

# Phrozen Resin User Guide

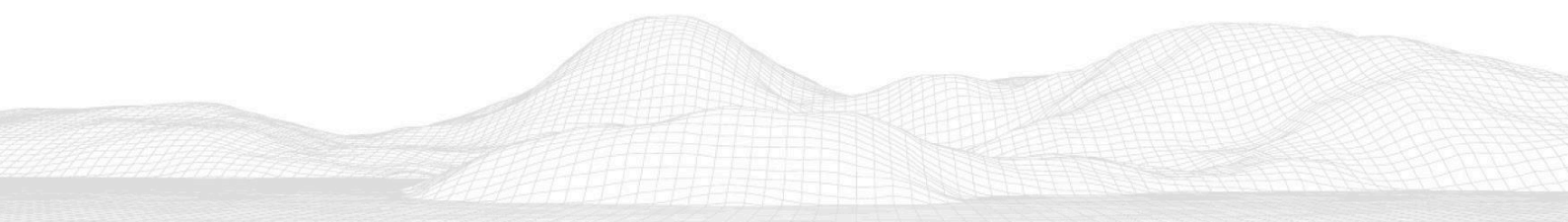
## Engineering Resin: FR940, Gray

### Outline

Before printing the perfect object, it is important to first understand the material limitations we are handling and how it can be successfully printed under various conditions. With this in mind, Phrozen provides the following design suggestions to help you better understand the properties of each material and how you can best utilize them to bring your wildest creation to life.


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## Section 1

# TDS

General Properties	Norm	Typical values	
Appearance	-	Gray	
Viscosity, 30	Cone/Plate Rheometer <sup>1</sup>	180–285 mPas	
Density (liquid resin)	ASTM D4052-18a	1.14 g/cm <sup>3</sup>	
Tensile Properties	Norm	Typical values	
		UV post-cured	UV +Thermal
E Modulus	ASTM D638	1812 MPa	1537 MPa
Ultimate Tensile Strength	ASTM D638	28.5 MPa	38.1 MPa
Elongation at Break	ASTM D638	3.8 %	4.9 %
Impact Properties	Norm	Typical values	
		UV post-cured	UV +Thermal
Notched Izod (Machined), 23 °C	ASTM D256	30.7 J/m	17.5 J/m
Thermal Properties	Norm	Typical values	
		UV post-cured	UV +Thermal
HDT at 0.45 MPa	ASTM D648	59.8 °C	82.8 °C
Hardness	Norm	Typical values	
		UV post-cured	UV +Thermal
Shore D	ASTM D2240	75-80D	82D
Flammability	Norm	Typical values	
V-0 Burning stops within 10 seconds on a vertical specimen; drips of particles are allowed as long as they are not inflamed.	UL94 V-0	3.0-3.3mm	
			

\*Except for the UL Test, which is printed on the Sonic Mini 4K, all other testing specimens are printed using Phrozen Sonic Mighty 8K or Sonic Mini 8K, and post-cured using Phrozen Cure & Wash.

\* After 60 minutes of post-curing, heat to 80°C for two more hours.

\* Increasing curing time can improve mechanical properties but also increase the risk of deformation.

Specimens are printed unless stated otherwise. The information in this TDS, including product recommendations, is based on our current knowledge and experience. Descriptions, drawings, photographs, data, proportions, weights, etc. provided may change without notice and do not establish the product's contractual quality. Request the relevant MSDS from your supplier or contact Phrozen Tech Co., Ltd at [sales@phrozen3d.com](mailto:sales@phrozen3d.com)

## Section 2

# UL Blue Card Certification

iq.ul.com

Plastics for Additive Manufacturing

E535425

Guide Information

View Certificate of Compliance

### PHROZEN TECH CO LTD

3rd Fl 287 Niupu Rd Zhongpu Vlg Xiangshan District, Hsinchu 300059 TW

### Phrozen-FR940 (#)

Process Category: VAT Polymerization - Liquid Crystal Display (LCD)  
Acrylic, furnished as Liquid

Color	Min. Thk (mm)	Flame Class	HWI	HAI	RTI Elec	RTI Imp	RTI Str
GY	3.0-3.3	V-0	-	-	50	50	50

Comparative Tracking Index (CTI): -	Inclined Plane Tracking (IPT) kV: -
Dielectric Strength (kV/mm): -	Volume Resistivity (10 <sup>x</sup> ohm-cm): -
High-Voltage Arc Tracking Rate (HVTR): -	Surface Resistivity (10 <sup>x</sup> ohms/square): -
Dimensional Change (%): -	High Volt, Low Current Arc Resis (D495): -

#### Processing Parameters

Build Plane: Horizontal & Vertical

Layer Thickness (mm): 0.05-0.1

Post Processing Method: Please see footnote (#)

For use with printer: Phrozen Sonic Mini 4K

Limited properties and ratings assigned to samples produced by the Additive Manufacturing technique representing a specific set of printing parameters and build strategy. Other print parameters and build strategies may result in significantly different results.

