Suction Unit

Medical suction apparatus

Medical Suction Apparatus: Is a medical device used for suction of fluid, mucous, blood and soft tissue during operation or outpatient clinic.

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Medical Suction Apparatus requires a vacuum to function effectively. *It uses negative pressure (vacuum) to remove fluids, secretions, or debris from a patient's body during medical procedures or treatments.* The vacuum created by the apparatus helps to draw out unwanted substances from areas such as the respiratory tract, surgical wounds, or other body cavities, aiding in maintaining clear airways and preventing complications.

Note: the physical action of negative pressure involves the movement of fluids or gases from areas of higher pressure to areas of lower pressure.

BASIC VACUUM

The term vacuum can be defined in two ways: as a space empty of matter or a space in which the pressure is significantly lower than atmospheric pressure. It is the lower pressure term that has clinical relevance. In fact, for clinical use, vacuum can be more simply defined as negative pressure. Suction is defined as the application of negative pressure to create movement of air, liquids or solids

The essential parts of the suction apparatus are:

1. Source of vacuum.
2. The reservoir.
3. The delivery tubing (which may include a nozzle and catheter)
4. bacterial filter
5. vacuum gauge

The efficiency of suction apparatus depends on:

1. The displacement (the volume of air sucked at unit of time, measured at atmospheric pressure, usually expressed in liters/min. when the pump is working).
2. The degree of negative (sub-atmospheric) pressure which can be produced by pump with regard to the time taken to achieve it.
3. The length and diameter of delivery tube.


Saline
Suction catheters and tubing
Suction machine
Mask and eye protector
Gloves
Little Suckers
Tip catheter
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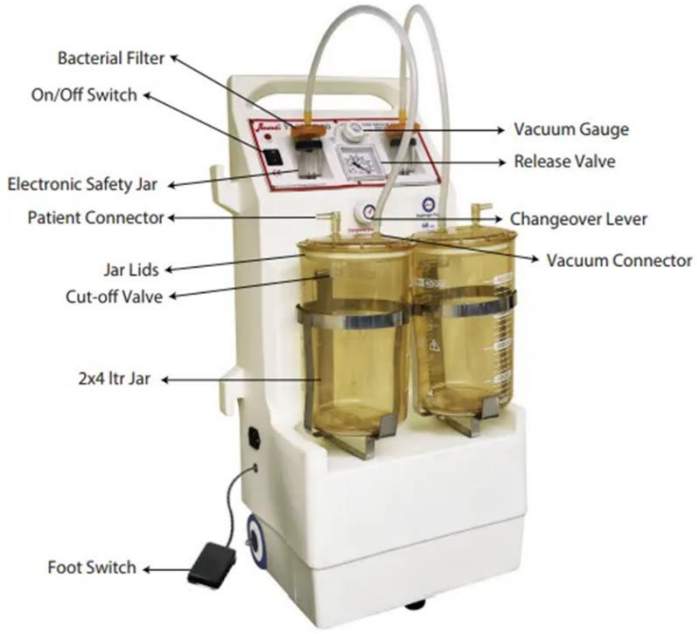

Bacterial Filter
On/Off Switch
Vacuum Gauge
Release Valve
Electronic Safety Jar
Patient Connector
Changeover Lever
Vacuum Connector
Jar Lids
Cut-off Valve
2x4 ltr Jar
Foot Switch

