PUMP ROOM

Component and equipment

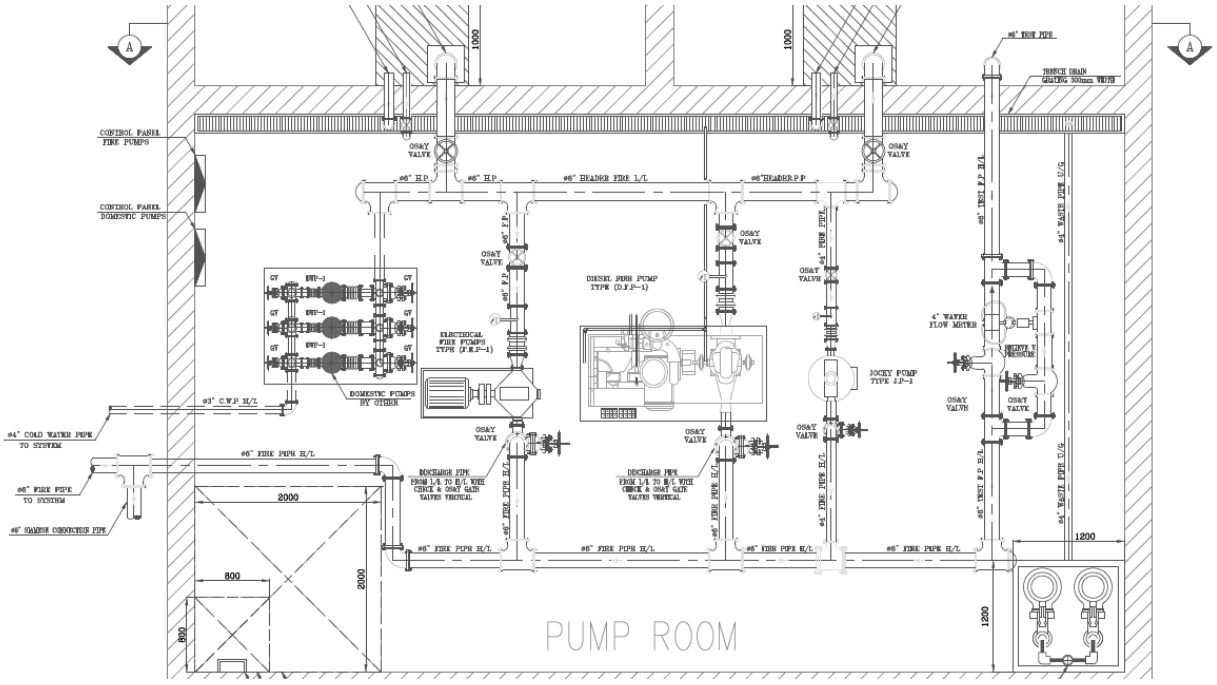


fig-1. Pump room

1- Gate valve

2- check valve

It prevents back flow, and allows only flow in on direction, and is installed in pump discharge line directly to prevent pumps from starting at a load or at the system pressure.

3- Suction header

It prevents vortex

4- Discharge header

5- Diesel pump

It's a 100% stand-by pump, operates in case of power failure with the failure of pressure make up process by the electric pump, or

even with the present of power if failure of pressure make up process.

fig-2. diesel pump

6- Jockey pump

It's the first pump to start in case of fire, It operates as a pressure maintenance pump so in case of a leakage in the system pressure it will makes the system pressure as recommended, and A jockey pump should be sized to make up the allowable leakage rate within 10 minutes or 1GPM (3.8 L/min), whichever is larger, and is used for this job instead-off starting the electric pump to protect it from starting until a serious problem occurs.

7- Electric pumps

It's the second pump to start in case of fire; it's the 100% duty pump.

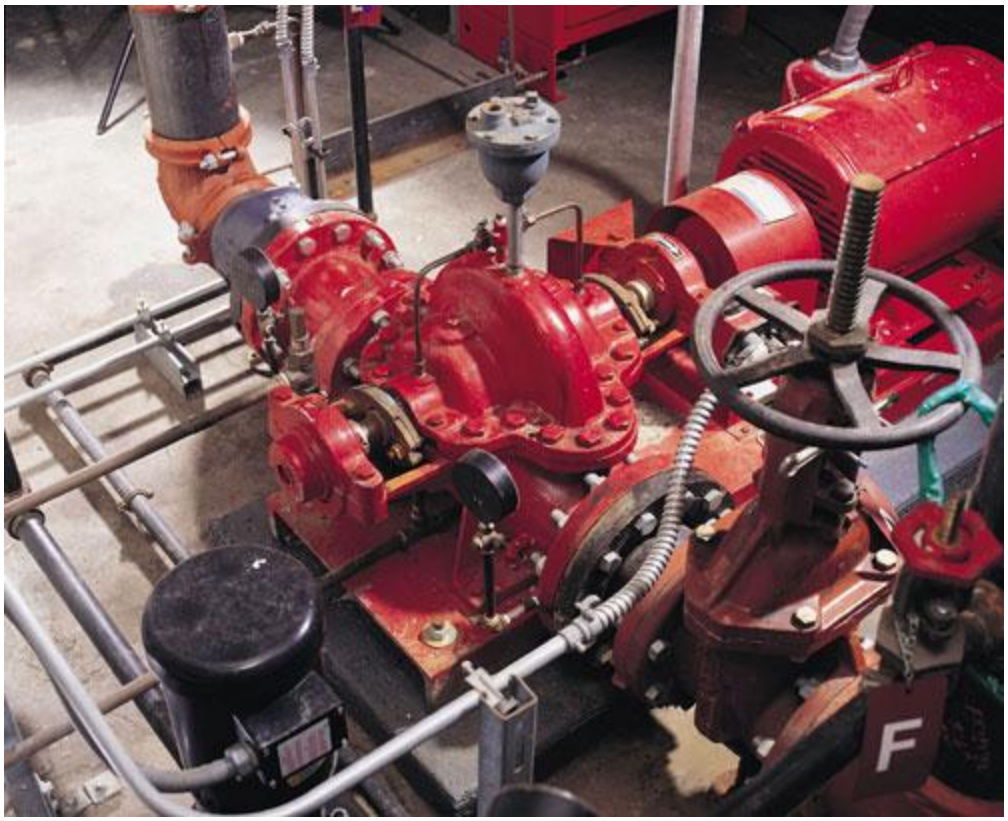


fig-3. electric pump

8- Pressure relief valve

A valve being set at a pressure higher than the system pressure or shut off pressure of the diesel pump to protect the system from the very high pressure generated by the diesel pump in case of sudden acceleration.

