

METAL X SYSTEM

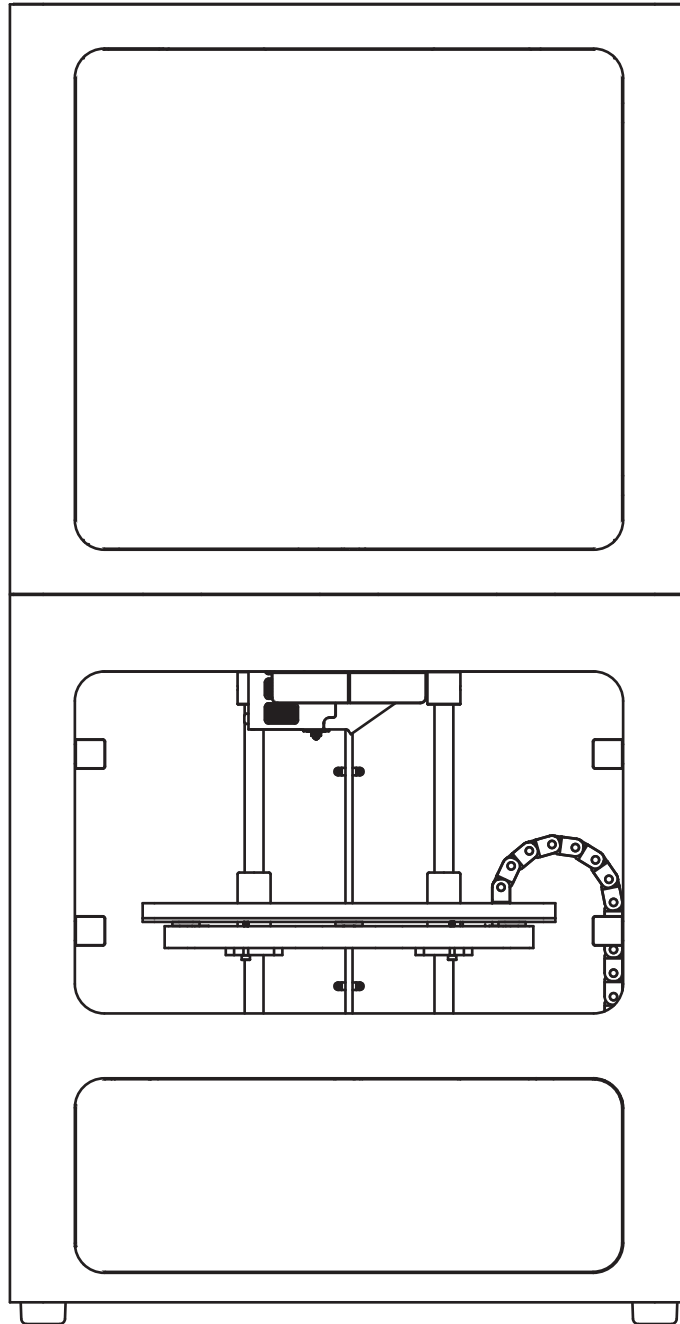


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OVERVIEW

SYSTEM COMPOSITION

The Markforged Metal X system consists of three components: the Metal X printer, Wash-1 debinding station, and Sinter-1 sintering furnace. The Metal X printer will arrive at your facility fully assembled and will require limited initial setup. Both the Wash-1 and Sinter-1 will require additional facilities modification and site preparation by authorized facilities maintenance staff and a certified electrician.

All specifications in this document are approximate and subject to change without notice. Specifications (e.g. electrical and gas requirements) can vary from region to region; consult your local suppliers and regulatory agencies for additional information.

FACILITIES PREPARATION

This guide addresses the following planning considerations:

- Modifications to the installation area
- Site accessibility
- Planning the production area
- Electrical and environmental requirements
- Network connectivity
- Environmental health and safety

All information in this guide assumes knowledge of the following:

- Architectural and planning requirements
- Applicable laws, regulations, and standards

WASTE DISPOSAL

Material handling, storage, and disposal should be performed according to local laws and regulations. See the Safety Data Sheets (SDS), if available, for storage and handling information. Follow your Environmental Health and Safety regulations where applicable, as well as supplier instructions.

SOFTWARE

MARKFORGED SOFTWARE INTEGRATION

Markforged Eiger software can be accessed at <https://www.eiger.io/>. All Markforged products can be accessed or controlled via Eiger.

SOFTWARE UPDATES

In order to improve performance and offer additional system capabilities, software and firmware updates are pushed regularly to all machines. Any machine that is online will be automatically prompted to update whenever changes are available. Updates should be performed at the earliest convenient time.

NETWORK REQUIREMENTS

For assistance with setting up your network, contact your internal IT team.

DHCP

Markforged products support DHCP only. Static IP functionality is not supported.

PORTS

Any corporate firewall or antivirus must allow communication on the following ports:

- 80
- 443
- 123

URLS

Markforged products must have access to the following sites:

- s3-us-west-2.amazonaws.com
- s3.amazonaws.com
- mfeiger-production.s3.amazonaws.com
- cdn.eiger.io
- www.eiger.io

BROWSER

Only Google Chrome is supported and Web Sockets must be enabled.

