

# ProJet® 4500

Professional 3D Printer



## Post Processing Guide

Original Instructions

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# 1 INTRODUCTION

**NOTE: For Material Safety Data Sheets, please reference: [www.3dsystems.com/materials/visijet-c4-spectrum](http://www.3dsystems.com/materials/visijet-c4-spectrum)**

Parts right out of the ProJet 4500 printer are ready to use and require no additional post-processing for strength. Depending on the part's application, additional processing steps can be performed to enhance color. This document provides processing instructions for two methods to enhance color on ProJet 4500 parts.

The simplest way to enhance part color is to clear off all excess core powder. White powder on the surface makes the color appear dull. Beyond removing excess core, dipping in solvents or waxes will make the color much more vibrant. Results from these methods can be seen below.



Left – Standard Cleaning; Middle – IPA 99% Dip; Right – Paraffin Wax Dip

## 2 SAFETY AND SUPPLIES

### SAFETY

- Read and understand the [MSDS](#) (Materials Safety Data Sheet) prior to using
- Wear protective clothing, gloves, and eye protection during procedures. Nitrile Gloves should be worn to prevent contact with Alcohol and waxes or other chemicals. This is not required, but is a recommended safety measure.
- Always work in an open, well ventilated space.
- Use containers recommended for dispensing and application.
- Have a spill system in place: catch pan, wax paper, or a drop cloth.

### SUPPLIES

#### Cleaning

- [Nylon Brush](#) is used to remove excess core powder from the part. These brushes can be found individually or as a set at many hardware stores.
- [External compressed air](#) will be used to blow away any core powder or dust on the part. Many facilities have compressed air lines that can be used. If there are none available, a can of compressed air may be used (found at hardware stores).

#### Solvent Wash

- [Plastic Bin](#) is necessary to contain the solvent. We used a 6qt. Sterilite® bin. The bin is made of Polypropylene & Polyethylene. Bins like this can be found at a container store or a super-center such as Walmart or Target.
- [Isopropyl Alcohol 99%](#) (referred to as IPA). IPA 70% can be used instead, but will not produce as vibrant colors. IPA 70% and 91% can be found at many local drug stores. IPA 99% must be purchased from a chemical supplier such as Sigma-Aldrich.
  - MSDS for IPA can be found at <http://www.airgas.com/msds/001105.pdf>
  - IPA has a Health rating of 2, Flammability rating of 3, and Physical Hazards rating of 0
- [Wax Paper](#) should be used as a drying surface. Wax paper can be found at grocery stores.

#### Wax Dip

- [Plastic Bin](#) is necessary to contain the wax. We used a 6qt. Sterilite® bin. The bin is made of Polypropylene & Polyethylene. Bins like this can be found at a container store or a super-center such as Walmart or Target.
- [Soy Wax](#) is used to enhance color in this process. We used Ecosoya Container Blend Advanced Soy Wax (sometimes referred to as Ecosoya CB-Advanced soy wax). This wax is used due to its relatively low melting temperature. It can maintain its liquid state at 50°C, below the distortion temperature of the part. This wax can be obtained from candle wax suppliers; ours came from an online supplier called Candle Science. Peak Candle is another great website to find this wax. The wax can be purchased in 2, 10, and 50 pound bags. The wax comes in flake form. When filling the container to hold the wax keep in mind that when the flakes melt, the liquid will be approximately half of the depth of the flakes.
  - Peak Candle website: <http://www.peakcandle.com/category/Waxes/Soy-Wax.aspx>
  - Candle Science: <http://www.candlescience.com/wax/ecosoya-advanced-soy-wax/>
- [Finishing Oven](#) is used to heat/melt the wax. We used a ProJet Finisher, which can be purchased through 3D Systems.
  - If you do not have a finishing oven, use a Paraffin Wax Heater; this can be found at beauty salons, spas, and spa supply stores. A Crock Pot, Double Boiler, Hot Plate or other heating device will work to melt wax.
- [Cooking Thermometer](#) will be used to monitor the temperature of the wax. This can be found at a kitchen supply stores or a local grocery.
- [Tongs or gloves](#) will be used to dip the part in wax. Tongs can be found at a grocery store. Gloves can be found in hardware stores and many other locations.

