



Post Processing Operation Guide and Best Practices for parts built on the ProJet™ 3500 and 5000 Professional 3D Printers



OVERVIEW

This document provides an updated set of procedures and best practices for post processing parts built on ProJet™ 3500 and 5000 Professional 3D Printers.

METHODS DISCUSSION

ProJet systems that produce plastic models utilize the wax support material VisiJet® S100 (ProJet 3000) or S300 (ProJet 3500, 5000). This support wax softens at 40°C (104°F) and melts (liquefies) at approximately 60°C (140°F). This basic characteristic allows for relatively simple removal of support wax by heat.

ProJet systems that produce wax models utilize the wax support material S200 (ProJet 3000) or S400 (ProJet 3500). This support wax melts at approximately 55-65°C (131-149°C). Since both part and support material are wax there is a melting point difference between the two materials to allow for safe support removal while preserving the wax part. This is achieved through lower temperature heating and the use of solvent to dissolve the wax support away from the wax part.

Being a plastic, there are certain geometries with thin walls and long, narrow portions that can warp or distort if subjected to heat for long periods of time. It is extremely important to monitor the amount of time any part is subjected to heat during the finishing process to prevent warping of the part.

**EXCESSIVE HEATING IS THE NUMBER 1 CAUSE OF
PART WARPING AND DEVIATIONS IN
MEASUREMENTS FROM ORIGINAL CAD MODELS.**

POST PROCESSING GUIDE FOR PLASTIC PARTS

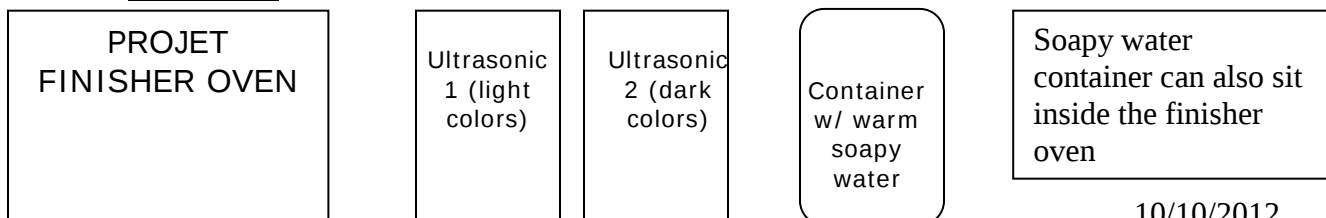
EQUIPMENT

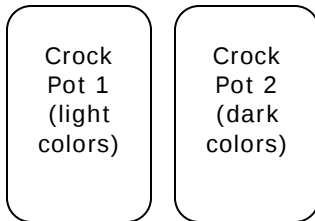
- **ProJet Finisher Oven/ProJet Finisher XL.** These ovens are sold through 3D Systems and are temperature controlled blown air ovens with a catch pan for melted wax.
 - o 3D Systems Part Numbers:
 - ProJet Finisher - 23400-930
 - ProJet Finisher XL - 316050

OR

- **Large consumer crock pots or industrial heat tanks with controlled heat capability.** It is recommended to use separate crock pots/tanks for cleaning dark and light colored parts. It has been shown that the material dye can leech out and color the liquid the part is submersed in. The two crock pots are to avoid discoloring the lighter natural parts (EX200, Crystal). Additional crock pots are not necessary for users building with only one material.
- **Heated ultrasonic cleaner(s) with digital timer and temperature control.**
 - o There are many brands of ultrasonic cleaners. 3D Systems utilizes cleaners from www.jewelsmall.com The specific model selected will depend on the size of parts being cleaned.
- **Corn oil or Mineral oil in bulk quantity.** The corn oil/mineral oil acts as a solvent to remove trace wax from the surface and inner crevices of the parts. Any kind of cooking oil, mineral oil or other light oil can be used. It is not recommended to use any kind of heavy oils (motor oil, heavy grease, etc.)
 - o BEST PRACTICE – Mineral oil is the preferred oil because it is colorless and lighter than corn oil. Corn oil can darken the finish on some parts.
- **A plastic container to hold warm, soapy water or running warm water**
- **Towels to completely dry parts OR Compressed air to aide in drying parts after the washes and rinses (optional).**

SETUP





Alternatively, the crock pots can be replaced by the ProJet Finisher Oven.

POST PROCESSING OPERATION

STEP 1: Remove Parts from platform

- Mechanical Action - Apply a quick light mechanical force such as dropping the platform from a height of about 6" onto a hard, flat table to release the models from the platform. This method is recommended for more durable parts
- Freezing – Place platform into a freezer for 10-15 minutes. The differential contraction will separate the parts from the metallic platform. Take care not to leave parts in the freezer too long as it could affect accuracy. This method is recommended for delicate parts that may break using mechanical action.
- Scraping – Use flat putty knife or painter's tool to gently scrape parts off platform. This method is recommended for durable parts are parts that do not have fragile features.

STEP 2: Remove bulk wax from part(s)

- Place parts in the ProJet™ Finisher set to **60°C (140°F)** to remove the bulk wax. Place parts on a grate and allow bulk wax to drip into the catch pan. Time required for bulk wax removal will depend on geometry and how much support wax was generated.

