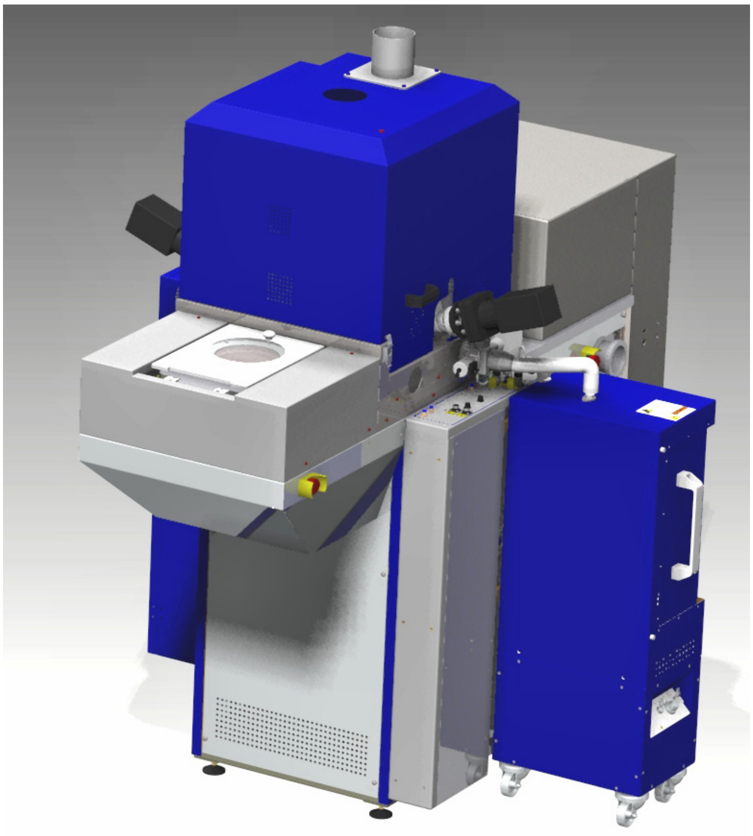
Installation Data Sheet

Oxford Instruments Plasma Technology

FlexAL®II

Issue 10 / April 2016 / Original Instructions



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Contents

Section **Page**

About this data sheet **3**
Floor and wall loadings **4**
Services **4**
Services connections 4
System dimensions **7**
Gas pod dimensions 9
System footprints 12
Electrical power supply requirements **13**
Earth connection 14
Residual current circuit breakers 15
Water cooling requirements **15**
Compressed air requirement **16**
Nitrogen requirement **17**
Process gas requirement **18**
Installation of low vapour pressure gases **19**
Keep the gas cylinder indoors 19
Maintain a positive temperature gradient 19
Extraction requirements **20**
Mandatory requirements for backing-pump extraction 20
Mandatory requirements for gas pod extraction 21
Mandatory requirements for precursor pod extraction 21
System heat load **21**
System noise emission **21**
Environment **22**
Mandatory specifications for the system environment 22
Room volume and air changes 22

About this data sheet

This data sheet provides basic information about the installation of an ALD **FlexAL®**II tool.

Floor and wall loadings

Table 1 lists typical weights of system components. Ensure that the floor is rated to support the weight of the main frame, the backing pump and the heater/chiller (if provided). Ensure that the wall is rated to support the weight of the gas pod.

Table 1 Typical weights of system components

Item	Typical weight	Comment
Main system	663 kg	Weight of a fully populated frame with a 6-way cabinet, 2 precursor cabinets, and the ozone delivery system.
12-line gas pod	70 kg	The gas pod fixings must be rated for four times this load.
Precursor pod	50 kg	
Pumps	See manufacturer’s information.	
Heater/chillers	See manufacturer’s information.	

Services

Consider the required services and plan how each service is to be provided to the system. There must be a means of isolating each service (e.g. electrical isolator, water shut-off valves, gas shutoff valves). These isolators must be located in close proximity to the system, must be clearly labelled, and must be easily accessible. Cables and pipes must not restrict access to the main electrical isolator, the emergency off buttons, or any other safety features.

Services connections

The possible services panels for **FlexAL®II** are shown in Figure 1, Figure 2 and Figure 3.

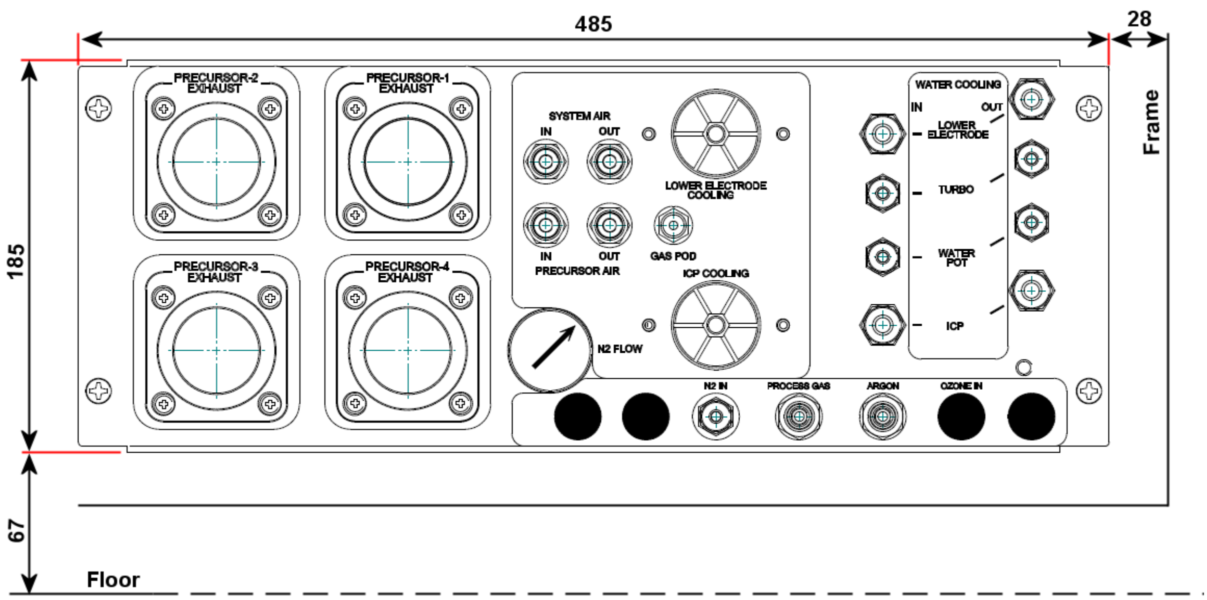


Figure 1 Services panel for FlexAL®II fitted with four precursor cabinets

Table 2 Connections on the services panel for four precursor cabinets

Legend	Type
Precursor Exhaust 1,2,3,4	ISO-KF NW40 flange
Precursor Air In/Out	6 mm push fit
System Air In/Out	6 mm push fit
Gas Pod (air in)	4 mm push fit
N2 In	1/4” swaged connection
Process Gas (in)	1/4” VCR
Argon (in)	1/4” VCR
ICP Water In/Out	3/8” swaged connection
Water Pot In/Out	1/4” swaged connection
Turbo In/Out (water)	1/4” swaged connection
Lower Electrode In/Out (water)	3/8” swaged connection

