

Masks, PPE and the COVID-19 Virus  
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## First a bit about the tests and testing

- For those who take a virus test, the rate for positive results from testing is between 6% and 11%. Of those who test positive about 2.62% of them will die from the virus. Or about 0.238% of people tested will die from COVID-19
- Even if you are COVID free, there is still a 3.2% chance of your test being reported as positive. Antibody tests are supposed to be the most accurate, but tests made between 8 and 14 days after exposure are only 70% positive.
- Even in a hospital setting one might have a 10% false positive or a 2% false negative infection result

## Facts on The Virus and Masks:

The virus is spread through airborne means. Droplets from sneezes and coughs are often 100-500 microns. Some are much smaller. The virus itself is approximately 0.01 microns, small enough to go through most masks.

Most of the masks will filter out the droplets, and we'll discuss that in a minute.

We have all heard a lot of information about the N-95 masks, but do you know your masks?

The masks are rated and ranked for efficiency in removal of 0.3 micron salt particles by NIOSH. They fit into several categories: **N is not oil resistant, P is oil resistant, R is somewhat resistant to oil.**

Masks come in several types and efficiencies. The 100 series is 99.7% effective at removing the test particles.

Surgical and conventional varieties of N-95 masks are available on the marketplace but are currently scarce as hen's teeth.

There are several types of filters available based upon particle removal efficiencies. Here are some technical references on masks and filtration efficiencies.

[https://www.ashrae.org/File%20Library/Technical%20Resources/COVID-19/I-P\\_S20\\_Ch29.pdf](https://www.ashrae.org/File%20Library/Technical%20Resources/COVID-19/I-P_S20_Ch29.pdf)

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3321141/>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5640248/>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC156669/>

NIOSH and OSHA are the organizations who “officially” rank and rate the masks. ASHRAE is another organization involved with filtration and filter efficiencies.

**ASHRAE categorizes filtration products as follows:**

An ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) filter refers to a fibrous filter that has efficiency up to 95% on particles as small as 0.5 microns. This type of filter is very similar to the HEPA filter but does not have as high of an efficiency rating. The MERV efficiency rating is 15 for this filter and can be used to capture bacteria, pollen, spores, and other harmful particulates.

ASHRAE Filter Classifications

MERV Rating	Average Particle Size Efficiency in Microns
1-4	3.0 - 10.0 less than 20%
6	3.0 - 10.0 49.9%
8	3.0 - 10.0 84.9%
10	1.0 - 3.0 50% - 64.9%, 3.0 - 10.0 85% or greater
12	1.0 - 3.0 80% - 89.9%, 3.0 - 10.0 90% or greater
14	0.3 - 1.0 75% - 84%, 1.0 - 3.0 90% or greater
16	0.3 - 1.0 75% or greater

**HEPA** is a type of pleated mechanical air filter. It is an acronym for "**high efficiency particulate air** [filter]" (as officially defined by the U.S. Dept. of Energy). This type of air filter can theoretically remove at least 99.97% of dust, pollen, mold, bacteria, and any airborne particles with a size of 0.3 microns (µm). The diameter specification of 0.3 microns responds to the worst case; the most penetrating particle size (MPPS). Particles that are larger or smaller are trapped with even higher efficiency. Using the worst case particle size results in the worst case efficiency rating (i.e. 99.97% or better for all particle sizes). Generally available for masks, and larger sizes

## ULPA Filters:

### Highest Efficiency

Ultra low particulate air (ULPA) filters have efficiency of up to 99.9995% on particles as small as 0.12 microns. ULPA filters have a MERV rating of 20 and are the highest quality filters available. ULPA filters provide better filtration for tobacco smoke, oil smoke, insecticide dust, carbon dust, and even capture some viruses.

