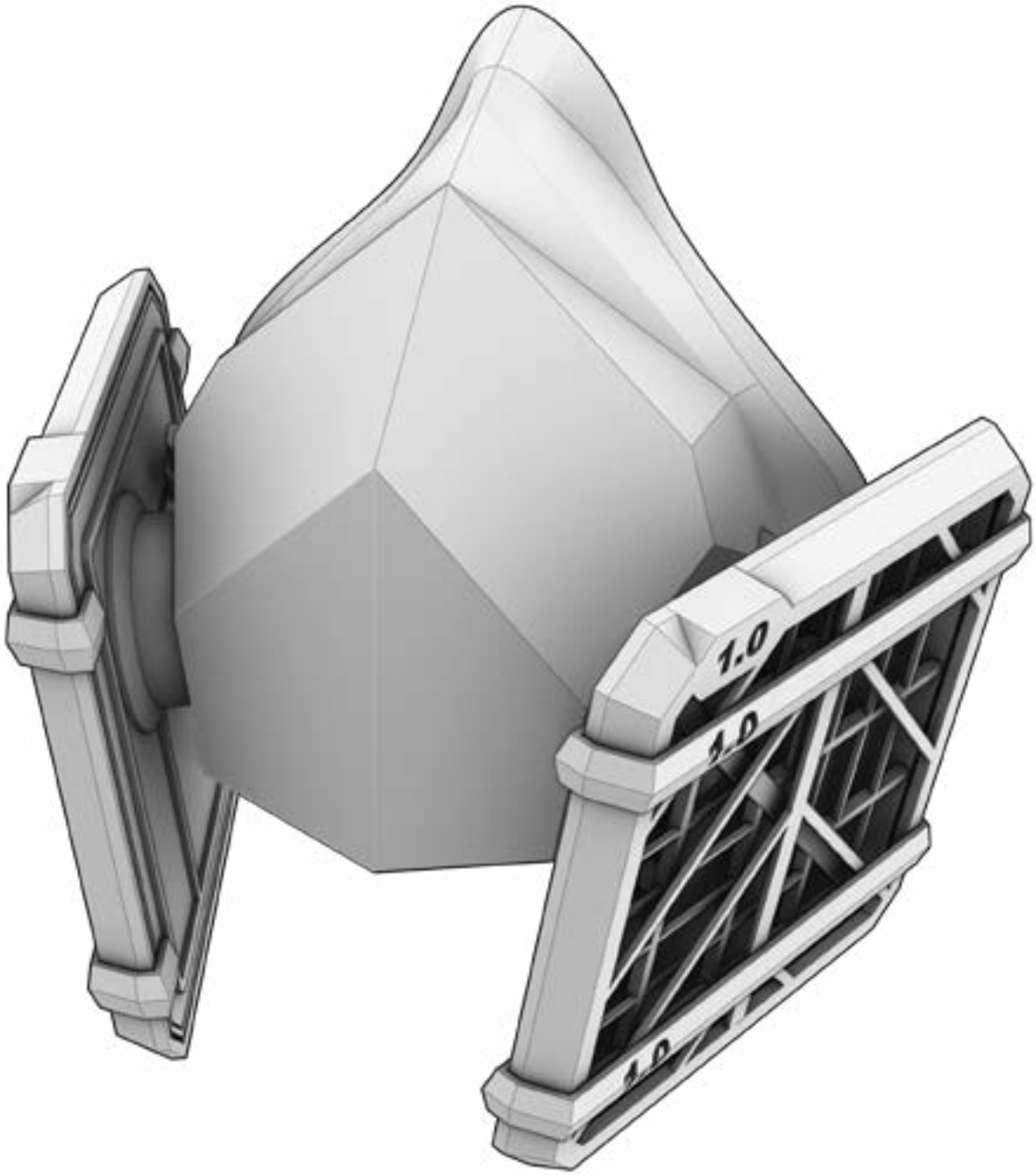
RENEGADE RESPIRATOR

3D PRINTABLE HALF-FACE RESPIRATOR with VARIABLE MEDIA CARTRIDGES

RESEARCH TEAM

Ken Marold : Design / Development / Fabrication
Evan Floyd : Testing / Analysis
Bobby Reed : Fabrication



