VPP: FormLabs Form 3+ and 4 Standard Operating Procedures

Author: Dr. Florian
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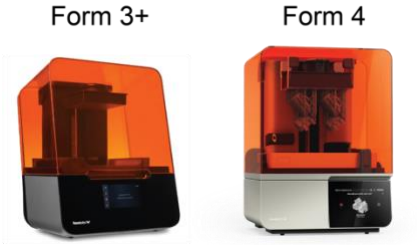
Form 3+ Manual
Form 4 Manual



Should I resin print this?

Due to the cost of the resin, cleaning agents, and maintenance of the printers, VPP is the most expensive method for producing a part in the Digital Fabrication Lab. Please complete the checklist below to determine if this is the right technique to manufacture your part:

- ☐ Does the part require fine details or a smooth finish?
- ☐ Are specific material properties like temperature resistance, flexibility, or transparency essential?
- ☐ Is the part primarily for aesthetic or low mechanical stress applications?
- ☐ Is the part small to medium-sized?
- ☐ Can you perform the necessary post-processing (like washing and curing) in a timely manner?

Prints over 50 mL of resin **require permission** from Prof. Florian. Please send an email with your mesh file and a justification of why the part needs to be resin printed based on the checklist above. Prints for senior design and class projects are more likely to be approved.

Students are only trained for the Form 3+ and Form 4 (not the larger 3L). Cleaning and post processing parts from the 3L is non-trivial due to the size of the build plate and lack of automatic washing instruments that can accommodate the large print bed.

Safety

When handling uncured resin or isopropyl alcohol, students must always wear:

- Safety glasses
- Gloves
- Lab coat

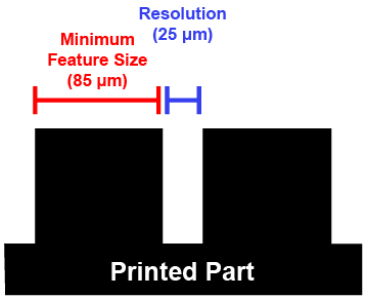
If resin gets on your skin, wash with plenty of water. If skin irritation or rash occurs seek medical advice/attention.

If your eyes are exposed: rinse with water for several minutes at the nearest eye wash station (right next to the printers). Remove contact lenses, if present and easy to do. If eye irritation persists seek medical advice/attention.

Resin will permanently stain clothing. Always wear a lab coat and make sure the path from the printers to wash station is clear from personal belongings (jackets, backpacks etc.)

Form 3+ Specifications (Product Link):

- Minimum feature size (XY): 85 µm
- Resolution: 25 µm
- Layer thickness: 25 – 300 µm
- Build Volume 145 × 145 × 185 mm
- Resins currently available:
  - High-Temperature (Form 3+)
    - SDS
  - Black Resin (Form 3+)
    - SDS



Form 4 Specifications (Product Link):

- Minimum feature size (XY): 50 µm
- Resolution: 50 µm
- Layer thickness: 25 – 300 µm
- Build Volume 200 × 125 × 210 cmm
- Resins currently available:
  - Clear Resin (Form 4)
    - SDS

Please note: Due to the wider bed on the Form 4, the build plate does not fit in the Form Wash (1st gen). You must remove the parts from the bed prior to washing in the basket. Be sure to have glasses and lab coat on. Proceed slowly as to not fling resin across the room.