### ULPA Filter Features

- 100% Fire Retardant
- Polyalphaolefin PAO Batch Tested (a test gas with an equal mean distribution of .3 microns distrusted through an aerosol generator)
- Unabridged, gasket closed cell neoprene
- Multi-level quality assurance
- Hand crafted with specialty purpose fiberglass material
- Up to 99.9995% efficiency on particles down to 0.12 microns in size.
- **MERV 20** (Note: I could not find an ASHRAE rating for MERV 20.)

Of the 49 NIOSH approved manufacturers, only 10 are made without exhalation valves, and that's important because even if you have an 95 mask, or a HEPA mask, you can't travel using it on commercial airlines **because it has an exhalation valve**

### So: What's available?

## Available Masks :

It's based on the filter fabric and the seal.

N-P-R 95 masks , Surgical N-95 masks, Dental Masks, Hospital Masks

Only 10 of 49 NIOSH approved manufacturers make masks w/o exhalation valves:

That's Approximately 20% but they are hard to find because of "Medical Priority"

[https://www.cdc.gov/niosh/npptl/topics/respirators/disp\\_part/n99list1.html](https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/n99list1.html)

There are approximately 30 manufacturers of N-95 surgical masks.

[https://www.cdc.gov/niosh/npptl/topics/respirators/disp\\_part/respsource3surgicaln95.html](https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/respsource3surgicaln95.html)

This is a surgical mask: made by 3M They don't have exhalation valves



Note the features, layers, nose bridge, and straps and comments.

Recently, there has been discussion whether N95 Filtering Facepiece Respirators (**FFRs**) or surgical masks should be the recommended minimum level protection for use in healthcare facilities during outbreaks of infectious diseases. Since the results of studies comparing effectiveness of N95 FFRs and surgical masks are inconsistent, it could not be determined if surgical masks provided comparable protection to healthcare professionals as N95 FFRs. It should be noted that respirators are designed to reduce the wearer's exposure to airborne particles. ***Respirators do not make claims regarding disease prevention.*** To determine the effectiveness of respirators in the workplace, it is important to verify the performance of the respirator and ensure the wearer is protected. Laboratory studies have demonstrated that FFRs provide greater protection against aerosols compared with surgical masks; however, the results of clinical studies have been inconclusive.

<https://blogs.cdc.gov/niosh-science-blog/2020/04/09/masks-v-respirators/>



Here are some commercial face masks typical of the stuff on the market- These were advertised for sale by AMAZON.

The one on the left has a PM 2.5 micron filter insert. Particle capture efficiency unknown, but it has an exhalation valve. The one on the right is a typical dental/surgical mask. Particle capture efficiency has not been established by NIOSH





*Here's an N-95 mask and a KN 95 mask Note the differences below:*

*The N-95 has elastic straps which hold the mask tight to the face.*

*The KN-95 has loops which fit over the ears and may not make a good seal.*

*The problem with the KN-95 mask might be that they do not properly seal unless they are pulled tight.*

*In order to pull the pictured KN-95 mask tight, one should pinch the metal strip at the nose to get a fit at the time of wearing, and then attach a Velcro or other strap through the loops so that it can be pulled tight to the face at the time it is put on.*



*The disadvantage of the N-95's without the valve is that they can collect condensate from your breath, making it harder to exhale. But it prevents the spread of your potentially contaminated droplets and vapors.*

## BASIC FACTS on Inhalation!

1. Some researchers say that droplets produced by sneezes and coughs are small enough to pass through most masks and float in the air for hours. One study suggested that between 20 and 25 feet from a “carrier” might be sufficient. Others say no.
2. The virus is very small, but it is carried by droplets, some of which may be as fine as 0.01 microns which will pass through most protective equipment with ease. Aerosols from sneezing and coughing is between 100 and 500 microns which may be filtered out. There is no guarantee that a mask will be the best protection, unless it's the right type.
3. The purpose of a mask can be two-fold. First is protection of you from inhaling something like a virus; Second is the reduction of transmission if you are infected and cough or sneeze. But, it's important to know some facts about the selection of masks.
4. The average person respires about 10,000 Liters (353 cubic feet of air per day, and all that it takes is one good dose of contaminated air to create an infection.

