

NLCFS - No Laser Cut Face Shield - Emergency PPE

Doc: V1.0

<https://github.com/dan0h/NLCFS>

This is a basic PPE face shield, it is composed of a Polypropylene band made in two parts, these slot together to produce a spaced face shield guide that can accept a standard UK 4-hole punched acetate sheet - this is a VERY basic form of PPE, and is considered EMERGENCY USE ONLY when no other PPE alternatives are available - it is hand cut using basic 3D printed tools - see below for notes for 3D printer owners/users.



DISCLAIMER:

This face shield is not medically approved, tested, or certified, it is intended as EMERGENCY use only where NO OTHER equipment is available.

Making this face shield requires sharp knives, before you cut, ensure no part of you, or anyone else would be in the path of the blade should you slip or mis-cut. Look four times, cut once, this isn't the time to be troubling your local hospital with a lacerated finger.

3D PRINTER OWNERS:

This face shield requires 3D printed tooling, if you have a 3D printer, consider printing one of the many existing designs instead ([link: https://3dverkstan.se/protective-visor/](https://3dverkstan.se/protective-visor/)), if however you would like to give someone the tools to make their own face shields, then this face shield is a viable option.

LASER CUTTING:

While this face shield was intended to be hand cut, it also laser cuts beautifully, and very quickly, the DXF's are available on the Github link above.

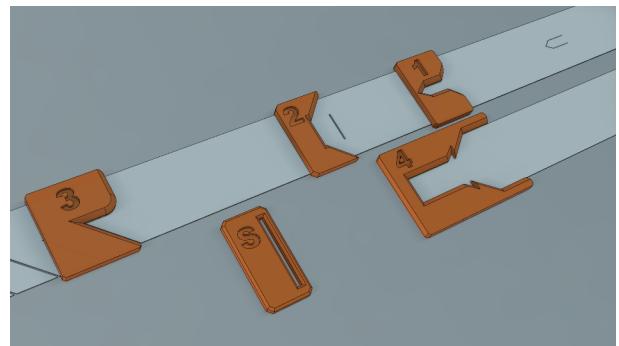


NLCFS - No Laser Cut Face Shield - Emergency PPE

3D Printed Tools:

If you are printing your own tools, print at 0.2mm layer height in a tough material, PETG or Co-polyester (nGen/CPE) works best. They can also be printed in PLA or ABS, but may be subject to warping, possibly impairing the function of the guides underneath.

Make sure the numbers are face down on your print bed.



1. Getting started

Materials:

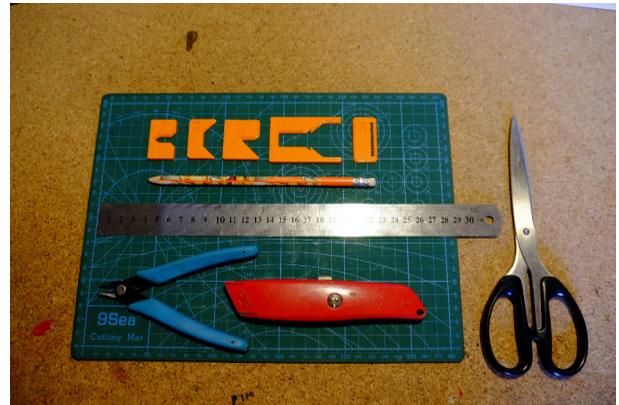
Polypropylene sheet at least 800mm wide, or a single strip 800x60mm. A4 acetate sheet.

Tools:

Cutting mat, 3D printed tools 1-5, sharp pencil, 30cm ruler (steel if possible), flush-cut snips (optional), craft/utility knife, sturdy scissors, UK 4 or 2 hole punch (Not shown).

Workspace:

Large flat area, kitchen or dining room table is ideal.

