ASTRA: ROBOTIC 3D PRINTER

BUYER'S GUIDE

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SPACEFACTORY

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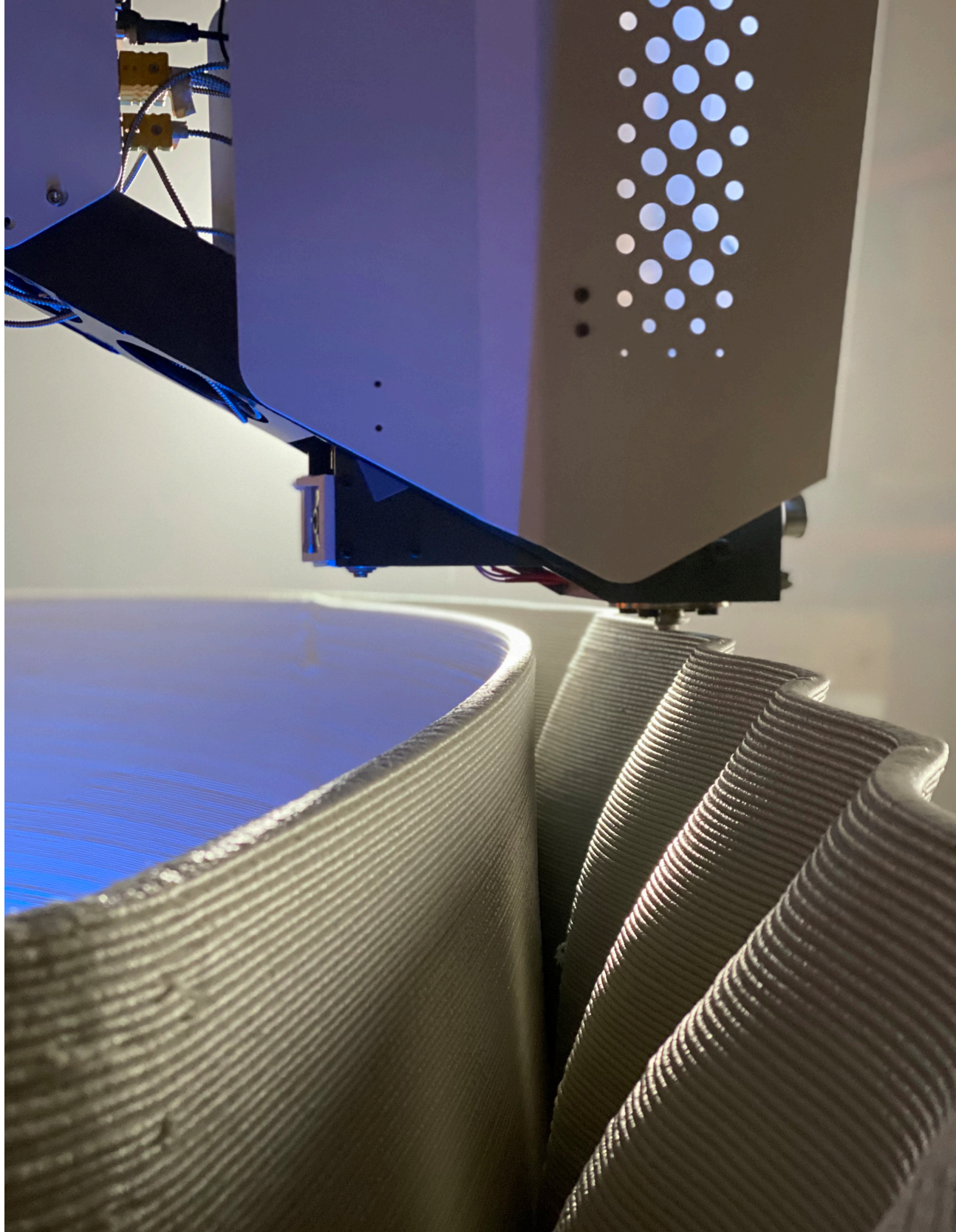


Why Robotic 3D Printing?