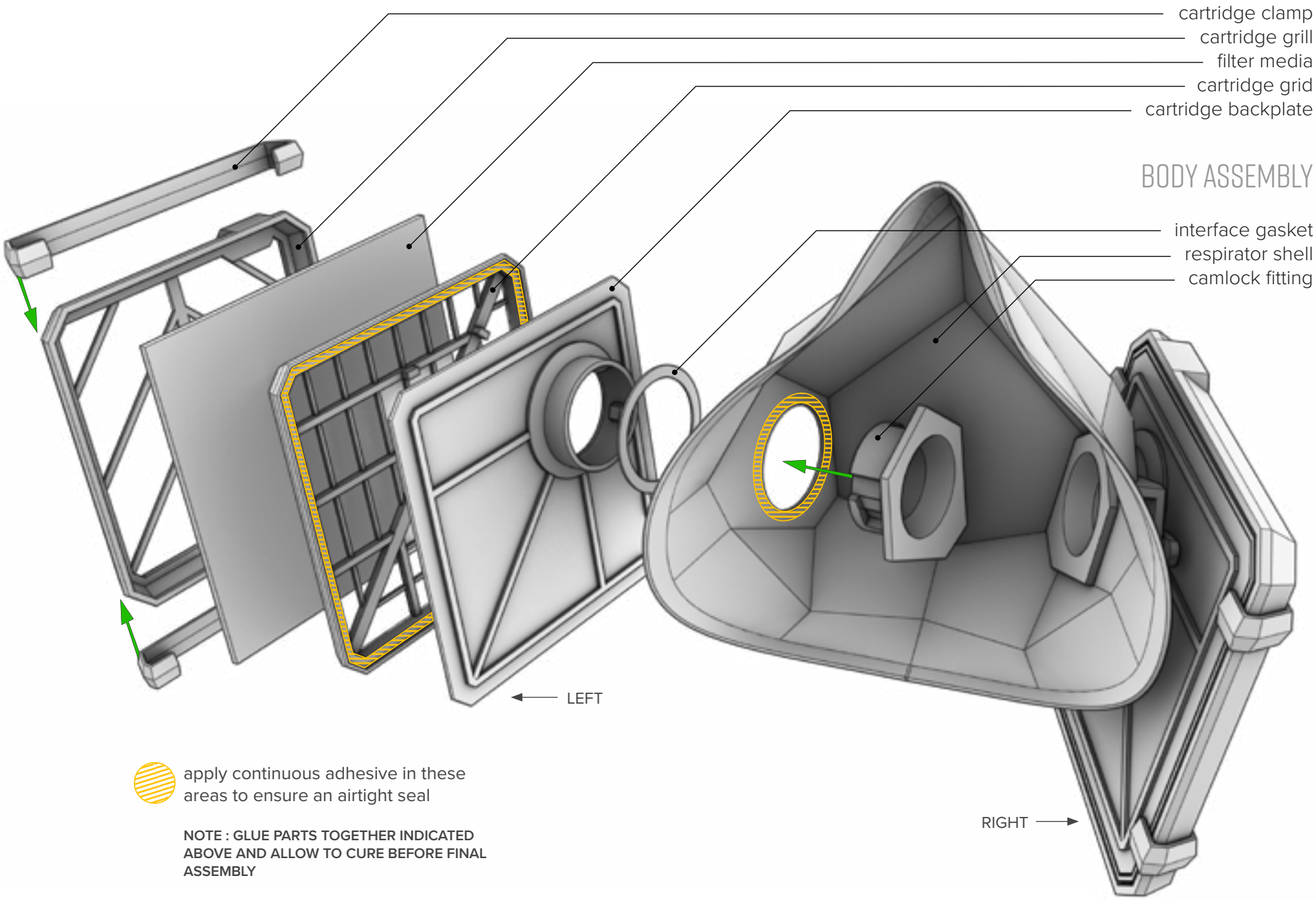
Renegade Respirator, U.S. Patent Pending

Support provided by the Vice President for Research and Partnerships of the University of Oklahoma.