CAD Modeling for Resin Printing

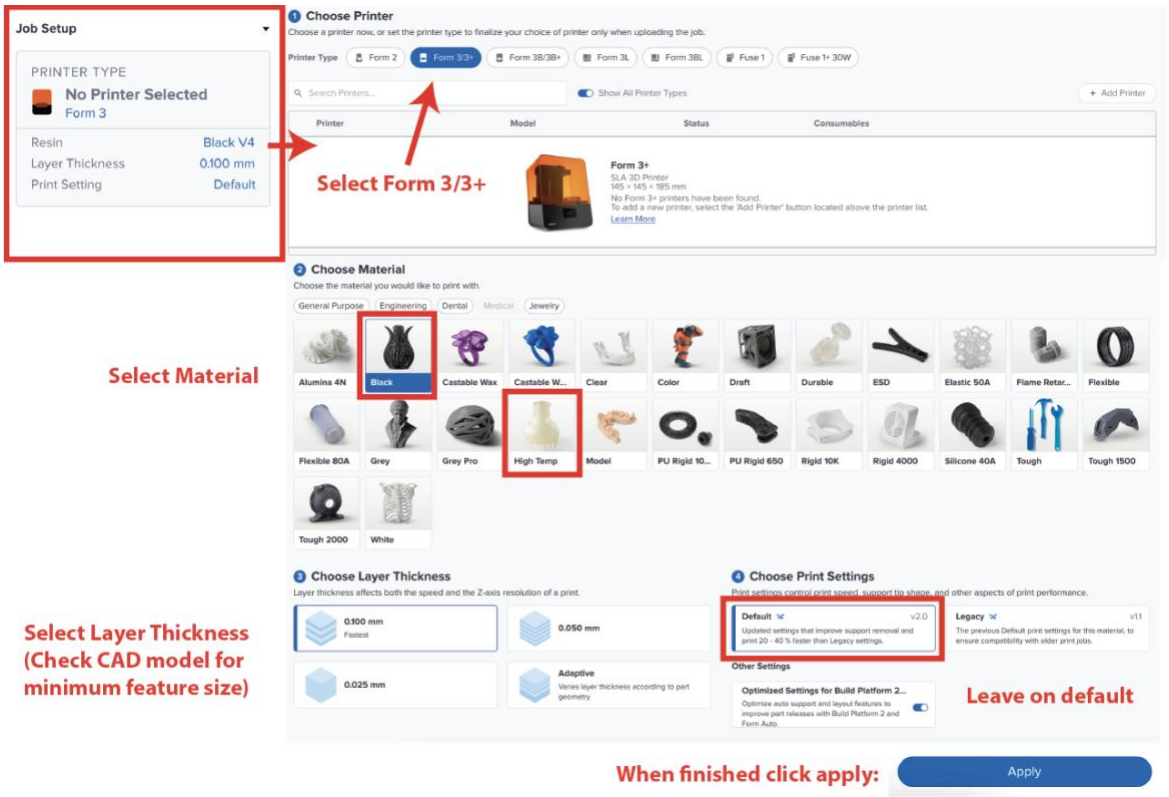
See FormLabs recommended specifications for designing parts for resin printing here.

Printing

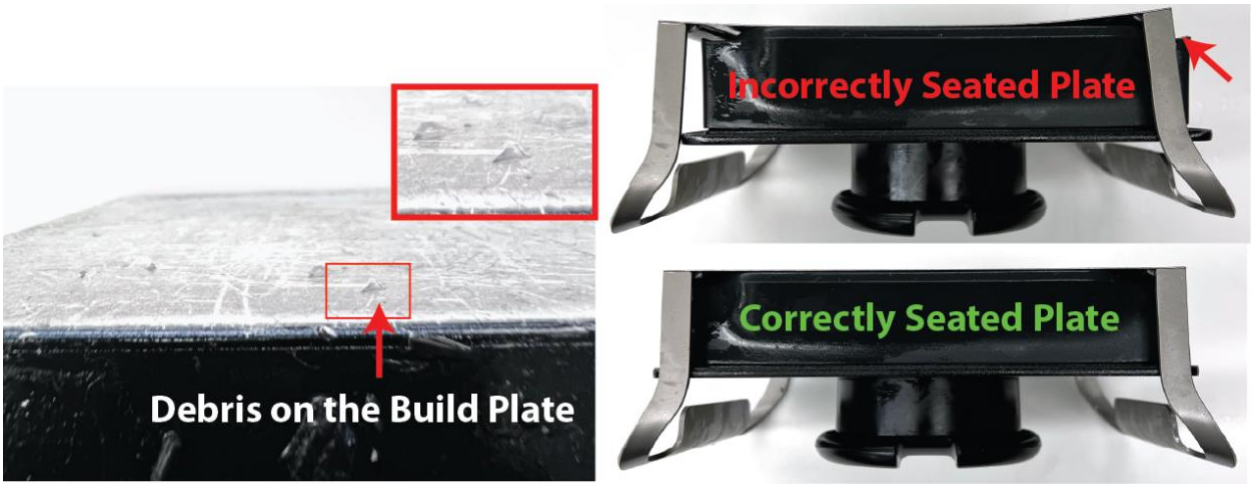
All resin prints must be washed and cured within ½ business days of completion. If the print finishes at 12 pm, then it must be off the build plate by 5 pm the same day.

