS motors, must remove the drive shaft, if coupling is provided on drivers with NRR'S, remove ratchet pins, if possible, otherwise rotate the drive coupling clockwise until pin stops tight against ratchet plate.

13. Only after verifying the proper rotation of the drivers, proceed with the coupling of the pump to the driver. On VSS units with flanged coupling, set the impeller lift using adjusting nut a top the motor after making up the threaded coupling.

#### **4.2 Preparatory for erection:**

##### **Cleaning of parts:**

During transit and storage of equipment after it has reached destination considerable dust and foreign material may have lodged on the various parts of the pump. After the equipment has been taken to site and just before erection all parts must be cleaned with great care, some of the precautions that must be observed are as follows.

##### **General:**

The entire machined surface should be cleaned with kerosene/ thinner to remove the antirust coat applied.

##### **Pump unit assembly:**

Rotate the impeller shaft by hand to see that impeller is free and rotating properly. Pull the shaft and press it back again. The shaft should move freely if there is no damage or dislocation in the bowls.  
If pump unit is stored for long period of time, check gland packing in the pump assembly under bearing housing of oil lubricated pump only. If it has dried up replace the same.

##### **Column Unit:**

###### **1. Shaft:**

The threads on shaft and coupling should be cleaned with kerosene/ thinner using a wire brush or old tooth brush.

###### **2. Shaft Enclosing Tubes /pipes:**

Clean the shaft from inside with the help of long stick wound cloth.

###### **3. Rubber bearings:**

The rubber bearing are to be cleaned with clear water. In any case these rubber bearing should not come in contact with oil grease or paint.

###### **4. Metallic bearing:**

The machined surface should be cleaned to remove anti-rust coat the oil grooves should be free from dirt & metal particles

###### **5. Head unit:**

###### **(A) Motor Stool:**

Clean the discharge head/ lower motor stool removing all dirt especially around the water way section. For oil lubricated model, check all connections for tank feed line. The parts required are:

1. Oil tank
2. Solenoid valve (if ordered)
3. Oil feeding valve
4. Plastic pipe
5. G.I Pipes

###### **(B) Thrust bearing Housing:**

Thrust Bearing housing to be cleaned thoroughly. Thrust bearing housing and bearing parts should be absolutely free from dust particles, hence these are to be suitably lubricated till they are actually used in the assembly.

###### **(C) Cooling coil/ other pipe connection for the pump with Mitchell thrust are bearing:**

Cooling coil should be checked with water connection for leakage and blockage. Other pipe connection also should be flushed and checked for leakage etc.

ALL THE BURRS AND SHARP EDGES FOR MACHINE SURFACE SHOULD BE REMOVED WITH SCRAPER OR SMOOTH FILE.

#### **4.3 Checking:**

Through all the parts are duly packed while dispatching from works, there is a possibility of bending of shaft and damage to the threaded and machined portions during transit. Hence following checks should be made.

1. Threaded portions of shaft and coupling are not damaged.
2. Threaded barrel coupling fits properly on the shaft. Coupling is not too tight or too loose on the shaft.
3. All the shaft to be checked for run out with help of "V" block and dial gauge or preferably on center lathe if available. The shaft run out should not exceed 0.08 mm at bearing portions and 0.125 mm on the other portions.

#### **Care to be taken during erection:**

1. Threaded portions of shaft and coupling are not damaged.
2. Avoid use of hammer.
3. Ensure perfect matching of contact surfaces.
4. Each and every part should be free from high points, burs, dust etc
5. Take care that no parts is left out through oversight every single item. However small has an important role in the proper function of the pump.
6. Take care that no foreign substance is dropped or left inside. It will get stick up and cause jamming.
7. While fitting the rubber rings care should be taken not to twist them or stress the joints. The rings prevent hydraulic leakage and hence their non- twisting is important (following method of fitting of rubber ring is convenient hold one side of the jointing in the hand and insert the opposite portion of the ring in the groove. Apply light tension along the ring a gentle pull by fingers and place it in position last.)
8. All tools equipment should be kept ready before starting the erection. Cross sectional drawing and erection instructions should be referred to during erection.
9. Erection should be done by specialized experienced personal.

#### **4.4 INSTALLATION PROCEDURE (PUMP UNIT ASSEMBLY OIL LUBRICATED):**

A. Care must be taken in handling and installing all parts particularly the shaft and tube, these are machined to close tolerances for accurate alignment and they must not be spring or bent mistreatment.

B. layout parts on suitable timber. The tube and shaft assembly should be placed inside the column section. Take care shaft bearing are not damage which serve as coupling for the length of tube.

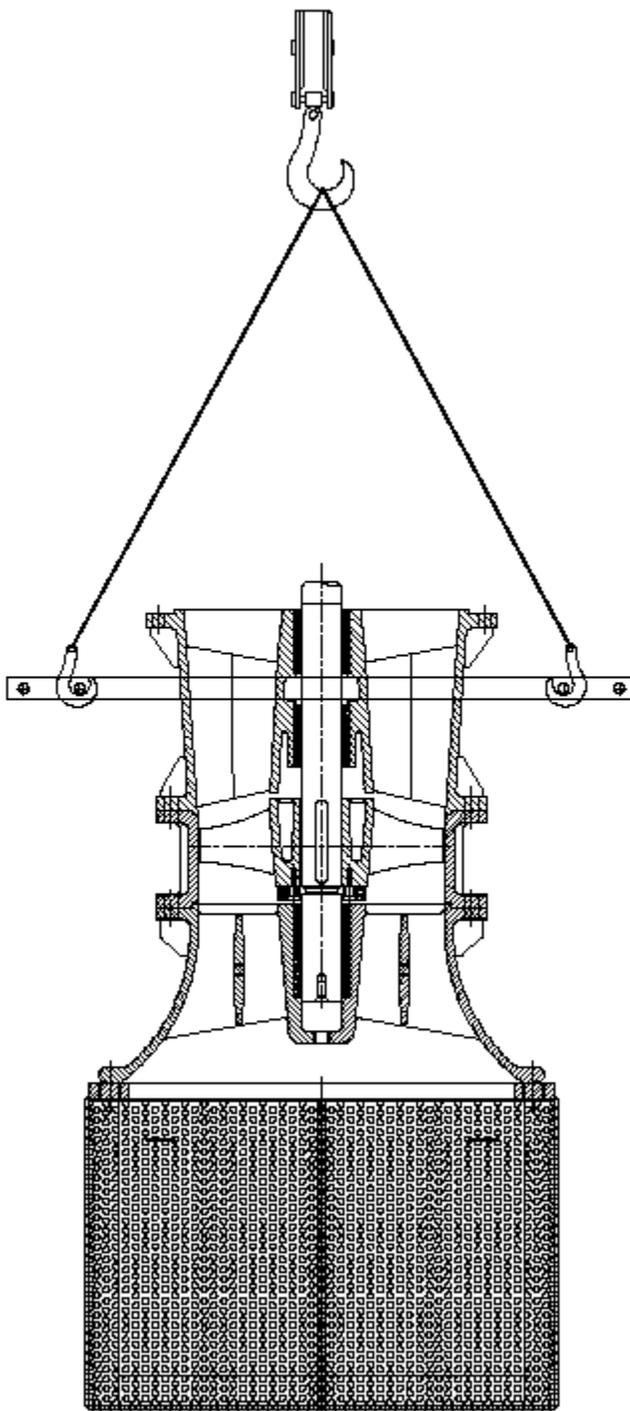
#### **Note:**

A bent shaft or tube should never be installed be sure all parts are clean threads are protected at all times. Installing bowl assembly

- a. Rotate the impeller shaft of bowl assembly by hand to see impeller is rotating freely and properly. Pull the shaft and press it back. The shaft should move freely. If pumps is oil lubricated stored for long time check gland packing in the pump assembly under bearing housing of oil lubricated pump only, if dried up replace the same.

If strainer is to be used it should be fastened to the suction bell mouth. Fastened bowl clamp to the top bowl below the flange or attach eyebolts through the bolt holes in the flange and lift the complete pump assembly over sump and rest it on two timber or I beams kept over the sump, just enough a part so that flange will rest on the support .FIG-

13



**FIG 13:- INSTALLATION OF BOWL ASSEMBLY  
WITH SUCTION STRAINER.**

#### IV. Installing the column assembly oil lubricated pump

Fit the shaft coupling on impeller shaft

- a. Use thread compound or grease for preventing the rust or seizing.
  - b. Half the length should come on each shaft.
  - c. Coupling should be free from dust.
  - d. Rotate coupling 2/3 times it fits smoothly on shaft.
2. the bottom section of the discharge column is usually Tapered Fasten a set column clamps to the top of the column section below the flange or use eye bolts in the bolt holes of the flange use a rope and throw a timber hi-tech around the column pipe about 300 mm from its lower end then a double half-hitch around the enclosing tube and double half hitch around the shaft cover open end of shaft enclosing tube to prevent any dirt from falling in raise the column section tailing the section in with the rope to prevent shaft from slipping clean the shaft thread and then inspect and clean the coupling.
4. Lower the shaft assembly and couple the shaft tightly with pipe wrench so that shaft end butts. Note shafting and tubes threads are left hand.
5. File off all wrench marks on shafts and coupling paint the shaft bearing threads with pipe threads compound.

Lower the elbow 6. Now lower and screw the shaft enclosing tube on the shaft bearing which serves as the coupling Tighten with pipe wrench till it butts.

7. After the enclosing tube has been assembled lower the column pipe, first clean the flange faces and painting with Thread compound

8. Now lower the column section in to position so that it may be firmly bolted to the top bowl flange through all bolt holes. Tighten on opposite bolts at hand on a small amount at a time until the flange faces are properly & firmly seated.

9. Remove lower clamps and complete assembly of flange make sure all flange holes are tilled with bolts and all bolts are tight. Lower until entire unit rests on the support by means of column flange

10. Remove line shaft bearing from the projecting enclosing tube and fill approximately half tube with SAE-10 or equipment lubricating oil over the end of shaft. Replace the line shaft bearing and proceed with installation of next column section repeat the installation procedure on each additional section of column assembly as above.

#### V Installing the column assembly

##### Water lubricated pump

The shafting in water lubricated pump is supported by bearing retainer which is either welded in the top of column pipe or a spate piece clamped between the flanges of two column section .FIG-14

Water lubricated pump with a total length of less than 3 m column will not have bearing retainer.

Follow the same the same installation procedure as the column assembly oil lubricated expect there will be no enclosing tubes screw bearing.

In water lubricated pump rubber bearing are used therefore oil must not be used. The shaft must be wiped clean and pit should be free of oil.

Installing top shaft:

Note- top shaft has a key way in the top end remove the top shaft from the packing rate and clean the shaft threads screw a thread protector or nut on the key way n end raise the shaft above the column screw the bottom end into the coupling of the projecting shaft, start the threads start the thread by hand and tighten it with pipe wrenches.

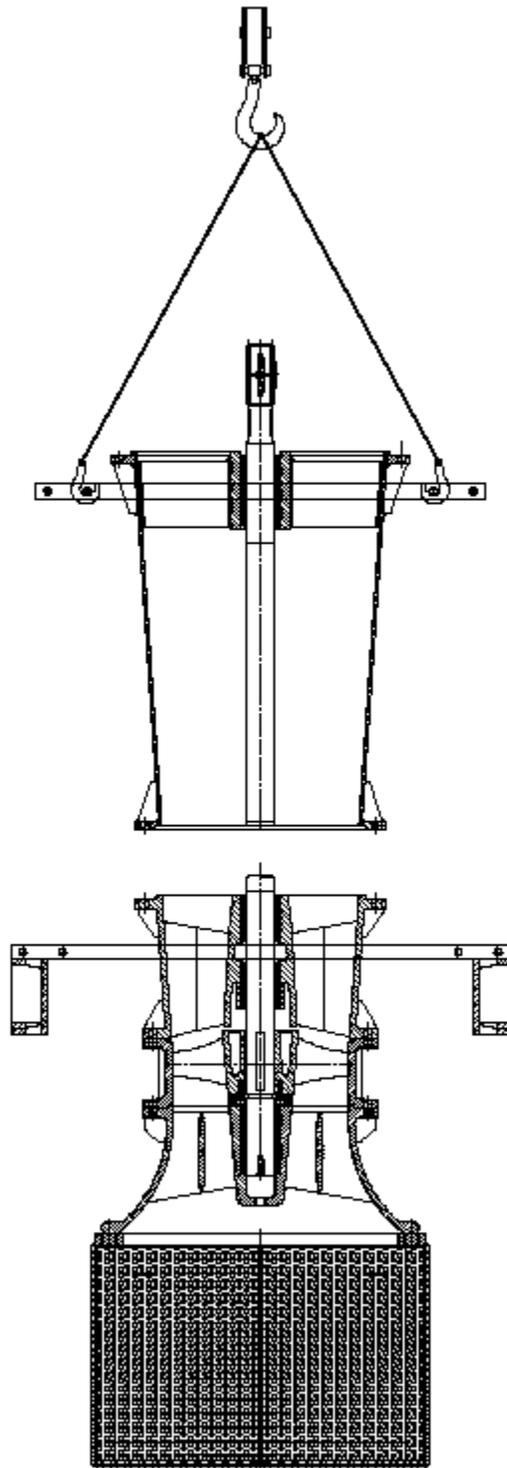
#### **VI Installing top enclosing tube**

Note – top tube has outside thread on the top end to accommodate the tube tension assembly.

After removing from the crate clean the thread screw thread protector on the top shaft making sure that the thread are protected screw tube into projecting line shaft bearing starting by hand tighten with pipe wrenches .

#### **VII installing the discharge elbow Oil lubricated pump**

- a. Remove the tube tension plate assembly from the elbow hoist the elbow over the top tube and shaft taking ca projecting into the opening for tube tension plate assembly bolt the elbow to the column assembly flange.
- b. Lower the whole assembly until the floor plate rests on the foundation or I beam. Make sure that pump hangs vertically and provide shim if necessary between floor plate and foundation hold in vertical position.



**FIG 14- INSTALLATION OF BOTTOM  
COLUMN PIPE.**

At this time the elbow may be aligned with the discharge line flange.

c. Now place the tube tension plate into position by slipping over the top shaft and screwing tightly in to the top enclosing tube using the tube tension plate wrench. Using the tube tension plate wrench adjusting the tube tension by tightening the TT plate approximately 1/6 th of a turn of the tension plate per 3m of tube will correct adjustment fasten tube tension plate to elbow with cap screw. fill rings of packing inside the tube tension plate clean and apply grease to threads of shaft enclosing tube and T.T nut and slip TT nut over shaft and screw with shaft enclosing tube and tighten with wrench .FIG-15

Connect oil feed line to the tube tension nut.

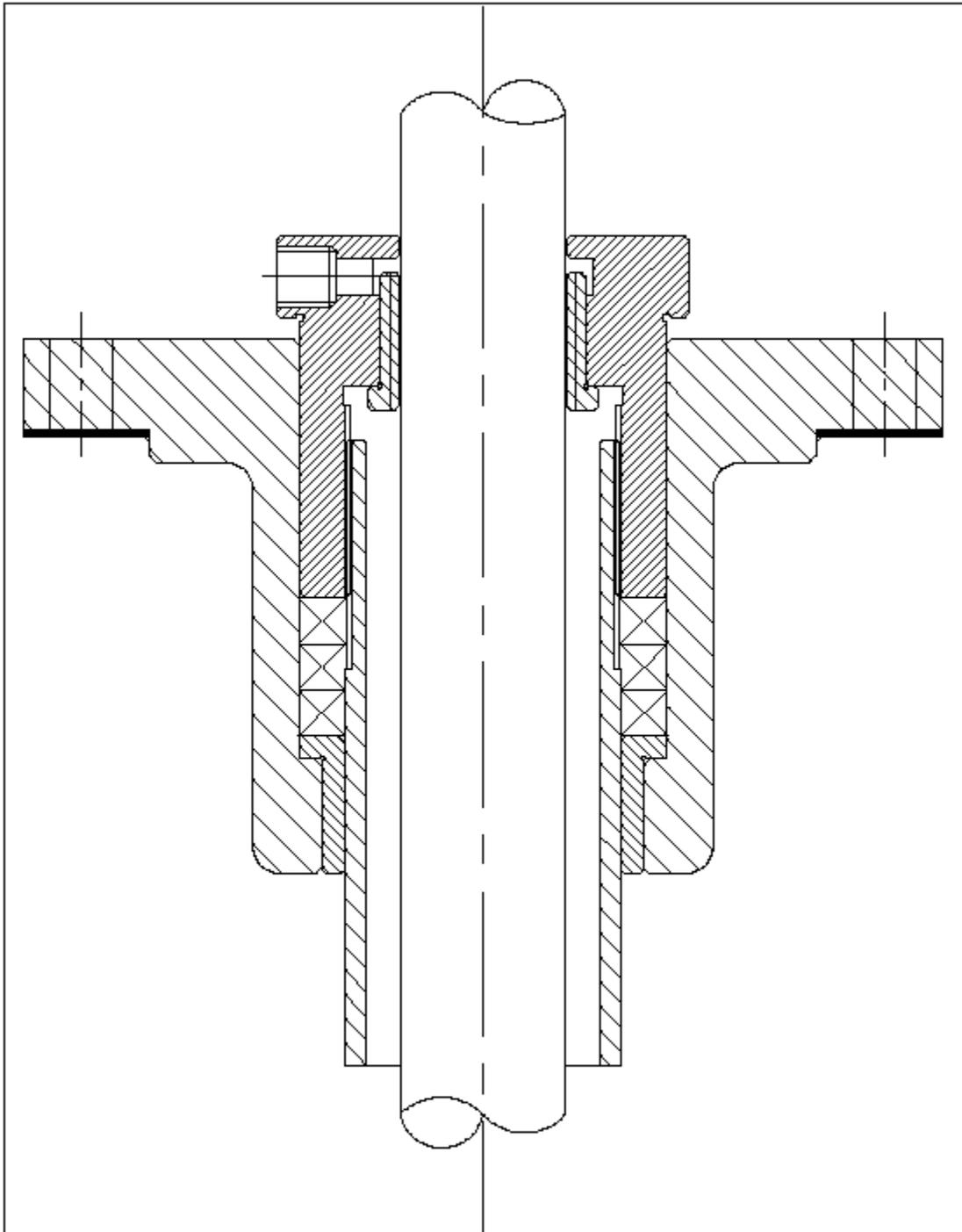
Connect the lubricating system and fill the oil reservoir Adjust the lubricator valve to permit oil to drip at one drop per sec adjust the valve to insure as adequate supply of oil at each bearing

**NOTE:**

After the installation of each column assembly check the shaft projection and tube projection over tube.

**NOTE:**

1.	Threads of line shaft and tubes are left hand. When connecting piping to the pump do not put a strain on the pump as this may cause misalignment.
2.	Care must be taken not to damage the bearing in the tube with the shaft threads.
3.	Check after assembly of every section of column and shaft assembly shaft is centered in the column, if not centered it has bent and must be removed.
4.	All shaft and column joints butt squarely metal to metal any dirt will prevent proper joints and result in unsatisfactory services all shaft joints should be tight use good grade of pipe compound / Teflon tape on each join of column / tube.



