

What you need to know about your face mask.

Overview

The following document provides more detail on 3D printed adult face mask respirators produced using the following design:

<https://pinshape.com/items/60983-3d-printed-adult-face-mask-respirator>



This mask is not a government-approved mask or respirator. To be perfectly clear, this mask should not be used unless commercial N95 or P3/FFP3 masks are either not available or must be used longer than manufacturer’s recommendations or CDC guidance. This is not a NIOSH or FDA evaluated face mask. No mask excludes all airborne particles, and the best protection is always to avoid situations that put the user at risk. If you decide to use this mask, you assume all risks associated with your usage, including but not limited to injury or death. The following instructions are provided to assist you in using the mask under the assumption of risk described above. The makers of the mask make no express or implied warranties or guarantees or representations of any kind with respect to your use of this mask.

A proper fit of the mask is essential for a proper seal. No facial hair should be present in the mask area of the face. A handheld hair dryer may be used to soften the edges of the mask and slightly mold it to the face to promote a proper fit. Make sure the plastic is not heated so much it can’t be touched. A proper seal may be indicated if you are unable to breathe in or out when the front of the mask is covered, *with the front cap off*. ***If you can’t properly seal the mask against your face, do not use the mask.***

The filter material should be a government-approved filter if at all possible. If a government-approved filter is not available and you decide to create your own filter, you may cut filter material from a HEPA vacuum cleaner bag (or other appropriate filter material) and it should

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fit completely inside the outer cap, completely cover the airway through the mask, and not be so thick that the cap cannot be secured on the mask. *A guide template for correct filter sizing is included.* The filter should be changed at least daily when worn, and when any potential exposure occurs. More can be found about the filter material in the More Details section below.

At least daily the mask should be sprayed down or preferably dipped in the CDC recommended bleach solution (5 tablespoons or 1/3rd cup bleach per gallon of water) and let the solution sit for at least one minute then thoroughly rinse with cold water. Do not use isopropyl alcohol or other disinfectants, or hot water/steam to disinfect the mask as this is likely to result in degradation or deformation of the mask and impair its ability to function.

The mask straps are shoelace material. These may be replaced with the material of your preference, provided it achieves a proper seal against your face.

More Details

Mask Construction

This mask has been 3D printed from polylactic acid (PLA) plastic, which is commonly used in food handling and medical implants, and is biodegradable. PLA is sunlight and temperature sensitive so keep your mask out of the sunlight and hot conditions. This mask is not a commercial product and as such the finish will have irregularities.

Mask Design

This mask has been designed to provide some reduction in personal risk in the absence of commercial N95 or P3/FFP3 masks or when commercial N95 or P3/FFP3 masks must be used longer than manufacturer's recommendations or CDC guidance. The design is completely open source and available free of charge at the link below. The best use of resources are when the mask is printed correctly locally, and distributed to those with high risk, as described in the situation above.

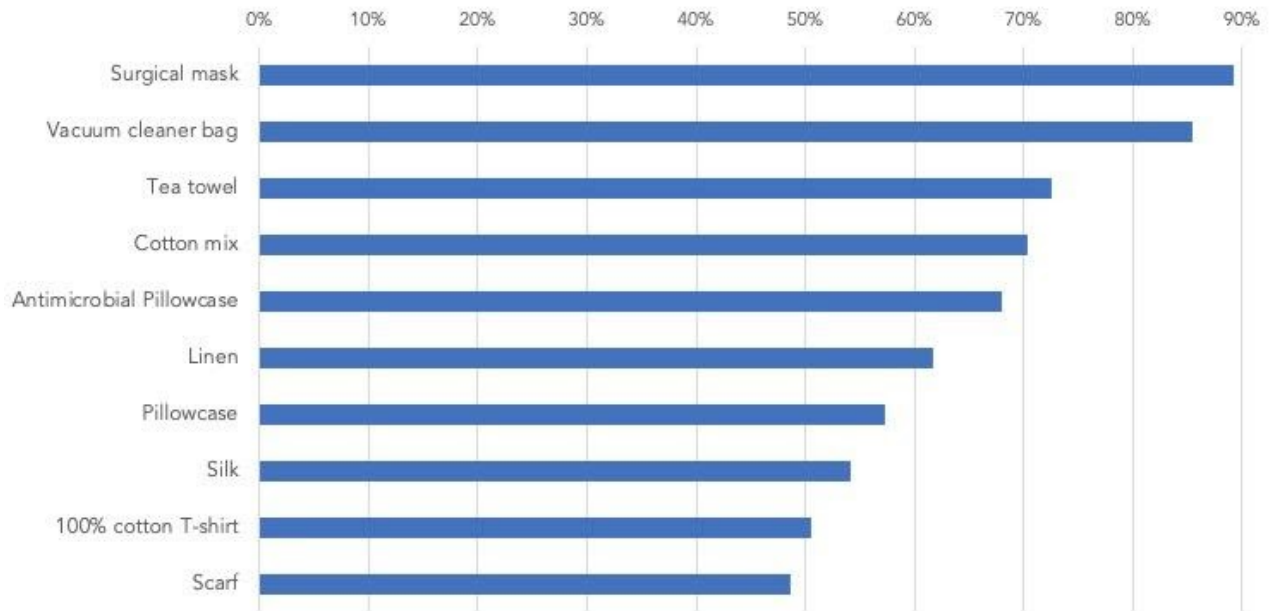
<https://pinshape.com/items/60983-3d-printed-adult-face-mask-respirator>

