

3D PRINTABLE COVID-19 EMERGENCY MASK v2

PRINTING + ASSEMBLY INSTRUCTIONS



STANDARD FILTER



SCREW-ON FILTER (N95)

DISCLAIMER: This 3D model has not been approved by any regulatory agency and has not passed any laboratory tests. It is a prototype designed by LAFACTORIA3D (a Spain-based company), presented among many other works in the CORONAVIRUSMAKERS community, created with the aim of providing emergency protective material to medical professionals who need it, given the current global shortage of supplies. It is not intended to replace any homologated mask, but to provide minimal protection. We cannot guarantee its operation, so use it at your own risk.

For its correct operation several factors are necessary and must be strictly adhered to. The most important is that the pieces must be perfectly printed, without gaps between layers, and with the best merge possible between walls. There can be no air inlets no matter how small. We also recommend using filaments with low porosity and that offer the possibility of sterilization without damage (TPU+, PETG, etc). It is very important to use a suitable filter, with enough filtering capacity or as close as possible to approved professional masks (see last page).

It is recommended to use glue or silicone to seal the union between the mask and the filter connector, as well as an adhesive rubber to place around the contour of the mask, avoiding skin damage because of an intensive use, and also improving the fit to the face.

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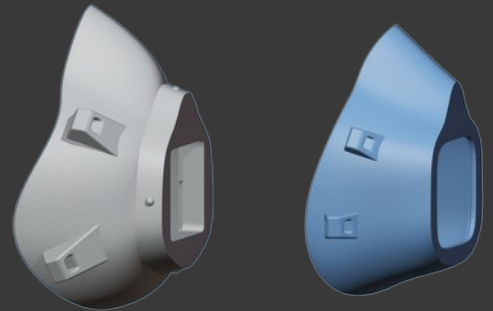
PRINTING + ASSEMBLY INSTRUCTIONS

v2 UPDATES AND IMPROVEMENTS

Important changes have been applied to the original version of the mask, published on Thingiverse on March 16, 2020. Most of these changes are intended to make the easiest print possible, using less time and material.

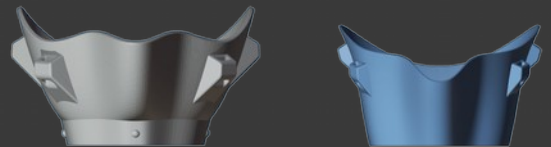
Redesigned curvature

The ailerons of the nose are reduced, avoiding in this way the bone of the nasal bridge, which allows a better facial adjustment in the largest number of faces possible.



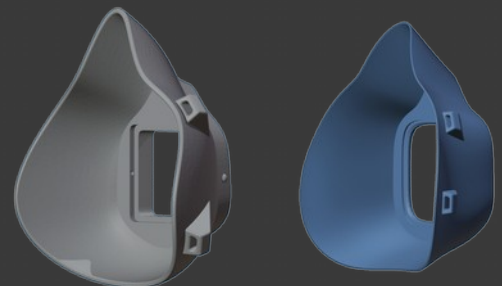
Universal connector for different filters

The new connection system allows the same mask to be compatible with different types of filters, simply by replacing the front connector with another.



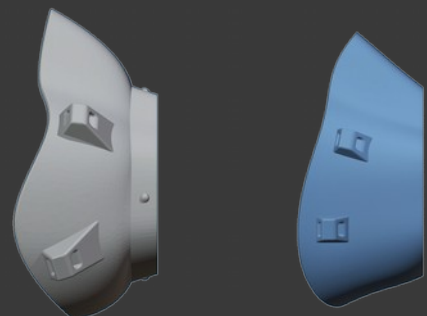
No need for support

The new design ensures that the use of support material is not necessary, after having flattened the bottom of the base, which facilitates the printing.



Thinner walls

The thickness of the mask has been significantly reduced, the base having a maximum width of 4mm and the rest of the mask only 0.8mm (to print with two walls).