METAL X

ELECTRICAL REQUIREMENTS

Circuit Type *	Dedicated branch circuit
Wiring System	Single phase with safety ground
Input Frequency	50 - 60 Hz

VOLTAGE/CURRENT COMBINATIONS

INPUT VOLTAGE	MINIMUM OVERCURRENT PROTECTION RATING	MAXIMUM CONTINUOUS OPERATING CURRENT
1234 volts	12341 amperes	12341 amperes
1234 volts	12341 amperes	12341 amperes
1234 volts	12341 amperes	12341 amperes
1234 volts	12341 amperes	12341 amperes
1234 volts	12341 amperes	12341 amperes
1234 volts	12341 amperes	12341 amperes
1234 volts	12341 amperes	12341 amperes

Please locate the appropriate voltage and current combination for your use case based on availability and local regulations.

METAL X

RECEPTACLE TYPES

COUNTRY	STANDARD RECEPTACLE TYPE	AVAILABLE ALTERNATE RECEPTACLE TYPES**
USA	NEMA 5-15	NEMA 5-20; NEMA L5-20
Germany	CEE 7/7	IEC309; NEMA L6-20
UK	BS 1363	IEC309; NEMA L6-20

*** Customer will need to purchase additional power cord to utilize alternate receptacle
 This list is not exhaustive. It is regularly updated as Metal X system shipments increase.*

METAL X

ENVIRONMENTAL REQUIREMENTS

CLIMATE CONTROL

Room Temperature (Operation)	18.8°C – 29.4°C (66°F – 85°F)
Humidity Requirement (Operation)	0% - 95%, non-condensing
Room Temperature (Idle)	18.8°C – 29.4°C (66°F – 85°F)
Humidity Requirement (Idle)	0% - 95%, non-condensing

VENTILATION REQUIREMENTS

The Metal X melts thermoplastics and emits thermoplastic odors during printing. Ensure the Metal X is used in a well-ventilated area. No dedicated exhaust is required for the printer. Additional measures may be required based on local regulations.

MATERIAL STORAGE

Material spools should be stored upright, such that none of the coils droop over each other. Keep spools under 40 degrees Celsius (104°F) for long-term storage.

Storage space should be free from dust and vapors if stored spools have been removed from original packaging.

Avoid impacts and shock when storing or transporting material.

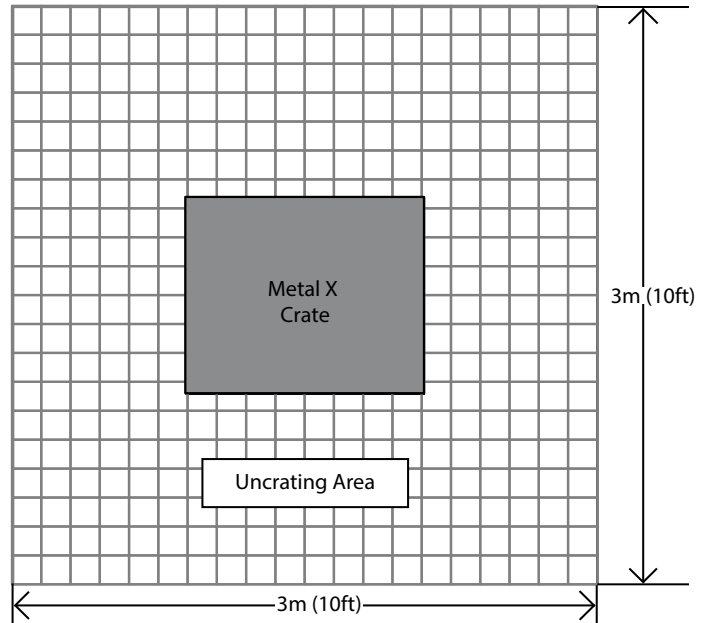
METAL X

INSTALLATION PLANNING

Crate Dimensions	1.02m x 0.53m x 1.12m (23in x 21in x 44in)
Crate Weight	115 kg (130 lbs)
Minimum Door Width to Move in Crate	1.22m (48in) clearance

SHIPPING AND UNLOADING

- Allow for an area of at least 3m x 3m (10ft x 10ft) to uncrate the printer
- Plan on having at least two people to remove the printer from the crate
- An elevator is required for moving the printer between levels
- A dolly or cart that can withstand the printer’s weight should be used to move the printer