9- Alarm check valve

It's consist of:

- Pressure switch (electric part) which gives a signal to fire alarm system in case of flow in pipes.
- Mechanical alarm which done automatically by water flow in pipes.

fig-4. alarm check valve

10- Water flow meter

11- Diesel pump electric control panel and pressure sensing line

12- Jockey pump electric control panel and pressure sensing line

13- Electric pump electric control panel and pressure sensing line

fig-5. fire pumps controllers

14- Vortex plate

It's installed in the tank in suction lines to prevent vortex in the tank water.

15- Electric pump casing relief valve

It's reliefs the pressure on the pump to protect it from damage in case of pump work and no exit for water in the system, and is being set at the shut of head or higher than system pressure.

fig-6. casing relief valve

16- Stainless steel flexible joints

17- Automatic air vent

18- Tamper switch

It gives a signal when a gate valve closed.

19- Flow switch

It gives signal when a flow happened in a pipe.

An arrangement for pump room:

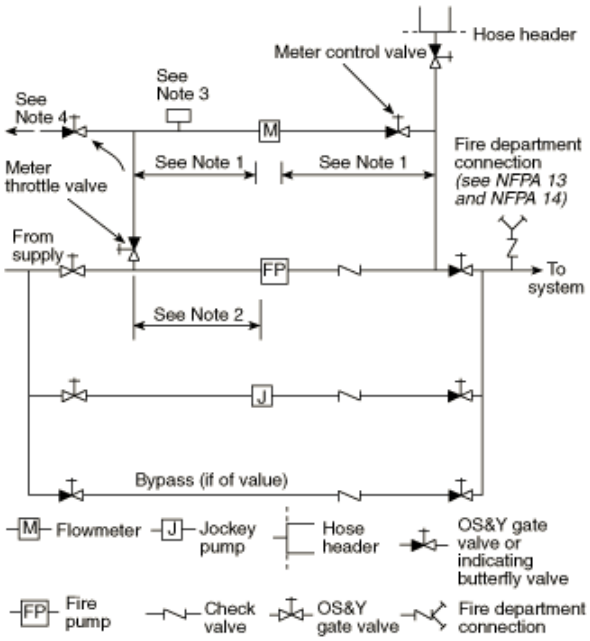


fig-7. an arrangement for a firefighting pump room

fig-8. firefighting pump room

Another arrangement for pump room:

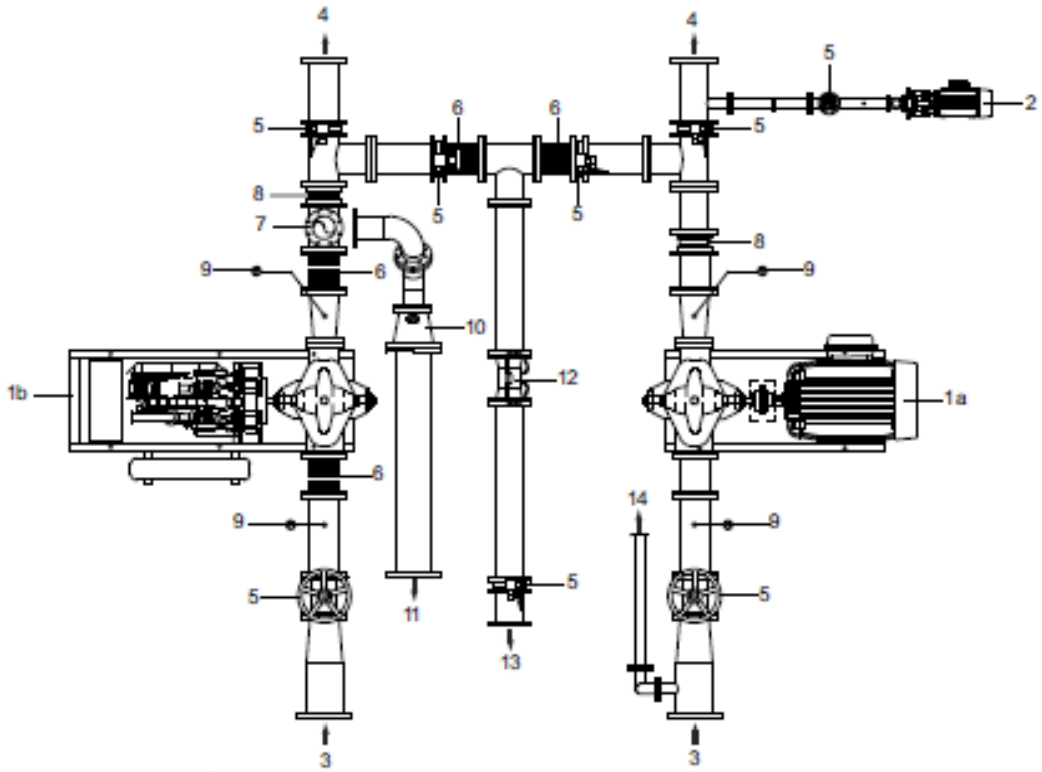


Fig. 3 Overview of fire system

Pos.	Description
1a	Fire pump, electrically powered (duty pump)
1b	Fire pump, diesel-powered (standby pump)
2	Jockey pump
3	From supply tank
4	To system

Pos.	Description
5	Valve
6	Expansion joint
7	Main relief valve
8	Check valve/non-return valve
9	Pressure gauge

Pos.	Description
10	Waste cone with sight glass
11	Discharge from relief valve
12	Flowmeter
13	Discharge from test line
14	Supply to jockey pump

fig-9. another arrangement of firefighting pump room

Sequence of operation

All pipes of the wet system are maintained at a pressure higher than system demand pressure.

