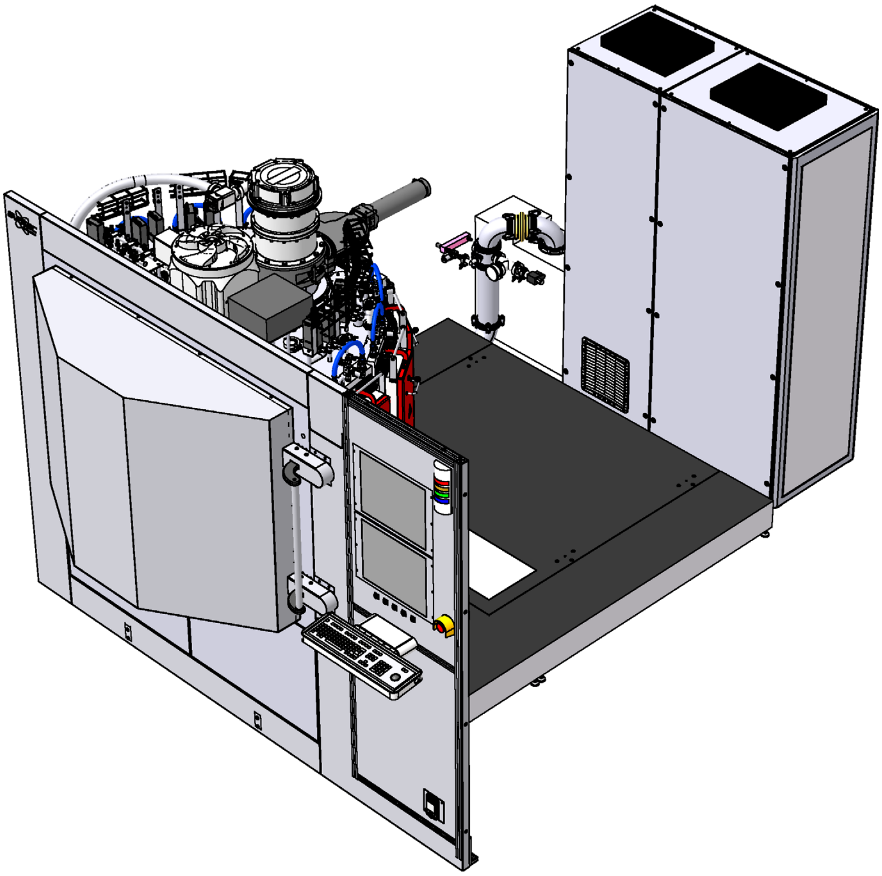
evatec
process systems



MSP 1200

High Throughput Batch Sputter Tool

Operating Instructions
179363BE
Edition 03/2016

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Chapter overview

1. Use, data

1. Use, data

1.1 Introduction

The MSP 1200 system documentation consists of the following items:

- Operating Instructions (179363BE; this manual)
- Safety Instructions (180430BE), only when running special processes on the MSP 1200
- Electrical diagram
- OEM manuals of third-party system components (PDF files, stored in the «OEM Manuals» folder located on the desktop of the system controller)

1.1.1 Validity of these Operating Instructions

Document identification:
Operating Instructions 179363BE Edition 03/2016

These Operating Instructions describe the MSP 1200 Batch Sputter Tool, termed simply «MSP 1200» in the following documentation.

These Operating Instructions may show or describe components which are not part of the Evatec scope of delivery. Such information is intended for better understanding. However, Evatec excludes any liability for such components and the corresponding information.

1.1.2 Intended use of the MSP 1200

The MSP 1200 is a high throughput batch sputter tool for precision optics. It is intended for coating of glass or polymeric substrates in large volumes by means of magnetron reactive sputtering.

To guarantee that the system is run in accordance with the binding stipulations, you must:

- Be qualified for working with the MSP 1200

- Read and observe the information contained in these Operating Instructions

- Adhere to the technical data

- Perform maintenance work punctually

1.1.3 Possible applications

The MSP 1200 is suitable for a wide range of high quality coating applications including classical optics, optical packaging, medical, lighting and automotive. Possible examples are the deposition of transparent conductive coatings, anti-reflection coatings, and the production of edge filters or bandpass filters.

The following materials can be deposited:

- Metals
- Transparent conductive materials (e.g. ITO)
- TiO_2, Ta_2O_5, Nb_2O_5, SiO_2 (well established)
- Si, Si_3N_4, Al_2O_3 and other oxides or nitrides including hafnium (on request)

Deposition of other materials are available on request.

1.1.4 Other uses and applications

Written permission from Evatec AG (Evatec) is required for uses other than those stipulated above. Any use beyond the applications described above will be regarded as not conforming to provisions. Evatec declines all liability for damages which occur when stipulations are disregarded.

1.1.5 Use of these Operating Instructions

These Operating Instructions contain the information required to ensure that the MSP 1200 is used correctly. The Operating Instructions are considered to be an integral part of the product. They must always be at hand near the MSP 1200.

The Operating Instructions describe all stages of the serviceable life of the MSP 1200: Transport, installation, initial commissioning, operation, maintenance (preventive work), service (corrective work, repair), storage, disposal. Check the table of contents to locate the relevant chapter.

NOTE:
Read Chapter 2. Safety, 🗎 23 prior to any work at the MSP 1200! It contains important information for your own personal safety. This chapter must have been read and understood by all persons who work at the MSP 1200 during any stage of its serviceable life.

Evatec delivers user documentation along with the product. Documents can be ordered through the Evatec support:

E-mail: support@evatecnet.com

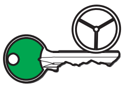
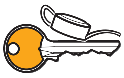
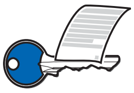
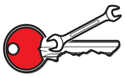
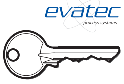
Contact us if you have queries about the contents of the documentation or if you wish to give us feedback.

1.2 User qualifications

Access rights

The end user assigns access rights to his personnel according to their level of training, knowledge, experience and responsibility.

This document uses symbols to assign the access rights defined by Evatec to chapters and sections. See Tab. 1-1, 🗎 8.

Manufacturing	Maintenance	Process	Service	Configuration
				

Tab. 1-1 *Symbols indicating access rights*

The scope of authorization increases in the following order:

- Manufacturing → Maintenance → Process → Service → Configuration

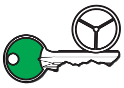
A higher level of authorization always requires full knowledge of all lower levels.

Examples: The «Manufacturing» symbol is relevant for all personnel. The «Process» symbol is relevant for process, service and configuration personnel.

Passwords

Together with the access rights, the end user assigns passwords to his personnel. The user name and the password identify authorized users. Authorized users can log into the system control and operate the MSP 1200 via the operating terminal.

1.2.1 Manufacturing personnel (Manufacturing)



Manufacturing personnel are responsible for operating the MSP 1200 during regular production.

Required experience: Training performed or authorized by Evatec. See Section 1.3 Training, 🗎 10.

1.2.2 Maintenance personnel (Maintenance)

Maintenance personnel have all the manufacturing personnel (Manufacturing) access rights.

In addition, maintenance personnel perform the preventive maintenance work.

Required experience: Training performed or authorized by Evatec. See Section 1.3 Training, 🗎 10.

1.2.3 Process personnel (Process)

Process personnel have all the maintenance personnel (Maintenance) access rights.

In addition, process personnel can create and modify process recipes.

Required experience: Training performed or authorized by Evatec. See Section 1.3 Training, 🗎 10.

1.2.4 Service personnel (Service)

Service personnel have all the Process personnel (Process) access rights.

In addition, service personnel perform corrective maintenance and service work. Service personnel also install and decommission the system.

Required experience: Training performed or authorized by Evatec. See Section 1.3 Training, 🗎 10.

Service personnel must have experience as a mechanic. Electrotechnical professional training and experience in work with high voltage systems are required for work on the electrical equipment.

1.2.5 Configuration personnel (Configuration)

Configuration personnel have the highest access rights. Only configuration personnel are allowed to assign the access rights to other personnel. They also have full access to all system parameters.

Required experience: Training performed or authorized by Evatec. See Section 1.3 Training, 🗎 10.

Configuration personnel must have experience as a mechanic. Electrotechnical professional training and experience in work with high voltage systems are required for work on the electrical equipment.

1.3 Training

This document is intended for technically qualified personnel who have successfully passed appropriate training for their access right on the MSP 1200. This training must have been performed or authorized by Evatec. Only appropriately trained personnel can correctly implement the safety regulations contained in this document.

Personnel without this training are considered as unauthorized. Unauthorized personnel are not permitted to work on the MSP 1200. Evatec declines all liability for damages which occur when stipulations are disregarded.

Evatec offers standard and user-tailored training for Evatec products. The training team will be pleased to provide you with further information.

Please send an e-mail to: training@evatecnet.com

1.4 System identification

1.4.1 Type label

The type label identifies the specific system and includes details of any customer-specific adaptations.

State all details shown on the type label when you contact Evatec. Whenever possible, also state the displayed software sequence step when you make diagnosis inquiries in the event of disturbances. This ensures fast and optimum support.

Position

Type labels are mounted in the following positions:

- At the back of the process chamber. See Fig. 1-1, 🗎 11.

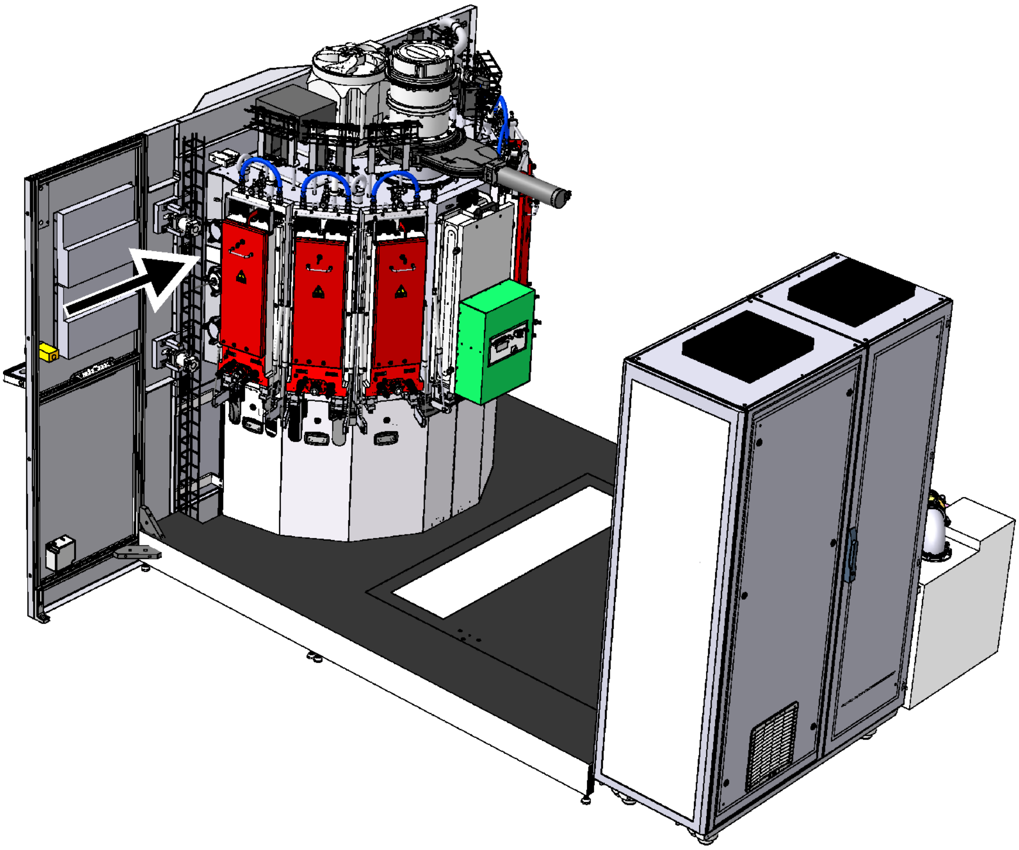


Fig. 1-1 *Position of the type label*

1.5 Performance data

NOTE:
The technical data stated here may differ from the information in the terms of offer or in the order confirmation. If this is the case, the data contained in the terms of offer or in the order confirmation respectively are binding.

1.5.1 System capacity

Substrate size	Capacity
180 mm × 110 mm	MSP1225: 60 Substrates MSP1232: 90 Substrates
180 mm × 136 mm	MSP1225: 48 Substrates MSP1232: 72 Substrates
∅ 8"	MSP1225: 16 Substrates MSP1232: 32 Substrates
∅ 6"	MSP1225: 44 Substrates MSP1232: 66 Substrates
∅ 4"	MSP1225: 96 Substrates MSP1232: 160 Substrates
∅ 2"	MSP1225: 360 Substrates MSP1232: 540 Substrates

Tab. 1-2 *System capacity*

1.5.2 Noise level

Normal operation	< 75 dB (A)
Short term	85 dB (A)

Tab. 1-3 *Noise level*

1.6 Installation data

NOTE:
The technical data stated here may differ from the information in the terms of offer or in the order confirmation. If this is the case, the data contained in the terms of offer or in the order confirmation respectively are binding.

1.6.1 Dimensions and weight

Fig. 1-2, 🗎 13 and Fig. 1-3, 🗎 14 show the dimensions of the MSP 1200 system components. These figures assume a one-floor setup.

For a description of the systems components see Section 3.2 System overview, 🗎 63.

Front view

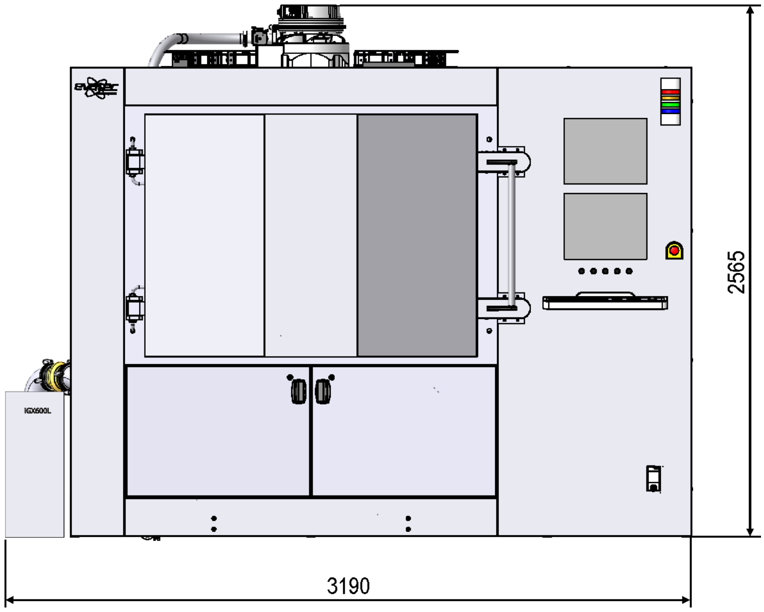


Fig. 1-2 *Dimensions of the MSP 1200 (in mm). Front view.*

Top view

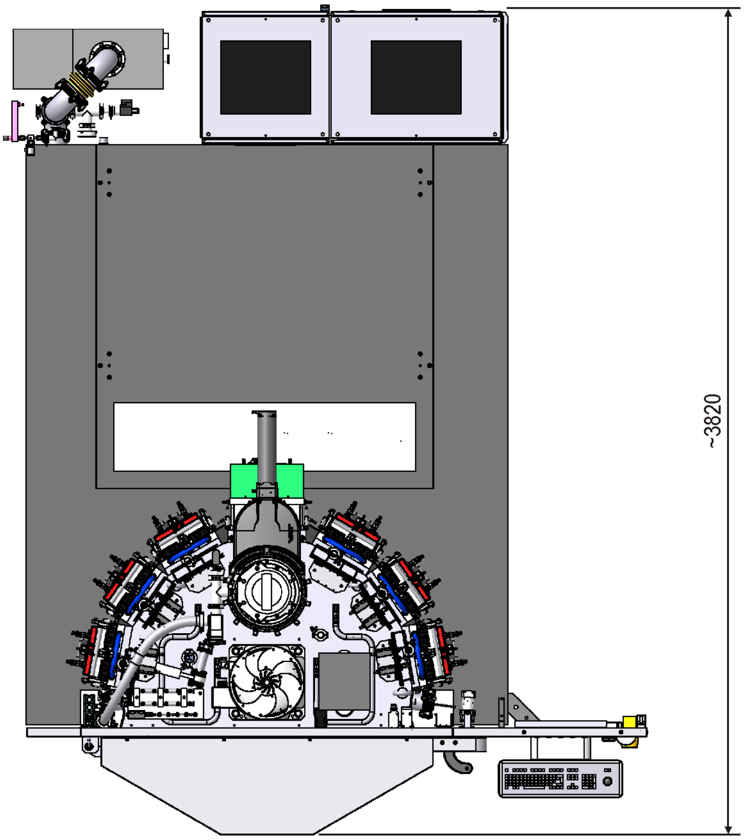


Fig. 1-3 *Dimensions of the MSP 1200 (in mm). Top view.*

NOTE:
The weight of a MSP 1200 system depends on the system configuration. Refer to the packing list for precise values.

Center of gravity

Fig. 1-4, 🗎 15 shows the center of gravity when the chamber door is open.

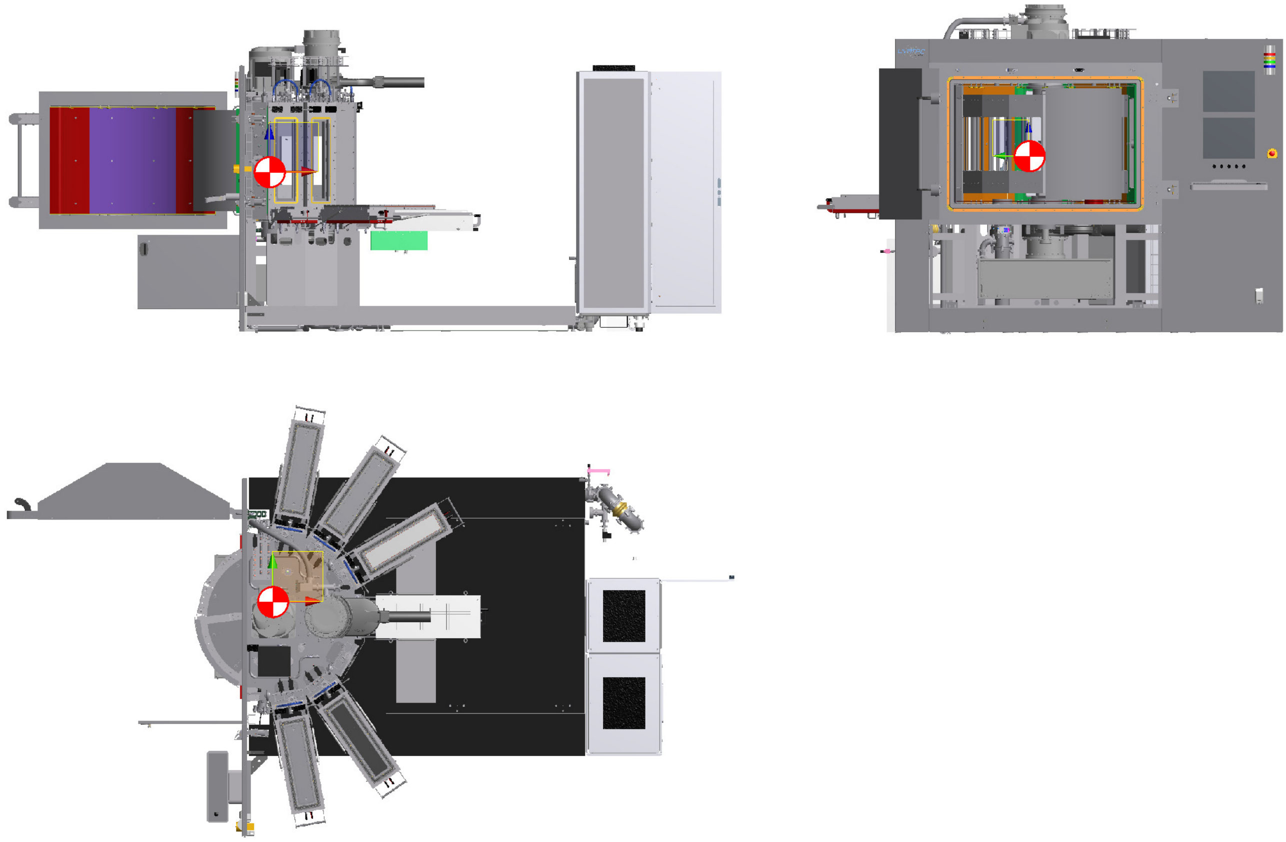


Fig. 1-4 *Center of gravity (chamber door open)*

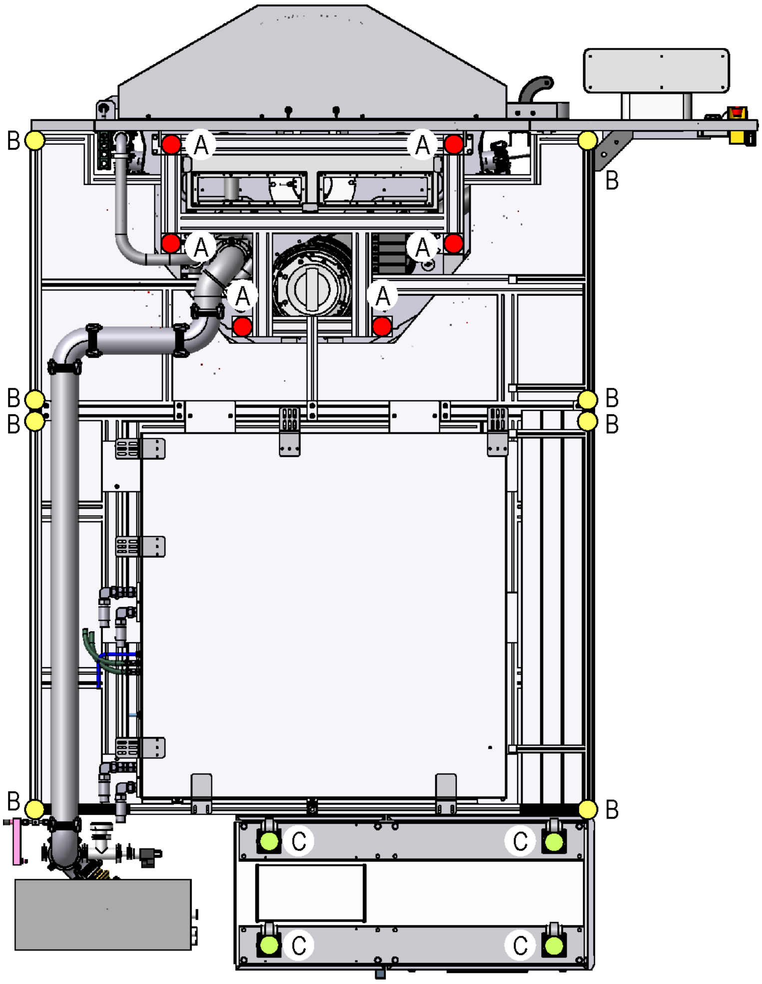


Fig. 1-5 *Floor load (bottom view)*

A 4650 N at each support
B 800 N at each support
C 1800 N at each support

1.6.2 Environmental conditions

The MSP 1200 requires the following environmental conditions:

Out of operation

Temperature	10…50 °C
Relative humidity	30…80 % (non-condensing)

Tab. 1-4 *Environmental conditions (out of operation)*

During operation

Temperature	15…35 °C
Relative humidity	40…60 % (non-condensing)

Tab. 1-5 *Environmental conditions (during operation)*

1.6.3 Electric power

Voltage	3 x 400 / 230 V AC (+6% -10%)
Frequency	50 Hz (60 Hz as an option)
Power consumption	120 kVA
Fuse protection at building	125 A
Connecting conductors	L1, L2, L3, N and PE
Fuse protection in building on-site	Customer specific (see electrical diagram)
Conductor cross section of mains power supply line	5 x 50 mm^2 Refer to the wiring diagram and adhere to the local regulations.
Grounding	See Grounding Instructions 120156

Tab. 1-6 *Electric power (on-site)*

1.6.4 Process gases

In the standard configuration, argon and oxygen are required as process gases for the MSP 1200. Additional process gases may be required depending on the process.

Hydrogen (optional)

For special processes, hydrogen may be used in the MSP 1200. In this case the Safety Instructions for the MSP 1200 (180430BE) must have been read and understood by all persons who work at the MSP 1200.

Acetylene (optional)

For special processes, acetylene may be used in the MSP 1200. In this case the Safety Instructions for the MSP 1200 (180430BE) must have been read and understood by all persons who work at the MSP 1200.

Argon

Purity	≥ 5N (free of condensate)
Operating pressure	0.5 barg (0.05 MPa; 7.25 psi)
Temperature	Approx. 20 °C
Connection	VCR 1/4"

Tab. 1-7 *Process gas argon (on-site)*

Oxygen

Purity	≥ 5N (free of condensate)
Operating pressure	0.5 barg (0.05 MPa; 7.25 psi)
Temperature	Approx. 20 °C
Connection	VCR 1/4"

Tab. 1-8 *Process gas oxygen (on-site)*

Nitrogen

Purity	≥ 5N (free of condensate)
Operating pressure	0.5 barg (0.05 MPa; 7.25 psi)
Temperature	Approx. 20 °C
Connection	VCR 1/4"

Tab. 1-9 *Process gas nitrogen (on-site)*

NOTE:
Suitable pressure reducers must be used for supplying process gases. The pressure at the outlet of the pressure reducer must not exceed 0.5 barg (0.05 MPa; 7.25 psi).