**FIG-15 OIL LUBRICATED CONSTRUCTION**  
**TUBE TENSION PLATE AND NUT ASSEMBLY.**

**NOTE:**

The sleeves should not be held by wrenches otherwise it will loose surface smoothness and rubber bearing will get soon worn out

1. Continue assembling column assembly till the required length of column is obtained.

2. After the installation of each column assembly check the shaft projection over column face this shaft projection and end play should be maintained through out the assembly

**Installing the discharged elbow water pump lubricated**

- a. remove packing box from elbow and hoist the elbow over the top shaft taking care shaft is not damaged bolt the elbow to column assembly Flange.FIG-16
- b. Lower the whole assembly until floor plate almost rest on the foundation I beam Make sure pump hange vertically and provide shims if necessary between floor plate and foundation to hold in vertical position.

At this time the elbow may be aligned with discharge line flange

- c. Now place the packing box into position by slipping over the top shaft and fasten the packing box to elbow with cap screw.
- d. Install packing and gland tighten gland nut for right amount of leakage during operation.
- e. Before starting the pump pre lubricate for about 5 minutes the rubber bearing of column assembly with clear cold water from pre lubrication tank. While doing so rotate the pump by hand or lever. Failure does so will seize the bearing and damage the pump. The value of prelub tank should be closed prior to switching on the pump.

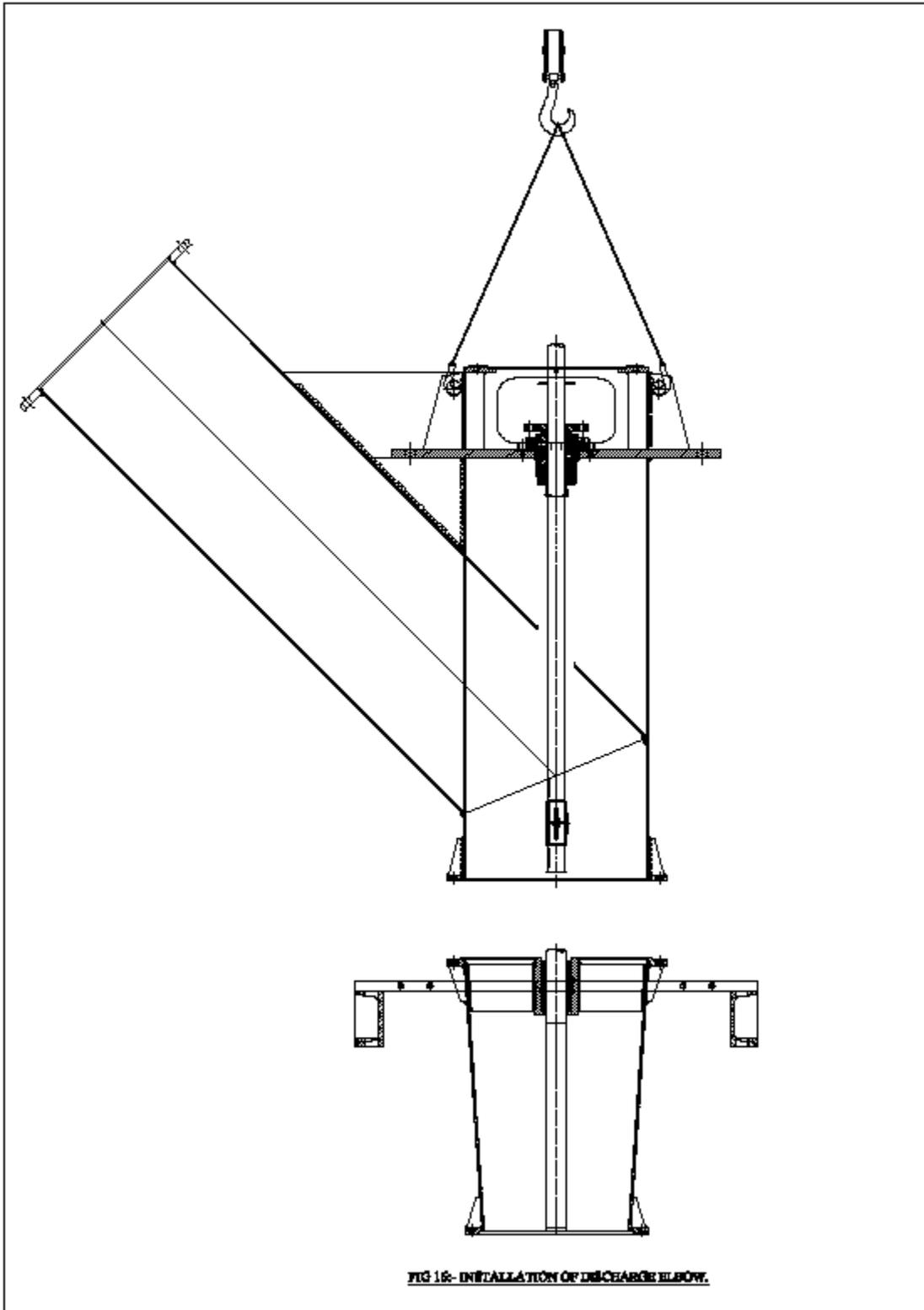
**Note:**

Discharge head top face must be leveled so that head shaft is aligned.

**4.11 EXTRENAL CLEAR WATER LUBRICATION:**

Procedure is similar to self water lubrication pumps the only difference being that the bearing holder are lubricated by external clear waters, shaft enclosing tubes are similar to those in oil lubricate pump.

- 1. Pressure of the external clear water should be 1 kg/cm more then the shut off pressure developed by the pump



2. Auxiliary supply of water should be given before main pump starts make necessary arrangement of auxiliary to main pump so that the main pump should automatically stop if the auxiliary supply of water is stopped due to any reason.

3. Pre lubrication is not required for these pumps.

#### **4.12 DRIVER:**

##### **A). VERTICAL HOLLOW SHAFT MOTOR.**

a. Remove the top cover of motor and motor coupling lift motor using eye bolts or hooks and clean bottom seat of motor .

b. Raise motor to about 150mm above top shaft lower care fully on to discharge elbow/discharge head. Take care not to damage the shaft.

c. If the hollow shaft of motor does not slip over the top shaft easily the top shaft will probably be bent during the operation.

d. Make sure pump is aligned with the foundation and pump shaft is centered in the motor hollow shaft.

e. Do not shim or install any packing between elbow and motor adjust level by using steel wedges or shims between base plate and foundation so that top shaft is centered in the motor hollow shaft.

f. Rotate the motor so that the terminal box is in desired direction. Match the holes of motor and elbow and tighten with bolts nuts.

g. Check the oil levels to the grease on the motor bearing. If required grease must be added while adding grease be sure to open the grease relief valve first.

h. Now connect the motor terminals to the leads from starter panel.

i. Start the motor and check rotation of motor and if required correct the rotation.

j. After checking the rotation place the drive coupling by slipping it over the top shaft. This must be a sliding fit, if necessary file dress and scrap but do not use force

k. Now remove coupling and check key way in coupling and top shaft with key to be fitted, it should be slide fit but not loose.

l. Put the coupling in place and insert the key.

m. The top of the key should be level with or slightly below the top of coupling. Threads the adjusting nut on the top shaft by hand.

##### **B. VERTICAL SOLID SHAFT MOTOR:**

Vertical solid shaft motors are used with thrust bearing housing. These are of following types.

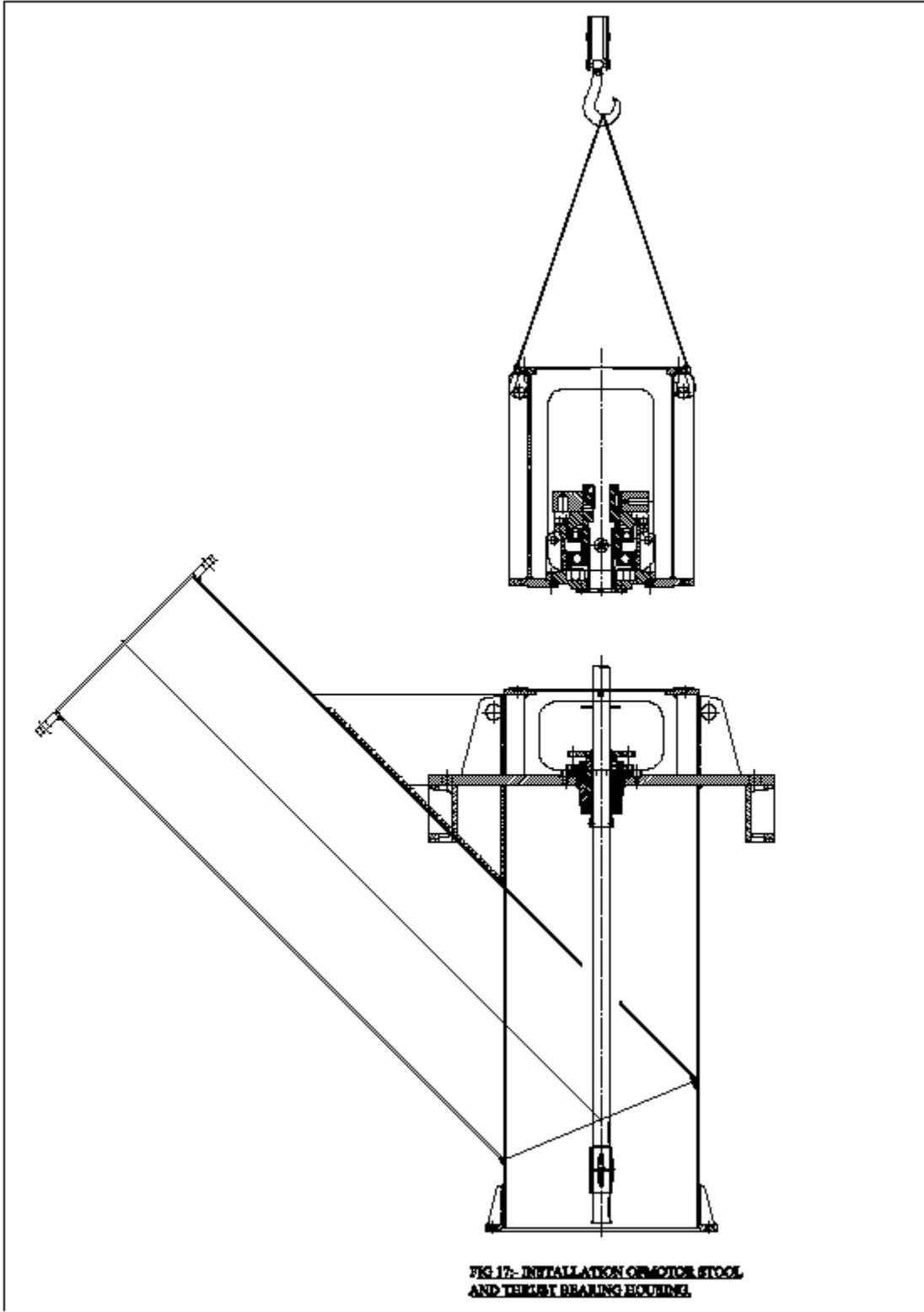
- 1 Anti friction type
- 2 Tilting pad type.

(Oil lubricated Mitchell type)

Clean the thrust bearing housing assembly bottom face and check grease and oil level in bearing housing.

Remove coupling from the thrust bearing housing raise bearing housing assembly above top shaft and lower carefully on to the discharge elbow/head take care not to damage the top shaft.

- 3 Make sure pump is aligned with the foundation and pump shaft is centered in the thrust bearing housing assembly.
- 4 After the TBH assembly is centered match the holes with elbow/ head and faster with bolts and nuts.FIG-17
- 5 Now raise motor stool over assembly clean bottom face and lower carefully on to the discharge elbow/head take care not to damage TBH assembly and tighten with bolts and nuts.
- 6 Remove drive coupling and proceed as mentioned in hollow shaft motor.
- 7 Check the parallel and angular alignment of coupling. There should be gap of 6mm between coupling faces.FIG-18



### **C. GEAR DRIVE:**

Remove the gear drive cover and coupling and proceed as outlined above for vertical hollow shaft motor, except starter panel connection, if connection to drive by a flexible shaft follow instruction accompanying the shaft.

### **D. BELT DRIVES:**

Remove belt pulley by loosening cap screw in top of pulley. Also removed the drive coupling and adjusting nut and precede as outlined for electric motor except for wiring.

### **ADJUSTMENT OF IMPELLER**

- a. Axial flow pump
  1. Install the gib key in the head shaft and screw on adjusting nut. Raise the propeller as far as it will go. Drop back one half the distance to center the propeller in bowl.
  2. Install two lock screws in adjusting nut, it may be necessary to turn the nut to match the tapped holes.
  3. Rotate the pump shaft by hand and make sure it turns freely.

### **B. Mixed flow pump**

Adjustment of impellers is very sensitive and requires certain trial and error.

- a. By having two suitable wrenches one on the drive coupling to keep the pump from rotating and the other on adjusting nuts raise line shaft by turning the adjusting nut by 1/6 turn at a time until impeller breaks free
- b. The pump will turn free usually by hand at this point. This is the lowest point of adjustment.

Install two lock screws in adjusting nut; it may be necessary to turn the nut to match the topped holes.

Rotate the pump's shaft by hand make sure it turns freely,

### **4.14 PIPE CONNECTIONS:**

#### **A. For oil lubricated pump:**

1. Delivery pressure gauge connection.
2. Oil lubrication connection for line shaft bearings.
3. Air vents connection for column pipe.
4. Cooling water inlet and outlet connection only of Mitchell thrust bearing.
5. If solenoid valve is used it is to be energized with separate electric connection so that pre lubrication to the bearing can be made before starting the pump.

#### **B. For self water lubricated pumps:**

1. Delivery pressure gauge connection.

2. Pre lubrication tank connection.
3. Air vents connection for column pipe.
4. Cooling water inlet & outlet connection (only for Mitchell thrust bearing)

**C. External clear water Lubricated pumps:**

1. Pressure gauge for connection.
2. Pressure gauge & inlet water connection for shaft enclosing pipe.
3. Cooling water inlet outlet connection (only for Mitchell thrust bearing)
4. Air vents connection for column pipe and for shaft enclosing tube.

**D. PIPE CONNECTION:**

Pipe connection is to be according to outline drawing supplied with the pump.

## **5 OPERATIONS**

### **5.1 COMMISSIONING**

**a. Oil lubrication pumps:**

For first starting one liter of lubricating oil should be poured as a pre lubrication of bearing holders. The oil can be poured directly from the plastic pipe or through solenoid & feed valve. Oil should be poured slowly as it has to pass through grooves of bearing. It takes approx 3-4 hours to pass 1 liter of lubricating oil. While pouring the oil coupling should be rotated slowly by hand for subsequent starting: the oils should be fed 5 minute before starting the main pump.

**b. Self water lubricated pumps:**

The bearing holders are lubricated by self water when the pumps are in operation. Hence for pre-lubrication clear cold water from pre lubrication should be given for about 5 minute before switching on the pump. The coupling should be rotated slowly by hand. fig-19, 20, 21&22.

**c. External water lubricated:**

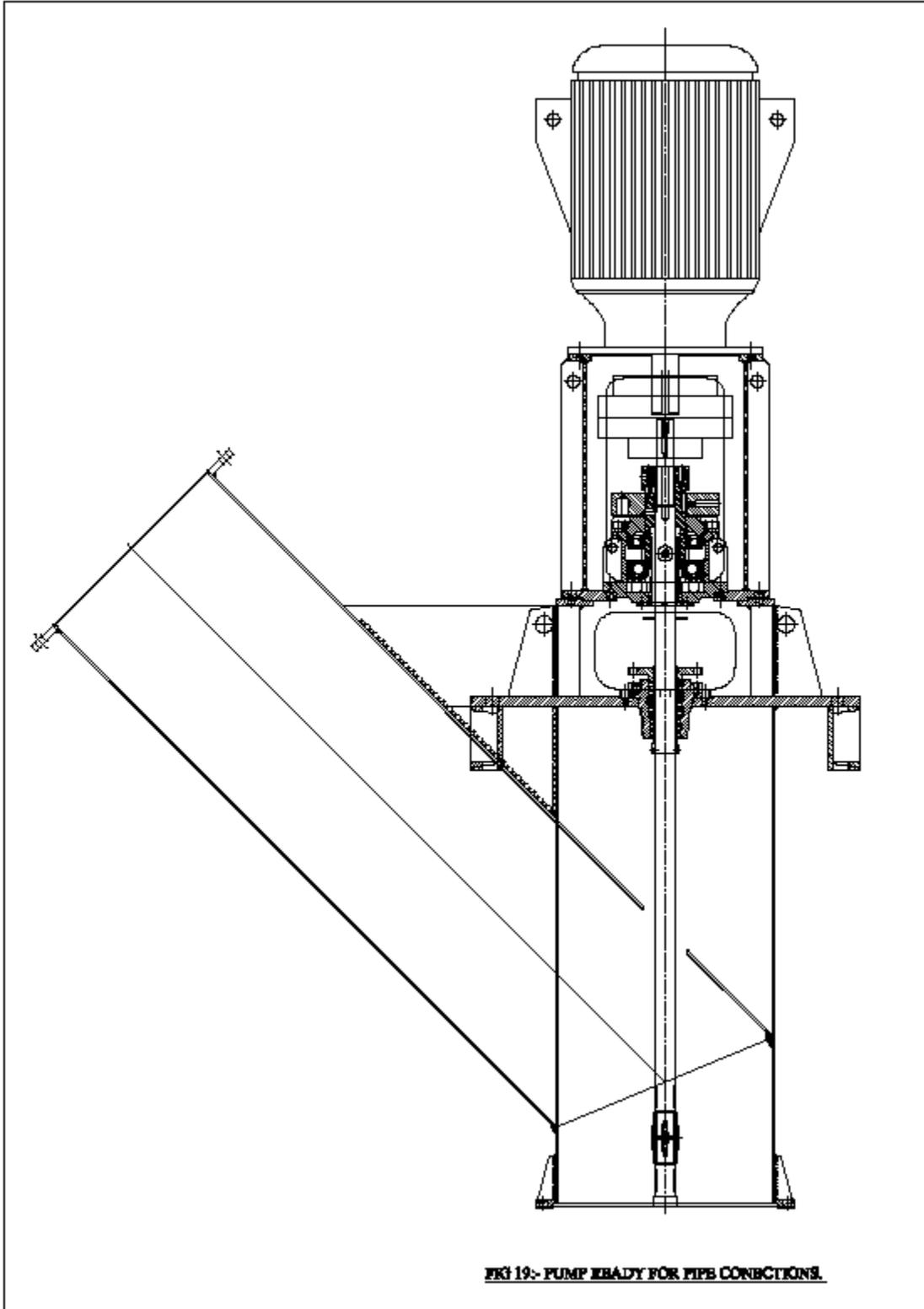
In these types bearing are lubricated with clear cold water from external source. Before starting the pump, starting the pump keep the air vent for enclosing tube open and feed external water till all air is vented out and clear water comes out smoothly from the air vent. if possible, make arrangement to interlock the external water source to the main pump such that main pump will stop immediately if external water supply fails for any reason.

