OPERATION & MAINTENANCE MANUAL

FOR

SFFECO FIRE PUMPS

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I. General Description

The basic function of the Fire Pump Controller is to run or to start the Pumps upon a Pressure drop in the Fire protection system piping as to cope up or to restore the pressure in the system piping.

II. Functions

II.1. Automatic Start. (Duty, Jockey & Diesel Pump)

Pressure drop on the fire fighting line either cause by the following;

a) An opening of a Fire hose reel.
b) An opening of a sprinkler head.
c) An opening of an Inspector Test Valve (ITV).
d) An opening of any kind that might cause a drop on the system pressure reaching the cut in pressure set in the pressure switch of the Fire pump.

II.2. Manual Start. (Duty, Jockey & Diesel Pump)

At anytime selecting the Fire pump mode selector switch to Hand;

a) If Jockey pump selected, Jockey pump start manually.
b) If Duty or Electric selected, Duty pump start manually.
c) Diesel engine selector switch to Auto and pressing start button Diesel pump start manually.

III. *Sequence of Operation*

III.1. ***Duty Pump.***

1. Auto *Off* Hand
2.Duty Motor Runs Indication Lamp.
3.Duty Motor Trips Indication Lamp.

1.1 Hand Functions:

Turn the Duty pump Selector switch to Hand position. Duty pump Motor will start instantaneously building a pressure of up to *NET PUMP PRESSURE.* Duty Motor will continuously run with an indication in the panel ñ*Duty Run*ò and only will stop by turning the Duty pump Selector switch to Off position. Duty pump when overloaded due to stalled rotor, Low voltage, single phase and etcé Duty pump will Trip or Stop, as not to damage the pump motor along with an indication in the panel ñ*Duty Trip*ò.

1.2 Auto Functions:

Turn the Duty pump Selector switch to Auto position. Duty pump Motor will start if pressure fall below or meet the pre-setted cut in pressure of the pressure switch with an indication in the panel ñ*Duty Run*ò, after reaching the pre-setted pressure, Duty pump motor will stop automatically. Duty pump when Overloaded due to stalled rotor, Low voltage, single phase and etc.. Duty pump will Trip or Stop, as not to damage the pump motor along with an indication in the panel ñ*Duty Trip*ò.

III.2. ***Water Low Level (Dry Run Protection).***

A Fire pump Motor Controller feature or function provided to prevent the pump from running dry or to run without water.

III.3. ***Jockey Pump.***

3.1 Jockey Pump Hand Functions:

Turn the Jockey pump Selector switch to Hand position. Jockey pump Motor will start instantaneously building a pressure of up to *NET PUMP PRESSURE.* Jockey pump will continuously run with an indication in the panel ñ*Jockey Run"* and only will stop by turning the Jockey pump Selector switch to Off position. Jockey pump when Overloaded due to stalled rotor, Low voltage, single phase and etc.. Jockey pump will Trip or Stop, as not to damage the pump motor along with an indication in the panel ñ*Jockey Trip*ò.

3.2 Jockey Pump Auto Functions:

Turn the Jockey pump Selector switch to Auto position. Jockey pump Motor will start if pressure fall below or meet the pre-setted cut in pressure of the pressure switch with an indication in the panel ñ*Jockey Run*ò, after reaching the pre-setted pressure, Jockey pump motor will stop automatically. Jockey pump when Overloaded due to stalled rotor, Low voltage, single phase and etcé Jockey pump will Trip or Stop, as not to damage the Jockey pump along with an indication in the panel ñ*Jockey Trip*ò.

III.4. ***Diesel Engine Pump:***

4.1 Diesel Engine Hand Functions:

Turn the Diesel engine pump Selector switch to Hand position and press the *Start button,* Diesel engine pump will start and run building a pressure of up to *NET PUMP PRESSURE.* Diesel engine pump will continuously run and only will stop by pressing the *Stop button* (*Red*) keep on pressing until the engine stops.

4.2 Diesel Engine Auto Functions:

IV. Maintenance & Service

IV.1. Maintenance Manual:

A fire pump is designed to increase the water pressure. The pump intake and discharge piping must be capable of flowing the required volume to which the pump will add the needed pressure for fire protection. The pump can be started manually but it is arranged to start automatically upon a drop in the system pressure or the activation of a fire suppression system. Automatic starting requires a Controller. The engines for operating the pump can electric or diesel.

Fire pumps are needed whenever the pressure requirements of a fire protection system exceed the capabilities of the available water supply. Two types of pumps are generally used: centrifugal fire pump, where water is available to supply the pump under pressure, such as city supply; and vertical turbine pumps, where the available water supply is in a static state, such a pond or reservoir.

Water enters the centrifugal fire pump through the suction inlet and passes to the centre of an impeller. Rotation of the impeller drives the water by centrifugal force into the rim, where it discharges. One of the unique features of the centrifugal pump is that it takes advantage of the inlet water pressure and adds the pumps pressure to it. For example a centrifugal pump with a rated pressure of 100 psi (6.9 Bar) at a certain flow (GPM or L/min) having a 25 psi (1.7 Bar) inlet pressure will produce a flow at 125 psi (8.6 Bar).

A vertical turbine pump usually has a right-angle gear drive with impellers connected to the pump head by a vertical shaft. As the pump operates the water is passed from one impeller to the next impeller, gaining additional pressure at each subsequent impeller until the water passes through the pump outlet. The number of impellers indicates the number of stages for the pump.

Fire Pumps are rated by there ability to pump a specific volume of water, usually measured in gallons per minute (GPM) or liters per minute (L/min) at a rated pump pressure and pump speed. The pump must be able to deliver 150% of this rated flow at 65% of its rated pressure. In addition, under no-flow condition the pressure must reach not more than 140% of the rated pressure (sometimes called the churn pressure). Most centrifugal pumps have a single impeller and are known as single stage pumps. For high pressure demands multi-stage pumps are required.

Pumps are started and stopped by controllers. They start the pump when they sense the need of additional pressure or upon activation of the fire extinguishing system. The controller can be arranged to stop the pump after reaching preset pressure and preset time. Pumps have timers so they will not continuously start and quickly stop, as would happen for small leak or small flow. For the same reason, a small low ï voltage pump, known as a jockey pump, is often installed in the piping parallel to the fire pump to prevent cycling of the fire pumps due to leaks.

Pumps are provided with circulation relief valves, to discharge water when the pump is being run with no water discharge. This valve is provided because without it the temperature of the water trapped in the pump casing would increase due to the centrifugal force created by the pump. The high temperature could damage the fire pump.

Pumps taking suction from ponds or wet pits are provided with screens to make sure that the pump is not damaged by the introduction of solid materials in to the pump. Foot valve are also provided on suction lines to assure that the pump maintains its óprimeô. (Centrifugal pumps need the inlet piping and the pump casing full of water in order to start pumping. The water is called ñpriming water or primeò.)

Where variable speed drivers are used (e.g. Engine driven pumps), pressure relief valves are required. The relief valve will open should pressure exceed the system design pressure due to engine over speed. Pressure relief valves are also needed when the pump discharge pressure can exceed the rated pressure of any piping or valves on the discharge side of the pump.

IV.2. Acceptance Test:

NFPA 20 includes a section on acceptance testing. As a minimum the following should be conducted:

1. Inspect the fire pump, its piping, valves, and controller. All need to be in service and conform to NFPA 20. Piping must have been hydrostatically tested at 200 psi (13.8Bar) minimum for 2 hours. If the output of the pump exceeds 150 psi (10.3 Bar), the hydrostatic test need to be performed at 50 psi or 3.4 bar above this maximum pressure. For example if the pressure relief valve for the fire pump is set to operate at 175 psi (12 Bar), the hydrostatic test needs to be performed with a minimum pressure of 225 psi (15.5 Bar).

2. Check the fire pump sensing line between the fire pump and the controller. It must contain a bronze check valve with 3/32 inch (2mm) hole (orifice) in the clapper. The check valve is provided to minimize the water hammer sensed by the controller pressure switch when the pump starts. The piping should have a dirt leg outside the controller to prevent the debris from reaching the controller pressure switch. The dirt leg has ½ inch (13mm) globe valve on each side of a strainer with a plugged outlet.

3. At a minimum three separate flows should be tested:

ÅNo flow at 140% of rated pressure.

Å100% of rated flow at 100% of rated pressure.

Å150% of rated flow at 65% of rated pressure.

During the actual flow tests the second two flows may not be achieved exactly, but these flows should be measured as close as practical. These three tests are further described below:

a. Operate the fire pump at no flow. All valves on the fire pump test header should be shut. (There should be one 2 ½ò inch or 64mm test header outlet for each 250 GPM (946 L/min rating of the pump. For example a 750GPM (2839 L/min fire pump would have three 2 ½ò (64mm) outlets at the test header). At no flow the pump will overheat and could deform the shaft. For this reason, it is imperative that a fire pump leak a drop of water per second around one shaft packing even when the pump is not running. With on flow the pump is doing little work. Read the fire pump suction and discharge gauges and record those pressures on the test form. The work that the pump is performing is the net pump head. This value is obtained by subtracting the suction pressure from the discharge pressure. This needs to be included in the test form. The pump should run smoothly without vibrations. The engine speed in revolutions per minute (rpm) should me measured and recorded. If an electric pump is being tested, the voltage and amperage needs to be measured and recorded. The fire pump controller needs to be tested as a part of the acceptance test. The fire pump must start at least 12 times during the three tests. 6 of those starts must be automatic and 6 must be manual. For each of the 12 starts, the fire pump must be run for at least 5 minutes, so the acceptance test will take at least one hour to perform.

b. For the test of the pump at rated flow and pressure, water must flow from the test header. The flow test described below uses straight-tipped nozzles and a handheld pitot tube to measure the water flow. Other flow testing devices are available such as flow meters.