At first in case of fire a sprinkler open or a fire hose cabinet will be used

This will makes the pressure of water to goes down, all pumps sensing lines matched to pressure transducer in pump control panel, when the pressure reach 6 bar the pressure transducer in jockey pump controller gives signal to start the jockey, if the pressure maintained constant or goes high this means it just a leak, and if the pressure reached 5 bar the electric fire pump will start as same as jockey pump, and if the pressure reached 4 bar in any case the diesel pump will start by the same way.(all numbers is for example)

The fire pump operation is as follows

(a) Motor-Driven Pump. To start a motor driven pump, the following steps should be taken in the order given below.

(1) See that pump is completely primed.

(2) Close isolating switch and then close circuit breaker.

(3) Automatic controller will start pump if system demand is not satisfied (e.g., pressure low, deluge tripped, etc.).

(4) For manual operation, activate switch or pushbutton, or manual start handle.

Circuit breaker-tripping mechanism should be set so that it will not operate when current in circuit is excessively large.

(b) Steam-Driven Pump. A steam turbine driving a fire pump should always be kept warmed up to permit instant operation at full rated speed.

The automatic starting of the turbine should not be dependent on any manual valve operation or period of low-speed operation. If the pop safety valve on the casing blows, steam should be shut off and the exhaust piping examined for a possible closed valve or an obstructed portion of piping. Steam turbines are provided with governors to maintain speed at a predetermined point, with some adjustment for higher or lower speeds. Desired speeds below this range can be obtained by throttling the main throttle valve.

(c) Diesel Engine-Driven Pump. To start a diesel engine-driven pump, the operator should be familiar beforehand with the operation of this type of equipment. The instruction books issued by the engine and control manufacturer should be studied to this end.

The storage batteries should always be maintained in good order to ensure prompt satisfactory operation of this equipment (i.e., check electrolyte level and specific gravity, inspect cable conditions, corrosion, etc.).

(d) Fire Pump Settings. The fire pump system, when started by pressure drop, should be arranged as follows.

(1) The jockey pump stop point should equal the pump churn pressure plus the minimum static supply pressure.

(2) The jockey pump start point should be at least 10 psi (0.68-bar) less than the jockey pump stop point.

(3) The fire pump start point should be 5 psi (0.34 bar) less than the jockey pump start point. Use 10-psi (0.68-bar) increments for each additional pump.

(4) Where minimum run times are provided, the pump will continue to operate after attaining these pressures. The final pressures should not exceed the pressure rating of the system.

(5) Where the operating differential of pressure switches does not permit these settings, the settings should be as close as equipment will permit. The settings should be established by pressures observed on test gauges.

(6) Example:

Pump: 1000-gpm, 100-psi pump with churn pressure of 115 psi.

Suction Supply: 50 psi from city — minimum static. 60 psi from city — maximum static.

Jockey pump stop = 115 + 50 = 165 psi.

Jockey pump start = 165 - 10 = 155 psi.

Fire pump stop = 115 + 50 = 165 psi.

Fire pump start = 155 - 5 = 150 psi.

Fire pump maximum churn = 115 + 60 = 175 psi.

(For SI units, 1 psi = 0.0689 bar.)

(7) Where minimum run timers are provided, the pumps will continue to operate at churn pressure beyond the stop setting. The final pressures should not exceed the pressure rating of the system components.

(e) Automatic Recorder. The performance of all fire pumps should be automatically indicated on a pressure recorder to provide a record of pump operation and assistance in fire loss investigation.

Shut off of the pumps

1- The Jockey pumps stops automatically when the pressure in pipes reached its rated pressure.

2- The Electric pump stops after reached the rated pressure by ten minutes
3- The Diesel pump stops after 30 minutes after reaching its rated pressure.

Power sources

There are two power sources:

- Normal
- Emergency

All pumps should be feed by the two ways of power in the building by the next ways:

The electric pump can be only feed by normal source if there is a diesel pumps but sometimes for safer it connected by the two sources.

The jockey should be feed the two sources.

The diesel pump needs to energize its battery in any time by this sequence:

At first in the diesel pump control panel a charger this charger works in case of no electric charge in diesel battery so it energized the battery and out from the circuits, and when the battery charged the diesel will start automatically without any need of external power source, but by the time the battery could be damage or have a problem, so its preferable to make the diesel pump in the two power source.

Note

Some codes allows to use two electric pumps one connected to normal source and one on the emergency source for cost reduction, but actually this way have some conditions must applied for safe, first is to make the

generator very close to the pump room and all pumps cables must be fire rated (the second condition is for all fire system cables).

Types of fire pumps

Always used type of pumps for fire application is centrifugal vertical in-line or horizontal in-line.

Centrifugal pumps

Centrifugal pumps shall be of the overhung impeller between bearings design. The overhung impeller design shall be close coupled or separately coupled single- or two-stage end suction-type [see Figures A-3-1.1(a) and (b)] or in-line-type [see Figures A-3-1.1(c), (d), and (e)] pumps. The impeller between bearings design shall be separately coupled single-stage or multistage axial (horizontal) split-case-type [see Figure A-3-1.1(f)] or radial (vertical) split-case-type [see Figure A-3-1.1(g)] pumps.