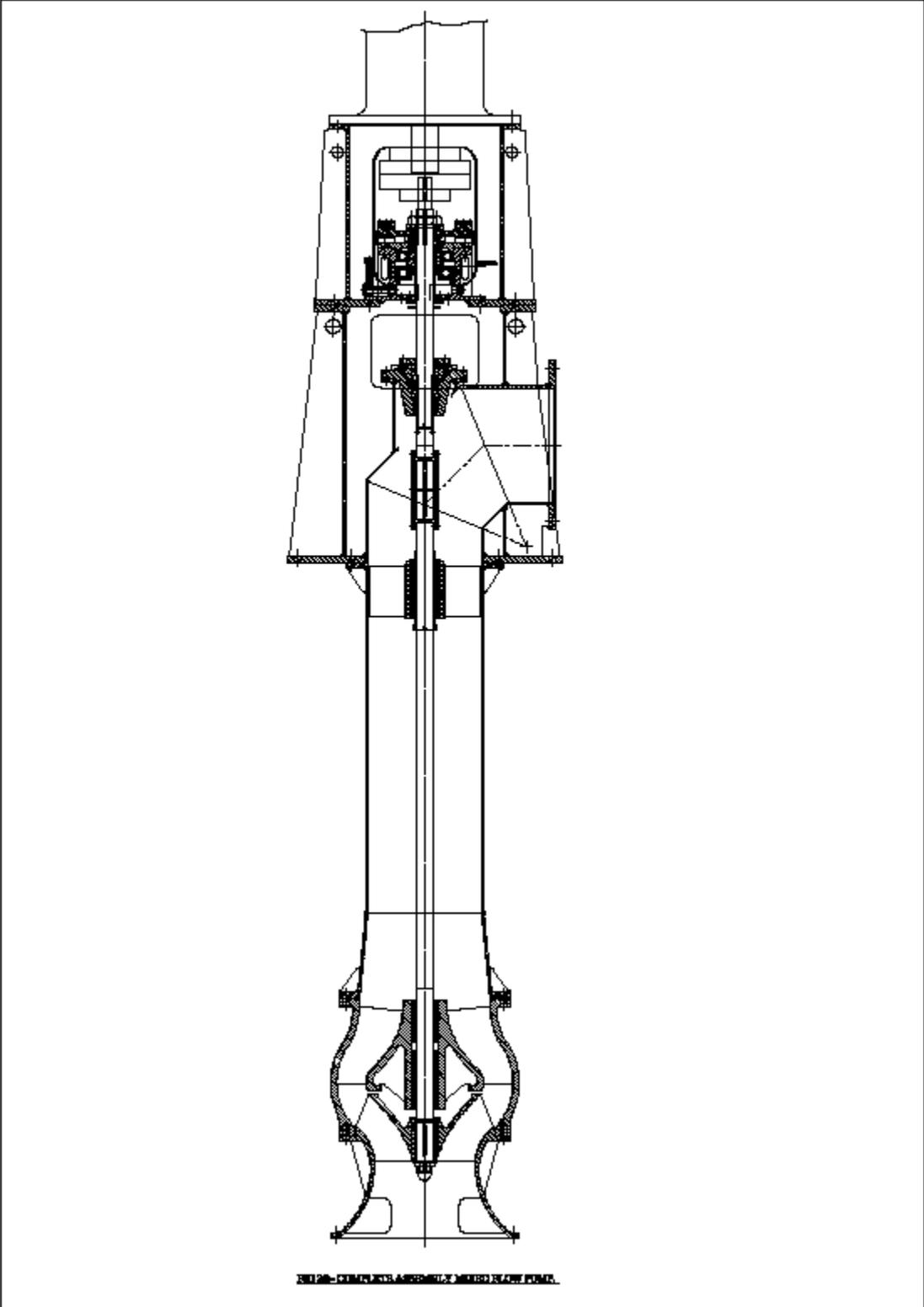
### **5.2 PRIOR TO STARTING**

Before starting the pump make sure that:

1. The rotor assembly rotates freely by hand or lever.
2. Minimum submergence is maintained as specified.

3. All air vents are open.
4. Inlet cock for Mitchell thrust bearing cooling is open.
5. Pre lubrication is made as per instruction given above.
6. The supply voltage is within the 5% of the voltage indicated on the name plate of the motor.
7. The cock of pressure gauge connection is closed.
8. The oil feed valve has oil feed of 10/15 drop per minute (for oil lubricated pumps )
9. The pressure of the external water in case of external water lubricated pumps is 1 kg/cm (one atmosphere above the full valve close pressure).
10. Coupling is properly aligned.
11. The discharge valve is in fully closed condition.
12. The discharge valve is in fully open condition.
13. The oil filled in the Mitchell





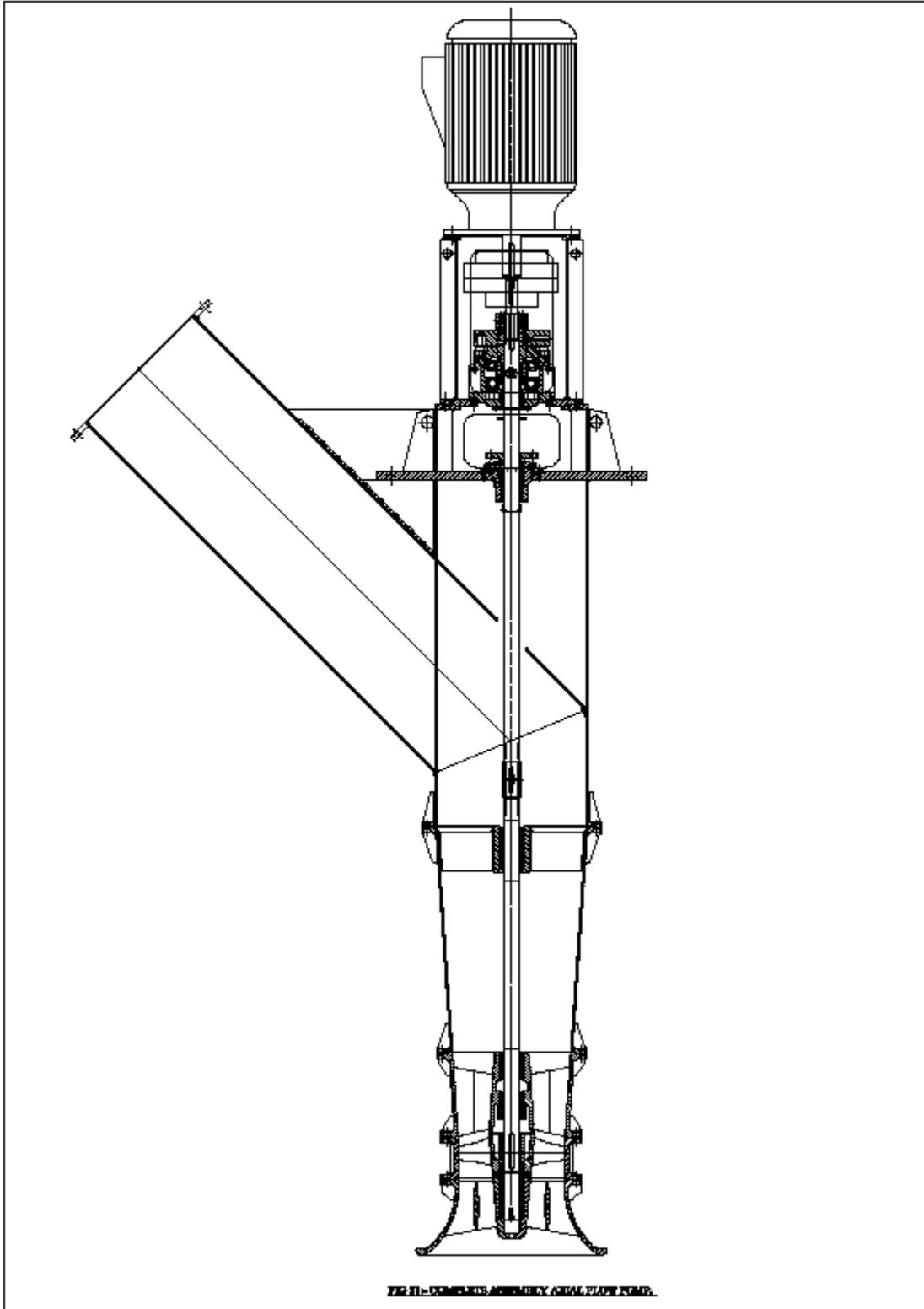
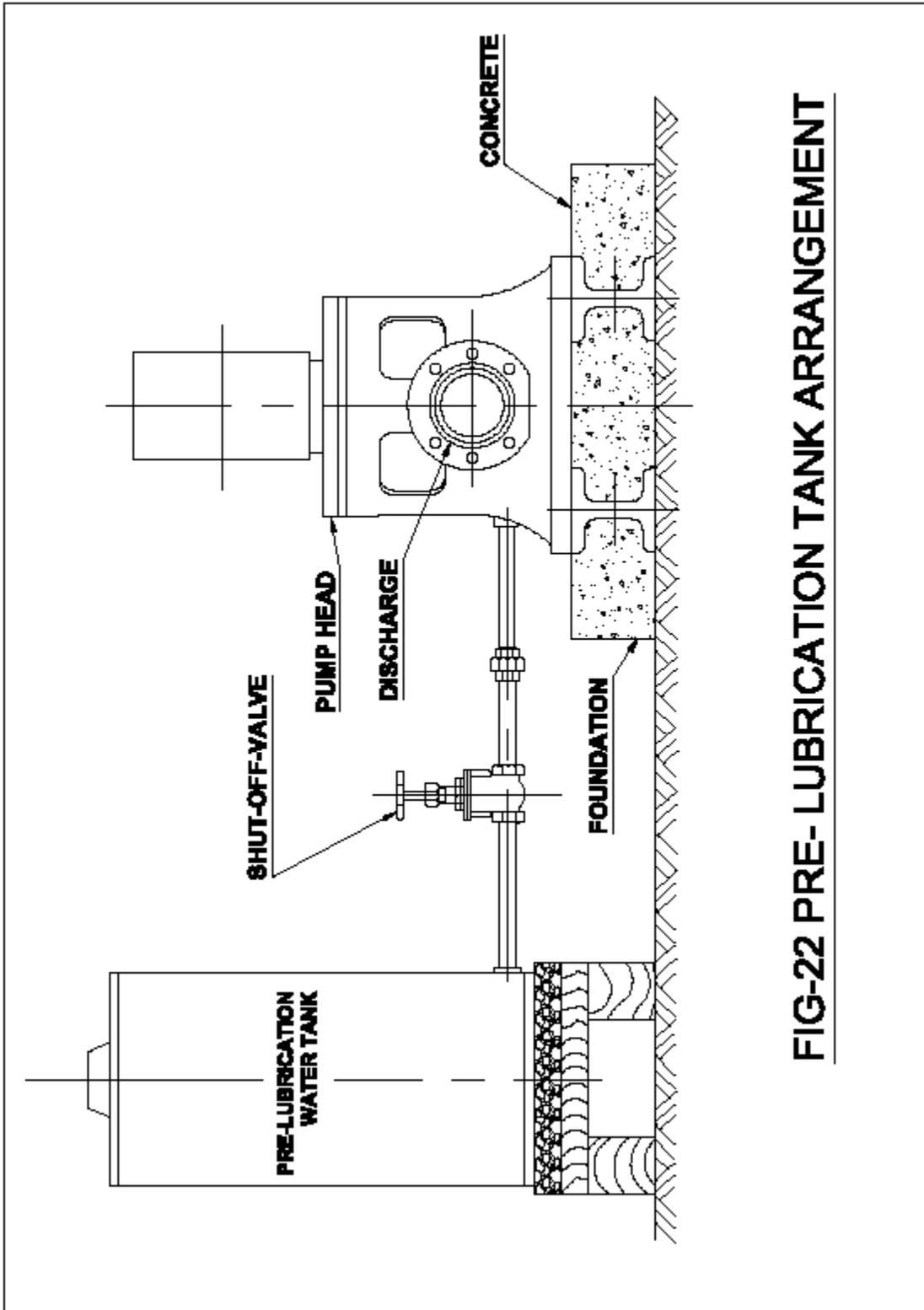


FIG. 11. - DETAIL OF THE ASSEMBLY OF THE MOTOR AND THE SHAFT.



**FIG-22 PRE- LUBRICATION TANK ARRANGEMENT**

Thrust bearing is up to the mark on the oil level indicator.

14. In the case of water lubricated pumps the stuffing box packing is inserted in such a way that their joints are staggered. The gland is not too tight.

15. Start the pump; Let the motor pick up full speed.

### **5.3 PUTTING THE PUMP IN OPERATION:**

1. Ensure that pump installation is complete.
2. Ensure that all the auxiliary equipment have been installed serviced and ready for operation.
3. Service the driver as recommended by the manufacturer.
4. Pre lubricant rubber bearing before staring the pump.
5. Start the pump, these pump are equipped with a stuffing box adjust stuffing box packing gland to allow a liberal amount of leakage part the packing a small taxable is desirable momentarily .
6. Momentarily bump start the driver to tighten the entire line shaft coupling then immediately stop the pump. This step is necessary only on the initial start up after pump installation.
7. Recheck the impeller adjustment making sure that the rotating element turns freely by hand
8. Set the discharge valve to a nearly closed position before starting the pump new installation. Head and capacity developed by the pump is as specified on the name plate of the pump.
9. Check the temperature of the pump and the motor bearing, temperature of the Mitchell thrust bearing should not exceed 50\*c. temperature of the thrust ball bearing should not be more that 75\*c.

Stop the pump immediately if any defects, discrepancies are detected and must not be started again unless they are rectified, report immediately to the supplier if it's not possible to rectify the defect.

10. Close the air release valve after air is vented out.
11. Close the cock of pre –lubrication (self lubricated pumps)
12. Adjust the discharge valve for specify duty condition.
13. Check the flow of water in the flow indicator provided on the outlet.

### **5.4 CHECK DURING RUNING:**

Check the following things and regulate if necessary:

1. UN interrupted flow of cooling water with Mitchell thrust bearing. Also check the temperature of the cooling water at outlet. It should not exceed 50 c.
2. Pump is running smooth. Check vibration and noise. Vibration should not exceed 0.1 mm vibration can be checked with vibrometer or dial gauge indicator.

3. The gland is not too tight (for water lubricated pumps) there should be a slight leakage through stuffing box.
4. Power consummation is within the limit. Check the current; it should not exceed the value given on the name plate of the motor.
5. Ensure that there is no mechanical friction in the pump.
6. There is a constant flow of lubrication to the bearing holder and thrust bearings.

<b><u>IMPORTANT POINTS TO KNOWN / REMEMBERED:</u></b>
1. Daily turn grease cup to force grease in to the packing box.
2. Check at regular intervals the oil level in the oil box and fill if necessary. (Change the oil after 500 hours of operation.)
3. Check packing for water leaking and tighten packing nut by hand only (never use a wrench). Allow some water to leak.
4. Do not continue to run the pump dry in case it loses its prime because this may damage the impeller and line shaft bearings.
5. Do not attempt to start pump before pre-lubricating line shaft bearing with one half of the water quantity stored in the tank.
6. Do not try to run the pump. If possible without suction lift. The lowest bowl should always be submerged in the water. In fact ideal operation conditions will be secured when then top bowl is also submerged. this may of course, vary according to the installation because a small capacity located in a large well will require less submerge than a large capacity pump in a small well.
7. Do not let the pump break suction if its capacity is too large for the well because this may cause vibration and damage to the column bearing. In this case it is better to throttle the pump through the discharge line valve.
8. Do not stop the pump if it delivers water with sand or mud. If so the sand and mud suspended in the water will settle in the bowls and impeller a cause them to stick. Throttle the pump by closing the discharge line valve and wait until water clear before stopping.
9. Do not attempt to restart the pump if it has been shaft or other serious damage for the following reason. When pump is stopped the water in the column backs down through impeller and tends to relate the pump backwards for a short period of time, depending upon the height of the column or the depth of pump setting. This backward rotation may or may not be noticed in pumps operated with belt drive. Wait until comes to a complete stop before restarting.
10. Just stopped because this strains the unit severely and may cause the breaking of the shaft or other serious damage to pump.

## 6. TROUBLE SHOOTING.

Operation trouble	Possible cause	Remedy :
<p>1. In case pump can not be started</p>	<p>a. Engine or motor trouble</p> <p>b. Power transmission trouble</p> <p>c. Pump trouble</p> <p>d. Well is not straight</p>	<p>1. Check speed of engine and in the case of electric motor, Whether voltage is low.</p> <p>2. Check compression of engine</p> <p>3. Check fuel supply.</p> <p>4. Check if fuses are burned out.</p> <p>5. Check position of overload relay.</p> <p>6. Check if motor is defective.</p> <p>7. Follow up instruction given by engine or motor manufacturing.</p> <p>8. Check clutch equipment.</p> <p>9. Check belt slip.</p> <p>10. Check angle gear drive if available.</p> <p>11. Check whether pump is sand locked (try to loose it through pipe wrench)</p> <p>12. Check whether packing too tight.</p> <p>13. Check adjustment of impellers in proceeding as above outlined.</p>
<p>II. In case pump does not deliver</p>	<p>A .Pump trouble</p>	<p>14. This appears when a new pump has been just installed and starts opening. It can only</p>



<p>developed is not sufficient</p> <p>v. in case pump uses too much power.</p> <p>VI. In case of excessive power vibration</p>	<p>a. Prime mover or pump trouble.</p> <p>b. Other cause</p> <p>c. engine or motor trouble</p> <p>e. Pumps trouble</p> <p>g. Other cause</p> <p>a. Pump trouble</p>	<p>9. Check whether suction pipe is leaking in case water level is below lowest impeller.</p> <p>Check whether pumping head too great.</p> <p>9. Check whether water contains gas or air.</p> <p>10. Check accuracy of capacity measuring device.</p> <ol style="list-style-type: none"> <li>1. Check for column pipe leaks.</li> <li>2. Check whether impellers damaged.</li> <li>3. Check whether line shaft bearing are worn out.</li> <li>4. Check adequate speed of pump (see above)</li> <li>5. Check whether air in the water or air or gas in the well.</li> <li>6. Check whether impellers are submerged or not.</li> </ol> <p>1. Check whether speed too high .(may be due to high voltage voltage</p> <p>Voltage or to wrong selection of pulleys.)</p> <ol style="list-style-type: none"> <li>2. Check whether line shaft is crooked.</li> <li>3. Check whether vibration of pump too high.</li> <li>4. Check whether packing too tight and if so loosen The packing nut.</li> <li>5. Check adjustment of impeller and condition of Same.</li> <li>6. Check alignment of pump head.</li> <li>7. Check whether bearing are worn out.</li> <li>8. Check whether water contains too much sand or other foreign matter.</li> <li>9. Check whether total pumping head is different From that the pump was designed for.</li> <li>10. Check whether well is clogged and throws line shaft Bearing out at alignment.</li> </ol>
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<p>VII. In case excessive wear is noticeds</p>	<p>b. Other causes</p> <p>a. motor</p> <p>b. pump</p> <p>Other causes</p>	<ol style="list-style-type: none"> <li>1. Check whether engine or motor coupling is Out of balance.</li> <li>2. Check whether voltage is varying.</li> <li>3. Check the engine speed.</li> <li>4. Check whether in shaft in bent.</li> <li>5. Check whether bearing are worn out.</li> <li>6. check whether impellers are out of balance due to foreign Matter caught in them.</li> <li>7. Check alignment of pump head.</li> <li>8. Check alignment of pump with engine or motor.</li> <li>9. Check whether well is crooked.</li> <li>10. Check whether water contains too much air or gas.</li> </ol> <ol style="list-style-type: none"> <li>1 Check whether line shaft is bent.</li> <li>2 Check whether lubrication is proper.             <ol style="list-style-type: none"> <li>3. Check whether vibration is too excessive.</li> <li>4. Check alignment of pump.</li> <li>5. Check whether well is crooked.</li> </ol> </li> <li>1. Check whether water contains too much sand foreign matter and gas or air.</li> </ol>
<p>VIII In case of excessive noise.</p>	<p>Motor</p> <p>Pump</p>	

<p>IX. Stuffing box</p> <p>a. Over heating.</p> <p>b. Packing wears too fast.</p> <p>c. Leaks excessively at stuffing box.</p>		<ol style="list-style-type: none"> <li>1. Motor noise bearing running dry.</li> <li>2. Pump bearing running dry.</li> <li>3. Broken column bearing returns.</li> <li>4. Broken shaft or shaft enclosing tube.</li> <li>5. Impeller running on beat.</li> <li>6. Cavitations due to low submergence or operation Beyond maximum capacity.</li> <li>7. Foreign material in pump.</li> </ol> <ol style="list-style-type: none"> <li>1. Packing is to tight.</li> <li>2. Packing is not lubricated.</li> <li>3. Wrong grade of packing.</li> <li>4. Stuffing box. In properly packed.</li> </ol> <ol style="list-style-type: none"> <li>1. Shaft or shaft sleeve surface rough or worn out.</li> <li>2. In sufficient or no lubrication.</li> <li>3. In properly packed.</li> <li>4a. Wrong grade of packing.</li> <li>B.Defective packing.</li> </ol>
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## **7. MAINTENANCE:**

### **7.1 DAILY CHECKS:**

1. Pressure gauge reading.
2. Water level in the sump.
3. Voltage & current.
4. Pumps motor bearing temperature.
5. Oil level in the Mitchell type thrust bearing.
6. Rate of flow of lubricating oil.
7. Leakage through stuffing box.