(#) - Soak object in Phrozen Wash with 95% alcohol for 45-60 seconds. Remove to well-ventilated area for min 30 minutes or gently use compressed air to dry the object with no exposure to light. Use post-curing equipment (Phrozen Cure & Wash/Phrozen Cure/ Phrozen Mega Cure) or other post-curing lamps with the same wavelength to cure for 30 minutes.

IEC/ISO small-scale test data does not pertain to building materials, furnishings and related contents. IEC/ISO small-scale test data is intended solely for determining the flammability of plastic materials used in the components and parts of end-product devices and appliances, where the acceptability of the combination is determined by UL.

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Last Revised: 2023-11-01

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#### IEC and ISO Test Methods

Test Name	Test Method	Units	Thk (mm)	Value
Flammability	IEC 60695-11-10	Class (color)	3.0-3.3	V-0 (GY)
Glow-Wire Flammability (GWFI)	IEC 60695-2-12	°C	-	-
Glow-Wire Ignition (GWIT)	IEC 60695-2-13	°C	-	-
IEC Comparative Tracking Index	IEC 60112	Volts (Max)	-	-
IEC AC Dielectric Strength (AC DS)	IEC 60243-1	kV/mm	-	-
IEC DC Dielectric Strength (DC DS)	IEC 60243-2	kV/mm	-	-
IEC Volume Resistivity (VR)	IEC 62631-3-1	10 <sup>x</sup> ohm-m	-	-
IEC Surface Resistivity (SR)	IEC 62631-3-2	10 <sup>x</sup> ohms	-	-
IEC Inclined Plane Tracking (IPT)	IEC 60587	kV	-	-
IEC Ball Pressure	IEC 60695-10-2	°C	-	-
ISO Heat Deflection (1.80 MPa)	ISO 75-2	°C	-	-
ISO Tensile Strength	ISO 527-2	MPa	-	-
ISO Flexural Strength	ISO 178	MPa	-	-
ISO Tensile Impact	ISO 8256	kJ/m <sup>2</sup>	-	-
ISO Izod Impact	ISO 180	kJ/m <sup>2</sup>	-	-
ISO Charpy Impact	ISO 179-1	kJ/m <sup>2</sup>	-	-

## Section 3

# Printing

## Printing Parameters

<b>Printer</b>	Sonic Mini / Sonic Mini 4K
<b>Layer Height</b>	50 $\mu\text{m}$
<b>Exposure Time</b>	1.5–2 s
<b>Bottom Exposure Time</b>	30–40 s
<b>Light-off Delay</b>	12 s
<b>Lift Distance</b>	6 mm
<b>Lifting Speed</b>	60 mm/min

<b>Printer</b>	Sonic Mini 8K
<b>Layer Height</b>	50 $\mu\text{m}$
<b>Exposure Time</b>	2.5–3 s
<b>Bottom Exposure Time</b>	30–40 s
<b>Rest Time After Retract</b>	3 s
<b>Lift Distance</b>	6 mm
<b>Lifting Speed</b>	60 mm/min

<b>Printer</b>	Sonic Mini 8K S
<b>Layer Height</b>	50 $\mu\text{m}$
<b>Exposure Time</b>	1.5–2 s
<b>Bottom Exposure Time</b>	10–15 s
<b>Rest Time After Retract</b>	3 s
<b>Lift Distance</b>	6 mm
<b>Lifting Speed</b>	60 mm/min

<b>Printer</b>	Sonic Mighty 4K
<b>Layer Height</b>	50 $\mu\text{m}$
<b>Exposure Time</b>	2.5–3 s
<b>Bottom Exposure Time</b>	30–40 s
<b>Light-off Delay</b>	12 s
<b>Lift Distance</b>	8 mm
<b>Lifting Speed</b>	60 mm/min