Smaller hooks

The hooks for elastic straps have been reduced almost in half, having to use less material.

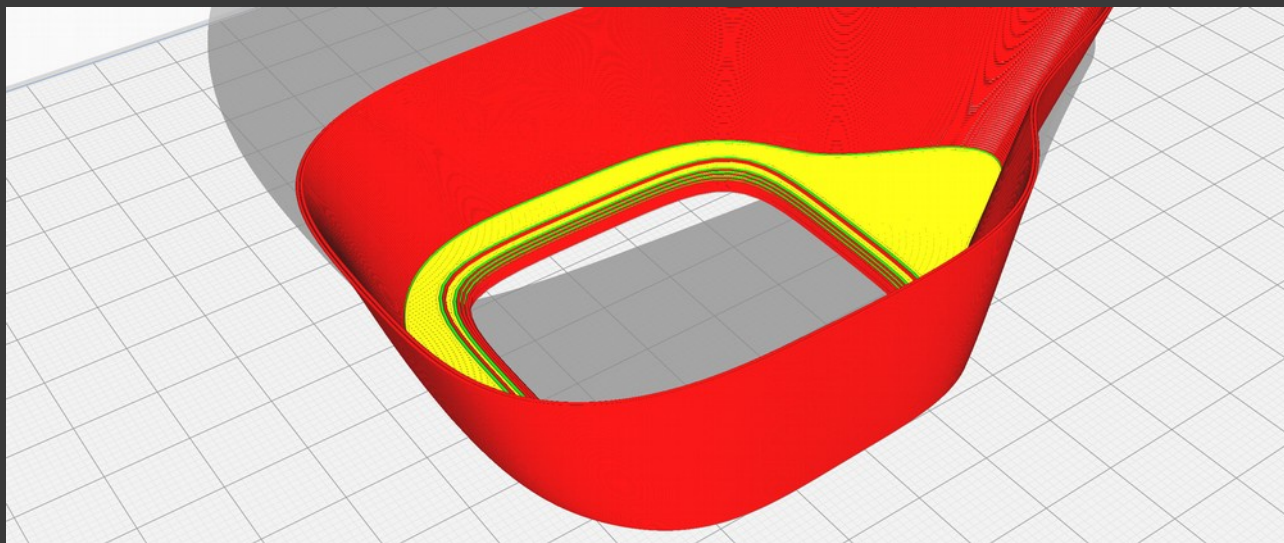
Three predefined sizes

The mask body is available in three sizes (S, M, L) so there is no need to scale the model before printing.

3D PRINTABLE COVID-19 EMERGENCY MASK v2

PRINTING + ASSEMBLY INSTRUCTIONS

PRINTING THE MASK



File to print (depending on size): **Mask_body_S.stl** / **Mask_body_M.stl** / **Mask_body_L.stl**

Reducing the thickness of the mask has reduced printing times from 3 hours to only 1 hour.

In other words, a printer working non-stop can now manufacture 24 masks per day.

For a correct printing we recommend using the following parameters (in all printed components):

Layer height

0.25mm

Bottom layers

2

Wall line count

2

Top layers

3

Line width

0.4mm (walls)

0.3mm (infill)