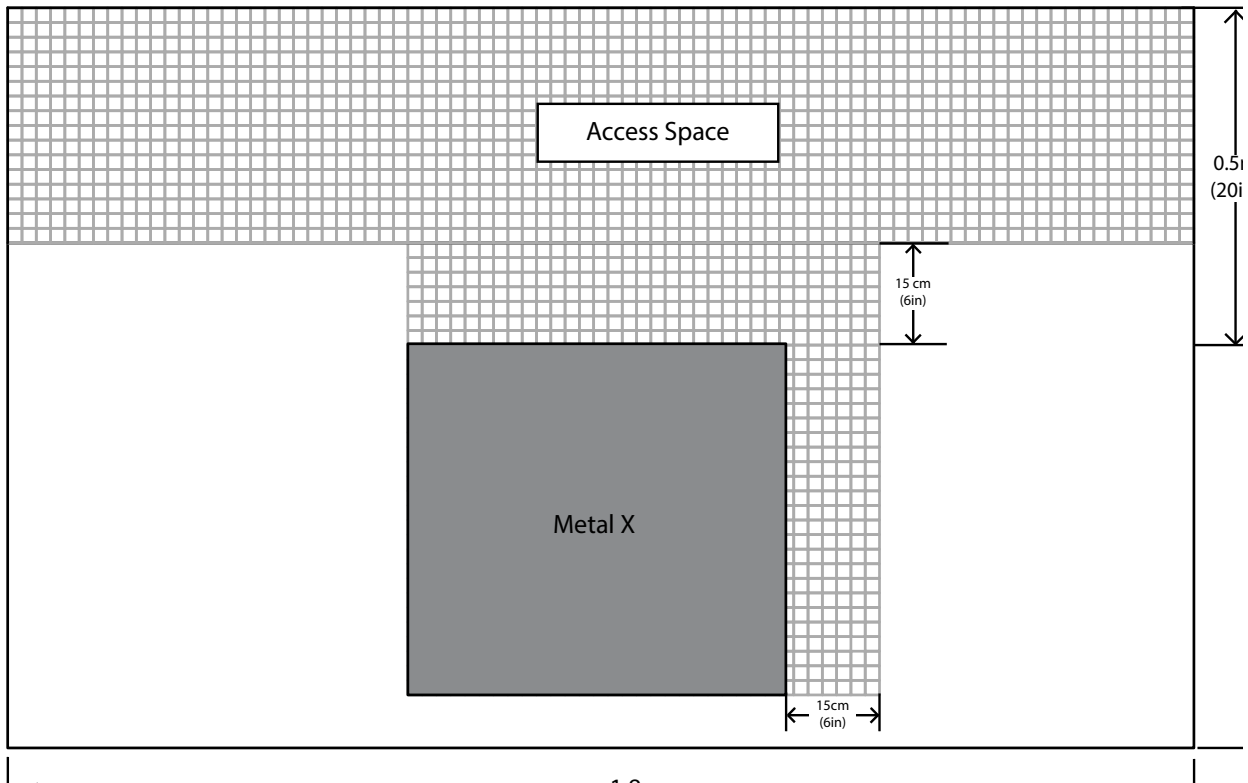
MOVING INFORMATION

Moving the Metal X after installation is not recommended. If you need to move the printer, please ensure all material is unloaded and spools are removed.

Always lift the Metal X from the bottom with at least two people.

METAL X

OPERATIONAL SPACE PLANNING



Ensure the new location of the Metal X meets all facility requirements including electrical and table requirements.

Printer Dimensions	0.58m x 0.53m x 1.12m (23in x 21in x 44in)
Printer Weight	60 kg (130 lbs)
Full Load Weight	75 kg (165 lbs)

ACCESS REQUIREMENTS

Connectivity Access (Wi-Fi, Ethernet)	0.15m (6in) at the back of the printer
USB Access	0.15m (6in) at the right side of the printer
Maintenance Access	0.5m (20in) between wall and back edge of printer table

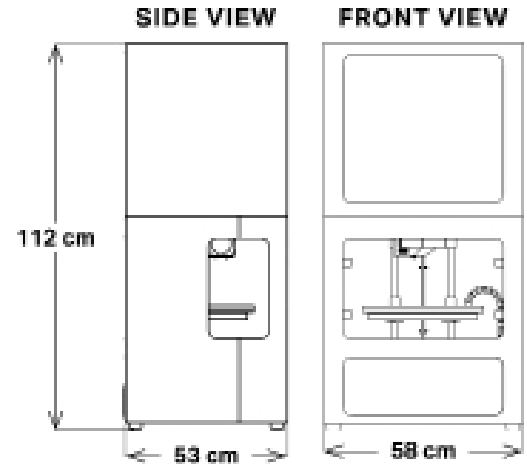
Notes:

- Place printer within 3m (10ft) of a dedicated outlet to ensure the cord will reach

METAL X

TABLE REQUIREMENTS

- Place the printer on a table of 750mm - 900mm (2.5ft – 3ft) in height for best access
- Ensure that the table can support 1.5x the full load weight of the printer
- Place the Metal X on a stable surface and take steps to dampen vibration, as excessive vibration may degrade system performance



ADDITIONAL INFORMATION

MACHINE CLEANING REQUIRED EQUIPMENT

A shop vacuum with a HEPA (high efficiency particulate air) filter is recommended for cleaning metal debris in and around the printer.

WASH-1

ELECTRICAL REQUIREMENTS

Circuit Type	Dedicated branch circuit
Wiring System	Single phase with safety ground
Input Frequency	50 - 60 Hz

VOLTAGE/CURRENT COMBINATIONS

INPUT VOLTAGE	MINIMUM OVERCURRENT PROTECTION RATING
100-120 volts - alternating current	123415234 amperes
100-120 volts - alternating current	123415234 amperes
100-120 volts - alternating current	123415234 amperes
100-120 volts - alternating current	123415234 amperes
100-120 volts - alternating current	123415234 amperes

Please locate the appropriate voltage and current combination for your use case based on availability and local regulations.

