

# Medical Face Shields, as built by Sailworks

April 6, 2020

Recognizing the shortage of PPE gear for healthcare workers in our community at this time of virus crisis, we set about to make face shields (a.k.a. "visors") using materials we had on hand in our windsurfing sail loft. This face shield design evolved through eight prototype iterations and was tested by local physicians, nurses, clinicians, hospital infection control managers, hospital materials managers, and the local public health officials. These face shields are lightweight, just 1.1 oz., easy to put on and adjust, secure and comfortable to wear. In the past two weeks we made 6,800 face shields using the materials and methods described below.



This isn't the only way to make a PPE face shield, but this method and construction is a fast and cost effective way to mass-produce a face shield that is wanted and appreciated by healthcare workers and first responders.

## **Materials**

The clear shield lens is 7-mil monofilm (0.007" PET film) that is commonly used for window panels in windsurfing sails. The lens is 13" wide by 9" tall, with 3" radiuses to the lower corners. See the attached DXF file.

The lens has a forehead stand-off made of foam, 1.125 " square in end profile, by 13" long. The foam is open cell poly-urethane, PU-2540 (2.5 lb density, 40 ILD). We purposely chose this foam as it has the best bonding characteristics to the two-sided PSA seam tape. The 2540 foam is soft and has a slightly sticky feel to touch. It fully bonds to the seam tape, such that when you try to pull the foam away from the tape the foam tears, but the foam/tape bond does not fail. The 1.125" dimension was chosen to allow a slight assembly tolerance to sticking the foam in place, and the square profile to ensure the foam strip could be stuck down in any axis to speed up that process.

The double-sided tape we used is a premium sailmaking seam tape with a high adhesion acrylic adhesive and polyester carrier. Its translucent, UV stable and non-yellowing with an excellent initial tack and long term bond.

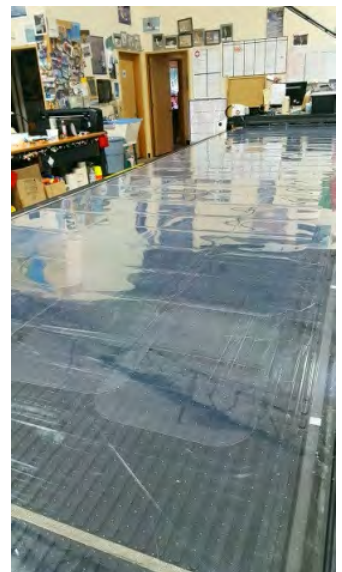
The elastic chosen is a 1" knitted elastic. Knitted elastic maintains its width when stretched (as opposed to woven elastic, which narrows when stretched), and it has an open structure that is not as hot or compressive to wear as a headband.

The elastic headband uses a 1" tri-glide fastener for easy length adjustment.

Specific materials, part names and sources are listed at the end of this document.

## **Cutting the Materials**

At Sailworks we have an Autometrix single-ply flatbed digital cutting table that we used for cutting the 7-mil PET film. The material is held in place by vacuum as the carriage and cutting head moves along. Our cutting table is 6' wide x 21' long. We can nest 120 pcs of the face shield lens over the table length and cut the entire table in under 7 minutes. The PET film is susceptible to finger prints and scratches from handling, so we wore nitrile gloves whenever the PET film was handled.



The 2540 PU foam was ordered from a regional foam distributor, custom cut in 82" x 13" x 1.125" planks, which we then cut by hand to 1.125" x 1.125" x 13" strips. The narrow width and slightly sticky nature of the foam did not lend itself well to machine cutting. We used Olfa 1" snap-off blade knives with copious blade lubrication with McLube Sail-Kote dry Teflon spray. Without the Teflon spray the blades would only cut cleanly for 10-15 strips, whereas a frequently lubed blade would cut two planks worth (140+ strips) before losing its edge. We used a steel ruler the same width as our strips (1.125") to cut against, and applied 2-sided tape to the topside of the ruler to keep the ruler stuck to our fingers (and our fingers out of the way of the knife) while cutting. We were cutting strips cleanly, and square at 20 strips per minute, then stopping to lube the blades.



The elastic was cut by foot pedal hot knife. Cut lengths for the elastic are 8" for the tri-glide side and 12" for the adjustment side, one piece of each per shield.

## Assembly

The seam tape was applied to the foam strips first, by pinning the 1" seam tape out, sticky side up, in long runs, and applying the foam to the tape in long chains. We prioritized the bond of the foam to the tape, where we could use a hand roller to firmly press the foam into the tape to ensure a good bond. The taped foam strips were then cut apart to individual pieces.



