



## Quality Control Guide for 3D Printing

Welcome to the Make4Covid Quality Control Guide for 3D Printing. We first wanted to start by saying thank you for your commitment to quality!

This guide is designed for both novice or expert printers alike. We hope it helps with clarifying and visualizing common quality control issues.

The benefit of this community is that we can help each other out. If you do not understand something or are having problems please do not be afraid to ask questions!

If you are experienced and can help others who may be struggling with issues such as print settings or using new materials, please offer a helping hand and provide your input and advice.

Our goal as a community is to work together to create the highest possible PPE to deliver to healthcare workers. We are all on the same team working towards that same goal.

We hope this guide will help you in our efforts!



## Design File and SOP Used

For the list of current M4C approved Design Files

[Click Here](#)

Reason for QC: Make4Covid Designs have been vetted and approved by physicians and industry experts.

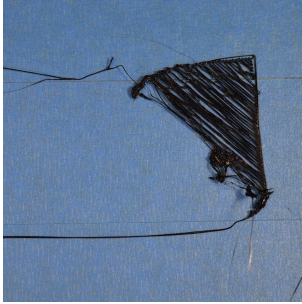

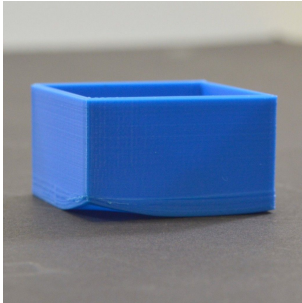
### Acceptable Grade Required to Pass: 3

Grade:	Comments/Feedback	Example
<b>0</b>	The design file used was not listed on the Make4Covid Fabrication Information page.	
<b>1</b>	The design file used was previously approved by Make4Covid. However, this design is not listed on our current Fabrication Information page.	
<b>2</b>	The design file used was approved on the Make4Covid Fabrication Information page. However, the Standard Operating Procedures (SOP) were not followed correctly.	Please don't work if you are sick!
<b>3</b>	The design file used was an approved listing on the Make4Covid Fabrication Information Page and all Standard Operating Procedures (SOP) were followed correctly.	

## Bottom/Initial Layer Adhesion

Reason for QC: Without proper adhesion of the initial layer, the print may lead to issues with peps, warping, or gaps in print which render the print useless.


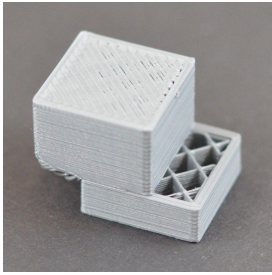
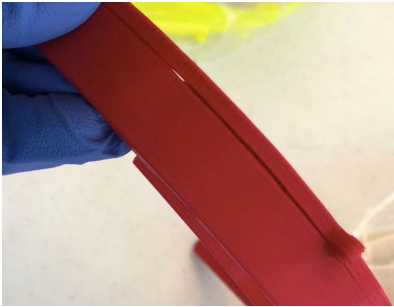

### Acceptable Grade Required to Pass: 2

Grade:	Comments/Feedback	Example
0	The print could not complete because the bottom layer did not adhere to the print bed	
1	The print was able to complete, but the bottom layer did not adhere correctly. There are noticeable gaps or cracks at the bottom of the print.	
2	The print was able to complete, but the bottom layer did not adhere properly. The bottom layer may be warped or detached from the print bed.	
3	The print was able to complete and the bottom layer adhered to the print bed. There are no noticeable gaps or cracks on the bottom layer	

## Layer Adhesion and Lamination

Reason for QC: Without proper adhesion of the layers, the print may lead to issues with peps, warping, or gaps in print which render the print useless.

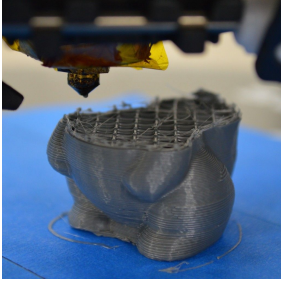
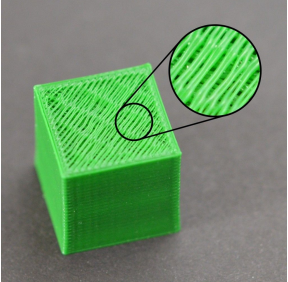
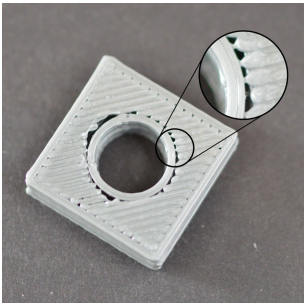

### Acceptable Grade Required to Pass: 3

Grade:	Comments/Feedback	Example
0	The layers broke away causing the print to fail.	
1	The printer shifted mid print causing overhangs that are not part of the 3D model	
2	The layers separated or did not bond correctly. The print completed but there are visible breaks or gaps in layers.	
3	Each layer adhered well to the layer before and the layers did not shift mid print.	

## Top Layer

Reason for QC: If there is an issue with your top layer it will make it difficult to disinfect your print. It is also a good sign that there are issues inside the print.