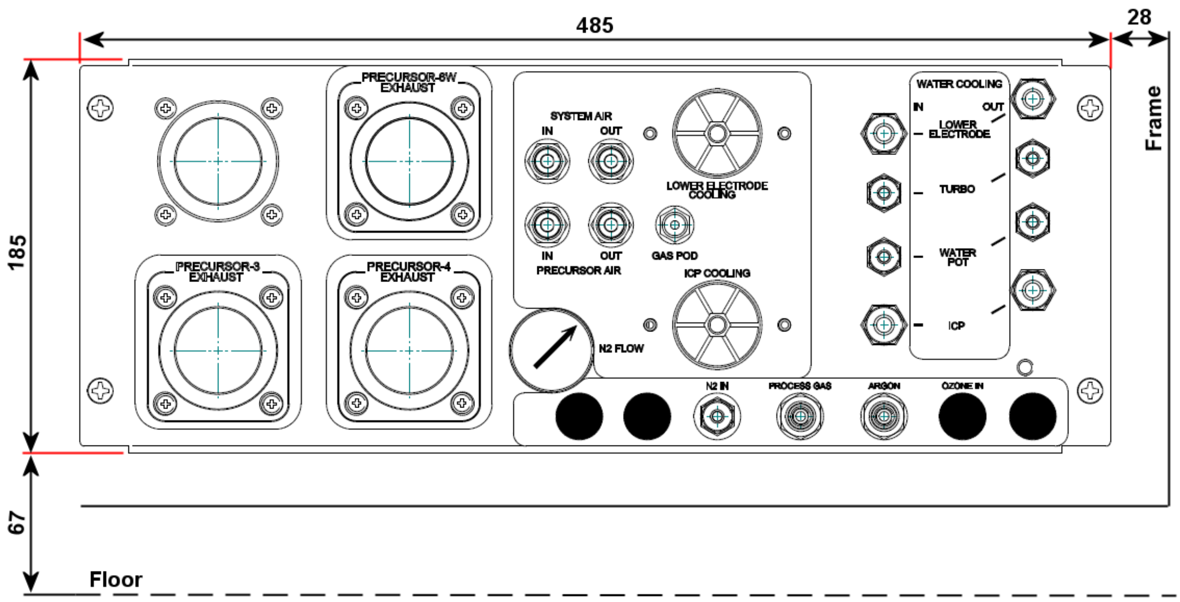


Figure 2 Services panel for a FlexAL®II fitted with one six-way and two single precursor cabinets

Table 3 Connections on the services panel for six-way precursor cabinet

Legend	Type
Precursor 6 Way Exhaust	ISO-KF NW40 Flange
Precursor Exhaust 3,4	ISO-KF NW40 Flange
Precursor Air In/Out	6 mm push fit
System Air In/Out	6 mm push fit
Gas Pod (air in)	4 mm push fit
N2 In	1/4” swaged connection
Process Gas (in)	1/4” VCR
Argon (in)	1/4” VCR
ICP Water In/Out	3/8” swaged connection
Water Pot In/Out	1/4” swaged connection
Turbo In/Out (water)	1/4” swaged connection
Lower Electrode In/Out (water)	3/8” swaged connection

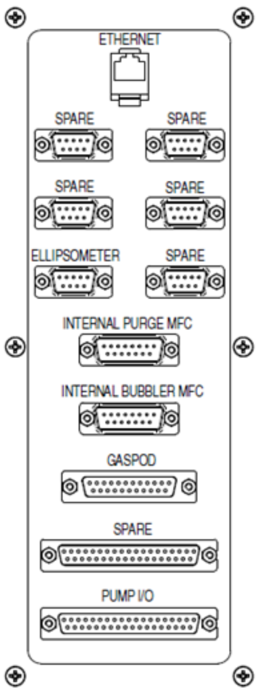


Figure 3 Comms panel

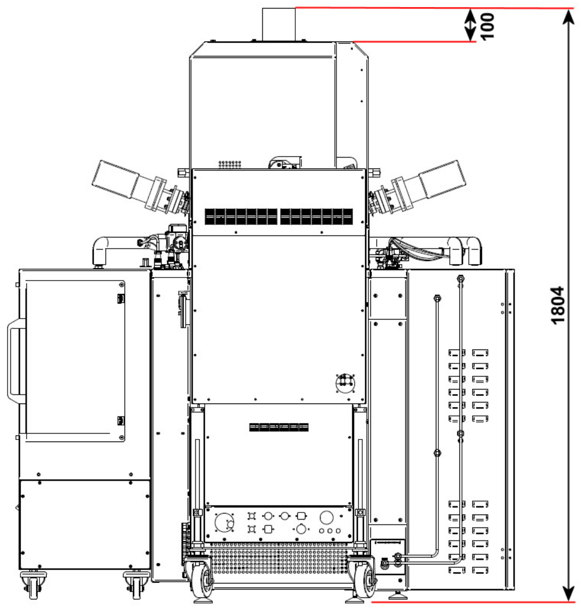
Table 4 Connections on the Comms panel

Legend	Type	Comment
Ethernet	Ethernet connector	Connect the supplied cable to the operator PC.
Spare	9-way D-type	
Ellipsometer	9-way D-type	Connect to the optional ellipsometer.
Internal Purge MFC	9-way D-type	Connect the supplied cable to the gas pod.
Internal Bubbler MFC	9-way D-type	Connect the supplied cable to the gas pod.
Gas Pod	25-way D-type	Connect the supplied cable to the gas pod.
Pump I/O	37-way D-type	Connect the supplied cable to the backing pump.

System dimensions

The generic drawings in Figure 4 to Figure 5 are for reference only. Dimensional drawings for a particular system can be obtained from Oxford Instruments Plasma Technology on request.

NOTE: OIPT recommends that service access space of at least 1 m is allowed between any obstacle (e.g. walls, partitions, etc), serviceable items (e.g. the power distribution unit), and items that require routine access (e.g. the precursor modules).