RENEGADE RESPIRATOR

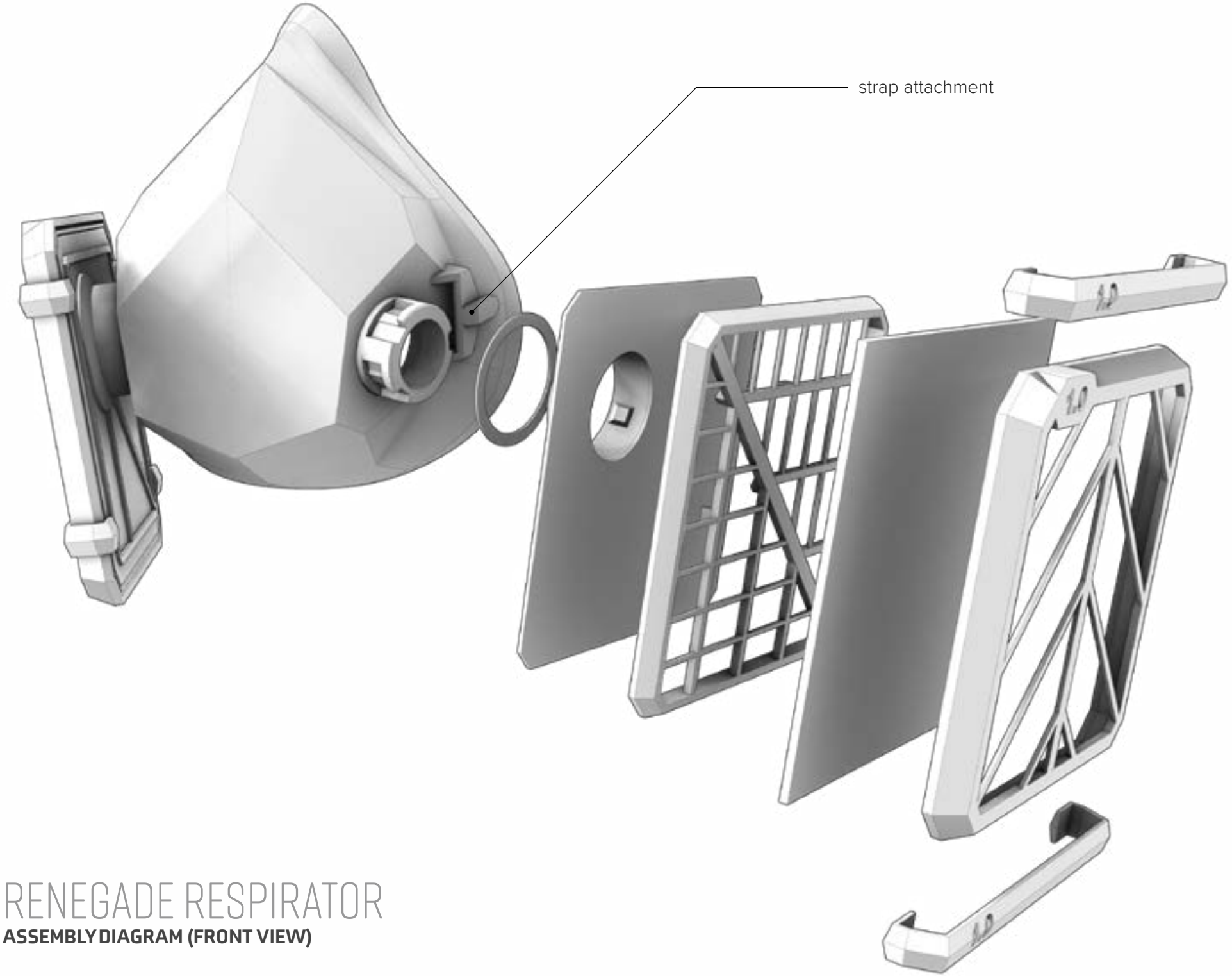
ASSEMBLY DIAGRAM (REAR VIEW)

CARTRIDGE ASSEMBLY



apply continuous adhesive in these areas to ensure an airtight seal

NOTE : GLUE PARTS TOGETHER INDICATED ABOVE AND ALLOW TO CURE BEFORE FINAL ASSEMBLY



RENEGADE RESPIRATOR

ASSEMBLY DIAGRAM (FRONT VIEW)

RENEGADE RESPIRATOR

FABRICATION SPECIFICATIONS

All prototypes and final designs were fabricated and tested using Lulzbot TAZ 6 and Mini 2, and Makerbot 3D Printers with the settings below. These are suggested settings and starting points for beginner to intermediate makers. We realize that personal settings can and will vary.

