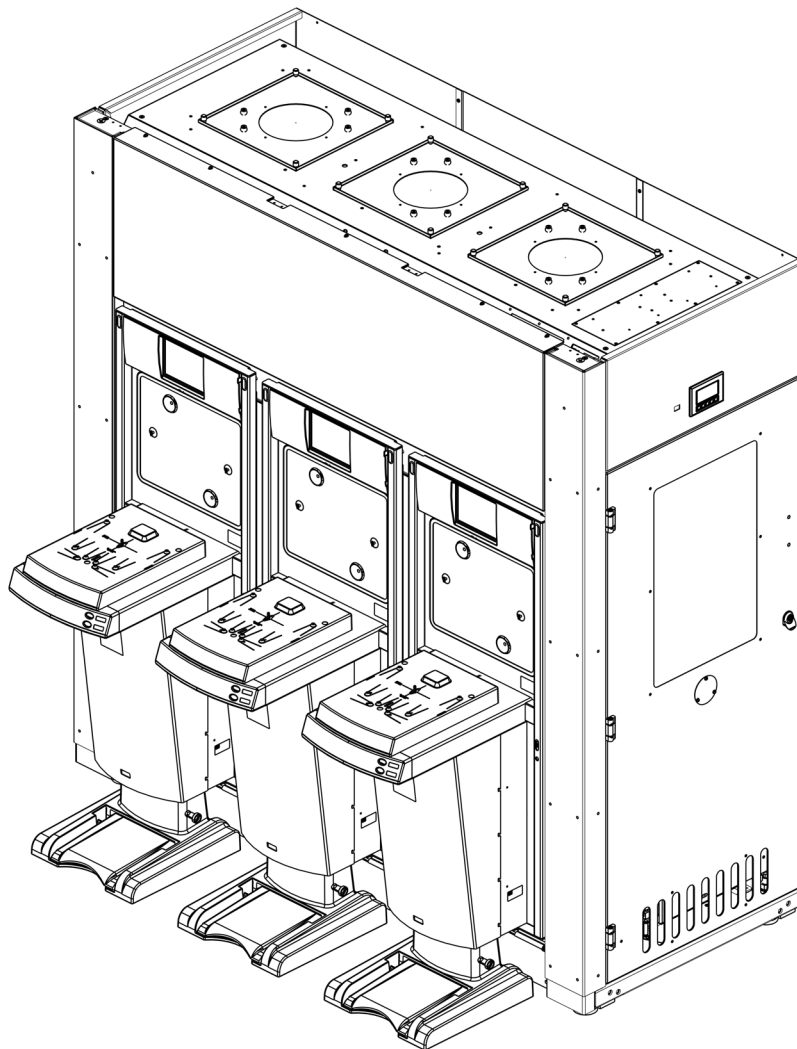




JET™ Common Platform (JCP) User Manual



219854 Revision A

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1

Introduction

The Jet system is intended for use by industrial customers and should be serviced only by Brooks or Brooks trained representatives. The service manuals and related materials are provided in English at no charge and are intended for use by experienced technicians. It is the responsibility of the user to obtain and assure the accuracy of any needed translations of manuals. If you require assistance please contact Brooks service department. Contact information can be found at www.brooks.com.

Jet System Overview

The Brooks Automation Jet™ system is an Equipment Front End Module or EFEM. It is the link between the factory's Material Transport System and the Process Tool.

The Jet system, shown in [Figure 1-1](#), is a SEMI-standard compatible interface system designed for manual, AGV, PGV, or OHV automated loading of carriers that contain wafers or other material waiting for horizontal transfer. It is a self contained and fully integrated atmospheric transfer system with robot, aligner, load ports, and controls mounted on an integral frame.

The mini-environment supports the robot, track, aligner, load ports, electronics, and Fan/Filter Unit, provides a single connection point for all facilities, and provides interface locations for the users process equipment. Quick and easy kinematic installation and replacement of all Brooks material handling modules keep service and reteaching time to a minimum. It uses a unique integrated control system that provides a single wire interface to factory controls, adequate delivery clearance for factory interface, and easy access by service personnel.

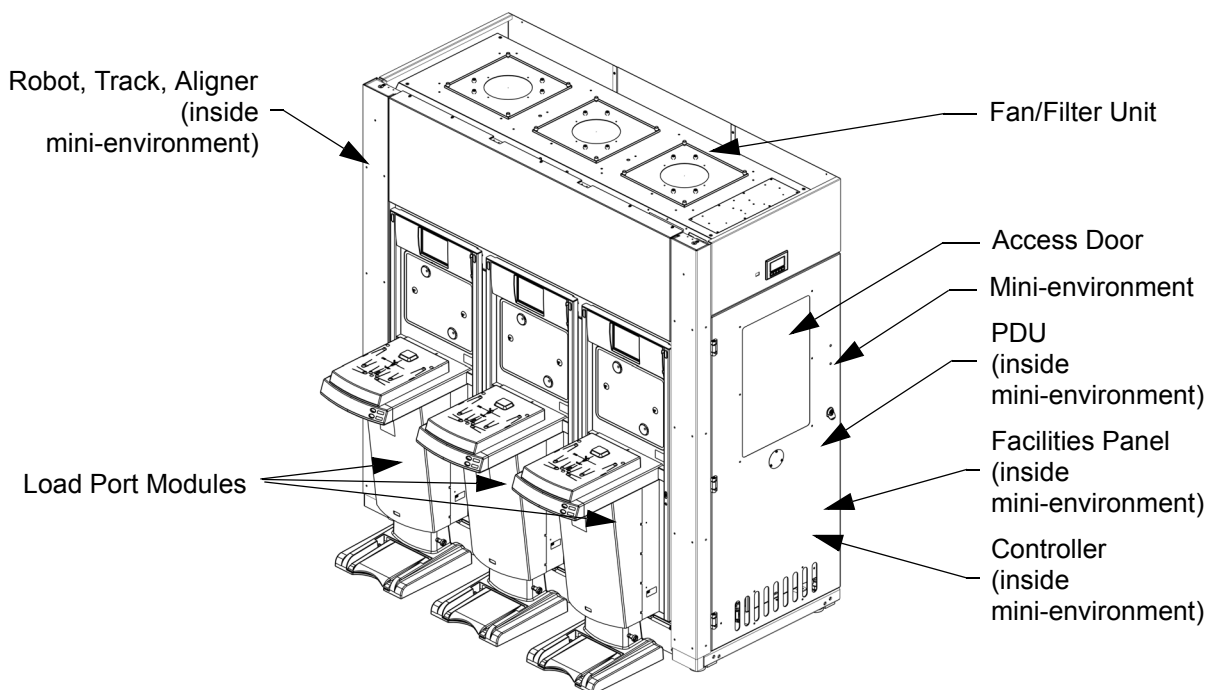


Figure 1-1: Jet System

Features

- Mini-environment with side doors and view ports for easy access and observation
- Fan/Filter Unit with covers integrated with the mini-environment
- Atmospheric Transfer Robot - (ATR)
- Atmospheric Track - (ATK)
- Atmospheric Wafer Aligner - (AWA)
- Semi Standard BOLTS Interface, 2, 3 position
- Internal Lighting (White is standard, Amber is optional)
- Internal Power Distribution Unit
- Quick facilities disconnect
- Two air test ports per I300I

Options

- EMO button for user defined and supplied Emergency Off circuit
- Teach Pendant
- Light Tower
- Operator Interface (swing-out arm or wing panel)
- Ionizer
- OCR (Optical Character Reader)
- Operator OHT Protection (Light curtain or protection bar)
- SEMI E84 interface for Load Ports
- Front air intake
- Wafer Mapping on Load Ports or Robot
- Two 19" racks above the FFU for user electronics (one rack on Jet 2 systems)
- Kinematic Coupling Pins

Subsystems

The Jet system is made up of several functional subsystems designed for ease of use, maintenance, and repair. These subsystems are modular in design to allow ease of maintenance and to minimize Mean Time To Repair (MTTR). The individual modules that make up the Atmospheric Transfer System are described briefly below and in detail in [Chapter 6: Operation](#).

The Jet system may use either the Razor, Reliance or Wafer Engine families of Automation components. For illustration purposes, the components shown here are the Razor Robot, Razor Track, Razor Wafer Aligner, and Fusion controller. When using this manual, always refer to the appropriate documentation for the specific components used on your system.

Atmospheric Transfer Robot - ATR

The ATR provides all material transport functions within the Jet system, which includes moving material from the Load Port Modules mounted on the front of the mini-environment to the aligner and the process stations. The ATR is a direct drive, continuous rotation material handler. This robot provides up to five axes of motion, allowing off-center pick and place and fast swap. For more information, refer to the robot manual.

Atmospheric Track - ATK

Within certain configurations of the Jet system, the robot is mounted on an ATK which moves the robot horizontally within the mini-environment, providing the robot access to all LPMs or process stations. The ATK is an atmospheric horizontal track that permits the robot mounted on it to access material carriers, process modules, and cluster tool load locks within its range of motion. For more information, refer to the track manual.

Atmospheric Wafer Aligner - AWA

The AWA provides centering and positioning of material passing through the Jet system before being transferred to the process stations. The AWA is an atmospheric pre-aligner used to align material in conjunction with the robot. Different configurations of the aligner provide aligning of 450 mm wafers, 300 mm wafers, 200 mm wafers, and rotating of reticles. The aligner provides edge contact or backside vacuum grip support of the material during alignment and is capable of aligning wafers with a notch type fiducial. For more information, refer to the aligner manual.

Load Port Module - LPM

The standard Load Port is Vision, but other 300mm BOLTS compatible load ports can be installed. The system may be configured with up to 3 Semi Standard BOLTS LPM interfaces designed for manual or automated loading of substrate carriers. Once the carriers are loaded and opened, the wafers (or other material) within the carriers are available for horizontal transfer. For more information, refer to the load port manual.

Fan/Filter Unit - FFU

FFU provides airflow and filtering to maintain an ISO Class 1 or better material handling environment. The FFU is optimized to work with the Brooks Automation Jet system.

Facilities Panel

The Facilities Panel provides a central location for all facilities, communications, and control connections to the Jet system. The Facilities Panel is mounted inside the EFEM on the rear of the system next to the Power Distribution Unit.

Power Distribution Unit - PDU

The PDU provides a central location for connection of power coming into the Jet system and for distribution of power within the Jet. The PDU is mounted inside the EFEM at the rear of the system.

Internal Lighting

LED light tubes provide internal lighting of the EFEM for system observation. Optional Amber lighting is available for lithography applications.

EFEM Safety Hub

The ESH (EFEM Safety Hub) is a central interface where multiple components may be interlocked together for the purpose of human and machine safety. The ESH utilizes proprietary safety logic to monitor the status of multiple automation components and interlock them together.

E-Stop Button - ESTOP

An Emergency Stop button is supplied to provide category 1 stop of the automation systems through the Safety Hub. Location of the button is determined by the location of user selected options.

Options

Options are available for the Jet system that increase its functionality. All options are available at the time of purchase for installation and configuration by Brooks Automation. Note that some of these options are only available as factory installed options.

Emergency Off Button - EMO

An optional SEMI compliant button marked with "EMO" is supplied to provide user-configured Emergency Off capability for the Jet system and the equipment to which it is connected. Location of this button is determined by the location of user selected options. Brooks does not supply EMO functionality for the JET. Brooks supplies only the button and associated cable to the facilities panel.

Mini-environment Options

Ionizer

An ionization system is available to help eliminate electrostatic discharge (ESD) and particle contamination caused by electrostatic attraction within the EFEM. The ionization system provides compliance to SEMI E-78.

OCR

Brackets are available for installing Optical Character Recognition (OCR) devices at the aligner. These brackets allow user supplied cameras to be positioned to read information on the top and bottom of wafers being transported through the Jet system. Check with Brooks Automation sales for availability of OCR for the particular aligner and wafer size requirement.

Light Curtain

A Light Curtain is available to provide additional operator and product safety when using an Over Head Transport (OHT) system to transfer material carriers to and from the Load Port Modules.

Protection Bar

A mechanical protection bar is available to provide additional operator and product safety when using an Over Head Transport system.

SEMI E84 Interface

A SEMI E84 IR transponder Interface is available to provide SEMI E84 communications between the Load Port Modules on the Jet system and AGV, RGV, or OHT systems for the automated handoff of material carriers.

Front Air Intake

A Front Air Intake is available for the FFU mounted on the Jet system. This allows the system to draw air from the cleanroom side when it is mounted in a wall.

Wafer Mapping

Mapping of the wafers in the carriers on the Load Port Modules is available as either an option for the LPM or an option for the robot.

Equipment Racks

Two 9U 19-inch equipment racks can be located above the FFU. These racks may be used for any user electronics. Note that only one rack is available on 2 Bay systems due to space restrictions. An IEC320 power strip is supplied for convenience. The maximum load on the power strip is 2A.

User Interface Options

Teach Pendant

A Teach Pendant is available to provide a general maintenance interface for the robot. It is used for position teaching and other functions, including component testing and calibration. For certain robots, a hand held enabling device is available.

Light Tower

A light tower is available to provide instant visual and audio status of the Jet system or any user defined events. Location of the light tower is determined by the location of user selected options. The light tower may be controlled through the robot interface or directly by the host via Ethernet.

Operator Interface

An Operator Interface with LCD display and keyboard is available to provide local control of the connected host computer. The Operator Interface is available as a swing-out arm or a wing panel.

Operation

The following sequence demonstrates the normal material transfer operation of the Jet system:

1. A wafer carrier is placed on one of the LPMs.
2. The LPM is opened and the wafers in the carrier are mapped.
3. The carrier map information is communicated to the TMC.
4. The robot picks a wafer from the LPM.
5. The robot places the wafer on the aligner.

6. The aligner orients the fiducial of the wafer, measures the eccentricity if required, and communicates the wafer position to the TMC.
7. The TMC instructs the robot to pick up the wafer from the aligner. An OFFSET PICK may be used to center the wafer on the end effector if necessary.
8. The robot places the centered and oriented wafer into the Load Lock or onto the stage of the process tool.
9. After processing, the robot removes the wafer from the process tool.
10. The robot places the processed wafer into the carrier on the LPM.
11. Wafer transfer continues until all wafers in the carrier on the LPM are processed.

Basic Configuration

The Basic Configuration of the Jet system is determined by the number of Load Port Modules (LPM) accommodated.

Table 1-1: Basic Configuration Matrix

	2-Bay	3-Bay
Load Port	2	3
Robot, 3/4/5 axis	1	1
Track	0	1010 mm*
Aligner	0-1	0-2
Robot Controller	1	1

* Some system configurations in a 3-Bay Jet EFEM may not require a Track.

Using this Manual

This manual provides documentation for operation and maintenance of the Brooks Automation Jet system. Although this document covers specific information and adjustments for the Jet system, there may be information in other manuals which affects the settings or operating mode of the system and the attached components.

The Jet system is set to system specifications and acceptance tested at Brooks Automation. Before adjusting or changing settings on a Jet system, consult the following documentation:

Load Port Module Manual
Atmospheric Transfer Robot User Manual
Traverser User Manual
Atmospheric Aligner User Manual
Controller User Manuals
Brooks Automation Jet System Wiring Diagrams
OEM Component Manuals (supplied with this manual)
Process Tool User Manual
Process Tool Controller User Manual
Process Tool Wiring Diagrams

NOTE: *All documents must be the latest revision.*

This manual is intended to provide information about a wide variety of Jet system configurations and options. It may contain references to items not installed on a specific system.

The commands for controlling the robot and other components used in the Jet system are defined in the Controller User Manual. The *Jet System User Manual* may refer the reader to this or other manuals for additional information.

This manual contains, as addendums and attachments, customized documents for a specific build of the Jet system. These documents are provided to allow service personnel to identify specific parts within the system and aid in maintenance and troubleshooting.

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2

Safety

For illustration purposes, the components shown here are the Razor Robot, Razor Track, Razor Wafer Aligner, and Fusion controller. When using this manual, always refer to the appropriate documentation for the specific components used on your system.

	 WARNING
 	Failure to review the Safety chapter and follow the safety warnings can result in death or serious injury. • All personnel involved with the operation or maintenance of this product must read and understand the information in this safety chapter. • Follow all applicable safety codes of the facility as well as national and international safety codes. • Know the facility safety procedures, location of safety equipment, and contact information. • Read and understand each procedure before performing it. • Only qualified personnel should perform the procedures

If safety-related upgrades or newly identified hazards associated with the Jet system are identified, the Brooks Automation Technical Support group will notify the owner of record with a Technical Support Bulletin (TSB).

Regulatory Compliance and Declaration of Incorporation (DOI)

The Product meets the requirements of the European Union's Machinery Directive 2006/42/EC as a partially completed machine. In accordance with the Directive, Brooks Automation has issued a Declaration of Incorporation and the Product does not have a CE mark affixed.

The Product meets the applicable requirements of SEMI Guidelines. In addition to this section, other sections may include regulatory information.

	Declaration of Incorporation of Partly Completed Machinery According to EU Directive 2006/42/EC Annex II 1. B.	Document #: XXXXX Rev.: X
---	--	---

Description JET EFEM
Part Number: (part number)
Serial Number:

SAMPLE

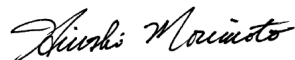
Business name and full address of the manufacturer of the partly completed machinery:
Brooks Automation Inc., 15 Elizabeth Drive, Chelmsford, MA, USA 01824

Name and address of the person, established in the Community, authorized to compile the relevant technical documentation:
Brooks Automation (Germany) GmbH, Göschwitzer Straße 25, 07745 Jena, Germany

The manufacturer declares:

- That the following Annex I essential health and safety requirements of Directive 2006/42/EC are applied and fulfilled and that the relevant technical documentation is compiled in accordance with part B of Annex VII and assembly instructions in accordance with Annex VI are provided:
1.1.2, 1.1.3, 1.1.5, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.3.9, 1.4.1, 1.5.1, 1.5.2, 1.5.3, 1.5.4, 1.5.6, 1.5.8, 1.5.9, 1.5.11, 1.6.1, 1.6.2, 1.6.3, 1.6.4, 1.7.1, 1.7.2, 1.7.3
- That the safety objectives set out in directive 2006/95/EC (LVD) have been applied to this partly completed machinery.
- That this partly completed machinery conforms with the provisions of directive 2004/108/EC (EMC).
- We will transmit, in response to a reasoned request by a national authority, relevant information on the partly completed machinery, on paper or in electronic form, without prejudice to our intellectual property rights.

The partly completed machinery must not be put into service until the final machinery into which it is incorporated has been declared in conformity with the provisions of Directive 2006/42/EC



Hiroshi Morimoto
Manager
Product Safety and Regulatory Compliance

(date)

Figure 2-1: Sample Product Declaration of Incorporation

Explanation of Hazard Alerts

This manual and this product use industry standard hazard alerts to notify the user about personal or equipment safety hazards.

Hazard alerts contain three elements:

- Signal Word and Color
- Safety Text
- Safety Icon (s) - not necessarily used with Notice

Signal Words and Color

Signal Words inform of the level of hazard.

	Danger indicates a hazardous situation which, if not avoided, will result in death or serious injury. Danger signal word is white on a red background with an iconic exclamation point inside a yellow triangle with black border.
	Warning indicates a hazardous situation which, if not avoided, could result in death or serious injury. Warning signal word is black on an orange background with an iconic exclamation point inside a yellow triangle with black border.
	Caution indicates a hazardous situation or unsafe practice which, if not avoided, may result in minor or moderate personal injury. Caution signal word is black on a yellow background with an iconic exclamation point inside a yellow triangle with black border.
	Indicates a situation or unsafe practice which, if not avoided, may result in equipment damage. Notice signal word is white on blue background with no icon.

Safety Text

Hazard alert text follows a standard, fixed-order, three-part format:

- Identify the type of hazard
- State the source of the hazard
- State the severity of the consequences if the hazard is not avoided
- State how to avoid the hazard

Safety Icons

- Hazard alerts contain Safety Icons that graphically identify the hazard involved.
- The safety icons in this manual conform to ISO 3864 and ANSI Z535 standards.

Alert Example

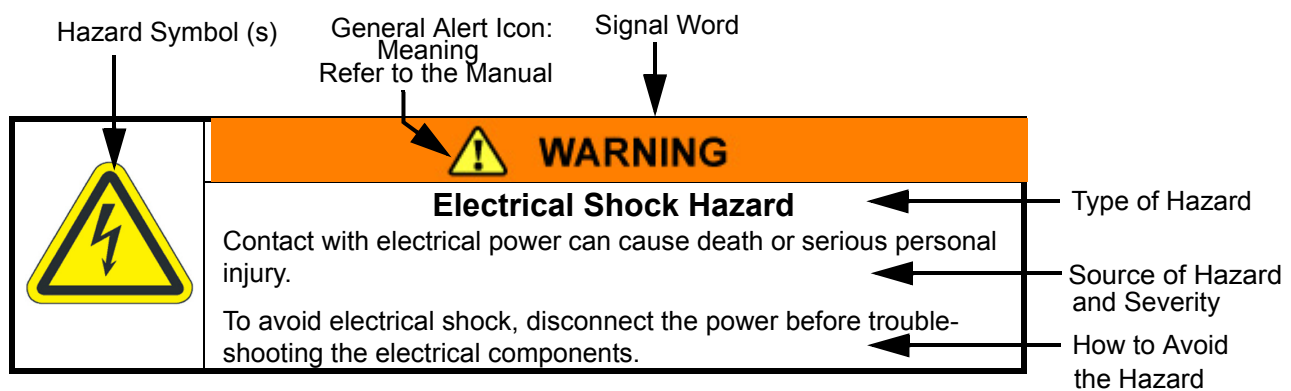


Figure 2-2: Components of a Safety Alert Example

General Safety Considerations

	 CAUTION
	Training This Product is a complex electro-mechanical device. Use by untrained personnel may cause equipment damage or personal injury. Only persons with proper training should attempt to install, service, or operate this product.

  	 CAUTION
	Personal Protective Equipment This product contains heavy objects that may cause personal injury. • Use safety shoes and head protection when installing or maintaining the product. • Wear protective eye wear at all times when setting up or testing the system.

	 CAUTION
	Seismic Restraint The use of this product in an earthquake prone environment may cause equipment damage or personal injury. The user is responsible for determining whether the product is used in an earthquake prone environment and for installing the appropriate seismic restraint in accordance with local regulations.

	 CAUTION
	Inappropriate Use Use of this product in a manner or for purposes other than for what it is intended may cause equipment damage or personal injury. Only use the product for its intended application. Do not modify this product beyond its original design. Always operate this product with the covers in place.

	 CAUTION
	Damaged Components The use of this product when components or cables appear to be damaged may cause equipment malfunction or personal injury. Do not use this product if components or cables appear to be damaged. Place the product in a location where it will not become damaged. Route cables and tubing so that they do not become damaged and where they do not present a personal safety hazard.

Notice
Emergency Off Required This equipment is not provided with an Emergency Off (EMO) circuit. Customer must provide an EMO circuit.

Location of Hazardous Points

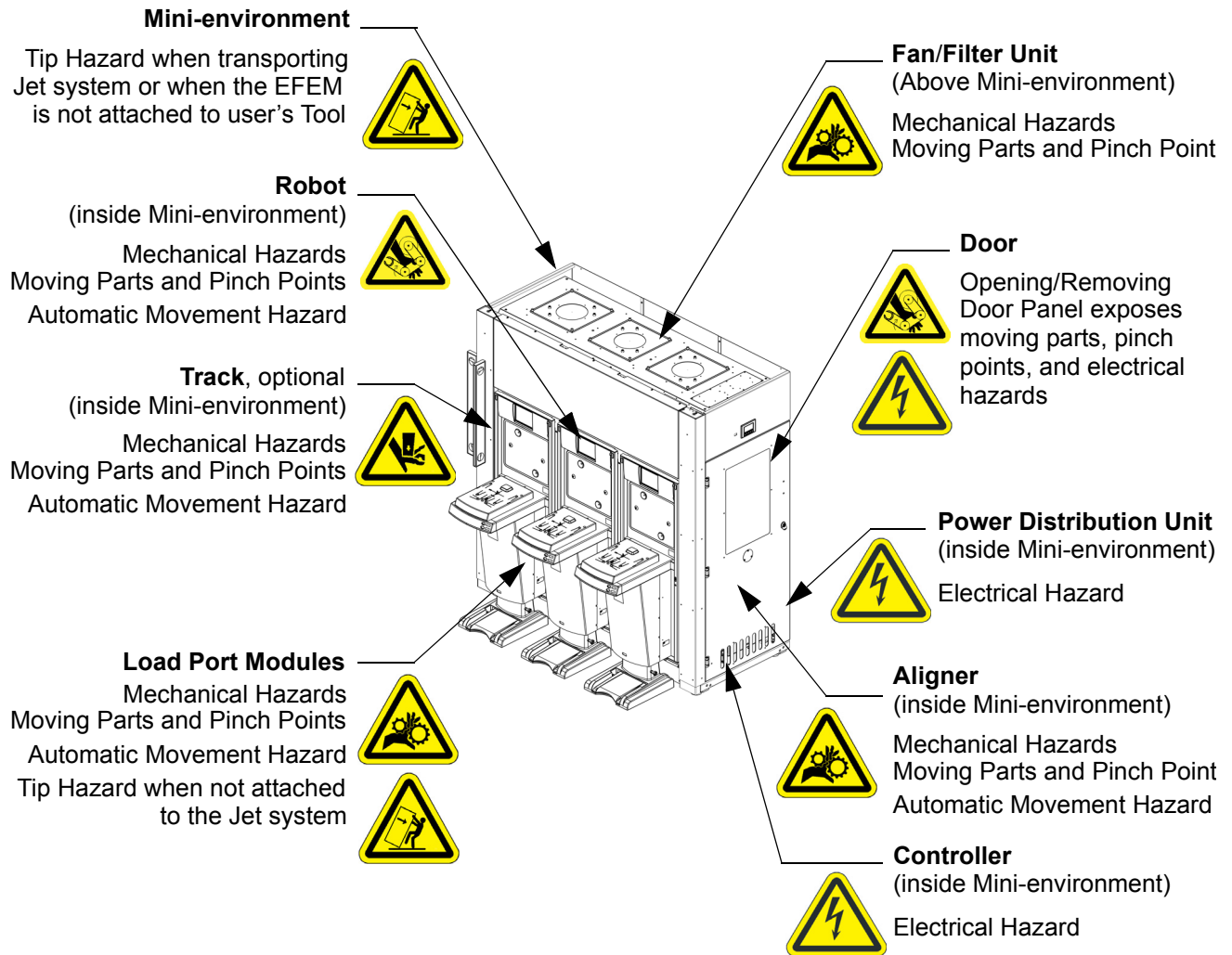


Figure 2-1: Locations of Hazardous Points on the Jet System

Safety Labels

Labels are used to alert personnel to hazards on or within the Jet system and to provide information about the Jet system.

The following tables list the labels that are placed on each Jet EFEM module. The figure following each table shows the label locations. To replace a lost or damaged label, order from Brooks Automation using the label part number.

For Robot and load port automation labels, please refer to the appropriate component manual supplied.

Table 2-1: Labels Used on the Jet System

 15 ELIZABETH DRIVE CHELMSFORD, MA 01824 USA	Product Information Label P/N: 218991 Qty: 2 Location: One located on the rear of the EFEM above the Facilities Panel, one located above the facilities panel inside the EFEM.
PRODUCT MODEL: JET ASSEMBLED IN: ABCDEFG YEAR OF CONSTRUCTION: 2013 MODEL NUMBER: 123456-1234 SERIAL NUMBER: 1234CHE12345 ELECTRICAL DIAGRAM: 123456-1234-BX	
SINGLE PHASE, 2-WIRE WITH GROUND VOLTAGE 200-240 VOLTS AC FREQUENCY 50-60 HERTZ LARGEST MOTOR/LOAD 14 AMPS FULL LOAD CURRENT 20 AMPS SCCR 10,000 AMPS RMS SYMMETRICAL AIC RATING 10,000 AMPS RMS SYMMETRICAL	
P/N 218991 REV A	

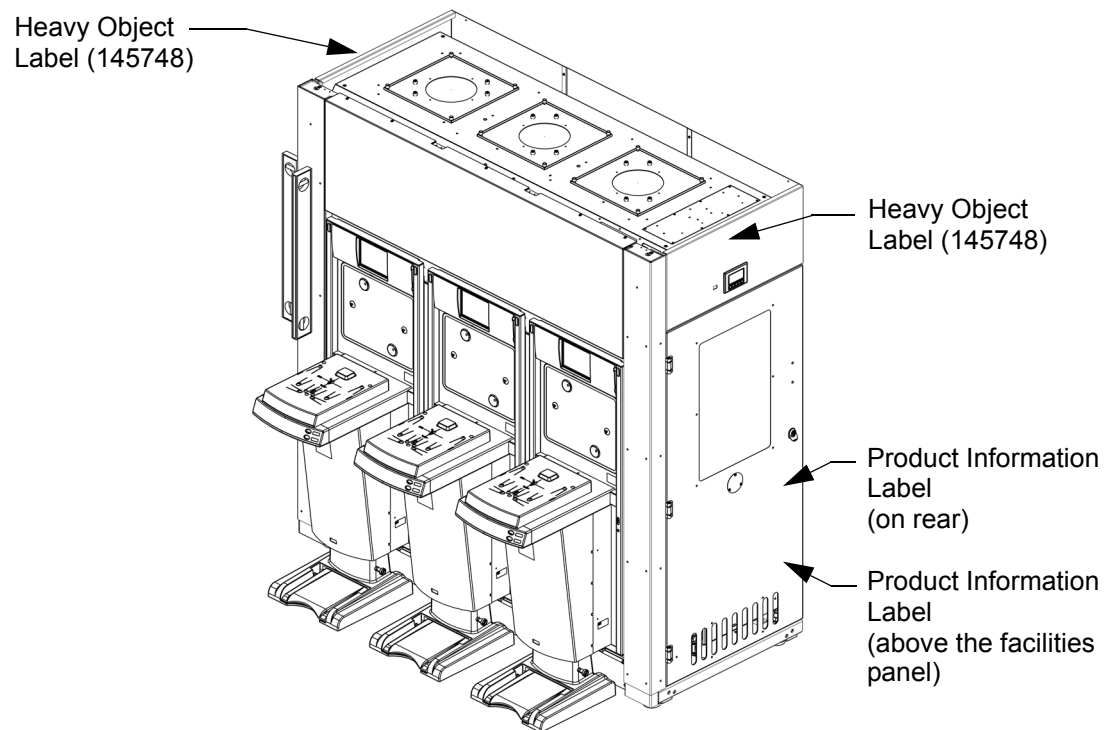


Figure 2-2: Label Locations on the Jet System

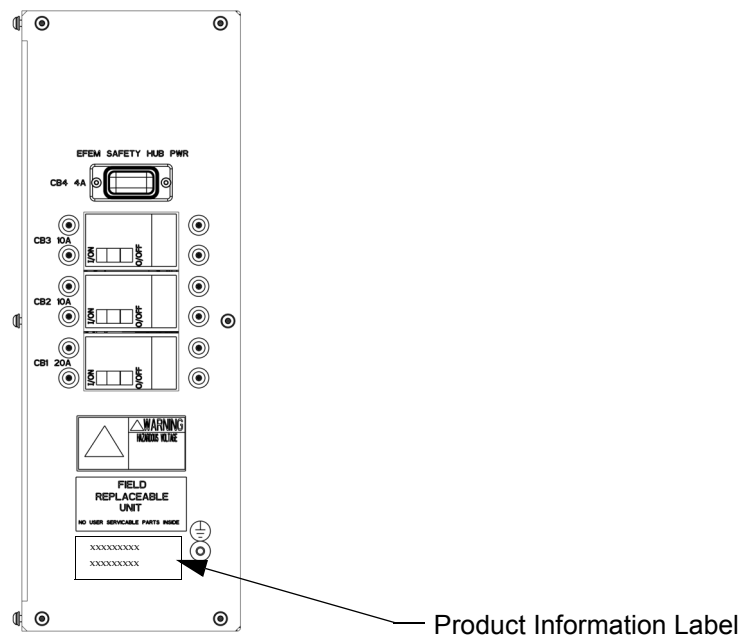


Figure 2-3: Label Locations on the Power Distribution Unit

Safety Interlocks

Safety interlocking is available for user safety. Operational interlocks are available to protect the Jet system and the material in transport from damage.

NOTICE

The Jet system provides only the personal safety and obstruction interlocks described below. Additional interlocks may be implemented by the user at their discretion.

Overriding interlocks can result in personal injury or equipment damage.

The following safety interlocks exist on the Jet system:

Name	Type	Function
EFEM Door Interlock	Safety Rated Coded Magnetic interlock switch 2 position switch Requires Service Key to override	Inhibits robot motion if either EFEM door is open See Door Interlock Circuit on page 6-8
Emergency Off (EMO)	Locking button	Function is user defined See Emergency Off (EMO) Circuit on page 6-8
Optional Interlocks	Optional interlocks provided by system or robot controller	Refer to the user manuals for the system controller or robot control- ler provided with your system
Emergency Stop	Locking Button	Inhibits robot motion if pressed.



WARNING

Automatic Motion Hazard

If the Door Interlock on the mini-environment is disabled, the possibility of automatic movement of components within the Jet system exists which may cause death or serious injury.

The Robot, Track, Aligner, Load Port Modules, and FFU Fans may move automatically:

Use of the Jet system when the Door Interlock is bypassed is at the user's own risk.

Location of Interlocks

All user safety interlocks are located as shown in [Figure 2-4](#).

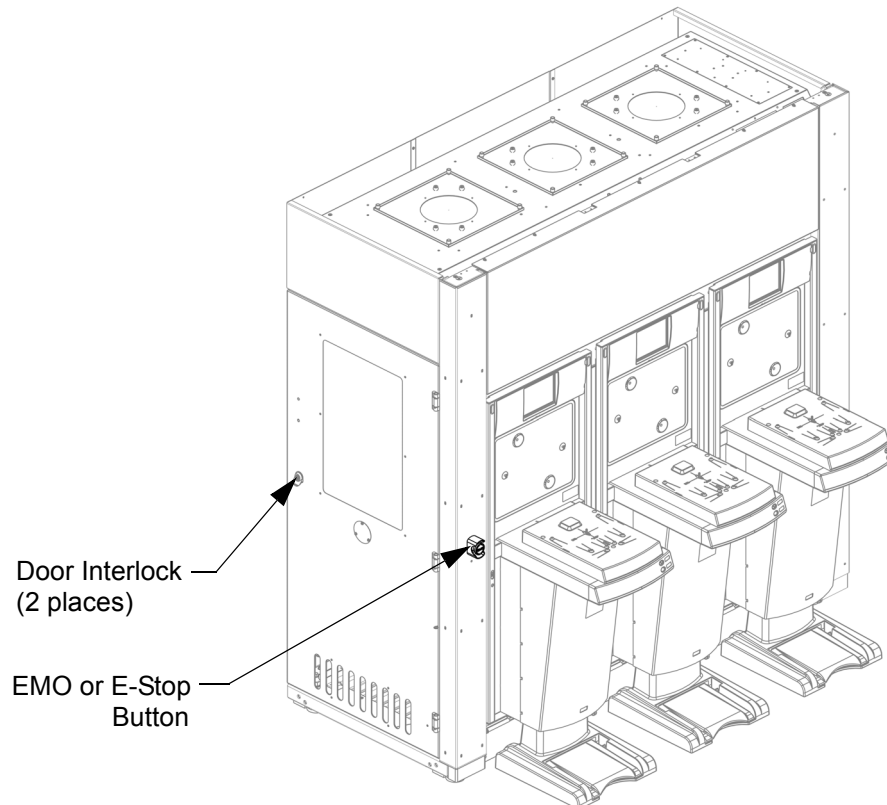


Figure 2-4: Safety Interlocks

Mechanical Hazards

	 WARNING
	Moving Mechanisms Moving mechanisms do not have obstruction sensors and can cause death or serious injury. • Be aware of and avoid working in the potential movement area of the product whenever power is applied. • Use physical barriers to prevent injury when working in the movement path.

	 CAUTION
	Pinch Point Moving parts of the JET system may cause squeezing or compression of fingers or hands resulting in personal injury. Do not operate the product without the protective covers in place. If a pinch occurs, perform one of the following: • Press EMO button (user responsible circuit) • Issue a HALT command • Turn off power from source • Press Emergency Stop button on Teach Pendant

 	 WARNING
	Lockout/Tagout Working with energized equipment may cause automatic or sudden movement which may result in death or serious injury. • All energy must be removed from the equipment per the facility's Lockout/Tagout procedure before servicing. • If local procedures are not available, follow the procedure for Lockout/Tagout in OSHA Standard 29CFR 1910.147. • Refer to the units specifications for system power requirements and use appropriate precautions.

 	 CAUTION
	Mechanical Moving parts hazard Moving parts of the JET system may cause automatic or sudden movement which may resulting in personal injury. Ensure that all the panels, doors, access ports, and load ports are installed prior to operation of the robot and load ports. Process module must be installed within 1/8" (3mm) of the wafer pass through opening in the rear of the Jet System.

Electrical Hazards

	 WARNING
	High Voltage Hazard Improper electrical connection or connection to an improper electrical supply can result in electrical shock or burns resulting in death or serious injury or cause an equipment fire and damage to the equipment. • Always provide the Jet system with the proper electrical code compliant connections and disconnect. • Maximum power consumption for the Jet system during normal operation is 200 - 240 VAC at 30 Amps. • Turn off power before servicing. • Ensure all circuit breakers are off before disconnecting main power.

 	 WARNING
	Lockout/Tagout Working with energized equipment may cause electrical shock which may result in death or serious injury. • All energy must be removed from the equipment per the facility's Lockout/Tagout procedure before servicing. • If local procedures are not available, follow the procedure for Lockout/Tagout in OSHA Standard 29CFR 1910.147. • Refer the units specifications for the actual system power requirements and use appropriate precautions.

Laser Hazard

A laser may be used in the Jet EFEM for wafer sensing. Lasers used with Brooks products are classified as CDRH Class I. National and international safety standards classify very low power laser CDRH Class I laser systems as follows:

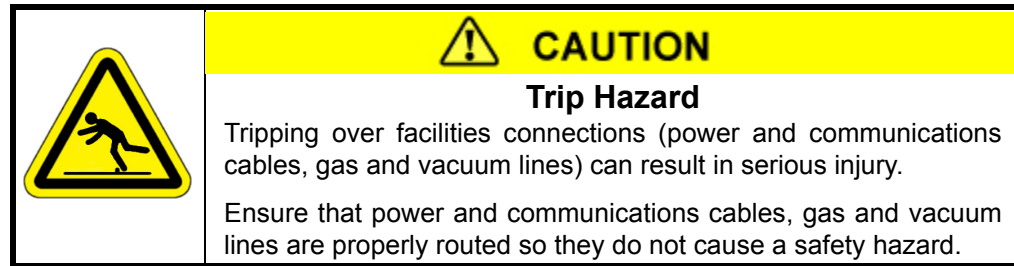
Class I: Very low power ($<CW: 0.4\mu\text{Watts}$ at visible wavelengths) -- does not emit laser radiation at known hazard levels (eye damage occurs at $1\mu\text{W}$).

