



# PAPR Documentation

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Last Updated: 5/12/2020

Other Helpful Docs

[Bill of Materials](#)

Click to download the [Rough Early 3D Model of the Blower Box](#)

- [You'll need this software to view.](#) if you don't already have something that will open an easm
- There are a few specifics that are not 100% correct, as the drawing was made from an 'unassemble-able' demo unit

[Patterns for the hood](#)

# PAPR Hood Construction

A couple of notes before we get started:

- Our Doctors requested 3 hoods and hoses for every blower unit to facilitate the decontamination process. Below are the instructions for making one.
- All Seam allowances are  $\frac{3}{8}$ " unless otherwise noted.
- The lower front and lower back are made 2 layers. The bottoms are not stitched closed to allow for an easier decontamination process.
- **Note that logos on the house wrap should be on the Back/wrong sided**

## A. Material notes:

### a. Main Fabric- All of the White Parts on the Parts List

#### i. [Home Depot Everbilt 9x150' Non-woven House Wrap](#)

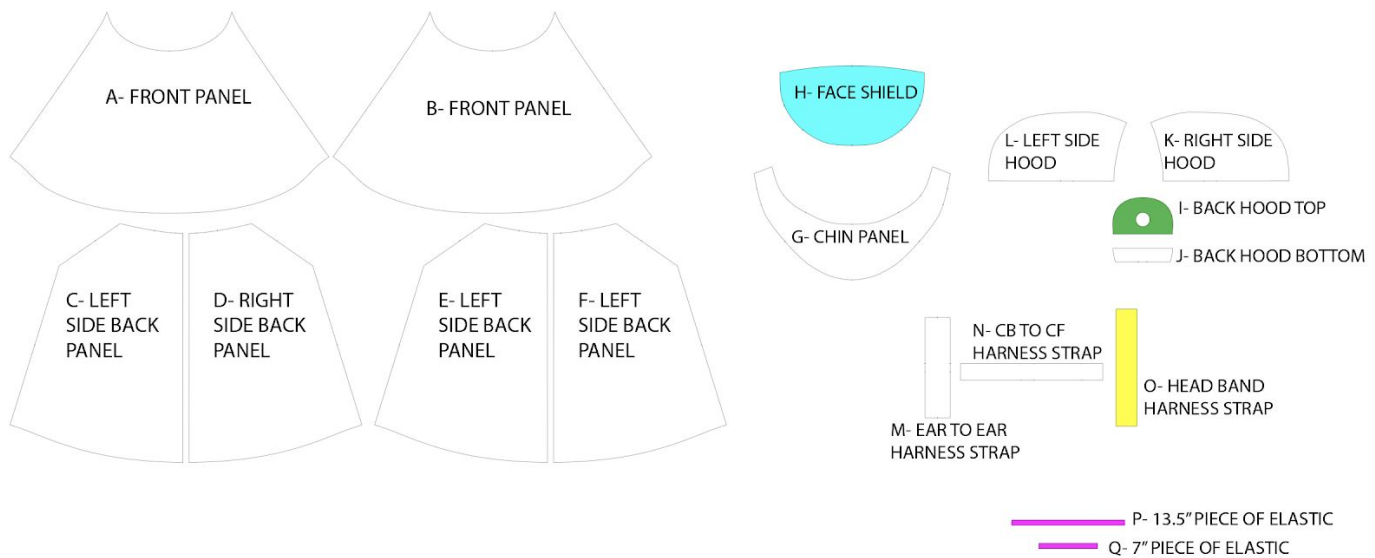
1. Note that this is a Tyvek style non-woven material. There are lots of varieties of Tyvek-Style House wrap. This is the preferred one, as it is slightly thicker, and sews more easily. Also the hand and drape of it works better as a garment.
2. [Here is the Spec Sheet.](#)
3. We used the logos side as our 'Wrong Side' of the fabric.
4. After talking with a career materials specialist from the outdoor industry who deals often with waterproof breathable fabrics, she recommended that any fabric below 1CFM would not allow .3 micron particles such as the COVID-19 virus to move through the fabric.
5. We chose this material because it is easily purchased in bulk amounts locally, and is waterproof and lightweight. We stayed away from woven fabrics (like a nylon ripstop that you might see on a backpacking tent), as the fibers that are exposed on one side may take longer to decontaminate.
6. This roll is 9 feet wide. We used a water jet to cut the roll down to 2 ~54" wide rolls to make it more manageable
7. We also used the water jet to cut the pattern pieces for speed and accuracy. We were able to get away with this as the house wrap does not absorb much water.

