# NAFFCO
# FIRE PUMPS

## VERTICAL TURBINE PUMP
## NVT - SERIES


# INSTALLATION, OPERATION & MAINTENANCE

INSTRUCTIONS

# 1. SAFETY

## 1.1. General Safety Instructions

DO NOT OPERATE THIS PUMP AT ANY PRESSURE, FLOW RATE, OR LIQUID TEMPERATURE OTHER THAN THOSE WHICH SHOWN ON THE NAME PLATE. DO NOT PUMP ANY LIQUID OTHER THAN WATER. IGNORING THIS WARNING CAN RESULT IN PUMP FAILURE AND SERIOUS PERSONAL INJURY OR DEATH.

If the safety labels are missed or damaged, contact NAFFCO and get label and replace.
While starting pump set make sure pump set drive shaft guard fixed in the pump set.
Only proper tools of correct size shall be used for maintenance and service.
Do not wear loose clothing that could catch on moving parts.
Pump room should be kept clean from oil, waste cloth, water and easily explosive materials.
Pump room should not be treated a like store room.
Fire pump should be monitored during running to ensure that it was started due to an actual demand and water tank should be monitored to avoid dry run condition.

## 1.2. Electric Hazards

Check proper earth connection of the electric, diesel, jockey controllers and electric motors.
Make sure safety labels and operation labels are stuck in the controllers if damaged please get from NAFFCO and replace.
Use only qualified personnel for installation and maintenance.
Electric motor cables terminals should be properly terminate and covered with terminal cover.
Inspect cable and connector if any damage replace immediately.
Do not keep tools on top of battery, this could result short circuit.

## 1.3. Mechanical Hazards

Wear eye protection during welding, grinding, drilling etc. Wear ear protection while operating diesel engine. Always wear safety shoes and safety gloves.
Monitor water leakage of pump gland packing. If excessive leak adjust the packing, do not place hands or finger into this area.
During maintenance disconnect battery negative terminal connector.
Do not refuel the engine when its running, fuel fumes are highly flammable.
Diesel engine exhaust pipe line should be insulated from temperature and it should be kept separate from discharge line.

# 2. INTRODUCTION

This manual provides general instruction for the installation, operation, maintenance, dismantling and assembling of vertical turbine fire pump manufactured by NAFFCO, U.A.E.

NAFFCO centrifugal pumps will give trouble-free and satisfactory service for a long time if they are properly installed and maintained periodically. Follow the instructions in this manual carefully. Do not run the pumps under operating instructions which differ from those specified by us. Motors, engines, controllers, jockey pump, right angle gear drives, drive shafts and other accessories are provided with their on individual IOM manuals. They should be consulted in tandem with the corresponding instructions provided in this manual for all installation, operation and maintenance activities described herein.

## 3. IDENTIFICATION

Every pump unit comes out with separate name plate. These name plates have serial number, model, flow rate and head.

It is important that the serial number should be quoted while claiming for spares or service. This will identify the unit exactly and ensure that correct advice and parts are selected. If it is known that any update or modification to the pump has been carried out since original supply then this information is also crucial.

## 4. HANDLING

Pump set shifting and lifting shall be done using forklift or crane or hoist(refer Fig Nos. 01-a, 01-b, 01-c). When lifting the fire pump set it should be very careful not to broke or bend it. Column and shaft should be supported by suitably sized timbers while laying on floor. Strainer if fitted on the pump should be removed prior to lifting to avoid using it as a pivot point during lifting. Only lifting lugs on the discharge head should be used whenever the entire pump is lifted as an assembled unit.

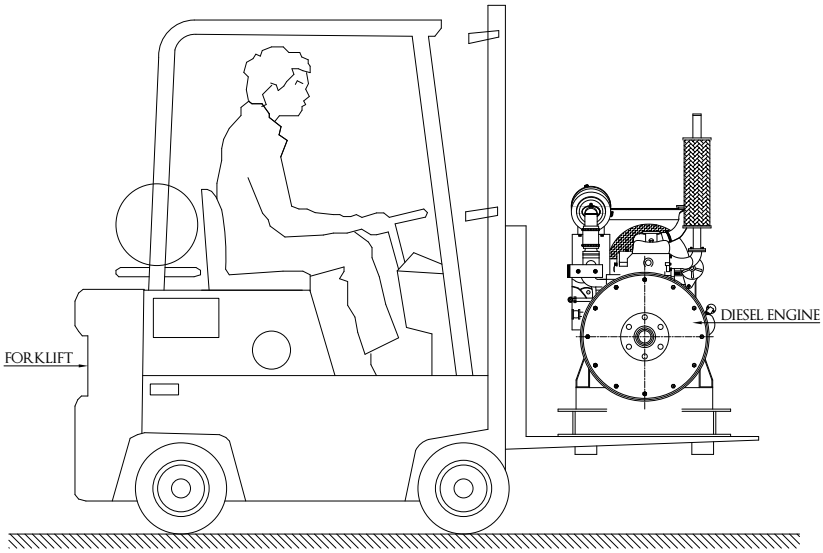



Fig. No. 01-a

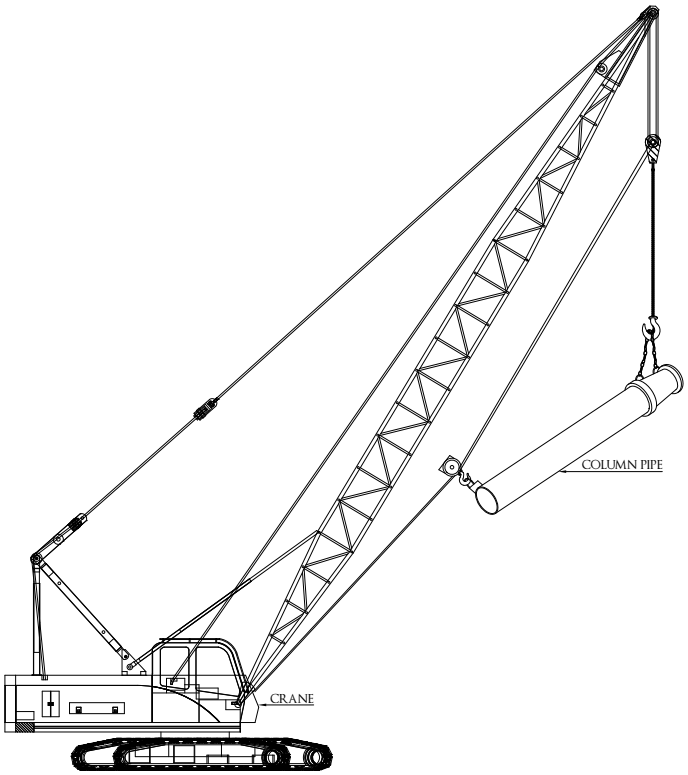



Fig. No. 01-b

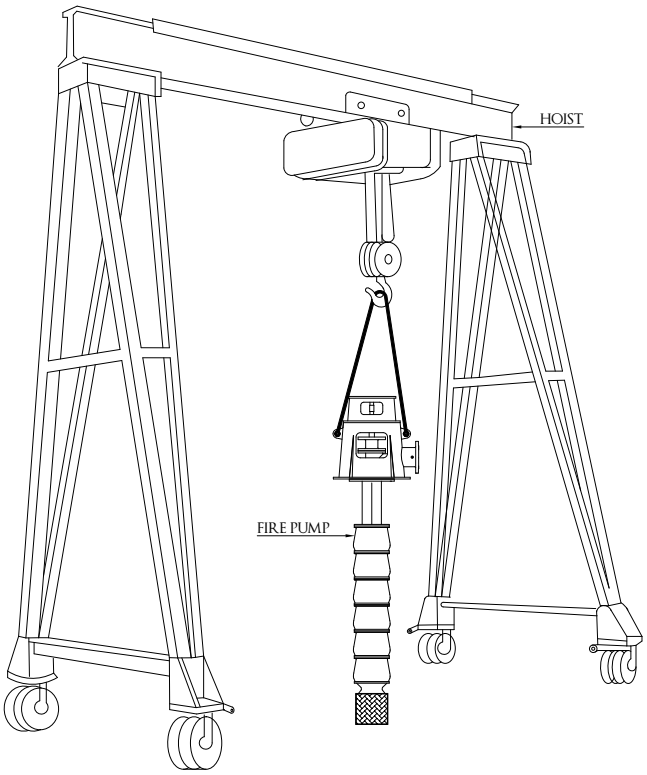



Fig. No. 01-c

## 5. INSTALLATION

Fire water pump sets and control systems should be installed in accordance with this IOM maual. Failure to install the supplied NAFFCO fire pump set fully in accordance with this IOM manual will void the equipment warranty. Proper ventilation and drainage system shall be provided for fire pump room.

### 5.1. FOUNDATION

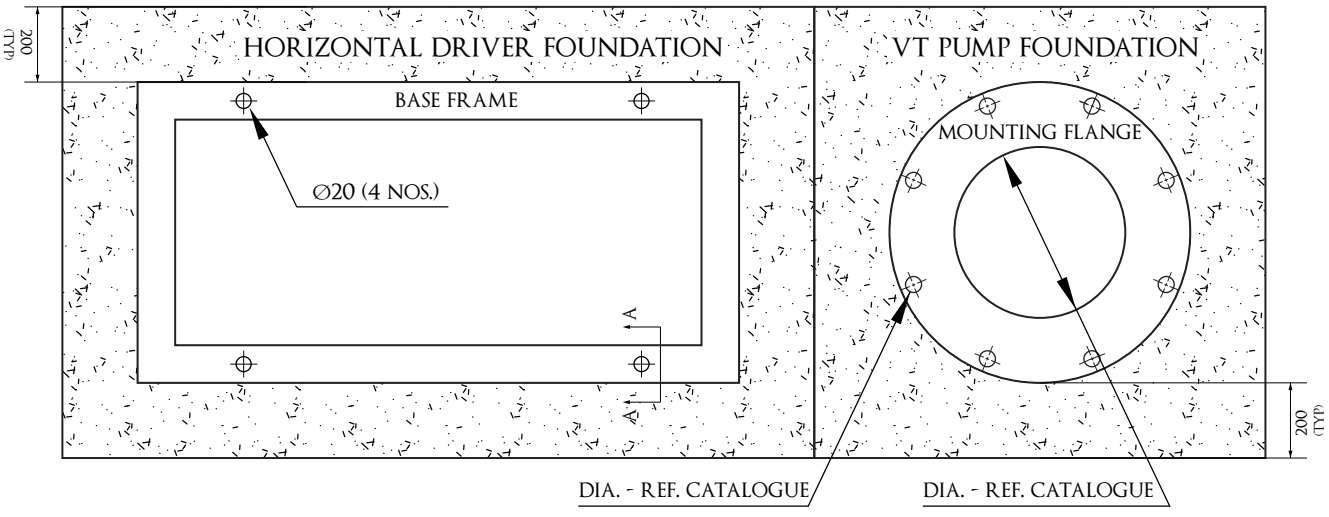



Fig. No. 02

We recommend that you install the pump on a concrete foundation above the water tank which is heavy enough to

provide permanent and rigid support to the entire pump. Foundation area should have adequate space for future inspection and maintenance activities and should be sufficient enough to provide a solid footing. The foundation must be capable of absorbing any vibration, normal strain or shock. It should have enough strength to support the complete weight of the pump including driver related components and weight of the water passing through the pump during operation.

As a rule of thumb, the weight of the raised concrete foundation should be 2.5 times the total weight of these components. If structural foundations are provided instead of concrete foundation then it should be constructed properly after a detailed structural strength analysis. The concrete foundation must have an absolutely level and even surface. Make sure the concrete foundation has set before mounting the pump discharge head and driver base frame by allowing a curing time of at least 48 hours.

The raised concrete base should be 200 mm larger than the mounting flange and driver base frame on all sides. (See Fig. Nos. 02 and 03). Pipe sleeves of the foundation bolt should be 2.5 times the bolt diameter embedded in the concrete. Foundation bolt locations should be exactly as shown on the assembly drawing (showing pump, gearbox, drive shaft, location of bolt holes for discharge head mounting flange and driver base frame) provided by manufacturer.