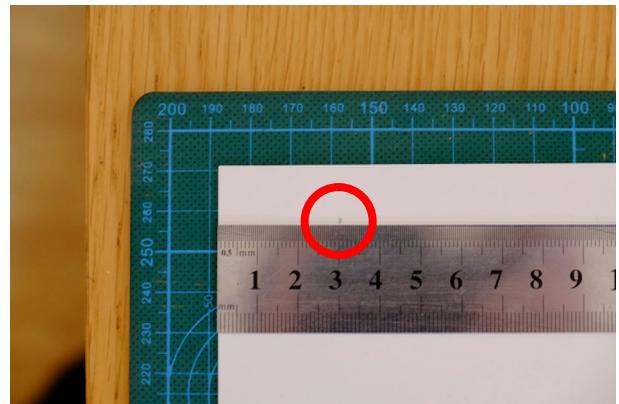


2. Measure & Cut the band

Place the Polypropylene sheet down with the **textured side facing upwards**, pencil doesn't mark the smooth side as well.

Take the ruler and measure **30mm** inwards from the straightest long edge of your material, this is the **800mm** long main band.

Using the sharp pencil, make a marking at **exactly 30mm**, it is important to be as accurate as you can, the maximum tolerated run out is about 0.5mm - this sounds insanely precise, but is surprisingly easy to achieve by hand, and tool 5 will shortly be along to sanity check your work :)



Work your way along the long edge, **making markings 30mm inwards every 30cm**.

Now, **align both ends of the ruler** with your first markings, and draw a line between the two points, check your position a couple of times to **ensure accuracy**!

Work your way along until you have a sharp, accurate pencil line **800mm long**, completely joining up your markings.



NLCFS - No Laser Cut Face Shield - Emergency PPE

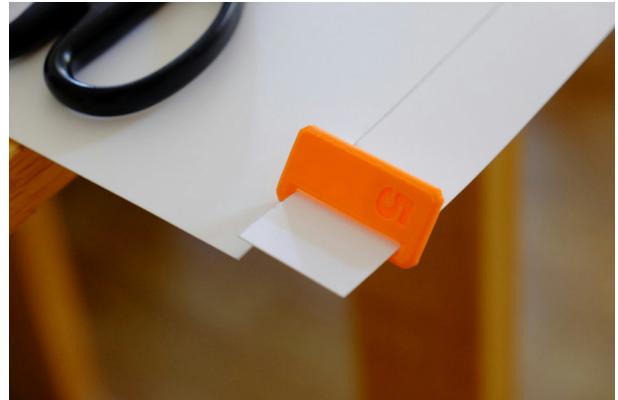
Terminate your beautifully drawn line with a link back to the edge, the smiley is optional, but does help with moral support.

Now, get ready with the scissors to start making the first cut, **have tool 5 (looks like a post box) ready**, this will be used to check the quality of your cut, and will allow you to identify high spots.



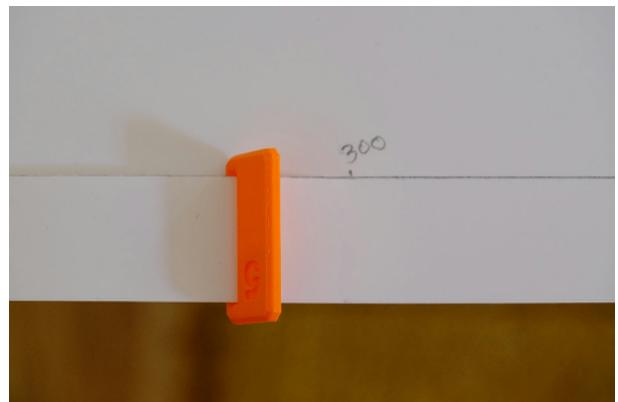
Pull your work piece clear of the edge of your working area, and **align the scissors carefully** - it is helpful to re-measure one more time before you start, to see if the OUTSIDE or INSIDE of your line is the one most accurate to 30mm, if you've drawn well, it'll be the middle, but **gauge which part of your line will give you the best results**, and aim to follow that down the 800mm length.

Make your first cut about **30mm long**, then, using tool 5 as shown, measure the accuracy. Tool 5 should have a tiny bit of movement, but should flow smoothly over the cut section...



...keep working your way along the line, slowly and carefully, using Tool 5 to sanity check the quality of your cut, any parts that are too thick and be flattened down very easily with an emery board, but with a little practice it is possible to complete the 800mm band with next to no error.