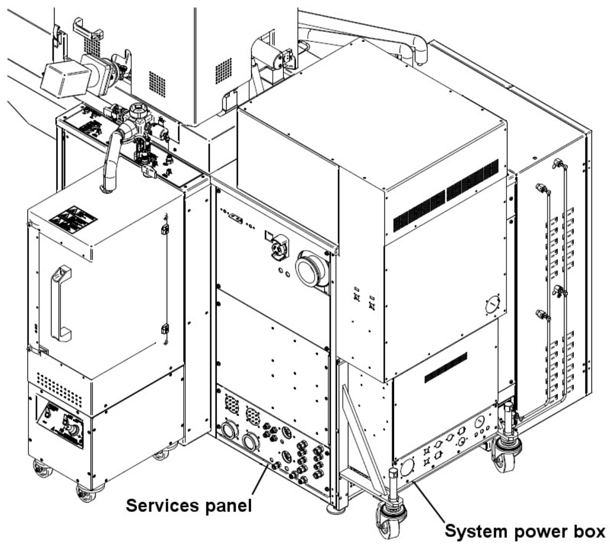


Figure 4 FlexAL®II system view

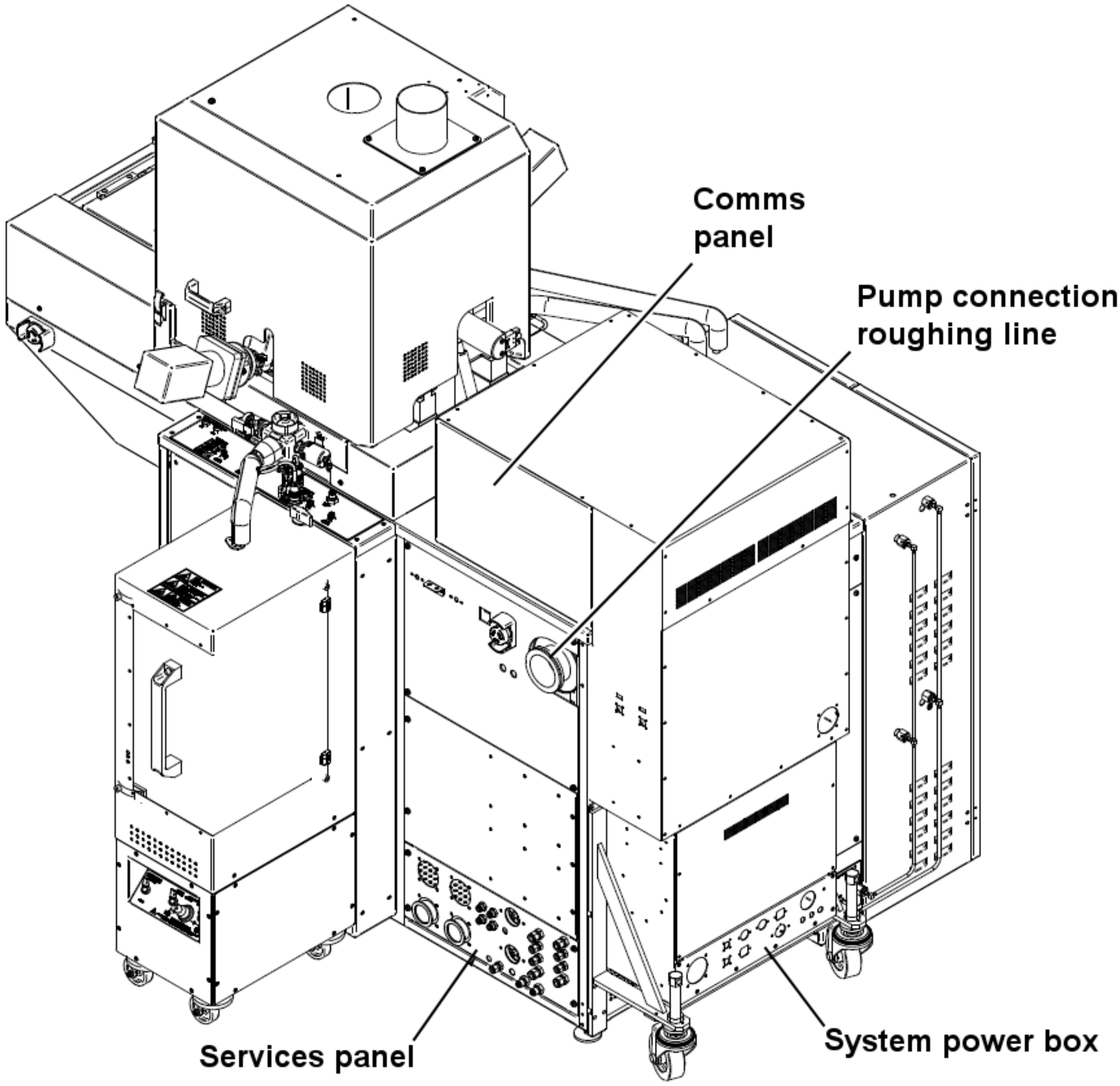


Figure 5 View of FlexAL®II with overhanging loadlock

Gas pod dimensions

Figure 6 to Figure 8 show the dimensions of the different gas pods.

