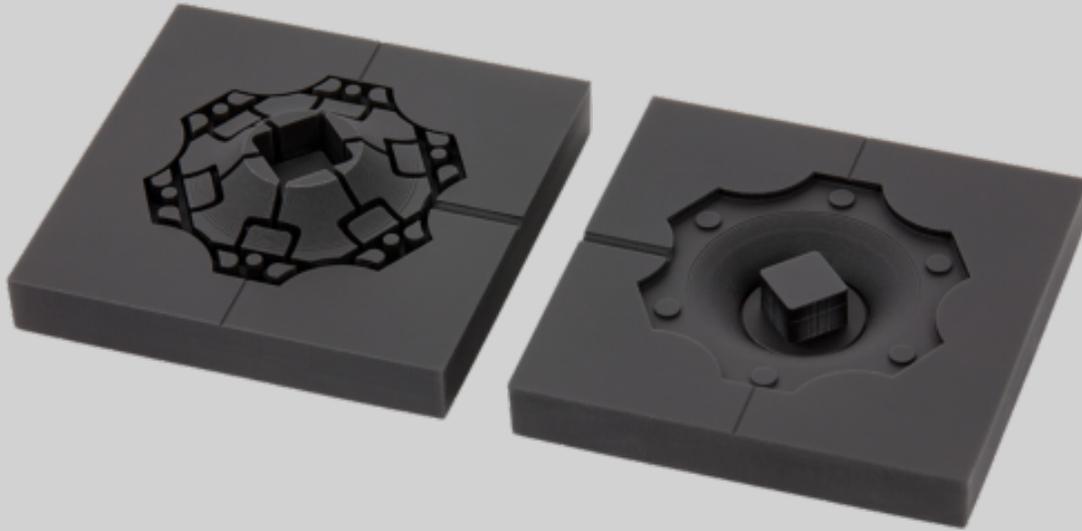


Material Best Practice Guide



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## About This Guide

This document helps you prepare, post-process, and finish parts in LOCTITE 3D IND147 HDT230 Tough. LOCTITE 3D IND147 HDT230 Tough Material Best Practice Guide: 81-00259\_R02, October 2023.

## History of Changes

Date	Changes	Revision
October 2023	Document creation	2.0

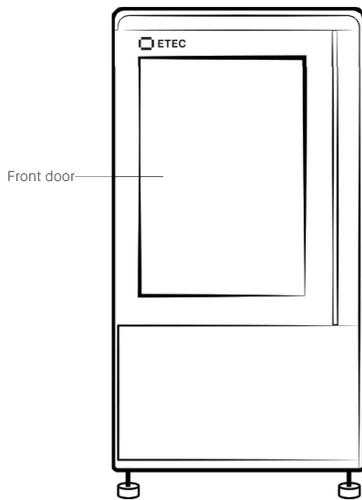
## About LOCTITE 3D IND147 HDT230 Tough

LOCTITE® 3D IND147 delivers high stiffness and toughness while withstanding temperatures between 230° and 290° C. This material is an excellent choice for a range of applications, such as tooling (molds) and the production of high-temperature end use parts.

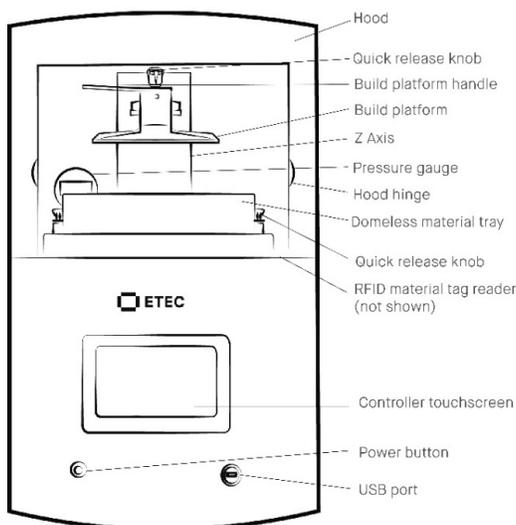
## Applicable Printers

This material is tested and approved for the following printer:

- Xtreme 8K™
- Envision One cDLM®



*Xtreme 8K Front View*



*Envision One Front View*

## Getting Started

### Primary Supplies

Primary supplies should be acquired prior to product delivery. Obtain the proper tools to prepare for successful printing and post-processing.