ÅConnect 2 ½ò (64 mm) diameter hoses to each test header outlet. Provide a straight-tip nozzle at the end of each hose. Install a calibrated pressure gauge on the handheld pitot tube for the various outlets that will be used for the tests at rated flow and pressure.

ÅOpen the valve for the first flow through a hose. Reach a point of flow, keep the valve in that position and measure the flow through the nozzle tip via the pitot tube. If the pitot reading indicates that a higher flow is needed, open the valve at the test header a bit more. If less water is needed, close the valve at the test header as needed. This continues until the correct pressure is measured at the pitot tube indicating the desired flow from the nozzle. Once this has occurred stabilize the control valve in this position. Control valves tend to open further during the flow, which requires the adjusting rocess to begin anew.

Å Open the valve for the second hose and measure its flow. Adjust as necessary as indicated above. This continues until water is flowing and stabilized through the necessary hoses. At this point check the pressure at each nozzle again to determine if the pressures are correct. Adjust a necessary.

ÅOnce all required hoses are flowing water at their calculated pressures, read the fire pump suction and fire pump discharge gauges. Measure the voltage and amperage of the electric fire pumps. Check the pump for overheating.

Å Start and stop the pump as desired as part of the requirement for the 6 automatic starts and 6 manual starts. The starts must include all pressure switches and remote starting signals. For diesel fire pumps, starts need to be arranged so that 6 occur using one set of batteries and 6 occur using the second set of batteries. Where emergency power is provided for the fire pump, usually via a generator, at least 6 of the 12 required tests need to occur with normal power disconnected. The transfer of power from normal to emergency power and the retransfer back to normal power cannot cause a circuit breaker to open the circuit. As part of a worse case scenario, the fire pump should be run at peak load under normal power, the normal power should then be disconnected, and the emergency power should pick up the load of the rotating fire pump within 10 seconds without causing the circuit breaker to open the circuit.

ÅFor the flow at peak load, the fire pump must deliver 150% of the rated capacity at 65% of the rated flow. For example, a 500 gpm (1893 L/min) at 100 psi (6.9 bar) fire pump must flow 750 gpm (2839 L/min) at 65 psi (4.5 bar). The procedure for starting flow, measuring flow with the pitot tube, and adjusting the flow for each hose is the same as the test for rated flow at rated pressure. Additional hoses may be needed, since the pump will discharge 50% more water.

Inspections:

An inspection is a visual examination of the fire pump system to verify that it appears to be in good operating condition and free of physical damage. The visual inspection is generally done from floor level by walking through the protected premises. Use the inspection form at the end of this chapter to record all inspection results.

Weekly:

- ☐ Check the pump house heating during heating season to assure it is operational.
- ☐ Check the fire pump system visually to assure that all devices appear normal and operational.
- ☐ Check ventilation louvers in the pump house to assure that they appear operational.
- ☐ Check suction and discharge pressure gauges for damage.

Monthly:

- ☐ Check the pressure on all fire pump gauges.
- ☐ Check for ñautomaticò indication of controller lights.
- ☐ Check all valves to make sure they are open.

The amount of water (gpm) flowed is determined by the formula::

$$GPM = 29.82\ Cd^2\ p^{1/2}$$

Where: C = nozzle coefficient (usually 0.9)
d = diameter of the outlet in inches.
p = Pressure recorded in the pitot tube in psi.

TABLE FP-01

Possible causes of fire Pump Troubles

Fire Pump Troubles	Suction				Pump																Driver &/ or Pump					Driver						
	Air Drawn into suction connection through leak(s)	Suction connection obstructed	Air pocket in suction pipe.	Well collapsed or serious misalignment	Stuffing box too tight or packing improperly installed.	Water seal or pipe to seal obstructed.	Air leak into pump through stuffing boxes.	Impeller obstructed.	Wearing rings worn.	Impeller damaged.	Wrong diameter impeller.	Actual net head lower than rated.	Casing gasket defective permitting internal leakage. (single stage and multi stage pumps)	Pressure gauge is on top of pump casing.	Incorrect impeller adjustment. (Vertical shaft Turbine type pump only)	Impellers locked.	Pump is frozen.	Pump shaft or shaft sleeve scored, bent, or worn.	Pump is not primed.	Seal ring improperly located in stuffing box, preventing water from entering space to form seal.	Excess bearing friction due to lack of lubrication, wear, dirt, rusting, failure, or improper installation.	Rotating element binds against stationary element.	Pump and driver misaligned.	Foundation not rigid.	Engine cooling system obstructed	Faulty driver	Lack of Lubrication	Speed too low.	Wrong direction of rotation.	Speed to high.	Rated motor voltage different from line voltage.	Faulty electric circuit, obstructed fuel system, obstructed steam pipe, or dead battery.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Excessive leakage at stuffing box.					✔													✔					✔									
Pump or driver overheats.				✔	✔	✔		✔			✔				✔			✔	✔	✔	✔	✔	✔	✔	✔		✔		✔	✔	✔	
Pump unit will not start.				✔	✔										✔	✔	✔				✔					✔	✔					✔
No water discharge.	✔	✔	✔					✔											✔													
Pump is noisy or vibrates.				✔	✔			✔		✔								✔			✔	✔	✔	✔			✔					
Too much power required.				✔	✔			✔										✔			✔	✔	✔	✔			✔		✔	✔	✔	
Discharge pressure not constant for same gpm.	✔				✔	✔	✔																									
Pump loses suction after starting.	✔	✔				✔	✔													✔												
Insufficient water discharge.	✔	✔				✔	✔	✔	✔	✔	✔	✔	✔		✔													✔	✔		✔	
Discharge pressure too low for gpm (L/min) discharge.	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔														✔	✔		✔	

IV.3. Inspection Guidelines:

1. Visually inspect all devices for loose mounting or assembly fastener.

2. Inspect all wiring for loose terminal fastener.

3. Inspect electrical power connections of the Fire pump controller for loose Connections, if loose, tighten and do the needful.

4. Check the controller and the motor load for proper rating.

5. If the Duty or Jockey motor does not run in the Manual mode, check the Circuit Breaker, Fuses, Contactor thermal overload relay.

6. If the motor (Duty, Jockey) runs in manual mode but not in Auto mode, check The pressure switch connection and do the needful.

7. If the motor rotation is in reverse, interchange any two phase of the incoming Power supply.

8. If Diesel engine does not run, check the Battery Voltage with a Volt Meter, if the Battery Voltage is Okay then check for the Battery Fuse.

9. Before starting the engine, check for the Oil level, Radiator cooling water and Fuel level.

***Semi Annually Inspection (Electrical Pumps)*:**

1. Inspect all wiring tighten all electrical connections.
2. Ensure all tamper valve indicators are in the `OPEN` position.
3. Inspect system pressure at 45 to 70 psi. (Basic design factor is 35 ï 95 psi)
4. Inspect pump glands for leakage. Tighten or replace if necessary.
5. Grease motor bearings, be sure to remove lower grease ports, inject 3 Strokes of grease into grease fittings, replace lower grease ports and Clean off excess grease.

6. Inspect disconnect fuses and wiring connections.

7. Open main electrical panel, inspect contact for wear/pitting, and tighten All electrical connections.

8. Verify all control panels are indicating `ON`.

9. Check water tank condition for any leakage and test operation of the Ball valve.

10. Check all valves, strainers and pipeline for leakage.

11. Test run the system to ensure correct operation of the pressure switch and Correct sequence of the duty pump and standby pump operation. Adjust Pressure switches setting if necessary. Duty pump should activate when the Pressure drops 20percent from system pressure. Standby pump should Activate when pressure drops 80percent from system pressure.

12. Capture any abnormal noise. Do the needful.

13. Open Corrective Work Order for remedial works.

14. Tagged PPM sticker once done

***Semi Annually Inspection (Diesel Pump)*:**

1. Check battery voltage, electrolyte level and charger condition.

2. Inspect all wiring connections and starter components.

3. Inspect fuel lines and fuel tank.

4. Bleed fuel pipeline to prevent air lock.

5. Make sure all control panels are showing on and valves are open.

6. Verify system pressure.

7. Check lubricant oil level in the crankcase. Top up if necessary.

8. Check and clean oil filter.

9. Check engine fuel injection system. Rectify if necessary.

10. Check engine starter panel. Rectify if necessary
11. Check fan belt tension. Tighten if necessary
12. Check engine bolts and nuts for tightness.
13. Test runs the pump in auto and manual.
14. Check that the pressure drops to 70 - 80% of system pressure before the pressure Switch activates the pump. Adjust pressure switch setting if necessary.
15. Capture any abnormal noise. Do the needful.
16. Open Corrective Work Order for remedial works.
17. Tagged PPM sticker once done.