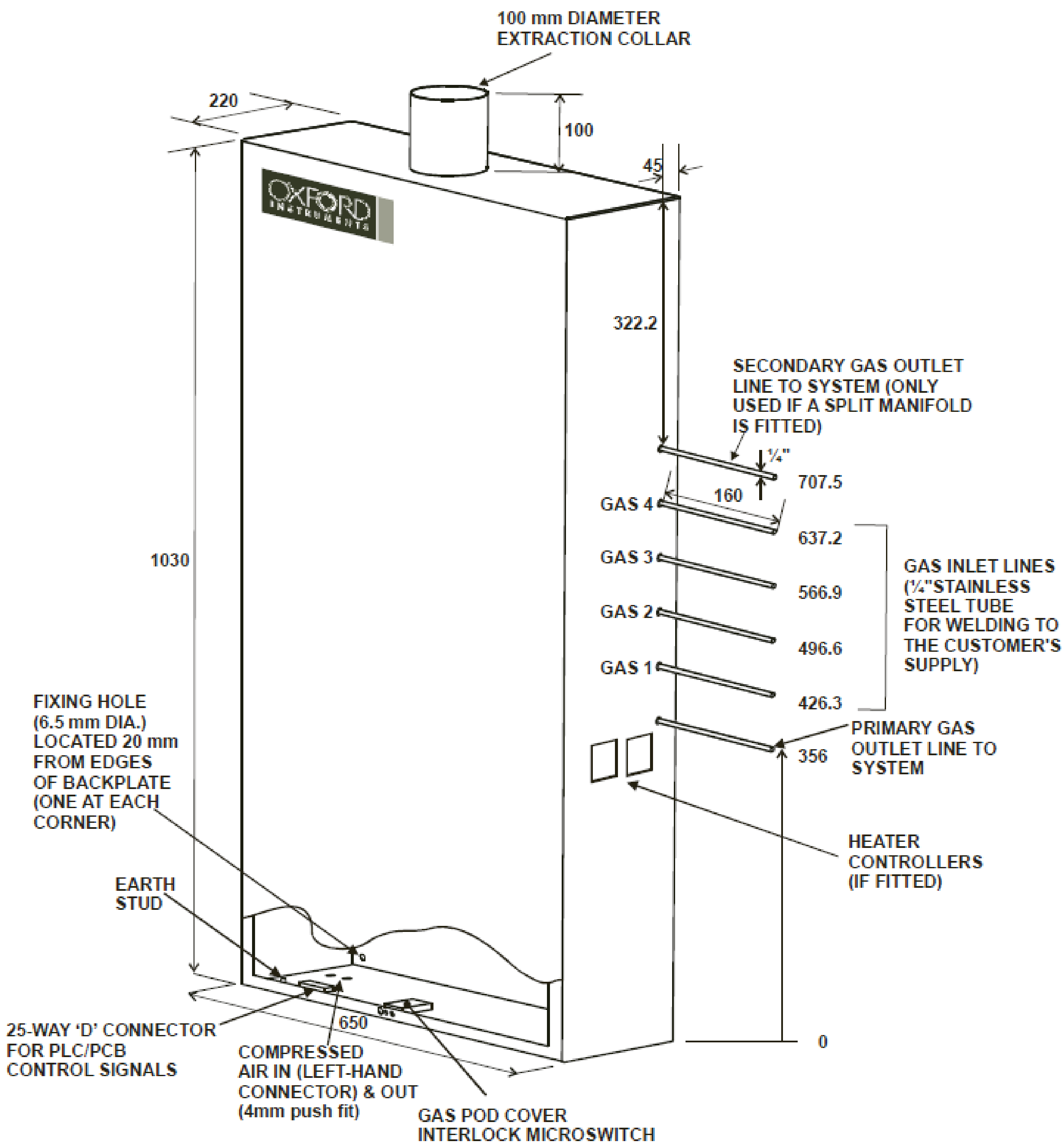


Figure 6 4-line gas pod

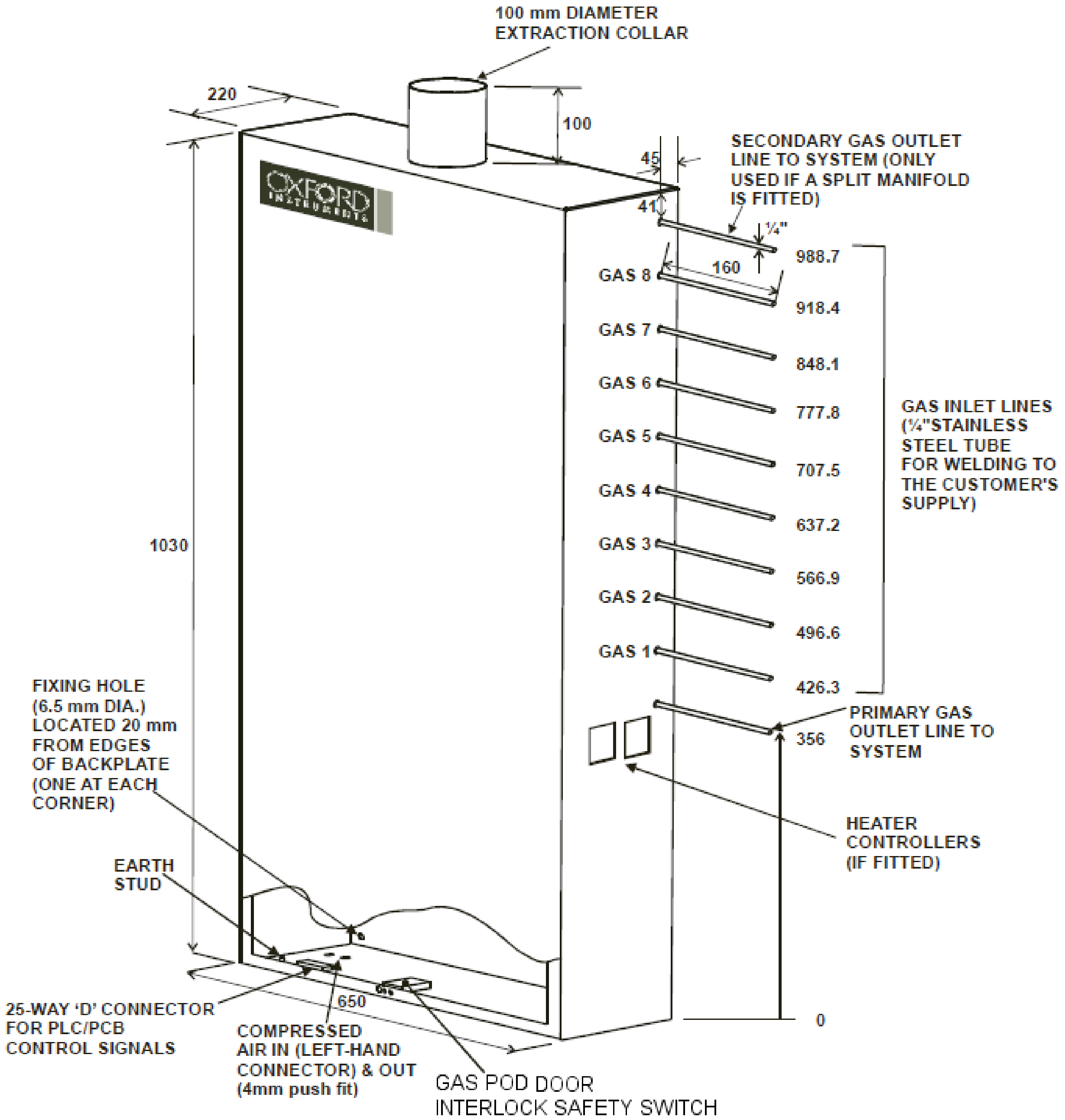


Figure 7 **8-line gas pod**

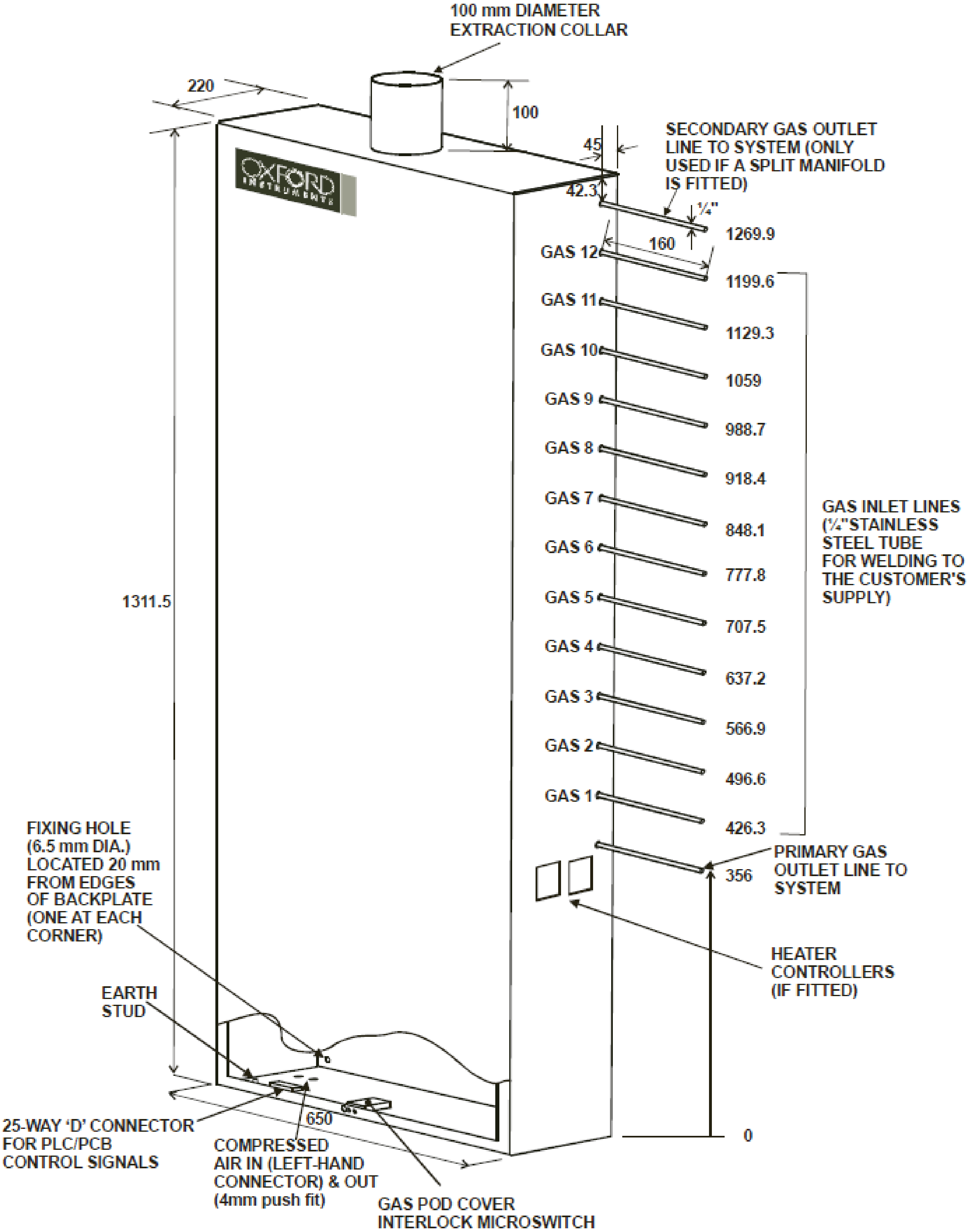


Figure 8 12-line gas pod

System footprints

Figure 9 shows the typical footprint of an ALD **FlexAL**®II installation.

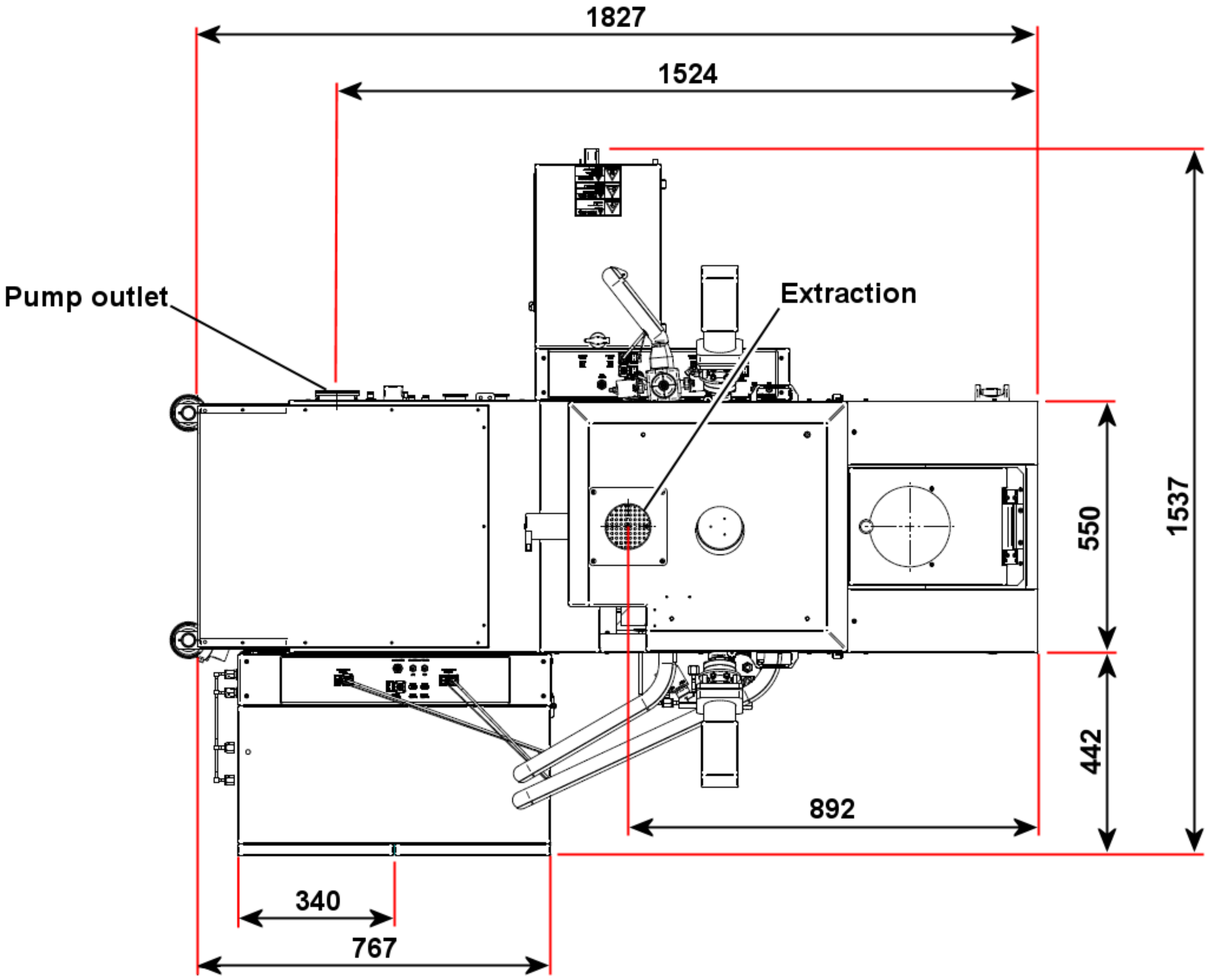


Figure 9 Floorplan of **FlexAL**®II system with overhanging loadlock

Electrical power supply requirements

NOTE: It is the users responsibility to purchase and organise the installation of a wall-mounted electrical safety isolation box that meets the local electrical regulations. The isolation box must be easily accessible and mounted as close to the system as possible.

The system requires one of the following electrical supplies:

Table 5 Electrical supply specification

Function	Connection	Parameter	Specification
System electrical supply (for a 208 V system)	Cable (4 metres in length)	Voltage	208 VAC ±10%
		Current	75 A
		Frequency	50/60 Hz
		Phases	3 phase + E
System electrical supply (for a 415 V system)	Cable (4 metres in length)	Voltage	380 VAC -10% to 415 VAC +6%
		Current	63 A
		Frequency	50/60 Hz
		Phases	3 phase, N + E

