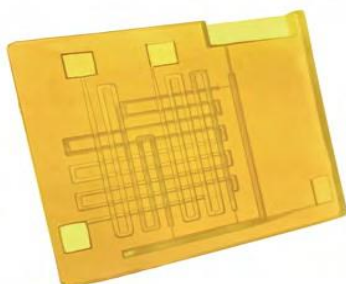


Processing Guide

Rigid 300 VP High Resolution

Rigid material for high precision printing

Cubic Ink® Rigid 300 VP High Resolution allows for printing with ultra-thin layers and a crisp XY-resolution while offering high print speeds due to its reactivity. Its low water uptake ensures dimensional stability in permanent contact to fluids.



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Materials can be used in



Micro-fluidics



Optical Applications

Performance Indicators

Tensile Strength	37 MPa
Elongation at Break	8%
Depth of Penetration	0.08 / 0.10
Water Uptake, 24 h, 23 °C	0.3%

Preparation

Printing

Washing

Post-Curing



LCD, DLP, mSLA

5 min IPA

Cure with UV

Preparation

Safety Guideline

Rigid 300 VP High Resolution is a chemical formulation in the liquid state and has to be treated as such until it is fully cured. Please use personal lab protection equipment such as appropriate gloves, goggles and lab coat. Wash contaminated body parts and equipment directly after occurrence and change contaminated gloves immediately. Do not consume the resin.

Danger



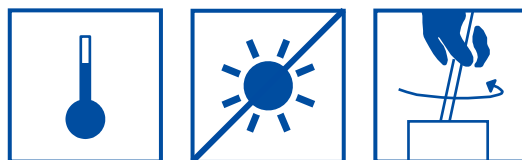
The information given in this document do not constitute a legally binding SDS, which will be provided at purchase.

Storage and Preparation

Please make sure the resin is stored at minimum at 23 °C.

Please make sure the resin is not exposed to light.

Please stir resin prior to use.



Printing

Print Settings

Rigid 300 VP High Resolution printed part properties may vary with printer, print settings, object orientation, part geometry and post-processing. The shown recommendations of printer and print settings are based on Cubic Ink®'s experiments and experience and do not include all possible processes and feasibility of the material (Table 1 - 3). The processor is welcome to explore the workflow regarding printer and print settings since Rigid 300 VP High Resolution is compatible with a broad range of LCD, DLP and mSLA. Nevertheless, Cubic Ink supports and customizes the processing guidelines together with their partners. If not stated otherwise specimens and objects are printed vertically.

Printing

General Curing Parameters

In Table 1 different curing characteristics are presented. The necessary critical energy as well as the penetration of depth indicate the reactivity and curing in depth abilities of the liquid resin.

Table 1: Curing Parameters measured at Cubic Ink® for Rigid 300 VP High Resolution.

Measurement	High Resolution - Yellow		
<u>405 nm, 8 mW/cm²:</u>			
E _c [mJ/cm ²]	4.25		
D _p [mm]	0.08		
Thickness after 0.6 s of exposure [mm]	0.01		
Thickness after 100 s of exposure [mm]	0.44		
<u>385 nm, 11 mW/cm²:</u>			
E _c [mJ/cm ²]	5.25		
D _p [mm]	0.10		
Thickness after 0.6 s of exposure [mm]	0.02		
Thickness after 100 s of exposure [mm]	0.55		
x-y-Compensation [%]	1.3 ¹	0.6 ²	1.4 ³
z-Compensation [mm]	0.11 ¹	0.05 ²	0.03 ³
Printable overhangs [°]	up to 50 ¹	up to 30 ²	up to 35 ³
Minimal wall thickness unsupported [mm]	0.2 ¹	0.4 ²	0.4 ³
Minimal wall thickness supported [mm]	-	0.4 ²	0.6 ³
Minimum pin thickness [mm]	1.0 ¹	0.5 ²	0.5 ³
Minimum hole thickness vertical [mm]	1.0 ¹	0.5 ²	0.5 ³
Minimum hole thickness horizontal [mm]	-	0.5 ²	0.5 ³

¹Measured with samples printed and cured via Prusa SLS1s (LCD 405 nm, 1.8 mW/cm², 25 µm) and 2x 30 min Prusa CW1S; ²Measured with samples printed and cured via Formlabs Form 4 (LCD 405 nm, 11 mW/cm², 100 µm) and 2x 30 min Prusa CW1S; ³Measured with samples printed and cured via Asiga Pro 4K (DLP 385 nm, 11 mW/cm², 100 µm) and 2x 30 min Prusa CW1S.

Printing

Print Settings

Table 2: Suggested curing times depending on wavelength, color, printing thickness and intensity of light source for Cubic Ink Rigid 300 VP High Resolution.