	 CAUTION
	Laser Radiation Laser radiation may cause serious eye injury. • Know the power and hazard level of all lasers. • Avoid exposure to laser hazards. • Do not look directly at or into the laser beam (no matter what Class of laser). • Follow any posted laser warnings or labels. • Do not attempt to service, repair, or remove the protective housing of the laser device.

Ergonomic Hazards

 	 CAUTION
	Heavy Object Hazard The Jet system weighs from 555.2 kg (1224 lb) to 895.4 kg (1974 lb) with Load Ports attached. The Load Port Modules weigh 59 kg (130 lb). Failure to take the proper precautions before moving any of these items could result in personal injury.

	 CAUTION
	Tip Hazard If components tip and fall, severe injury could result. Use caution when moving the Jet system or the Load Port Modules.



Environmental Considerations

Noise

The Jet system provides no direct noise hazard. Any sounds produced are minimal and cause no hazardous conditions.

Vibration

The Jet system provides no direct vibration hazard. Any vibrations produced are minimal and cause no hazardous conditions.

Venting

Follow the facility's environmental procedures for vacuum pump exhaust.

Hazardous Material Disposal

The Jet system may contain the following items that may require special handling for disposal or recycling:

Lithium Batteries

A Lithium battery may be located in the controller to maintain data when power is removed. If a Lithium battery is removed or replaced, it must be handled in accordance with all Federal, State, Local, and Facility procedures for the disposal of hazardous materials.

NiMH Battery

A NiMH battery may be located in an optional Uninterruptable Power Supply (UPS) located in the controller. If a NiMH battery is removed or replaced, it

must be handled in accordance with all Federal, State, Local, and Facility procedures for the disposal of hazardous materials.

Material Safety Data Sheets - MSDS

Hazardous materials may be present in the product as shipped by Brooks. These materials may vary, depending on the configuration of the Jet system. Refer to the manual for each component to identify hazardous substances that may be in the system.

3 Specifications and Site Requirements

Overview

This chapter details the specifications of the 300mm Jet systems and the requirements for their installation.

Dimensions are shown for a typical system. For illustration purposes, some of the specifications and illustrations show the Razor Robot, Razor Track, Razor Wafer Aligner, and Fusion controller. When using this manual, always refer to the appropriate documentation for the specific components used on your system.

300mm Jet System Specifications

NOTICE

All drawings within this manual are generic and may not fully represent all builds of the Jet system.

Refer to the documents provided with your system.

To obtain drawings and documents for your system, contact Brooks Technical Support.

300mm System Mechanical Specifications

Dimensions:	Refer to Figure 3-1 , Figure 3-3 , and Table 3-1 for typical physical dimensions. For the actual dimensions of the specific system, including foot and seismic tie-down locations, refer to the Mechanical Layout Drawing supplied with the system.
Weight:	Refer to Table 3-1 for typical weights, For the actual weight of the system, including floor loading and center of gravity, refer to the Mechanical layout Drawing supplied with this manual.
Exposed Materials:	Aluminum Stable-Cast® 3, Aluminum 6061-T6, Stainless Steel, Nickel Plate, Epoxy Powder Coat, Aegis SC1071, PEEK
Vacuum Port:	8 mm Quick Connect
Ground Clearance:	50.8 mm (2.00 in) under frame 38.1 mm (1.50 in) under foot supports
LPM Interface:	BOLTS per SEMI E154 300mm Load Port
Leveling Provision:	Adjustable feet to meet WTP -0.5/+2.5 inch range
Rolling Provision:	4 casters
Lifting Provision:	4 removable forking brackets provided under the frame
Seismic Brackets:	User provided

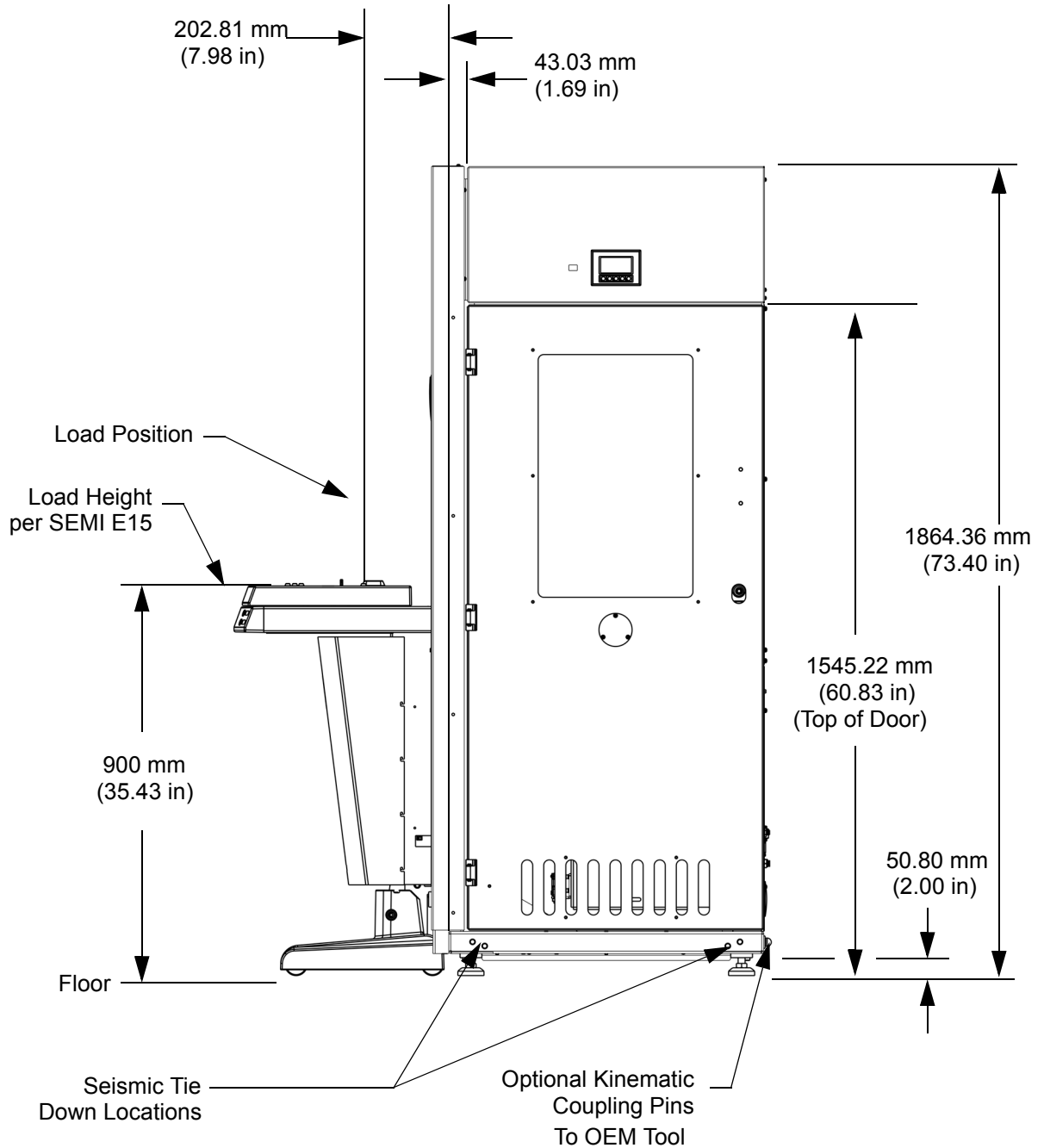


Figure 3-1: 300mm Jet System Installation, Typical - Side View

NOTE: Dimensions shown are typical dimensions. For the actual dimensions of a specific system, refer to the Mechanical Layout Drawing supplied with the system.

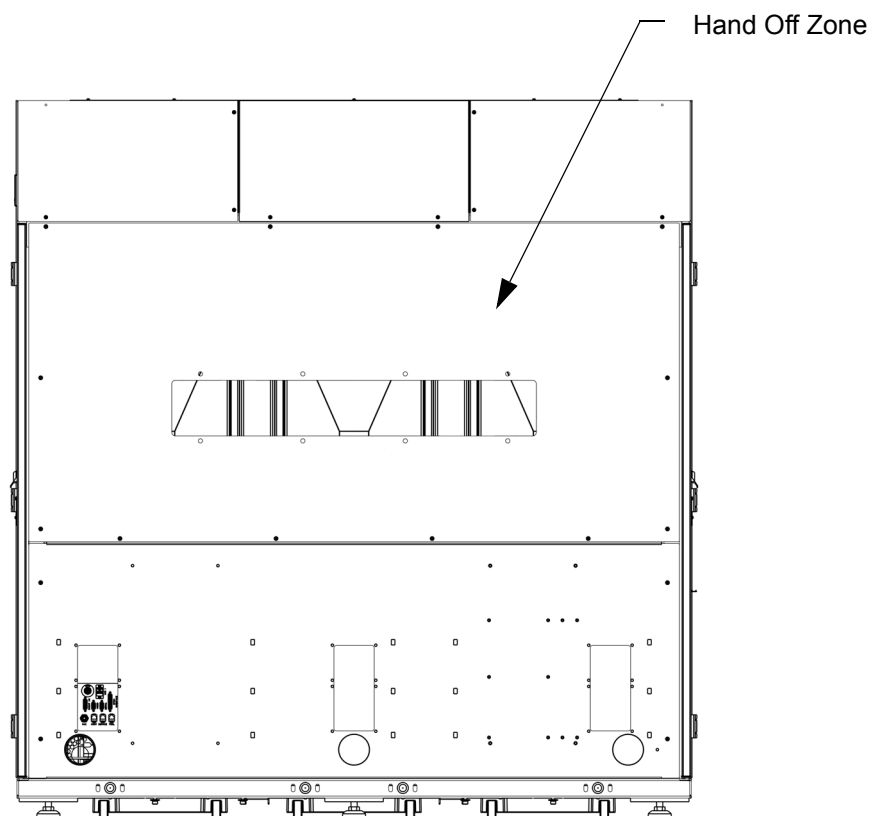


Figure 3-2: 300 mm Jet System Installation, Typical - Rear View

NOTE: For the actual dimensions of the specific system refer to the Mechanical Layout Drawing supplied with this manual.

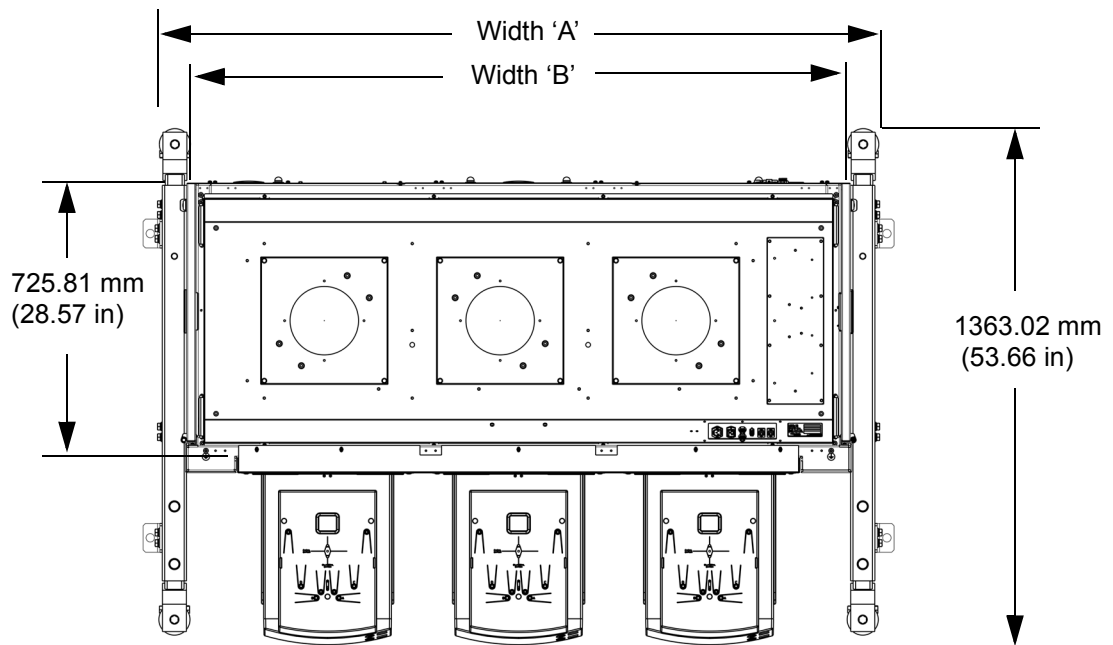


Figure 3-3: 300mm Jet System Installation, Typical - Top View

Table 3-1: 300mm Jet System Space Requirements, Typical

Model	Width 'A'	Width 'B'	Weight	Weight with Optional Storage
2 Bay	1402.89 mm (55.23 in)	1250.62 mm (49.23 in)	542.5 kg (1196 lb)	NA
3 Bay	1907.90 mm (75.11 in)	1755.62 (69.12 in)	665.4 kg (1467 lb)	NA

NOTE: Dimensions shown are typical dimensions. For the actual dimensions of the specific system refer to the Mechanical Layout Drawing supplied with this manual.

Center of Gravity and Floor Loading

Center of gravity and floor loading information for the Jet system varies based on the configuration. For specific information, refer to Mechanical Layout Drawings.

Power Specifications

Electrical, System: 200-240VAC, 50/60Hz, single phase,(L1,L2,PE)
System full load current 20A
Constant load range 5-14A depending on configuration
Overvoltage Category II
The Jet PDU is supplied with 10,000 AIC circuit breakers.
SCCR 10,000A

NOTE: *The facility is responsible for the main disconnect device between the Jet system and the facility's power source and for ensuring that it complies with the correct electric codes. Service to the Jet system must have the appropriate fuse or circuit breaker rating.*

Brooks Automation recommends circuit breakers, ground-fault protection, contactors, and/or EMO circuitry for equipment and personal safety. Refer to the Wiring Diagrams and owners manuals supplied with the system.

NOTICE

Before connecting or disconnecting main power to the Jet system, ensure all Jet system and related equipment circuit breakers are in the OFF position.

Damage to internal components may result if circuit breakers are left in the ON position.

and part numbers. Brooks Automation recommends construction of the power cable using 10 AWG wire for each pin on the connector that is wired. Refer to [Figure 4-11 on page 4-20](#) for the location of this connection. Brooks supplies a mating power connector Hubbel 2321 with each system.

Table 3-3: AC Power Connectors

Connector on PDU	Connector required for power cable
Hubbell 2325 (NEMA L6-20P) or Flanged inlet connector 250 VAC, 20A, single Phase, male	Hubbell 2321 (NEMA L6-20R) or Connector body 250 VAC, 20A, single Phase, female

Facilities Specifications

Vacuum: ≤ 80 kPa @ 100 cc/sec
(required for LPM and active grip End Effectors)

Network Interface Connections

Network: Ethernet, 10/100 Mbit/sec

Ethernet Communications

The Jet system uses the Ethernet communications protocol to connect a number of different devices to a factory controller, using a single communications cable. Each device connected to the cable has a unique network device address. Only communications addressed to a specific device through the network will be received by that device. The configuration for the various devices using Ethernet is described in [Chapter 6: Operation](#).

Network communications allows the Host Controller to communicate with the Jet system using the commands listed in the component user manuals. When the Teach Pendant and the Host Controller are unavailable, a personal computer running a network communications application may be connected to the Jet system’s network port, using the same cable to communicate with the system as the host controller.

The configuration of the Atmospheric Robot external network communications protocol is described in [Table 3-4](#). If more than one Jet system is connected to the same network, the IP Address of each system must be unique to avoid IP conflicts.

The Ethernet IP address of the components can be changed using system commands found in the component user manuals.

Standard Ethernet IP Address

The [Table 3-4](#) lists the default IP addresses of host controlled components in the Jet EFEM. For systems where the robot controller is in control of the device, those addresses cannot be externally controlled by the host. See the system selection guide for guidance.

Table 3-4: Host Controlled Ethernet Address

System Ethernet Module	IP Address	Subnet Mask
Atmospheric Robot Controller / Razor	20.20.249.20	255.255.255.0
Atmospheric Robot Controller / Reliance	20.20.249.2	255.255.255.0
Atmospheric Robot Controller / Wafer Engine EC4	20.20.249.20	255.255.255.0
Vision Load Port 1 (Port 4449)	20.20.249.22	255.255.255.0
Vision Load Port 2 (Port 4449)	20.20.249.23	255.255.255.0
Vision Load Port 3 (Port 4449)	20.20.249.24	255.255.255.0
Vision Load Port 4 (Port 4449)	20.20.249.25	255.255.255.0
Ionizer Controller	20.20.249.28	255.255.255.0
Jet Fan Filter Unit (Automatic Pressure Controlled)	20.20.249.26	255.255.255.0
EFEM Ethernet Light Tower Controller	20.20.249.35	255.255.255.0
Ethernet to Multi-Port Serial Gateway (if present) *	20.20.249.5	255.255.255.0
* See serial gateway Port Addressing.		

Serial Gateway Port Addresses

[Table 3-5](#) does not apply to the single serial port gateway Advantech 4571L.

These settings reflect default load port and load port carrier ID setup. Port numbers are reserved. Alternate uses of ports should be given other port numbers.

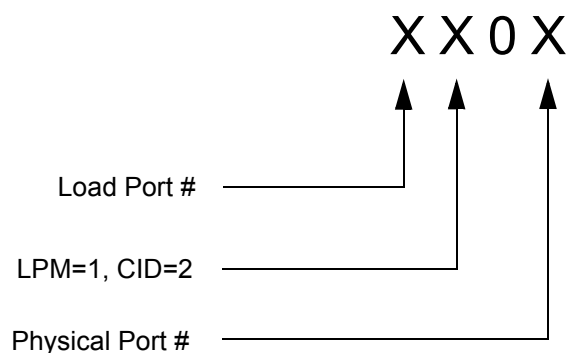


Figure 3-5: TCP Port Format

Table 3-5: Serial Gateway Port Addresses

Device	Control Physical Port #	Port ID
Load port 1	1	1101
Load port 1 Carrier ID	2	1202
Load port 2	3	2103
Load port 2 Carrier ID	4	2204
Load port 3	5	3105
Load port 3 Carrier ID	6	3206
Load port 4	7	4107
Load port 4 Carrier ID	8	4208

The Ethernet cables are standard network cable (UTP-CAT5e) with an 8-pin RJ-45 connector that connect to the Jet system Facilities Panel. The connector pin-outs are provided in [Table 3-6](#). Pins not identified with a signal name are to be left unconnected. Refer to [Figure 4-12 on page 4-21](#) for the connection location.

Table 3-6: Standard Ethernet Network Connector Pin Assignments

Pin ID	Signal Name
1	TX+
2	TX-
3	RX+
4	
5	
6	RX-
7	
8	

Options Available

System

Teach Pendant
Ionizer
Light Tower
Operator Interface
Equipment Racks

LPM

Mapping
Carrier ID Support
OHT SEMI E84 Interfaces
AGV SEMI E84 Interfaces
Light Curtain Protection
Mechanical Bar Protection

Robot

Edge contact end effector
Edge grip end effector
Underside vacuum grip end effector
Reflective or through beam mapping

Aligner

200 mm

300 mm

Other sizes may be available upon request.

6" Reticle

Optical Character Reader

Mechanical and electrical mounting for Cognex 1741. Check with sales team for available OCR options.

Site Requirements

Environment

ISO 14644-1 Class ISO 6 or better cleanroom ambient

Temperature:

Operating: 10° C to 30° C (50° F to 86° F)

Shipping: -25° C to 55° C (-13° F to 131° F), up to 65° C (149° F) for 24 hrs.
max

Storage: -25° C to 55° C (-13° F to 131° F), up to 65° C (149° F) for 24 hrs.
max

Humidity: 5% to 80% (relative, non-condensing)

Lighting: Standard lighting provided in the cleanroom environment where the Jet system is installed is sufficient for proper operation. Maintenance may require additional light.

Service Access

The Jet system requires service access as specified in SEMI E72. Refer to the Mechanical Layout Drawing supplied with the system for system dimensions. Typical service space is shown in [Figure 3-6](#) and [Figure 3-7](#).

Ensure that installation of the Jet system provides access to items required for service after installation, such as the service doors and connection panels.

Ensure adequate lighting in service areas outside of the JET Mini-Environment Enclosure.

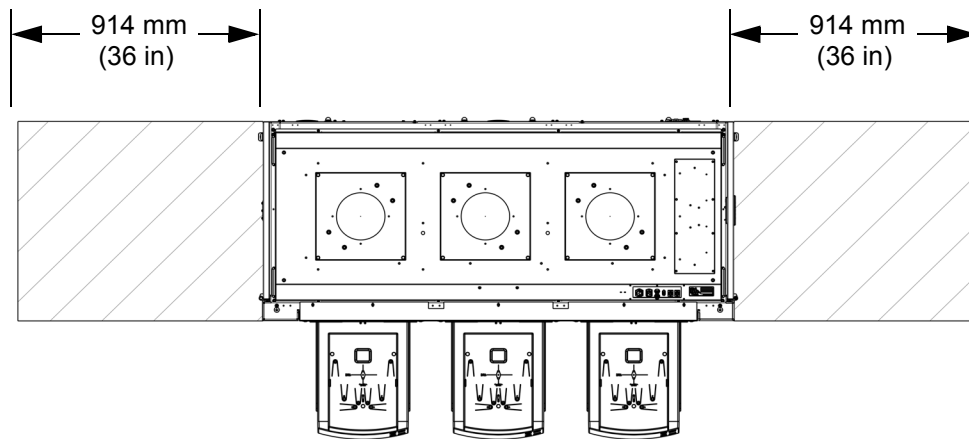


Figure 3-6: Service and Exclusion Zones - Horizontal

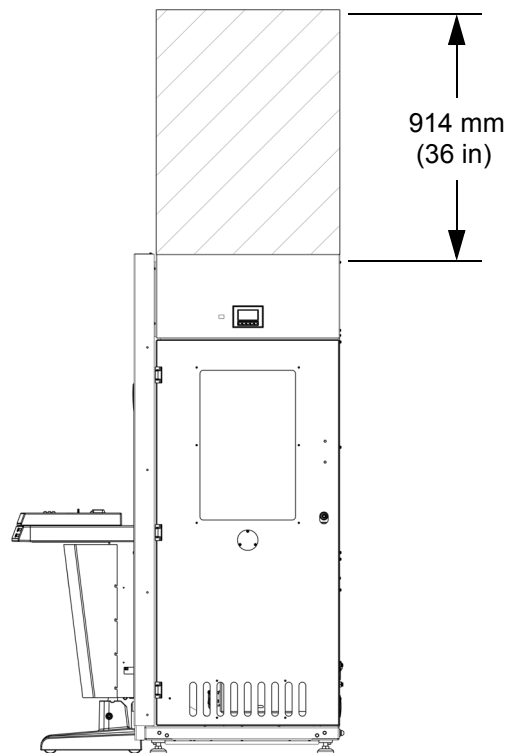


Figure 3-7: Service and Exclusion Zones - Vertical

Moving the Jet System

Various locations within the site where the Jet system will be installed must meet the following minimum requirements to ensure proper handling of the Jet system:

- | | |
|----------------|--|
| Door Openings: | See system mechanical specifications and system layout for exact dimensions. |
| People: | A minimum of four people are required to move the Jet system within the facility. |
| Floor: | <p>The Jet system is designed to roll easily across smooth interior floors only. The floor where the Jet system is installed must be capable of supporting the weight of the Jet system as described in Table 3-1 or Table 3-2</p> <p>The weight information provided is maximum weight, specific Jet systems may weigh less</p> |

4

Installation

Overview

This chapter provides installation instructions for the Brooks Automation Jet system.

For illustration purposes, the components shown here are the Razor Robot, Razor Track, Razor Wafer Aligner, and Fusion controller. When using this manual, always refer to the appropriate documentation for the specific components used on your system.

	 WARNING
 	The Jet system contains high voltages and other hazards which, if not properly handled, may result in serious injury or death. • All personnel involved with the operation or maintenance of this product must read and understand the information in the Safety Chapter. • Follow all applicable safety codes of the facility as well as national and international safety codes. • Know the facility safety procedures, location of safety equipment, and contact information. • Read and understand each procedure before performing it. • Only qualified personnel should perform the procedures.

Unpacking and Inspection

The Jet system is typically shipped in one package which is sealed to maintain clean-room conformance. Additional crates may be used for options and documentation.

One set of shipping documents is attached to the outside of the main shipping crate for easy access. An additional set of the same documents is attached to the equipment inside the shipping crate.

	 CAUTION Tip Hazard Tip hazard exists when moving the Jet system or the Load Port Modules. Failure to take the proper precautions before moving the system, especially while rolling it out of the shipping crate, could result in personal injury. • Inspect the travel route of the Jet system to be sure the travel path is level and clear of debris and obstacles. • Cover dips, thresholds, or any uneven floor transitions with plates. • Ensure that all force exerted on the Jet system or its components when moving is below the center of gravity. • Personal Protection Equipment such as safety glasses and steel toe shoes should be worn at all times when installing the Jet system.
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	 CAUTION Heavy Object Hazard The Jet system weighs from 555.2 kg (1224 lb) to 895.4 kg (1974 lb) with Load Ports attached. Each Load Port Module weighs 59 kg (130 lb). Failure to take the proper precautions before moving any of these items could result in personal injury. Use a minimum of four people to move the Jet system.
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Tools and Materials

The following tools and materials are required for unpacking the Jet system.

- Metric hex wrenches
- Inch hex wrenches
- Open end wrenches or adjustable wrenches
- Utility knife
- Fork truck or appropriate lift

Unpacking and Moving Instructions

1. Upon receiving the crate(s), inspect the attached shipping indicators for disturbance. Also, visually verify that each crate is not damaged. Report any damage to the containers to the shipper and to Brooks Automation.
2. Remove the cover of each shipping crate. Unpack, inspect, and verify the contents against the shipping documents. Do not remove any protective wrapping.

The Jet system was assembled and bagged in plastic in a cleanroom environment. To ensure the cleanliness of the system, only unbag it in a cleanroom environment.

Save all shipping materials for possible future use. If the Jet system is shipped, the original shipping crate must be used. If the original crates have become lost or damaged, contact Brooks Automation for replacements. Refer to [Appendix E: Packing and Shipping Instructions](#)

The number of shipping crates and their contents will depend on the items purchased. Refer to the shipping documents for the exact contents. [Figure 4-1](#), below, is provided for reference only.

Table 4-1: Packing Checklist Reference

Package	Contents
Jet System	1. System (mini-environment with FFU) on casters with installed options that may include robot, track, aligner, load port modules, EMO Button, etc.
Installation and Options Kit	1. Copy of AT (Certificate of Performance Testing) ¹ 2. User Manuals 3. Teach Pendant (if ordered) 4. Light Tower (if ordered) 5. Operator Interface (OI) Module (if ordered) 6. Wing Panel OI 7. Light Curtain (if ordered)

1. The Acceptance Test (AT) is a permanent record of the Jet system as it was manufactured by Brooks Automation. It provides information about serial numbers, model numbers, and embedded software versions as well as critical data about load port designations, system assignments, station names, etc. Make copies of the Acceptance Test record and keep a copy close to the Jet system. If maintenance is required, data from the AT will be needed.
3. Cut open the bag the Jet system is shipped in and unbolt the four tie-down brackets from the base of the shipping container as indicated in [Figure 4-1](#).
4. Using a fork lift with 6 inch wide forks (maximum), lift the Jet system from the back using the Fork Brackets (rear locations shown in [Figure 4-1](#)). Note that the system may slightly tip forward on the forks.

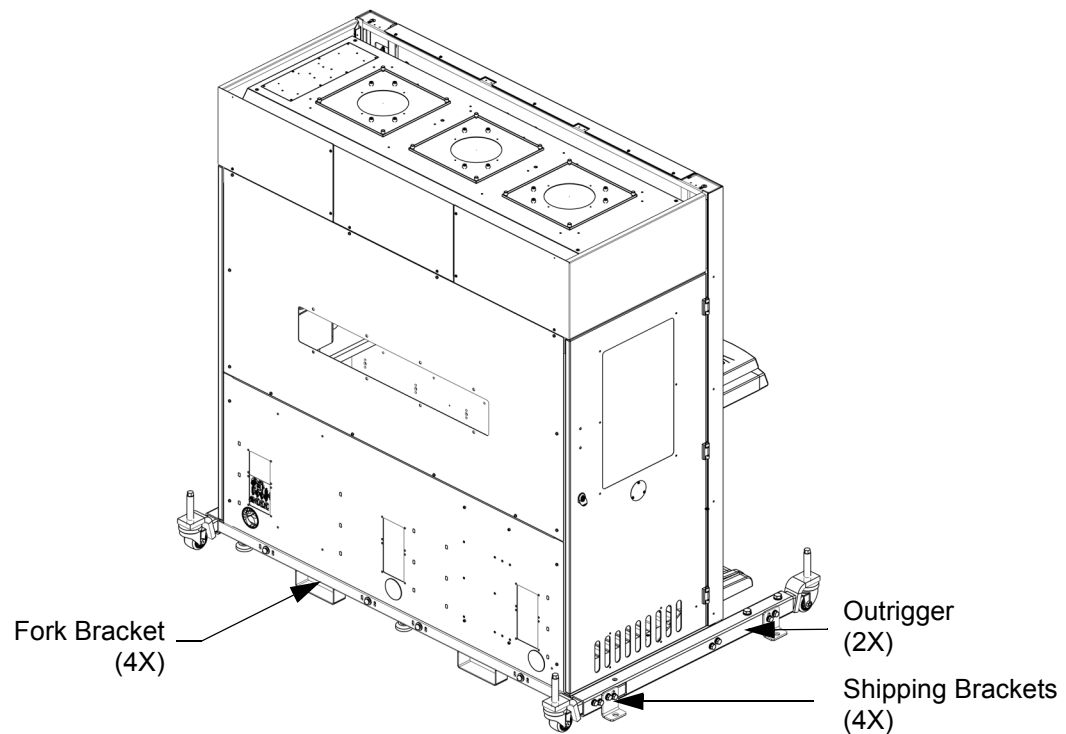


Figure 4-1: Shipping Tie-Downs (300mm System Shown)

5. Slide the base of the shipping container out from under the Jet system.
6. Move the Jet system into the facility as far as the fork lift is allowed to travel.
7. Ensure the feet are high enough to keep them from touching the ground before the Jet system is lowered from the forklift:
 - A. Raise the feet if necessary by loosening the jam nut (against the frame) and turning the stem of each caster clockwise.
 - B. Tighten the jam nuts on all feet.
8. Remove the four Fork Brackets and save for future use. If the Jet system is shipped, the Fork Brackets must be replaced before shipping.
9. Lower the Jet system to the floor and move the fork lift away from the system.
10. Confirm that the feet are high enough to provide rolling clearance. Adjust as required.

NOTICE

When rolling the Jet system on its casters, push on the mini environment only.

Do not push on any externally mounted components (Load Port Modules, Light Tower, and so forth) as damage to those components could result.

11. Roll or use a hoist to move the Jet system into the unpacking area.
12. Unpack, inspect, and verify the contents of all crates against the shipping documents. Do not remove any protective wrapping.

NOTE: *Report any damage or missing material immediately to the shipper and to Brooks Automation.*

13. Move the contents of all crates into the unpacking area.
14. Vacuum and wipe down all of the bags for all items.
15. Remove the outer bags. Do not remove the inner bags. Vacuum and wipe down all inner bags.
16. Move the Jet system and any additional material to its final location in the Cleanroom.
17. Remove all inner bags and any additional wrapping.
18. Carefully inspect the Jet system and all additional items for signs of damage. Report damage to the shipper and to Brooks. Do not install damaged equipment.

Installation Procedure

Tools and Materials

The following tools and materials are required during final unpacking and installation of the Jet system.

- Metric hex wrenches
- Inch hex wrenches
- Open end wrenches or adjustable wrenches
- 10mm and 24mm open end wrench for leveling feet
- 19mm and 26mm open end wrench for casters
- Metric hex wrench with ratchet, 8 mm x 100 mm
- Utility knife
- Scale (ruler)
- MicroTool wafer level or bubble level
- Two 1 m bubble level with magnetic base or equivalent
- Fork Truck or other appropriate lifting device

Move the Jet to Location

  	 CAUTION
	Tip Hazard Tip hazard exists when moving the Jet system or the Load Port Modules. Failure to take the proper precautions before moving the system, especially while rolling it out of the shipping crate, could result in personal injury. • Inspect the travel route of the Jet system to be sure the travel path is level and clear of debris and obstacles. • Cover dips, thresholds, or any uneven floor transitions with plates. • Ensure that all force exerted on the Jet system or its components when moving is below the center of gravity. • Personal Protection Equipment such as safety glasses and steel toe shoes should be worn when installing the Jet system.

	 CAUTION Heavy Object Hazard The Jet system weighs from 555.2 kg (1224 lb) to 895.4 kg (1974 lb) with Load Ports attached. Each Load Port Module weighs 59 kg (130 lb). Failure to take the proper precautions before moving any of these items could result in personal injury. Use a minimum of four people to move the Jet system.
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The outriggers can be rotated so that the rear of the EFEM can be placed close to the wafer transfer system. See [Outrigger Configuration Procedure on page 6-17](#) for outrigger operation.

Position the Jet System

1. Install the Load Port Modules, if required. Refer to their manuals.
2. Position the Jet system with the Load Port Modules in the proper position for carrier hand-off, starting with the left-most LPM. Refer to the datum marks on the Load Port Module's shuttle cover as shown in [Figure 4-2](#).

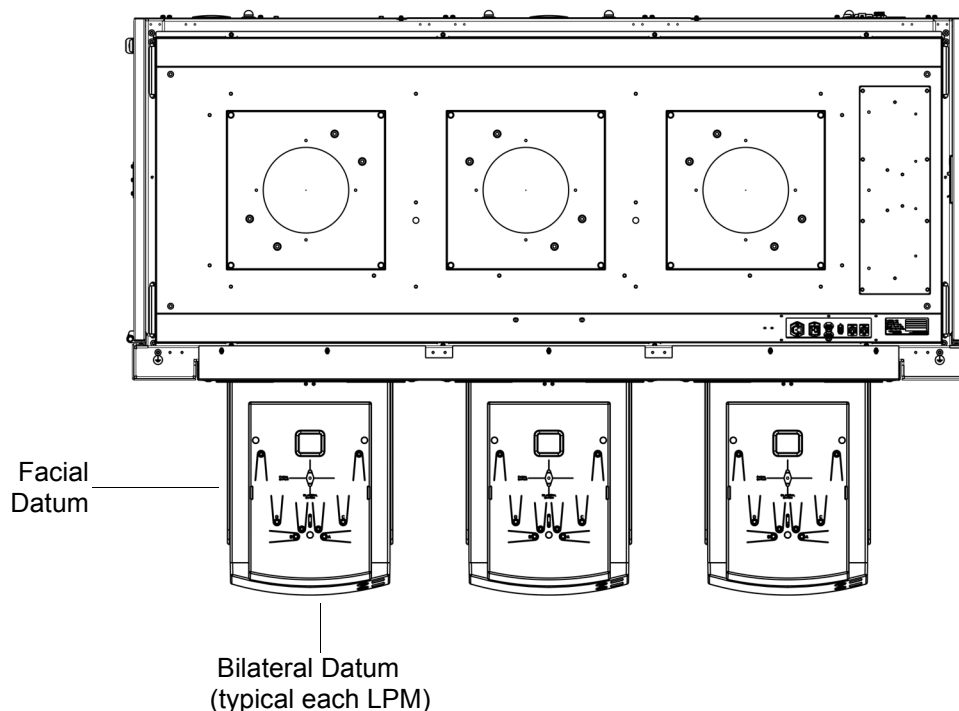


Figure 4-2: Positioning the Jet system (300mm System Shown)

Set the Material Transport Plane

The Jet system frame has adjustable feet to support the system, to set the Material Transfer Plane, and to compensate for an uneven floor.

NOTE: *The material handling components of the Jet system are kinematically mounted and adjusted at the factory. No additional adjustments to the components should be required when the system is properly installed.*

1. Loosen and back-off the locking nut for each foot.
2. Use three feet to level the system. Use the two feet at each of the front corners and one foot at the rear center. Adjust the foot height by turning the stem of each foot clockwise using an 8mm hex wrench in the socket on the end of the foot shaft until the outrigger wheels or casters are just off the floor.
3. Remove each outrigger, if provided, by removing the four bolts securing them. Store the outriggers and hardware for possible reuse.
4. Adjust the three leveling feet by equal amounts until the bottom of the system frame is approximately 2 inches off the floor at each foot. Do not use the reinforcing plates for the feet as the reference.
5. Check the distance between the left-most lower BOLTS mounting hole and the floor. Adjust the three leveling feet equal amounts so that the distance measures 68.0 mm (2.677 in). See [Figure 4-3](#).

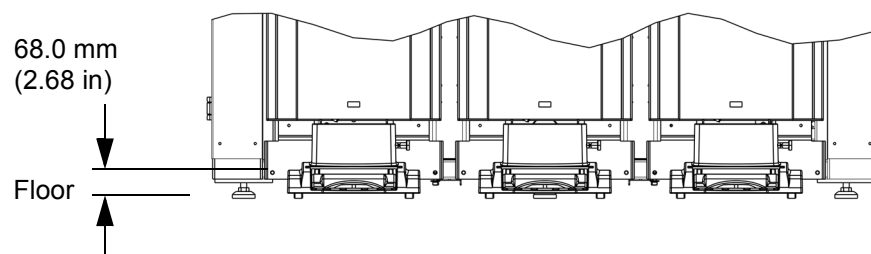


Figure 4-3: Setting Jet System Frame Height (300mm System Shown)

The height adjustment sets the Jet system so the load/unload height for the Load Port Modules is 900mm (35.95 inches) per SEMI E154. See [Figure 4-4](#).

This also provides a Wafer Transfer Plane, WTP, at the rear of the Jet system of 1100.0 mm (43.31 in) per SEMI E21 when using a standard rear panel.