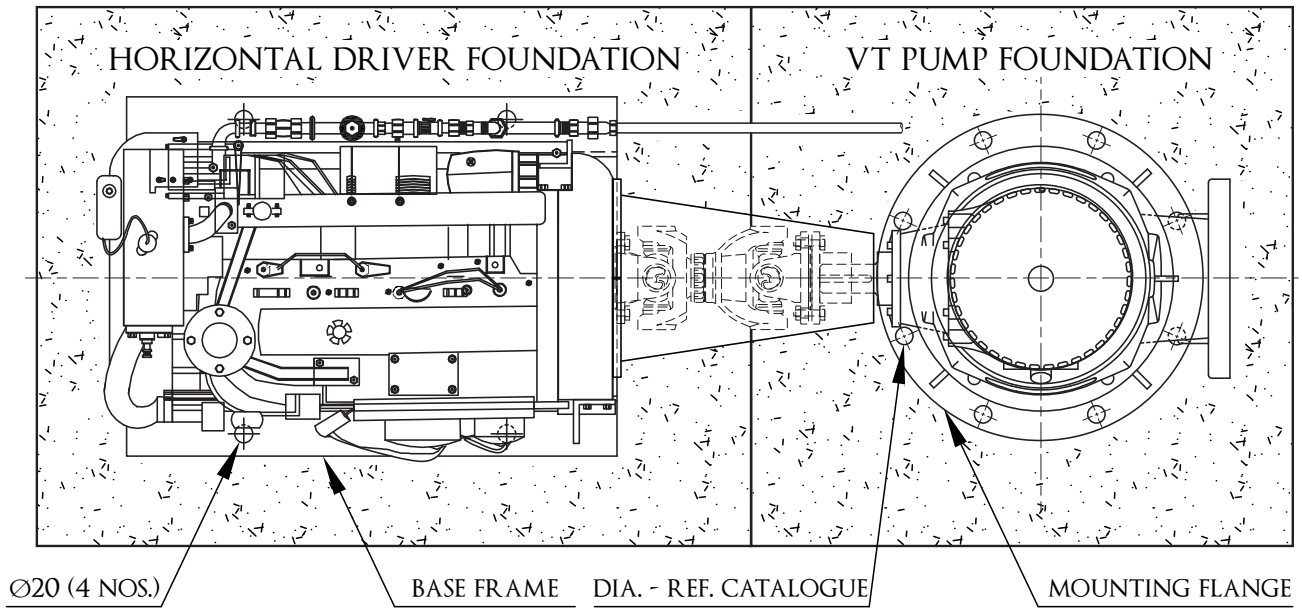



Fig. No. 03

## 5.2. Mounting the pump

Pumps are usually supplied assembled. First clean the discharge head base mounting flange. Inspect the concrete foundation for dust, dirt, oil, chips water etc. and remove any contaminants. Refer grout manufacturer's instructions for cleaning and follow the same. Remove water and/or debris from anchor bolt holes/sleeves also. When using sleeve type bolts fill the sleeves with packing or rags to prevent grout from entering it.

Fit shackles on the lifting lugs with bolts. Sling through the shackles and hoist the pump into position over foundation. Shackles and slings should be rated to handle in excess of the pump weight. Lower the pump assembly carefully until the discharge head is just above the foundation bolts and guide it so that it doesn't strike the sides of the concrete foundation opening. Orient the pump so that the discharge nozzle is in the right direction and the holes in the base

mounting flange align with the foundation bolts. Continue to lower the pump assembly until the bolts enter the holes in the base. Place wedges under the discharge head base mounting flange adjacent to the bolt holes, one under the each of the four sides. For structural foundations use shims under the corners. Lower the hoist until the full weight of the pump assembly is resting on the wedges or shims on the foundation.

Remove the slings. Hand tighten the anchor bolt nuts. By adjusting the wedges or shims and nuts on the anchor bolts, adjust the discharge head flange center line to the correct elevation. While maintaining the correct elevation adjust the nuts and wedges or shims to achieve the required levelness. Level the pump in two directions at 90° on the machined top surface of the discharge head (refer Fig. No. 04). The levelness tolerance is 0.005 inches per foot. Build a barrier or

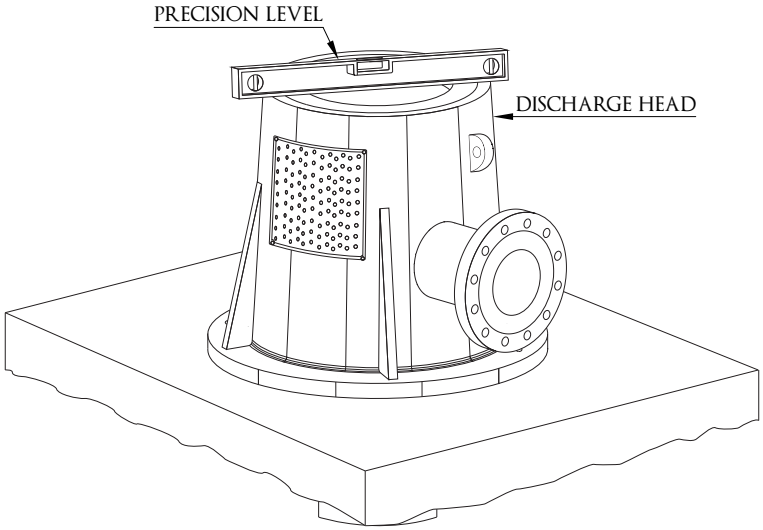



Fig. No. 04

frame (dam) on the foundation enclosing an area around the discharge head base that includes all alignment wedges to retain the grout between the base mounting flange and the foundation (refer Fig. No. 05). Recommended dam height is approximately 1/2 inch (12 mm). Follow grout manufacturer's instructions for other grouting procedures and pour the grouting material into the dammed-in area up to the level of dam and force it between the discharge head and the

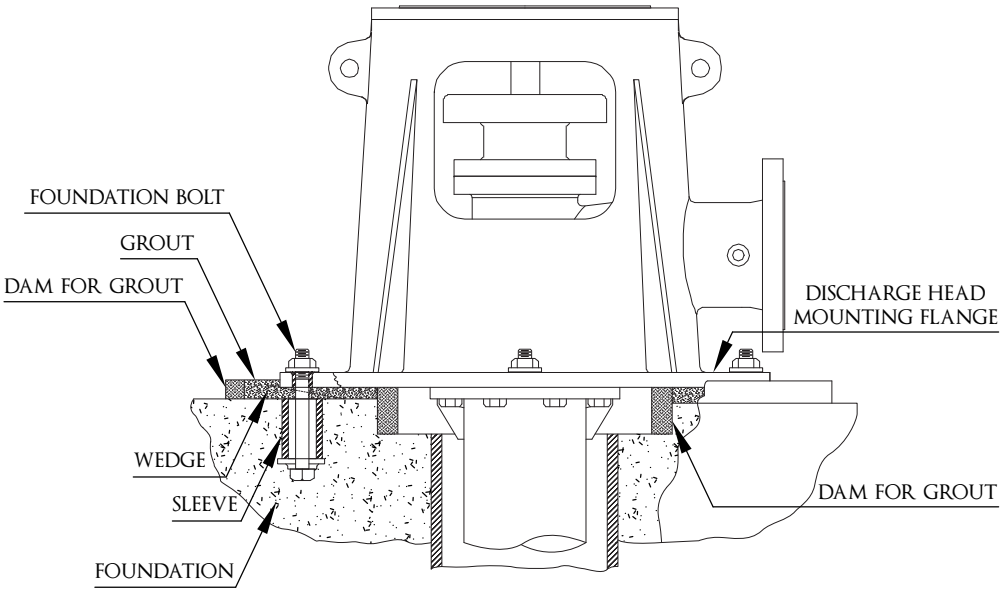



Fig. No. 05

foundation all around. Remove the air bubbles from grout as it is poured by puddling, using a vibrator, or pumping the gout into place. Level off the grout flush with the top of the dam. Allow the grout to cure at least 48 hours and after that tighten the foundation bolts.

### 5.3. Mounting hollow shaft drive(r)

Hollow shaft drive(r) refer to hollow shaft motors or hollow shaft gear drives. Clean the top end thread of the middle line shaft, and the threads of the coupling. Apply a thin film of oil to the threads. Screw the coupling onto shaft for half its distance. A fine wire inserted in the drilled hole at the center of the coupling can be used as a gage to determine when the coupling is correctly positioned.

Be sure to remove the wire after installing the coupling. Upon completion of the installation pump run out should be checked at the positions indicated in the Fig. No. 6. Attach the base of the dial indicator on the discharge head or driver support. Place the stylus on the shaft at the locations indicated in Fig. No. 06. Rotate the shaft slowly 360°. Check that the shaft run out is within 0.06". (1.5 mm) TIR.

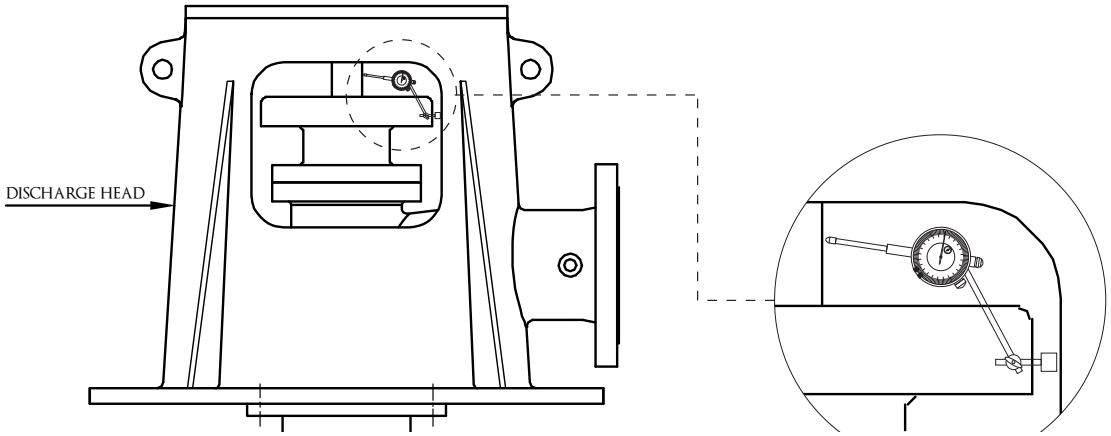



Fig. No. 06

After finishing the installation of the coupling, inspect the driver mounting flange of the discharge head and clean the surface thoroughly. Remove the driver top cover cap screws and lift off the cover. Remove the top drive coupling or clutch and the hold down bolts.

Attach a sling to the lifting lugs of the driver and hoist the driver up. Inspect the mounting surface register and clean these surfaces thoroughly. Any burrs found on the mounting surface should be removed using a smooth mill file and clean afterwards. Position the driver above the discharge head. Orient the terminal box of the motor or input shaft of the right angle gear in the desired position.

Align the driver mounting holes with the respective holes on the top surface of the discharge head. Lower the driver until the registers engage and the driver firmly rests on the discharge head and secure the driver with the provided cap screws. Now take top shaft and position it properly over the motor quill shaft. Lower it through the motor quill shaft to meet the middle line shaft top coupling. Apply a thin film of oil to the threads of the top shaft.

Screw the top shaft into the coupling manually until the resistance is felt. Completely tighten the joint using a pair of pipe wrenches. Follow the alignment checking procedure described in the section 5.3 and ensure the proper alignment. Lubricate the driver bearings and make the necessary cooling line connections for gear drives. With the motor in place and top shaft projecting through the driver quill shaft make temporary electrical connections. After removing the

ratchet pin or balls (with rotating half of the ratchet) check the motor rotation. Motor must rotate counter-clockwise when viewed from the top end. Refer Fig. No. 07-a and 07-b for the details of general arrangement of the driving mechanism for hollow shaft driver.

HOLLOW SHAFT MOTOR MOUNTING COMPONENTS ASSEMBLY

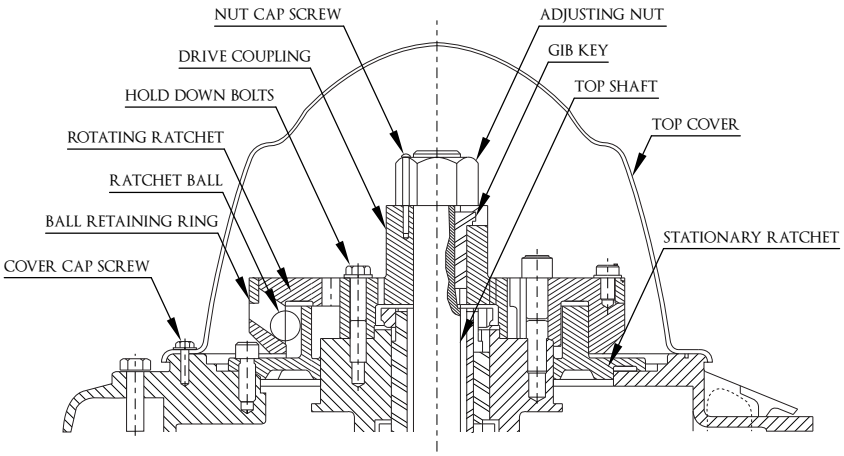



Fig. No. 07-a

Disconnect the temporary electrical conncetions before proceeding further. Install the top drive coupling or clutch over the top shaft. Insert the ratchet pins. In case of ball type ratchet place the ratchet balls and install the rotating half of the ratchet on top of that and place the ball retaining ring. Match the coupling lugs with corresponding holes in the motor. Tighten the hold down bolts evenly, ensuring that the driver coupling is properly seated in the register fit.