**Note:** See [Xtreme 8K Site Prep Guide](#) and [Envision One Series Site Prep Guide](#) for more information on the recommended accessories and primary supplies.

The following supplies are required to print IND147 material:

- Loctite 3D IND147 HDT230 High Heat Black: Product Codes RES-01-7009 (1 kg) and RES-99-1027 (5 kg)
- Personal Protective Equipment (PPE).
- Material mixing:
  - Envision One: Dual Motion Bottle Roller, Product Codes ACC-26-1000 (110V) and ACC-26-1000 (220V), and rubber spatula.
  - Xtreme 8K: Silicone mixing blade attachment and industrial mixing drill.
- Material filtering:
  - Envision One: Cone-shaped paint filter and spare material storage bottle.
  - Xtreme 8K: 5-gallon bucket and paint strainer.
- Part removal:
  - Envision One: Paint scraper.
  - Xtreme 8K: Razor scraper.
- Washing unit options:
  - Envision One: Ultrasonic, Elma S40H or similar. See [product profile](#) for details.
  - Xtreme 8K (small parts): PWA 2000, Product Code ACC-22-2000.
  - Xtreme 8K (medium and large parts): Desktop Orbital Shaker Washer, Product Code ACC-02-6000.
- Washing agent option:
  - 99% isopropyl alcohol (IPA).
- Spray bottle.
- Air compressor.

- Parchment paper.
- Curing unit:
  - PCA 4000: Product Code ACC-06-1000.
- Optional: Programmable thermal oven up to 120° C, such as Desktop Metal's Shop System Drying Oven, Product Code SHP-PC0001.

## Design Parts IND147

All parts printed in IND147 must be printed on supports rather than on the build platform. Keep this in mind when designing parts for IND147.

Add channels or drainage holes to hollow parts. This allows uncured material to drain from the hollow features during the printing process.



**Important:** Parts printed on the Xtreme 8K have a part volume limitation of: 190 mm x 190 mm x 180 mm.



**Note:** Parts with features under 5.0 mm have a high risk of fracturing with minimal pressure.

IND147 material has a propensity for high cure stressing, which can affect feature formation and deformation. "High cure stressing can cause the part to curl up, towards the top layers of the print. This is minimized by orientation and supporting guidelines, see [Support Parts Envision One RP Software on page 9](#).



**Note:** Cure stressing can exhibit differently on the same part, even if oriented and supported the same way.

## Minimum Feature Size

Minimum feature size is dependent on:

- Printer
- Material
- Feature geometry

All design features include recommendations for absolute minimum feature size and recommended minimum feature size. Absolute minimums are the smallest resolvable feature size. Recommended minimums are dimensions that will minimize part issues, especially for large parts, such as cure stress and fracturing.



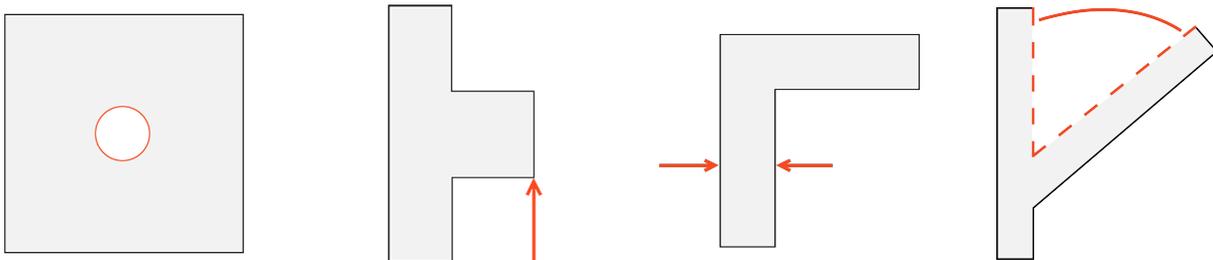
**Note:** Absolute minimum feature sizes are only valid for smaller features within the part geometry (Ex: text, small channels, etc.). They should not be used for the main components of design methodology.

