



Observations Regarding Face Covering Designs Using Commonly Available Materials

The Center for Disease Control has recommended that the public should wear cloth face coverings in public settings¹. A Sandia COVID-19 LDRD effort, the Sandia E-PiPEline Team, systematically evaluated design options for face coverings constructed from commonly available materials (CAMs). The design options were analyzed with subject matter expert input considering the design's **effectiveness** (metric fiber density, material construction, and water saturation), **reusability** (degree of inertness), **producibility** (ability to obtain materials, build time), **cost**, and **comfort** (fit on face, breathability). Observations for the design of face coverings using CAMs are provided here.

DESIGN SPACE

The principle design characteristics and alternatives considered for the construction of a face covering are listed below.

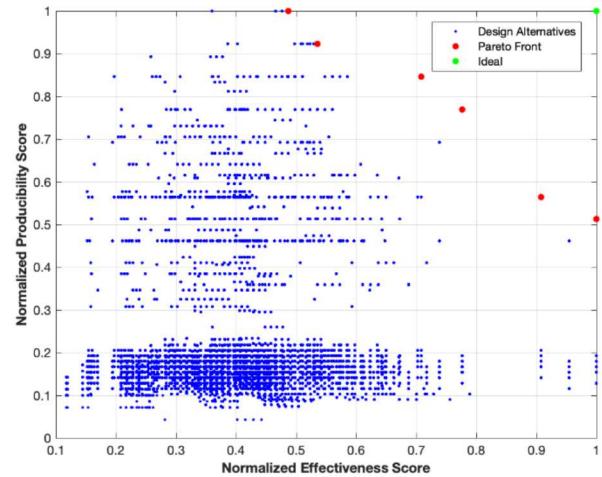
Number and materials of layers: 1-3 layers; woven cotton materials, paper-based materials, synthetic fabrics

Connection method and location between layers: sewn, glued, stapled; around edge or center and edges

Treatments of the top layer: machine wash, bake in oven, iron, machine dry, none

Attachment methods: integrated designs, compression straps, Velcro straps

The graphic at top illustrates the results of scoring more than 200,000 designs evaluated for face coverings using CAMs. The normalized design scores are shown in blue, with the best options shown in red. The scores are normalized relative to the highest score in the **effectiveness** and **producibility** metrics.



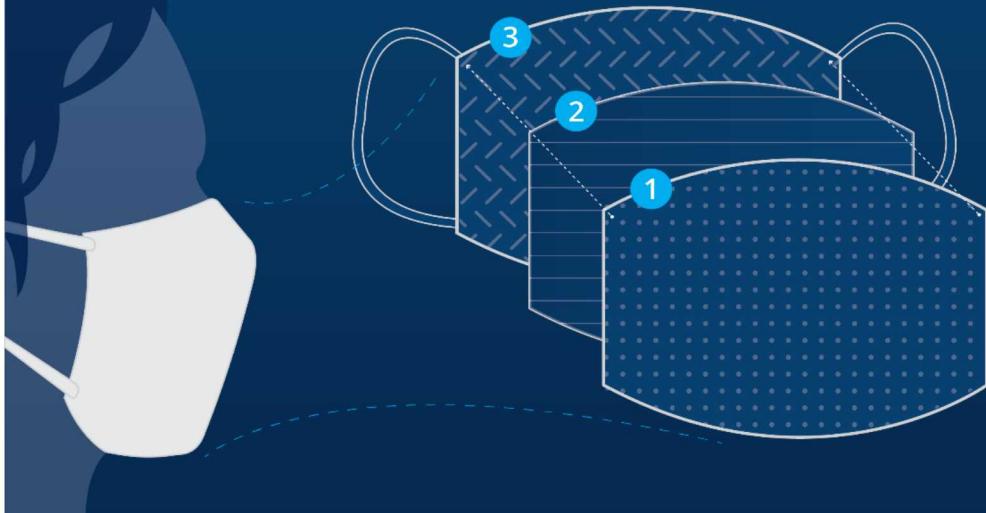
DESIGN OBSERVATIONS

- More layers increase effectiveness
- Full coverage over mouth and nose reduces chances of particles reaching the face
- Mask conformability improves effectiveness

MATERIAL OBSERVATIONS

- Leverage cotton and paper-based materials to capture aerosolized water droplets within the fiber matrix
- The placement of natural-based materials sandwiched between two water repelling synthetic based materials decreases liquid movement towards the face
- Using materials with high fabric density to improve particle filtration while maintaining user breathability
- Prioritize user safety by selecting materials that reduce loose material particle inhalation hazards

Face Covering with 3 Layers of Material



- 1 Increased material fiber density and water repulsion for improved particle blocking and user breathability.
- 2 Higher filtration effectiveness leveraging the material's ability to enhance particle collisions and attraction to water to allow for better viral particle entrapment and water droplet capture.
- 3 Designed for skin-material compatibility with high fabric density. Increased water repulsion for improved blocking of particles and reduced viral transmission via fabric wicking to the mouth and nose.

¹ <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover.html>