Insert the gib key into the keyway. Key must fit snugly but with a sliding fit and should have a slight clearance with the

HOLLOW SHAFT GEAR MOUNTING COMPONENTS ASSEMBLY

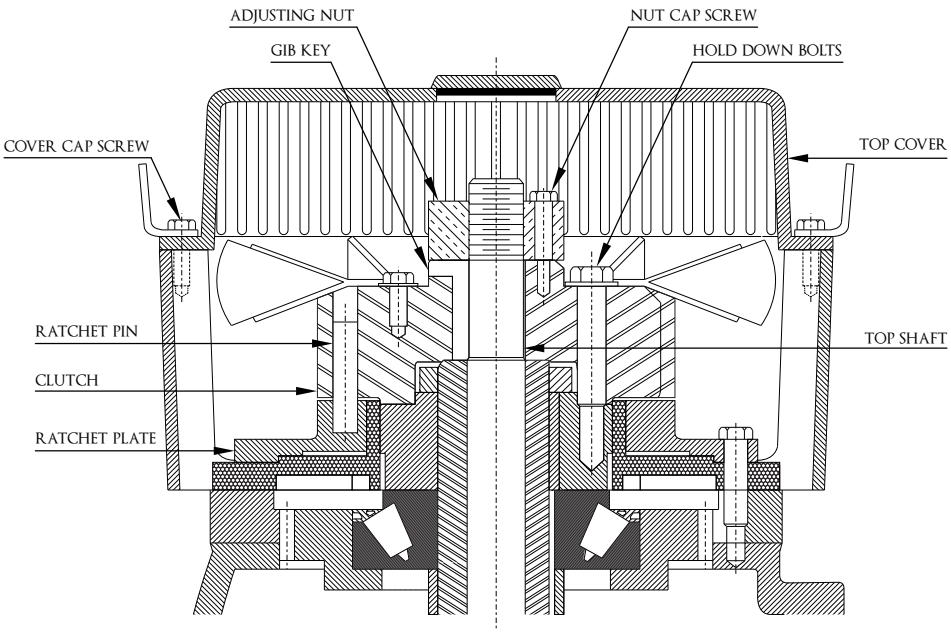



Fig. No. 07-b

bottom of the keyway. Care should be taken to ensure that the gib key is not too high so as to hold up the adjusting nut from seating on the drive coupling. Install adjusting nut to a hand tight.

Shaft adjustment up or down is accomplished by turning the adjusting nut. Before any adjustment is made, the impellers will be resting on the lateral bowl wear rings, and considerable resistance due to friction can be felt when turning the shaft by hand.

To set impellers to the mid position proceed as follows: Turn the adjusting nut in counter clockwise direction, thus lifting the shaft, until the impellers just clear their seats and the shaft/motor/gear drive turns freely by hand. This position at which the shaft begins to rotate is the starting position of the adjustement. 1/36 to 1/48 turns per unit length (m) of pump shaft should be made for pump models NVT 6-22 & NVT 4-60 and 1/36 to 1/54 turns per unit length (m) of pump shaft, should be made for pump models NVT 6-115, NVT 8-170, NVT 8-230, NVT 10-285 & NVT 10-340 further after the starting position of adjustement. Further adjustements may be necessary after starting the pump if a high power consumption by the pump is observed with caused diagnosed as too small impeller clearance.

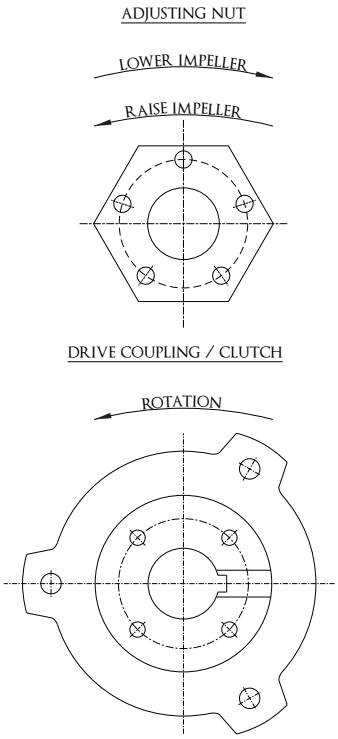



Fig. No. 08

Line-up one of the holes in the adjusting nut with the nearest hole in the driver coupling (Fig. No. 08). Insert the cap screw in the hole and tighten it.

## 5.4. Mounting Horizontal Driver (Engine or Horizontal Motor)

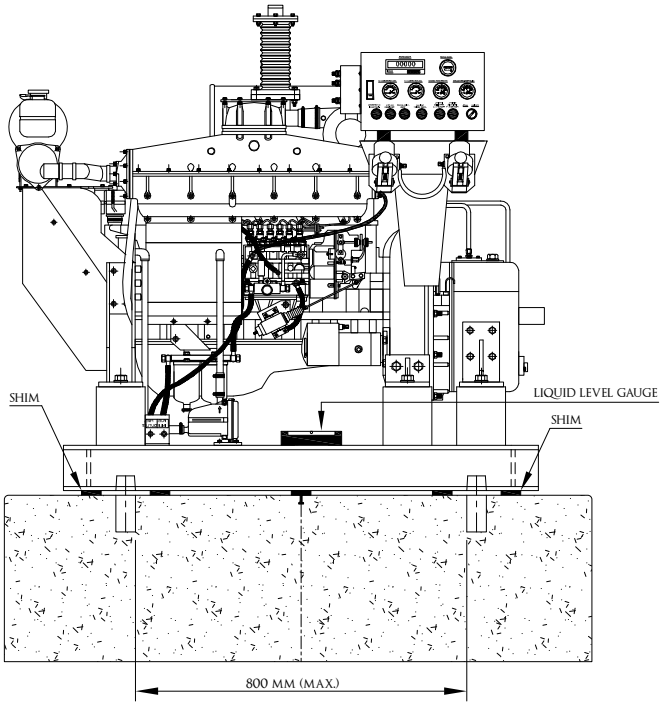



Fig. No. 09

The horizontal drivers are mounted on the base frame while shipping from the factory. Use the lifting arrangement shown in the Fig. No. 01-a for hoisting the driver assembly. Lift the driver assembly and orient it so that the holes in the base frame align with the foundation bolts. Lower the pump assembly until the bolts enter the holes in the base.

Fit shims to left and right of the foundation bolts, between the base frame and the foundation. If the shims are more than 800 mm apart, position extra shims equal distant between them. Lower the hoist until the full weight of the horizontal driver assembly is resting on the shims on the foundation.

Align the driver assembly using a precision spirit level (on the base frame) as shown in the Fig. No. 9. All shims must be perfectly flush and uniformly tighten up using securing means. Base plates have to be grouted with non-shrinking mortar up to the upper edge of the frame after having been fixed in position.

### 5.5. Mounting Drive Shaft

Check flange bores and shaft diameters for proper fit. Clean all mating surfaces, bores and faces removing grease, oil, dirt, nicks, paint and other contaminants to insure proper fit and function of mating parts. Companion flanges are bored for a slip fit over driver and gear shafts.

Align flange key with shaft key and gently tap flange on to shaft with extreme care to avoid any damage for flange or flange face. Tighten the set screw provided over keyway to lock flange into position.

Makes sure that the shaft at both driven end and driver end are not extended out beyond the flange face or pilot bore boss. Check the run-out of flange face and pilot diameter. Ensure that the total indicated run out is below 0.003" (see Fig. No. 10). In cases where fly wheel adapter disc is used for connecting drive shaft to diesel engines, instead of fitting companion flanges on the stub shaft, this disc should be properly aligned and tightly bolted onto the engine flywheel.

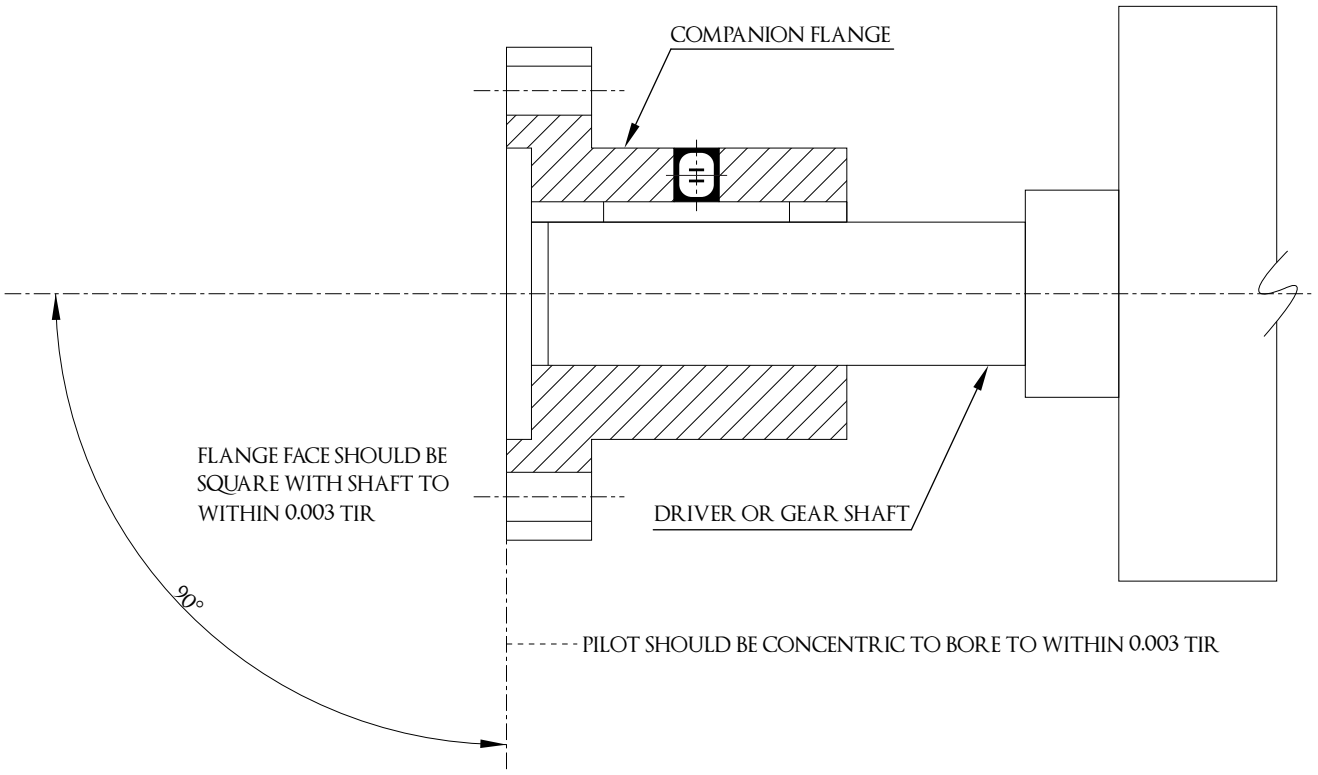



Fig. No. 10

Once the companion flanges / fly wheel disc is fixed in place, lift the drive shaft, compress it and lower it into position between mating flanges (see Fig. No. 11).

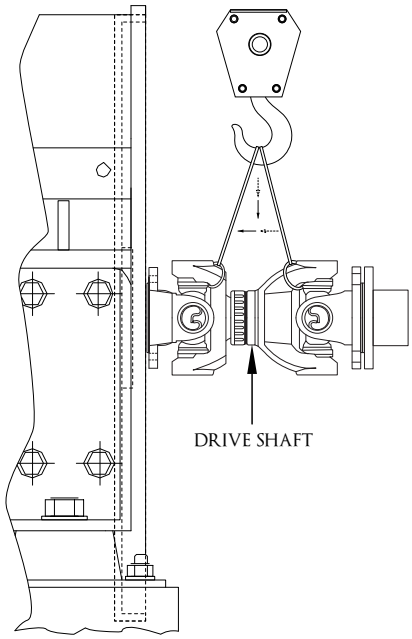



Fig. No. 11

Align pilot bore boss into companion flange mating diameter. Align bolt holes of drive shaft flange and companion flange / adapter disc. Secure drive shaft to companion flange using bolts / studs with hand tight on both ends. Extend shaft at slip section until pilot bore boss aligns with companion flange pilot bore boss. Align holes and tighten the bolts/studs to firmly secure the drive shaft to the companion flanges/ fly wheel adapter disc.

Do the alignment as specified in the section 5.7. After the alignment lubricate all joints and slip splines. Add lubricant to until clean lubricant appears at all four bearing seals. Disconnect the screws and separate the two halves of the drive shaft guard. Fix the guard in place to properly cover the drive shaft and secure it with the screws.

## 5.6. Aligning Pump and Driver

The the components of the Vertical Turbine fire pumps are equipped with register fits enabling the automatic alignment of mating parts. Nevertheless we recommend that the alignment between the driver and top shaft be checked during installation of the driver and after the discharge piping is connected. To do the same follow the procedure described below.

Mount the magnetic base of the dial indicator on the drive plate. Place the contact point of the dial on shaft and slowly turn rotor and check the dial indicator reading variation (Fig. No. 12).

Confirm that the shaft run out is within 0.06". (1.5 mm) TIR. If it is not within this limit then it indicates a misalignment. In such cases check the following possible causes:

1. Bent top shaft

2. Burrs or foreign matter between shaft ends, between driver flange and discharge head top flange, discharge head mounting flange and foundation. (If any leveling problem is found between discharge head mounting flange and foundation it can be corrected by shimming between them).

3. Eccentricity of vertical driver to discharge head.

The cause of misalignment should be corrected before proceeding further with the installation.