### b. Headband - Yellow on the parts list

- i. We used a ~3mm thick Spacer mesh that we had on hand from personal stock
- ii. We used the laser cutting to cut these, as the water jet would send sand into the mesh and the fabric would absorb the water.
- iii. You can get this material in various forms from companies like [owfinc.com](#) and [rockywoods.com](#)

- iv. If a spacer mesh is not available, you could consider a non stretch flannel woven, or something with a bit of thickness to it that will be comfortable for hours next to skin.
- c. Plastic Face Shield - Cyan on the Parts list
  - i. This will likely be the hardest piece to source (outside of the actual filter for the blower unit).
  - ii. We used .020 thick PETG plastic. You can likely also use .030. This material is getting bought up across the US right now, and is proving to be hard to find.
  - iii. Some considerations while looking for substitutes:
    - 1. Thickness matters- too thick and it may not bend or sew well.
    - 2. Material matters- I've only tested sewing through this PETG. Other plastics may crack or shatter when perforated a few hundred times with a sewing needle. Test before you buy bulk quantities. If all other criteria are met, but it can't be sewn, you may be able to use a double sided adhesive for the seams.
    - 3. Clarity matters- Docs and nurses need to be able to see clearly through the plastic. Some plastic are slightly opaque at the thickness we need.
    - 4. Substitute ideas (which haven't been tested by me): transparency films (like for an overhead projector), or maybe even laminating film (one sample we got would need to be heated to be clear).
  - iv. Upper Back Hood- Green in the parts list
    - 1. We needed something durable and a bit stiff to attach the hose to the hood.
    - 2. We used [PVC Shower Pan Liner](#).
    - 3. We used a water jet to cut it.
  - v. Elastic - Pink on the parts list
    - 1. Elastic is becoming difficult to source nationwide. We have used ¾" foldover elastic as well as ½" flat elastic. We have not tried to use ⅛" bungee (which might be easier to find) which might work if you put it in a casing.

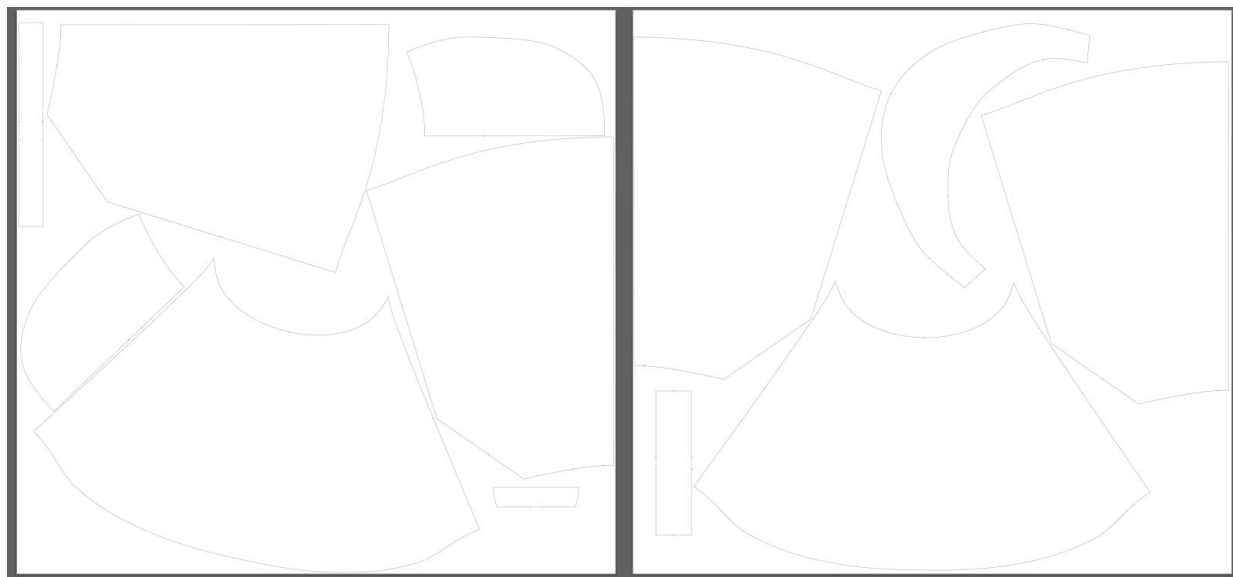
## B. Parts List/Diagram:



### C. Construction

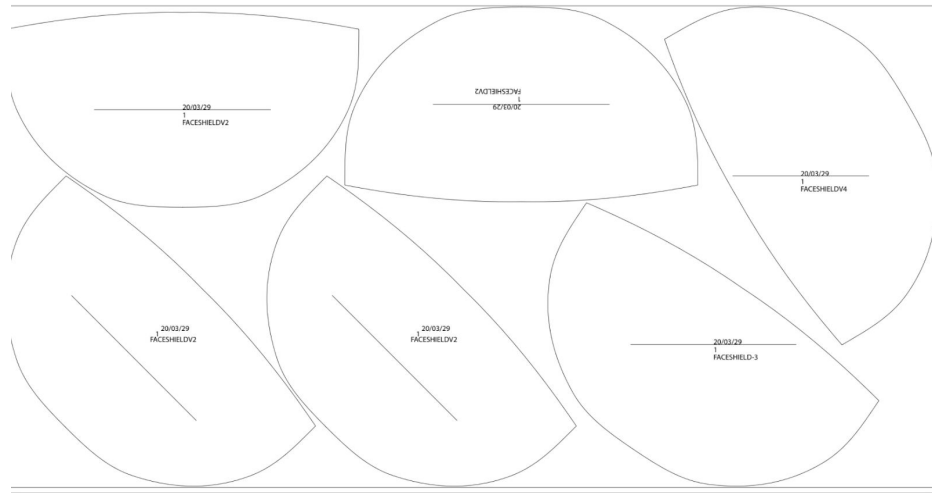
#### a. Cut out all pieces.

- i. We used a waterjet to cut the fabric in bulk. The pieces end up slightly damp, so I wouldn't let it set around for too long, but we didn't have much issue with cutting ~230 layers at a time.
- ii. Here was our layouts for the housewrap pieces based on the constraints of our machine:



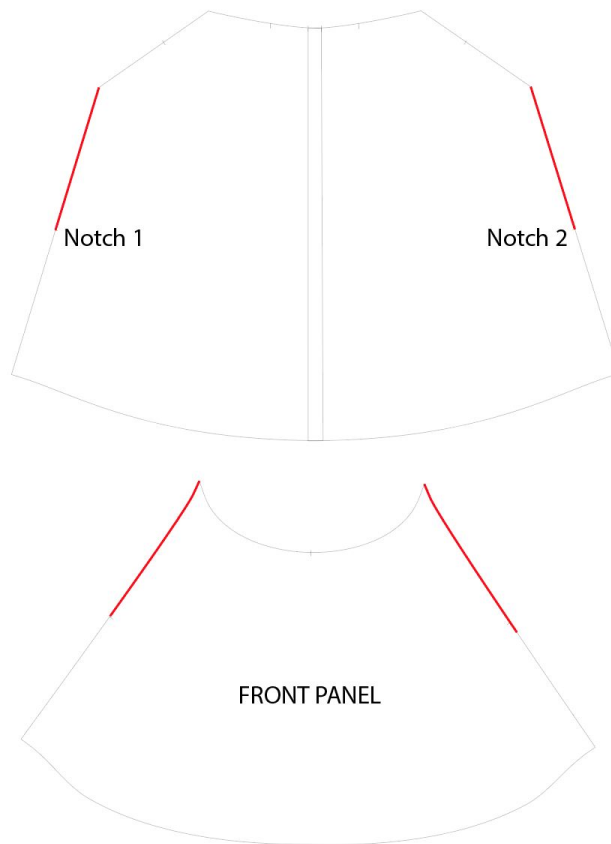
- iii. Note that center seam on back panels could be eliminated and pieces conjoined, but it significantly increased our material usage
- iv. Also, some of the pieces are 'off grain'. Because this is a non-woven, there didn't seem to be an issue with cutting on a bias.

- v. For the PETG Face Shield, we used 2x4' sheets, getting 6 pieces per sheet using this



layout:

- b. Sew the Front Panels (A+B) together.
- Place the two panels together, with the logos facing each other and sew along the sides and top using a  $\frac{1}{4}$ " seam allowance. Do not sew along the bottom. This is left open for easier cleaning and drying of the hood.
    - Once done sewing both sides are the "Right side of the fabric" and this piece can be flipped without issue.
- c. Assemble the Back Panel (C+D and E+F)
- With right sides of C+D together, sew down the long straight seam (this is the Center Back) to combine into one back panel.
  - Repeat the above with pieces E+F.
  - Now lay the wrong sides of the two full back panels together and sew along the perimeter **except for the bottom**. Again this is left open for cleaning.
  - Once done sewing both sides are the "Right side of the fabric" and this back panel can be flipped without issue.
- d. Sew the Front Panel to the Back Panel
- Align the front panel on top of the back panel, and using a  $\frac{3}{8}$ " seam allowance, stitch from the notch at the side panel to the top point of the front panel. Repeat on the other side.
  - Illustration for clarity.