NOTE: *The rear WTP can be customized by installing a rear panel with the transfer opening(s) located at a different height. Contact Brooks Automation for more information.*

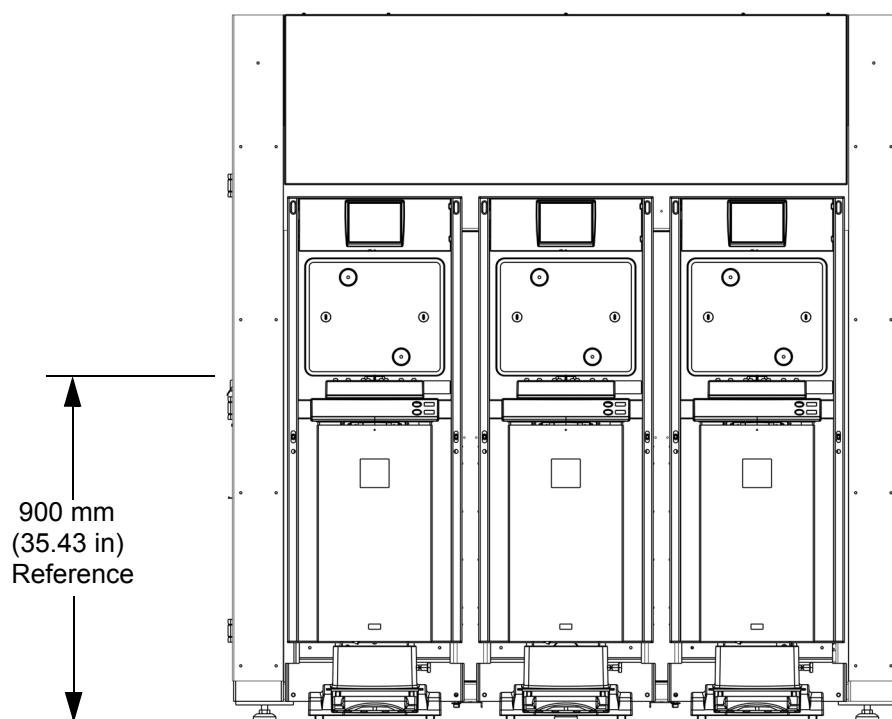


Figure 4-4: The Jet System Material Transport Plane

Level the Jet System

1. Place 2 magnetic levels on the left front corner post approximately 48 inches off the ground as shown in [Figure 4-5](#). One level must be on the front side and one level must be on the left side of the Jet system.

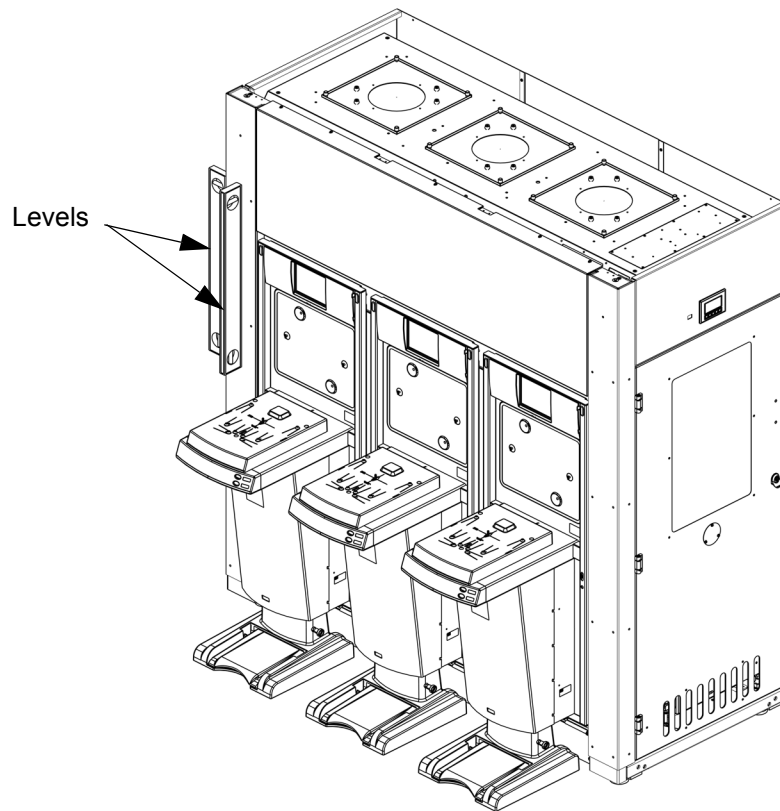


Figure 4-5: Leveling the Jet System

2. Adjust the left and right front and the middle rear leveling feet until the bubble is centered in each level. Take care not to change the height of the system as set for the material transfer plane. Recheck the height and readjust as required.
3. After the level of the system and the height of the transfer plane have been verified, verify the Pitch and Roll of the LPMs.
 - A. For Jet systems shipped with the LPMs attached, center a MicroTool Electronic Wafer Level (or a MicroTool Electronic Level placed on a wafer) onto the kinematic pins of LPM #1, as shown in [Figure 4-6](#), and check the Pitch and Roll.

Pitch and Roll should each be $0 \pm 0.04^\circ$. If not, adjust the leveling feet in small increments until $0 \pm 0.04^\circ$ is achieved. Recheck the frame Pitch and Roll and verify the bubbles in the levels are still centered.

- B. For Jet systems shipped with the LPMs removed, center a MicroTool Electronic Wafer Level (or a MicroTool Electronic Level placed on a wafer) onto the kinematic pins of each LPM, as shown in [Figure 4-6](#), and check the Pitch and Roll.

Pitch and Roll should each be $0 \pm 0.04^\circ$. If not, adjust the Kinematic Mount on each LPM in small increments until $0 \pm 0.04^\circ$ is achieved.

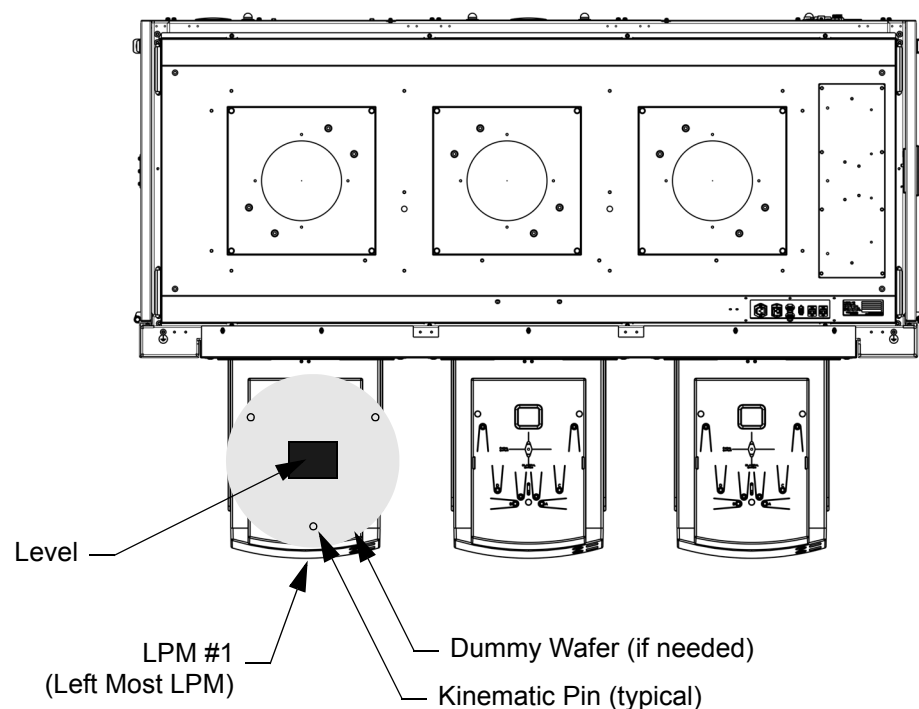


Figure 4-6: Verifying System Pitch and Roll at LPM

4. Open and lower the door of the load port at the far right location. This is LPM2 on a 2-Bay Jet, LPM3 on a 3-Bay Jet, LPM4 on a 3-Bay Jet.

5. Move the lower end effector (EE 1) to the far right load port location as shown in [Figure 4-7](#).

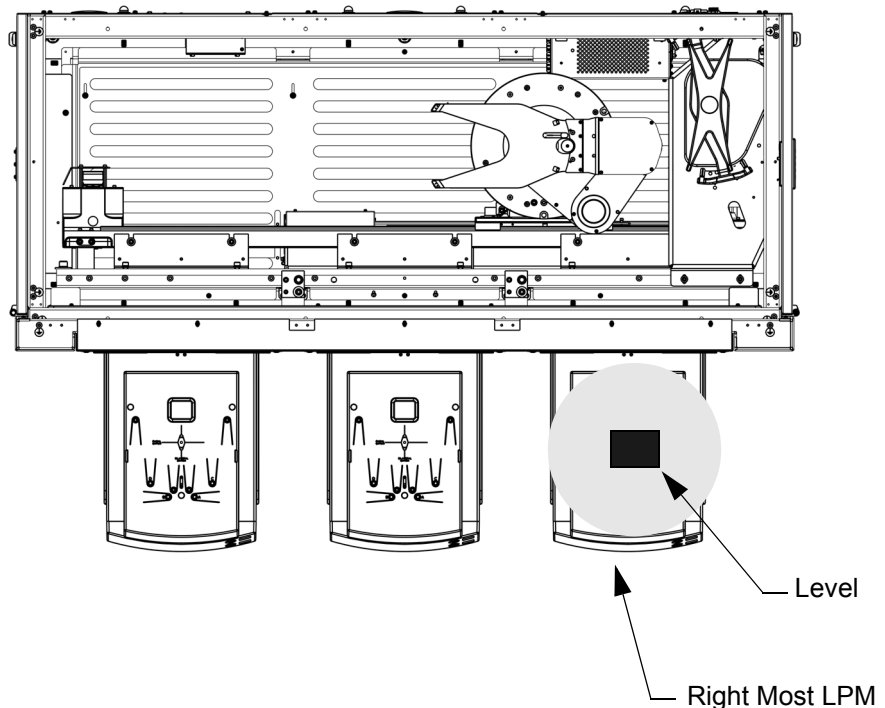


Figure 4-7: Verifying System Pitch and Roll at Robot

6. On a 5-axis robot, rotate the lower end effector (EE 2) out of the way on top of the forearm, as shown in [Figure 4-7](#).
7. Place the MicroTool Electronic Wafer Level on End Effector 1 in the orientation shown in [Figure 4-7](#). Hold the signal wire to the robot wrist using an alligator clip.
 - If the end effector is an active grip, slide the gripper back, place the wafer, and release the grip so the wafer sits in the center of the grips.
 - If the end effector is a passive grip (edge contact), center the Wafer Level on the pads.
8. Verify the Pitch and Roll are $0 \pm 0.04^\circ$. If not contact Brooks Automation.
9. Lower the remaining feet of the EFEM until they make firm contact with the floor but do not change the level of the Jet system.
10. Secure all feet by tightening the jam nut against the frame for each foot. Use a 8mm hex wrench in the socket on the top end of the shaft of the foot to hold the foot in position. Use a box end wrench to tighten the jam nut.

11. Remove all levels and any other equipment.
12. Open the EFEM door by inserting a 4 mm hex wrench into the door latch and turning counter-clockwise to unlock the door then pulling the door open.

Remove Protective Packaging

The Jet system is shipped with its internal components (robot, aligner, etc.) covered in protective packaging. This packaging must be removed before installation is started.

Mini-environment Module

1. Remove protective wrapping from any installed optional equipment.
2. Remove protective wrapping from any loose cable ends or connectors.
3. Remove the protective film from all windows.

Load Port Module(s)

1. Remove protective wrapping from any loose cable ends or connectors.
2. Remove protective film from all displays.

Remove Shipping Brackets

The Jet system is shipped with shipping brackets and foam blocks that must be removed before the removed before the system is installed or used.

NOTICE

Save all shipping brackets and foam pads for future use.

If the Jet system is shipped to another location, the original shipping brackets and foam must be used.

1. Shipping brackets secure the robot arm to the robot flange. The type of brackets vary based on the type of arm installed. Remove the brackets and save in a convenient place. Note that the robot shipping bracket is used as the Homing Fixture to calibrate the robot.

2. On systems with a 5-axis robot, a foam pad is placed between the end effectors. Remove the pad and the plastic ties holding the end effectors together and save the pads for future use.
3. On systems with a track, shipping brackets are used to secure the track carriage to the frame. Remove the brackets and save for future use.
4. On systems with an aligner, foam pads are placed between the Lift Chuck and the Rotate Chuck. Remove the pads and the plastic ties holding the chucks together and save the pads for future use.
5. On the Load Port Modules, the pod door opening paddle is secured in place for protection during shipment. Remove the foam pads securing the paddle within the Jet system and save for future use.

Mount Tie-Down Brackets

The Jet system has 4 tie-down points that provide anchoring to eliminate movement and provide seismic anchoring for earthquake protection per SEMI S2. Two tie-down points are located on each end as shown in [Figure 4-8](#).

NOTE: *Seismic hold-down brackets for facilities requiring earthquake protection are the responsibility of the user.*

The shipping brackets supplied with the Jet System (shown in [Figure 4-1](#)) are for shipping only. The user must supply their own brackets and hardware for facility tie-down or seismic tie-down.

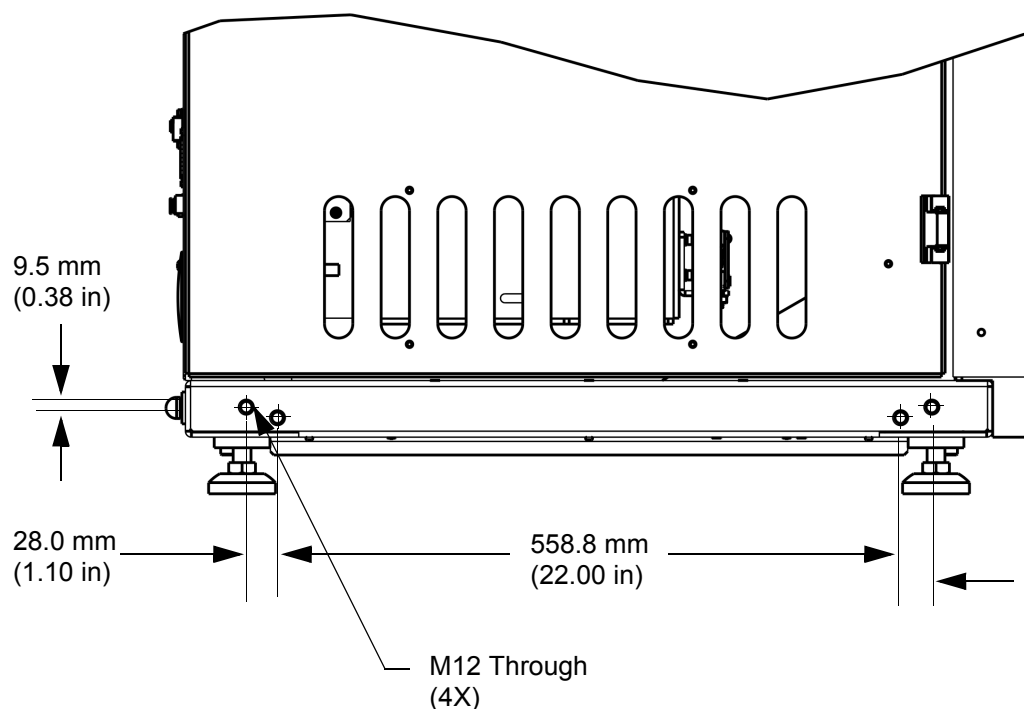


Figure 4-8: Tie-down Locations on 300mm System (Each End)

1. Install Grade 5 or better M12 mounting hardware (not supplied) at each of the four tie-down points to secure the user supplied brackets.
2. Secure the user supplied bracket to the facility's floor using Grade 5 or better mounting hardware (including flat washers and split washers) and tighten to a torque of 11 newton meters (100 inch pounds).

Install User Interface Options Removed for Shipping

Some items are removed so they do not get damaged during shipment. After the Jet system is installed, these items must be re-attached to the system prior to operation.

Install the Light Tower

The Light Tower is mounted to the front of the Jet System, as shown in [Figure 4-9](#), on either the left or right side depending upon system configuration.

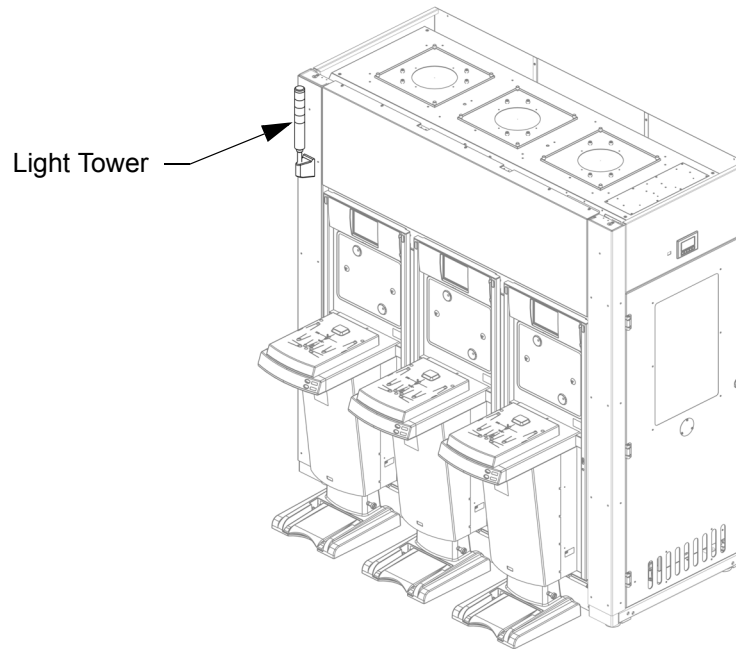


Figure 4-9: Installing the Light Tower

1. Remove the Light Tower from the shipping container.
2. Remove the protective film over the Light Tower mount on the front of the Jet.
3. Unwrap the Light Tower and remove the protective wrapping from the cable.
4. Insert the plug in the Light Tower base into the jack inside the mounting bracket on the Jet.
5. Slide the Light Tower base over the mounting bracket and slide the base down to seat it onto the bracket.
6. Insert the mounting screw through the hole in the bottom of the base and tighten.
7. Adjust the Light Tower as required to ensure it is vertical.

Install the Wing-Panel Operator Interface

The Wing-Panel Operator Interface is mounted to the side of the Jet System, as shown in [Figure 4-10](#). It may be mounted on either the left or right side depending upon system configuration. This assembly weighs 100 pounds and it requires 2-man lift.

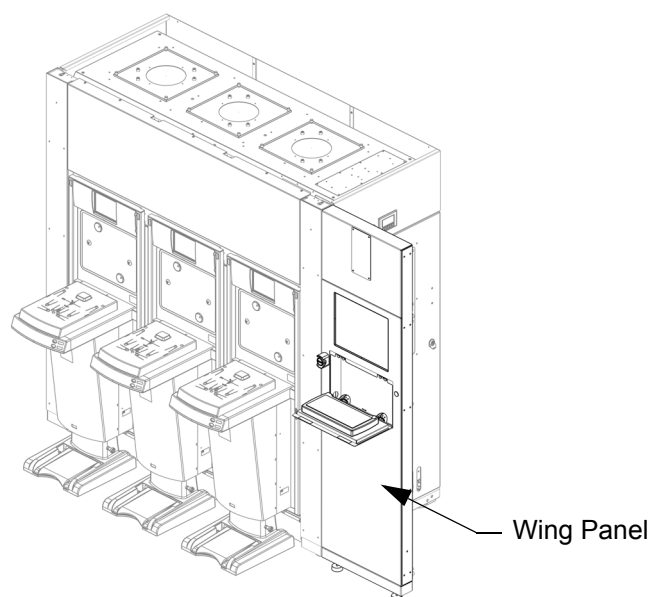


Figure 4-10: Installing the Wing-Panel Operator Interface

1. Remove the wing panel from the shipping container.
2. Remove the protective film over the wing panel mounts on the side of the Jet.
3. Remove the protective wrapping from the cables coming out through the wing panel mounts.
4. Unwrap the wing panel assembly and remove the protective wrapping from all cables.
5. Remove the rear panels from the wing panel assembly.
6. Connect all cables from the wing panel to their mating cables and tighten all connectors.
7. Locate the mounting holes on the wing panel over the studs on the Jet. Install and tighten the mounting hardware.
8. Replace the rear panels on the wing panel assembly.

9. If configured with a light tower, this will have been shipped detached from the wing panel and must be attached.

Final Adjustments

The Jet system is shipped pre-configured and fully adjusted. Once the Jet system is properly installed no additional adjustment is required.

Connecting the Process Tool to the Jet System

After the Jet system is installed, the OEM's Process Tool must be mated to the Jet, adjusted to the Material Transfer Plane, and leveled. Once mated, the Process Tool should be bolted to the floor as specified by the facility.

When mating the Jet system to the OEM's Process Tool, kinematic alignment pins may be used to position the Jet system to the tool. If the kinematic alignment pins are being used, confirm that the mating features for the pins have been machined into the frame of the Process Tool. Contact Brooks Automation for detailed drawings showing the location of these pins.

1. Roll the process tool up to the Jet system.
2. If the kinematic alignment pins are used, align the 0.75-inch pins on the lower mating edge of the Jet system to the alignment features on the process tool. Refer to the detailed drawings for the position of the pins.
3. When the pins are in place, perform any final adjustments to the Process Tool, such as leveling and bolting to the floor.

Facilities Connections

The standard configuration of the Jet system requires electrical power, vacuum, and communication connections. These facilities connections are typically made to the Jet system at the Facilities Panel and to the Power Distribution Unit inside the EFEM. See [Figure 4-11](#).

Additional facilities may be required depending on the actual configuration. See system interface drawing and block diagram for details of any additional facilities requirements.

Refer to [Chapter 3: Specifications and Site Requirements](#) for descriptions and specifications of all required facilities specifications.

NOTICE



Safety glasses should be worn at all times when connecting any facilities to the Jet system.



WARNING

Lockout/Tagout

Working with energized equipment may cause sudden movement or electrical shock and may result in death or serious injury.

- All energy must be removed from the equipment per the facility's Lockout/Tagout procedure before servicing.
- If local procedures are not available, follow the procedure for Lockout/Tagout in **OSHA Standard 29CFR 1910.147**.
- Refer to the system power requirement specifications and use appropriate precautions.

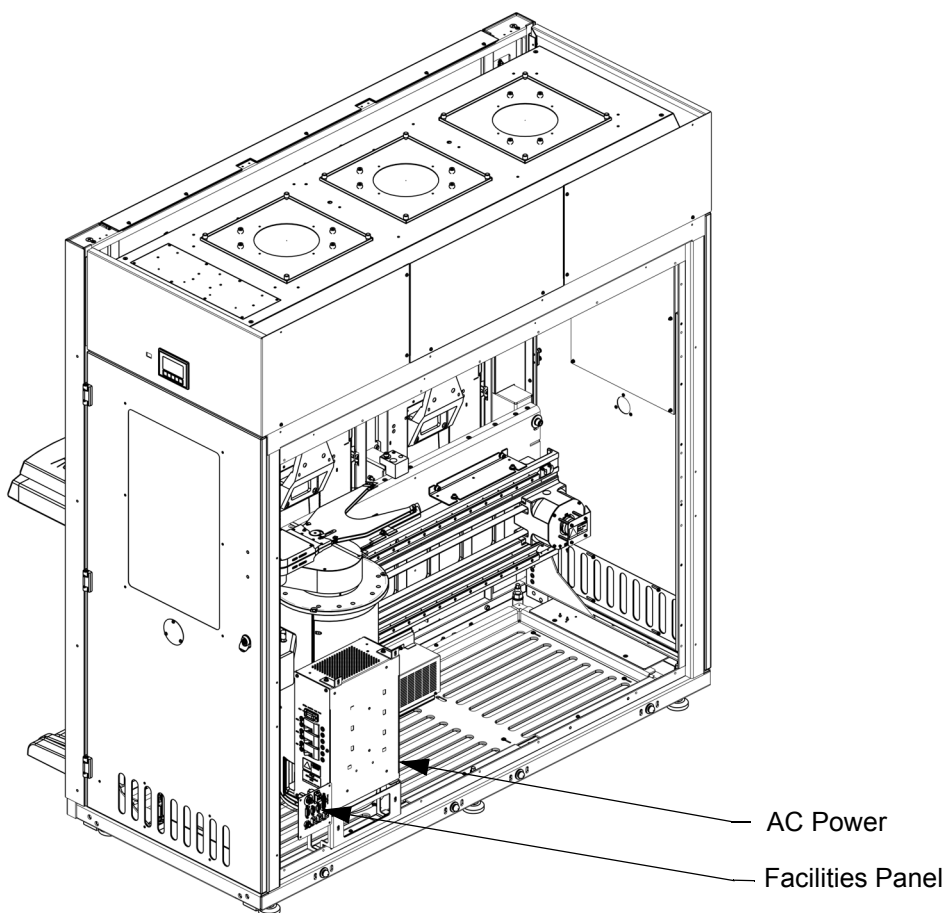


Figure 4-11: Facilities Connections (Rear covers removed for clarity)

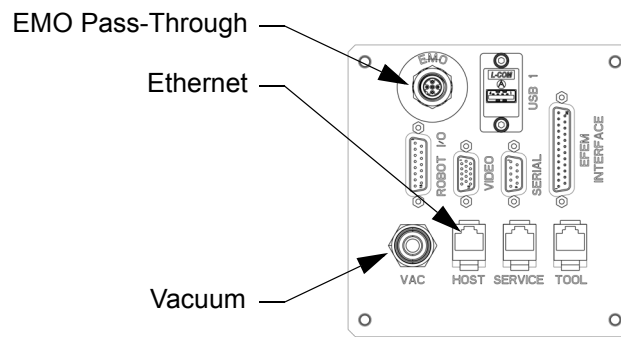


Figure 4-12: Facilities Panel

Electrical

Electrical power is connected to the Jet system for operation of the robot, load ports, sensors, and other subsystems. An AC electrical connection is provided on the Jet system's Power Distribution Unit, located in the rear of the system as shown in [Figure 4-11](#).

1. Obtain an appropriate electrical cable suitable for the electrical power requirements specified in [Facilities Specifications on page 3-8](#).
2. Connect the power cable from the main power disconnect of the facility to the power connector on the PDU as shown in [Figure 4-11](#).

NOTICE

Do not connect the Jet system power supply to facility power until all installation procedures have been completed.

EMO Circuit

An EMO button can be supplied with the Jet system for the user's convenience. The EMO circuit and all EMO wiring is the responsibility of the user. Refer [Figure 4-13](#).

A pass-through connection from the EMO button for the user's EMO circuit is provided at the Facilities Panel through a 5-Pin M12 Plug connector as shown in [Figure 4-12](#). This connection may be used for wiring convenience to bring the signal from the EMO button the host system's EMO circuits.

Once the EMO circuit is wired and tested, remove the Warning label from the EMO button.

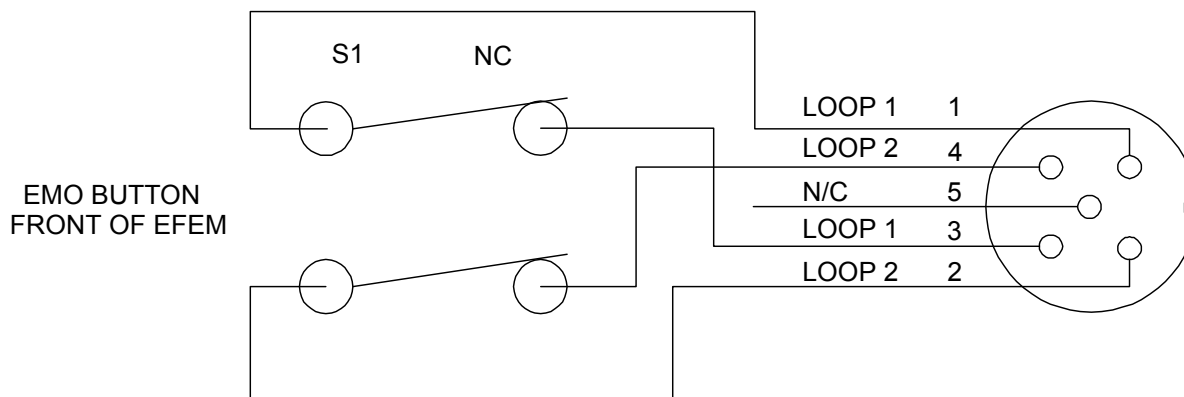


Figure 4-13: EMO Wiring Circuit

Vacuum

Vacuum must be supplied to the Jet system at the facilities panel for operation of the Load Port Modules and may be required for operation of the robot's end effector. Refer to [Facilities Specifications on page 3-8](#) for vacuum requirements.

NOTICE

Do not turn on the vacuum connection until all connections to the Jet system have been completed.

Connect the vacuum line from the facility to the 8 mm Quick Connect on the Facilities Panel as shown in [Figure 4-12](#).

Clean Dry Air - (CDA)

CDA is not required on standard Jet systems but may be required by certain load ports or other options. CDA connection is made using 8 mm (0.31 inch) O.D. tubing. Refer to the Interface drawing and component manuals for pressure and flow specifications.

Communication Connections

The standard configuration of the Jet system is designed to use 10/100 Mbps Ethernet communications with a Host Controller. The following procedures provide the information required to make all communications connections to the Jet system as shown in [Figure 4-11](#).

NOTICE

Never connect or disconnect the communications lines with power applied to the Jet system as damage to internal components may result.

Network

Communications for operation of the Jet system is accomplished using a Local Area Network (LAN). The LAN must be Ethernet compatible using the TCP IP protocol.

Connect the cable for network communications from the plant network to one of the Ethernet connectors on the Facilities Panel as shown in [Figure 4-12](#).

Power-up Sequence

The following procedure describes the steps to safely apply power to the Jet system and verify that it is ready for operation.

	 WARNING Automatic Motion Hazard Moving mechanisms have no obstruction sensors and can cause death or serious personal injury. The Robot, Aligner, Track, Load Port Modules, and FFU Fans have the possibility of automatic movement: Do not operate the Jet system without the protective covers in place. If interlocks are disabled, the possibility of automatic movement of systems within the Jet system exists.
---	---

1. Confirm that all of the installation procedures previously described in this chapter have been completed.

2. Operational Safety and Interlock Checks:
 - Ensure that the mini-environment doors are closed and secured.
3. Mechanical Check:
 - A. Verify all shipping brackets and packaging have been removed.
 - B. Ensure that the Jet system is properly and securely installed.
 - C. Ensure that the Load Port modules are properly and securely mounted to the Jet system.
 - D. Ensure that any equipment the Jet system is connected to is properly secured within the facility.
 - E. Ensure that all panels and fasteners are secure.
 - F. Ensure that the EMO button is functional. Remove the shipping warning label from the EMO button.
4. Facility Check:
 - A. Ensure that all facilities are capable of meeting, or exceeding, the requirements as described in the [Facilities Specifications on page 3-8](#).
 - B. Ensure that the power, communications, and vacuum connections have been completed.
 - C. Check all cables. Verify the connectors are fully seated and screws and locks are secured to ensure good continuity.
 - D. Verify all internal cables are routed in a safe place and away from any internal movement.
 - E. Verify all external cables are routed in a safe place and away from any travel areas.
 - F. Inspect all cables for restricting bend radii or excessive tension.
5. Pre-operation Check:
 - A. Ensure that no packing material or other objects have been left in the mini environment.
 - B. Ensure that there are no obstructions in the travel path of the robot and its end effector(s).

NOTE: *Some of the internal components of the Jet system may present travel obstructions to the robot end effector. It is the user's responsibility to control the robot to ensure that the robot and any material in transport do not come into contact with these components.*

	 WARNING
	High Voltage Hazard Improper electrical connection or connection to an improper electrical supply can result in electrical shock or burns resulting in death or serious injury or cause an equipment fire and damage to the equipment. • Always provide the Jet system with the proper electrical code compliant connections. • Maximum power consumption for the Jet system during normal operation is 200 - 240 VAC at 20 Amps. • The AC circuit must be properly protected.

	 WARNING
	Automatic Movement Turning on the facility power and air creates the possibility of automatic movement which may cause death or personal injury. Stand back. Keep away from all components that may move.

6. Turn on the AC power connection to the Jet system from the facility's electrical services.
7. Turn on vacuum and air supply if used.
8. Perform a Ground Continuity check from the surfaces of the Jet system to a known good ground.

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5 Alignment and Teaching

Overview

This chapter provides basic adjustment and calibration instructions for the Brooks Automation Jet system. When using this manual, always refer to the appropriate documentation for the specific components used on your system.

 	 WARNING
	The Jet system contains high voltages and other hazards which, if not properly handled, may result in serious injury or death. • All personnel involved with the operation or maintenance of this product must read and understand the information in the Safety Chapter. • Follow all applicable safety codes of the facility as well as national and international safety codes. • Know the facility safety procedures, location of safety equipment, and contact information. • Read and understand each procedure before performing it. • Only qualified personnel should perform the procedures

Jet System Alignment and Teaching

The components of the system were aligned at the factory prior to shipment. However, even a small misalignment can interfere with proper system operation. Thus, prior to use, the components within the Brooks Automation Jet system must be aligned to each other to prevent misplacement of material or collision of the robot with other parts of the system. Also, the Jet system must be aligned with the system that it will be operating in to prevent misplacement of material or collision of any material handling components.

Brooks Automation recommends performing the alignment procedures under the following circumstances:

- A complete alignment when the Jet system is first set up at the user's site.
- A complete check when performing routine maintenance.
- A complete check when the controller or any of the material handling modules (aligner, load port, robot, etc.) are replaced.
- A complete check if the Jet system was involved in a material transfer error or a collision.
- A complete check if the Jet system was involved when an Emergency Off (EMO) occurred.
- A partial check at the appropriate station(s) whenever any component, such as a Load Lock Module, is replaced.

Required Tools and Test Equipment

Performing the alignment procedure requires the following tools and materials:

- The parameter sheet for all robot stations from the System Acceptance Test (AT) shipped with the system
- A portable computer running control software, or a keyboard, mouse, and monitor, or the Teach Pendant, connected to the controller
- MicroTool Dummy Wafers or test material of the type and size for which the system is being set up
- The User Manual for the controller
- The User Manual(s) for each device that interfaces with the Jet system

Alignment Process

Alignment consists of adjusting the mechanical components of the system using a teach pendant or a computer to operate the Jet components. The Jet system must be installed and attached to the process tool or the customer's system.

Proper alignment ensures that the robot or material being transferred does not contact the surfaces of the Jet system and no sliding motions occur between material and support surfaces.

	 WARNING
	Tip Hazard Tip hazard exists when the Jet system is not attached to the process tool which may cause death or serious injury. Be aware of tip hazards and take appropriate precautions when aligning the components of the Jet system. Wear Personal Protection Equipment such as steel toed shoes and eye protection.

 	 WARNING
	Automatic Motion Hazard The possibility of automatic movement exists with Jet system components. These components do not have obstruction sensors and may cause death or personal injury. The Robot, Track, Aligner, Load Port Modules, and FFU Fans all have the possibility of automatic movement: Safety interlocks may require being overridden while using the Jet system's Teach Pendant. The user is responsible for any damage to the Jet system or their system as a result of using the Teach Pendant incorrectly.

NOTICE
DO NOT perform a "Home" operation of any of the material handling modules within the Jet system during the alignment procedure unless specifically directed to do so.

NOTICE

It is important to perform the alignment in the sequence shown in this section for maximum operating performance of the Jet system.

1. Read and understand [Chapter 2: Safety](#).
2. Reach each of the Alignment Procedures and be familiar with the safety warnings to ensure safety while performing the procedures.
3. Become familiar with the robot and all attached subsystems.
4. Understand the use of the Teach Pendant and remote service computer.
5. Ensure the Jet system, the process tool, and all associated components are at room temperature.
6. Power up and initialize the Jet system and all devices that interface with the Jet system. The system must be in the following state:
 - All process tool Load Lock vacuum chambers must be at atmosphere
 - All process tool Load Lock atmospheric doors must be open
7. Follow the alignment procedures in this section in the order presented. Refer to the user manual for the affected component as required.
8. Record the Station coordinates for the robot in the appropriate worksheet provided in [Appendix B: Station Identification on page 9-3](#).

Position the Jet System

Position the Jet system as required. Verify the height of the Jet system to ensure the Material Transfer Plane for the Load Port Modules is set correctly.

If an automated handling system (AGV or OHV) is being used, ensure the Jet system is properly aligned for transfers. Refer to [Position the Jet System on page 4-8](#) for instructions on positioning the system, if required.

Dock the Load Port Modules (LPM) to the EFEM

The LPMs attach to the Jet system using the kinematic mounts attached to the system. Typically, the Jet system is shipped with the LPMs attached. If the LPMs must be attached, refer to the Load Port User Manual.

Level the Jet System

Adjustable feet are provided on the Jet system. These feet are used to support the Jet system, to compensate for an uneven floor, and to relieve the casters. The Jet system must be located such that there is user access for service as shown in [Service Access on page 3-12](#). Refer to [Set the Material Transport Plane on page 4-9](#) for instructions on leveling the system. Leveling or adjusting the position is usually only necessary on new installations.

Once the Jet system has been leveled, all of the modules mounted to it through kinematic mounts should be level and properly aligned within the system, eliminating the need for any additional leveling.

Adjust the Robot and Track

The ATR robot and ATK track are kinematically mounted within the Jet system. This mounting ensures proper alignment once the system is properly installed. Adjusting the position is usually only necessary on new installations.

Adjust the End Effector(s)

The condition of all end effectors must be verified to ensure proper material handoff. Refer to the robot user manual for instruction on adjusting the end effectors. It should not be necessary to adjust the end effectors unless this is a new installation.

Adjust the Aligner

The AWA aligner is kinematically mounted within the Jet system. This mounting ensures proper alignment once the system is properly installed. Adjusting the position is usually only necessary on new installations.

Adjust the Load Port Modules

The Load Port Modules are kinematically mounted to the Jet system. This mounting ensures proper alignment once the system is properly installed. Adjusting the position is usually only necessary on new installations.

Locate and Level the Process Tool

Follow the manufacturers directions for adjusting and leveling the process tool. Refer to [Connecting the Process Tool to the Jet System on page 4-19](#) for instructions on positioning the process tool. Positioning is usually only necessary on new installations.

Ensure that the rotation axis of the process robot is perpendicular to the reference plane of the transfer chamber and that the material planes in all attached modules are parallel to the transfer module reference plane in the Jet system.

Manually Teach the Robot all Material Transfer Stations

The control software uses a station naming system for identifying specific locations within the Jet system. By identifying physical locations in this manner, it is only necessary to provide the controller with the station name instead of the complete coordinate set each time a command is issued to the controller. Multiple names may be assigned to a single physical location.

Teach the Aligner Location

The aligner acts as the “center point” of wafer transfers through the Jet system. It is used to orient the fiducial of the wafers, and it may be used to assist in centering the wafer on the robot’s end effector. Configuring the Jet system, when using an aligner, requires teaching the robot the location of the aligner first. Once taught, the aligner becomes the reference point for all other alignments within the Jet system.

End effector movement to the aligner is in a straight line from the robot’s body to the aligner chuck. No via is required, and a via should not be taught for the aligner station as it may slow down throughput. To ensure proper handoff of the wafer between the robot and the aligner, the aligner station must be taught to the robot. Refer to the controller user manual for instructions on teaching the aligner station.