IV.4. Periodic Test:

Tests are required at various frequencies as required in NFPA 20 and noted below. Use the test forms at the end of this manual to record all test results. Maintenance should be performed on equipment that fails to perform as desired when tested.

Weekly:

- ☐ Perform fire pump operating test..
- ☐ Check packing gland tightness. (The gland should be adjusted so that there is a slight drip to allow cooling of the bearings.)
- ☐ Check suction and discharge pressure gauge readings during fire pump operating test.
- ☐ Check steam trap. (Steam turbine)
- ☐ Operate speed governor. (Internal combustion)
- ☐ Operate over speed trip. (Internal combustion)
- ☐ Check steam relief valve. (Steam turbine)
- ☐ Check controller timer for proper shut down of fire pump.
- ☐ Make sure control alarms function properly.

Annually:

- ☐ Conduct pump performance test. (Flow test to verify pump performance with the manufacturerôs original pump curve.)
- ☐ Verify pump speed at each flow.
- ☐ Record suction and discharge pressure at each flow.
- ☐ Verify setting of relief valve.
- ☐ Operate water flow and alarm switches.
- ☐ Confirm Valve positions.

Maintenance:

Maintenance is the work necessary to keep the equipment operable or make repairs. Repairs to fire pump systems must be made immediately to assure that the system will operate when needed.

Perform maintenance for fire pumps in accordance with manufacturerôs recommendations. Maintenance is usually performed at the time of the weekly or annual fire pump tests.

Annually:

- ☐ Service hydraulic system.
- ☐ Service mechanical transmission.
- ☐ Service motor.
- ☐ Electrical System.
- ☐ Controller.
- ☐ Diesel engine components.

Record Keeping:

Records should be kept of the inspections, tests, and maintenance. The forms at the end of the manual have spaces for recording the necessary data. The forms should be used to record all visual inspections and to record all tests and maintenance.

Weekly Inspection

Fire Pumps.

This form covers a 3 month period.

Year: _____ **System:** _____

Location: _____

Y = Satisfactory; N = Unsatisfactory. (explain on reverse) ; N / A = Not Applicable

Date													
Inspector													
Heat in Pump room is 40ºF (4.4ºC) or higher.													
Intake air louvers in pump room appear operational.													
Pump suction, discharge and bypass valves are open.													
No piping or hoses leak.													
Fire pump leaking one drop of water per second at seals.													
Suction line pressure is normal													
System line pressure is normal.													
Suction reservoir is full.													
Controller pilot light (power on) is illuminated.													
Transfer switch normal power light is illuminated.													
Isolating switch for standby power is closed.													
Reverse phase alarm light is not illuminated													
Normal phase rotation light is illuminated.													
Oil level is vertical motor sight glass is normal.													
Diesel fuel tank is atleast 2/3 full.													
Controller selector switch is in "AUTO" position.													
Voltage readings for batteries are normal.													
Charging current readings are normal for batteries.													
Battery pilot lights are on or battery failure pilot lights are off.													
All alarm pilot lights are off													
Record engine running time from meter.													
Oil level is normal in right-angled gear drive pumps.													
Crankcase oil level is normal.													
Cooling water level is normal.													
Electrolyte level in batteries is normal.													
Battery terminals are free of corrosion.													
Water jacket heater is operational.													
For steam driven pumps, steam pressure is normal.													
Examine exhaust system for leaks.													
Check lube oil heater for operation (diesel pump)													
Drain condensate trap of cooling system.													
Check for water in diesel fuel tank.													

Monthly Inspection

Fire Pumps.

This form covers a 1 year period.

Year: _____ **System:** _____

Location: _____

Y = Satisfactory; N = Unsatisfactory. (explain on reverse) ; N / A = Not Applicable

Date												
Inspector												
Remove battery corrosion and clean battery case.												
Check battery charger and charger rate.												
Equalize charge in battery system.												
Exercise isolating switch and circuit breaker.												
Inspect, clean and test circuit breakers												

Notes

Quarterly Inspection

Fire Pumps.

This form covers a 1 year period.

Year: _____ **System:** _____

Location: _____

Y = Satisfactory; N = Unsatisfactory. (explain on reverse) ; N / A = Not Applicable

Date				
Inspector				
Check crankcase breather on diesel pump for proper operation.				
Check exhaust system insulation for integrity.				
Check exhaust system clearance to combustibles to prevent fire hazards.				
Check battery terminals to assure they are clean and tight.				
Check electrical wirings for chafing where subject to movement.				
Check operation of safety devices and alarms (semi annually)				

Notes

Annual Inspection
Fire Pumps.

Year: _____ **System:** _____
Location: _____

Y = Satisfactory; N = Unsatisfactory. (explain on reverse) ; N / A = Not Applicable

All Pumps – Hydraulic System.	
Suction pressure gauge: _____ psi (bar)	
Discharge pressure gauge: _____ psi (bar)	
Pump starting pressure from pressure switch in controller: _____ psi (bar)	
Pump run time from controller: _____ minutes	
Suction line control valves are sealed open.	
Discharge line control valves are sealed open.	
Bypass line control valves are sealed open.	
All control valves are accessible.	
Suction reservoir is full.	
Pump shaft seals dripping water (1 drop per second)	
System is free of vibration or unusual noise when running.	
Packing boxes, bearings and pump casing are free of overheating.	
Electric Fire Pumps only	
Isolating switch is monitoring abnormal power.	
Normal-phase rotation pilot light is "on".	
Reverse phase pilot light is "off"	
Oil level in vertical motor sight glass is in normal range.	
Steam Fire Pumps only	
Steam pressure gauge reading normal: _____ psi (bar)	
Record time to reach running speed: _____ min. & _____ seconds.	
Diesel Fire Pumps only	
Diesel tank is 2/3 full.	
Batteries are fully charged.	
Battery charger is operating properly.	
Battery terminals are clean.	
Battery state of charge is checked.	
Battery pilot lights are "on"	
Battery failure pilot lights are "off"	
Engine running time meter is recording pump operation properly.	
Oil level in right-angle gear drive is normal.	
Diesel engine oil level is full.	

Y = Satisfactory; N = Unsatisfactory. (explain on reverse) ; N / A = Not Applicable	
Diesel Fire pumps only.	
Diesel engine water level is full.	
Water-jacket heater appears to be working properly.	
Water-jacket piping is drip tight.	
Diesel engine water hose is in good condition.	
Coolant antifreeze protection is adequate.	
Cooling line strainer is clean.	
Solenoid valve is operating correctly.	
Bearings and valves are lubricated	
All Pumps – controls.	
Casing relief is free of damage.	
Pressure relief valve is free of damage.	
All valves, fittings and pipe are leak tight.	
Condensate drain trap is clean.	
Fire pump controller power is "on"	
Transfer-switch normal pilot light is "on"	
Jockey pump is operational.	
Jockey pump controller power is "on"	
Jockey pump controller is set on "auto"	
Fire pump shaft coupling appears properly aligned.	
Packing glands appear properly adjusted.	
Test header control valve is closed.	
Test header is in good condition.	
Test header valves and caps are in good condition.	
Test header valve handles are in good condition.	
Test header valve swivel rotation s nonbinding.	
Bypass control valves are open.	
Control valves are sealed / not tampered	
Control valves are locked.	
Control valves are properly tagged and identified.	
Flow meter control valves are closed.	
Relief valves and cone are operational.	
Relief-valve pressure appears properly adjusted.	

Notes _____

_____

_____

_____

Continue on reverse if necessary.

Quarterly and Semi-Annual Maintenance

Fire Pumps (Diesel only)

This form covers a 1 year period.

Year: _____ **System:** _____

Location: _____

Y = Satisfactory; N = Unsatisfactory. (explain on reverse) ; N / A = Not Applicable

Quarterly				
Date				
Inspector				
Clean Strainer.				
Clean filter.				
Clean dirt leg.				
Clean crankcase breather.				
Clean water strainer of cooling system.				
Examine wire insulation for breaks or cracks.				
Semi Annually				
Date				
Inspector				
Test antifreeze level.				
Clean boxes, panels and cabinets.				
Test all safeties and alarms for proper operation				

Notes _____

Annual Maintenance

Fire Pumps.

Date: _____ **Inspector:** _____ **System:** _____
Location: _____

Y = Satisfactory; N = Unsatisfactory. (explain on reverse)	
Lubricate pump bearings.	
Lubricate coupling.	
Lubricate right-angle gear drive.	
Grease motor bearings.	
Replace flexible hoses and connector.	
Replace oil at 50 hours or annually.	
Replace oil filter at 50 hours or annually.	
Calibrate pressure switch settings.	
Check accuracy of pressure sensors.	
Clean pump room louvers.	
Replace circuit breaker or fuses (every 2 years or as needed)	
Remove water and foreign material from diesel fuel tank.	
Rod out the heat exchanger or cooling system.	
Fire pump controller in service.	
Jockey pump controller in service.	
Fire alarm panel "normal"	

Notes _____

Weekly Operating Tests

Fire Pumps.

This form covers 1-month period.