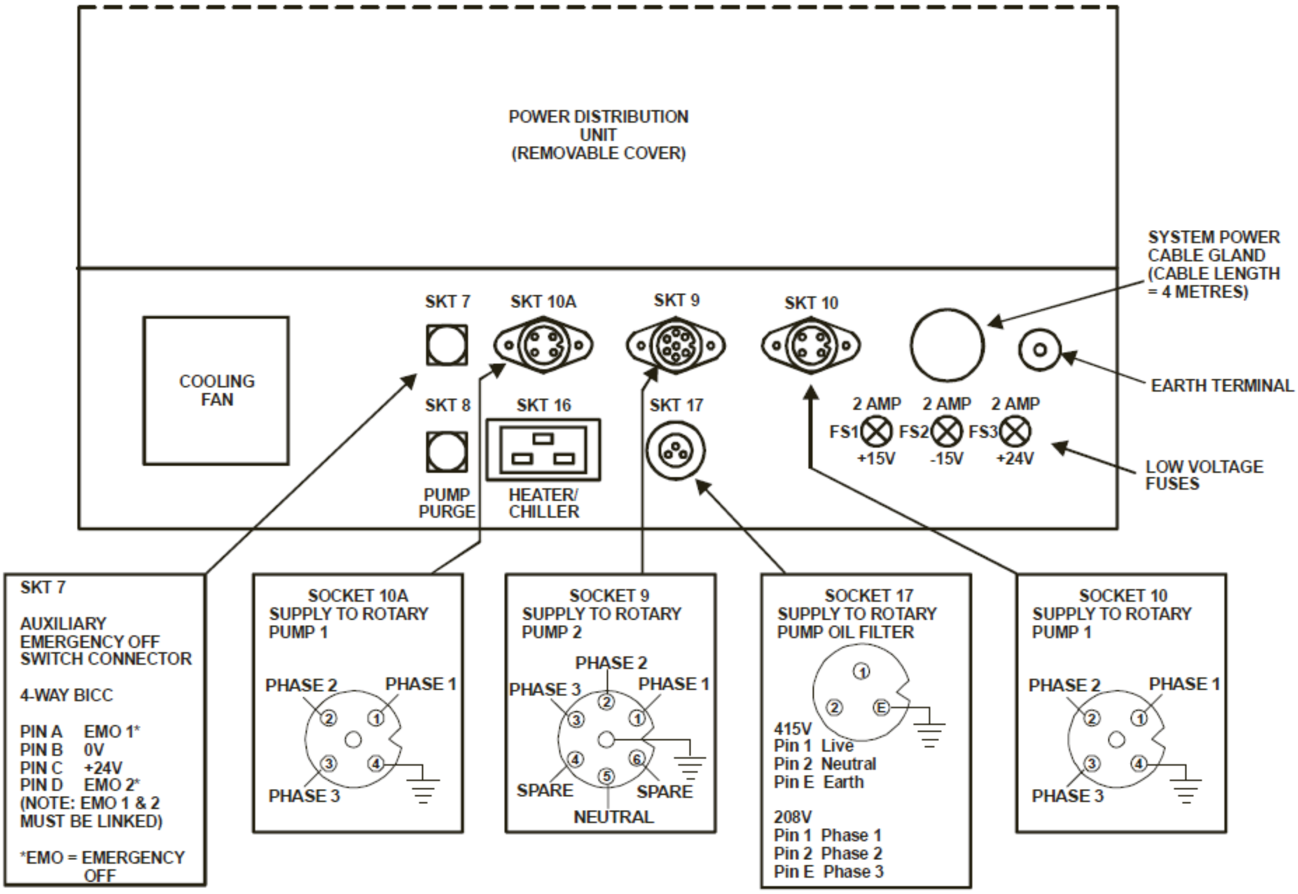


Figure 10 Electrical connections

Earth connection

It is essential that the system earth must be connected before the electrical power connections. An earth continuity test is required for all permanently connected equipment, using suitable safety test equipment.

To meet international standards for RF interference, our systems are fitted with filtration on the mains supply inputs. As a result, there is significant leakage to earth (ground) from the mains supply.

An earth continuity test is required for all PERMANENTLY CONNECTED EQUIPMENT, using a CLARE tester or similar equipment.

International standard IEC950, section 5.2, requires that a label is attached at the point where the system is connected to the factory electricity supply: either to the safety isolation box, or to the transformer, or to the electrical supply outlet socket. This label must contain the following text:

Warning

High leakage current.

Earth connection essential before connecting supply

Residual current circuit breakers

Fitting a residual current circuit breaker (RCCB), also known as an earth leakage circuit breaker (ELCB, or ELB), to the electrical supply of the system is NOT recommended. This is because the equipment contains filters on the power lines. These filters create a small leakage current, which can cause spurious trips of the RCCB.

NOTE: The leakage current caused by the filters is in accordance with International standard IEC 60950-1.

Oxford Instruments Plasma Technology accepts no responsibility if the customer fits an RCCB, which then proves unsuitable.

Water cooling requirements

The system requires cooling water in accordance with the specifications in Table 6.

Table 6 System water cooling specification

Function	Connection	Parameter	Specification
Chamber turbo pump	1/4” stainless steel swaged connection	Flow	1 lpm (0.27 gpm (US))
		Temperature	15°C to 25°C. (59°F to 77°F)
Baseplate cooling	3/8” stainless steel swaged connection	Flow	2 lpm (0.53 gpm (US))
		Temperature	10°C to 25°C. (50°F to 77°F)
ICP and AMU	3/8” stainless steel swaged connection	Flow	1 lpm (0.27 gpm (US))
		Temperature	15°C to 25°C. (59°F to 77°F)
Loadlock turbo pump (if required)	1/4” stainless steel swaged connection	Flow	1 lpm (0.27 gpm (US))
		Temperature	15°C to 25°C. (59°F to 77°F)

Compressed air requirement

Compressed air must be supplied via a filter and oil mist separator, as shown in Figure 11.

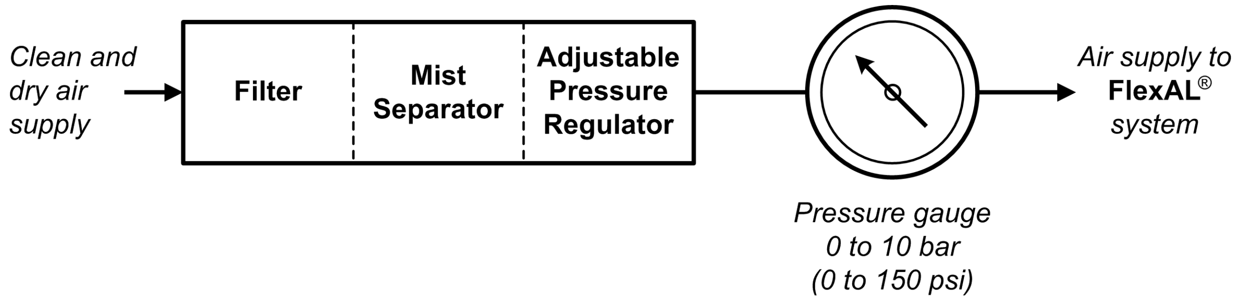


Figure 11 Compressed air supply

The system requires compressed clean, dry air (CDA) in accordance with the specifications given in Table 7.

Table 7 System compressed air specification

Function	Connection	Parameter	Specification
CDA inlet to filter/mist separator/regulator unit	Customer specific	Minimum pressure	6 bar (90 psig)
CDA inlet to system	6 mm push-fit connector	Maximum flow rate	5 lpm (0.2 cfm). (This flow is in addition to the gas pod flow)
		Regulated pressure	3.0 to 6.0 bar. (45 to 90 psi)
		Pressure monitoring	0 to 10 bar. (0 to 150 psi)
		Oil content	Less than 10 ppm
		Maximum moisture content (expressed as the dew point)	-3°C (25°F)
		Filtration	Maximum particle size of 0.3 microns
CDA inlet to gas pod	6 mm push-fit connector	Flow	5 lpm (0.2 cfm). (This flow is in addition to the system flow)
		Pressure	4.0 to 6.0 bar. (60 to 90 psi)
CDA inlet to each precursor module	6 mm push fit connector	Flow	1.25 lpm (0.05 cfm) per module
		Pressure	6.0 to 7.0 bar (60-90 psi)

NOTE: The CDA inlet pressures to the system must be limited to 6 bar (90 psi).