ETEC recommends the following minimum feature sizes for parts printed in IND147 on the Xtreme 8K:

Design Feature	Xtreme 8K Absolute Minimum	Envision One Absolute Minimum	Xtreme 8K & Envision One Recommended Minimum
Wall Thickness	0.15 mm	0.15 mm	5.0 mm
Engraving Depth	0.10 mm	0.10 mm	0.20 mm
Embossing Height	0.10 mm	0.10 mm	0.30 mm
Positive Features	0.45 mm	0.30 mm	0.90 mm
Negative Features	0.45 mm	0.30 mm	0.75 mm
Hole Diameter	0.60 mm	0.40 mm	1.20 mm
Unsupported Walls	0.15 mm	0.15 mm	5.00 mm
Bridge Gap	0.40 to 8.0 mm	0.40 to 8.0 mm	0.50 to 2.0 mm
Unsupported Horizontal Overhang <b>Note:</b> The value is maximum, not minimum.	2.0 mm	1.5 mm	1.5 mm

### Self-Supporting Angle

The absolute maximum self-supporting angle for parts printed with IND147 is 75° from the horizontal surface of the build platform. The recommended maximum self-supporting angle is 70°. This means that parts at 75° or smaller angles may be printed without supports, but some deformation can occur.



*Hole Diameter, Unsupported Horizontal Overhang, Minimum Wall Thickness, Self-Supporting Angle*

## Software

### Orient Parts Envision One RP Software

Envision One RP Software automatically orients your model, adds supports, if necessary, and sends the file to the printer, resulting in your three-dimensional model. Everything that is printed using ETEC printers must pass through this software successfully.

- **Spacing:** Place parts a minimum of 2.0 mm apart.
- **Level at build platform:** Place supported parts 10.0 mm from the build platform.
- **Resolution:** 100 µm Z resolution (dependent on layer thickness).



**Tip:** Parts greater than 5.0 mm thick must be oriented specifically and supported on as much of the face as possible to reduce cure stressing. Parts less than 5.0 mm thick and with reasonable lengths & widths have higher freedoms of part orientation and supporting.



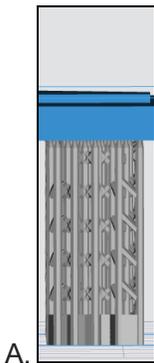
**Tip:** Limiting the canted angle of the part helps to limit the cure stress seen in parts.

### Support Parts Envision One RP Software

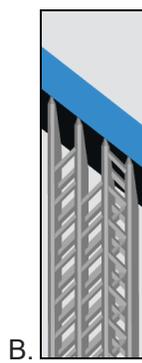
All approved applications require supports. Support as much of the face of the part as possible to mitigate cure stressing in parts.



**Important:** Do not print parts flat-to-plate in IND147. All parts must use supports.



A.



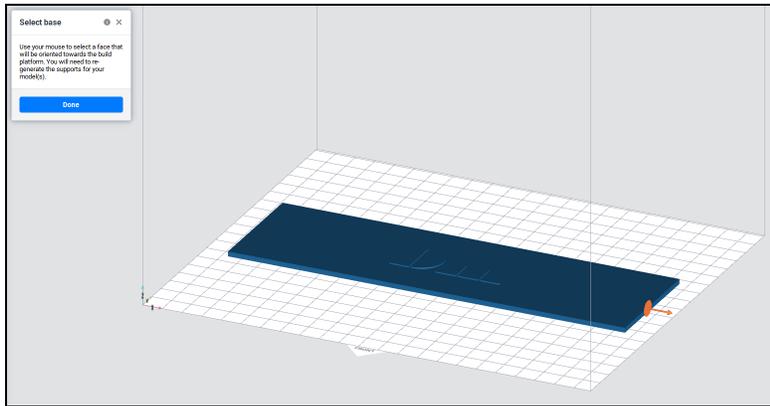
B.