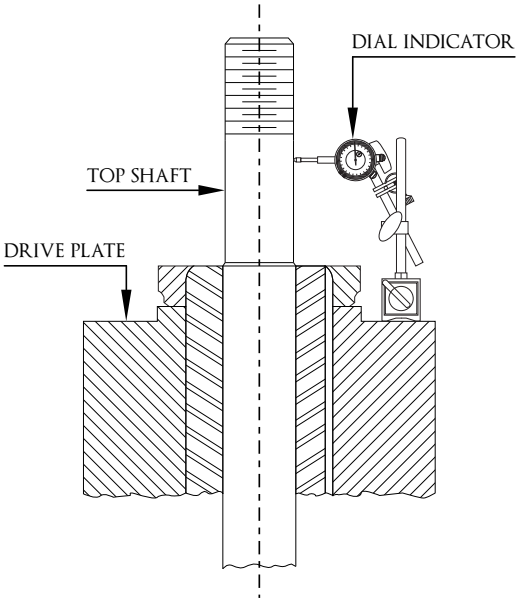
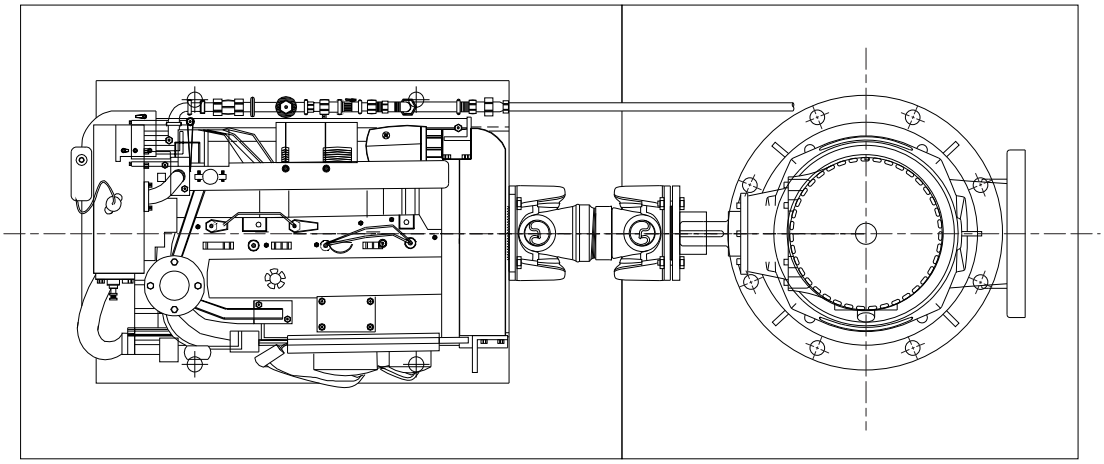



Fig. No. 12

## 5.7. Drive Shaft Alignment

Make sure that the engine crank shaft / motor shaft center line is on the same center line as the right angle gear drive shaft when examined from the top view (Fig. No. 13) and parallel in the side view (Fig. No. 14).



TOP VIEW

Fig. No. 13

Universal joint operating angles at each end of a drive shaft should always be at least 1°. At the same time this deflection angles $\theta_1$ and $\theta_2$ must be equal within ±0.5°. Shaft yokes must be aligned in phase (Fig. No. 15).

The maximum joint operating angle of 3° is recommended for optimum bearing life. Parallel offset is the recommended method for achieving the desired angle. Measure the distance "A" and "B" as shown in the Fig. No. 16 (same unit). If the ratio between "A" and "B" (A/B) is between 0.0175 and 0.0524 then the angle will be approximately between 1° and 3°.

Engine crank shaft / motor shaft center line and right angle gear drive shaft center line should be parallel in side view as

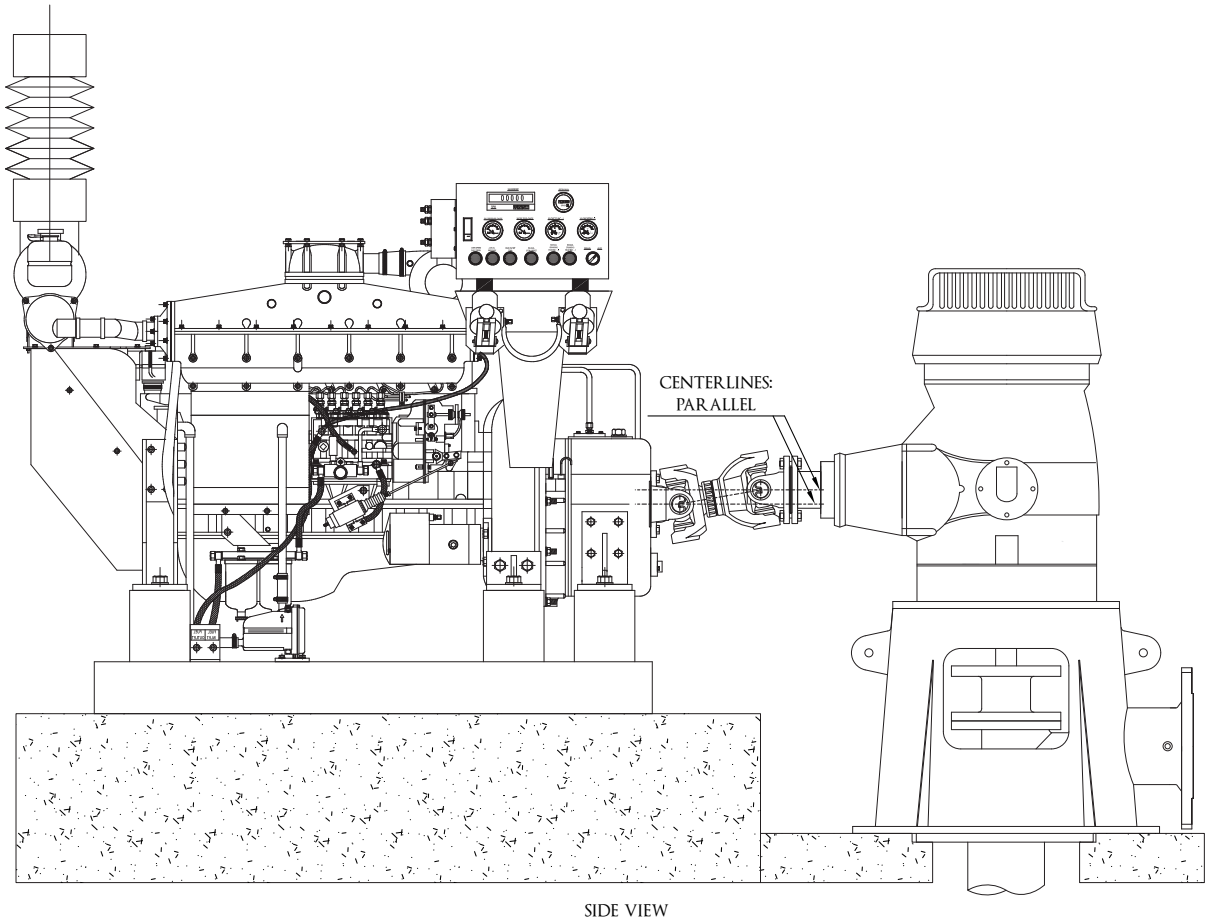



Fig. No. 14

shown in the Fig. No. 14 in order for the angle $\theta_1$ and $\theta_2$ be equal when the angle is measured using the method described herein. If it can not be ensured then an inclinometer, angle finder or angle locator should be used as shown in the Fig. No. 17.

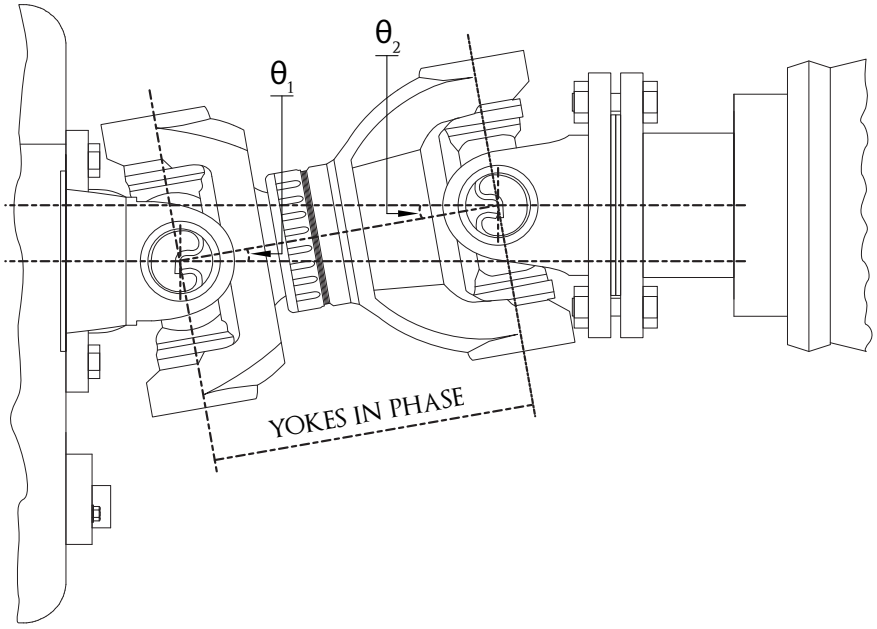



Fig. No. 15

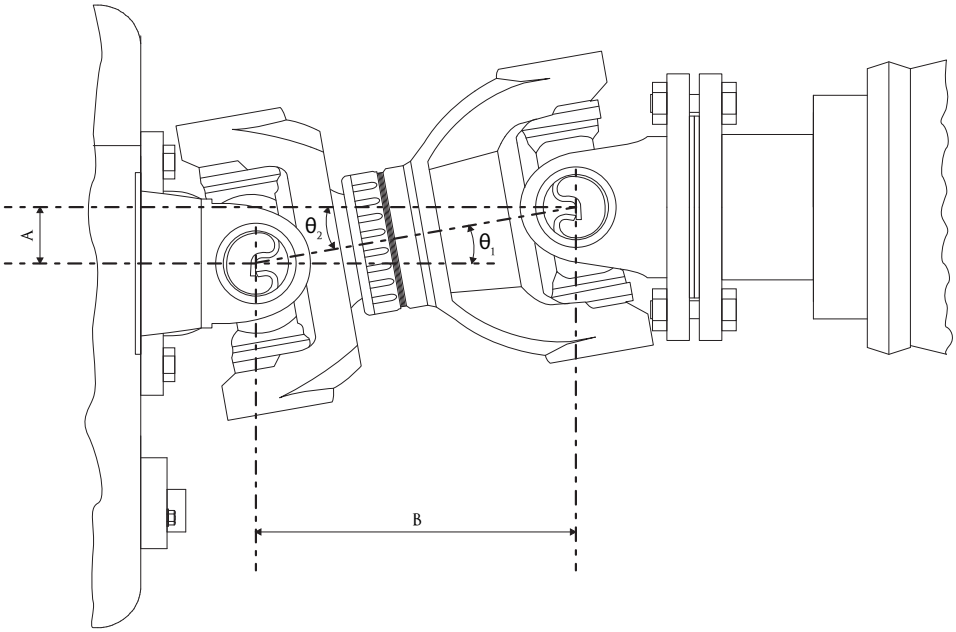
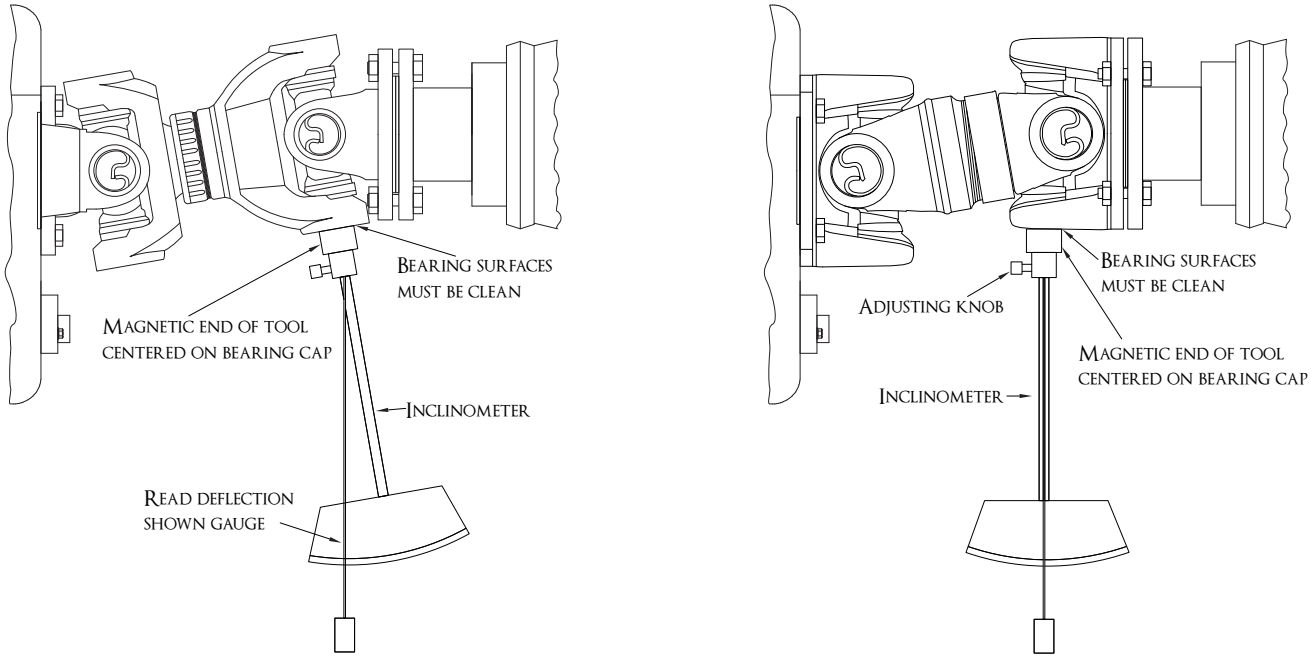



Fig. No. 16




MEASURING THE OPERATING ANGLE OF THE REAR UNIVERSAL JOINTS

PREPARATION FOR CHECKING THE REAR JOINT'S OPERATING ANGLE

Fig. No. 17

## 5.8. WATER TANK

Water tank should provide sufficient and reliable water supply for the fire protection system. The depth of the tank should match with the pump length and it should be confirmed by cross-checking with the pump dimensional drawing.