### **7.2 PERIODICAL/PREVENTIVE MAINTENANCE:**

Replenish the lubricating oil.

Replenish the grease for pump & motor bearings.

Change the stuffing box packing.

Check the strainer (if supplied) is not choked or damaged.

Check silt deposition.

Check the measuring instrument.

Check the level on the motor stool as there is a possibility of resetting of foundation in the course of time or disturbance in delivery pipe line.

#### **IMPORTANT:**

**If the pump stand idle for a long period, it is to run a short period once in a week at its max. Speed to prevent the shafts and impeller from sticking.**

**Pump should never run dry. Dry running will result into seizing bearing and other mating surface.**

## **PREVENTIVE MAINTENANCE:**

To ensure satisfactory operation of the pump scheduled inspection and periodic maintenance are required. Sintech suggests an inspection and maintenance log be kept and the inspector reports any problems.

A guide for preventive maintenance for normal applications is given below unusual application with abnormal heat, moisture, dust etc may required more frequent inspection and service.

<b>ITEMS</b>	<b>ACTION REQUIRED</b>
Stuffing box & mechanical seal	Inspect every 100 hrs of operation for excessive leakage. Adjust or replace packing as required. Replace mechanical seal.
Pump alignment	Check for changes annually and care it as required.
Noise level & pump vibration	Check for changes annually and care it as required.
Replenish the lubricating oil	As required.
Replenish grease for pump & motor	As required
Check for strainer	Whether it is choked or damage at the time of over hauling.
Check silt deposition	Every 24 hrs.
Check for measuring instruments	
Check the level on motor stool as there is possibilities of resetting of foundation in course of fine or disturbance in delivery pipe line.	First check in 3 months
Clean dirt, oil & grease from discharge head and driver	As required.
Clean driver ventilation passes	As required.
Check oil level in reservoir, it should never be loess ½ full, refill check drip rate.	Every 24 hrs of operation.
Check oil in thrust bearing housing	Change after 500 hrs of operation or six months or it turns blackish.
Tighten all loose bolts and check for excessive vibration	As required.
If packing is grease lubricated add as required	100 hrs.

## **8. OVERHAULING:**

1. With normal daily operating speed the pump will due for overhaul after about every three years. This work should be carried out by specialized fitters.
2. As the parts are to be cleaned and to be checked thoroughly for wear & tear after dismantling below following parts are to be checked for clearance, if it exceeds those limit given table the parts are to be replaced.

### **Max clearance in mm**

- |                                    |        |
|------------------------------------|--------|
| a. Impeller & casing ring          | 1mm    |
| b. Impeller & impeller guide piece | 2mm    |
| c. Shaft & bearing bush            | 0.8 mm |

NOTE: - MAXIMUM CLEARANCE SHOULD NOT BE MORE THAN DOUBLE OF NORMAL CLEARANCE.

2.The rubber rings, rubber bearing used for water lubricated pumps must not come in contact with grease oil petrol paint are to be cleaned in clear cold water.

3. While ordering for spare parts the details of the name plate must be quoted in full particular the name of the pump order no. pump machine No. and the name of the spares parts required and quantity. Cross drawing & spare parts list are given on previous pages

Keep the sufficient stock of spare parts in order to meet the emergency requirement.

## BEARIG CLEARANCE

**THE FOLLOWING ARE AVERAGE CLEARANCE FOR  
BRONZE/RUBBER BEARING**

SN.	SHAFT DIA(mm)	DIMETERAL BOWL BEARING CLEARANCE(MM)			
		BRONZE		RUBBER	
		NORMAL	REPLACEMENT	NORMAL	REPLACEMENT
1	38-50	0.250	0.350	0.400	0.550
2	50-62	0.275	0.375	0.450	0.700
3	68	0.300	0.400	0.600	0.825
4	68-100	0.300	0.400	0.800	1.00

**NOTE-**

**SPECIAL MATERIAL STAINLESS STEEL WEAR RING  
AND HIGH TEMPERATURE LIQUIDS ABOVE 180°F  
REQUIRE SPECIAL CLEARANCES**

## **8A. THRUST BEARING HOUSING:-**

These thrust bearing housings are supplied with vertical solid shaft motors which are not taking vertical thrust load.

These are of following types-

- (A) Oil lubricated
- (B) Oil lubricated (Water cooled)
- (C) Grease lubricated
- (D) Mitchell type thrust bearing flossing

#Most thrust bearings are lubricated by a positive circulating of oil through the bearings. Which are mounted in sealed oil reserve oil?

Thrust bearing housings are supplied without oil. Before first time operations and at the oil changes to reserve oil grit particles oil reservoir sump. Use same type of oil to flush reserve oil as specified for lubrication. Remove drain plug before flushing. Flushing oil may be poured through oil fill opening after removing oil fill plug. The proper oil level when unit is not running shall not be more than 3mm to 6mm from the top of the oil sight gauge. Over filling may result in overheating of the unit.

During operation the oil level in sight gauge may be higher than the recommended range material above. Under no circumstances it is allowed rotate unit when oil level is below required level. To avoid oxidation of the antifriction bearings during shut down period lasting more than a week. It is recommended to fill up the oil reservoir until the oil sums over the oil retainer tube so that bearings remain completely immersed in the oil before startup do not forget to drain the excess oil to its required level.

### **IMPORTANT:-**

The oil in bearing housing should be filled up to the mark on the oil level indicator with the pump in idle condition oil should not be replaced during operation. Maximum temperature of oil should not exceed 50° C. Replace the oil before it becomes black and oil reservoir should cleaned at the same time. Change oil once every six months provided the operating temperature does not exceed 50°C. For operating temperature around 100°C the oil should be changed every two/three months or 500Hrs operation.

### **SPECIFICATION OF OIL For Bearing lubrication:-**

For lubrication of bearing use oil as per SAE 20w / 20or. CLP 68 to DIN 5157 or ISO – VG 46 having properties as given blow.

Kinematic viscosity at 40°C Min – 41.4 mm<sup>2</sup>/sec and max 50.6 mm<sup>2</sup>/sec.  
Flash point +175°C, Solidification point -15°C

Pour point	-	0 - 5°C
Water content	-	Not above 0.1%
Ash content	-	Not above 0.05%

Hard asphalt - 0% Neutralization member not above 0.3 mgr

**The lubrication oil should** be confirmed to following grades of oil available in market or equivalent

Manufacturer	Speed 1450 RPM	Speed 2900 RPM
Indian Oil	Servo system 81	Servo system 57
Hindustan petroleum	ENKLO 57	ENKLO 53
ESSO	TERESSO-68	TERESSO-46
SHELL	TELLUS-68	TELLUS- S 46
CASTROL	HYS PIN AWS 68	HYS PIN AWS 68
MOBIL OIL	DTE 26	DTE 24
TEXACO PROMAX	REGAL R&O 68	REGAL R&O 46

The similar drives have the thrust bearings cooled by air circulation and need no attention as oil temp is below 50°C, except to check the oil level is at the proper level.

If operating temp of oil exceeds 50°C the thrust bearings are provided with water cooling system, the regulating volume should be adjusted so that water feels cool to hand when leaving the bearing. This can be checked by removing plug from the tee or overflow and feeling water. The approx rate of flow in cooling system is given in following table:

**COOLING WATER REQUIRED FOR MITCHELL THRUST BEARING / OIL LUBRICATED THRUST BEARING (LPM)**

SPEED RPM	THRUST LOAD IN KG			
	5000	7000	10,000	12,000
1460	8	11	22	25
960	6	10	19	22
730	5	9	17	20
585	4	8	15	18
Shaft Dia. (mm)	70	90	120	150

**GREASE LUBRICATED THRUST BEARING:-**

The bearings are pre-lubricated at factory. Re grease the bearing according to the following procedure and per the schedule given in table.

1. Whip dirt from grease fitting.
2. Check relief port 180° a part from fitting to make sure it is fitting.
3. Fill the grease cavity through the fitting until fresh grease comes out from the relief hole.

4. Ensure after re greasing relief port is plugged.

**NOTE:**

The bearing temperature usually rises after re greasing due to an excess supply of grease temperature will return to normal after the pump has over flow the excess grease from the bearings usually it takes two to four hours.

For most operating conditions lithium based grease is recommended. This grease is acceptable for bearing temperatures of 5°C to 150°C.

The normal running conditions when the bearing housing perfect temp. Is as below 80°C, we recommend lithium or lithium calcium based mineral grease for roller/ (ball bearing such as.

<b>Manufacturer</b>	<b>Grade</b>
Bharat	MP-3 Grease
HP	Lithon3/NATRB-3
Cortex	Star Fak-3
Indian oil	Servogem-3
Esso	Beacon 2, Unirex N3
Shell	Alvania Ep2, Limona LX1

The first Re-lubrication should be done before the initial commissioning of pump then after words every 1000 hrs of operation or 6 Months whichever is earlier.

**REFILLING PERIOD (IN OPERATING....)**

SHAFT SIZE	THRUST LOAD (KG)	THRUST BRG. NO. (KG)	SPEED (R P M)			
			1460	960	730	585
36	600	SKF7312 SKF6215	900	1000	1100	1200
38	1100	SKF7214BG	900	1000	1100	1100
45	1600	7317	800	900	1000	1000
55	2000	SKF7316 SKF6219	700	800	900	9000

The frequency of lubrication depends on the operating condition; however as a general guide line the re- lubrication period is given in table:

**NOTE:-**

**VERTICAL SOLID SHAFT MOTOR:**

**When pump is supplied with thrust bearing housing, do not secure driver to discharge head until thrust bearing housing and flexible coupling are installed.**

## **8B.ALIGNMENT**

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

6. Attach a sling to lifting lugs of driver, hoist motor, inspect the mounting surface, register and shaft extension and clean these surfaces thoroughly. If burrs are found, clean with smooth file and clean thoroughly.
7. Orient the motor conduit box in the required position. Align the motor mounting holes with matching holes on the discharge head / motor pedestal louvers the motor until the register engages and motor pedestal. Secure motor with bolt and nuts.
8. Remove drive coupling and proceed as mentioned in the hollow shaft motor.

### **COUPLING INSTALLATION:**

1. Apply a thin layer of oil on the pump key and insert key in to head shaft key way seat.
2. Gently lower pump hub coupling in to head shaft.
3. Thread on the adjusting nut on to the head shaft until flush with top of the head shaft.
4. Apply thin layer of oil on the driver key and insert key in to the driver shaft key way seat. Place with driver hub on to the drive shaft and key slide it up the drive shaft.
5. Adjust the impeller and slide driver hub down and check the parallel and angular alignment of coupling. There should be gap of 6mm between coupling faces couple coupling helps with pin bush bolts.

#### **a) Flexible coupling**

A flexible coupling will not compensate for misalignment of the pump and driver shaft. The Purpose of the flexible coupling is to compensate for temperature changes and permit the movement of the shaft without interference with each other while transmitting power from driver to the pump.fig 23&24.

#### **Type of misalignment**

There are two types of misalignment between the pump shaft and driver shaft.

- a. Angular misalignment.

Shaft with axis concentric but not parallel.

- b. Parallel misalignment.

Shaft axis parallel but not concentric.

The two halves of the coupling should be at least 4-6 MM apart so that they cannot touch each other when the drive shaft is rotated. Necessary tool for checking is straight edge and an outside caliper. For proper gap between coupling halves faces refer G.A. drawing supplied with pump.

A Check for parallel alignment is made by placing straight edge across both coupling periphery at the top, bottom and both the sides, the unit will be in parallel alignment when straight edge reset evenly on the coupling periphery at all positions , Care must be taken to have the straight edge parallel to the axis of the shafts.

B check for angular alignment is made by using outside caliper across the width of the coupling faces at various points.

### **Factors that may disturb alignment**

The unit should periodically check for alignment, If unit does not stay in line after being properly, installed. The following are possible causes.

- 1) Setting seasoning of the foundation.
- 2) Pipe strains, distorting or shifting of the pump.
- 3) Wear of the bearing.

### **Final coupling alignment**

The final coupling alignment must be made after the piping has been connection. If realignment is required, disconnect the piping first, these proceed with alignment. Reconnected the piping after alignment has been completed and recheck the alignment before connecting the coupling.

A flexible coupling must not be used to compensate for misalignment resulting from poor installation or temperature changes.

**Note** for maximum life keep misalignment valve as near to zero as possible

- A) Check parallel alignment by placing straight edge across to the coupling flanges and measuring the maximum offset at various points around the periphery of the coupling. Do Not Rotate the coupling. If the maximum offset exceed the figure in table, realign the coupling (FIG-23,24&25)
- B) Check angular alignment with caliper measure from the outside of one flange to the outside of one flange to the outside of the other at interval of approx 90. Around the periphery of the coupling .The difference between maximum and minimum must not exceed the figure shown in table. If correction is required, check the parallel alignment (FIG-23,24&25)

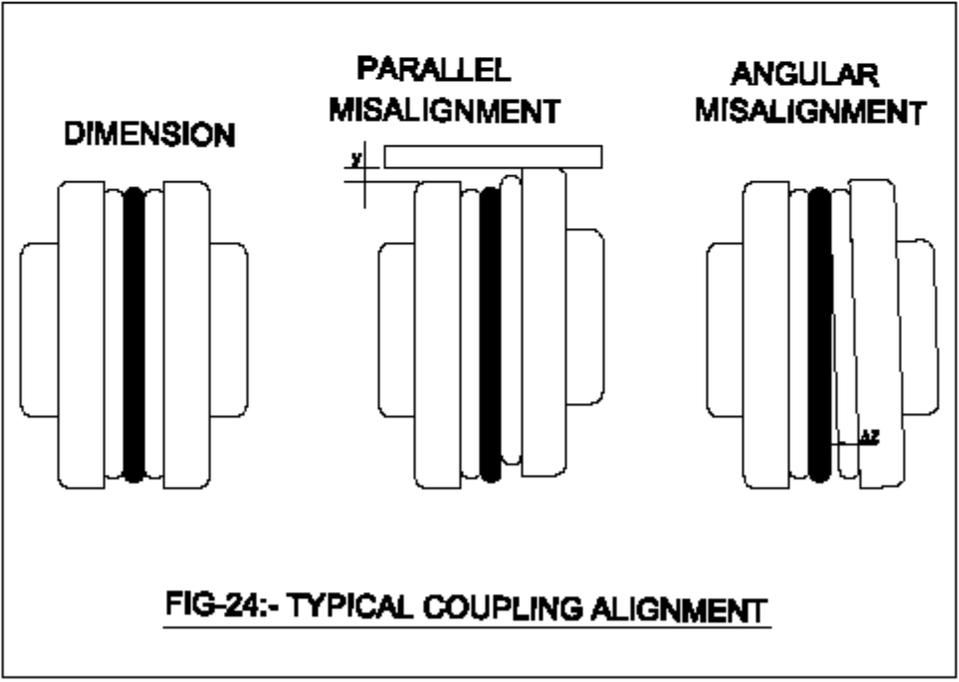
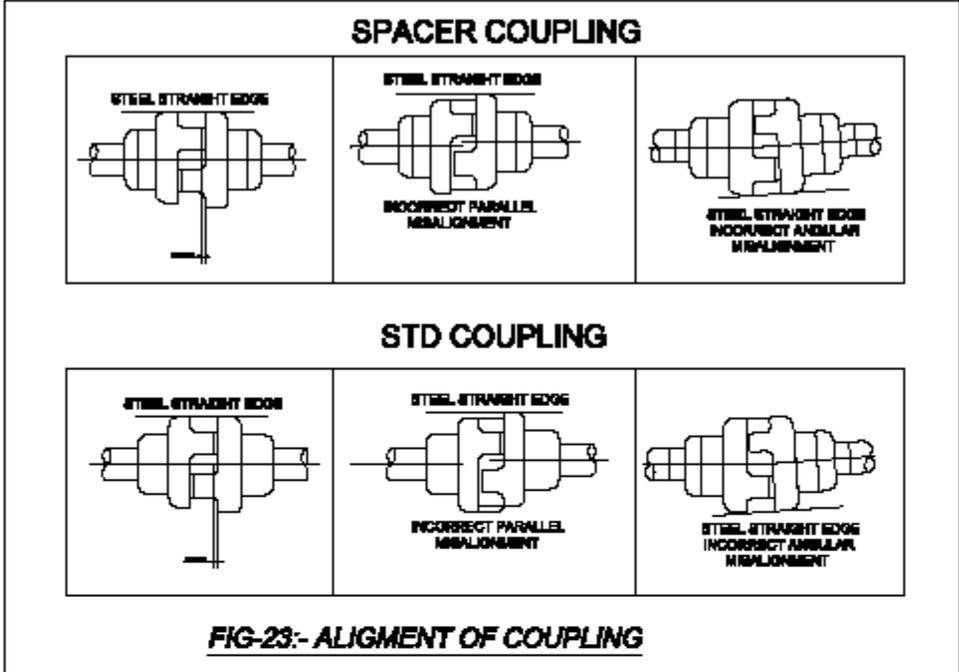
### **PUMP ALIGNMENT:**

Check the pump shaft alignment just below the pump coupling half by means of dial indicator. The maximum total indicated run out at this point should not be more than 0.125mm for 2900 RPM or 0.200 for slower speed. Preferably run out should be 0.075mm and 0.125mm. Care must be used when rotating shaft so the play in the lower driver bearing does not give a false reading.

