

## 1. Safety Instructions

To avoid injuring yourself or others, please adhere to the following guidelines:

- Read and understand the Material Safety Data Sheet (MSDS) and the safety instruction on the label of the material drum before using the material.
- Avoid contact with eyes, skin & clothing by wearing the following Personal Protective Equipment (PPE) and wash hands regularly after handling material.
  - Safety Glasses/Goggles
  - Gloves
  - Laboratory Coat
- Provide adequate ventilation.
- Keep the work area clean. If material is found on clean areas, it should be cleaned off immediately with a disposable paper towel and absolute ethanol. Avoid the ethanol from polluting the material while cleaning.
- Avoid spreading material on clean surfaces.
- Prevent build-up of volatile substances from materials and solvents.
- Remove dust from clean and finished parts.

## 2. Preparing Equipment

### 2.1 Recommended Operating Conditions

- Ambient temperature of 20°C– 25°C (68°F – 77°F).
- Humidity of less than 40%.
- Minimize dust, as it can build-up and reduce the performance of the optics on your SLA machine, potentially leading to an increase in scattered UV light. Ultimately, this could increase the viscosity of the material in the vat.
- Use UV filters for lighting and external windows.

### 2.2 Maintenance and Inspection before Printing

Contact us for up-to-date technical support for your equipment. Below are a few common checks that will help you build parts successfully:

- **Recoater Blade**
  - Keep the re-coater blade clean. Remove debris from the bottom and periodically check the gap and rake of the blade. If there is residual material, use appropriate tools to clean it off.
  - Keep bearing rails clean and oiled.
  - Periodically check belts, sprockets and bearings.
  
- **Optics and Overhead Mirror**
  - Keep mirrors and optics dust free and clean. Periodic preventative maintenance will increase the life of the laser beam and improve its quality.
  
- **Machine Computer**
  - Inspect the cooling fans for electronic components regularly to ensure they are working properly.
  - Run the anti-virus software regularly and every time before an external USB flash disk is plugged in.
  - Make sure the latest printing control software service packs are installed in your system for optimal performance.

- **Replacing Material**

When replacing material, make sure you clean the vat thoroughly, dispose of used material and cleaning products (solvents, paper towels, etc.) properly and follow vat installation procedures. The vat must be thoroughly air-dried after cleaning. Residual resin material and solvent must be cleaned off to avoid mixing with the material and causing quality deterioration.

### 2.3 Suggested Parameters for Single-layer Scanning

	Available Range	Suggested Value	
Temperature of Resin	20-25°C	23°C	Without heating
Ambient Humidity	Below 38%	Below 36%	
Laser Power	300mw	300mw	
Scanning Space	≤0.1mm	0.08mm	
Scanning Speed of Support (mm/s)	≤4000	1500	
Scanning Speed of Border (mm/s)	≤8000	4500	
Scanning Speed of Filling (mm/s)	≤12000	7000	

### 3. Post-processing

#### 3.1 Part-cleaning Procedure

- For parts with a wall thickness ≤1mm, keep the parts in the resin for 10-20 min after scanning for better initial strength.
- Drain excess material off the parts in the vat.
- Remove the parts from the platform.
- Wash the parts for 5-15 minutes in 99% isopropanol before removing the support. If the support is still too hard, put the part back into the absolute ethanol for another 10-15 min. Please avoid keeping the parts in the absolute ethanol for too long as it will damage the parts.
- Use soft brush to clean off the resin material adhered to the part.
- Dry and further clean the parts with compressed air and place them in a well-ventilated area to allow all absorbed ethanol to vacate the part.
- You can also use TPM for cleaning, but its cleaning effect is not as good as absolute ethanol and might require repeated cleaning.

### 3.2 UV Post-cure

- After thoroughly air-drying the parts and checking that they are free from liquid resin residue, UV post-cure (use ProtoFab UV furnace) the parts for at least 20 minutes.
- Place the parts in a dry place (humidity below 40%) before the post-curing is completed to avoid the moisture being absorbed into the part and causing expansion and deformation.
- Air-dry the parts after sanding (water free material for sanding is suggested).

### 3.3 UV Post-cure and Thermo-cure

In order to achieve the best performance, enhance waterproofness and prolong the deformation time, the parts should go through both UV post-cure and thermo-cure.

- After thoroughly air-drying the parts, UV post-cure the parts (use ProtoFab UV furnace) for at least 60 minutes.
- Thermo-cure the parts for 120 minutes in the oven with uniform temperature of 160°C. The suggested heating-up procedures are: directly heat up the oven from indoor temperature to 160°C at the speed of 0.5°C /min; when the temperature reaches 160°C, keep it for 120 min; the cool-down time of the oven should be longer than 2 hours. Sand burying of thermo-cure is suggested for even heating of the parts. The humidity should also be ensured at suggested level during post-processing.