Eight means or mechanisms of providing negative pressure or vacuum

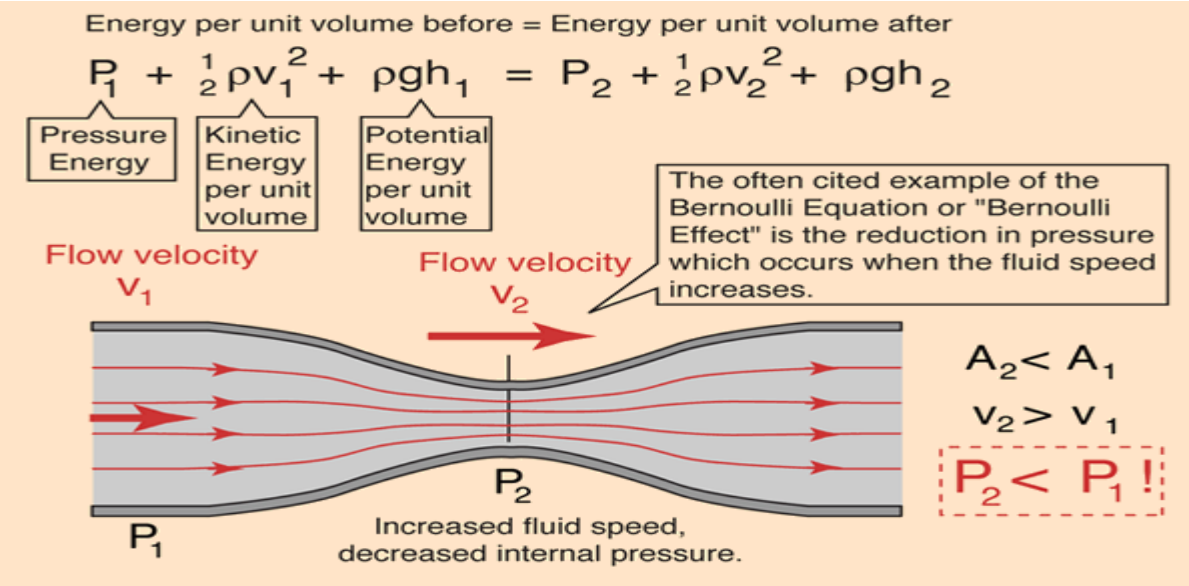
1- Venture tube

a short tube with a tapering constriction in the middle that causes an increase in the velocity of flow of a fluid and a corresponding decrease in fluid pressure and that is used especially in measuring fluid flow or for creating a suction ,

Commonly used for

1- saliva suction on dental units

2- in dry mode on steam sterilizer



2- Thermotic

This thermotic pump is engineered to provide suction by alternating the expansion and contraction of air within a cylinder at regular intervals. This unit is designed for such specialized uses as gastric lavage, abdominal decompression, and is

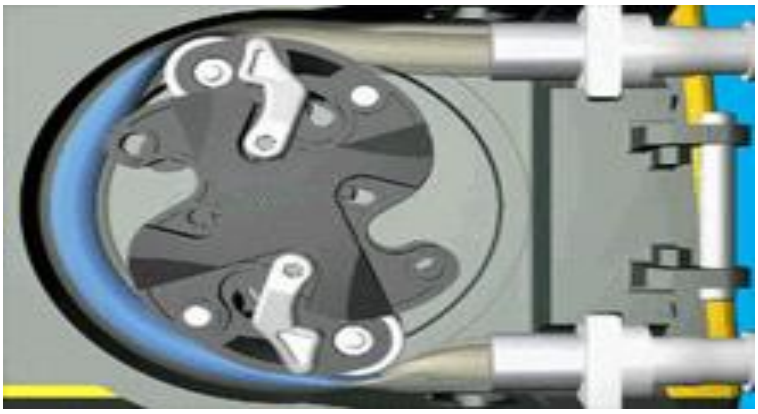
- Sealed chamber with heating element
- Heating element is De-energized
- Check valve allows air to come into the heating chamber (attached to suction bottle
- Usually very low pressure vacuum, check at chamber for suction
- Fragile heating element especially filaments .Controlled by a bimetallic strip thermostat