Wavelength	Temperature [°C]	Layer thickness [μm]	11 mW/cm ² [s]	8 mW/cm ² [s]	5 mW/cm ² [s]	2 mW/cm ² [s]
385 nm	30	25	0.69	0.95	1.53	3.81
405 nm	30	25	-	0.68	1.08	2.70

Rigid 300 VP High Resolution was tested on several printers such as

Prusa SL1S Speed (LCD, 405 nm, 2 mW/cm²), Phrozen 8K Mighty (LCD, 405 nm, 2 mW/cm²), Phrozen 8K Mega S (LCD, 405 nm, 3 – 5.6 mW/cm²), Asiga Pro 4K80/ Max 2 (DLP, 385 nm, 2 - 11 mW/cm²), Formlabs Form 4 (LCD, 405 nm, 2 - 11 mW/cm²). For more information, please contact us.

Table 3: Examples of print settings at Cubic Ink for Rigid 300 VP High Resolution.

Printing system	Color	Layer thickness [μm]	Exposure time bottom layer [s]	Exposure time default layer [s]
Prusa SL1S Speed	-	25 (bulky objects)	25.0	6.7 – 7.7
(LCD, 405 nm, 2 mW/cm ²)	-	25 (small channels)	25.0	4.0 – 4.5
Formlabs Form 4	-	25	10.0	0.60
(LCD, 405 nm, 11 mW/cm ²)				
Asiga Pro 4K80	-	25	5.6	0.71
(DLP, 385 nm, 11 mW/cm ²)				

Washing

Removing & Washing

- Washing with [Cubic Ink Cleaner 400](#) or isopropyl alcohol up to 5 min
- Ultrasonic bath or adequate mixing equipment is beneficial
- Rinse with IPA beneficial
- **Small channels must be thoroughly free of residual resin and afterwards cleaning fluid**

Cleaning

- Treatment with compressed air optional

Drying

- Let dry at ambient conditions for at least 2 – 6 hours
- To accelerate the process: Dry for 30 – 60 min at 50 °C

Post-Curing

Rigid 300 VP High Resolution needs to be post-cured to reach its final material properties. The post-cure used on the TDS (2) contained 2 x 30 min UV-treatment via Prusa CW1S (LED, 405 nm). Other examples of post-curing are possible with regard to wavelengths, intensities, time and additional thermal post-cure are shown in Table 4 to emphasize different effects of UV-curing chambers, wavelengths, intensities, time and additional thermal post-cure.

Rigid 300 VP High Resolution is post-cured via

- UV-cure is necessary
- Temperature in UV-chamber as high as possible (up to 80 °C)
- If possible, use vacuum or nitrogen atmosphere

Table 4: UV post-processing carried out at Cubic Ink for Rigid 300 VP High Resolution (printed with 25 µm).

Post-Process	E-Modulus [GPa]	Tensile strength [MPa]	Elongation at break [%]	HDT B [°C]
2 x 30 min Formcure L, 80 °C	3.0	64	4.5	77
2 x 6000 flashes Otofflash, N ₂	1.9	38	4.3	57
2 x 30 min Prusa	1.9	37	8.0	52
2 x 90 min Phrozen	2.0	41	6.8	54
30 min RSCure, vac.	2.2	44	4.8	59

Formlabs Formcure L = LED, 375 and 405 nm; NK Optik Otofflash G171-6 = light-flashes, 350 – 550 nm, N₂; Prusa CW1S = LED 405 nm; Phrozen = LED 405 nm; Rapidshape RSCure = upper + lower wavelength, 170%. Tensile testing DIN EN ISO 527-1 5A-specimens, 5 mm/min, 23 °C; HDT B DIN EN ISO 75, all specimens printed vertically.

Post-Curing

General Effects of Post-Curing

- Washing and drying:
 - The washing fluid and time of washing can influence the final material properties.
 - In some cases (e.g. using higher temperatures while post-curing) cracks can occur if not washed as recommended and not dried thoroughly.
- UV-Post-cure:
 - Higher wavelength (e.g. ≥ 405 nm) better for cure in depth, shorter wavelength (e.g. ≤ 365 nm) better for surface cure.
 - Broad spectra light sources or the combination of multiple wavelengths improve the overall curing process.
 - The higher the intensity of a light source, the shorter the time in the curing chamber.
 - Part orientation in the chosen UV-chamber is crucial. Most chambers focus the LED-spots in the middle of the volume. Placing flat objects on the bottom may cause nearly no or less irradiation by light. Curing time may need to be adjusted depending on the geometry of the part.
- UV Post-cure with vacuum or nitrogen atmosphere:
 - Better for surface cure. Decrease of time in UV-chamber.
 - Less stickiness.
- UV-Post-Cure with simultaneously temperatures above 60 °C:
 - Good for cure in depth and surface cure. Decrease of time in UV-chamber.
 - Not that much depending on the color and geometry of the part, the effect of temperature influences the homogeneity of curing.
- Additional thermal post-cure after finished UV-cure:
 - Good for final cure in depth and surface cure.
 - Recommended temperature varies between 80 - 130 °C for 1 – 5 hours for most materials, between 130 - 190 °C for 0,5 – 5 hours for very high temperature resistant materials.

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