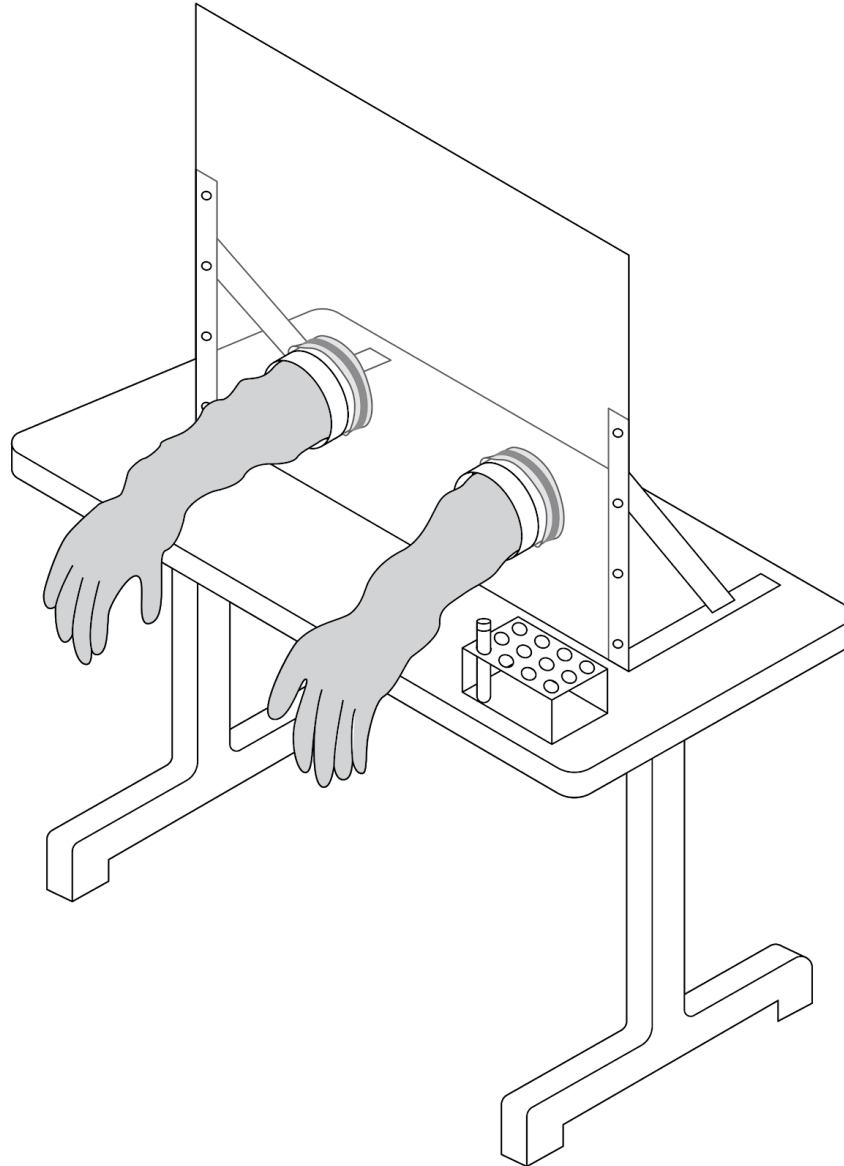


Droplet Barrier Desk



An open source project from volunteers at [Sector67](#) in Madison, WI and [Group Health Cooperative](#) of South Central Wisconsin, Dr. Alison Craig-Shashko, M.D., GHC-SCW Pediatrician and Chief of Staff and Jeff Steenis, GHC-SCW Facilities Manager.

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Disclaimer

This design was developed during the COVID-19 Pandemic. More specifically, the units were developed in response to a dire, national shortage of personal protective equipment (PPE). This desk is not a replacement for PPE, though it is an attempt to mitigate the risks to health care workers during PPE supply shortages. The design is a modified desk with a clear shield. It is not specifically medical equipment. Building furniture is inherently dangerous, and you could be injured or killed building furniture. Collecting test specimens of any kind without the necessary PPE can also injure or kill health care workers. Misuse of this design or failure to appropriately disinfect and clean the design and associated disposable supplies may increase the chance of harm to health care workers and/or patients. Like most furniture, this desk has not been tested scientifically. Use these specifications at your own risk and these specifications are provided on an “as-is” basis with no representations or warranties, oral or written, express or implied, including but not limited to implied warranties of fitness for a particular purpose. Consult your Infection Control department before use in your facility. Users of these specifications are responsible for all patient care decisions, including the decision to build and use the desk for patient care. Neither Group Health Cooperative of South Central Wisconsin or Sector67, nor its employees, agents, directors, officers, successors, volunteers, and assigns, nor the writers of these instructions, assume liability or responsibility for loss, damage, illness, injury, or death related to the construction or use of desks constructed using these specifications.