Year: _____ **System:** _____

Location: _____

Y = Satisfactory; N = Unsatisfactory. (explain on reverse); N / A = Not Applicable

Date					
Inspector					
Operate fire pump for 10 minutes (30 minutes for diesel pump)					
Check packing gland tightness. (slight leak at no flow)					
Record suction pressure from gauge in psi (bar)					
Record discharge pressure from gauge in psi (bar)					
Adjust gland nuts if necessary.					
Check for unusual noise or vibration.					
Check packing boxes, bearings, or pump casing for overheating.					
Record pump starting pressure.					
Observe time for motor to accelerate to full speed (diesel and steam pumps)					
For reduced-voltage or reduced-current starting, record time controller is on first step.					
Record time pump runs after starting for pumps having automatic stop feature.					
Record time for diesel engine to crank.					
Record time for diesel engine to reach running speed.					
Check oil pressure gauge, speed indicator, water and oil temperatures while engine is running.					
Check heat exchanger for cooling water flow.					
Record steam pressure for steam operated pumps.					
Check water tank float switch.					
Check solenoid for proper operation.					
Operate speed governor (internal combustion engine only)					
Check steam trap (steam turbine only)					
Check steam relief valve (steam turbine only)					
Check controller alarms.					

Record any notes that the inspector believes to be significant.

_____

_____

_____

_____

_____

_____

_____

_____

Monthly and Semi-Annual Tests

Fire Pumps.

This form covers 1-year period.

Year: _____ **System:** _____

Location: _____

Y = Satisfactory; N = Unsatisfactory. (explain on reverse) ; N / A = Not Applicable

Monthly												
Date												
Inspector												
Exercise isolating switch and circuit breaker.												
Test antifreeze to determine protection level.												
Test battery/s for specific gravity / state of charge.												
Test circuit breakers and fuses for proper operation.												
Semi – Annually												
Date												
Inspector												
Operate manual starting means.												
Operate safety devices and alarms.												

Notes _____

Annual Performance Tests

Fire Pumps

Date: _____ **Inspector** _____ **System:** _____
Location: _____

Pump Manufacturer and model: _____
Type: ☐ Centrifugal ☐ Turbine

Controller manufacturer and model: _____

Rated Capacity: _____ Gpm (L/min)

Water Supply Source: _____

Rated Pressure: _____ psi (bar) **Rated speed:** _____ rpm
Power ☐ Electric ☐ Diesel ☐ Steam

Automatic starts performed 6 times.		Timer indicates total run time: _____min	
Automatic start functions properly		Timer reset and graph paper changed?	
Automatic stop functions properly.		Test data and flow chart completed. (Attach all water flow charts, electrical power charts and performance curve etc.	
Automatic start: _____ psi (bar)			
Automatic stop: _____ psi (bar)		Fire pump electrical power readings recorded at each flow condition?	
Manual starts performed 6 times.			
Manual start functions properly.		Fire pump motor speed: _____rpm	
Manual stop functions properly.		Fire pump discharge flow: _____Gpm (L/min)	
Manual start: _____ psi (bar)			
Manual stop: _____ psi (bar)		Jockey pump operational	
Remote start functions properly.		Jockey pump appears properly aligned.	
Remote stop functions properly.		Jockey pump valves open.	
Remote start: _____ psi (bar)		Jockey pump "turn on" _____psi	
Remote stop: _____ psi (bar)		Jockey pump "turn off" _____psi	

Notes _____

Annual Test Summary Page

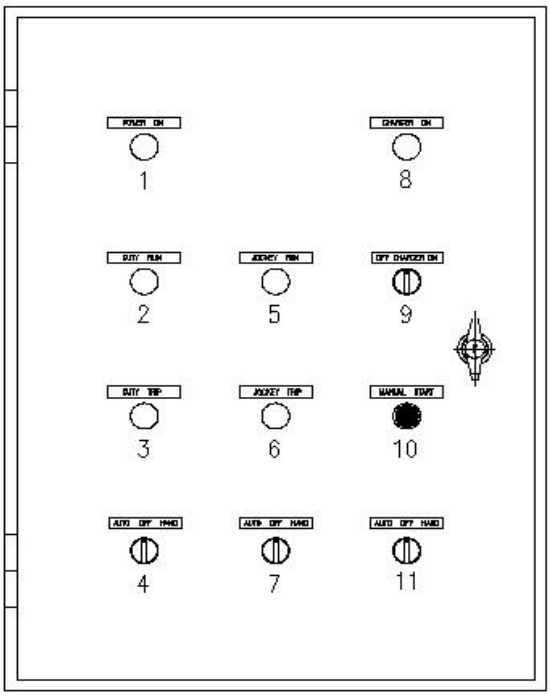
Fire Pumps.

Date: _____ **Inspector:** _____ **System:** _____
Location: _____

	Test 1	Test 2	Test 3
Approximate percent of rated pump discharge. (gpm) / (L/min)	0	100%	150%
Nozzle size in inches (mm)	No flow		
Pilot pressure in psi (bar)	None		
Flow in gpm (L/min)	None		
Pump suction in psi (bar)			
Pump discharge in psi (bar)			
Net pump head (discharge pressure minus suction pressure)			
Pump speed (rpm)			
Operate electric circuit breaker.			
Test emergency power supply.			
Check for excessive back pressure in exhaust system.			

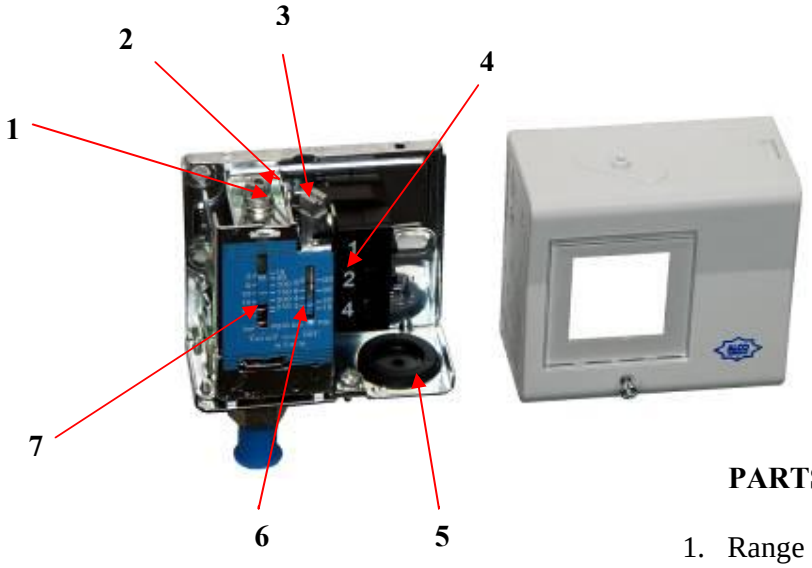
Notes

V. *Fire Pump Set Parts & Controller Description*



LEGEND:

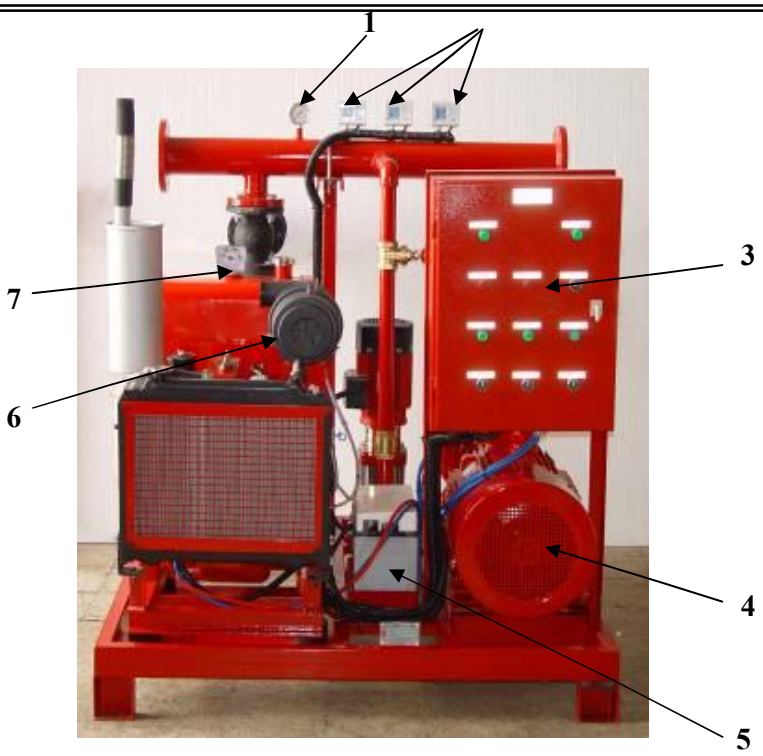
1	–	POWER ON
2	–	DUTY RUN
3	–	DUTY TRIP
4	–	AUTO OFF HAND (DUTY PUMP)
5	–	JOCKEY RUN
6	–	JOCKEY TRIP
7	–	AUTO OFF HAND SW (JOCKEY PUMP)
8	–	CHARGER ON
9	–	CHARGER ON OFF SW
10	–	MANUAL START
11	–	AUTO OFF HAND (ENGINE)



Pressure Switch (PS1)

