GrabCAD Print Pro™ for J3™/J5™ Series Printers Best Practices Guide

DOC-09130 Rev. B

stratasys

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DOC-09130 Rev. B

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Contents

Revision History

Revision	Release Date	Description of Changes
A	May 2024	Original document.
B	July 2024	Added Print on Tray, Print on: Tray Height Adjustment Wizard, and Support as Material

Smart Insert

The *Smart Insert* function enables you to use GrabCAD Print Pro to plan one or more pauses during your print job at specific slices or heights in advance. During these pauses, you can open the printer door and embed electronic sensors, electronic components, mechanical parts, etc. When you resume printing, the printed part continues to be printed.

In your CAD software, you create a Smart Insert assembly comprising at least 2 parts:

1. a model to be printed with a cavity for an inserted object
2. an object that is inserted into the cavity

Figure 1: Assembly with a smart insert

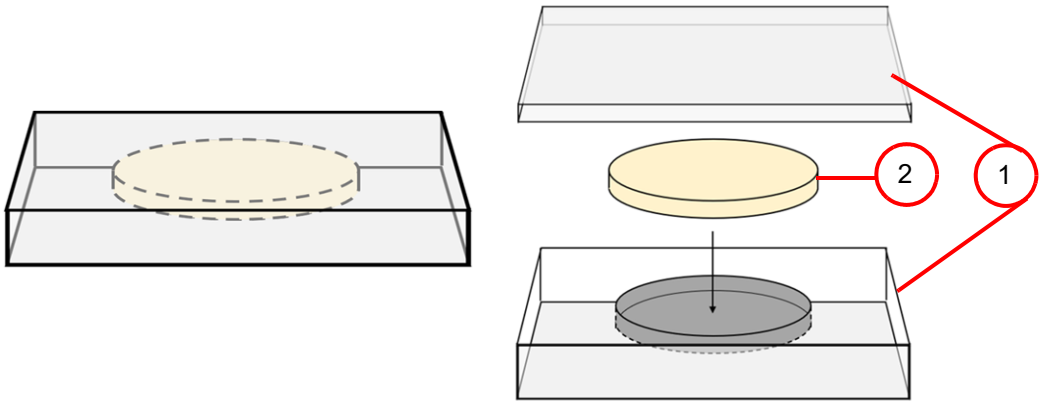
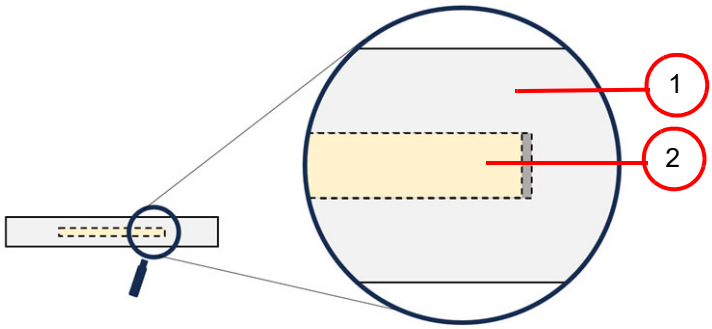


Figure 2: Cut view of the assembly

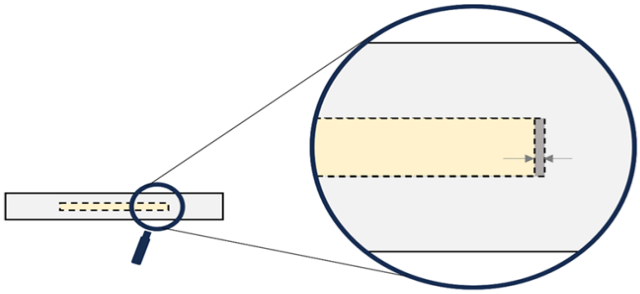


Design Considerations - Smart Insert

This section provides recommendations and tips for designing a model with an inserted object.

- When designing the cavity, include a 100-micron offset between the printed part and the object to be inserted. A snug transition is desired (see Figure 3).

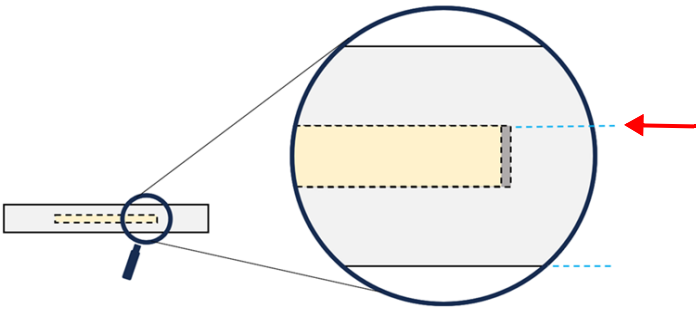
Figure 3: Cavity tolerance ±100 micron



- To ensure that the printer pauses at the correct height, you need to measure the height from the base of the model to the top of the part. You can do this using the measuring tools in your CAD software (or using a caliper).

  The height of the inserted object should not exceed the height of the printed model. When printing is resumed, the next layer requires a level surface at the next slice.
- When measuring the height, verify that the part is in its proper print orientation.
- If a model has multiple stops or the tray has multiple models with different stops, define all the stops of all the models in the *Planned Stops* section.

Figure 4: Assembly with a planned stop



For example, for an assembly with 3 objects:

1. First planned stop
2. Second planned stop
3. Printed part with inserted parts
4. 3 inserted objects

Figure 5: Assembly with 3 objects inserted (cut view)

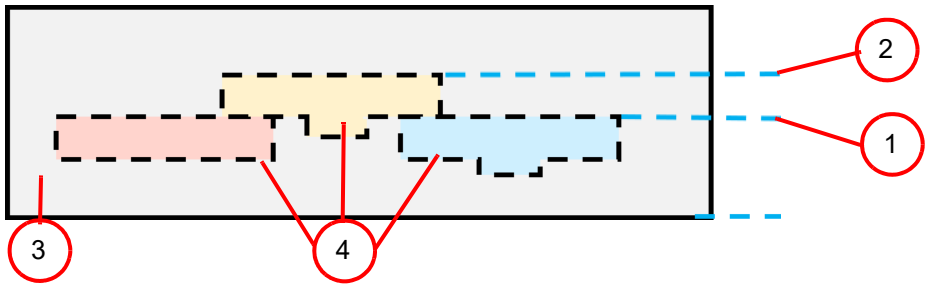
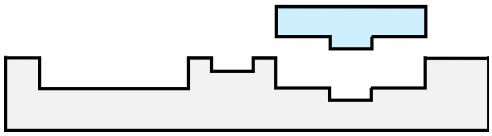
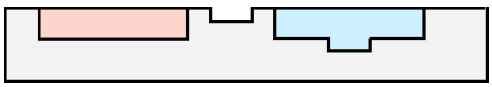
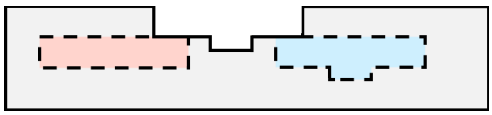
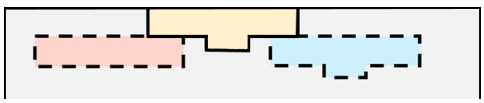
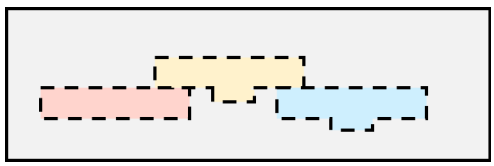


Table 1: Multiple Smart Inserts and planned stops (cut views)

#	Multiple Smart Inserts (cut view)	Description
1		Paused at the first planned stop (Printed in a *Glossy* finish)
2		Placing an object
3		Objects inserted (Make sure the heights of the objects do not exceed the level of the printed parts.)
4		Print resumed (until it is paused at second planned stop)
5		Object inserted (Make sure the height of the object does not exceed the level of the printed part.)
6		Print resumed (until it is completed with smart inserts)

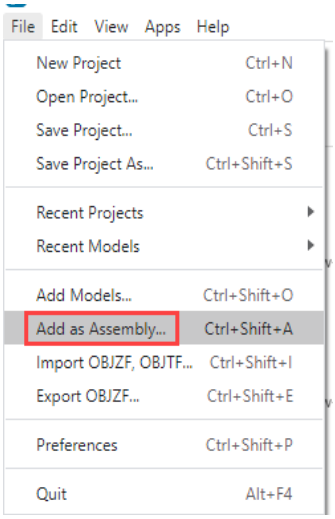
Printing Workflow - Smart Insert

Prepare for printing in GrabCAD Print Pro.

1. Create a design in your CAD as a single assembly with a printed part and an object to insert.
2. Load the assembly from the *File* menu, and select *Add as Assembly.*

   The STLs that you designed as an assembly are imported.

Figure 6: Loading parts as an assembly

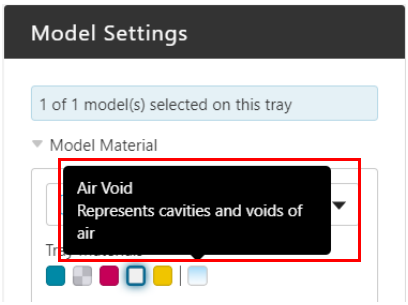


3. In the *Model Settings* panel, assign *Air* as the material for the cavity part (object).

   This ensures that support material is not printed in the cavity.

> Printing in a *Glossy* finish also ensures no support material is printed.

Figure 7: Assigning *Air* as the material of the air void

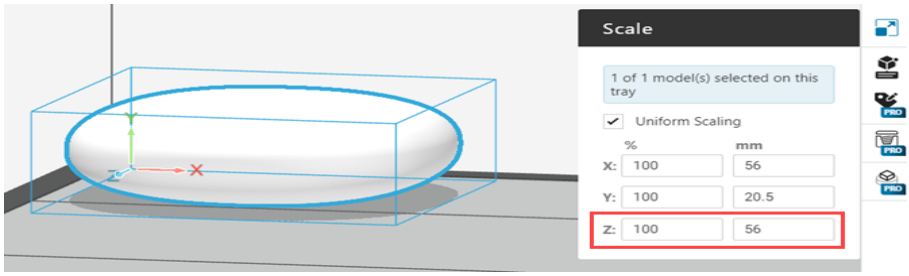


4. Measure the distance from the bottom of the model to the top of the object insert (GrabCAD Print™ calculates the height for the carpet or pedestal).

   Repeat this measurement for each air void enclosure.

> You can use the GrabCAD Print, *Scale* screen to measure the Z coordinate.

