

Knowledge Domain: Plumbing

Unit: Filters

Skill: Substitution

Tools and Parts Required:

- 1) A selection of different types of filters

For adapting larger filter:

- 2) Scissors
- 3) Tape
- 4) Pen
- 5) Cardboard (optional)

Introduction

It is important for medical equipment to have clean filters because dirty filters can reduce air flow and reduce the performance of medical equipment. If a filter is missing or damaged, you will need to substitute with another filter. This guide will help you find appropriate filter substitutes.

Identification and Diagnosis

If the flow of air through the machine is reduced, remove the filter and test the air flow. If the flow of air increases substantially when the filter is removed, the filter is clogged and should be replaced. If the machine gives an error like “clogged filter” or “blocked air line,” the filter should be replaced.

Some machines may sense that the filter has been removed. This sensor is usually mechanical. You can defeat the sensor with tape when determining if a new filter is needed.

If you have a machine with a dirty filter that you cannot clean or replace, you need to find a substitute filter. If you find a machine with a missing or damaged filter that you cannot replace, you need to find a substitute filter.

Procedure

Consider the following when substituting filters:

1. **Size.** Look at the space your replacement filter will occupy. Does the filter have to be a certain size or shape? Make sure the replacement filter will fit.
2. **Connections.** Are there connections to other parts of the machine? Make sure the filter can connect properly with the rest of the machine. You may need to adapt the filter's connections.
3. **Pore size.** The pore size is how big the holes are in the filter. If you have the original filter, check if it is labeled



with the pore size. Use substitute filter with a similar pore size or smaller. If you don't know the pore size, try to estimate the pore size using Table 1.