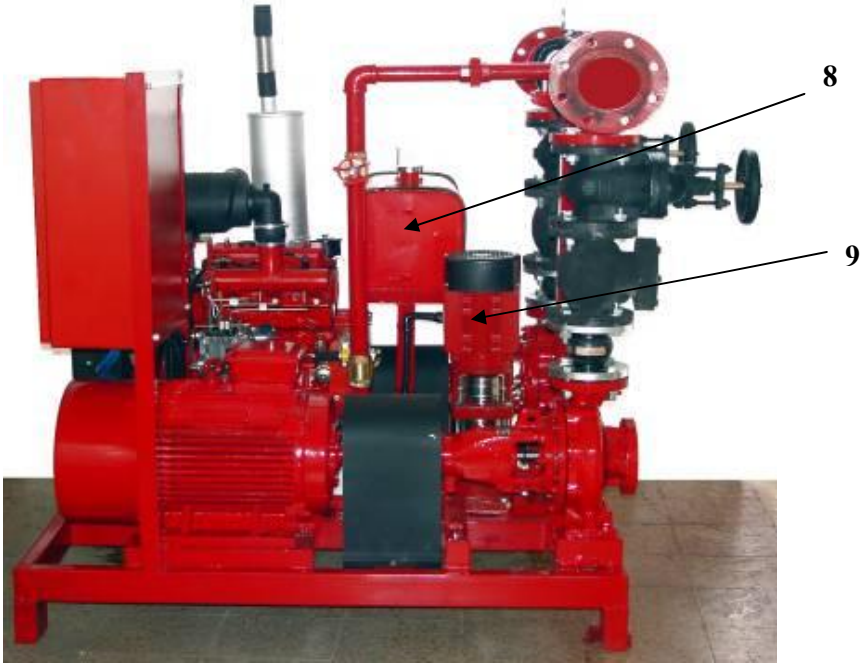
PARTS DESCRIPTION:

1. Range Spindle.
2. Lock plate.
3. Differential Spindle.
4. Electrical Terminal.
5. Cable Entry Grommet.
6. Pressure Differential Range.
7. Cut-In Pressure Range.



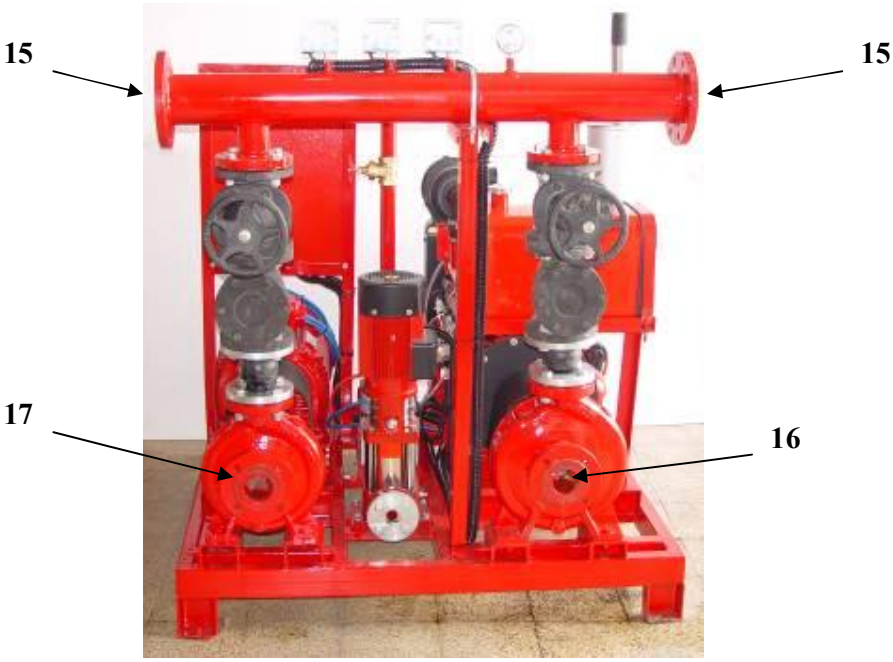
PARTS DESCRIPTION:

1. System Pressure Gauge.
2. System Pressure Switch.
3. Fire Pump Controller.
4. Duty Pump Motor.
5. Diesel Engine Battery.
6. Engine Air Intake Filter.
7. Diesel Fuel Gauge.
8. Diesel Fuel Tank.
9. Jockey Pump Motor.



PARTS DESCRIPTION:

10. Engine Exhaust Muffler.
11. Engine Heat Radiator.
12. Diesel Engine.
13. Starter Motor.
14. Fire Pump Discharge Line.
15. Manifold
16. Diesel Pump Suction Port.
17. Duty Pump Suction Port.



Battery .

PARTS DESCRIPTION:

18. Battery Negative.

19. Battery Positive.

20. Oil Dip Stick.

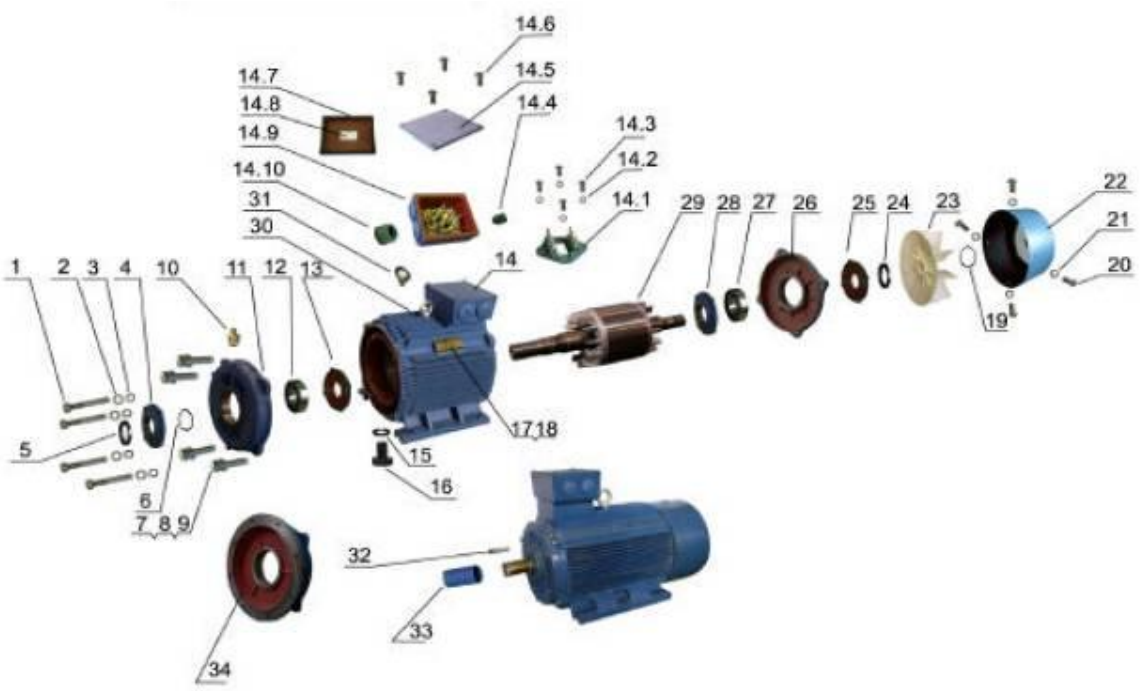
21. Engine Stop Solenoid.

22. Fuel Pump.

23. Fuel Injection Pump.

Fuel System

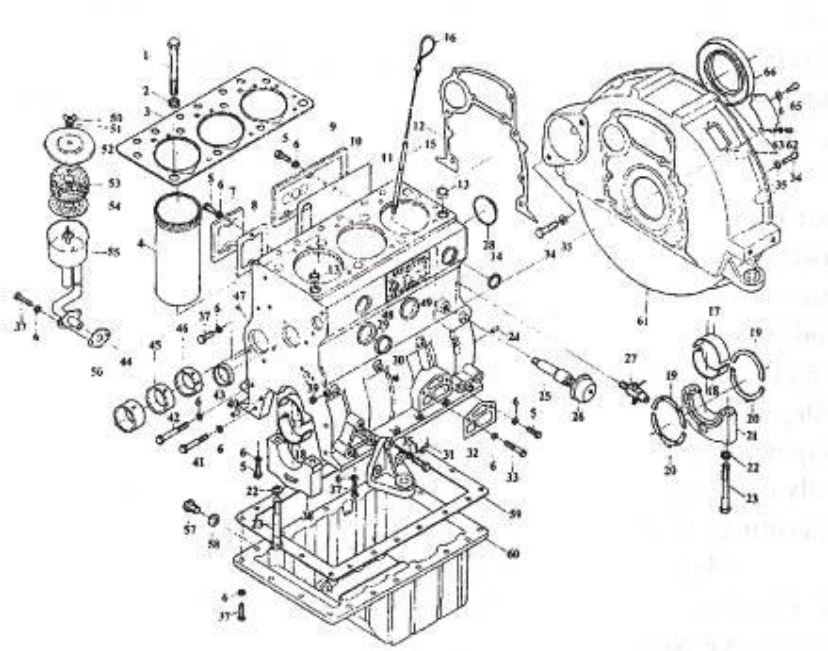
VI. Electrical Motor Components



1、	Bolt	14.9	Terminal box holder
2、	Washer	14.10	Cable inlet
3、	Washer	15、	Seal ring
4、	Bearing cap	16、	Plug screw
5、	Seal ring	17、	Nameplate
6、	Wave form elastic washer	18、	Rivet
7、	Balt	19、	Retainer ring
8、	Washer	20、	Balt
9、	Washer	21、	Washer
10、	Oil cup	22、	Fan cover
11、	End cover	23、	Cooling fan
12、	Bearing	24、	Seal ring
13、	Bearing cap	25、	Bearing cap
14、	Terminal box	26、	End cover
14.1	Connecting board	27、	Bearing
14.2	Washer	28、	Bearing cap
14.3	Screw	29、	Rotor
14.4	Cable inlet	30、	Stator
14.5	Terminal box cover	31、	Eyebolt
14.6	Screw	32、	Key
14.7	Terminal box seal	33、	Shaft sleeve
14.8	Connecting diagram	34、	Flange