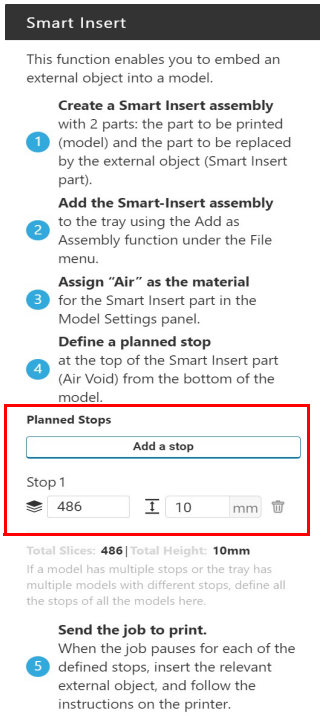
Figure 8: Measuring height using the *Scale* screen



5. Enter the measurement as a *Planned Stop* at the top of the cavity, as measured from the bottom of the model.

> If a model has multiple stops or the tray has multiple models with different stops, define all the stops of all the models in the *Planned Stops* section.

Figure 9: Defining a planned stop for a Smart Insert



6. Send the job to print.
7. When the job pauses, open the printer door, and insert the relevant object.

   The account holder receives an email notification that the print has paused.
8. Measure and record the total height (in mm) from the tray to the top of the inserted object.

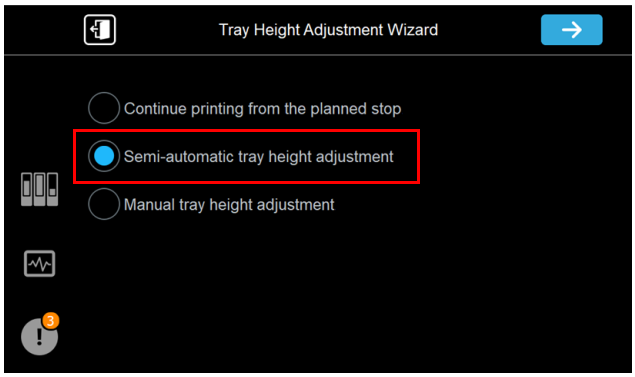
   Verify that the measurement from the CAD software and the actual height are the same.
9. Close the printer door.
10. In the *Tray Height Adjustment* wizard that appears, select the option that applies:
    - If *Planned Stop* height is the same as the actual height, select *Continue printing from the planned stop* and continue with step 12.

      Figure 10: *Tray Height Adjustment* wizard—Continue

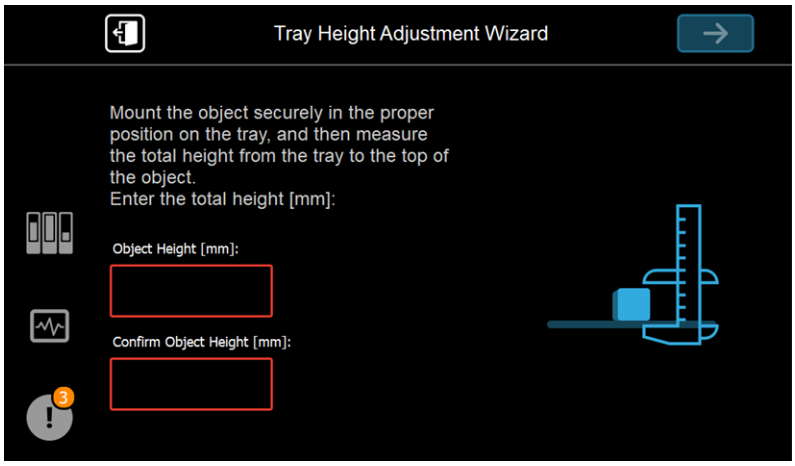
    - If *Planned Stop* is not the same as the actual height, select *Semi-automatic tray height adjustment* and continue with step 11.

      Figure 11: *Tray Height Adjustment* wizard—Semi-automatic

11. Enter and confirm the *Object Height* (total height from the tray to the top of the object):

Figure 12: Enter the object height



a. In the *Object Height* box, enter the recorded total height in mm (from the tray to the top object) and tap **Enter**.

b. In the *Confirm Object Height* box, confirm the height, tap **Enter**, and tap **Next**  .

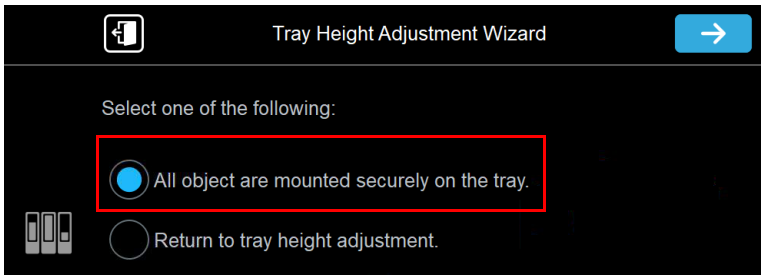
The tray adjustment is in progress. If there is an problem, you have the option to tap Stop 

.

Figure 13: Tray adjustment in progress

c. Verify that the objects/models are secured. and select *All objects are mounted securely on the tray*, and tap **Next**  .

Figure 14: *Confirmation* screen



The tray height adjustment process begins.

d. When the check mark appears, tap **Next** .

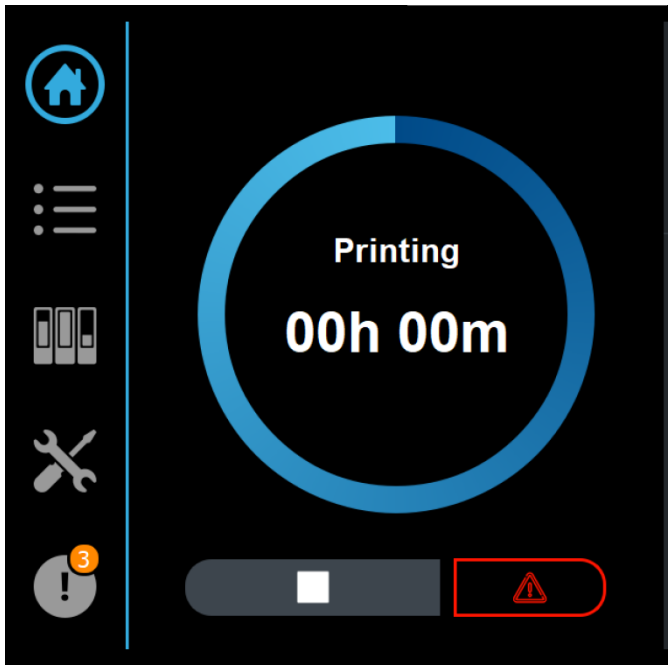
e. Continue with step 12.

12. To resume printing, refer to *Resuming Production After Printing has Stopped*, as described in the User Guide.

- The Emergency Stop button appears in the printer interface.

  If there is an problem, you have the option to tap **Stop** .

Figure 15: *Tray adjustment in progress*



- The model is printed after the object is inserted.

If there are more defined Planned Stops in the job, and the job continues until the next pause, continue with step 7.

Figure 16: Printed smart inserts

Print on Object

The *Print on Object f*unction enables you to use GrabCAD Print Pro to plan a pause during your print job at a specific slice or height in advance. During the pause, you can open the printer door and secure an object in a printed jig. When you resume printing, the design is printed on the object.

In your CAD software, you create a Print on Object assembly with 3 parts, as follows:

1. the model design you wish to print on the surface of the object
2. the object you want to print on
3. a jig to guide the placement of an object

Figure 17: Assembly with a jig, object, and model design

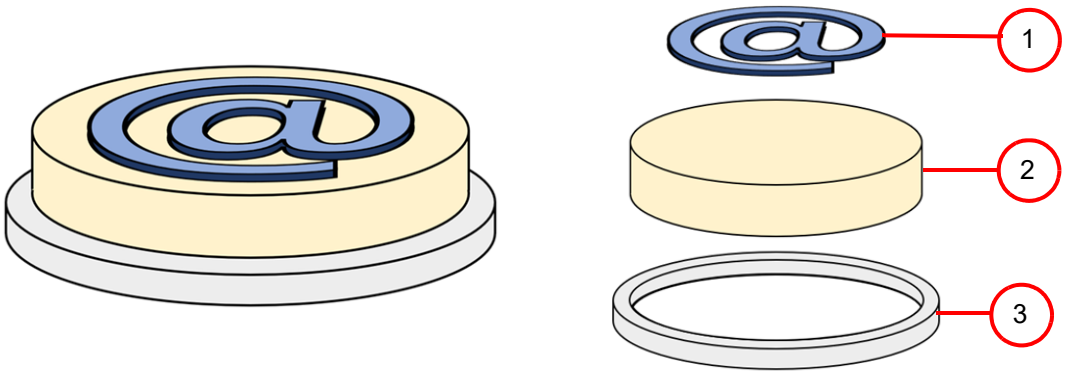
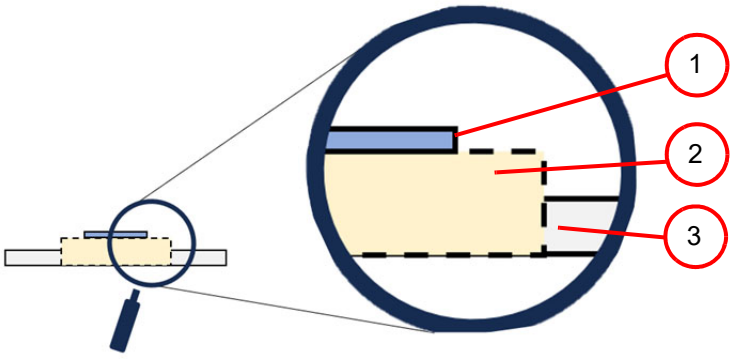


Figure 18: Cut view of the assembly



Design Considerations - Print on Object

This section describes recommendations and tips for printing a 3D design on top of an object.

- For every object, the jig should be printed directly on the tray and has to be designed in a manner that prevents the object from moving during the printing process.
- When printing on an object that features an overhang, such as cantilever, an inverted cone, or an inverted pyramid, design a jig that entirely supports the overhanging area (see Figure 19 and Figure 20).