The tolerance for the band is **30mm +0.6mm maximum**, this sounds impossibly accurate for a hand cut, but Tool 5 will help to keep things on track, use it every 100mm or so.



At the end of your 800mm cut, terminate by cutting in from the long edge, freeing your 800mm strip from your work material.

You should now be left with an 800x30mm strip, which should pull cleanly all the way through Tool 5 from end to end, with only very minimal error.

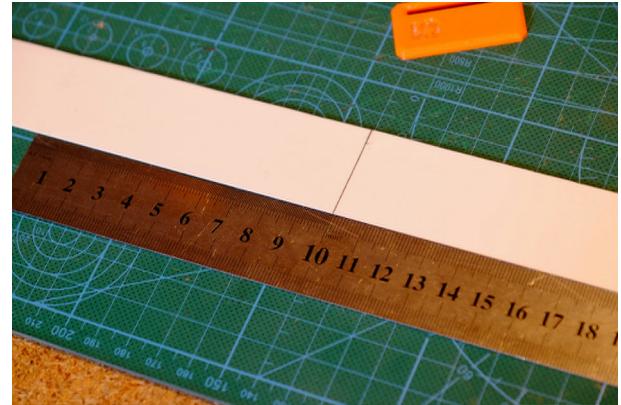


NLCFS - No Laser Cut Face Shield - Emergency PPE

3. Detailing the band

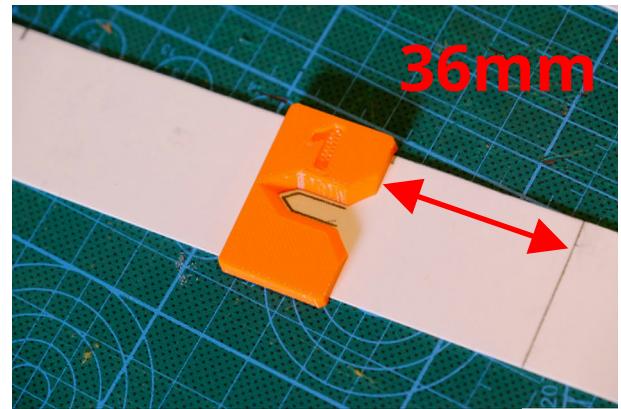
The band now needs the detail features that will allow assembly, and the addition of the front acetate screen.

The first step is to **mark the centre of the band**, measure along to 400mm, and mark the middle with a clean, sharp line, the easiest way is just to mark at 300mm, then tap on another 100mm, **this gives a middle datum from which all the markings will be referenced**.

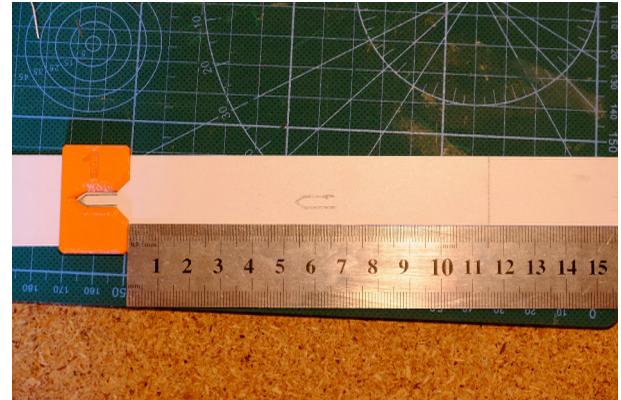


For this stage, **always work left of center**, ie, the tools, marks and cuts should be left of the middle, the right hand side of the band should at this stage, be left untouched, we'll return through this section again shortly, to detail the right hand side - at which point your band should be starting to look symmetrical.

Position Tool 1 as shown, **36mm from your middle datum** and mark in the center of the cutout of Tool 1, with a sharp pencil. If the band was cut within tolerance, the tool should locate itself over the band to ensure the marking is squared correctly.