RECEPTACLE TYPES

COUNTRY	RECEPTACLE TYPE
USA	NEMA 5-15
Germany	CEE 7/7
UK	BS 1363

*** Customer will need to purchase additional power cord*

WASH-1

ENVIRONMENTAL REQUIREMENTS

CLIMATE CONTROL

Room Temperature (Operation)	18.8°C – 29.4°C (66°F – 85°F)
Humidity Requirement (Operation)	0% - 95%, non-condensing
Room Temperature (Idle)	18.8°C – 29.4°C (66°F – 85°F)
Humidity Requirement (Idle)	0% - 95%, non-condensing

VENTILATION REQUIREMENTS

The Wash-1 requires a minimum of 2.8 m³/min (100 CFM) of facility exhaust provided through a 0.1m (4in) diameter round duct. Only **metal** exhaust tubing is permitted -- plastic or plastic-lined exhaust lines may be compromised by the exhaust vapors.

SOLVENT STORAGE

The Wash-1 uses Opteon SF79 solvent (formerly sold as Opteon Sion).

Opteon SF79 should be stored and handled in accordance with its Safety Data Sheet.

The Wash-1's fluid capacity is 8.5 gallons. In advance of initial system install, you must purchase three 45lb (5 gallon) pails of Opteon SF79 or equivalent, to cover the initial fill of the device with sufficient extra solvent remaining.

WASH-1

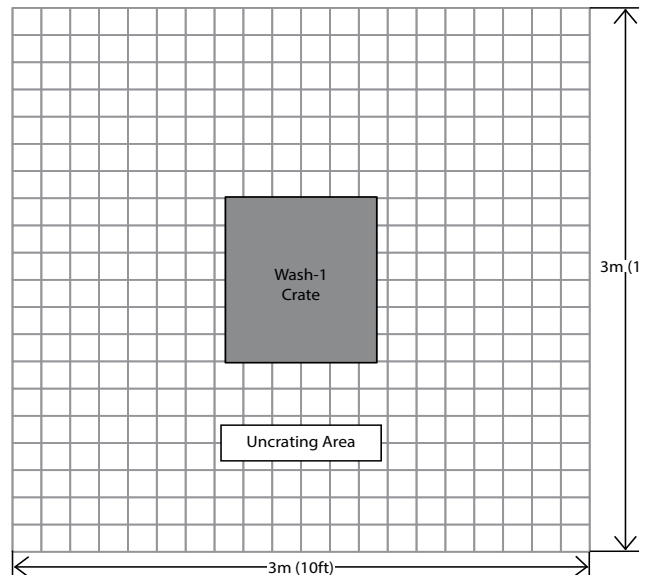
INSTALLATION PLANNING

Crate Dimensions	0.78m x 0.91m x 1.22m (31in x 36in x 48in)
Crate Weight	135 kg (300 lbs)
Minimum Door Width to Move in Crate	0.92m (36in) of clearance

SHIPPING AND UNLOADING

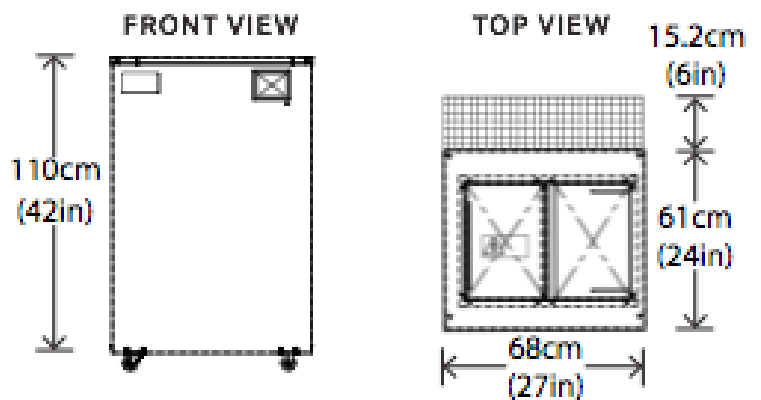
Allow for an area of at least 3m x 3m (10ft x 10ft) of space to uncrate the washer

- Plan on having at least two people remove the washer from the crate
- An elevator is required for moving the washer between levels
- The Wash-1 has integrated wheels which should be used when moving the machine



MOVING INFORMATION

- Transporting the Wash-1 away from its operating location after installation is not recommended. If you need to transport the washer, please remove all parts and drain fluid from the machine. Solvent should be heated before draining.
- Ensure the wheels are unlocked and moving freely before trying to move the Wash-1. Do not lift or carry the Wash-1 to a new location.
- Always lock wheels when the Wash-1 is not in transit.
- Ensure the new location of the Wash-1 meets all facility requirements including electrical and ventilation requirements.