License	2
Disclaimer	2
Before You Begin	3
Tools required	4
Materials required	4
Assembly process	5
Step 1: Gather materials and tools	5
Step 2: Cutting the transparent plastic sheet	5
Step 3: Cutting holes in the sheet	6
Step 4: Mount shelf brackets to base	8
Step 5: Drilling mounting holes in transparent plastic sheet	10
Step 6: Mount the transparent plastic sheet and arm hole flanges	11
Step 7: Attach gloves	12
Materials Recommendations	15
Transparent Sheet	15
Arm Hole Flanges	15
Shelf Brackets	16
Gloves	17
Desk Base	17
Photos of two versions of the desktop barrier shield	18

Before You Begin

This document has been assembled at the request of Group Health Cooperative of South Central Wisconsin to share a method for building a desk with a droplet barrier shield. The purpose of the shield is to reduce the amount of personal protective equipment used by a health care provider while collecting nasopharyngeal, nasal, and throat cultures during the COVID-19 pandemic.

These instructions were written to guide a builder with little or no experience through the process of selecting materials for and fabricating this protective shield. If you are a person with limited building experience please follow these directions carefully and if possible consult an experienced builder if you have questions.

This document has been written with the understanding that different materials will be available in different areas, so several options were given for each of the major components. If none of the listed options are available to you, substitutions may be made. It is strongly recommended that you consult with the medical professionals you are working for before making any substitutions.

General guidelines for substitutions are as follows:

- No wood parts anywhere, wood cannot be sterilized.
- All metal parts must have a smooth surface texture and be corrosion resistant, this includes fasteners. Use only aluminium, stainless steel, or powder coated (a type of durable paint) steel.
- All plastic parts must have a smooth surface texture.
- Avoid all 3d printed parts, they are too porous and cannot be sterilized.

Tools required

- Drill with bit(s)
- Jig saw with blade, new if possible
- Wrenches
- Screw driver
- Masking tape
- File and/or sandpaper
- Scrap piece of wood to protect workbench when drilling

Materials required

(see Materials Required at the end of this document for specific recommendations and suppliers)

- 30 x 36 inch (76.2 x 91.44 cm) transparent plastic sheet; larger material can be cut to size
- Two flanges
- Two shelf brackets
- Fasteners
- Non-latex gloves with suitable attachment method
- Base material, likely a sturdy table, either purchased or provided

Assembly process

Step 1: Gather materials and tools

The first step is gathering materials and tools for your build. We give many options for different materials and sources for materials, and we have tried to make sure each option works with every other option. Nonetheless, it is important to start by gathering all of your materials and tools together to make sure everything is going to work together. Please note that for each option for materials, there is also an "additional materials needed" list. Pay close attention to these lists. Different shelf brackets or flanges require different fasteners. Make sure you have all the materials needed before beginning, otherwise you may find yourself stuck part way through the building process.

Step 2: Cutting the transparent plastic sheet

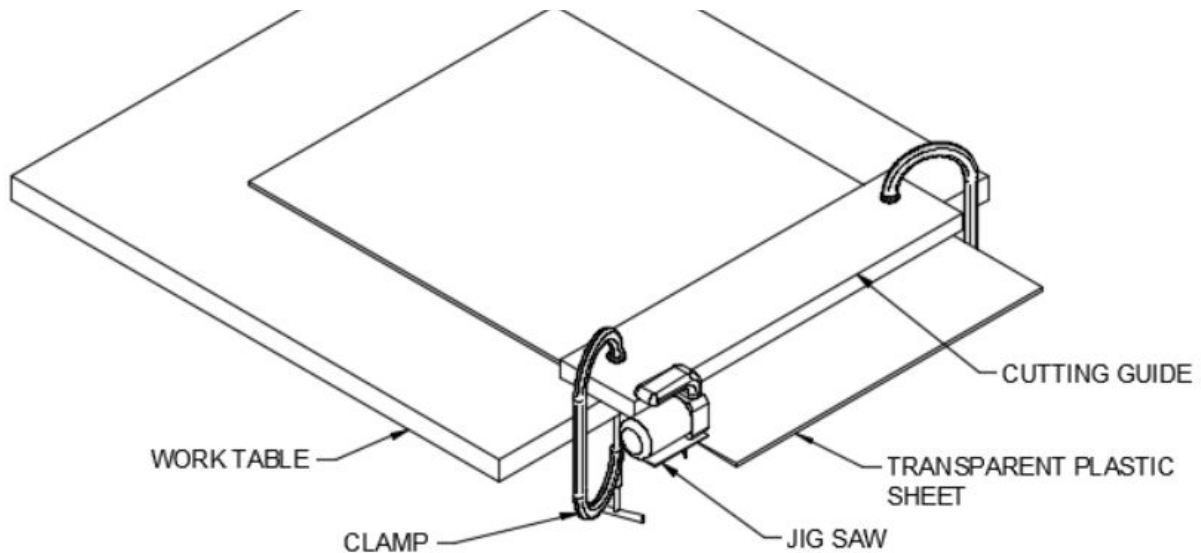
Cutting the transparent plastic sheet to size