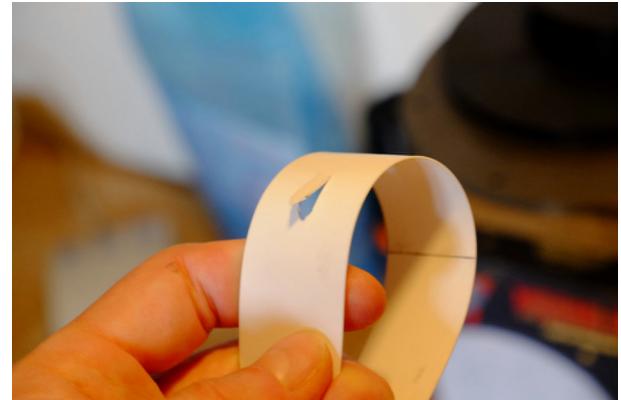


...repeat the last step with the tool positioned at **116mm from the middle datum**, and again draw the middle "point" of the cutout from Tool 1.



Remove Tool 1, and now cut **VERY CAREFULLY** with a craft knife along the outer edge of the marked "points", you are aiming for two small tabs, that will stick out, as shown in the picture...

...these are to hold the acetate in place.



NLCFS - No Laser Cut Face Shield - Emergency PPE

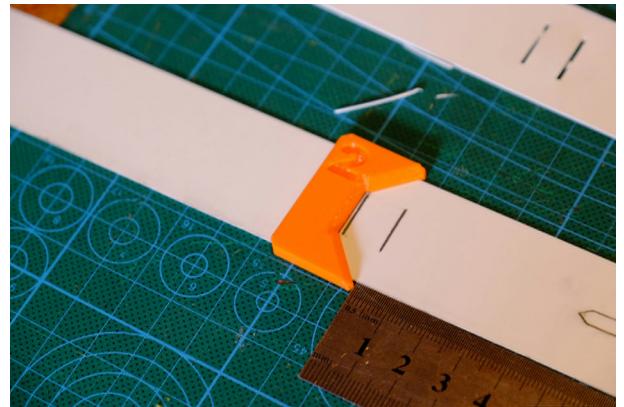
Next, Tool 2 should be used to make the vertical slots that the tongue will fit into, this is the part that will band around the forehead.

Position Tool 2 at **170mm from the datum**, and pencil in the vertical line...



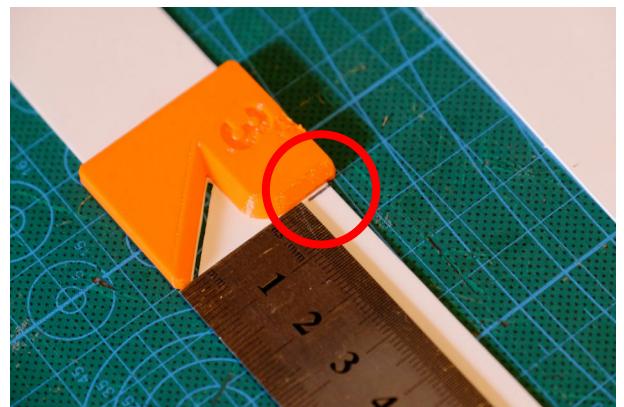
...repeat the last step at **180mm from the datum**, you should have two vertical lines as shown in the image.

As with the previous operation, cut carefully around the outside of your pencil markings to leave two slots, approximately **1mm wide, and 14mm long/tall, 10mm apart from each other**.



Now its time for Tool 3, to cut the adjuster markings. **This is a row of seven slots, at 45 degrees, spaced 15mm apart**.

Position tool 3 at **280mm from the datum**, pencil a mark at the top edge of the tool...



...now mark again **15mm along, repeat this until you have 7 reference marks, 15mm apart along the top edge**.

These are where you should position Tool 3 to cut each of the slots.