WASH-1

OPERATIONAL SPACE PLANNING

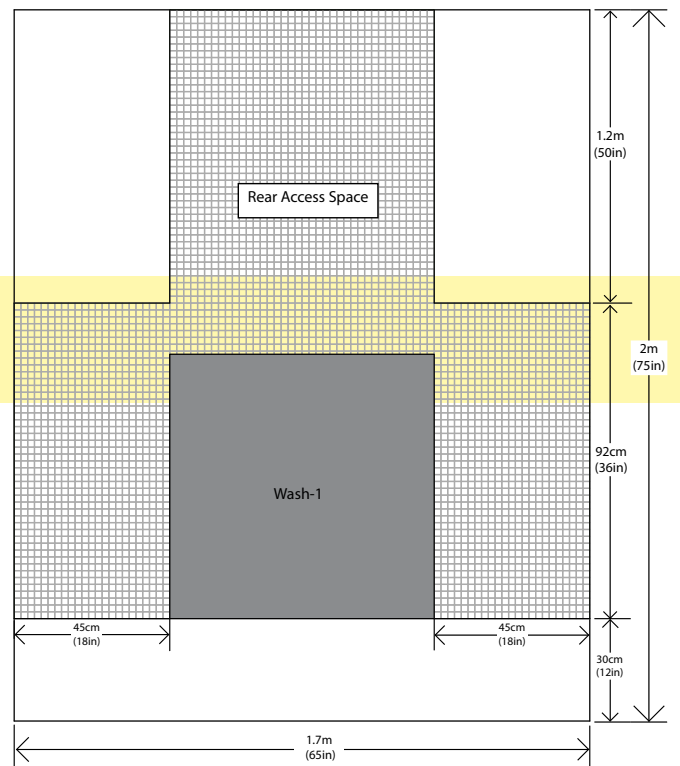
Washer Dimensions	0.68m x 0.61m x 1.10m (27in x 24in x 42in)
Washer Weight	135 kg (300 lbs)
Full Load Weight	180 kg (400 lbs)

- The washer should sit directly on the floor
- Floor surface should be flat, stable, and capable of supporting the fully loaded weight of the washer

ACCESS REQUIREMENTS

Operational Access	0.45m (18in) at both right and left sides of the washer 0.61m (24in) behind and above the washer
Maintenance Access	1m (36in) at the back of the washer

- Place washer within 2m (6.5ft) of dedicated outlet to ensure the cord will reach
- Place washer in a space that has a height clearance of at least 1m (3ft) above the top of the unit to ensure room to remove and replace the basket
- Access requirements may vary from region to region; consult your local regulatory body for further information



WASH-1

ADDITIONAL INFORMATION

LOCAL SOLVENT REGULATIONS

Consult local regulations to determine if Opteon SF79 is allowed in your region. For questions about SF79 substitutes, contact your Reseller. Always dispose of spent solvent in accordance with local regulations.

MACHINE CLEANING REQUIRED EQUIPMENT

A catch container of adequate size and chemical resistance to Opteon SF79 is required to aid in the process of removing spent solvent.

ADDITIONAL EQUIPMENT NEEDED

- 0.01g resolution scale
- Drum wrench (for opening Opteon SF79)
- 4in ducting (to attach Wash-1 to facility exhaust)

SINTER-1

ELECTRICAL SPECIFICATIONS

Circuit Type	Dedicated Branch Circuit
Frequency	50 - 60Hz
Wiring System	Single phase with protective bonding
Conductor Type	Copper conductors only
Phase Conductor Range	6AWG - 2AWG (13.3 - 33.6mm ²)
Equipment Ground Conductor Range	10AWG - 4AWG (5.26 - 21.1mm ²)
Conduit Size Accepted	(1) ¾in (19.1mm) Trade Size conduit entry provided; can be field punched to 1in (25.4mm) Trade Size if necessary
Install Type	Hardwire (no wire included); permanent installation methods

IMPORTANT NOTE: The Sinter-1 places an unbalanced electrical load on a 3-phase power distribution system. Carefully review the system requirements in the Sinter-1 Electrical Specifications table.

VOLTAGE/CURRENT COMBINATIONS

INPUT VOLTAGE	OVERCURRENT RATING
13241234 volts	12341 amperes
1234124 volts	12341 amperes
1234123 volts	12341 amperes
1234123 volts	12341 amperes
123412 volts	12341 amperes
1234123412 volts	12341 amperes

Please locate the appropriate voltage and current combination for your use case based on availability and local regulations.

SINTER-1

ENVIRONMENTAL REQUIREMENTS

CLIMATE CONTROL

Room Temperature (Operation)	18.8°C – 29.4°C (66°F – 85°F)
Humidity Requirement (Operation)	0% - 95%, non-condensing
Room Temperature (Idle)	18.8°C – 29.4°C (66°F – 85°F)
Humidity Requirement (Idle)	0% - 95%, non-condensing
Heat Transferred to Environment	4kW (13,600 BTU/hr) Peak Output

VENTILATION REQUIREMENTS

The Sinter-1 requires a minimum of 2.8 m³/min (100 CFM) of facility exhaust provided through a 100mm (4in) or 150mm (6in) diameter round duct. Facility exhaust should terminate within 610mm (24in) of furnace footprint. Only **metal** exhaust tubing is permitted; plastic or plastic-lined exhaust lines may be compromised by the exhaust vapors.