If you bought a sheet that is already the size you need you can skip this step.

Many suppliers will be happy to cut your material to size for you. If you need to cut your own, here are some suggestions for successful cutting:

- Leave any protective coverings on the transparent plastic until all of your cutting and drilling are done. If the protective film has already been removed, use masking tape to cover the area being cut/drilled. This will help to prevent scratching and chipping while cutting and drilling and also give you a good surface for marking.
- A table saw is a great way to cut transparent plastic sheets. If you have access to a plastics cutting blade that would be best. If not, a woodworking blade will do. Make sure it is a fine-toothed blade, around 80 teeth for a ten inch diameter blade. The sharper the blade the better. Feed the material into the saw at a steady rate. Going too fast will cause the plastic to chip, going too slow will cause heat to build up and possibly melt the material. It is important to avoid pausing mid cut, this will allow a lot of heat to build up in one area and cause problems. Slightly too fast is likely better than a little too slow. There are many good videos on YouTube detailing how to cut transparent plastic on a table saw. [Here is one.](#)
- If you don't have a table saw, a jigsaw is a good option. Again using a blade designed to cut plastics is best, but if you don't have one a woodworking blade is

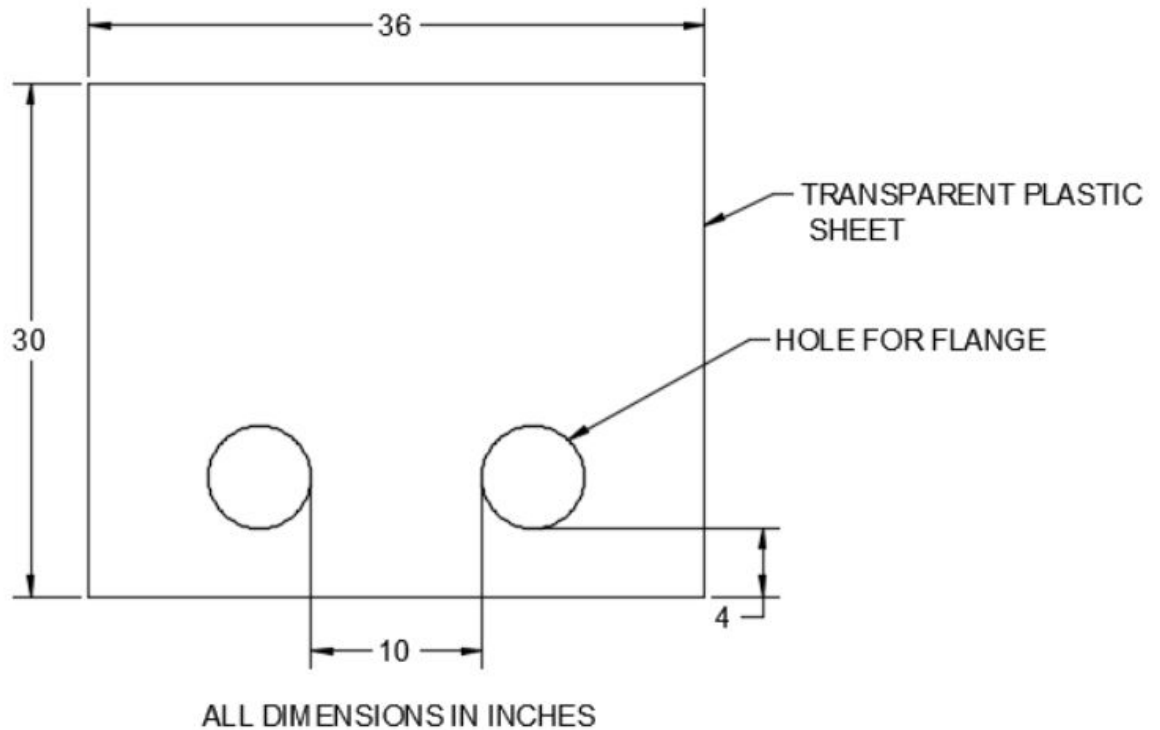
a good choice. Use a fine-toothed blade, as sharp as possible. A steady cutting speed is important, too fast and the material will chip, too slow and it will melt. It is best to clamp your material to a sturdy work table in such a way that you will not cut the table with the saw. If you have something to clamp to your material to guide the saw in a straight line, that is even better, as illustrated below. [Here is a useful video.](#)