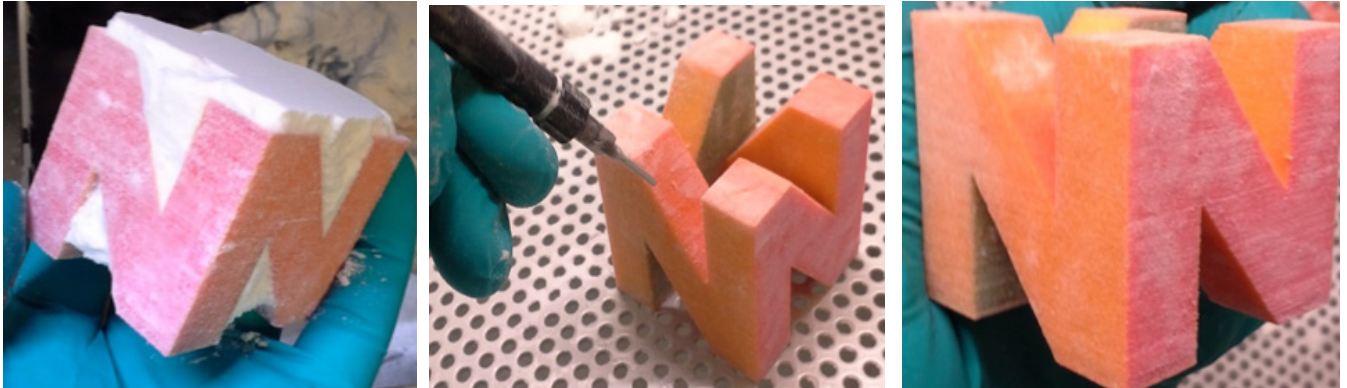
### 3 CLEANING THE PART

Thoroughly cleaning the parts when they come out of the printer is the first step in the process to achieving better color. The core material is white and when not fully removed from a part surface the colors will appear dull and faded. Additionally, the excess core material can be recycled when you use the Cleaning Station area of the printer.

#### BASIC CLEANING

##### Cleaning

1. Use the machine's compressed **air wand** to blow off the part in the ProJet 4500's cleaning station



Cleaning with machine's air wand

2. Use the paint brush included in the accessory kit in conjunction with the air wand to gross de-powder as much core off the part as possible.
  - **DO NOT** brush the parts in the printer's cleaning station with anything other than the included soft bristle paintbrush. This may introduce cured and colored powder into the feeder thus contaminating the clean core material. Contaminated core material may lead to discolored parts and possible printer failure.



Cleaning with Soft Bristle Paintbrush

**NOTE:** These steps are all that are needed to clean your part. Further cleaning and post-processing is left to your discretion.



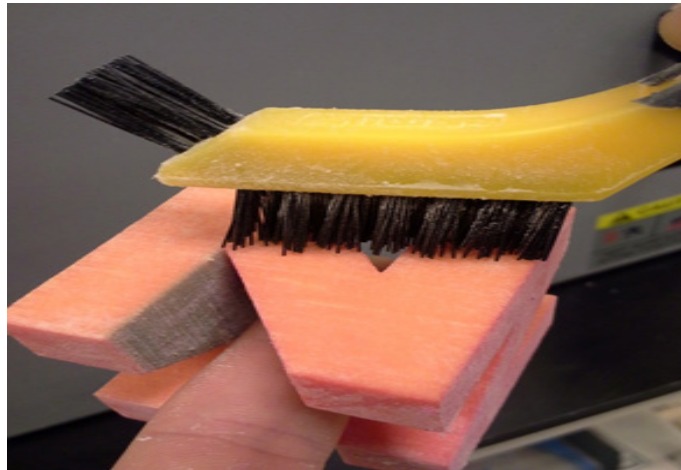
Standard Cleaning



## ADVANCED CLEANING

### Brushing

1. Externally from the printer, use a stiffer nylon brushes to further clean the part surfaces as seen in Figure 4.
  - **DO NOT** use metal bristle brushes to clean the part. Metal brushes are too aggressive which may dull the color at the surface, result in a non-uniform color appearance and/or deteriorate the surface finish.
  - **DO NOT** brush in the printer's cleaning station.