SINTER-1

CONSUMABLES STORAGE

Store all consumables for the Sinter-1 in a cool, dry place and leave them in their original packaging.

SUPPLY GASES

- A wall-mounted rack with capacity for three or more cylinders should be installed at an appropriate height in accordance with local regulations and in specific alignment below the gas supply panel, as shown in the figure on page 20, with adjacent space allocated for dewar
- Store and handle unused gas cylinders and dewars according to safe and proper handling guidelines and in compliance with proper training and local regulations
- Condensation on the argon dewar can lead to wet floors under and around the dewar which should be treated with caution

GAS SUPPLY REQUIREMENTS (17-4PH STAINLESS STEEL)

CYLINDER REQUIREMENTS

- Two 300ft³ (50L) cylinders of ultra-high purity (UHP, grade 5, or 99.999% pure) mix gas: **2.9% hydrogen/ 97.1% argon nominal, acceptable blend tolerance up to +/-10%, +/-5% preferred**
- One 300ft³ (50L) cylinder of UHP argon
- One medium- or high-pressure (MP or HP) dewar of UHP liquid argon (LAR) with integrated wheels; 230L size recommended

REQUIRED FITTINGS

- Mix gas cylinder connections as delivered from your supplier should be CGA 350
- Argon cylinder and dewar connections as delivered from your supplier should be CGA 580

SINTER-1

CYLINDER CONNECTIONS BY REGION

Country	Connection Standard	Inert Cylinder Connection	Inert Dewar Connection	Mix Cylinder Connection
USA	CGA	CGA 580	CGA 580	CGA 350
UK	BS 341	No. 3	No. 3	No. 4
Germany	DIN 477	No. 6	No. 6	No. 1
Italy	UNI	4412	4412	4405
Japan	JIS B 8246	22/23-R	22/23-R	22-L
Canada	CGA	CGA 580	CGA 580	CGA 350
Other countries	<i>No cylinder connections provided by Markforged; consult local supplier 1/4" male NPT fitting; 3000psi rated minimum; integral check valve not required if supplied check valve is used</i>			

IMPORTANT NOTE: The Sinter-1 places an unbalanced electrical load on a 3-phase power distribution system. Carefully review the system requirements in the Sinter-1 Electrical Specifications table

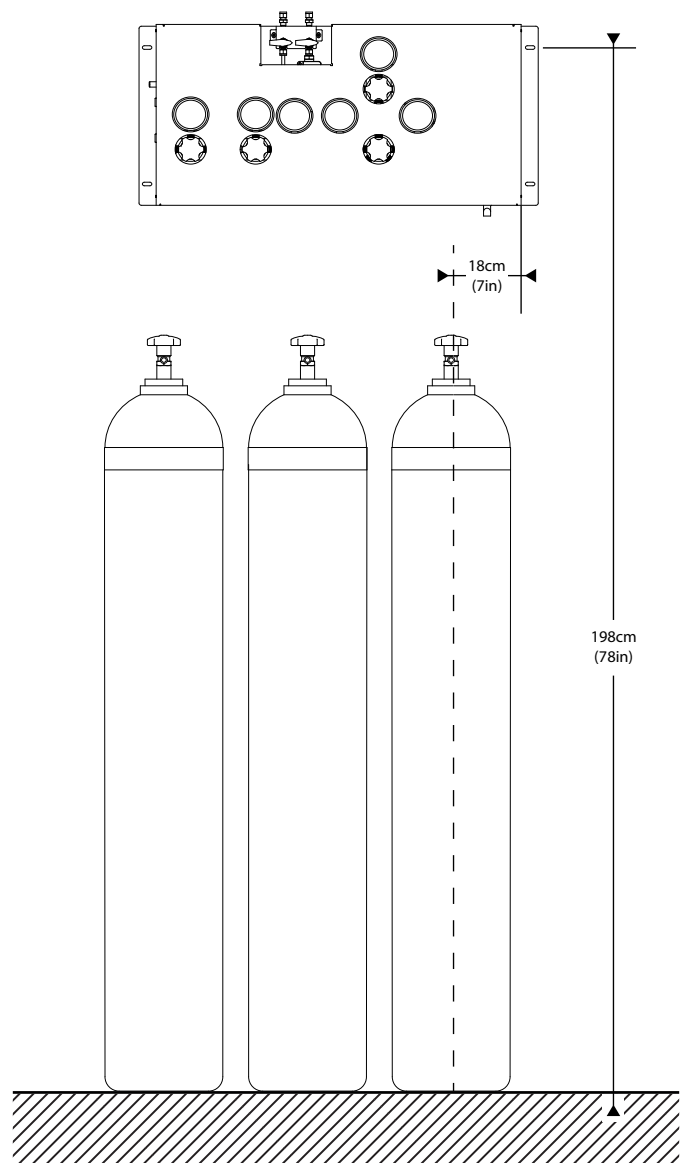
SINTER-1

GAS SUPPLY PANEL MOUNTING REQUIREMENTS

Panel Installation Height	Top mounting holes 1.98m (78in) from floor
Panel Dimensions	900mm (35in) wide, 400mm (15in) tall
Dewar + Cylinder footprint	1.40m (55in) wide 700mm (27in) deep at dewar, 300mm (12in) deep at cylinders
Operational Access	1m (39in) frontal cylinder access for typical access. 800mm (31in) wide passage for dewar transit