Regardless of what cutting method you use, there may be sharp corners left on your transparent plastic sheet. There are a lot of ways to remove sharp corners, one of the best is with a deburring tool available at most hardware and home improvement stores. If you don't have a deburring tool, a file will do the job nicely. There is no great secret to this, hold the file at 45° to your work and use light pressure on each stroke. It does not take much work to make a sharp edge smooth and safe.

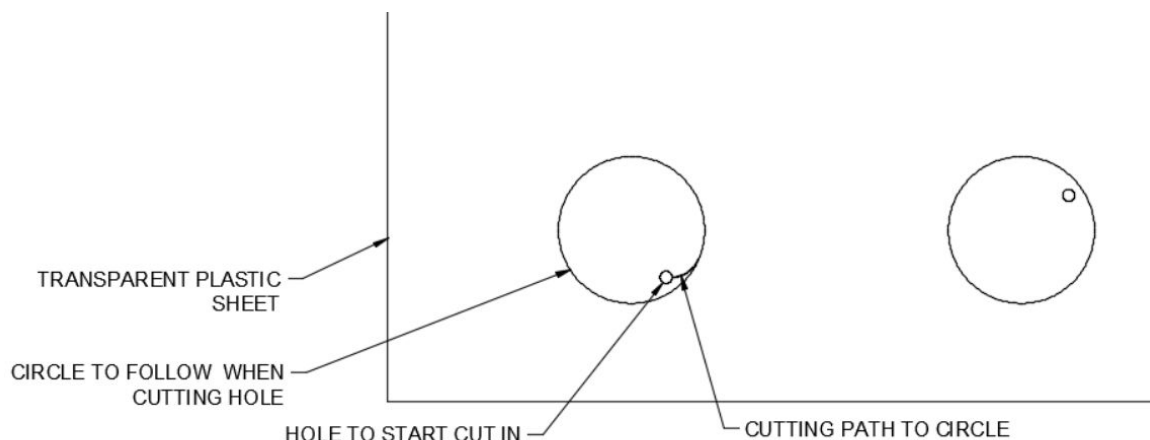
Step 3: Cutting holes in the sheet

Likely the best tool for this step will be a jig saw. The first thing that needs to be done is to determine where the holes for the flanges will be. Illustrated below is a suggestion for hole placement. The hole size should be determined by the width of the chosen flange and glove. Our prototype was built to have a flange that allowed for 5.5" opening. This fit both disposable gloves listed below, which have a 9-10" linear sleeve width (18-20" circumference)



Cutting a hole out of the middle of the sheet is a little different than cutting the sheet down to size. Here are some suggestions for making a successful cut:

- Leave the protective film on the transparent plastic sheet. Lay out the flanges you will be using in the correct locations with the narrow part of the flange facing down. Trace around the outside of the narrow part of the flange with a marker.
- Next, drill a hole inside both circles to have a place to start the cut. See illustration below.