Brushing with Nylon Brush

2. Be very careful when brushing fine features. Brush them extremely gently with the nylon brush. Features below 3mm thickness risk breaking when brushed, do so cautiously if you choose. Support any fine features with your fingers while brushing.

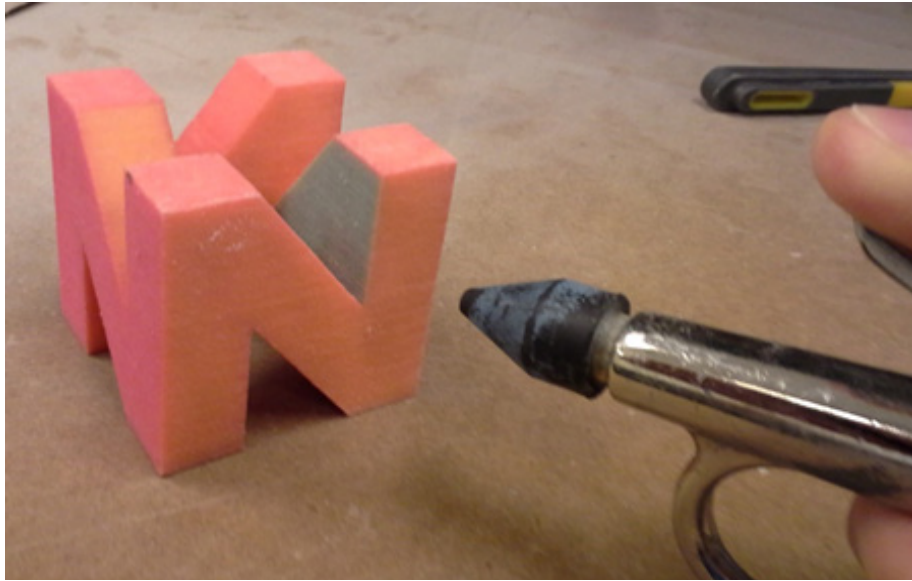


Standard Cleaning



Nylon Brush Cleaning

3. Use an external source of high pressure air to blow off dust from brushing.
  - It is not recommended to use high pressure air to dust fine features. This increases the risk of breaking. If you decide to blow off a part with fine features do your best to only blow off the larger features; avoid fine features.
  - **DO NOT** use the air wand from the printer's cleaning station to dust. This will contaminate the core powder in the machine.



Blow any dust off with external compressed air

Now that the part is thoroughly cleaned, certain post-processing methods can be used to enhance the color if desired. There are two (2) methods of post-processing: Solvent Wash and Wax Dip. Be sure to weigh the pros and cons of each method and the desired outcome of your geometry.

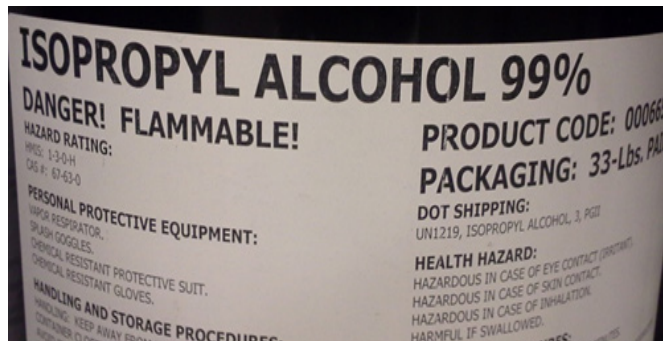
### METHOD 1: SOLVENT WASH

- **SAFETY NOTE 1:** Work in a well-ventilated area. Do not perform this process in a small confined unventilated area.
- **SAFETY NOTE 2:** Always use gloves and safety glasses when working with solvents.
- **SAFETY NOTE 3:** IPA 99% is a highly flammable liquid; it has a very low flash point of 12°C. Keep away from any possible ignition source.

