A Guide to Understanding Masks and Respirators

Compiled by The National M.G.T. & G.C.C. Office of the Nation of Islam

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A Guide to Understanding Masks and Respirators

The following information is research regarding face masks. It includes reasons for using protective face masks, the types of pollutants these masks filter out, as well as the different types of masks and their effectiveness.

Section 1: Reasons for Using Protective Face Masks

Masks are tools that help purify the air for the person who is wearing the mask. They create a barrier between the wearer and the air they are breathing, which in turn helps to guard the lungs against potentially harmful or hazardous particles. There are many reasons that a person might choose to wear a mask. The main purpose of a mask is to protect the person wearing it against respiratory illnesses and other ailments that can be caused by inhaling pollutants, such as dust, allergens, chemicals, and pathogens such as bacteria and viruses. (National Center for Biotechnology Information (NCBI), 03.13.2009, Beneficial cardiovascular effects of reducing exposure to particulate air pollution with a simple facemask)[1]

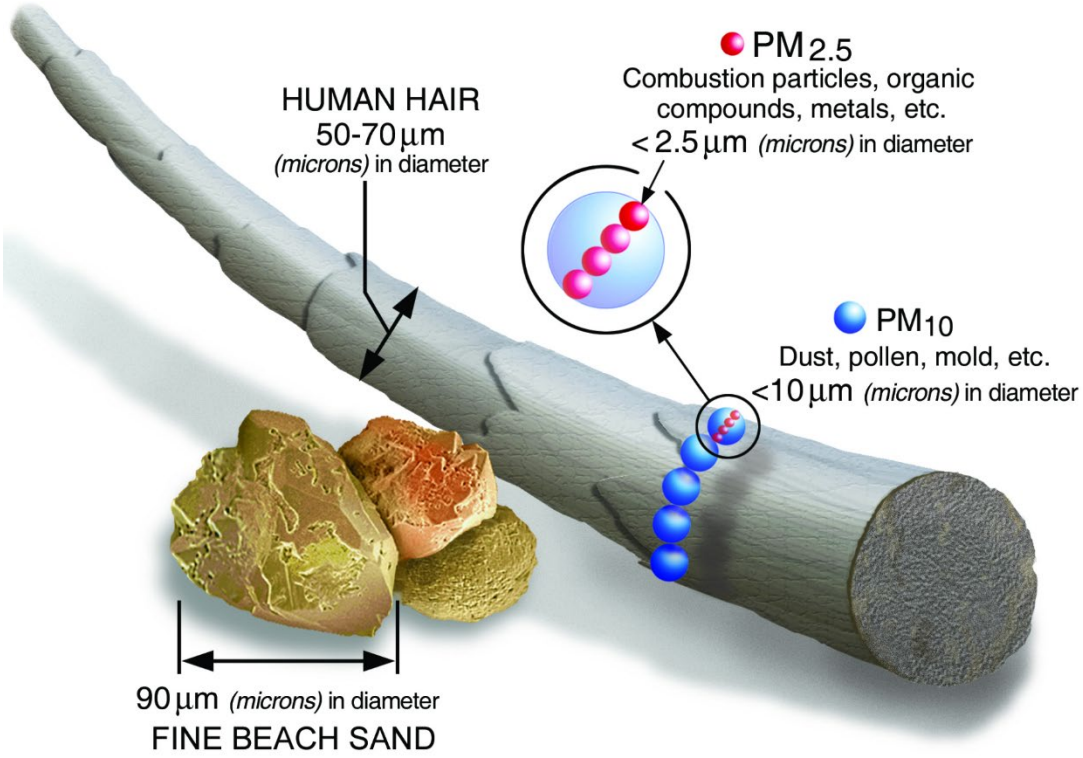
Masks, in general, provide some level of protection against germs and pollutants. Joseph Tsang, an infectious disease specialist who worked as a consultant for the Hong Kong Hospital Authority, says there are two reasons to wear a mask. He states, “Wearing a mask is not just for protecting yourself from getting infected but also minimizing the chance of potential infection harboring in your body from spreading to people around you.” Tsang indicated that the three layers of a surgical mask filter (pictured on the left) help to reduce the risk of contact with droplets, which is one of the ways viruses are transmitted. He states, “Whenever you foresee to have someone within two to three meters (6.5 to 10 feet) apart, then it’s better to wear a mask.” (Leung, H., 03.12.2020, Why Wearing a Face Mask Is Encouraged in Asia, but Shunned in the U.S.)[2]

Although masks can be beneficial, all masks are not created equally. Different types of masks protect against different types of particles. Some masks block larger particles such as dust, whereas other masks block larger particles as well as smaller particles that cannot be seen with the naked eye, such as bacteria and viruses. While a mask provides a layer of protection, no mask offers 100% protection against viruses. The wearer must also follow the prevention guidelines set forth by the World Health Organization (WHO), such as maintaining social

distancing, washing hands frequently, practicing good hygiene, and more. So what is the science behind the mask? The next section discusses the different sizes of particles that can ill-effect an individual. And Insha'Allah, a mask can protect you from some of these.