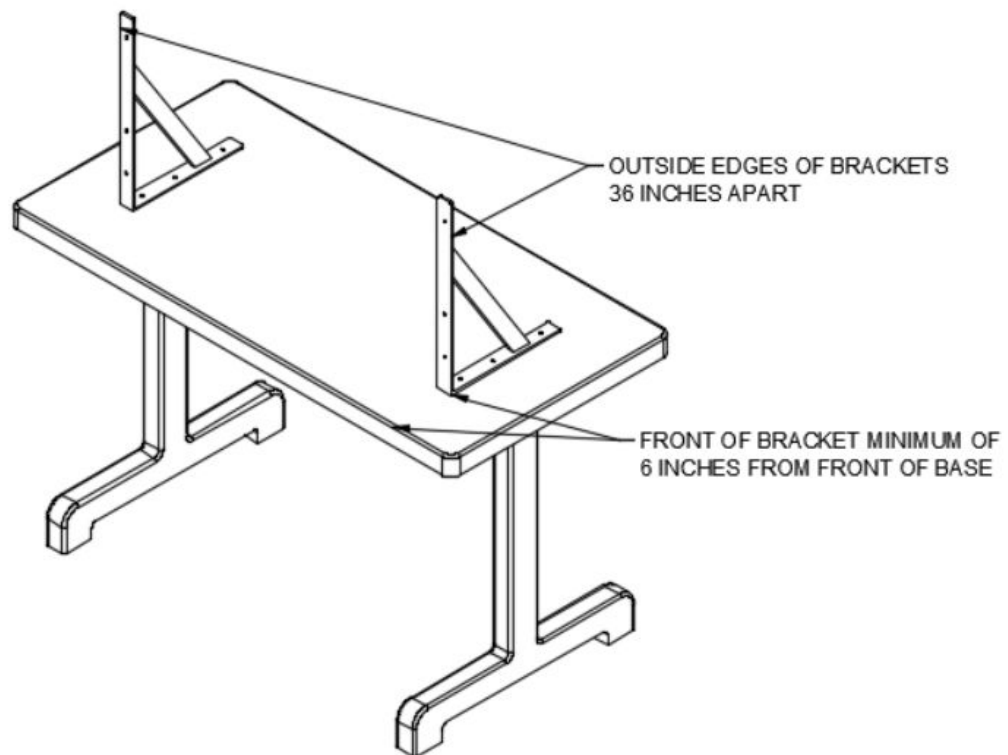
To start the cut, place the blade of the jigsaw into the starting hole and cut along a path arcing from the starting hole onto the circle you traced around the flange. It is better to cut the hole slightly too big rather than too small. When cutting a circle, it can be hard to maintain the proper cutting speed, resulting in a poor quality cut. If this happens to you, you can use a file or rasp to clean up your cut and round the edges of the cut. Coarse 80 or 100 grit sandpaper is a good way to round and smooth the edges of the cut. Be sure to clean any debris from cutting/drilling/filing operations **BEFORE** removing the protective film from the panel. Otherwise, static electricity will make the little bits want to attach to the surface.

If you have availability and experience with a large diameter hole-saw drill-bit this would also provide a suitable hole, the holes we cut are 6" but you should verify your hole diameter based on the supplies you collected.

Step 4: Mount shelf brackets to base

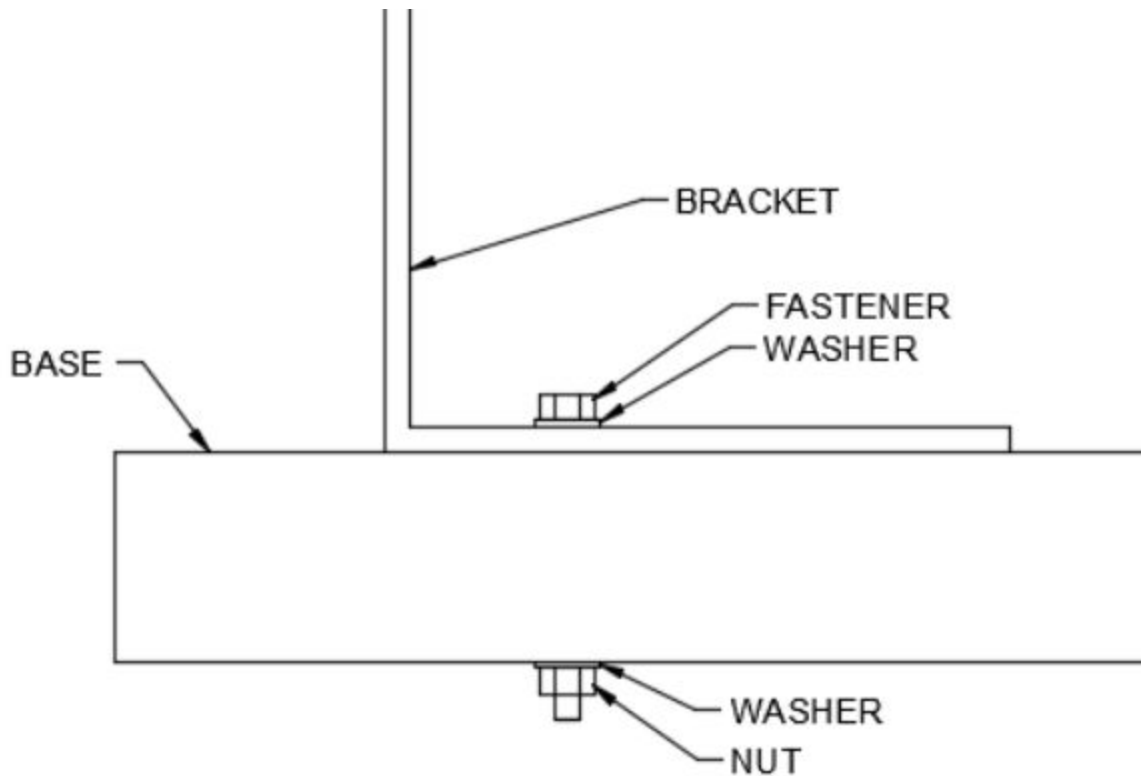
Note: Depending on what you have chosen for a base and shelf brackets, it may make more sense for you to mount the brackets to the transparent plastic sheet before mounting them to the base, so feel free to take the next steps in any order. It's also possible to clamp the barrier to a desk which may be more suitable for your use, c-clamps or woodshop bar clamps are more than suitable.