LULZBOT TAZ 6 / MINI 2 KEY SETTINGS

Layer Height : 0.18 mm
Initial Layer Height : 0.25 mm
Line Width : 0.5 mm
Wall Thickness : 1.04 mm
Wall Line Count : 2
Infill Density : 25%
Top/Bottom Thickness : 1 mm
Extruder Temperature : 215 C
Print Speed : 80 mm/s
Infill Speed : 80 mm/s
Wall Speed : 40 mm/s
Travel Speed : 175 mm/s

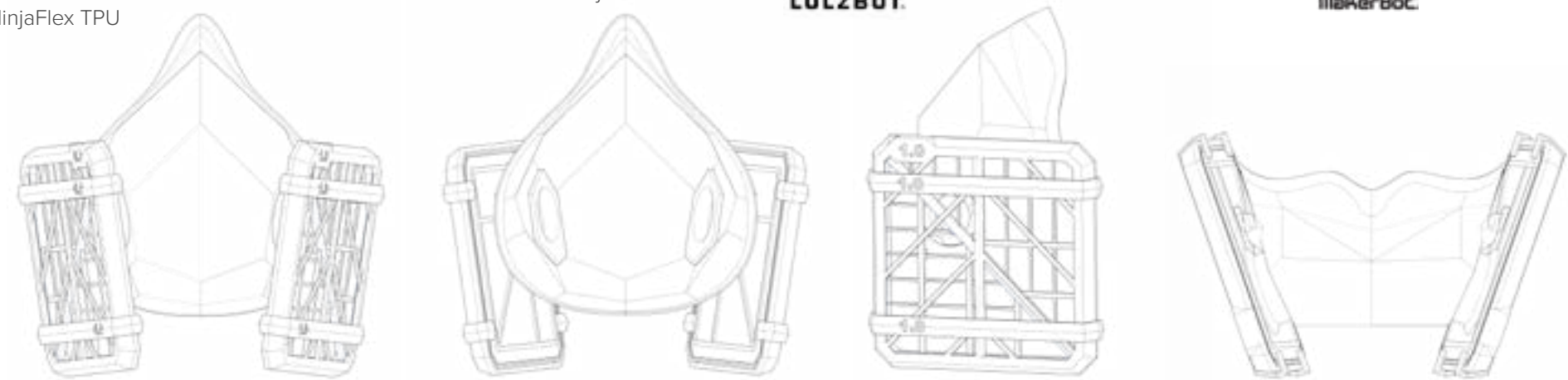
Lulzbot TAZ 6 Tool Head : Single Extruder Tool Head v2.1 (.50mm Nozzle)
Lulzbot Mini 2 Tool Head : E3D Titan Aero SE (.50mm Nozzle)

Printer / Filament Brand Used : TAZ 6 / Gizmo Dorks PLA
Printer / Filament Brand Used For Interface Gasket : Mini 2 / Ninjatek NinjaFlex TPU

MAKERBOT KEY SETTINGS

Layer Height : 0.2 mm
Line Width : 0.5 mm
Wall Width : 0.5 mm
Wall Line Count : 4
Infill Density : 100%
Top/Bottom Thickness : 0.8 mm
Extruder Temperature : 215-230C
Print Speed : 120 mm/s
Infill Speed : 90 mm/s
Travel Speed : 150 mm/s

Filament Brand Used During Prototyping : Makerbot Filament PLA
Filament Brand Used For Interface Gasket : n/a



FRONT REAR SIDE TOP

RENEGADE RESPIRATOR

TESTING METHODOLOGY& FILTER MEDIA SPECIFICATIONS

The Renegades Respirator was tested and passed both the full 8 exercise fit test and the shortened 4 exercise fit test, both are OSHA approved fit test techniques. The test probe was an N95 probe kit, installed in the front of the mask with silicone sealant on the inside.