1.6.5 Monomers (optional)

For special processes, monomers may be used in the MSP 1200. In this case the Safety Instructions for the MSP 1200 (180430BE) must have been read and understood by all persons who work at the MSP 1200.

1.6.6 Vent gas

Nitrogen

Purity	≥ 3N (free of condensate)
Operating pressure	0.5 barg (0.05 MPa; 7.25 psi)
Temperature	Approx. 20 °C
Connection	∅ 12 mm

Tab. 1-10 *Vent gas (on-site)*

1.6.7 Compressed air

Quality	Clean, dry, 5 µm filtered
Operating pressure	5…7 barg (0.5…0.7 MPa; 73…102 psi)
Temperature	Approx. 20 °C Min. 2 °C above the dew point of the ambient air
Connection	∅ 8 mm

Tab. 1-11 *Compressed air (on-site)*

1.6.8 Water supply

Cold water

Quality	Refer to the water specifications in the «System Documentation» binder.
Temperature	Approx. 20 °C Min. 2 °C above the dew point of the ambient air
Pressure at inlet	4…7 barg (0.4…0.7 MPa; 58…102 psi) An optional booster pump may be supplied in order to increase the water pressure to the required level
Pressure at outlet	Unpressurized
Consumption	120 l/min (typical)
Screw connection for house installation (inlet and outlet)	∅ 25 mm or M 36 x 2 and 5 meters of a hose G 1"
Screw connection of blow-out circuit (outlet)	∅ 13 mm or G 1/2"
Water drain	Open outlet

Tab. 1-12 *Cold water (on-site)*

Hot water

Quality	Refer to the water specifications in the «System Documentation» binder.
Temperature	Max. 60 °C
Pressure at inlet	4…7 barg (0.4…0.7 MPa; 58…102 psi) An optional booster pump may be supplied in order to increase the water pressure to the required level
Pressure at outlet	Unpressurized
Consumption	20 l/min (typical)
Screw connection for house installation (inlet and outlet)	∅ 25 mm or M 36 x 2 and 5 meters of a hose G 1"
Screw connection of blow-out circuit (outlet)	∅ 13 mm or G 1/2"

Tab. 1-13 *Hot water (on-site)*

2. Safety

2. Safety

2.1 Introduction

2.1.1 Compulsory reading material!

NOTE:
Read this chapter prior to any work at the MSP 1200! It contains important information for your own personal safety. This chapter must have been read and understood by all persons who work at the MSP 1200 during any stage of its serviceable life.

2.1.2 Residual dangers

The MSP 1200 is designed according to the most recent state of the art technology and to the officially approved safety regulations. The equipment has been subjected to a meticulous safety check and a safety acceptance test.

However it is impossible to rule out the possibility of residual dangers during operation. Hazards exist:

- For limb and life of the operator
- For the MSP 1200 and other property

For this reason, all work carried out in conjunction with the MSP 1200 must be performed by trained personnel only and in accordance with these Operating Instructions. The technical data must be observed on principle.

2.1.3 Responsibilities regarding safety

Evatec scope of responsibility
Evatec is responsible for the safety of the MSP 1200. Please note that the atmospheric handling is not a part of the MSP 1200.

End user scope of responsibility
The end user is responsible for safety in the workspace around the MSP 1200. The end user is also responsible for making sure that all safety regulations pertaining to work at the MSP 1200 are adhered to.

For detailed information on the scope of responsibility, please refer to the sales contract.

2.2 General safety regulations for the end user

2.2.1 Personnel

All personnel who work at the MSP 1200 must have the required technical qualifications and have received appropriate instruction and training. They must be informed about all dangers and risks in conjunction with this system.

Unauthorized persons are not allowed access to the MSP 1200.

2.2.2 System documentation

Reading and understanding

The end user must ensure that each person who works at the MSP 1200 during any stage of its serviceable life has read and understood the relevant parts of the system documentation.

OEM manuals

The «OEM manuals» folder on the desktop contains several OEM manuals for individual system components. (OEM = original equipment manufacturer.) OEM manuals may contain safety-relevant information and are an integral part of the system documentation.

Safekeeping

The system documentation is delivered with the MSP 1200 and is an integral part of the product. The system documentation must always be at hand near the MSP 1200.

Completeness

Always use a complete and original version of the system documentation! Sections in the documents may contain cross-references to other sections which, in turn, include important information. Incomplete copies of the system documentation cannot convey all the necessary information.

2.2.3 Transport, installation and commissioning

Transport, installation and commissioning of the MSP 1200 may only be carried out when technically qualified and authorized Evatec personnel supervise the work.

Supply connections

The end user provides the connections to supply the MSP 1200 with electric power, gases, compressed air, water, etc. in the required capacity and quality.

Supply lines for these media must be laid at an adequate distance to each other. The lines must be protected against all kinds of mechanical damage or stress. Lines on the floor must be covered properly to prevent the risk of tripping.

Exhaust gases

The end user must take appropriate measures to ensure a safe removal and eco-friendly disposal of the exhaust gases.

Safety labels

Safety labels must be used to notify personnel of residual dangers. The safety labels must be mounted in the MSP 1200 production area at all necessary locations.

Acceptance check

Subsequent to initial commissioning, the end user is responsible to perform a system acceptance check according to the local regulations concerning prevention of accidents.

At the end of a successful system acceptance check, the acceptance report will be signed by an authorized representative from Evatec and by a specialist delegated by the end user.

2.2.4 Operation

The MSP 1200 must only be used as stipulated. See Section 1.1.2 Intended use of the MSP 1200, 🗎 6.

All work instructions and procedures which could impair personnel or equipment safety are strictly prohibited. The branch-specific and local regulations concerning prevention of accidents must be followed.

Work place

With appropriate instructions and checks, the end user guarantees for a work environment around the MSP 1200 that is orderly and clean. All components that are required for operation or maintenance must be easily accessible. This is especially important in the gray room area.

Lighting

The work place lighting must conform with the local regulations. Illuminance levels of at least 300 lux (gray room) and 500 lux (clean room) are recommended. A flashlight may be used when working under the module.

Escape, rescue and alarm plan

The end user is responsible for creating an escape, rescue and alarm plan for the work place and the MSP 1200 surroundings.

Gas cylinders

Gas cylinders must be handled, fastened and connected according to the relevant regulations. Close the valves on the gas cylinders when the system is not running.

Waste

The end user is responsible for the eco-friendly removal and disposal of ecologically harmful waste produced by specific processes.

2.2.5 Maintenance and service

The end user is obliged to make sure that the MSP 1200 is only operated when it is in perfect technical condition. All maintenance and service work must be performed in accordance with the information provided in the system documentation.

Operating state

Bring the MSP 1200 to the particular operating state that is required for all maintenance or service work.

Lockout / tagout (LOTO)

Components that are being serviced must first be locked out and tagged out. This must be done according to the lockout/tagout procedure. See Section 2.8 Lockout/tagout procedure, 🗎 50.

Safety devices

Only remove safety devices once the MSP 1200 is completely shut down and disconnected from the mains supply. Make sure that the removed safety devices have been reinstalled and remounted before the unit is switched on again.

Spare parts

Use only original spare parts. Non-original spare parts can cause malfunctions, equipment damage or even fatal injuries.

All orders for parts must contain the order number and a description of the required part. Refer to the parts catalog.

Contamination declaration

Vacuum parts which are returned (for repair or exchange) to Evatec must always be accompanied by a contamination declaration that has been filled out completely and signed. For this purpose, copy the form in the binder «System Documentation».

Modifications

Unauthorized modifications and alterations that influence the safety of the MSP 1200 are prohibited. Consult Evatec prior to making any modifications to the system. The end user must draw up a safety concept and provide the required safety devices if adaptations are made to the MSP 1200.

A written permission by Evatec is required for modifications of the software.

Final checks

After maintenance or service work, check to make sure that all safety devices are mounted and functioning faultlessly. In particular, check the safety devices subsequent to all work on the electrical system. This is, for example, relevant for the grounding system and safety circuits.

Revision checks

The end user is responsible to perform the revision checks according to the local regulations concerning prevention of accidents.

At the end of a successful revision check, the acceptance report for revision check is signed by an authorized representative from Evatec and by a specialist delegated by the end user.

Obligation to report

The end user must immediately report any changes or observed irregularities which occur at the MSP 1200 to Evatec.

2.2.6 Disposal

The end user must adhere to the pertinent regulations when disposing of the MSP 1200 or components of the system.

2.3 Access to the system

2.3.1 Control and passwords

Control During the process the MSP 1200 is controlled exclusively by means of a graphic user interface (GUI). The GUI consists of a color monitor, a keyboard, and a mouse or a trackball. The KHAN system controller controls and monitors all system functions. See Section 5. Graphic user interface, 🗎 111.

Passwords Different operating modes are available for controlling the MSP 1200. The operating modes are password protected depending of the authorization of the personnel. The access rights are set up hierarchically according to the level of technical knowledge and responsibility. This means that a higher level of authorization always requires full knowledge of all lower levels. Tab. 2-1, 🗎 29 shows the access rights required for selection of the operating modes of the KHAN system controller.

Operating mode	Description	Manufacturing personnel	Maintenance personnel	Process personnel	Service personnel	Configuration personnel
Manufacturing	Operation with stored process recipes	✓	✓	✓	✓	✓
Maintenance	Operation for maintenance purpose	⊘	✓ password ******	✓ password ******	✓ password ******	✓ password ******
Process	Development of new process recipes	⊘	⊘	✓ password ******	✓ password ******	✓ password ******
Service	Operation for service and test purpose	⊘	⊘	⊘	✓ password ******	✓ password ******
Configuration	Access to hardware configuration parameters	⊘	⊘	⊘	⊘	✓ password ******

Tab. 2-1 *Access to the KHAN system controller*

2.3.2 Admittance to the production areas

With respect to the operational rooms, we distinguish between the «clean room» and the «gray room».

Clean room

The clean room is the production room of the MSP 1200. It may be entered by manufacturing, maintenance and service personnel.

During production, the process chamber door is generally closed. The chamber door may only be opened for loading and unloading of the process chamber. Other doors at the framework of the process chamber and at the electrical racks must also be kept closed.

Gray room

The gray room contains the majority of the MSP 1200 system components. It is not necessary to enter the gray room during production. Normally, the gray room is accessed for maintenance and service work only.

Only maintenance and service personnel may enter the gray room of the MSP 1200. The same rule applies for additional supply rooms in a two-floor setup of the system.

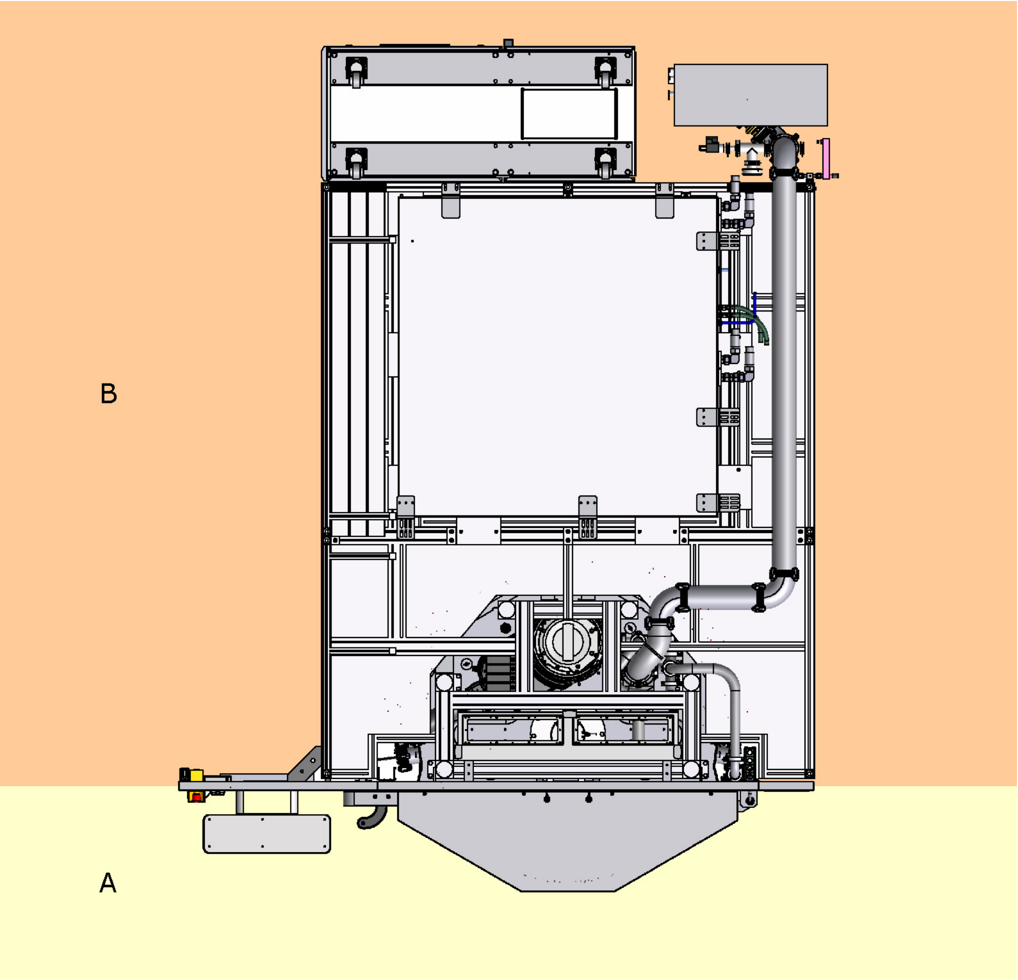


Fig. 2-1 *Operating rooms of the MSP 1200*

A Clean room
B Gray room

2.4 *Hazard alerts in these Operating Instructions*

The hazard alerts are defined for the following three hazard levels:

⚠	**⚠DANGER**
	DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or severe injury.

⚠	**⚠WARNING**
	WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or severe injury.

⚠	**⚠CAUTION**
	CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

❗	***NOTICE***
	NOTICE is used to address practices not related to personal injury.

NOTE:
A note such as this one indicates particularly important, but not safety-relevant information.

2.5 Danger areas for manufacturing personnel

The following sections describe the danger areas for manufacturing personnel.

2.5.1 Dangers originating from mechanical energy

NOTE:
The figure below shows a typical MSP 1200 system. Your actual system may differ from this figure in some respects.

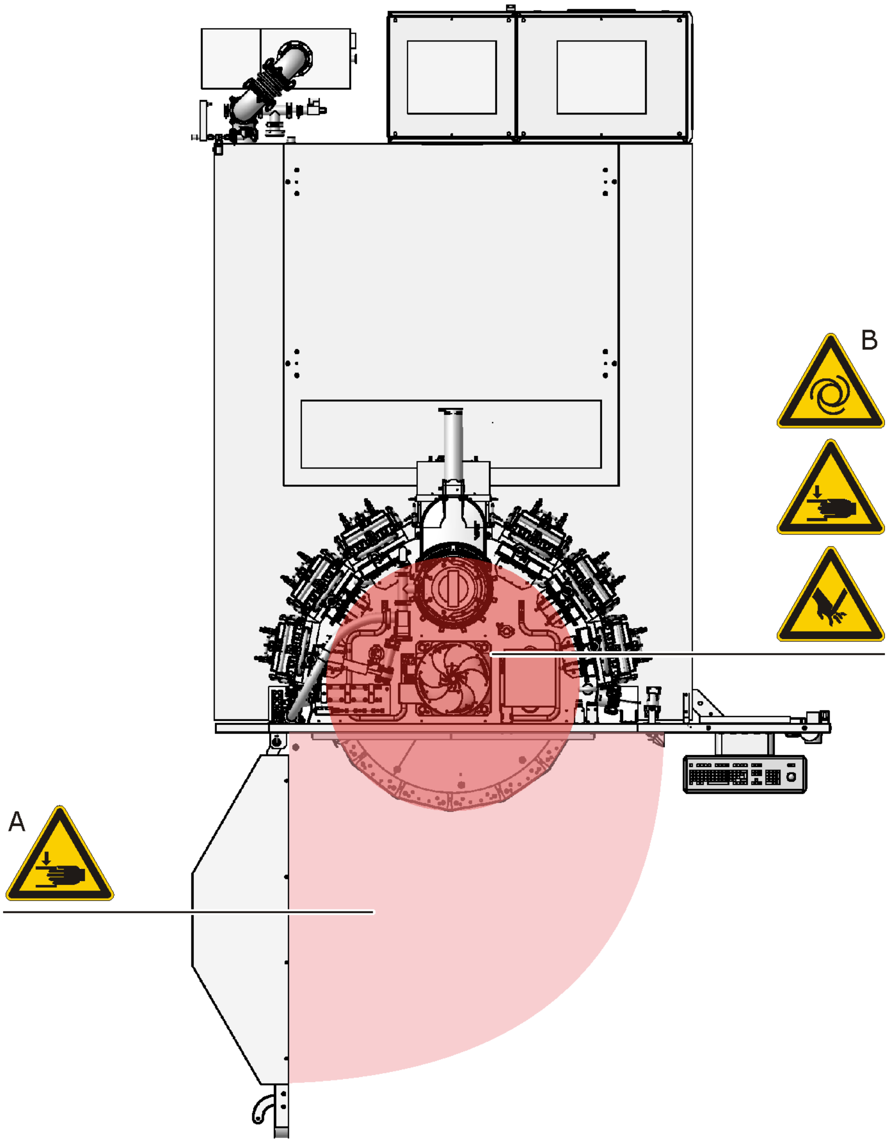


Fig. 2-2 *Danger areas for manufacturing personnel: Mechanical energy*

A Chamber door
B Interior of the process chamber

Personnel working in the danger areas must pay particular attention to the following hazard alerts.

Item A ***Chamber door***

⚠WARNING

Heavy component: Chamber door.

The chamber door is a heavy component. When closing the chamber door, improper handling of the door may result in contusions.

Always use the handle when you are opening or closing the chamber door. Before closing, make sure that nobody else is near the door.

Item B ***Interior of the process chamber***

⚠WARNING

Heavy, large components: Substrate carriers.

The substrate carriers are heavy. If a substrate carrier falls down by mistake, it may break or cause injuries.

Handle substrate carriers with care.

⚠WARNING

Broken glass.

The vacuum chamber may contain pieces of broken glass. Broken glass may cause cut injuries.

Wear safety goggles, protective gloves and protective clothing with long sleeves. Use a vacuum cleaner to remove the broken glass.

NOTICE

Fingerprints.

Fingerprints in a vacuum chamber may impair the process.

Prevent the vacuum chambers from contamination. Put on clean room gloves before you touch any parts in a vacuum chamber.

2.5.2 *Dangers originating from chemicals*

NOTE:
The figure below shows a typical MSP 1200 system. Your actual system may differ from this figure in some respects.

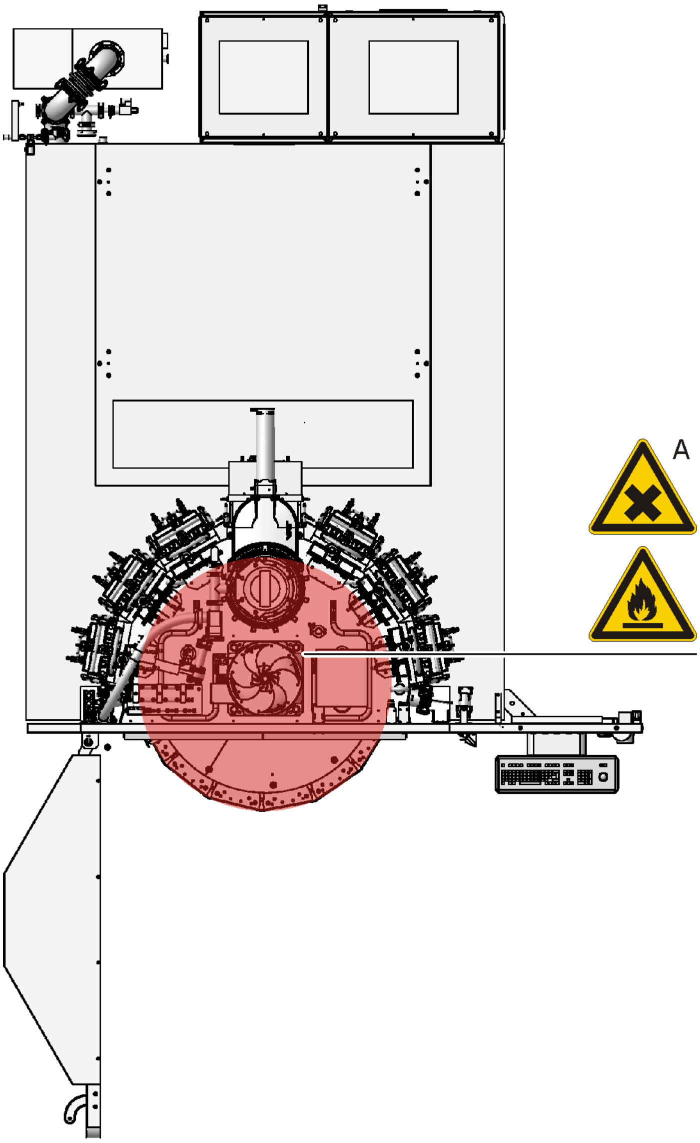


Fig. 2-3

Danger areas for manufacturing personnel: Hazardous substances

A Interior of the process chamber

Personnel working in the danger areas must pay particular attention to the following hazard alerts.

Item A

Interior of the process chamber

⚠WARNING

Harmful process materials.

Depending on the process, the interior of the process chamber may be contaminated with metal dust, oxides and other potentially harmful chemicals. Depending on the process, these chemicals may also be flammable.

When performing any work inside the process chamber, wear a fine dust mask (P2), protective gloves, safety goggles, and protective clothing with long sleeves. Read the safety data sheets and follow all instructions.

Hydrogen, Acetylene (optional)

For special processes, hydrogen or acetylene may be used in the MSP 1200. In this case the Safety Instructions for the MSP 1200 (180430BE) must have been read and understood by all persons who work at the MSP 1200.

Monomers (optional)

For special processes, monomers may be used in the MSP 1200. In this case the Safety Instructions for the MSP 1200 (180430BE) must have been read and understood by all persons who work at the MSP 1200.

2.5.3 Dangers originating from heat

NOTE:
The figure below shows a typical MSP 1200 system. Your actual system may differ from this figure in some respects.

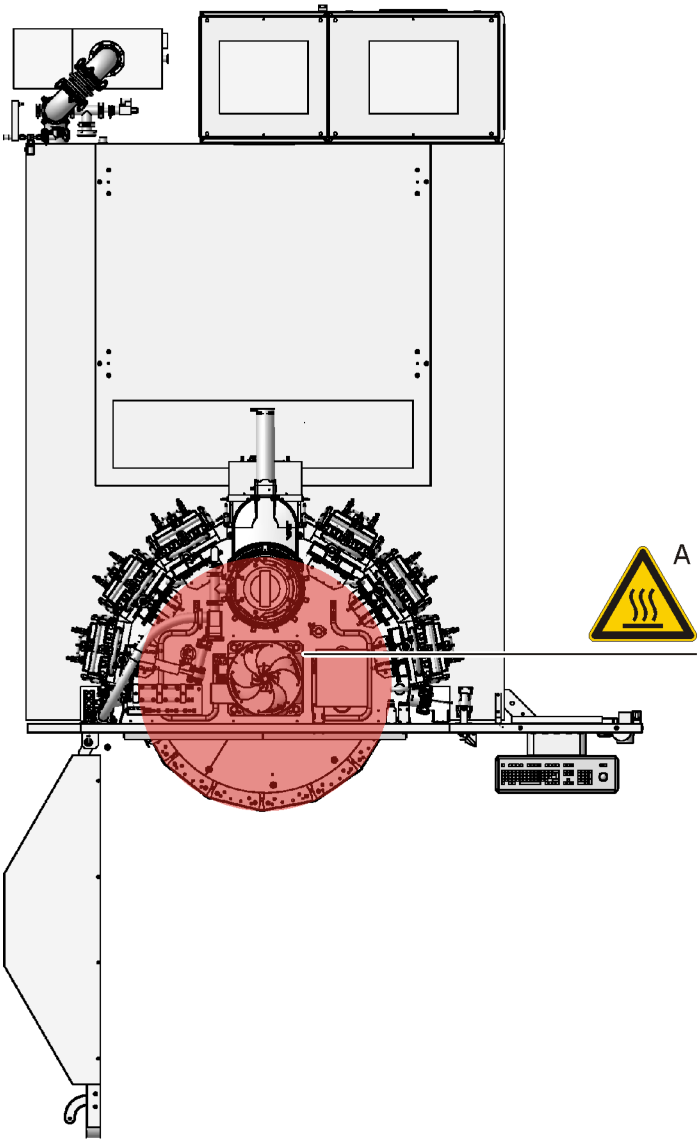


Fig. 2-4 *Danger areas for manufacturing personnel: Thermal energy*

A Interior of the process chamber

Personnel working in the danger areas must pay particular attention to the following hazard alerts.

Item A ***Interior of the process chamber***

	⚠CAUTION
	Hot parts: Sputtering sources, substrates. Parts in the process chamber heat up during the process. After the process they may still be hot enough to cause burns. Allow the parts to cool down to room temperature before working in their vicinity. Wear protective gloves and protective clothing with long sleeves.

Laser thermometer

A laser thermometer is recommended for checking the temperature of parts that might be very hot or cold.

A laser thermometer is a non-contact infrared thermometer equipped with a laser pointer for aiming the thermometer. Fig. 2-5, 🗎 37 shows a typical example.