Overview

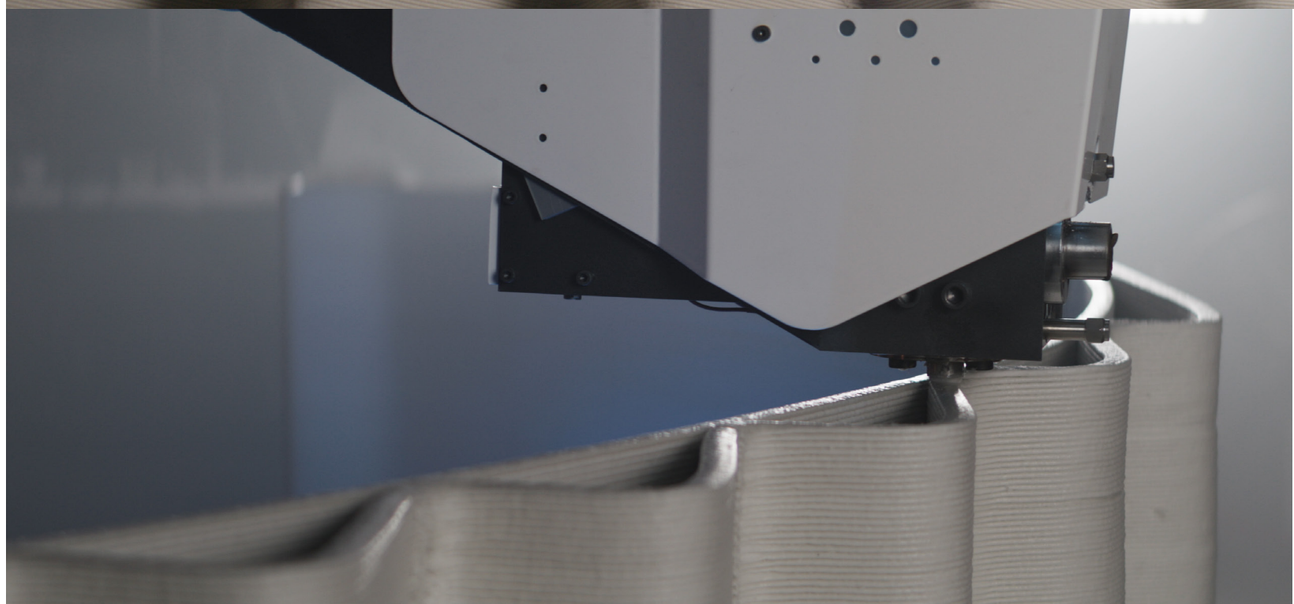
Robotic 3D printing combines thermoplastic extrusion technology with a multi-axis robotic arm to create a much more flexible 3D printer than conventional three-axis (XYZ) machines – at a fraction of the cost.

The ASTRA Robotic 3D Printer is built on top of the ABB industrial robotic platform, offering world-class precision, speed, and reliability. In addition to scale and cost advantages over purpose-built gantry systems, ABB's kinematics enable smooth, high-fidelity pathfinding, whatever your project looks like.

Each ASTRA is fully integrated with hardware, onboard electronics, material handling, and software engineered for ease of use. Designed to print with recyclable polymer composite pellets, ASTRA constructs 3D models into quick-setting, near-net shapes intended for architectural and manufacturing applications.

ASTRA bridges industrial automation and IOT with an open architecture designed for future hardware and software extensibility. Compatible with Cura generated G-code, ASTRA brings a best-of-both-worlds approach: industrial reliability with a modern, nimble user experience.

- Lower cost without sacrificing quality and scale
- Fully integrated hardware, electronics, material handling and software
- Applicable to a range of architectural and manufacturing uses
- Recyclable, high performance polymer composite material
- Open architecture - hardware and software extensibility
- Compatible with Cura generated G-code



ASTRA Specifications

Extruder

ASTRA's 30mm diameter Nitralloy 135 hardened steel barrel is powered by 4 heat zones and is capable of extruding composite pellets to thicknesses ranging from 10mm to 35mm at temperatures up to 315°C.

Melt Pump

ASTRA includes a melt pump to regulate throughput and eliminate surging of the extruder screw, resulting in a clean, even bead of extruded material. Both melt pump and extruder screw are powered by top-of-the-line Yaskawa motors with torque and motion feedback.

Robotic Arm

The extruder is mounted to an ABB IRB 6700-245/3.00, a high payload industrial robotic arm. Six degrees of freedom and an extensive reach allow for both orthogonal and polar build envelopes with print speeds up to 200mm per second.