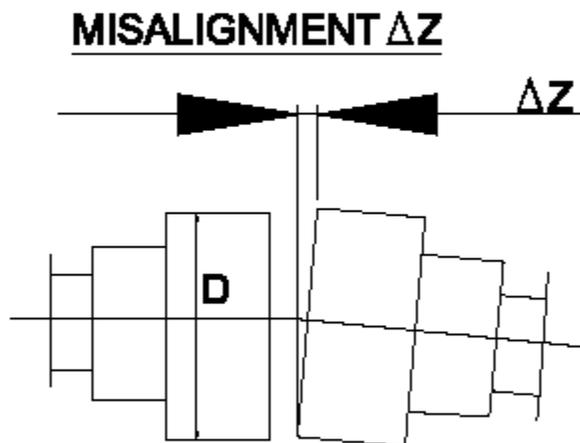
### **NOTE:**

Removing the coupling bolts and rotating the driver coupling half relative adjusting nut can result in lower run out.

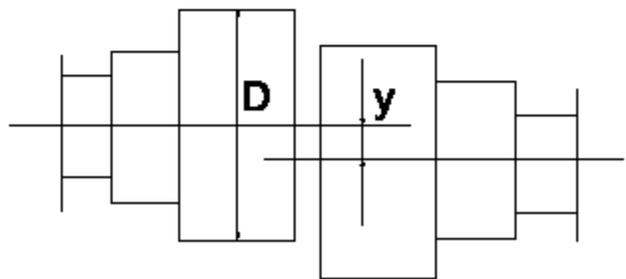




COUPLING DIAMETER D.	SPEED			
	<1500 RPM		>1500 RPM	
	$\Delta Z$ MAX	Y MAX	$\Delta Z$ MAX	Y MAX
100	0.08	0.10	0.05	0.08
101-200	0.11	0.15	0.08	0.10
201-300	0.15	0.20	0.10	0.15
301-400	0.20	0.25	0.10	0.15



**MISALIGNMENT y**



**FIG-25:- PERMISSIBLE MIS ALIGNMENT.**

### **PUMPS WITH EXTERNAL WATER LUBRICATION:**

The external water provided for holder must be clear cold water. The pressure of the external water must be atmosphere above the close valve pressure of the pump. This pressure should be about 30 lit/min.

The pump should not be started unless all air is vented out through shaft enclosing tubes by feeding external pressurized water. It is essential to expel the air from shaft enclosing tubes from time to time by operating air vent when the pump is in operation.FIG-26

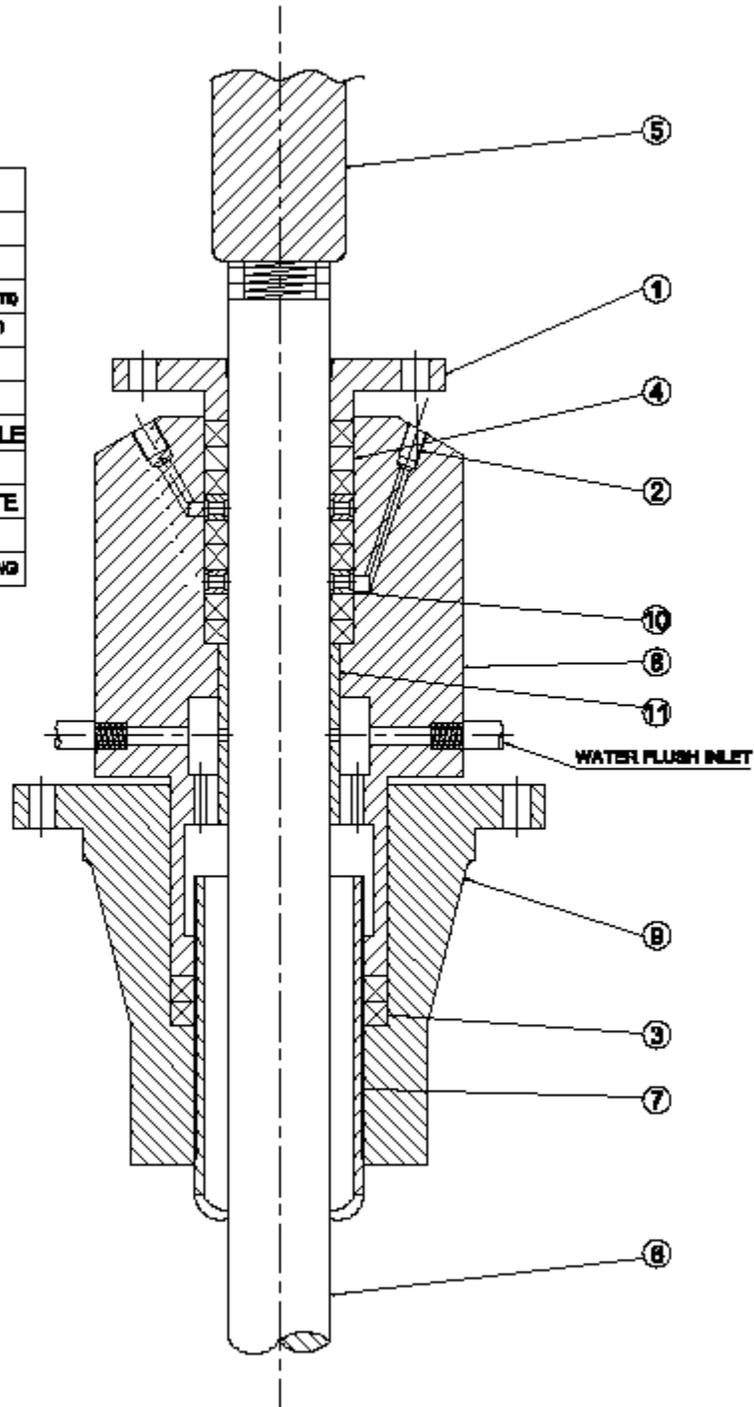
**The Rubber bearing should never run dry.**

### **NOTE:**

If the delivered water quantity starts decreasing close gradually the discharge line valve until pump deliver a steady flow if pump runs dry stop the operation of pump immediately because otherwise impeller and rubber bearing may be seriously damaged.

Watch closely a new pump during its hours of operation for smooth noiseless and vibration free running.

NO.	DESCRIPTION
1	PACKING GLAND
2	GREASE FITTING
3	PACKING (TUBE TENSION PLATE)
4	PACKING (TUBE TENSION NUT)
5	SHAFT COUPLING
6	HEAD SHAFT
7	TUBE TENSION NIPPLE
8	TUBE TENSION NUT
9	TUBE TENSION PLATE
10	LANTERN RING
11	TUBE TENSION NUT BEARING



**FIG-28 EXTERNAL WATER CONSTRUCTION  
TUBE TENSION NUT/PACKING BOX ASSEMBLY**

## **8D.Stuffing box**

Stuffing boxes are packed at the factory all packing is subjected to wear and should be given regular inspection generally packing boxes in pumps should be checked for excessive leakage every 150 hours of operation and gland should be readjustment if necessary.

Adjustment is accomplished by lightly tightening gland nuts, and then loosening them so they can be adjusted with figure pressure to allow a small flow of liquid to lubricate the packing 30-60 drops per minute If the flow of liquid has increased and cannot be reduced by lightly tightening of the gland replace the packing and /or shaft sleeve.

### **Note**

**Do not tighten gland to stop all leakage, leakage is necessary to ensure cooling ,flushing and lubrication of the packing and to prevent shaft sleeve damage**

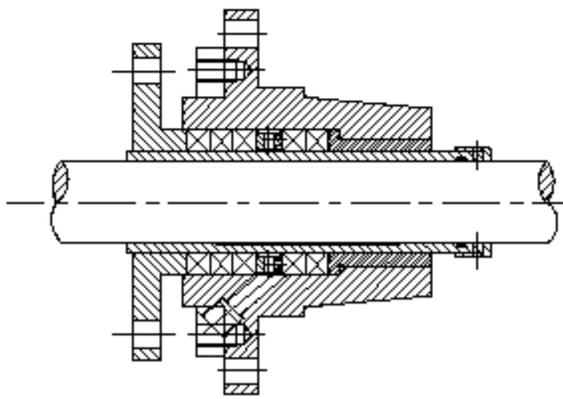
The stuffing box is fitted with lantern /water seal ring .The sealing chamber should be connected to a source of clear, fresh water. The recommend water pressure is 1kg / cm 2 above the maximum discharge pressure.

If water is not available grease lubrication is acceptable.FIG-27

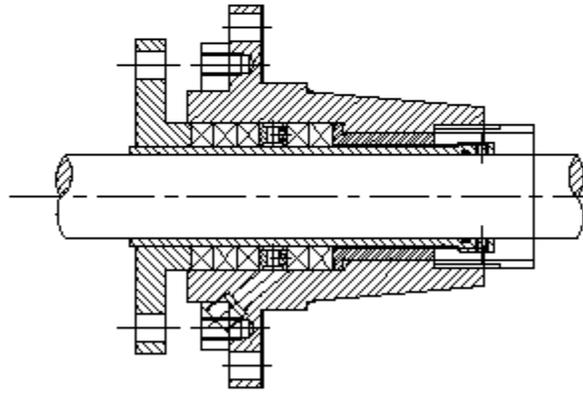
### **Packing replacement**

Use genuine packing suitable for handling liquid at required temperature, Pumping conditions, and the replacement procedure is as under.

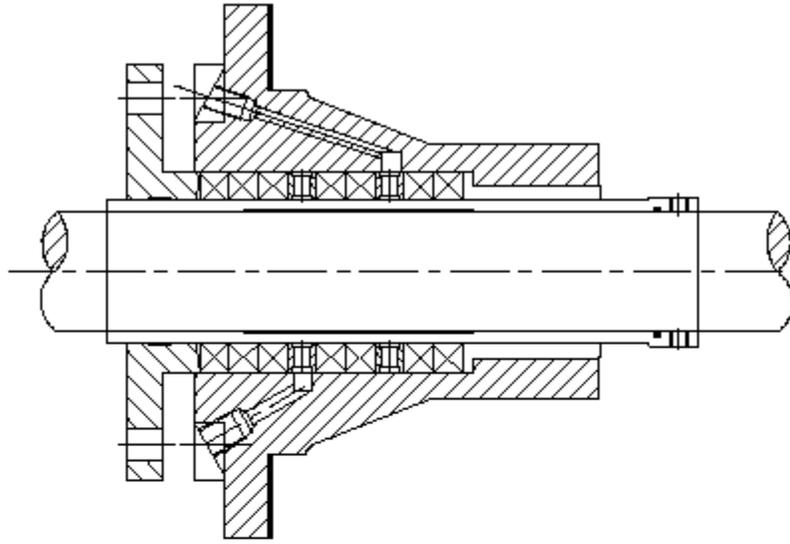
- 1) Stop the pump.
- 2) Unbolt and remove gland
- 3) Use a flexible packing tool with hook/ wood screw attachment for removal of the packing and water seal ring.
- 4) Clean packing box and shaft sleeve.
- 5) Inspect shaft sleeve for wear or rough finish and replace if necessary. Sleeve should have smooth surface.
- 6) Install the packing box with new packing and lantern ring in the following order 2 ring + 1 lantern ring + 3 rings packing + gland.
- 7) For renewing packing rings of suitable quality and dimension. It should be cut clean in an oblique manner, the ends of the ring laid around the shaft should slightly touch. If necessary, measure the ring length on the shaft out Side the pump.
- 8) Before inserting the turns clean the gland space. Apply light grease on gland packing and individual rings are to be placed with joints staggered by 90°c and are to be pushed backwards with the gland, consider the sequence as mentioned above for lantern ring.



STANDARD PACKING BOX



MEDIUM PRESSURE  
PACKING BOX



HIGH PRESSURE  
PACKING BOX

(FIG-27) PACKING BOX ARRANGEMENT.

- 9) Slightly tighten by hand the gland nuts, during operation carefully tighten nut. The glands need certain time to set. A correctly maintained gland should leak 30 to 60 drops per minute.
- 10) After prolonged stand still of the during which the gland may set hardened, they have to be freed and turn shaft by hand.
- 11) Too heavily tightened gland would result in dry running, heating up, burning of the packing material, and damage to the shaft/shaft sleeve. In such case the shaft with sleeve and gland with have to be replaced.
- 12) The gland can only be tightened if the shaft surface is perfect (Ground or polished), the bearing are correct and sleeve are concentric. Maximum eccentricity of about 0.075 mm to 0.125 mm depending on size and operating condition is permissible.
- 13) Packing base data given in table 3 In

THE GLAND SHOULD NEVER RUN DRY
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**14) Usual causes of packing failure**

- a. Packing has not been installed properly.
- b. Packing used is not suitable for the temperature and pressure involved or may be subject to attack by the liquid being handled.
- c. Inner rings are not properly seated so that the outer rings are carrying the entire load.
- d. Dist or foreign Material in the stuffing box is causing repaid wear of shaft or shaft sleeve.
- e. Lantern ring not in line with the tapped hole sealing connection.

<b>Pump takes too Much power</b>	<b>Packing too tight</b>	<b>Release gland pressure. Retighten reasonably. Keep leakage flowing-if none; check packing, sleeve or shaft</b>
<b>Pump leaks excessively at stuffing box</b>	<b>Defective packing</b>	<b>Replace worn packing. Replace packing damaged by lack of lubrication.</b>
	<b>Wrong type of packing</b>	<b>Replace packing not properly installed or run-in. Replace improper packing with correct grade for liquid being handled.</b>
	<b>Scored shaft or shaft sleeves</b>	<b>Put in lathe and machine true and smooth or replace.</b>
<b>Stuffing box overheating</b>	<b>Packing too tight</b>	<b>Release gland pressure.</b>
	<b>Packing not lubricated</b>	<b>Release gland pressure and replace all packing if any burnt or damaged.</b>
	<b>Wrong grade of packing</b>	<b>Check with pump or packing manufacturer for correct grade.</b>
	<b>Insufficient cooling water to jackets</b>	<b>Check if supply line valves opened or line clogged.</b>
	<b>Stuffing box improperly packed</b>	<b>Repack</b>
<b>Packing wears too fast</b>	<b>Shaft or shaft sleeve worn or scored</b>	<b>Re-machine or replace.</b>
	<b>Insufficient or no lubrication</b>	<b>Repack and make sure packing loose enough to allow some leakage.</b>
	<b>Improperly packed</b>	<b>Repack properly making sure all old packing removed and box clean.</b>
	<b>Wrong grade packing</b>	<b>Check with pump or packing manufacturer.</b>
	<b>Pulsating pressure on external seal</b>	<b>Makes packing move and prevents it taking a 'set'. Remove cause of pulsation.</b>

## **The Rubber bearing should never run dry.**

### **NOTE:**

If the delivered water quantity starts decreasing close gradually the discharge line valve until pump deliver a steady flow if pump runs dry stop the operation of pump immediately because otherwise impeller and rubber bearing may be seriously damaged.

Watch closely a new pump during its hours of operation for smooth noiseless and vibration free running.

### **STUFFING BOX/ PACKING BOX:**

All packing is subject to wear and should be given regular inspection. Generally stuffing box of pumps should be checked every 150 hours of operation or weekly and gland should be readjusted if necessary. Initial adjustment is accomplished by tightening gland nuts finger tight.

**NOTE:** Excessive tightening of the gland may cause shaft sleeve damage.

### **PACKING REPLACEMENT:**

For general service application with pump temperature 0 c- 90 c use a good grade of soft square asbestos long fiber packing thoroughly lubricated and graphite.

The replacement procedure should be as under.

1. Stop the pump

**NOTE:** Lock out electrical power to prevent accidental starting and causing possible injury.

2. Unbolt and remove gland.
3. Remove packing with flexible packing tool with hook.
4. Clean the packing box and shaft sleeve.
5. Inspect the shaft sleeve for wear or rough finish and replace the sleeve if necessary.
6. Install the new packing stagger the packing end joints 180° and firmly seat each ring of packing.
7. Reinstall the gland and tighten. After the pump has started adjust the gland so that there is a steady leakage.

### **8E.PUMP DISASSEMBLY & REASSEMBLY:**

Major maintenance beyond lubrication adjustment of impeller or wear ring clearance and replacement or an adjustment of the packing will require disassembly of the pump. The following are step by step instruction procedure.

**CAUTION:**

Before working on motor or pump lock out driver power to prevent accidental starts up and physical injury.

**NOTE:**

Pump components should be match marked prior to disassembly to ensure they are assembled in correct location.

**DRIVER REMOVAL:****VERTICAL HOLLOW SHAFT (VHS) MOTOR:**

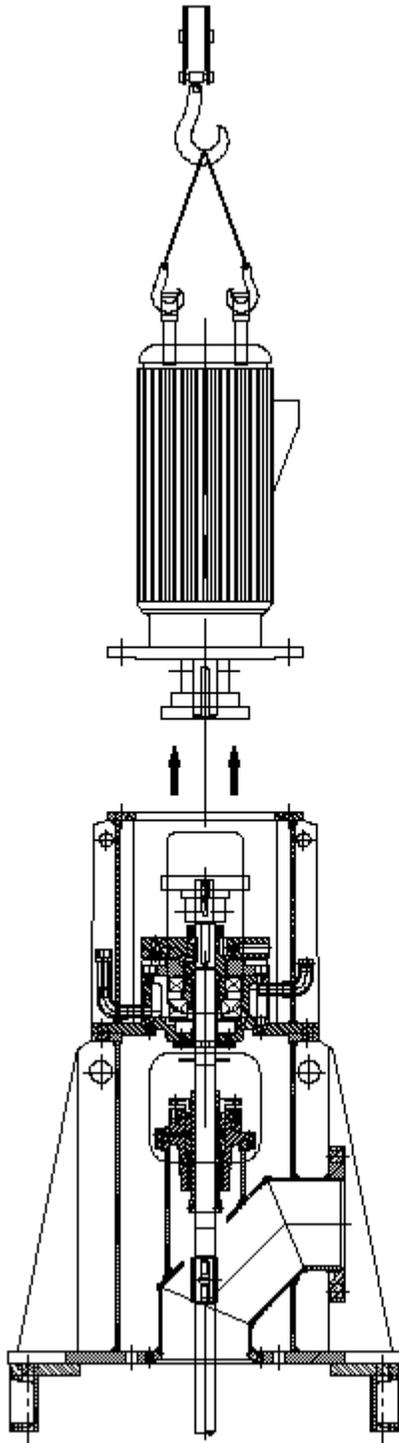
- A. Stop the pump and cut the power to the motor close the discharge valve. Disconnect the electrical cables from the motor. Disconnect and remove gauges and all other auxiliary piping (stuffing box lubrication, oil grease lines etc.) FIG-28

Tag the electrical leads so that they can be reassembled the same way they were disassembled.

