



COVID-19 Response: Mask Fabrication Initiative

FRC Team 5740 - Trojanators

Purpose

Following the increasing spread of the virus COVID-19 across the world, the 2020 FIRST Robotics Competition season has been suspended. This has left thousands of people out of work, school and activities. The effects of this virus can be reduced with proper personal protective equipment (PPE), however there is a mass shortage of items including face masks, gowns, gloves, and other necessary items to keep patients and healthcare workers safe. As a combative effort against COVID-19, homemade protective face masks from provided materials can be donated to healthcare facilities as noted by the [CDC's strategy to optimize the supply of face masks](#).

Due to the mask shortage, fabricating homemade masks can protect those in healthcare facilities, while teaching and strengthening important life-skills. This initiative applies ready hands to a deserving cause, and keeping with the spirit of the FIRST community by making a positive impact.

Mask Specifications

These masks are fabricated from 100% cotton material and lined with interfacing. Elastic bands hold the mask on the face and the interfacing provides a dense material for air filtration. The masks are one-size-fits-all for adults and they are made from a standardized list of materials. An example mask with a midweight interfacing is depicted in Figure 1 on page 2.



Figure 1: Example finished face mask.

Homemade masks must be washed in a washing machine on the hottest setting with soap before donating them to a healthcare facility. After washing, place the masks in a sealable bag, or container, to donate. This can reduce the chance of contamination. Healthcare facilities should sanitize donated masks according to their sanitization protocols prior to distributing them for use.

Tools & Materials

JOANN Fabrics is providing face mask fabrication kits to community members free of charge. Additional resources regarding mask donations and fabrication are found on their [Make To Give Response](#) website. The kits can also be replicated with similar materials. This document will provide details about the JOANN Fabrics kits, but can be adapted to other methods and materials. The list of Tools Needed provides a general list of required equipment to make the masks, regardless if you receive a mask kit. The list of Materials Needed is a list of items found in the kits.

Tools needed:

- Sewing equipment (sewing machine, thread, pins, etc.)
- Scissors or seam ripper
- Iron and ironing board (or suitable place to iron)
- Rotary cutter for fabric (can be used in place of scissors)



- Ruler or other measuring tool
- Washing machine and dryer

Materials needed:

- 100% cotton fabric
- [1/4" or 1/8" flat elastic](#)
- [Featherweight](#) or [midweight](#) fusible (iron-on) interfacing *

*Interfacing is not always provided in JOANN Fabrics mask kits. If interfacing is not provided, masks can be made without the use of interfacing and still be effective. If interfacing is not being used, skip procedure steps 3-6 below.

Procedure

The following steps outline the methods to sew a face mask. If unfamiliar with sewing, online example [resources](#) and [videos](#) are easily accessible. A video that follows nearly identical to the steps to this document can be found [here](#).

1. Measure and cut a 12 by 9 inch piece of cotton material.
2. Measure and cut a 7 inch long piece of elastic. Repeat until two elastic bands are cut.
3. Interfacing:
 - a. If interfacing is "thin", (lightweight) measure and cut a 12 x 9 inch piece.
 - b. If interfacing is "thick", (midweight) measure and cut a 6 x 9 inch piece.
4. Heat an iron using the cotton setting, with the highest steam setting activated. A high heat and steam setting is needed for the fusible interfacing to bond to the fabric. A video pertaining to the ironing process can be found [here](#).
5. Place the interfacing with the bonding (sparkly/glossy) side facing upward on an ironing board, place the fabric with the printed side upward on top of the interfacing. Allow 3 to 7 minutes of ironing time per mask to ensure maximum bondage.
 - a. Thin (lightweight) interfacing will line up with all sides as in Figure 2 on page 4.

- b. Thick (midweight) interfacing will line up with the 9 inch sides as shown in Figure 3 below.