*Two examples of a part supported in Envision One RP. The supports on example A are perpendicular to the part, which leads to easy support removal and finishing. The supports on example B are more parallel to the part, which makes support removal and finishing more difficult*



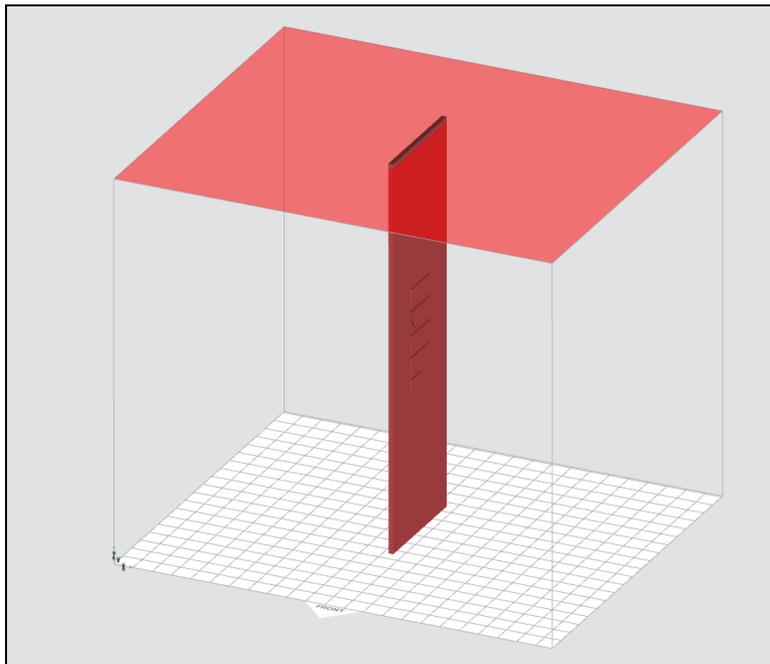
**Tip:** Supports perpendicular to the part are easy to remove. The more parallel the supports are to the print, the more difficult they are to remove and finish.

1. Identify the smallest face on the bounding box of your part.



*Step 1: Sample part in Envision One RP Software with the smallest surface selected using the Select Base tool*

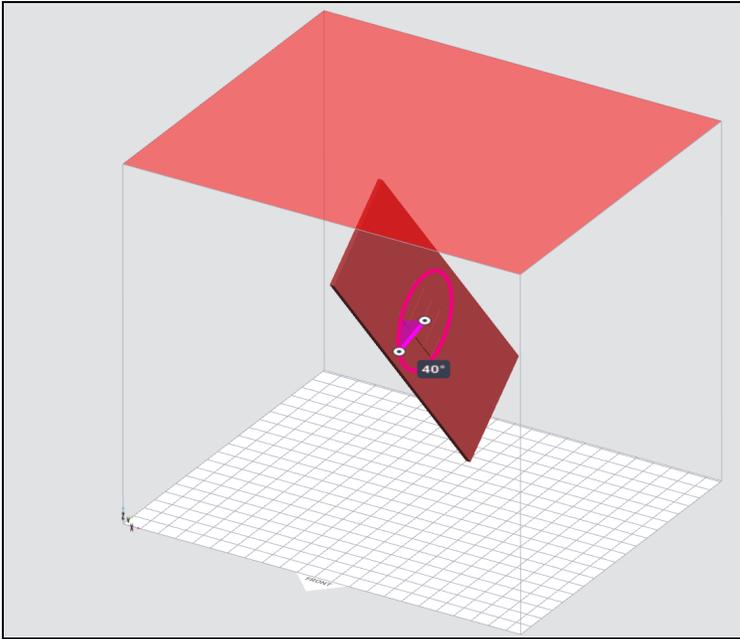
2. Orient the part with the smallest surface flat/parallel to the build platform.