{All figures are in the appendices}

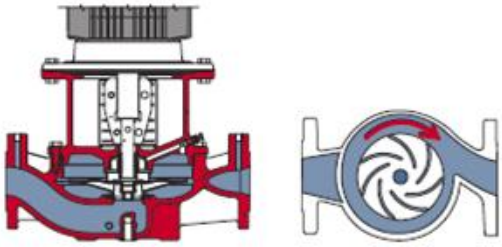


fig-10. flow in a centrifugal pump

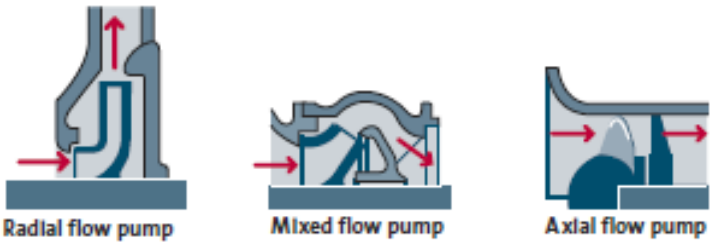


fig-11. types of flow in centrifugal pumps

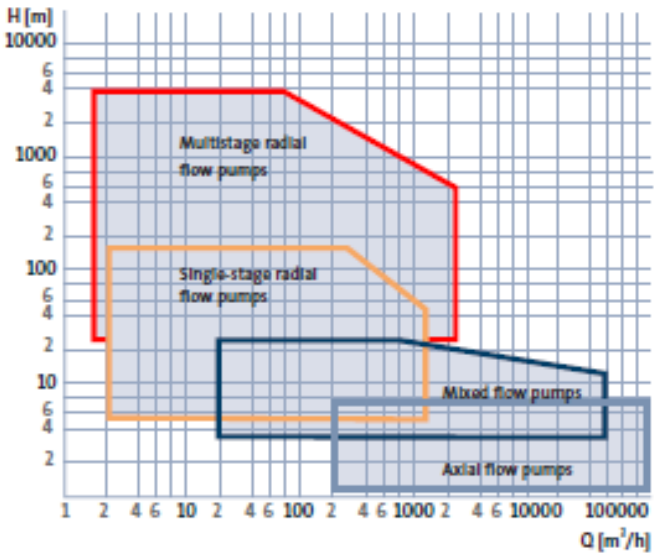
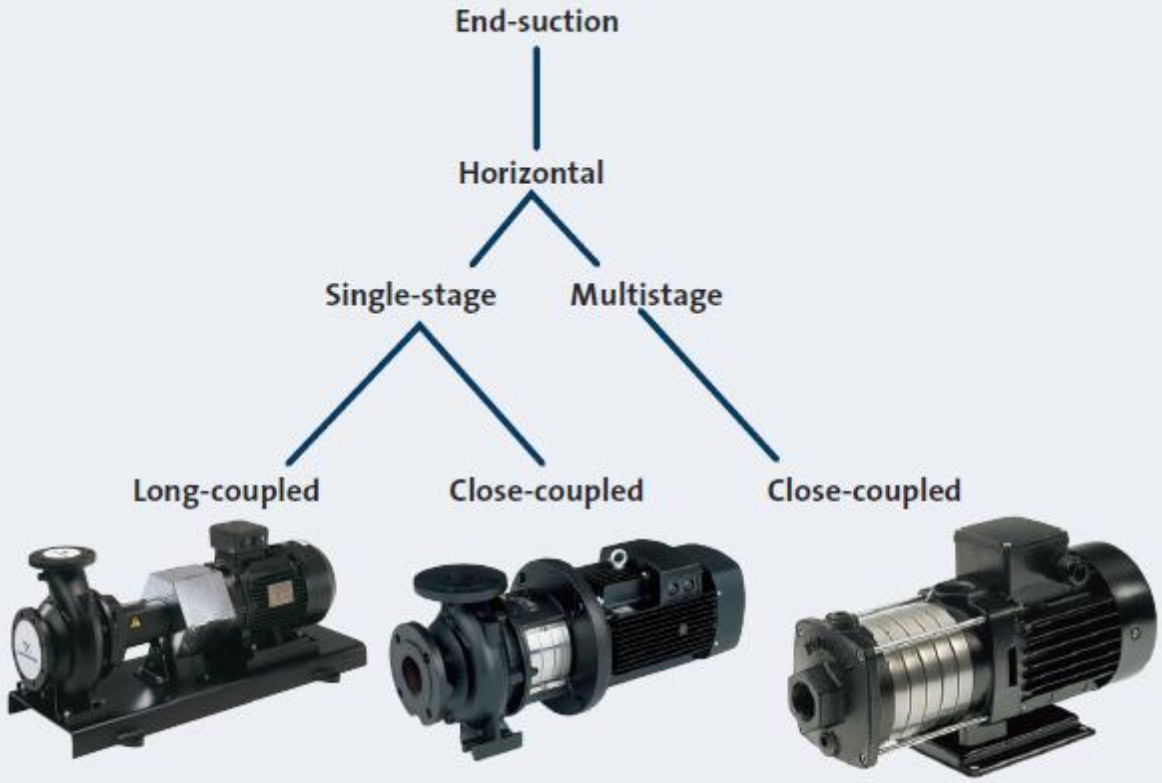


fig-12. ratings of centrifugal pumps

1.1.4 Most common end-suction and in-line pump types



End-suction pump	=	The liquid runs directly into the impeller. Inlet and outlet have a 90° angle. See section 1.1.9
In-line pump	=	The liquid runs directly through the pump in-line. The suction pipe and the discharge pipe are placed opposite one another and can be mounted directly in the piping system
Split-case pump	=	Pump with an axially divided pump housing. See section 1.2.2
Horizontal pump	=	Pump with a horizontal pump shaft
Vertical pump	=	Pump with a vertical pump shaft
Single-stage pump	=	Pump with a single impeller. See section 1.1.7
Multistage pump	=	Pump with several series-coupled stages. See section 1.1.8
Long-coupled pump	=	Pump connected to the motor by means of a flexible coupling. The motor and the pump have separate bearing constructions. See section 1.1.9
Close-coupled pump	=	A pump connected to the motor by means of a rigid coupling. See section 1.1.9