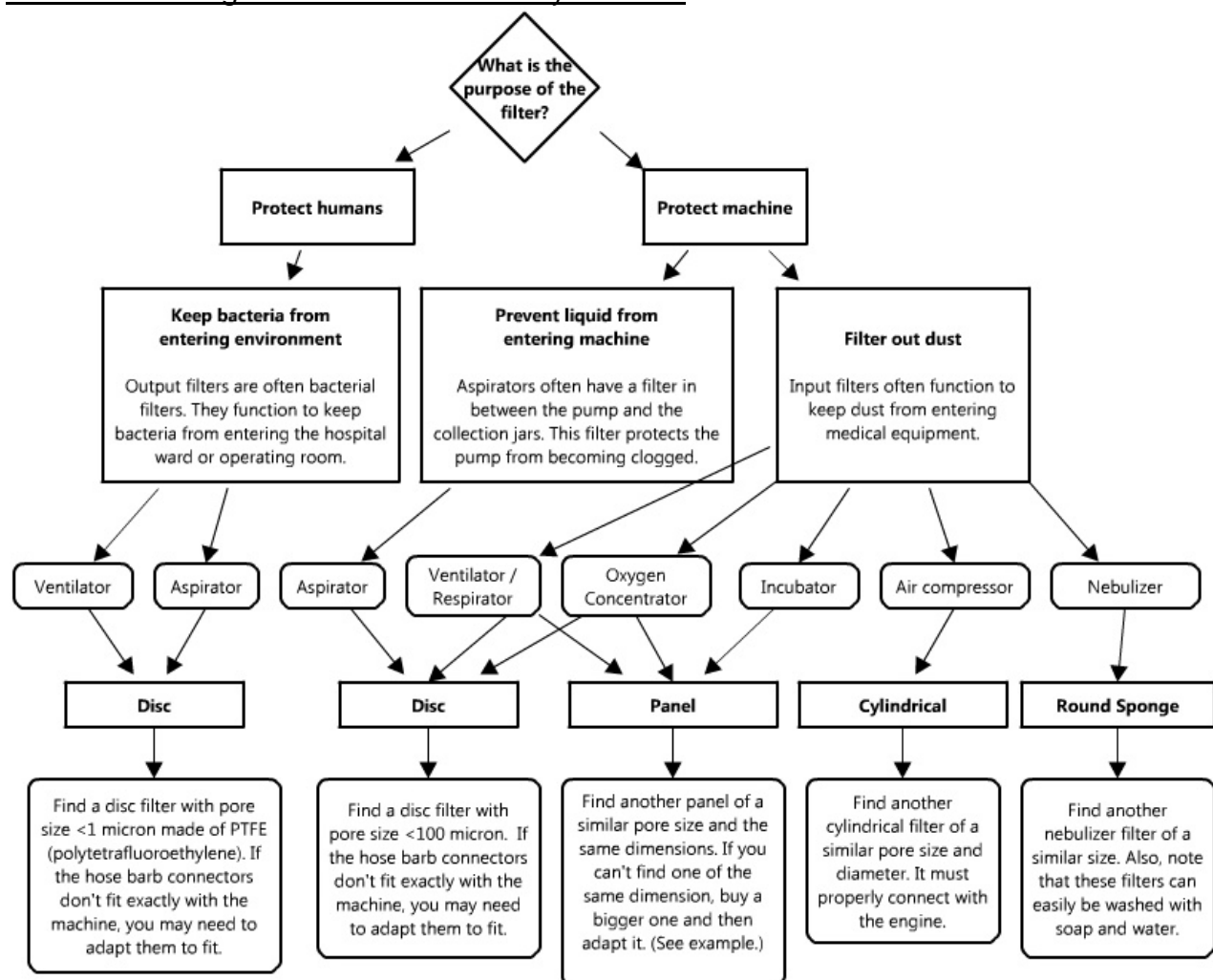
Table 1. Pore sizes of common objects

Note: one micron (μ) is one-millionth of a meter

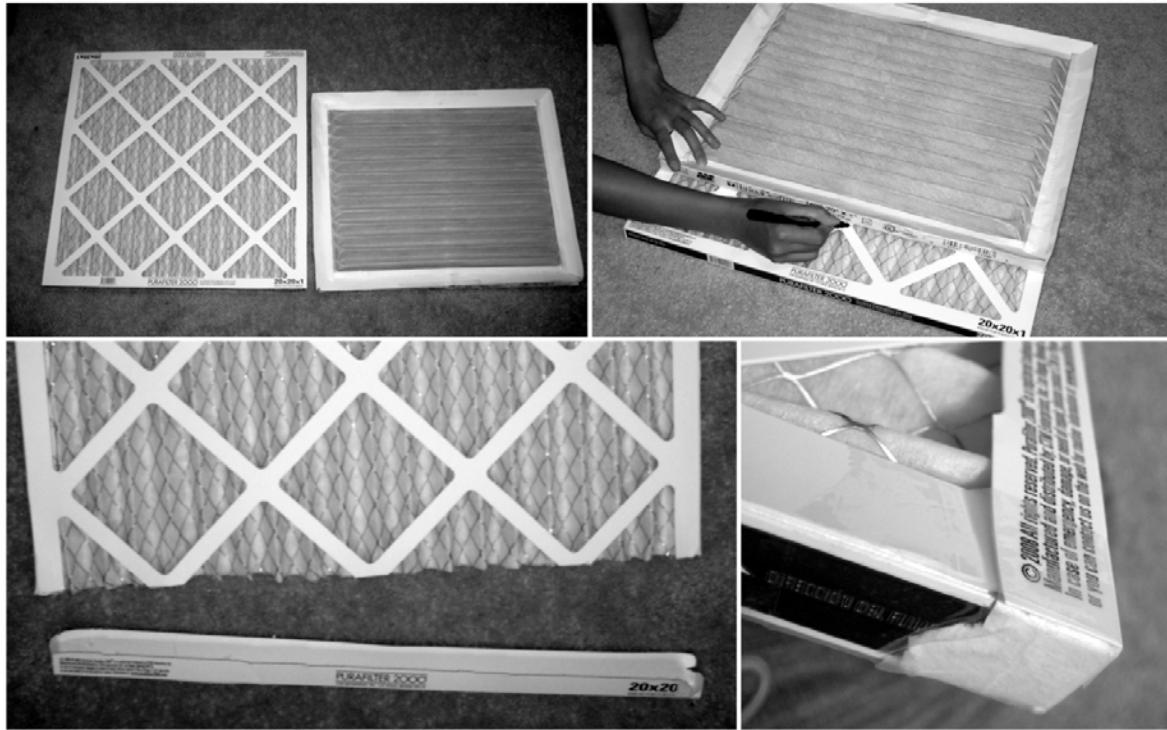
Particle	Particle Size (μ , microns)		
Atmospheric Dust	0.001 – 40	Mold	3 – 12
Smoke	0.01 - 0.1	Red Blood Cells	5 – 10
Corn Starch	0.1 - 0.8	Coffee	5 – 400
Face Powder	0.1 – 30	Cloth	10 – 1000
Bacteria	0.3 – 60	Human Hair	60 – 600
Milled Flour, Corn	1 – 100	Mist	70 – 350
Spider web	2 – 3	Beach Sand	100 – 10000
		Glass Wool	1000
		Eye of a Needle	1230

For pore sizes of more objects, see: http://engineeringtoolbox.com/particle-sizes-d_934.html

Use the following flowchart to substitute your filter:



How to adapt a large panel filter to a smaller size



1. **Buy a new filter.** Buy a filter that is the same thickness, but larger in dimension than your original filter
2. **Trace the old filter.** Put your old filter on top of the new one, lined up with one corner. Trace out the exact size of the old filter on the new filter.
3. **Cut the new filter to size.** Cut the new filter along the lines you marked.
4. **Reinforce the cut edges.** Now you have a filter with side(s) without any cardboard support. The cardboard is important to give the filter structure so the filter does not get sucked into the machine and so air does not flow around the filter. Use the casing that you cut off and some tape to reinforce the edges. (Alternatively, you can use cardboard from the old filter or other sources.)

If you are unable to find a substitute, you may need to fabricate your own filter.

Exercise

Your instructor will give you a machine with a damaged or missing filter. Determine what type of filter is needed. Choose an appropriate filter from the ones provided. Adapt the filter as needed and install the filter. Your instructor must verify your work before you continue.

Preventative Maintenance and Calibration

Always verify proper operation of every medical device before returning to use.