<b>Printer</b>	Sonic Mighty 8K
<b>Layer Height</b>	50 $\mu\text{m}$
<b>Exposure Time</b>	2.5–3 s
<b>Bottom Exposure Time</b>	30–40 s
<b>Rest Time After Retract</b>	3 s
<b>Lift Distance</b>	8 mm
<b>Lifting Speed</b>	60 mm/min

<b>Printer</b>	Sonic Mighty 12K (Upgrade Kit)
<b>Layer Height</b>	50 $\mu\text{m}$
<b>Exposure Time</b>	2.5–3 s
<b>Bottom Exposure Time</b>	30–40 s
<b>Rest Time After Retract</b>	3 s
<b>Lift Distance</b>	8 mm
<b>Lifting Speed</b>	60 mm/min

<b>Printer</b>	Sonic Mega 8K*
<b>Layer Height</b>	50 μm
<b>Exposure Time</b>	30–40 s
<b>Bottom Exposure Time</b>	2.5–3.5 s
<b>Rest Time After Retract</b>	3 s
<b>Lift Distance</b>	8 mm
<b>Lifting Speed</b>	45 mm/min

<b>Printer</b>	Sonic Mega 8K S
<b>Layer Height</b>	50 μm
<b>Exposure Time</b>	15–20 s
<b>Bottom Exposure Time</b>	1.5–2 s
<b>Rest Time After Retract</b>	3 s
<b>Lift Distance</b>	8 mm
<b>Lifting Speed</b>	60 mm/min

\* Mega 8K has a higher peeling force. Therefore, a longer exposure time is necessary to increase the success rate.

\* Be sure to cover the hood when printing to maintain the best printing condition of the resin.

## Cleaning

1. After removing the printed object from the building stage, use the Phrozen Wash and Cure Kit for post-processing.
2. Soak the object in Phrozen Washing Station filled with 95% alcohol for 45–60 seconds to remove uncured resin from the surface. Do not soak models for more than 60 seconds in alcohol (or other solvent such as IPA), as it may damage the surfaces.
3. Make sure to clean the inner parts of hollow objects completely.
4. After the object has been thoroughly cleaned, leave it in a cool, well-ventilated place for at least 30 minutes without exposure to light. Alternatively, you may gently apply compressed air to dry the printed object.

\*When printing flat on the building plate, remove the printed objects carefully to avoid deformation on the objects.

## Post-Curing

1. Use Phrozen post-curing equipment (Phrozen Curing Station/Phrozen Cure/Phrozen Mega Cure) or other post-curing lamps with the same wavelength to cure printed objects for 30–60 minutes for the best results.

## Section 4

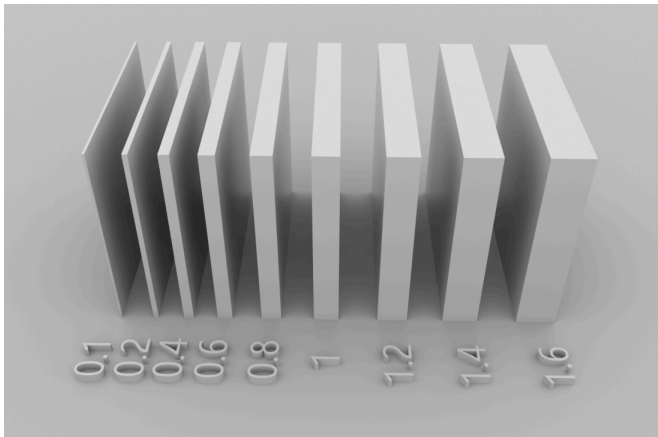
# Design Specifications

※Note: All indicators are limited to each resin; the value will vary with different machines and environmental conditions.※

### Minimum Unsupported Wall Thickness

This indicator shows the minimum wall thickness that can be printed independently with no support without causing any bending or breaking.

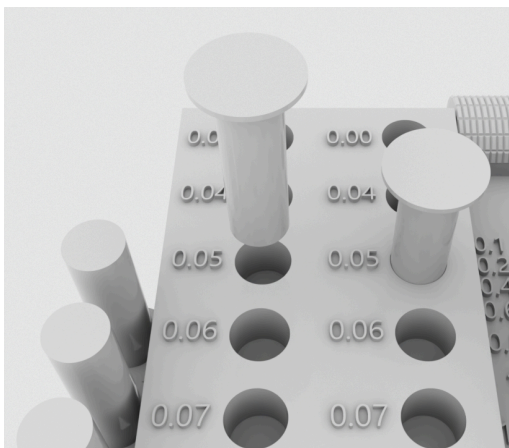
Recommended thickness:  $\geq 0.4$  mm



### Size Tolerance, X-Y plane

This indicator shows the minimum dimensional tolerance between the hole and the column parallel to the XY plane.