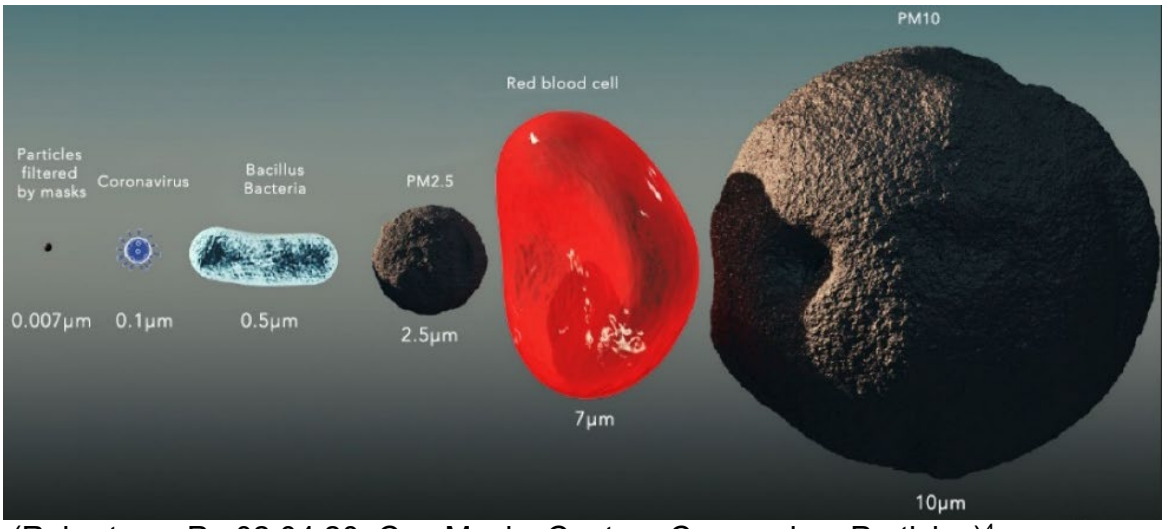
Section 2: Particulate Matter

Masks work by filtering small particles from the air that we breathe. These small particles are also known as particulate matter (PM). According to the Environmental Protection Agency (EPA), particulate matter (PM) is the "term used for a mixture of solid particles and liquid droplets found in the air." Particulate matter (PM) is measured using micrometers, also referred to as microns (µm). A micron is a tiny unit of measurement—so tiny that there are 25,400 microns(µm) to one inch. The illustration below helps to give more perspective. The average fine beach sand is 90 µm (microns) in diameter. The average human hair diameter is 50 – 70 µm (microns). On average, the human eye cannot see particles that are smaller than 50 – 60 microns. Next, we see dust, pollen, mold, etc. (represented by the blue dots), which are less than 10 microns (µm). These particles are referred to as particulate matter 10 (or PM_{10}) because they are 10 microns or less in width. Approximately 5 of these dust particles will fit across the diameter of the average strand of human hair. Combustion particles, organic compounds, metals, etc. (represented by the pink dots) are even smaller, measuring less than 2.5 microns (µm). These fine particles are referred to as particulate matter 2.5 (or $PM_{2.5}$) because they are 2.5 microns or less in width. Four of these $PM_{2.5}$ particles will fit on a dust particle. Viruses measure even smaller at approximately 0.1 microns. This means that 900 viruses can line across the diameter of one small grain of sand.