To mount the shelf brackets to the base, first you will have to decide on the location of the brackets. Orient the brackets so the longer part will mount to the transparent plastic sheet and the shorter part mounts to the base. This will give better support to the more flexible sheet. Place the brackets on the base and move them around until you are satisfied with their location. Make sure that once the screw holes are drilled in the base they will be accessible from below. Also make sure your brackets are spaced correctly to hold the transparent plastic sheet, there should be 36 inches from outside edge to outside edge. See illustration below.



Once you are satisfied with the location of the shelf brackets trace the mounting holes onto the base. Next use a drill bit 1/16" larger than the fasteners you will use to drill the mounting holes into the base.

Then fasten the bracket to the base. Put a washer on each fastener before putting fasteners in mounting holes. Then put a washer on the fastener from below the base, followed by a nut. Wait until all fasteners are in place before tightening. Then tighten the fasteners securely. The illustration below shows how each fastener should look.



Step 5: Drilling mounting holes in transparent plastic sheet

To drill the shelf bracket mounting holes, place the transparent plastic sheet in position with reference to the brackets and the base. If you have clamps available, they can be used to hold the sheet in place. Trace onto the sheet the locations of all of the mounting holes on the brackets. Remove the sheet from the base and brackets and place it on a work table. Before drilling, place a piece of scrap wood under the sheet where it will be drilled -- you will be drilling through the transparent plastic and into the scrap wood.

Using a drill bit $\frac{1}{16}$ " larger than the fasteners, carefully drill the mounting holes in the sheet. The best type of drill bit is one designed for use with plastics. If you do not have one available, a woodworking bit (twist drill, not a spade bit) is okay. The sharper the better. First drill a small hole about $\frac{1}{8}$ " in the desired location. Then switch to your final size drill bit and drill your finish hole. Use moderate speed, around 500 rpm, and light even pressure. When you are almost all the way through the transparent plastic, decrease drilling pressure. Drill bits have a tendency to "burst through" when the material at the bottom of the hole gets thin. Reducing pressure for the last little bit of drilling, and drilling into scrap wood will minimize this tendency. When you are finished drilling one hole see if your drill bit feels hot. If it is, increase drilling pressure slightly. If

you have any scrap transparent plastic to practice on, it is highly recommended you do so. [Here is a video with some pointers.](#)

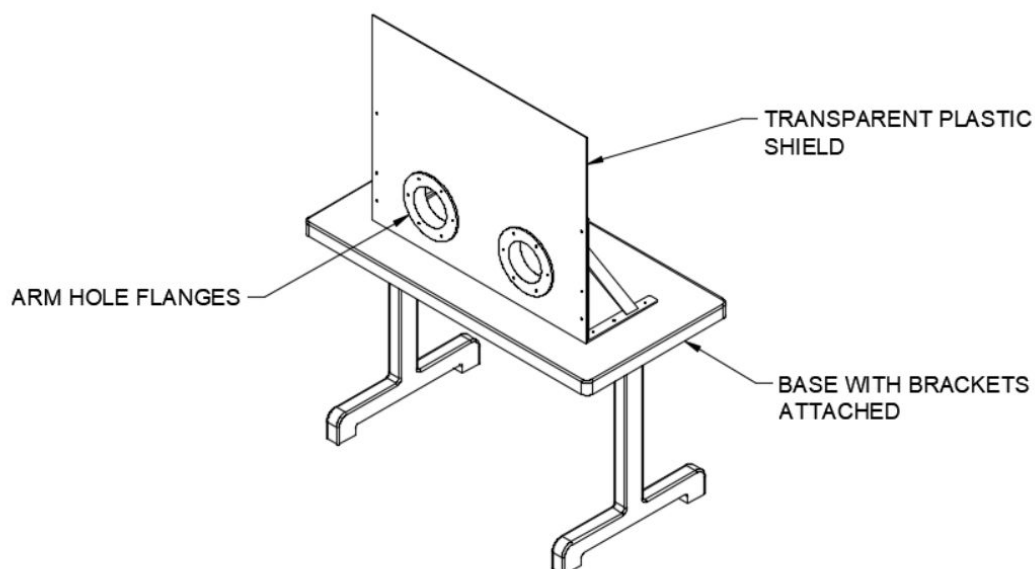
To drill the mounting holes for the arm hole flanges, use the same procedure as above. Please be careful to use the correct size drill bit, it may not be the same as the one you used to drill the holes for the shelf brackets. You should use a drill bit 1/16" larger than the fasteners you are using to mount the arm hole flanges.

