

Suction machine

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 - identifying common faults
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13.3.4 Maintain a suction machine

Unit B 13.3 Maintaining General Bedside Nursing Equipment

Module 279 18 B Medical Instrumentation I

Function: removing unwanted materials

What is suction ?

Suction applies negative pressure, which is any pressure less than atmospheric pressure to allow for the movement of fluids or substances.

Why is it important ?

Suction may be used to clear the airway (mouth, trachea) of blood, saliva, vomit etc. so that a patient may breathe and growth of micro-organisms / infection is prevented



Hand suction pump



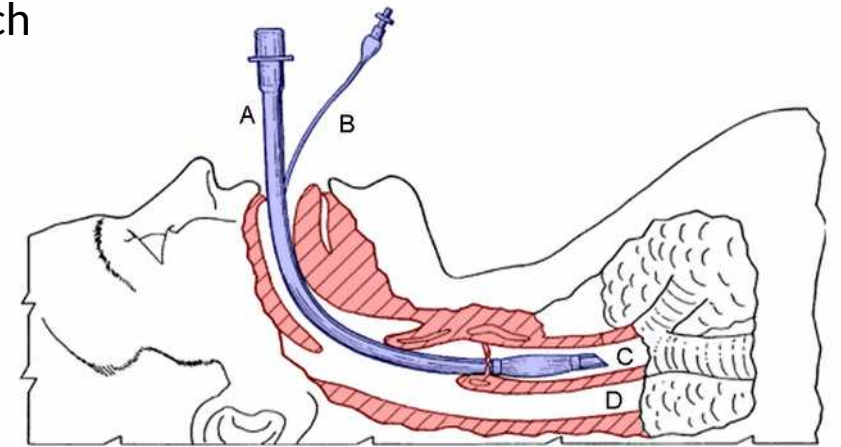
Surgical suction pump

Use: all the time ...

A suction pump can have hundreds of uses in the medical setting, all of which relate to removing fluids and substances from the body. For example,

- removing ingested toxins (a stomach pump),
- unwanted fats (liposuction),
- mucosal secretions from the esophagus,
- blood from the surgical field,

and many other applications....

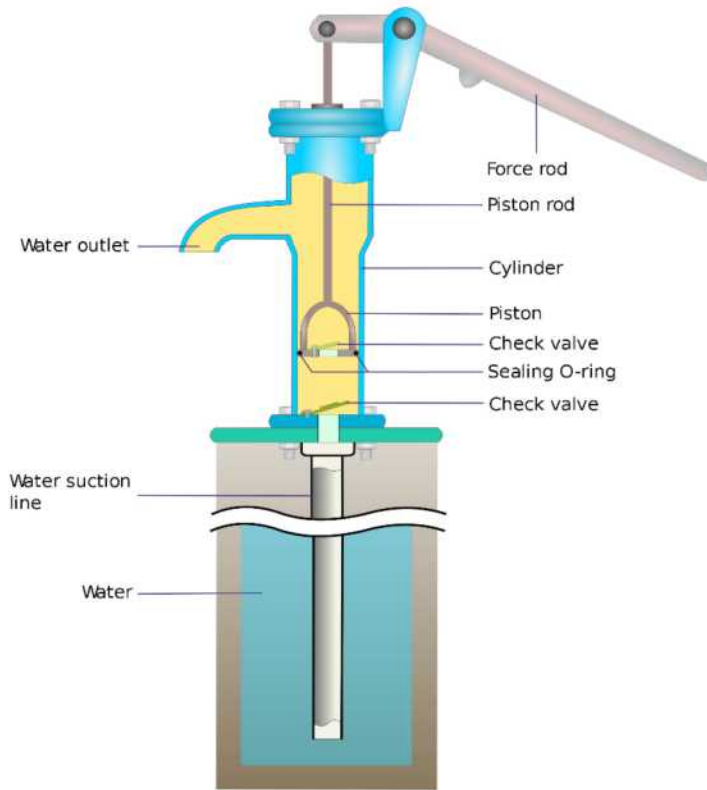


In all cases, the suction level can either be totally adjustable or has **low, medium and high** settings:

- the high settings are used for airway and gastric suctioning,
- the medium setting for chest tubes,
- the low setting for wound suction.