Fig. 2-5 *Laser thermometer (example)*

2.6 Danger areas for maintenance and service personnel

Maintenance and service personnel are exposed to additional dangers as described below.

2.6.1 Dangers originating from electric power

Because the MSP 1200 is a highly automated system, virtually all system components are connected to electric power. The main sources of danger originating from electric power are listed below:

Component	**Source of danger**
Control and power rack	Connected to mains voltage Primary side of the main switch is always live!
Planar Magnetron sputtering sources	Connected to high voltage and high current power supplies
Ion beam source	Connected to high voltage and high current power supplies
High vacuum pump	Connected to mains voltage
Fore vacuum pump	Connected to mains voltage

Tab. 2-2 *Components connected to electric power*

Maintenance and service personnel working in the danger areas must pay attention to the following hazard alerts.

High voltage

⚠ **WARNING**

High voltage.

The interior of the system contains parts which carry levels of high voltage. Touching live parts will cause an electric shock. The shock may be lethal.

Prior to any work in the danger area:
- Lock out and tag out the main power supply
- Ground the equipment

Make sure that no one is in the danger area before you switch the main power supply on again

UPS (optional)

⚠DANGER

Uninterruptible power supply (UPS).

The control and power rack could be optionally equipped with a UPS unit. The UPS unit contains stored electrical energy.

Prior to any maintenance or service work, switch off the UPS and disconnect the outlets. Read and understand the OEM manual for the UPS.

Mains voltage

⚠DANGER

Mains voltage.

The system contains parts which are connected to the mains supply. Touching these parts will cause an electric shock. The shock may be lethal.

Prior to any work in the danger area:
- Lock out and tag out the main power supply
- Ground the equipment
- Make sure that no one is in the danger area before you switch the main power supply on again

⚠DANGER

Primary side of the main switch.

Parts inside of the supply rack may be connected to the primary side of the main switches. These parts are always live. Touching these parts will cause an electric shock. The shock may be lethal.

Prior to any work in the danger area:
- Lock out and tag out the power lines leading to the supply rack
- Ground the equipment
- Make sure that no one is in the danger area before you energize the supply rack again

Basic rules

NOTE:
Only personnel who have completed electrotechnical professional training and who have experience in work with high voltage systems are permitted to perform work on the electrical equipment.

NOTE:
Perform a safety check subsequent to all work at the electrical equipment. In particular, make sure that all safety devices are mounted and functioning faultlessly.

2.6.2 *Dangers originating from mechanical energy*

NOTE:
The figure below shows a typical MSP 1200 system. Your actual system may differ from this figure in some respects.

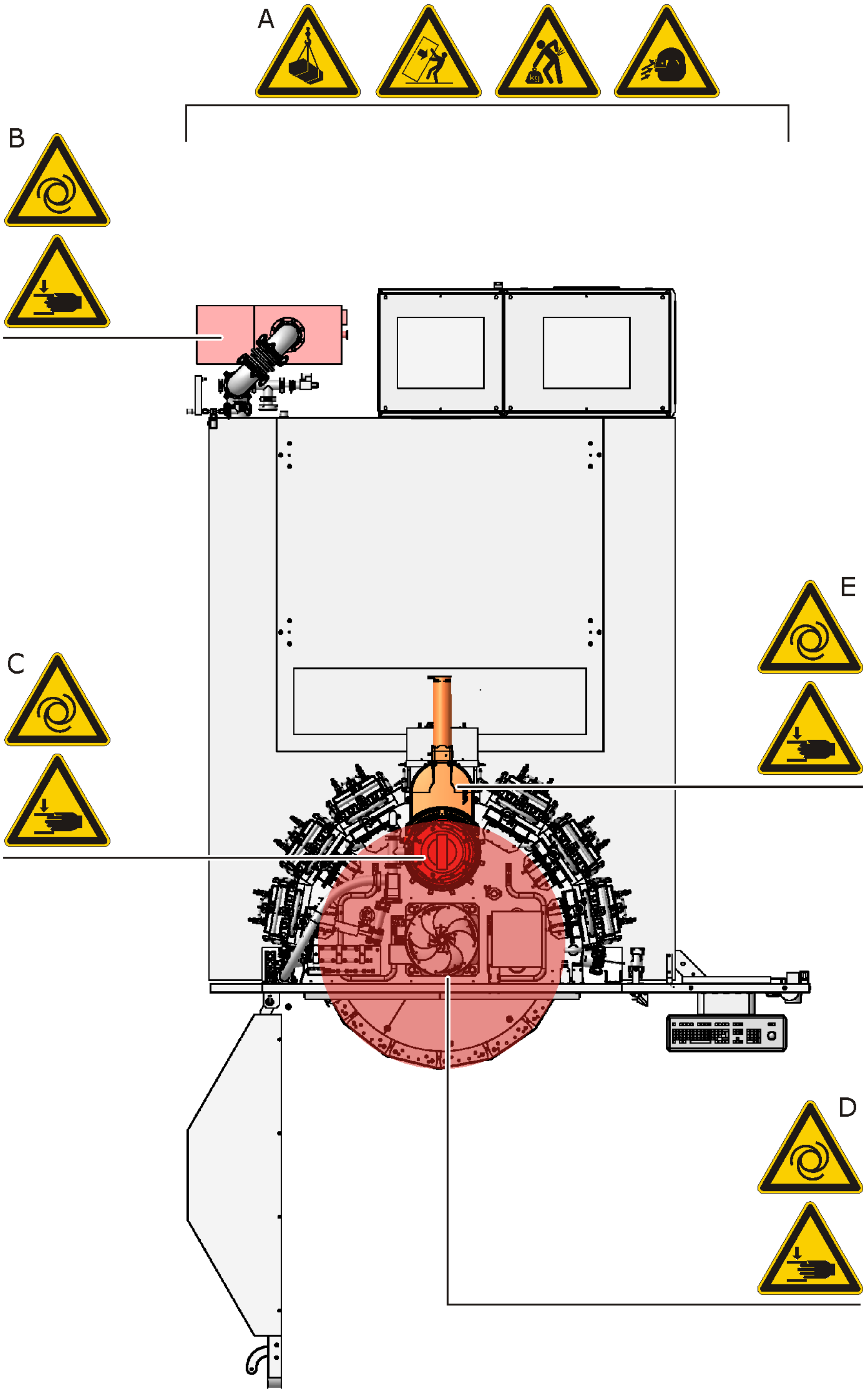


Fig. 2-6 *Danger areas for maintenance and service personnel: Mechanical energy*

A All system components
B Fore vacuum pump
C Turbomolecular pump
D Interior of the process chamber
E High vacuum valve

Maintenance and service personnel working in the danger areas must pay attention to the following hazard alerts.

All system components

⚠WARNING

Heavy components.

Improper handling of heavy components may cause serious contusions, fractures or even lead to death.

Use suitable equipment to lift and transport heavy components. Wear stable footwear. Always keep a safe distance to suspended loads. Never stay under a suspended load!

⚠WARNING

Transport units.

Improper use of transport units may result in personal injury and material damage.

Only authorized personnel are permitted to use transport units such as floor conveying units, cranes and lifting units.

⚠WARNING

Heavy, large components.

Improper handling of heavy components during dismounting and mounting may result in serious contusions and fractures.

Secure all parts prior to dismounting and mounting work.

⚠WARNING

Compressed air system.

Opening or damaging pressurized components may lead to serious eye and skin injuries.

Shut off the supply to the compressed air system and let off the pressure before you carry out any kind of work to these parts.

Item B ***Fore vacuum pump***

⚠WARNING

Automatic start of the fore vacuum pump.

The unexpected automatic start of the fore vacuum pump may cause serious injuries to your hands.

Make sure that the fore vacuum pump is locked out and tagged out before you perform any work to it.

Item C ***Turbomolecular pump***

⚠WARNING

Turbopump rotor.

The turbopump rotor runs at an extremely high speed. Touching the rotor will shred your fingers. Running up a turbopump outside of a vacuum system will also damage the turbopump.

Only run up a turbopump when it is mounted to a vacuum system.

Item D ***Interior of the process chamber***

⚠WARNING

Moving components: Substrate cage (turntable), shutters.

Automatic movements of these components may cause contusions.

Make sure that components are at standstill. Wear protective gloves and protective clothing with long sleeves.

Item E ***High vacuum valve***

⚠WARNING

High vacuum valve.

Automatic movements of the high vacuum valve may cause serious contusions or fractures.

Before dismounting and servicing the high vacuum valve, lock out and tag out the electrical and pneumatic system. Cover the open end of the high vacuum valve with a blank flange.

2.6.3 Dangers originating from heat

NOTE:
The figure below shows a typical MSP 1200 system. Your actual system may differ from this figure in some respects.

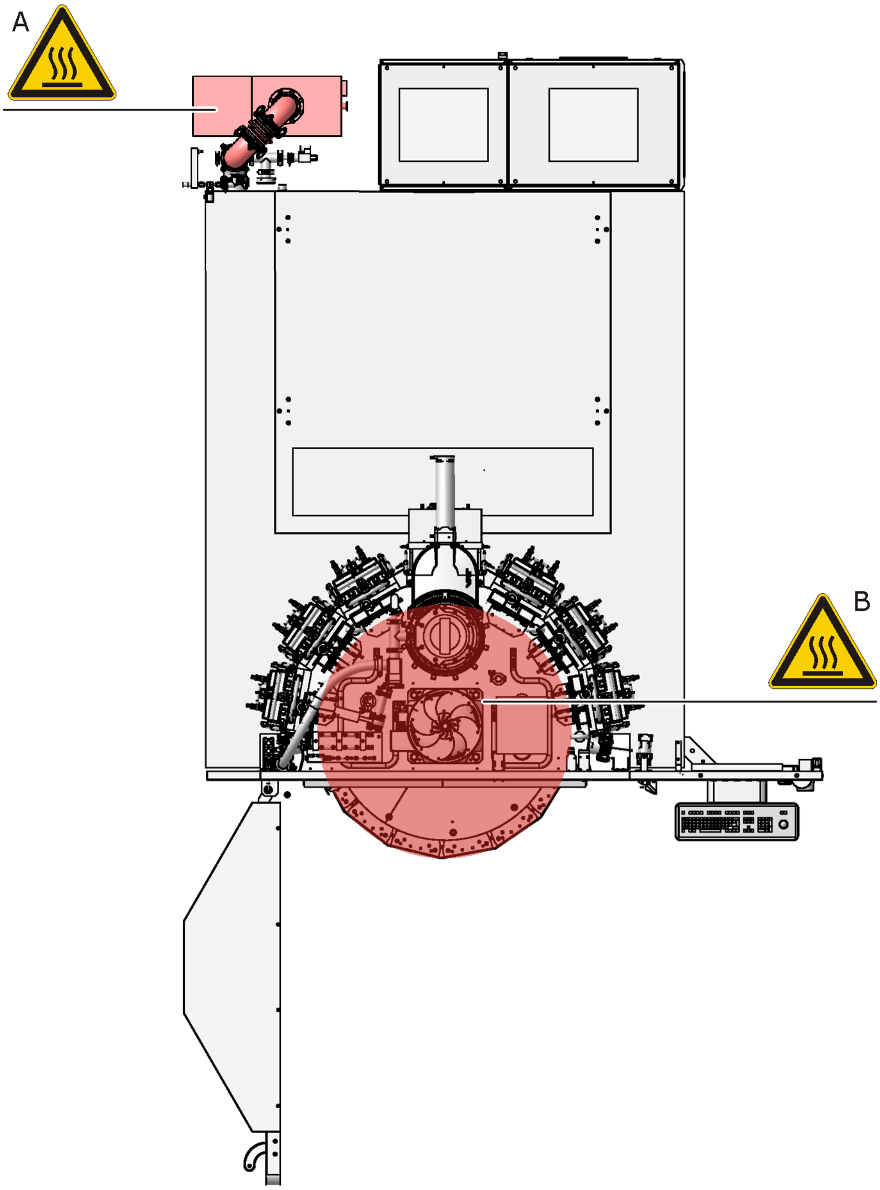


Fig. 2-7 *Danger areas for maintenance and service personnel: Thermal energy*

A Fore vacuum pump
B Process chamber walls

Maintenance and service personnel working in the danger areas must pay attention to the following hazard alerts.

Item A ***Fore vacuum pump***

⚠CAUTION

Fore vacuum pump.

The fore vacuum pump may heat up to exceed temperature levels of 80 °C. Touching the fore vacuum pump may result in burns.

Wear protective gloves and protective clothing with long sleeves. Do not put inflammable objects (e.g. cleaning cloths) onto the fore vacuum pump.

Item B ***Process chamber walls***

⚠CAUTION

Hot process chamber walls.

The process chamber walls can be heated with hot water. Touching the process chamber walls can result in burns.

Wear protective gloves and protective clothing with long sleeves.

2.6.4 *Dangers originating from magnetic fields*

NOTE:
The figure below shows a typical MSP 1200 system. Your actual system may differ from this figure in some respects.

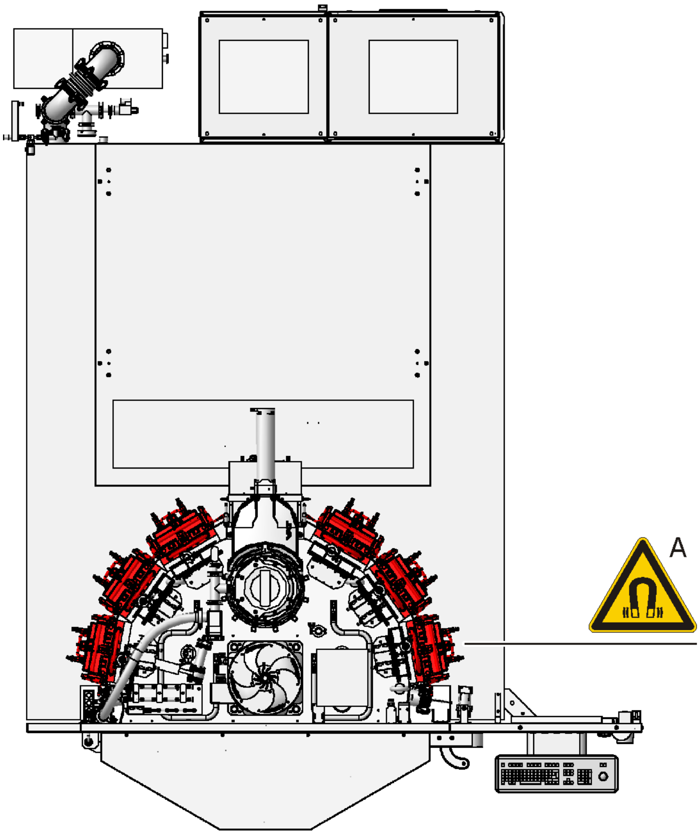


Fig. 2-8 *Danger areas for maintenance and service personnel: Electromagnetic fields*

A Sputtering sources

Personnel working in the danger areas must pay particular attention to the following hazard alerts.

Item A ***Sputtering sources***

	⚠WARNING
	Strong magnetic field. The permanent magnets in the sputtering source generate a strong magnet field. The magnet field may have a negative influence on pacemakers and other electronic implants. This may be fatal. Persons who are fitted with aids of this kind are not permitted to enter the area surrounding the MSP 1200 (minimum distance 20 cm).

2.7 Safety circuit

The MSP 1200 is equipped with a safety-relevant electric circuit. This circuit is triggered by the following events:

- An EMO (emergency-off) button is pressed
- A door or a cover that is secured by a safety switch is opened

Bypassing the safety circuit

⚠DANGER

Bypassing the safety circuit.

Some service tasks can only be performed if the safety circuit is bypassed. The system is not safe in this state. System components may be live even though protective covers have been removed.

Only experienced service technicians are allowed to bypass the safety circuit temporarily for service tasks. Access to the system must be prohibited using ropes, posts and «DO NOT ENTER» signs. Proceed with the utmost care while the safety circuit is bypassed.

2.7.1 EMO (emergency-off) buttons

Fig. 2-9, 🗎 46 shows a typical EMO button. EMO buttons are red with a yellow collar.

EMO buttons are used to shut down potentially hazardous components if dangerous situations crop up.

Fig. 2-9 *EMO button*

Positions Fig. 2-10, 🗎 47 shows the positions of the EMO buttons in the MSP 1200.

NOTE:
The figure below shows a typical MSP 1200 system. Your actual system may differ from this figure in some respects.

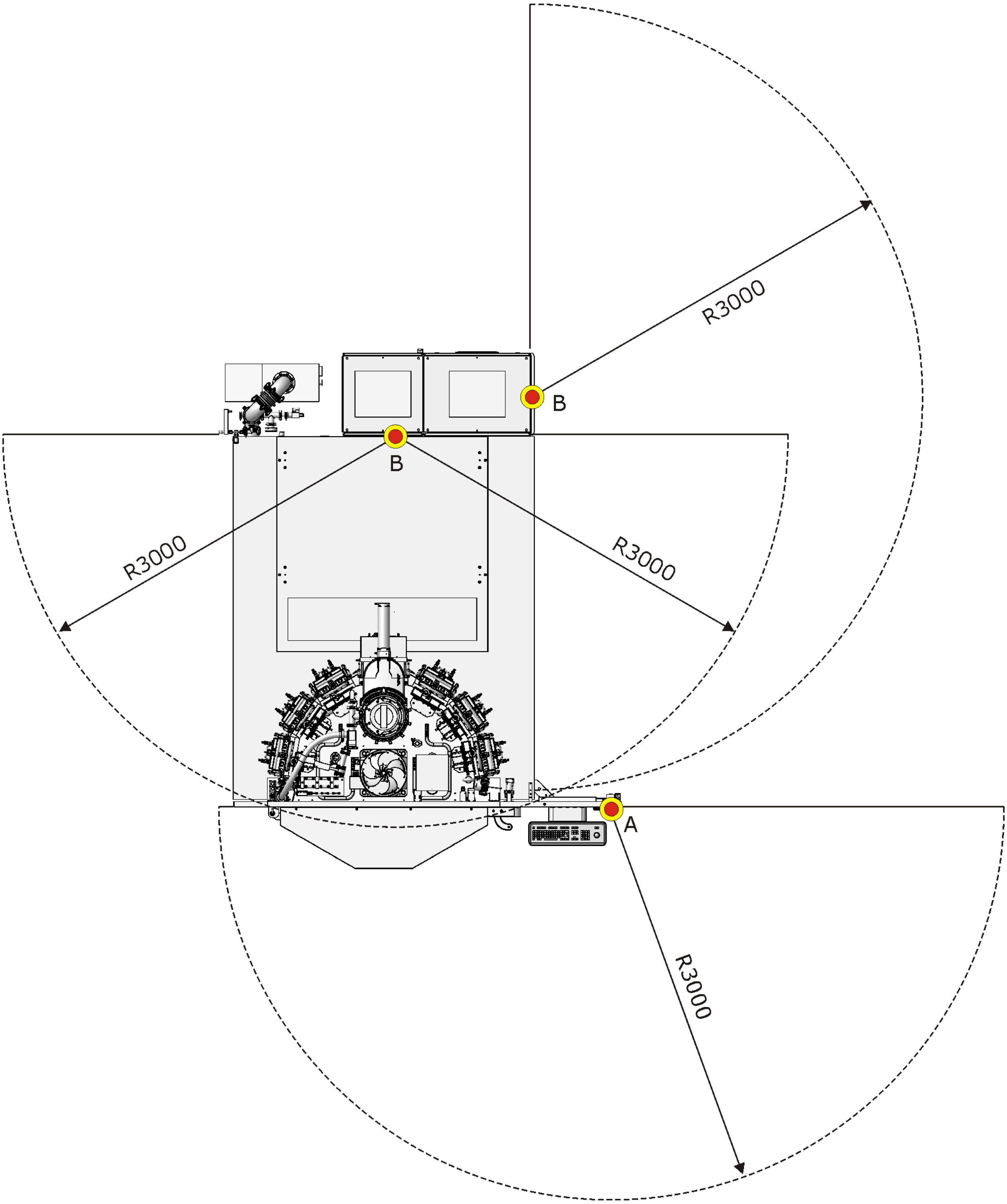


Fig. 2-10 *Positions of the EMO buttons (typical example)*

A At the GUI
B At the control and power rack

Consequence

Pressing an EMO button has the following consequences:

- The sputter sources are switched off
- All power supplies are switched off
- At the system control, the outputs for controlling movable components are switched off. This means that all movement comes to a standstill.
- An alarm message is displayed at the GUI

Switching on again

See Section 6.7.3 Resuming operation after an EMO, 🗎 144.

More detailed information on the safety circuit is included in the unit-specific electrical documentation on the MSP 1200.

2.7.2 Safety switches

Several doors or protective covers in the MSP 1200 are protected by safety switches. These switches turn off dangerous system parts in their vicinity when the door or protective cover is being opened.

Position Fig. 2-11, 🗎 49 shows the safety switches installed in the MSP 1200.

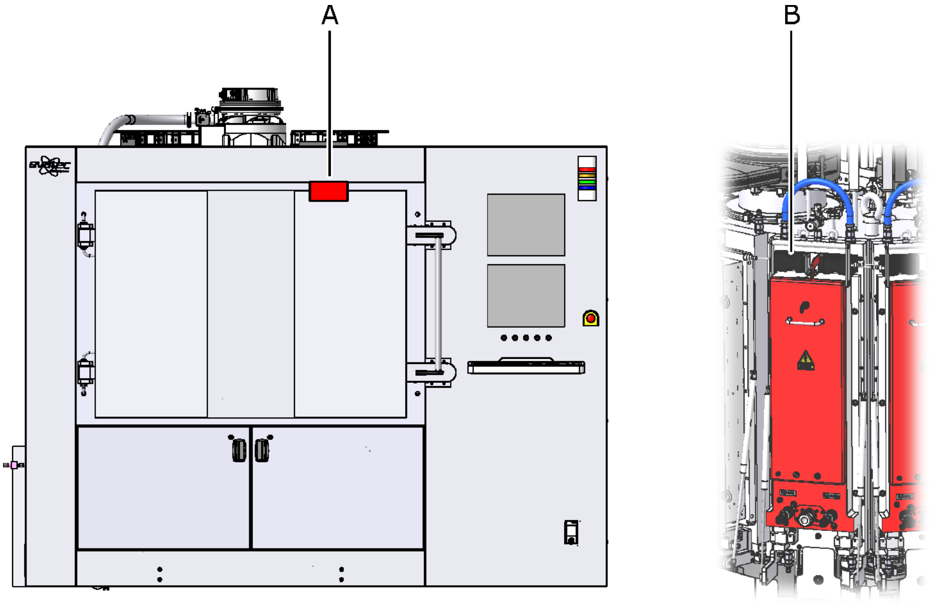


Fig. 2-11 *Safety switches*

A Safety switch «Chamber door open»
B Safety switch «Sputtering source or sputtering source cover open»

NOTE:
Each sputtering source is secured with separate safety switches.

Consequence Disconnecting a safety switch has the following consequences:

- Dangerous system parts in the vicinity of the switch are turned off
- An alarm message is displayed at the GUI

2.8 Lockout/tagout procedure

Maintenance and service work can be extremely dangerous if the serviced components are not shut down and secured properly. Contact with live parts, the release of stored energy, or the unexpected start-up of the serviced component can cause serious injury to personnel and also damage the equipment.

These hazards can be avoided through the strict use of the lockout/tagout procedure. In short, this means that you have to shut down, de-energize, lock out, and tag out the component before servicing it. In the following, this procedure will be described in detail.

2.8.1 Applying lockout/tagout devices

Before beginning any maintenance or service work, the following steps must be performed in the given order:

Shutting down

1 Prepare the component for shutdown (if necessary). Also make sure that the shutdown of the component will not affect running processes.

2 Shut down the component

Locking out

3 Isolate the component from all energy sources. For this, switch the relevant energy-isolation devices to the safe or OFF position. Typical examples of energy-isolation devices are:
- Mains plug, power breakers, switches, fuses (electric power)
- Shut-off valves (process gases, vent gas, compressed air, water)

4 Lock the energy-isolation device in the safe position. Apply a padlock which can only be opened with your personal key. Take the key with you! This ensures that the component cannot be re-energized by mistake.

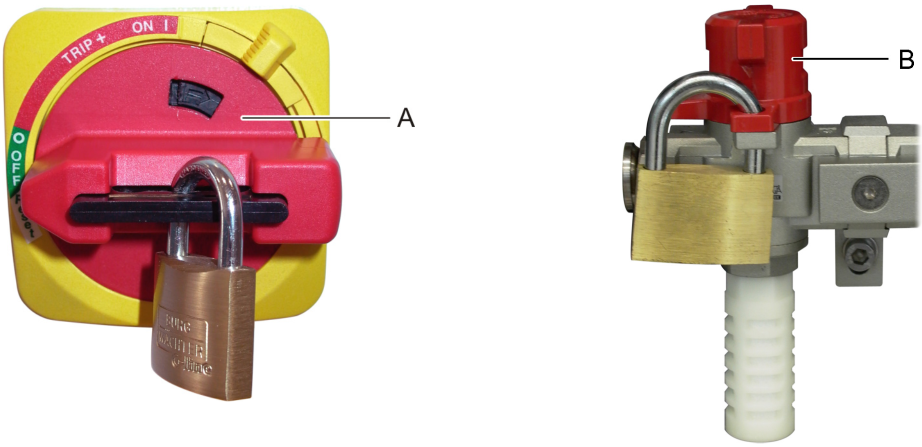


Fig. 2-12 *Energy isolation devices locked in the safe position (examples)*

A Power breaker
B Shut-off valve

Tagging out

5 Post a prominent tag onto each lockout device. This tag is a warning to others that the component must not be put back into operation until the lock and the tag have been removed by the authorized person. Tags must be written in a language that can be understood by all personnel. They must contain the following information:

- A warning text or prohibitive sign
- Name and phone number of the person in charge
- Date and time when the component has been locked out

Fig. 2-13 *Front and back of a lockout tag (example)*

A Front
B Back

Releasing stored energy

6 Release, restrain, or otherwise render safe all potential hazardous stored or residual energy. Typical examples of stored energy are:

6.1 Voltage. Residual voltage may be stored in capacitors. Discharge the components with the discharging rod.

6.2 Heat. Heaters and adjacent components may still be hot. Allow the components to cool down.

6.3 Pressurized gas. Compressed air and other pressurized gases may be stored in the related gas lines. Use the pressure relief valve.