Material Handling

An energy efficient and compact industrial vacuum pulls polymer composite pellets from plug-and-play material boxes to the extruder. ASTRA has been tested with a wide range of polymer composites including glass fiber reinforced polypropylene, talc filled polypropylene, basalt fiber reinforced PLA, and glass fiber reinforced polycarbonate.

Onboard Electronics

ASTRA's electronics are housed within the extruder assembly and in a dress pack mounted to the robotic arm. Each subsystem controller (heating, motion, material handling) is connected via ethernet for complete profile awareness during a print.

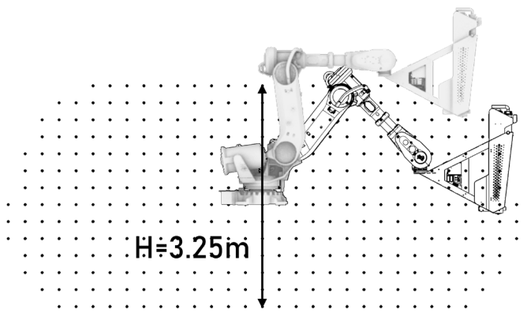
Software

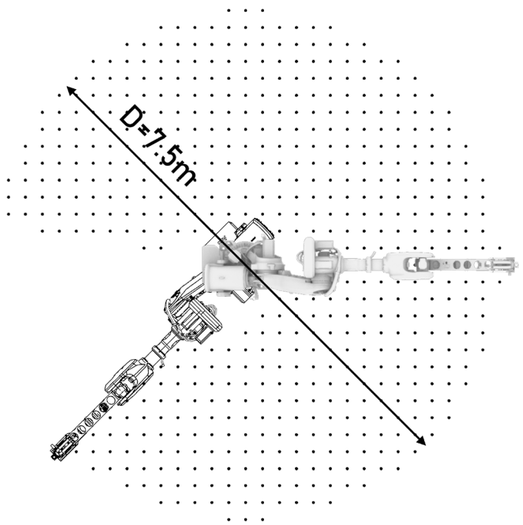
ASTRA runs on G-code generated with Ultimaker Cura, a popular open-source slicer. Our proprietary post-processor transcodes the raw G-code into 6-axis motion and extrusion instructions optimized for large scale 3D printing.

Performance Metrics	
Build Envelope	
Orthogonal Envelope	1200 mm x 2400 mm x 1200 mm
Polar Envelope	300° / 3750 mm radius x 3250 mm max ht
Extrusion	
Throughput	90 lb/hr
Print Temperature	175°C – 315°C
Heating	6 kW controlled in 4 zones
Layer Height	2 mm – 10 mm
Layer Width	10 mm – 35 mm
Height/Width Ratio	1 : 4 - 1 : 5
Kinematics	
Mobility	6-axis
Print Velocity	5 mm/s – 200 mm/s
Motor 1 - Extruder	6000 rpm / 3.0 kW
Motor 2 - Melt Pump	6000 rpm / 1.0 kW
Repeatability	0.05 mm
Accuracy	0.10 mm