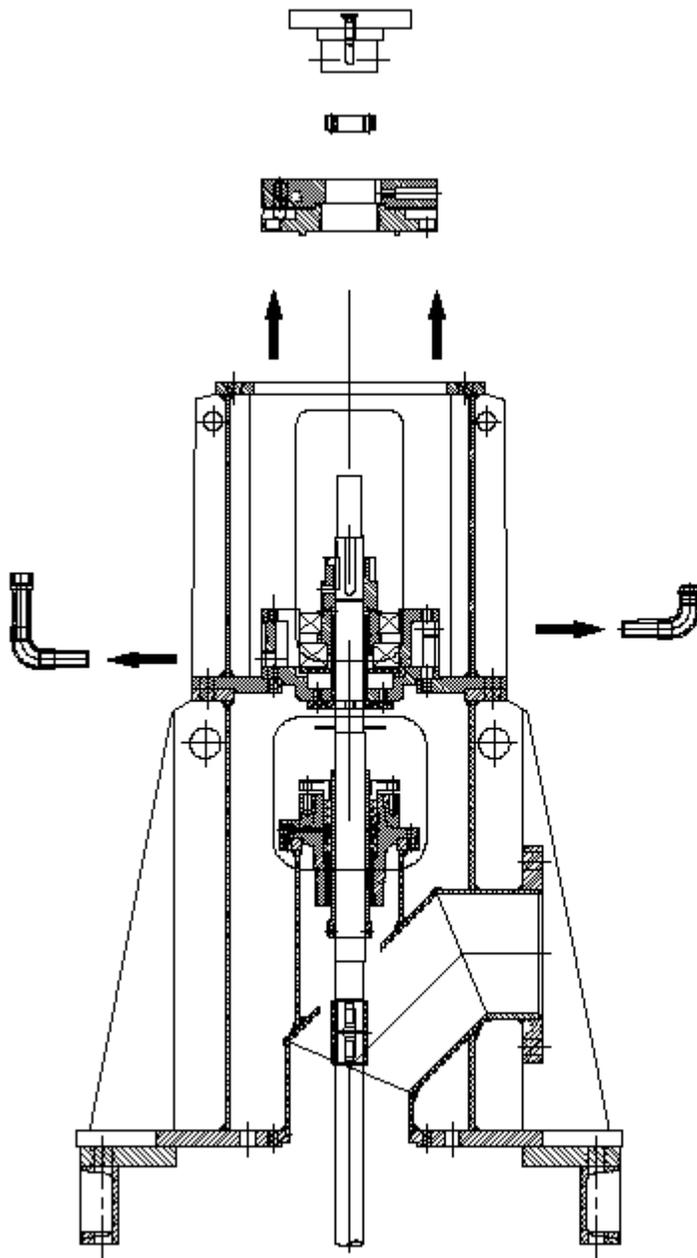
- B. Remove the driver cover adjusting nut lock screw and gib key. Fig-29 Remove adjusting nut and driver coupling.
- C. Disconnect the shaft coupling under the driver (if used) and remove top shaft. Remove the cap screw holding driver to discharge head or pedestal. Lift the motor driver from the head and set aside.

**VERTICAL SOLID SHAFT (VSS) MOTOR DRIVER:**

- A. Stop the pump and cut the power to the VSS motor /driver. Close the discharge valve .disconnect the electrical cables from driver and tag the electrical leads so they can be assembled the same way they were disassembled.FIG-28



**FIG-28 REMOVAL OF MOTOR FROM  
SURFACE DISCHARGE ELBOW.**



**FIG-29 REMOVAL OF COUPLING, ADJUSTING  
NUT AND NRR ASSEMBLY.**

**CAUTION:**

Check with proper electrical testing equipment to be certain all electrical power to the driver and accessories associated with the pump is disconnected.

- B. Remove the bolts holding the coupling halves together slowly so that the impeller does not drop.
- C. Remove bolts and nuts holding the driver to discharge head or pedestal.
- D. Lift the driver from the head and set aside.
- E. Disconnect bearing housing and remove spindle with bearing and bearing housing with oil sleeve. Fig-30.

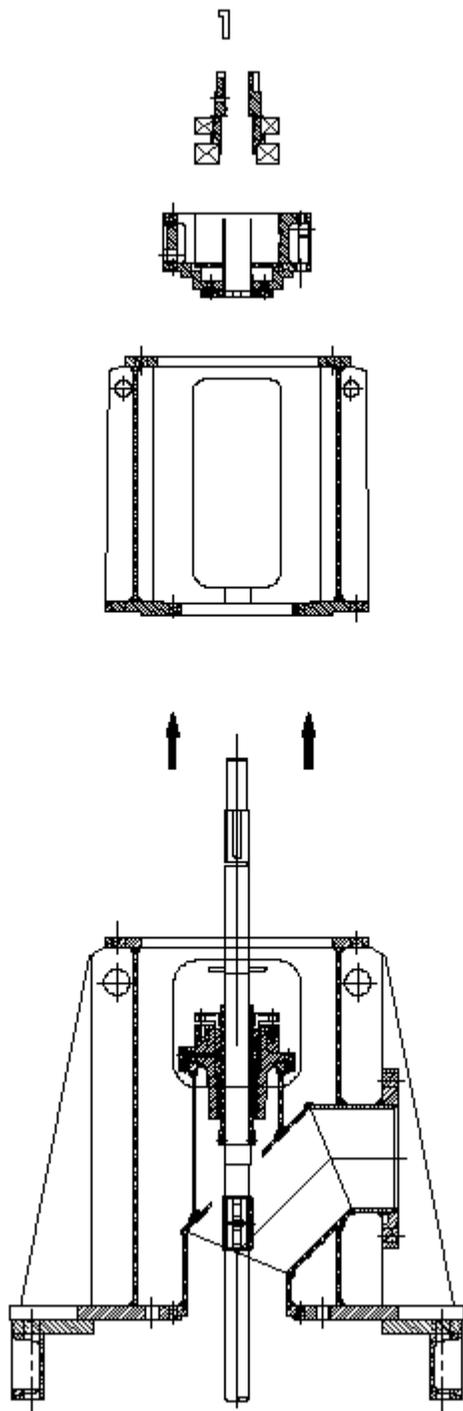
**GEAR HEAD DRIVE:**

- A. Pumps which are driven through a gear drive, remove the driver shaft between the gear and prime mover.
- B. Uncouple gear head from pump shaft and mounting flanges and lift off with lifting lugs or eye bolts and set aside.

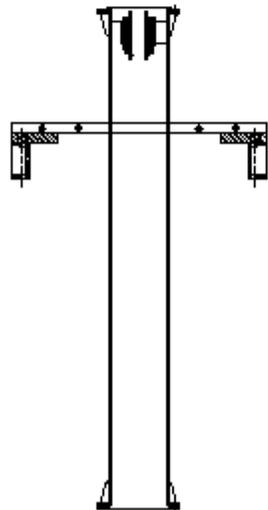
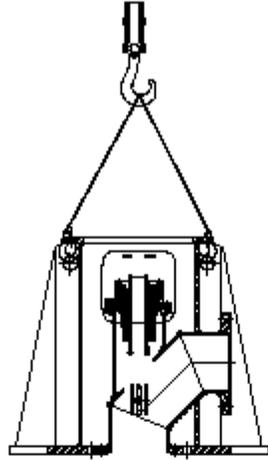
**HEAD AND COLUMN ASSEMBLY:**

**WATER/SELF LUBRICATED:**

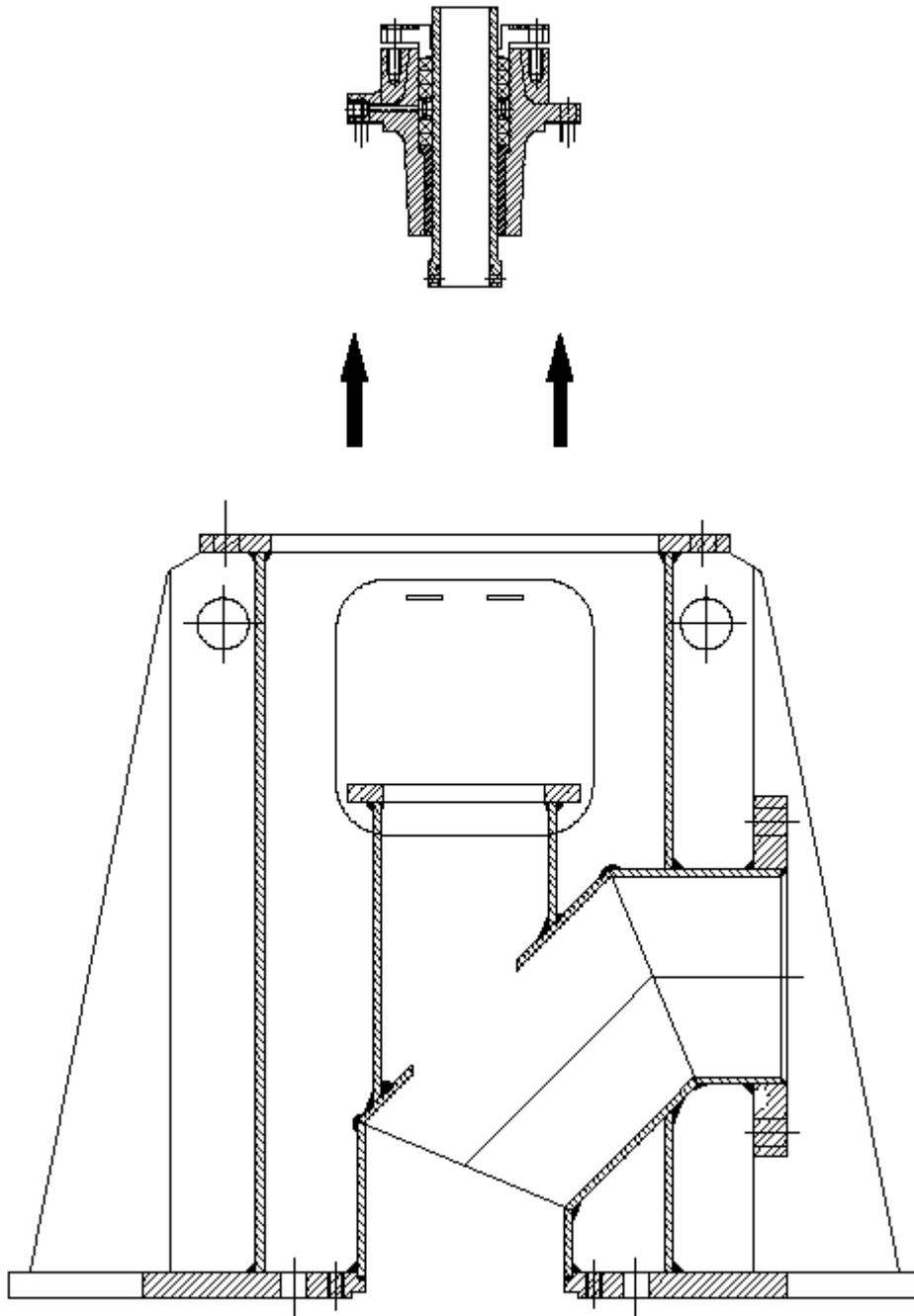
- A. Remove and disassemble the pump head the column. Packing box and shafting according to the following procedure which is essentially the reverse of the installation procedure.
- B. Remove the packing gland bolts gland water slinger and packing.
- C. Loosen and remove all the discharge piping flange bolts.
- D. Lift entire unit with lifting lugs and install a column clamp just below upper column flange leaving space to remove flange bolting .lower the unit so that the column clamps rests on adequate supports. Fig-31
- E. Remove the head lift the discharge head of the unit and set aside.
- F. Remove the packing box bolts and remove the box from the discharged head and shaft to a work area for inspection and cleaning. Fig-32



**FIG-30 REMOVAL OF GIB KEY, SPINDLE WITH BEARING  
AND BEARING HOUSING WITH OIL RETAINER SLEEVE.**



**FIG-61 REMOVAL OF SURFACE DISCHARGE HEAD/ELBOW.**



**FIG-32 REMOVAL OF PACKING BOX  
FROM DISCHARGE HEAD/ELBOW.**

G. Disconnect and remove muff coupling. Fig-33

H. If packing box bearing is found to be worn out which is or interference fit in the packing box. The removal of this bearing will require use of mechanical press or bearing may be removed by machinery use care when re-coming bearing not to damage bores or hubs.

**FLANGE COLUMN:**

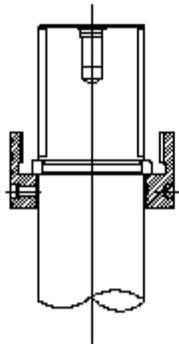
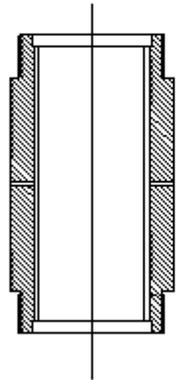
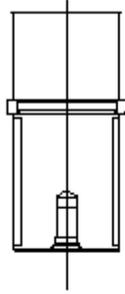
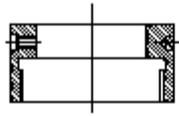
- A. Install eyebolts of sufficient size in the column flange holes and lift the unit and reposition the clamps below the next column flange.
- B. Use column and shaft clamps or other acceptable method to safety support and lift this assembly.
- C. Unbolts column flange and lift column enough to loosen the shaft coupling, when all component are loose carefully lift this assembly from the pump unit. With soft skid boards under the column to protect the flange, slowly lower the column and shaft onto the floor and move to a convenient work area. Fig-34

**Note:** Shaft threads are left hand.

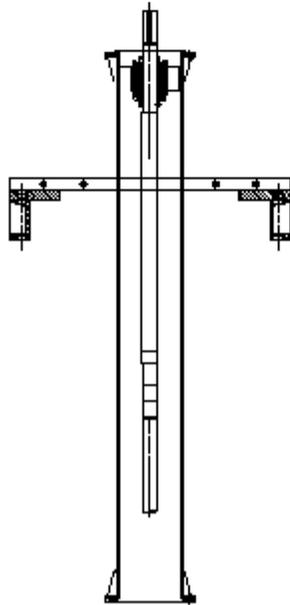
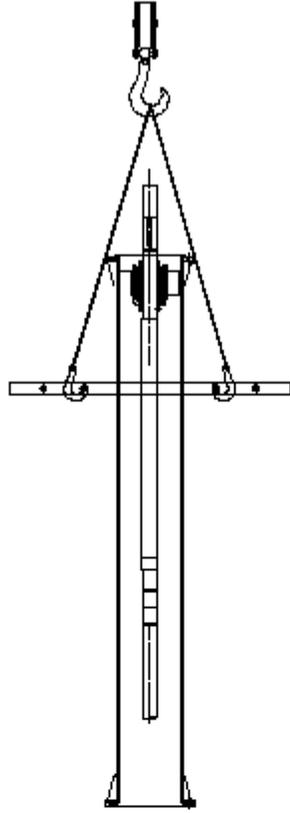
- D. Repeat above step A, B and C until all column and shaft sections have been removed from the unit.
- E. Remove the bearing retainer assembly for cleaning and inspection.
- F. Remove shaft section from column pipe remove coupling from shaft and inspect for wear or damage.
- G. Inspect bearing and retainers for damage.
- H. If the top and intermediate drive shaft sleeves show wear or damage remove the sleeve.

**NOTE:**

Measure and record the position of the sleeve on the shaft before removal. They must be put back in exactly same place.



**FIG-33 DISCONNECTED MUFF COUPLING.**



**FIG-34 REMOVAL OF COLUMN ASSEMBLY.**

- A. Unscrew the column coupling and lift column enough to loose shaft coupling. When all components are loose carefully lift this assembly from the pump unit. With soft skid boards under the column to protect the threads, slowly lower the column and shaft assembly onto the floor and move to a convenient area.

**NOTE:** Shaft threads are left hand & column threads are right hand.

- B. Repeat above steps A, B and C until all column and shaft section have been removed from the unit.
- F. Remove the bearing retainer assembly for inspection and cleaning.
- G. Remove shaft section from column pipe remove coupling from shaft and inspect for wear or damage.
- H. Inspect bearing and retainer for damage.
- I. If top and intermediate drive shaft sleeves show wear or damage remove the sleeve.

### **HEAD AND COLUMN (OIL LUBRICATED)**

- A. Remove and disassembled the pump head the column tube tension nut and shafting according to the following procedure which is essentially the reverse of the installation procedure.
- B. Loosen and remove the tube tension nut and set aside for inspection.
- C. Loosen and remove all the discharge piping flange bolts.
- D. Lift entire unit with the lifting lugs and install a column clamp just below the upper column flange leaving space to remove the flange bolting. Lower unit so that the column clamp rests on adequate supports.
- E. Remove the bolts holding the column to the discharge head. Lift discharge head off the unit and set aside.

### **FLANGED COLUMN (OIL LUBRICATED)**

- A. Install eye bolts of sufficient size in the column flange and lift the unit and reposition the clamp below the next column flange.
- B. Use column and shaft clamps to safety support and lift the assembly.
- C. Unbolt column flange and lift column enough to loosen the enclosing tube and shaft coupling. When all components are loose carefully lift this assembly from the pump unit. Slowly lower the column, tube and shaft assembly onto floor and shift to convenient place.

**NOTE:** Shaft threads are left hand & Enclosing tube threads are left hand.

- D. Repeat above steps until all column tube shaft section have been removed.
- E. Remove shaft and tube section from column pipe. Remove shaft from tube section remove coupling from shaft and inspect for wear or damage.
- F. Inspect connector bearing for wear or damage.

### **PUMP BOWL DISASSEMBLY:**

For disassembly of the pump bowl proceed in accordance with steps listed below. Select clean place for work refer to assembly and part list for part identification. Fig-35

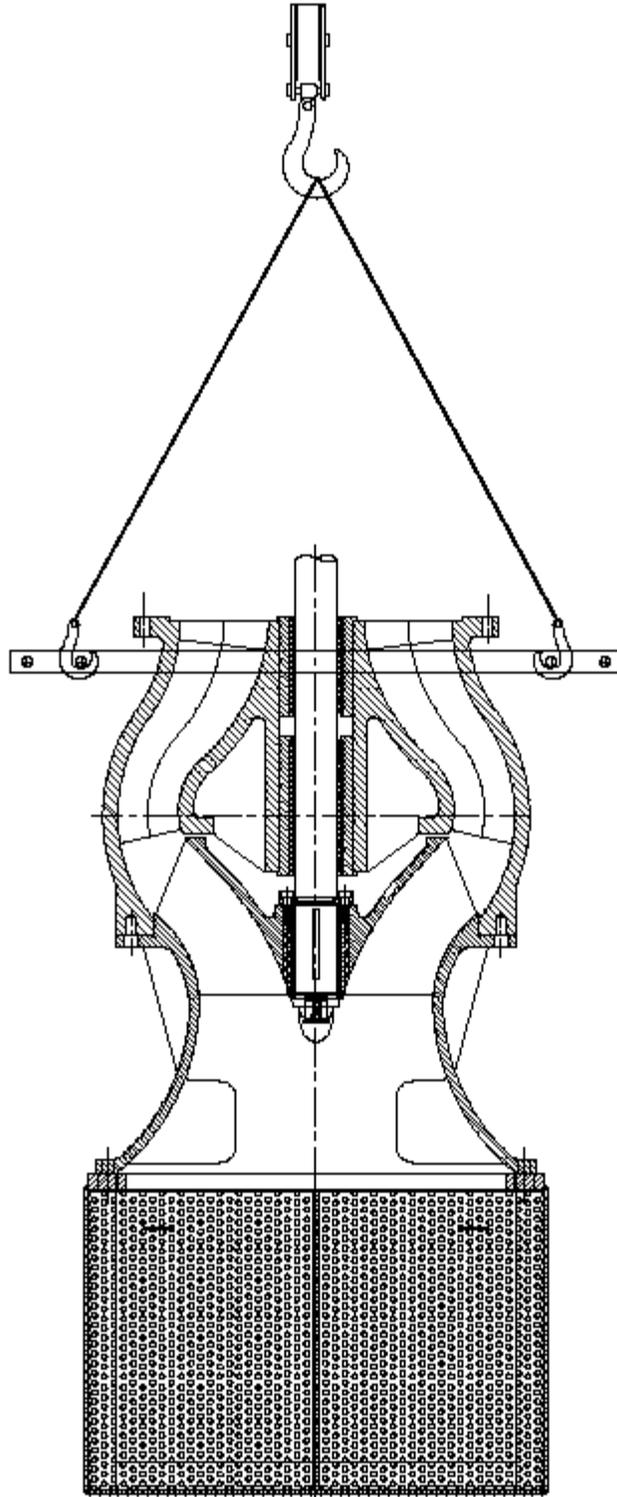
The bowl assembly consists of a suction bell/ case intermediate bowls top bowl impellers and securing hardware bearing and pump shaft.