ALTERNATIVE: USING CROCK POT AND WAX BATH

- Prepare a wax bath in crock pot/heated tank by melting paraffin wax (can be obtained at hobby store – candlemaking section) at approximately **140°F (60°C)**.
- Place parts directly into the wax bath and allow support wax to melt. Place multiple parts or small parts in a wire mesh basket and submerge in wax bath. Time will depend on amount of

support wax on part. Over time the wax level will rise. Pour excess wax out periodically to maintain an acceptable level in the bath.

NOTE: ONLY LEAVE PARTS SOAKING IN WAX BATH OR PROJET FINISHER AS LONG AS IT TAKES TO REMOVE BULK WAX FROM PART. MONITOR PERIODICALLY USING TIMERS AND REMOVE AS SOON AS BULK WAX CAN FALL EASILY FROM PART.

STEP 3: Remove residual wax from part surface

- Fill Ultrasonic cleaner with oil and heat to **60° C (149° F)**. During the first fill it is recommended to run the ultrasonic action for 30-45 minutes to initially heat the oil.
- Place parts into corn oil bath and set ultrasonic cleaning cycle for **5-15 minutes** depending on part size and quantity. Avoid cleaning for more than 30 minutes. The ultrasonic cleaning will shut off automatically when the cycle is complete.

NOTE: The ultrasonic action will generate additional heat energy even after the heater control is set. This can cause spikes in heating and distortion of parts if they are left in the ultrasonic cleaner for long periods of time.

STEP 4: Remove oil from the surface of parts

- Remove parts from corn oil bath shaking off excess and place into heated crock pot of soapy water. Water should be kept warm, not scalding with dishwashing liquid to create a soapy bath. Dawn dish detergent is preferred as it has an anti-grease agent. Agitate parts in bath by hand for several seconds until oil is removed.
- If there is a source of running, hot water like a sink, place parts under running water and apply a small amount of dish detergent to parts to create soap and rinse oil off parts.
- Use low pressure compressed air to aid in blowing excess oil from the surface of the part.

DO NOT USE COMMERCIAL CLEANING FLUIDS AS THEY ARE ABRASIVE AND CAN DISCOLOR THE PART

STEP 5: Final Part Inspection

- Inspect part carefully for any remaining wax or oil. Use an absorbent towel to wipe the surface completely dry. Use a cotton tipped applicator to carefully remove any small amounts of oil that may have pooled in crevices.

SPECIAL SIZE CONSIDERATIONS FOR CLEANING PROJET 5000 PARTS

ProJet™ Finisher XL

The ProJet™ Finisher XL is designed to accommodate larger parts and more parts created on the ProJet™ 5000. It functions in the same manner as the standard size ProJet™ Finisher and can be used to remove bulk wax from parts.

It is not recommended to use the wax bath option to remove bulk wax as the wax requirements to submerge large parts would be significant.

Corn Oil Bath / Ultrasonic

The size of tank and/or ultrasonic cleaner required will depend on the largest part typically being built. A typical size tank for cleaning a variety of large and small parts would be 10-20 gallon liquid capacity. The tank should have heating control and ultrasonic is optional.

Jewelsmall (www.jewelsmall.com) is an online company that provides a variety of industrial ultrasonic cleaners. They have large and custom options available for designing an ultrasonic cleaner to meet specific customer needs.

Soapy Water Rinse

It is recommended to use warm running water with soap to remove the corn oil from large 5000 parts. A single part may not fit into a standard crock pot or heating tank. Filling a basin with warm, soapy water and pouring over the part is also effective.

Supporting Geometries During Cleaning

Because ProJet™ 5000 parts are generally longer and larger there is a potential for certain geometries to sag under their own weight when heated. Consideration must be given to these geometries and positioning in the oven should be taken to make sure long, thin features are supported during post processing.

MAINTENANCE OF CLEANING EQUIPMENT

- The level of melted wax in the crock pots/tanks and in the finisher drip pan will increase over time. Once the liquid level reaches **1-2 inches from the top** of the pot, pour excess wax into an appropriate storage container for disposal.
- Change the oil in the ultrasonic cleaners when parts no longer come out of the oil wax free or when the oil becomes cloudy in appearance.

RECOMMENDED EQUIPMENT LIST

NOTE: This is a recommended equipment list. Some items may not be available in your area. Please look for comparable equipment that has the minimum features you will need to effectively clean parts.

OVEN (industrial grade oven is recommended. Do not use any oven with exposed heating elements, i.e. toaster oven)

- ProJet™ Finisher Oven | Part# - 23400-930 | Supplier – 3DS
- ProJet™ Finisher XL Oven | Part# - 316050 | Supplier – 3DS

ULTRASONIC CLEANER (Should have time and temperature controls)

- 4L Heated Ultrasonic Cleaner | Model# SH180-4L | Supplier – www.jewelsmall.com
- 10gal Heated Ultrasonic Cleaner | Model# SH720-10G | Supplier – www.jewelsmall.com
- 18gal Heated Ultrasonic Cleaner | Model# SH1200-18C27khz | Supplier – www.jewelsmall.com

HEATED TANKS/CROCK POT (any tank that can heat liquids and maintain a constant temperature)

- 7 quart Crock Pot | Model# SCV700-B2 | Supplier – Wal-Mart (for washing oil off small to medium parts)
- 8 quart Crock Pot | Model# 33182 | Supplier – Wal-Mart (for washing oil off medium to large parts or as a wax bath for bulk wax removal)

BEST PRACTICES AND TIPS FOR OPTIMUM PART CLEANING