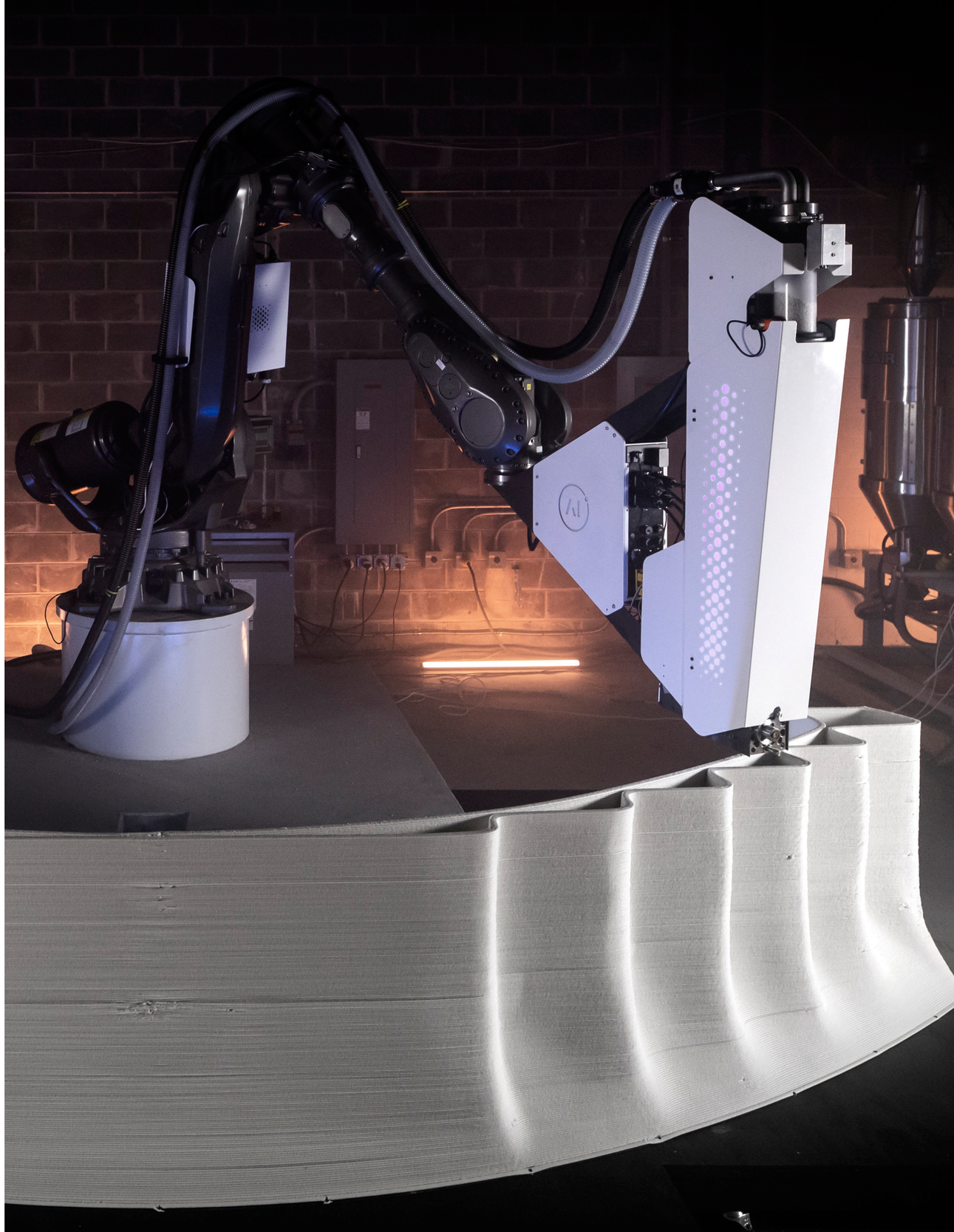
Component Specifications	
Power Supply	
Robot	480V 30A
End Effector	208V 3-phase: 30A-20A-20A
Onboard Computer	120V AC 20A
Dimensions	
Robot	X: 2560 mm Y: 1009 mm Z: 2321 mm
Robot Mass	1540 kg
TCP Offset	X: 1152 mm Y: 0 mm Z: 605 mm
End Effector Mass	132 kg
Barrel Length	762 mm
Barrel Inner Diameter	30 mm
Nozzle Diameter	12 mm

Material Delivery Station	
Material	Polymer Composite Pellets
Vacuum	22 L 200 Air watts
Controls	Electronically actuated dual-valves
Dimensions	410 mm x 410 mm x 1020 mm
Mass	45 kg
Handling Capacity	350 lb/hr





Range of Motion/Build Envelope Diagram



System Components

Robotic Arm (1)
ABB's IRB 6700 is a six axis robotic arm that can handle up to a 245 kg payload and has a 3m reach. This payload capacity effectively meets the mass and torque load of the ASTRA end effector, of 132 kg and 1220 Nm respectively.