Turbine impellers are secured to the shaft by either a taper pin lock or key and split thrust ring. Follow only those procedures that apply to the particular construction supplied.

<b>NOTE: Match mark bowl assembly in sequence of disassembly to aid in the reassembly procedure.</b>
--

### **FLANGED BOWLS:**

- A. Place the bowl assembly in a horizontal position blocked to prevent rolling.
- B. Measure and record axial end play. This must be checked on reassembly of the bowls.
- C. Remove the shaft coupling measure and record shaft projection over column seat. This must be checked on assembly.



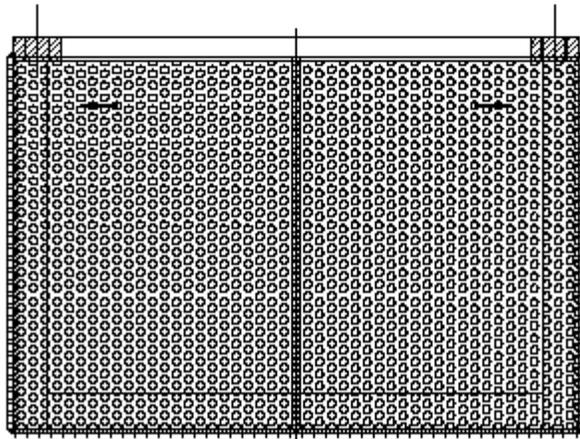
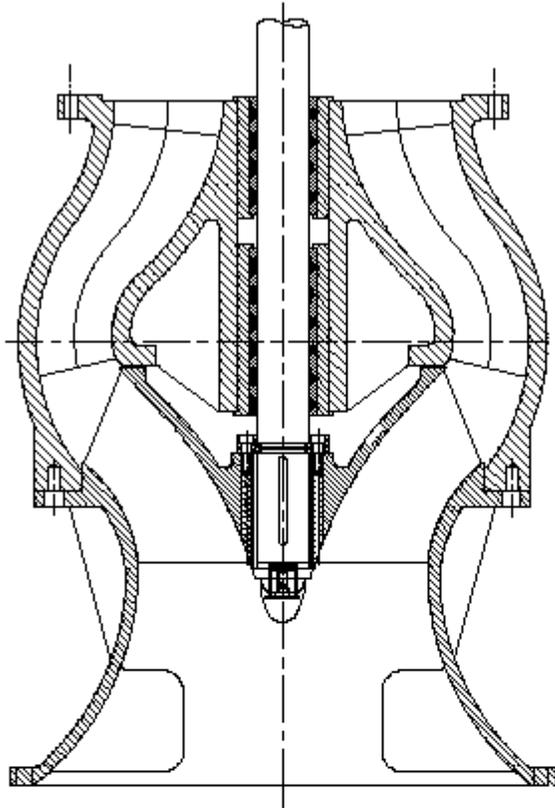
**FIG 35- REMOVAL OF BOWL ASSEMBLY.**

**TAPER LOCK CONSTRUCTION DISASSEMBLY:**

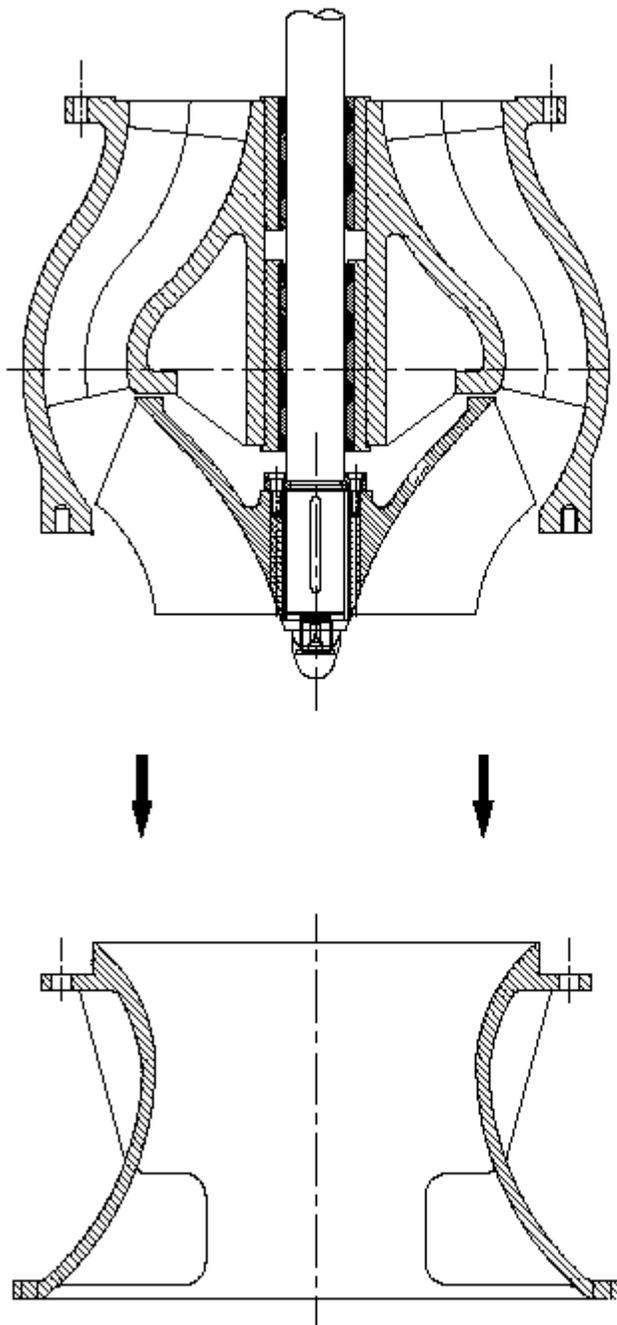
- A. Remove cap screw holding the discharge case and to intermediate bowl and remove from the pump shaft and keep aside for inspection.Fig-36
- B. Pull the shaft upward until the impeller is in its up most position and strike the hub of the impeller by taper collect driver until the impeller is off the taper collect.
- C. To remove the collate insert a screw driver in the collate slit and spread open slide the collate and impeller off the pump shaft.
- D. Repeat the above procedure C, D, E, & F until the bowl assembly is completely disassembled.
- E. If impeller is to be reused they should be marked so that they are re installed in the same bowl.
- F. Remove the shaft from suction bell/suction case.Fig-37
- G. Measured and record the location of the sand color, remove the sand color only if it is damaged and replacement is required.
- H. Check wear ring on bowl/impeller (if supplied) for wear and damage. if required then replaces the same.

**KEYED BOWL ASSEMBLY:**

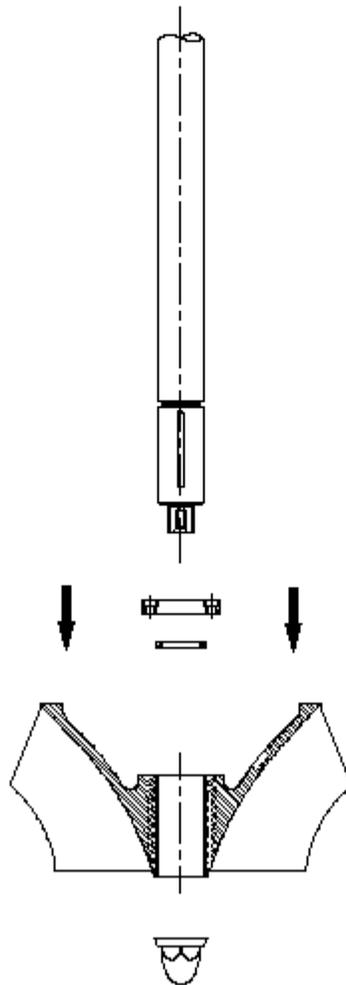
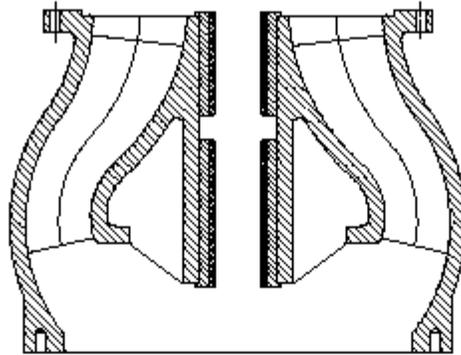
1. Remove cap screw that screw top bowl to intermediate bowl.
2. Slide off top bowl from the pump shaft.
3. Remove cap screw and split thrust ring from pump shaft.Fig-38
4. Slide impeller off the pump shaft and remove the key. If impeller is seized to the shaft strike impeller with mallet (fiber) and drive impeller off the pump shaft.Fig-38
5. Repeat the above procedure will bowl assembly is completely disassembled.
6. Remove the shaft from the suction bell/suction case.
7. Measure and record the location of the sand collar only if it is damaged and replacement is required.
8. Pump bowl assembly is now disassembled and ready for inspection.
9. Check wear rings liner on bowl / (if supplied) for wear and damage, required then replace them.



**FIG 36:- REMOVAL OF BASKET STRAINER.**



**FIG 37:-DISASSEMBLY OF BOWL ASSEMBLY**  
**REMOVAL OF SUCTION BELL.**



**FIG 38 REMOVAL OF PUMP SHAFT IMPELER.**

**INSPECTION FOR REPLACEMENT:**

After the components are disassembled each part should be thoroughly cleaned and inspected for wear and damage. Do not clean rubber bearing with petroleum based solvents. It is not necessary to remove bearing and wear ring unless inspection indicates replacement is necessary.

### **WEAR RING LINER REMOVAL:**

#### **A. BOWL:**

1. Remove set screw or grind off tack weld when wear ring are furnished with these locking methods.
2. With point chisel cut two "V" shaped grooves on the bowl wear ring approximately 180° a part. Take care not to damage wear ring seat.
3. With a chisel, knock the end of one half of the ring in and take the ring out.
4. Special material such as chrome steel, set up the bowl in a lathe and machine the wear ring off taking care wear ring seat is not damaged.

### **BOWL AND LINE SHAFT BEARING REMOVAL:**

Using an arbor press and a piece of pipe or sleeve with outside diameter slightly less than the outside diameter of the bearing to press the bearing out.

#### **NOTE:**

Bowl bearing are press fit do not remove unless replacement is necessary.
---

### **INSPECTION AND REASSEMBLE:**

1. Clean all pump parts thoroughly with suitable cleaner.
2. Check bearing retainer for deformation and wear.
3. Check shaft for straightness and excessive wear on bearing surface. The maximum allowable total indicator run out must be less than 0.041mm per meter or not 0.125mm for every 3 meter of shafting. Fig-39
4. Visually check impeller and bowls for damage. Check all bowl bearing for excessive wear and corrosion.
5. Replace all badly worn or damage parts with new parts in addition. Replace all gasket and packing as required.

### **WATER RING INSTALLATION:**

Place chamfered face of the bowl or impeller wear ring to ward the ring seat and press the ring in to the seat. Use arbor press or equal methods making sure the ring is flush the edge or the wear ring seat.

## **INSTALLATION OF BOWL AND:**

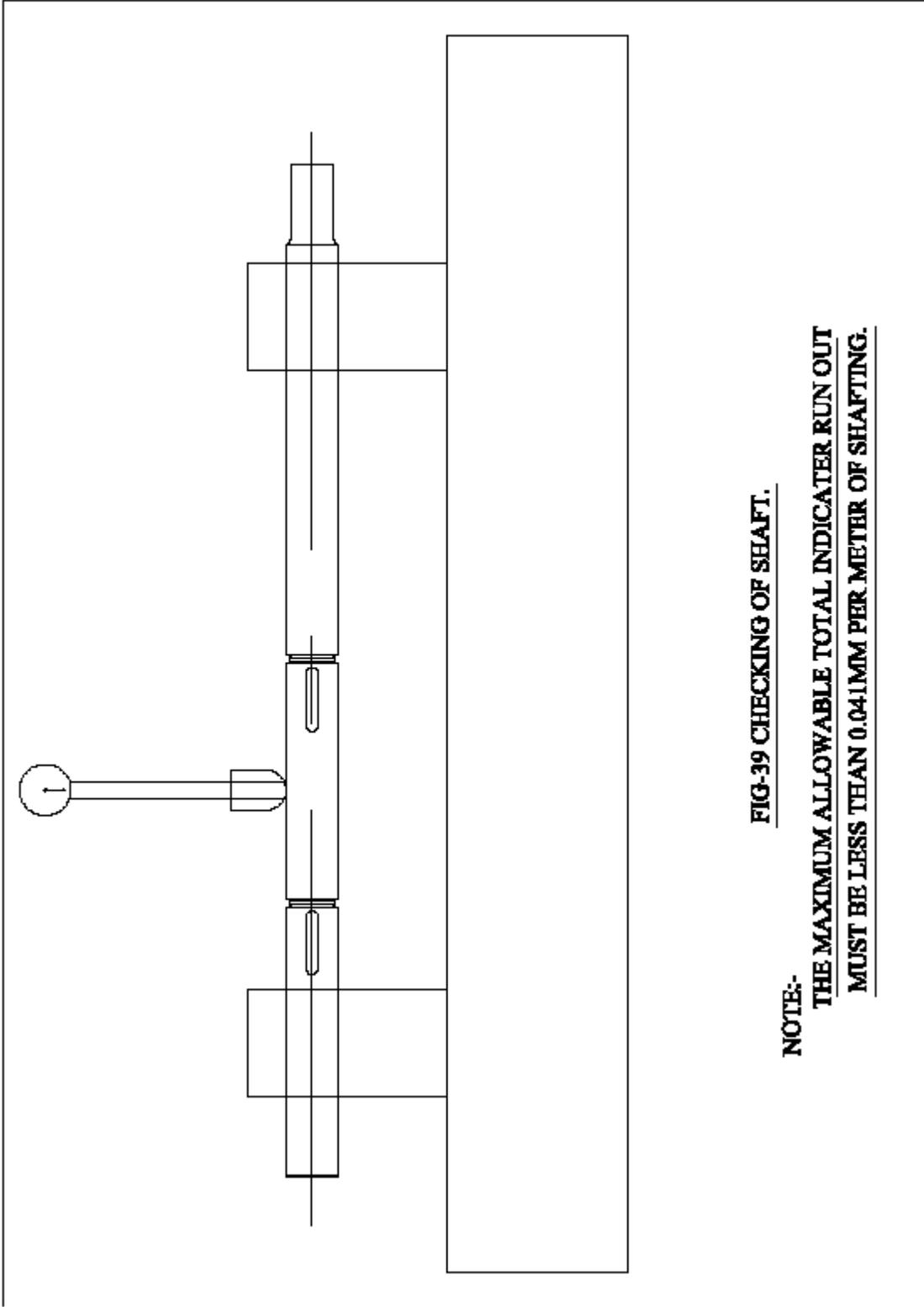
### **LINE SHAFT BEARING:**

1. Press bearing into retainer using an arbor or equivalent method.
2. Press bearing in suction bell/case by using an arbor press or equivalent method top of the bearing should project above suction hub equal to the depth of the counter bore in the sand collar.
3. Place the bowl with flange chamfered and press bearing thoroughly chamfered side of bowl hub until the bearing is flush with the hub by using an arbor press or equivalent method.

### **REASSEMBLY OF THE BOWL ASSEMBLY:**

#### **WITH TAPER COLLECT CONSTRUCTION:**

1. In reassembly apply a thin film of turbine oil to mating parts.
2. If the collar is not assembled to the shaft install the sand collar. The sand collar is attached to the shaft with lock screw the larger end of the counter bore of the sand collar goes toward the suction bell /case bearing. Slip the sand collar over the shaft and position it so that bottom of the sand collar is set and sand collar is locked with lock screw. Slide the plain end of the pump shaft into the suction bell/case bearing until the sand collar rests against the suction bell/case hub.
3. Hold the shaft in position by inserting a long cap screw with an assembly jig in to the bottom end of the suction hub and screw tight into the threaded hole at the end of the shaft. Be sure that shaft has been cleaned and checked for straightness.
4. Slide the first impeller over the shaft and it seats on the suction case/bell set.
5. Insert a screw driver into the slot in the taper lock to spread the slot and slide taper lock over the pump shaft. Holds the impeller against bowl and slide the taper lock in to the impeller hub is sure to taper lock have been cleaned.



**FIG-39 CHECKING OF SHAFT.**

**NOTE:-**  
**THE MAXIMUM ALLOWABLE TOTAL INDICATER RUN OUT**  
**MUST BE LESS THAN 0.041MM PER METER OF SHAFTING.**

6. Hold impeller firmly against the suction bell/case seat and drive the taper lock into the place with taper lock driver after the impeller is secured in position the top end of the taper lock should be 3mm above the impeller hub.
7. Slide intermediate bowl into shaft and screw with cap screw to suction bell.
8. Repeat above procedure for no of stages required.
9. Remove long cap screw and the assembly jig at the end of suction hub.
10. Check shaft rotates freely without rubbing. Also check for adequate lateral movement (end play).
11. With impeller in lowest position and measure the shaft projection over the column seat.
12. Fill suction bell case bottom end with water proof grease and fix pipe plug. The shaft should be in lowest position while filling grease. Now bowl assembly is ready for installation.

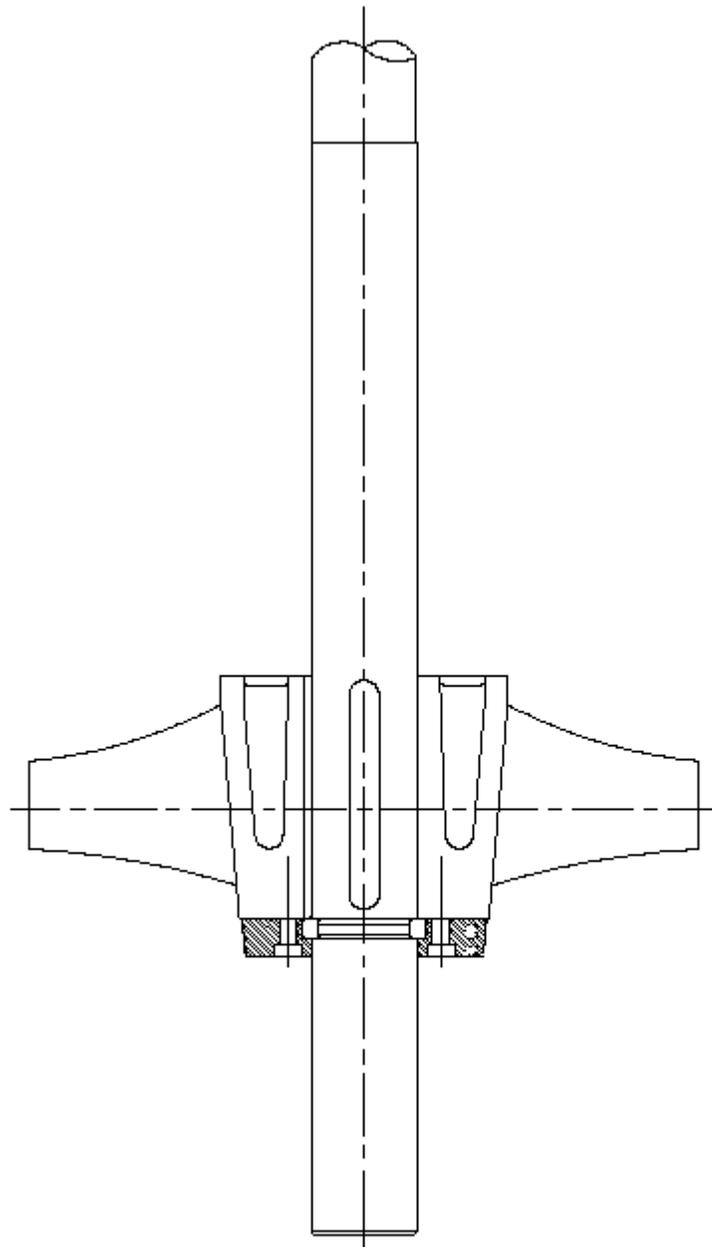
### **KEYED CONSTRUCTION BOWL ASSEMBLY:**

1. Install key in to pump shaft key way slide impeller over shaft and locate it on the key way.
2. Install split thrust ring on pump shaft groove and secure to impeller with cap screw.