Let's look at the way to check a mask to see if it is effective for you.

**Most people we have observed don't know how to wear a mask properly.**

In order to wear a mask properly, one must have a full-contact seal between their face and the edges of the mask. This means that the mask must cover the mouth and nose and make a reasonably tight seal to their face. That means NO BEARDS, scars, or other facial deformities! These features defeat the purpose of a mask because it allows air to come in around its edges.

See OSHA for facial hair guidance with respiratory protection.

A mask must not have air gaps around your cheeks, mouth or nose. Many people who wear masks have a 'glasses fogging' problem. That means that the mask is not sealing against your face around your nose. **IF AIR GETS OUT, IT CAN GET IN, rendering the mask useless.**

Some people don't understand that if you do not cover your nose, your mask is useless. We all breathe in and out through our noses. That's a direct path to contamination of your lungs and an invitation to the virus to enter your nasal cavity and infect you. The virus most commonly starts as an infection in the sinuses or in the lungs, so both must be protected.

## WEARING MASKS FOR PROTECTION

### KN-95 MASKS

If you wear a KN-95 mask, you need to modify them to fit your face.

This can be done with a Velcro strip, or even with two small pieces of string. Attach the string to the back of your ear loops and loop them together in a bow knot to pull the mask tight. You need to pull the mask against your face so that it touches your cheeks and covers from the bridge of your nose down past your lower lip and on to your chin, or even below your chin depending on the mask fit. It should be snug but not cut into your face.

Here's how to check if you have a proper mask seal **FOR ANY TYPE OF MASK:**

1. Touch the edges of your mask to make sure it is properly adjusted and in contact with your face.
2. Take a deep breath.
3. If you feel the mask snug a little more on your face while you breathe in, you have a pretty good seal.
4. Go and enjoy your day.

If you don't have a good seal, or if you are feeling the 'glasses fogging' effect when you exhale, you need to tighten your mask. If you have had jaw or dental surgery like some of us have had, it's even more important to make sure that your mask fits properly.

## Hospital Masks

The most often seen masks are the rectangular “hospital”, ‘isolation”, or “dental” mask with ear loops. Versions of these masks are being made by various companies and individuals to introduce an aspect of style and individuality for the wearer. These masks are multi-folded and occasionally multi-layered fabric. Unfortunately, these are the least effective masks for protecting against the spread of the virus, especially when there is a great deal of variability in the material and construction used for each mask.

Most people don’t know how to wear a hospital mask. The mask has loops which fit over the ears. The mask fairly well covers your mouth and nose, but many people wear the mask without a proper cheek seal. The mask should be adjusted to fit tight against one’s face and cheeks. Many people wear their hospital masks with big bulges on their cheeks. That defeats the purpose of the mask from inhaling and from exhaling. Adjust the mask so that it fits snugly against your cheek. Some masks have a wire clip for improving the seal across your nose. If you still have the ‘glasses fogging’ effect, try adjusting the mask around your nose and see if you can pull it tighter. If the fogging effect persists, then try to further adjust the mask or try another mask of different construction.

In paper (link) sent out with this notice, there is a link to the popsugar website on making a dental mask fit better: <https://www.popsugar.com/fitness/tighten-your-face-mask-with-this-doctor-tiktok-trick-47603893>

**One of the biggest mistakes made in wearing a face covering is assuming that that will protect you from exposure. Properly worn, along with social distancing, they will reduce your chances of contracting the virus. They will not eliminate your chances of catching the disease. None-the-less, proper wear and handling of your mask is essential to reducing your risks of exposure.**

Even if no one is nearby, don't pull your mask under your nose. It may feel cooler and easier to breathe. But, it is increasing your risk of exposure. If the mask has been doing its job it will have captured droplets from those around you. Locating the mask under your nose increases the likelihood that you will inhale any viruses captured on the outside of your mask. The same problem exists when you handle the outside of a mask and bring your hands to your eyes, nose, or mouth. Protecting your respiratory system during the pandemic is serious business. It is not just a suggestion from government agencies. Each individual must take protection from the virus seriously. Currently, the virus is resurging. It is not going away soon. Continued vigilance is necessary by everyone. Wearing the most effective respiratory protection available is essential.