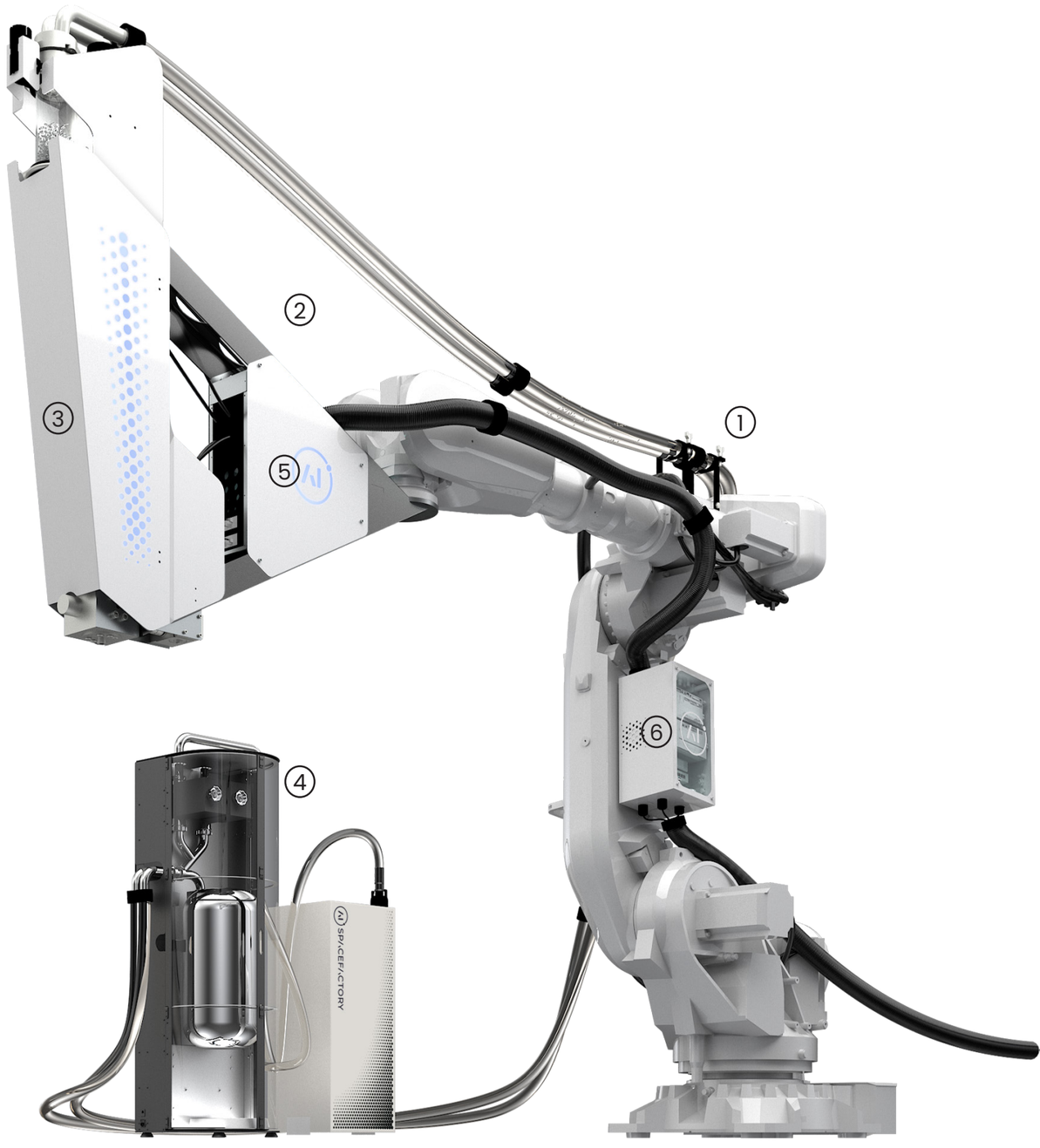
Boom (2)
The fabricated steel boom carries the components of the extrusion system including its controls. It's unique V-shape allows for a larger vertical range of motion while optimizing the torque exerted on the robot.

Extruder (3)
The extruder system is comprised of a hopper, feed section, barrel, screw, and melt pump. The system is driven by two Yaskawa Servo Motors coupled to GAM Gearboxes. Material fed from the delivery station arrives at the hopper before it passes through the extrusion system, which then deposits the layers of thermoplastic.

Material Delivery Station (4)
The Material Delivery Station sends pellets from the material boxes to the extrusion system via hoses connecting each of up to two boxes to a valve and then the hopper system. The material flow is controlled by these valves and a 700AW vacuum.

Onboard Computer (5)
The onboard computer resides within the boom, and contains all of the control systems for heating and extruding material. It features connector panels that link it to the extruder and dress pack as well as provide interfaces for accessories and diagonstics.

Dress Pack (6)
While the dress pack also contains electronic controls for the system, it is kept separately from the onboard computer to alleviate the weight on the robot's primary axis. These controls include the motor drivers and additional power supplies and USB/ethernet ports.