Teach the LPM Locations

The LPMs provide the interface for material transfer from the facility. End effector movement to the LPM stations may use a compound curve from the robot’s body to the station. In this case, a via may be required to provide a transition point from radial movement to orthogonal movement into the station. Note that the material will move in a straight line, but the robot’s arm must follow a curved path to accomplish that.

To ensure proper handoff of the material between the robot and the load ports the LPM stations must be taught to the robot. Refer to the controller user manual for instructions on teaching the material transfer stations.

Teach the Process Tool Locations

The process tool provides material handoff locations within the tool that are accessed by the ATR robot in the Jet system for material transfer. End effector movement to these material transfer stations may use a compound curve from the robot's body to the station. In this case, a via may be required to provide a transition point from radial movement to orthogonal movement into the station. Note that the material will move in a straight line, but the robot's arm must follow a curved path to accomplish that.

To ensure proper handoff of the material between the robot and these stations, the material transfer stations must be taught to the robot. Refer to the controller user manual for instructions on teaching the material transfer stations.

Final Checkout

Once all material handling devices in the Jet system have been set up for all transfers, verify proper transfer of material to and from all stations within the system.

NOTE: *This procedure must be performed during initial setup and at any time that any material handling device is damaged, removed and replaced, or changed.*

	 CAUTION
	Eye Injury Hazard Breaking material may produce flying shards which may cause personal injury. Wear protective eye equipment at all times when using wafers or any other fragile material.

Procedure Category

Type 2 Procedure: Equipment is energized and all energized circuits are covered or insulated. Work is performed remotely using the teach pendant or service computer.

Required Tools and Test Equipment

- MicroTool Dummy Wafer(s) or test wafer(s) of the appropriate size
- FOUP(s) of the appropriate size
-

Checkout Procedure

1. Using the Teach Pendant, PICK the material from one station and PLACE it into another station while observing the system to verify proper operation.
2. Repeat the procedure to transfer the material back to its original location.
3. Repeat the procedure for each end effector for each station.

6

Operation

Overview

This chapter provides a review of the Jet system and general operation instructions for the Jet and the major subsystems. The operation of the Jet system is covered for both normal and emergency conditions.

This chapter is not a complete reference for developing the software and hardware for Jet system operation. The user is required to configure the details of operation for their specific application, such as material transfer routing and option configuration.

For illustration purposes, the components shown here are the Razor Robot, Razor Track, Razor Wafer Aligner, and Fusion controller. When using this manual, always refer to the appropriate documentation for the specific components used on your system.

	 WARNING
 	The Jet system contains high voltages and other hazards which, if not properly handled, may result in serious injury or death. • All personnel involved with the operation or maintenance of this product must read and understand the information in the Safety Chapter. • Follow all applicable safety codes of the facility as well as national and international safety codes. • Know the facility safety procedures, location of safety equipment, and contact information. • Read and understand each procedure before performing it. • Only qualified personnel should perform the procedures.

Theory of Operation

The Jet system is a self-contained atmospheric mini-environment for use as an Equipment Front End Module, EFEM, front-end for process and metrology tools. The system provides a positive-pressure ISO Class 1 mini environment for atmospheric material handling with a precision robotic system for horizontal material transfer.

Wafers, or other material, are introduced into the Jet system through Load Port Modules (LPMs). These modules allow up to 25 wafers to be loaded at one time using SEMI standard wafer carriers. The LPMs provide Carrier ID as an option for tracking carrier location within the facility. Wafers may then be passed through the Jet system to the user's process tool.

The material in each load port module attached to the front of the Jet system is mapped to ensure proper material transfer. Material is then transferred to and from the Load Port Modules as specified. Wafers may be aligned as part of the transfer to a process tool attached to the rear of the mini-environment. After processing the material is returned to the carriers on the load port modules.

The mini-environment enclosure provides support for the Fan/Filter Unit, internal lighting, ionizers, and any other equipment associated with the EFEM. The FFU creates a laminar air flow that provides a positive pressure within the EFEM to control airflow and prevent contamination from the surrounding environment from entering the EFEM. Vents on the side and bottom of the mini-environment enclosure allow regulation of the air flow through the mini-environment.

The mini-environment provides air test ports per I300I (one per door). It is the user's responsibility to perform any particle measurements. Optional ionizers placed within the airflow reduce/eliminate static charges on the material being transferred within the mini-environment.

The mini-environment has SEMI compatible load port interfaces and provides a centralized location for all facilities connections. All material handling components are installed using kinematic mounts that are adjusted at the factory.

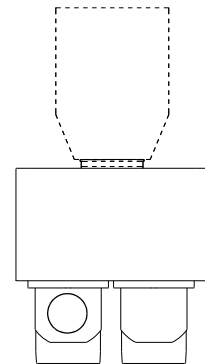
In all configurations of the Jet System, one side of the EFEM is designated as the "Service Side". The Service Side provides access to the system controller, Power Distribution Unit, Facilities Panel, FFU electronics, and aligner, if installed. Typically, the EMO button and the optional Light Tower are installed on the outside of the EFEM on the Service Side.

The Jet mini-environment enclosures are available in 2-bay and 3-bay models formed from CRS (cold rolled steel) with a conductive powder coat finish to provide structural rigidity and noise immunity.

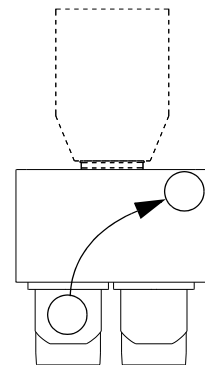
Operation Overview

The following sequence demonstrates the normal operation of the Jet system. The sequence shown is for a Jet system with two Load Port Modules, one robot without a track, and one aligner connected to a process tool with one load lock. The wafer flow is from one Load Port Module to the process tool load lock and then back to the original Load Port Module.

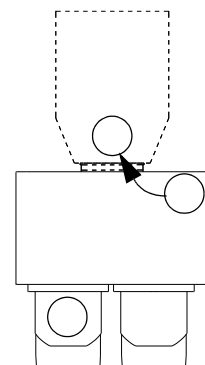
1. Load material to be processed into the system:
 - A. A wafer carrier is placed on one of the Load Port Modules attached to the Jet system.
 - B. The host instructs the Load Port Module to open the wafer carrier and map the wafers in the carrier.
 - C. The LPM provides the wafer map to the host when requested.



2. Pick wafer from carrier and align:
 - A. The host instructs the atmospheric robot to remove a wafer from the carrier on the LPM and place it on the atmospheric aligner within the Jet system.



3. Align wafer and place into the process tool:
 - A. The host instructs the atmospheric aligner to align the wafer and orient the fiducial of the wafer.
 - B. The host instructs the atmospheric robot to pick the wafer from the aligner.

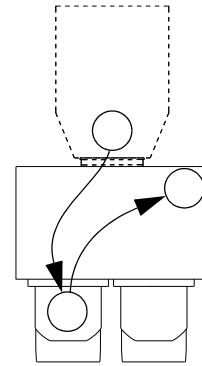


The aligner measures the angle and eccentricity of the wafer and adjusts the robot end effector's position during the pick to center the wafer on the end effector.

- C. The host instructs the robot to place the centered and oriented wafer into the user's process tool.

4. Pick next wafer from carrier and align. Place processed wafer into the carrier.

- A. The host instructs the atmospheric robot to remove the next wafer from the carrier on the LPM and place it on the atmospheric aligner within the Jet system.
- B. The host instructs the robot to remove the processed wafer from the user's process module and place it into the carrier on the LPM.



5. The cycle (steps 3 and 4) repeats until all wafers in the carrier have been processed.
6. Once all of the wafers within the wafer carrier have been processed, the wafer carrier is removed and replaced with the next carrier to be processed.

Block Diagrams

A Block Diagram showing communications and power within the Jet system is provided in the system manual.

Station Naming System

Control software uses a station naming system for identifying specific locations within the Jet system and the system it is interfacing with, as shown in [Figure 6-1](#). The Jet systems use a true Cartesian coordinate system where each station is given a name and identified by its X, Y, and Z position. By identifying the stations in this manner, it is only necessary to provide the controller with the station name instead of the complete coordinate set each time a station related command is issued. Multiple station names may be given to a single physical location.

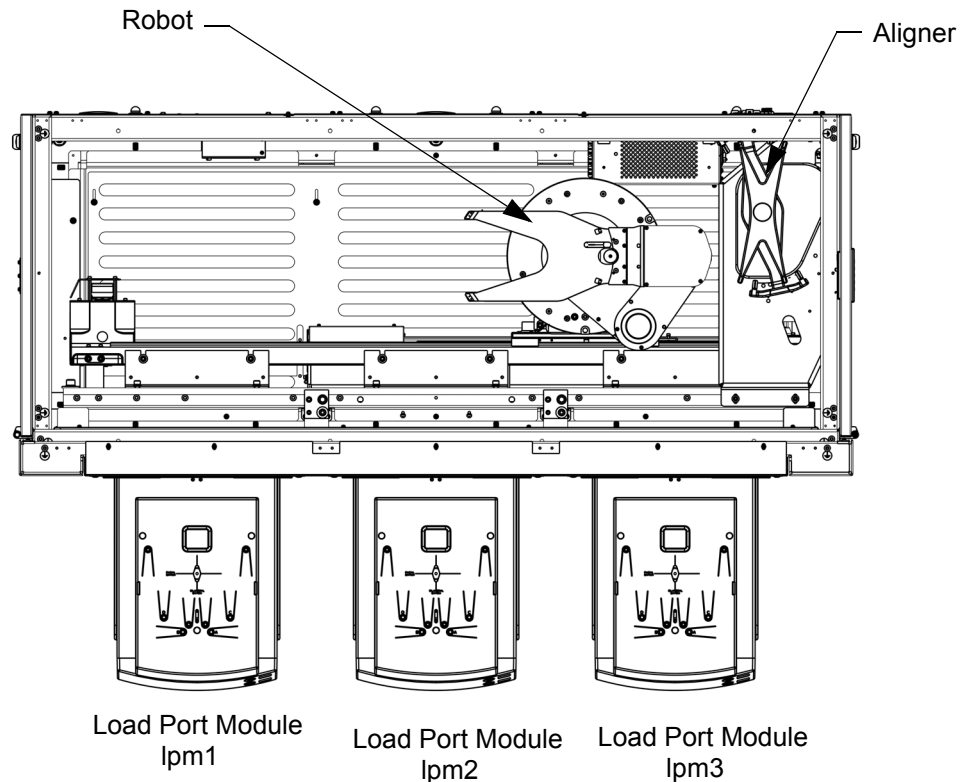


Figure 6-1: Station Assignments - Jet System 2

Brooks Automation configures the stations on the Jet systems as shown unless different station assignments are specifically requested. All references to setting stations in this manual will reflect the standard Brooks EFEM station assignments.

Frame of Reference

Before setting stations or using the Jet system, it is important to understand the Frame of Reference used within the system.

Material is transferred to specific locations, or stations, within the system by the robot. Each location is defined by its X, Y, and Z position within the system's Frame of Reference. Station definition is the process of defining each of these locations, which are then stored in the controller's memory for future reference. It is important to note that the system's frame of reference is defined by the controller, as described below, and that each station is defined by the X, Y, and Z coordinates, and by other station values.

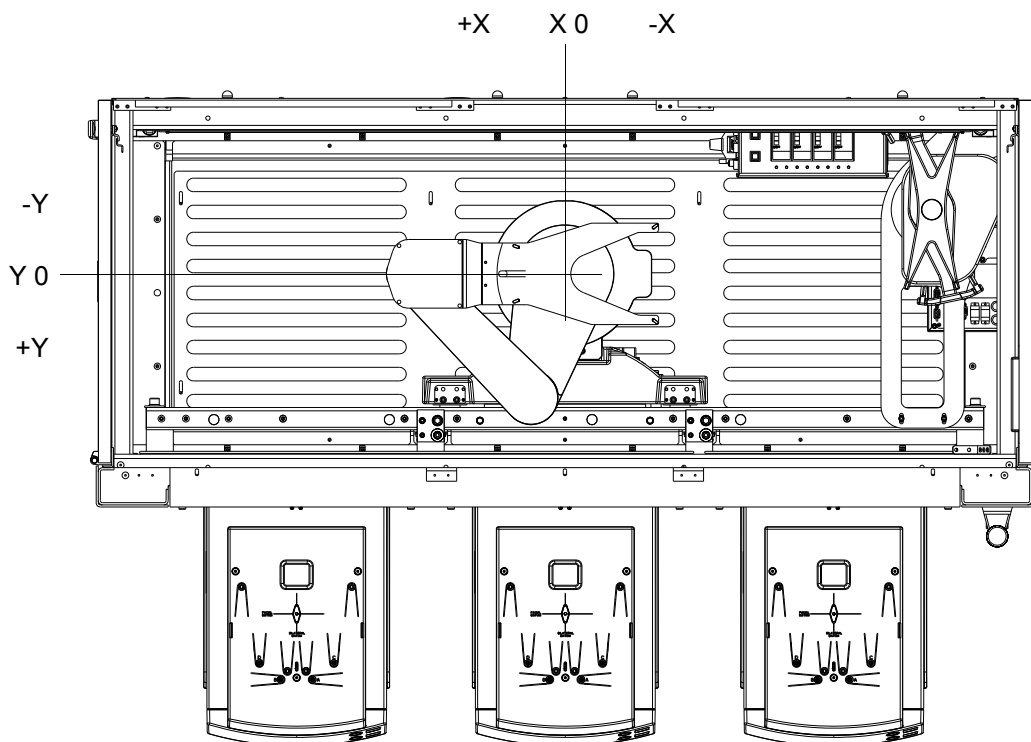


Figure 6-2: Global Cartesian Frame of Reference - Fixed Robot

System Frame of Reference

The typical frame of reference for the Jet system is defined by the global cartesian coordinate system. The top view shown in [Figure 6-2](#) is a horizontal x-y plane, and each position within this plane is defined using a cartesian coordinate notation. The third axis in the Jet system's Frame of Reference is the vertical, or Z, axis.

When the robot is mounted in a fixed location, as shown in [Figure 6-2](#), the system's origin is centered on the robot as shown. When the robot is mounted on a track, the system's origin is centered on the robot's position when the track is at its Home location, as shown in [Figure 6-3](#)

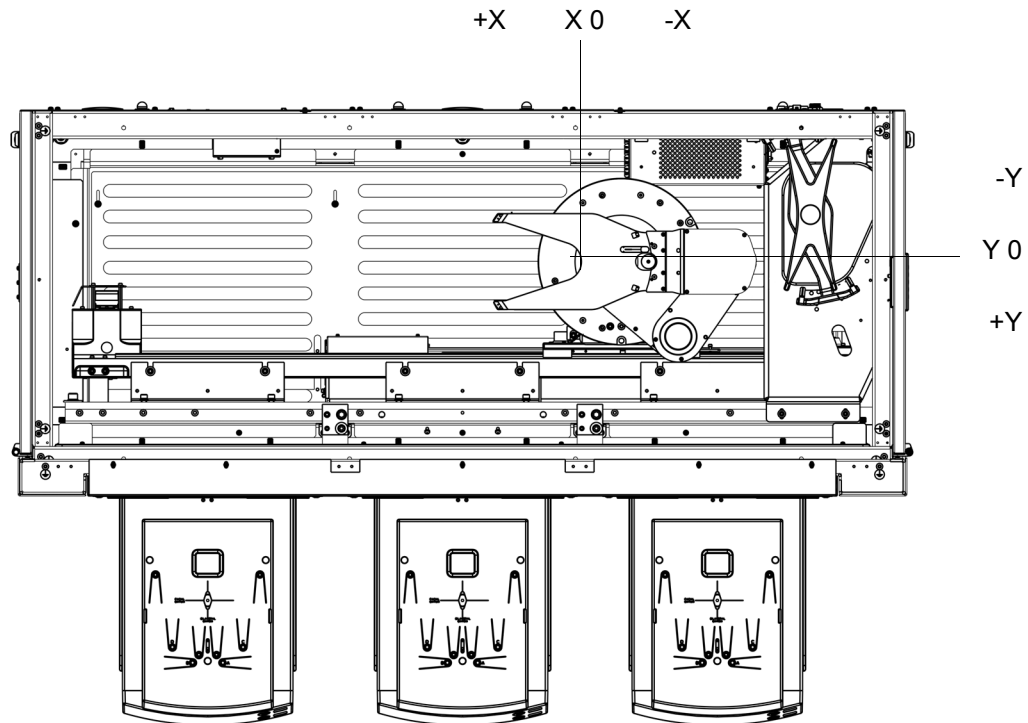


Figure 6-3: Global Cartesian Frame of Reference - Robot on Track

Robot Frame of Reference

The typical cylindrical frame of reference for the ATR robot is defined by the robot's coordinate system regardless of how the robot is mounted. Looking at the top view of the system, the robot's rotational, or T (theta), position value increases from 0° at the Home position to 360° in a counter-clockwise direction. The robot's radial, or R, axis is measured from the center-line of the robot radially outward to the material center location on the end effector in millimeters.

The robot's vertical, or Z, axis is measured from the robot's vertical Home position in millimeters. The robot's optional wrist, or W, axes increase from 0° at the Home position to 180° in a counter-clockwise direction and 0° to -180° in a clockwise direction. The optional track, or S, axis, is measured from the track's Home position in millimeters.

Safety Interlocks

The Jet system is provided with safety interlocks to ensure the safety of the operators and service personnel. See [Safety Interlocks on page 2-10](#).

	 CAUTION
	Failure to review the Safety section and follow the safety warnings can result in death or serious injury. Do not attempt to perform alignment or teach procedures until you have read and understand the information in the Safety chapter. Read and understand each procedure before performing it. Only qualified personnel should perform the procedures

 	 WARNING
	Automatic Motion Hazard If the Door Interlock for the mini-environment is bypassed or disabled, the possibility of automatic movement of components within the Jet system exists. These components do not have obstruction sensors and may cause death or serious injury. Be aware that the Robot, Track, Aligner, Load Port Modules, and FFU Fans have the possibility of automatic movement. Be aware that components in the system have power applied. Be aware that use of the Jet system with the Door Interlock bypassed is at the user's own risk.

Door Interlock Circuit

Access into the Jet system is through the side doors. These doors contact a safety interlock switch that signals the system controller that an unsafe condition is in effect when the door is open. The door interlock disables the servos of the robot to prevent motion while the door is open. The state of this interlock may be monitored through the controller.

Emergency Off (EMO) Circuit

The EMO button supplied with the Jet system is provided to allow the user to configure a single EMO button to control all material handling and processing components connected to the Jet system. A pass-through connection for the user's EMO circuit is provided at the Facilities Panel through a Eurofast connector. The action caused by

pressing the EMO button is determined by the user.

Typically, the button will be configured so that pressing it will remove all power from the Jet system and all attached components. Once the emergency is resolved, which can include determining the reason for the emergency and checking the station involved during the emergency, power can be restored to the Jet system and all attached components. With power restored the robot and all attached components should be re-initialized. Processing can then be restarted.

NOTICE
The controller may contain an Uninterruptable Power Supply (UPS) that is used to provide a controlled shutdown of the controlled equipment (E-Stop) and of the controller in the event of power loss.

Start-Up

The Jet system is started by applying power and plant facilities as previously specified. Once this is done, the Jet system is ready to operate and will accept commands over the Ethernet communications line.

NOTE: *All switch settings, communications connections, power connections, and facilities connections should be made before power is applied.*

This section describes the recommended procedure for powering up the Brooks Automation Jet system under normal circumstances.

1. Verify that all of the installation procedures previously outlined have been completed.
2. Ensure that all switch settings are set according to the instructions.
3. Turn on the PDU starting with CB1, then CB2, CB3, and finally CB4.
 - FFU Display turns on
 - Interior service lights turn on
4. Turn on all load ports.
5. Turn on the robot automation controller.
 - Refer to the robot user manual for correct initialization sequence.
6. If the initialization sequence executes without error, then all the components are communicating successfully.
7. Ensure all components are properly referenced (calibrate the robot, home the aligner, etc.).

Normal operation of the Brooks Automation Jet system is controlled by the user's controller. Normal operation would typically proceed as follows:

1. Power up the Jet system as previously described.
2. Power up the user's controller as directed.
3. Once all systems are up and running properly, proceed as directed by the user's controller.

Normal Running

The exact usage of the Jet system must be determined by the user. Each component has been described in this manual with the intention of providing the user with the knowledge to use this tool in the most appropriate manner for their application.

Safe Shutdown

The following shutdown procedure is used to remove power from the Jet system in an orderly manner and place the components within the Jet system in safe conditions. This procedure is used to prepare the system for repair, removal, or maintenance.

NOTE: *When the host controller is to be shut down, the Jet system should be shut down first.*

NOTICE

The shutdown procedure is used in the normal shutdown of the Jet system.

This procedure completely removes the power source and all other facilities to the Jet system and provides guidelines for lockout/tagout.

This procedure is NOT the same as an EMO circuit or other safety interlock.

1. All material transfers should be completed (move all material to the appropriate LPMs).
2. Command all modules (aligner, robot, LPM, etc.) to a known safe position (e.g., Home).
3. Turn off and relieve all pressure from process supply lines to the Jet system (e.g., vacuum) compressed air if applicable.
4. Shut down the robot controller.
 - A. See Automation User manual for correct procedure for shutdown.
 - B. Shut down the controller by turning off the Power Switch.

NOTE: *Once the controller has been shut down it must remain off for at least 5 seconds before turning it back on.*

5. Turn off Power at the PDU starting with CB2 and CB3 and then the main power CB1.
6. Remove the power cable from the source and disconnect it from the Jet system.
7. If moving the Jet System, disconnect the communication cables to the Jet system.

8. Secure the Jet system using Tagout procedures defined by the facility.

The Jet's main power circuit breaker includes an energy isolating device to prevent the controller from being plugged into the facilities power outlet, along with information about the purpose of the tagout and the person responsible. If no such procedures exist, follow the procedure for Lockout/Tagout in OSHA Standard 29CFR 1910.147.

9. Secure the compressed air supply line using tagout procedures defined by the facility.

These procedures may include an isolating device to prevent the supply lines from being connected into the facilities supply, along with information about the purpose of the tagout and the person responsible. If no such procedures exist, follow the procedure for Lockout/Tagout in OSHA Standard 29CFR 1910.147.

NOTE: *This procedure only shuts down facilities to the Jet system and its subsystems. Any user equipment will remain powered up.*

10. Verify that Power has been successfully shut down by testing the AC outlets on the PDU using a volt meter.

Lockout/Tagout Procedure

 	 WARNING
	Lockout/Tagout Working with energized equipment may cause automatic or sudden movement which may result in death or serious injury. • All energy must be removed from the equipment per the facility's Lockout/Tagout procedure before servicing. • If local procedures are not available, follow the procedure for Lockout/Tagout in OSHA Standard 29CFR 1910.147. • Refer to the units specifications for system power requirements and use appropriate precautions.

1. Notify affected personnel that a lockout/tagout is required.
2. Complete safe shutdown of the JET EFEM per process in [Safe Shutdown on page 6-12](#).
3. Turn off PDU circuit breakers in order CB3, CB2, CB1.
4. Rotate CB1 padlock bar to the locking position as shown in [Figure 6-4](#).

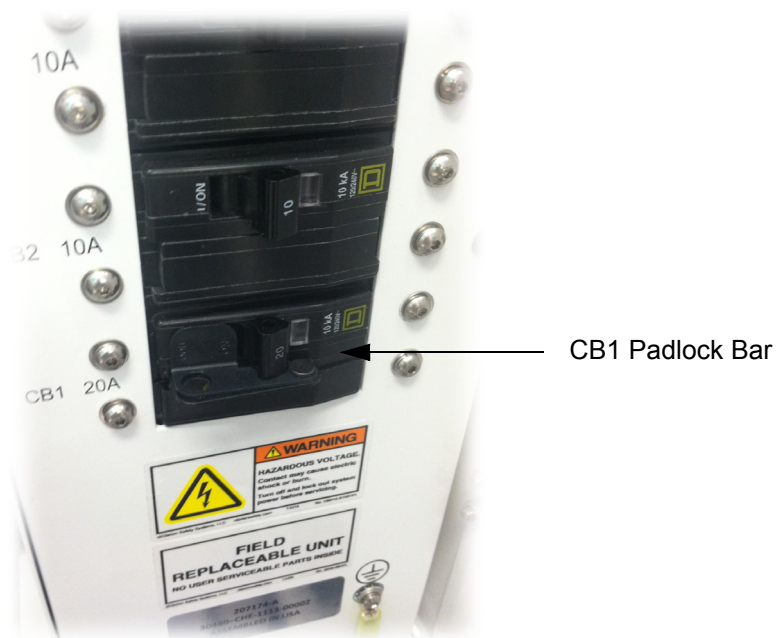


Figure 6-4: Padlock

5. Attach a lock and warning tag onto the locking bar as shown in [Figure 6-5](#).
6. Use a volt meter to electrically verify that the Jet EFEM is de-energized.

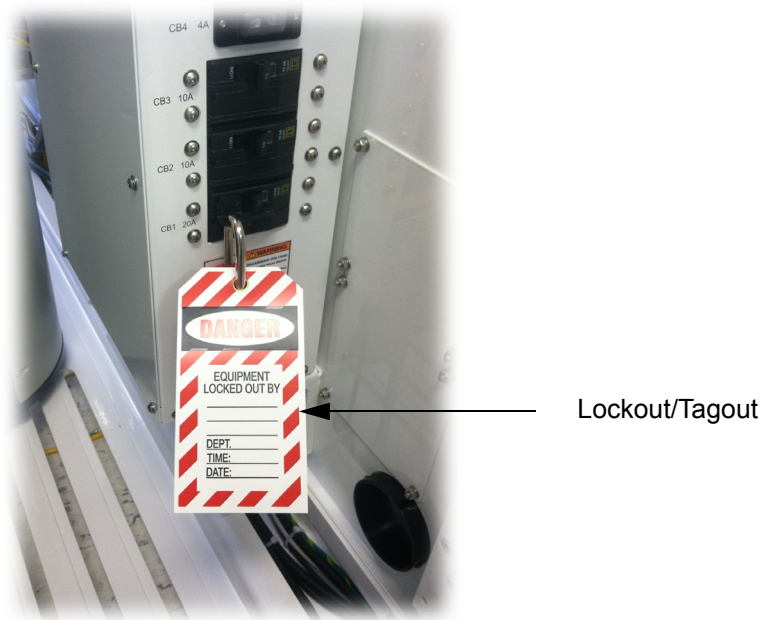


Figure 6-5: Lockout/Tagout

Remove Lock and Tag

1. Inspect the work area to ensure that non-essential items have been removed and that components are intact and capable of operating properly.
2. Check the area around the equipment to ensure that all employees have been safety positioned or removed.
3. Remove only the locks and tags you have attached.
4. Notify affected employees that locks and tags have been removed immediately after removing locks and tags and before starting equipment.

Jet System Component Overview

The Jet system components and subsystems are discussed in this section. Some components may not be present on a particular system.

The EFEM consists of a mini-environment with a Fan/Filter Unit (FFU), a material transfer robot, a wafer aligner, an optional track to allow the robot to access more than two load port modules, and up to three Load Port Modules (LPMs).

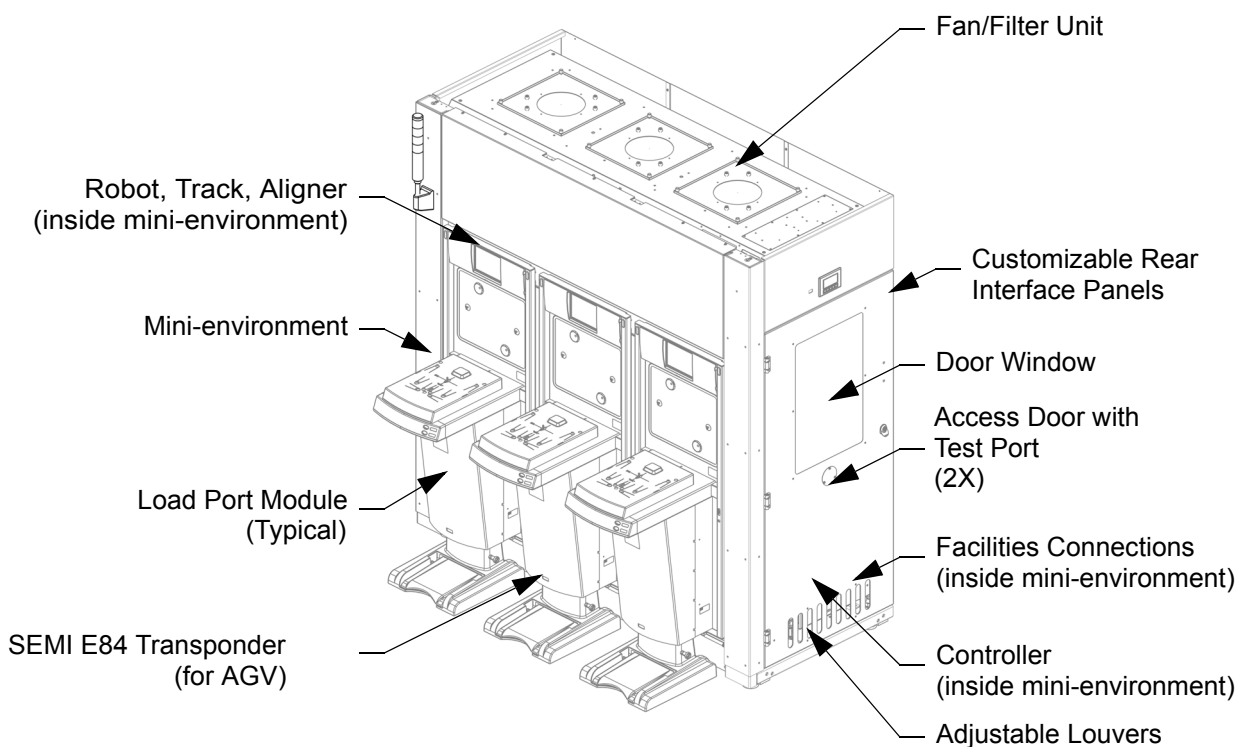


Figure 6-6: Jet System

Outrigger Configuration Procedure

This procedure describes the procedure for rotating the rear outrigger wheel position for flush Jet installation. The jet should be in front of its final location before performing these steps.

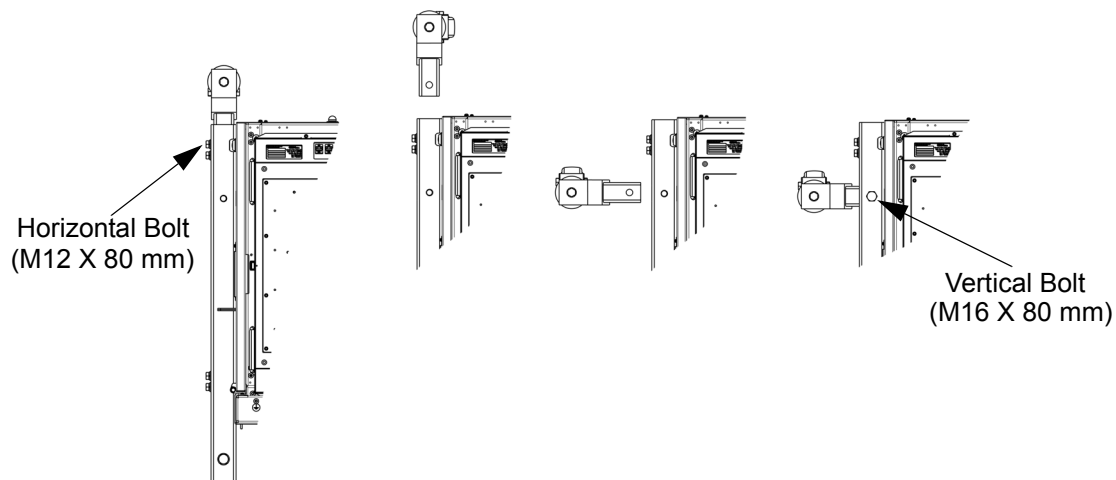


Figure 6-7: Outrigger Installation

1. Adjust the casters till the wheels are no longer in contact with the floor and the EFEM is sitting on the leveling pads.
2. Remove the horizontal bolt retaining the caster. Remove the spare vertical bolt from the top of the outrigger assembly and set it aside.
3. Remove the caster and replace the horizontal bolt in the outrigger assembly.
4. Align the caster with the cutout on the outrigger assembly and insert the caster into the cutout.
5. Secure the caster using the vertical bolt retained from Step 2.
6. Lower the wheels to lift the Jet slightly off the ground.
7. Move the Jet into position.

	CAUTION
	Tip Hazard
JET EFEM must not be transported with outriggers in alternate position. Use only for final positioning.	

Fan/Filter Unit with Active Pressure control (FFU)

The Fan Filter Unit (FFU) provides airflow and filtering to maintain an ISO Class 1 or better material handling environment within the Jet system while maintaining positive internal pressure.

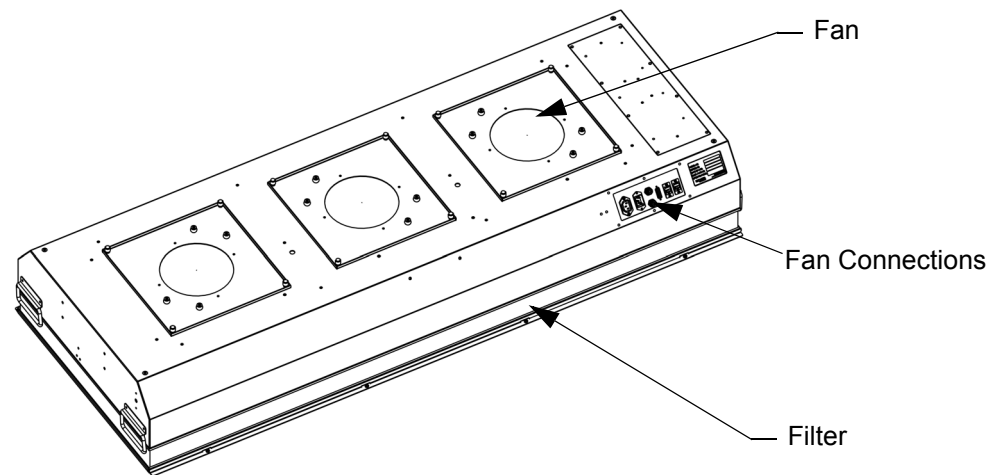


Figure 6-8: Fan/Filter Unit

Description

The Fan/Filter Unit is equipped with an active differential air pressure that provides set-point monitoring.

The FFU operates between 200-240VAC. Communications is through Ethernet Modbus TCP protocol. A touchscreen display is provided for monitoring FFU status as well as changing the pressure setpoint, hi, and low pressure alarms may be adjusted. All features may be set and monitored via Ethernet. Additional discrete IO is available through a DB9 connector. Fan and pressure status only are available through discrete IO.

The pressure setpoint and alarms are factory set to meet SEMATECH best practices and ISO Class 1 specifications. Changing the pressure setpoint and EFEM vent louvers may cause the EFEM to be out of spec with ISO Class 1 specifications.

FFU Controller

The FFU Controller is integrated in the unit. An external display with touch screen is mounted to the upper panel or door on the service side. The controller is designed to automatically control air pressure in the mini-environment. Differential pressure is monitored and a PID control algorithm is used to adjust the fan speed. For direct communication to the FFU via Ethernet, see FFU programmers guide supplied with this manual.

Fan Speed Adjustment

Fan speed or mini-environment pressure may be set by the user. The fan is then monitored and driven to maintain the commanded set-point.

Set-points and units of measure may be set using the touch screen display or through the Ethernet communications interface.

Air Pressure Sensors

The FFU uses a pressure transducer to monitor air pressure in the mini-environment. Tubing is run to the mini-environment and to the bay side to monitor the change of pressure from one side of the FFU to the other. The pressure differential between the EFEM and the Bay/Chase is monitored through the connection to the FFU Controller.

Theory of Operation

The FFU provides a clean, laminar air flow through the mini-environment. User adjustable and monitored fan speed provide air control with the doors closed. All controls are accessed and controlled through software, eliminating moving parts.

Operational Interlocks

- If a fan fails or operates erratically, an indicator light is activated, and a signal is sent to the host.
- If the pressure in the mini-environment deviates from the set point, an indicator light is activated, and a signal is sent to the host.

Start-Up

To start the Fan/Filter Unit, ensure it is in a safe state and connected to the Power Distribution Unit. Once the controller is running, the FFU is controlled through the Ethernet connection. The FFU will automatically ramp up to its set-point without manual intervention in the mode it was previously set to.

Basic Fan/Filter Unit Functions

All FFU functions, including fan speed, are controlled and monitored through an Ethernet connection. Fan motor and pressure alarms are also available on discrete IO.

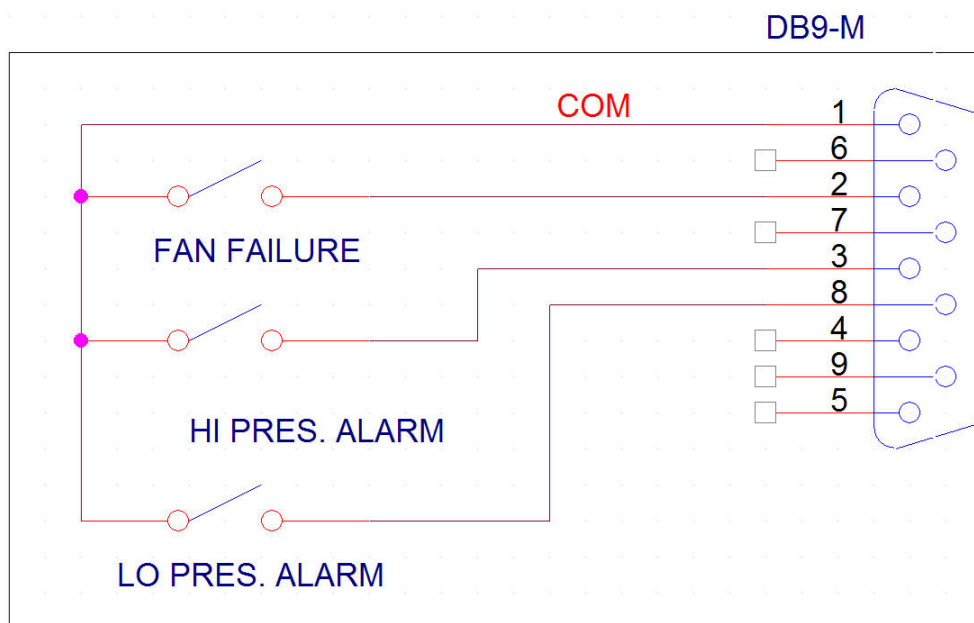


Figure 6-9: FFU IO Connector Pinout

Shutdown

To shutdown the Fan/Filter Unit, remove power from the Power Distribution Unit.

Connections, Controls, and Indicators

Figure 6-10 shows the location of all connections and indicators on the Fan/Filter Unit.