## Respirators

There are several manufacturers of powered respirators on the market – if you can get them. Most have a “medical priority” restriction and are unavailable, but if you need or want one ask your supplier. The most common manufacturers are 3M, MSA, Ford Motor Company, Icon Safety Systems, and the University of Toronto. Each type of PAPR has its own advantages/disadvantages.

With a PAPR breathing is easier and you are breathing filtered air which if one adds a cartridge to the PAPR inlet, is also removing certain types of chemicals. Note: These units do not supply air in an anoxic environment!

The three basic types of PAPR masks are Full Face, Half Face and Hoods. See the attached pictures

**BIOVIZR** is one of the newest on the market, made by the U of Toronto, and it costs about \$250. Airlines have already indicated that they would not allow these to be worn on flights. See the paper for references

**Icon Safety Systems** has a powered fan design which works when you inhale. They start at \$500, but with facepieces and charging accessories it will run about \$750. I have two of them and they are excellent.

**3M and MSA and Ford Designs** are classical, with a belt fan, cartridges, and a hose connecting you to the facemask



Half face unpowered respirator



Full Face unpowered Respirator



Bio VYZR powered PAPR

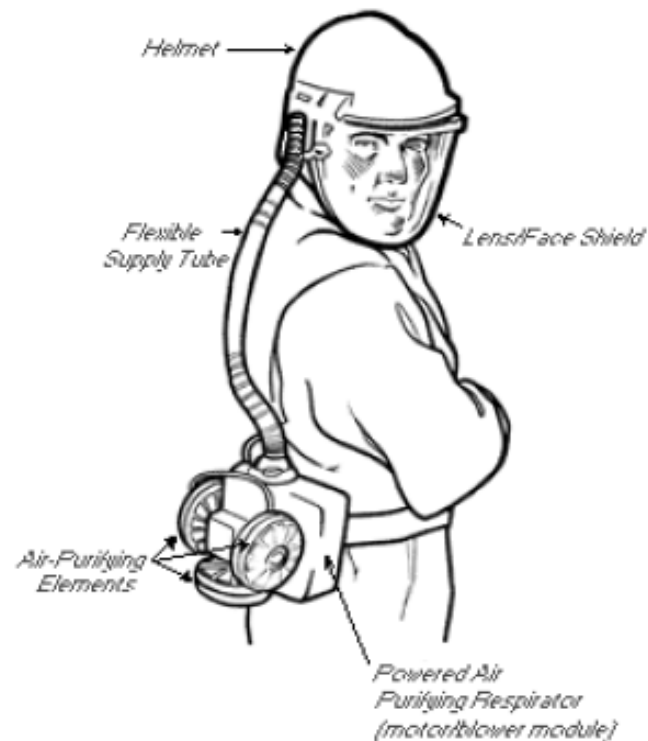


Clean Space 2 powered Respirator



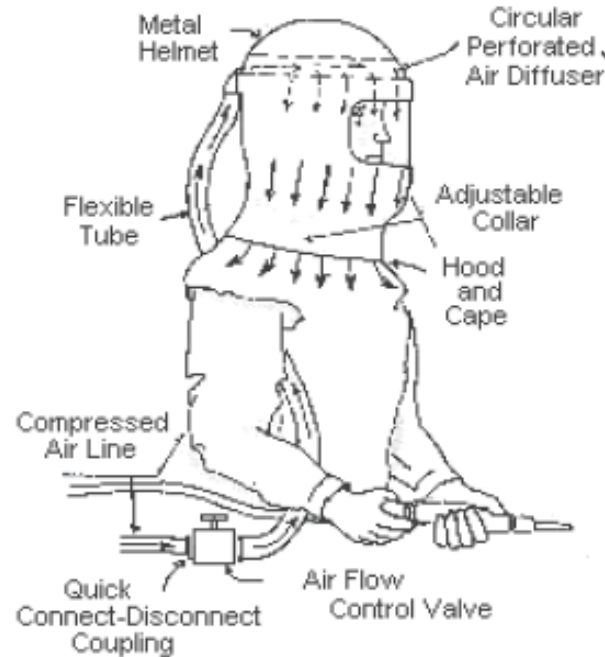
# Respirators

## Powered Air Purifying Respirator

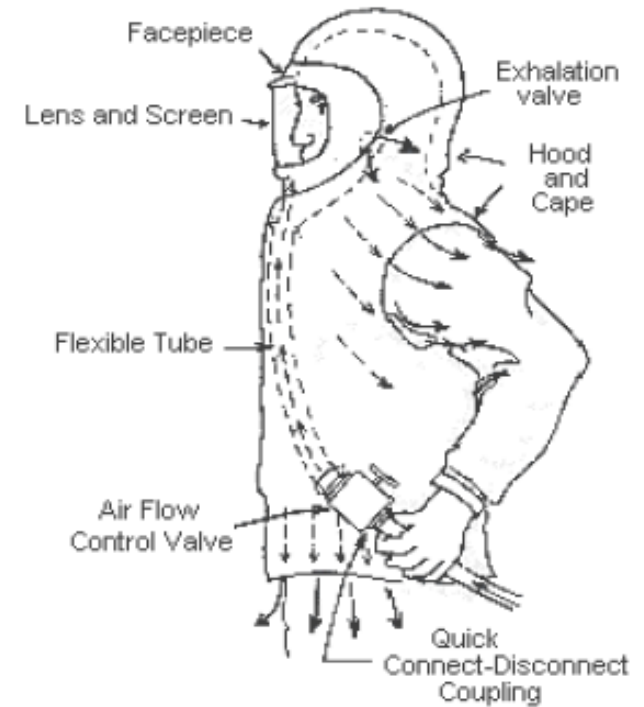


**Loose-Fitting Facepiece**

## Supplied Air Respirators (Hoods)



**Abrasive Blasting Respirator  
(Hood Respirator)**