System Components

1	Extruder motor	6	Feed section	11	Burst plug	16	Melt pump motor
2	20:1 Inline gearbox	7	LED lighting	12	Melt pump	17	50:1 Inline gear box
3	Vibration motor	8	Extruder barrel	13	Printer nozzle	18	1:1 Right angle gearbox
4	Material hopper	9	Thermocouples	14	Fans	19	Onboard computer
5	Protective enclosure	10	Heater bands	15	Boom	20	LED ring light

21	Material hoses
22	Cable harness
23	Motor drivers
24	Dress pack enclosure

Material Delivery Station

Vacuum (1)
The material flow is controlled by a 22 liter, 700AW vacuum. System noise is minimized through an integrated muffler near the motor. The vacuum filter is easily serviced by opening the station doors and dropping the housing onto the lower rest.

Valves (2)
The two valves in the Material Delivery Station control which box material is pulled from. These electric actuated 2-piece stainless steel ball valves allow the Delivery Station to automatically switch between boxes when necessary to ensure material flow is uninterrupted during a print.

Material Box (3)
Each Delivery Station can connect to two Material Boxes. Each Box has a cam and groove coupling that connects to the Delivery Station's hoses and an RFID tag that allows the onboard computer to recognize the type of material.

Onboard Computer (4)
The Delivery Station also has its own onboard computer, which contains the electronics necessary to control the vacuum and valves within it. This computer also communicates material information and system status to other subsystems via ethernet.

RFID Reader (5)
An RFID reader is integrated into the Delivery Station. The reader allows the Delivery Station to recognize new material boxes, confirm the material they contain, and adjust print parameters accordingly.