Nitrogen requirement

Compressed nitrogen must be supplied via a filter and semiconductor grade regulator, as shown in Figure 12. All tubing used in the installation must be electropolished stainless steel. All pipe-work fittings and pressure regulators must be semiconductor grade.

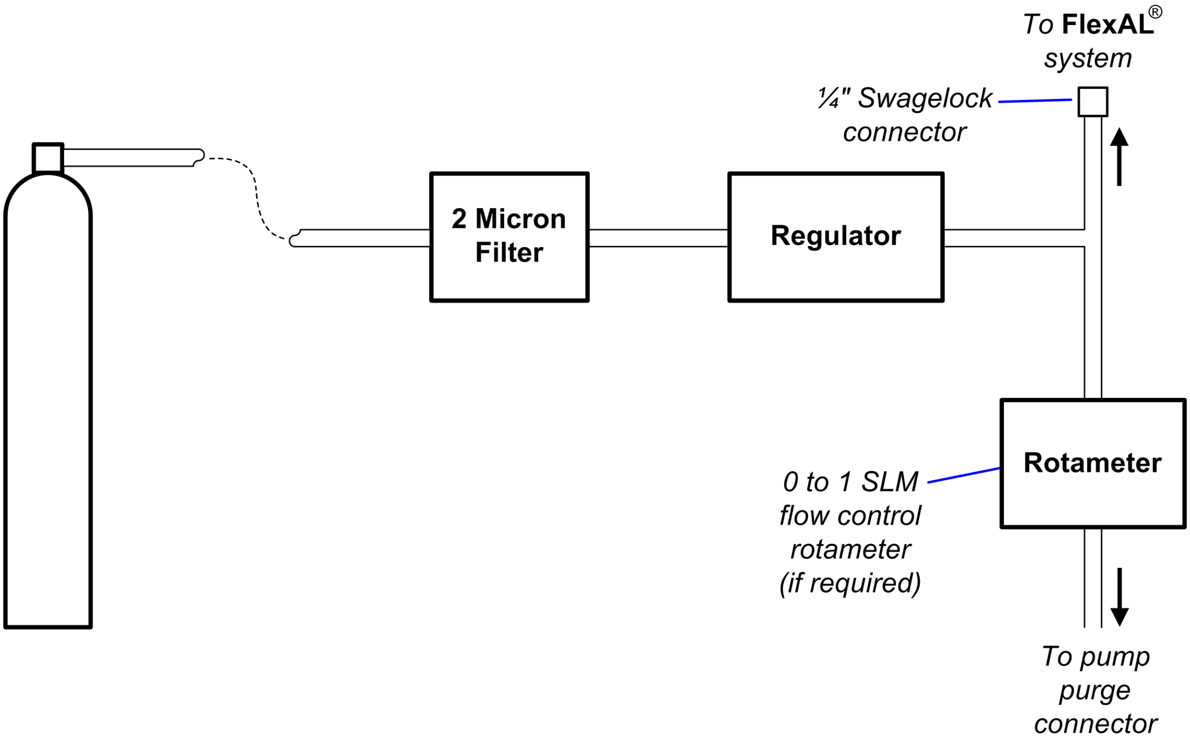


Figure 12 Nitrogen supply to the system

The system requires nitrogen in accordance with the following specification:

Table 8 System nitrogen specification

Function	Connection	Parameter	Specification
Regulated N_2 inlet to system	1/4" stainless steel swaged connection	Flow	5 lpm (0.2 cfm)
		Pressure	3.0 bar (45 psi) minimum
		Regulation	0.5 bar to 5 bar (7.5 to 75 psig)
		Filtration	2 micron filter mounted adjacent to the system
		Purity	Better than 99.99% to satisfy process requirements
		Minimum pressure at input to system	3 bar (45 psig). Certain pumps, for example Edwards Drystar pumps, may need up to 5 bar (75psig) to ensure satisfactory purging. Check with the vendor's instructions.
Regulated N_2 inlet to each precursor module	1/4" stainless steel swaged connection	Flow	10 lpm (0.4 cfm) per module
		Pressure	3.0 bar (45 psi) minimum

Process gas requirement

Process gas is supplied to the gas pod from an external supply. All tubing used for process gas supply must be electropolished steel. All pipework fittings and regulators must be semiconductor grade.

The customer must fit manual shut-off valves on all gas lines as close to the gas pod inlets as possible. Each valve must be clearly labelled with the gas it controls. These valves are sometimes referred to as *point-of-use* valves. Figure 13 shows a typical installation for these valves.

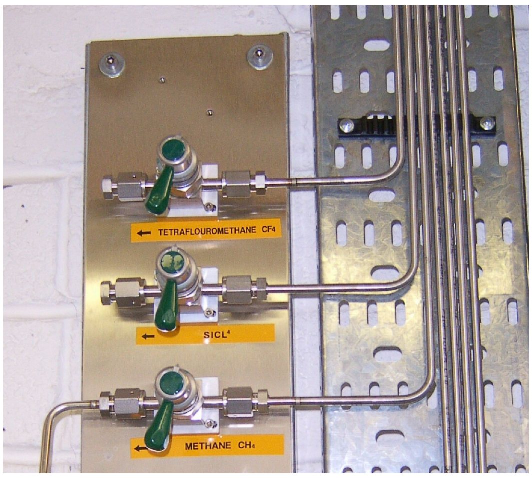


Figure 13 Gas supply point-of-use valves

All process gas supplies must conform to the specification given in Table 9.

Table 9 Process gas supply specification

Function	Parameter	Specification
Process gas supplies	Pressure	2.0 to 3.0 bar (30 to 45 psig)[1]
	Regulation	0.5 to 5 bar (7.5 to 75 psig)
	Purity	At least 99.99% to satisfy process requirements
	Filtration	A 2 micron filter is fitted to each gas line, as part of the gas pod. Other grades of filter can be fitted, if required.

1. Low vapour pressure gases can be used (see Installation of low vapour pressure gases), but they require special consideration to prevent unwanted condensation of material in the gas lines. It may be necessary to heat the gas lines and the gas handling equipment in the gas pod. Contact Oxford Instruments Plasma Technology for advice.

The system requires a pipework connection between the gas pod and the system gas inlet. This connection must comply with the specification given in Table 10.

Table 10 Process gas connection specification

Function	Connection	Parameter	Specification
Process gas in	1/4" electropolished stainless steel pipe, welded at the gas pod	Pressure	2.0 to 3.0 bar (30 to 45 psi)
	1/4" stainless steel VCR at the system		

Installation of low vapour pressure gases

Special precautions must be taken if low pressure gases (such as $SiCl_4$, BCl_3 or C_4F_8) are used. The low vapour pressure can lead to condensation in the gas supply lines, particularly where the gas passes through a cooler region of pipework. This condensation can result in a build up of liquid in the gas pipe, usually at the low points or U-bends in the gas line. Liquid build-up can produce unstable gas flows, especially if liquid condenses or flows into the MFC.