*Step 2: Orient the part with the smallest surface flat/parallel to the build platform*

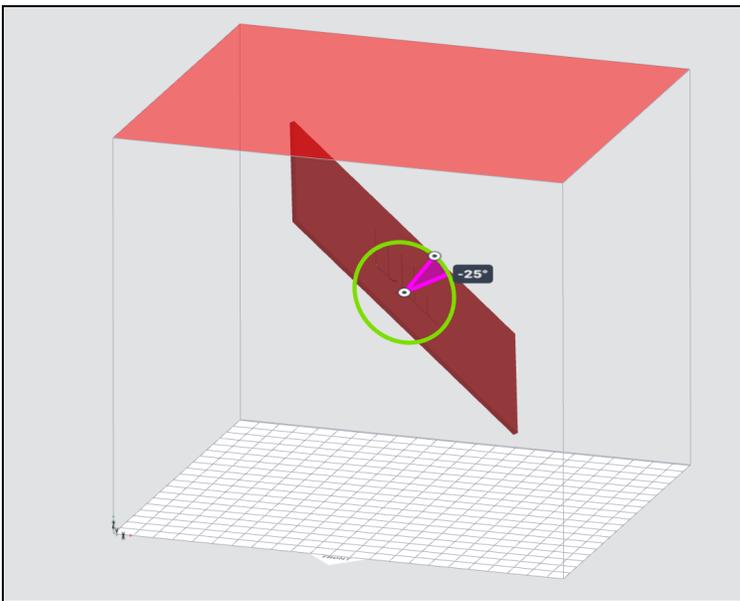
- a. If the smallest face is within 50 mm of continuous surface or if part has a non-continuous surface, then leave the part as-is.

- b. If the smallest face exceeds 50 mm of continuous surface or if part exceeds the allowed build height, then rotate the part around the smallest face's shortest edge until the starting layers (preferably the first 25% of the layers) are under 50 mm of continuous surface or within the build height.



*Step 2b: Rotate part around the smallest face's shortest edge*

- c. If the part does not fit within build height or if the first 25% of the layers exceed 50 mm of continuous surface, then cant/ lean the part along the pivot point axis, respective to the horizontal plane.



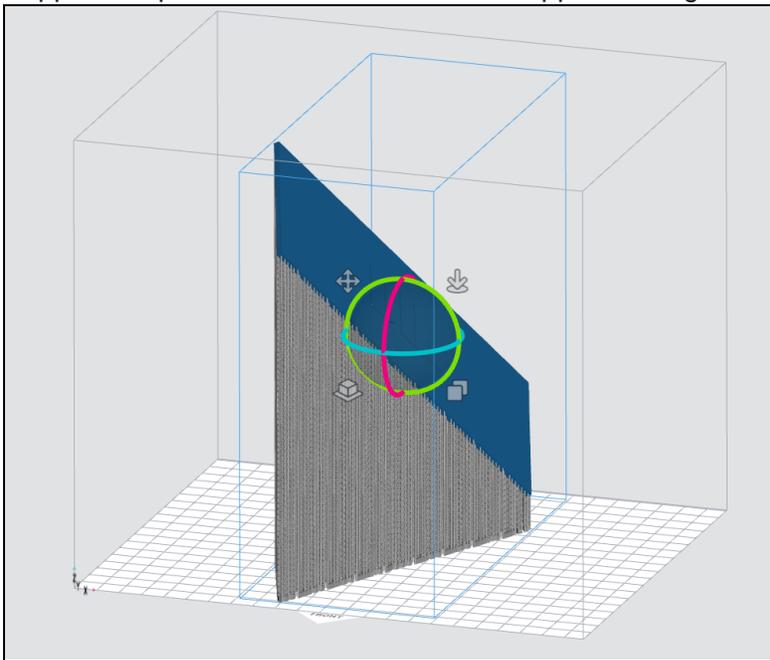
*Step 2c: Cant /lean the part along the pivot point axis, respective to the horizontal plane*

3. **Xtreme 8K only:** Rotate the part along the Z axis until the broad side of the part is perpendicular to the recoater movement.