fig-13. most end-suction and in-line pump types

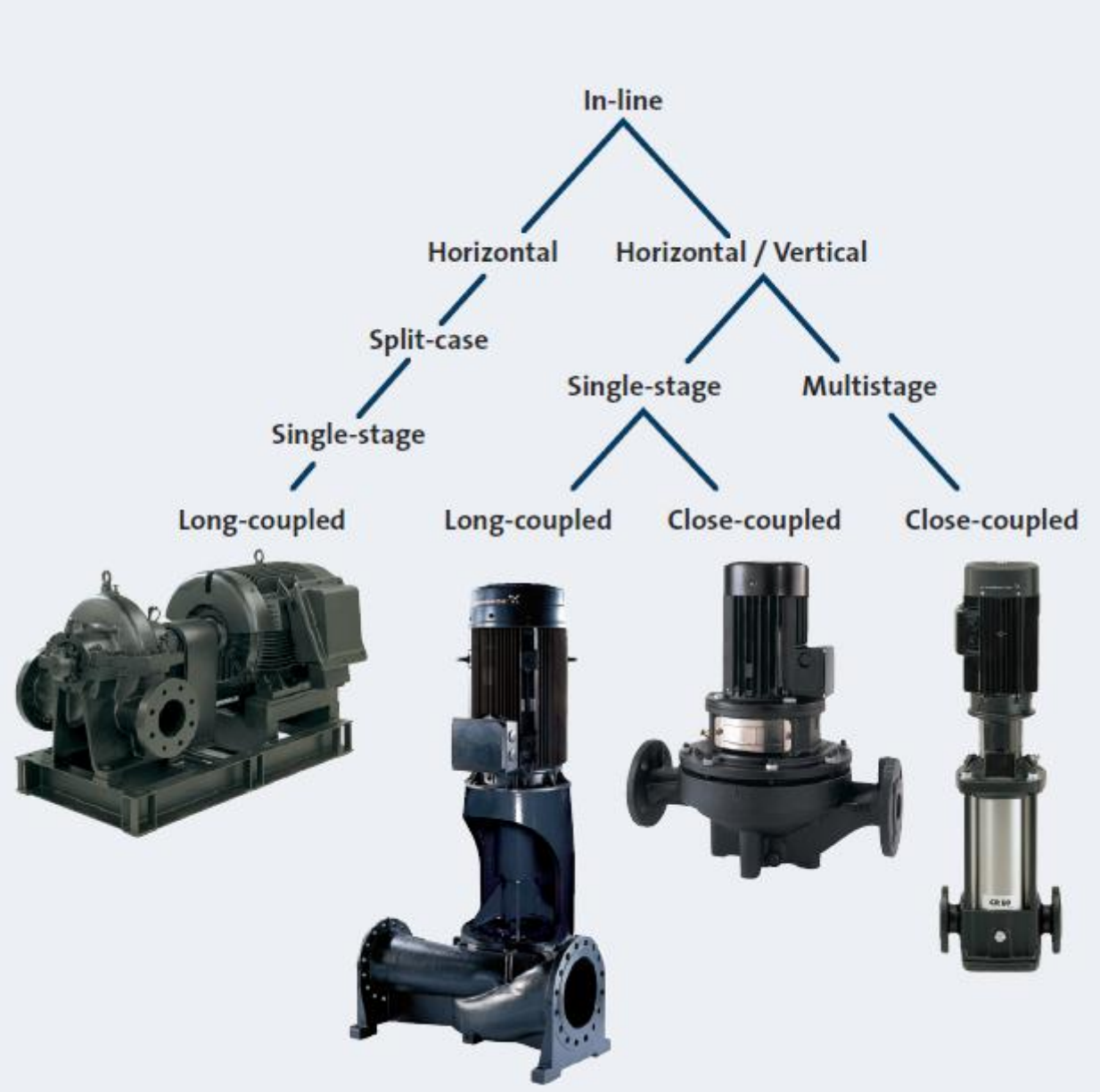


fig-14. classification of centrifugal pumps

Centrifugal pumps applications

Centrifugal pumps shall not be used where a static suction lift is required.

Automatic Air Release

Pumps that are automatically controlled shall be provided with a listed float-operated air release valve having 1/2 in. (12.7 mm) minimum diameter discharged to atmosphere.

Exception: Overhung impeller-type pumps with top centerline discharge or vertically mounted to naturally vent the air.

Vertical Shaft Turbine-Type Pumps

Suitability

Where the water supply is located below the discharge flange centerline and the water supply pressure is insufficient for getting the water to the fire pump, a vertical shaft turbine-type pump shall be used.

Positive Displacement Pumps

Application

Positive displacement pumps are used for pumping water, foam concentrates, or additives. The liquid viscosity will impact pump selection.

Selection of fire pumps

When selecting fire pumps you should be sure that the pump is specified for this application, UL listed FM approved and will pass the hydraulic test required for fire pumps.

When talking about different parameters of a pump:

Capacity, head of the pump and voltage frequency is all the needed data to select a pump.

The fire pump starts in a case of maintenance and emergency only so the loud sounds of it caused by higher RPM and higher power consumption

will not be a problem and that for initial cost reduction, because the higher RPM the smaller the pump.

Sizing of pump accessories:

Table-pump accessories sizing

Pump Rating		Minimum Pipe Sizes (Nominal)				
gpm	L/min	Suction[1, 2] (in.)	Discharge[1] (in.)	Relief Valve (in.)	Relief Valve Discharge (in.)	Meter Device (in.)
25	95	1	1	3/4	1	1 1/4
50	189	1 1/2	1 1/4	1 1/4	1 1/2	2
100	379	2	2	1 1/2	2	2 1/2
150	568	2 1/2	2 1/2	2	2 1/2	3
200	757	3	3	2	2 1/2	3
250	946	3 1/2	3	2	2 1/2	3 1/2
300	1,136	4	4	2 1/2	3 1/2	3 1/2
400	1,514	4	4	3	5	4
450	1,703	5	5	3	5	4
500	1,892	5	5	3	5	5
750	2,839	6	6	4	6	5
1,000	3,785	8	6	4	8	6
1,250	4,731	8	8	6	8	6
1,500	5,677	8	8	6	8	8
2,000	7,570	10	10	6	10	8
2,500	9,462	10	10	6	10	8
3,000	11,355	12	12	8	12	8
3,500	13,247	12	12	8	12	10
4,000	15,140	14	12	8	14	10
4,500	17,032	16	14	8	14	10
5,000	18,925	16	14	8	14	10

[1] Actual diameter of pump flange is permitted to be different from pipe diameter.