NOTES:

- The Gas Supply Panel will be hung on a provided mounting cleat, then secured to the wall according to a provided 4-hole rectangular bolt pattern
- Gas Supply Panel should be placed within 3.6m (12ft) horizontal travel of the furnace, as measured between the nearest edges of the two devices
- The Gas Supply Panel is heavy and should be lifted and installed onto the mounting cleat by at least two people



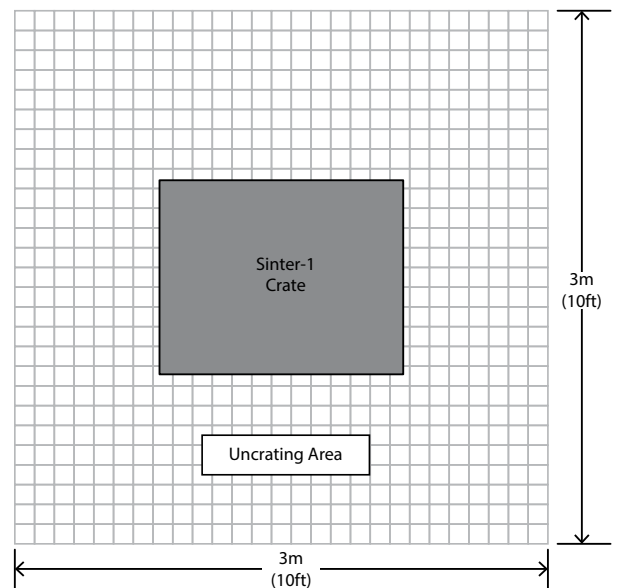
SINTER-1

INSTALLATION PLANNING

SHIPPING AND UNLOADING

Crate Dimensions	1.32m x 1.10m x 1.50m (54in x 43in x 58in)
Crate Weight	225kg (500 lbs)
Minimum Door Width to Move in Crate	1.52m (60in) Clearance

- Allow for an area of at least 3m x 3m x 1.5m (10ft x 10ft x 5ft) to uncrate the furnace
- Plan on having at least four people to remove the furnace from the crate
- An elevator is required for moving the furnace between levels
- A dolly or cart that can withstand the furnace’s weight should be used to move the furnace



MOVING INFORMATION

Moving the Sinter-1 after installation is not recommended as the insulation is fragile after initial use. If you need to move the furnace after bakeout, please contact your Reseller for assistance.

To place Sinter-1 on a table, lift the unit from the bottom with at least four people. Do not attempt to manually carry Sinter-1 over a distance.

Alternatively, a forklift with straps can be used to move the unboxed Sinter-1 to a new location. Lifting of the Sinter-1 via forklift should be done with two straps according to the following criteria:

- Straps should pass under the furnace, front to back
- The centerline of each strap should be 175mm from each end of the furnace
- The straps must be a minimum of 1.8m (6ft) long, though 2.4m (8ft) straps are recommended
- The use of corner protection to avoid abrasion damage is encouraged

SINTER-1

Sinter-1 is not intended to be lifted directly from below via forklift as there is insufficient clearance under the unit.

Be sure any doors have a clearance of 900mm (36in) to allow clearance when moving Sinter-1 after uncrating.

Ensure the new location of the Sinter-1 meets all facility requirements including electrical and table requirements.

OPERATIONAL SPACE PLANNING

Furnace Dimensions	1.27m x 510mm x 610mm (50in x 20in x 24in)
Furnace Weight	90 kg (200 lbs)
Full Load Weight	115 kg (250 lbs)