Figure 19: Objects with overhang

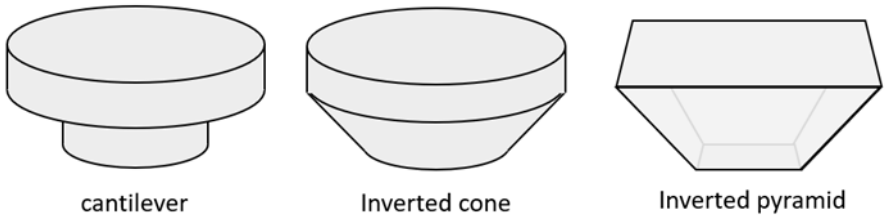
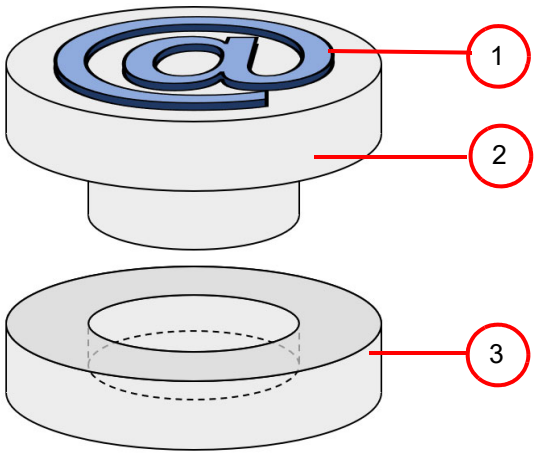


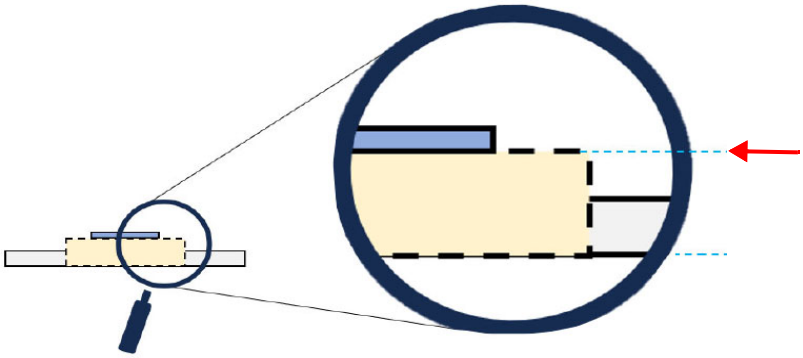
Figure 20: Assembly with jig designed to support an overhanging geometry



- When designing the jig, include a ±100-micron offset between the jig and the object to be inserted. A snug transition is desired, (see Figure 3).
- Verify the object geometry is modeled and the part is in the proper orientation.
- To ensure that the printer pauses at the correct height, you need to measure the height from the base of the model to the top of the object to print on. You can do this using the measuring tools in your CAD software (or using a caliper).

- If a model has multiple stops or the tray has multiple objects with different stops, define all the stops of all the objects in the *Planned Stops* section for each air void.

Figure 21: Assembly with a planned stop



Printing Workflow - Print on Object

Prepare for printing in GrabCAD Print Pro.

1. Create a design in your CAD as a single assembly with the jig, the object to print on and the model design that you want to print on the object.
2. Load the assembly and set priorities as follows:
   a. From the *File* menu, select *Add as Assembly*.

      The STLs that you designed as an assembly are imported.

Figure 22: Loading parts as an assembly

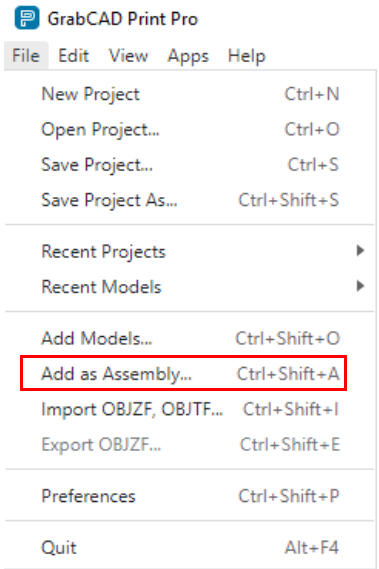
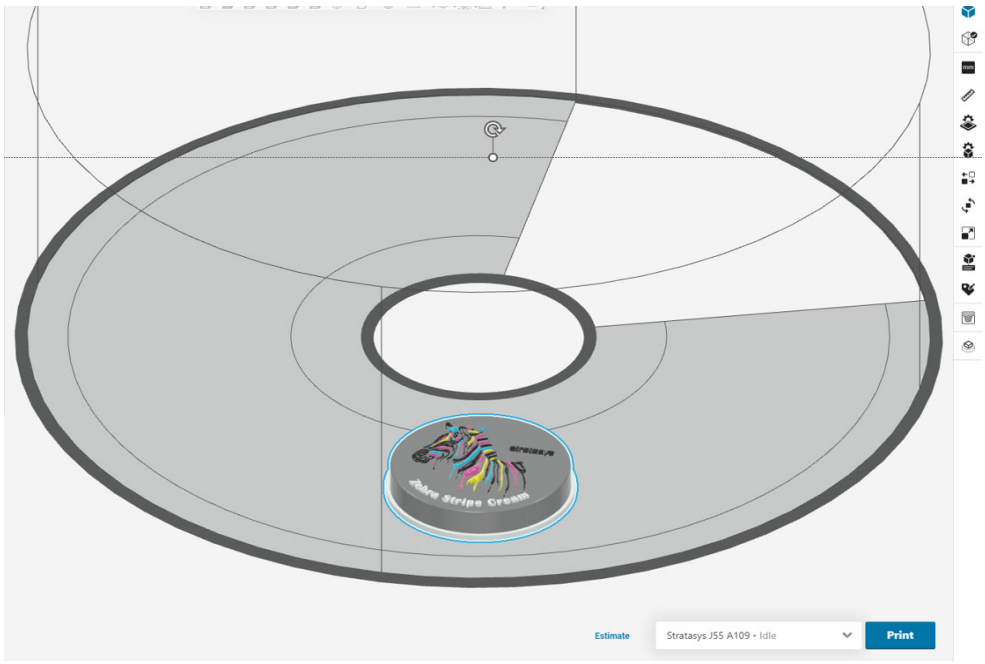
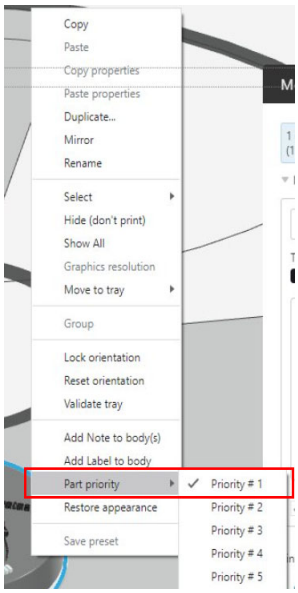


Figure 23: Imported assembly on the tray - example



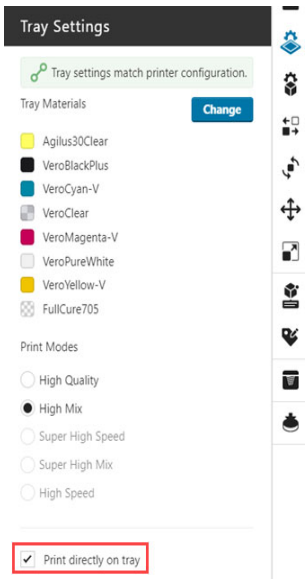
b. Right-click the assembly and set *Part Priority* for each of the parts as follows:
   - For the jig—*Priority #* is *1*
   - For the Air void (placeholder of the object)—*Priority #* is *2*
   - For the Model design—*Priority #* is *3*

Figure 24: Setting Part Priority- example



3. In the *Tray Settings* panel, select the *Print directly on tray* option. This ensures proper adhesion of the jig to the tray.

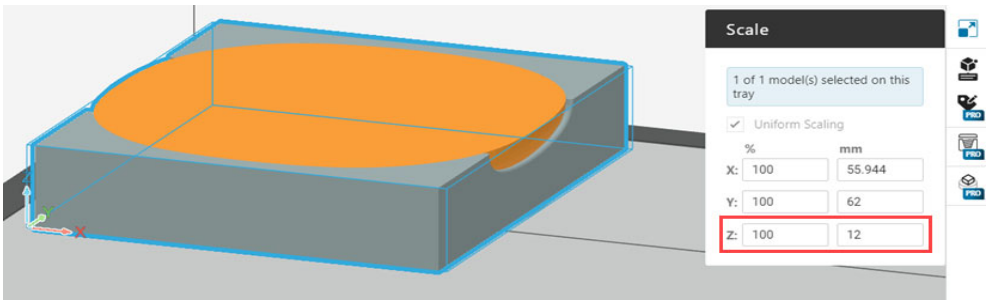
Figure 25: *Print Directly on the Tray* option



4. Measure the distance from the bottom of the model to the top of the object (GrabCAD Print calculates the height for the carpet or pedestal).

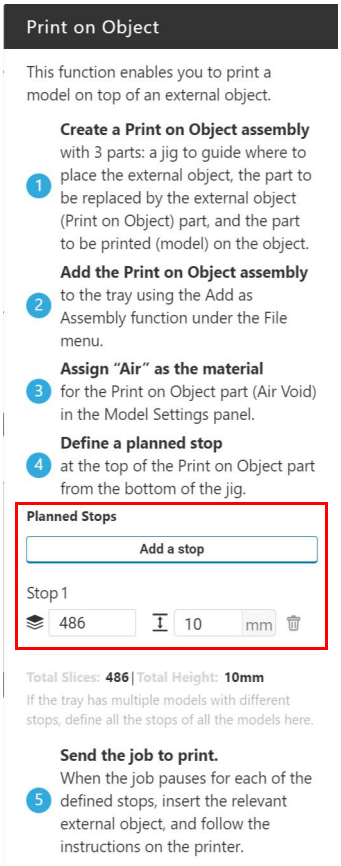
> You can use the GrabCAD Print, *Scale* screen to measure the Z coordinate or CAD.

Figure 26: Measuring height using the *Scale* screen



5. Enter the measurement as a *Planned Stop* for the object you want to print on.

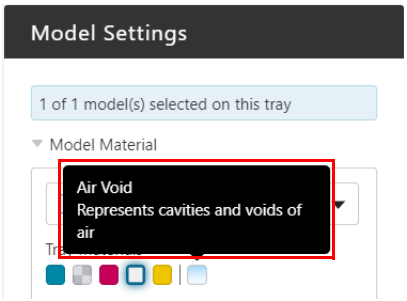
Figure 27: Defining a planned stop for Print on Object



6. In the *Model Settings* panel, assign *Air* as the material for the object to be printed on.
   This ensures that support material is not printed as part of the model.

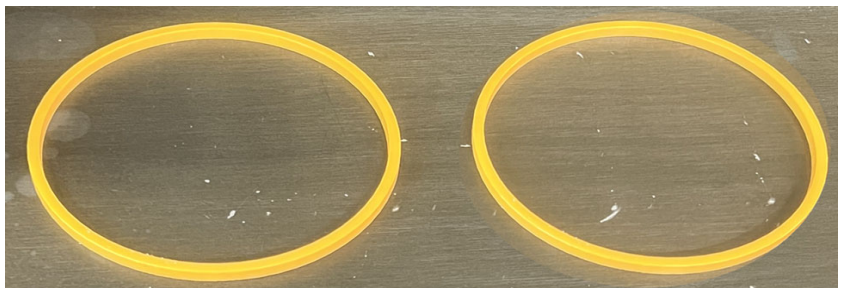
> Printing in a *Glossy* finish also ensures no support material printed.