(EPA, n.d., Particulate Matter (PM) Basics)[3]

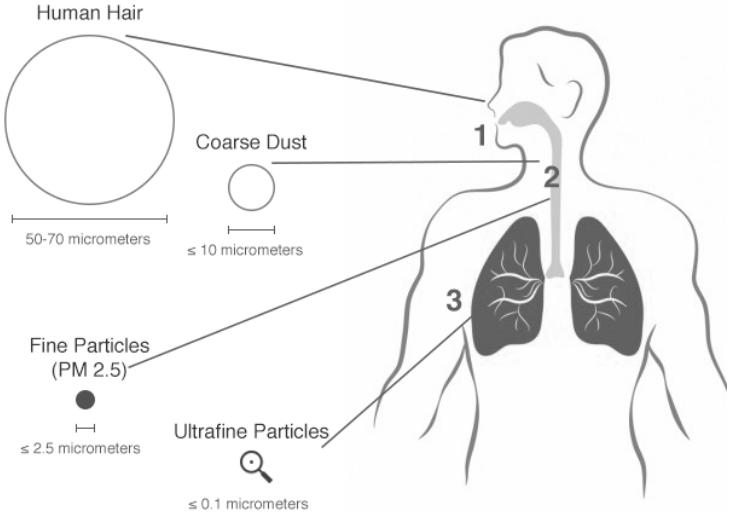
The image below illustrates the size of the coronavirus in comparison to other particles, including a red blood cell. The first image on the left shows a microscopic particle that is filtered by masks and measures 0.007 microns, which is over ten times smaller than the coronavirus.



(Robertson, P., 02.04.20, Can Masks Capture Coronavirus Particles)[4]

The Environmental Protection Agency (EPA) defined the following **PM_{10}** and **$PM_{2.5}$** seen on certain masks.

"PM_{10}: inhalable particles, with diameters that are generally 10 micrometers and smaller;
$PM_{2.5}$: fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller." (EPA, n.d., Particulate Matter (PM) Basics)[3]



Because the coronavirus is so incredibly small, it can travel deep into the lungs and cause life-threatening respiratory distress and illness. This picture illustrates how deep, different particles can travel through the respiratory system based on their particle size. (Light Air, n.d., Particle Size and Air Purification-Size Matters)[5]

As you can see, the particles that travel further into the respiratory system are less than or equal to 2.5 microns. Research has shown that wearing masks can be effective at filtering these fine and ultrafine particles from the air that we breathe. However, wearing a mask alone is not enough protection. Everyone, including those who wear masks, should adhere to other practices such as: keeping their hands out of their faces by not constantly adjusting the mask, proper handwashing, social distancing, cleaning, sanitizing, and disinfecting their environments to prevent the spread of infectious disease.

Section 3: The Difference Between a Mask and a Respirator

There are two different types of face protection available to wear: 1) masks and 2) respirators. Although masks and respirators both offer protection, they are not the same and offer varying levels of protection.

A mask is loose-fitting and provides the wearer protection against large droplets, splashes, or sprays of bodily or other hazardous fluids. A surgical mask is a face mask often worn by medical professionals and designed to help protect against large droplets, splashes, sprays, or splatter that may contain viruses and bacteria. Surgical masks also protect a patient from the wearer's respiratory emissions. Unlike other face masks, surgical masks are regulated and must be cleared by the U.S. Food and Drug Administration (FDA). Because of the loose fit, leakage occurs around the edge of the mask when the user inhales. Although it does provide some protection, the loose fit of surgical masks is not designed to provide a reliable level of protection from inhaling airborne particles such as bacteria and viruses. Masks do not have a fit test requirement, which means there is no test required to determine whether or not the mask properly fits the face of the person who is wearing it. (CDC, n.d., Infographic - Understanding the Difference, Surgical Mask, N95 Respirator) [6]

A respirator is a masklike device that is very efficient at filtering airborne particles. Respirators are designed to have a very close facial fit over the nose and mouth. This tight and close fit is to prevent the inhalation of harmful airborne particles. In the United States, respirators are regulated by the National Institute for Occupational Safety and Health (NIOSH). These respirators have the word NIOSH listed on them along with the approval type (for example, N95). They are secured tightly to the face and usually have two head straps and an adjustable nose clip. Respirators have a fit test requirement to ensure that there are no gaps and that it seals properly. With a proper fit, the N95 respirator filters out at least 95% of airborne particles, including large and small particles. When properly fitted and worn, minimal leakage will occur around the edge of the respirator when the user inhales. It is important to note that each country has a unique rating system, and this information is specific to the United States' respirators. (CDC, n.d., Infographic - Understanding the Difference, Surgical Mask, N95 Respirator)[6]

For your reference, the following is a guide outlining how respirators are rated in the United States. Respirators have both a letter and number combination that is a code that tells what level of protection it offers. Masks, however, are not rated.