Infill

15-20%

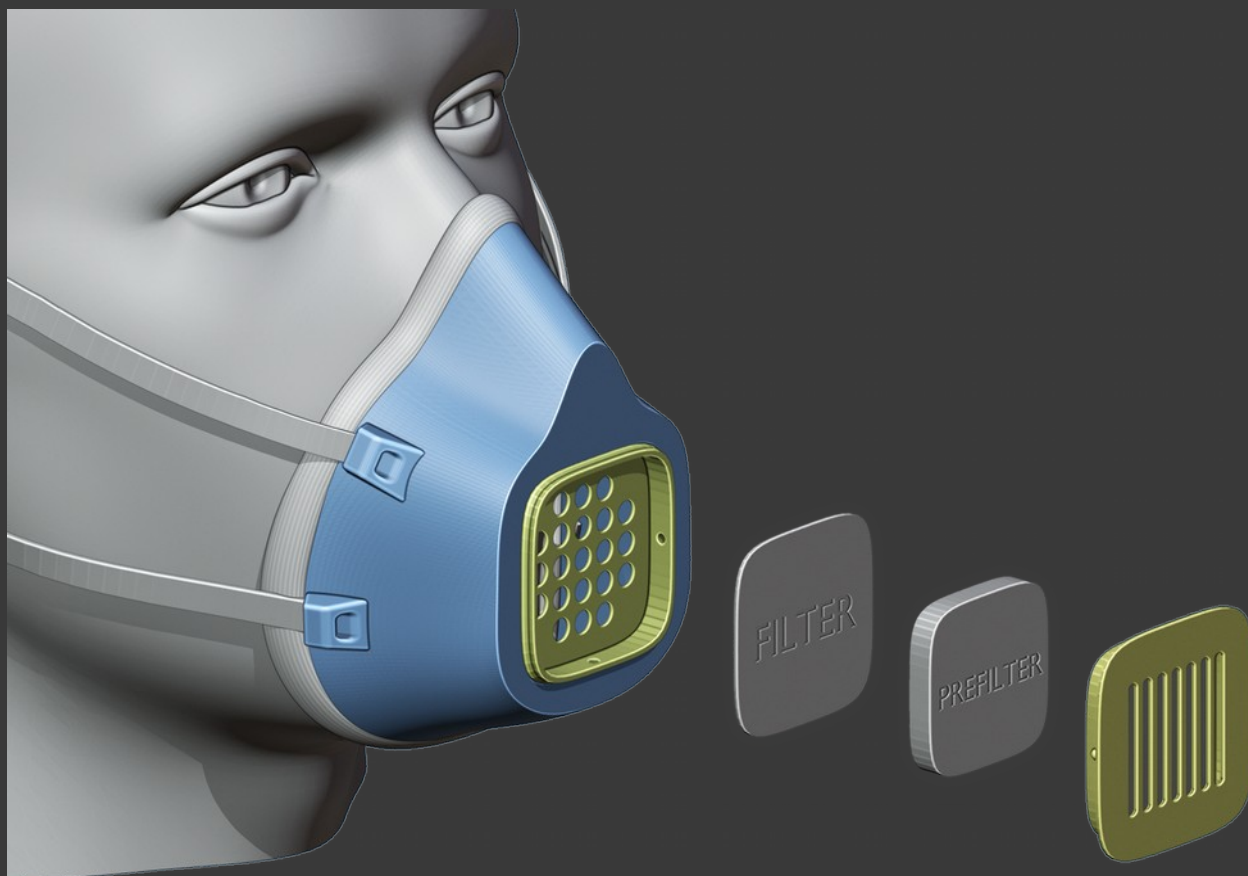
No need to use support material, since the model has been specially designed for it. The only hanging part is the lower area of the hooks for the rubber strips, but since it is a relatively short horizontal distance it prints without difficulty.

We also recommend turning off the “Print Thin Walls” (CURA) setting to prevent it from making more than 2 passes when printing the mask external walls. The recommended printing speed (although this depends a lot on the machine used) would be 45mm/s, except for the walls where we would reduce it to 35mm/s to guarantee a good surface finish without cracks. It is advisable to limit the speed of the first layer enough to guarantee a good adherence of the piece.

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PRINTING + ASSEMBLY INSTRUCTIONS

STANDARD FILTER



This is a modification of the original filtering system, but removing the cap (which consumed a lot of material and printing time) and replacing it with a more compact one, easy to remove. The objective is to facilitate cleaning / sterilization of the structure and its parts, in addition to expediting the change of filters.