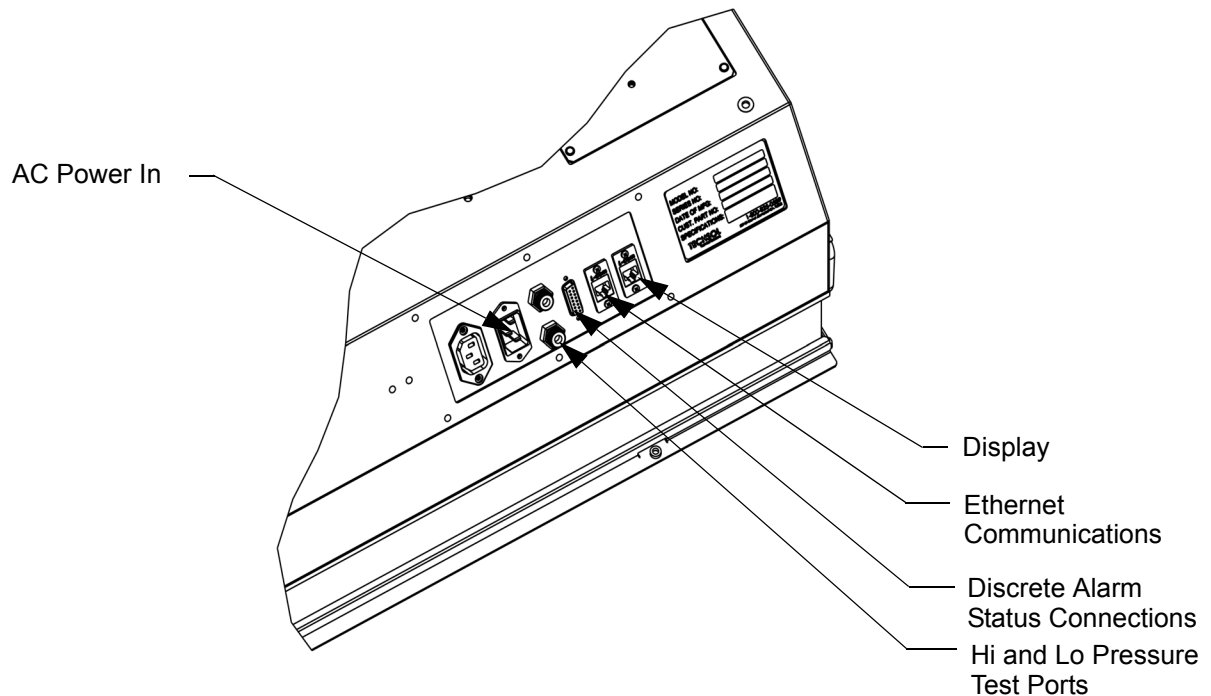


Figure 6-10: Fan/Filter Unit Connections

Automatic Pressure Control Display Operating Procedure

Main Screen Operation (Function F1)

Pressing Function key F1 will display the main screen.

1. **Differential Pressure Reading** - The pressure transducer will display real time pressure readings in both units of Pascal and inches of water column ("Wg).

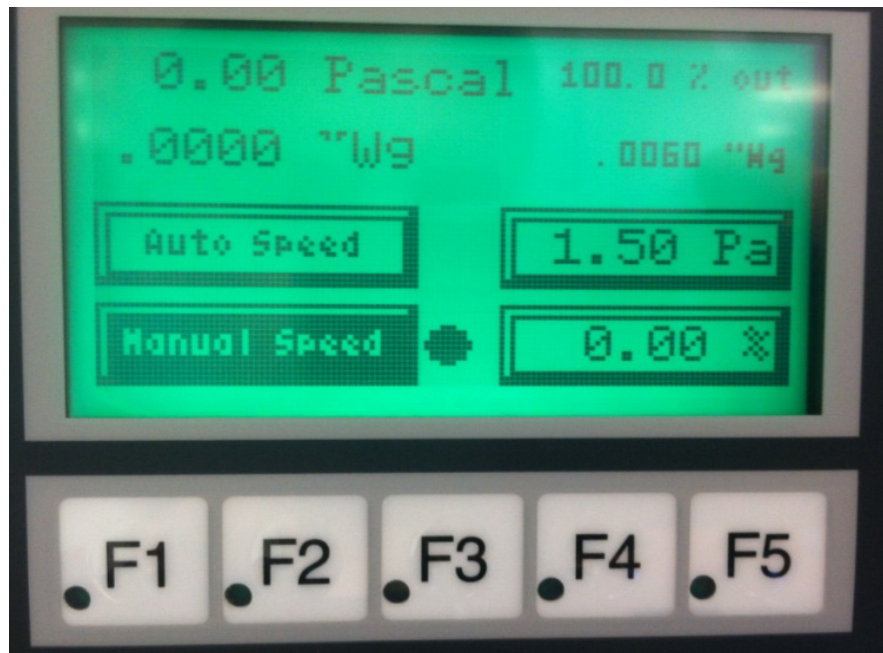


Figure 6-11: Main Screen (F1)

2. **Auto Speed Mode Button** - Enabling this mode will automatically adjust the fan motor speed to maintain the differential pressure set point value.
3. **Manual Speed Mode Button** - Enabling this mode will set the fan speed to the manual speed set point.
4. **PID Speed Output** will display the output of the PID controller. The value is shown in percentage of maximum fan speed. This display value is only valid during Auto Speed mode.
5. **Differential Pressure Set Point**
 - The differential pressure set point is displayed in units of Pascal. When pressed, a keypad will appear allowing the set point to be changed. Set point must be set in units of Pascal.
 - The differential pressure set point is displayed in units of inches of water column (\"Wg).
6. **Manual Speed Set Point** - will display the manual speed set point in percentage of maximum fan speed. When pressed, a keypad will appear allowing the set point to be changed. Acceptable values are 0 - 99.99%.

Alarm Screen Operation (Function F2)



Figure 6-12: Alarms (F2)

Pressing the function key F2 will display the Alarms screen. Pressing F2 again or F1 will return to the main screen.

1. **Low Differential Pressure Alarm** - This indicator will flash when the M-E differential pressure falls below the set point. The alarm will activate after the delay time set point. When pressure returns above the set point, the alarm will deactivate.
2. **Low Pressure Alarm Set Point** - This button will display the low differential pressure alarm set point. When pressed, a keypad will appear allowing the set point to be changed.
3. **High differential Pressure Alarm** - This indicator will flash when the M-E differential pressure rises above the set point. The alarm will activate after the delay time set point. When pressure returns below the set point, the alarm will deactivate.
4. **High Pressure Alarm Set Point** - This button will display the high pressure alarm set point. When pressed, a keypad will appear allowing the set point to be changed.
5. **Delay** - This button will display the time delay set point for both alarms to activate. When pressed, a keypad will appear allowing the set point to be changed. The delay can be set to 0 or in increments of 1 minute. Non-zero values will prevent unintended alarm signals during the delay time.

Fan Speed Status Screen

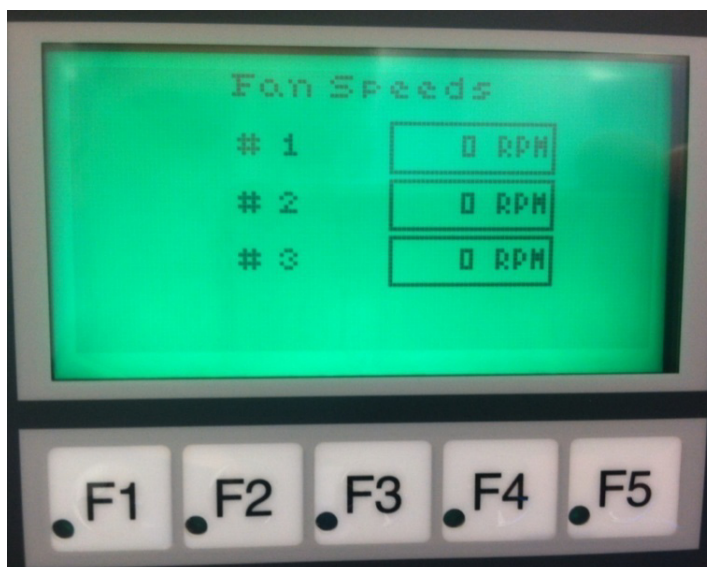


Figure 6-13: Fan Motor Speeds (F3)

Pressing function key F3 will display the Fan motor status screen. Each fan motor is displayed in units of RPM. There are no function buttons in this screen. Pressing F3 again or F1 will return to the main screen.

Internal Setup

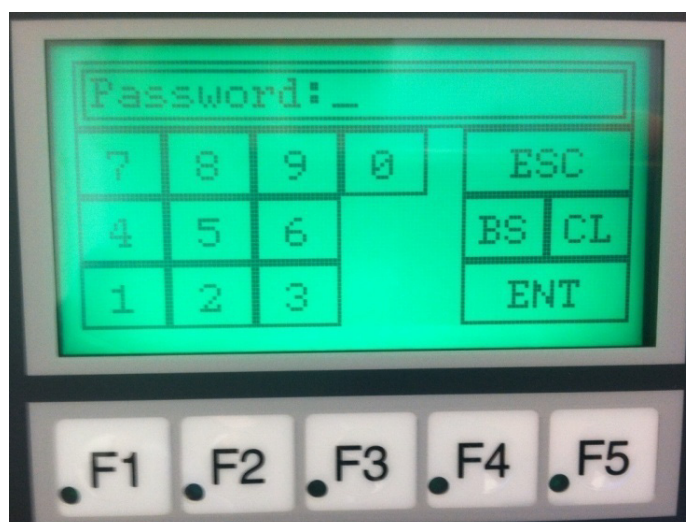


Figure 6-14: FFU Settings (F5)

This screen provides access to factory PID control settings. Contact Brooks Automation support. Pressing ESC will return to the main screen.

NOTE: *PID control settings are factory calibrated for optimal performance for the JET EFEM. Changing these settings without proper procedure and test equipment may reduce the mini-environment cleanliness performance and the life expectancy of the fan motors and filter media.*

Facilities Panel

The Facilities Panel, shown in [Figure 6-15](#), is the user interface to the Brooks Automation Jet system. It provides a central location for all facilities, communications, and control connections.

The Facilities Panel is mounted inside the mini-environment on the Service Side on the rear of the system next to the Power Distribution Unit. For some specialized installations, the Facilities Panel may be mounted in other locations or orientations.

Access to the Facilities Panel for user connections is through the cable port below the Facilities Panel.

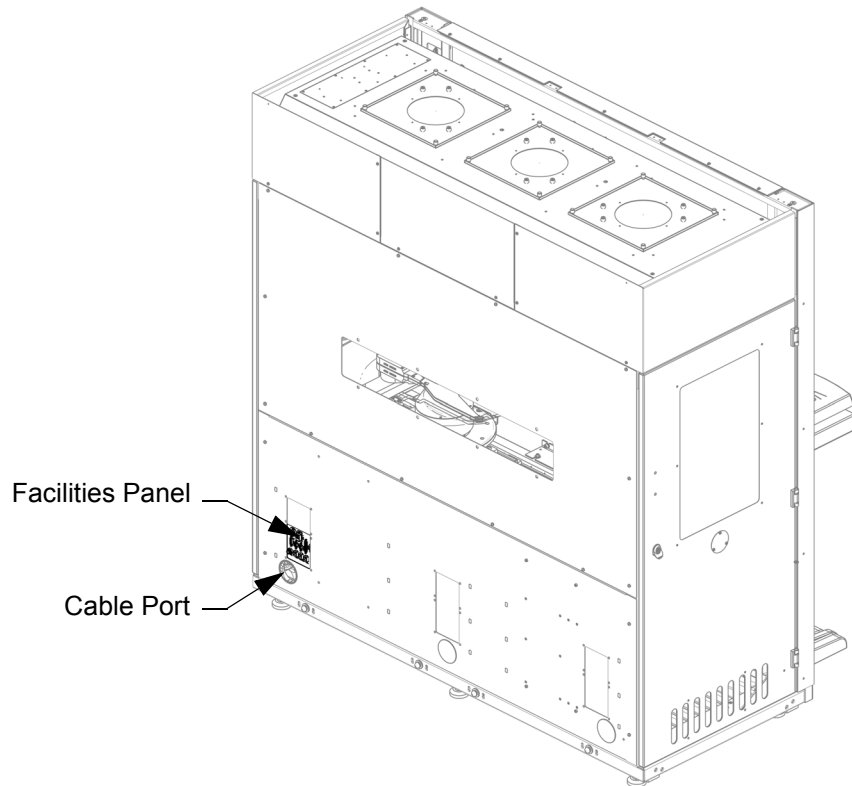


Figure 6-15: Facilities Panel

Facilities Panel Functions

The Facilities Panel provides the following functions:

- Creates a central connection point for all Jet system facilities connections
- Enables complete access to the controller through an RJ-45 connector for use with IEEE 802.3 style communication (Ethernet)
- Provides a central location for all user connections (EMO and User Interface)

The Jet system is controlled by a single cable from the host controller using an Ethernet LAN. Different configurations of the Jet system provide different external interfaces.

Connections, Controls, and Indicators

Figure 6-16 shows the location of all connections found on the Facilities Panel. Table 6-1 lists the connections found on the Facilities panel, and shows which type of connectors are used.

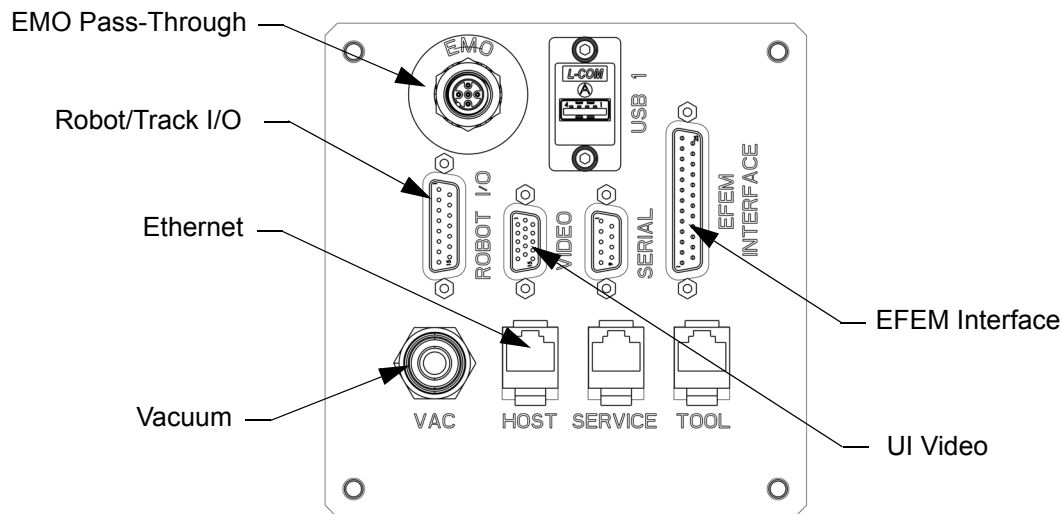


Figure 6-16: Facilities Panel Connections

Table 6-1: Facilities Panel Connections

Label	Description	Connector Type
EMO	Pass through connection to EMO button for user EMO circuit	Female M12 Pin
ROBOT I/O	Accepts connector from robot or track I/O cable	DB15
Host	Ethernet from Host Controller to controller	RJ-45
Service	Ethernet to controller and other Jet System devices	RJ-45
Tool	Spare Ethernet pass-through for additional devices	RJ-45
Video	User Interface video connection	Female HD-15
VAC	Vacuum	8 mm Quick Connect
USB	User Interface Keyboard/Mouse	USB A

Power Distribution Unit - PDU

The Power Distribution Unit (PDU), shown in [Figure 6-17](#), provides a single point for connection to the plant's facilities for AC power. The PDU distributes AC and DC power to all installed devices in the Jet system which provide their own conversion from AC power or are connected to the DC power source within the PDU.

PDU is located in the rear of the Jet EFEM on the Service Side. It is easily accessible for service. User connection access is through the cable port below the Facilities Panel.

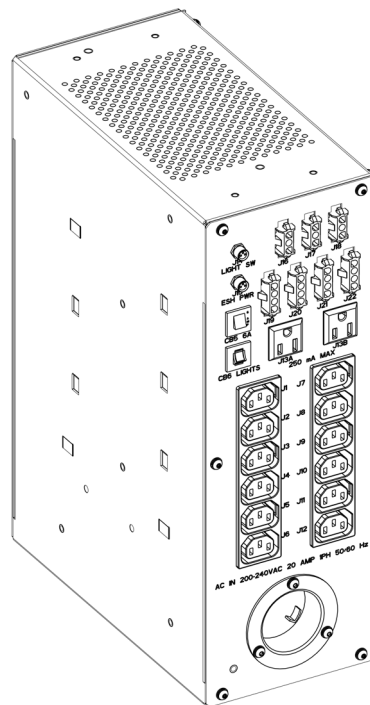


Figure 6-17: Power Distribution Unit

PDU Functions

The Power Distribution Unit provides the following functions:

- Creates a central connection point for all power connections
- Provides 24 VDC power for units requiring DC power
- Has a line filter to prevent Immunity to external line noise
- Provides overcurrent protection to connected components.
- Provides light switching.

Block Diagram

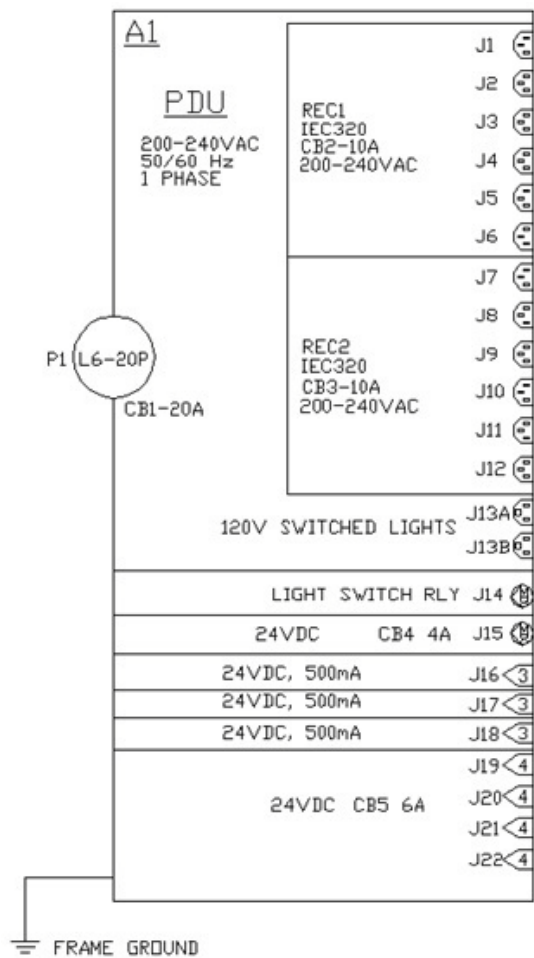


Figure 6-18: Power Distribution Unit Block Diagram

Connections, Controls, and Indicators

The location of the user accessible controls on the PDU are shown in [Figure 6-19](#). The descriptions of the controls are shown in [Table 6-2](#).

The locations of the connections on the PDU are shown in [Figure 6-19](#). The descriptions and types of connectors that are used are shown in [Table 6-3](#).

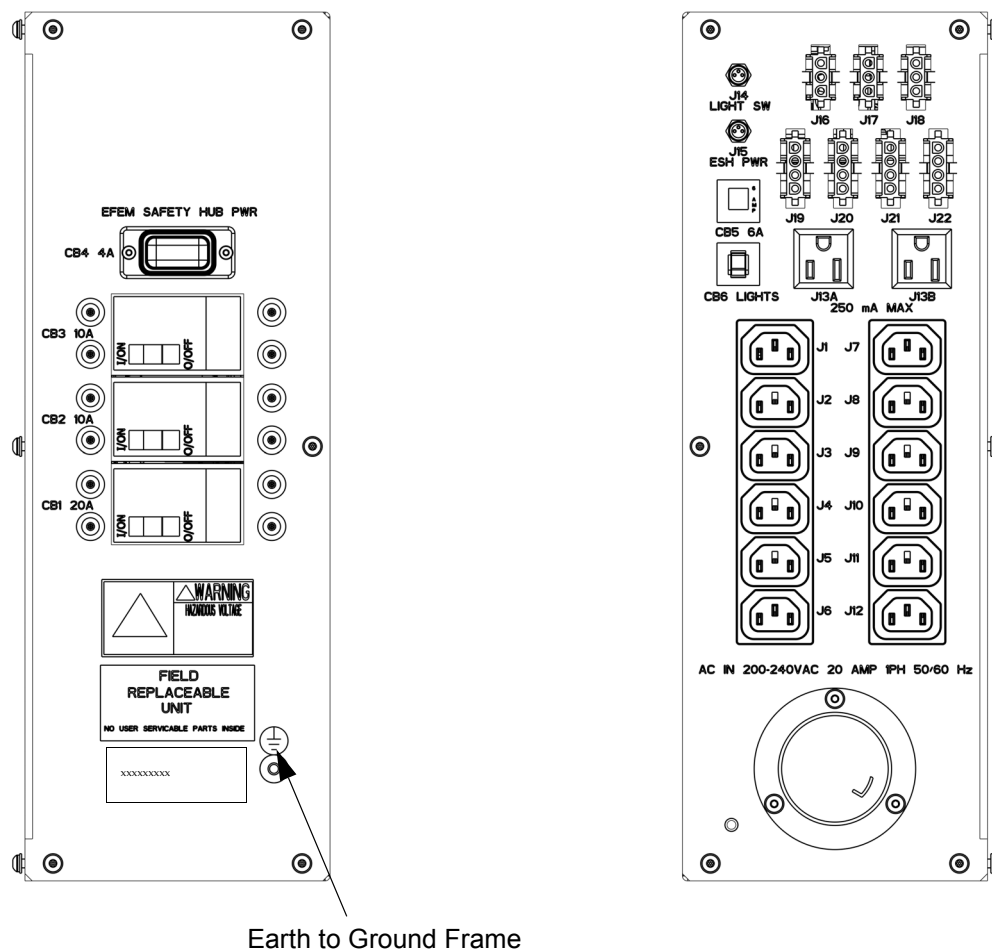


Figure 6-19: Power Distribution Unit Connections and Controls

Table 6-2: Power Distribution Unit Controls

Name	Type	Function
CB1	Circuit Breaker, 20 A	Main AC Power
CB2	Circuit Breaker, 10 A	AC to J1-J6 and internal 24VDC Power Supply
CB3	Circuit Breaker, 10 A	AC to J7-J12 and AC transformer to interior lights.
CB4	Circuit Breaker, 4A	24VDC and power switch to EFEM Safety Hub

Table 6-3: Power Distribution Unit Connections

Label	Description	Connector Type
AC IN	200-240 AC power inlet, 20A	NEMA L6-20
J1-J6	100-240 AC power outlets, 10A, CB2	IEC320
J7-J12	100-240 AC power outlets, 10A, CB3	IEC320
J13A, J13B	Interior Lights Power, 120V, 0.25A max	NEMA 5-15
J14	Interior Light Switch connection, 0.5A max	M8 3-pin receptacle
J15	EFEM Safety Hub Power, 4A max	M8 3-pin receptacle
J16-J19	General purpose 24VDC, 0.5A max each	Mate-n-Lock 3-pin receptacle
J20-J22	General purpose 24VDC, 6A max total	Mate-n-Lock 4-pin receptacle

Internal Lighting

Internal lighting to monitor operation within the Jet System EFEM is provided by a white or amber LED lamp system.

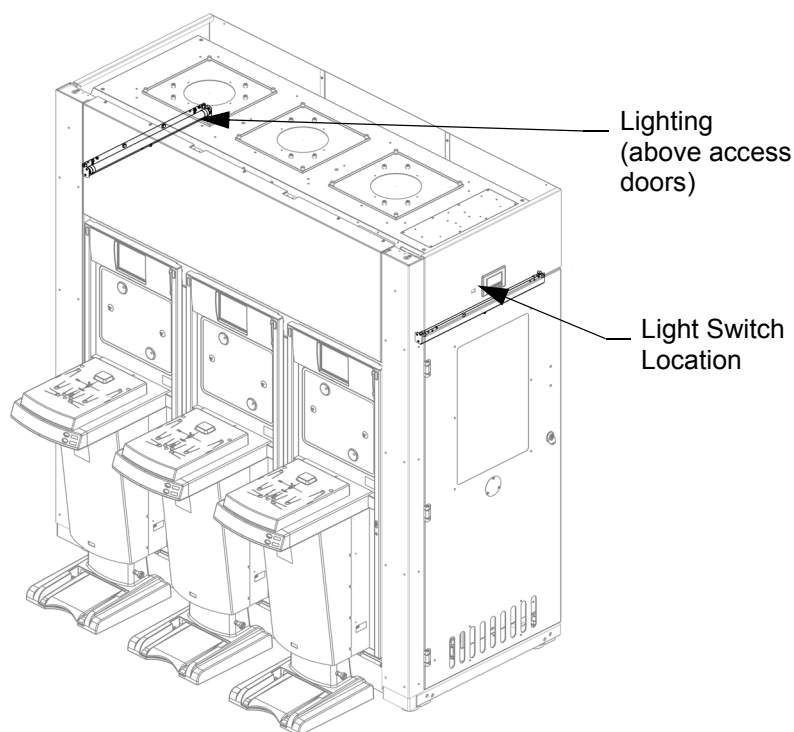


Figure 6-20: Optional LED Lighting

Description

The internal lighting fixtures provide lighting within the material handling zone of the Jet mini-environment with LED light tubes installed above the EFEM access doors.

The LED tubes are powered by a 120V isolation transformer with max load of 0.25A. The lights can be switched on and off with a switch mounted externally on the upper door or panel on the service side. Optional Amber lights are available.

The ESH (EFEM Safety Hub) is a central interface for the EFEM where multiple components may be connected and operated by a common communication system. The ESH includes proprietary safety logic to monitor the status of multiple automation components and interlock them together. Automation components include the atmospheric robot, load ports, emergency stop switches, and up to two wafer transfer systems. Other components connected include common interface for the light tower, safe air valve if required, FFU discrete status, as well as capability of additional IO for sensors and actuators. All components connected to the ESH are operational through the atmospheric robot controller.

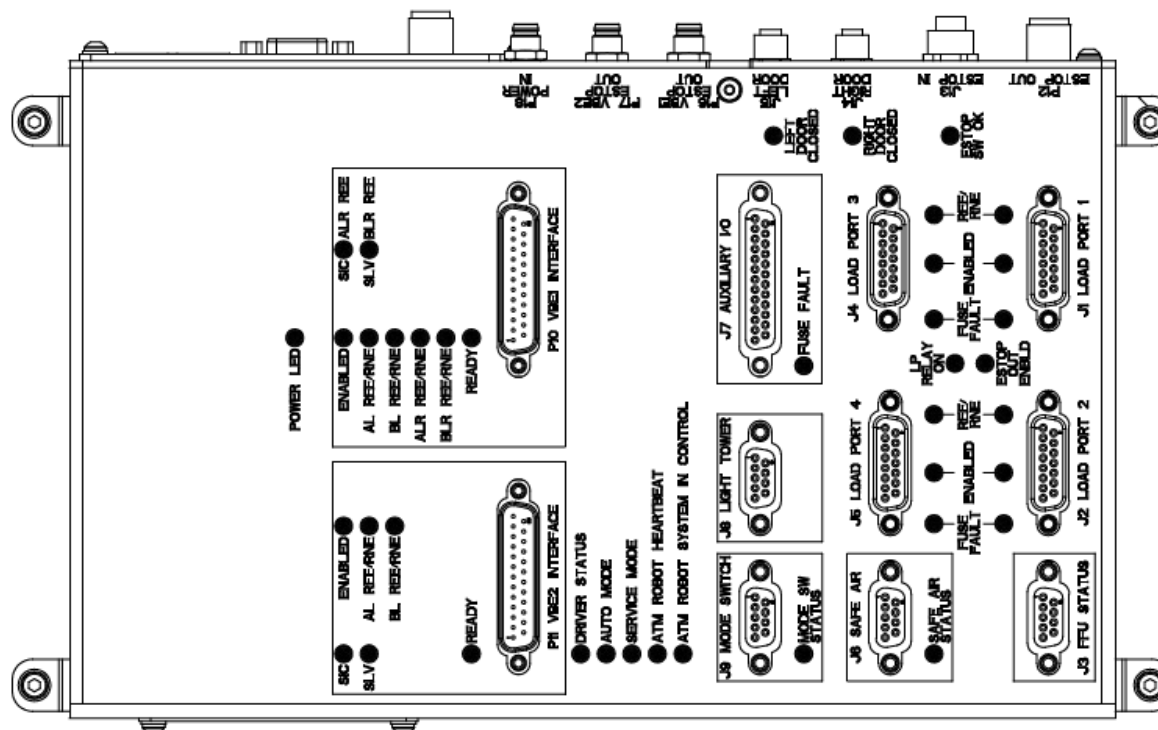


Table 6-4: EFEM Safety Hub Primary System LED

LED Label	LED Description	LED Status					
		Red	Red/ Orange Flashing	Green	Green/ Orange Flashing	Amber	Off
POWER LED	24V Status	N/A	N/A	Safety Hub Power On	N/A	N/A	Safety Hub Power Off
E-STOP OUT	Global E-Stop Output	N/A	N/A	E-Stop Enabled	N/A	N/A	E-Stop Disabled
ESTOP SW OK	Global E-Stop Input Status	Fuse Fault	One Switch Open	Both switches closed and registered	Both switches closed but not registered	N/A	E-Stop switch open or NC
SAFE AIR STATUS	Safe Air Valve Status	Fuse Blown	Air On in Off Mode	Air On	Transition	Air Off	N/A
MODE SW STATUS	EFEM Safety Mode Select Switch Status	Fuse Blown	N/A	Mode SW in Auto position	N/A	Mode SW in Service Position	Mode SW in Halt Position or NC
AUTO MODE	EFEM Safety Hub Auto Mode Status	N/A	N/A	EFEM In Auto Mode	N/A	N/A	EFEM not in Auto Mode

Table 6-4: EFEM Safety Hub Primary System LED

LED Label	LED Description	LED Status					
		Red	Red/ Orange Flashing	Green	Green/ Orange Flashing	Amber	Off
SERVICE MODE	EFEM Safety Hub Auto Mode Status	N/A	N/A	N/A	N/A	EFEM in Service Mode	EFEM not in Service Mode
ATM ROBOT HEARTBEAT	ATM Robot Heartbeat Monitor	N/A	N/A	ATM Robot Heartbeat ¹ Flashing or On	N/A	N/A	No Heart- beat or NC
ATM ROBOT SYSTEM IN CONTROL	ATM Robot SIC Status	ATM Robot 24V Power Fault	N/A	ATM Robot SIC True	N/A	ATM Robot SIC False	ATM Robot Off
RIGHT DOOR CLOSED	Right Access Door Switch Status	Fuse Fault	One Switch Open	Both switches closed and registered	Both switches closed but not regis- tered	N/A	Both switches open or NC
LEFT DOOR CLOSED	Left Access Door Switch Status	Fuse Fault	One Switch Open	Both switches closed and registered	Both switches closed but not regis- tered	N/A	Both switches open or NC

Table 6-4: EFEM Safety Hub Primary System LED

LED Label	LED Description	LED Status					
		Red	Red/ Orange Flashing	Green	Green/ Orange Flashing	Amber	Off
DRIVER STATUS	Output driver Status	Driver Fault	N/A	Drivers OK	N/A	N/A	Safety Hub Power Off
AUX IO FUSE FAULT	AUX IO 24V power out	Fuse Blown	N/A	N/A	N/A	N/A	Fuse Ok

1. Heartbeat LED may be flashing or solid depending on the Robot controller state.

Table 6-5: EFEM Safety Hub Wafer Transfer Station (Vacuum Back End) LED

LED Label	LED Description	LED Status					
		Red	Red Flashing	Green	Green/ Orange Flashing	Amber	Off
VBEx READY	VBE Power Status	Fuse Blown	N/A	VBE Ready	N/A	N/A	VBE is Off or NC
VBEx ENABLED	EFEM Ready / VBE Enabled	Fault	N/A	N/A	N/A	VBE Enabled	VBE Disabled

Table 6-5: EFEM Safety Hub Wafer Transfer Station (Vacuum Back End) LED

LED Label	LED Description	LED Status					
		Red	Red Flashing	Green	Green/ Orange Flashing	Amber	Off
VBE1 BLR REE / SLAVE	Load Lock B Right REE Sta- tus/ VBE1 Slave Status	N/A	N/A	BLR REE True	N/A	VBE in slave mode	BLR REE False or NC
VBE1 ALR REE / SIC	Load Lock A Right REE Sta- tus/ VBE1 SIC Status	N/A	N/A	ALR REE True	N/A	VBE1 SIC true	ALR REE False & SIC False
VBE1 AL RNE / REE	Load Lock A RNE Status/ Load Lock A REE Status	AL RNE False AL REE False	N/A	AL RNE True AL REE False	N/A	AL RNE False AL REE True	AL RNE True AL REE True
VBE1 BL RNE / REE	Load Lock B RNE Status/ Load Lock B REE Status	BL RNE False BL REE False	N/A	BL RNE True BL REE False	N/A	BL RNE False BL REE True	BL RNE True BL REE True
VBE1 ALR RNE / REE	Load Lock A Right RNE Sta- tus/ Load Lock A Right REE Status	AL RNE False AL REE False	N/A	AL RNE True AL REE False	N/A	AL RNE False AL REE True	AL RNE True AL REE True

Table 6-5: EFEM Safety Hub Wafer Transfer Station (Vacuum Back End) LED

LED Label	LED Description	LED Status					
		Red	Red Flashing	Green	Green/ Orange Flashing	Amber	Off
VBE1 BLR RNE / REE	Load Lock B Right RNE Sta- tus/ Load Lock B Right REE Sta- tus	BL RNE False BL REE False	N/A	BL RNE True BL REE False	N/A	BL RNE False BL REE True	BL RNE True BL REE True
VBE2 SLAVE	VBE 2 Slave Mode Status	N/A	N/A	N/A	N/A	VBE in Slave Mode	VBE not in Slave Mode
VBE2 SIC	VBE 2 System In Control Status	N/A	N/A	N/A	N/A	VBE2 SIC Active	VBE2 SIC Not Active
VBE2 AL RNE / REE	Load Lock A RNE Status/ Load Lock A REE Status	AL RNE False AL REE False	N/A	AL RNE True AL REE False	N/A	AL RNE False AL REE True	AL RNE True AL REE True
VBE2 BL RNE / REE	Load Lock B RNE Status/ Load Lock B REE Status	BL RNE False BL REE False	N/A	BL RNE True BL REE False	N/A	BL RNE False BL REE True	BL RNE True BL REE True

Table 6-6: EFEM Safety Hub Load Port

LED Label	LED Description	LED Status					
		Red	Red Flashing	Green	Green/ Orange Flashing	Amber	Off
LP RELAY ON	Load Ports Door Motion Safe Relay Status	N/A	N/A	Relay On	N/A	N/A	Relay Off
LOAD PORT x FUSE FAULT	Load Port 24V logic power out	Fuse Blown	N/A	N/A	N/A	N/A	Fuse Ok
LOAD PORT x ENABLED	Load Port door motion enabled	N/A	N/A	Door Motion Enabled ¹	N/A	N/A	Door Motion Disabled ¹
LOAD PORT x RNE / REE	Load Port RNE Status/Load Port REE Status	LPM RNE False LPM REE False	N/A	LPM RNE True LPM REE False	N/A	LPM RNE False LPM REE True	LPM RNE True LPM REE True

1. Load port enabled requires both RNE to be true and for the Safety Hub to be in either AUTO or SERVICE modes.

Table 6-7: Wafer Engine Robot Adapter LED

LED Label	LED Description	LED Status					
		Red	Red Flashing	Green	Green/ Orange Flashing	Amber	Off
ENB SW/ FUSE FLT	Live Man switch status/ Adapter board Fuse Status	Live Man SW not installed/ Fuse Blown	N/A	Live Man SW is installed/ Fuse OK	N/A	Fuse Fault and Live Man SW is installed	Live Man SW not installed and Fuse OK
L2 ROBOT ENABLE	Wafer Engine Robot Enabled Status	Enable Switch Opened	N/A	Enable Switch Closed	N/A	N/A	Safety Hub Power Off
L3 ETHERNET	Ethernet module status	Comm Error	Comm Error	Connected	Connecting	Connected with comm. Error	NC

Table 6-8: Reliance Robot Adapter LED

LED Label	LED Description	LED Status						
		Red	Red Flashing	Alternating Red/ Green	Green	Green/ Orange Flashing	Amber	Off
ROBOT STA-TUS	Robot connection and Adapter Board Fuse Status	ESH Adapter Board Fuse Fault and Robot power is off	N/A	N/A	Robot power is on	Robot power is on	ESH Adapter Board Fuse Fault and Robot power is on	Safety Hub Power Off and Robot Power Off
ROBOT ENABL E	Wafer Engine Robot Enabled Status	Enable Switch Opened	One channel is open	NC	Enable Switch Closed	Enable Switch Closed	N/A	Safety Hub Power Off

Table 6-9: Razor Robot Adapter LED

LED Label	LED Description	LED Status					
		Red	Red Flashing	Green	Green/ Orange Flashing	Amber	Off
L1 FUSE FAULT	Adapter Board Fuse Status	ESH Adapter Board Fuse Blown	N/A	N/A	N/A	N/A	Fuse OK
L2 ROBOT ENABLE	Robot Enabled Status	Enable Switch Opened	N/A	Enable Switch Closed	N/A	N/A	Safety Hub Power Off
L3 ETHERNET	Ethernet module status	N/A	N/A	N/A	Connected and Live	N/A	Not Connected

ESH Connections

The ESH provides interlocking for up to four load ports, two door switches, e-stop switch, safe air valve, light tower, FFU status, and auxiliary IO. The ESH can be configured to interface with multiple kinds of robots by replacing the robot adapter board. The robot adapter board typically has both a safe IO connection and an industrial Ethernet connection. Both of these connections are internal to the JET system and are not accessible to the user. The user may query the status of the ESH through the robot controller. The user may also request access to auxiliary IO through the robot controller interface.

Safety Interlocking

The ESH is designed to mitigate or remove all human and machine safety related hazards within the JET EFEM identified by a through risk assessment in all modes of operation and service of the system. The ESH provides operator and service personnel protection using multiple methods such as controlling the robot speed during service, preventing automated door movement, preventing robot collisions with automated doors and valves, and providing appropriate safety interlocks for personnel. The ESH can be used to control CDA if required in the system. The ESH can also be used as a global emergency stop system.

Operation Mode Selection Key Switch

The mode selection key switch has three states. AUTO - HALT - SERVICE. All state changes must pass through HALT. The key can be removed in all but the service position. The switch also includes a status indicator light and a buzzer alarm.

