SUPPLEMENTAL DATASHEET

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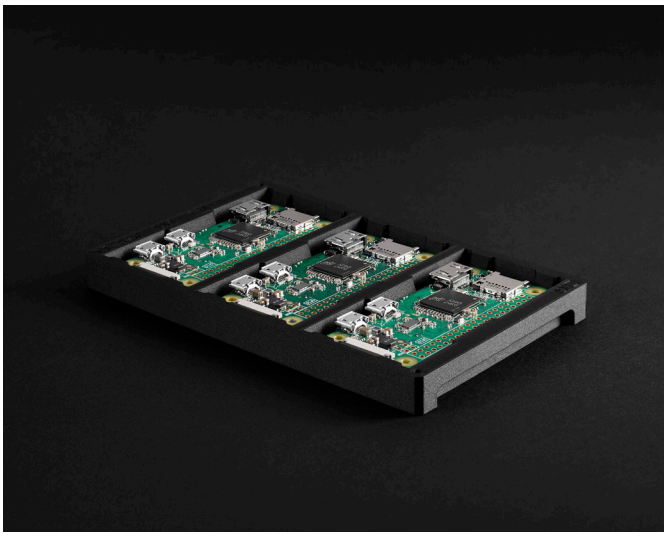
Onyx ESD v2



Onyx ESD v2 is an ESD-safe micro carbon fiber filled nylon composite base material with similar mechanical properties and surface finish to Markforged Onyx. It is static-dissipative and reinforceable with continuous fibers to achieve up to 10x strength compared to existing ESD-safe plastics.

This datasheet covers surface resistance data and test methods. Please refer to the Markforged Composites Datasheet for more detailed mechanical data.

Surface Resistance Testing / Definitions

We developed this material to be static-dissipative, as tested under ANSI/ESD STM11.11. This results in an ESD-safe rating under most other testing standards, including ASTM D257, MIL-STD-1686C, MIL-HDBK-263B. Samples were prepared using recommended settings to optimize for uniformity of surface resistance. Results may vary based on print settings, test environment, and geometry.

Material Property	Test	
Surface Resistance	ANSI/ESD STM11.11	10^5 - 10^7 Ohms (optimal ESD-safe settings[1]) 10^5 - 10^9 Ohms (default Eiger settings)
Tensile Stress at Yield [MPa]	D638	52
Tensile Modulus [GPa]	D638	4.2
Available layer heights [mm]		0.100 0.125
Available Continuous Fiber Reinforcements		Carbon Fiber, Kevlar, HSHT FIberglass, Fiberglass
Compatible Printers		X7, FX10, FX20

Conductive | <10^4 ohms

Electrons flow easily across surface

Can allow static charge to pass through, potentially damaging sensitive electronics

Achievable by a wide range of materials including metals, machinable polymers with conductive additives, and 3D printer filaments with conductive additives

Static Dissipative | 10^4 - 10^{11} ohms

Controlled flow of electrons across surface

Restricts or eliminates charge passthrough

Requires fine process control to achieve target range, most commonly found in large batch polymer production i.e. injection molding, extrusion, rolling

Insulative | >10^{11} ohms

Limits flow of electrons across surface

Charge can persist for later discharge, potentially damaging sensitive electronics

Includes most polymers and 3D-printer filaments

[1] Print settings for sample preparation. Bolded settings denote differences between Eiger default and Optimal ESD settings. Layer Height (mm) - 0.100, Use Supports - Yes, Supports Angle - 45, Raise Part - Yes, Use Brim - Yes, Fill Pattern - Triangular Fill, Fill Density - 37%, Roof & Floor Layers - 4, Wall Layers - 2

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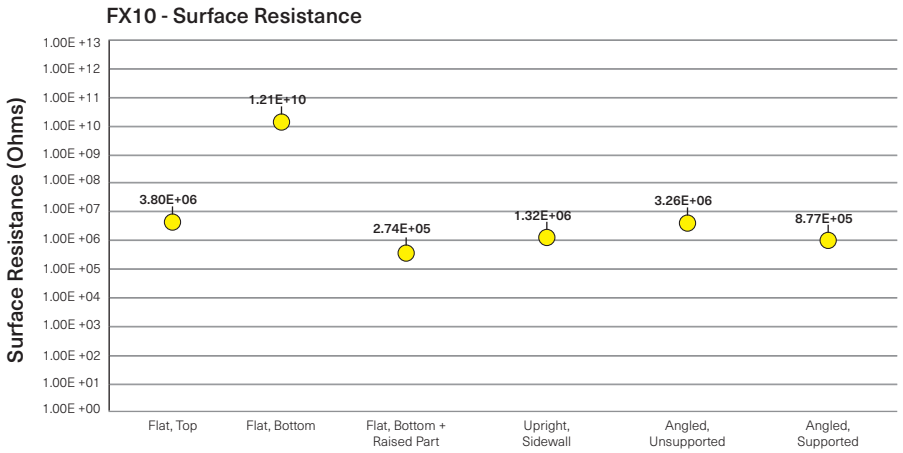
Test Description