VII. Spare Parts for Diesel Engine

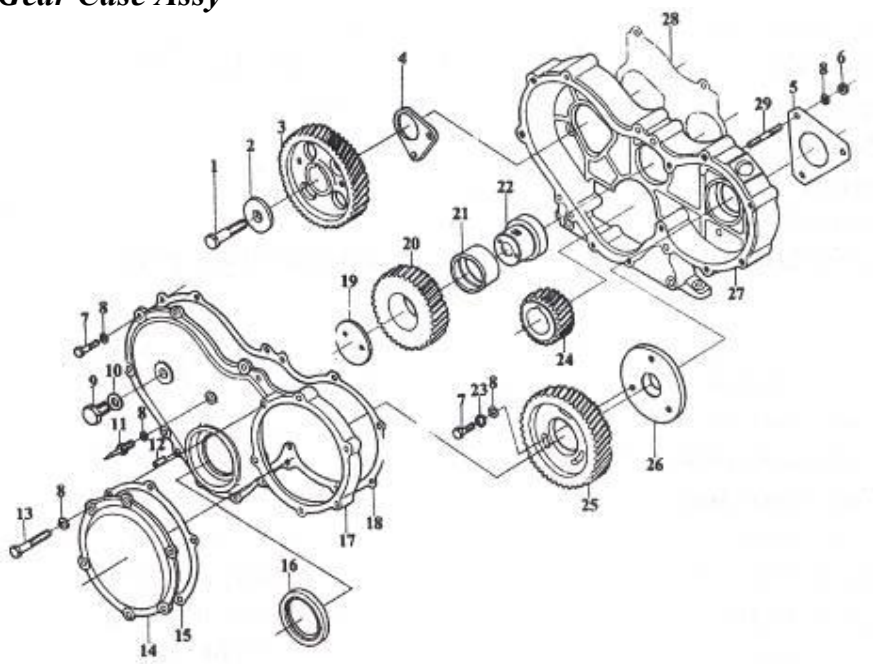
Engine Body Assy



Engine Body Assy

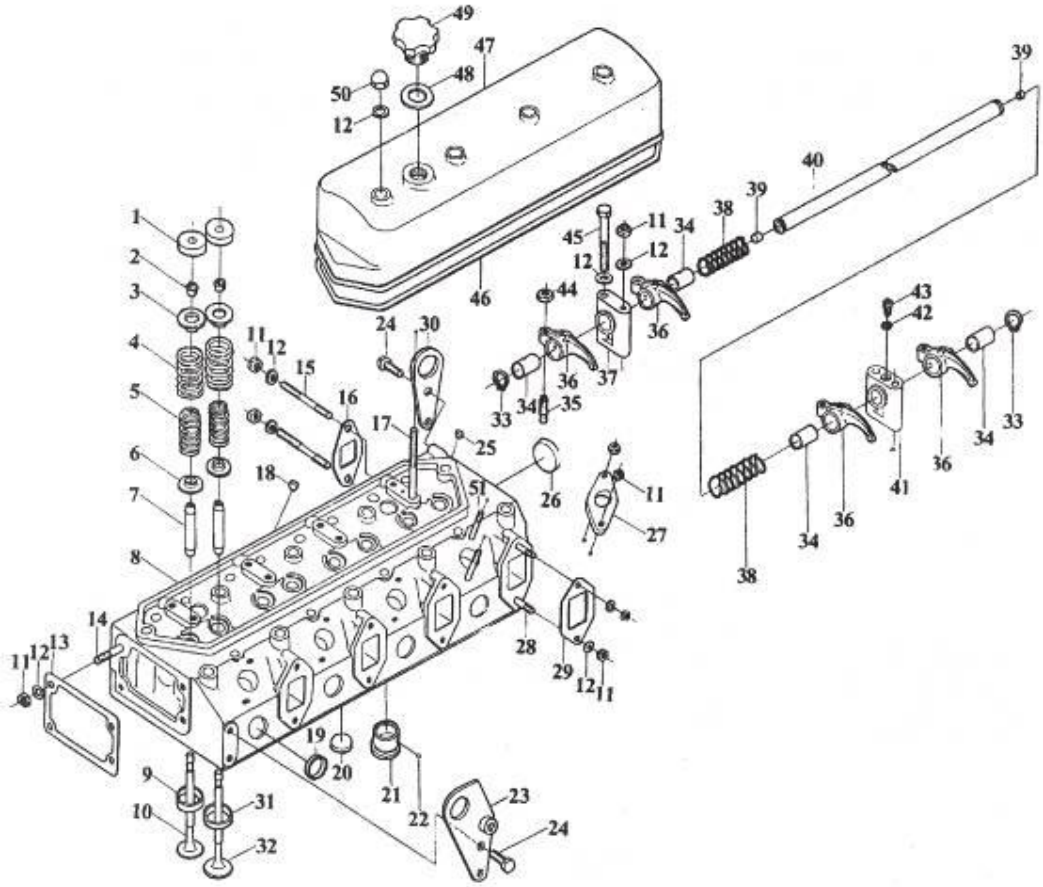
Ser No	Name of Parts	Qty	Ser No	Name of Parts	Qty
1	Cylinder head bolt	8	34	Bolt M10×30	14
2	Cylinder head bolt washer	8	35	Washer10-140HV	14
3	Cylinder head gasket	1	36	Stand bar	2
4	Cylinder sleeve	3	37	Bolt M8×20	29
5	Bolt M8×25	6	38	Main bearing cap	3
6	Washer8-140HV	49	39	Z1/4"taper plug	2
7	Side cover(II)	1	40	Pin B8×20	1
8	Side cover(II)gasket	1	41	Bolt M8×55	4
9	Side cover(I)	1	42	Bolt M8×60	8
10	Side cover(I)gasket	1	43	Bowl-shaped plug piece	2
11	Engine body	1	44	Front camshaft bush	1
12	Flywheel housing gasket	1	45	Middle camshaft bush	1
13	Locating sleeve	2	46	Rear camshaft bush	1
14	Bowl-shaped plug piece	3	47	Stopper	3
15	Dipstick sleeve weldment	1	48	Rivet 2×5	4
16	Oil level dipstick	1	49	Name plate	1
17	Main bearing half shell(upper)	4	50	Butterfly nut M6	1
18	Main bearing half shell(lower)	4	51	Washer6-140HV	1
19	Upper thrust piece of crankshaft	2	52	Respirator cover	1
20	Lower thrust piece of crankshaft	2	53	gasket	1
21	Rear main bearing cap	1	54	Respirator partition	1
22	Main bearing bolt washer	8	55	Respirator weldment	1
23	Main bearing cap bolt	8	56	Respirator gasket	1
24	PinB10×20	2	57	Oil drain plug	1
25	Connecting pipe for oil pressure	1	58	Washer	1
26	sensor	1	59	Oil sump gasket	1
27	Sensor for oil gauge	1	60	Oil sump	1
28	Water drain cock	1	61	Flywheel housing	1
29	Plug piece	6	62	Screw M6×12	2
30	Bowl-shaped plug piece	3	63	Washer6-140HV	2
31	Z1/8"taprt plug	1	64	Cover plate	1
32	Bowl-shaped plug piece	1	65	Bolt M8×30	2
33	Oil gasket	1	66	Cased sealPG80×100×12	1

Triming Gear Case Assy



Ser No	Name of Parts	Qty	Ser No	Name of Parts	Qty
1	Bolt M12×30	1	16	Oil seal PG55×75×12	1
2	Camshaft timing gear hold down	1	17	Timing gear case cover	1
3	Camshaft timing gear	1	18	Timing gear case cover gasket	1
4	Camshaft thrust plate	1	19	Idle gear hold down	1
5	Fuel injection pump gasket	1	20	Timing idle gear	1
6	Nut M8	3	21	Timing idle gear bush	1
7	Bolt M8×20	7	22	Timing idle gear shaft	1
8	Washer8-140HV	17	23	Washer 8	3
9	Oil drain plug	1	24	Crankshaft timing gear	1
10	Washer	1	25	Fuel injection pump timing gear	1
11	Pointer	1	26	Fuel injection pump timing gear seat	1
12	Pin B8×20	2	27	Timing gear case	1
13	Bolt M8×40	6	28	Timing gear case gasket	1
14	Front cover of timing gear case	1	29	Stud M8×20	3
15	Front cover gasket of timing gear case	1			