[2] Applies only to that portion of suction pipe specified in 2-9.3.

Installation cautions

All pumps should be installed in a fixed armed concrete base withstands lateral vibration by 1.5 times the weight of the pump.

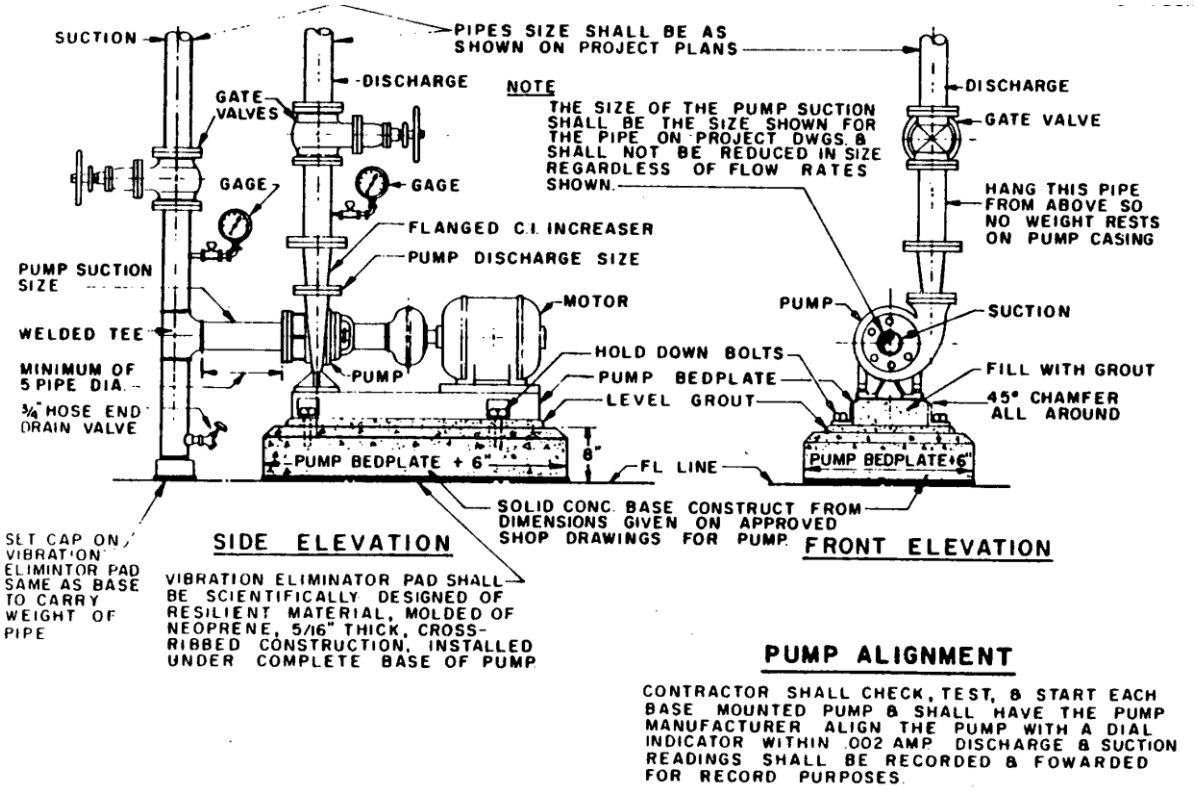


fig-15. fire pump installation

All elbows in pumps discharge should fixed with a support.

fig-16. elbows supports

Modulating valves after and before the metering device should be installed by a special distance from the meter for accurate readings.

fig-17. installation of flow rate measuring device

Two check valves installed in each sensing line in the opposite direction of to the control panel should have at least 5 feet between each other and should be drilled by 3/32 inch drill.

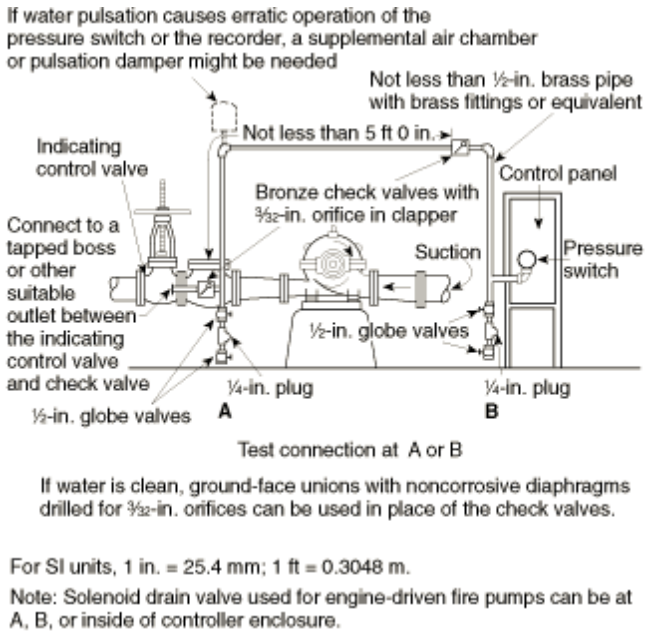


fig-18. Piping connection for each automatic pressure switch (for fire pump and jockey pumps).

Sensing lines materials should be series 300 stainless steel, brass or copper.

All sensing line size should be ½ inch.

Fire pumps installed by bolts in anchors which are welded in the armed base, the floor and base should be epoxy coated after all, and the pumps lying on a membrane rubber layer between it and the base.