Step 6: Mount the transparent plastic sheet and arm hole flanges

Before everything is assembled, it is time to peel off the protective film from the transparent plastic sheet. From now on it must be handled carefully to avoid scratching.

Place the transparent plastic sheet on the base, with the mounting holes for the shelf brackets lined up with the shelf bracket holes. Using the appropriate fasteners (these will likely be much shorter than the fasteners used to mount the brackets to the base), fasten the transparent plastic shield in place. Use nuts and washers just like you did when mounting the brackets to the base. When possible, leave the heads of the fasteners facing the patient side, and the nuts facing the care provider. This should give a more professional look and make the patient side easier to clean when necessary.

The arm hole flanges should mount the same way, again using nuts and washers as you did when mounting the brackets to the base. The flanges should be oriented so the tubes project toward the care provider side of the shield. See illustration below.



Step 7: Attach gloves

How the gloves are attached will vary depending on what type of flange and gloves are being used. The general procedure will be to pass the glove through the arm hole flange front to back with the cuff of the glove on the care provider side. On the care provider side, the cuff will be folded back over the tube part of the arm hole flange, like a cuff, so when selecting a flange option, make sure that the diameter of the cuff of the glove you've selected is large enough to go over the flange without excessive stress but not so large that it can't be sealed against the flange effectively.

There are several options for securing the glove cuff to the arm hole flange. The option you choose will depend on the materials you have at hand, and how frequently you intend to change the glove.

First decide what gloves you will be using, and how often you will be replacing them. If you intend to replace gloves frequently, you will want to have a relatively simple and fast way to attach and remove them. If you intend for the glove to stay attached for an extended period, you can afford a more time consuming attachment method.

Options for attaching the gloves to the flange include.

- Tape
- Heavy duty rubber bands
- Hose clamps
- Binder clips
- Velcro straps



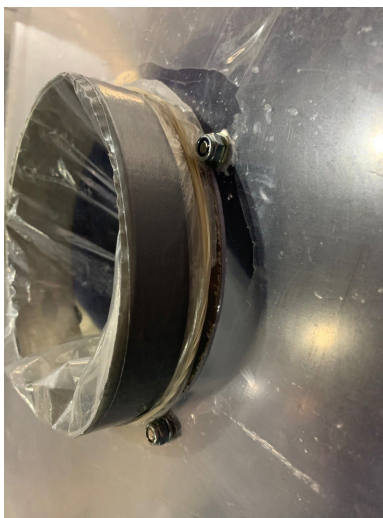
Once you've attached the gloves, check that they are secure and can't be dislodged when the provider inserts or extracts their hands and arms. Test this with the actual protective equipment that will be used. Some combinations can create a great deal of friction or sticking, others can be very slippery. One option to increase the friction between the glove cuff and the flange is to first put a layer of double sided sticky tape around the flange. The double-sided tape used for attaching plastic film over windows to winterize them works very well to help adhere slippery gloves to the flange.

Regardless of the method of attachment you choose, you will want to:

- Carefully: examine the results for a good seal
- Think through the process steps to maintain good isolation between the patient side and the provider side, throughout the removal and installation of the gloves
- Document the glove replacement steps
- Train providers on the process
- Have providers practice the technique until they are comfortable and proficient
- Consider applying a set of medical gloves over the shoulder length glove to ensure appropriate grip of test swabs. Also allows for the possibility for disinfecting and reuse of the shoulder length glove. Change medical gloves with each patient.

This video shows installing a glove in a sandblasting cabinet. Although the equipment is different, the principle is the same. [Glove attachment video](#)

This photo demonstrates one way to secure the glove, particularly if you are cleaning and reusing the same glove between patients. This involves cuffing the glove over the flange, then securing with a strip of electric tape and rubber band.