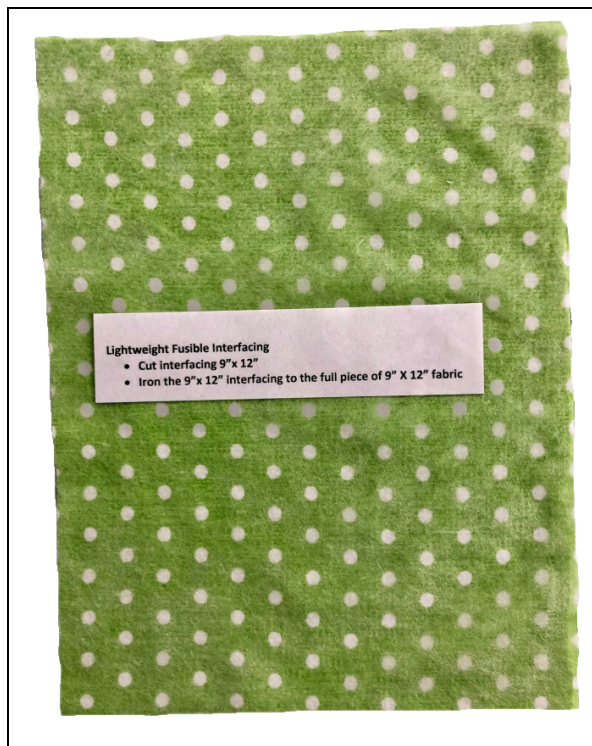


Figure 2: 12x9 inch lightweight interfacing.

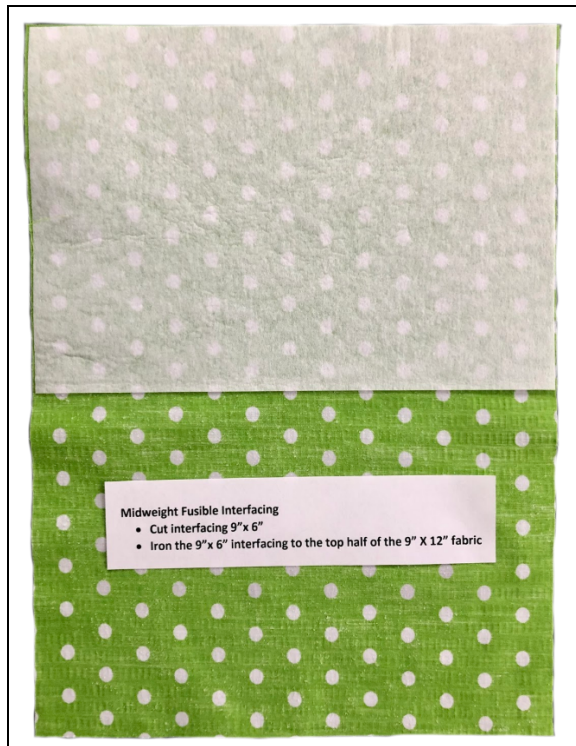


Figure 3: 6x9 inch midweight interfacing.

6. Once the interfacing is bonded to the material, fold the material in half with the print on the inside (right side together for experienced sewers), creating a 6 x 9 inch piece of material.
7. Using a 1/4" seam allowance, sew the 9 inch edge with the openings by sewing from each corner proceeding inward 3 inches, leaving a purposeful gap used to flip the mask inside out later. Figure 4 on page 5 notes the necessary gap with the red circle.

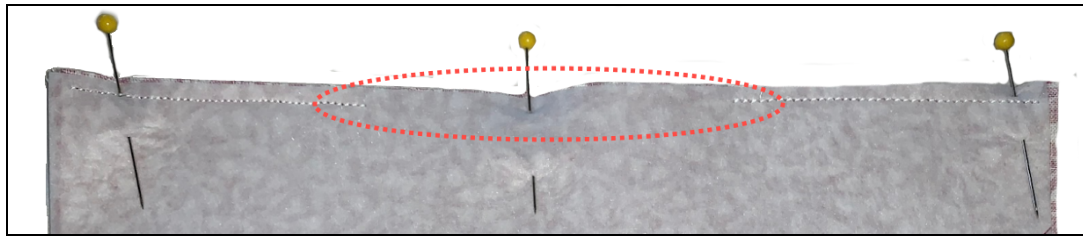


Figure 4: Face mask: Step 7 with denoted seam placement.