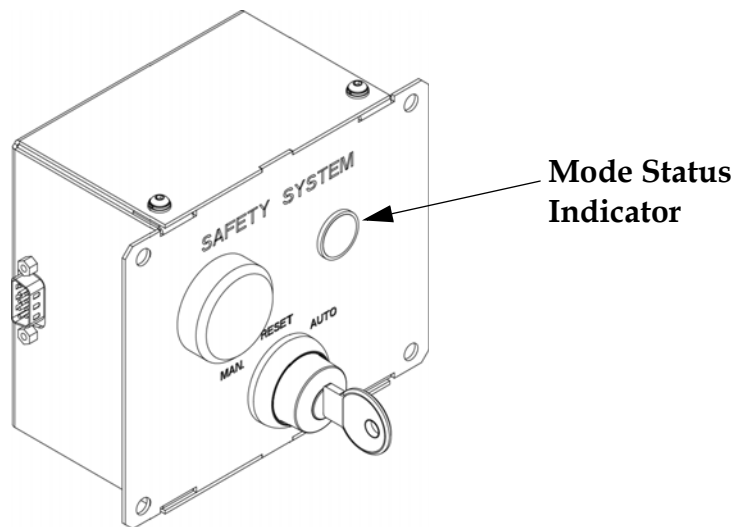


Figure 6-22: Mode Select Switch

Table 6-10: Safety Mode Status Indicator

LED Status					
Red	Red Flashing	Green	Green/ Orange Flashing	Amber	Off
N/A	Fault Condition	EFEM In Auto Mode	N/A	EFEM in Service Mode	EFEM in Halt Mode

Load Port Interlocking/Handshaking

The ESH provides a common interface for the atmospheric robot to monitor the load port door status (Robot Extend Enable or REE). It also controls the load port door motion interlock circuit with both the robot extension status (Robot Not Extended or RNE) and the EFEM system status which includes system operating mode and access door status.

Atmospheric Robot Interface

The ESH can be configured to connect to any robot control system that has digital IO and industrial Ethernet connection. The ESH monitors the health of the robot control system using an heart beat generated by the robot system software over the digital IO. All safety critical signals are passed between the ESH and the robot over digital IO. All other machine safety, non-safety IO, and diagnostics are passed through Ethernet. The atmospheric robot must have a two channel enabling circuit. The robot provides the ESH a System-In-Control signal to indicate if it is not in teach mode.

Process Module Interface

The ESH can support up to 2 independent wafer transfer systems and interlocking/handshaking for up to 8 stations. The interface to the process module is possible through two DB25 connections. Also each independent process module can be connected to the ESH global E-stop circuit (dual channel). The ESH provides a common interface for any atmospheric robot to interlock to all wafer transfer atmospheric doors. The ESH also interlocks the EFEM access door status to the wafer transfer systems. The ESH monitors the heartbeat generated by the wafer transfer systems to determine system health. The ESH also provides each wafer transfer system with a heartbeat so they may monitor the status of the ESH and atmospheric robot health.

EFEM Access Door Interlocks

The ESH can monitor two independent coded magnetic door switches. Door switches are used to interlock the access doors for personnel safety. Opening a door and interrupting the switch will disable the robot, load ports, and process module atmospheric doors motion. During service mode, the doors are muted, allowing service personnel to gain access to the inside of EFEM without the use of an interlock bypass but robot motion speed is reduced.

Operation Modes

AUTO: Automatic mode allows the robot to operate at full speed and allows all load port and process module doors to operate automatically. Opening of the EFEM access doors will stop all the above mentioned components and cause an audible alarm to

sound. Reset of the system may be performed by closing the doors and switching the keyswitch to HALT and then back to AUTO or to initiate a software reset through the dedicated robot host interface command.

SERVICE: Service mode allows a qualified service technician to perform teaching or service to the automation equipment with limited operation. The EFEM access door interlocks will be muted allowing access to the inside of the EFEM without an interlock bypass. The robot will be allowed to operate with reduced speed with the use of either a teach pendant or host control with enabling device. Operation of the process module atmospheric doors must be done manually. Load port doors are operational. All handshaking will be active to stations. Switching from SERVICE mode to AUTO mode requires first going through HALT mode.

HALT: Halt mode will put the EFEM into a safe state for maintenance. All motion shall be prevented from automatic motion. The robot will be disabled as well as load port doors and process module atmospheric doors shall not be allowed to move. The system may be switched to either AUTO or SERVICE modes from HALT mode. The ESH will establish the state of all interlocks and health monitors prior to enabling either of the requested states. In the event that an interlock is not armed or a health monitor is not in a correct state, the ESH will sound an alarm and will remain in HALT mode.

Teach Pendant

A teach pendant is a hand held device that is connected directly to the robot controller for the purpose of teaching and diagnostics of the robot. The device includes an emergency stop switch and a 3-position enabling switch that must be held in the center position to allow the robot motors to be powered.

Robot Enabling Device

A robot enabling device is a hand held control that is directly connected to the robot controller. This device may be used in lieu of a teach pendant, in conjunction with an alternative teaching device such as a laptop computer. The device is equipped with both an emergency stop switch and a 3-position enabling switch that must be held in the center position to allow the robot motors to be powered.

NOTE: *A teach pendant or robot enabling device must be used when operating the atmospheric robot in the service mode. If one of these devices is not connected and in use, the service technician shall only be able to enable the robot motors if the EFEM access doors are closed. The robot shall in SERVICE mode move at reduced speeds.*

Light Tower Connection

A light tower with up to 5 colors and 2 audible alarms can be connected to the ESH. The light tower can be controlled by the host via the atmospheric robot command line. The atmospheric robot can flash the lights on command at a rate of 1 Hz. Note that upon power failure, all lights and alarms will default to the off state by the ESH and the robot controller.

Safe Air Valve

The ESH can support pneumatically controlled components such as load ports and pneumatic doors and valves. A safe air valve can be connected to the ESH to deliver CDA in AUTO or SERVICE mode and to monitor air pressure and shut off air in case of emergency stop.

FFU Status

The FFU Discrete outputs can be directly connected to the ESH. Signals such as differential pressure alarms and fan motor status can be monitored through the robot control interface. The FFU cannot be controlled through this path. Actual pressure cannot be read through this path.

Auxiliary IO

The ESH provides a discrete IO connector for the use of monitoring switches, sensors and operating valves and other devices. The IO cannot be used for safety required applications, but can be used through the robot controller interface. Additional non-safety critical handshaking can also be performed through this connection.

Emergency Stop IN/OUT

The ESH includes provisions for the connection of E-STOP switches. Switches connected to the E-STOP IN circuit shall override any and all modes of operation. Activation of the E-STOP shall cause the E-STOP OUT to activate as well as all process modules connected to the JET System. Recovery of an E-STOP condition requires the reset of the ESH and robot controller and any connected module. The ESH can operate as a global E-STOP for the host system by connecting additional modules to the E-STOP OUT M12 connection. Multiple modules may be connected to the ESH using a 2NC serial chain.

Multi-Mode

The ESH and connected process modules may operate independently in order to facilitate service and maintenance operations without impacting other modules that may not be in service. This is the typical connection configuration. Global E-STOP will still cause all modules to stop. Refer the ESH programmer's guide for more details.

Single (Master/Slave) Mode

The ESH may serve as a master to up to two wafer transfer modules. In this connection scheme, the JET EFEM mode state shall enforce the state upon the slave process modules. Refer the ESH programmer's guide for more details.

Table 6-11: EFEM Safety Hub - Ethernet to Serial Gateway Connections

Label	Description	Connector Type
J1 LOAD PORT 1	Load port 1 Interlock and hand-shaking	DB15 Receptacle
J2 LOAD PORT 2	Load port 2 Interlock and hand-shaking	DB15 Receptacle
J3 FFU STATUS	FFU pressure and fan status inputs	DB9 Receptacle
J4 LOAD PORT 3	Load port 3 Interlock and hand-shaking	DB15 Receptacle
J5 LOAD PORT 4	Load port 4 Interlock and hand-shaking	DB15 Receptacle
J6 SAFE AIR	Safe Air Valve connection	DB9 Receptacle
J7 AUXILIARY I/O	Auxiliary I/O connection	DB25 Receptacle
J8 LIGHT TOWER	Light Tower connection	DB9 Receptacle
J9 MODE SWITCH	Mode selector switch connection	DB9 Receptacle
P10 VBE1 INTER-FACE	Process module interface 1	DB25 Plug
P11 VBE2 INTER-FACE	Process module interface 2	DB25 Plug
P12 ESTOP OUT	E-Stop connection to additional modules	M12 5-pin Plug
J13 ESTOP IN	E-Stop switch input connection	M12 5-pin Receptacle
J14 RIGHT DOOR	Right Door switch input connection	M8 4-pin Receptacle
J15 LEFT DOOR	Left Door switch input connection	M8 4-pin Receptacle

Table 6-11: EFEM Safety Hub - Ethernet to Serial Gateway Connections

Label	Description	Connector Type
J16 VBE1 ESTOP OUT	Process Module 1 E-Stop Out connection	M8 4-pin Plug
J17 VBE2 ESTOP OUT	Process Module 2 E-Stop Out connection	M8 4-pin Plug
P19 POWER IN	24VDC Power Input	M8 3-pin Plug
P30 ROBOT ESTOP OUT	Razor Robot Enabling Output (E-Stop)	M12 5-pin Plug
J33 ROBOT SAFE I/O	Razor Robot Safety I/O Connection	HD15 Receptacle
J31 ENET 0	Industrial Ethernet connection IN	RJ-45
J32 ENET 1	Industrial Ethernet connection OUT	RJ-45
J40 RELIANCE	Reliance Robot Connection	DB50 Receptacle
J50 WAFER ENGINE	Wafer Engine Robot Connection	HD26 Receptacle
J51 ENET 0	Industrial Ethernet connection IN	RJ-45
J52 ENET 1	Industrial Ethernet connection OUT	RJ-45

EMO Button

An optional Emergency Off (EMO) Button is provided on the Jet for the user to configure to provide emergency off signal to the equipment to which the Jet is attached.

The EMO is typically mounted on the front of the mini-environment on either side of the LPMs. It is wired to the Facilities Panel which provides a pass-through connection for wiring convenience.

The action caused by pressing the EMO button is determined by the user. The user is responsible for the EMO circuitry. Typically, the button is configured so that pressing it removes all power from the Jet system. Once the emergency is resolved power can be restored to the EFEM as described in [Power-up Sequence on page 4-23](#), and processing can be restarted.

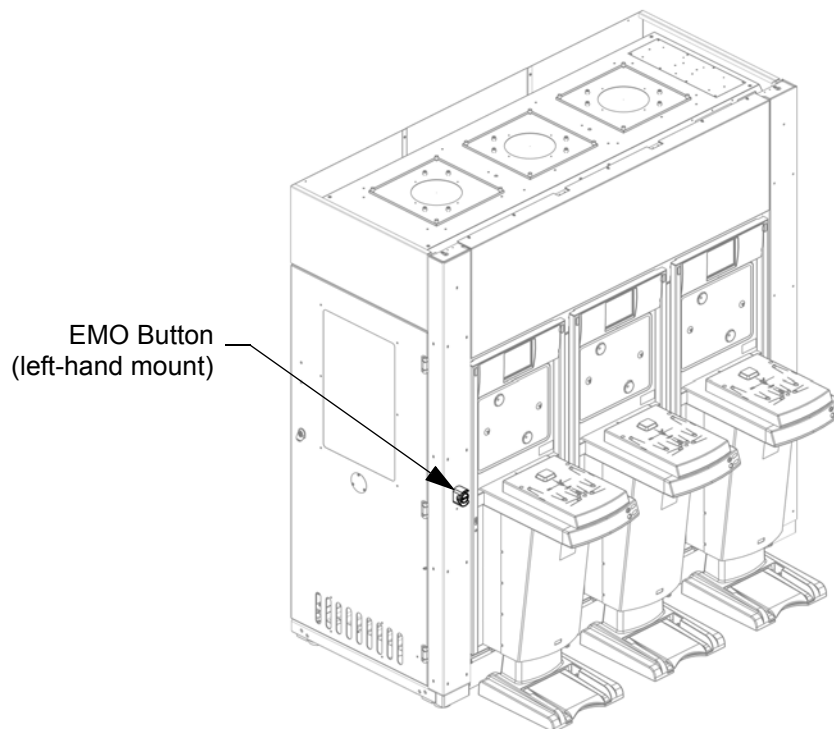


Figure 6-23: EMO Button

Emergency Stop Button

An Emergency Stop button is provided on the Jet for the purpose of stopping the Jet system automation. An E-Stop button is required by the EU Machinery Directive. Additional modules attached to the JET system may be connected to the JET Emergency stop system should the user require it. The E-Stop button will typically be located in the same area as the EMO as shown in [Figure 6-23](#).

Ethernet Switch

The 10/100 Mbps Ethernet Switch provides a single point of connection for internal Ethernet communication within the Jet system. It provides distribution for up to fifteen Ethernet devices. The switch is located inside the mini-environment on the lower rear electronics panel.

Switch Operation

The devices connected to the Ethernet Switch are accessed through standard Ethernet communications to the specified IP Address for each device connected to the switch. LEDs on the switch indicate the status of each Ethernet channel. Refer to the System Block Diagram, Schematics, and OEM manuals supplied with this manual for additional information.

Connections, Controls, and Indicators

[Figure 6-24](#) shows the location of all connections, controls, and indicators found on the Ethernet Switch. [Table 6-13](#) provides descriptions of the user accessible controls and indicators.

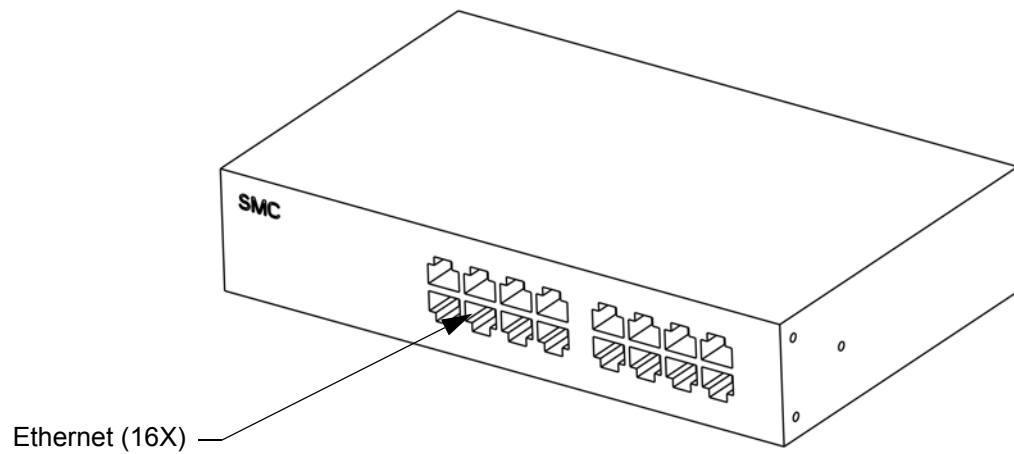


Figure 6-24: Ethernet Switch Module - Controls and Indicators

Table 6-12: Ethernet Switch Module Connections

Label	Description	Connector Type
Ethernet (x16)	10/100 Mbps MDI-X	RJ-45
PWR	110-240 VAC	Male IEC 320

Table 6-13: Ethernet Switch Module - Controls and Indicators

Name	Type	Function
Power	Green Lamp	Power Normal condition: ON
Link/ Act (16X)	Green Lamp	Link Status/ Activity ON: Port connected Off: Port not connected Blink: Port active

Ethernet to Discrete I/O Gateway

The Ethernet to Discrete I/O Gateway, provides a discrete I/O communications interface through the Ethernet. It is located on the lower rear electronics panel. This device may be used if the host is to operate the light tower directly over Ethernet. Otherwise the light tower shall be operated through the robot controller.

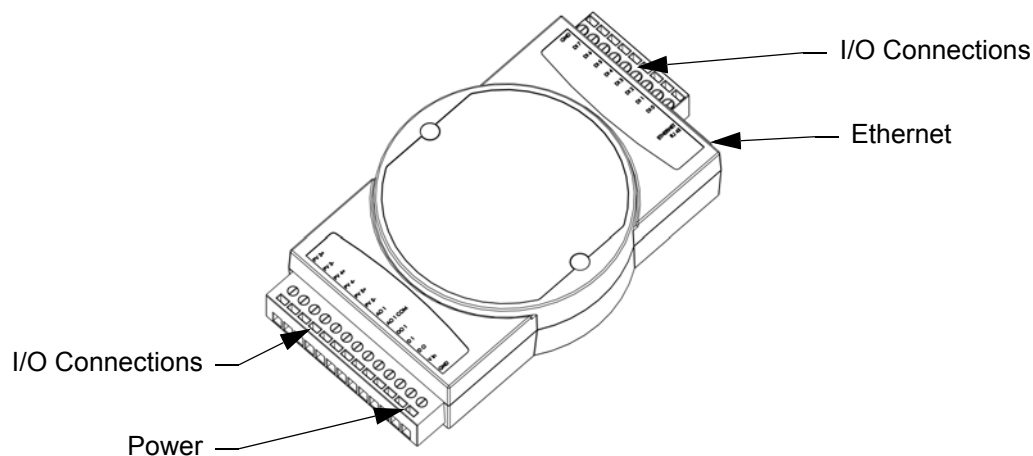


Figure 6-25: Ethernet to Discrete I/O Gateway

Gateway Operation

The I/O points monitored and controlled through the Ethernet Discrete I/O Gateway are accessed through standard Ethernet communications to the specified IP Address and Port for each point connected to the gateway. The gateway is powered from a remote power supply.

NOTE: *If more than one Ethernet Discrete I/O Gateway is installed on the Jet system, the IP address settings cannot be the same for each node.*

Refer to the System Block Diagram, Schematics, and OEM Manuals supplied with this manual for additional information.

Ethernet to Serial Gateway

The Ethernet to Serial Gateway, provides a Serial I/O (RS-232, RS-422, RS-485) communications interface through the Ethernet. The gateway can support between 1 and 8 serial devices depending on configuration. Typical uses for Ethernet to Serial Gateways in JET are for communications to serial load ports, aligners, RF ID Readers, and other optional components.

Serial gateways may be located on the lower rear electronics panel or at the component that requires it.

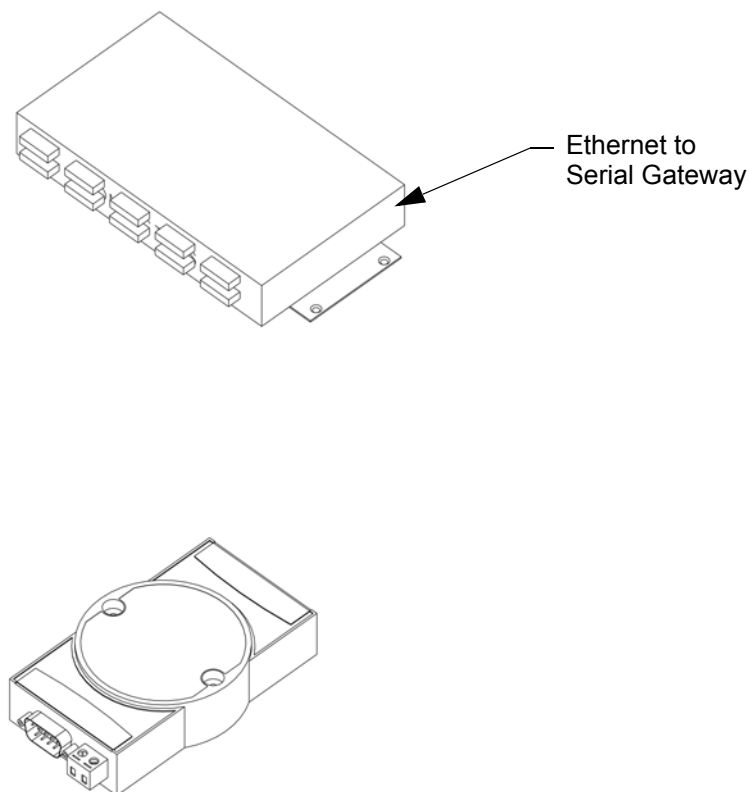


Figure 6-26: Ethernet to Serial Gateway Location

The Ethernet to Serial Gateway provides web-based configuration of all operating parameters. The Ethernet address and serial I/O port are user configurable. I/O types (RS-232, RS-422, RS-485) and serial communications settings for each channel are also user configurable.

Gateway Operation

The devices connected to the Ethernet Serial Gateway are accessed through standard Ethernet communications to the specified IP Address and Port for each device connected to the gateway. The serial data stream is internally buffered allowing the gate-

way to send and receive data using the standard software commands for the devices with a gateway header to direct the command to the appropriate serial communications channel.

NOTE: *If more than one Ethernet Serial Gateway is installed on the Jet system, the IP address settings cannot be the same for each node.*

Refer to the System Block Diagram, Schematics, and OEM manuals supplied with this manual for additional information.

Single Gateway Connections

Figure 6-27 shows the location of all connections found on the Ethernet to Serial Gateway. Table 6-14 lists the connections found on the gateway, and shows which type of connectors are used.

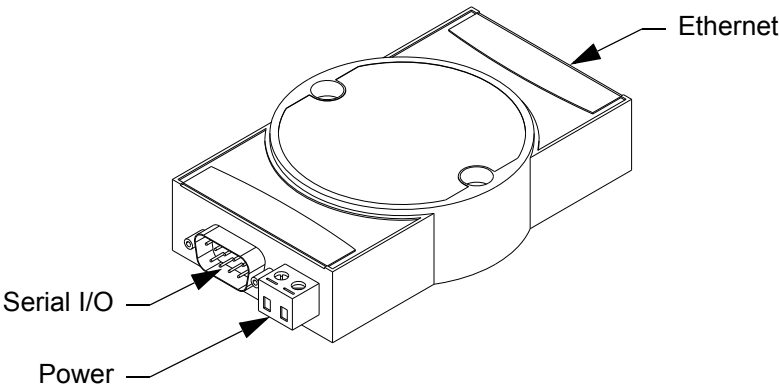


Figure 6-27: Ethernet to Serial Gateway

Table 6-14: Ethernet to Serial Gateway Connections

Label	Description	Connector Type
Ethernet	Ethernet In	RJ-45
Port 1	Serial I/O	Male DB-9
PWR	24 VDC	Terminal Block

Optional Ionizers

An optional ionization system is available to help eliminate electrostatic discharge (ESD) and particle contamination caused by electrostatic attraction within the Jet system. The system guarantees intrinsically balanced ionization without the need for complicated feedback circuits, and no adjustment is required.

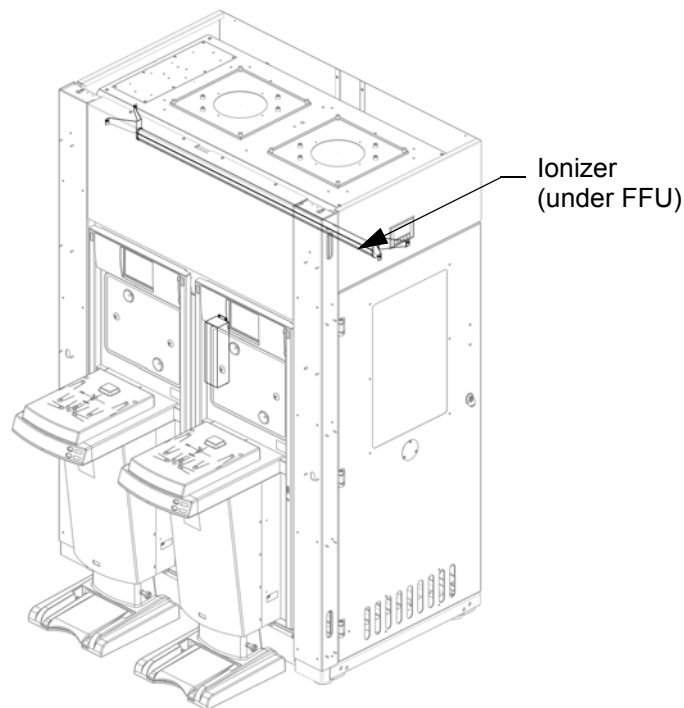


Figure 6-28: Optional Ionizers

Description

The Ionizer is mounted in the top of the mini-environment below the air filter. The ionizer features a unique aerodynamic design that ionizes a local area with minimal disruption to the laminar air flow and an intelligent controller. The output and balance of the ionization unit can be adjusted, providing reduced maintenance cost and better alarm handling. Ionizer status and alarms are displayed through the controller software.

The ionizers operate on 24 VDC, which is provided by the 24 VDC power supply in the PDU. Local power supplies and low emitter output current helps eliminate shock hazards, ozone, EMI, and contamination caused by emitter point erosion. Refer to the System Block Diagram, Schematics, and OEM manuals supplied with this manual for additional information.

The ionizer can be controlled and monitored over Ethernet.

Optional Optical Character Reader Mounting

Mounting for user installed Optical Character Reader (OCR) systems is available as an option. These mounts support cameras at the aligner for top surface scanning, bottom surface scanning, or both top and bottom scanning.

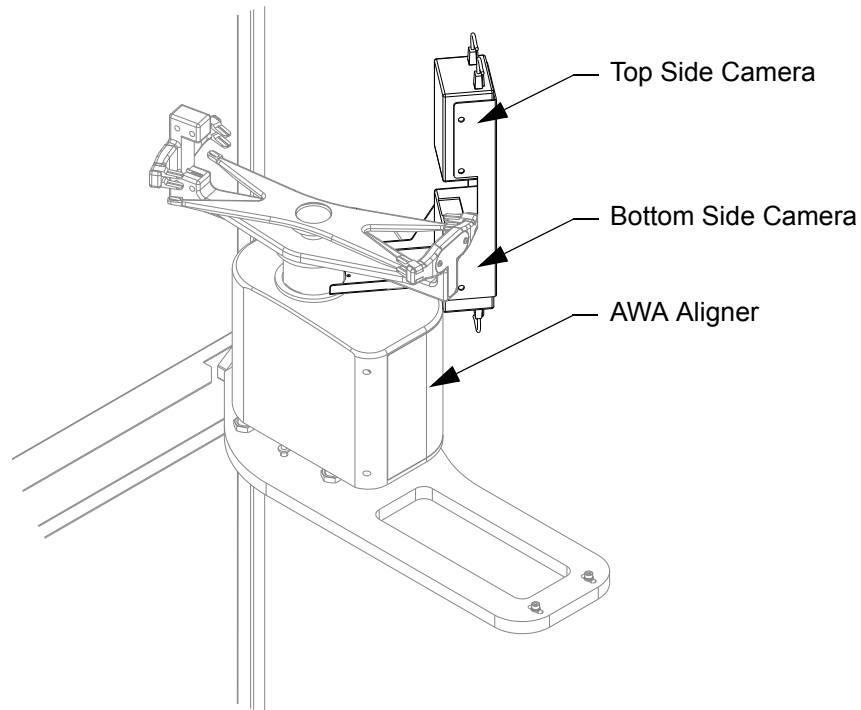


Figure 6-29: Optional OCR

Description

The optional OCR mounting system is designed to hold an OCR camera at the correct distance from a wafer on the AWA aligner to read the Wafer ID (WID) information etched into the wafer. The aligner provides precise positioning of the wafer at the camera to locate the WID for scanning. All camera control and OCR conversion are performed by the user's controller.

Mounts are available to hold cameras for top, bottom, and top and bottom scanning as shown in [Figure 6-29](#). The cameras currently supported by the optional OCR mounting system are:

- Cognex OCR

Optional Light Curtain

An optional Light Curtain can be installed on the front of the Jet system. While this option is typically installed on Jet systems used with OHT systems, it can be installed on any Jet.

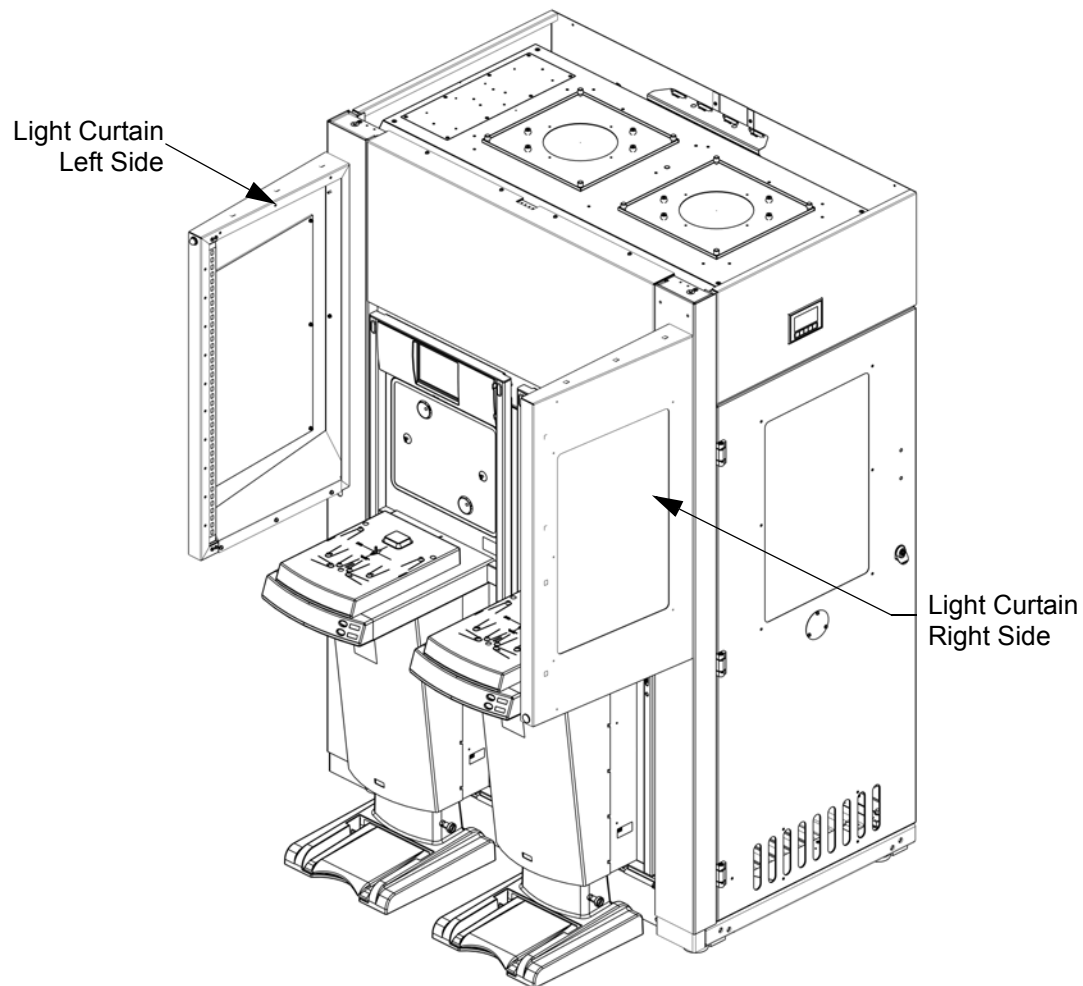


Figure 6-30: Optional Light Curtain

Description

The Light Curtain provides product and operator safety when an operator manually accesses the Load Port Modules attached to the Jet system. The user accessible areas of the LPMs are separated from the general facility area by the light curtain. The top of the light curtain is open allowing access by an OHT system.

Theory of Operation

The Light Curtain consists of a series of infrared LEDs and detectors on the sides of the enclosure. The light from the LEDs is focused on the receivers providing a “curtain” of light across the front of the enclosure. When any of the beams of light are broken for any reason, such as by an operator placing or removing a material carrier within the enclosure, the LPM’s interlock circuit is activated.

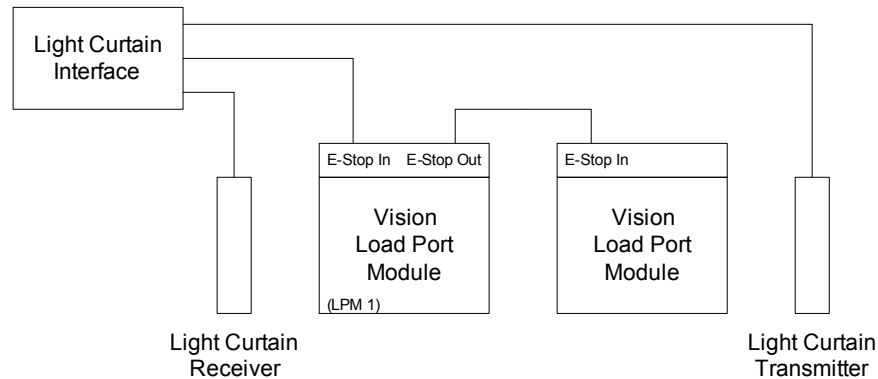


Figure 6-31: Light Curtain Block Diagram

The hardware interlock automatically disables each LPM’s SEMI E84 interface to the OHT system by turning off the HO_AVBL and E84-ES signal, preventing any automatic FOUP hand off while the beams of the light curtain are broken. At the same time the LPM sends an event (if enabled) to the controller running the LPMs, indicating that the HO_AVBL signal is off. Once the light beams are cleared, the interlock automatically re-enables the SEMI E84 interface and the LPM sends an event (if enabled) to the controller running the LPMs, indicating that the HO_AVBL signal is on.

Safety Interlocks

The Light Curtain provides a hardware interlock with the Load Port Modules. When any beam of light within the Light Curtain is broken, the interlock disables (turns off or prevents turning on) the HO_AVBL signal. When the obstruction in the Light Curtain is removed, the interlock enables the HO_AVBL signal.

Optional Light Tower

An optional light tower is available to provide instant visual and audio status of the system or any user defined events.

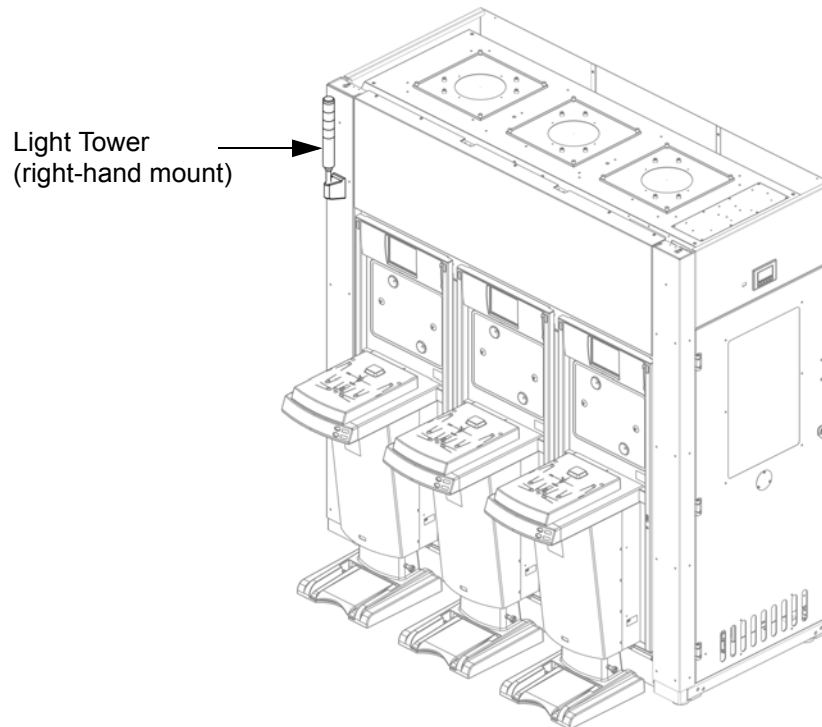


Figure 6-32: Optional Light Tower

Description

The Light Tower provides four user-controllable lamp modules and an audible alarm. The lamp modules are comprised of LED arrays in four colors: RED, AMBER, GREEN, and BLUE. The light tower also has a separate audible alarm. Power for the light tower is provided by the 24 VDC power supply in the PDU, with control of the light tower provided through a connection to the System controller or Ethernet to Discrete I/O Gateway. The Light Tower is mounted directly to the forward support column of the Jet mini-environment, and may be mounted on either the left or right side.

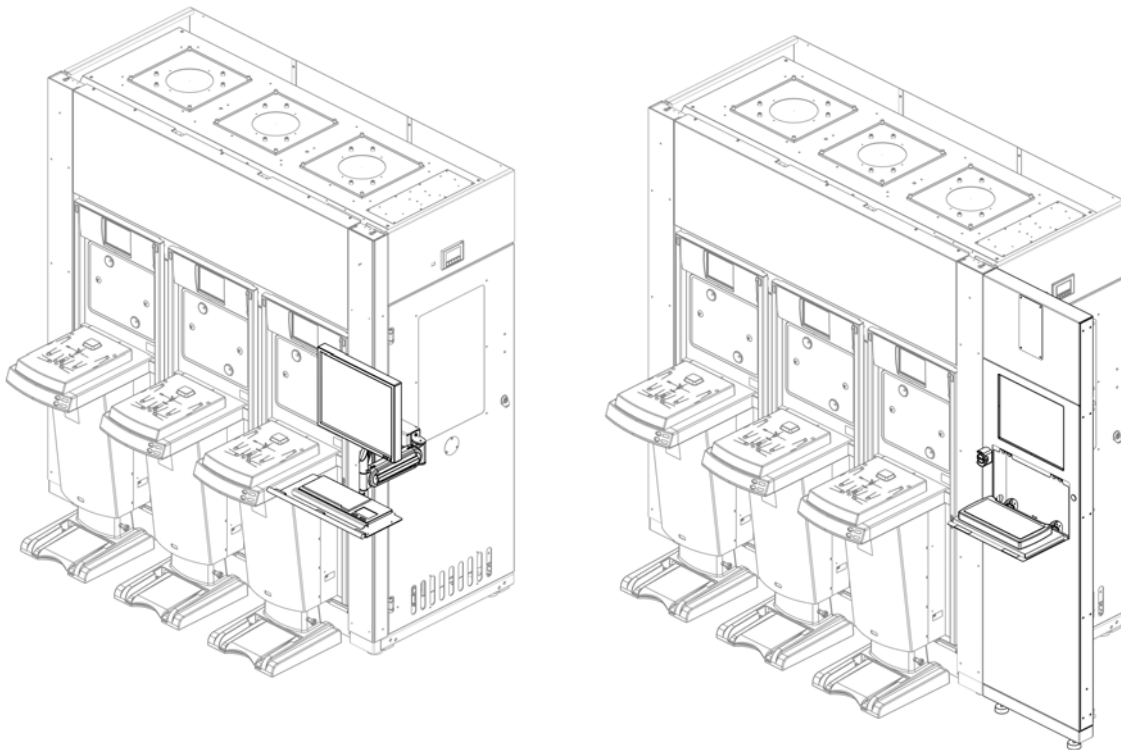
Theory of Operation

When the optional light tower is installed, it may be configured as a resource within the Jet system's workspace. This allows the controller software to directly control the status of each light and the alarm. The configuration of the Ethernet network within the Jet system also allows direct control of the Light Tower by the user instead of

through the controller software. When being controlled by the user, external FLASHING mode may be generated by cycling the control pin connections at a user-determined rate.