Pros	Cons
<ul style="list-style-type: none"> <li>• Best Surface Finish</li> <li>• Simple</li> <li>• Fast</li> <li>• Good for bulkier parts</li> <li>• Good for parts with small holes or “caves”</li> </ul>	<ul style="list-style-type: none"> <li>• Requires ventilation</li> <li>• Small features may dissolve, deform, or warp</li> <li>• May cause color distortion on monochrome parts.</li> <li>• Can bind/lock moving parts.</li> </ul>

1. Fill a container with enough solvent to fully submerge the part.
  - We recommend [Isopropyl Alcohol \(IPA\)](#) for a solvent as it is easily attainable, relatively safe, and works well.

**NOTE: Rubbing Alcohol is typically 70% IPA and 30% water. IPA 70%, and IPA 50% will bring out color in the parts, but not nearly as effectively as IPA 99% or IPA 91%**



2. **Wearing gloves**, submerge your model in the solvent to cover all of the surface area for just a few seconds.



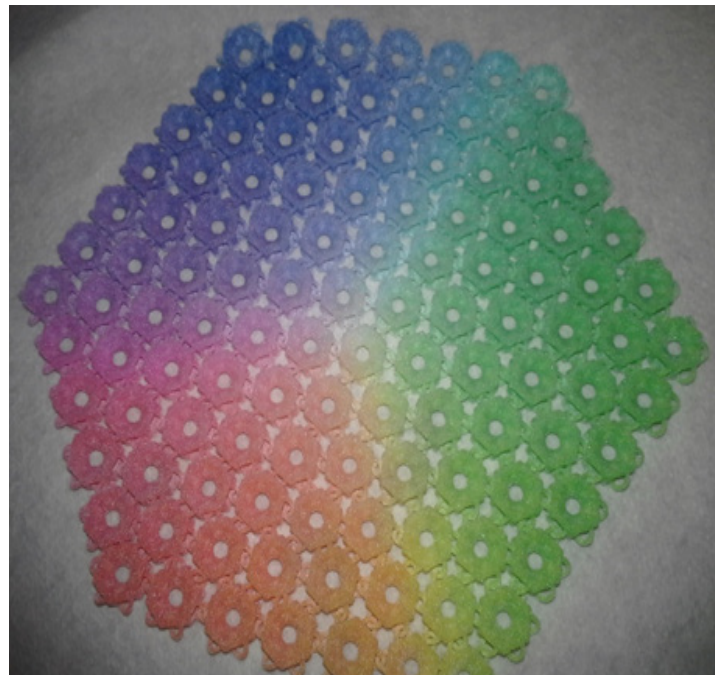
Dip the part in IPA 99%. Fully submerge the part, covering all surfaces evenly with IPA 99%



3. Remove and immediately place on a clean surface (such as wax paper) to dry for 2-4 minutes. Orient that part so excess solvent will drip off.
- We recommend the use of wax paper.
  - The part will become sticky to the touch after 15 seconds. If possible avoid touching it until completely dry.
  - To speed the drying process blow dry with compressed air or use a fan.
  - For moving/interconnected parts, keep the connections moving while drying. This will prevent connections from fusing together.



Clean surface for drying



Keep interconnected parts moving parts to prevent the part from binding.

4. Repeat the dipping process if desired.

## METHOD 2: SOY WAX DIP

Pros	Cons
<ul style="list-style-type: none"><li>• Best Color</li><li>• Masks the odor of untreated part.</li><li>• Will not dissolve small features.</li><li>• Great for larger surfaces</li><li>• Works for moving/interconnected parts.</li></ul>	<ul style="list-style-type: none"><li>• Lengthy</li><li>• Wax may congeal in tight spaces.</li></ul>

1. Place Ecosoya CB Advanced Soy Wax (enough to completely submerge a part, approximately 3.5lbs) in a container, in a finishing oven at **50°C (122°F)**. The wax comes in flakes, it will melt to approximately ½ its depth in liquid form (keep this in mind when filling the container). Melting wax will typically take **4-8 hours**; wax should be melted before it is needed or maintain a liquid state to avoid a delay. To speed the melting process you may increase the heat of the oven, and then cool the wax back down until it reaches **50°C**. Be careful to not melt your container; it is recommended not to exceed **70°C (158°F)**. Place a cooking thermometer in the wax to ensure it is **50°C**.