Ensure the proper submergence of the pump for reliable operation of the pump. The minimum submergence level is given in the Fig. No. 18. The maximum quantity of water required for the fire fighting system at any condition, for the amount of time for which the fire pump is designed to operate, should be above this level (i.e. this is the lowest pumping water level).

The distance between the bottom of the strainer and the bottom of the tank should be at least one-half of the pump bowl diameter but not less than 12 in (305 mm). The distance between pump center line and tank wall should be more than the diameter of bowl. Distance between the center lines of two pumps installed adjacently should be more than four times the diameter of the bowl of the pump with largest bowl size.

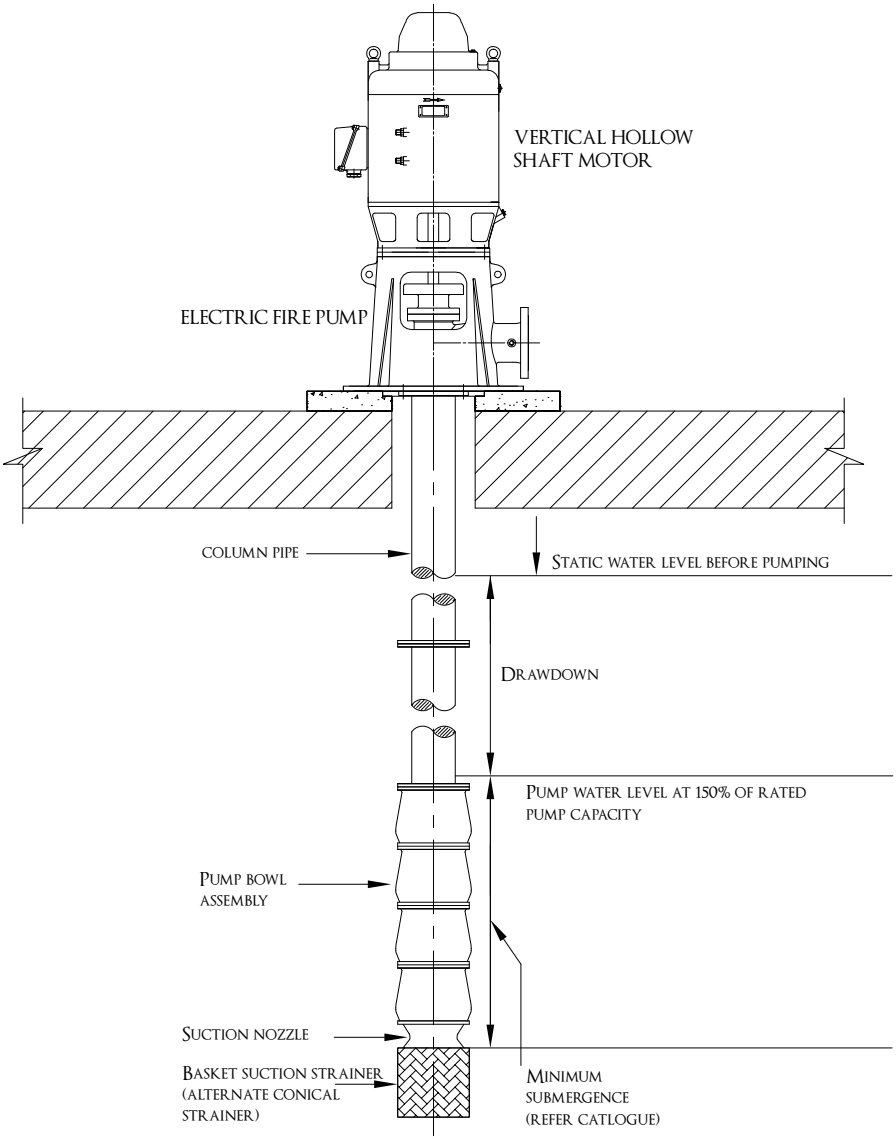



Fig. No. 18

## 5.9. Delivery Piping

Ensure that bolt grouting or chemical anchors are allowed to dry thoroughly before connecting any pipe work.

Note that fire pump sets have regulatory requirements for piping and these must be strictly observed. Refer to the appropriate standard for details. (See Fig. No. 19).

The discharge piping should be supported independently and close to the pump so that no strain is transmitted to the pump when the flange bolts are tightened. Use pipe hangers or other supports at intervals necessary to provide supports closest to the pump discharge head.

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

Make sure that all piping joints are airtight. Where increasers are used in discharge line it should be concentric type. Failure to comply with this may adversely affect the performance of the pump by causing the formation of air pockets in the pipe work.

Piping should be flushed clean before connecting to the pump.

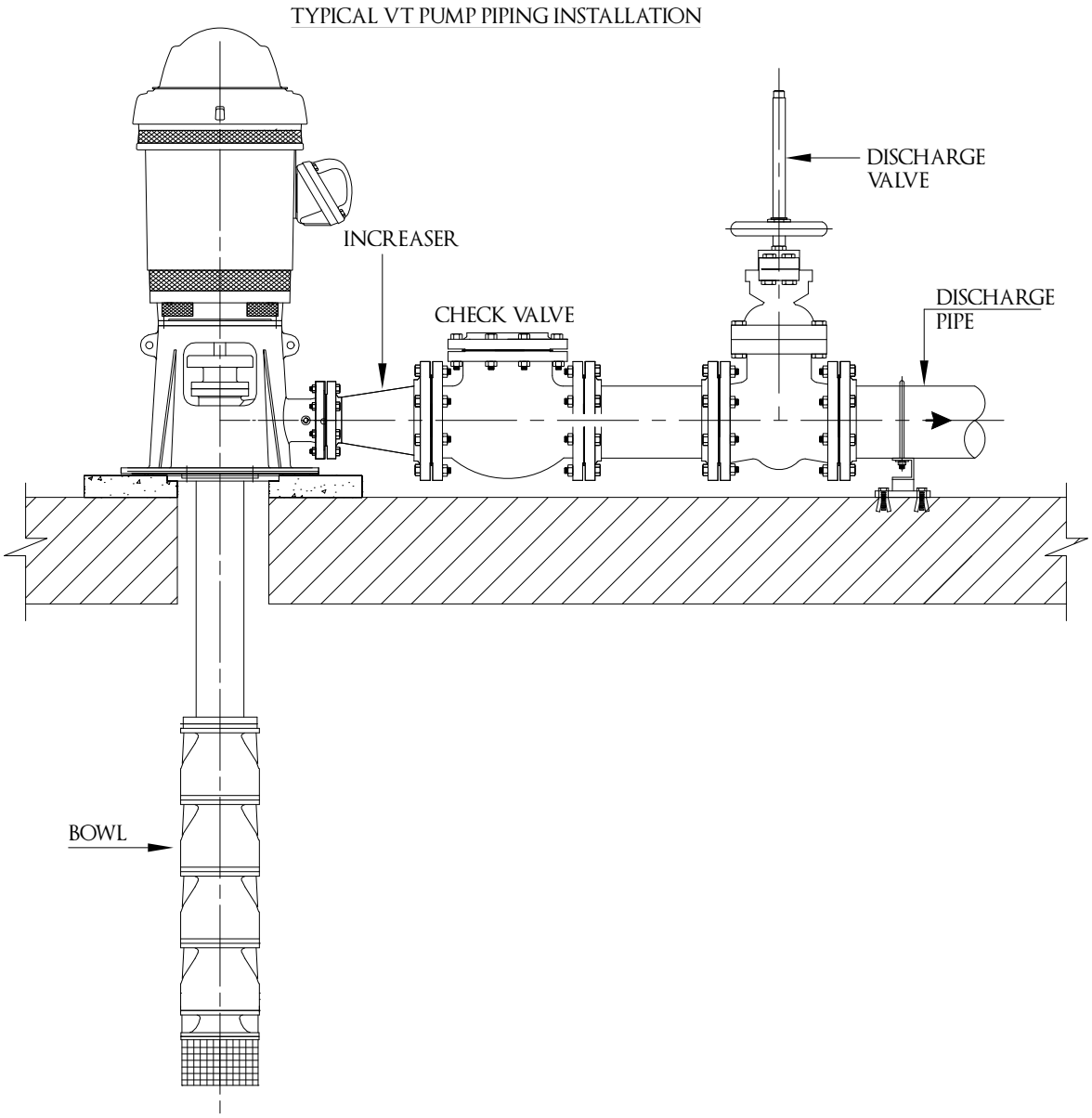



Fig. No. 19

## 5.10. Check List for Fire Pump Set after installation

| SL. NO | DESCRIPTION | RESULT | |
|---|---|---|---|
| 1 | Sufficient distance between pump strainer bottom and tank bottom is maintained. | Yes ☐ | No ☐ |
| 2 | Sufficient distance between pumps. | Yes ☐ | No ☐ |
| 3 | Impeller adjustment is done | Yes ☐ | No ☐ |
| 4 | Discharge pressure gauge. | Yes ☐ | No ☐ |
| 6 | Check valve in discharge piping. | Yes ☐ | No ☐ |
| 7 | Isolation valve in discharge piping. | Yes ☐ | No ☐ |
| 11 | All isolation valves supervised in the open position | Yes ☐ | No ☐ |
| 15 | Cooling system from heat exchanger or cooling water supply pipe line from pump discharge is installed (Engine). | Yes ☐ | No ☐ |
| 16 | Cooling line return line one size higher than inlet and this return water should be visible to monitor. | Yes ☐ | No ☐ |
| 17 | Diesel tank located above ground (Outlet of diesel tank should be above or same level of diesel engine inlet). | Yes ☐ | No ☐ |
| 19 | Water supply to the fire pump adequate to meet fire pump requirements and Local Civil Defense. | Yes ☐ | No ☐ |
| 22 | The surface of the foundation must be completely horizontal and perfectly flat. | Yes ☐ | No ☐ |
| 23 | The foundation should be 200 mm larger than the base frame on all four sides. | Yes ☐ | No ☐ |
| 25 | Pump discharge head base and horizontal driver base grouting had penetrated to the required areas to form a rigid foundation | Yes ☐ | No ☐ |

| SL. NO | DESCRIPTION | RESULT | |
|---|---|---|---|
| 26 | Discharge pipes are provided with proper support to avoid strain on pump. | Yes ☐ | No ☐ |
| 27 | Right angle gear drive is properly aligned with the pump top shaft | Yes ☐ | No ☐ |
| 28 | Stuffing box cooling lines are connected properly to discharge line and disposal area | Yes ☐ | No ☐ |
| 29 | Wiring between drivers, controllers and power supply is done as per manufacturer's wiring / connection diagrams. | Yes ☐ | No ☐ |
| 30 | Drive shaft guard and pump stuffing box guard are fixed. | Yes ☐ | No ☐ |

## 6. OPERATION

### 6.1. Check List for Fire Pump Set Prior to Operation / Commissioning

| SL. NO | DESCRIPTION | RESULT | |
|---|---|---|---|
| 1 | Check the foundation. | Yes ☐ | No ☐ |
| 2 | Check the discharge pipeline strain. | Yes ☐ | No ☐ |
| 3 | Check the lubrication of drivers (motor, gear and engine) if stored long time. | Yes ☐ | No ☐ |
| 5 | Confirm that the pump is submerged in the water at the recommended level. | Yes ☐ | No ☐ |
| 5 | Ensure there is sufficient water in the tank to complete the test. | Yes ☐ | No ☐ |
| 6 | Commissioning test shall use water at ambient temperature as the test liquid. | Yes ☐ | No ☐ |
| 8 | Fully open all auxiliary lines and ensure that they are functioning properly. | Yes ☐ | No ☐ |
| 9 | Ensure the voltage, frequency and no. of phases power supply are matching with the name plate of the equipment. | Yes ☐ | No ☐ |

| SL. NO | DESCRIPTION | RESULT | |
|---|---|---|---|
| 10 | Check the circuit wiring connections, terminals and proper earthing of equipment prior to final energization. | Yes ☐ | No ☐ |
| 11 | Check the diesel level to complete the testing. Batteries are full energized condition ensure battery terminals are tight (diesel pump set). | Yes ☐ | No ☐ |
| 12 | Check the drive shaft and discharge head to driver alignment and make sure that the it is within the specified tolerance. | Yes ☐ | No ☐ |
| 13 | Rotate pump shaft manually to confirm that the pump is free and the impellers are correctly positioned. | Yes ☐ | No ☐ |
| 14 | Make sure the proper connection of discharge line. Ensure all fasteners are tightened. | Yes ☐ | No ☐ |
| 15 | Ensure that all joints and splines of drive shaft are lubricate before startup. | Yes ☐ | No ☐ |
| 16 | Check the all the fasteners of drive shaft for tightness. | | |
| 17 | If heat exchanger engine, cooling line should be connected from discharge line and also that flow of lines is visible. | Yes ☐ | No ☐ |
| 18 | Make sure exhaust muffler is connect and insulated properly. | Yes ☐ | No ☐ |
| 19 | Make sure fuel tank having sufficient fuel. | Yes ☐ | No ☐ |
| 20 | Make sure pressure sensing line connected with in between control valve and non-return valve. | Yes ☐ | No ☐ |
| 21 | Stick reflective tape on the pump shaft for checking speed by the tachometer. | Yes ☐ | No ☐ |
| 22 | Start the electrical motor and verify the direction of rotation. | Yes ☐ | No ☐ |
| 23 | Check the performance of the driver (engine or motor). | Yes ☐ | No ☐ |
| 24 | Observe the noise during running for further investigation and rectification if any. | Yes ☐ | No ☐ |

### 6.2. Start up

Start the pump against a closed discharge valve only. Once the pump has reached full speed slowly open the valve and set to the duty point. Start up of the engine and controllers shall be as given in their respective IOM manuals. Automatic starting of the pumps shall be based on pressure setting.