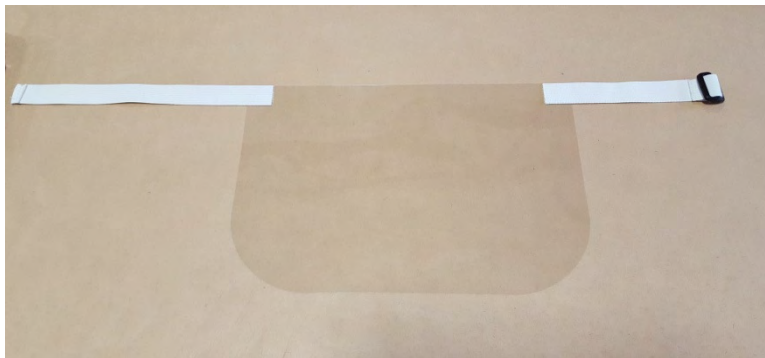
The shorter 8" piece of elastic requires lacing onto the tri-glide fasteners, then elastic parts were then sewn. One end of the shorter (8") elastic is bar-tacked to the center bar of the tri-glide fastener with as short a tail as possible. One end of the longer (12") elastic is folded and bar-tacked to itself to form a 1/2" stopper end. We ganged up long runs of the parts and bar tacked them on automatic Juki LU-2828 sewing machines with a 5-stitch x 5 pass stitch pattern.

The free ends of the elastic parts were then pre-taped across the 1" seam tape in long chains, rubbed out with the hand roller and then snipped apart in groups of 20 pcs. The 20-pc groupings aiding in keeping count of parts in progress, and made the tape backing removal fast and manageable (i.e. remove a single 20-pc tape backing and then cut the elastics apart, rather than cut the elastics apart and then remove twenty 1-pc tape backings).



The elastics pieces were then stuck onto the upper corners of the PET film lens with a 1" x 1" contact area, with an alignment template positioned below. The seam tape bonding to the PET film is instant and permanent, so placement of the elastic has to be precise at the first drop.

The elastics were then stapled twice within the 1" x 1" contact patch with a pistol grip stapler, with the turned end of the staples to the inside (to be later covered by the foam).



*Some background here, as stapling the elastic to the PET film was a hot point of discussion and testing in our development of the face shield construction. It's not a very high tech or elegant solution, but it proved be the best choice for a few reasons. First, its fast and easy, and imposes the least amount of handling on the PET film lens. It also proved to be quite strong for the purposes of the face shield. The alternatives we tested were sewing the elastic to the PET film, both*

*with bar-tacks and box stitches patterns, neither of which were stronger than the staples. PET film does not like to be sewn directly and requires some additional reinforcing to adequately hold stitches (we're experts in this area from our sailmaking) which would add to the cost and assembly time. Further, also found that sewing the elastic in place increased the handling of the PET film and the potential for scratching the film.*

The pre-taped foam strips are then placed across the top of the face shield. The 2-sided tape bonds readily to the PET film, but extra pressure is applied to the ends of the foam where it is bonding to the elastic ends.

The last step is to lace the adjustment end of the elastic and its bar-tacked fold, through the tri-glide fastener. When set to its longest adjustment length, the face shield will lay flat for easy packing. We were provided a face shield care sheet by the Health Dept (see attached file) that we interleaved between the face shields to help stop scratches during shipment. We packed 10 shields to a 14" x 27" poly bag, and then ten 10-packs into a 24" x 14" x 14" box.

Good luck on your face shield production! We're sure your local healthcare providers will be grateful.

Bruce Peterson  
Sailworks  
541-386-6561  
bruce@sailworks.com

**STOP THE VIRUS!!**

## **Materials and Sources We Used**

### **0.007" PET film**

Part name: 7-mil Monofilm  
Dimension-Polyant  
78 Highland Drive  
Putnam, CT 06260, USA  
Contact: Zack Clayton  
Direct: 860-928-8327  
zack.clayton@dimension-polyant.com  
www.dimension-polyant.com

Part name: #E088, 7-mil Monofilm  
Bainbridge International Inc.  
15242 Transistor Lane  
Huntington Beach, CA. 92649-1142  
Contact: Erik Reynolds  
Office: (714) 373-3322  
EReynolds@bainbridgeintusa.com  
www.bainbridgeintusa.com