CONNECTOR

Estimated printing time: **20 minutes**

File to print: **Filter_standard_connector.stl**

The connection system has been improved, allowing a more efficient isolation of the air flow, and facilitating the connection to the mask with a single “click”.



CAP

Estimated printing time: **20 minutes**

File to print: **Filter_standard_cap.stl**

The large original cover is replaced by this more compact one, significantly reducing the time required for its manufacture.

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PRINTING + ASSEMBLY INSTRUCTIONS

ASSEMBLING THE STANDARD FILTER

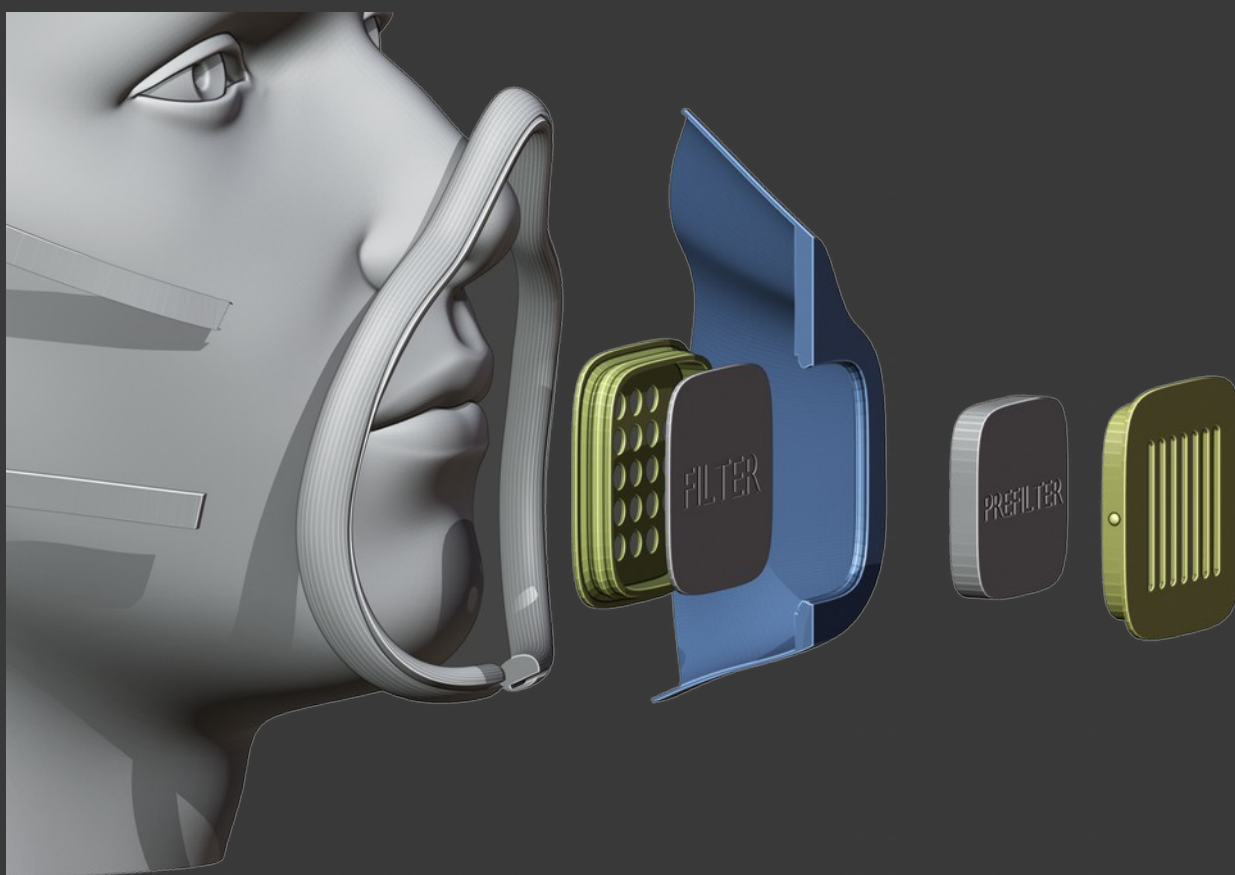
We will need three printed parts (mask, connector and cap).