### 6.3. Methods of Stopping

Manual:

Manual shut down shall be accomplished by operation of push-button on the outside of the controller enclosure.

Automatic shutdown after automatic start:

Automatic shutdown shall not be permitted where the pump constitutes the sole supply of fire sprinkler or standpipe system or where authority having jurisdiction has required normal shutdown.

Automatic shutdown shall be permitted only where the controller is arranged for automatic shutdown after all starting and returning causes have returned to normal.

## 7. MAINTENANCE

### 7.1. Weekly Inspection And Testing

The purpose of the weekly fire pump inspection and test is to ensure the fire pump is in an operation condition free of physical damage and is capable of providing continuous delivery for required fire protection demands. An additional purpose of the weekly test is to detect deficiencies that may not be obvious by visual inspection.

### 7.2. Visual Inspection

- Check the power indicating light on the controller to verify that there is power to the pump
- Make sure that the temperature in the pump room is not less than 40°F (70°F for diesel engines without heaters) during colder months.
- Check ventilating louvers to make sure that they are free to operate.
- Check pump discharge valves to make ensure that they are open.
- Examine piping, fitting, and connections for any physical damage or leakage.
- Check discharge gauge to make sure that the pressure reading is normal.
- Check the system pressure gauge to ensure that the system pressure reading is normal.
- Make sure that the test header valves are closed in properly.
- Check pressure sensing line leakage and block (open drain valve and check block).
- Check free rotation of the pumps.
- Check to make sure the phase reversal alarm pilot light is off.

- Make sure fuel tank is ¾ full.
- Check the diesel and jockey pump controllers and verify the selector switch is in the automatic position.
- Check batteries to ensure that the voltage readings on them are normal.
- Check batteries and verify that the charging current readings on them are normal.
- Check oil filter, fuel filter and air filter conditions.
- Ensure proper clean exhaust vent.
- Check battery terminals to ensure that they are free of corrosion and connections are tight.
- Check and make sure cooling water level is normal in diesel engine if radiator type.
- If provided, check to ensure that the water jacket heater is operating (Heat exchanger diesel engine).
- Check to ensure that the antifreeze in cooling system heat exchanger is adequate.
- Check all hoses, fuel lines, and cooling line connections for any leakage and to ensure they are in a good condition.
- Also refer section no. 11. Fire pump Inspection,Testing and Maintenance Schedule.

### 7.3. Jockey Pump – Testing

- Verify start and stop settings on the pressure maintenance pump (jockey pump) by dropping the pressure in the sensing line.

### 7.3. Electric Fire Pump – Test Procedure

- Ensure that the discharge line is closed in the system
- After completion of all inspection procedures, start the pump automatically by slowly dropping the pressure in the controller sensing line. After starting, the pump should be run at least 10 minutes.
- Record the pressure at which the pump automatically started.
- Record the pump suction and discharge pressures.
- Check the pump packing glands to ensure proper tightness and adequate lubrication (should be slow drips – approximately 1 drop per second – adjust glands if necessary with pump off).
- If horizontal motor then check and verify that the right angle gear drive and drive shaft is operating smoothly without any abnormal vibration or noise.
- Check the pump stuffing box packing gland and discharge head for any signs of overheating (stuffing box should be warm to the touch – discharge head should be cool to the touch).
- Check for any unusual noise or vibration from pump or motor.
- Verify operation of all supervisory signals (i.e., pump running, loss of power, phase reversal, etc.).
- Verify all the valves are back to the normal position.
- Verify that pump is left in the automatic start mode upon completion of each test.

### 7.4. Diesel Fire Pump – Test Procedure

- Ensure that the discharge line is closed in the system
- After completing all inspection procedures, start the pump by slowly dropping the pressure in the controller sensing line. The pump should be run a minimum of 30 minutes.
- Record the pressure at which the pump automatically started.

- Observe how long it takes the engine to crank and once started how long it takes to reach the running speed.
- Record the pump discharge pressures.
- Check the pump packing glands to ensure proper tightness and adequate lubrication (should be slow drips – approximately 1 drop per second – adjust glands if necessary with pump off).
- Check the vertical turbine pump, right angle gear drive, universal joint drive shaft and diesel engine for any unusual noise or vibration.
- Check the pump stuffing box packing gland, and discharge head for any signs of overheating (stuffing box should be warm to the touch – discharge head should be cool to the touch).
- Verify proper operation of pressure relief valve.
- Check the heat exchanger for cooling water flow.
- Record cooling system temperature.
- Check engine speed and record rpm.
- Check oil pressure (should match manufacturer's recommendation) and record.
- Record current reading (should be +2 to +5 amps after 5 minutes of running time).
- Verify that engine will start off of both sets of batteries.
- Verify operation of all supervisory signals (i.e., pump running, controller in automatic mode, etc.).
- Verify all valves are back to normal position.
- Verify that pump is left in the automatic start mode upon completion of each test.

## 8. DISMANTLING AND REASSEMBLY

### 8.1. General

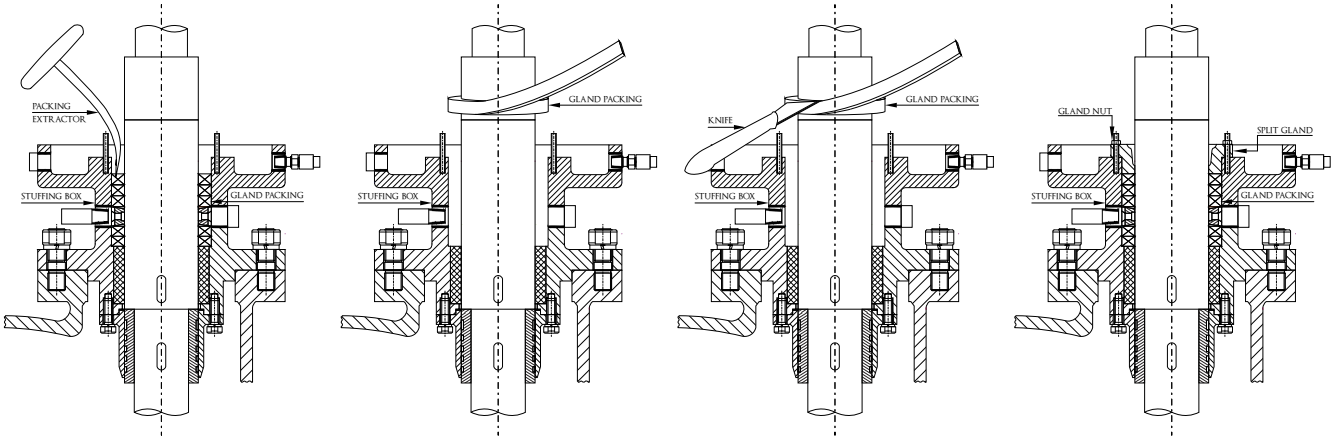
Before dismantling, make sure the pump set is disconnected from the power supply and cannot be switched on accidentally. The discharge shutoff valves must be closed.

### 8.2. Gland Packing Replacement

When the gland leaks excessively and adjustment has no effect then it is time to replace the gland packing.

1. Remove the guarding, on discharge head, surrounding the stuffing box.
2. Remove the gland retaining nuts and withdraw the gland clear of the stuffing box.
3. Carefully remove the old packing using a packing hook. (see Fig. No. 20-a).
4. Remove lantern ring by inserting a wire hook in the slots of the ring and pull it from packing box.
5. Remove all traces of the old packing material and clean the stuffing box thoroughly.
6. Gland packing is normally supplied as continuous coil or rope. The requisite number of rings of the required length must be cut from this coil / rope.
7. Tightly wrap one end of the packing around the shaft sealing sleeve like one coil of a coil spring (see Fig. No. 20-b).
8. Mark the coil with a sharp knife at the point where the gland packing rope touches the end wrapped on the sleeve. The point marked should be such that the ends of the ring obtained by cutting at that point will meet each other without overlapping (see Fig. No. 20-c).

9. Cut the coil on the marked point to form a gland packing ring. It should be cut diagonally at an angle of 45 degree.
10. Check the first ring to ensure a correct fit in the stuffing box before cutting further.
11. Cut the balance required rings using the first ring as a template.
12. Grease the packing rings for easy installation.
13. Twist the packing rings sideways to get it around the shaft easily.
14. Fit the first ring into the stuffing box. When the entire ring is fitted in using the fingers, tamp it down using split wood bushing and push the ring down firmly until it seals on the shaft and the bore of the stuffing box.
15. Turn the shaft to ensure it is not binding; fit the second ring with the joint 120 degree apart to ensure that there is no direct leak path. Turn the shaft again.
16. Fit the lantern ring. This should be slightly above its final position to allow for the slight compression of the packing when secured. Fit the remaining rings, again with their joints 120 degree apart and turning the shaft between each fitting each ring to ensure free movement.
17. Place the split glands on the top of the top ring and press it down slightly.
18. Tighten the nuts evenly to finger pressure on the split gland studs (see Fig. No. 20-d).




a. Remove old packing with extractors. b. Wrap packing around the shaft before cutting. c. Cut the rings from the spiral wrap at a 45° angle. d. Typical stuffing box assembly.

Fig. No. 20

## 8.3. Dismantling

- Detach all auxiliary supply lines.
- Disconnect power supply from motor and engine by disconnecting the electrical connections.
- Make sure that the motor or diesel engine will not start accidently.
- Remove drive shaft guard in case of horizontal prime movers by removing its screws.
- Remove the drive shaft by removing its fasteners.
- Remove hollow shaft motor or right angle gear drive by uncoupling it from the top shaft and removing the bolts between driver bottom and the discharge head top end.
- Lift off the driver (hollow shaft motor or right angle gear drive) by lifting lugs or eyebolts furnished.
- Unscrew the top shaft and the coupling between top shaft and middle line shaft.

- Disconnect discharge head from the discharge piping.
- Clear a large area adjacent to the pump as a storage space for laying the pump horizontally for further disassembly
- Place parallel timbers on the ground in the cleared area to support the pump horizontally.
- Remove anchor bolts from the discharge head bottom mounting flange.
- Fit shackles on the lifting lugs with bolts. Sling through the shackles and lift the pump vertically until the pump strainer clears the foundation.
- Cover the opening in the foundation.
- Lower the pump into a horizontal position and lay it on to the timbers on floor.
- Remove the gland packing following the procedure described under section '8.2. Gland Packing Replacement'.
- Remove the stuffing box cap screws and disassemble the stuffing box from the discharge head. Remove the gasket.
- Before proceeding further make sure that the discharge head, each column sections and bowl assembly are supported independently of each other using wooden blocks under them as shown in the Fig. No. 21.
- Disconnect column pipe and discharge head by removing the bolts connecting them.
- Remove the discharge head carefully without damaging or bending the shaft.
- Disconnect the top column section by removing the bolts from the joint below it.
- Carefully remove the top column section without causing any damage to the shaft.
- Remove other column sections also as described above and this will expose the line shaft couplings and bearing retainers.
- Whenever a line shaft coupling is exposed then the line shaft and coupling should be removed by holding the lower line shaft and unscrewing the coupling and upper line shaft.
- Check if there are any nicks or burrs on the shaft and remove if any.
- After the removal of upper line shaft and coupling lift the bearing retainers out of the female register of the flanged column and remove it.
- Complete the removal of all remaining columns, middle line shafts sections and their couplings by repeating the previous steps.
- Remove cap screws that secure top bowl to intermediate bowl.
- Slide top bowl off the pump shaft.
- Remove cap screws and split thrust ring from pump shaft.
- Slide impeller off the pump shaft and remove the key.
- Gently strike the impeller using a fiber mallet and drive impeller off the shaft in cases where the impeller is seized to the shaft.
- Repeat the above procedures until the bowl assembly is completely disassembled.
- Take each bowl and inspect it to confirm the locking method used in each particular bowl.

- Incases where set screws are used unscrew them first.
- Whereever tack weld is used grind off it carefully.
- Carefully cut two “V” shaped grooves approximately 180° apart on the bowl wear ring using a diamond point chisel without causing any damage to the wear ring set.
- Pry out the bowl wearing ring by knocking the one end of half of the ring in using a chisel or drift.
- Carefully cut two “V” shaped grooves approximately 180° apart on the impeller wear ring using a diamond point chisel without causing any damage to the wear ring set.
- Pry off the impeller wearing ring by knocking the one end of half of the ring out using a chisel or drift.
- Bowl bearings are press-fitted to the shaft, hence they should not be removed unless a replacement is necessary.
- Use an arbor press to press the bearing out with the help of a pipe or sleeve having an outside diameter slightly smaller than the outside diameter of the bearing.
- Use bearing pullers to pull out the suction bell bearings.