6.4 Pressurized liquid. May be stored in water lines and hydraulic systems. Use the pressure relief valve.

6.5 Mechanical energy, stored in springs, flywheels, or similar parts. Relief the energy as required.

Verifying

7 Verify the isolated and de-energized state of the component

NOTE:
If a possibility exists for re-accumulation of hazardous energy, regularly verify during the maintenance or service task that such energy has not reaccumulated to hazardous levels.

2.8.2 What to do if a device cannot be locked

Sometimes an energy-isolating device cannot be locked with a padlock. In this case, you may apply a lockable cover which encloses the energy-isolating device and renders it inoperative. A wide range of these lockout devices is available commercially, such as:

- Circuit breaker lockouts
- Electrical plug lockouts
- Ball valve lockouts
- Gate valve lockouts

Instead of locking a particular switch or valve inside of a cabinet, you may lock and tag the entire cabinet instead. If you have any questions concerning lockout/tagout, refer to the safety department of your company.

2.8.3 Removing lockout/tagout devices

⚠DANGER

Lockouts and tagouts.

Personnel who work on de-energized components may be seriously injured or killed if someone removes lockout/tagout devices and re-energizes the component without their knowledge.

Respect lockout and tagout devices! Locks and tags must not be removed by anyone except the person who attached them.

Proceed as follows to remove lockout/tagout devices:

1 Inspect the component to ensure that it is operationally intact and that nonessential items are removed from the area

2 Inform all persons working at the system that the component will be energized again

3 Remove the lockout/tagout devices

4 Make sure that everyone is positioned safely and away from the component

5 Energize the component

2.9 Appendix

2.9.1 Material safety data sheets (MSDS)

Material safety data sheets contain safety relevant information on materials.

The end user is responsible for obtaining the material safety data sheets for all used materials (process gases, coating materials, pump oils, cleaning agents, etc.). The sheets can be obtained as follows:

- Material safety data sheets for all materials provided by Evatec can be found in the «OEM Manuals» folder located on the desktop of the system controller
- Suppliers of chemicals generally include material safety data sheets with the delivered chemicals
- Material safety data sheets are available on the Internet. Example: Enter «msds argon» into a search engine for safety relevant information on argon.

Read the material safety data sheets thoroughly and follow all directions. Verify that you are using the latest revisions of the material safety data sheets. We recommend you to keep all sheets in the «System Documentation» binder.

2.9.2 Hazardous materials and waste

Hazardous materials required for operation and maintenance:

Vent gas and process gases
- Argon
- Nitrogen
- Oxygen

Coating materials
Refer to the material safety data sheets for the used coating materials and follow all directions.

Cleaning agents
- Distilled water
- Isopropanol (IPA)

Hydrogen, Acetylene (optional)
For special processes, hydrogen or acetylene may be used in the MSP 1200. In this case the Safety Instructions for the MSP 1200 (180430BE) must have been read and understood by all persons who work at the MSP 1200.

Monomers (optional)
For special processes, monomers may be used in the MSP 1200. In this case the Safety Instructions for the MSP 1200 (180430BE) must have been read and understood by all persons who work at the MSP 1200.

Grease
- FM 090 (fluorinated grease)
- Ultratherm 2000 (vacuum grease)

For a detailed list of operating materials, see Section 7.2.2 Operating materials, 🗎 148.

Items that become solid waste as a result of operation, maintenance or service:

- Wipes contaminated with coating material
- Vacuum cleaner bags containing coating material

Exhaust gases coming from the fore vacuum pump may contain process gases. The exhaust gases must be directed out into the facility exhaust treatment system.

2.9.3 Contamination declaration

The «OEM Manuals» folder contains a contamination declaration form.

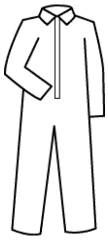
This form is used for declaring the degree of contamination of parts that you wish to return to Evatec for inspection or repair purposes. It is relevant for components that are used for generating a vacuum or for parts that are used under vacuum conditions.

Please print out the form, fill it out, sign it and include it with the packaged goods. Evatec will not accept parts that come in without a valid form!

2.9.4 Personal protective equipment (PPE)

PPE includes all clothing and other work accessories designed to create a barrier against workplace hazards. It must be worn during potentially hazardous work in order to prevent injuries or illness. Tab. 2-3, 🗎 56 shows the PPE that is required for working with the MSP 1200.

Operator and higher

Personal protective equipment	Typical examples
Protective clothing with long sleeves	
Disposable clean room gloves (class 100) Chemical resistant gloves (impermeable) may be necessary depending on the used coating materials!	
Fine dust mask (P2)	
Welding glasses Filter lenses shade 2…4 (unbreakable)	
Safety shoes	

Maintenance and higher

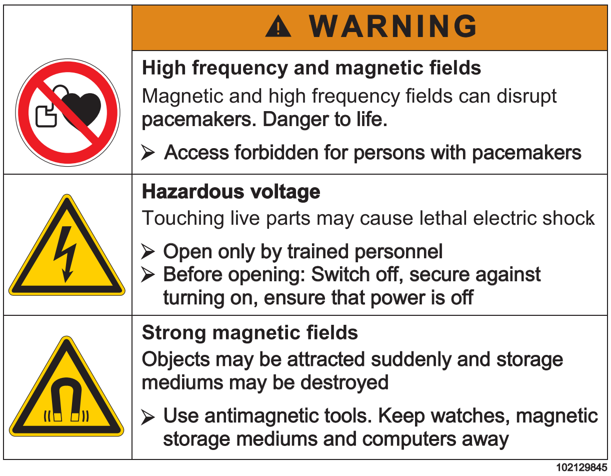
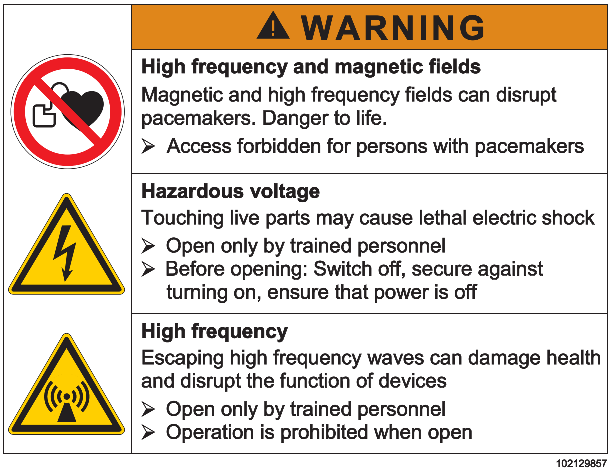
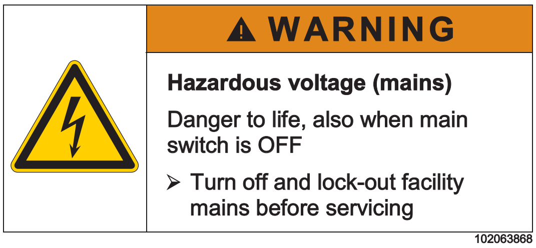
Personal protective equipment	**Typical examples**
Lockout/tagout kit containing all the required lockout devices and lockout tags	

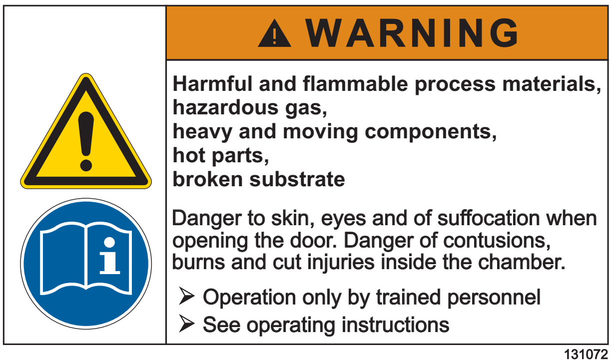
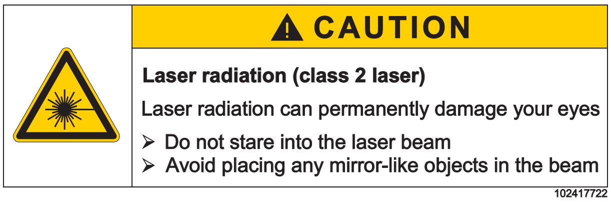
Tab. 2-3 *Personal protective equipment (typical examples)*

NOTE:
The end user is responsible for providing all users with the required PPE. The PPE must conform with the national standards and laws.

2.9.5 *Safety stickers on the MSP 1200*

The following safety stickers are attached to the MSP 1200 or its components:

Safety stickers	**Order no. and position**
⚠ WARNING **High frequency and magnetic fields** Magnetic and high frequency fields can disrupt pacemakers. Danger to life. ➢ Access forbidden for persons with pacemakers **Hazardous voltage** Touching live parts may cause lethal electric shock ➢ Open only by trained personnel ➢ Before opening: Switch off, secure against turning on, ensure that power is off **Strong magnetic fields** Objects may be attracted suddenly and storage mediums may be destroyed ➢ Use antimagnetic tools. Keep watches, magnetic storage mediums and computers away 102129845	102129845 On the sputtering sources
⚠ WARNING **High frequency and magnetic fields** Magnetic and high frequency fields can disrupt pacemakers. Danger to life. ➢ Access forbidden for persons with pacemakers **Hazardous voltage** Touching live parts may cause lethal electric shock ➢ Open only by trained personnel ➢ Before opening: Switch off, secure against turning on, ensure that power is off **High frequency** Escaping high frequency waves can damage health and disrupt the function of devices ➢ Open only by trained personnel ➢ Operation is prohibited when open 102129857	102129857 On the plasma source
⚠ WARNING **Hazardous voltage (mains)** Danger to life, also when main switch is OFF ➢ Turn off and lock-out facility mains before servicing 102063868	102063868 On the control and power rack

Safety stickers	Order no. and position
 **WARNING** **Harmful and flammable process materials, hazardous gas, heavy and moving components, hot parts, broken substrate** Danger to skin, eyes and of suffocation when opening the door. Danger of contusions, burns and cut injuries inside the chamber. ➢ Operation only by trained personnel ➢ See operating instructions 131072	131072 On the front side and back side of the process chamber
 **CAUTION** **Laser radiation (class 2 laser)** Laser radiation can permanently damage your eyes ➢ Do not stare into the laser beam ➢ Avoid placing any mirror-like objects in the beam 102417722	102417722 On the front side of the process chamber

NOTE:
Safety stickers must not be removed. If they are no longer clearly legible, they must be replaced. Please refer to the spare parts catalog for the order number.

3. Description

3. Description

3.1 Process technology

3.1.1 Cathode sputtering (sputtering)

Sputtering is a process which is used to produce thin films. Ion bombardment removes particles of coating material from a target. These particles are deposited and settle on a substrate.

Plasma

A plasma is required to execute a sputtering process. A plasma is an ionized gas. This can be created by subjecting a gas at reduced pressure to an electrostatic field or a high-frequency alternating field.

Plasma ignition

The following example uses argon as a process gas. The gas is exposed to an electrostatic field in order to produce a plasma. The negative pole of the voltage is applied to the target, i.e. the target constitutes the cathode. The positive pole of the voltage is generally connected to the housing ground.

Ionizing radiation (cosmic radiation and natural radioactivity) is always present. As a result, gas always contains a small amount of gas ions. This means that some atoms in the process gas are split up into positive argon ions and negative electrons in accordance with the following chemical reaction:

$\mathrm{Ar} \rightarrow \mathrm{Ar}^{+} + e^{-}$

The electric field accelerates the argon ions to the cathode and the free electrons to the anode. In the process, the accelerated electrons collide with further atoms and ionize these atoms with their kinetic energy. The above process is repeated continuously and therefore produces an avalanche of argon ions and electrons. The plasma ignites.

Gas pressure

In order to maintain a plasma when applying a voltage of a few hundred volts, the pressure of the process gas must be within a range of about 10^{-4} to 10^{-2} mbar (0.01 to 10 Pa). If the pressure level is set too high, the accelerated electrons will collide with the gas atoms before they can achieve the minimum energy that is required for ionization. On the other hand, if the pressure is too low, the particle number density is reduced and the probability of collision decreases.

Sputtering process

Subsequent to plasma ignition, large amounts of positive argon ions impact on the target (Fig. 3-1, 🗎 61). Their high mass gives them a high level of impulse transmission. This is transferred to the atoms on the target surface and thus causes single atoms or whole clusters of atoms to be removed. Ion impact also generates heat and this, in turn, induces undesirable target heating. The target is therefore cooled with water.

Deposition

The atoms removed from the target move freely inside the process chamber and then settle on the substrate and other surfaces. Appropriately positioned masks allow for localized material coating on the substrate. The procedure is called «deposition». Fig. 3-1, 🗎 61 shows a typical arrangement. Here, the substrate carrier is positioned parallel to and opposite the target.

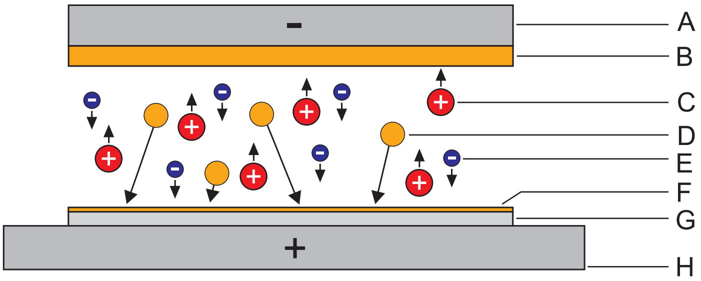


Fig. 3-1 *Principles of sputtering*

A Cathode (negative pole)	*E Free electrons*
B Target	*F Deposited layer*
C Gas ions	*G Substrate*
D Target material particles	*H Substrate carrier and anode (positive pole)*

Advantages

The method of sputtering has two main advantages over the method of thermal evaporation of material:

- The sputtering process is largely a stochastic procedure. This means that the chemical composition of the deposited layer corresponds with the target even when alloys or chemical compounds are sputtered.
- The sputtering process endows particles with a substantially higher level of energy than the thermal evaporation process. This improves layer adhesion and produces a compact layer structure even at low substrate temperatures.

3.1.2 Planar Magnetron technology

The sputtering source of the MSP 1200 is equipped with a permanent magnet assembly that is positioned behind the target. The magnetic field compels the free electrons to additional circular movements so that they all move in helical (screw-like) paths. This lengthens the electron path, thereby increasing the probability of collisions between electrons and gas atoms. The degree of dissociation of the process gas and therefore the plasma density is increased accordingly.

The «Planar Magnetron» technology offers the following advantages over conventional sputtering systems:

- Highly stable plasma
- Increased sputtering rate
- Decreased sputtering voltage (i.e. low particle energy)
- Performs well even at low gas pressure

3.1.3 Reactive sputtering

For sputtering, a process gas that is chemically inert and that does not react with the target atoms is normally used. A typical process gas is the noble gas argon. The chemical composition of the deposited layer corresponds with the target material.

During reactive sputtering, a «reactive gas» such as oxygen or nitrogen is mixed with the chemically inert process gas. As a result, compounds of the target material and the reactive gas will form and deposit on the substrate. Typical applications are the deposition of oxides and nitrides if a metal is used as the target and oxygen or nitrogen are used as reactive gases.

Fig. 3-2, 🗎 62 shows the principle of DC magnetron reactive sputtering.

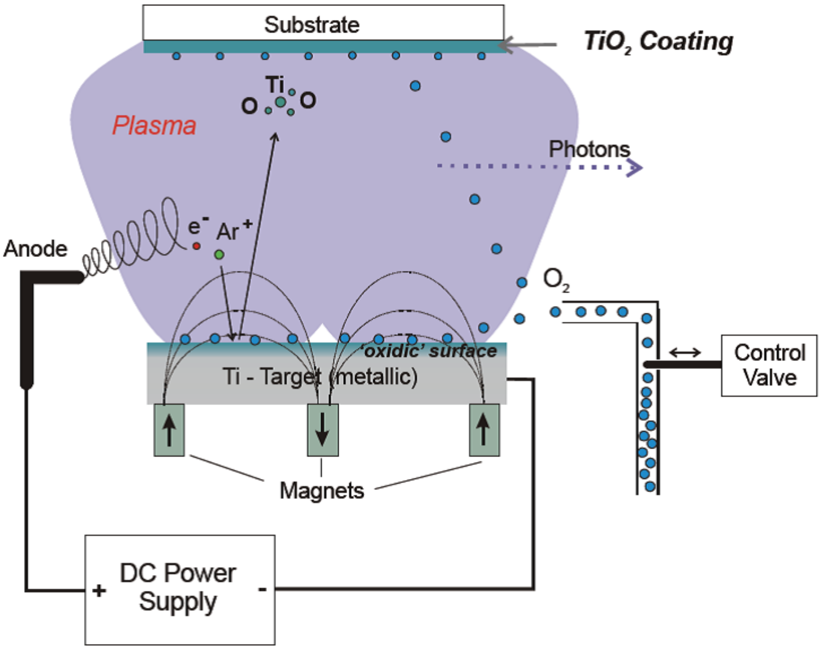


Fig. 3-2 *DC magnetron reactive sputtering (example)*

In this example, titanium (Ti) is used as a target, and oxygen (O_2) is used as a reactive process gas. As the result of the reactive sputtering process, a titanium dioxide (TiO_2) coating is deposited on the substrate.

3.2 System overview

Top view Fig. 3-3, 🗎 63 shows a top view of the MSP 1200.

NOTE:
The figure below shows a typical MSP 1200 system. Your actual system may differ from this figure in some respects.

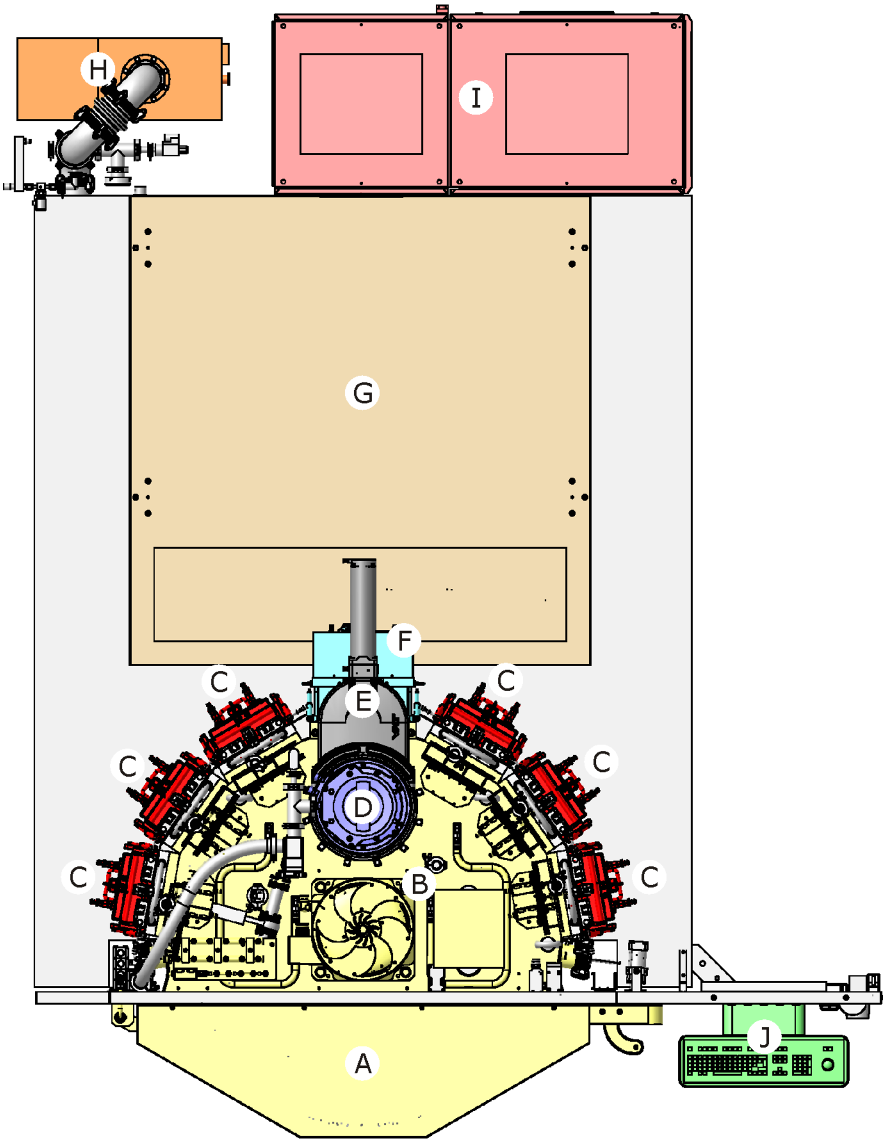


Fig. 3-3 *MSP 1200 system overview (top view)*

A Chamber door
B Process chamber
C Sputter source
D Turobomolecular pump
E High vacuum valve
F Plasma source
G Media battery
H Fore vacuum pump
I Control and power rack
J Graphic user interface (GUI)

Process module

The process module provides the environment for the coating process. It contains the following components:

- Process chamber door
- Sputtering sources
- Process chamber
- Substrate cage
- Shutter
- Plasma source
- Optical film thickness monitor

See Section 3.3 Process module, 🗎 65.

Vacuum system

The vacuum system contains the following components:

- Fore vacuum pump
- Turbomolecular pump
- High vacuum valve

See Section 3.5 Vacuum system, 🗎 76.

Process gas supply

The process gas supply contains the following components:

- Flow controllers
- Gas shower
- Measurement devices

See Section 3.6.4 Process gas, 🗎 86.

Water circuit

The water circuit contains the following components:

- Water battery
- Water temperature controller

See Section 3.7 Electrics, 🗎 87.

Electrics

The electrical system contains the following components:

- Control and power rack

See Section 3.7 Electrics, 🗎 87.

3.3 Process module

Fig. 3-4, 🗎 65 shows the process module of the MSP 1200.

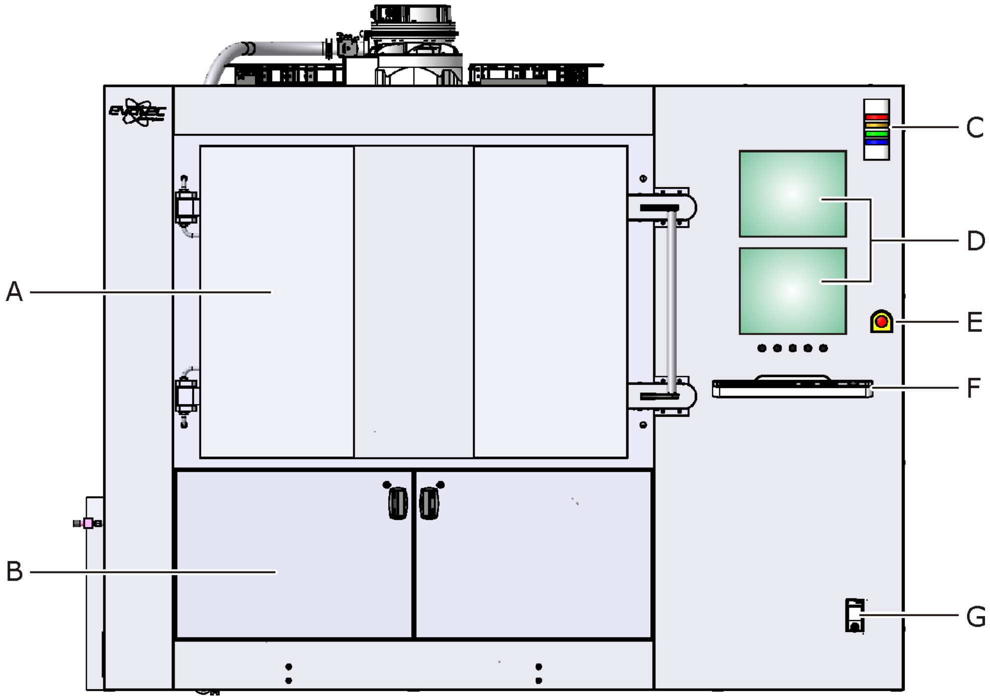


Fig. 3-4 *Process module*

A Process chamber door
B Cabinet door

C Signal tower
D Monitors
E EMO button
F Keyboard
G Power socket

3.3.1 Process chamber door

Fig. 3-5, 🗎 66 shows the process chamber door.