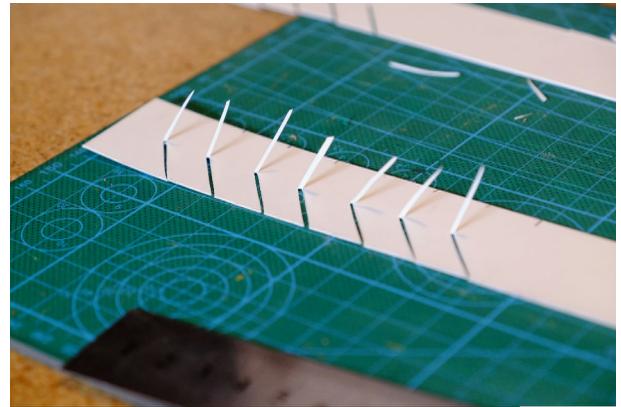


NLCFS - No Laser Cut Face Shield - Emergency PPE

Position Tool 3 at your first marking, and pencil in a diagonal line from the middle of the tool, as if you were drawing the diagonal part of the uppercase letter R.

Move along to the next marking, and repeat to draw seven diagonals - **these can now be cut approximately 1mm wide with scissors.**

Lift up the sprues of plastic in the slots...



These sprues can now be trimmed away with a pair of flush cuts, or can be snapped away carefully by hand if cutters are not available...

Optionally you can trim away the corner of your band to a diagonal (see below image).



CUTTING THE OPPOSITE SIDE!

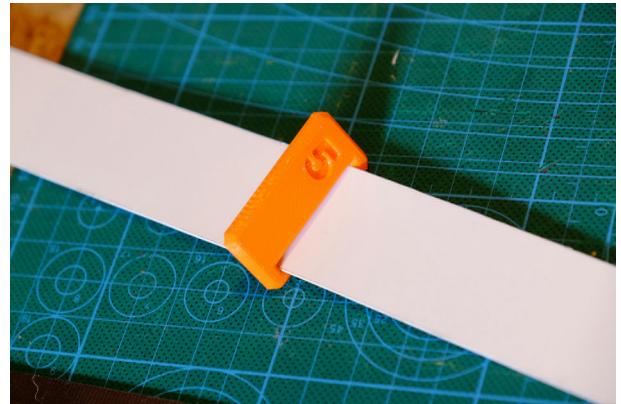
Now looking at your band from above, rotate it by 180 degrees to move your worked side over to the right, go back to the beginning of section 3, and repeat all the steps until your band looks like the image below - take care to ENSURE the adjuster slots are on opposite SIDES as well as opposite ends of the band!



4. Making the tongue

The tongue is part of the headband, and is used to create a gap between the acetate sheet and the wearers face - it is made from another strip of Polypropylene **330x30mm**.

Use the same techniques from section 2, mark up accurately, draw up and cut out a section 330x30mm, once again ensuring it **passes through Tool 5 without snagging**, or being excessively loose.



NLCFS - No Laser Cut Face Shield - Emergency PPE

Tool 4 is now required to cut the ends of the tongue, these engage with the two slots cut into the band, to space out the acetate.

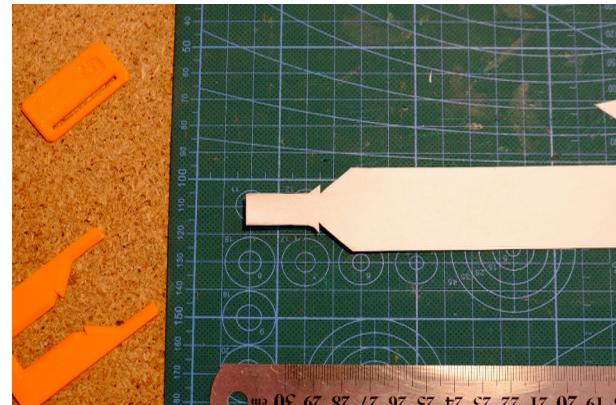
Place tool 4 as shown, and draw out the inner shape and diagonal up to the edges of the strip.



Using the markings from Tool 4 as a guide, **take a pair of scissors and cut the end of the tongue to match the image shown to the right**, the small barbs lock into the slot, preventing the face shield from coming apart.