1. In PreForm (download here), configure the print for the Form 3+ or Form 4 by clicking on Job Setup in the right panel. This will bring up a window where you will select the printer (Form 3/3+ or Form 4), material (black, high temp, or clear),

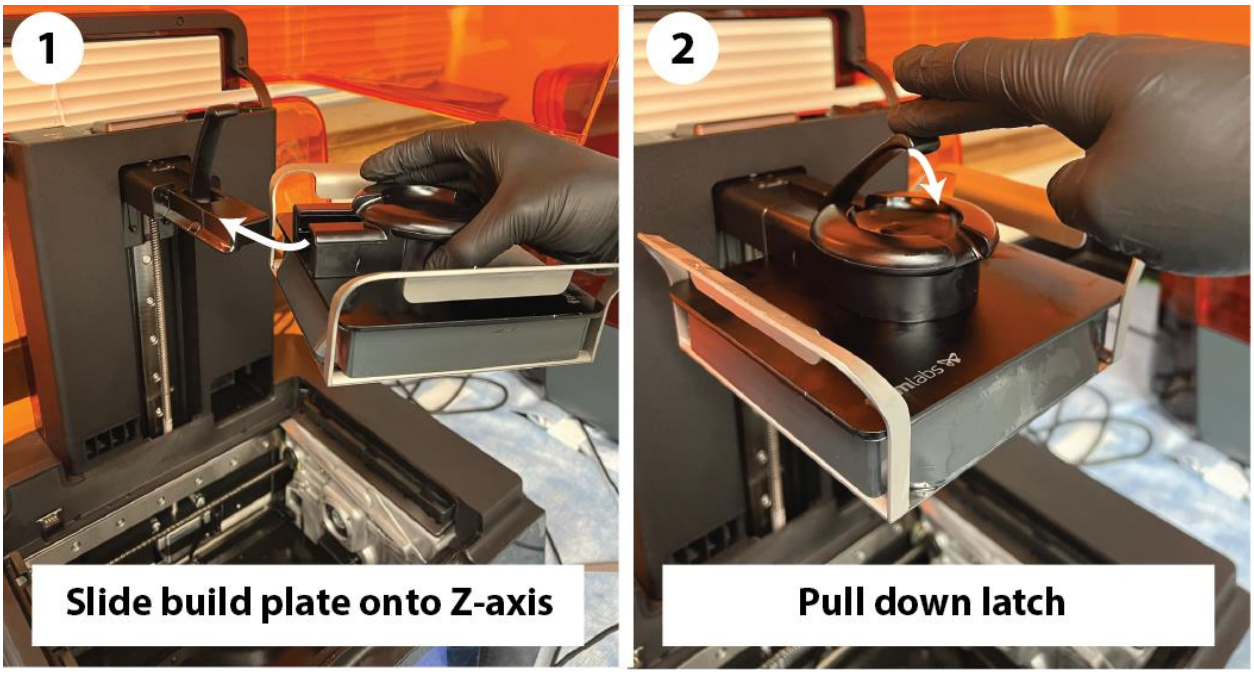
and layer thickness. The layer will set the minimum feature size that can be printed in the Z direction. Decreasing the layer height will significantly increase the print time. Leave the print settings on default. When finished, click apply in the bottom right corner.



