Processing Guide

High Temperature 303 VP-ESD

ESD material with very high heat resistance

Cubic Ink High Temperature 303 VP-ESD material meet customers ESD-requirements and target applications where high heat and chemical resistance is necessary.

The material is fairly low viscous and versatile processable in terms of printer and post-curing.

Materials can be used in

Tooling | Machinery | Transportation

Performance Indicators

Volume Resistivity	6.6 x 10^7 Ω·cm
HDT A	216 °C
Chemical resistance	Very Good
Thermal stability	Very Good

Preparation

Printing

LCD, DLP, mSLA

Washing

1 -3 min IPA

Post-Curing

Cure with UV / Thermal

Preparation

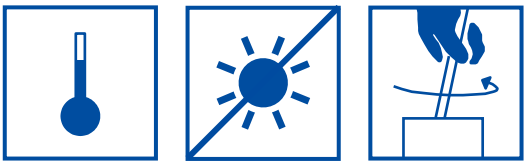
Safety Guideline

High Temperature 303 VP-ESD 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 thoroughly prior to use and before each printing job.

Printing

Print Settings

High Temperature 303 VP-ESD 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 High Temperature 303 VP-ESD 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. To reach good material properties it is beneficial to have a throughout curing during printing, e.g. high overcure rates are favorable. Please note, that **it is not recommended to print layer thicknesses higher than 50 µm**. Please contact us for further information

Table 1: Curing Parameters measured at Cubic Ink for High Temperature 303 VP-ESD Black.

Measurement	Black
405 nm, 8 mW/cm²:	
E_c [mJ/cm²]	4.19
D_p [mm]	0.14
Thickness after 1 s of exposure [mm]	0.08
Thickness after 5 s of exposure [mm]	0.32
385 nm, 11 mW/cm²:	
E_c [mJ/cm²]	5.89
D_p [mm]	0.12
Thickness after 1 s of exposure [mm]	0.07
Thickness after 5 s of exposure [mm]	0.27
x-y-Compensation [%]	0.50[1]
z-Compensation [mm]	0.36[1]
Printable overhangs [°]	up to 45[1]
Minimal wall thickness unsupported [mm]	-
Minimal wall thickness supported [mm]	0.2[1]
Minimum pin thickness [mm]	1.0[1]
Minimum hole thickness vertical [mm]	1.0[1]
Minimum hole thickness horizontal [mm]	-

[1]Measured with samples printed and cured via Prusa SL1S (LCD 405 nm, 2 mW/cm², 50 µm) and 2x 20min Prusa CW1S followed by thermal treatment of 3 h at 190 °C; For more details, please contact us.

Printing

Print Settings

Table 2: Suggested curing times depending on wavelength, color, printing thickness and intensity of light source for High Temperature 303 VP-ESD.

Wavelength	Color	Layer thickness [µm]	11 mW/cm²	8 mW/cm²	5 mW/cm²	2 mW/cm²
385 nm	Black	50	0.9 s	1.2 s	2.0 s	4.9 s
405 nm	Black	50	-	1.2 s	2.0 s	4.9 s

High Temperature 303 VP-ESD 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 High Temperature 303 VP-ESD Black.

Printing system	Color	Layer thickness [µm]	Exposure time bottom layer [s]	Exposure time default layer [s]
Prusa SL1S Speed (LCD, 405 nm, 2 mW/cm²)	Black	50	30	15 - 25
Phrozen 8K Mighty (LCD, 405 nm, 2 mW/cm²)	Black	50	32	15 - 25
Asiga Pro 4K80 (DLP, 385 nm, 11 mW/cm²)	Black	50	40 - 110	1.3 – 3.0

Washing

Removing & Washing

- Careful handling of green bodies
- Washing with isopropyl alcohol (IPA) up to 3 min
- Ultrasonic bath or adequate mixing equipment may be used

- Alternatively, washing with Cubic Ink Cleaner 400 up to 3 min if throughout curing was achieved during printing
- Rinse with IPA

Cleaning

- Treatment with compressed beneficial
- Use sponges to clean holes and cavities

Drying

- Let dry at ambient conditions for at least 30 min
- Drying for 60 – 180 min at 50 °C is beneficial

Post-Curing

High Temperature 303 VP-ESD Black needs to be post-cured to reach its final material properties. The post-cure used on the TDS (Version 4) contained 30 min UV-treatment via Prusa CW1S (LED, 405 nm) followed by thermal treatment of 3 h at 190 °C. Other examples of post-curing are shown in Table 4 to emphasize different effects of UV-curing chambers, wavelengths, intensities, time and additional thermal post-cure.

High Temperature 303 VP-ESD Black is post-cured via

- **Intense and homogenous UV-cure is necessary**
- Temperature in UV-chamber as high as possible (≥80 °C)
- If possible, use vacuum or nitrogen atmosphere
- Thermal post-cure recommended if low intense light chambers were used to gain full potential of material properties. To avoid cracking the pre-used UV curing needs to be as thoroughly as possible, e.g. due to increased time, temperature during UV post curing or due to increased light dose and overcure during printing.
- Thermal post-cure is carried out in ventilated oven. Do not place too many parts on the tray to avoid exothermal expansion.

Table 4: UV post-processing carried out at Cubic Ink for High Temperature 303 VP-ESD Black (printed with 50 µm).

Post-Process	E-Modulus [GPa]	Tensile strength [MPa]	Elongation at break [%]	HDT B [°C]
Green	2.3	45	2.9	<80
2 x 20 min Prusa + 30 min 130 °C	3.2	61	2.0	157
2 x 20 min Prusa + 3 h 190 °C	3.7	48	1.7	220

Prusa CW1S = LED 405 nm; Phrozen = LED 405 nm. 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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