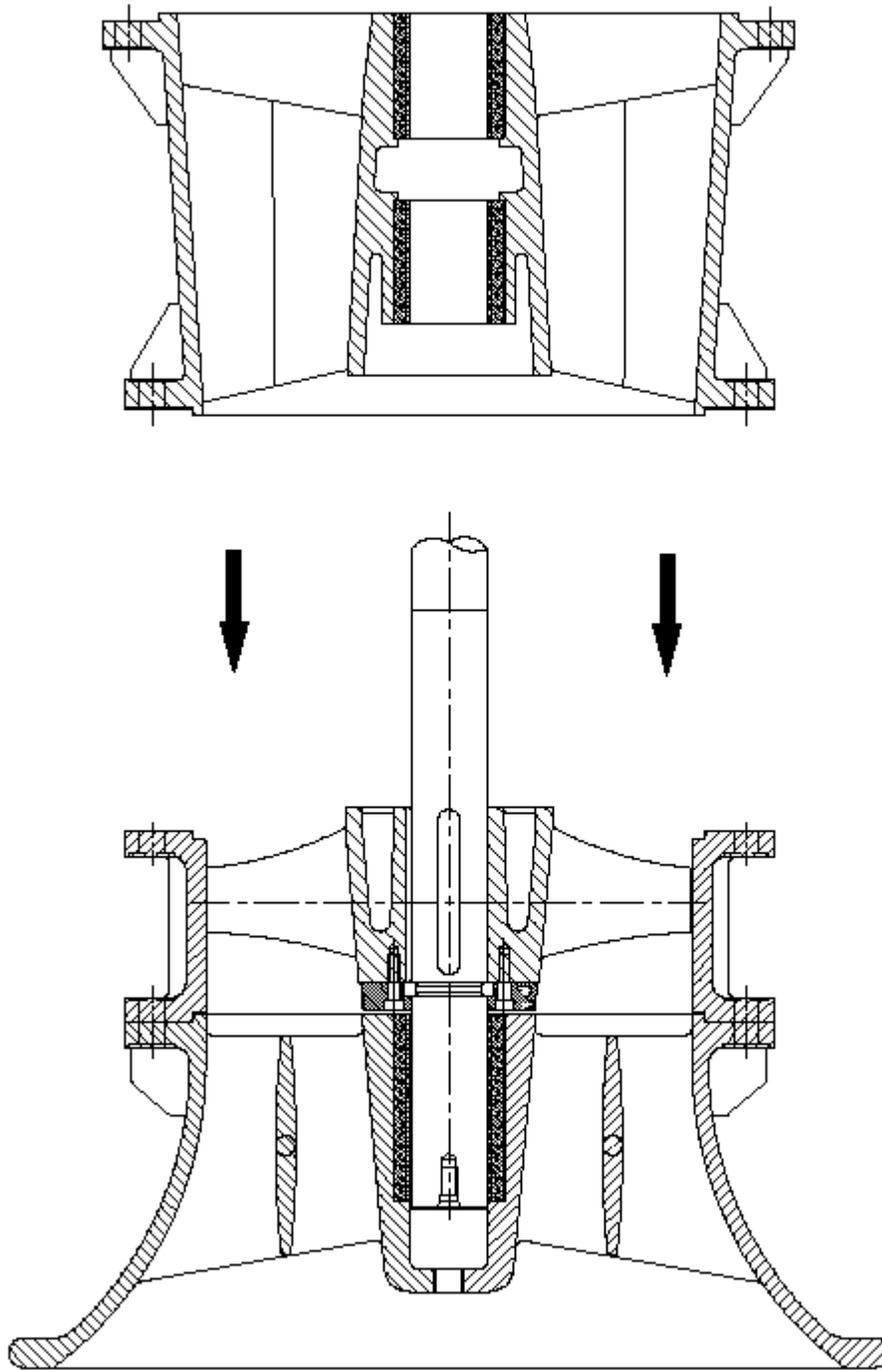
If the sand color is not installed to the shaft. The sand color is attached it to the shaft with lock screw. The larger end of the counter bore o the sand color goes towards suction belt/ case bearing. Slip the sand color over the shaft and position it so that bottom sand color is set in with the y dimension and sand color is locked with lock screw. Slide the plain end of shaft in to the suction bell case bearing until the sand color rest against the suction case hub.Fig-40

3. Slide inter mediate bowl on to the shaft and secure with cap screw to the suction bell/ Case.Fig-41
4. Repeat above procedure for number of stage required.
5. Check that shaft rotates freely without rubbing. Also check for lateral end play.
6. With impeller in lowest position and measure the shaft projection over the column seat.
7. Fill suction bell case bottom end with water proof grease and fix pipe play. The shaft should be in lowest position while filling grease.Fig-42

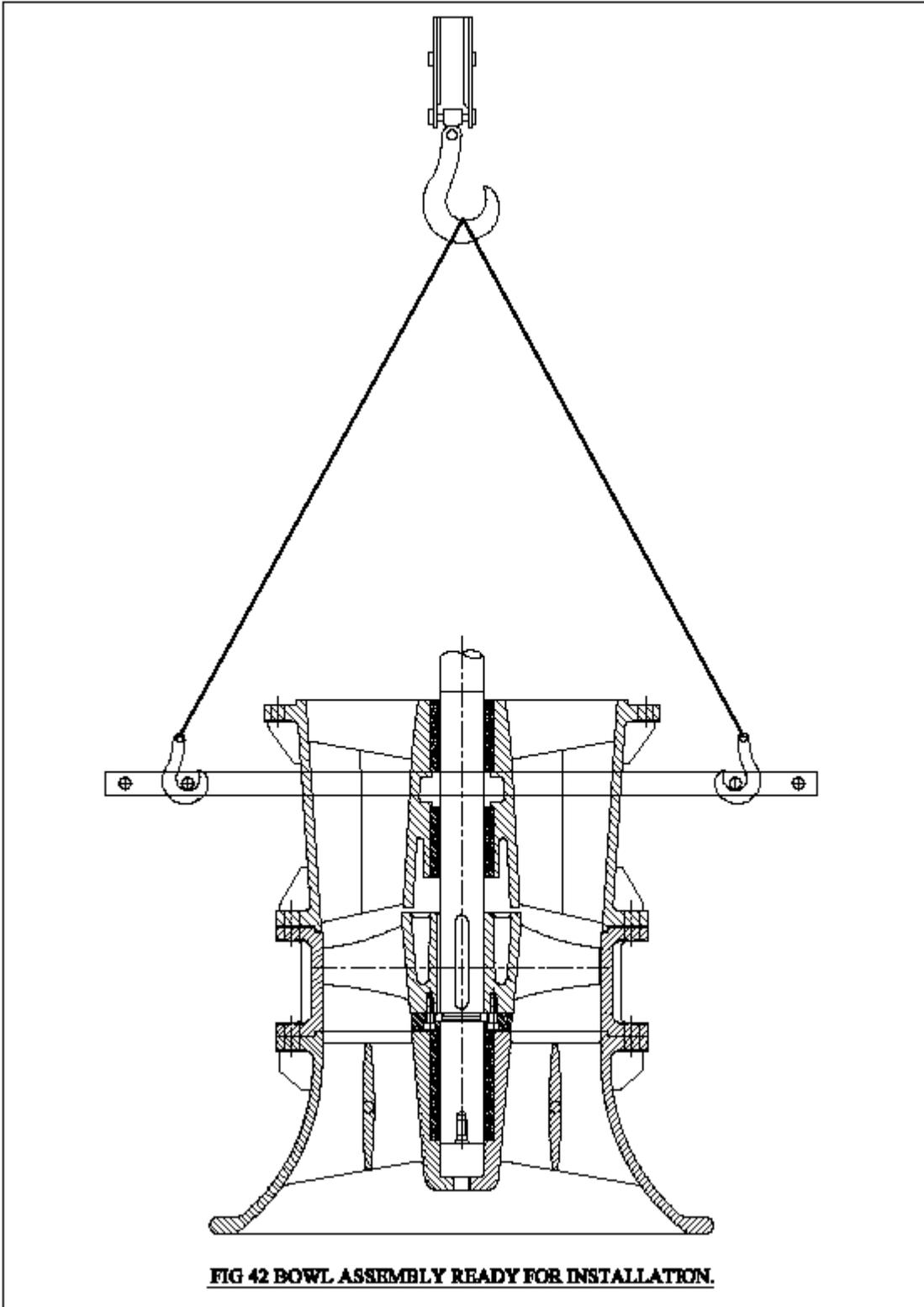
Now bowl assembly is ready for installation



**FIG 40 ASSEMBLY OF PROPELLER  
WITH PUMP SHAFT.**



**FIG 41 ASSEMBLY OF PROPELLER PUMP.**



**FIG 42 BOWL ASSEMBLY READY FOR INSTALLATION.**

**9 SPARE PARTS**

RECOMMENDED SPARE PARTS FOR  
2YEARS OF NORMAL OPERATION

Refer fig 4 to 10

1 Impellers	50%
2 Wear Ring	100%
3 Shaft sleeves	100%
4 Bushes	100%
5 Gaskets	100%
6 Bearings	100%
7 Pump shaft	50%
8 Couplings	30%
9 Keys	50%
10 Collets	50%
11 Spider bush	50%
12 Line shaft	30%
13 Packing box	
Assembly	30%
14 Inter Bowl	30%
15 Screw bearing	50%
16 Gland Packing	400%
17 Oil seal	100%

## **GENERAL INFORMATION & SAFETY INSTRUCTIONS:**

1. The products supplied by **SPPL** have been designed with safety in mind. Where hazards cannot be eliminated, the risk has been minimized by the use of guards and other design features. Some hazards cannot be guarded against and the instructions below **must be complied with** for safe operation. These instructions cannot cover all circumstances. Installation, operation and maintenance personal must be use safe working practices at all the times.
2. **SPPL** products are designed for installation in designated areas, which are to be kept clean and free of obstructions that may restrict safe access to the controls and maintenance access points. A pump duty nameplate is fitted on the unit and must not be removed. Loss of this plate could make identification impossible. This in turn could affect safety and cause difficulty in obtaining spare parts. If accidental loss or damage occurs, contact **SPPL** immediately.
3. Access to the equipment should be restricted to the person not responsible for installation, operation and maintenance and they must be trained, adequately qualified and supplied with appropriate tools for their respective tasks.
4. Most accidents involving product operation, maintenance and repair are cased by failure to observe safety rules or precautions. An accident can often be avoided by recognizing potential situations before an accident occurs. A person must be aware of potential hazards associated in activities of installation, operation and maintenance of equipments.
5. **SPPL** requires that, all personnel that are responsible for installation, operation or maintenance of the equipment, have access to and study the product instruction manual before any work is done and that they will comply with all local and industry based safety instructions and regulations.
6. Ear defenders should be worn where the specified equipment noise level exceeds locally defined safe levels. Safety glasses or goggles or face shield should be worn where working with pressurized systems and hazardous substances. Other personal protection equipment must be worn where local rules apply. Wear safety shoes, helmets and cotton overalls (apron) when you enter pump house. Noise level should not exceed 90 dbA and 100 dbA for motor driven and engine driven pumps respectively.
7. Do not wear loose clothing or Jewell, which could catch on the controls or become trapped in the equipment.
8. Read the instruction manual before installation, operation or maintenance of the equipment. Check and conform that he manual is relevant copy of comparing pump type on the nameplate and with that on the manual.
9. Note that “limits of product application permissible use” specified in the manual. Operation of the equipment beyond these limits will increase the risk from hazards noted below and may lead to premature and hazardous pump failure.

10. Clear and easy access to all controls, gauges and dials etc. must be maintained at all times. Hazardous or flammable materials must not be stored in pump rooms unless safe area or racking and suitable containers have been provided.
11. Use suitable earth and tripping devices for electrical equipments.
12. Improper installation, operation, maintenance, lubrication, repair of this SPPL product could result in injury or fatal.

If tool, procedure, work methods are operating technique not specifically recommended by SINTECH PRECISION PRODUCTS LIMITED is used, it should be ensured that it is a safe for personnel around and others. It should be ensured that the product will not be damaged or made unsafe by the operation, lubrication and maintenance or repair procedure you choose.

### **SAFETY INSTRUCTIONS WHILE HANDLING AND STORAGE:**

When lifting the pump, use the lifting points specified on general arrangement drawing. Use lifting equipment having a safe working load rating suitable for the weight specified. Use suitable slings for lifting pump which is not provided with lifting points. The use of fork-lift truck and chain crane sling equipment is recommended but locally approved equipment of suitable rating may be used

Do not place fingers or hands etc. into the suction or discharge pipe outlets and do not touch the impeller, if rotated this may cause severe injury. To prevent ingress of any objects, retain the Protection covers or packaging in place until removal is necessary for installation. If the packaging or suction and discharge covers are removed for inspection purposes, replace afterwards to protect the pump and maintain safety.

### **SAFETY INSTRUCTIONS WHILE ASSEMBLY & INSTALLATION**

Do not place fingers or hands etc. into the suction or discharge pipe outlets and do not touch the impeller. If rotated this may cause severe injury. To prevent ingress of any objects, retain the Protection covers or packaging in place until removal is necessary for installation.

Do not touch any moving or rotating parts. Guards are provided to prevent access to these parts. Where they have been removed for maintenance they must be replaced before operating the Equipment.

Shaft alignment must be checked again after the final positioning of the pump unit and connection to pipe work as this may have disturbed the pump or motor mounting position. If hot liquids (above 80°C) are being pumped. Alignment should be checked and reset with pump and motor at their normal operating temperature. If this is not possible, SINTECH can supply estimated initial Offset figures to suit extreme operating temperatures.

Failure to support suction and delivery pipe work may result in distortion of the pump casing with the possibility of pump failure.

## **SAFETY INSTRUCTIONS WHILE COMMISSIONING & OPERATION**

Do not touch any moving or rotating parts. Guards are provided to prevent access to these parts, where they have been removed for maintenance they must be replaced before operating the equipment.

Check that the pump is primed. Pump should never be run dry as the pumped liquid acts, as lubricant for the close running fits surrounding impeller and damage will be incurred.

Failure to supply the stuffing box mechanical seal with cooling of flush water may result in damage and premature failure of the pump.

Do not touch surfaces which during normal running will be sufficiently hot to cause injury. Note that these surfaces will remain hot after the pump has stopped; allow sufficient time for cooling before maintenance. Be cautious and note that other parts of the pump may become hot if a fault is developing.

Do not operate water pumps in temperatures below freezing point, without first checking that the pumped fluid is not frozen and the pump is free to turn. Pumps in these environments should be Drained down during inactivity and re-primed before starting.

In addition to local or site regulations for noise protection, SINTECH the use of personal ear protection equipment in all enclosed pump rooms and particularly those containing diesel engines car must be taken to ensure that any audible alarm or warning signal can be heard with ear defenders worn.

Be aware of the hazards relating to the pumped fluid, especially the danger from inhalation of noxious and toxic gases, skin and eye contact or penetration. Obtain and understand the hazardous substance data sheets relating to the pumped fluid and note the recommended emergency and first aid procedures.

## **SAFETY INSTRUCTIONS WHILE MAINTENANCE & SERVICING**

Before attempting any maintenance on a pump particularly if it has been handling any form of hazardous liquid. It should be ensure that the unit is safe to work on. The pump must be flushed thoroughly with suitable cleaner to purge away any of the product left in the pump components. This should be carried out by the plant operator and a certificate of cleanliness obtained before Starting work. To avoid any risk to health it is also advisable to wear protective clothing as recommended by the site safety officer especially when removing old packing which may be contaminated

Check and ensure that the pump operates at below the maximum working pressure specified in the manual or on the pump nameplate and before maintenance, ensure that the pump is drained down.

Wear a suitable mask or respirator when working with packing and gasket components which contain fibrous material, as these can be hazardous when the fibrous dust is inhaled. Be cautions, if other supplier's components have been substituted for genuine SINTECH parts, these may then contain hazardous materials.

Be aware of the hazards relating to the pumped fluid, especially the danger from inhalation of noxious and toxic gases, skin and eye contact or penetration. Obtain and understand the hazardous Substance data sheets relating to the pumped fluid and note the recommended emergency and first aid procedures.

Isolate the equipment before any maintenance work is done. Switch off the mains supply remove fuses, apply lock-outs where applicable and affix suitable isolation warning signs to prevent inadvertent reconnection. In order to avoid the possibility of maintenance personnel inhaling dangerous fumes or vapors, it is recommended that the maintenance work be carried out away from the pump locations by removal of bearing housing and shaft assembly to a suitable to a suitable maintenance area.

## ANNEX - 1

### ORDER FORM FOR PUMP SPARE PARTS

#### ORDERING INSTRUCTION

1. Date of order / Enquiry.

2. Your reference.

3. Name plate information.

(Every pump has the following plate fastened to the Pump providing necessary identification of the Pump.)

A. W.O.

B. Model

C. S. No.

D. M<sup>3</sup>/HR

E. MWC

F. Motor kw.

G. RPM

H. SUC

I. DEL


W.O. <input type="text"/>
Model <input type="text"/> S.No. <input type="text"/>
M <sup>3</sup> /HR <input type="text"/> MWC <input type="text"/> Motor kw <input type="text"/>
RPM <input type="text"/> SUC <input type="text"/> DEL <input type="text"/>
<b>SINTECH PRECISION PRODUCTS LTD.</b> C-189&190, SITE No.1, BULANSHAHAR ROAD INDUSTRIAL AREA, GHAZIBAD-201009(U.P.)INDIA Ph. : 0120 – 417600, 2866320/21 Website:www.sintechpumps.com E-mail:info@sintechpumps.com

Image of Name Plate

4. Part Name (Refer to cross section drawing.)

5. Part No.

6. Pump Application.

7. MOC of required Part.

8. Quantity.

## **NOTE –**

Diagrams given in this manual are only for reference and are indicative. The actual product may differ from this Technical data and product design / drawings are subject to change without notice.