Respirator Rating Letter Class

- N – Not Oil Resistant
- R – Resistant to Oil
- P – Oil Proof

Respirator Rating Number Class

- 95 - Removes 95% of all particles that are at least 0.3 microns in diameter
- 99 - Removes 99% of particles that are at least 0.3 microns in diameter
- 100 - Removes 99.97% of all particles that are 0.3 microns in diameter or larger. HE or HEPA quality filter

Using the rating letter and number class, you would know that an N95 Respirator mask is not resistant to oil and removes 95% of all particles that are at least 0.3 microns in diameter. The following chart by the CDC displays equivalent masks provided by other countries.

Country	Performance Standard	Acceptable product classifications	Standards/Guidance Documents	Protection Factor ≥ 10
Australia	AS/NZS 1716:2012	P3 P2	AS/NZS 1715:2009	YES
Brazil	ABNT/NBR 13698:2011	PFF3 PFF2	Fundacentro CDU 614.894	YES
China	GB 2626-2006	KN 100 KP100 KN95 KP95	GB/T 18664—2002	YES
Europe	EN 149-2001	FFP3 FFP2	EN 529:2005	YES
Japan	JMHLW-2000	DS/DL3 DS/DL2	JIS T8150: 2006	YES
Korea	KMOEL-2017-64	Special 1st	KOSHA GUIDE H-82-2015	YES
Mexico	NOM-116-2009	N100, P100, R100 N99, P99, R99 N95, P95, R95	NOM-116	YES
US NIOSH Requirements	**NIOSH approved 42 CFR 84**	**N100, P100, R100 N99, P99, R99 N95, P95, R95**	**OSHA 29CFR1910.134**	**YES**

On March 28, 2020, the U.S. Food and Drug Administration (FDA) sent out an Emergency Use Authorization (EUA) indicating the countries and mask types it would allow to be imported into the country. The Chinese KN95, which is comparable to the U.S.'s N95, was not on the list. According to the EUA, the KN95 masks were initially excluded due to concerns about KN95 masks being fraudulent and the FDA's lack of knowledge regarding the criteria used to meet Chinese standards. It is important to note that 3M is one of the manufacturers of the KN95 mask.

On April 3, 2020, the FDA issued a new EUA regarding the importation of KN95 masks. On the FDA's webpage entitled FAQ's on Shortages of Surgical Masks and Gowns, the following question was asked: "Can respirators approved under standards used in other countries, such as KN95, be used in the U.S. during the COVID-19 pandemic?" The FDA's answer to this question explains the agency's current stance (as of this writing) under the new EUA regarding this. It states that "On April 3, 2020, in response to continued respirator shortages, the FDA issued a new EUA for non-NIOSH-approved N95 respirators made in China, which makes KN95 respirators eligible for authorization if certain criteria are met, including evidence demonstrating that the respirator meets certain standards." The FDA's response further states that "…for the duration of the pandemic, when FDA-cleared or NIOSH-approved N95 respirators are not available, the FDA generally would not object to the importation and use of respirators without an EUA, including KN95 respirators. Although not required, if a KN95 respirator does not have an EUA, the FDA encourages importers to take the appropriate steps to verify the product's authenticity prior to importing." (U.S. Food and Drug Administration, 04/09/2020, FAQs on Shortages of Surgical Masks and Gowns)[7]

Now that we have looked at the primary differences between masks and respirators, in the next section, we will discuss the different types of masks and the level of protection that they provide.

Section 4: Types of Masks

There are various types of masks that people may choose to wear. These masks range from homemade masks to commercially available masks. At first look, some may appear to be very similar, but in actuality, they are all different and offer varying degrees of protection. It is important to note that all masks, even homemade ones, offer some degree of protection. Here are some of the different types of masks and how they are designed to perform:

Cotton Handkerchief – A handkerchief is a small, cotton piece of cloth usually used as a clothing accessory or to blow your nose. Some choose to wear it as a face mask. Research shows that it blocks 28% of 0.007 micron particles. (Talhelm, Thomas, 03.01.2020, N95 Masks vs. Surgical Masks: Which Is Better at Preventing The Coronavirus?) [8] (Part Fibre Toxicol, 03.13.2009, Beneficial cardiovascular effects of reducing exposure to particulate air pollution with a simple facemask)[9]

Homemade Mask – A homemade mask is a mask that is sewn by an individual, usually comprised of cotton fabric. Research has shown that these types of masks filtered 69.4% of virus sized particles. (Research Gate, August 2013, Testing the Efficacy of Homemade Masks: Would They Protect in an Influenza Pandemic)[10]

