

## FACILITY CONSIDERATIONS

PANDA™ is designed to minimize facility requirements to the extent possible. However, any operations with metal powders require planning and safety considerations. This information is provided to aid in facility planning, and not intended as directive. While the Open Additive team is happy to provide this informational background, **users are responsible for effective and safe operations in their facility and should always consult direct sources and their own safety office for review of site needs.** At delivery, if system cannot be installed or training conducted due to failure to meet basic facility requirements, any additional expenses incurred may be charged to customers on final invoice. Open Additive offers personnel and facility safety bundles as ancillary equipment to make it easy to get started in metal AM.

## SYSTEM SIZE AND WEIGHT

The PANDA measures approximately 76 W x 29 D x 80 H inches (1.9 x 0.7 x 2.0 m), weighing approximately 1000-1300 lb (450-600 kg) depending on configuration. A loading dock is recommended (not required) for delivery, with transit areas accessible to hand or mechanized pallet jack. The system is designed so that it can fit through a standard single doorway (32 x 80 in) at final destination.

## WORK AREA

A 10 x 10 ft (3 x 3 m) unobstructed work area is recommended for PANDA operations. At least 18 inches (0.5 m) separation from walls is necessary. Figure 1 shows a system installed at Open Additive's facility.

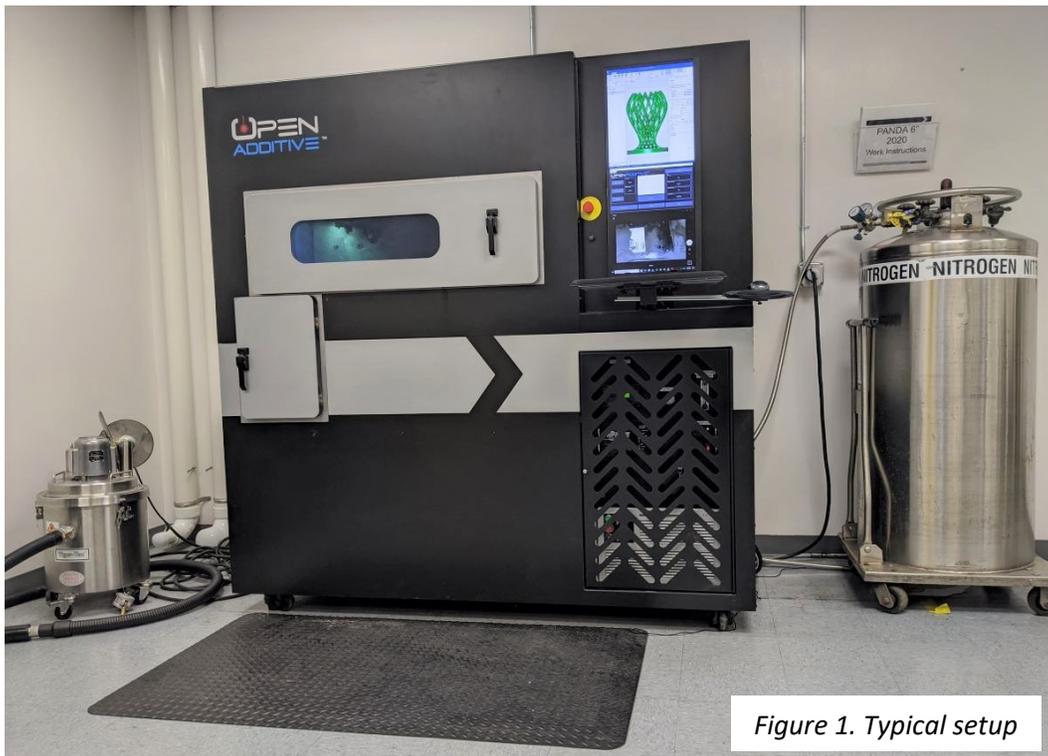


Figure 1. Typical setup

## FLOORING

In general, no special flooring modifications are necessary, other than use on tile or concrete base flooring. Conductive flooring is recommended for use with reactive powders, but an anti-static ESD mat may be used as a suitable replacement (as shown in Figure 1).

## ELECTRICAL

The system requires one 200-240V/20A single-phase circuit for the 500 W laser. If a 1000 W laser is used (includes external chiller) or a second laser added, an additional 200-240V/20A circuit is required. The system also requires a 110-120V/15A circuit for the onboard power conditioner which powers the rest of the workstation. Access to a nearby 110-120V circuit is recommended for portable vacuum use.