Optional Operator Interface (OI) Module

An optional Operator Interface (OI) Module is available to provide the user with a convenient, and easy to use, method of local control and monitoring of the Jet system. Both styles of OI Module are configured with a monitor and keyboard.



Swing Arm Interface

Wing Panel Interface

Figure 6-33: Optional Operator Interface Modules (Right Hand Mount Shown)

Description

The OI Module provides the user with an interface for local control of the Jet system and, if desired, the tool to which the EFEM is connected. The Swing Arm version of the OI Module is supplied with a 19-inch LCD monitor and a keyboard with touchpad. The Wing Panel version of the OI Module is supplied with a 17-inch LCD monitor and a keyboard with trackball. The OI Module is mounted directly to the forward

support column of the Jet mini-environment, and may be mounted on either the left or right side.

NOTE: *When the OI is mounted on the Service Side of the Jet system the EMO button and Light Tower will be mounted on the other side of the Jet to eliminate the possibility of having the OI obstruct them.*

Optional SEMI E84 Interface

An optional SEMI E84 Interface is provided through the LPM to support AGV, PGV, RGV, or OHT systems. The SEMI E84 electronics module mounts inside the LPM it is associated with, and the optical transmitter/receiver modules are mounted in the appropriate relation to the Load Port Module, as shown in [Figure 6-34](#).

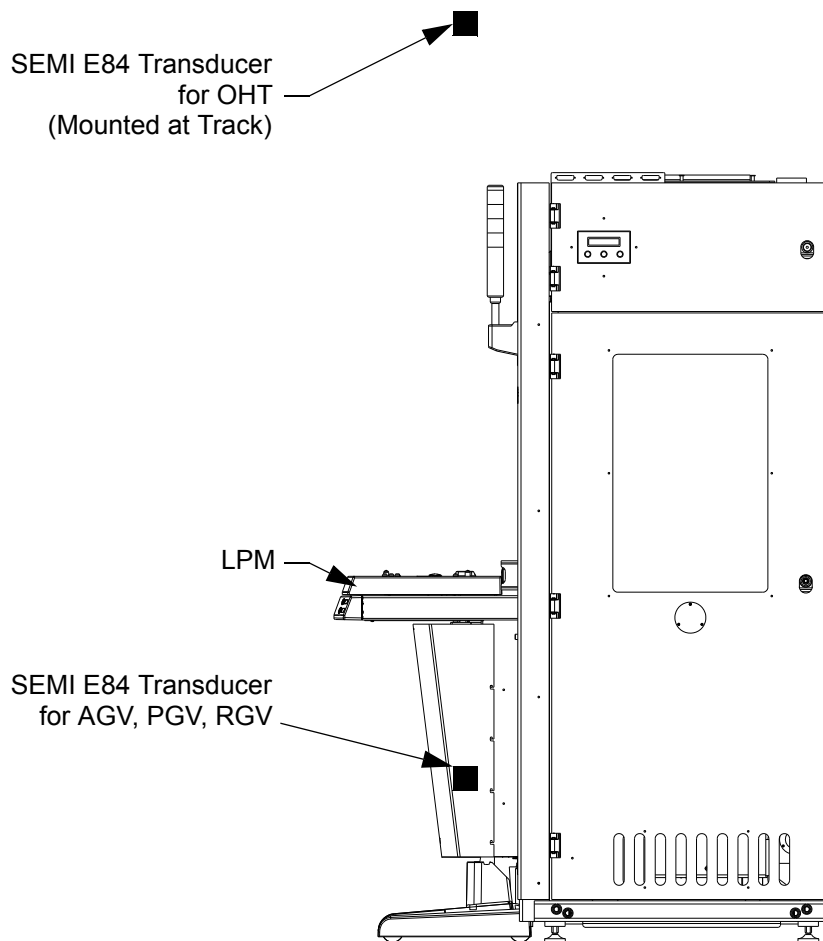


Figure 6-34: Optional SEMI E84 Interface

Description

Each Load Port Module is equipped with two SEMI E84 interfaces, one for AGV, PGV, or RGV use and the other for OHT use. These interfaces allow the SEMI E84 interface hardware to be connected to the LPM. The LPM then provides the handshaking between the automated material handling equipment and the LPM for the movement of carriers on and off the LPM. The LPM sends Events indicating the status of the SEMI E84 system to the controller directing load port operation, which may then send status information to the user's Tool Controller.

Theory of Operation

The LPM's controller manages the handshaking between the Load Port Module and the user's AMHS for the user's tool controller. The sequencing mechanism ensures complete compliance with the SEMI E84 specification.

The LPM initiates the handoff procedure automatically if the load port is in the UNLOADED position, and then notifies the user's tool controller when the handoff is complete using an event.

Safety Interlocks

Interfaces according to SEMI E84 are not designed to be used as a safety interlocking system according to SEMI S2, even if the names of some signals as defined by SEMI E84 could be misunderstood as such. (i.e., Emergency Stop).

Optional Front Air Intake

An optional Front Air Intake is available for systems that will be mounted in a Bay and Chase environment where it may be preferable to pull air from the Bay environment instead of the Chase environment.

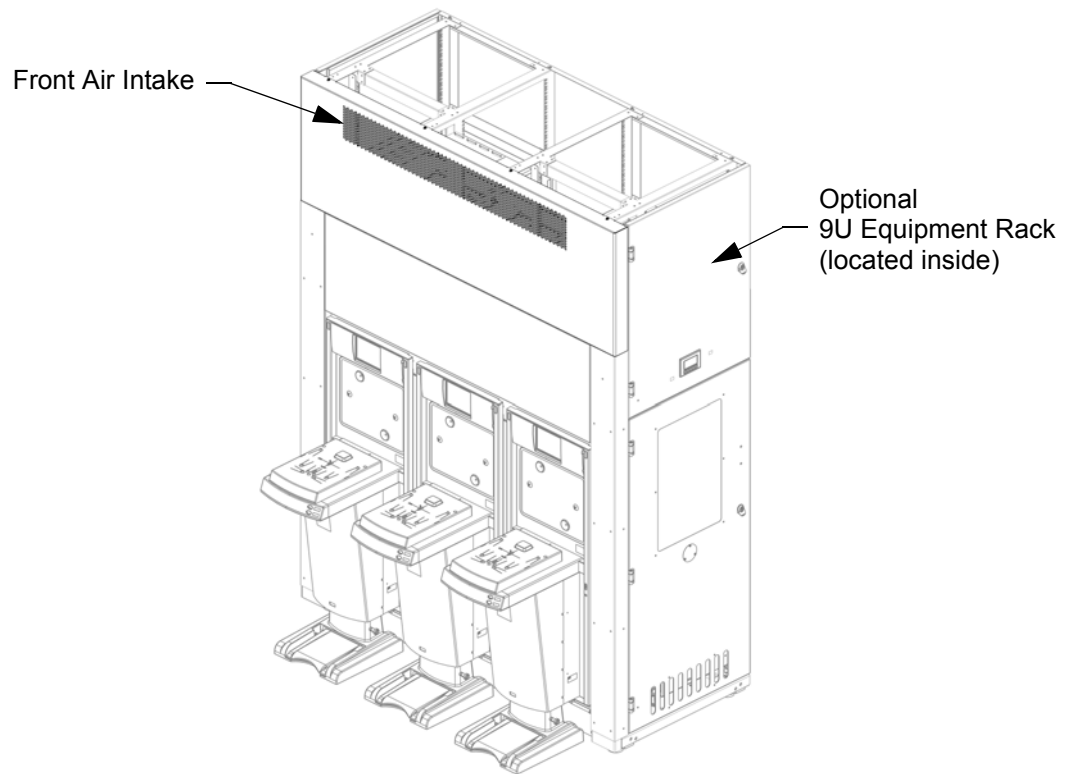


Figure 6-35: Optional Front Air Intake

Description

The Front Air Intake is mounted on top of the Jet System, as shown in [Figure 6-35](#). The overall dimensions of the Front Air Intake unit are the same as the [Optional Overhead Storage](#) unit, allowing installation of the 9U Equipment Racks, if desired. Hinged doors at each end of the Front Air Intake unit provide access to the FFU and the optional equipment racks.



Figure 6-36: Power Strip

A single IEC320 power strip with 4 outlets is provided with overhead storage. The power strip is current limited by PDU-CB3. The recommended current limit on this power strip is 2 Amps.

Optional Wafer Mapping

Optional through-beam wafer mappers are either available on the robot end effectors or are integrated into the load port.

Description

Wafer mappers mounted on end effectors are capable of identifying present, missing, and cross slotted wafers. These wafer mappers may be used to map wafers being presented to the Jet system on the load ports or at any other station where mapping is desired.

Wafer mappers mounted on the LPMs are capable of identifying present, missing, cross slotted, and double slotted wafers. These wafer mappers are used to map wafers being presented to the Jet system on the individual load port.

Optional Overhead Storage

Optional equipment storage is available in two 9U Equipment Racks mounted above the FFU.

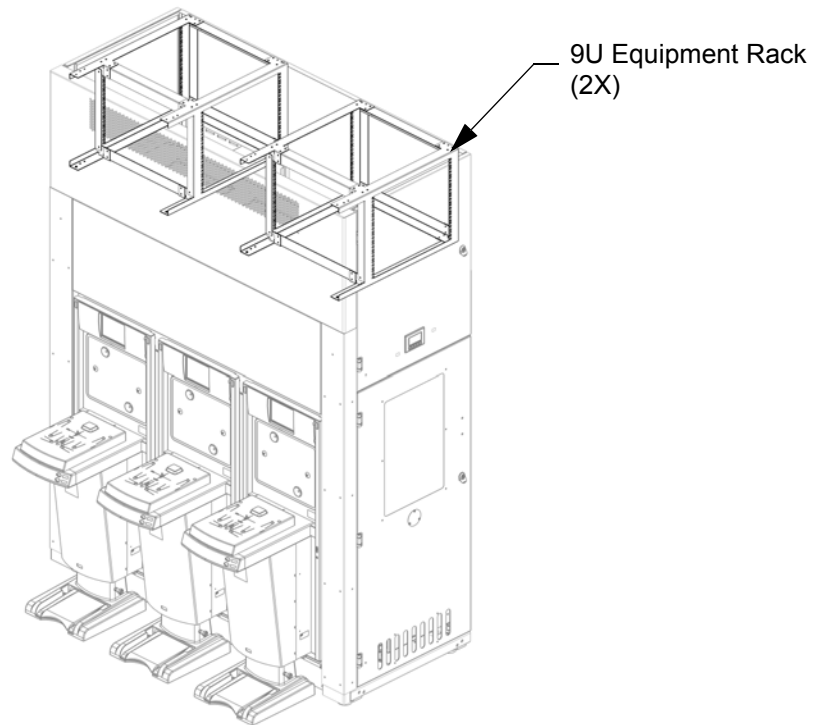


Figure 6-37: Optional Overhead Storage

Description

Two 9U 19" racks are mounted above the FFU for user electronics (one rack on Jet 2 systems), as shown in [Figure 6-37](#). Hinged doors at each end of the rack enclosure provide access to the FFU and the optional equipment racks.

To provide ease of service of the FFU, leave the bottom locations on the racks open if the racks are not be fully populated.

NOTICE

Be careful when servicing items mounted in the optional racks since their location may present an Ergonomic Hazard.

Optional Mechanical Protection

An optional Mechanical Protection Bar can be installed on the front of the Jet system. While this option is typically installed on Jet systems used with OHT systems, it can be installed on any Jet.

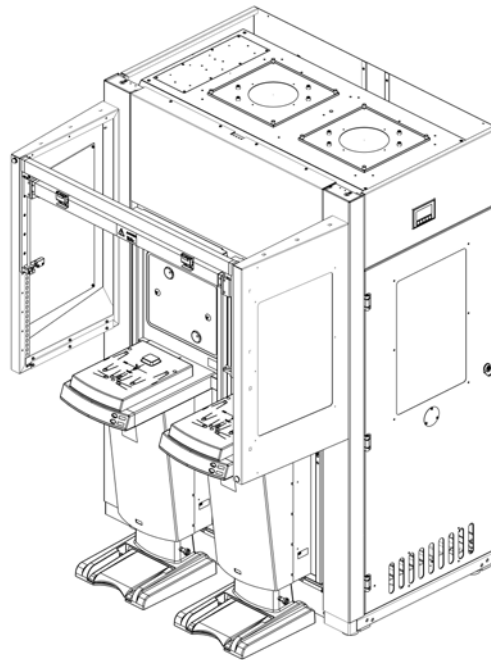


Figure 6-38: Optional Mechanical Protection

Description

The Protection Bar provides product and operator safety when an operator manually accesses the Load Port Modules attached to the Jet system. The user accessible areas of the LPMs are separated from the general facility area by the Protection Bar. The top of the Protection Bar is open allowing access by an OHT system.

Theory of Operation

The Protection bar consists of an aluminum bar spanning across the front of all the load ports. The bar physically prevents personnel from entering the space reserved by the OHT to deliver and retrieve FOUPs. A coded magnetic safety switch is used to detect if the bar is in the lowered (safe) position. Lifting the bar such as by an operator placing or removing a material carrier within the enclosure, the LPM's interlock circuit is activated.

The hardware interlock automatically disables each LPM's SEMI E84 interface to the OHT system by turning off the HO_AVBL and E84-ES signal, preventing any automatic FOUP hand off while the beams of the light curtain are broken. At the same time the LPM sends an event (if enabled) to the controller running the LPMs, indicating that the HO_AVBL signal is off. Once the Protection Bar is lowered, the interlock automatically re-enables the SEMI E84 interface and the LPM sends an event (if enabled) to the controller running the LPMs, indicating that the HO_AVBL signal is on.

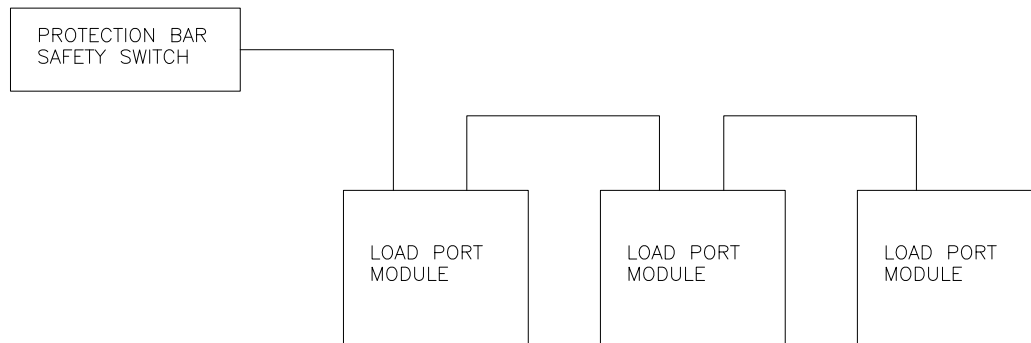


Figure 6-39: Mechanical Protection Bar - Block Diagram

Operating Procedure to gain access to the Load Ports

1. Notify appropriate personnel that the OHT hand off to the system will be disabled.
2. Observe the Over Head⁴³Transport system for activity.
3. When safe to do so, lift the protection bar with two hands until both latches engage the upper fixed bar.
4. Verify that the OHT system E84-ES is disabled.

Operating Procedure to restore OHT Operation

1. Verify that all non-essential materials are removed from the load ports.
2. Verify that there are no load port errors.

3. Using two hands hold the protection bar and release both latches.
4. Lower the bar to the safe position.
5. If manually required by the Host, re-establish E84 HO_AVBL.
6. Verify that OHT operation has resumed.

7 Preventive Maintenance

Overview

For illustration purposes, the components shown here are the Razor Robot, Razor Track, Razor Wafer Aligner, and Fusion controller. When using this manual, always refer to the appropriate documentation for the specific components used on your system.

	 WARNING
	The Jet system contains high voltages and other hazards which, if not properly handled, may result in serious injury or death. • All personnel involved with the operation or maintenance of this product must read and understand the Safety Chapter. • Follow all applicable safety codes of the facility as well as national and international safety codes. • Know the facility safety procedures, location of safety equipment, and contact information. • Read and understand each procedure before performing it. • Only qualified personnel should perform the procedures.
	

Preventive Maintenance

The Jet system is designed to require very little routine maintenance. Refer to the user manuals of the system components for the component preventive maintenance recommendations.

Preventive Maintenance procedures and schedules assume that the Jet system is operating in a clean, dry, inert environment. The user should adjust the Preventative Maintenance Schedule as appropriate.

NOTE: *Brooks Automation offers training for troubleshooting and repair of the Jet system. Only qualified, properly trained persons should perform any maintenance or repair procedures. Damage resulting from improperly performing a procedure is not covered under warranty or service agreements.*

Parts

If parts are required for preventive maintenance, contact Brooks Automation Technical Support.

Schedule

Refer to the component manuals the corresponding component maintenance procedures.

	 WARNING
	Automatic Motion Hazard If the Door Interlock for the mini-environment is disabled, the possibility of automatic movement of components within the Jet system exists. These systems have no obstruction sensors and may cause death or serious injury. Be aware that the Robot, Track, Aligner, Load Port Modules, and FFU Fans have the possibility of automatic movement: Be aware that the use of the Jet system with the Door Interlock bypassed is at the user's own risk.

Table 7-1: Preventive Maintenance Schedule

Component	Maintenance Action	Frequency
ATR Robot	Material Support Pad Inspection Material Support Pad Cleaning Robot End Effector Adjustment	Refer to Robot manual
Track	Rail and drive lubrication	Refer to Track manual
Aligner	Material support pad cleaning	Refer to Aligner manual.

General Cleaning Procedures

The surfaces of the Jet system should be cleaned as a part of normal servicing.

Procedure Category

Type 1 Procedure: Equipment is fully de-energized.

Required Tools and Test Equipment

- Isopropyl alcohol (100%)
- DI water
- Cleanroom wipes

	 WARNING Toxic Chemicals / Environmental Hazards The Jet system may be used in an environment where hazardous materials are present which may cause death or serious injury. • Be aware that surfaces may be contaminated. • Refer to the facility's Material Safety Data Sheets to determine proper handling. • Follow the facility's procedures to certify the environment is safe. • Dispose of cleaning cloths per the facility procedures and local regulations.
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	 WARNING Lockout/Tagout Working with energized equipment may cause sudden movement or electrical shock and may result in death or serious injury. • All energy must be removed from the equipment per the facility's Lockout/Tagout procedure before servicing. • If local procedures are not available, follow the procedure for Lockout/Tagout in OSHA Standard 29CFR 1910.147. • Refer to the unit's specifications for the system power requirements and use appropriate precautions.
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General Cleaning Procedure

NOTICE
Wipes used in maintenance must be moistened only. Squeezing the wipe should not cause any cleaning liquid to drip. Do not allow cleaning liquids to come in contact with bearings, seals, etc. Alcohol should not be used on the optional perfluoroelastomer (Kalrez) end effector pads.

1. Remove any hazardous materials from the Jet system's surfaces, following the facility's procedures for those materials.
2. Clean all exposed surfaces using cleanroom wipes moistened with isopropyl alcohol.
3. Once all contaminants have been removed, use cleanroom wipes moistened with DI water to remove any residues.
4. Once all residues have been removed, use dry cleanroom wipes to dry all surfaces.

8 Troubleshooting and Repair

Overview

Troubleshooting information for the Brooks Automation Jet system is provided to the Field Replaceable Unit (FRU) level. FRU kits contain the removal/replacement procedures. Repair procedures are provided for replacing consumables.

For illustration purposes, the components shown here are the Razor Robot, Razor Track, Razor Wafer Aligner, and Fusion controller. When using this manual, always refer to the appropriate documentation for the specific components used on your system.

 	 WARNING
	The Jet system contains high voltages and other hazards which, if not properly handled, may result in death or serious injury. • Only qualified persons should be allowed to troubleshoot the Jet system. • All personnel involved with the operation or maintenance of this product must read and understand the information in the Safety Chapter. • Follow all applicable safety codes of the facility as well as national and international safety codes. • Know the facility safety procedures, location of safety equipment, and contact information. • Read and understand each procedure before performing it.

Basic Troubleshooting

This section covers the initial determination of the problem area within the Jet system and provides direction to the second step of the troubleshooting process. If a specific problem is suspected, refer to that problem in [Table 8-1](#). If the problem has not been identified, review each of the symptoms identified in [Table 8-1](#) to help determine the problem area.

If the problem is not covered here, refer to the individual User Manuals for the components within the system for additional troubleshooting procedures.

Table 8-1: Initial Troubleshooting

Symptom	Possible Problem Area
Power lights do not turn on	See Power Related Troubleshooting on page 8-3
System powered but no response to user's controller	See Communications Troubleshooting on page 8-4
System powered but no response from components within system	
Material slipping on end effector	See Motion Control Troubleshooting on page 8-5
Components within the Jet system not operating	See Robot Troubleshooting on page 8-5 See Track Troubleshooting on page 8-6 See Aligner Troubleshooting on page 8-6 See Load Port Module Troubleshooting on page 8-7 See Fan/Filter Unit Troubleshooting on page 8-7
Material Mapping not correct	See Material Mapping Troubleshooting on page 8-8

Power Related Troubleshooting

Refer to the Wiring Diagram in the back of this manual for all troubleshooting procedures.

Troubleshooting Guide

Table 8-2: Power Related Troubleshooting (FCC Information Shown)

Problem Description	Possible Causes
Power lights do not turn on	Verify the Power Cable from the facility's power is fully seated and secured. Check the facility's power to the Jet system. Verify correct power rating. Verify power cables within the Jet system are fully seated and secured. Verify voltage output from the controller.
System Power Fault lamp on controller is ON	The controller has detected a problem with the system wiring. Verify all wiring is correct. If problem continues contact Technical Support.
No DC power to one or more of the Motion or I/O Nodes (Fuse Blown lamp on controller is ON)	One or more fuses are blown. Inspect the fuses on the front panel of the controller and replace as required. Refer to Figure 8-1 and Table 8-3 .

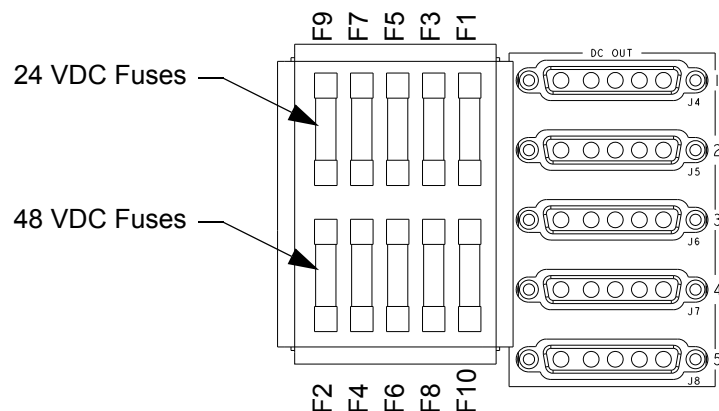


Figure 8-1: Fuse Locations (FCC Shown)

Table 8-3: Fuse Descriptions (FCC Fuses Shown)

Name	Type	Function
F1	Fuse, Slo-Blo, 8A, 3AG, RC6	+24 VDC - J4
F2	Fuse, Slo-Blo, 8A, 3AG, RC6	+48 VDC - J4
F3	Fuse, Slo-Blo, 8A, 3AG, RC6	+24 VDC - J5
F4	Fuse, Slo-Blo, 8A, 3AG, RC6	+48 VDC - J5
F5	Fuse, Slo-Blo, 8A, 3AG, RC6	+24 VDC - J6
F6	Fuse, Slo-Blo, 8A, 3AG, RC6	+48 VDC - J6
F7	Fuse, Slo-Blo, 8A, 3AG, RC6	+24 VDC - J7
F8	Fuse, Slo-Blo, 8A, 3AG, RC6	+48 VDC - J7
F9	Fuse, Slo-Blo, 8A, 3AG, RC6	+24 VDC - J8
F10	Fuse, Slo-Blo, 8A, 3AG, RC6	+48 VDC - J8

Communications Troubleshooting

Refer to the Wiring Diagram for the system and the controller when troubleshooting.

Table 8-4: Communications Troubleshooting

Problem Description	Possible Causes
System powered but no response to user's controller	Verify the Interface Cable is fully seated and secure. Check for proper connection and continuity. Check communication to user's host controller. Verify user's controller is correctly set up. Verify software guidelines were correctly written.
System powered but no response from components within system	Ensure internal power cables are properly seated. Ensure internal network cables are properly seated.
Intermittent Communication to user's controller on Ethernet	Ensure all network cables are properly seated.

Motion Control Troubleshooting

Refer to the Wiring Diagram for the motion controller when troubleshooting.

Table 8-5: Motion Control Troubleshooting

Problem Description	Possible Causes
Material slipping on end effector	For vacuum gripping end effectors, ensure that vacuum is connected and meets pressure specifications. For edge-contact end effectors, ensure smooth end effector motion. For all end effectors, ensure all material contact surfaces are clean.

Robot Troubleshooting

Refer to the Wiring Diagram for the robot when troubleshooting.

Table 8-6: Robot Troubleshooting

Problem Description	Possible Causes
ATR robot not operating	Check that power is connected and meets specifications. Check that vacuum is connected and meets specifications. Verify Firewire cable is fully seated and secure.

Track Troubleshooting

Refer to the Wiring Diagram for the Track when troubleshooting.

Table 8-7: ATK Track Troubleshooting

Problem Description	Possible Causes
ATK track not operating	Check that power is connected and meets specifications. Verify Firewire cable is fully seated and secure.

Aligner Troubleshooting

Refer to the Wiring Diagram for the aligner when troubleshooting.

Table 8-8: AWA Aligner Troubleshooting

Problem Description	Possible Causes
AWA aligner not operating	Check that power is connected and meets specifications. Verify Firewire cable is fully seated and secure.

Load Port Module Troubleshooting

Refer to the Wiring Diagram for the Load Port Module when troubleshooting.

Table 8-9: Load Port Module Troubleshooting

Problem Description	Possible Causes
Load Port Modules not operating	Check that power is connected and meets specifications. Check that vacuum is connected and meets specifications. Verify Ethernet cable is fully seated and secure. Check communication to controller. Verify controller is correctly set up. Check that CDA is connected and meets specifications.

Fan/Filter Unit Troubleshooting

Refer to the Wiring Diagram for the Jet system when troubleshooting.

Table 8-10: Fan/Filter Unit Troubleshooting

Problem Description	Possible Causes
Fan/Filter Unit not operating	Check that power is connected and meets specifications. Verify Ethernet cable from Ethernet Switch to Ethernet to Serial Gateway is fully seated and secure. Verify Serial cable from Ethernet to Serial Gateway to FFU is fully seated and secure. Check communication to controller. Verify controller is correctly set up.

Material Mapping Troubleshooting

Material mapping performance depends on the surrounding conditions and material coatings. The default settings provide a good starting point for most material types, but may not be ideal for all coatings. If the robot is having difficulty correctly identifying material presence or condition, follow these recommended solutions for each specific problem.

Table 8-11: Mapping Troubleshooting

Mapping Issue	Table
Correctly Placed Wafers Map as Cross Slotted	Table 8-12
Correctly Placed Wafers Map as Double Slotted ¹	Table 8-13
Correctly Placed Wafers Map as Missing	Table 8-14
Missing Wafers Map as Correctly Placed, Doubled, or Cross Slotted	Table 8-15

1. Detection of double-slotted wafers is not guaranteed using the robot for mapping. The recommended configuration to detect double slotted wafers is using a LPM with load port mapping.

Table 8-12: Correctly Placed Wafers Map as Cross Slotted

Possible Cause	Solution
Cassette not level to mapping sensor	Using a bubble level, ensure the level of a wafer in the cassette is the same as the mapping sensor level by placing the bubble level on both the wafer in the cassette and the mapping sensor.

Table 8-13: Correctly Placed Wafers Map as Double Slotted

Possible Cause	Solution
Wafers are not placed into cassette completely or are staggered.	Lift cassette and tilt back to slide wafers into cassette completely.

Table 8-14: Correctly Placed Wafers Map as Missing

Possible Cause	Solution
Cassette not level to mapping sensor	Using a bubble level, ensure the level of a wafer in the cassette is the same as the level of the mapping sensor by placing the bubble level on both the wafer in the cassette and the mapping sensor.

Table 8-15: Missing Wafers Map as Correctly Placed, Doubled, or Cross Slotted

Possible Cause	Solution
Reflective surfaces causing false readings	Make sure that all reflective surfaces located directly behind the cassette are covered with a non-reflective material.
Ambient light causing false readings	In rare cases, direct sunlight can cause the sensor to produce false readings. Make sure all direct sunlight is blocked from the cassette nest area of the tool.

Repair Philosophy

Once the failed unit has been identified, a Field Replaceable Unit (FRU) can be ordered. The FRU is shipped with directions for removing the failed unit and installing the new unit. Refer to the system documentation for the FRUs available for your system.

Refer to the appropriate component User Manuals for additional troubleshooting and repair procedures. Refer to the Brooks Customer Care Program for detailed information about Spare Parts, Repair Programs and Maintenance Training.

The following repair options are available:

On-Site Repair

Facilitated On-Site Repair offers the fastest way to fix a hardware problem in the field through the use of Brooks Field Service personnel and factory authorized repair parts.

Exchange Units

Advanced Exchange Units are stocked at the user's facility and are designed to keep Mean Time To Repair (MTTR) and Jet system downtime to a minimum.

Factory Repair Services

Factory Repair Services requires that the failed FRU be removed from the Jet system and returned to Brooks Automation for diagnosis and factory repair.

Two alternatives are available for factory repair:

- Expedited Repair Service provides a typical one-week repair turnaround from receipt of the FRU at Brooks Automation.
- Standard Repair Service provides a typical four-week repair turnaround from receipt of the FRU at Brooks Automation.

Parts Service

The appropriate FRUs may be ordered through the Brooks Priority Part Service (PPS). PPS provides overnight shipment of parts directly from the Brooks Chelmsford, MA facility. Note that any items identified as "long lead time" may take longer to ship.

FFU Filter Replacement

This procedure provides the steps for removal of the Fan/Filter Unit from the Jet system. FFU removal is required to replace the filter media. Two people are required to remove the FFU.

Procedure Category

Type 1 Procedure: Equipment is fully de-energized.

Required Tools and Test Equipment

- Metric Allen Wrenches
- Flat blade Screwdriver

	 WARNING
	Toxic Chemicals / Environmental Hazards The Jet system may be used in an environment where hazardous materials are present which may cause death or serious injury. • Be aware that surfaces may be contaminated. • Refer to the facility's Material Safety Data Sheets to determine proper handling. • Follow the facility's procedures to certify the environment is safe.

	 WARNING
	Lockout/Tagout Working with energized equipment may cause sudden movement or electrical shock and may result in death or serious injury. • All energy must be removed from the equipment per the facility's Lockout/Tagout procedure before servicing. • If local procedures are not available, follow the procedure for Lockout/Tagout in OSHA Standard 29CFR 1910.147. • Refer to the specifications for the system power requirements and use appropriate precautions.

NOTICE
After changes are made to the system, including the size of the wafer, the alignment of the system should be checked. See Chapter 5: Alignment and Teaching.

Replacement Procedure

1. Turn off and disconnect all power, communications, and air connections as detailed in [Safe Shutdown on page 6-12](#).
2. Open the Upper Service Side Door.
Disconnect the cables running to the display.
Disconnect the ground wire connected to the door.
3. Open the Lower Service Side Door.
Disconnect the ground wire connected to the door.
4. Access the FFU on the top of the Jet system. See [Figure 8-2](#).
5. Remove the upper and lower service doors on the service side of the Jet by unlatching the doors and removing the hinge pins (2 hinges on the upper door, 3 hinges on the lower door).
6. Slide the doors off of the hinges and store in a safe location.

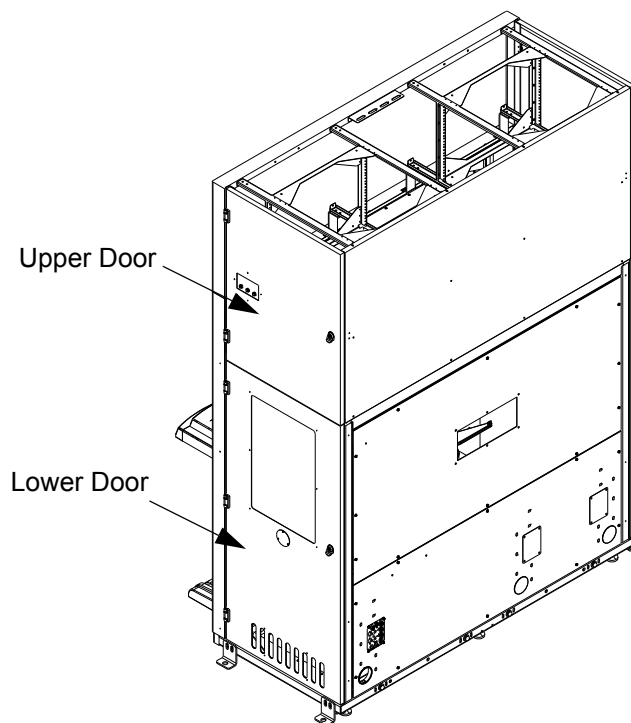


Figure 8-2: Access the FFU

7. Remove the hinge bracket for the upper door by removing the screws that attach the bracket to the upper enclosure. (2 for a standard enclosure, 4 for an enclosure with electronics bays) See [Figure 8-3](#).
8. Store the hinge in a safe location.

NOTE: *It may be necessary to remove the hinges to access the mounting screws.*

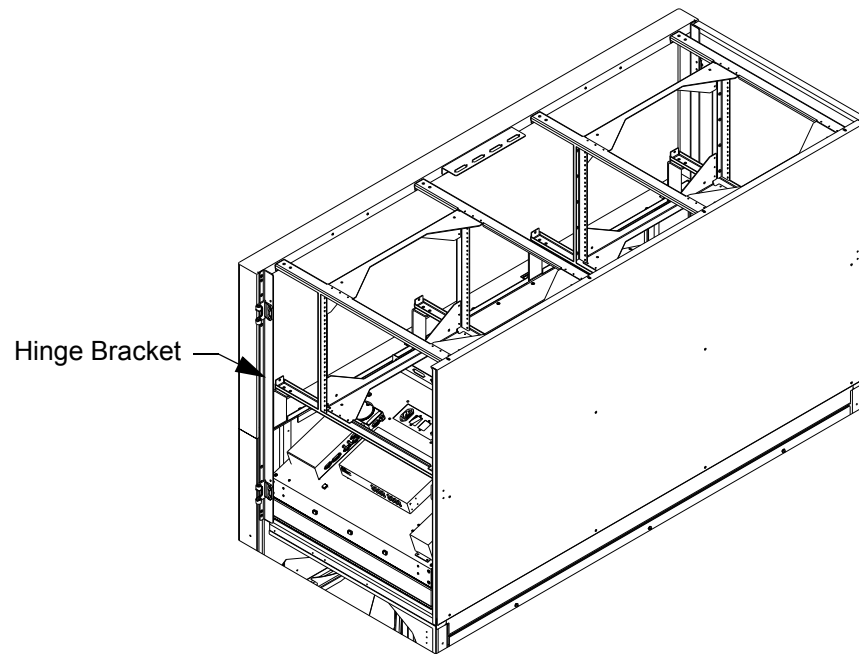


Figure 8-3: Remove Hinge Bracket

9. Disconnect all cables connected to the FFU. Remove any cable ties as necessary. Temporarily secure the cable bundle at the wireway.
10. Remove the sheet metal covers over the front Electronics Bay. See [Figure 8-4](#).
 - A. Remove the screws holding each front cover to the front of the EFEM (4 screws on the small cover, 6 screws on the large cover).
 - B. Remove the screws holding each front cover to the front of the EFEM (4 screws on the small cover, 6 screws on the large cover).
 - C. Store the covers in a safe location.

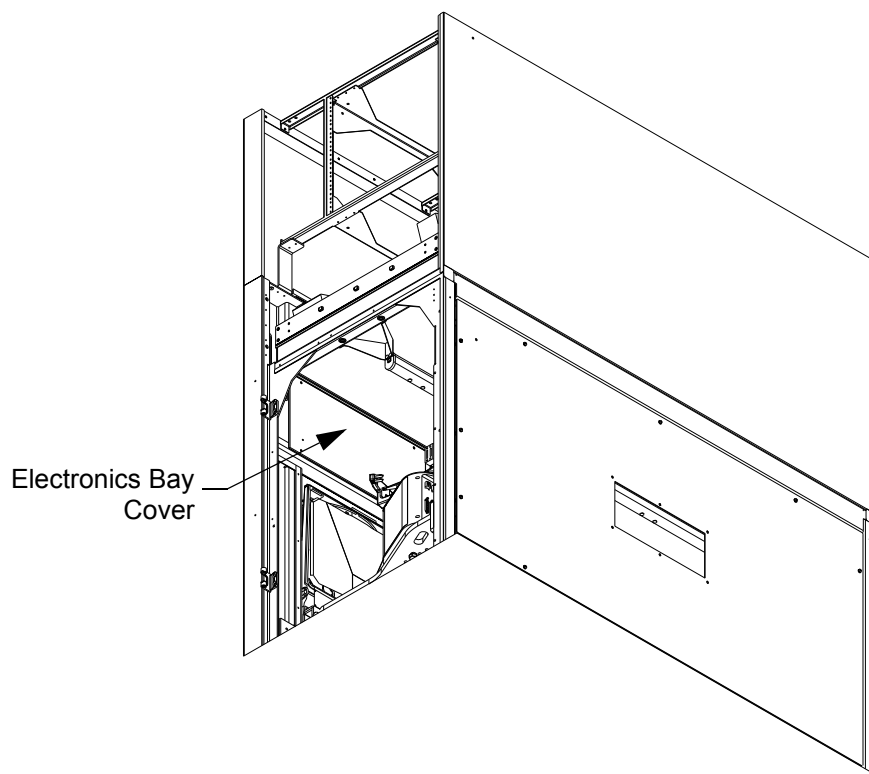


Figure 8-4: Remove Electronics Bay Covers

11. Remove the sheet metal panel that holds the LED Service Light. See [Figure 8-5](#).
 - A. Disconnect the LED service light.
 - B. Remove the screws securing the sheet metal panel that the light is mounted to (6 screws on a 2 bay, 8 screws on a 3 bay, 10 screws on a 4 bay system).
 - C. Store the panel and the light in a safe location.