8 EXERCISE - FIT TEST RESULTS

Normal Breathing : 134
Deep Breathing : 119
Head Side-to-Side : 150
Head Up and Down : 123
Speaking : 112
Grimmacing : 155
Bending Over : 119
Normal Breathing : 144

Overall : 130

4 EXERCISE - FIT TEST RESULTS

Bending Over : 99
Jogging-in-Place : 131
Head Side-to-Side : 162
Head Up and Down : 141

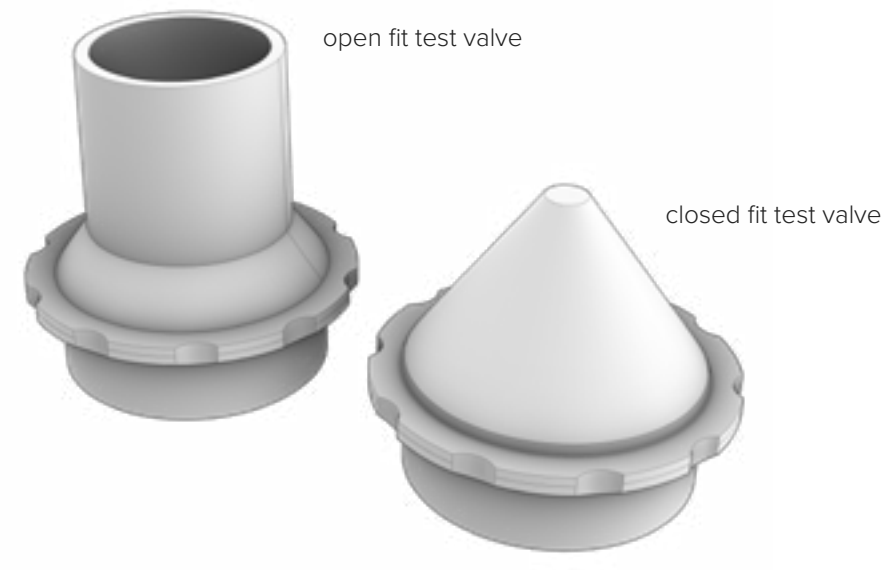
Overall : 129

FIT TESTING

To implement your own fit testing procedures please use the included fit testing valves (shown below). These valves are designed to work with the existing cam lock fitting interface.

FILTER MEDIA RECOMMENDATIONS

BRAND	LAYERS	EFFICIENCY
Caring brand, 4 ply non-woven medical sponges	4	94.7%
Filtrete 1500 by 3M (house HVAC filter)	4	94.9%
Nordic Pure MERV 14	3	93.9%
Kirby Vacuum Bag	2 / 3	98% / 99.6%



RENEGADE RESPIRATOR

HEAT MOLDING & FIT CUSTOMIZATION

STEP 01

Clean the mask after printing, remove burrs and strings. Use a 150 grit sand paper to sand the inside surface that you expect to contact your face. The smoother the better. Use a cloth wetted with acetone to further smooth the sanded surface if desired.

STEP 02

Install the camlock valves with silicone or similar sealant/adhesive

a. Allow to fully cure before heat molding
b. Apply the valves before heat molding to better retain mask shape

STEP 03

Place the mask shell in an oven preheated to 80°C (176°F) for 3 minutes. Place the mask open side up, on a folded paper towel placed in a baking dish to prevent the metal grill from melting the shell. Set up a mirror or camera phone on selfie mode nearby the oven to use during Step 04.

STEP 04

Remove the mask shell from the oven and gently press the mask shell to your face with a slight pivoting motion. Lightly anchor below your chin then pivot to contact the rest of your face. Use your fingers to gently press the mask against your nose bridge and cheek bones. Use the mirror or phone on selfie mode to guide your actions.