Scientific principles

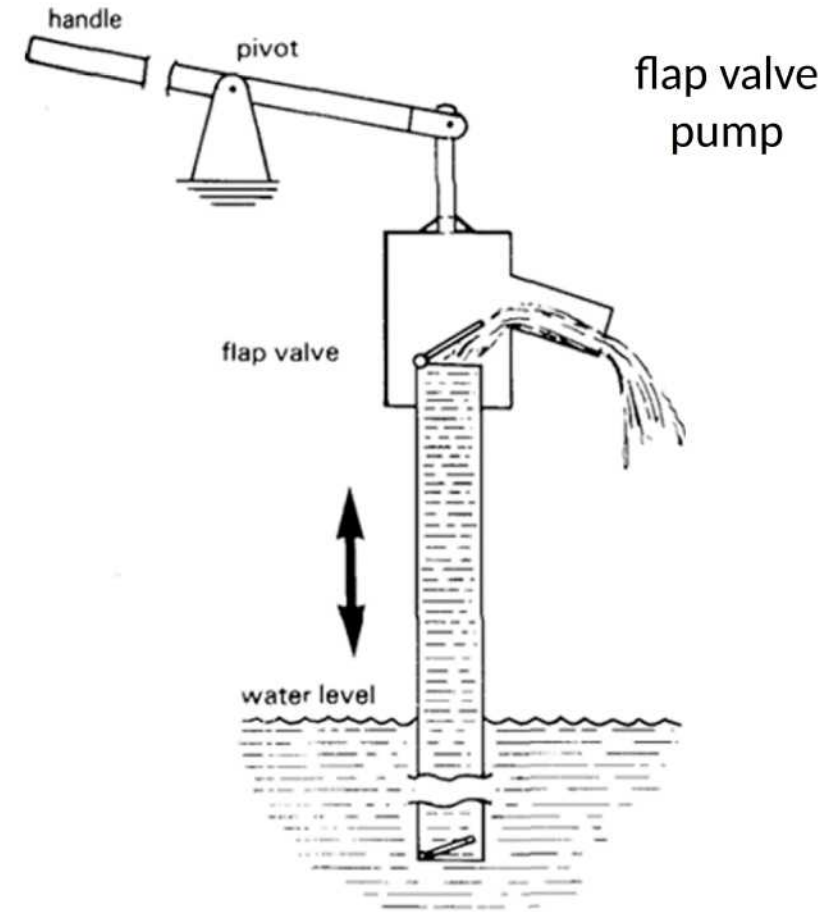
Positive displacement pumps use a mechanism to repeatedly expand a cavity, allow gases to flow in from the chamber, seal off the cavity, and exhaust it to the atmosphere.



Inside a **water pump**, a piston/valve system expands a small sealed cavity to reduce its pressure below that of the atmosphere.

This causes some fluid from the well to be pushed into the pump's cavity.