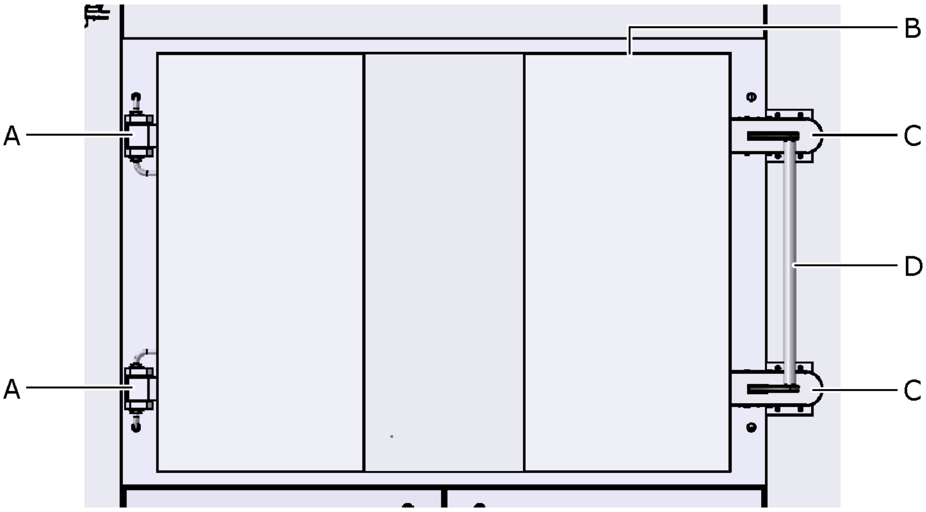


Fig. 3-5 *Chamber door*

A Hinge

B Safety switch
C Door lock
D Handle

The chamber door is mounted on two hinges (item A). If unlocked, the door can be moved by means of a handle (item D).

A safety switch (item B) shuts down potentially dangerous components inside of the process chamber when the door is being opened.

The door is locked by means of pneumatic door locks (item C).

Door locks

The chamber door is locked by means of four pneumatic door locks. Fig. 3-6, 🗎 67 shows one of the door locks.

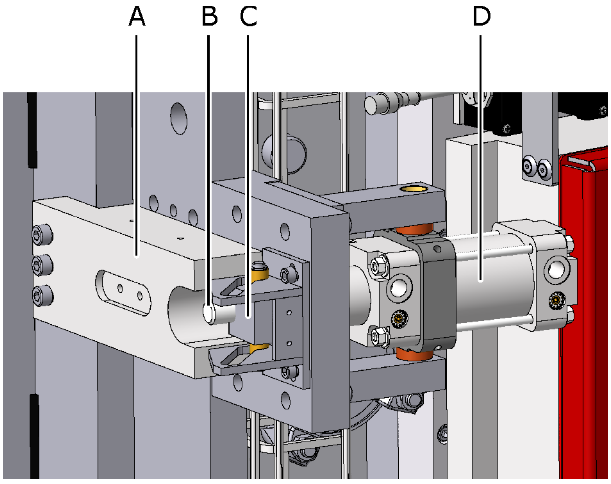


Fig. 3-6 *Door lock*

A Clasp
B Piston rod
C Bar
D Pneumatic cylinder

Each door lock consists of a pneumatic cylinder (item D) with a piston rod (item B) in its center. The piston rod can perform both longitudinal and angular movements. The rod ends with a bar (item C) which fits through an opening in the clasp (item A) if aligned properly.

As displayed, the assembly is in the unlocked position. In order to lock the door, the piston rod first makes a 90° turn. It then retracts and pulls the bolt housing towards the process chamber frame.

3.4 Process chamber

The process chamber provides the environment for the coating process. The chamber is made of stainless steel. Water tubing is welded to the outside of the chamber wall for heating or cooling of the process chamber.

Interior of chamber

Fig. 3-7, 🗎 68 shows the interior of the process chamber.

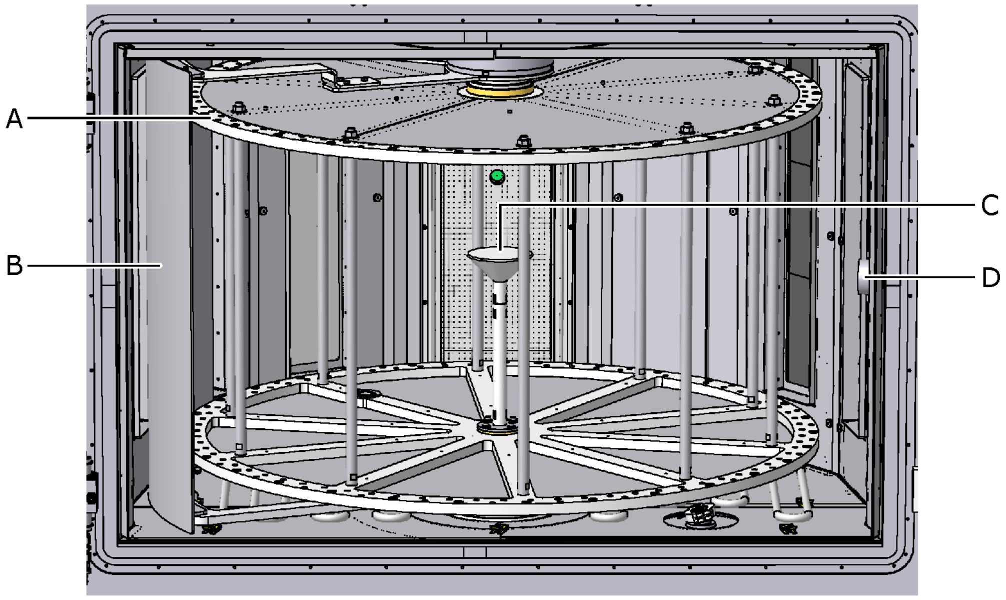


Fig. 3-7 *Interior of the process chamber*

A Substrate cage	*C Reflectance shield*
B Shutter	*D Optical film thickness monitor*

Back of chamber

Fig. 3-8, 🗎 69 shows the back of the process chamber.

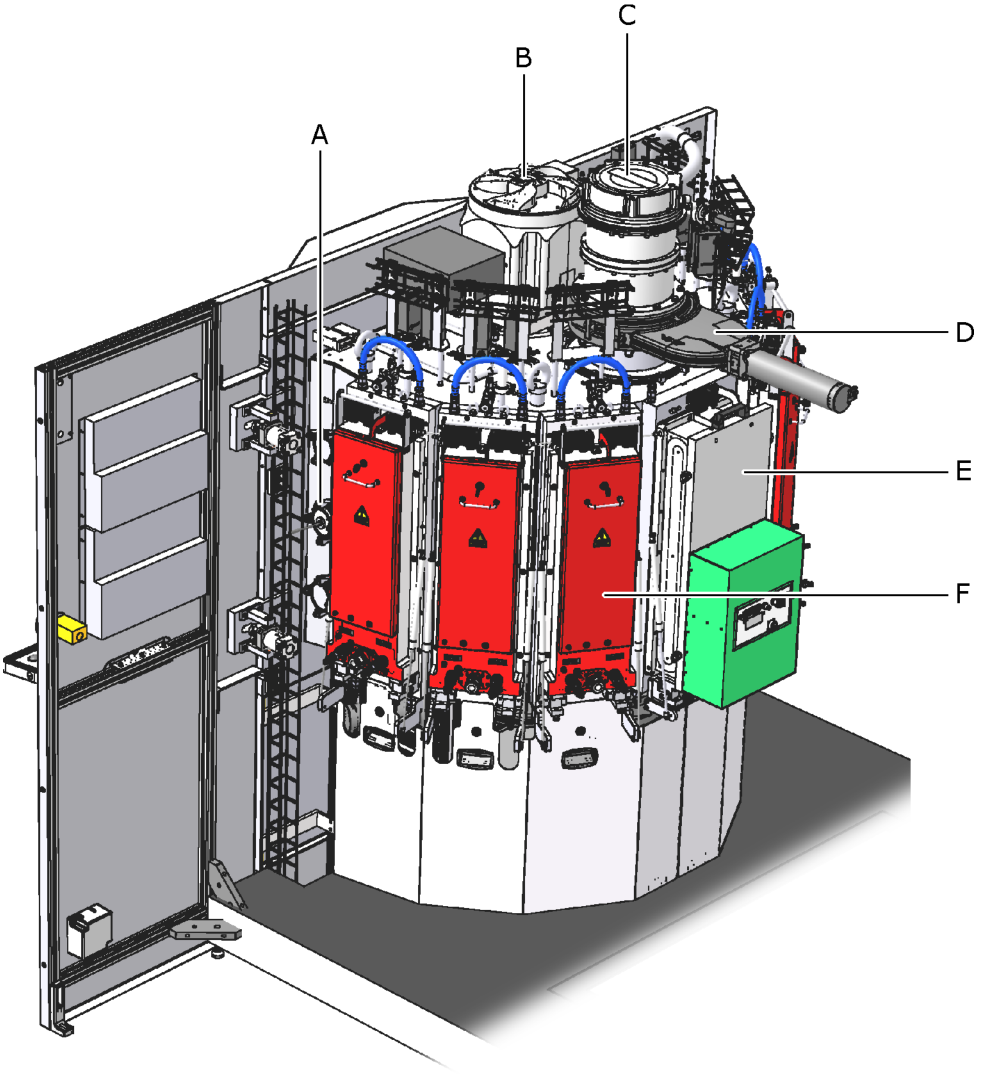


Fig. 3-8 *Back of the process chamber*

A Port for optical film thickness monitor
B Rotary drive for substrate cage
C Turbomolecular pump
D High vacuum valve
E Plasma source
F Sputtering source

3.4.1 Substrate cage

Fig. 3-9, 🗎 70 shows the substrate cage.

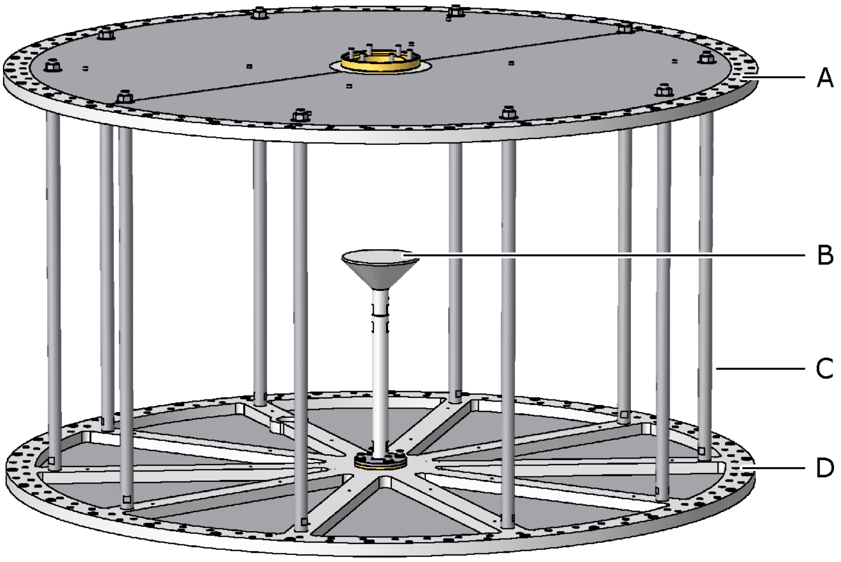


Fig. 3-9 *Substrate cage*

A Top ring
B Reflectance shield
C Distance shaft
D Bottom ring

Substrates are not directly placed on the substrate cage. Instead, they are mounted on the back sides of the substrate carriers. The shape and size of the substrate carriers are end user specific.

The loaded substrate carriers are then hooked into the substrate cage.

Rotary drive

During the coating process, the substrate cage is rotated by a direct rotary drive. The movement of the substrates ensures uniform coating of all substrates.

The rotary drive is mounted on a flange on top of the process chamber. See Fig. 3-8, 🗎 69.

The rotary drive is controlled by the KHAN system controller.

3.4.2 Shutter

Fig. 3-10, 🗎 71 shows the shutter.

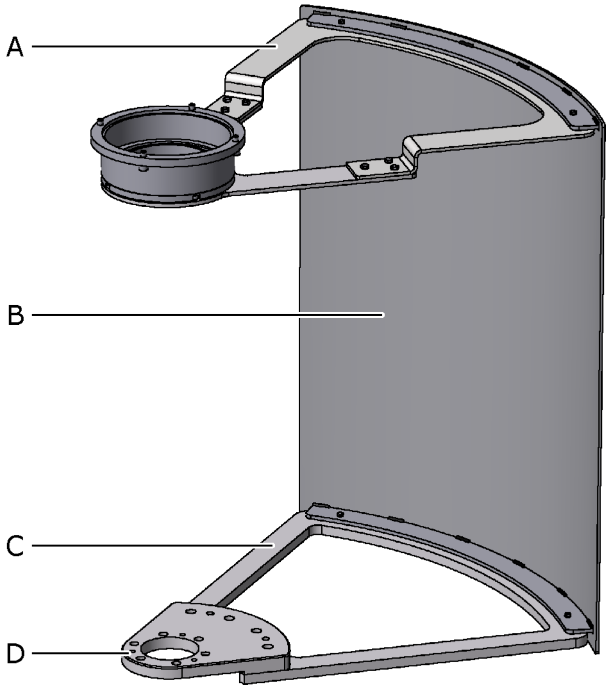


Fig. 3-10 *Shutter*

A Guide
B Shutter sheet
C Shutter holder
D Mounting position for shutter drive

The shutter is used to cover the substrates during process start. It is also used to cover the sputtering sources not being used during the coating process.

The targets are cleaned before each process. This is done by positioning the shutter in front of the targets to be cleaned and then igniting a plasma.

The shutter drive makes it possible to freely position the shutter in the process chamber.

3.4.3 Sputtering sources

The Planar Magnetron sputtering sources are mounted on the back side of the process chamber. They can be folded down for maintenance and service work.

NOTE:
Two source sizes (25" and 32") are available for the MSP 1200.

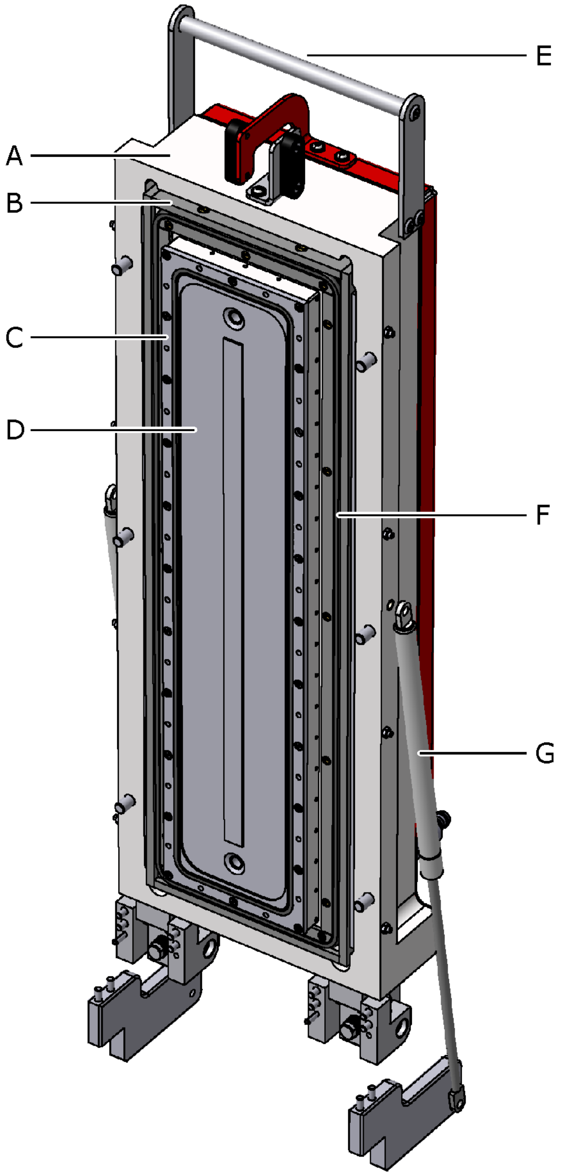


Fig. 3-11 *Planar Magnetron sputtering source*

A Outer housing	*E Handle*
B Inner housing with magnet system	*F Viton seal*
C Clamping frame	*G Gas spring*
D Cooling plate	

Corrective shutters are mounted in the frame of the sputtering sources. Correct positioning the corrective shutters results in homogeneous coating of all substrates in the substrate carrier.

3.4.4 *Plasma source (optional)*

Fig. 3-12, 🗎 73 shows the plasma source.

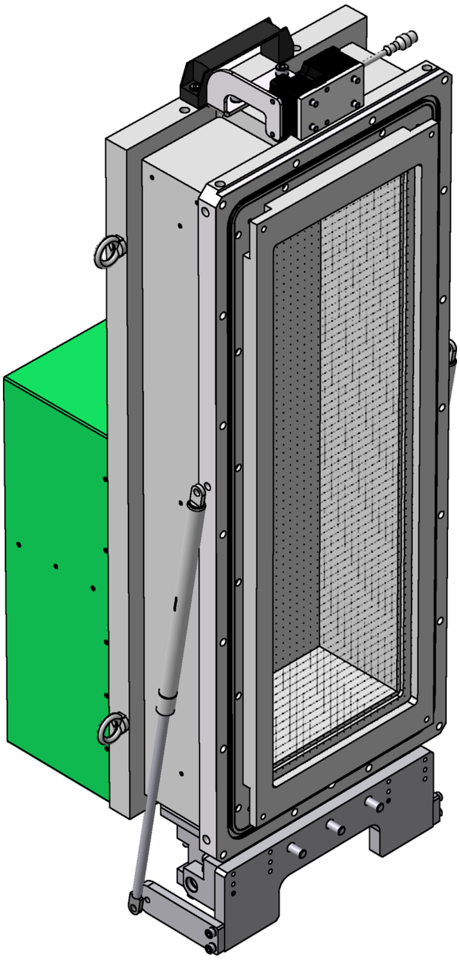


Fig. 3-12 *Plasma source*

The plasma source is an optional component. It can be used for the following tasks:

- Cleaning the substrates prior to the coating process
- Etching
- Supporting the sputtering process

For more information on the plasma source, refer to the separate OEM manual.

3.4.5 *Film thickness monitor*

The film thickness monitor determines the thickness of the films from the reflection data. This makes it possible to deposit films of precise thickness as required for optical applications.

The broad band measuring system GSM 1101 (Broadband) compares actual reflectance spectra with pre calculated end spectra. If the spectra fits best, the film is complete and the coating process is stopped.

Fig. 3-13, 🗎 74 shows the basic principle.

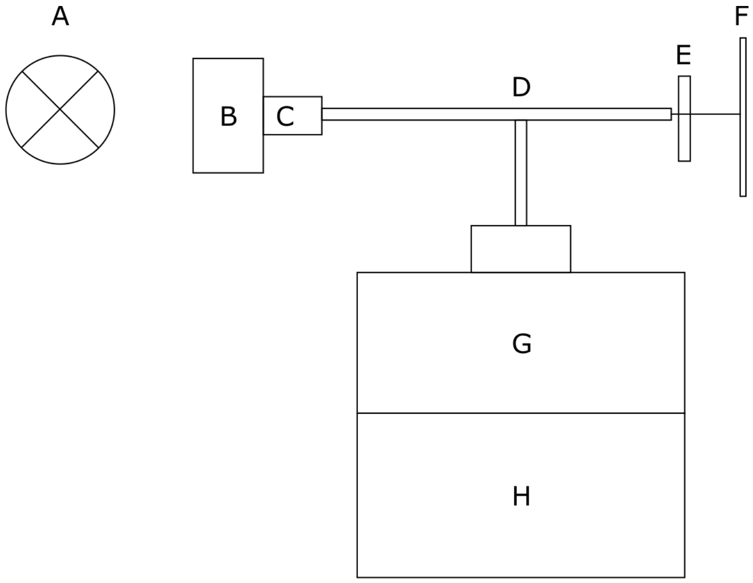


Fig. 3-13 *Film thickness monitor*

A Lamp
B Shutter
C Coupling to optical fiber cable
D Optical fiber cable
E Window
F Film
G Spectrometer
H Diode array connected to a PC

After passing the shutter (item B), the light beam is fed into an optical fiber cable. The light beam travels through the window (item E) at the process chamber. It encounters the film (item F) from which it is reflected.

In the optical fiber cable, the beam is guided to a spectrometer (item G) and then measured by means of a diode array (item H).

3.4.6 *Plasma emission monitor (PEM)*

A plasma emission monitor is installed at each sputtering source. Fig. 3-14, 🗎 75 shows the basic principle of the plasma emission monitor.

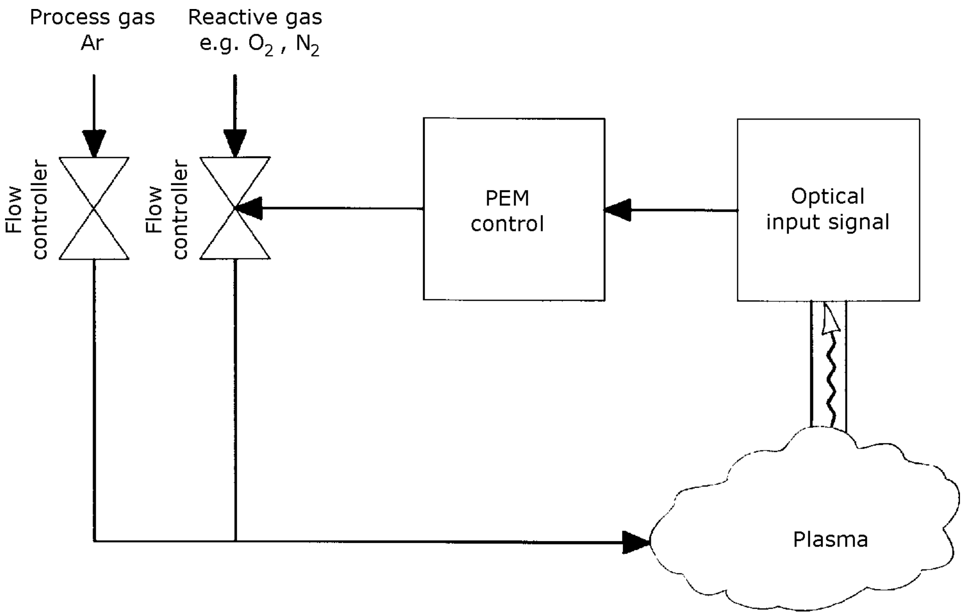


Fig. 3-14 *Plasma emission monitor (PEM)*

A collimator tube detects the intensity of special plasma spectral lines by means of a photomultiplier.

The process is stabilized by the oxygen portion of the argon/oxygen mixture (Ar/O_2). The oxygen portion is regulated by the PEM control, resulting in a constant plasma intensity.

3.5 Vacuum system

Sputter coating processes can only be performed under vacuum. For this reason, the MSP 1200 is equipped with a vacuum system.

3.5.1 Vacuum diagram

Fig. 3-15, 🗎 76 shows the vacuum diagram.

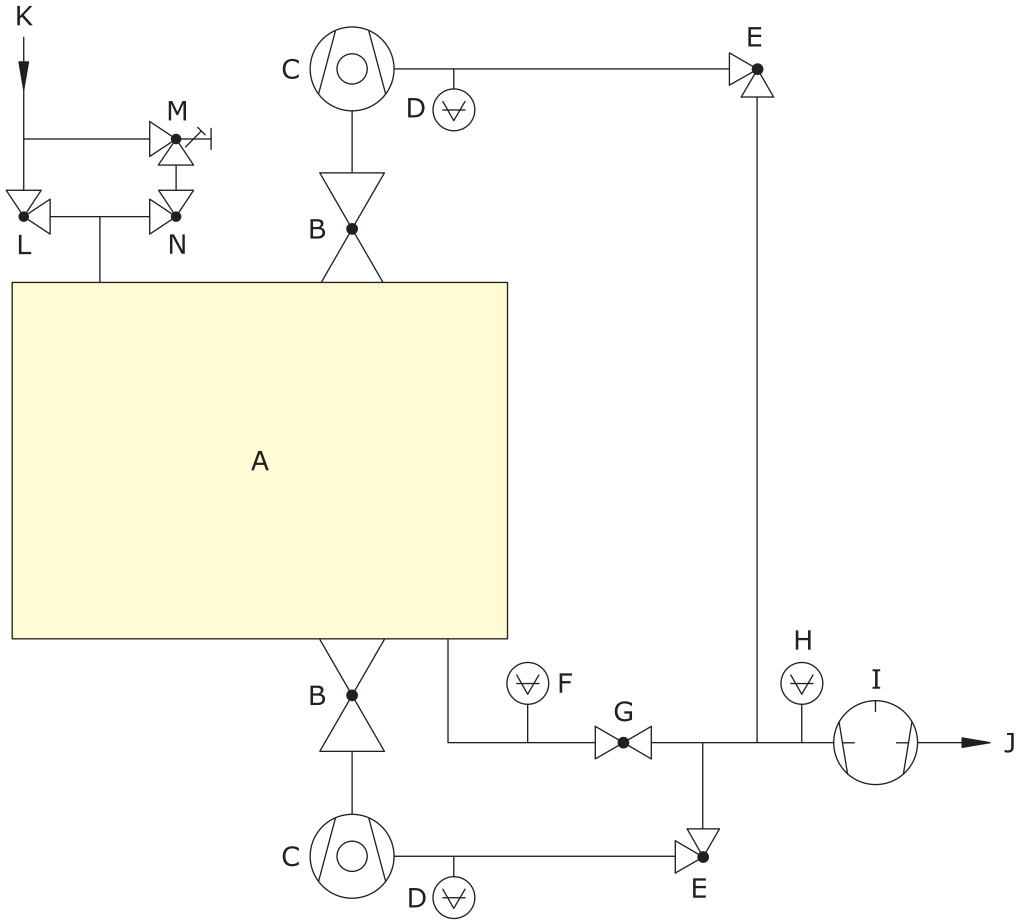


Fig. 3-15 *Vacuum diagram*

A Process chamber
B High vacuum valve
C High vacuum pump
D Fore vacuum gauge
E Fore vacuum valve
F High vacuum gauge
G Bypass valve

H Bypass gauge
I Fore vacuum pump
J Exhaust
K Vent gas supply (dry nitrogen gas)
L Fast vent valve
M Throttle
N Soft vent valve

Fore vacuum A fore vacuum pump is used to pump down the process chamber to a fore vacuum and also to pump the outlet of the turbomolecular pump.