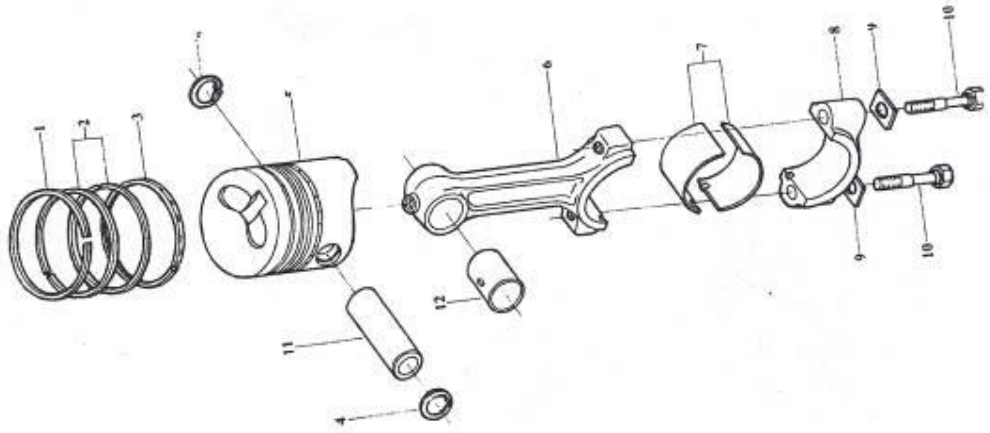
Cylinder Head Assy



Cylinder Head Assy

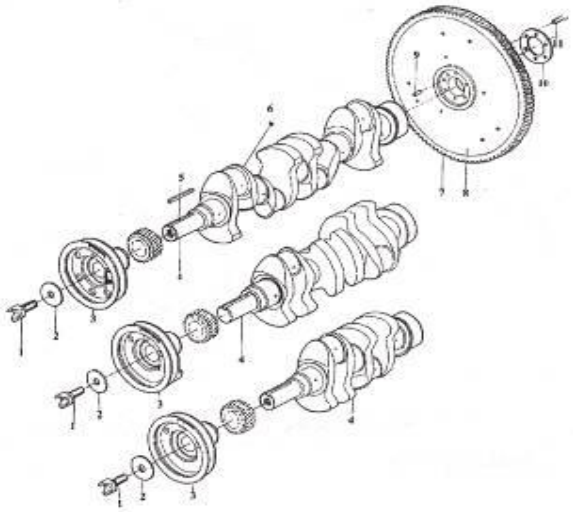
Ser No	Name of Parts	Qty	Ser No	Name of Parts	Qty
1	Spring seat cover (upper)	8	27	Injector hold down	4
2	Valve collets	16	28	Stud	8
3	Valve spring seat (upper)	8	29	Intake pipe gasket	4
4	Valve spring (outer)	8	30	Rear hoisting ring	1
5	Valve spring (inner)	8	31	Intake valve seat	4
6	Valve spring seat (lower)	8	32	Intake valve	4
7	Valve stem guide	8	33	Check ring 16	2
8	Cylinder head	1	34	Rocker arm bush	8
9	Exhaust valve seat	4	35	Valve clearance adjusting screw	8
10	Exhaust valve	4	36	Valve rocker arm	8
11	Nut M8	36	37	Rockshaft carrier	3
12	Washer 8-140HV	32	38	Rockshaft spring	3
13	Thermostat housing gasket	1	39	Rockshaft stopper	2
14	Stud M825	4	40	Rockshaft	1
15	Stud M830	8	41	Rockshaft rear carrier	1
16	Exhaust pipe gasket	4	42	Washer 6-140HV	1
17	Rocker arm seat fixed bolt	4	43	Rockshaft locating screw	1
18	Bowl-shaped plug piece	4	44	Nut M8×1	8
19	Bowl-shaped plug piece	4	45	Bolt M8×60	4
20	Bowl-shaped plug piece	1	46	Cylinder head bonnet gasket	1
21	Swirl-chamber splice block	4	47	Cylinder head bonnet	1
22	Steel ball 3	4	48	Filler cap gasket	1
23	Front hoisting ring weldment	1	49	Filler cap	1
24	Bolt M820	4	50	Cap nut M8	4
25	Stopper	1	51	Stud M865	8
26	Bowl-shaped plug piece	1			

Piston-connecting Rod Assy



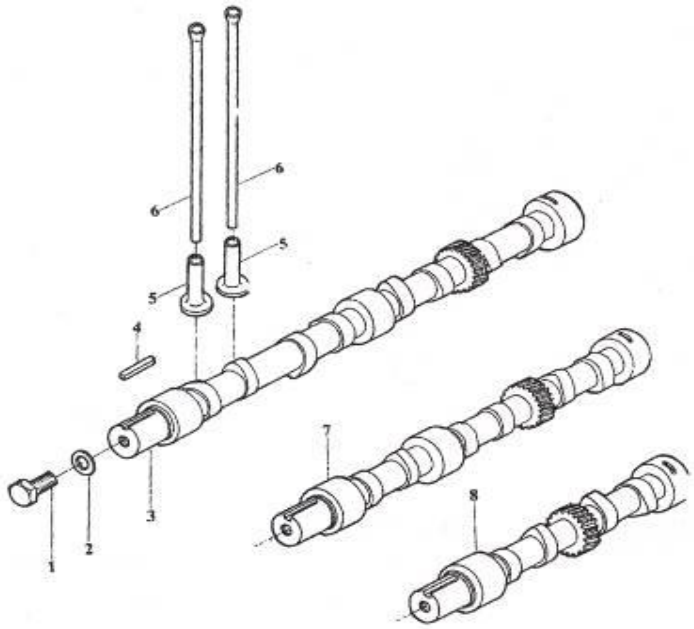
Ser No	Name of Parts	Qty	Ser No	Name of Parts	Qty
1	Top compression ring	1	7	Connecting rod bearing shell	2
2	2nd and 3 compression ring	2	8	Connecting rod cap	1
3	oil ring unit	1	9	Connecting rod bolt lock plate	2
4	circlip for hole 26	2	10	Connecting rod bolt	2
5	piston	1	11	Piston pin	1
6	connecting rod	1	12	Connecting rod bush	1

Crankshaft-flywheel Ass



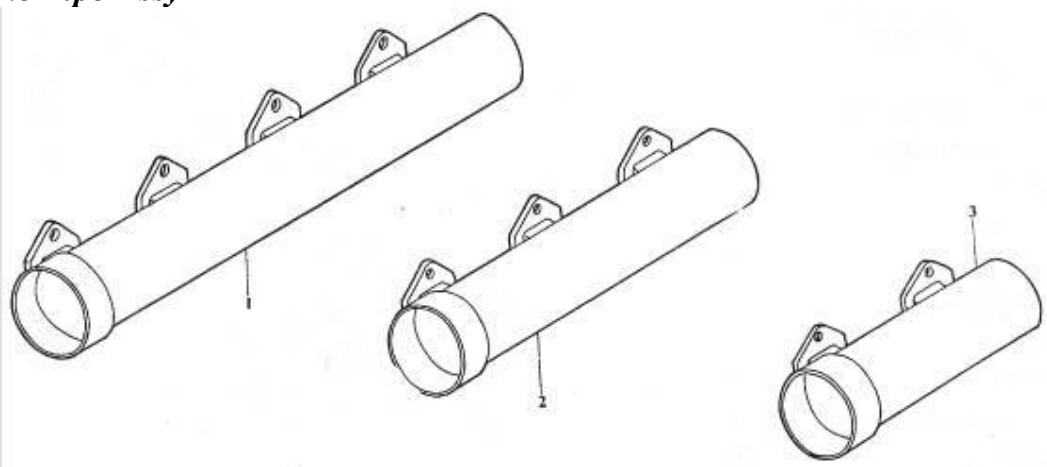
Ser No	Name of Parts	Qty
1	Starting claw	1
2	Starting claw backing plate	1
3	Crankshaft belt pulley	1
4	Crankshaft	1
5	KeyC10×64	1
6	Plug	4
7	Flywheel gear ring	1
8	Flywheel	1
9	PinB8×20	1
10	Flywheel bolt backing plate	1
11	Flywheel bolt	6

Camshaft Assy



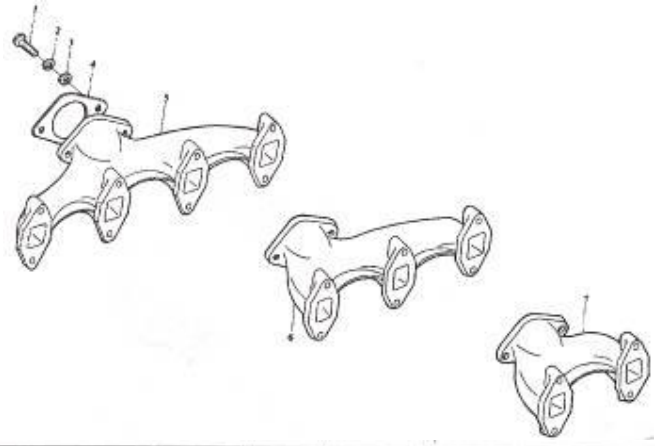
Ser No	Name of Parts	Qty	Ser No	Name of Parts	Qty
1	Bolt M12×30	1	5	Tappet	8
2	Washer 12-140HV	1	6	push rod	8
3	Camshaft	1	7	camshaft	1
4	KeyC8×22	1	8	camshaft	1