We place the connector from the inside, pressing tightly so that it clicks into place. Inside, we will place the main filter, occupying the entire surface of the connector, without gaps. Later we will install the pre-filter inside the cover, which then fits into the connector from the outside.

Once the set is assembled, we will install two elastic rubber straps to hook on the four hooks of the mask. It should be a little tight to prevent it from falling or leaking air from the sides.

Optionally it is possible to install an adhesive rubber strip bordering the contour of the mask, to avoid damage to the skin after several hours of use, and also to improve grip and facial fit.

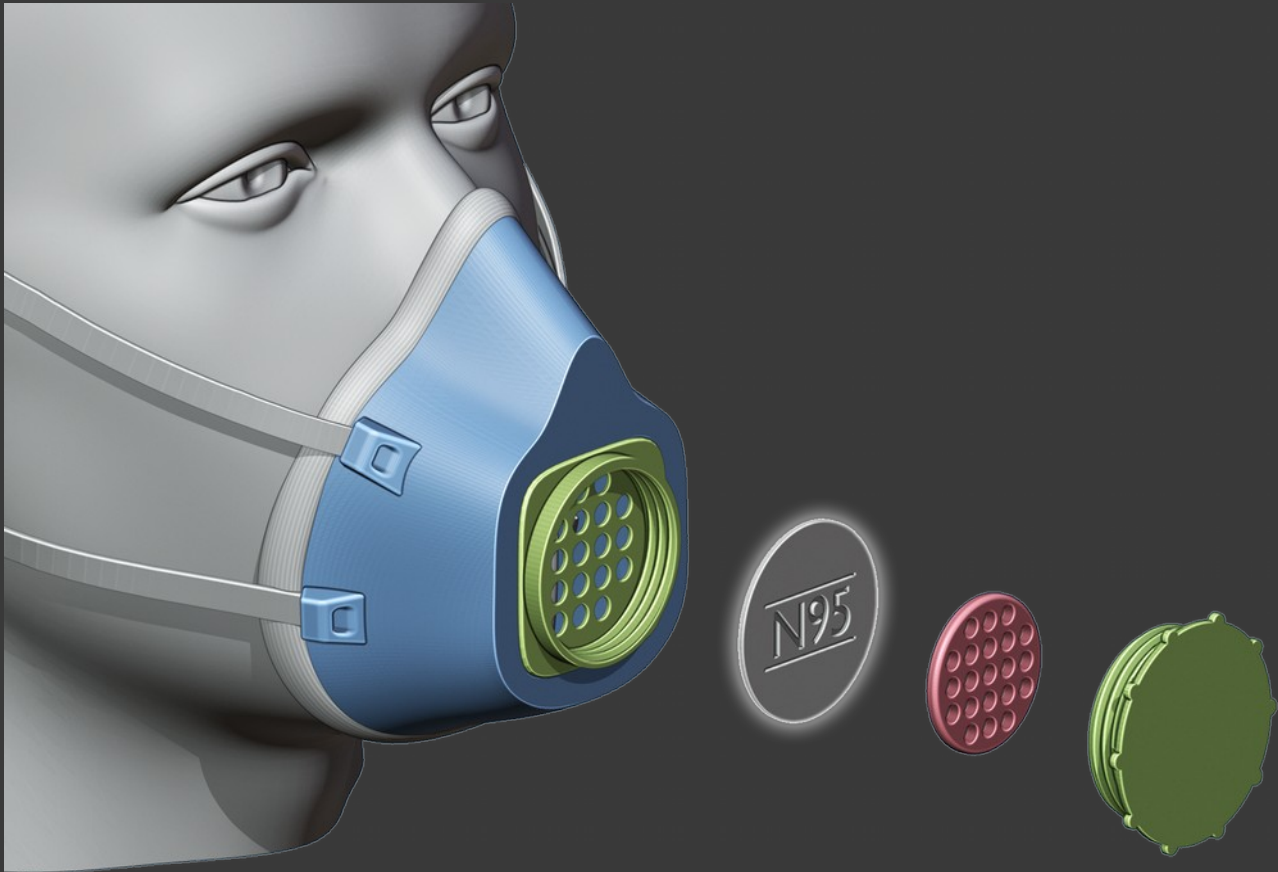
It is also recommended to use glue or silicone to completely seal the air inlet between the connector and the mask itself.