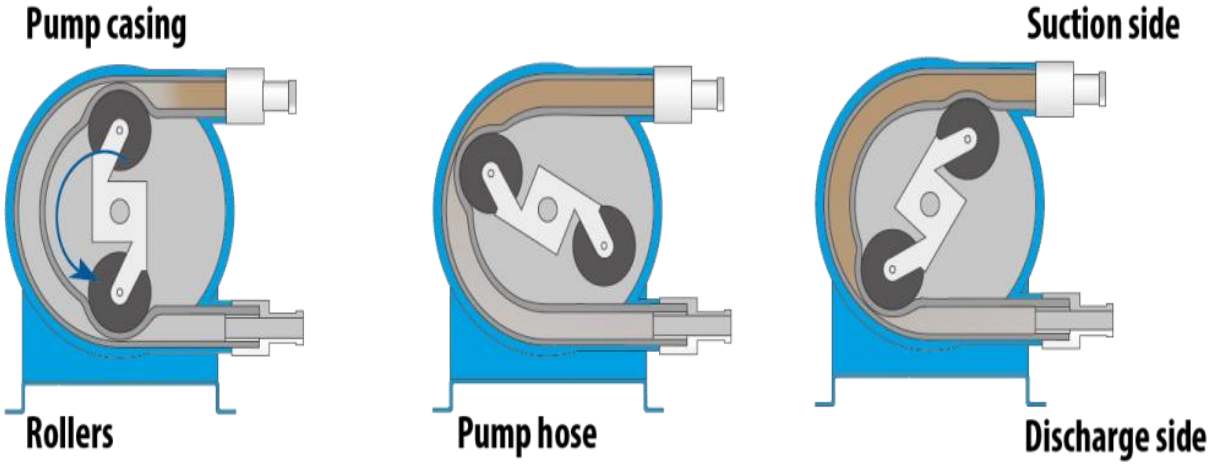
Discuss this (Thermotic mechanism can be used to generate negative pressure (vacuum) through temperature manipulation).

When the chamber is heated, the air inside it expands, creating a lower pressure compared to the surrounding environment. Conversely, cooling the chamber causes the air inside to contract, again resulting in higher pressure. This pressure difference is utilized to generate suction, allowing the unit to remove fluids or gases from a specific area or source.

3-Peristaltic pump is a type of displacement pump used for moving bodily fluids from the body and back into the body within sterile tubing to reduce contamination, is mad from Tubing along rollers (series of rollers – fingers) Fingers (vanes) operated by stepping motor or electromagnet.

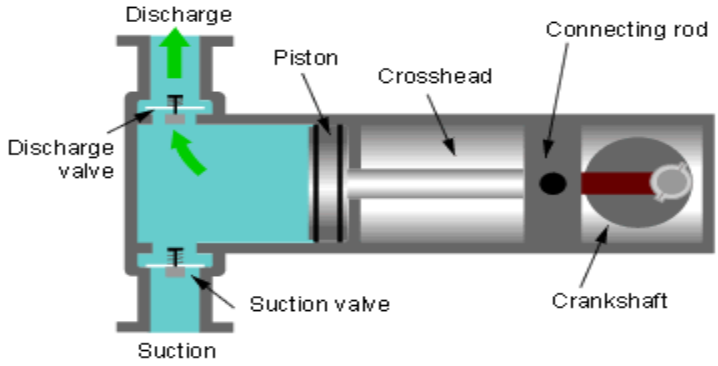
- It operates by using a mechanism that involves squeezing and releasing a flexible tube or hose to create a pumping action. This design allows for precise control of the flow rate and the ability to handle a wide range of fluids.

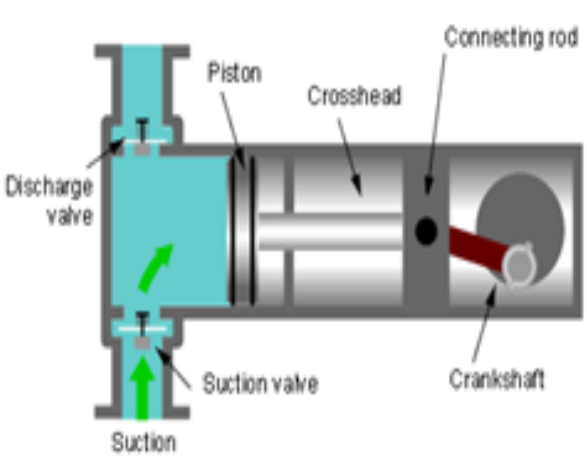


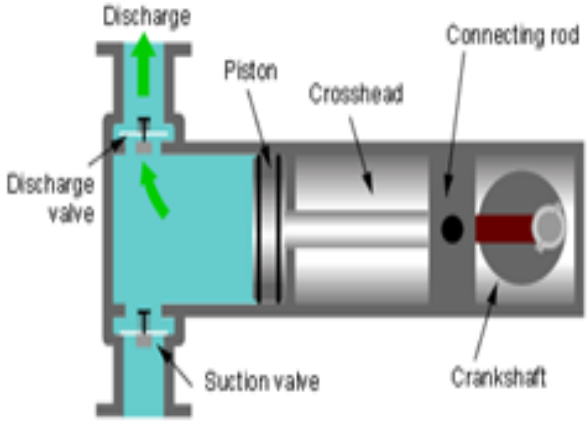


4-Piston pump:

It is a high vacuum pump, it required hydraulic oil. The level of oil should be checked at periodic time, that works by using a reciprocating piston to move fluid. The piston moves back and forth inside a cylinder, creating pressure variations that draw in and push out the fluid.