Another photo of a velcro band on the cuff



Materials Recommendations

Transparent Sheet

Dimensions:

You will need one piece 36 inches by 30 inches or sized to your preference. Width can be adjusted to your chosen table. The thickness should be around 3/16" to provide sufficient strength for the glove holes. If this exact thickness is not available, get something as close as you can.

There are two types of commonly available transparent sheet material: acrylic and polycarbonate. Acrylic is a brittle transparent sheet. It has slightly better scratch resistance but not one that will substantially change its application here. Acrylic can be scored with a razor blade and split, as well as cut with woodworking saws. Acrylic will tend to stress crack over time with alcohol-based cleaners. While this is worth noting, it's unlikely to impact its function in this application with the length of use and number of cleaning cycles. Polycarbonate is another transparent sheet type typically sold with acrylic in a hardware store. Polycarbonate is slightly softer but much more durable. It is impossible to shatter or crack polycarbonate as it will bend from stress rather than break. If possible we recommend using polycarbonate for this reason, but acrylic will work as well.

Suppliers:

[Home Depot](#)

[Menards](#)

[True Value](#)

[Midland Plastics](#) (call location closest to you to order, follow link to find location and phone number); otherwise search for "plastic supplier" in your area to find a plastic distributor

Arm Hole Flanges

- [Option 1](#) Note: these are sold in pairs, you will need one pair for each unit you are making.

Additional materials required for this option

- Twelve (12) 1/4"-20 bolts 1 inch long with nuts and washers

- [Option 2](#) Note: this option will require additional mounting hole to be drilled
Additional materials required
Note this is a one (1) pack of flanges, two (2) flanges will be required for each unit built

Additional materials required:

- Eight (8) 1/4 20 bolts 3/4inch long with nuts and washers

- [Option 3](#) Note: this is a one (1) pack of flanges, two (2) flanges will be required for each unit being made.

Additional materials required:

- Twelve #10-32 machine screws 3/4 inch long

It's possible to use foam tape, caulk, or other sealant to close up any gaps between the arm holes and the transparent plastic sheet. The solutions provided above will minimize these holes but be aware you may need to seal up gaps as you go.

Shelf Brackets

- [Option 1](#) Note: this is a ten pack of brackets, you will need 2 brackets for each unit you are making.

Additional materials needed for this option

- Six (6) 1/4"-20 bolts 3/4 inch long with nuts and washers (for securing to transparent plastic sheet)
- Six (6) 1/4"-20 bolts should be long enough to pass through both the bracket and the base with enough extra length to add the washers and nut to secure to the base

- [Option 2](#) Note: this is a one (1) pack of brackets you will need two (2) brackets per unit you are making.

Additional materials required for this option

- Six (6) #10-32 machine screws 1/2 inch long with washers and nuts (for securing to transparent plastic sheet)
- Six (6) #10-32 bolts should be long enough to pass through both the bracket and the base with enough extra length to add the washers and nut to secure to the base

- [Option 3](#) Note: this is a one (1) pack of brackets you will need two (2) brackets for each unit you are making.

Additional materials needed for this option

- Six (6) #10-32 machine screws 1/2 inch long with washers and nuts (for securing to transparent plastic sheet)

- Six (6) #10-32 bolts should be long enough to pass through both the bracket and the base with enough extra length to add the washers and nut to secure to the base

Gloves

- [Option 1](#): Medical grade - Shoulder length PICC line cover from Brownmed. Non-latex. 10" straight sleeve width.
- [Option 2](#): Veterinary grade - OB Glove. Non-latex. 9" straight sleeve width.
- [Option 3](#): Nitrile long-sleeve Glove. Confirm that it is latex free.
- [Option 4](#): Other latex free, shoulder length glove whose cuff fits around your flange, probably need 9-10" linear width at the end of the glove. Sandblasting gloves are widely available but not intended for medical use.

Desk Base

The droplet barrier shield can be clamped to any narrow table or cart with wheels (ideally with brakes). Ideally, there is shelf space on the patient side to allow for placement of swab materials.

All surfaces must be clean-able with medical disinfectants. No wood unless laminated. Stainless steel, plastic, or laminate would be suitable.

An ideal table would have leg room for the provider. And a cover on the patient side.

A sheet or blue chux could be placed on the patient side to cover the surface.

- [Option 1](#): Uline table with casters
- [Option 2](#): Overstock table with casters
- [Option 3](#): Harbor Freight plastic cart - provider could place their feet/legs on the lower cart shelf
- We also converted an on-hand desk for one unit:



Photos of two versions of the desktop barrier shield

Finished prototype described in this document:



Original prototype