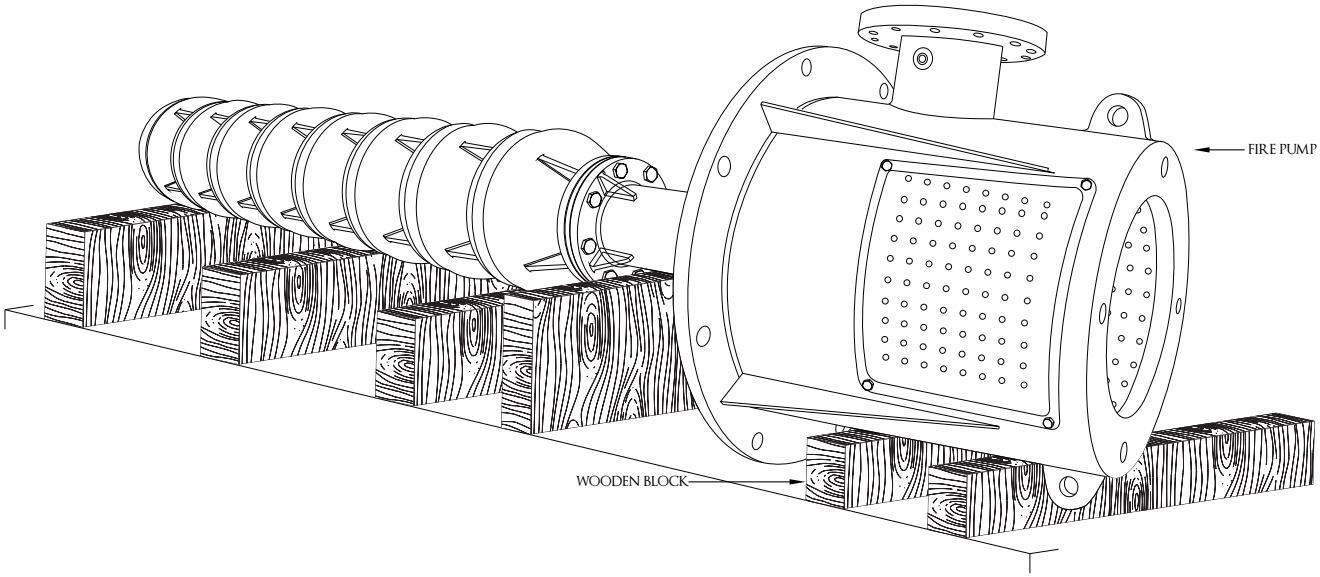



Fig. No. 21

## 8.4. Inspection, Replacement and Reassembly

Inspect the pump parts after thorough cleaning. Check the bearing retainers for deformation and wear. Shafts should be checked for straightness and excessive wear on bearing surfaces. Maximum allowable average total run out is 0.0005" TIR per foot and 0.005" TIR for every 10 feet to shafting. Impellers and bowls should be visually inspected for the presence of cracks or pitting. Ensure that all bowl bearings are free from excessive wear and corrosion before reusing the same. If any part is found worn or damaged to an extend that prohibits there reuse then such parts should be replaced with new parts. Additionally, gaskets and packing should be replaced wherever their condition necessitates it.

Reassembly of the unit is basically the reverse of disassembly done in accordance with standard engineering practices. Thorough cleaning and visual check is mandatory for all parts during reassembly. Utilize the information available from the Fig No. 22 and the section 5 “Mounting” during reassembly and installation.

## 8.5. Exploded View of Split case Fire Pump

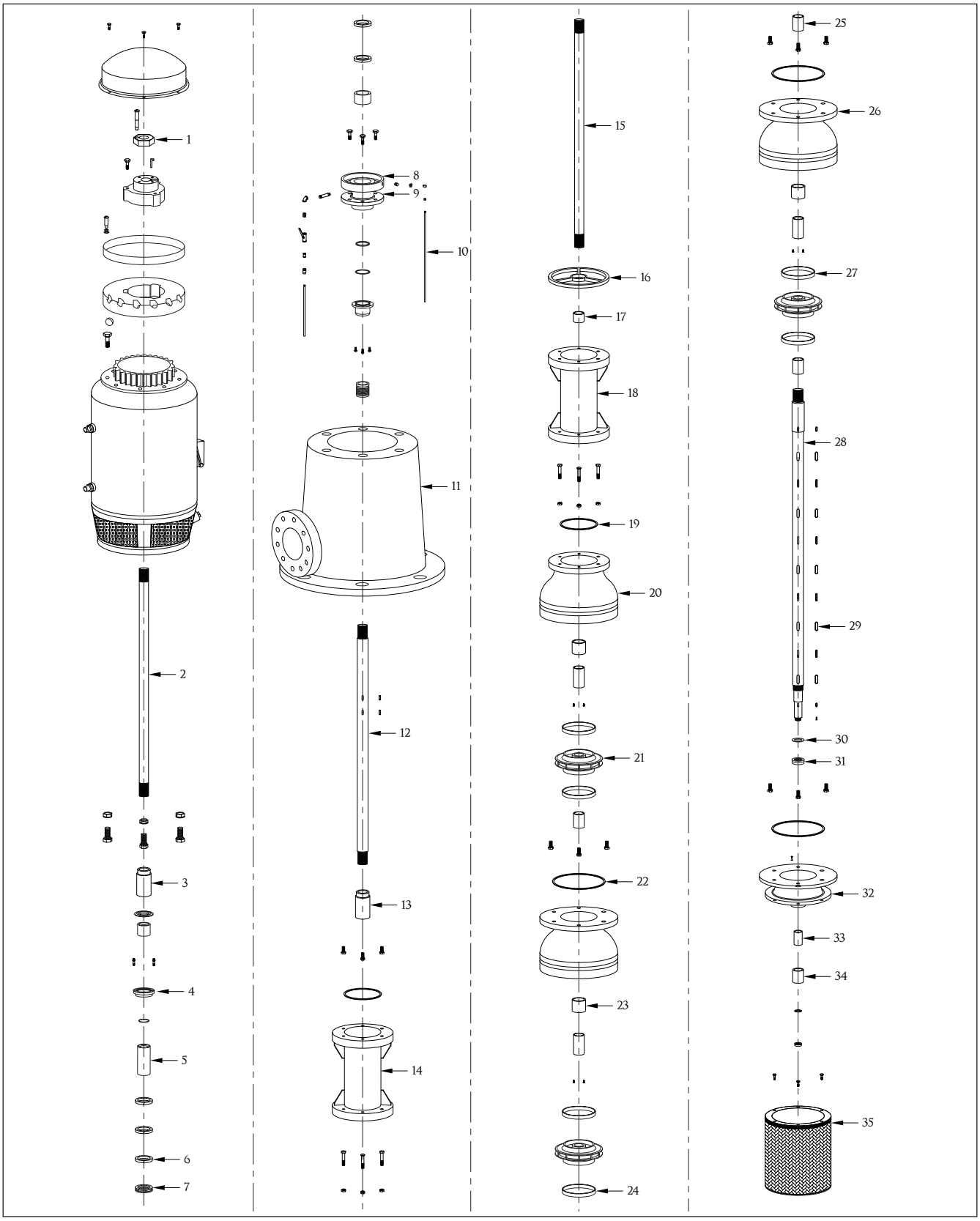



Fig. No. 22

### 8.6. Parts Details of Vertical Turbine Fire Pump

| Sl. No. | Part No. | Part Name | Sl. No. | Part No. | Part Name |
|---|---|---|---|---|---|
| 1 | NVT-****13001 | Adjusting Nut | 19 | NVT-****13019 | "O" Ring |
| 2 | NVT-****13002 | Top Shaft (Driver Shaft) | 20 | NVT-****13020 | Top Bowl |
| 3 | NVT-****13003 | Top Shaft Coupling | 21 | NVT-****13021 | Impeller |
| 4 | NVT-****13004 | Split Gland | 22 | NVT-****13022 | Bowl "O" Ring |
| 5 | NVT-****13005 | Upper Line Shaft Sleeve | 23 | NVT-****13023 | Guide Bearing |
| 6 | NVT-****13006 | Gland Packing | 24 | NVT-****13024 | Wear Ring |
| 7 | NVT-****13007 | Lantern Ring | 25 | NVT-****13025 | Impeller Sleeve |
| 8 | NVT-****13008 | Stuffing Box | 26 | NVT-****13026 | Bottom Bowl |
| 9 | NVT-****13009 | Sleeve, Upper | 27 | NVT-****13027 | Impeller Wear Ring |
| 10 | NVT-****13010 | Flushing Pipe | 28 | NVT-****13028 | Impeller Shaft |
| 11 | NVT-****13011 | Discharge Head | 29 | NVT-****13029 | Impeller Key |
| 12 | NVT-****13012 | Upper Line Shaft | 30 | NVT-****13030 | Impeller Lock Nut Washer |
| 13 | NVT-****13013 | Line Shaft Coupling | 31 | NVT-****13031 | Impeller Lock Nut |
| 14 | NVT-****13014 | Upper Line Column Pipe | 32 | NVT-****13032 | Suction Bell |
| 15 | NVT-****13015 | Middle Line Shaft | 33 | NVT-****13033 | Sleeve for Suction Bell |
| 16 | NVT-****13016 | Bearing Retainer | 34 | NVT-****13034 | Suction Bearing |
| 17 | NVT-****13017 | Sleeve for Bearing Retainer | 35 | NVT-****13035 | Strainer |
| 18 | NVT-****13018 | Middle Line Column Pipe | | | |

**** - Replace with digits that appears before and after letters "VT" in the pump model name; e.g. for NVT 6-115 replace "****" with 6115.

Note – if any abnormal operation or condition is noted during the weekly test, the pump should be shut down and left in the shut down position until repairs are made. Repair should be completed as soon as possible and the pump retested.

## 9. SPARE PARTS, TOOLS & CONSUMABLES

### 9.1. Spare Parts Policy

Spare parts are available for purchase from factory. All spare parts being supplied are certified by manufacturer for suitability and operation.

To ensure best operation and efficiency of the supplied equipment, always use genuine spare parts supplied by Original Equipment Manufacturer (OEM).

When ordering repair parts, provide the complete model number including suffix letters and the serial number (both are engraved on the nameplate) and part name and/or number.

## 9.2. Recommended Spare Parts

- Packing
- Shaft couplings
- Bowl wear rings
- Impeller wear rings
- Gasket Set
- Packing gland
- Impeller keys
- Guide bearings

## 9.3. Recommended Tools And Instruments

- Pipe Wrenches
- Bearing puller
- Calibrated vernier caliper
- Calibrated micrometer
- Spanner – 1 set
- Multimeter
- Fiber Mallet
- Screw Driver
- Packing hook & wire hook
- Pocket knife
- Machinist's level

## 9.3. Recommended Consumables

- Lubricating oil
- Grease
- Vaseline
- Sulfuric Acid
- Diesel Fuel Oil

## 9.4. Recommended Lubricant Standards

- Grease for pump assembly related applications : Lithium based, NLGI No. 2
- Grease for drive shaft related applications : Lithium based, NLGI No. 2
- Oil for pump assembly related applications: General Hydraulic Oil, ISO Viscosity Grade 32
- Oil for gear applications: Rust and Oxidation Inhibited Gear Oils, AGMA No. 5, ISO Viscosity Grade 220