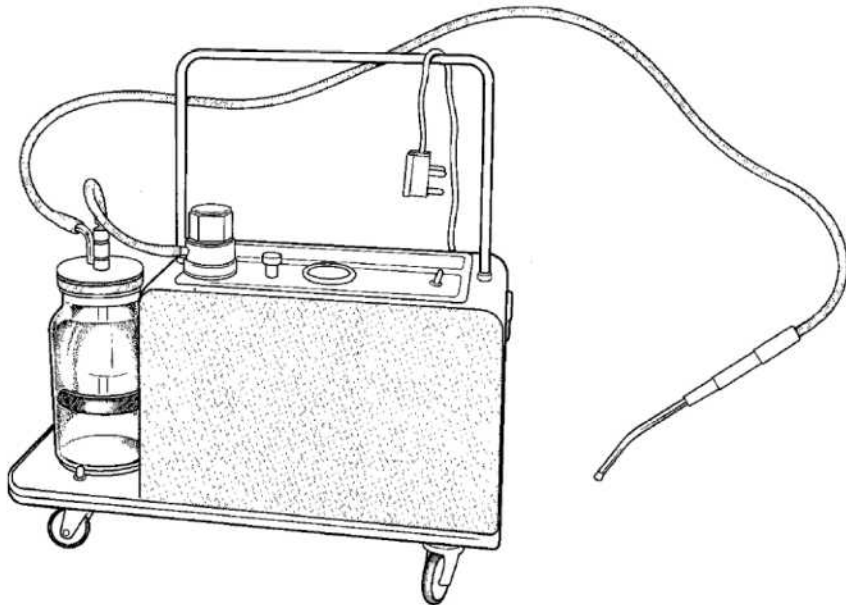
The pump's cavity is then sealed from the chamber, opened to the atmosphere, and squeezed back to a minute size.



The suction pump has been known for thousands of years

Types of Suction: 1. Electric suction machine

This machine has an **electric pump** which evacuates a bottle (reservoir), to which is attached a suction tube. The system incorporates a **pressure gauge** and a mechanism to facilitate **regulation of the vacuum**, by allowing air to be drawn in from the room.



Types of Suction: 2. Wall-supplied suction

This normally works in the same way as the electric suction machine. The difference is that the motor generating the suction is **further away**, and is connected to **several outlets**. This type of suction therefore requires a much **larger reservoir** since more than one outlet may be in use at one time. The wall suction equipment includes a large tank that is evacuated by a pump and to which the suction line is connected. The tank is fitted with a **pressure switch** that automatically turns on the pump if the vacuum falls below a certain level.

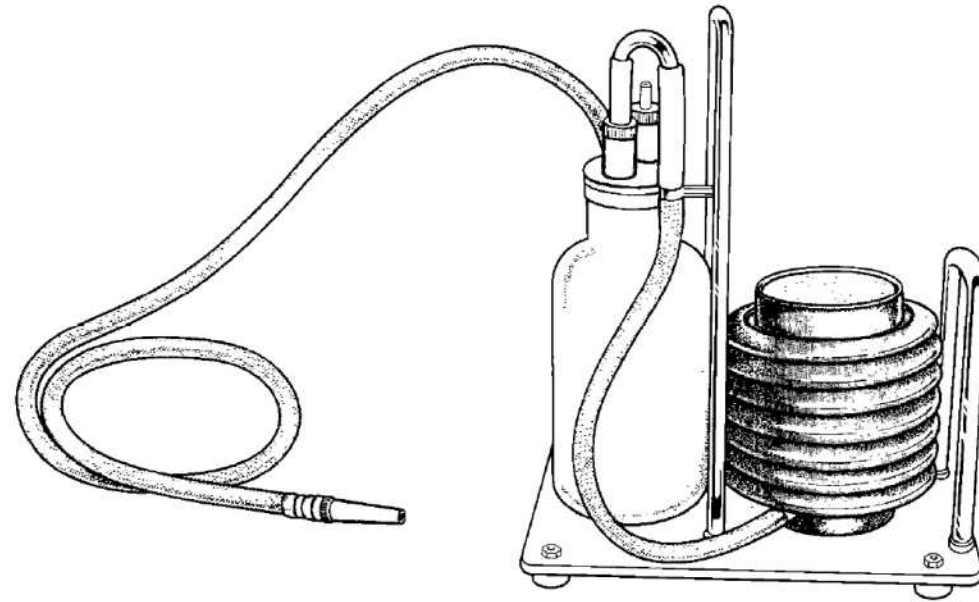
Most suction equipment has a device for regulating the level of vacuum, such as a simple bleed-off screw, or a spring-operated device, that keeps the vacuum at the set level. Wall suction systems often have **high and low settings**, the latter often being used for infants and children.