Recommended tolerance:  $\geq 0.2$  mm

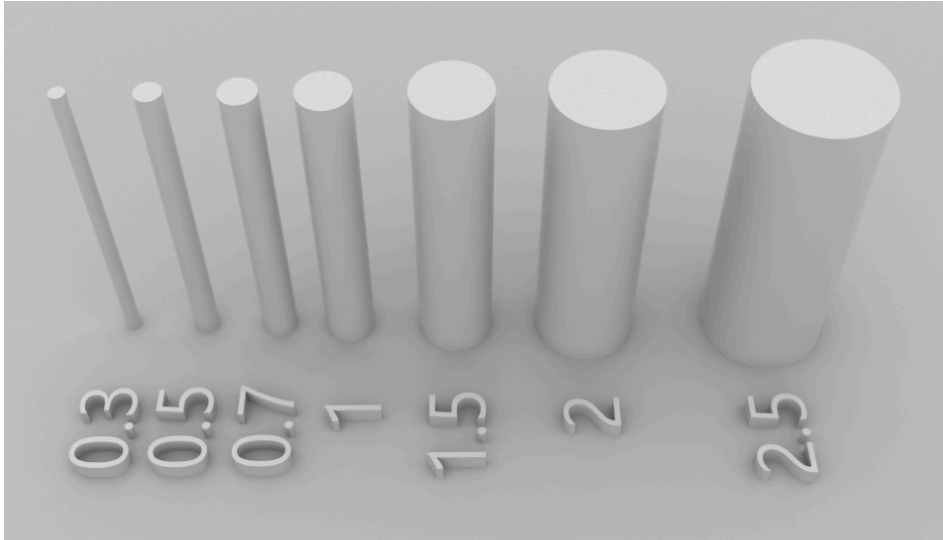




## Minimum Pin Diameter

This indicator shows the minimum column diameter of pillars and supports that can be printed independently without bending or breaking.

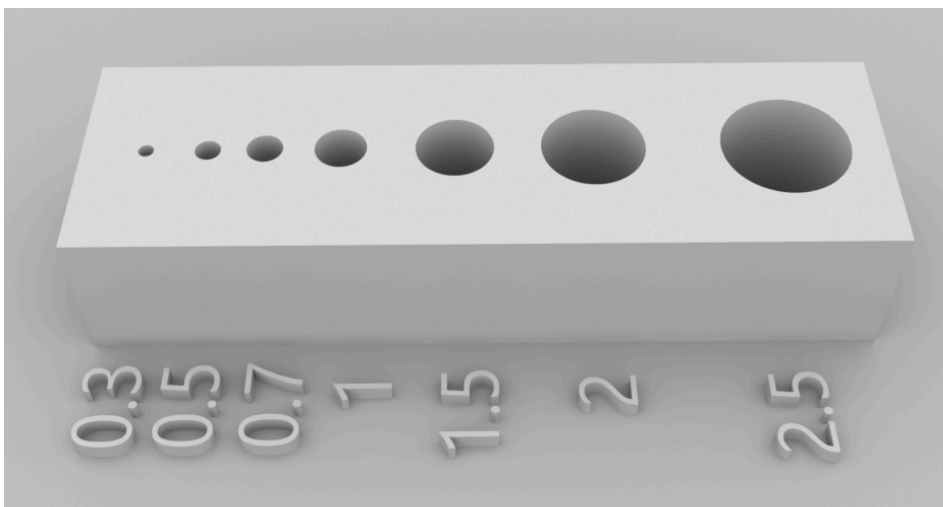
*Recommended diameter:  $\geq 0.7$  mm*



## Minimum Hole Diameter, X-Y plane

This indicator shows the minimum hole diameter that can be successfully printed parallel to the XY plane.

*Recommended diameter:  $\geq 1$  mm*



### Minimum Embossed Detail Width, X-Y plane

This indicator shows the minimum line width that can successfully be printed with embossed details.