This mask design has gone through many iterations and differs significantly from early versions of masks available online. Specific differences in this design versus various others include improved fit to the face, greater mask thickness (which through tortuosity may reduce the chance of airborne particle transmission through the mask structure), enlarged airway and filter area (which improves air flow and reduces air velocity through the filter), elimination of seams or contacts in the airway (which may reduce the chance of airborne particle transmission through the airway).

Filter Material

The effectiveness of filter materials varies greatly depending on the material. No mask prevents all airborne particle transmission. An N95 mask prevents transmission of 95% of airborne particles larger than 0.3 microns. The chart below depicts data from a 2013 England National Public Health study on the efficacy of filter materials in preventing transmission of virus sized airborne particles.

Effectiveness of Household Materials at Capturing Virus-sized (0.02 micron) Particles



In this study standard vacuum cleaner bags and surgical masks performed nearly similarly, however HEPA vacuum bags prevent transmission of 99.7% of airborne particles larger than 0.3 microns which make them one of the best household filter materials to utilize. True HEPA filters have a serial number assigned to them somewhere on the bag. There are different types of HEPA vacuum cleaner bags, some use thin layers of woven synthetic fibers (like polypropylene) while others have a thicker cloth construction or glass fiber material. The thicker cloth or glass fiber HEPA filter bags are not to be used. **Surgical masks may be worn over this mask to provide barrier protection against droplet transmission**, improving the life of the filter material.

Media and Other Reporting on 3D Printed Face Masks

The media and others have reported on the efficacy of 3D printed face masks. While much of the reporting is supportive of 3D printed masks and other homemade masks, there is enough other reporting that it warrants covering here. The following is provided for informational purposes only and are not warranties or representations of any kind with respect to your mask. This information does not necessarily apply to any other mask you may use.

Reporting has indicated a number of different potential concerns. The key issues focus on 1) the possibility of transmission of airborne particles through the mask structure, 2) efficacy of the filter material, 3) ability to disinfect, and 4) the proper fit of the mask to the face. We take all of these issues seriously and address each below.

1) There is reporting that there can be small holes between individual layers as large as 6-8 microns, which may increase the risk of transmission of airborne particles. While it is true that there can be small holes between individual layers as large as 6-8 microns, the reporting neglects the mitigating effect of the wall thickness of the mask and the resulting tortuosity, and that the while 3D prints are layers of filament, this face mask design has criss-crossing lines of filament in each layer which significantly reduces the risk that a small hole would likely be connected to another small hole in any direction.

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2) Another issue frequently raised is the efficacy of the filter material. It is true that if an ineffective or improperly installed filter material is used then the level of protection the mask provides is greatly reduced. It's precisely for this reason that filter material was covered extensively above and how to use filter material in this mask is as simple as we can make it.

3) The ability to disinfect masks properly is another issue, and it is a very serious issue as failure to disinfect properly can increase risk of transmission. The reporting on this accurately cites problems with using isopropyl alcohol or undiluted bleach on PLA, and the impact of using hot water or steam. All of these will damage the mask which is why we recommend, above, the practice of spraying the mask down with the CDC recommended diluted bleach solution and allowing it to sit for at least one minute before rinsing thoroughly with cold water in order to properly disinfect this mask.

4) Proper fit of the mask to the face is essential to proper function, so it's not surprising this was raised as an issue. In fact for most early designs this was a fatal flaw. This design was modified several times to adjust the fit to the face and can be scaled to fit face sizes outside of the average face size. In addition, the use of PLA allows the edges to be heated and molded to the face. ***The fit can be checked with the mask snug on your face and breathing in while covering the airway on the front of the mask with the front cap off.*** Your face should pull into the mask and you should not be able to breathe in with a good fit. As said previously, ***if you can't properly seal the mask against your face, do not use the mask.***

Questions or Feedback

If you have any questions regarding your mask, or feedback regarding the mask, please let us know at dothe3d@gmail.com. We hope that we have been able to provide a face mask that will reduce your risk when you need it. Thank you for doing your part to protect all of us as well.