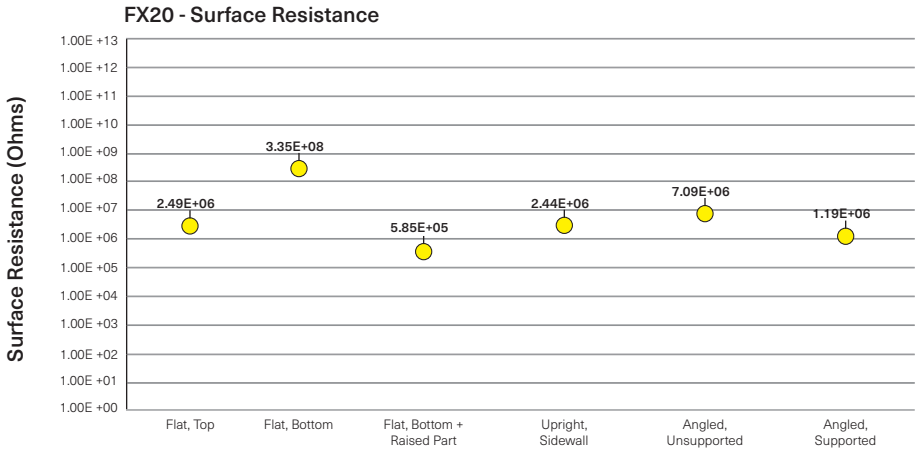
Surface resistance testing of printed Onyx ESD v2 platens (76mm x 127mm x 5mm) was performed according to ANSI/ESD STM11.11. Three distinct print orientations were tested, representing six distinct surface types commonly encountered in 3D printing. To ensure repeatable and statistically significant results, six samples for each orientation were tested internally and verified by a third party lab. The graphs to the right plot the geometric mean of measured surface resistance. Surface resistance data for Industrials is based on a default layer height of 100µm. Surface resistance data for FX10 and FX20 uses a default layer height of 125µm.

Conditioning of specimens before measurement is necessary, where specimens must be placed in a conditioning chamber at 12% +/-3% RH and 23°C +/- 2°C

Instrumentation required:

1. Resistance meter
2. 5lb concentric ring surface resistance probe
3. Test plates

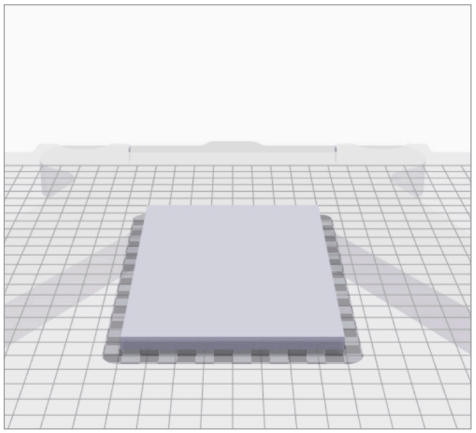




Notes on Print Orientation

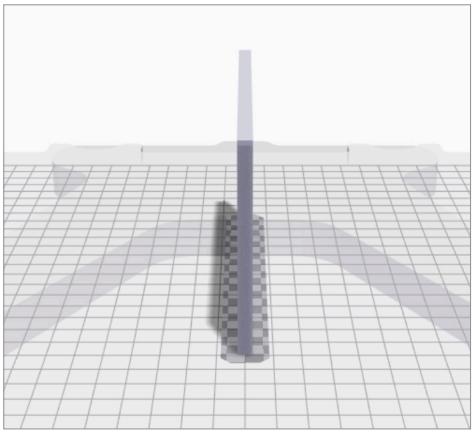
Below are visual representations of the different print orientations used to complete surface resistance testing.

Flat



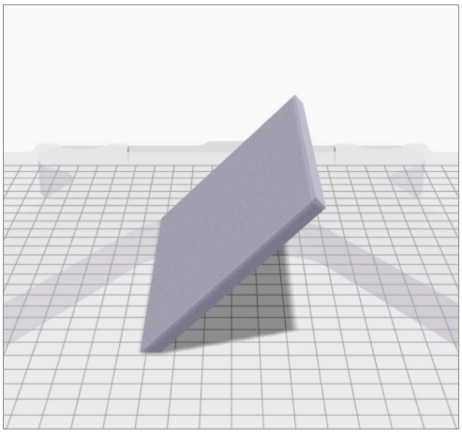
The Raised Part feature prints the part above a thin layer of supports. Turn on for the most consistent surface resistance.

Upright



Sidewall values were measured individually, and averaged for simplicity.

Angled (45°)



The unsupported side faces up, while the supported side faces down.