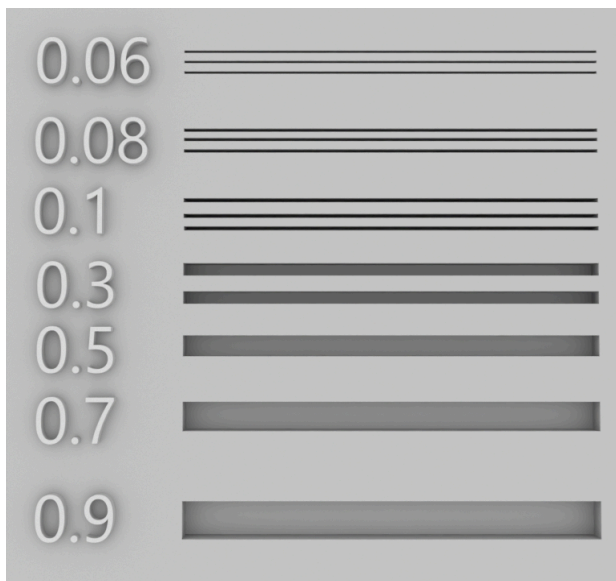
*Recommended width:  $\geq 0.1$  mm*



### Minimum Engraved Detail Width, X-Y plane

This indicator shows the minimum line width that can successfully be printed with engraved details.

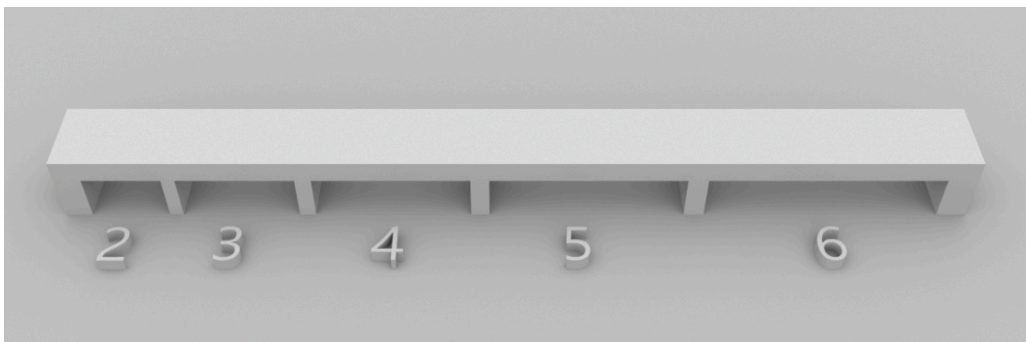
*Recommended width:  $\geq 0.5$  mm*



## Maximum Horizontal Bridge Span

This indicator shows the maximum width between the supporting walls that can be printed without deforming the bridge.

*Recommended width:*  $\leq 6$  mm

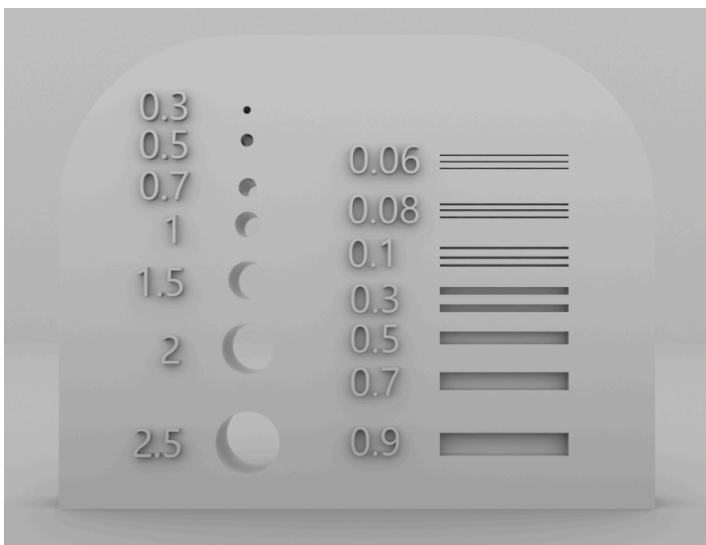


## Minimum Hole Diameter and Engraved Detail Width, Z-Axis, at 0.05mm Layer Height

This indicator shows the minimum hole diameter and engraving groove width that can be successfully printed on the Z-axis with a layer thickness of 0.05mm.

*Recommended diameter:*  $\geq 0.7$  mm

*Recommended width:*  $\geq 0.3$  mm



## Section 5

# Applications