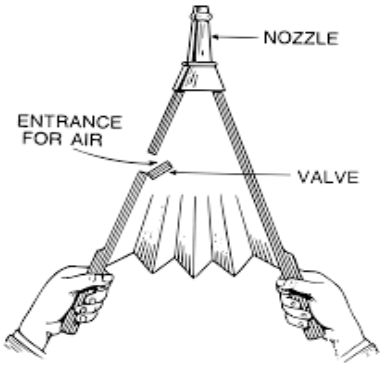


Reciprocating Piston Pumps: They consist of a hydraulic chamber were a reciprocating piston is placed. This way, solvent gets in the pump when the piston moves back and is pushed into the column when the piston moves forward.

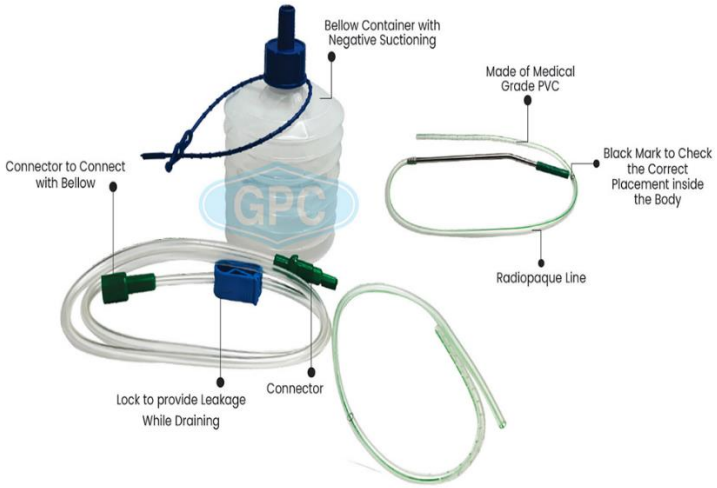
Note: the physical principle of a piston pump relies on the reciprocating motion of a piston to alternately increase and decrease the volume within a cylinder, resulting in suction and compression strokes that enable the pump to draw in and expel fluids at a controlled rate and pressure.

Bellow:

A bellows is a flexible, expandable, and contractible component typically made of airtight material. It is often used to create a sealed chamber that can expand, and contract as needed. Used to draw air from one direction and expel it in another.

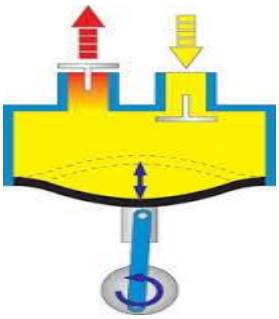


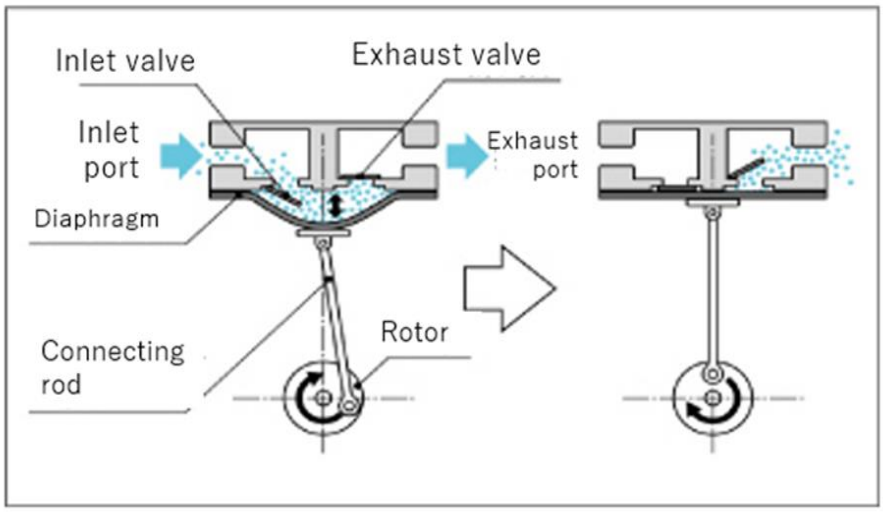

Bellows Metering Pump



6-Diaphragm:

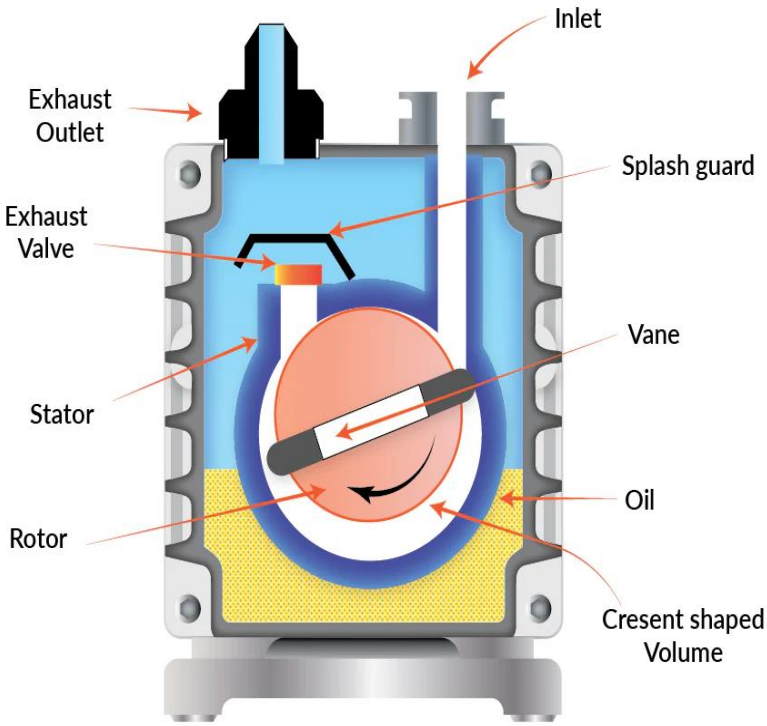
Use rubber diaphragm within well closed chamber to make negative pressure with the help of two valves, one for suck air and other for push it out.

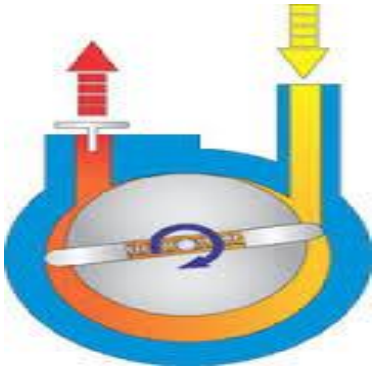




7- Rotary van:

Make use of rotating vanes to take the fluid from one side and push it to other side.

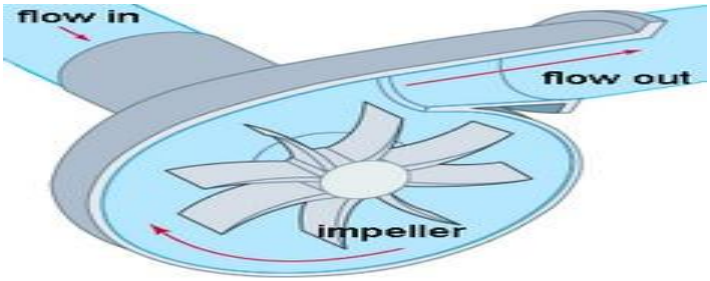




8-Centrifugal pump

Motor spins a turbine wheel at high speed (found in common vacuum cleaners) Large volume of air moves through the pump creating a negative pressure Air movement carries particles with it Commonly found in high-speed dental suction unit

Note: Impellers play a crucial role in the operation of centrifugal pumps and other fluid-handling equipment by imparting kinetic energy to the fluid, which results in the movement and pressurization of the fluid.