Intake Pipe Assy



Ser No	Name of Parts	Qty	Ser No	Name of Parts	Qty
1	Intake pipe assy	1			

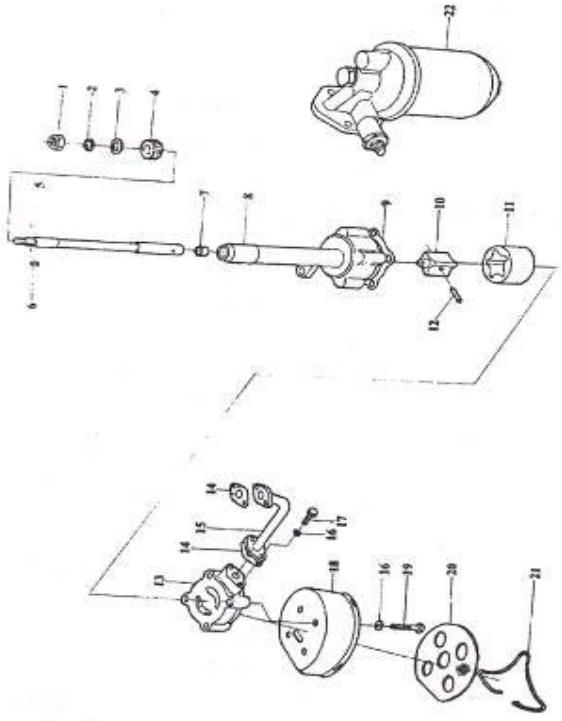
Exhaust Pipe Assy



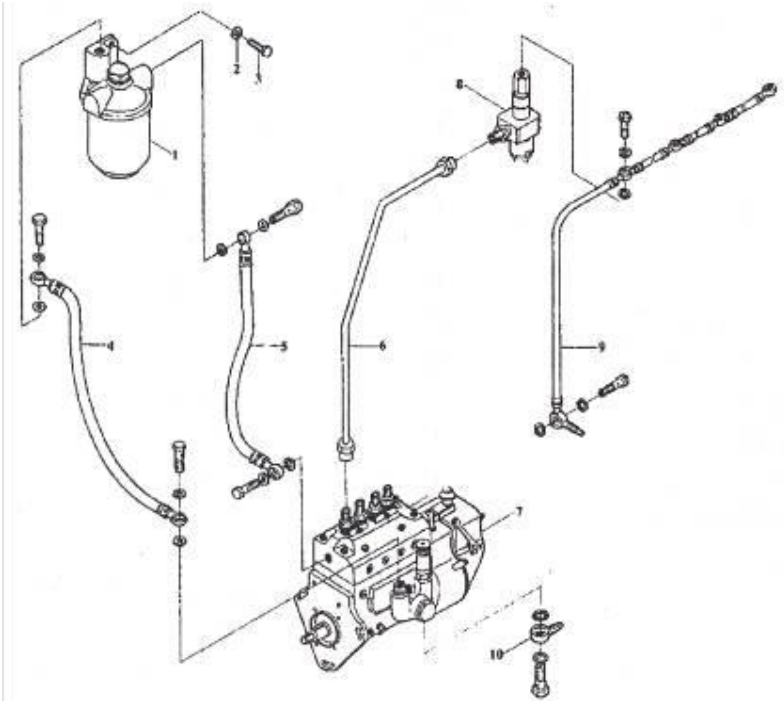
Ser No	Name of Parts	Qty	Ser No	Name of Parts	Qty
1	Bolt M1030	2	4	General exhaust pipe gasket	1
2	Washer 10	2	5	Exhaust pipe	1
3	Washer 10-140HV	2			

Lubricating System Assy

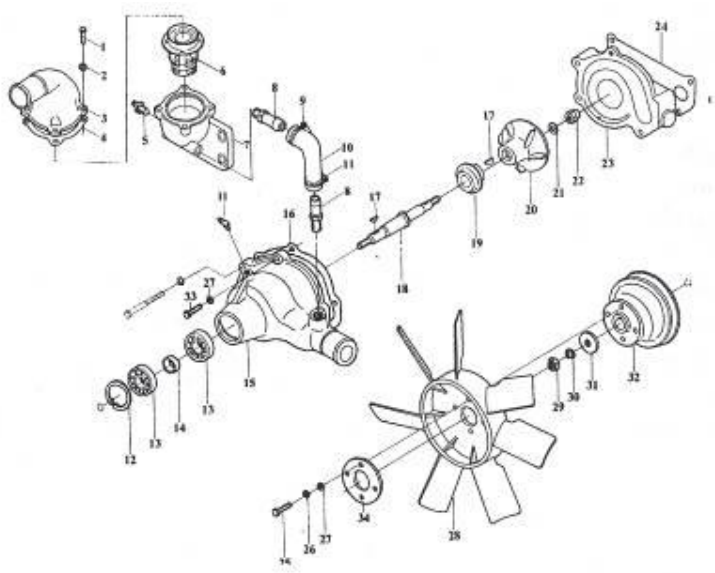
Ser No	Name of Parts	Qty
1	Nut m10	1
2	Washer 10	1
3	Washer10-14-HV	1
4	Oil pump drive gear	1
5	Oil pump shaft	1
6	Semicircular key 3×5×13	1
7	Oil pump body bush	1
8	Oil pump body	1
9	Oil pump gasket	1
10	Inner rotor	1
11	Outer rotor	1
12	Cylindrical pin	1
13	Oil pump cover	1
14	Oil outlet pipe flange gasket	2
15	Oil line unit	1
16	Washer 8-140HV	6
17	Bolt m8×20	2
18	Gauze filter body	1
19	Bolt m8×40	4
20	Gauze filter weldment	1
21	Gauze support	1
22	Oil filter assy	1



Fuel System Assy



Cooling System Assy



Cooling System Assy

Ser No	Name of Parts	Qty	Ser No	Name of Parts	Qty
1	Bolt M6×20	4	18	Water pump shaft	1
2	Washer6-140HV	4	19	Ceramic gear water seal	1
3	Thermostat cover	1	20	Water pump impeller	1
4	Thermostat cover gasket	1	21	Copper washer	1
5	water temperature induction plug	1	22	Cap nut M10	1
6	Thermostat SH130	1	23	Water pump rear cover	1
7	Thermostat housing	1	24	Water pump gasket	1
8	Small circulating adapter	2	25	Bolt m8×20	4
9	Screw clip ϕ3/4"~1 1/8"	2	26	Washer 8	4
10	Rubber bent pipe	1	27	Washer 8-140HV	5
11	Oil cup 45° M10×1	1	28	Fan	1
12	Check ring 40	1	29	Nut m10	1
13	Single-row ball bearing 60203	2	30	Washer 10	1
14	Bearing spacer	1	31	Washer	1
15	water pump housing	1	32	Water pump belt pulley	1
16	water pump gasket	1	33	Bolt M8×30	1
17	semicircular key 4×6.5×16	2	34	Fan holddown	1

VIII. Troubleshooting Chart

Fire Pump Troubles	Suction				Pump																Driver &/ or Pump					Driver						
	Air Drawn into suction connection through leak(s)	Suction connection obstructed	Air pocket in suction pipe.	Well collapsed or serious misalignment	Stuffing box too tight or p acking improperly installed.	Water seal or pipe to seal obstructed.	Air leak into pump through stuffing boxes.	Impeller obstructed.	Wearing rings worn.	Impeller damaged.	Wrong diameter impeller.	Actual net head lower than rated.	Casing gasket defective per mitting internal leakage. (single stage and multi stage pumps)	Pressure gauge is on top of pump casing.	Incorrect impeller adjustment. (Vertical shaft Turbine type pump only)	Impellers locked.	Pump is frozen.	Pump shaft or shaft sleeve scored, bent, or wor n.	Pump is not primed.	Seal ring improperly located in stuffing box, preventing water from entering space to form seal.	Excess bearing friction due to lack of lubrication, wear, dirt, rusting, failure, or improper installation.	Rotating element binds again st stationary element.	Pump and driver misaligned.	Foundation not rigid.	Engine cooling system obstructed	Faulty driver	Lack of Lubrication	Speed too low.	Wrong direction of rotation.	Speed to high.	Rated motor voltage different from line voltage.	Faulty electric circuit, obstructed fuel system, obstructed steam pipe, or dead battery.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Excessive leakage at stuffing box.					✔													✔					✔									
Pump or driver overheats.				✔	✔	✔		✔			✔				✔			✔	✔	✔	✔	✔	✔	✔	✔	✔		✔		✔	✔	✔	
Pump unit will not start.				✔	✔										✔	✔	✔				✔					✔	✔						✔
No water discharge.	✔	✔	✔					✔											✔													
Pump is noisy or vibrates.				✔	✔			✔		✔								✔			✔	✔	✔	✔			✔					
Too much power required.				✔	✔			✔										✔			✔	✔	✔	✔			✔		✔	✔	✔	
Discharge pressure not constant for same gpm.	✔				✔	✔	✔																									
Pump loses suction after starting.	✔	✔				✔	✔													✔												
Insufficient water discharge.	✔	✔				✔	✔	✔	✔	✔	✔	✔	✔		✔													✔	✔		✔	
Discharge pressure too low for gpm (L/min) discharge.	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔														✔	✔		✔	

Fire Pump Set Trouble Shooting Chart.

IX. FIRE PUMP CATALOGUES