Figure 28: Assigning *Air* as the material of the air void



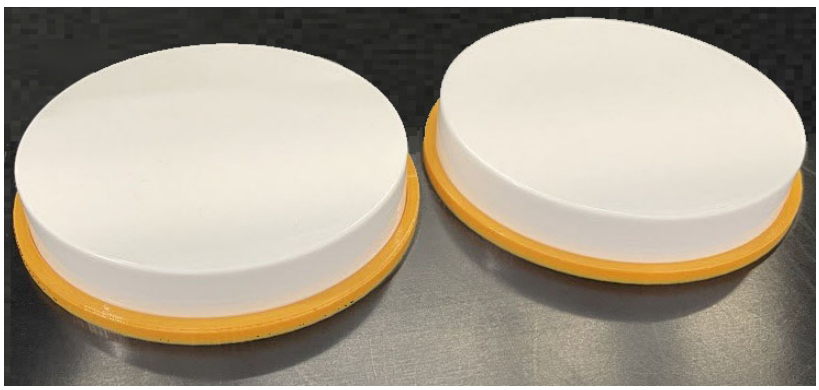
7. Send the job to print.
   The jigs are printed on the tray.

Figure 29: Printed jigs - example



8. When the job pauses, open the printer door, place the objects within the printed jigs.
   The account holder receives an email notification that the print has paused.

Figure 30: Objects placed in the printed jigs (example)



9. Measure and record the total height (in mm) from the tray to the top of the object.

> Verify that the measurement from the CAD software and the actual height are the same.

10. Close the printer door.
11. In the *Tray Height Adjustment* wizard that appears, select the option that applies:
    - If *Planned Stop* height is the same as the actual height, select *Continue printing from the planned stop* and continue with step 13.

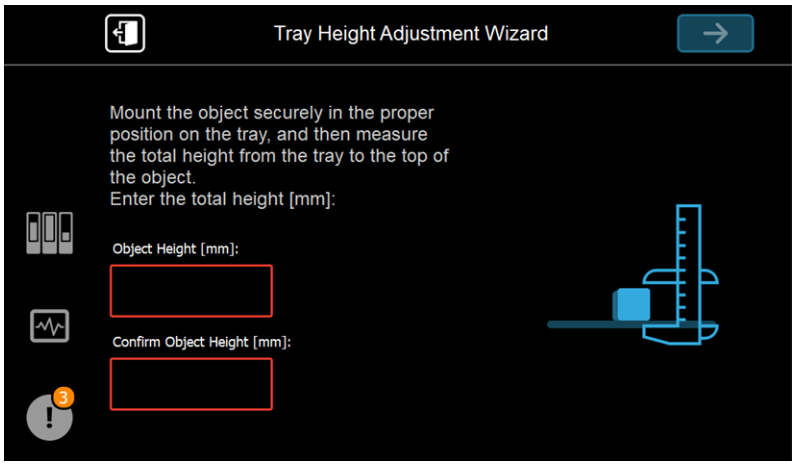
Figure 31: *Tray Height Adjustment* wizard—Continue

    - If *Planned Stop* is not the same as the actual height, select *Semi-automatic tray height adjustment* and continue with step 12.

Figure 32: *Tray Height Adjustment* wizard—Semi-automatic

12. Enter and confirm the *Object Height* (total height from the tray to the top of the object):

Figure 33: Enter the object height



a. In the *Object Height* box, enter the recorded total height in mm (from the tray to the top object) and tap **Enter**.

b. In the *Confirm Object Height* box, confirm the height, tap **Enter**, and tap **Next**  .

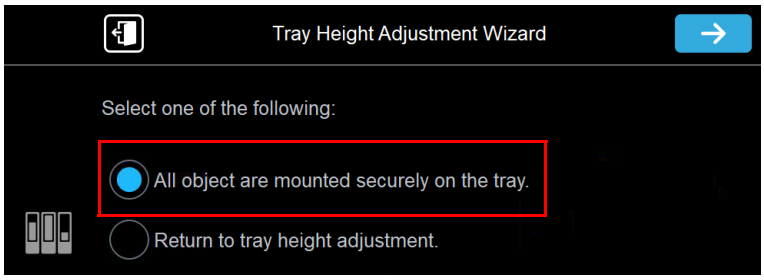
The tray adjustment is in progress. If there is an problem, you have the option to tap **Stop** 

.

Figure 34: *Tray adjustment in progress*

c. Verify that the objects/models are secured and select *All objects are mounted securely on the tray*, and tap **Next**  .

Figure 35: *Confirmation* screen



The tray height adjustment process begins.

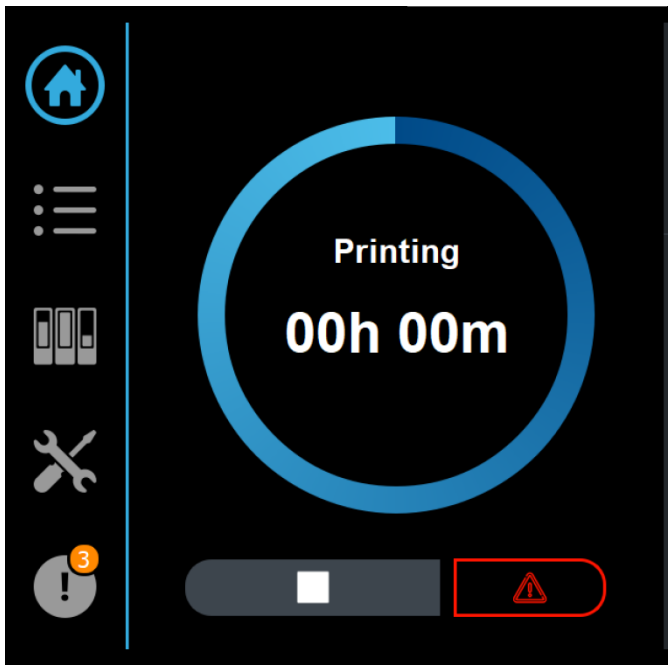
d. When the check mark appears, tap **Next** .

e. Continue with step 13.

13. To resume printing, refer to *Resuming Production After Printing has Stopped*, as described in the User Guide.

- The Emergency Stop button appears in the printer interface. If there is an problem, you have the option to tap Stop .

Figure 36: *Tray adjustment in progress*



- The model designs are printed on the objects.

Figure 37: Model designs printed on the objects

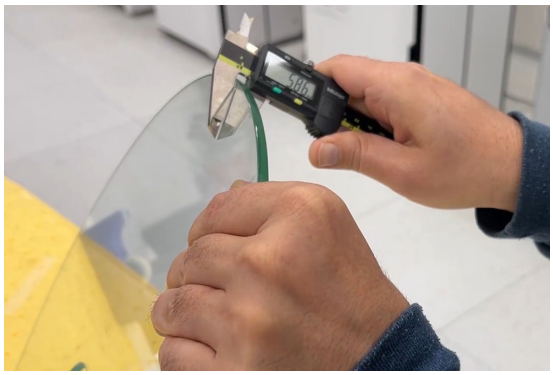
Print on Tray

The *Print on Tray* function enables you to print a model directly on an object that functions as the base surface without using support material, a carpet, or a pedestal underneath the model. You need to adjust the build tray's start position and its distance from the roller. This ensures that the print block does not collide with the object surface during printing, and that the model is printed accurately.

Ensure that the object remains stable and in place while printing the model, and then set up the print job.

1. Using a caliper, measure and record the total height (in mm) of the width of the object to print on.

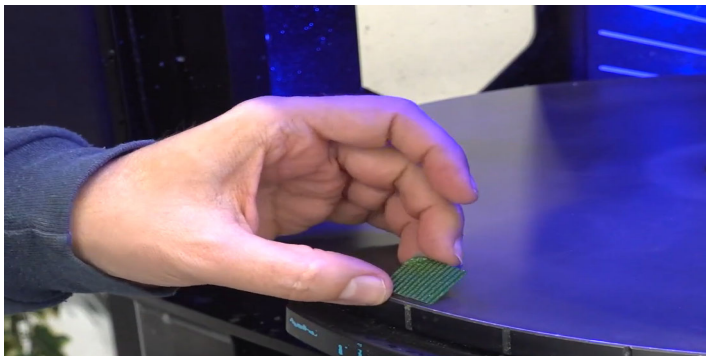
Figure 38: Measuring the thickness of the object



2. Place double-sided adhesive tape on the tray and peel off the backing.

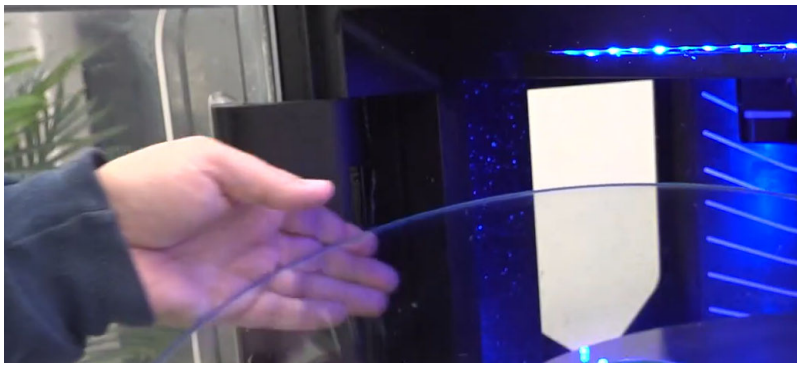
> The method of securing the object may vary. If you use double-sided adhesive tape, add the thickness (in mm) of the double-sided tape to the total height measurement.

Figure 39: Placing double-sided adhesive tape on the build tray



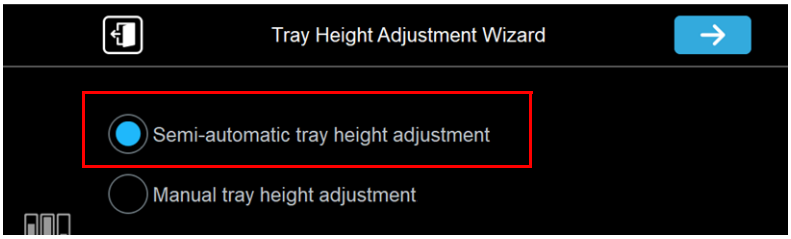
3. Place the object on the tray and verify that it is secured.

Figure 40: Placing the object (glass) on the tray



4. From the *Wizards* screen, tap **Tray Height Adjustment**, and then tap **Next**.
5. In the *Tray Height Adjustment* wizard, select Semi-automatic tray height adjustment.