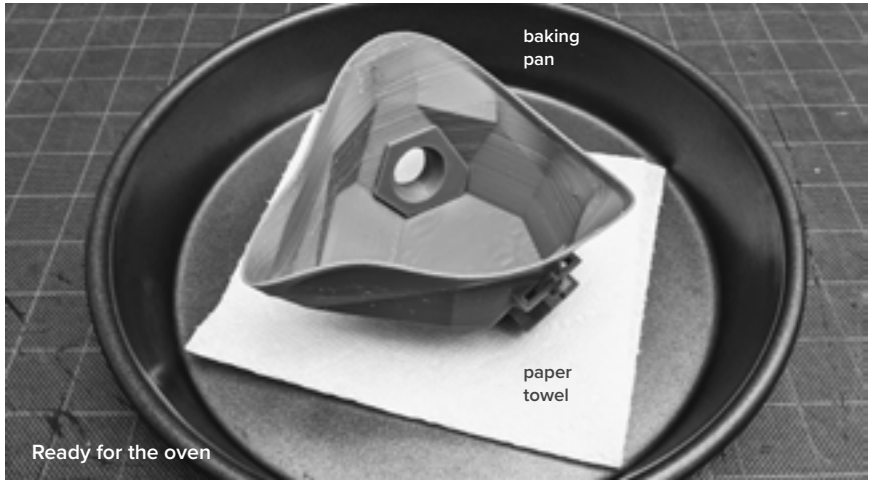
a. Shape your hand position similar to yelling across a field, use your index fingers and thumbs to gently contour the soft plastic to your face shape.
b. The mask hardens within seconds even though it still feels warm.
c. Inspect the fit in the mirror and note how well it seats on your nose bridge and upper cheeks. These are the most likely areas to leak.

STEP 05

Repeat the heat molding process, this time press a little bit harder on the sides of your nose and upper cheeks. **Don't over do it!** Don't press your fingers towards each other, that will make a crease on the top of your nose bridge and cause a leak. Try to apply even pressure with your whole finger, not just the finger tips.

STEP 06

A gasket may be added around the edge of the mask to improve comfort and fit.