Dust Mask –A dust mask is a mask that has not been tested to any government performance standards for filtration. They are designed to block larger particles while doing activities such as mowing grass, gardening, etc. to prevent irritation to the mouth, nose, and throat. Dusk masks are not respirators and cannot protect against extremely small particulate matter. There is usually no printing on the mask. (Michigan State University, n.d., Dust Mask vs. Respirator)[11]

Surgical Mask – This type of mask is a face mask that is approved by the FDA for use as a surgical mask. They do not have printing on the mask. The mask is loose-fitting and is fluid-resistant to provide the wearer protection against large droplets, splashes, or sprays of bodily or other hazardous fluids. Surgical masks protect a patient from the wearer's respiratory emissions. Research has shown that surgical masks filtered 80% of virus sized particles. (National Center For Biotechnology Information (NCBI), 03.13.2009, Beneficial cardiovascular effects of reducing exposure to particulate air pollution with a simple facemask)[1]

Cycling Mask – A cycling mask is a reusable mask worn by cyclists to block pollutants. This mask uses a disposable filter. Research shows that it blocks between 55.1% - 82.8% of 0.007 micron particles depending on the filter type used. It can be used with N95 and N99 disposable filters. (National Center For Biotechnology Information (NCBI), 03.13.2009, Beneficial cardiovascular effects of reducing exposure to particulate air pollution with a simple facemask)[1]

N95 Mask – The N95 mask is a respirator mask that is tight-fitting and filters at least 95% of non-oil based airborne particles. It is NIOSH approved and usually has two head straps and an adjustable nose clip.

N99 Mask –The N99 mask is a respirator mask that is tight-fitting and filters at least 99% of non-oil based airborne particles. It is NIOSH approved and usually has two head straps and an adjustable nose clip.

N100 Mask – The N100 is a respirator mask that is tight-fitting and filters at least 99.97% of non-oil based airborne particles. It is NIOSH approved and usually has two head straps and an adjustable nose clip.

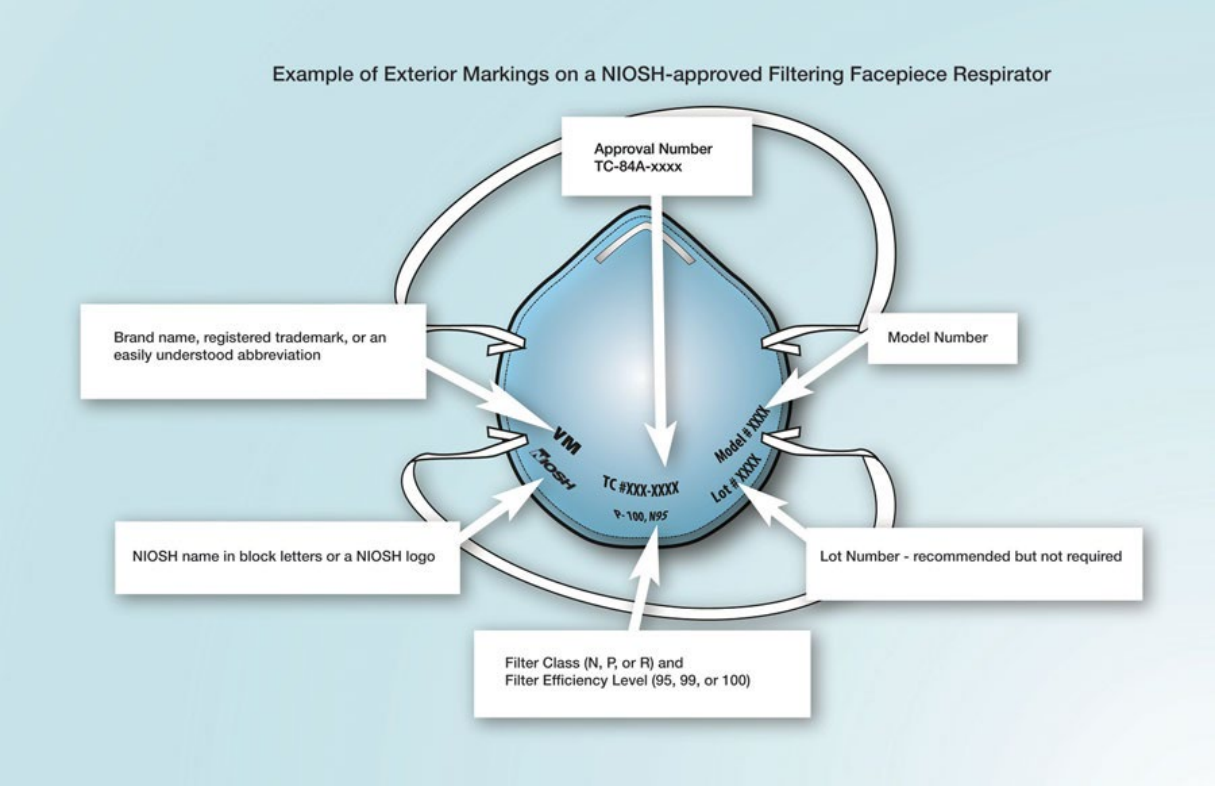
As we can see, there are a variety of masks available commercially which offer varying degrees of protection. Let's look more closely at some of the more common disposable masks and their effectiveness.