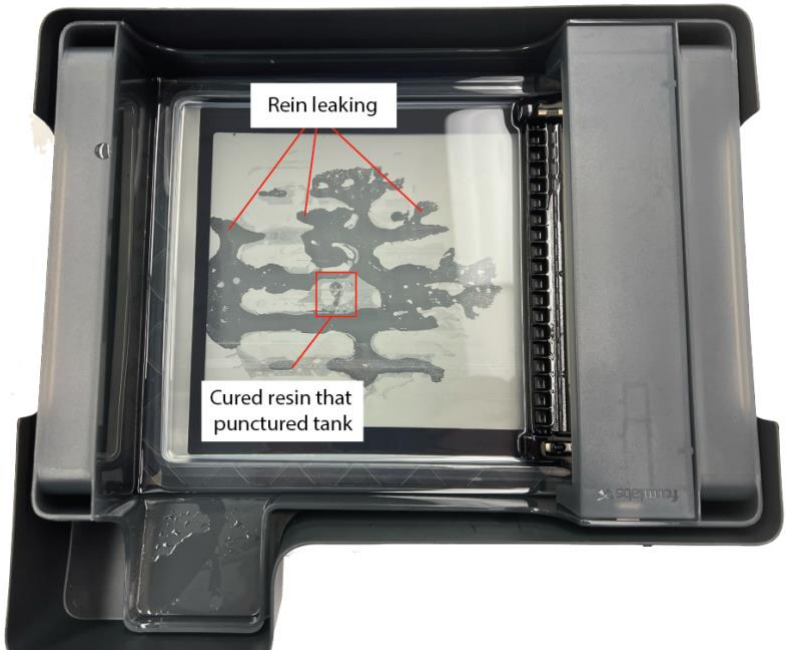
2. Before uploading your print, carefully inspect the build plate to 1) confirm that it is clear of the previous print by rubbing your gloved hand on the surface and 2) ensure that the magnetic plate is seated correctly. Failing to do either will result in a print failure and may cause significant damage to the resin tank. The bed scraper tool or designated screwdriver can be used to remove any cured resin. Scratching the build plate does not damage it.



3. If not already installed, slide the build plate onto the Z-axis post. Pull down the latch to secure the build plate.

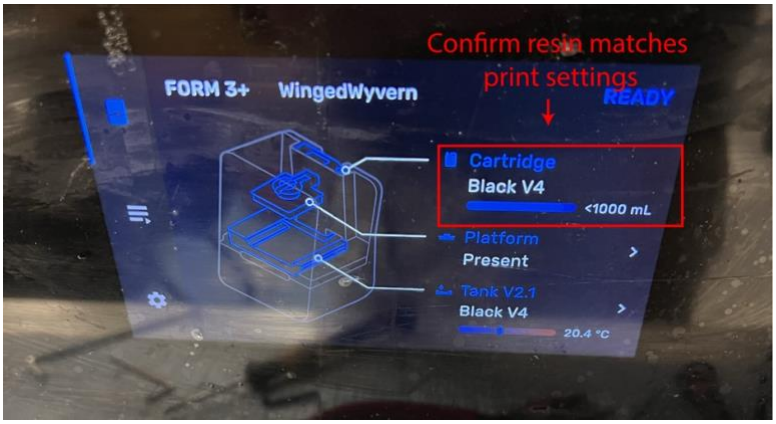


4. Carefully inspect the resin tank. For translucent resins (e.g., high temp), you will be able to see the film at the bottom of the tank. A non-homogenous color or sheen could suggest a leak – seek help. For opaque resins (e.g., black), a low rein level, which is apparent by the film not being completely covered in resin could also be a sign of a leak – seek help.