High vacuum The process chamber is evacuated to high vacuum by turbomolecular pumps.

Vacuum gauges Vacuum gauges are mounted at the back of the process chamber, at the intake line of the fore vacuum pump, and at the intake of the turbomolecular pump.

Venting The process chamber is vented by a two-stage venting unit. Its structure is as follows:

- At high vacuum conditions, the process chamber is vented slowly via the throttle and the soft vent valve
- After a minimum pressure is reached, the fast vent valve opens. Now the process chamber is quickly vented to atmospheric pressure via the additional vent gas line.

Pressure relief valve The process chamber is protected by a pressure relief valve. This valve prevents the chamber pressure from rising above ambient pressure.

NOTE:
The pressure relief valve closes by its self-weight. For this reason, the valve must always be mounted upright. In this position the flange and the O-ring of the pressure relief valve are aligned horizontally.

3.5.2 Fore vacuum pump

The fore vacuum pump is used to evacuate the vacuum chambers from ambient pressure to a fore vacuum. It is also used to pump the outlets of the turbomolecular pump.

Several pump models are available for the MSP 1200, and the fore vacuum pump may also be supplied by the end user. Fig. 3-16, 🗎 78 shows a typical example.

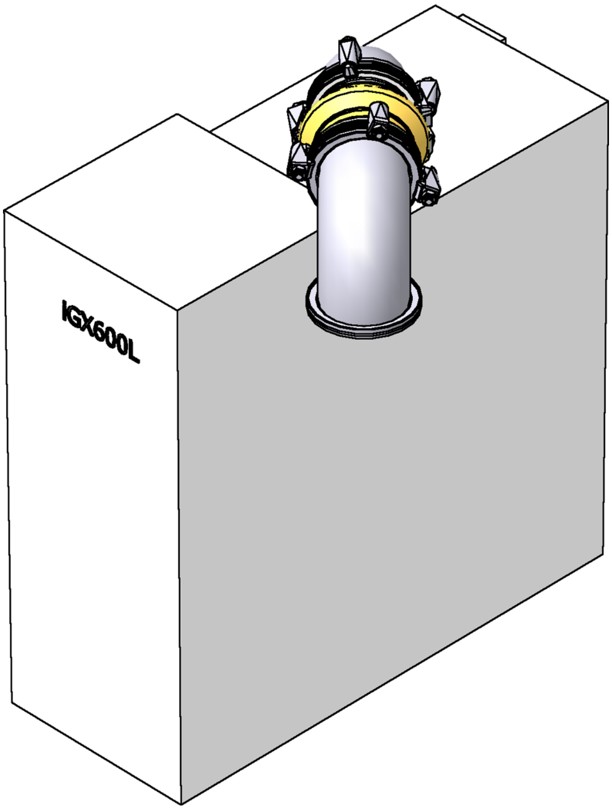


Fig. 3-16 *Fore vacuum pump (example)*

For more information on the fore vacuum pump, refer to the separate OEM manual.

3.5.3 Turbomolecular pump

The turbomolecular pumps are used to evacuate the process chamber from a fore vacuum to a high vacuum.

Several turbomolecular pump models are available for the MSP 1200.
Fig. 3-17, 🗎 79 shows a typical example.

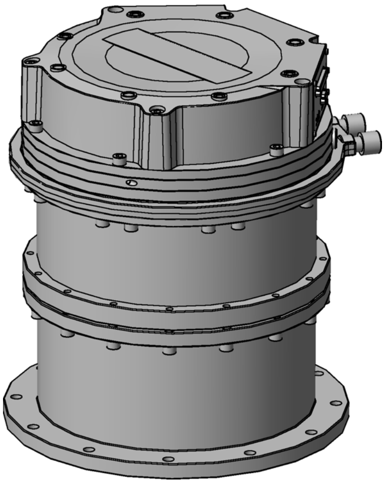


Fig. 3-17 *Turbomolecular pump (example)*

A turbomolecular pump contains an arrangement of rotor/stator pairs mounted in series. The rotor has a number of angled blades and rotates at high speed, comparable to the average thermal velocity of gas molecules. When molecules hit the lower side of the blades, momentum is transferred to them, pushing the molecules toward the pump outlet.

For more information on the turbomolecular pump, refer to the separate OEM manual.

3.5.4 Vacuum gauges

The following vacuum gauges may used for the vacuum system of the MSP 1200:

Model	Type	Range [mbar]	Information
TPR 280	Pirani	5×10^{-4} to 1×10^{3}	See separate OEM manual
MPG 500	Cold cathode and Pirani	1×10^{-9} to 1×10^{3}	See separate OEM manual

Tab. 3-1 *Vacuum gauges*

Fig. 3-18 *Vacuum gauges*

Left: TPR 280
Right: MPG 500

3.6 Media supply

3.6.1 Media battery

The MSP 1200 has a media battery installed in the system platform as compact unit. See Fig. 3-19, 🗎 81.

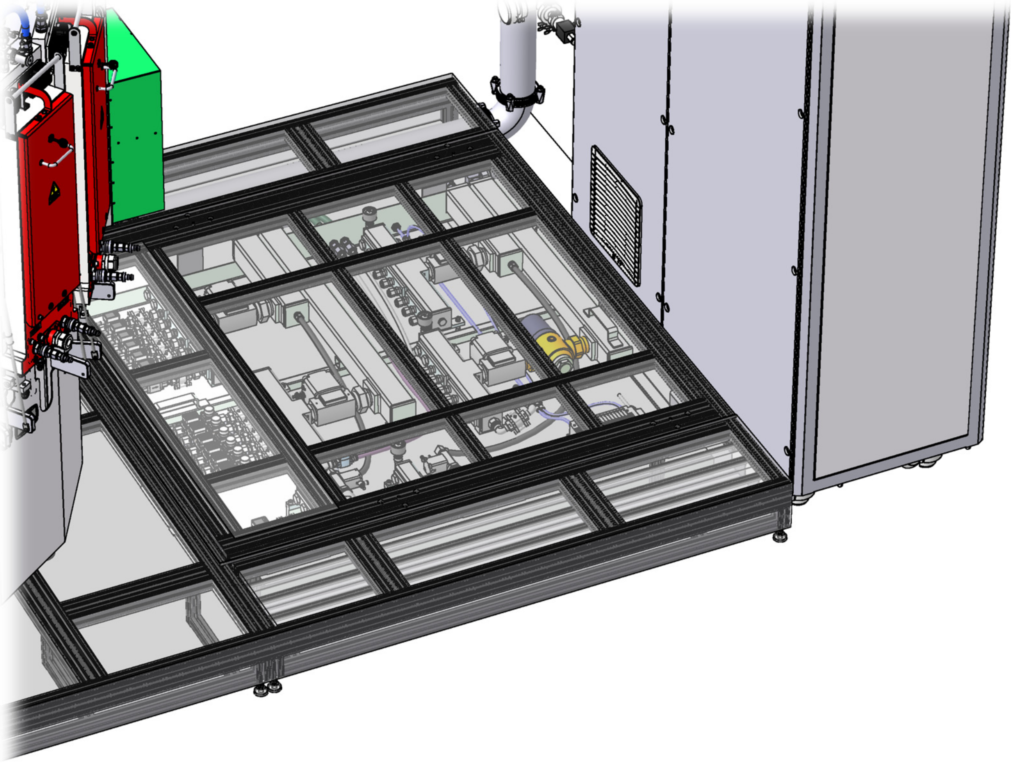


Fig. 3-19 *Media battery (cover shown transparently)*

Cooling water and compressed air are fed in from the media connection panel via the power rack base to the media battery.

The media battery contains:

- Shut-off valves, flow monitors and pressure gauges for the water supply. See Section 3.6.3 Cooling water, 🗎 83.
- Pressure gauges and solenoid valves for the compressed air supply. See Section 3.6.4 Process gas, 🗎 86.

Lift the cover at the system platform to access the media battery.

3.6.2 Compressed air

Compressed air diagram
The following components require compressed air for operation:

- All pneumatically actuated shut-off valves
- Door locks at the process chamber
- Blow-out circuit (used to blow the water circuit free from water)

NOTE:
For details, please refer to the delivered compressed air diagram.

Supply The compressed air is to be provided by the end user.

Power failure If a power failure should occur, all electrically or pneumatically actuated valves switch to their neutral position.

3.6.3 Cooling water

Water diagram
Fig. 3-20, 🗎 83 shows the basic water circuit.

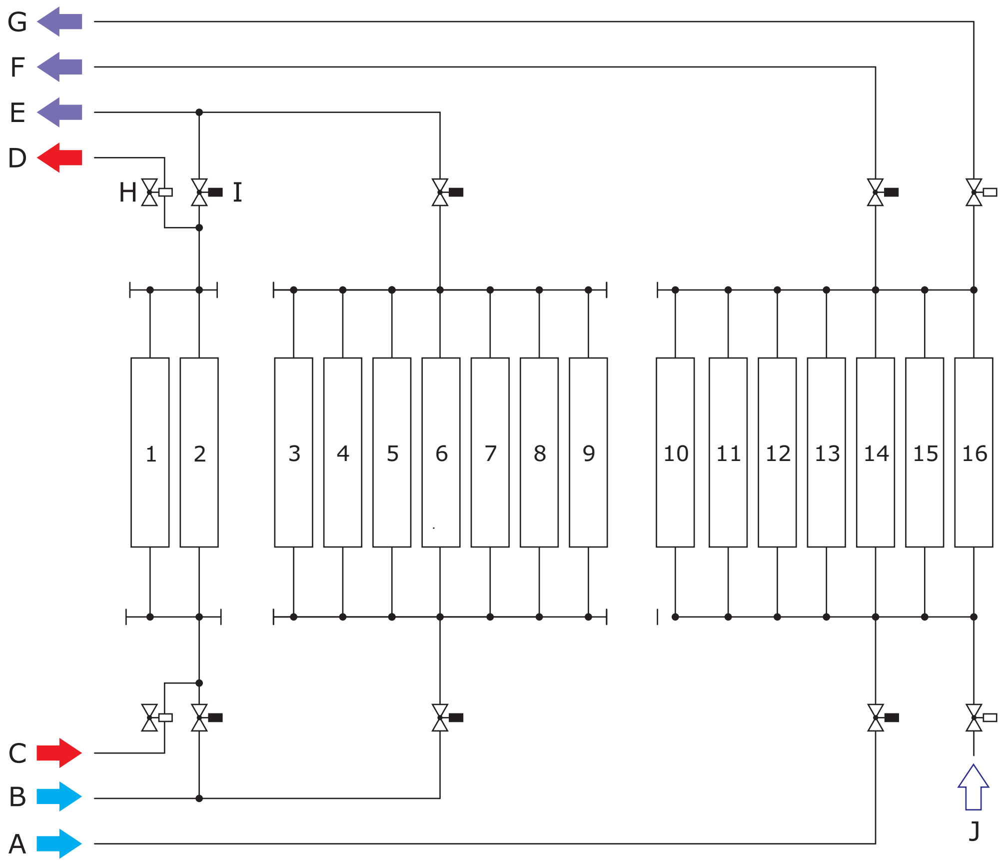


Fig. 3-20 *Water circuit (standard layout)*

A	*Cold water inlet (max. 30 °C)*
B	*Cold water inlet (max. 30 °C)*
C	*Hot water inlet (max. 90 °C)*
D	*Hot water outlet (max. 90 °C)*
E	*Cold water outlet (≈ 50 °C)*
F	*Cold water outlet (≈ 50 °C)*
G	*Drain (≈ 50 °C)*
H	*Pneumatic shut-off valve (NC)*
I	*Pneumatic shut-off valve (NO)*
J	*Compressed air supply*

Cooling and heating

The items 1…16 designate water branches.

- The branches 1,2 can either be cooled or heated
- The branches 3…9 and 10…16 can only be cooled

Only cold water is used during processing. Hot water may be used to heat the process chamber and components inside the process chamber during the pumpdown process. This reduces the pumpdown time of the system because adsorbed water molecules are more easily removed from a hot surface than from a cold one.

Water branches

In the standard configuration, the branches in the water circuit are connected as follows:

Branch	Component	Type
1	Process chamber	Hot/cold
2	Process chamber	Hot/cold
3	Sputtering source 1	Cold
4	Sputtering source 2	Cold
5	Sputtering source 3	Cold
6	Sputtering source 4	Cold
7	Sputtering source 5	Cold
8	Sputtering source 6	Cold
9	Plasma source	Cold
10	Power supply PEII	Cold
11	RF generator	Cold
12	Reserve	Cold
13	High vacuum pump 1 (turbo)	Cold
14	High vacuum pump 2 (turbo)	Cold
15	Fore vacuum pump	Cold
16	Plasma source matching	Cold

Tab. 3-2 *Branches in the water circuit*

Branches

Each branch consists of three components connected in series as follows:

- Component to be cooled/heated
- Water flow controller
- Check valve

NO / NC

NO designates a «normally open» valve:
The valve is open if de-energized, and closed if energized.

NC designates a «normally closed» valve:
The valve is closed if de-energized, and open if energized.

Blow-out circuit

The sources are connected to a blow-out circuit.

If service work is to be performed to these components, the water branches can be blown free from water using compressed air. The water-air mixture ends up in the blow-out circuit outlet.

Water temperature controller (optional)
An optional water temperature controller may be used in the cold or hot water circuit of the MSP 1200. See Fig. 3-21, 🗎 85.

Fig. 3-21 *Water temperature controller (example)*

This component allows to accurately maintain a specified temperature level in a water circuit. The water returning from the system is first cooled down in a heat exchanger. Then a heater warms up the water to the specified temperature level. A circulating pump sustains the water flow in the circuit.

3.6.4 Process gas

Process gas diagram
Fig. 3-22, 🗎 86 shows a simplified process gas diagram. For details, please refer to the delivered process gas diagram.

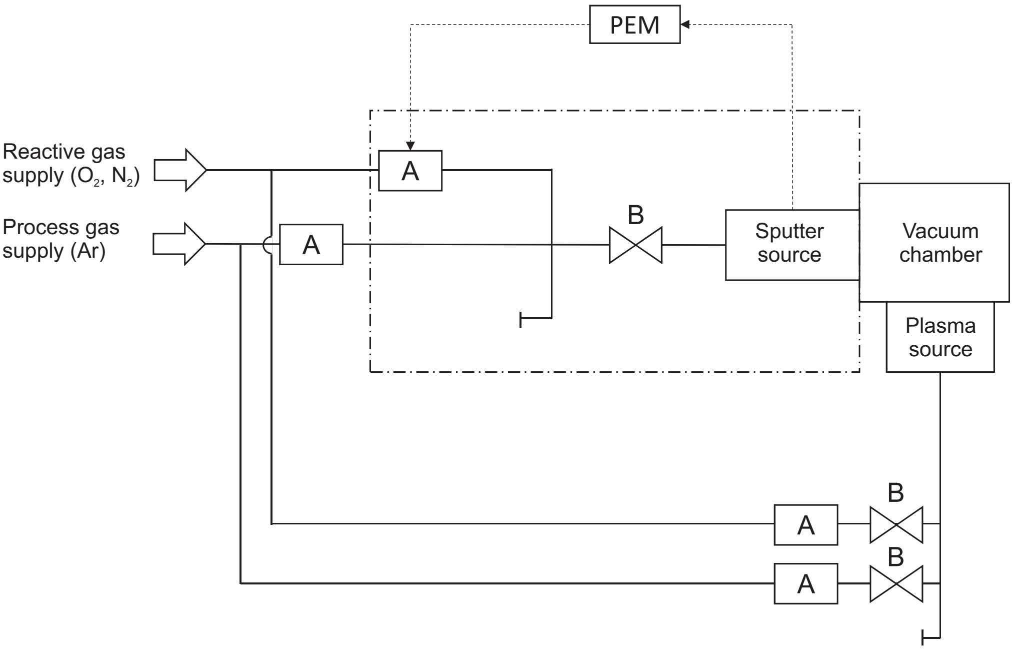


Fig. 3-22 *Process gas diagram (simplified)*

A Mass flow controller
B Shut-off valve

Hydrogen, Acetylene (optional)
For special processes, hydrogen or acetylene may be used in the MSP 1200. In this case the Safety Instructions for the MSP 1200 (180430BE) must have been read and understood by all persons who work at the MSP 1200.

3.6.5 Monomers (optional)

For special processes, monomers may be used in the MSP 1200. In this case the Safety Instructions for the MSP 1200 (180430BE) must have been read and understood by all persons who work at the MSP 1200.

3.7 Electrics

3.7.1 Control and power rack

Fig. 3-23, 🗎 87 shows the control and power rack.

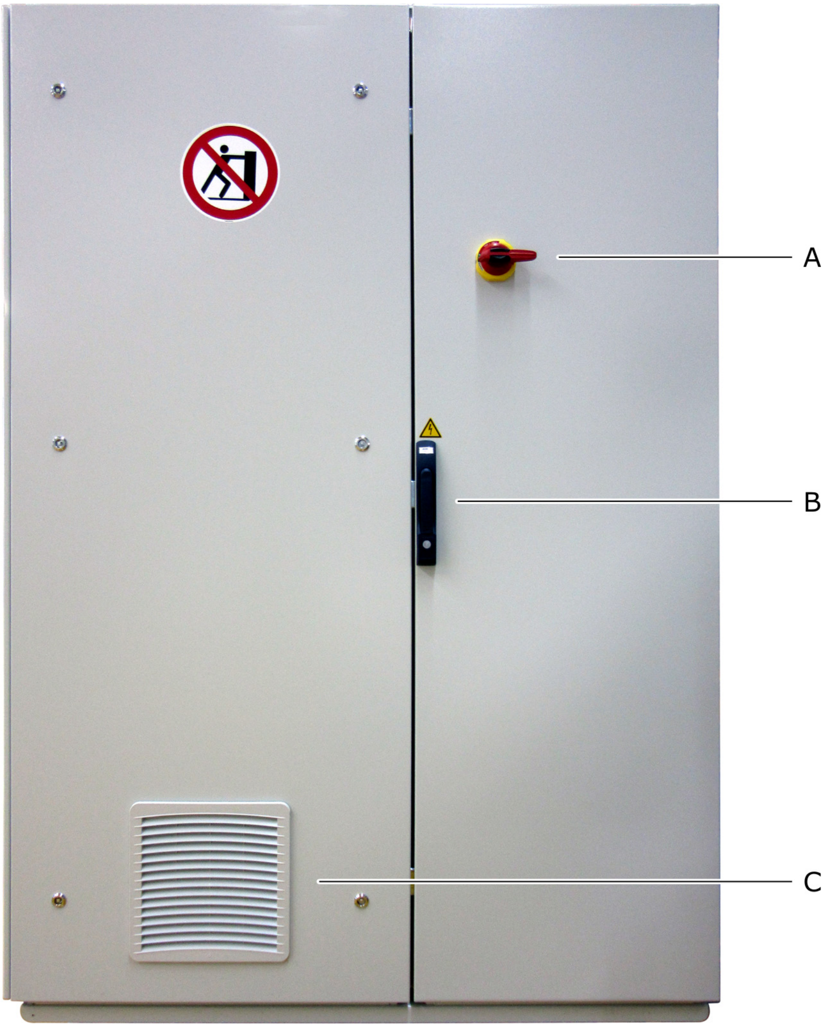


Fig. 3-23 *Control and power rack*

A Main switch
B Door lock
C Air filter

Power rack

The power rack contains the main switch (item A) and other equipment necessary to supply the system components with power.

The power rack must be kept closed during regular operation. For this, it contains a door lock (item B) with a removable key. Air can enter the power rack through a filter (item C) in the left rack door.

A list of the breakers and other components in the rack is pasted to the inside of the rack door.

For more information on the power rack, refer to the electrical documentation and to the separate OEM manuals.

Control rack

The control rack contains the following components:

KHAN system controller
This is the system controller of the MSP 1200. For more information on the KHAN system controller, refer to the KHAN user's guide 118278. Also see Section 3.8 System control, 🗎 89.

GSM1101
The GSM 1101 is used for the optical film thickness measurement during the coating process. For more information on the GSM, refer to the separate OEM manual.

Process chart recorder
Used for recording process charts.

3.8 System control

3.8.1 Graphic user interface (GUI)

The user operates the MSP 1200 exclusively with the GUI (graphic user interface). The GUI is located in the clean room area. See Fig. 3-24, 🗎 89.

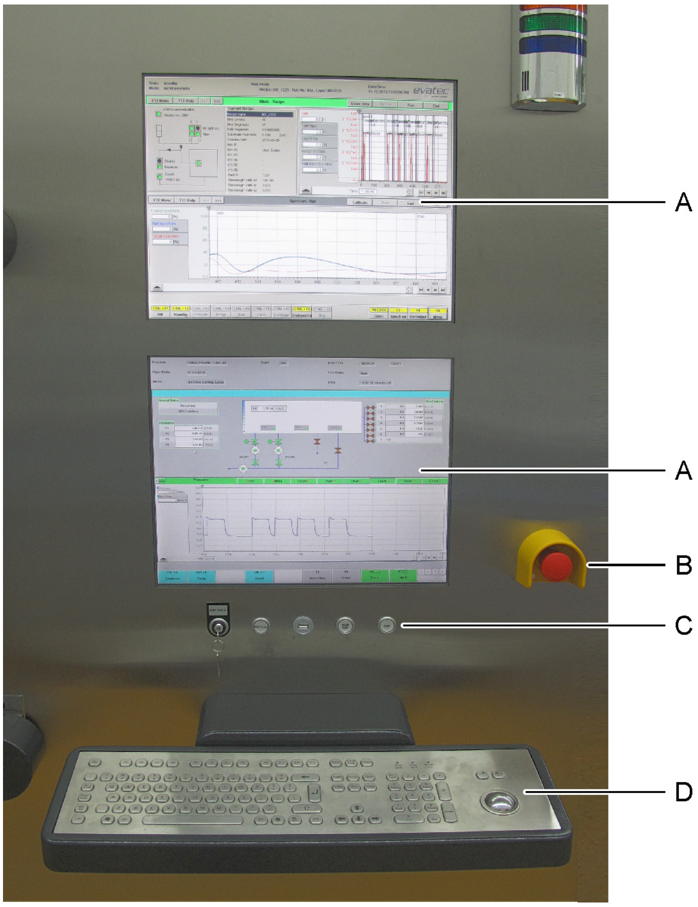


Fig. 3-24 *Graphic user interface (typical example)*

A TFT monitor
B EMO button
C Control panel
D Keyboard

3.8.2 KHAN system controller

Fig. 3-25, 🗎 89 shows the KHAN system controller.

Fig. 3-25 *KHAN system controller (typical example)*

The KHAN system controller is the main system controller. It communicates with all control units and controls all process steps.

3.8.3 System control diagram

Fig. 3-26, 🗎 90 shows the system control diagram.

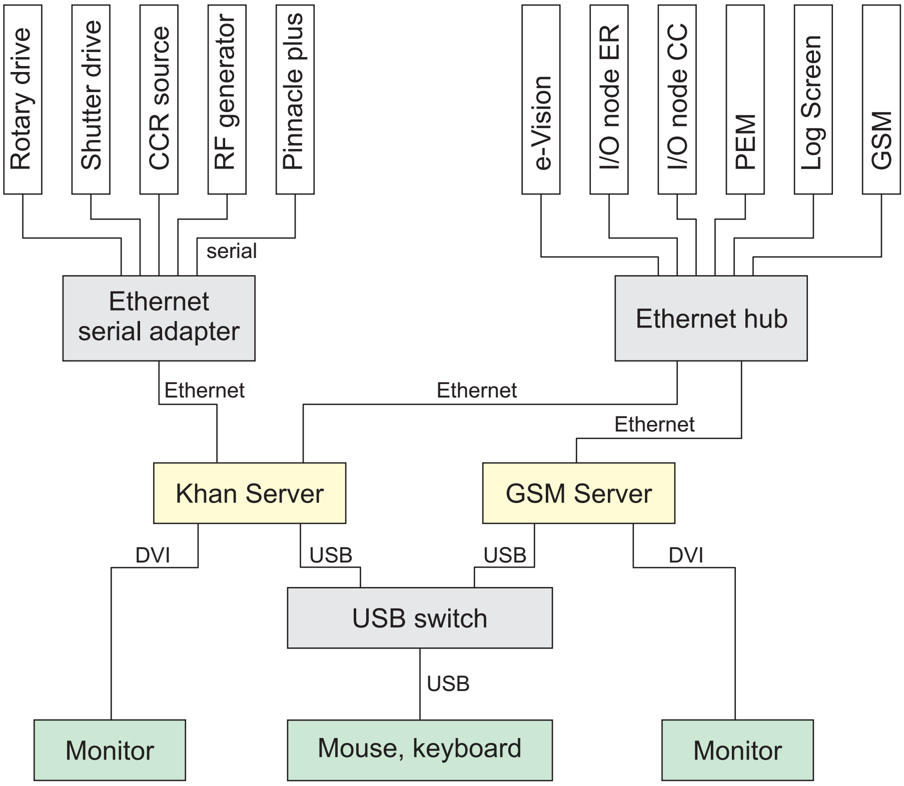


Fig. 3-26 *System control diagram*

3.9 *Process sequence*

The overall process consists of several main states which are performed in sequence. Each main state of a process is normally divided into several sub-states.