Modern systems are calibrated in kPa (kiloPascals); a low vacuum is up to about **30 kPa**, and a high vacuum may be up to about **100 kPa** (≈ 75 mmHg).



Types of Suction: 3. Foot-operated suction unit

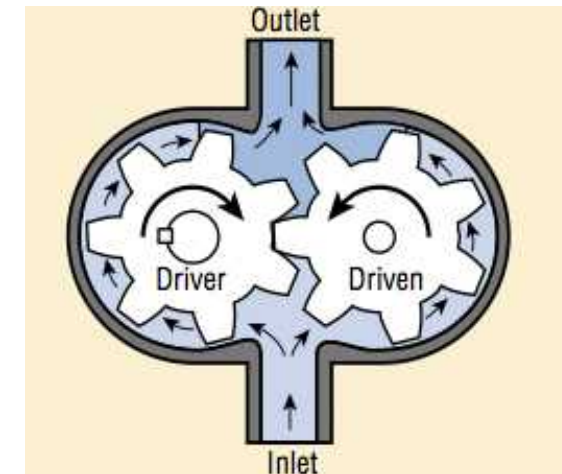
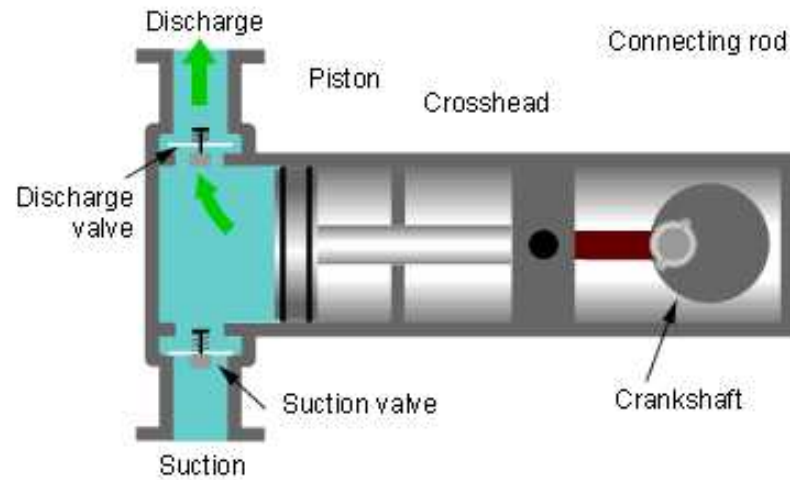
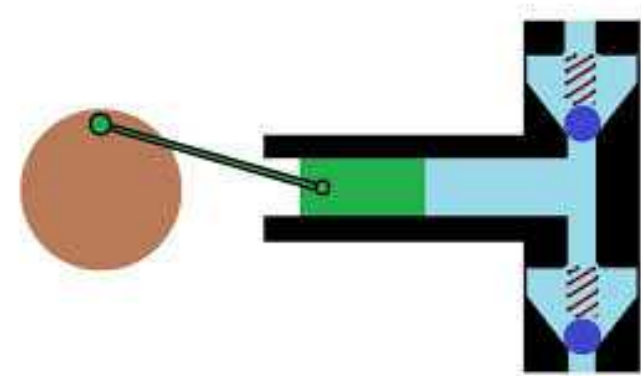
This is the simplest type of suction unit and is operated by pressing on a **piston** with the foot. On the return stroke of the piston (operated by a spring), suction is created, and a series of valves directs the flow as required.