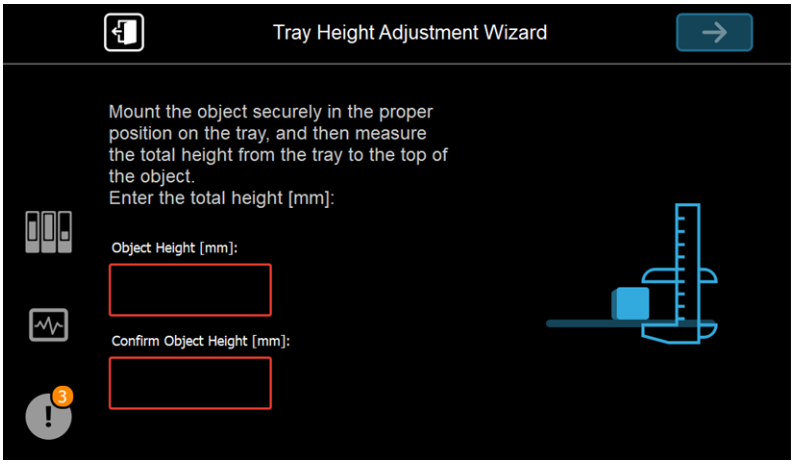
Figure 41: *Tray Height Adjustment* wizard—Semi (Print on Tray)



To manually adjust the tray height, refer to the J5 Series User Guide.

6. Enter and confirm the *Object Height* (total height from the tray to the top of the object surface):

Figure 42: Enter the object height

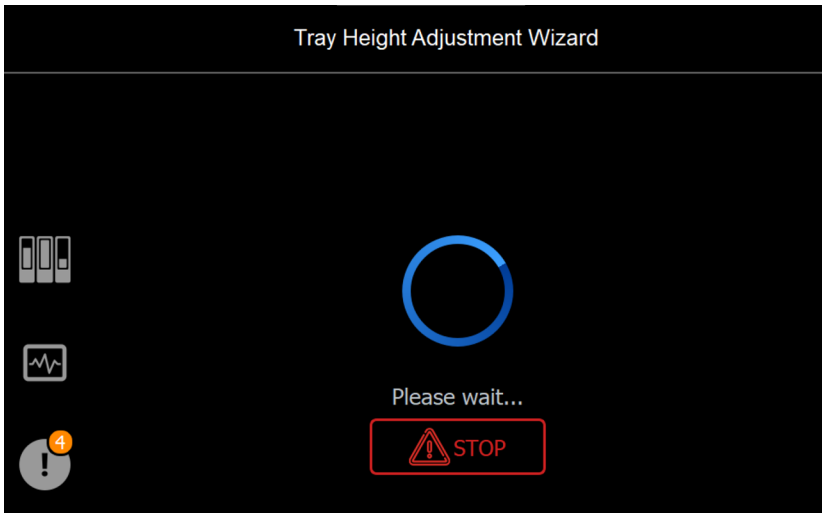


a. In the *Object Height* box, enter the recorded total height in mm (from the tray to the top object) and tap **Enter**.

b. In the *Confirm Object Height* box, confirm the height, tap **Enter**, and tap **Next**  .
The tray adjustment is in progress. If there is an problem, you have the option to tap **Stop** 

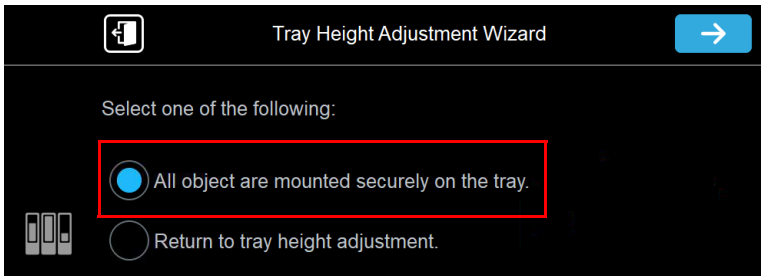
.

Figure 43: Tray adjustment in progress



c. Verify that the objects is secured to the tray and select *All objects are mounted securely on the tray*, and tap **Next**  .

Figure 44: *Confirmation* screen

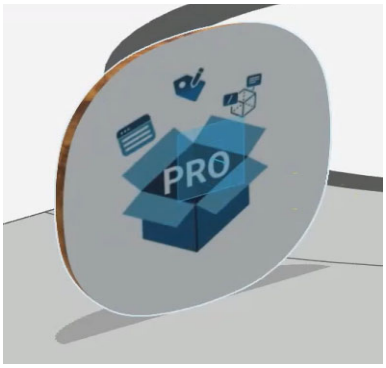


The tray height adjustment process begins.

d. When the check mark  appears, tap **Next**  .

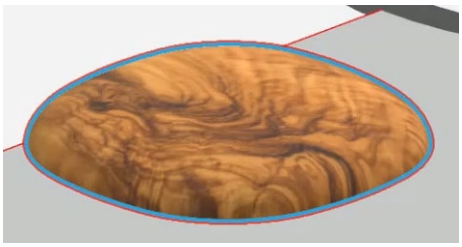
7. In GrabCAD Print, add your model.

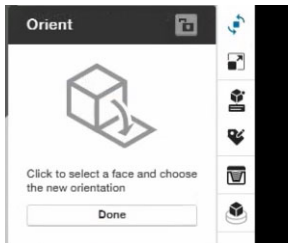
Figure 45: Added model in GrabCAD Print



8. In the *Orient* tool and click **Orient Face to Plane**.
9. In the Orient to Plane dialog box, select *Bottom*.

Figure 46: Added model in GrabCAD Print





10. In the *Model Settings* tool, set the finish to *Glossy*.
11. In the *Tray Settings* tool, set the *Print directly on tray* option.

> If you want to detach the model after printing it on the glass, add a separating agent to the glass before you print the model.
>
> For example, spray a silicon spray on the glass, and then print the model.

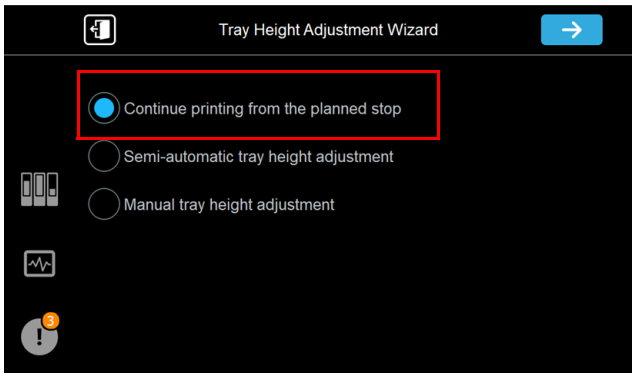
12. Send the job to print.
13. Remove the model from the glass, if relevant.

Print-On Tray Height Adjustment Wizard

The Tray Height Adjustment wizard enables you to set the tray height according to the functionality:

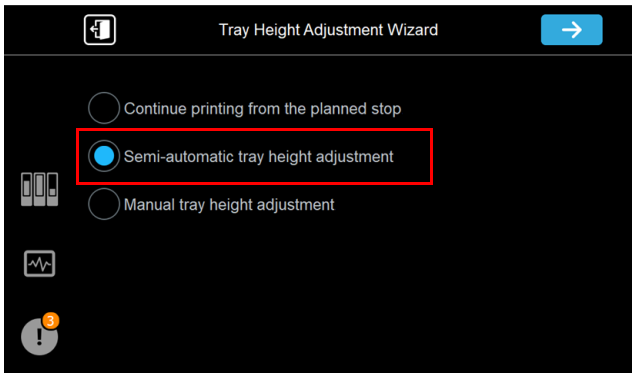
- For the *Smart Insert* and *Print on Object* functions, the *Tray Height Adjustment* wizard enables you to select the method for setting the tray height for the top surface of the inserted or print-on object, as follows:
  - *Planned Stop*—When the Planned Stop is the same as the actual height.

Figure 47: *Tray Height Adjustment* wizard—Continue (Planned Stop)



  - *Semi-automatic tray height adjustment*—When the Planned Stop is not the same as the actual height.

Figure 48: *Tray Height Adjustment* wizard—Semi-automatic



See “Smart Insert” (page 5) or “Print on Object” (page 14).

- For the *Print on Tray* function, the *Tray Height Adjustment* wizard enables you to select the *Semi-automatic tray height adjustment* method for printing a model directly on an object that functions as the base surface without using support material, a carpet, or a pedestal underneath the model.

- If you select the *Semi-automatic tray height adjustment* option, you need to enter the height of the object from the tray to the top surface to be printed.

Figure 49: *Tray Height Adjustment* wizard—Semi (Print on Tray)

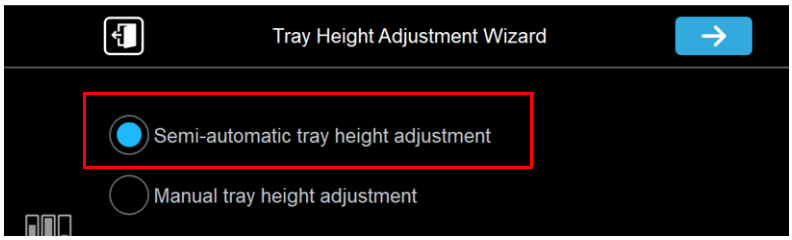
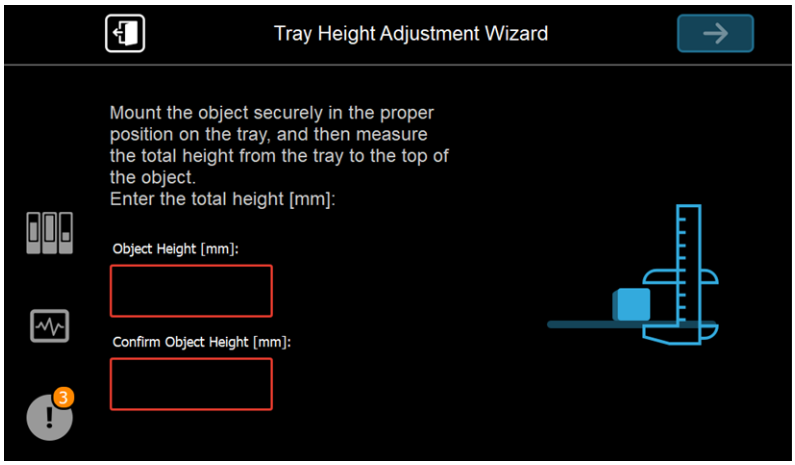


Figure 50: Enter the object height



- If you select the *Manual tray height adjustment* option, refer to the J5 Series User Guide for instructions.

Figure 51: *Tray Height Adjustment* wizard—Manual

See “Print on Tray” (page 25).