Section 5: N95/N99 and Other Mask Filter Material

Many N95 and other pollution masks are made from a material of randomly aligned, extremely thin fibers (usually polypropylene) to capture the particles. The fibers are given an electrostatic charge to enhance the filter performance by increasing the filter's ability to attract particles to its surface. This means that not as much filtering material would need to be used in the mask, making it easier for the wearer to breathe. Some filters include a layer of activated charcoal (activated carbon) as an additional layer of filtration. Activated charcoal not only helps to trap dust and debris, but it is also widely used to absorb smoke, fumes, and odors to help purify the air. There are other filtration materials not listed in this document.

Section 6: Authentic N95/N99/N100 vs. Counterfeit

Due to the high demand and shortage of N95 respirators, counterfeit products are on the rise. Many have been victimized with counterfeit products due to the lack of knowledge in differentiating between a certified N95 respirator and a counterfeit. There are a few things that you need to know when examining a respirator mask. In the article entitled “Counterfeit Respirators / Misrepresentation of NIOSH-Approval,” the CDC gives an example of the exterior markings that should be present on a NIOSH-approved Filtering Facepiece Respirator (FFR), such as an N95. Being able to identify these markings will assist you with securing a respirator mask proven to provide the level of filtration that you desire to have. An example of the markings on an approved respirator mask can be seen in the illustration below.



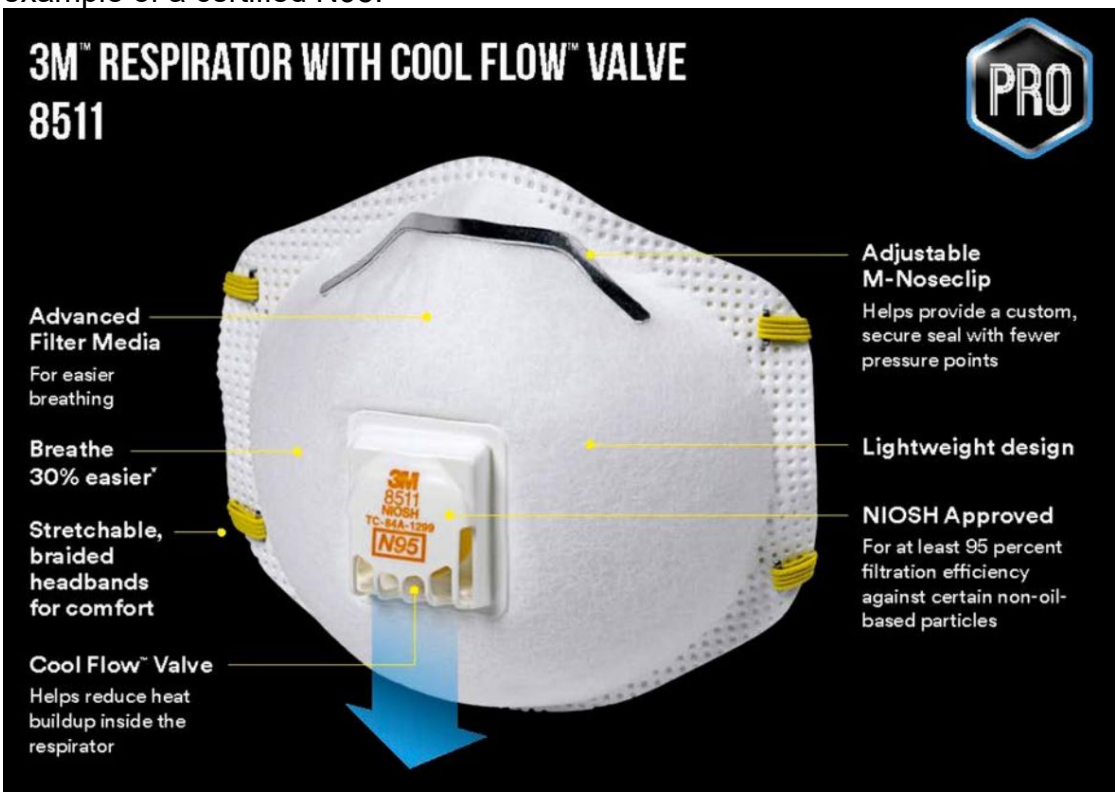
(CDC, 04.21.20, Counterfeit Respirators / Misrepresentation of NIOSH-Approval)[12]