Ready for the oven

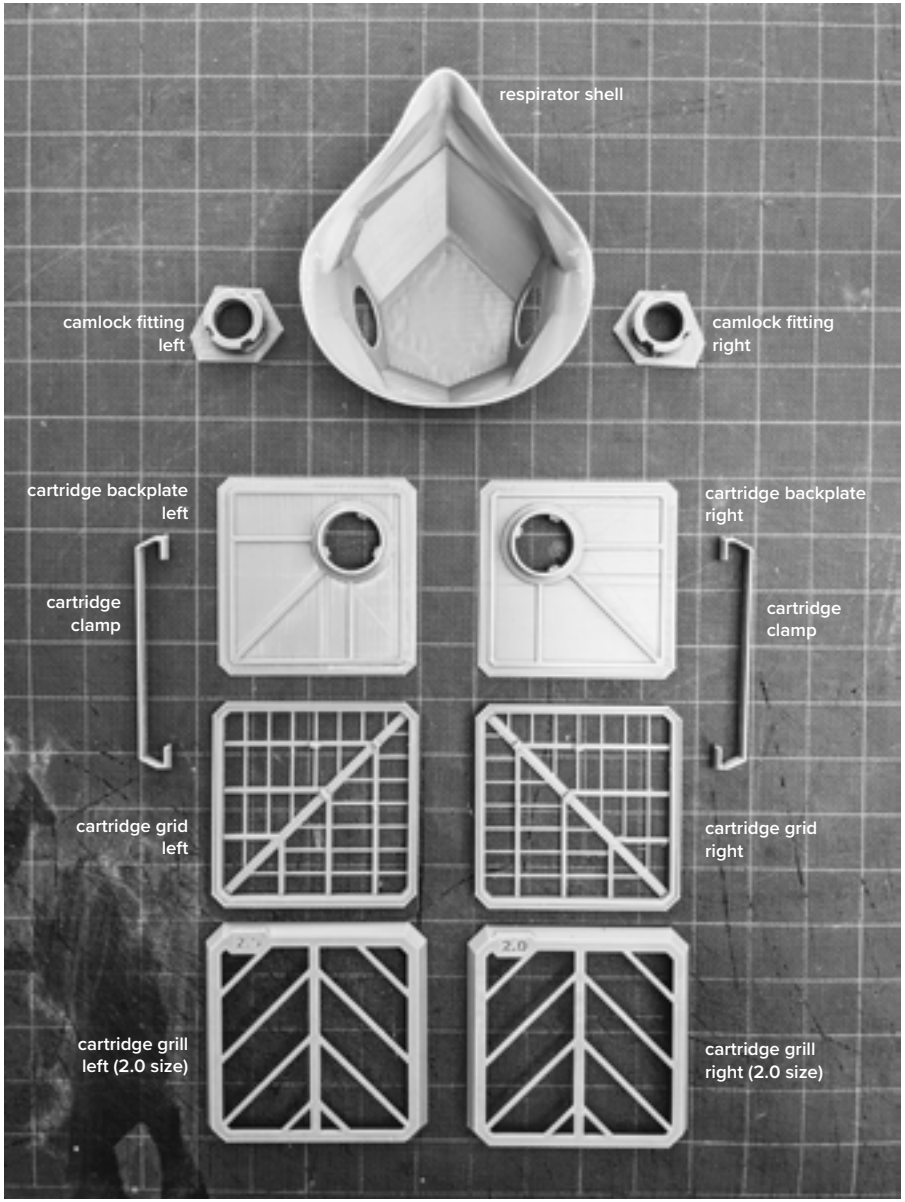
YOUTUBE VIDEO TUTORIAL

https://youtu.be/mmbe5S_4X2c

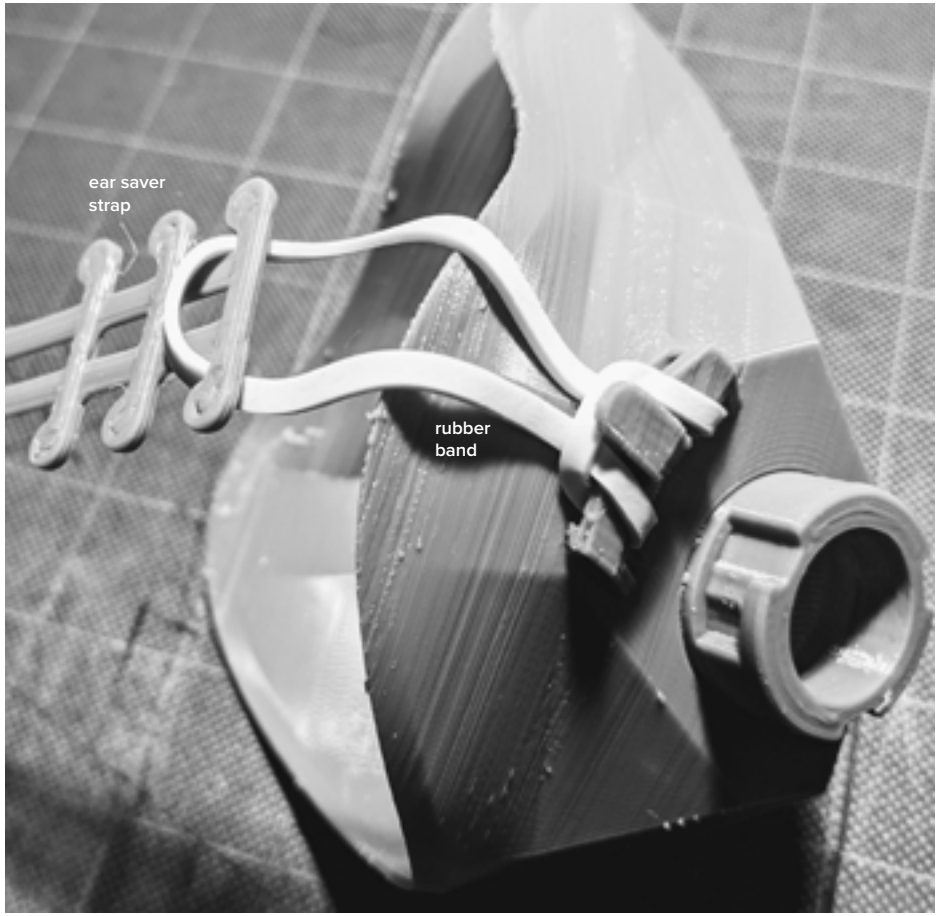
RENEGADE RESPIRATOR

MISCELLANIA

EXAMPLE PRINTED PARTS



RUBBER BAND + EAR SAVER BAND



SILICONE HEAD STRAP

The Renegade Respirator is optimally paired with the silicone head strap developed by the University of Oklahoma Tom Love Innovation Hub.

https://www.ou.edu/foroklahoma/Designs/silicone-strap