**NOTE: If a different wax is used, be sure that the wax has a melting point  $\leq 50^{\circ}\text{C}$ .**



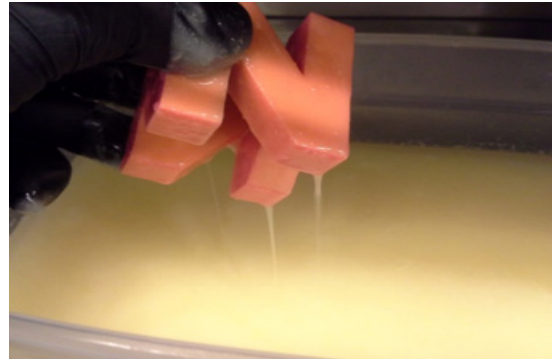
Set Oven Temperature, place wax in Sterilite tub, use thermometer to check wax temperature

2. With the oven at **50°C** place the part in the oven to warm up for **10-15 minutes**.



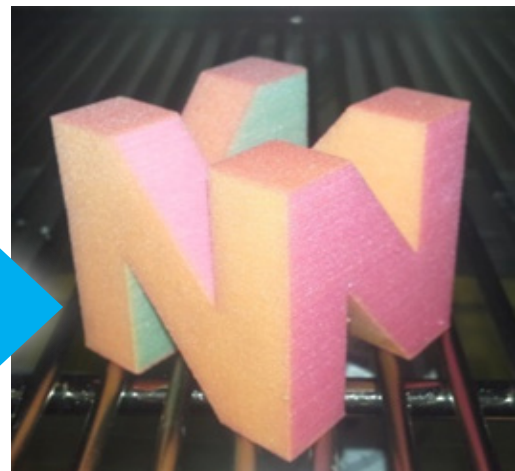
Preheat part in the oven for 10-15 minutes before waxing.

3. Wax contains oils that may separate over long periods of time in the liquid states. Stir the wax if it has become stagnate. Dip the part in the wax. Dip only long enough to cover all surfaces; this should take approximately 20 seconds for an entire part.
  - a. Be careful as the oven and wax are warm. Use tongs or gloves if necessary.
  - b. When melting wax it will appear opaque at first but will become translucent over time.



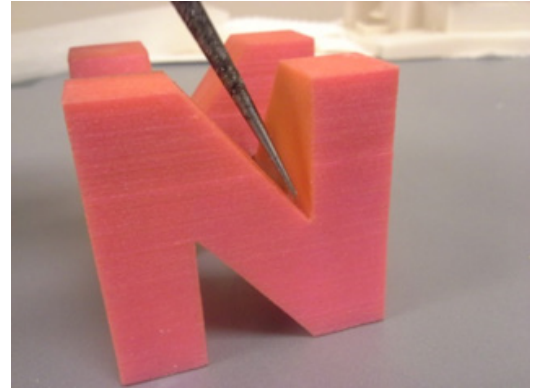
Dip part in wax. Use gloves or tongs if necessary.

4. Remove excess wax by placing the part back in the oven. Place the part above the open wax container and let any excess wax drip off into the container. The part will need to be oriented into two (2) or more positions to clear off the bulk of the wax. Wrapping the part in the paper towel will speed the process.
  - a. Parts with small features (cross-sections  $\leq 4\text{mm}$ ) must to be kept under  $50^{\circ}\text{C}$  to prevent distortion.
  - b. At  $50^{\circ}\text{C}$  it will take approximately 1 hour for the wax to completely melt off the part.
  - c. Large robust parts (all cross-sections  $\geq 15\text{mm}$ ) can be subjected to temperatures up to  $60^{\circ}\text{C}$  to speed the process.



After dipping parts are covered in wax. Keep in oven to let excess wax drip off.

5. There may be drops of liquid wax clinging to the bottom surfaces of the part. Dab these off with a paper towel. If any undesired visible wax remains on the part use the paper towel to get as much off. If a paper towel doesn't work use a scraper (for large surfaces) or a pic (for tight areas) to remove the extra wax. If more than a paper towel is used, you may want to place the part back in the oven for approximately 5-10 min to allow the wax smooth out along the surface.



Remove any leftover wax. Place the part back in oven for 5-10 minutes.



Left – Standard cleaning; Middle – IPA dipped; Right – Wax Dipped





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