5. Close the orange hood immediately after installing build plate to prevent external light from curing the resin.

6. Confirm that the resin in the tank matches the material selected during the job setup tab in PreForm. Generally, one Form 3 printer has high temp resin and the other black resin. The Form 4 will always have clear resin. Students are not permitted to swap tanks/materials. If the resin cartridge is running low, please request a new one from Prof. Florian.



7. Upload the print through the USB connector next to the printer by clicking *Upload Print* in the bottom right corner of PreForm. Once the upload is finished, you may have to click start on the printer's touch screen or it may start automatically. You may unplug your computer. The printer will go through a series of checks before lowering the build plate into the resin tank. **You must wait until it displays the time remaining and layer count on the screen (1 of X) before leaving**.

8. After the print is complete, remove it and thoroughly inspect the print for any missing sections or defects. If the print is successful, acknowledge this by pressing the check mark (✓) on the printer's display. **This action signals to the next user that the resin tank is free from debris and the printer is ready for use.** There have been instances where prints failed to adhere to the build plate from the first layer, leaving a layer of cured resin on the tank's film. Such situations can misleadingly indicate that the printer is available for a new job, despite the presence of failed print remnants. Therefore, it is crucial to confirm the print's **success** or **failure** on the printer's interface, ensuring the printer is properly prepared for the next user. If your print fails, then you must print a cleaning mesh. Please see the FormLabs guide for this procedure.

9. After you remove the build plate by lifting up the latch and pulling it away from the Z-axis, turn the plate right-side up and walk over to the FormWash. With the parts still attached to the bed, use the Form Wash to rinse the remaining liquid

resin from printed parts' surfaces with isopropyl alcohol (IPA). Some resins may absorb IPA or be degraded in its presence, so carefully select their wash times. See FormLabs wash settings for all resins.

- High-Temp Resin: Wash for 5 minutes, remove from build plate then wash for another 5 minutes.
- Black Resin: Wash for 10 minutes, remove from build plate then wash for another 5 minutes.
- The Form Wash have an isopropyl alcohol (IPA) level between the min and max fill lines printed on the outside. If the IPA level is low send an email to Prof. Florian.

10. At the end of the wash, use the yellow IPA bottle to squirt some fresh IPA over the part (only a couple seconds). Any runoff should flow back into the Form Wash to replace what is naturally lost by evaporation. Make sure you wear safety glasses for all post-processing steps.

11. Remove the build plate and flex it over the Form Wash's basket to release the parts. You will pull the handles towards each other on the back of the build plate as pictured below. When released, ensure the magnetic build plate snaps back to a position where it sits flat and even (see step 2). Please note: If the wash station was low on IPA, then the build plate may still be covered in resin. If this is the case, use a paper towel and IPA to wipe around the model before flexing the bed to prevent resin from being flung across the DFL.

12. With a paper towel and the IPA squirt bottle, wipe down the build plate. The plate should be free of cured resin (see step 2).

13. Once dry, place the build plate back into the printer for the next user (see step 3). Close the orange hood.

14. The printed parts must dry for at least 30 minutes for the isopropyl alcohol to fully evaporate after washing. Wet parts that are post-cured will remain tacky.

15. Use Form Cure to expose printed parts to additional UV light and heat to stabilize the parts for performance. Longer cure times lead to a stronger part but often more warping. Assess your application and determine if strength or dimensional accuracy is more important. *Leave the support structure on during curving to minimize warping*.
    - Black resin
        i. Recommended: 30 min at 60°C
        ii. Full cure: 60 min at 60 °C
    - High Temp resin
        i. Recommended: 60 min at 60°C
        ii. Max heat resistance: 60 min at 80°C
    - Clear resin
        i. Recommended: 5 min at room temperature
        ii. Full cure: 15 min at 60°C
    - For all other resins: https://support.formlabs.com/s/article/Form-Cure-Time-and-Temperature-Settings?language=en_US

16. Remove supports after curing over trash can.