## 4. Disposal Instruction

In some areas, partially cured or uncured waste UV material may be classified as hazardous waste, and requires special packaging.

### 4.1 Transportation disposal

Contact the governmental or other body that regulates waste disposal in your area to determine the disposal protocols.

### 4.2 Packaging-Transportation-Disposal Methods

Packaging-Transportation-Disposal methods must prevent any form of human contact with the waste UV material, even if it is classified as nonhazardous or unregulated. This therefore precludes the use of disposal methods that might result in groundwater or surface water contamination.

#### 4.3 Solvent Disposal

Solvents should be isolated in a sealed, marked container and disposed of as “hazardous waste” in accordance with all applicable laws and regulations.

#### 4.4 Clean-up Material Disposal

Soiled clothing, empty containers, etc., should be disposed of in accordance with the applicable “hazardous waste” guidelines. If any of these items contain uncured or partially cured UV-curable materials, the disposal method used must prevent any form of human contact, including any that could result in groundwater or surface water contamination.

## 5. FAQ/Troubleshooting

Below are some examples of common issues and troubleshooting solutions. Consult this part of the guide if you are having difficulties and do not hesitate to contact our for support.

#### 5.1 Issue: Roughness

The top surface of the part is not smooth and level.

Solution: Check re-coating blade

- This condition is somewhat common and arises due to the viscosity of the material and the presence of debris that may become suspended in it.
- Check the re-coating blade to make sure the bottom surface is clean and filter debris from the vat.
- It is very important that you maintain the correct material viscosity in your stereolithography machine. The viscosity can increase over time, and this can cause problems in building parts.

If the viscosity increase is severe enough, the material may have to be replaced, resulting in significant expense and lost production time.

- If increasing viscosity is identified early, the material can, in most cases, be saved. Regularly measuring resin viscosity can provide an early indication of the problem. This must be done even if the machine is not used often, as resin viscosity can change even when the machine is idle.

## 5.2 Viscosity Measurement

Depending on the viscosity range of the material you want to test, use the appropriate-sized cup, based on Zahn Cups guidelines. You will also need a long-stem thermometer that mounts onto the Zahn cup handle and a stop watch.

Procedure:

- Ensure the material in the vat is at part-building temperature.
- Mount the thermometer on the Zahn cup handle and hold the tip of the thermometer so it is half way up the bowl. The tip of the thermometer should not touch the material in the bowl, but be suspended above it.
- Turn the thermometer on and set it to Celsius.
- Lower the machine platform about 100 mm below the material surface.
- Slowly immerse the Zahn cup at a 45° angle into the vat of material, being careful not to create bubbles, and rest the cup on the platform. Be careful that it does not fall into the material.
- Monitor the temperature of the material with the thermometer. Wait until the Zahn cup and material have reached the vat temperature. Once the Zahn cup thermometer shows a steady reading, you can take a measurement.
- Slowly lift the Zahn cup completely out of the material. Start the stopwatch when the top of the cup leaves the material.

- Watch the stream of material flowing from the hole at the bottom of the cup. When the stream just under the cup breaks and changes from a continuous flow to individual drops, stop the stopwatch.
- Read the number of seconds on the stopwatch and use the table on the following page to determine the approximate viscosity of the material.
- Repeat the procedure to obtain at least two values that are close to each other. When finished, turn the thermometer off to save the battery.
- Record the following data in a chart for each material and machine:
  1. Date
  2. Temperature of material
  3. Readings (seconds)
  4. Viscosity (from table)
- If the viscosity of the material starts to increase significantly after having been stable for some time, inform ProtoFab and provide us with the data from the table.
- Clean the cup and thermometer by wiping them with a paper towel. Wash the cup and thermometer stem with solvent and dry them. Do not remove the long-stem thermometer from the Zahn cup until the stem is completely clean.
- Remember: Whenever you have material in your machine, measure and record its viscosity once a week.

**Table of Approximate Viscosity in cps Linked to Zahn #4 Cup Test Time**

<b>Seconds</b>	<b>Approximate Viscosity(CPS)</b>
20	245
22	280
24	310
26	340
28	375
30	410
32	440

34	470
36	505
38	540
40	570
42	600
44	635
46	667
48	700
50	730
52	765
54	800
56	830
58	860
60	895
62	930
64	960
66	990
68	1030
70	1060
72	1090
74	1120
76	1150
78	1190
80	1220
82	1255



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