The substrates are coated in successive sputtering cycles. Fig. 3-27, 🗎 91 shows an example of a sputtering cycle.

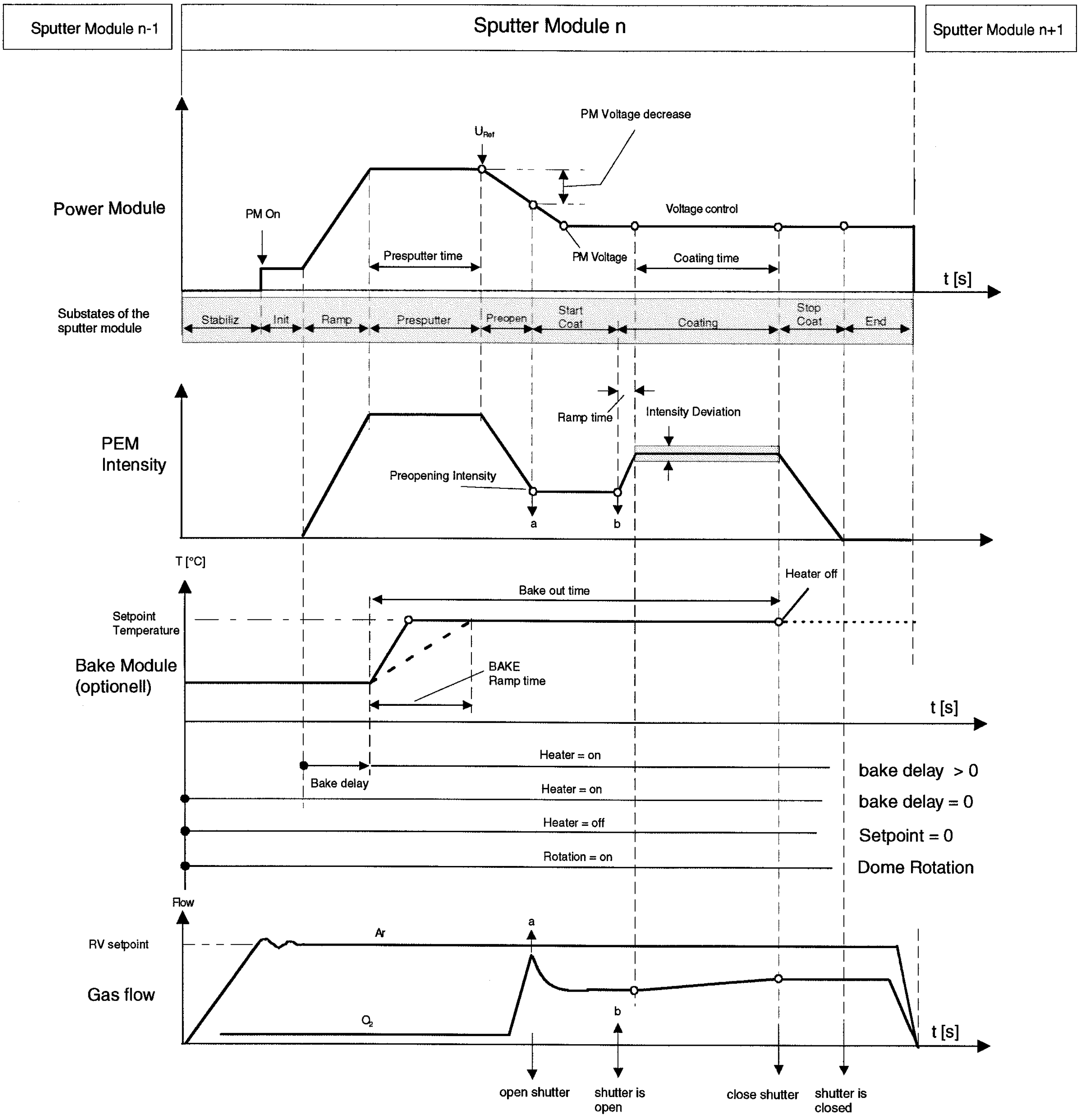


Fig. 3-27 *Example of a sputtering cycle (e.g. silicon)*

4. Installation

4. Installation

4.1 Introduction

This chapter is for personnel with the access right «Service» or higher.

This chapter contains general guidelines for installation of the MSP 1200 and provides directions for set-up, connection and function checks.

NOTE:
Only specially trained Evatec service technicians are allowed to install the MSP 1200 and to perform the function checks.

Responsibilities

Unless otherwise stated in the sales contract, the responsibilities are as described in Section 2.1.3 Responsibilities regarding safety, 🗎 24.

Documentation

Evatec delivers the following MSP 1200 documentation to the end user:

With the sales contract:

- Layout plan
- Media sheets
- Specifications for electrical connections

As part of system delivery:

- Delivery papers
- Operating Instructions
- A set of OEM manuals
- Electrical documentation

NOTE:
All diagrams which are required for installation, commissioning and maintenance of the system can be found in the OEM folder or in these Operating Instructions.

4.2 Packaging and external transport

Packaging

The MSP 1200 leaves the factory in packaging which suits the type of transport used and the specific order requirements.

- The system is dismantled into several equipment groups
- Each of the groups is wrapped up with polythene sheet (clingwrap) and then packed in a wooden crate
- The crates are placed on transport base plates which are accessible for fork-lift trucks

Depending on their content, the packing units are labeled with the packing symbols, information stickers and indicators shown below.

Packing symbols

Fig. 4-1 *Packing symbols: «Top», «Fragile», «Keep dry»*

Fig. 4-2 *Packing symbols: Center of gravity*

Information stickers

Achtung	Empfindliches Gerät
Attention	Fragile Apparatus
Attention	Appareil Fragile
Attenzione	Merce Frangibile
Atención	Aparato Frágil

Fig. 4-3 *Information stickers: Fragile apparatus*

Indicators

Some packing units may be labeled with shock or tilt indicators. These indicators show if the unit has been exposed to unacceptable shocks or tilting.

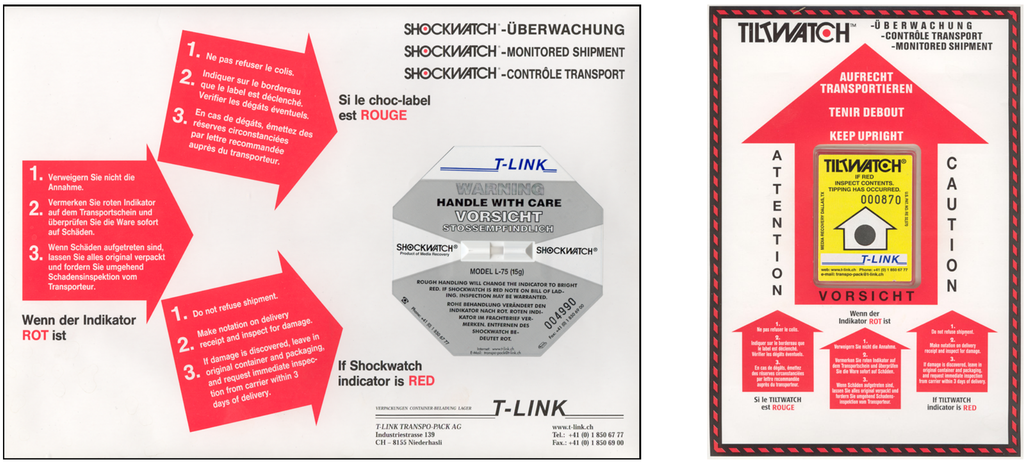


Fig. 4-4

Shock and tilt indicators

NOTE:
Pay attention to the indicators. If an indicator is red, follow the instructions found on the indicator.

External transport

The MSP 1200 may only be transported in its original packing units. The commissioned transport company must be specialized in the transport of heavy and delicate commodities.

⚠CAUTION

Condensation water.

During the external transport (e.g. in an airplane), the system may cool down considerably. After the transport, the system may still be cold enough to form condensation water at the outside of the packaging.

Do not unpack the system right after it has been shipped. Wait one day to make sure that the system is at room temperature. Remove the clingwrap layers in the gray room/clean room area only.

4.3 Internal transport and unpacking

Proceed as follows after the MSP 1200 has been received:

Checking the papers

1 Check the delivery papers to make sure that the delivered goods match the order

2 Take out the unpacking instructions and follow the directions for handling

3 Pay attention to the transport symbols on the packing units

4 Check the shock and tilt indicators (if any). Adhere to the instructions on the sticker if an indicator has been triggered.

Waiting

5 Wait one day to make sure that the system is at room temperature

⚠CAUTION

Condensation water.

During the external transport (e.g. in an airplane), the system may cool down considerably. After the transport, the system may still be cold enough to form condensation water at the outside of the packaging.

Do not unpack the system right after it has been shipped. Wait one day to make sure that the system is at room temperature. Remove the clingwrap layers in the gray room/clean room area only.

Internal transport

⚠WARNING

Heavy components.

Improper handling of heavy components may cause serious contusions, fractures or even lead to death.

Use suitable equipment to lift and transport heavy components. Wear stable footwear. Always keep a safe distance to suspended loads. Never stay under a suspended load!

⚠CAUTION

Transport malpractices.

Transport malpractices may damage the system.

Keep the crates upright and pay attention to the transport symbols.

⚠WARNING

Transport units.

Improper use of transport units may result in personal injury and material damage.

Only authorized personnel are permitted to use transport units such as floor conveying units, cranes and lifting units.

6 Move the crates to the installation site by means of a fork-lift truck. Some units also have eyebolts for transport by means of a crane.

Unpacking

7 Open the wooden crates

8 Check to make sure that no signs of condensation water are visible on the polythene sheet (clingwrap)

9 Unwrap the polythene sheet

NOTE:
Dispose of basic packing materials that are no longer needed (wooden crates, clingwrap). It is a good idea to have these materials recycled.

Special packing materials

10 Carefully remove special packing materials (if any)

NOTE:
Keep the special packing materials for later use. You will need them to transport and store the system. See Section 9.1 Storage, 🗎 214.

Transport safety devices

11 Remove the transport safety devices (if any)

NOTE:
Keep the transport safety devices for later use. You will need them to transport the respective units.

Examining the system

12 Examine the system for signs of transport damage and to make sure that it is complete. Lodge any complaints immediately.

4.4 Installation: Components

NOTE:
Only specially trained Evatec service technicians are allowed to install the MSP 1200 and to perform the function checks.

4.4.1 Setting up the components

Set up the individual components according to the layout plan.

NOTE:
The installation floor should be selected in accordance with the SEMI S2 standard.

Dust
The MSP 1200 can only be operated efficiently in a dust-free work environment.

Vibrations
During the deposition process, the MSP 1200 must not be exposed to notable vibrations. For this reason, make sure that no equipment creating heavy vibrations is installed in the vicinity of the MSP 1200. Also make sure that the ground on which the system is installed is capable of absorbing vibrations.

Escape routes
The MSP 1200 must be installed in such a way that all doors and covers can be opened easily for maintenance and service work.

The clearance distance for escape routes must be in keeping with the local safety regulations.

Lighting
The work place lighting must conform with the local regulations. Illuminance levels of at least 300 lux (gray room) and 500 lux (clean room) are recommended. A flashlight may be used when working under the module.

4.4.2 Mounting earthquake brackets

For reasons of earthquake safety, the MSP 1200 must be screwed down to the floor in an appropriate manner. Use screws and earthquake brackets for this purpose.

4.4.3 Mounting prohibitive signs

1 Mount the relevant prohibitive signs at all necessary locations in the MSP 1200 production area

4.5 Installation: Electrics

4.5.1 Setting up electrical connections

1 Set up the electrical connections for the MSP 1200. Pay attention to the following hazard alert:

⚠DANGER

Mains voltage.

The system contains parts which are connected to the mains supply. Touching these parts will cause an electric shock. The shock may be lethal.

Prior to any work in the danger area:
- Lock out and tag out the main power supply
- Ground the equipment
- Check to make sure that no one is in the danger area before you switch the main power supply on again

- Adhere to the specifications in Section 1.6.3 Electric power, 🗎 17

- Only personnel who have completed electrotechnical professional training and who have experience in work with high voltage systems are permitted to perform work on the electrical equipment

- The main electric cable which is connected to the main terminals (primary side) of the power rack must be secured by a robust strain relief

- Lay the cables between control cabinet and processing unit so that the signaling cables are at an adequate distance to the power cables. This ensures that the power cables cannot disturb the signaling cables.

NOTE:
In the traffic area of the system, all supply lines must be laid in cable ducts to ensure mechanical protection.

4.6 Installation: Operating media

Shut-off valves

NOTE:
The end user must install lockable shut-off valves for all media:

- **Vent gas**
- **Process gases**
- **Compressed air**
- **Cooling water**

The shut-off valves must be installed between the media supply and the MSP 1200. They must be easily accessible.

The shut-off valves must be used by maintenance and service personnel for the lockout/tagout procedure. See Section 2.8 Lockout/tagout procedure, 🗎 50.

4.6.1 Connecting the gases

Gas cylinders

Pay attention to the following hazard alert if gas cylinders are used for supplying the system with gases:

⚠WARNING

Gas cylinders.

Improper handling of gas cylinders may cause an explosion and lead to serious personal injury and material damage.

Adhere to the country-specific safety regulations when handling, fastening and connecting gas cylinders. Close the valves at the gas cylinders when the system is not running.

Vent gas

Fig. 4-5, 🗎 102 shows the vent gas connection point for the MSP 1200.

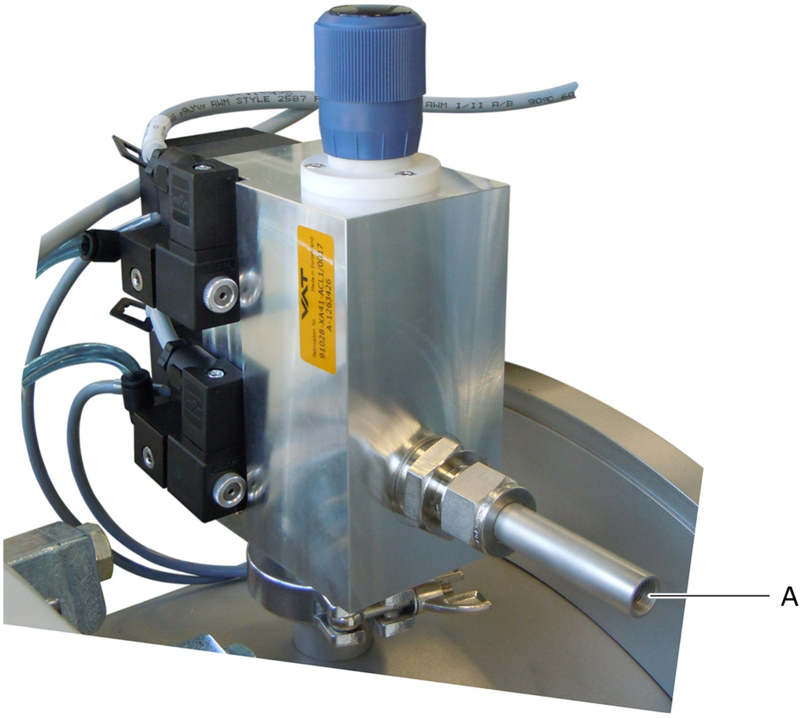


Fig. 4-5 *Vent gas connection point*

A Vent gas inlet

1 Connect the vent gas supply to the MSP 1200. Adhere to the specifications in Section 1.6.6 Vent gas, 🗎 19.

NOTE:
In the traffic area of the system, all supply lines must be laid in cable ducts to ensure mechanical protection.

Process gases (Ar)

⚠WARNING

Argon (Ar).

Argon displaces air which is required for breathing. The gas is odorless, so you may faint without noticing it. You may fall down and suffer serious head injuries or even suffocate.

Read the safety data sheets and follow all instructions.

Reactive gases (O_2, N_2)

⚠WARNING

Oxygen (O_2).

Oxygen gas may cause flammable substances to ignite spontaneously.

If oxygen is used as a process gas, only oxidation resistant vacuum grease may be used in the oxygen lane.

⚠WARNING

Nitrogen (N_2).

Nitrogen displaces air which is required for breathing. The gas is odorless, so you may faint without noticing it. You may fall down and suffer serious head injuries or even suffocate.

Read the safety data sheets and follow all instructions.

2 Connect the process gas supply lines to the flow controllers located under the process chamber. Adhere to the specifications in Section 1.6.4 Process gases, 🗎 18.

NOTE:
Open the process gas supply before you connect the line to the flow controller. You can connect the line to the flow controller once the incoming gas flow has forced the remaining air out of the line.

NOTE:
In the traffic area of the system, all supply lines must be laid in cable ducts to ensure mechanical protection.

4.6.2 *Connecting the compressed air supply*

⚠WARNING

Compressed air system.

Opening or damaging pressurized components may lead to serious eye and skin injuries.

Shut off the supply to the compressed air system and let off the pressure before you carry out any kind of work to these parts.

⚠CAUTION

Condensation of humidity.

Humidity may condense at the supply lines if the temperature of the compressed air is too low. The condensation may cause an electric short-circuit.

The temperature of the compressed air must exceed the dew point of the ambient air by at least 2 °C.

1 Connect the compressed air supply to the water battery of the MSP 1200. See Fig. 3-19, 🗎 81. Adhere to the specifications in Section 1.6.7 Compressed air, 🗎 20.

NOTE:
In the traffic area of the system, all supply lines must be laid in cable ducts to ensure mechanical protection.

4.6.3 Connecting the hot and cold water

⚠WARNING

Water circuit.

The media battery of the MSP 1200 has no overpressure protection. Overpressure in the water circuit may lead to serious eye and skin injuries.

The end user must install suitable pressure relief equipment to ensure that overpressure cannot occur in the water circuit.

⚠CAUTION

Condensation of humidity.

Humidity may condense at the supply lines if the temperature of the cooling water is too low. The condensation may cause an electric short-circuit.

The temperature of the cooling water must exceed the dew point of the ambient air by at least 2 °C.

1. Connect the cold water supply to the water battery of the MSP 1200. See Fig. 3-19, 🗎 81. Adhere to the specifications in Section 1.6.8 Water supply, 🗎 20.

2. Connect the hot water supply to the water battery of the MSP 1200. See Fig. 3-19, 🗎 81. Adhere to the specifications in Section 1.6.8 Water supply, 🗎 20.

NOTE:
If necessary, insert the supplied adapter between the in-house connection and the hoses leading to the media distributor. See Fig. 4-6, 🗎 105.

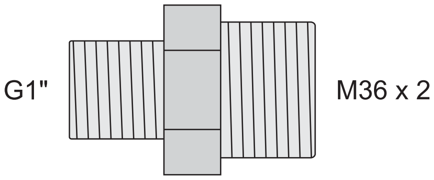


Fig. 4-6 *Adapter between the in-house connection and the hose*

3. Connect the water lines for components in the system

NOTE:
In the traffic area of the system, all supply lines must be laid in cable ducts to ensure mechanical protection.

4.6.4 *Drawing off pump exhaust gases*

1 Direct the exhaust gases of the fore vacuum pump through condensate separators

2 Draw off these gases and direct them out into the open air

3 Also draw off the exhaust gases from the pressure relief valve of the cryopump and direct them out into the open air

4 Make sure that the exhaust lines end at an adequate distance to any supply point for fresh air

4.7 Initial commissioning

4.7.1 Function tests

NOTE:
Only specially trained Evatec service technicians are allowed to install the MSP 1200 and to perform the function checks. The function tests are not described in these Operating Instructions.

4.7.2 Determining the noise level

⚠CAUTION

Noise.

Working in a noisy environment for an extended period of time may impair your hearing.

The end user must perform measurements to determine the noise level of the system. If necessary, he must prescribe and provide appropriate ear protection.

4.7.3 Revision checks

The revision checks must be performed in accordance with the relevant national safety regulations. According to the DIN / EN 60204-1 standard, the following regulations apply to revision checks:

The customer is obliged to make sure that the electrical equipment and operating equipment is being checked for proper functioning:

- Prior to first commission and after technical modifications or service work prior to recommissioning by an electrical engineer or supervised by an electrical engineer, and
- On a regular basis

The service periods must be chosen appropriately to make sure that system faults, which are likely to appear, will be detected in time.

When performing the checks, the corresponding rules in electrical engineering must be observed. The customer is also responsible for performing a revision check of the safety circuit after technical modifications, changes or maintenance work, and before recommissioning of the system. The standard also stipulates to perform a revision check of the safety circuit on a regular basis, with appropriate intervals.

Evatec recommends to have revision checks performed by Evatec service personnel, based on a service contract, every other year. Revision checks are to be performed in a systematic manner. They must be filed in a logbook and included as a proof in the maintenance documentation.

NOTE:
This information is only relevant for the system as a whole. Refer to the appropriate OEM manuals for revision checks on individual components. This information should also be filed in the logbook.

Safety circuit and wiring

The safety circuit must be checked after the system has been modified or after maintenance work has been performed to safety-relevant components or assemblies.

For documentation of the safety checks, you find a form (1698/FR1) in the «System Documentation» binder. If this form is missing, please request it from Evatec.

1 Check the safety circuit according to the system wiring diagrams. Actuate the safety interlock several times (at least five times). See Section 4.7.1 Function tests, 🗎 107.

2 Check the return conductor and the grounding and protective conductor connections of the MSP 1200. In particular, check the points of attachment by making a visual inspection and by waggling them.

3 Check that all cables which conduct high levels of electric current have a good contact. The contacts must not be loose, colored or corroded.

Pressure relief valve

4 Check if the closure weight inside of the pressure relief valve can be lifted easily. This ensures that the valve will open if the chamber pressure rises above ambient pressure.

Compressed air

5 Check the entire compressed air installation for tightness and for any signs of damage or brittle hoses

Water circuit

6 Check that the cooling water flow monitor responds when the pressure or the throughput falls below the stipulated minimum limit value. Repeat this check procedure several times (at least five times).

7 Check the entire cooling water installation for tightness and for any signs of damage or brittle hoses

Mechanical checks

8 Inspect all consumable parts for signs of wear or damage. Refer to the relevant OEM manuals for more detailed information.

9 Check that all mechanical protection devices (e.g. hoods, covers, interlocks) are mounted properly

10 You must test the mechanical stability of the system if any mechanical or static changes have been made to the system (e.g. holes drilled through the reinforcing ribs). If necessary, reinforce the appropriate parts.

Acceptance report

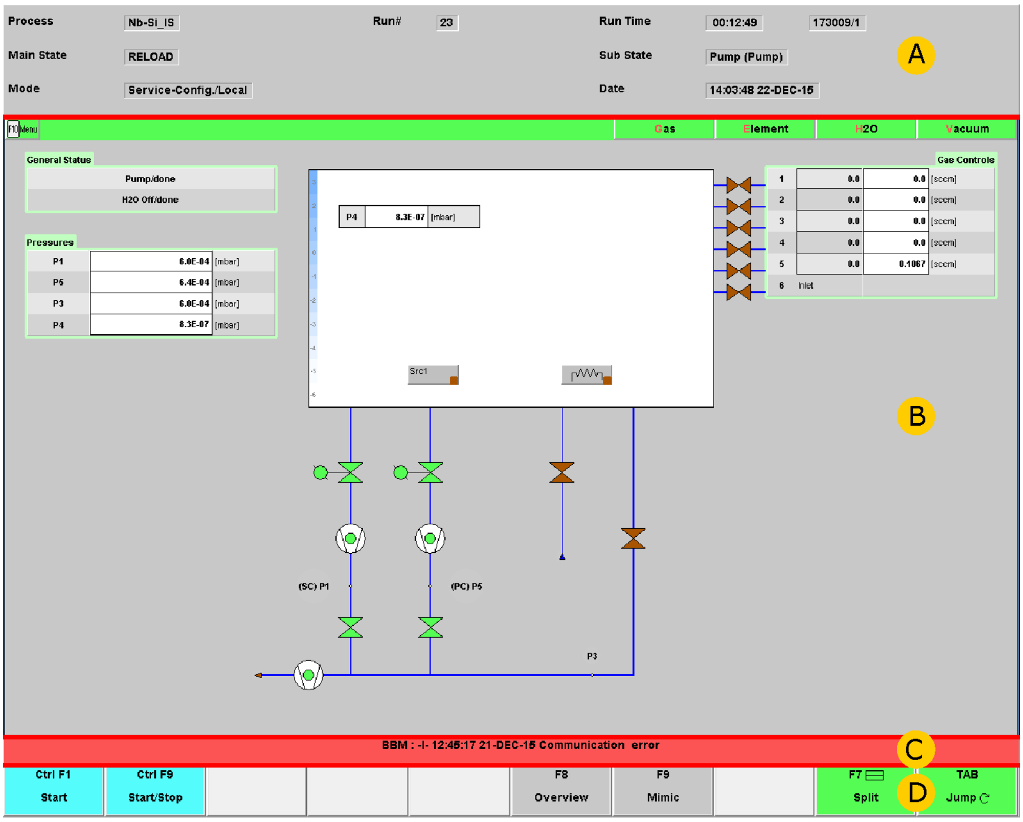
The end user technician and the Evatec technician must provide written confirmation that the revision checks have been performed. Use the form «Acceptance report for safety and interlock circuits» in the binder «System Documentation».

5. Graphic user interface

5. Graphic user interface

5.1 Screen layout

Fig. 5-1, 🗎 112 shows a typical screen of the GUI.