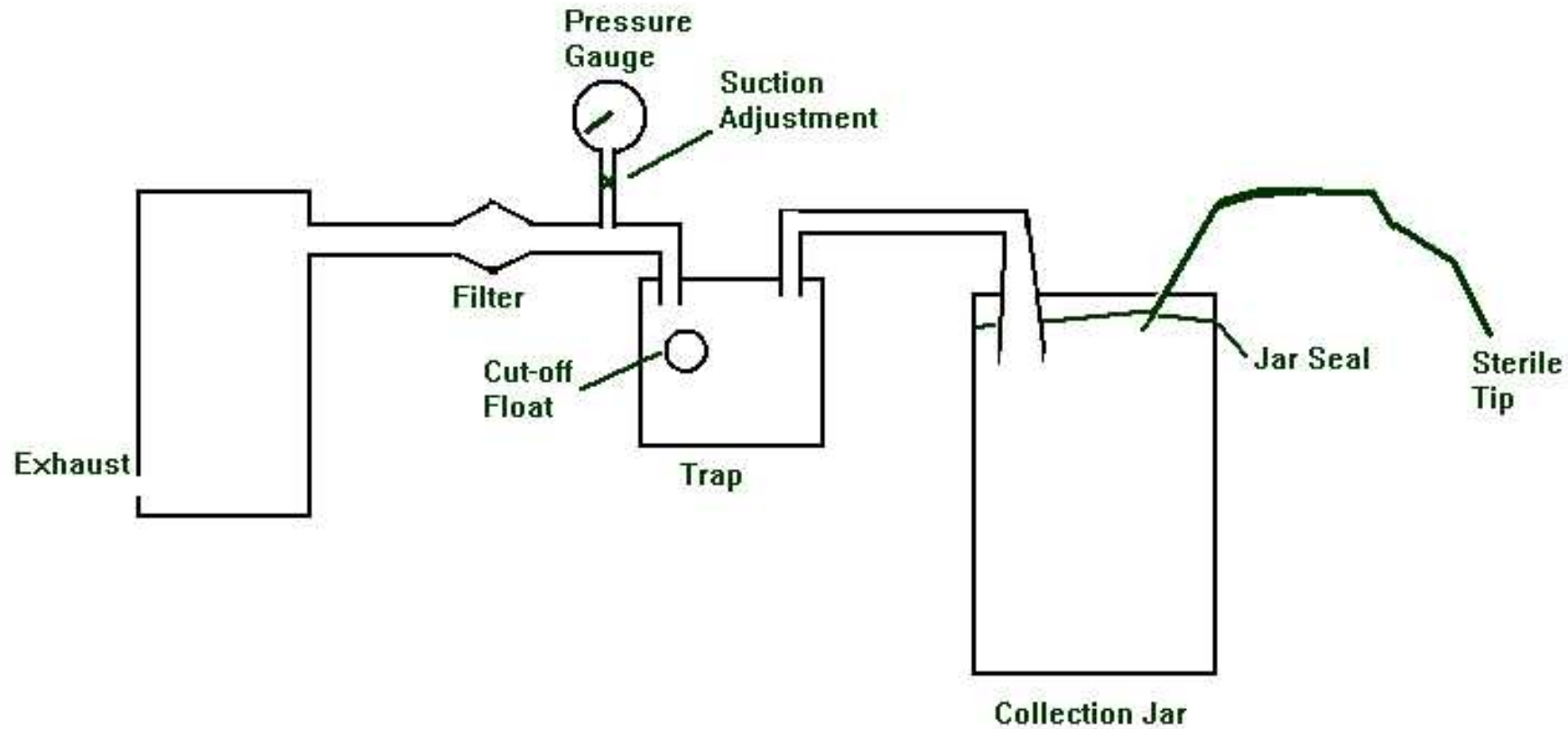
1 mmHg = 0.133 kPa = 1.36 cmH₂O = 0.535 inH₂O = 0.193 psi

Types of Suction: 4. Piston pumps

These suction pumps can have one or more pistons that are operated by an induction motor, with each piston sucking in turn.