An authentic respirator mask will contain the following information:

- Approval Number
- Model Number
- Lot Number (Recommended but not required)
- Filter Class & Filter Efficiency Level (i.e., N95, N99, N100, etc.)
- NIOSH name in block letters or the NIOSH logo
- Brand Name, registered trademark or an easily understood abbreviation

When considering a respirator mask, ensure that the above-required information is printed on it. It is important to note that manufacturers may not place the information in the same place, as illustrated in the above example. However, even if the required

information is not located in the same place, it should be on the mask. Here is an example of a certified N95:



(Home Depot, n.d., 3M Cool Flow Paint Sanding Respirator (Model 8511, N95)[13]

Although the manufacturer, 3M, does not place the markings in the same place, they are printed in one central location on the respirators.

The following are some examples of masks that are not NIOSH approved N95 respirators:

There are no markings on the face of the respirator. (11/6/2019)

NIOSH does not approve any type of respiratory protection for kids. (11/6/2019)

There are no markings on the face of the respirator. (11/6/2019)

This product is not NIOSH-approved. Look at the markings on the front. The logo is wrong, there is no approval number (TC-84A-xxxx). (11/6/2019)

This product is not NOSH approved. No NIOSH logo or approval number on the face of the product. (11/6/2019)

This product is not NOSH approved. No NIOSH logo or approval number on the face of the product. (11/6/2019)

(CDC, April 21, 2020, Counterfeit Respirators/Misrepresentation of NIOSH-Approval)[12]

After finding the printed information on the respirator mask, carefully examine the information to determine if the product is legitimate or counterfeit. There are some common signs that indicate whether or not a respirator is counterfeit. The CDC states that some of the things to look for are:

- *No markings at all on the filtering facepiece respirator*
- *No approval (T.C.) number on filtering facepiece respirator or headband*
- *No NIOSH markings*
- *NIOSH spelled incorrectly*
- *Presence of decorative fabric or other decorative add-ons (e.g., sequins)*
- *Claims for the approval for children (NIOSH does not approve any type of respiratory protection for children.)*
- *Filtering facepiece respirator has ear loops instead of headbands*

(CDC, 04.8.20, Counterfeit Respirators / Misrepresentation of NIOSH-Approval)[12]

In addition, refer to Section 3 for a reminder on how to tell the difference between a mask and a respirator. Only a respirator will have a NIOSH rating, such as N95, N99, or N100. Masks are not rated.

For more information on spotting a counterfeit respirator mask, go to https://www.cdc.gov/niosh/npptl/usernotices/counterfeitResp.html. To verify the authenticity of a NIOSH approved respirator mask, you may enter the approval number listed on the mask or the manufacturer name into the search tool on this website: https://wwwn.cdc.gov/niosh-cel/

Section 7: Disposable Masks and Filtration Effectiveness

The following chart displays the filtration effectiveness of three types of masks. This chart appears on smartfilters.com. Each mask shows the mask type, the standards used by the countries listed, and the filtration effectiveness. (Robertson, P.,03.15.2020, Comparison of Mask Standards, Ratings, and Filtration Effectiveness)[14]

In the United States, the standards are broken down into three levels. Each level has a different standard of required protection, with Level 1 being a general standard, Level 2 being an intermediate standard, and Level 3 being the standard for maximum barrier protection. For more information on the American Society for Testing and Materials (ASTM) levels that are used in the United States, you may visit https://www.beckershospitalreview.com/quality/the-4-fs-of-medical-mask-selection.html