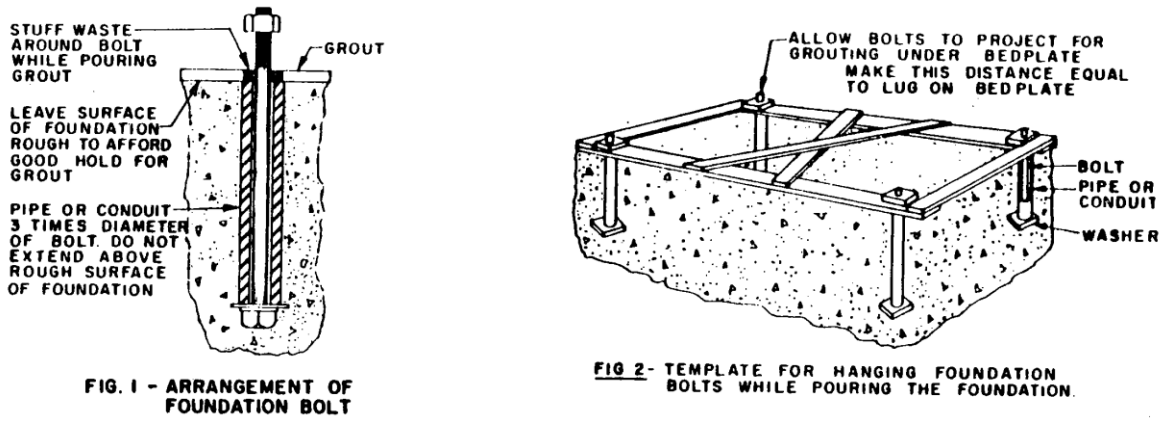


fig-19. installation of firefighting pumps base

Pressure relieving valve of the diesel pump should be connected to its discharge directly before the check valve.

The length of the exhaust pipe by the diesel pump must be coordinated with the supplier for allowable back pressure, and this pipe should be insulated with Aminat.

Fuel piping arrangement should be constructed be the supplier advisement.

Engines shall be started no less than once a week and run for no less than 30 minutes to attain normal running temperature. They shall run smoothly at rated speed.

The engine fuel supply (suction) connection shall be located on the tank so that 5 percent of the tank volume provides a sump volume not usable by the engine. The fuel supply shall be located on a side of the tank at the level of the 5 percent sump volume. The inlet to the fuel supply line shall be located so that its opening is no lower than the level of the engine fuel transfer pump. The engine manufacturer's fuel pump static head pressure limits shall not be exceeded when the level of fuel in the tank is at a maximum.

{For fuel piping material and sizing please refer to appendices.}

Flame-resistant flexible hoses listed for this service shall be provided at the engine for connection to fuel system piping. There shall be no shutoff valve in the fuel return line to the tank.

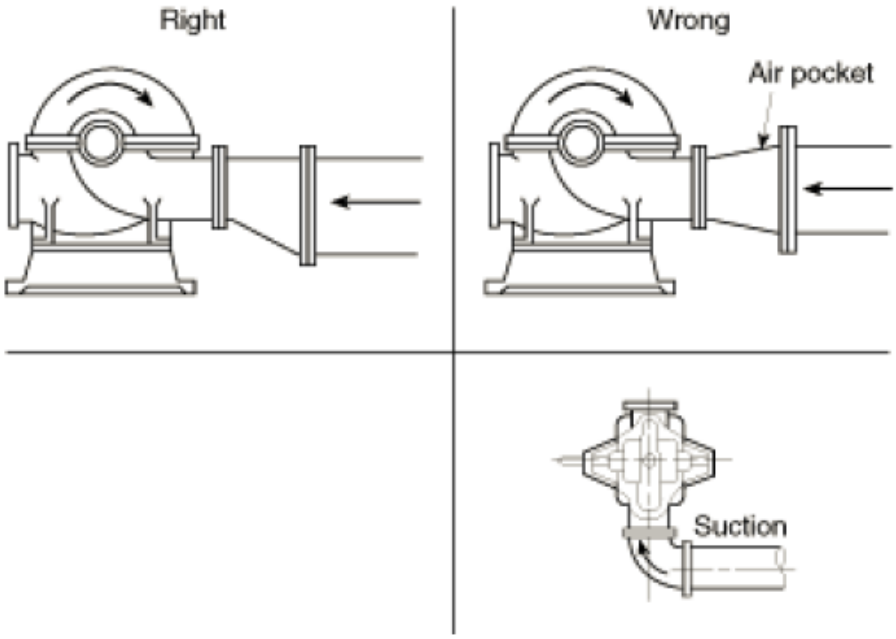


fig-20. Right and wrong pump suctions.

All the equipment and component should have to be UL listed and FM approved and a serial number.

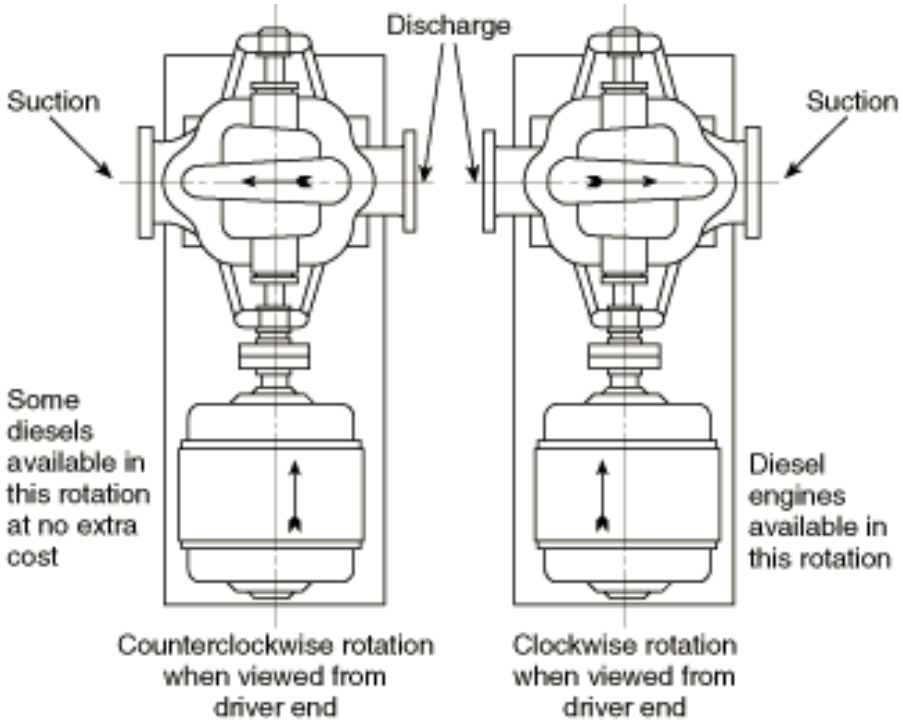


fig-21. Horizontal pumps shaft rotation.