Air as Material

Air as Material enables you to use air as a virtual material when printing parts. The *Air as Material* feature in GrabCAD Print Pro™ is useful for controlling the part weight, textures, and surface finish.

When designing the voids that are filled with air, ensure that the top of the voids are sealed. To create a sealed air void, design the seal and the tip of the voids as follows:

- The minimum thickness of the seal is 1 mm.
- Set the tip of the void with an angle less than or equal to 7°, depending on the geometry (see Figure 52 and Figure 53).

Important:
The degree of the angle needed to seal the tip of the void may differ for different printing materials.

Figure 52: Air voids with tips (left); *Model Settings* dialog - *Air Void* selected (right)

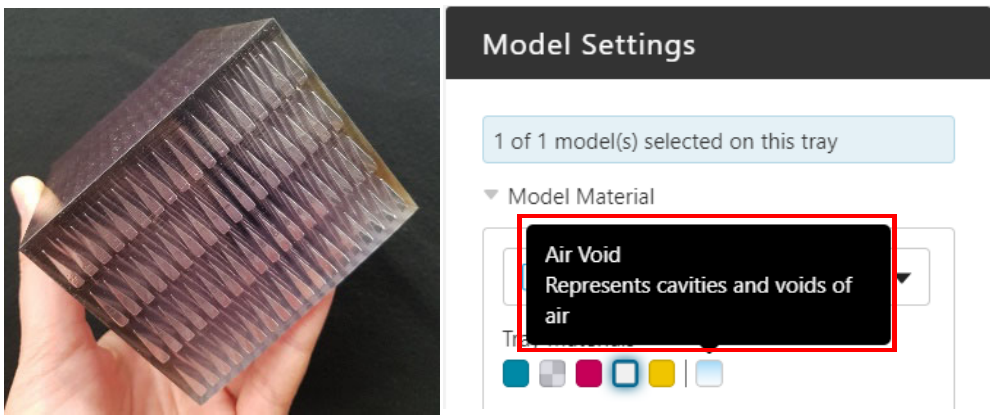


Figure 53: Air voids with tips (left); *Air Void*s with tips (right)

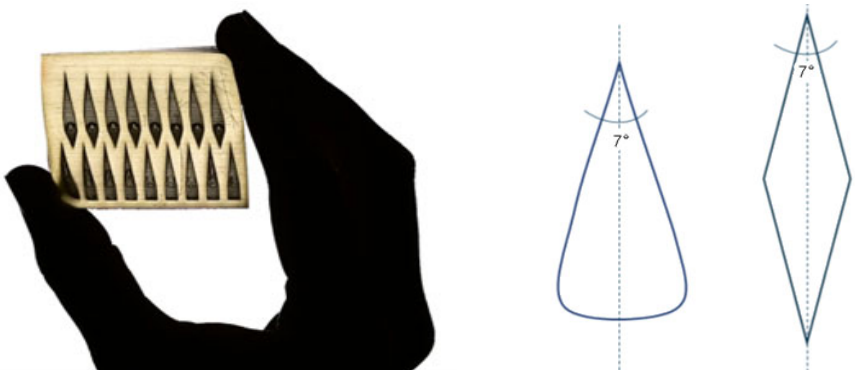


Figure 54: *Air Assignment* in GrabCAD Print Pro - part

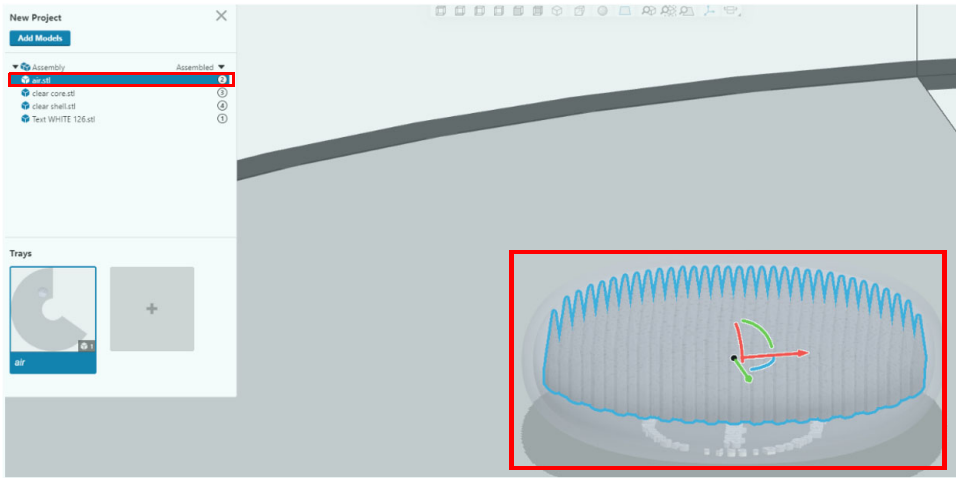


Figure 55: *Model Setting* dialog box—Air Void selected

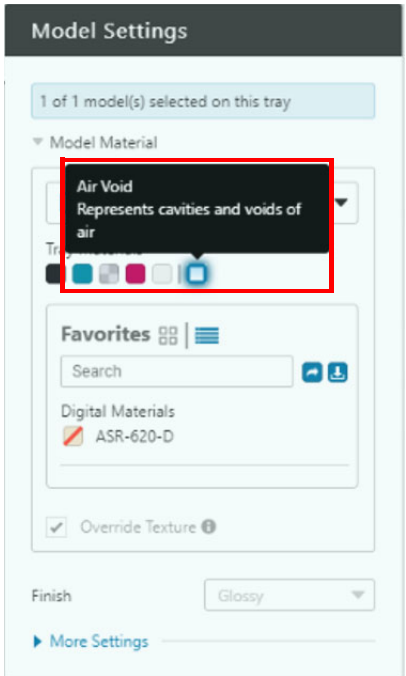
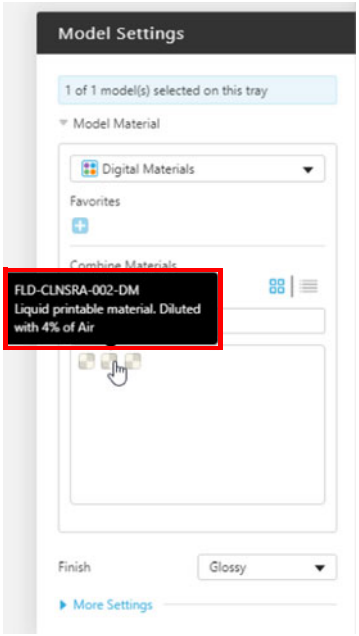


Figure 56: *Model Setting* dialog box—Cleanser and Air *Digital Materials* selected



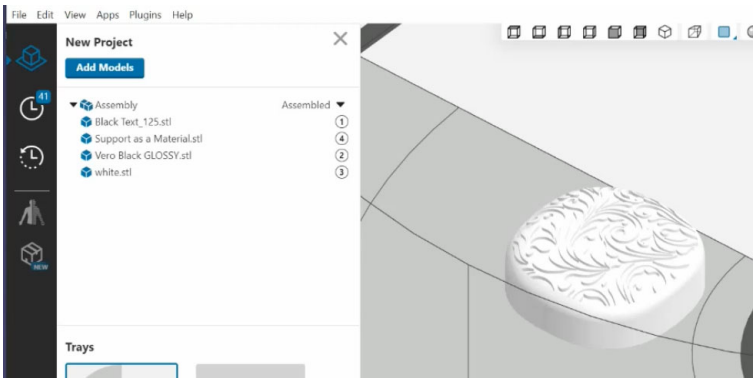
Support as Material

Use support as a model material for direct control over support placement for designing (textures, molding, tooling applications, etc.). Set the model to a glossy finish so that the body that has the support material assigned acts as a mask. For example, in Figure 57, the support assignment of the support material, leaves a matte-effect finish on the black part, which will be printed in a glossy finish.

Figure 57: Loaded model assembly

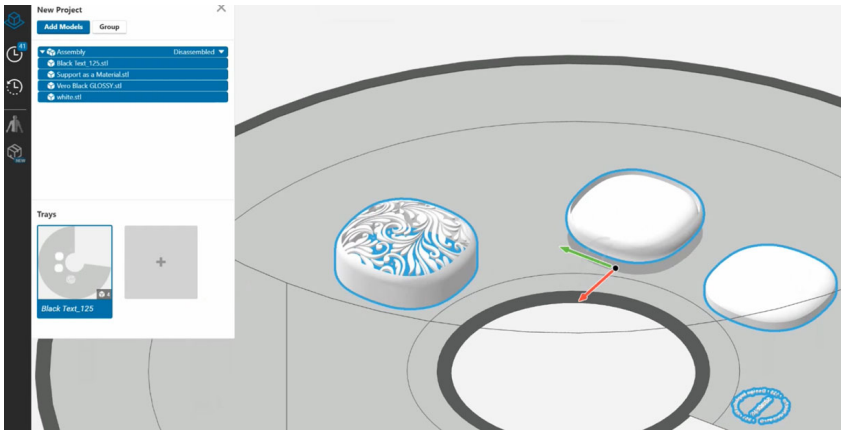
1. Design a model assembly for implementing support as material.
2. In GrabCAD Print Pro, load the designed model assembly.

Figure 58: Loaded model assembly



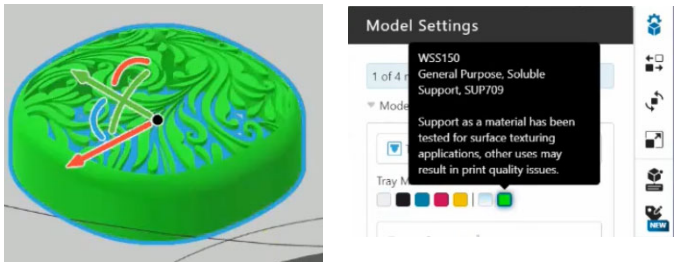
3. Disassemble the model.

Figure 59: Disassembled model into parts



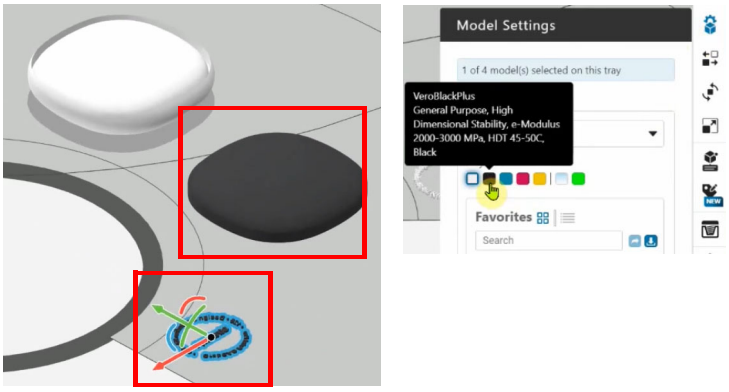
4. Assign materials to the relevant parts:
   a. In *Model Settings*, assign support material to the outer part for a textured effect. WSS150 support material must be loaded, for this option to work.