## SHIELDING GAS

For operations, PANDA requires argon or nitrogen gas through bottles, Dewar, or central supply for use as a shielding gas. Dewar or central gas supply are recommended (if using bottles, automatic tank switch-over mechanism is recommended for uninterrupted operation over long builds). Shielding gas supplies are purchased separately, typically through an industrial gas supplier. Connection to the system is made through a ½-inch push-to-connect hose, but other fittings can be used as needed. Shielding gas must be ready on site at time of installation for proper system checkout and user training. Note that use of nitrogen gas, while less expensive, is not suitable for all materials, such as many reactive powders.

## VENTILATION

Since system operations involve the use of shielding gas, there is an asphyxiation hazard. In general, use in a well-ventilated area is sufficient. If required or desired, the exhaust port may be vented to the outdoors – no special filter is needed as the port includes a HEPA filter to capture any powder or debris particles. However, such external ventilation does not protect against a supply leak or system purging when the door is opened. As such, proper room ventilation is preferred over direct system venting measures. Users should consider use of a room oxygen sensor/alarm for use in confined spaces.

## ENVIRONMENTAL CONTROL

Normal indoor environmental controls (air conditioning, central heating) to maintain room temperature conditions are generally adequate. Separate temperature and humidity control measures may be desired for use in confined spaces or for applications requiring very high process control, as high temperature and humidity may affect powder quality.

## POWDER HANDLING

Metal powders require proper storage, handling, and disposal in accordance with Safety Data Sheets and OSHA/NFPA guidelines. Only an explosion-proof vacuum rated for metal dust should be used for

cleaning up any spilled metal powders or cleaning out the system. Reactive powders should be kept in flammable storage cabinets. Any recycling/sieving of reactive powders should always be conducted inside a contained chamber filled with inert shielding gas, with anti-static ESD mat or flooring. Items contaminated with powders should be bagged/marked and disposed of in hazardous waste containers, and passivated with sand or similar if necessary (e.g., used filters).

## FIRE SAFETY

A Type D extinguisher is required to be on hand in case of metal powder fires (never use a Type A/B/C extinguisher on a metal dust or condensate fire). A Type A/B/C extinguisher should also be on hand for general needs (non-metal fires). A facility sprinkler system is not required or recommended. If in place, PANDA can still be used, but there is risk of equipment damage if sprinklers were to activate.

## LASER SAFETY

PANDA is designed with laser safe window and safety interlocks such that the system will not fire the laser if a door is ajar. With the sheet metal panels in place, the system conforms to operation as a “Class 1” device per ANSI Z136.1-2014 Safe Use of Lasers. As such, laser safety glasses or other protective measures are not required. The system should not be operated with panels off or interlocks bypassed.

## PERSONNEL SAFETY

It is recommended that operators use lab safety glasses (ANSI Z87.1), nitrile gloves (or equivalent), powered air purifying respirator (full or half mask), anti-static lab coat, and antistatic shoe covers or conductive soles when system is open for build setup, build removal, cleaning, maintenance, or other actions creating possibility for direct exposure to metal powders. Items contaminated with powders should be disposed as hazardous waste. As a general rule of thumb, 10-ft (3-m) clearance from the system is an adequate safe distance for personnel not wearing PPE when the system is open.

## RECOMMENDED RESOURCES

- Powder Safety Awareness for Additive Manufacturing, Sandia National Labs, SAND2014-19158PE, <https://www.osti.gov/servlets/purl/1242062>
- NFPA 484 Standard for Combustible Metals, National Fire Protection Association, <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=484>
- UL 3400 Outline of Investigation for Additive Manufacturing Facility Safety Management, UL LLC, [https://standardscatalog.ul.com/standards/en/outline\\_3400\\_1](https://standardscatalog.ul.com/standards/en/outline_3400_1)
- Lessons Learned in Establishing the NIST Metal Additive Manufacturing Laboratory, NIST Technical Note 1801, <https://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.1801.pdf>
- ANSI Z136.1-2014 Safe Use of Lasers, Laser Institute of America, <https://www.lia.org/store/product/ansi-z1361-2014-safe-use-lasers-electronic-version>