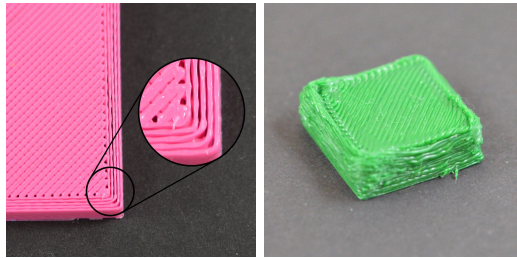
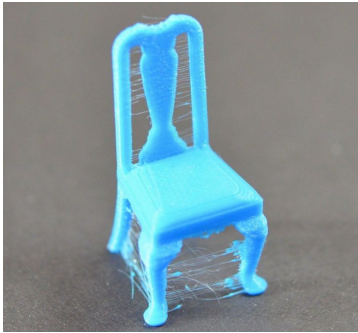
### Acceptable Grade Required to Pass: 3

Grade:	Comments/Feedback	Example
<b>0</b>	The print failed and the top layer did not complete	 A photograph of a 3D printed object, possibly a container or a mold, with a grey, textured top surface. The top layer is incomplete, showing a grid-like pattern that is not fully formed. A yellow nozzle is visible above the object, suggesting it is still in the printing process.
<b>1</b>	There are noticeable gaps and cracks in the top layer	 A photograph of a bright green 3D printed cube. A magnifying glass is positioned over the top surface, showing a close-up of the layer lines. There are visible gaps and cracks between the layers, indicating a poor top layer quality.
<b>2</b>	The top layer is complete, but there are gaps or cracks still visible	 A photograph of a white 3D printed square with a circular hole in the center. A magnifying glass is positioned over the top surface, showing a close-up of the layer lines. There are visible gaps and cracks between the layers, indicating a poor top layer quality.
<b>3</b>	There are no visible gaps or cracks in the top layer	 A photograph of a white 3D printed curved part, possibly a handle or a bracket. The top surface is smooth and shows no visible gaps or cracks, indicating a high-quality top layer.

## Correct Filament Extrusion

Reason for QC: Poor filament extrusion can cause deformities in the print making it difficult to properly sanitize the part. These errors usually occur due to a problem with print settings or the machine itself.

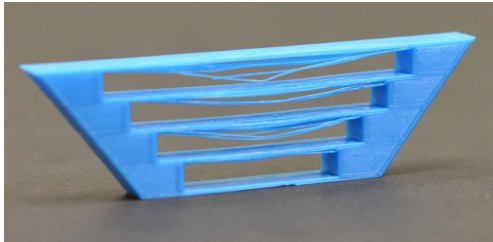

### Acceptable Grade Required to Pass: 2+

Grade:	Comments/Feedback	Example
<b>0</b>	The printer did not extrude filament correctly, causing a failed print or noticeable gaps or deformities in the final print.	
<b>1</b>	The printer under extruded material creating noticeable gaps between the perimeter or infill pattern <b>OR</b> The printer over extruded causing the layers to overflow resulting in messy edges	
<b>2</b>	The printer extruded correctly over the model areas, but there is some strings or ooze visible.	
<b>3</b>	The printer extruded correctly for the duration of the print. There are no noticeable cracks in the print and the edges appear smooth and uniform.	

## Proper Bridging and Support

Reason for QC: Support or bridging may not be required to print. When they are required, errors in the support structure or bridging settings may cause prints to sag, droop or deform.

### Acceptable Grade Required to Pass: 2+

Grade:	Comments/Feedback	Example
0	Support was not used where it was require <b>OR</b> The support failed to print and adhere causing a failed print or significant deformations	
1	The print has overhangs without support added causing a droop with visible breakage in the layers	
2	Areas above support structures create inconsistencies in the printed surface. There are no visible cracks or sharp edges. Any support was removed with no damage to the part	
3	Any support was removed and there is no damage on the part. The surface is smooth.	

## **Scale**

If this is your first print of this part or you have none available to compare to, there are two ways to check the scale of your part.

1. Using a sanitized ruler or tape measure measures the distance between the ends of the face shield. It should measure 17cm.
2. Print out this [scaling sheet](#) and ensure that it is printed to scale. Place the part on top of the scaling sheet and verify that it overlaps and is the same size.

Reason for QC: If the scale of the part is off, we won't be able to attach it correctly to the shields. Sometimes printer settings can mess with the print size.

### **Acceptable Grade Required to Pass: 3**

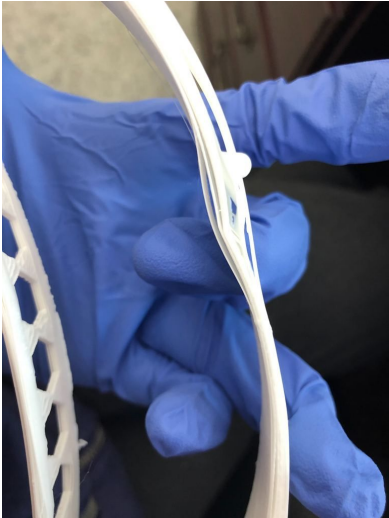
<b>Grade:</b>	<b>Comments/Feedback</b>	<b>Example</b>
<b>0</b>	The print is at a different scale than intended. More than 3 cm difference	
<b>1</b>	The print is close to the correct size but the difference is significant enough that it might not fit with other parts. More than 1mm difference	
<b>2</b>	The print is the same size as other prints made on the same printer, with the same print settings and material. At least one of those prints was measured and was the correct size.	
<b>3</b>	The print was measured using one of the approved methods and is within 1mm of the expected scale.	

### **Bend/ Strength Test**

After letting your print cool for 20 seconds take both ends of the face shield and bend them in about 1 inch. Then bend it out about 1 inch

Reason for QC: If the scale of the part is off, we won't be able to attach it correctly to the shields.  
Sometimes printer settings can mess with the print size.

### **Acceptable Grade Required to Pass: 3**

<b>Grade:</b>	<b>Comments/Feedback</b>	<b>Example</b>
<b>0</b>	During the bend test the part snaps into pieces	
<b>1</b>	The part stays the whole but begins to splinter. Layers begin to separate	
<b>2</b>	The print stays together and there are no noticeable cracks but the part can't be bent that far (too stiff) or it stays bent instead of springing back to shape.	
<b>3</b>	The bend test is completed with no noticeable deformities or cracks. It springs back into shape	