Part name: Melinex 516, 0.007" PET  
PolymerFilms  
3311 E. Central Ave.  
Fresno, Ca 93725  
Contact: Yvette Causor  
T: 559-383-3456  
ycausor@polymershapes.com  
www.polymerfilms.com

### **1" High Tack Seam Tape**

Part name: #J446 <----- *This is the best seam tape!*  
Bainbridge International Inc.  
15242 Transistor Lane  
Huntington Beach, CA. 92649-1142  
Contact: Erik Reynolds  
Office: (714) 373-3322  
EReynolds@bainbridgeintusa.com  
www.bainbridgeintusa.com

Part name: BT-89538 Clear PET tape or #3869 TESA  
Bron Tapes Northwest  
6970 South 220th Street  
Kent, WA 98032  
Contact: Chris Longphre  
c 541-400-0259  
crlongphre@brontapes.com  
www.brontapes.com

## **Foam**

Product name: PU-2540  
IN-EX UPHOLSTERY SUPPLIES  
2234 NE Columbia Blvd  
Portland, OR 97211  
Contact: David  
503-235-0614  
supplies@inexupholstery.com  
www.inexupholstery.com

## **Elastic**

Product name: EL1BL (black) or EL1WH (white) 1" knit elastic  
Rex Pegg Fabrics, Inc.  
Contact: Dustin Snyder  
253-272-5162 | 1-800-933-3232  
dsnyder@rexpeggfabrics.com  
www.rexpeggfabrics.com

HiTex Corp  
16110 Woodinville-Redmond Road NE  
Woodinville, WA 98072  
Contact: Terri Rollins  
Tel: (800) 286-0659  
terri@hitexcorp.com  
www.hitexcorp.com

Perfect Fit 1 LLC  
6633 NE 59th Pl  
Portland OR 97218  
Tel: 503-234-9325  
sales@perfectfit.com  
www.perfectfit.com

## **Fastener**

Part name: 1" tri-glide #105-0100  
Fastening Systems  
2288 Valley Boulevard,  
Pomona, CA 91768  
Contact: Connie Colburn  
Tel: 909-464-1263  
ccolburn@fasteningsystems.com  
www.fasteningsystems.com



## Important Information About this Face Shield

This shield has not been tested or cleared by the U.S. Food and Drug Administration for use in health care. The user accepts this face shield without any warranty or guarantee as to its performance.

Due to a shortage of products like these, the United States Centers for Disease Control and Prevention has made the following recommendation for cleaning and reusing medical products that resemble this face shield:

### Selected Options for Reprocessing Eye Protection

#### **Adhere to recommended manufacturer instructions for cleaning and disinfection.**

When manufacturer instructions for cleaning and disinfection are unavailable, such as for single use disposable face shields, consider:

1. While wearing gloves, carefully wipe the *inside, followed by the outside* of the face shield or goggles using a clean cloth saturated with neutral detergent solution or cleaner wipe.
2. Carefully wipe the *outside* of the face shield or goggles using a wipe or clean cloth saturated with EPA-registered hospital disinfectant solution.
3. Wipe the outside of face shield or goggles with clean water or alcohol to remove residue.
4. Fully dry (air dry or use clean absorbent towels).
5. Remove gloves and perform hand hygiene.

From: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/eye-protection.html>, accessed 3/26/2020

## Important Information About this Face Shield

This shield has not been tested or cleared by the U.S. Food and Drug Administration for use in health care. The user accepts this face shield without any warranty or guarantee as to its performance.

Due to a shortage of products like these, the United States Centers for Disease Control and Prevention has made the following recommendation for cleaning and reusing medical products that resemble this face shield:

### Selected Options for Reprocessing Eye Protection

#### **Adhere to recommended manufacturer instructions for cleaning and disinfection.**

When manufacturer instructions for cleaning and disinfection are unavailable, such as for single use disposable face shields, consider:

6. While wearing gloves, carefully wipe the *inside, followed by the outside* of the face shield or goggles using a clean cloth saturated with neutral detergent solution or cleaner wipe.
7. Carefully wipe the *outside* of the face shield or goggles using a wipe or clean cloth saturated with EPA-registered hospital disinfectant solution.
8. Wipe the outside of face shield or goggles with clean water or alcohol to remove residue.
9. Fully dry (air dry or use clean absorbent towels).
10. Remove gloves and perform hand hygiene.

From: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/eye-protection.html>, accessed 3/26/2020