Figure 60: Assigned support as material



   b. In *Model Settings*, set the finish to *Glossy*.
   c. Assign model material to the marked parts.

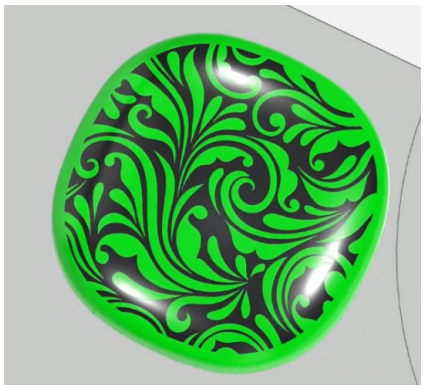
Figure 61: Parts that are assigned VeroBlack Plus model material



5. Reassemble the model.

6. Set the *Model Settings* to a glossy finish.

Figure 62: Re-assembled model



7. Send the re-assembled model to print.

Voxel Printing

Voxel printing enables the fabrication of many different parts with complex material distribution, such as a gradient or a sophisticated pattern.

In a program, such as Matlab, you slice the model and generate a stack of PNGs. Each slice contains the voxel information.

After processing these files in the Stratasys Voxel Print Utility, import the generated GrabCAD voxel file (*.*gcvf* file) into GrabCAD Print Pro for printing.

This section provides instructions for voxel printing with GrabCAD Print Pro on Stratasys J3 and J5 series 3D printers.

Important:

Verify that the computer workstation you use to send the information to the printer has the minimum requirements. For detailed information, refer to the relevant Site Preparation Guide available on the Customer Support site, https://www.support.stratasys.com/en.

Slice Preparation Guidelines

When preparing the slices (PNGs files), consider the following guidelines:

- The number of slices for each material must be identical.
- Make sure that you prepared one PNG for each slice. If a certain material is not used in a specific slice, create an empty PNG file (blank) for it.
- It is recommended that the layer thickness of the slices you prepare match the printer layer thickness. The printer layer thickness is 0.01875 mm

  When printing the slices, if the slice thickness does not match the printer layer thickness, the printer compensates for the difference. This may include repeating or skipping slices.
- When assigning colors to your model, it is recommended that you use the RGB values of the PolyJet base materials. The RGB values of PolyJet base materials are shown in the following table:

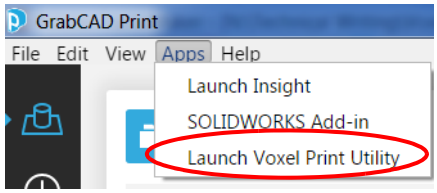
Color	Red	Blue	Green
Cyan	0	89	158
Magenta	161	35	99
Yellow	213	178	0
Black	30	30	30
White	220	222	216

Generating a GrabCAD Voxel File from PNG Files

After preparing the PNG file, you need to process it in the Voxel Print Utility in GrabCAD Print Pro. This utility generates a GrabCAD voxel file (*.*gcvf* file) that you import into GrabCAD Print Pro for printing.

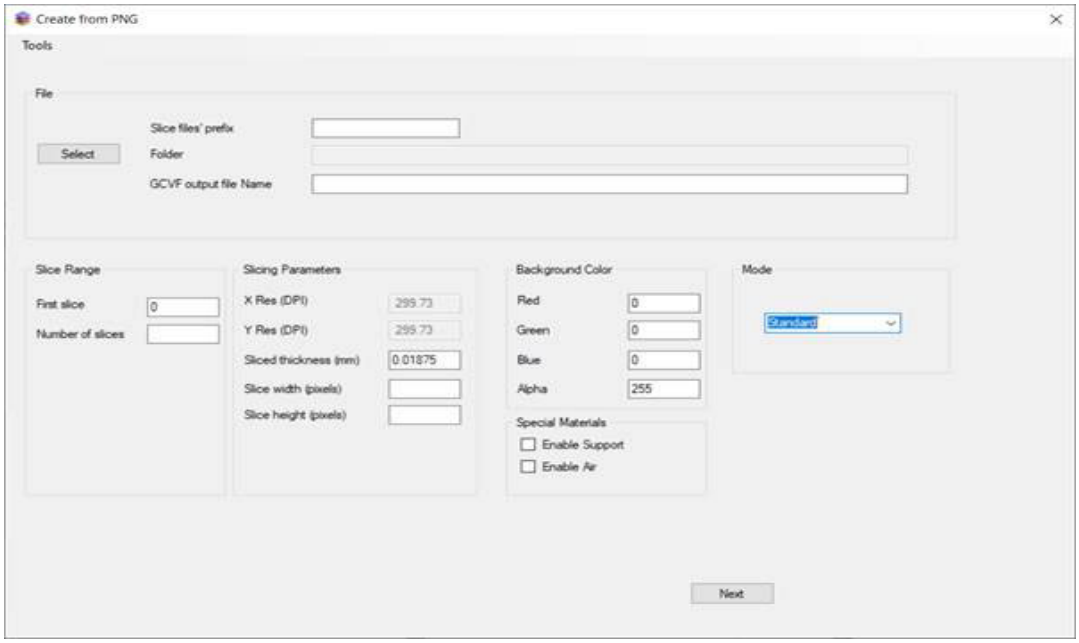
1. In GrabCAD Print Pro, from the *Apps* menu, select **Launch Voxel Print Utility**.

Figure 63: Launching Voxel Print Utility



2. In the Voxel Print Utility, verify the *Slicing Parameters* are according to the dpi and thicknesses.

Figure 64: Voxel Print Utility

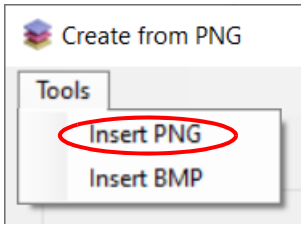


Important: Slicing Parameters

- Slice resolution = 300 x 300 DPI
- Slice thickness = 0.01875 mm

3. From the *Tools* menu, select **Insert PNG**.

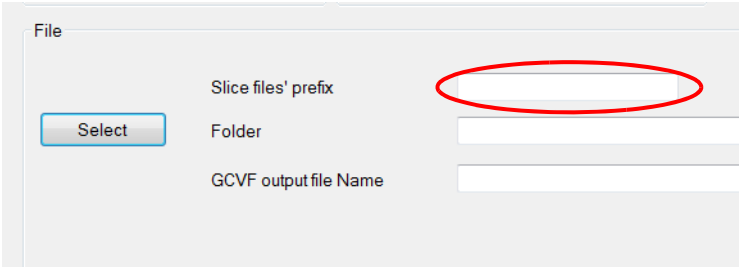
Figure 65: Inserting PNG file



The file size of a single **.gcvf* file cannot exceed 2 GB.

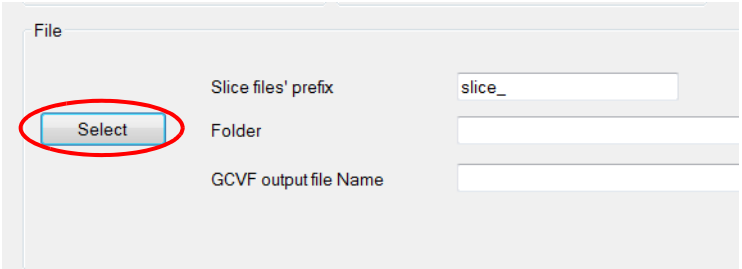
4. In the *Slice file prefix* field, enter a prefix for the image files, such as '*slice_*'. This prefix is assigned to all image files.

Figure 66: Slice file prefix



5. Click **Select** and navigate to the folder that contains the PNG files.

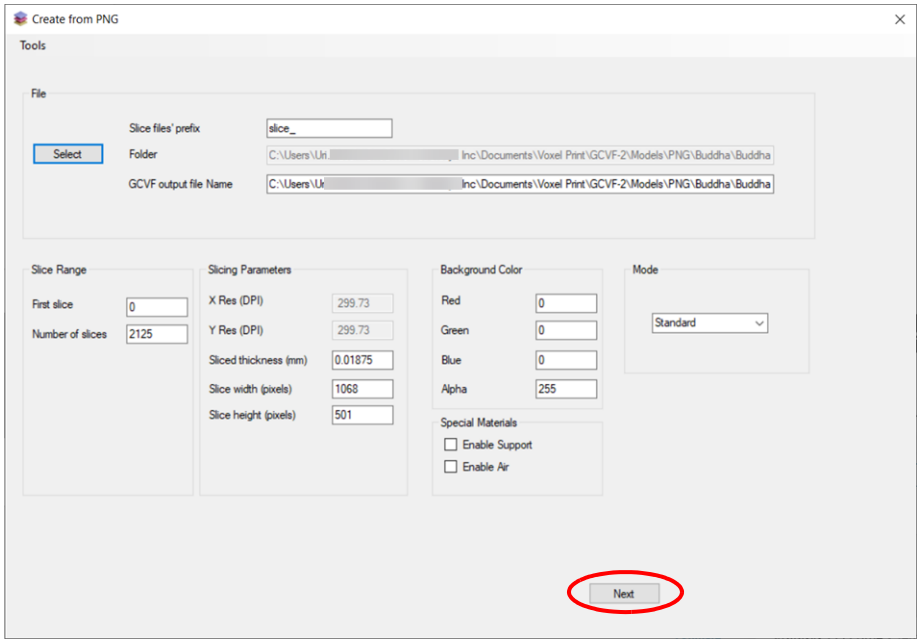
Figure 67: Slice file prefix selection



6. Select the folder with the PNG files.

   The location of the files, the path to the GCVF file, and all relevant slice information appear in the screen.

Figure 68: PNG file selection

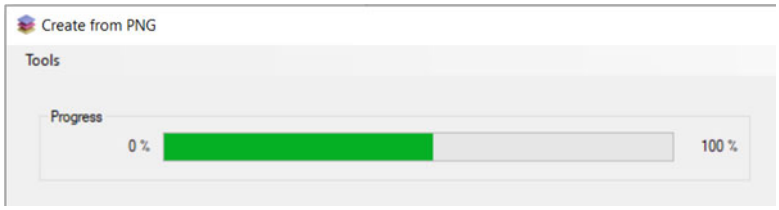


7. Click **Next**.

   A progress bar shows the progress of the **.gcvf* file generation, and when the **.gcvf* file generation is complete, the *Material Mapping* screen appears.

> The file generation can take a few minutes, depending on the size of the file.