Construction



The essential elements of a suction machine are the **source of suction**, the **tubing**, the **collection canister** or bottle and if present, a **manometer** to measure the amount of suction

Maintenance and repair

Get to know the level of suction to be expected from a unit. Lower levels will indicate a problem somewhere in the system.

The most common problem is a **leak**, which may be in the tubes or inside the machine. A leak will cause the flow and pressure to cease or be **reduced**. It may be that the bottle is not screwed in place properly. Check the sealing washer, and check that the bottle itself is not cracked. The tubing can be replaced with any compatible tubing. To find the leak, rub the top with soapy water while blowing through the cleaned-off tube (close off the distal end). Bubbles will form where there is a leak.



To check the bottle and its tubing, remove the tubing where it comes out from the machine and put a finger over the end with the machine turned on. The pressure gauge should go to its maximum. If it does not, then there is a problem inside the machine itself. If it does, the problem is with the bottle or the tubes.

Maintenance and repair

If a high vacuum is recorded on the gauge with none at the suction tube, this is usually caused by a **blockage** in the system. **Material from the collection bottle can migrate into the suction machine.** This can be very damaging to the machine. To avoid this, machines should be operated with some sort of filter or valve before the suction machine. However, the filter and valve present problems because they can get clogged. If the device is operated without a filter, the suction pump can be damaged. Remove the head to see if it can be cleaned and repaired.



On some electric machines, **bacterial (or micro-) filters** are used. These should be replaced after each patient, but in the developing world they are not. If the unit is used without the filter, it will eventually need to be rebuilt. However, this may be a short term solution. For a more long term solution, the filter may be replaced by any filter 3 micron size.

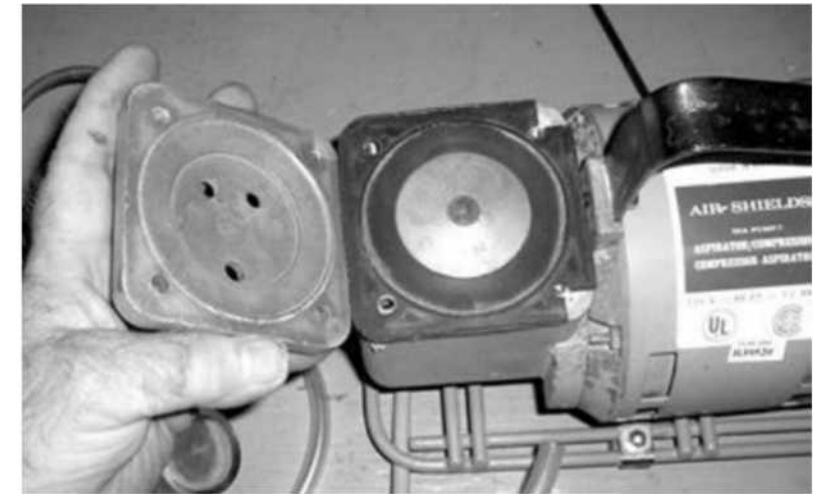
Maintenance and repair

The collection bottle often **breaks**. Any glass or rigid plastic bottle can be used as a substitute. It must be air-tight and have two connections of the proper size to fit the collection set. The seal between the collection bottle and its cap can be improved with a small amount of petroleum jelly, or replaced with rubber, or even leather, cut to the proper size and shape.



If the problem appears to be inside the machine, take off the covers. If the tubing is not at fault and is tight on the connectors, and if the pressure gauge is working properly, then the fault must lie with the **motor**. Dismantle the motor in an attempt to locate the problem.

Noise is a frequent complaint from electrical pumps. Try placing a pad under the machine to reduce the vibration noise between the suction machine and the floor.