The gas pressure at the system can be very low if the gas cylinder is cold, e.g. if it is kept outdoors in the winter. Observe the following guidelines if using low vapour pressure gases:

Keep the gas cylinder indoors

Keep the gas cylinder indoors (in an extracted gas cabinet) to avoid loss of line pressure when the outside temperature is cold. DO NOT heat the gas cylinder with a heated jacket as this can cause condensation when the gas passes through the cooler gas lines.

Maintain a positive temperature gradient

Maintain a positive temperature gradient from the cylinder to the MFC. This is best achieved by positioning the gas pod close to the system, which results in short pipe runs. If this is not possible, then the gas lines must be heated by wrapping a suitable heater tape around them.
The MFC in the gas pod may also need to be heated. OIPT offers a heated MFC kit for use with low vapour pressure gases.
The MFC temperature should be maintained above the temperature of the gas line, which should in turn be maintained at a higher temperature than the gas cylinder. A typical setup might be as shown in Figure 14.

MFC 40°C (104°F) or above

Gas line 30°C to 40°C (86°F to 104°F)

Gas cylinder at room temperature

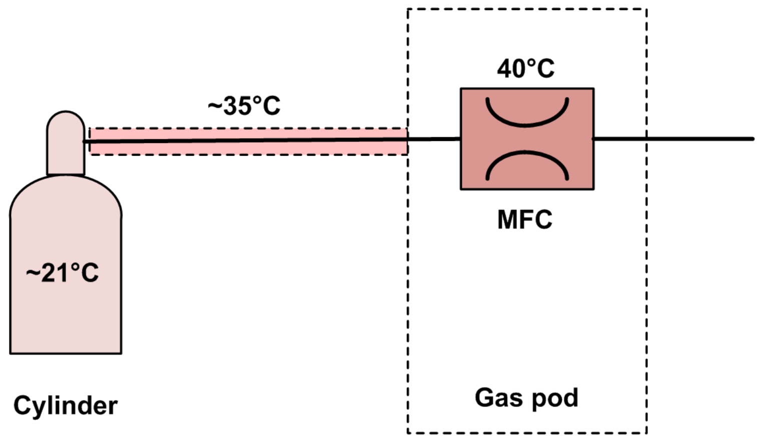


Figure 14 Typical heated gas line showing the temperature gradient

If condensation problems are suspected:

1 Pump out the gas lines completely.
2 Optimise the heater tape arrangement and temperature setpoints.
3 Refill the gas line.

For $SiCl_4$ it is important to use a dedicated $SiCl_4$ MFC.

Extraction requirements

The system requires air extraction for the pump exhausts, gas pod, and precursor modules. If toxic, flammable or corrosive gases are to be used on the system at any time, the extraction system must be designed accordingly.

The extraction system must comply with the following specifications:

Table 11 Extraction specifications

Function	Connection	Parameter	Specification
Gas pod	100 mm (4”) diameter tube	Flow	12-line gas pod: 3 m^3/minute (106 cfm)
		Minimum vacuum	-375 Pa (-1.5 inches water)
Backing pump exhaust	Refer to the manufacturer’s information		
Precursor modules	1 x 40 mm diameter tube for every 2 precursor modules	Flow	1 or 2 modules fitted: 3 m^3/minute (106 cfm)
			3 or 4 modules fitted: 6 m^3/hour (212 cfm)
ICP source cover	100 mm (4”) diameter tube	Flow	3 m^3/hour (1.8 cfm)
Ozone generator (if fitted)	100 mm (4”) diameter tube	Flow	3 m^3/minute (106 cfm)
		Minimum vacuum	-375 Pa (-1.5 inches water)

If you are using low hazard or low pressure gases, consult Oxford Instruments Plasma Technology for advice. Less extraction may be permissible for your configuration.

Mandatory requirements for backing-pump extraction

The installation must provide an extraction system that matches the backing pump exhaust and conforms to local safety standards. In particular, all fittings and pipework connected to the backing pump exhaust must be made from industry standard stainless steel in accordance with local safety regulations.

Specialised equipment such as scrubbers and furnaces may be needed to dispose of hazardous gases. The routing of the pump exhaust line must be arranged so that condensates cannot flow back into the pump.

NOTE: There is a risk of damage from cross-contamination if backing pumps share the same exhaust system. This applies whether the pumps are on the same system or on different systems. Damage caused by any cross-contamination is not covered by the system warranty.

Care must be taken to route mutually incompatible exhaust gases through separate exhaust ducts. In particular, oxygen enriched exhaust gases must not be mixed with exhausts from mineral oil pumps as this can cause an explosion.

Mandatory requirements for gas pod extraction

The gas pod must be connected to the customer's gas extraction system via a 100 mm (4”) diameter pipe collar. Fit a suitable monitoring device to the gas pod extraction. The output contacts of the device must be closed when the minimum flow rate is achieved, and open when not.

It is the customer’s responsibility to ensure that the gas extraction system, including any necessary gas sensors, meets local safety regulations.

Mandatory requirements for precursor pod extraction

Precursor pod extraction is required to remove any hazardous vapours from the precursor pod(s) in the event of an accidental release. The precursor cabinet must be extracted to a similar service as described for the gas pod (see previous section). The precursor extraction must NOT be connected to the main facility pump exhaust. Stainless steel flexible hose is recommended for connecting the precursor pod to the extraction system.

Abatement of the extracted precursor pod is governed by local health and safety requirements.

It is the **FlexAL®II** owner’s responsibility to install any gas detection or minimum air flow monitoring devices that their risk assessment deems to be necessary.

System heat load

The typical heat load for the clean room installation is:

Table 12 Typical system heat loads

System state	Heat load
Operating	8 kW
Passive	4 kW

NOTE: These specifications do not include externally sited components such as pumps, heater/chillers, transformers, etc.

System noise emission

The maximum noise emission from the system is 75 dB, measured 500 mm above the backing pump. Noise emission from the system could be reduced by siting ancillary equipment (e.g. backing pump, heater/chiller) remotely in a service area.

Environment

Mandatory specifications for the system environment

The **FlexAL®II** system is rated for use in a pollution degree 1 installation category environment (laboratory or clean industrial environment).

lists the mandatory environmental specifications.

Table 13 Mandatory environmental specifications

Item	Specification
Operating temperature	5°C to 25°C (41°F to 77°F)
Storage temperature	0°C to 50°C (32°F to 122°F)
Maximum humidity	80%[1]
Minimum humidity	10%[2]
Electrostatic build-up	Low static environment [2]
Ambient light level	300 lux minimum
Altitude	Up to 2000 m (6562 ft)
Cleanliness	Clean room class 10,000 or better

1. High humidity has a progressively significant effect on system performance. At humidity greater than 50%, the rate of chamber pump-down after venting the chamber is affected significantly, and at humidity greater than 65%, the rate of chamber pump-down may not meet system specifications.

2. Low humidity introduces a risk of electrostatic build-up, with subsequent discharge to the system producing a malfunction or damage. The systems are tested to EN 61000-4-2:1995 + A1:1998, + A2:2001. OIPT recommends the use of an environment, which protects against electrostatic build-up, and extra precautions are necessary at low humidity.

Room volume and air changes

The room should have a volume of at least 30 m^3 (or more as dictated by the tool size) and should be ventilated with at least 4 air changes per hour. This is essential to keep oxygen levels high and prevent increased fume levels.

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