*The same part placed in two orientations on the Xtreme 8K: the left part does not face the movement of the recoater and is not recommended; the right part faces the movement of the recoater and is best practice*

4. Support the part with the recommended support settings and print.



Step 4: Final supported part



**Note:** Parts can have inconsistencies within same part, using the same support settings, during the same print, due to inconsistent cure stresses in the material.

## Recommended Support Settings

Support Setting Feature	Recommended Support Setting
Minimum contact tip thickness	0.45 mm
Minimum support beam thickness	1.30 mm
Minimum support beam height	10.0 mm
Minimum space between supports	1.75 mm
Support base type	Fence
Maximum height of support structures	400.00 mm
Minimum clearance from part (distance from a support beam to a surrounding model surface)	1.00 mm
Minimum reinforcement spacing (distance between reinforcement cross bars)	5.00 mm
Maximum angle	80°

## Print Preparation

### Pre-Heat Material

Follow instructions on material pre-heating (before addition to vat/material tray) as specified in the [LOCTITE 3D IND147 Technical Data Sheet](#) provided by Henkel.



**Important:** All material heating must be done outside of the printer.

Allow the material to return to room temperature prior to pouring material into the vat/material tray.

### Crystallization

IND147 can exhibit a crystal formation dependent on environmental temperature. This phenomenon is referred to as *crystallization* and has been observed in new bottles of resin and overtime in the Xtreme 8K material vat.

If crystallization is observed in the material vat/tray or material bottle, refer to the [LOCTITE 3D IND147 Technical Data Sheet](#) provided by Henkel.



*IND147 crystallization*

### Mix Material

1. Shake the sealed material bottle.
2. Wait for bubbles to subside before filling the material vat/tray.
3. Mix the material before each print. The material should be a uniform color.
  - a. **Xtreme 8K:** Mix material in the vat for 3 min at a gentle speed with the silicone mixing blade attachment on a drill.
  - b. **Envision One:** Mix material in the material tray with the rubber spatula.

## Fill Material Vat/Tray

Do not overfill the material vat/tray. Overfilling can cause the material to overflow at the start of the print job.



**Important:** Ensure there are no small, cured particles in the material. See [Maintain Materials Xtreme 8K](#) and [Maintain Materials Envision One](#).

To add more material to the printer, carefully pour material into the material vat/tray between prints. See [Add Material Xtreme 8K](#) and [Add Material to Domeless Material Tray Envision One](#).



**Note:** Do not add material to the vat/ tray during a print. Adding material while the print is paused, or during a print, will cause a small shift line in the part.

## Print IND147

Before starting a print:

- Ensure the build platform is clean and free of cured material.
- Ensure the material level is correct.
- Xtreme 8K: Check the build platform.
- Xtreme 8K: Check the recoating blade gap.

To start and complete the print see [Xtreme 8K Operations & Maintenance Guide](#) or [Envision One Series Operations and Maintenance Guide](#).



**Tip:** Do not use excess force in the removal process. Parts can be brittle and have the propensity to fracture easily.



**Xtreme 8K Tip:** To remove parts, place a paint scraper into a perforation on the buildplate, under the support beams. Gently pry the part off of the buildplate.

## Xtreme 8K: Material Maintenance

### Replenish Material Vat

If the vat is not replenished within normal operation, then replenish the vat weekly with 15% (21 kg) of fresh material that has been pre-heated.