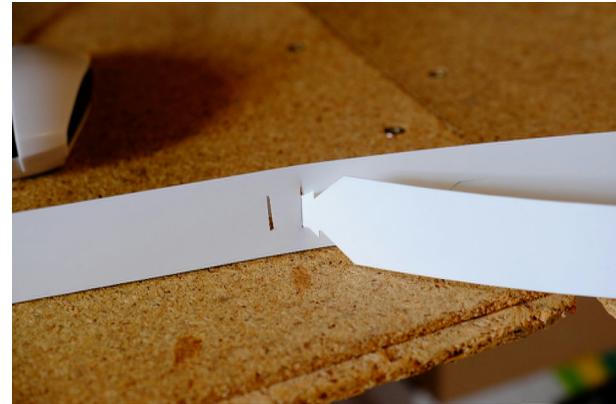
Dimensions are fairly tolerant, but it should be cut to match Tool 4 **as accurately as possible**.

Repeat this step for **BOTH** ends of the tongue.

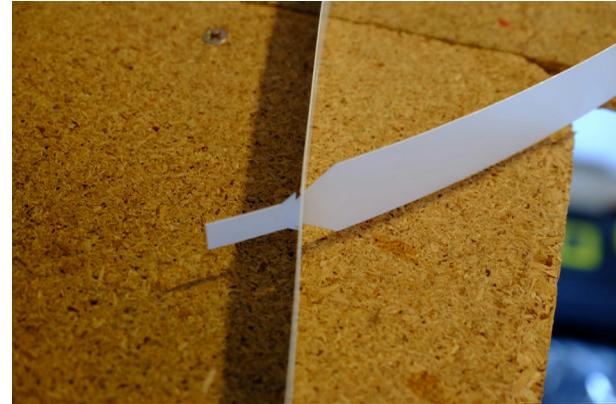


5. Assembly

The tongue can now be used to reinforce the band, insert the leader of the tongue into the **first slot from the center on the left hand side**, use the leader to pull the tongue past the barbs...



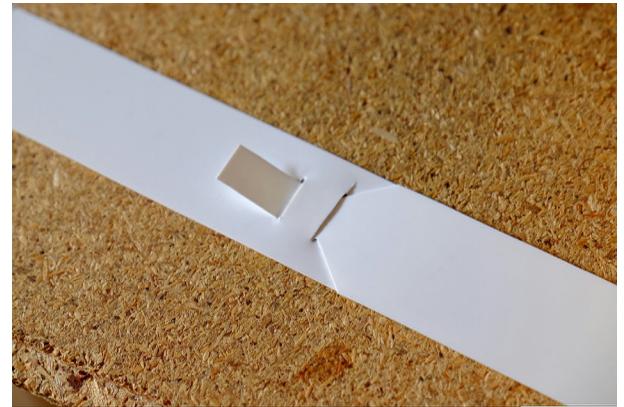
Make sure both sides of the barb are cleanly through, this should take some effort but once located should prevent the tongue from pulling back through.



NLCFS - No Laser Cut Face Shield - Emergency PPE

Now push the leader back into the next slot, so the barbed side is on the outside of the shield, and the **tongue leader protrudes onto the inside.**

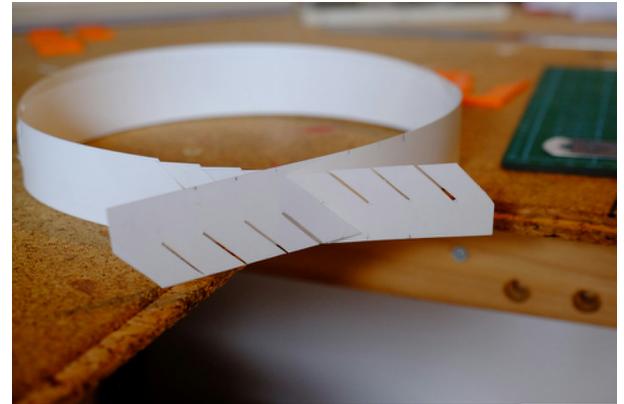
Repeat these steps with the other end of the tongue...



The face shield is now assembled and ready to accept a UK 4-hole punched acetate sheet via the four prongs along the front edge.



Sizing the face shield is achieved by using combinations of the diagonal slots, once sized to a snug fit (the material has a good degree of tolerance, so erring toward a tight fit is best), the band can be taped in place or locked by using a rubber band over either end of the shield prior to interlocking the diagonal slots.



6. Punch and fit Acetate

26/04/2020 - TBC