Mask Type	Standards	Filtration Effectiveness		
Single-Use Face Mask 	**China:** YY/T0969	3.0 Microns: ≥95% 0.1 Microns: ✕		
Surgical Mask 	**China:** YY 0469	3.0 Microns: ≥95% 0.1 Microns: ≥30%		
	USA: ASTM F2100	Level 1	Level 2	Level 3
		3.0 Microns: ≥95% 0.1 Microns: ≥95%	3.0 Microns: ≥98% 0.1 Microns: ≥98%	3.0 Microns: ≥98% 0.1 Microns: ≥98%
	Europe: EN 14683	Type I	Type II	Type III
		3.0 Microns: ≥95% 0.1 Microns: ✕	3.0 Microns: ≥98% 0.1 Microns: ✕	3.0 Microns: ≥98% 0.1 Microns: ✕
Respirator Mask 	**USA:** NIOSH (42 CFR 84) **China:** GB2626	N95 / KN95	N99 / KN99	N100 / KN100
		0.3 Microns: ≥95%	0.3 Microns ≥99%	0.3 Microns ≥99.97%
	Europe: EN 149:2001	FFP1	FFP2	FFP3
		0.3 Microns: ≥80%	0.3 Microns: ≥94%	0.3 Microns: 95%

3.0 Microns: Bacteria Filtration Efficiency standard (BFE).

0.1 Microns: Particle Filtration Efficiency standard (PFE).

0.3 Microns: Used to represent the most-penetrating particle size (MPPS), which is the most difficult size particle to capture.

✕: No requirements.

Section 8: How to Wear and Remove a Disposable Mask

Wash your hands thoroughly and completely, with soap and water, before putting on a mask. If soap and water are not available, use hand sanitizer. Inspect the mask to make sure there are no holes or tears on either side of the mask. Determine which end of the mask is the top and which side is the front. The top of some masks usually has a stiff bendable edge that is meant to mold to the shape of your nose. The front is usually the colored side of the mask and should face away from you, while the white side touches your face.

Putting on a Mask

Be sure that the exterior of the mask is facing outwards, and the top of the mask is facing up. If the mask has **ear loops**, hold the mask by the ear loops and bring the mask toward your face, covering your nose and mouth. Place a loop around each ear to secure the mask to your face. If the mask has **ties**, hold one tie in each hand, and bring the mask to your face, covering your nose and mouth. Place the ties over the back of your head toward the crown, and secure by tying them in a bow. If the mask has **elastic bands (such as a respirator mask)**, hold the front part of the mask in the palm of one hand with the straps hanging outside of the mask. Place the mask on your face, covering your nose and mouth. Pull the bottom strap up and over the top of your head and put it behind your head, letting it rest at the nape of your neck below your ears. Pull the upper strap up and over the top of your head and put it behind your head toward the crown of your head.

If the mask has a stiff nose piece, mold or pinch the nose piece of the mask over the bridge of your nose to obtain a tight seal. For a respirator mask, perform a fit check to ensure there is a good seal against the skin. Always follow the manufacturer's instructions for wearing a respirator.

Do not touch the front of the mask while you are wearing it. The front of the mask may have contaminants that will get on your hands.

Removing a Mask

Disposable face masks are meant to be used once and then thrown in the trash. In case of a mask shortage, contact the mask manufacturer to see if it can be used for a longer period of time. If the mask becomes moist, remove and replace the mask.

Wash your hands with soap and water before removing a mask. If soap and water are not available, use hand sanitizer. When removing the mask, it is important that you do not touch the front of the mask because the front part will be contaminated. **If the mask has ear loops**, hold and unhook both ear loops and gently lift the mask away from your face. **If the mask has ties***,* untie the bottom bow first, followed by the top bow. As the ties are loosened, pull the mask away from your face. **If the mask has elastic bands** (such as a respirator mask) that go behind your head, using both hands, reach behind your head and pull the bottom strap out and to the sides. Then pull the bottom strap up and over your head. Next, reach behind your head and use both hands to grab the upper strap. Pull the upper strap out and to the sides, and then pull it over

your head. Keep pulling on the upper strap as you remove it, allowing the mask to fall forward away from your face.

If the mask cannot be reused, hold the mask by the ear loops, ties or elastic bands and dispose of the mask in the trash. Wash your hands with soap and water before touching anything else. If soap and water are not available, use hand sanitizer.

Section 9: Conclusion

In closing, wearing a mask provides some degree of protection from pollutants and germs. The level of protection can have a large fluctuation. As we saw in section 4, a cotton handkerchief only filters 28% of 0.007 microns, whereas an N99 respirator effectively filters 98.5% - 99.7 % of 0.007 micron particles. Although the respirator is preferable to protect against airborne contagions, having a handkerchief or another type of mask would be better than having nothing at all. Likewise, even if you have the best and highest level of protection available, no protection is 100% foolproof.

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