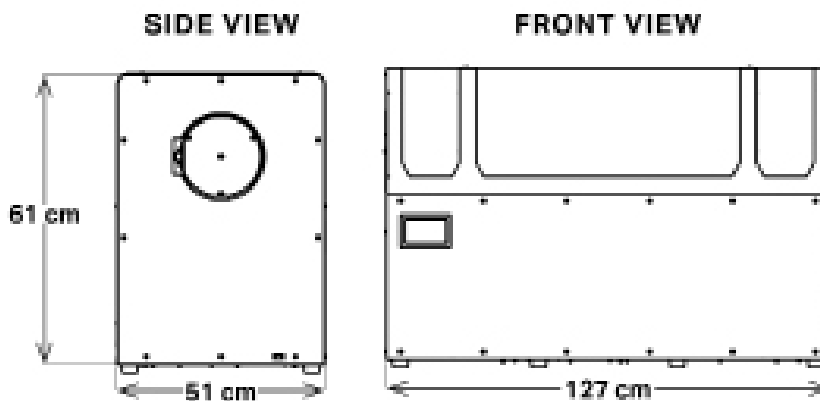


TABLE REQUIREMENTS

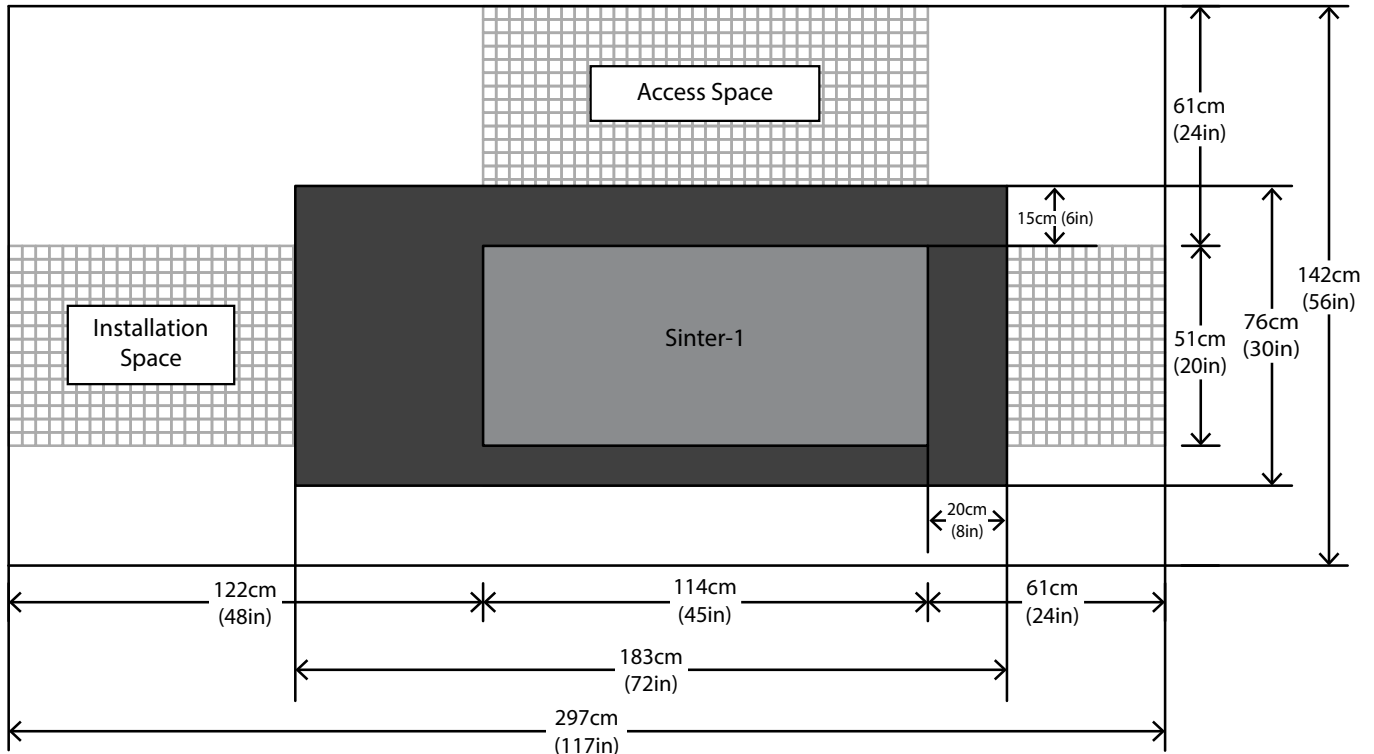
- Non-flammable, non-melting work surface
- Place the furnace on a table 860mm - 910mm (34 - 36in.) in height for best access
- Ensure the table can support 1.5x the full load weight of the furnace
- The recommended work surface is a 1.82m x 762mm (72in x 30in) steel-topped table or equivalent
- If the furnace is placed on a table that is less than 1.82m (72in) in length, an additional stand or small table of similar height to the main table will be required to aid in tube installation

SINTER-1

ACCESS REQUIREMENTS

Connectivity Access (Wi-Fi, Ethernet)	150mm (6in) of clearance at rear of furnace
USB Access	150mm (6in) at rear of the furnace 150mm (6in) on left side of the furnace
Overhead Clearance	No flammable materials within 920mm (36in)
Operational Access	300mm (12in) on all sides
Maintenance Access	610mm (24in) between wall and back edge of furnace 610mm (24in) on the right and left sides of the furnace for normal maintenance 1.22m (48in) on the left side and 610mm (24in) on the right side of the furnace for tube installation

● Access requirements may vary from region to region; consult your local regulatory body for further information



SINTER-1

EMERGENCY PLANNING

Emergencies with the Sinter-1 are unlikely but it is recommended that facilities consider the following as a precaution.

FIRE EXTINGUISHERS

It is recommended that facilities have a multipurpose fire extinguisher near Sinter-1.

If a facility evaluation shows insufficient room volume and/or ventilation for safe gas cylinder and dewar storage, oxygen monitoring equipment should be installed in compliance with local regulations for alert and evacuation levels.

EMERGENCY EXITS AND EVACUATION PLAN

Anyone operating or working near the Sinter-1 should be aware of all emergency exits and should be familiar with escape routes in the unlikely event that an evacuation is necessary.