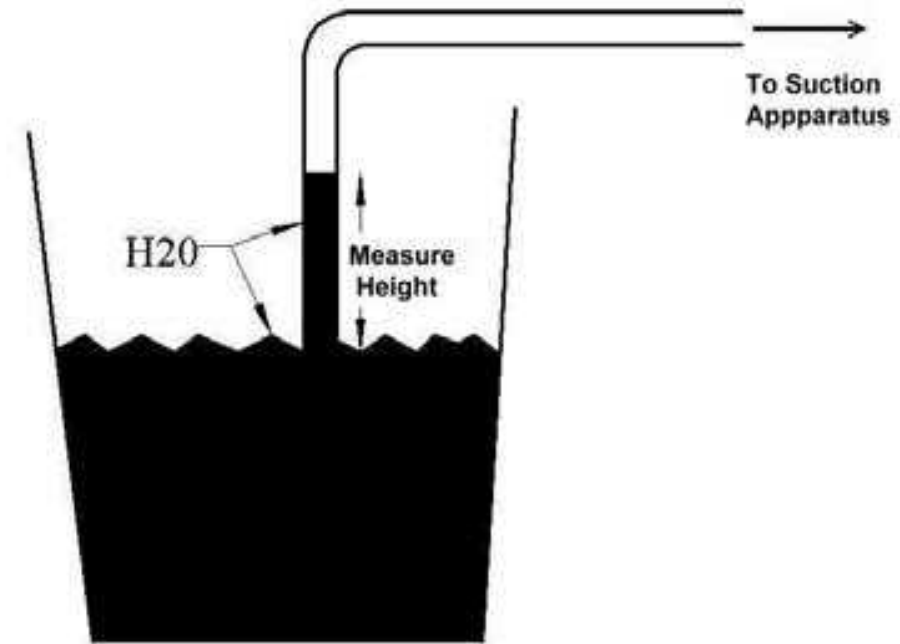
Maintenance of **Piston pumps** requires keeping the unit well oiled; if this is not done, the pump will stop or operate very slowly.

Safety and Testing

To avoid the possibility of **infection**, make sure that the machine has been sterilized before starting to work on it; do not put any parts in your mouth, and wash your hands afterwards. Do not suck or blow into any part of the machine, and handle all parts with care. Cover any cuts or abrasions, and wear a pair of gloves.

Most suction apparatuses cannot be calibrated, per se.

However, the accuracy of the pressure gauge can be checked as can the ability of the suction machine to pull a vacuum in the desired range. To check the pressure, place water in a bucket. Turn on the vacuum and draw the water as high as it will go, typically **between three and five feet**. Record the height in millimetres and calculate the actual pressure in mmHg as the $(\text{Height of Water (in cm)} / 13.6)$ (mmH₂O/mmHg). This can be compared to the pressure shown on the gage and compared with the physicians intended use.



Fault	Possible Cause	Solution
1. Machine is not running	No power from mains socket	Check power switch is on. Check mains power is present at socket using equipment known to be working. Contact electrician for rewiring if power not present.
	Fuse blown	Check for leaks or wire causing fuse to blow and correct this. Replace fuse with correct voltage and current rating. Test operation.
	Electrical cable fault	Try cable on another piece of equipment. Contact electrician for repair if required.
	Internal wiring or switch fault	Refer to electrician
2. Poor fluid flow, pressure gauge low	Tube /seal / bottle leaking or disconnected	Close different tubes by bending. When pressure gauge changes, leakage point has been passed. Replaced damaged tube or seal.
	Air outlet valve blocked	Clean outlet valve
	Control valve stuck	Operate control valve through full range. Send for repair if stuck
	Internal or control error	Refer to technician

Find what you need on line !

3. Poor fluid flow, pressure gauge high	Blocked filter or tube	Disconnect each tube one at a time. When air flow is stopped, blockage has been passed. Replace filter or unblock tube.
4. Filter discoloured	Floating valve broken	Change filter, clean or replace floating valve
5. Electrical shocks	Wiring fault	Refer to electrician
6. Manual suction is jammed	Internal slider stuck	Refer to technician for greasing

END

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