Figure 69: PNG file creation



8. In the *Material Mapping* screen, ensure color accuracy of the model printed on the PolyJet 3D printer, as follows:

   a. Inspect the base colors that the Voxel Print Utility identified in the PNG files (right side).

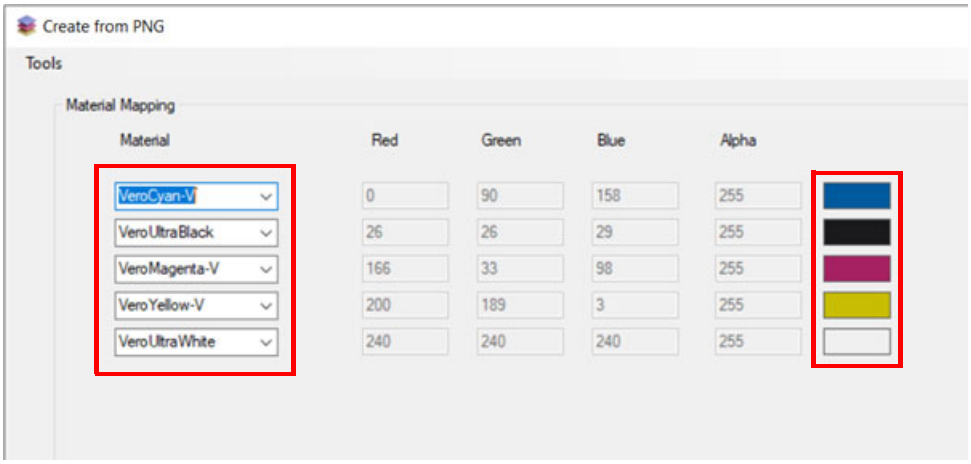
   b. Match each of the base colors with a suitable PolyJet model material (left side).

   c. In the *Materials* column, select each PolyJet Model material you want to use based on the color matching.

For example, the blue color on the right side could be mapped to *VeroCyan™V* in the *Materials* column.

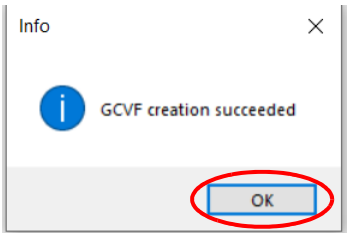
Before printing, make sure that the Model materials that you assigned are loaded in the material cabinet.

Figure 70: Matching each base color extracted from the PNG files with material



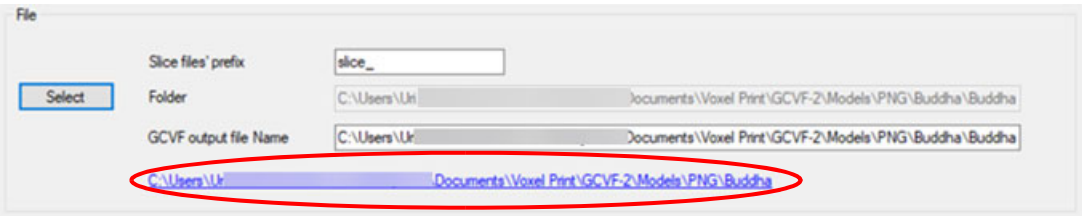
9. Click **Finish**.
10. When the following message appears, click **OK**.

Figure 71: GrabCAD Voxel files created



11. Click the link to access the file.

Figure 72: GrabCAD Voxel files created



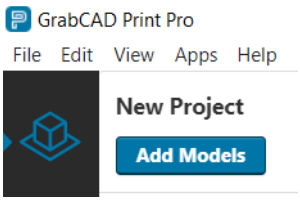
12. Close the Voxel Printing Utility.
13. To print the voxel file, continue with “Printing a Voxel Print Job” on page 42.

Printing a Voxel Print Job

To print a voxel print job:

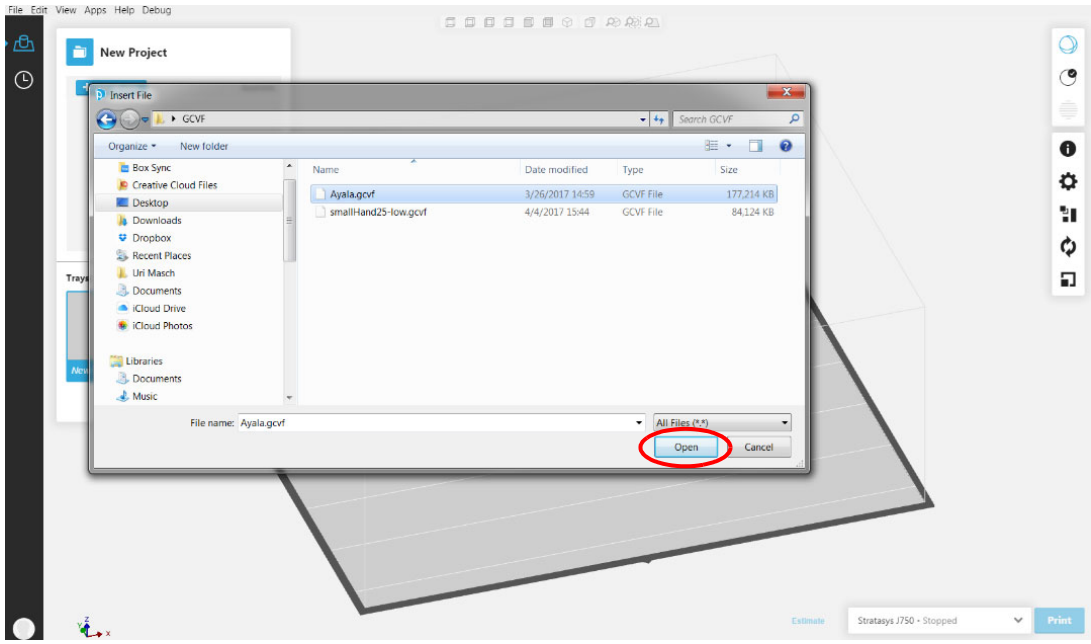
1. In GrabCAD Print Pro, *Print* screen, select **Add Models**.

Figure 73: Adding models



2. Navigate to the location of the **.gcvf* file you generated, select it, and click **Open**.

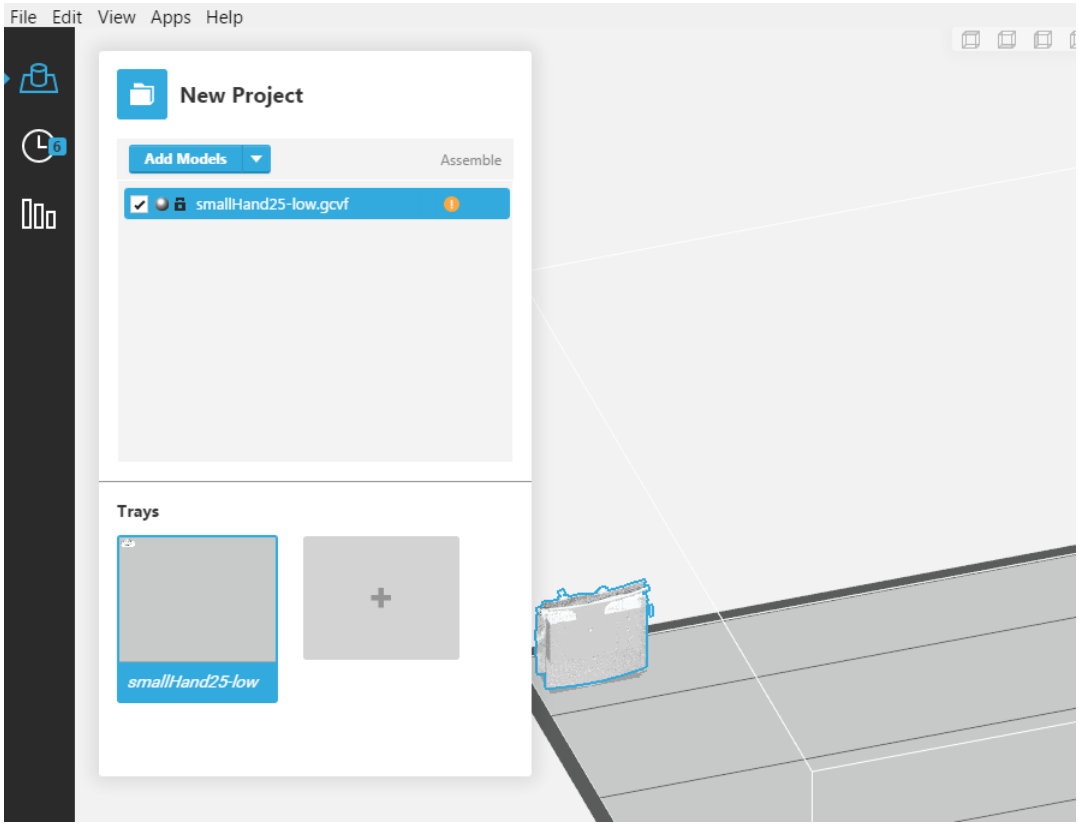
Figure 74: Opening the voxel file



GrabCAD Print Pro validates the file and loads it.

Before printing, make sure that the Model materials that you assigned are loaded in the material.

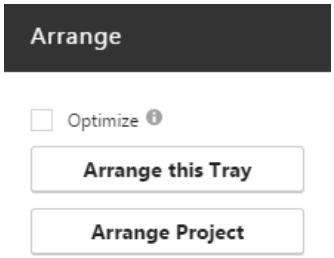
Figure 75: Model loaded



Important:

- During the **.gcvf* file generation, an **.stl* file of the model is created. GrabCAD Print Pro uses this *.stl* file to display the model on the tray, as shown in the above figure. Since it is not possible to view the colors you assigned to the model in GrabCAD Print Pro, it is very important that you make sure that the correct materials are loaded in the material cabinet.
- An exclamation mark icon appears near the filename (shown above) if the **.gcvf* file contains a material that is not loaded in the tray materials. If you do not load the required material in the printer, the printer ignores the material assignment in the **.gcvf* file, and prints the file as an *stl* file using a default material.
- Only *Matte* surface finish is available, (not *Glossy*).
- *Grid* style selection is available.
- You can add copies of the model on the tray by right-clicking on the model and selecting **Duplicate**.
- The *Scale* and *Orient* options are not available. To change the size or the orientation of the model, you need to generate a new **.gcvf* file with the desired size and/or orientation.
- You can use the *Arrange* (tray) option. Tray arrangement is performed according to the orientation defined in the PNG files.

  Do **not** select the *Optimize* check box.



3. Click **Print** to send the file to print.

High Speed Mode

The High Speed mode enables users of J55™ Prime printers with GrabCAD Print Pro to print with 2 model materials and 1 support material. For more information about this printing mode, refer to the printer User Guide.