**Loose-Fitting Hood with Blouse**

## **MAINTAINING YOUR EQUIPMENT:**

The home-made masks can be washed and washing them after each use is a good idea. Always bear in mind that if the respirator is doing its job, the outside and inside will be potentially contaminated with viruses and other contaminants. After handling your mask, it is essential that you wash your hands thoroughly with soap and water. You can use sanitizer if soap and water is not available.

The N-95 and KN-95 respirators can be sprayed lightly with hydrogen peroxide or alcohol after each use. Spray the inside and outside of the mask and allow it to air dry in a clean location. An alternative method of disinfecting the N-95 and KN-95, (and other) respirator masks is through heat. The consensus is that the mask should be disinfected after each use. This can be done by heating the respirator filter in a 158°F oven for an hour.

However, that may be impractical especially if there are multiple opportunities for donning and doffing the mask each day. At a minimum, plan on cleaning things like the N-95, KN-95 and other masks at the end of the day.

If you are using dental or medical masks, they are designed to be disposable. The reliability of reusing them is not known at this time.

The half-face and full-face respirators need to be cleaned after each daily use following manufacturer's recommendations. The cartridges need to be changed at least daily because of potential contamination with a biological contaminant.

Wearing a commercial half- or full-face respirator properly requires the wearer to be fit tested to assure no leakage occurs anywhere along the sealing surface. This is done by a trained person using one of several chemicals that can be detected by the wearer if there is a leak in the facepiece. Because of the cost, low availability, and awkwardness of these respirators, they will rarely be chosen for general wear.

**STAY SAFE**