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PRINTING + ASSEMBLY INSTRUCTIONS

SCREW-ON FILTER (N95)



Instead of snapping on the lid with a click, this screw-on version allows air to enter through various side channels located at the bottom of the cap. This format of masara is recommended in case of having an N95 approved filter.



CONNECTOR

Estimated printing time: **30 minutes**

File to print: **Filter_N95_connector.stl**

The cap is screwed into this part, after placing the filters.

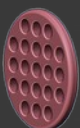


CAP

Estimated printing time: **30 minutes**

File to print: **Filter_N95_cap.stl**

Screw-on, includes lateral ventilation channels.



BUTTON (optional)

Estimated printing time: **10 minutes**

File to print: **Filter_N95_holder.stl**

It is used to prevent the filter from obstructing the ventilation channels.

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PRINTING + ASSEMBLY INSTRUCTIONS

ASSEMBLING THE SCREW-ON FILTER (N95)

We will need three printed parts (mask, connector and cap).

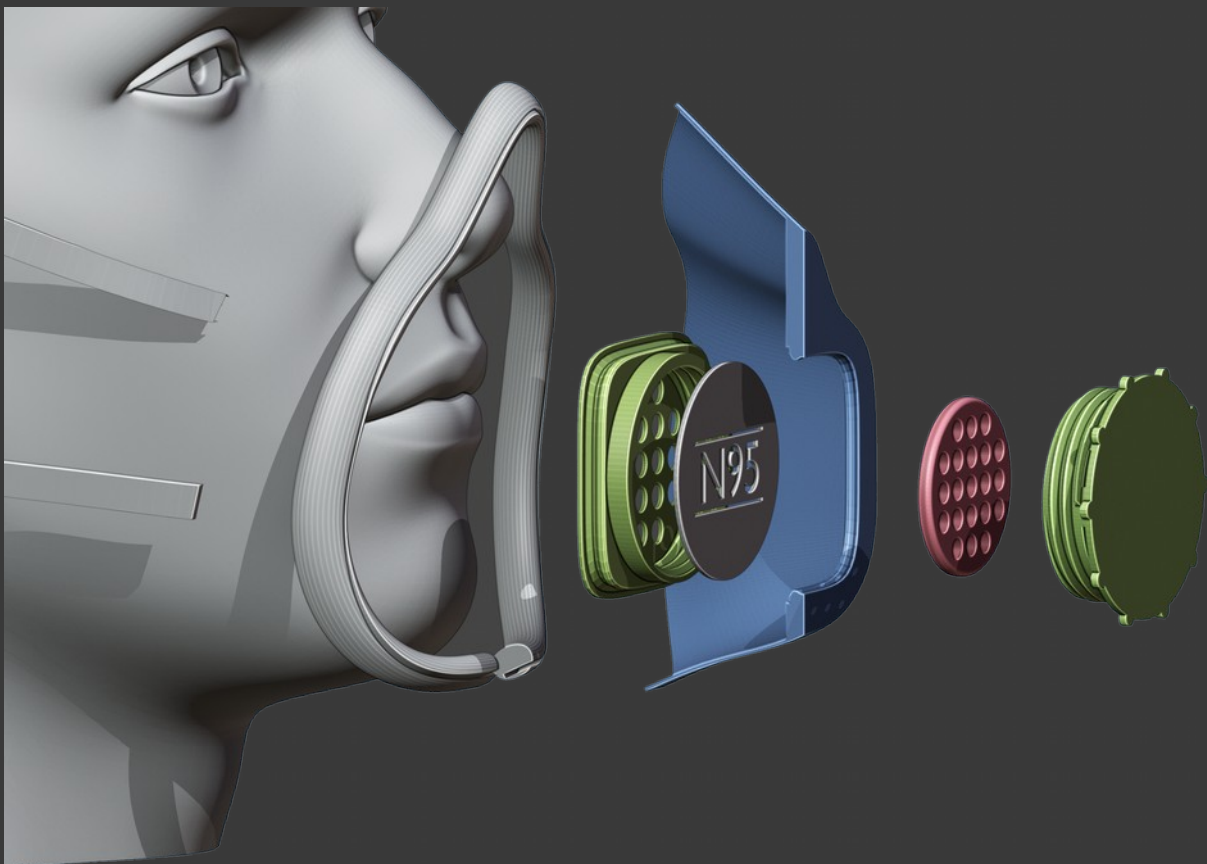
We place the connector from the inside, pressing tightly so that it clicks into place. Inside, we will place the N95 disc filter, occupying the entire surface of the connector.