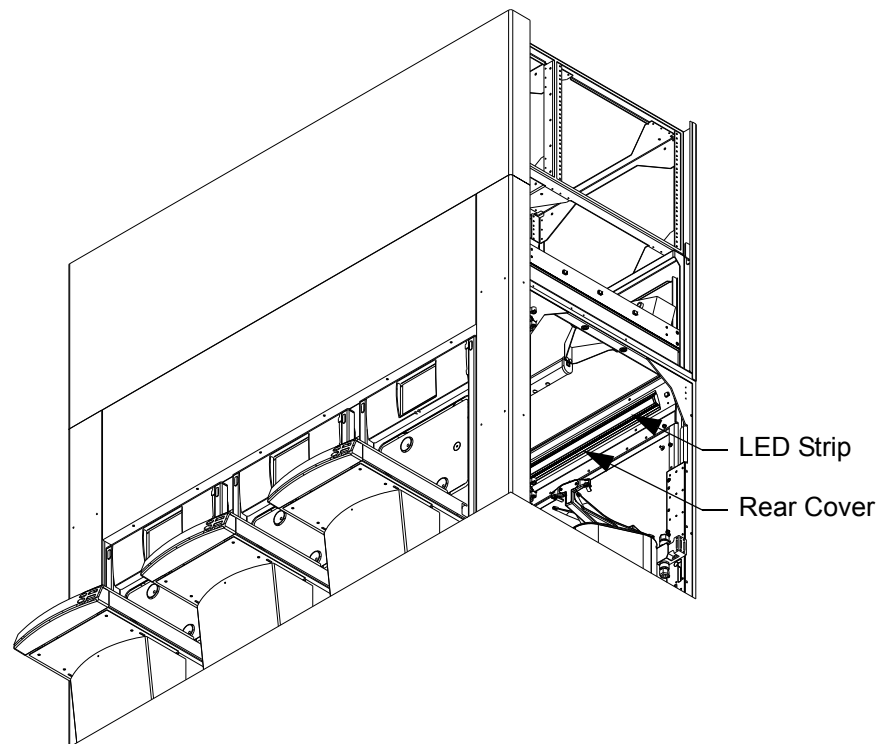


Figure 8-5: Remove LED Light Strip

12. Remove the mounts securing the FFU to the EFEM by removing the screws securing the FFU to the Jet system from within the mini-environment (6 screws on a 2 bay, 8 screws on a 3 bay, 10 screws on a 4 bay system). See [Figure 8-6](#).

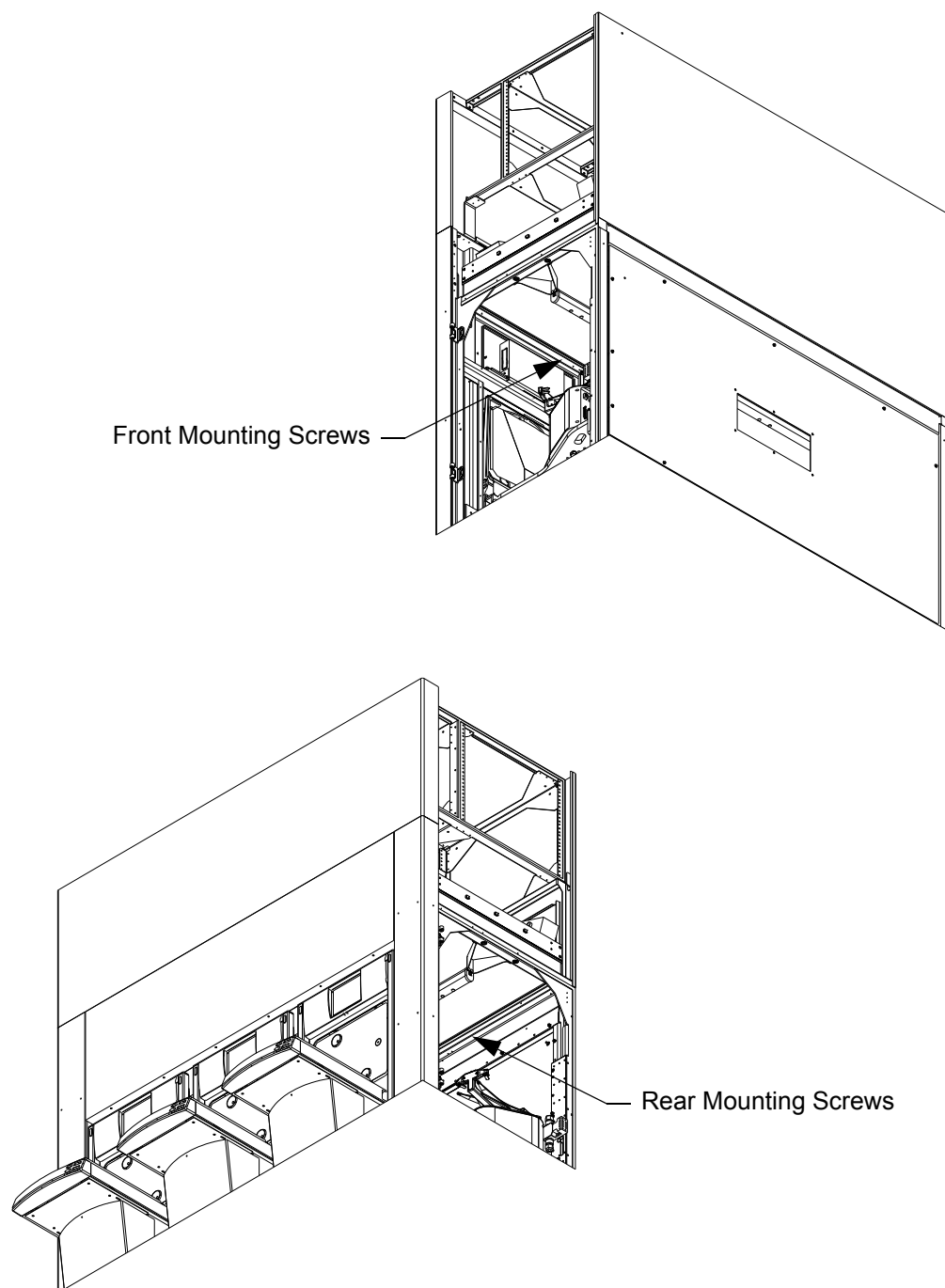


Figure 8-6: Remove FFU Mounting Screws

13. Locate the attached tabs on the Filter Nut Bar and slide the nut bars out from between the filter and the overhead rack. See [Figure 8-7](#)

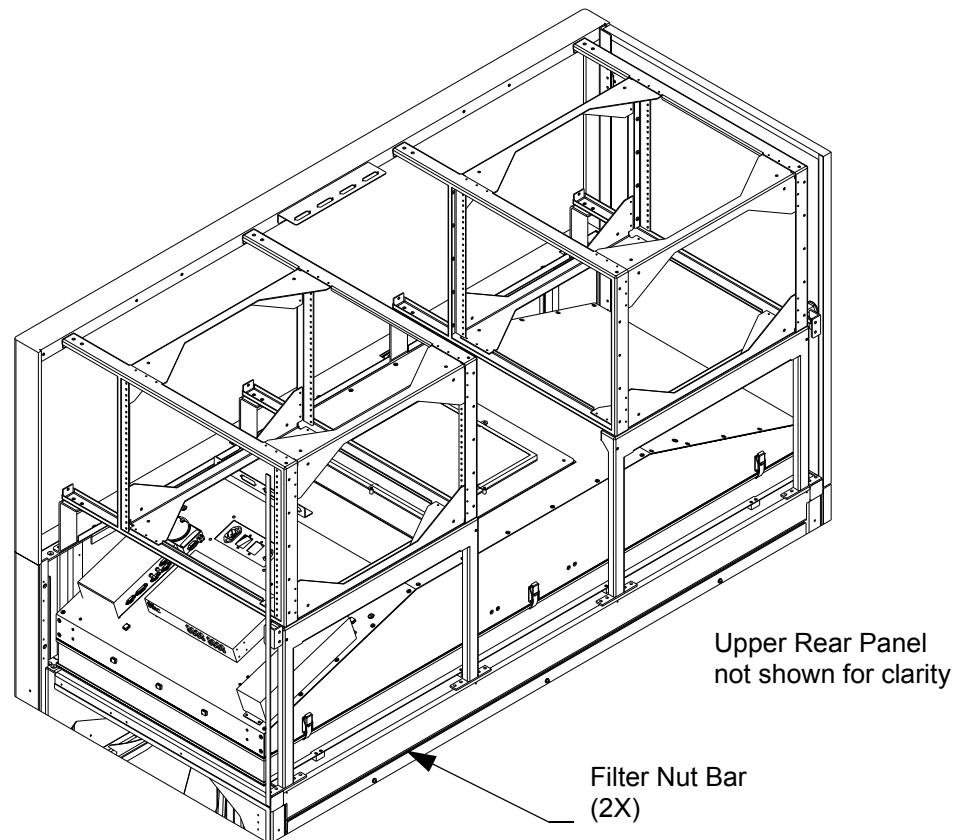
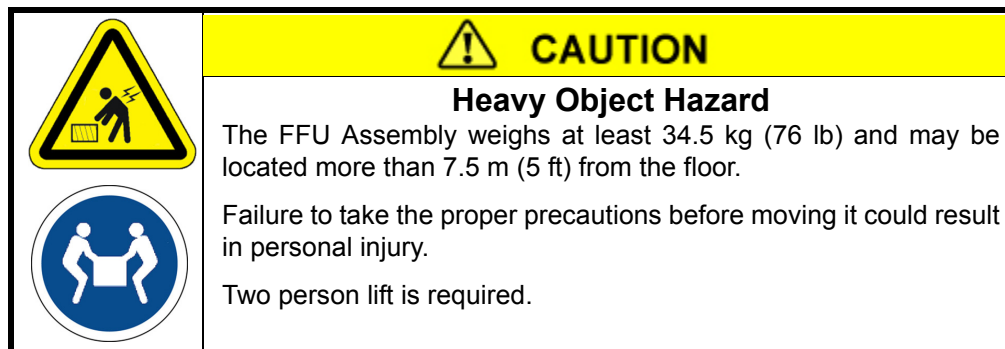


Figure 8-7: Remove Filter Nut Bars

14. Remove the FFU from the top of the Jet system. Be careful to minimize the contact between the FFU and the upper electronics rack, if equipped. Remove equipment from the lowest position of the Service Side Rack, if required. See [Figure 8-8](#).



- A. Open non-service side upper and lower doors.
- B. Using two people, one at each end of the FFU, slightly lift the FFU on each end to break gasket seal.
- C. Push the FFU from the non-service side.

When able, slightly lift the FFU on the Service Side to reduce sliding friction and remove.

Second person should enter the EFEM and lift and guide the FFU from below. Avoid contact with the face of the filter media.

- D. After partial extraction, the FFU may be tilted downward on the frame edge. Avoid dragging the gasketed edge of the filter on the frame.
- E. Store the FFU in a safe location, ensuring that the filter media on the bottom of the FFU is not damaged.

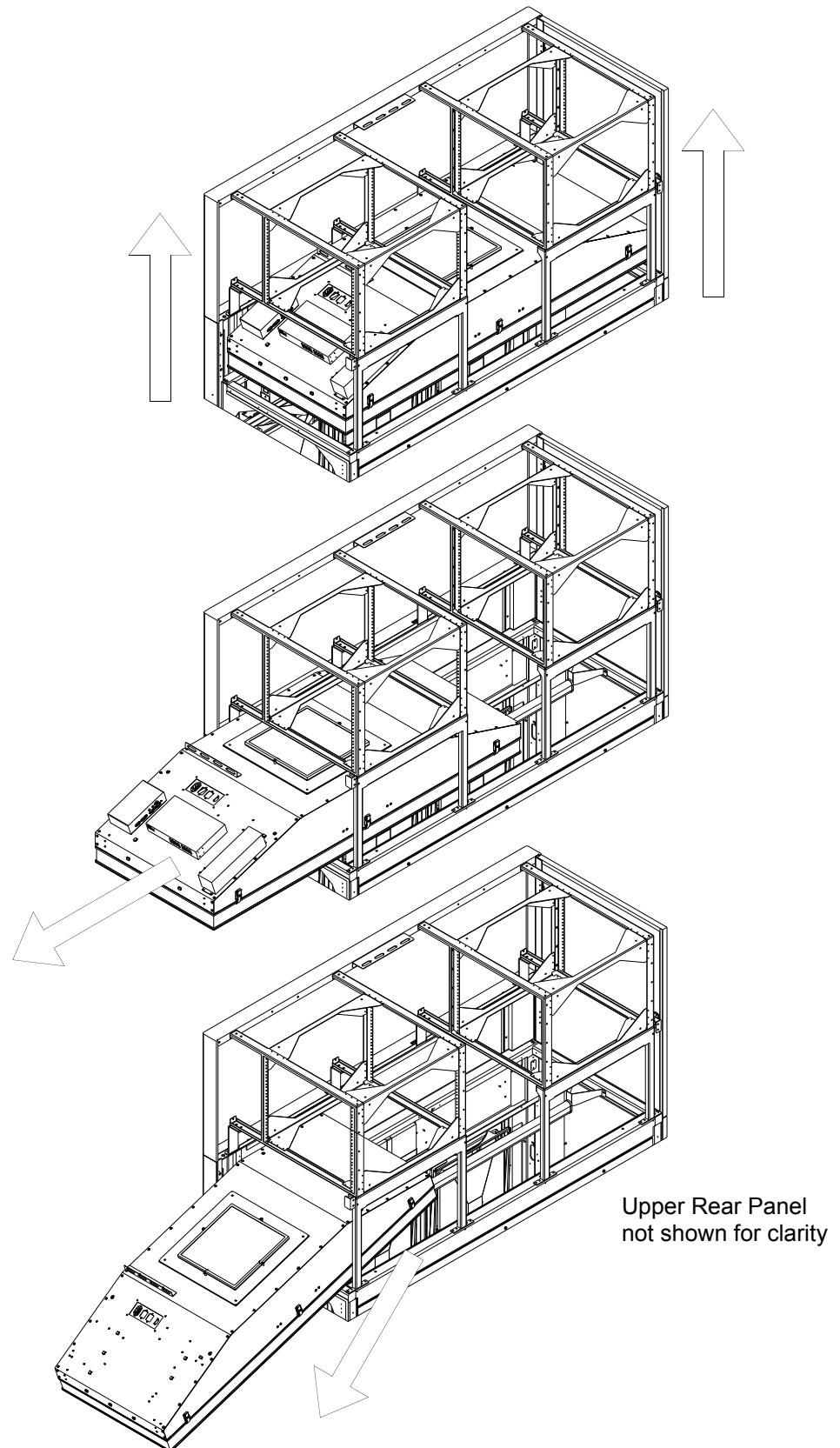


Figure 8-8: Remove the FFU

15. Verify the seal area on the EFEM is clean and free of any old gasket material.
16. Install new filter on the FFU. See [Figure 8-9](#).
 - A. Release the latches securing the filter to the FFU.
 - B. Using two people, one at each end of the FFU, lift the FFU from the old filter and set it in place on the new filter.
 - C. Close the latches to secure the new filter to the FFU.

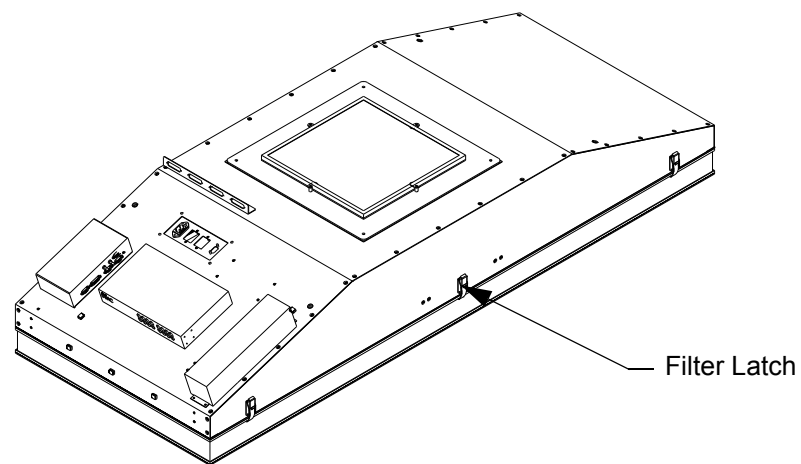
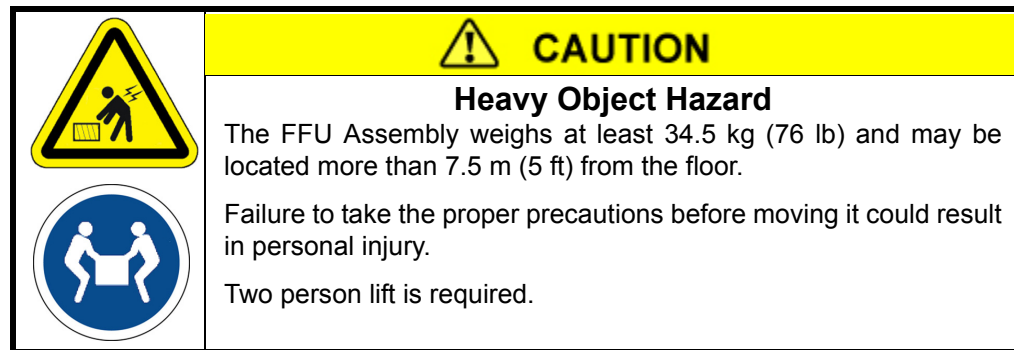


Figure 8-9: Replace Filter

17. Replace the FFU on the top of the Jet system.



NOTE: *When moving the FFU on a Jet that has the Upper Electronic Racks installed, try to minimize contact between the FFU and the racks.*

- A. Using two people from the service side of the EFEM, tip the FFU upward and insert the end above the EFEM. Ensure that the FFU is correctly oriented so the control electronics mounted on the FFU are in the same position as when the FFU was removed.
 - B. Push the FFU from the service side, slightly lifting the FFU to avoid contact with the face of the filter media. The second person should enter the EFEM and lift and guide the FFU from below - DO NOT TOUCH THE FILTER MEDIA.
 - C. Replace the eight screws securing the FFU to the Jet system from within the mini-environment.
18. Using the attached tabs, slide the Filter Nut Bar between the filter and the overhead rack, ensuring the bar is making contact with the filter.
 19. Replace the screws securing the FFU to the Jet system from within the mini-environment (6 screws on a 2 bay, 8 screws on a 3 bay, 10 screws on a 4 bay system).
 20. Replace the sheet metal panel for the LED service light and reconnect the light (6 screws on a 2 bay, 8 screws on a 3 bay, 10 screws on a 4 bay system).
 21. Install each Electronics Bay cover to the front of the EFEM using the screws previously removed (4 screws on the small cover, 6 screws on the large cover).

22. Reconnect all cables connected to the FFU (replace any cable ties that were previously removed).
23. Replace the hinge bracket for the upper door by installing the screws (2 for a standard enclosure, 4 for an enclosure with electronics bays) holding it to the Upper Enclosure.

NOTE: *Replace the hinges if they were removed.*

24. Replace the upper and lower service doors on the service side of the Jet by sliding the doors onto the hinges and inserting the hinge pins (2 hinges on the upper door, 3 hinges on the lower door).
25. Reconnect the ground wire to the Lower Service Side Door.
26. Reconnect the cables running to the display. Reconnect the ground wire to the Upper Service Side Door.
27. Return the system to operation.
 - A. Remove the shields from the vacuum line and reconnect the line to the Jet system.
 - B. Remove the shields from the ends of the power cables and reconnect the power cables.
 - C. Turn on all power supplied to the Jet system and all devices connected to the Jet.
 - D. Turn on the vacuum supply to the Jet system and all devices connected to the jet.

9

Appendices

The Jet system may use either the Razor and Fusion family of components or other robot, aligner, and controller products. For illustration purposes, the components shown in this manual are the Razor Robot, Razor Track, Razor Wafer Aligner, and Fusion controller. When using this manual, always refer to the appropriate documentation for the specific components used on your system.

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Appendix A: Contact Brooks Automation Technical Support

When contacting Brooks Automation for Technical Support, please have the following information available.

1. Record the part number and serial number from the equipment.
2. Provide the installed location of the equipment.
3. Provide name, e-mail address, and telephone number of the person to contact.
4. List any error codes received during the failure.
5. Prepare a detailed description of the events relating to the error.
 - Time that the equipment has been in operation
 - Work done on the equipment prior to the error
 - Functions that the equipment was performing when the error occurred
 - Actions taken after the error and results of those actions
 - Other information that may assist the Specialist
6. Contact Brooks Automation Technical Support:

Brooks Location	GUTS [®] Contact Number
North America	1-800-FOR-GUTS (1-800-367-4887) US/Canada +1-978-262-2900
Europe	+49 1804 CALL GUTS (+49 1804 2255 4887)
Japan	+81-45-477-5980
China	+86-21-5131-7066
Taiwan	+886-3-552-5225
Korea	+82-31-288-2500
Singapore	+65-6464-1481

For additional contact information, please go to the Brooks Automation web site at (www.brooks.com) or send an e-mail to techsupport@brooks.com.

Appendix B: Station Identification

The Brooks Automation Jet system is customized at the factory to the users specified parameters. Accompanying the Jet system is a Brooks Automation Acceptance Test (AT) which lists all the factory assigned parameters.

In the occurrence that the user replaces any modules within the Jet system or re-configures the Jet system, the new parameters should be recorded in the table provided in this section. [Table 9-1](#) provides space for recording the station parameters for the load port modules, the aligner, the load locks, and any additional stations.

Table 9-1: Station Assignments Log

Stn	Station Type Name	E/V	R	T	W	Track	Z	Lower	Slots	Pitch
lpm1	LPM 1 - EE 1	Final								
		Via								
	LPM 1 - EE 2	Final								
		Via								
lpm2	LPM 2 - EE 1	Final								
		Via								
	LPM 2 - EE 2	Final								
		Via								
lpm3	LPM 3 - EE 1	Final								
		Via								
	LPM 3 - EE 2	Final								
		Via								
lpm4	LPM 4 - EE 1	Final								
		Via								
	LPM 4 - EE 2	Final								
		Via								

Table 9-1: Station Assignments Log (Continued)

Stn	Station Type Name	F/V	R	T	W	Track	Z	Lower	Slots	Pitch
align1	Aligner: - EE 1	Final								
		Via								
	Aligner: - EE 2	Final								
		Via								
pm1	Load Lock 1 - EE 1	Final								
		Via								
	Load Lock 1 - EE 2	Final								
		Via								
pm2	Load Lock 2 - EE 1	Final								
		Via								
	Load Lock 2 - EE 2	Final								
		Via								
		Final								
		Via								
		Final								
		Via								
		Final								
		Via								
		Final								
		Via								
		Final								
		Via								
		Final								
		Via								

Appendix C: Consumables

Consumable items are identified for each unique Jet System based on the demands placed upon that system.

All standard consumable items are listed below in [Table 9-2](#). Refer to the individual User's Manuals for lists of the consumable items to be stocked for the components of the Jet System.

Refer to the System Manual Addendum, if provided, for a list of all consumable items for that specific configuration.

Contact Brooks Automation Technical Support for the part numbers for specific consumables and for additional consumables requirements.

Table 9-2: Consumables

Description	Frequency
EFEM FFU Filter, ULPA	As Required
Pad, Wafer Support, Edge Grip 300 mm	As Required
Tip, Left, Edge Grip, 300 mm	As Required
Tip, Right, Edge Grip, 300 mm	As Required
Pad, Wafer, End Effector, .123 Thk	As Required
Emitter Tip, Ionizer, Silicon	As Required

Appendix D: Tooling and Fixtures

Table 9-3 provides a list of the specialized tools and fixtures supplied with the Jet system, including shipping brackets. Table 9-4 provides a list of the optional specialized tools and fixtures used for servicing the Jet system.

Table 9-3: Tools and Fixtures Supplied with the Jet System¹

Tool	Description and Use
Robot Shipping Brackets	Used to secure the robot arm to the robot flange during shipment.
Track Shipping Brackets	Used to secure the carriage to the track during shipment.
Aligner Shipping Brackets	Used to secure the aligner during shipment.
LPM Shipping Brackets	Used to secure the paddle to the LPM frame during shipment.
Outriggers	Used to support the Jet system when moving it within facility.
Service Key	Used to override the Jet system door interlock switch during service.

1. Contact Technical Support for brackets for specific configurations.

Table 9-4: Optional Tools and Fixtures for the Jet System¹

Tool	Description and Use
Electronic Level	MicroTool EL-5003 Electronic Spot Level, used for leveling during initial installation.
Dial Indicator and fixture	Leveling End Effectors.
Dummy Wafer	MicroTool CF Series Carbon Fiber Dummy Wafers, used for system set-up and test.
Pass-through socket wrench, ¹⁵ / ₁₆ in., with 6 in. extension	Socket wrench with ratchet, socket, and extension used to adjust the system's feet.
Metric hex wrench with ratchet, 8 mm x 100 mm	Long hex wrench used to adjust the system's feet (slides inside the pass-through socket).

1. Contact Customer Service to order optional tools and fixtures.

Appendix E: Packing and Shipping Instructions

If the Jet system is shipped, it must be properly packaged to ensure it arrives undamaged. The Jet system was originally assembled and packaged in a cleanroom environment. Care should be taken to ensure that it is repackaged in the same type of environment.

The following procedure instructs the correct method of handling and packaging the system for shipment.

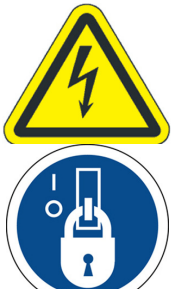
NOTE: *The original shipping crates must be used when shipping the Jet system. If the original crates have become lost or damaged, contact Brooks Automation for replacements.*

 CAUTION	
 	Heavy Object / Tip Hazard The Jet system weighs from 555.2 kg (1224 lb) to 895.4 kg (1974 lb) with Load Ports attached. Each Load Port Module weighs 59 kg (130 lb). Failure to take the proper precautions before moving any of these items could result in personal injury. When moving the Jet system, ensure that all force exerted is below the center of gravity. Use a minimum of four people to move the Jet system when rolling it across the floor, or use a hoist device.

Required Tools and Equipment

- Metric hex wrenches
- Inch hex wrenches
- Open end and adjustable wrenches
- Fork Lift or appropriate lift device

Packing Procedure

	 WARNING Electrical Shock Hazard The Jet system uses electrical power that may cause death or serious injury. Before beginning this procedure, the Jet system must be shut down following the procedure provided in Safe Shutdown on page 6-12.
---	--

1. Turn off and disconnect all power, communications, and vacuum connections as detailed in [Safe Shutdown on page 6-12](#).
2. Ensure the system has been properly decontaminated following the facilities decontamination procedures. Follow all Federal, State, Local, and Facility procedures for the disposal of any hazardous materials.
3. Remove any tie-downs from the floor and the frame.
4. Release the Jet system from the process tool.
5. Secure the robot Arm to the Flange to prevent movement and damage during shipment by using the shipping brackets supplied with the Jet system when it was received.
Secure robot controller by moving the latch to the locked position.

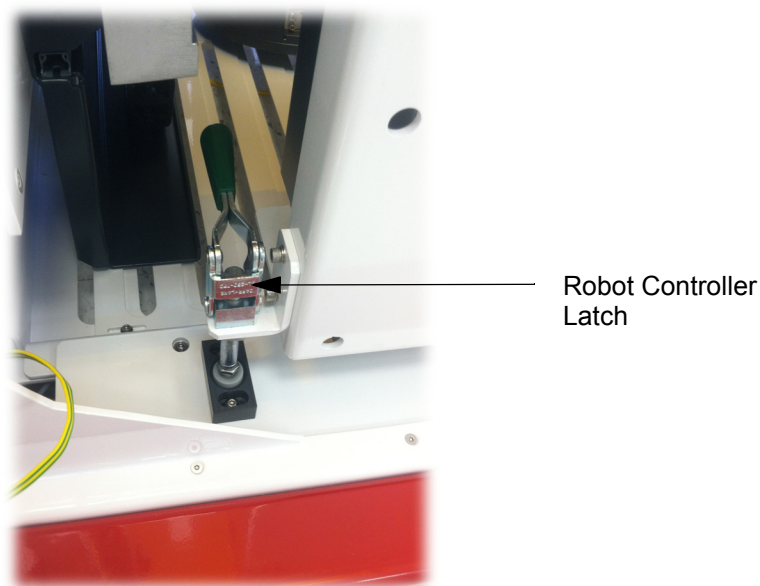


Figure 9-1: Robot Controller Latch

NOTICE

The end effector is delicate and should be handled carefully.

6. Secure the aligner Rotate Chuck to the Lift Chuck to prevent movement and damage during shipment by placing the pads supplied with the Jet system when it was received between the chucks and using plastic ties to hold the chucks together.

NOTICE

Do not apply any force on either the Rotate Chuck (Theta Axis) or the Lift Chuck (Z Axis) as damage to internal mechanisms may occur.

7. Secure the track Carriage to the track Frame to prevent movement and damage during shipment by installing the shipping fixtures supplied with the Jet system when it was received.
8. If the Jet will be shipped with the load ports attached the pod door opening paddle must be secured with the foam blocks supplied with the Jet system when it was received.
9. Replace all other shipping materials (i.e., brackets, foam, etc.).
10. Attach the two outriggers to the sides of the Jet system frame as shown in [Figure 9-1](#).

11. Attach the four tie-down brackets to the outriggers as shown in [Figure 9-1](#).

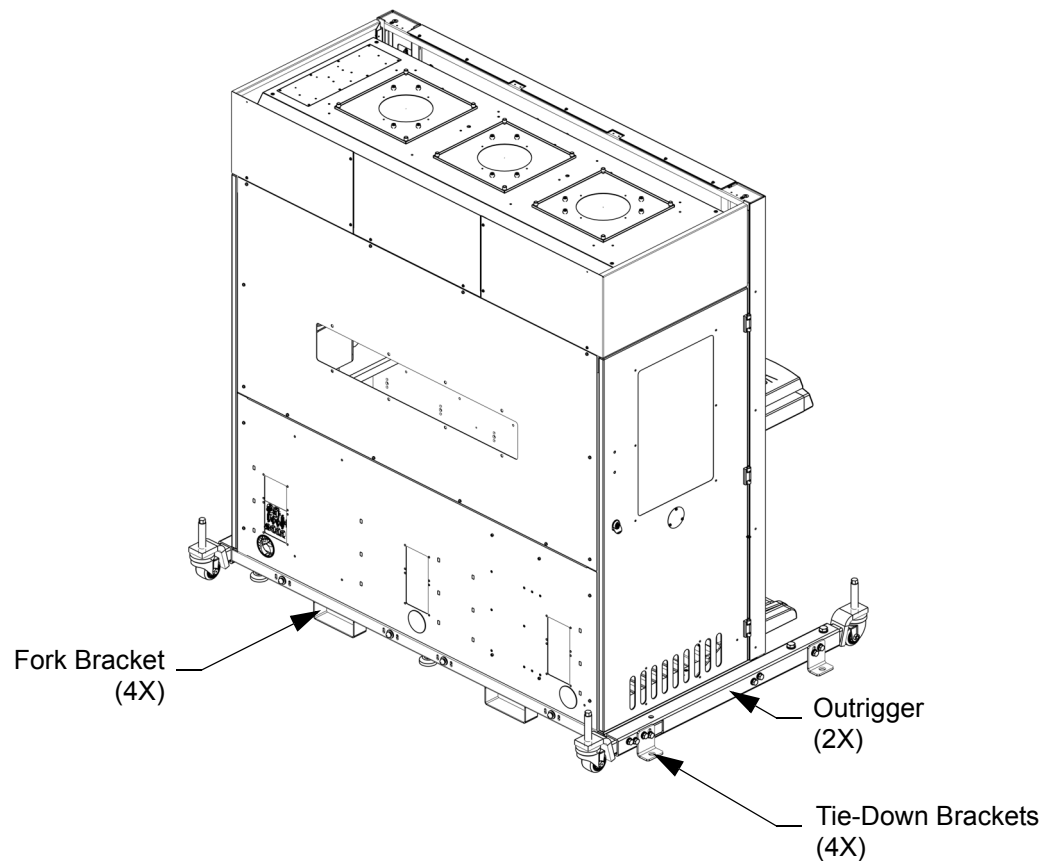


Figure 9-1: Shipping Tie-Downs

12. Raise all feet by loosening the jam nut (against the frame) of each foot and turning until the Jet system is resting on the casters and the feet will clear any obstacles in its path then turn the jam nut until it is locked against the frame to secure the feet.

NOTE: All casters must touch the ground.

13. Roll the Jet system into the Depack area.

NOTICE

When rolling the Jet system on its casters, push on the mini environment only.
Do not push on any externally mounted components (Load Port Modules, Light Tower, etc.) as damage to those components could result.

14. The entire Jet system should be wrapped, bagged, and packed following standard packing procedures for a cleanroom environment. Ensure that all wrapping/bagging covers the bottom of the Jet system to ensure cleanliness.
15. Use a fork lift with 6 inch wide forks (maximum). Position the forks at the lift points on the back side of the Jet system and lift the system slightly. Note that the system may tip forward on the forks slightly.
16. Install the four Fork Brackets at the lift points as shown in [Figure 9-1](#)
17. Using the fork lift, move the Jet system to the shipping area.
18. Slide the base of the shipping container under the Jet system.
19. Lower the Jet system onto the container base and secure using the tie-down brackets (shown in [Figure 9-1](#)).
20. Perform any final bagging and crating required.
21. Add tip indicators, shock indicators, moisture indicators, etc. to the outside of the crate as desired to verify proper handling during shipment.

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10

Drawings

Overview

This section identifies the items that have been identified as Field Replaceable Units (FRUs) available for user service of the Jet System. FRUs for individual Brooks Automation components within the system are identified in the component's user manual. Refer to the system documentation for the specific part and serial numbers. Configuration specific FRUs that are not covered in this section are detailed in documentation that came with your system.

The Jet system may use either the Razor and Fusion family of components or other robot, aligner, and controller products. For illustration purposes, the components shown here are the Razor Robot, Razor Track, Razor Wafer Aligner, and Fusion controller. When using this manual, always refer to the appropriate documentation for the specific components used on your system.

All Field Replaceable Units identified in this manual are generic and may not represent your Jet System. To obtain the specific list of FRUs available for your system, refer to your system Bill Of Material, BOM, or contact Brooks Technical Support.

NOTICE

This list of FRUs is not controlled. Changes may have been made or additional items added to the list at any time.

For information on the FRU list, contact Brooks Automation Technical Support.

Jet System

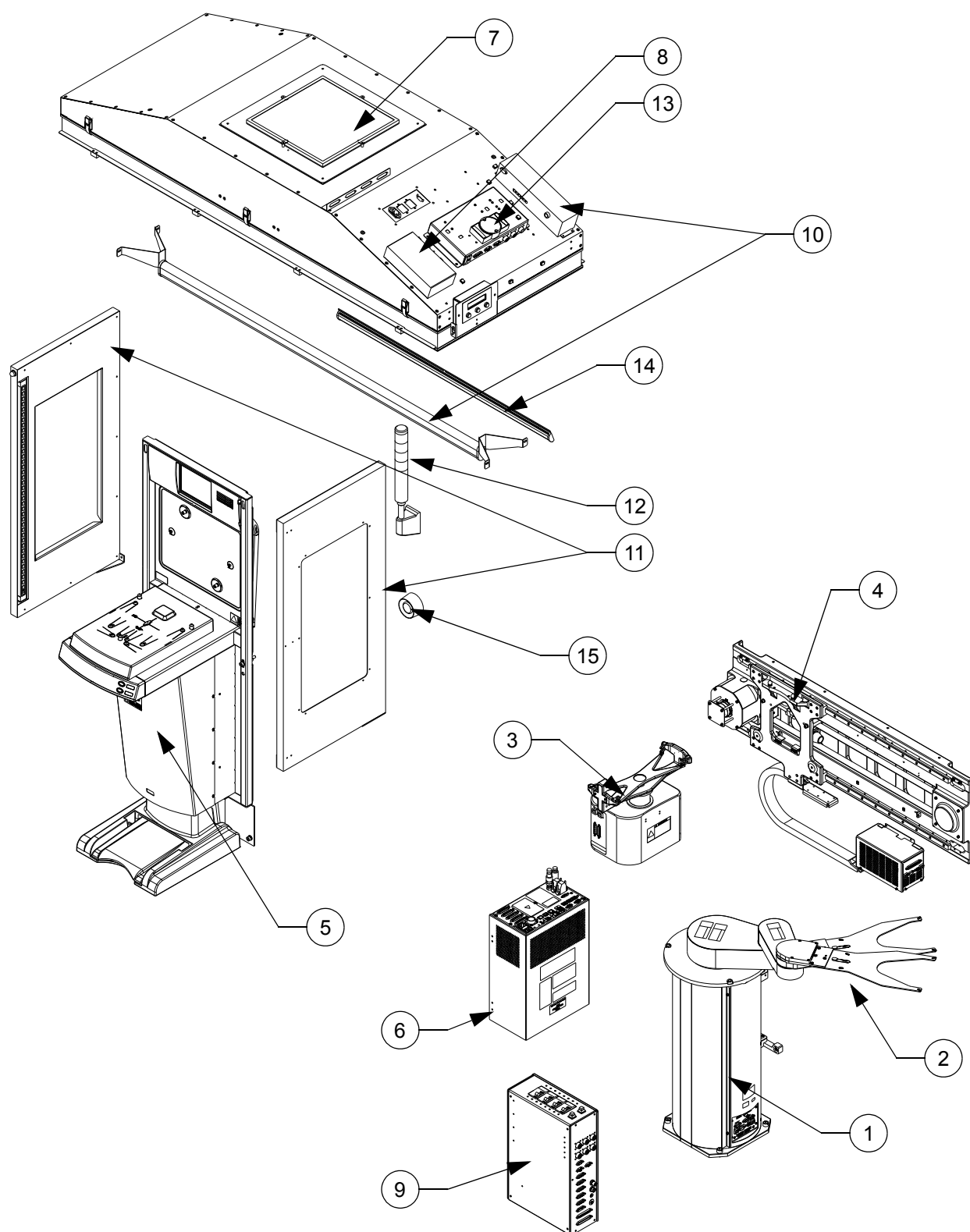


Figure 10-1: Jet System FRUs (Razor Robot, Track, and Aligner and Fusion Shown for Reference)

Table 10-1: Jet System FRUs¹

Balloon	Item Description
1	KIT, FRU, ASSY, 4 AXIS,
	KIT, FRU, ASSY 5 AXIS,
2 ²	ASSY, END EFFECTOR A
	ASSY, END EFFECTOR B
3	KIT, ALIGNER FRU
4	KIT, FRU, TRACK 505
	KIT, FRU, TRACK 1010
5	ASSY, LPM
6	KIT, FRU, FCC, FUSION
7	KIT, FRU, FFU FAN
8	KIT, FRU, FFU CONTROLLER
9	PDU
10	KIT, FRU, IONIZER BARS/CONTROLLER, JET
11	KIT, FRU, LIGHT CURTAINS, JET
12	Light Tower
13	Light Tower Controller
14	Internal Lighting
15	EMO push button
	Ethernet Switch
	I/O Node
	UI Interface Display Panel
	UI Keyboard
	Window, Side Maintenance Door

1. Contact Technical Support for FRUs for specific configurations.
2. Note that changing end effectors to different part numbers requires retuning the robot and may require additional changes to the configuration of the Jet system to ensure proper operation.

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