#### Prepare the new material:

1. Pre-heat 15% (21 kg) of brand new material as specified in the [LOCTITE 3D IND147 Technical Data Sheet](#) provided by Henkel.
2. Allow the new material to return to room temperature.
3. Shake the new material in the sealed material bottle.

#### Replenish the vat:

1. Remove 15% (21 kg) of the old material from the vat. See [Clean Material Tank Xtreme 8K](#). Store in a clean, opaque bottle until ready for reuse.
2. Add the new, pre-heated material to the material vat to replace the 15% removed. See [Add Material Xtreme 8K](#).
3. Mix material in the vat for 3 min at a gentle speed with the silicone mixing blade attachment on a drill.

#### Reuse the old material:

1. Preheat the stored, old material according to guidance from the [LOCTITE 3D IND147 Technical Data Sheet](#) provided by Henkel.
2. Allow the old, pre-heated material to return to room temperature.
3. Shake the old, pre-heated material in the sealed material bottle.
4. Follow steps to replenish the vat, adding the old, pre-heated material instead of new material.

### Test Material

It is recommended to test the material in the vat every 4-6 weeks for the flexural mechanical properties (D790) to ensure mechanical properties are within required specifications. Pay close attention to the flexural stress and strain of the material.

## Post-Processing

### Materials Safety

The **Safety Data Sheet (SDS)** for materials used in the printing process are available either from ETEC or directly from suppliers. Read and understand the information provided in these documents prior to attempting to operate the printer or handle any media.

#### **WARNING**

**Fire hazard:** Some materials used for washing may be flammable. Do not wash parts in proximity of any potential ignition source. Washing or drying equipment must be approved for use with flammable solvents. Read SDS and contact your EHS Representative.

### Remove Parts from Build Platform, Remove Supports

For best results, remove supports before cleaning parts.

1. Remove excess resin from parts using compressed air. Parts can be left attached to the build platform for sturdiness.
2. Remove parts from the build platform with the razor scraper (if still attached).



**Tip:** Do not use excess force when removing parts from the build plate. Parts can be brittle and have the propensity to fracture easily.



**Xtreme 8K Tip:** To remove parts, place a paint scraper into a perforation on the buildplate, under the support beams. Gently pry the part off of the buildplate.

3. Remove supports from the parts (if applicable):
  - a. Use gentle pressure to press against the portion of the support beams that is closest to the part surface. Separate the support tips from the part.
  - b. Pull the part in the opposite direction of the supports. The supports should separate from the part with minimal difficulty.
  - c. Provide extra care to thin-walled areas or areas with long supported overhangs.

## Clean Printed Parts

Clean parts using one of the following washing units:

- Envision One: Ultrasonic, Elma S40H or similar. See [product profile](#) for details.
- Xtreme 8K (small parts): PWA 2000. See [PWA 2000](#).
- Xtreme 8K (large parts): Desktop Orbital Shaker Washer.



**Important:** Parts printed in IND147 on the Xtreme 8K and Envision One have different washing unit recommendations. Use the washing unit that is compatible with the printer in use.



**Important:** Do not expose IND147 to 99% IPA for longer than 2.5 minutes per cleaning cycle, and no longer than 5 minutes total. Excess exposure to alcohol may cause erosion on the surface of part, and the surface can turn blue/white with prolonged exposure.



**Tip:** Do not wipe the surface of parts with paper towels or other abrasive materials because parts are susceptible to surface marks/scuffs.



**Tip:** Parts can scuff easily if there is abrasion between parts, or between parts and the washing container. Ensure parts are spaced properly, or lower the agitation speed to minimize part-to-part contact and washing container-to-part contact.

### Clean Envision One parts with the Ultrasonic:

1. Remove excess resin from parts using compressed air.
2. Wash parts in the Ultrasonic with 99% IPA for 2 minutes at 25° C.
3. Remove the parts as soon as the program is done and dry with compressed air for 60 seconds.
4. Wash parts in the Ultrasonic with 99% IPA for 1 minute at 25° C.
5. Remove the parts as soon as the program is done and dry with compressed air for 15-30 seconds.
6. If the surface of the parts is glossy after drying, spray with IPA and remove residue with compressed air. The surface should be matte.