Installed the connector, we place the pressure button inside the cover, which will screw on the connector leaving the lateral air inlets free.

Once the set is assembled, we will install two elastic rubber straps to hook on the four hooks of the mask. It should be a little tight to prevent it from falling or leaking air from the sides.

Optionally it is possible to install an adhesive rubber strip bordering the contour of the mask, to avoid damage in the skin after several hours of use, and also to improve grip and facial fit.

It is also recommended to use glue or silicone to completely seal the air inlet between the connector and the mask itself.



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WHAT FILTERS TO USE WITH THE PRINTED MASK?

Ideally, you can use FFP3 type filters (such as N95) or FFP2.

In case of not having an approved filter material, there are several alternatives relatively easy to obtain, with different degrees of filtering efficiency based on 1 micron particles.

(Information taken from: <https://smartairfilters.com/en/blog/best-materials-make-diy-face-mask-virus>)



SURGICAL MASK	97%
VACUUM CLEANER BAG	95%
DISH TOWEL	83%
COTTON BLEND	74%
100% COTTON T-SHIRT	69%
ANTIMICROBIAL PILLOWCASE	65%
SCARF	62%
PILLOWCASE	62%
LINEN	60%
SILK	58%

MORE LINKS OF INTEREST (recommended reading)

(ENGLISH) Simple Respiratory Protection—Evaluation of the Filtration Performance of Cloth Masks and Common Fabric Materials Against 20–1000 nm Size Particles

<https://academic.oup.com/annweh/article/54/7/789/202744>

(ENGLISH) Disposable Face Mask Ratings: N95, P2, BFE, CE. What does NIOSH Approved mean?

<https://www.nipissingu.ca/sites/default/files/2018-06/Disposable%20Face%20Mask%20Information.pdf>

(ENGLISH) Submicron and Nanoparticulate Matter Removal by HEPA-Rated Media Filters and Packed Beds of Granular Materials

<https://ntrs.nasa.gov/search.jsp?R=20170005166>

(ESPAÑOL) Aspectos físico-químicos de la prevención del contagio por aire: mascarillas

<https://foro.coronavirusmakers.org/index.php?p=/discussion/90/aspectos-fisico-quimicos-de-la-prevencion-del-contagio-por-aire-mascarillas>

(ESPAÑOL) Información sobre filtros

<https://docs.google.com/document/d/1qcUulXBupfjPoHO8ndF7U2yxTGApq1IXWNcBXVhNDRU>