- iii.
- iv. At the openings, open this body panel and add a back tack over the notched area to prevent any tearing. This stitch should go through the body of panel and the seam allowance underneath.
- e. Attach the chin panel (G).
  - i. With right sides together, using a  $\frac{3}{8}$ " seam allowance, attach the bottom edge of the of the Chin Panel to the Front/Back Panel. It starts that the upper back 'shoulder point'.
- f. Attach the Face Shield (H).
  - i. If your plastic has a protective film, go ahead and peel it off.
  - ii. Align the bottom edge of the face shield with the right side of the chin panel, and stitch in place with a  $\frac{3}{8}$ " seam allowance.
  - iii. I found on my machine it was easiest to have the plastic against my presser foot and the fabric facing the feed dogs.
  - iv. Set this whole assembly aside for now.
- g. Make the top 'hood' (parts I+J, K, L)
  - i. With right sides together, sew the bottom edge of the Back Hood Top to the Back Hood Bottom using a  $\frac{3}{8}$ " seam allowance. Set aside.
  - ii. With right sides together, sew along the top, long curved edge of the two side hood pieces (L+K) using a  $\frac{3}{8}$ " seam allowance.

- iii. With right sides together, Attach the two side pieces (K+L) to the back hood piece (J+I).
- h. Attach the hood to the body.
  - i. After checking the alignment of notches, sew the top of the hood to the main body, using a  $\frac{3}{8}$ " seam allowance.
    1. Again, here I found it easiest to sew with the plastic up. To do this, I laid the hood portion inside of the body portion so that the right sides were together.
  - ii. When done set aside
- i. Make the head harness.
  - i. Take the head band harness strap (O) and fold it in half lengthwise, so you end up with a doubled up strip that is 2 layers thick and approximately 1.25" wide. Sew along the open edge with a  $\frac{1}{4}$ " seam allowance.
  - ii. Fold piece N along the length, and sew together with a  $\frac{1}{4}$ " seam allowance
  - iii. Fold piece M along the length and sew together with a  $\frac{1}{4}$ " seam allowance.
  - iv. With the pieces perpendicular to each other, align the center point of the sewn edge head band (O) with the notches at 2.5" on piece N and stitch in place along the seam line only.
  - v. With the pieces perpendicular to each other, align the center point of the Ear to Ear Strap (M) between the notches at the middle of piece N and stitch in place along the middle.
  - vi. Now bend the Head Band Harness Strap (O) around and connect it at the ends to the Ear to Ear Strap (M) with a stitched box.
- j. Attach the head harness.
  - i. Check alignment to make sure that the harness will sit on the head with the forehead band (not the over the head strap (N)) against the skull. In the seam allowance back tack the end of the Head Harness to the side side seam (it should sit above first notch on the bottom edge of the Chin Panel (G)).
    1. There's a lot going on here, so make sure you dont have any extra parts under the needle before you start sewing.
  - ii. Repeat the same at the other side.
  - iii. Now move to the center front and attach the short tail of the CB to CF Harness to the seam allowance of the faceshield.
  - iv. Now attach the end of the longer portion of the CB to CF Harness Strap to the center back between the two notches.
- k. Add Elastic to draw everything in.
  - i. Take the 13.5" piece of elastic (P), mark the middle with a pencil. Tack one end to the second notch on bottom side of the chin panel. While stretching the elastic, using the

center mark and the notches on the body of the hood to get the stretch right, stitch the elastic into place. Tack at the end.

- ii. Using the 7” piece of Elastic (Q), t the back collar, tack the elastic at the intersection of bottom chin panel to the ‘back shoulder point’, and stretch the elastic while sewing it along the back collar. Stop at the ‘back shoulder point’/chin strap intersection.
- I. Invert the hood to right side out.
    - i. We found starting at one of the pointy ends of the shield and slowly working your way out of the elasticized sections with the shield worked best to avoid creasing the shield.
  - m. Add Flanged Bushing (construction of this plastic piece will be covered in a different section).
    - i. Peel the adhesive off the double stick tape. Add the bushing through the hole in the upper back hood panel (I).
    - ii. Press to ensure the seal of the glue.
  - n. Add Male Union Fitting piece
    - i. Using a sturdy flat surface, firmly press fit the Male side of the union fitting onto the hood.
      1. Be sure that you are not pressing onto the shield causing marks.
      2. No glue is put onto this piece in case it needs to be removed in the future.