**Clean Xtreme 8K parts with the PWA 2000:**

1. Remove excess resin from parts using compressed air.
2. Wash parts in the PWA 2000 with 99% IPA for 2.5 minutes on High.
3. Remove the parts as soon as the program is done and dry with compressed air for 20 to 40 seconds.
4. Repeat **Steps 2-3**.
5. If the surface of the parts is glossy after drying, spray with IPA and remove residue with compressed air. The surface should be matte.

**Clean Xtreme 8K parts with the Desktop Orbital Shaker Washer:**

1. Remove excess resin from parts using compressed air.
2. Wash parts in the Orbital Shaker with 99% IPA for 2.5 minutes at 100 RPM.
3. Remove the parts as soon as the program is done and dry with compressed air for 20 to 40 seconds.
4. Repeat **Steps 2-3**.
5. If the surface of the parts is glossy after drying, spray with IPA and remove residue with compressed air. The surface should be matte.



**Note:** A new washing solution for large parts is in development.

## Dry Parts

Parts must be completely dry before post curing.

1. Dry parts with compressed air.
2. Place the parts in a dark room on a clean surface lined with parchment paper.
3. Leave the parts to dry for 60 minutes.

## Post Cure Printed Parts

Post cure parts in the PCA 4000. See [Hardware Operations PCA 4000](#).



**Important:** ETEC only supports ETEC's curing units.



**Important:** Parts printed in IND147 on the Xtreme 8K and Envision One have different post curing instructions. Follow the post curing instructions for the printer in use.

### Post cure Envision One parts:

1. Place parts in the curing unit with as much space between them as possible. Parts should never touch one another while curing.
2. Set the PCA 4000 to 2 x 30 minutes, 60° C, 100% power.
3. Flip the parts between cycles for an even cure. Let the parts cool completely before handling them or starting the next cycle.

### Post cure Xtreme 8K parts:

1. Place parts in the curing unit with as much space between them as possible. Parts should never touch one another while curing.
2. Set the PCA 4000 to 2 x 20 minutes, 20° C, 100% power.
3. Flip the parts between cycles for an even cure. Let the parts cool completely before handling them or starting the next cycle.

## Optional: Thermal Treatment

Thermal treatment of parts is necessary to achieve HDT properties. This step is not required if high HDT is not needed for the specific part application. The Shop System Drying Oven from Desktop Metal is recommended for thermal treatment. See [Desktop Metal's Shop System Drying Oven](#).



**Important:** Thermal treatment is required only to achieve HDT properties.



**Important:** Parts printed in IND147 on the Xtreme 8K and Envision One have different thermal treatment instructions. Follow the thermal treatment instructions for the printer in use.

### Thermal treat Xtreme 8K parts:

1. Place parts in the room temperature oven.
2. Program the oven for the following:
  - a. Heat from Room Temp to 170° C at 5° C/min.
  - b. Hold the heat at 170° C for 1 hour.
  - c. Cool the oven from 170° C to 40° C at 2.2° C/min.
3. Allow parts to cool completely before use.

### Thermal treat Envision One parts:

1. Preheat the oven to 170° C.
2. Place the parts in the oven.
3. Hold the heat at 170° C for 3 hours.
4. Turn off the oven. Allow the parts to cool completely in the oven before use.

## Finish Parts

Finishing is the final step in post-processing a printed model. With finishing, you can remove all traces of supports and polish models as needed, depending on the final part application. Each finishing process depends on the size and geometry of the printed part.



**Tip:** Minimize part finishing by limiting the amount of supports used, or by making supports as perpendicular to the surface as possible.



**Note:** Sanding parts may cause white scuff marks that differ from the natural surface finish of the part.



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