## 10. FAULTS & REMEDIES

| Pump doesn't start. | Pump runs without discharge. | Flow rate is insufficient. | Insufficient discharge pressure. | Pump ceases after running for a while. | Pump requires excessive power. | Abnormal noise level. | Excessive vibrations | Excessive leak at stuffing box. | Stuffing box is overheating | Packing wears out too fast. | Fault | Remedy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ☞ | | | | | | | | | | | Electrical circuit open or not completed. | Check circuit and correct accordingly. |
| ☞ | | | | | | | | | | | Low voltage supply to electric driver. | Check whether driver wiring is correct and receiving full voltage. |
| | ☞ | ☞ | ☞ | | | | | | | | Speed is too low. | Check if driver is directly across the line and receiving full voltage. |
| ☞ | | | | | | | | | | | Defective motor. | Consult factory. |
| | ☞ | ☞ | ☞ | | | | | | | | Wrong rotation. | Ensure that pump is rotating CCW when viewed from above. Check engagement of motor coupling. |
| | | | | ☞ | | | | | | | Excessive horsepower required. | Investigate and rectify the cause for excessive horse power requirement. |
| ☞ | | | | | | | | | | | Improper lateral adjustment. Impeller binds against bowls. | Reset impeller adjustment. |
| | | ☞ | ☞ | | | | | | | | Impellers adjusted too high. | Adjust impellers. |
| | ☞ | ☞ | | | | | | | | | Closed discharge valve. | Fully open the discharge valve. |
| | ☞ | ☞ | ☞ | ☞ | | | | | | | Obstruction in liquid passage. Suction strainer clogged. | Pull pump, inspect suction strainer, impeller and bowls. |
| | ☞ | ☞ | ☞ | | | | | | | | Insufficient submergence of pump bowls. | Lower pump if possible or adjust water level in tank as necessary. |
| | | ☞ | ☞ | | | ☞ | ☞ | | | | Cavitation. | Insufficient NPSH available. Consider lowering the bowl assembly by adding column. |

| Pump doesn't start. | Pump runs without discharge. | Flow rate is insufficient. | Insufficient discharge pressure. | Pump ceases after running for a while. | Pump requires excessive power. | Abnormal noise level. | Excessive vibrations | Excessive leak at stuffing box. | Stuffing box is overheating | Packing wears out too fast. | Fault | Remedy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ☞ | | | | | | | Break suction. | Check dynamic water level in the well. Lower bowl assembly by adding column. |
| | ☞ | ☞ | ☞ | | | | | | | | Static lift too high. | Consult factory for adding stages or increase impeller diameter. |
| | ☞ | ☞ | ☞ | | | | | | | | Field head requirement greater than design head. | Check system friction loss, increase discharge piping size. Consult factory for adding stages or increase impeller diameter. |
| | ☞ | | | | | | | | | | Damaged bowl assembly; broken or disconnected shaft. | Pull pump and repair all damaged components. |
| | | ☞ | ☞ | | | | | | | | Excessive pump wear. | Pull pump and repair as required. |
| | | | | ☞ | ☞ | | ☞ | | | | Damaged impeller. | Inspect, replace if damaged. |
| | | | | | | ☞ | ☞ | | | | Bent shaft. | Straighten as required. |
| | | | | | | ☞ | | | | | Rotating parts binding loose or broken. | Replace as required. |
| | | | | ☞ | ☞ | ☞ | ☞ | | | | Bearings are worn out / damaged / defective. | Replace bearings. |
| | | | | | | | | | | ☞ | Shaft or shaft sleeve worn. | Pull pump and re-machine, or replace shaft and/or sleeve. |
| | | ☞ | ☞ | | | | | | | | Air or gas in the water. | If successive start and stop does not remedy, lower pump if possible, or close discharge valve to maintain well pumping level at a lower gpm. |

| Pump doesn't start. | Pump runs without discharge. | Flow rate is insufficient. | Insufficient discharge pressure. | Pump ceases after running for a while. | Pump requires excessive power. | Abnormal noise level. | Excessive vibrations | Excessive leak at stuffing box. | Stuffing box is overheating | Packing wears out too fast. | Fault | Remedy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ☞ | ☞ | | | | | | Pumping higher viscosity or specific gravity liquid than designed for. | Test liquid for viscosity and specific gravity and re-evaluate the system. |
| | | | | ☞ | | | ☞ | | | | Misalignment. | Realign pump and driver. |
| | | | | | | | ☞ | | | | Motor or gear drive hollow shaft end play maladjustment. | Adjust the end play as given in the driver IOM manual. |
| | | | | | ☞ | | | | | | Foreign object lodged between impeller and bowl. | Remove object as required. |
| | | | | | ☞ | | | | ☞ | | Packing is too tight. | Release gland pressure. Retighten. Keep the leak flowing. If no leak then check packing, sleeve or shaft. |
| | | | | | | | | ☞ | | | Defective packing. | Replace worn packing. |
| | | | | | | | | ☞ | ☞ | ☞ | Wrongly installed packing | Replace / re-pack the packing not properly installed. |
| | | | | | | | | | ☞ | ☞ | Insufficient or no lubrication for packing. | Release gland pressure and replace all packing if burnt or damaged. Re-grease packing as required. |
| | | | | | | | | ☞ | ☞ | ☞ | Wrong grade of packing. | Replace improper packing with correct grade as recommended by factory. |
| | | | | | | ☞ | ☞ | | | | Resonance. | Check piping strain and alter resonant piping. Stiffen or weaken the pump or structure. |

## 11. FIRE PUMP INSPECTION, TESTING AND MAINTENANCE SCHEDULE

| | Description | Visual Inspection | Check | Change | Clean | Test | Frequency | Date | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A. | Pump system | | | | | | | | | | | | |
| | 1. Check packing leak and lubricate | | X | X | | | Monthly | | | | | | |
| | 2. Check operating vibration | | X | | | | Semiannually | | | | | | |
| | 3. Check accuracy of pressure gauges and sensors | | X | X | | | Annually (change or re-calibrate when 5% out of calibration) | | | | | | |
| | 4. Check coupling, driver hollow shaft, pump top shaft alignment | | X | | | | Annually | | | | | | |
| B. | Mechanical transmission | | | | | | | | | | | | |
| | 1. Lubricate coupling & driveshaft | | | X | | | Annually | | | | | | |
| | 2. Lubricate right-angle gear drive | | | X | | | Annually | | | | | | |
| C. | Electrical system | | | | | | | | | | | | |
| | 1. Exercise isolating switch and circuit breaker | | | | | X | Monthly | | | | | | |
| | 2. Trip circuit breaker (if mechanism provided) | | | | | X | Annually | | | | | | |
| | 3. Operate manual starting means (electrical) | | | | | X | Semiannually | | | | | | |
| | 4. Inspect and operate emergency manual starting means (without power) | X | | | | X | Annually | | | | | | |
| | 5. Tighten electrical connections as necessary | | X | | | | Annually | | | | | | |
| | 6. Lubricate mechanical moving parts (excluding starters and relays) | | X | | | | Annually | | | | | | |
| | 7. Calibrate pressure switch settings | | X | | | | Annually | | | | | | |
| | 8. Grease motor bearings | | | X | | | Annually | | | | | | |
| | 9. Voltmeter and ammeter for accuracy (5%) | | X | | | | Annually | | | | | | |
| | 10. Any corrosion on printed circuit boards (PCBs) | X | | | | | Annually | | | | | | |
| | 11. Any cracked cable/wire insulation | X | | | | | Annually | | | | | | |
| | 12. Any leaks in plumbing parts | X | | | | | Annually | | | | | | |
| | 13. Any signs of water on electrical parts | X | | | | | Annually | | | | | | |
| D. | Diesel engine system | | | | | | | | | | | | |
| | 1. Fuel | | | | | | | | | | | | |

## 11. FIRE PUMP INSPECTION, TESTING AND MAINTENANCE SCHEDULE

| | Description | Visual Inspection | Check | Change | Clean | Test | Frequency | Date | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (a) Tank level | X | X | | | | Weekly | | | | | | |
| | (b) Tank float switch | X | | | | X | Weekly | | | | | | |
| | (c) Solenoids valve operation | X | | | | X | Weekly | | | | | | |
| | (d) Strainer, filter, or dirt leg, or combination thereof | | | | X | | Quarterly | | | | | | |
| | (e) Water and foreign material in tank | | | | X | | Annually | | | | | | |
| | (f) Water in system | | X | | X | | Weekly | | | | | | |
| | (g) Flexible hoses and connectors | X | | | | | Weekly | | | | | | |
| | (h) Tank vents and overflow piping unobstructed | | X | | | X | Annually | | | | | | |
| | (i) Piping | X | | | | | Annually | | | | | | |
| | 2. Lubrication system | | | | | | | | | | | | |

## 11. FIRE PUMP INSPECTION, TESTING AND MAINTENANCE SCHEDULE

| | Description | Visual Inspection | Check | Change | Clean | Test | Frequency | Date | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (a) Oil level | X | X | | | | Weekly | | | | | | |
| | (b) Oil change | | | X | | | 50 hours or annually | | | | | | |
| | (c) Oil filter(s) | | | X | | | 50 hours or annually | | | | | | |
| | (d) Lube oil heater | | X | | | | Weekly | | | | | | |
| | (e) Crankcase breather | X | | X | X | | Quarterly | | | | | | |
| | 3. Cooling system | | | | | | | | | | | | |
| | (a) Level | X | X | | | | Weekly | | | | | | |
| | (b) Antifreeze protection level | | | | | X | Semiannually | | | | | | |
| | (c) Antifreeze | | | X | | | Annually | | | | | | |
| | (d) Adequate cooling water to heat exchanger | | X | | | | Weekly | | | | | | |
| | (e) Rod out heat exchanger | | | | X | | Annually | | | | | | |
| | (f) Water pump(s) | X | | | | | Weekly | | | | | | |

## 11. FIRE PUMP INSPECTION, TESTING AND MAINTENANCE SCHEDULE

| | Description | Visual Inspection | Check | Change | Clean | Test | Frequency | Date | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (g) Condition of flexible hoses and connections | X | X | | | | Weekly | | | | | | |
| | (h) Jacket water heater | | X | | | | Weekly | | | | | | |
| | (i) Inspect duct work, clean louvers (combustion air) | X | X | X | | | Annually | | | | | | |
| | (j) Water strainer | | | | X | | Quarterly | | | | | | |
| | 4. Exhaust system | | | | | | | | | | | | |
| | (a) Leakage | X | X | | | | Weekly | | | | | | |
| | (b) Drain condensate trap | | X | | | | Weekly | | | | | | |
| | (c) Insulation and fire hazards | X | | | | | Quarterly | | | | | | |
| | (d) Excessive back pressure | | | | | X | Annually | | | | | | |
| | (e) Exhaust system hangers and supports | X | | | | | Annually | | | | | | |
| | (f) Flexible exhaust section | X | | | | | Semiannually | | | | | | |
| | 5. Battery system | | | | | | | | | | | | |
| | (a) Electrolyte level | | X | | | | Weekly | | | | | | |
| | (b) Terminals clean and tight | X | X | | | | Quarterly | | | | | | |

## 11. FIRE PUMP INSPECTION, TESTING AND MAINTENANCE SCHEDULE

| | Description | Visual Inspection | Check | Change | Clean | Test | Frequency | Date | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (c) Case exterior clean and dry | X | X | | | | Monthly | | | | | | |
| | (d) Specific gravity or state of charge | | | | | X | Monthly | | | | | | |
| | (e) Charger and charge rate | X | | | | | Monthly | | | | | | |
| | (f) Equalize charge | | X | | | | Monthly | | | | | | |
| | (g) Clean terminals | | | | X | | Annually | | | | | | |
| | (h) Cranking voltage exceeds 9 volts on a 12 volt system or 18 volts on a 24 volt system | | X | | | | Weekly | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | 6. Electrical system | | | | | | | | | | | | |
| | (a) General inspection | X | | | | | Weekly | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | (b) Tighten control and power wiring connections | | X | | | | Annually | | | | | | |
| | (c) Wire chafing where subject to movement | X | X | | | | Quarterly | | | | | | |
| | (d) Operation of safeties and alarms | | X | | | X | Semiannually | | | | | | |
| | (e) Boxes, panels, and cabinets | | | | X | | Semiannually | | | | | | |
| | (f) Circuit breakers or fuses | X | X | | | | Monthly | | | | | | |
| | (g) Circuit breakers or fuses | | | X | | | Biennially | | | | | | |
| | (h) Voltmeter and ammeter for accuracy (5%) | | X | | | | Annually | | | | | | |
| | (i) Any corrosion on printed circuit boards (PCBs) | X | | | | | Annually | | | | | | |
| | (j) Any cracked cable/wire insulation | X | | | | | Annually | | | | | | |
| | (k) Any leaks in plumbing parts | X | | | | | Annually | | | | | | |
| | (l) Any signs of water on electrical parts | X | | | | | Annually | | | | | | |

## 12. POLICY ON WARRANTY OF NAFFCO PUMP SETS

NAFFCO's obligation and liability under this warranty being limited to replacing or repairing any part proving defective under normal use and service, and reasonable cost of repair and replacement of said part or parts, within one (1) years from the date of Testing & Commissioning, at NAFFCO's facilities.

This warranty certificate must be presented to obtain services pursuant to the warranties set forth herein.

This warranty does not cover sets repaired by workshops not authorized by NAFFCO.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular purpose and the obligation and liability of NAFFCO under this warranty shall not include any transportation, any other charges, liability for direct, indirect or consequential damages and delay resulting from the defect or any other obligations or liability on the part of NAFFCO, and NAFFCO neither assumes nor authorizes any other person to assume for it any other liability in connection with such equipment.

This warranty will be considered void by the following:

1) Failure to provide regular maintenance in accordance with safety regulations.
2) Evidence of quantities of sand, mud and construction debris in the installation. Sand and mud are abrasives and will damage shafts and bearings. Construction debris may lock impeller and cause the motor to burn out.
3) Pumping industrial wastes, corrosive liquids, paints, plaster, sludge etc. Unless specifically designed for this service.
4) Use of this equipment for temporary de-watering purposes on construction jobs.
5) Careless handling, accidental damage, faulty or improper installation or wiring.
6) Pumping liquids in excess of 150° Fahrenheit unless specifically designed for this service.
7) Pumping equipment is not services as per our IOM manual.
8) Damaged decomposition from chemical action or wear caused by abrasive materials.
9) Damaged by misuse, accident, neglect, or from improper operation, maintenance, installation, modification or adjustment.
10) Parts repaired outside seller's factory without prior written approval.

NAFFCO makes no warranty as to starting equipment, electrical apparatus or other material not of its manufacture, since the same are usually covered by warranties of the respective manufacturers.

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## NOTES

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|---|---|
| Project Name | :..... |
| Location | :..... |
| Commissioned By | :..... |
| Date of Commissioning | :..... |
| Signature of Commissioning Engineer | :..... |

NAFFCO
PASSION TO PROTECT

**NAFFCO**
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**www.naffco.com**



NF-NE-P-IOM/2019/V.01

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