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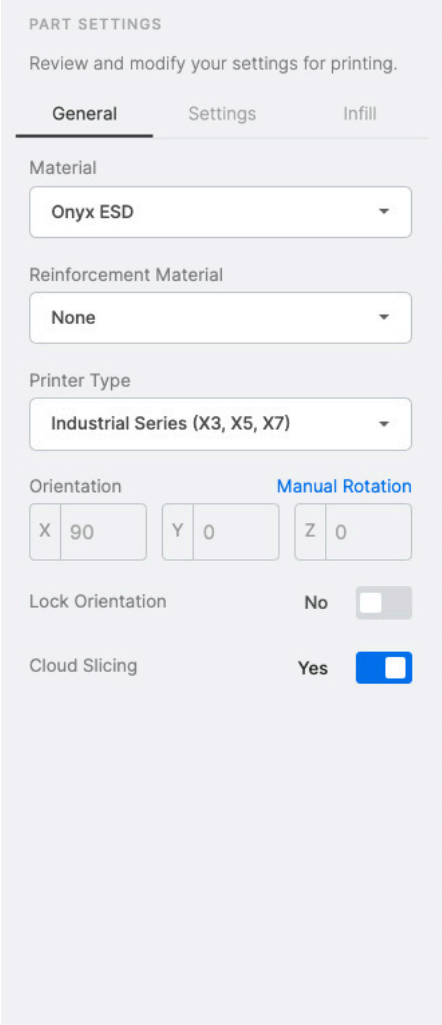
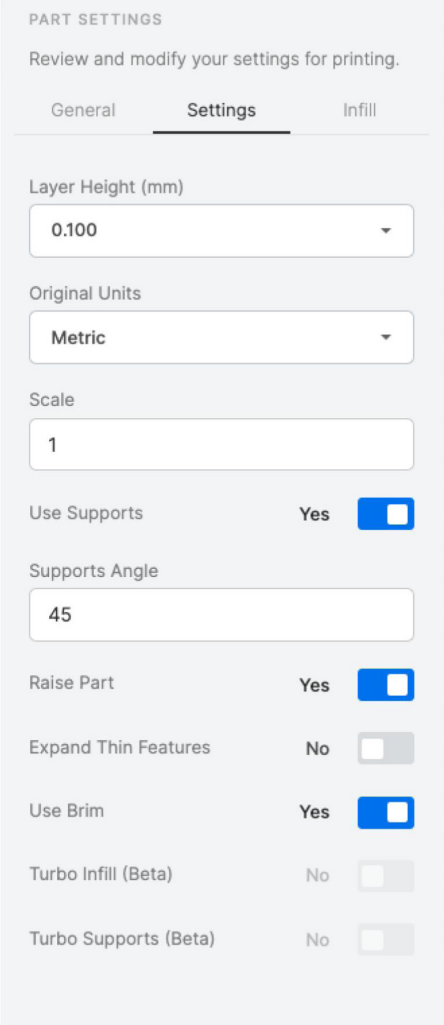
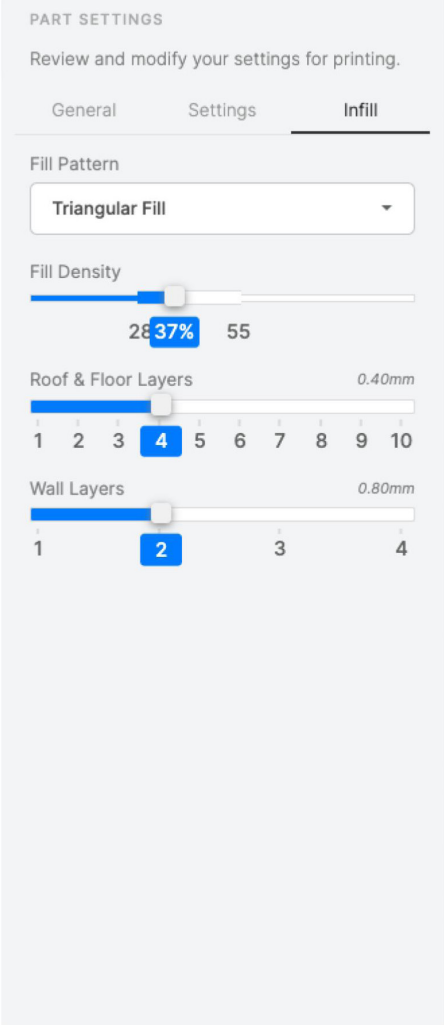
Optimal Onyx ESD v2 Print Settings

Below are print settings that should be used to optimize surface resistance and result in every surface of your part meeting the narrowest range
of 10^5-10^7 ohms.







To learn more about specific testing conditions or to request test parts for internal testing, contact a Markforged representative. All customer parts should be tested in accordance to customer's specifications.

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