3D Print Material

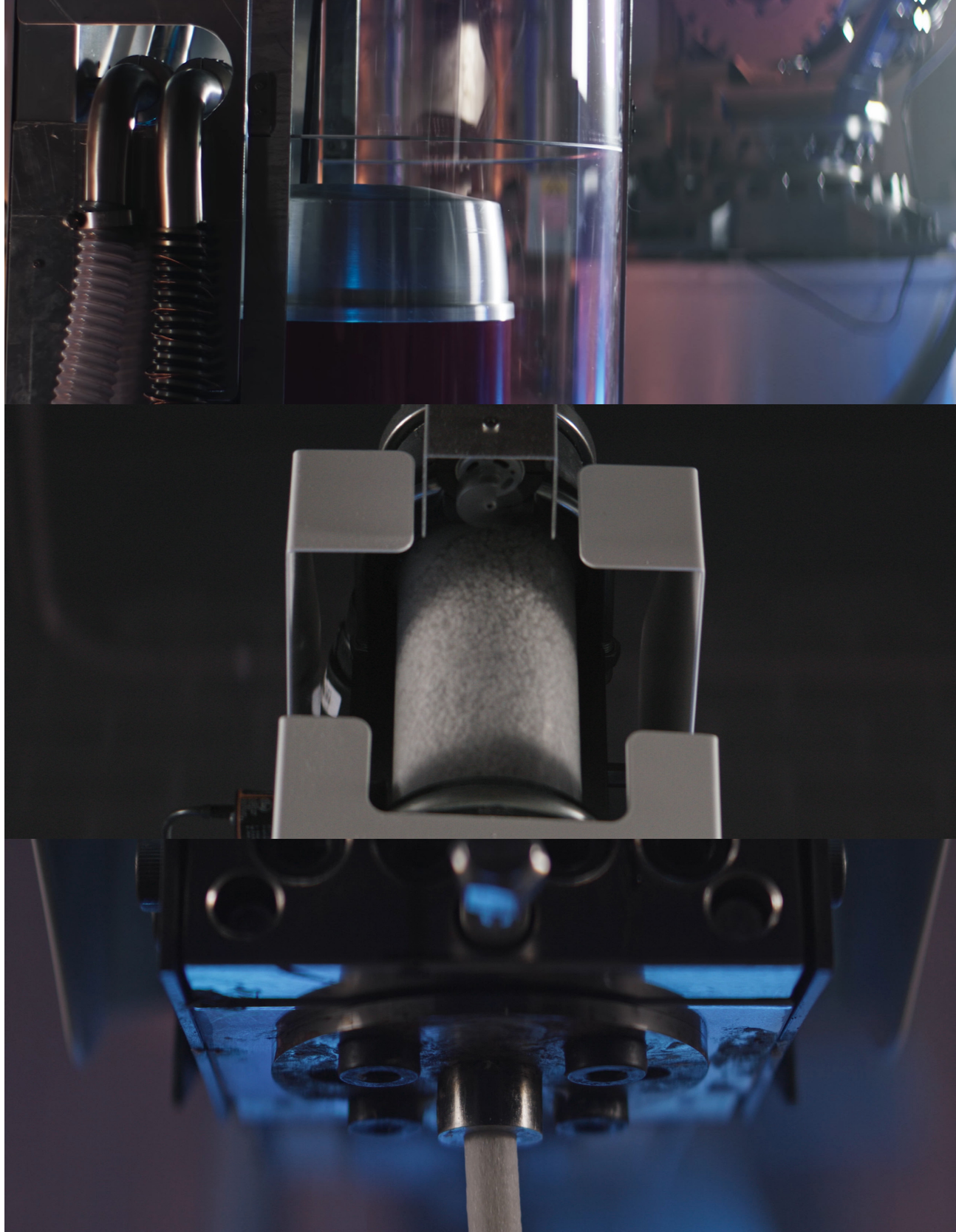
Overview

AI SpaceFactory's Robotic 3D Printing System can work with a wide range of materials, Astra's primary material is White Matter as a result of extensive material testing and optimization.

Our material is currently undergoing ASTM testing for tensile, compressive, flexural, and shear properties, and we will report that data once received.

Material Specifications	
Product Name	White Matter
Material Description	Glass Fiber Reinforced Polypropylene
Storage Requirements	Store in dry cool environment
Composition	40% long glass fiber/60% polypropylene

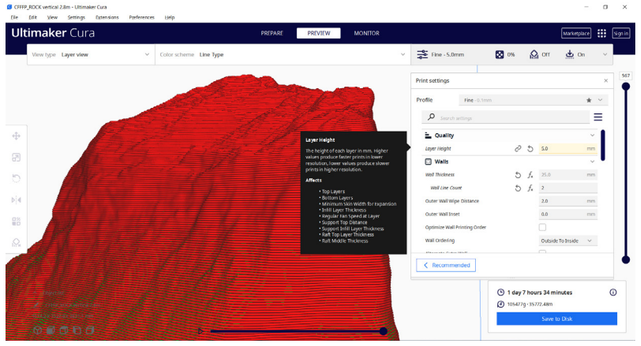
Thermal Properties	
Melting Point	165°C
Working Temperature	175°C - 200°C



Software Solution

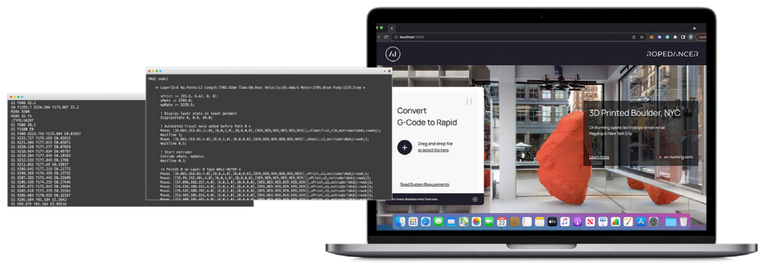
Cura Integration

Start by loading ASTRA's print profile, then prepare prints with a few clicks or dive into custom settings for in-depth control.



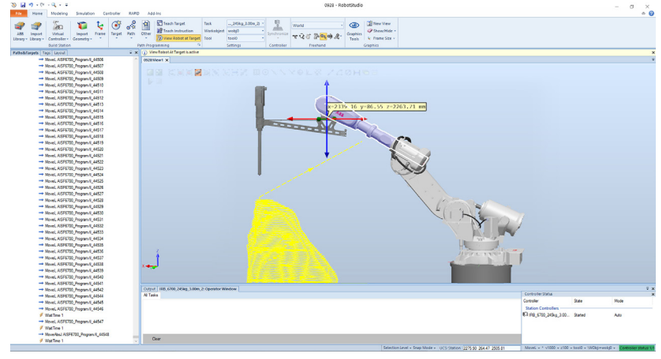
Ropedancer Transcoder

Convert G-Code to Rapid Code with a simple drag-and-drop. Features: CSV file consumption for processing target coordinates generated by Grasshopper, Excel, or custom script. Built-in JSON editor for customizing Ropedancer settings. Polar-mode option for printing outside the standard build envelope.