8. Pin the elastic bands on each 6 inch side curving the loose elastic band inward. Pin each end in place and pin the loose elastic on the inside so it does not get caught while sewing the sides. Back the ends of the elastic to make the masks more sturdy. Note that the elastic placement shown in Figure 5 below occurs under the first layer of fabric. Figure 6 below is the appearance of the fabric before sewing each side. Loose elastic is kept inside of the pocket of fabric and is exposed after flipping.



Figure 5: Visual of elastic placement.



Figure 6: Actual elastic placement.

9. Using a $\frac{1}{4}$ " seam allowance, sew each 6 inch side of the material as shown in Figure 7. Backstitch over the elastic to ensure that it is secure. To backstitch on a sewing machine, simply sew 1-2 stitches forward and then put your machine in reverse for 1-2 stitches in order to secure the seam.



Figure 7: Sewn mask before flipping.

10. Flip the mask inside out through the 3 inch opening on the 9 inch side, the mask's structure should look identical to Figure 8 below.



Figure 8: Mask before pleating.

11. Using 2-3 pins, pin the gapping seam closed, as pictured in Figure 9 below.
12. Place 3 pins on each side splitting it into quarters, these will be used to pleat the mask.
13. Fold the mask from the bottom into three pleats and pin into place, the pleats should nest into each other. More information regarding the pleats is in [this](#) video. Refer to Figure 9 on page 7 for a visual of the finished mask with pleats.



Figure 9: Finished mask after pleating.

14. Sew around the entire perimeter of the mask, backstitching over the pleats and closing the 3 inch gap used to flip the mask inside out. Remove pins once completely sewn.
15. Disinfect fabricated masks by washing them in a washing machine with the hottest water setting. A gentle or hand wash cycle, or a laundry bag, may be used to prevent the masks from becoming tangled especially if the washing machine contains a center agitator. After washing the masks, place them in the dryer and dry them on a high heat setting. Place each mask into individual plastic bags or containers to lessen the chance of contamination.
16. Communicate that all recipients should cleanse the masks before use in a health care setting according to their facilities procedures, and that the masks can be washed daily for reuse.

Future Work

There are several variations of these masks that can be made with similar guidelines. Some examples of these variations include:

- Sewing a pipe cleaner at the top face to allow the mask to bend and form to the face.



- Removing the interfacing and leaving a pocket to slide in pieces of reusable furnace filter.
- 3D printing masks to be attached with elastic.

All of these variations are acceptable ways to assist health care professionals in this time of need, Team 5740 decided to choose the described mask because the materials are most readily available and it allows for maximum scalability of this initiative.

Acknowledgements and Disclosures

A special thanks to JOANN Fabrics for providing kit materials from all their stores nationwide. Their in-kind donations are crucial in assisting healthcare professionals amidst this shortage of PPE. For more information regarding their initiative visit [this](#) webpage.

Please note that these masks **are not** specified as PPE equipment and do not hold up to the CDC's standards of personal protective equipment. The CDC states that these masks should only be used as a last resort. Team 5740 is not liable for any issues caused from or associate with the wearing of said masks or the fabrication process. Other than the donation of materials, JOANN Fabrics is not associated with this individual effort.

If any questions arise, suggestions, or an opportunity to scale this initiative is found, please contact frc5740@gmail.com. If you are unsure of which facilities are in need of donations, contact the email above or your local health care facilities. Please spread the word about this initiative within your communities and on social media by using #FIRSTfightsCOVID. We are asking contributors to please fill out [this](#) form so we can present our data to Joann Fabrics, healthcare facilities, and FIRST.

Together we can help save lives and contribute to the fight against this pandemic.



References

-CDC mask supply guidelines:

[Strategies for Optimizing the Supply of N95 Respirators: COVID-19 | CDC](#)

-JOANN Fabrics mask making instruction site

[Make to Give - Support Our Medical Personnel](#)

-Business Insider article regarding homemade face masks

[How to make an effective face mask at home](#)