Vacuum properties and needs

1. Using a high-capacity pump connected to a large reservoir in a central position.
2. Patient side of pipeline is fitted with a self-closing non interchangeable valve, attached to reservoir bottle and delivery tube.
3. Should be a trap, to prevent liquid and solid matter being drawn into pipeline system which difficult to relieve it.
4. A pressure regulator to avoid high pressure applied to patient.
5. A switch on/off to control work of central vacuum pump which operate intermittently to maintain vacuum in central reservoir.
6. Two pumps used, one in used other is stand by.
7. Output of vacuum should discharge to open air through a filter to avoid spread of infection.

Reservoir properties:

Whatever the source of vacuum the size of reservoir is important.

1. Sufficient capacity should be allowed for all the matter to be aspirated.

If too big reservoir used, the total time to build up negative pressure in it increased even if closed completely.

2. Rim of jar should be free from chips, sealing washer, should be in a good order to avoid any leak.
3. Graduated jar so the aspirated volume especially blood can measure.
4. If a large jar is used, a big neck is selected so hand easily enter to clean it and sterilization.

Delivery tubing properties:

1. The diameter and length of delivery tubing should allow the greatest possible amount of suction at the patient end.
2. According to gas law, there is low resistance by wide tube and short length as possible.
3. Using a firm wall tubing to prevent collapse and kinking.

Suction nozzle and catheter properties:

1. Smooth out line tip shape to prevent damage to delicate surface.
2. Used mostly disposable plastic suction end, or other which can be cleaned and sterilized by autoclaving and reused.
3. May be necessary to use a long narrow tube catheter as bronchial suction but otherwise, excessive length should be avoided.
4. Two moving holes to prevent blockage.

Blockage get when the pressure is too high to pass air into delivery tubes.

Bled valve, a hole at proximal end of catheter to avoid reduced capacity, it can blocked by a finger if required to increase suction pressure.

Control system of the apparatus:

The following control systems may be used in suction apparatus:

1. Cut off valve: when the level of liquid reaches to a certain limit, it will shut off connecting with suction source to avoid liquid entering pump and causing it failure.

2. Bacterial filter:
    - Best placed between the reservoir and pump to prevent spread of infection.
    - Should change at regular intervals.
    - Sterilizing liquid may be used in reservoir.
3. Vacuum control valve:

To decrease degree of vacuum as a bled valve places between reservoirs and pump.

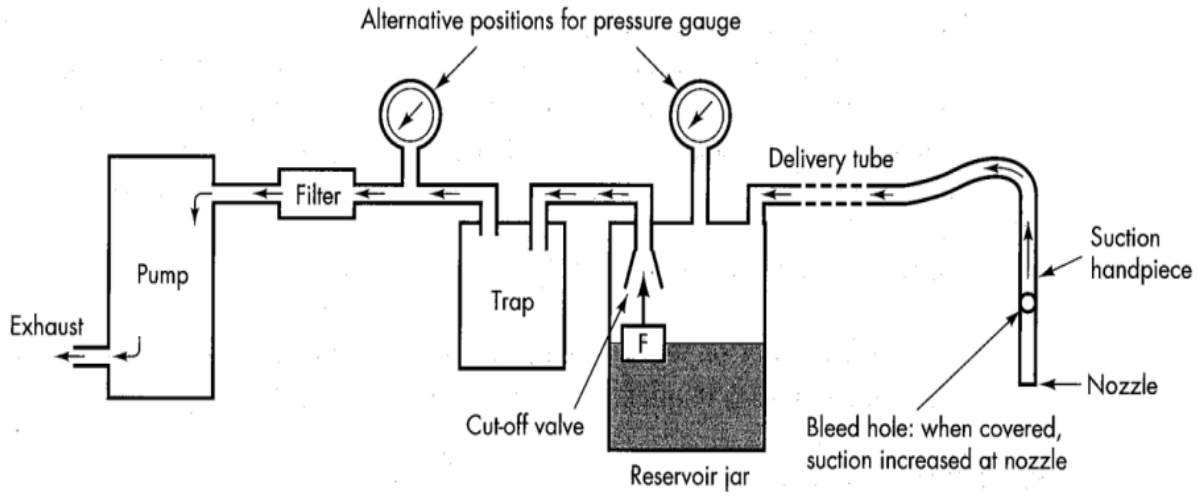
4. Vacuum gauge:

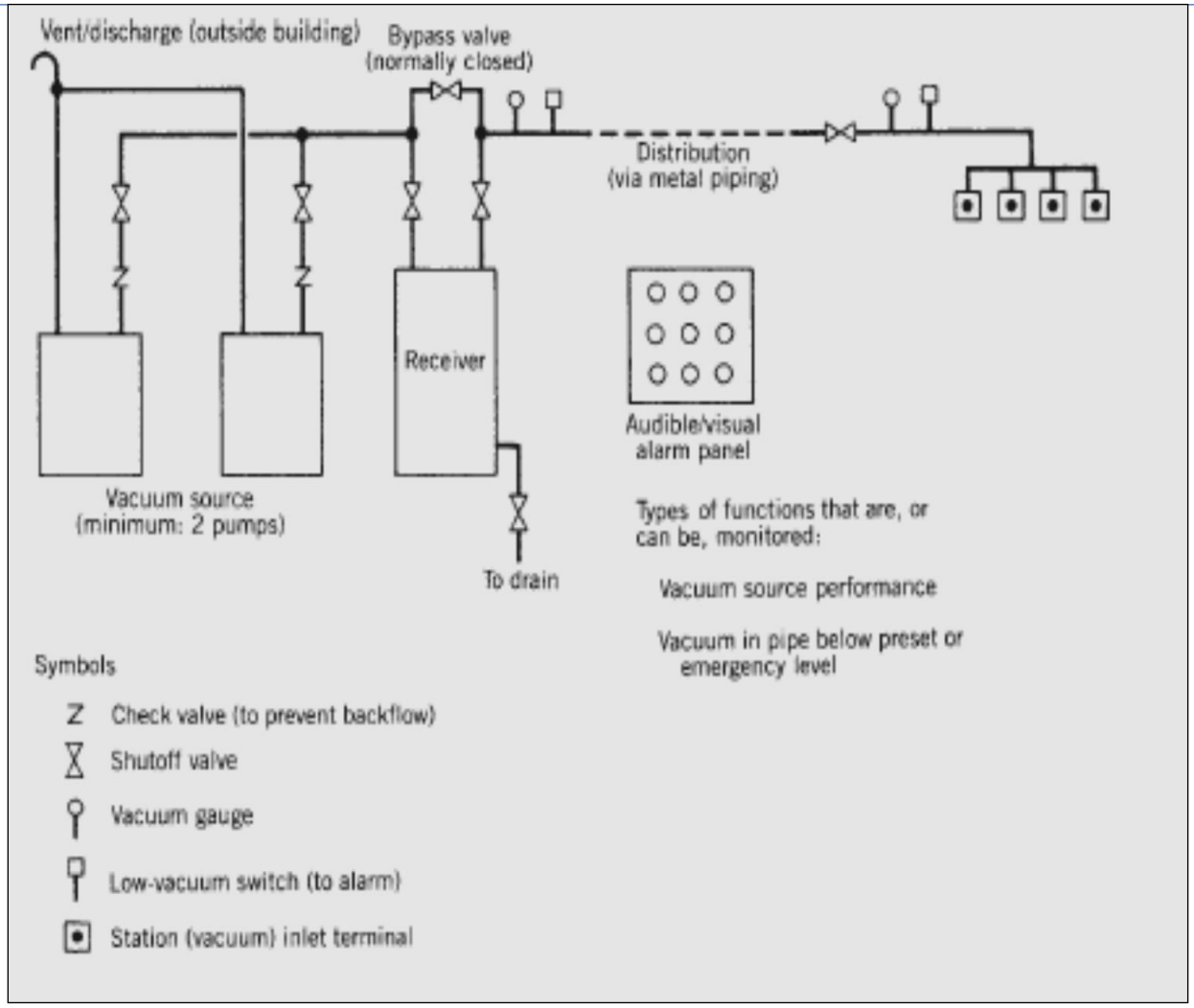
Calibrated by mmHg from 0-760 fitted to tubing between vacuum central valve and reservoir on the top of reservoir itself.

5. A stop valve: when a pump gives low displacement, the valve used to occlude delivery tube.

Operation of suction unit

Suction applies negative pressure, which is any pressure less than atmospheric pressure (760 mmHg, 100kPa), to allow for the movement of fluids or substances. The suction developed by the machine will be measured as a pressure. The common units of pressure are millimeters of mercury (mm Hg) or pascals (Pa or kPa),





Central suction unit