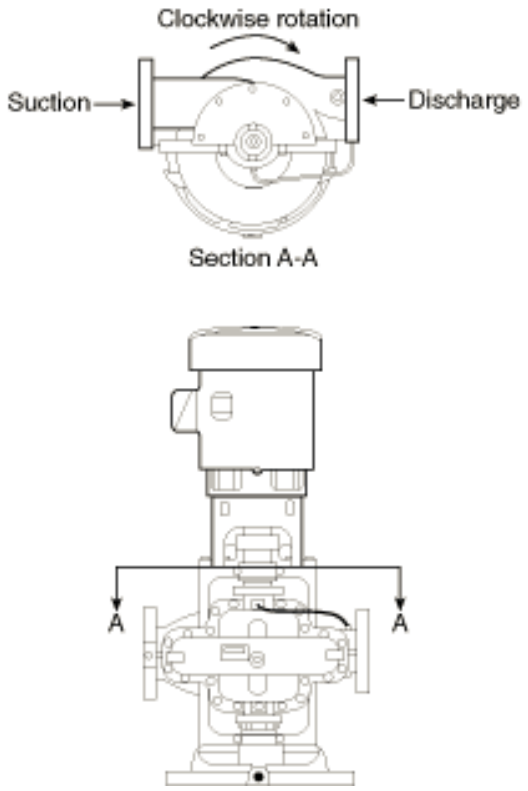


fig-22. Vertical pump shaft rotation

All pipes in the pump room should be hot dip galvanized if the source of water could cause rust of pipes or if the fire water tank and the domestic water tank is the same tank and pipes passes through the tank walls should be put into the wall when its being built not after that and if so it should been cured with special chemical insulation material.

fig-23. Fig-17 pipes through tank walls

Pump type / Pipework			A. In-line close-coupled (horizontal or vertical mounting)	B. End-suction close- coupled (horizontal or vertical mounting)	C. End-suction long-coupled (only horizontal mounting)
To the pump:	From the pump:				
Along floor	Along floor		▲ Best choice	◄ Good choice	◄ Good choice
	To ground		▲ Best choice	◄ Good choice	◄ Good choice
	To ceiling		◄ Good choice	▲ Best choice	▲ Best choice
From ground	Along floor		◄ Good choice	▲ Best choice	▼ Least good choice
	To ground		◄ Good choice	▲ Best choice	▼ Least good choice
	To ceiling		◄ Good choice	▲ Best choice	▲ Best choice
From ceiling	Along floor		▲ Best choice	▼ Least good choice	▼ Least good choice
	To ground		▲ Best choice	◄ Good choice	◄ Good choice
	To ceiling		◄ Good choice	▲ Best choice	▲ Best choice
Wall-mounted	Wall-mounted		▲ Best choice	◄ Good choice	× Not applicable

fig-24. Recommended type of a pump according to tanks types

Hydraulic test

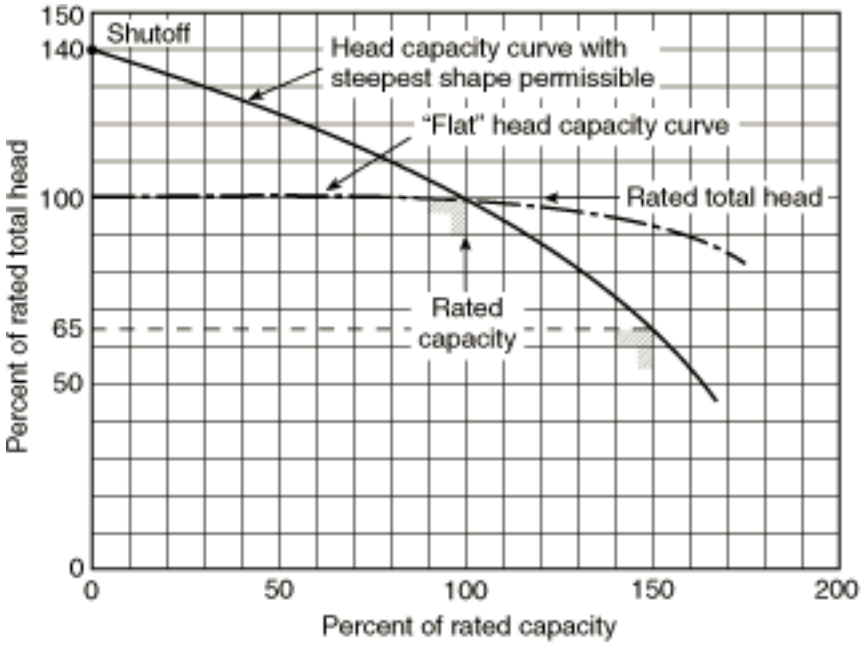


fig-25. Pump characteristics curves

Listed pumps can have different head capacity curve shapes for a given rating. Figure 18 illustrates the extremes of the curve shapes probable. Shutoff head will range from a minimum of 101 percent to a maximum of 140 percent of rated head. At 150 percent of rated capacity, head will range from a minimum of 65 percent to a maximum of just below rated head. Pump manufacturers can supply expected curves for their listed pumps.

Pumps Manufacturers

Jtt Bell, Gossett Paterson, Peapless, Fairbanks, aurura, KSB,Armstrong and Grundfus.