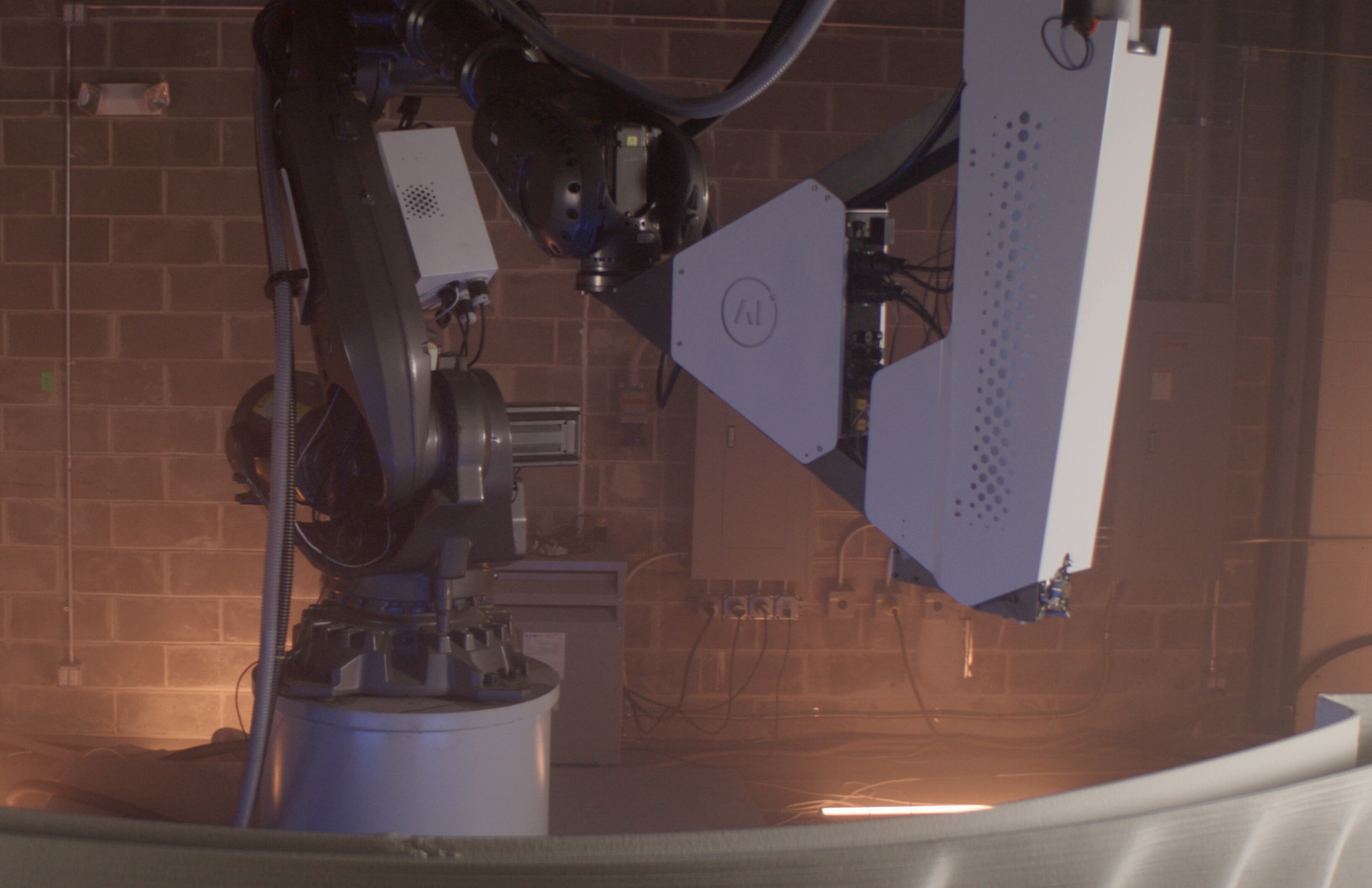
RobotStudio

The world's most used offline programming tool for robotics, ABB's simulation and offline programming software, RobotStudio is built on the ABB Virtual Controller, an exact copy of the real software that runs your robots in production. This allows for high fidelity simulations, using real robot programs and configuration files identical to those used on the shop floor.



PHOBOS

Our proprietary on-board operating system, PHOBOS controls every aspect of ASTRA's function, from commanding motors to regulating temperatures. PHOBOS also interfaces with the AAB robot controller to ensure the smoothest possible print.



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