Process: Nb-Si_IS
Run#: 23
Run Time: 00:12:49 173009/1
Main State: RELOAD
Sub State: Pump (Pump)
Mode: Service-Config./Local
Date: 14:03:48 22-DEC-15

General Status
Pump/done
H2O Off/done

Pressures

P1	6.0E-04	[mbar]
P5	6.4E-04	[mbar]
P3	6.0E-04	[mbar]
P4	8.3E-07	[mbar]

P4 8.3E-07 [mbar]

Gas Controls

1	0.0	0.0	[sccm]
2	0.0	0.0	[sccm]
3	0.0	0.0	[sccm]
4	0.0	0.0	[sccm]
5	0.0	0.1067	[sccm]
6	Inlet		

BBM : -I- 12:45:17 21-DEC-15 Communication error

Fig. 5-1 *Typical screen*

A Info bar
B Main area
C Alarm display
D Function key bar

Each screen is divided into the following areas:

- Status bar (item A).
  See Section 5.1.1 Status bar, 🗎 113.
- Main area (item B).
  See Section 5.1.2 Main area, 🗎 114.
- Alarm display (item C).
  See Section 5.1.3 Alarm display / function key bar, 🗎 115.
- Function key bar (item D).
  See Section 5.1.3 Alarm display / function key bar, 🗎 115.

5.1.1 Status bar

The status bar is located at the top of the screen.

Process Nb-Si_IS
Run# 23
Run Time 00:12:49 173009/1
Main State RELOAD
Sub State Pump (Pump)
Mode Service-Config./Local
Date 14:03:48 22-DEC-15

Fig. 5-2 *Status bar*

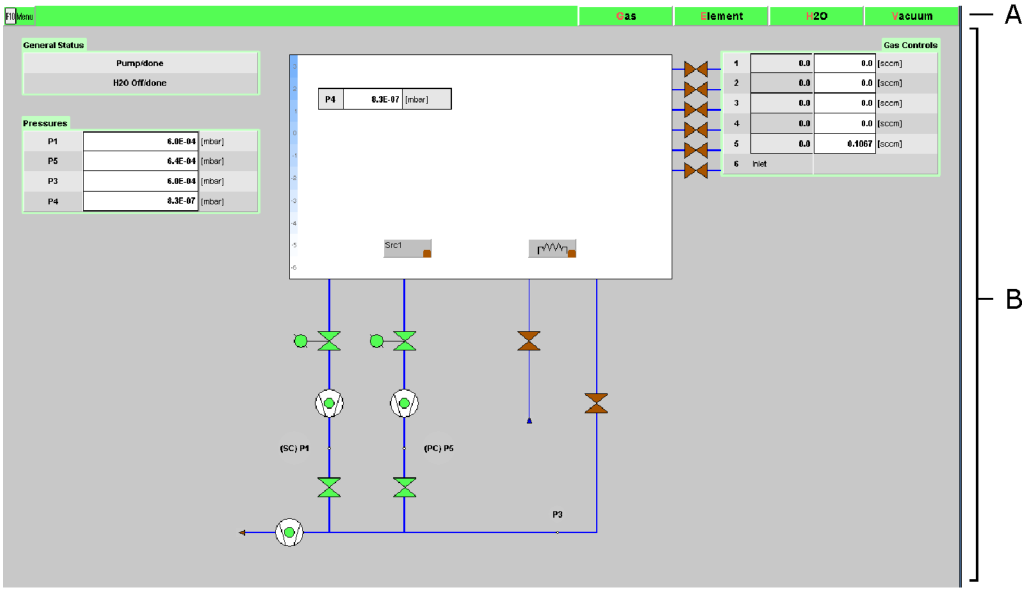
The status bar displays the following information:

Field	**Meaning**
Process	Process name
Run#	Number of the running process. The counter increases by 1 at the start of each process run.
Run Time	Elapsed process time
Main State	Main process state
Sub State	Process substate
Mode	Operating mode
Date	Time and date

Tab. 5-1 *Fields in the info bar*

5.1.2 Main area

The main area is used for dialog between the operator and the system controller. The layout of the main area depends on the current process step or the menu selected by the user. Fig. 5-3, 🗎 114 shows an example.



General Status

Pump/done

H2O Off/done

Pressures

P1	6.0E-04	[mbar]
P5	6.4E-04	[mbar]
P3	6.0E-04	[mbar]
P4	8.3E-07	[mbar]

P4 8.3E-07 [mbar]

Gas Controls

1	0.0	0.0	[sccm]
2	0.0	0.0	[sccm]
3	0.0	0.0	[sccm]
4	0.0	0.0	[sccm]
5	0.0	0.1067	[sccm]
6	Inlet		

Fig. 5-3 *Main area (example)*

A Control bar
B Mimic diagrams, charts, tables, input fields, etc.

Screen windows

The main area can be divided up into several windows if necessary. Up to four windows are supported. All window borders are fixed.

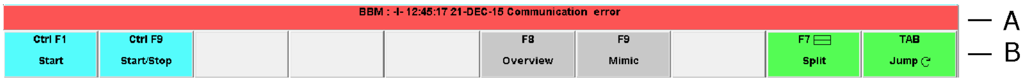
Control bar

Each of these windows contains a separate control bar. When a window is active, the control bar has a green background and the available command buttons are displayed:

- [Menu] button (hotkey **F10**):
  This button is always shown at the left side of the control bar. Click this button to return to the main menu.
- Hotkey buttons:
  A list of other currently available hotkeys is shown at the right side of the command bar.

5.1.3 *Alarm display / function key bar*

The alarm display and the function key bar are located at the bottom of the screen. See Fig. 5-4, 🗎 115.



BBM : -/- 12:45:17 21-DEC-15 Communication error

Fig. 5-4 *Alarm display / function key bar*

A Alarm display
B Function key bar

Alarm display The alarm display show alarm messages on a yellow or red background. See Section 6.7.2 System alarms, 🗎 143.

Function key bar The function key bar shows all currently available process control commands and some other general commands. The listed commands can be actuated using the respective function keys.

Color		**Description**
🟦	Cyan	Available process control commands. ◆ Ctrl-F1 = Start ◆ Ctrl-F2 = Wait ◆ Ctrl-F3 = Continue ◆ Ctrl-F4 = Retry ◆ Ctrl-F5 = Next ◆ Ctrl-F6 = Hold ◆ Ctrl-F7 = Abort ◆ Ctrl-F8 = Reload ◆ Ctrl-F9 = Start/Stop See Section 6.5.3, 🗎 134.
🟥	Red	F5 = Alarm Ack. Acknowledges an alarm. See Section 6.7.2, 🗎 143.
⬜	Gray	F8 = Overview. Selects the «Overview» screen. This screen displays the setpoint data and the measured data for the current process step. F9 = Mimic. Selects the «Mimic» screen. This screen displays the current state of the pumping station and sources using colored symbols.
🟩	Green	F6 = Zoom. Enlarges the currently selected window. F7 = Split. Shrinks the currently selected window. Tab = Jump. Activates the next window in the consecutive sequence of windows.

Tab. 5-2 *Keys in the function key bar*

5.2 How to operate the KHAN system controller

The KHAN system controller has a menu structure consisting of two levels. Both levels may be displayed on the same screen, as shown in Fig. 5-5, 🗎 116.

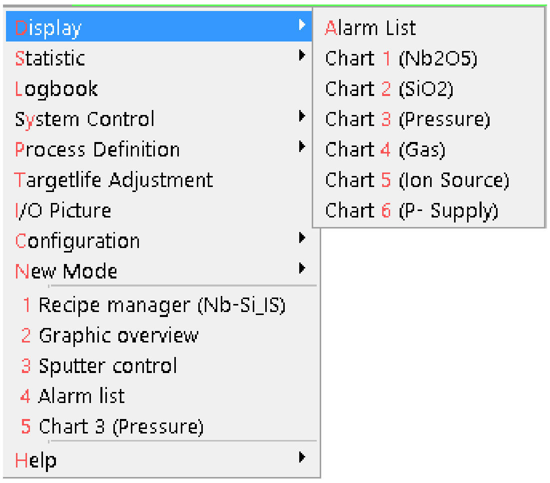


Fig. 5-5 *Menu structure (example)*

Left: Main menu
Right: Submenu

Navigating
Within the menu you can navigate using the cursor keys, the hotkeys, and the trackball. A menu item that has been selected is highlighted with a blue background.

Working with the cursor keys
After having selected a menu item with the cursor keys, press the **Enter** key to execute the function. In parameter screens, the cursor keys also allow you to select the parameter fields.

Working with hotkeys
Hotkeys are menu items or buttons that contain a red letter. Press the letter which is displayed in red to execute the function. If there are also input fields on the screen, it is necessary to press the **Alt** key while you are activating the hotkey displayed in red.

Working with the trackball
A menu item can be selected by moving the trackball pointer on it. Click on the item in order to execute the function.

Canceling a selection
If you have selected the wrong menu by mistake, press the **Esc** key. This brings you back to the previous screen.

You may also press **F10** instead. This brings you back to the main menu.

5.3 Operating modes

The MSP 1200 can be in one of the following operating modes:

- Manufacturing
- Maintenance
- Process
- Service
- Configuration

The Manufacturing mode can be accessed by any operator. The other operating modes are password protected.

5.3.1 Manufacturing mode

The Manufacturing mode is used to execute an existing process or load a new process into the main memory. In addition, various commands which are required to control the pumping station or for manual operation of the system are available.

For more information on the process parameters, please refer to the instruction manual of the KHAN system controller and to the corresponding process instructions.

5.3.2 Maintenance mode

The Maintenance mode offers all functions that are available in the Manufacturing mode.

In addition, this mode offers functions that are required for the preventive maintenance work.

5.3.3 Process mode

The Process mode offers all functions that are available in the Maintenance mode.

In addition, this mode allows to create new processes or to modify existing processes and to store them under a new name.

5.3.4 Service mode

The Service mode offers all functions that are available in the Process mode.

In addition, this mode allows to select and to activate the input/output channels and to display the actual state of the channels on the screen.

5.3.5 Configuration mode

The Configuration mode offers all functions that are available in the Service mode.

In addition, this mode allows to modify the system configuration.

5.4 Selecting the operating mode

The operating modes can be invoked from the menu item [New Mode] in the main menu. This opens a submenu with the available operating modes. See Fig. 5-6, 🗎 119.

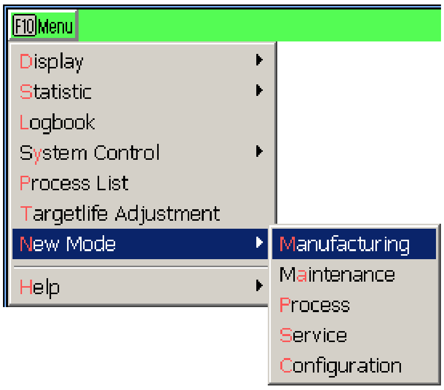


Fig. 5-6 *Selecting the operating mode*

The «Mode» field in the status bar displays the currently selected operating mode. See Section 5.1.1 Status bar, 🗎 113.

6. *Production*

6. Production

6.1 Operating elements

6.1.1 EMO buttons

EMO buttons are used to shut down potentially hazardous components if dangerous situations crop up. The MSP 1200 is equipped with several EMO buttons. See Section 2.7 Safety circuit, 🗎 46.

Fig. 6-1 *EMO button*

6.1.2 Graphic user interface (GUI)

The GUI constitutes the interface between the user and the KHAN control software. It consists of the following components:

Hardware

- KHAN system controller
- Rack server
- TFT monitor
- Keyboard
- Trackball

See also Section 3.8.1 Graphic user interface (GUI), 🗎 89.

Software

- KHAN control software

For more information, refer to the KHAN user’s guide 118278.

6.1.3 Control panel

Fig. 6-2, 🗎 123 shows the control panel below the GUI monitor.

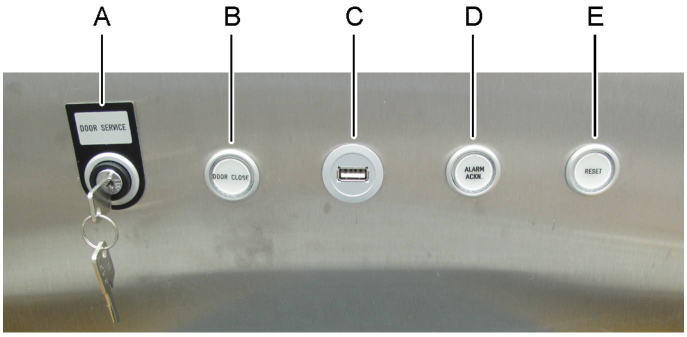


Fig. 6-2 *Control panel below the GUI monitor*

A DOOR SERVICE key switch
B DOOR CLOSE button
C USB connection
D ALARM ACKN. button
E RESET button

A	DOOR SERVICE This key switch is intended for service personnel only. It allows you to open the door locks immediately.
B	DOOR CLOSE Press this button to open or close the chamber door.
C	USB connection going to the KHAN system controller
D	ALARM ACKN. Acknowledges the most recent alarm.
E	RESET Activates the safety circuit. This is required after switching on the system or after an emergency-off.

6.1.4 *Signal tower*

A signal tower is mounted at the upper right corner of the process module. See Fig. 6-3, 🗎 124.

Fig. 6-3 *Signal tower*

The signal tower indicates the status of the MSP 1200 with visual signals.

The end user can assign the signal colors as required. By default, the signal colors are assigned as follows:

Color		**Meaning**
🟥	Red	Alarm. The system is stopped until the cause of the alarm has been removed.
🟨	Yellow	System is ready for unloading and loading
🟩	Green	Process is running
🟦	Blue	Customer-specific configuration

Tab. 6-1 *Colors used for the signal tower (default setting)*

6.2 *Prerequisites for production*

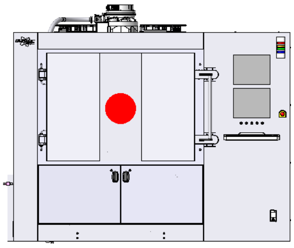
The MSP 1200 is ready for production if the following conditions are met:

- All components are switched on
- The operating media are switched on
- No equipment error is present

NOTE:
These conditions must be established by personnel with the access rights Service or higher. Call a service technician if the conditions are not met.

6.3 *Opening and closing the process chamber*

6.3.1 *Opening the chamber door*

	Number of persons	1 (Manufacturing)
	Special tools and materials	
	PPE	Protective clothing Clean room gloves Fine dust mask (P2)
	Location	Chamber door
	System status	Standby

Proceed as follows to open the process chamber:

Preparations

1 Vent the process chamber. For this, click the [Vent] command button in the «Vacuum Control» screen. See Section 6.6.4, 🗎 141.

2 Set the system to the main state «Reload»

Normally, the process chamber is opened after a batch has been processed. In this case the controller program is already in the «Reload» state.

Protective clothing

3 Put on the following protective clothing:
- Protective clothing with long sleeves
- Fine dust mask (P2)
- Clean room gloves

Opening the door

4 Press the DOOR CLOSE button
- The door locks are being unlocked
- The chamber door can be opened manually

Hazard alerts Pay attention to the following hazard alerts:

⚠WARNING

Harmful process materials.

Depending on the process, the interior of the process chamber may be contaminated with metal dust, oxides and other potentially harmful chemicals. Depending on the process, these chemicals may also be flammable.

When performing any work inside the process chamber, wear a fine dust mask (P2), protective gloves, safety goggles, and protective clothing with long sleeves. Read the safety data sheets and follow all instructions.

⚠WARNING

Broken glass.

Pieces of broken glass may be scattered around in the vacuum chamber. Broken glass may cause cut injuries.

Wear safety goggles, protective gloves and protective clothing with long sleeves. Use a vacuum cleaner to remove the broken glass.

⚠CAUTION

Hot parts: Evaporation sources, substrate heaters.

Parts in the process chamber heat up during the process. After the process they may still be hot enough to cause burns.

Allow the parts to cool down to room temperature before working in their vicinity. Wear protective gloves and protective clothing with long sleeves.

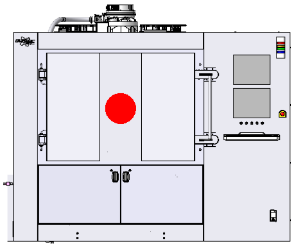
NOTICE

Fingerprints.

Fingerprints in a vacuum chamber may impair the process.

Prevent the vacuum chambers from contamination. Put on clean room gloves before you touch any parts in a vacuum chamber.

6.3.2 *Closing the chamber door*

	Number of persons	1 (Manufacturing)
	Special tools and materials	Lint-free cloth Isopropanol
	PPE	Protective clothing Clean room gloves Fine dust mask (P2)
	Location	Chamber door
	System status	Standby

Proceed as follows to close the process chamber:

Sealing surfaces

1 Clean the chamber door seal with a lint-free cloth moistened with isopropanol

2 Check the seal for proper seating and for signs of damage

3 Clean the surface facing the seal and check it for scratches

Closing the door

⚠WARNING

Heavy component: Chamber door.

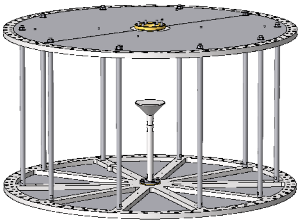
The chamber door is a heavy component. When closing the chamber door, improper procedures may result in contusions.

Before closing the chamber door, make sure that nobody else is anywhere near the chamber door. Two-handed operation is required when closing the chamber door.

4 Make sure that nobody else is anywhere near the chamber door

5 Close the chamber door manually and press the DOOR CLOSE button

6.4 *Reloading the substrate cage*

	Number of persons	1 (Manufacturing)
	Special tools and materials	Clean substrate carriers
	PPE	Protective clothing Clean room gloves Fine dust mask (P2)
	Location	Process chamber
	System status	Standby

NOTE:
In order to perform this work, a pedestal may have to be placed in front of the process chamber for ergonomic reasons.

Proceed as follows to reload the substrate cage:

Opening the door

1 Open the chamber door. See Section 6.3.1 Opening the chamber door, 🗎 126. **Pay attention to the hazard alerts in this reference.**

Reloading

2 Remove a substrate carrier from the substrate cage and place it on a clean work surface (under a flowbox)

3 Remove the processed substrates from the substrate carrier

4 If necessary, put the empty substrate carrier aside for cleaning. Get a clean and empty substrate carrier instead.

5 Load unprocessed substrates into the empty substrate carrier

6 Mount the refilled substrate carrier in the empty position of the substrate cage

7 Rotate the substrate cage so you can remove the next substrate carrier. Reload all substrate carriers in the substrate cage this way.

Cleaning

8 Clean the process chamber with a vacuum cleaner

Closing the door

9 Close the chamber door. See Section 6.3.2 Closing the chamber door, 🗎 129. **Pay attention to the hazard alerts in this reference.**

6.5 Running a process

6.5.1 Loading a process recipe

Because many different coating processes may be performed with the MSP 1200, the software allows you to store and load process recipes. The «Recipe» screen is used for this.

Proceed as follows to load a process recipe:

Active recipe

1 Press **F10** or select [F10 Menu]

2 Select [Process Definition] > [Active Recipe]. See Fig. 6-4, 🗎 131.

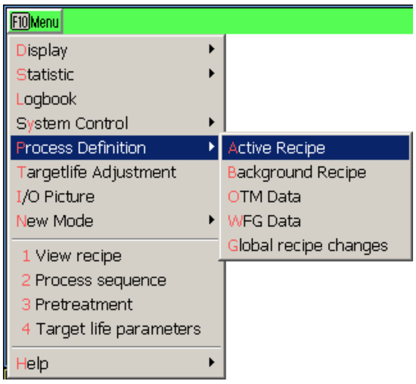
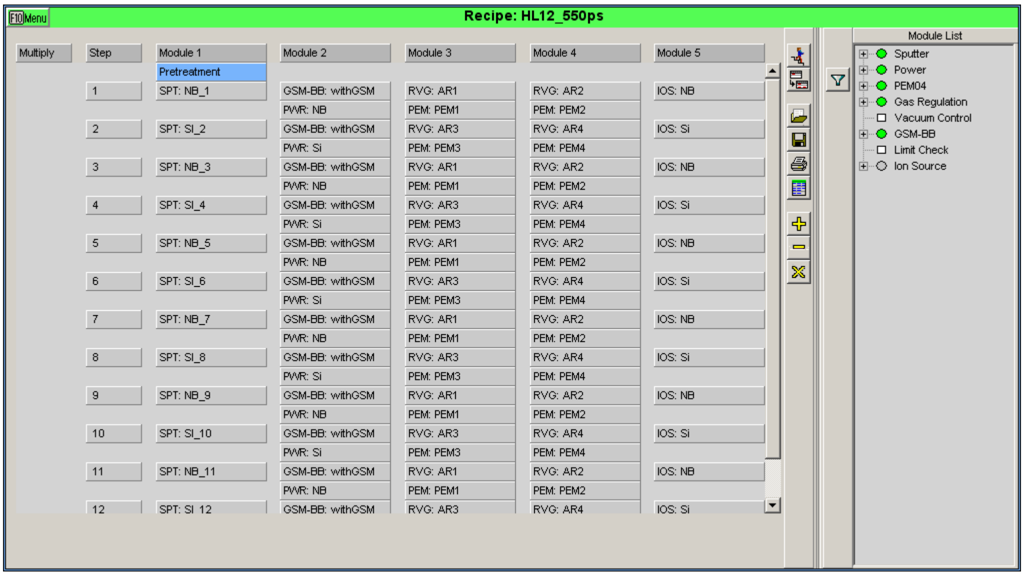


Fig. 6-4 *Opening the «Recipe» screen*

The «Recipe» screen opens in the main area. The currently active recipe is displayed. See Fig. 6-5, 🗎 131.



Recipe: HL12_550ps

Multiply	Step	Module 1	Module 2	Module 3	Module 4	Module 5
		Pretreatment				
	1	SPT: NB_1	GSM-BB: withGSM	RVG: AR1	RVG: AR2	IOS: NB
			PWR: NB	PEM: PEM1	PEM: PEM2	
	2	SPT: SI_2	GSM-BB: withGSM	RVG: AR3	RVG: AR4	IOS: Si
			PWR: Si	PEM: PEM3	PEM: PEM4	
	3	SPT: NB_3	GSM-BB: withGSM	RVG: AR1	RVG: AR2	IOS: NB
			PWR: NB	PEM: PEM1	PEM: PEM2	
	4	SPT: SI_4	GSM-BB: withGSM	RVG: AR3	RVG: AR4	IOS: Si
			PWR: Si	PEM: PEM3	PEM: PEM4	
	5	SPT: NB_5	GSM-BB: withGSM	RVG: AR1	RVG: AR2	IOS: NB
			PWR: NB	PEM: PEM1	PEM: PEM2	
	6	SPT: SI_6	GSM-BB: withGSM	RVG: AR3	RVG: AR4	IOS: Si
			PWR: Si	PEM: PEM3	PEM: PEM4	
	7	SPT: NB_7	GSM-BB: withGSM	RVG: AR1	RVG: AR2	IOS: NB
			PWR: NB	PEM: PEM1	PEM: PEM2	
	8	SPT: SI_8	GSM-BB: withGSM	RVG: AR3	RVG: AR4	IOS: Si
			PWR: Si	PEM: PEM3	PEM: PEM4	
	9	SPT: NB_9	GSM-BB: withGSM	RVG: AR1	RVG: AR2	IOS: NB
			PWR: NB	PEM: PEM1	PEM: PEM2	
	10	SPT: SI_10	GSM-BB: withGSM	RVG: AR3	RVG: AR4	IOS: Si
			PWR: Si	PEM: PEM3	PEM: PEM4	
	11	SPT: NB_11	GSM-BB: withGSM	RVG: AR1	RVG: AR2	IOS: NB
			PWR: NB	PEM: PEM1	PEM: PEM2	
	12	SPT: SI_12	GSM-BB: withGSM	RVG: AR3	RVG: AR4	IOS: Si

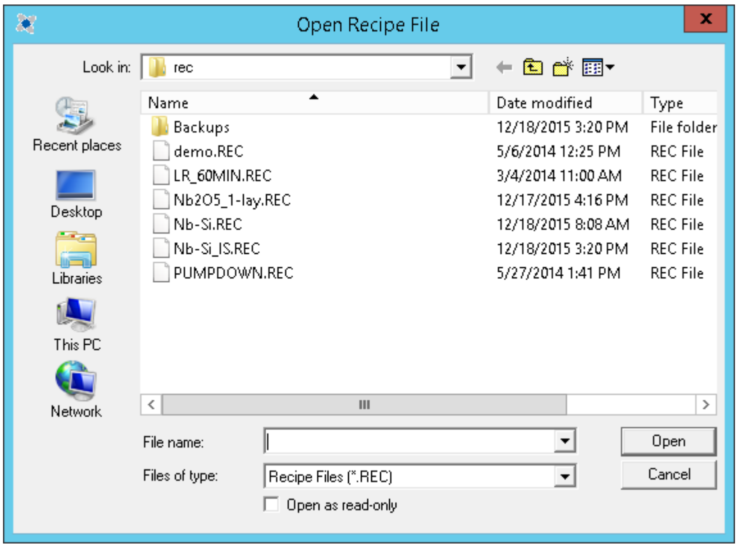
Fig. 6-5 *«Recipes» screen*

Loading a recipe

3 If you do not want to use the currently active recipe, you can load another one. Click the «Open file» button. See Fig. 6-6, 🗎 132.

Fig. 6-6 *«Open file» button*

The dialog «Open Recipe File» opens. See Fig. 6-7, 🗎 132.



Open Recipe File

Look in: rec

Name	Date modified	Type
Backups	12/18/2015 3:20 PM	File folder
demo.REC	5/6/2014 12:25 PM	REC File
LR_60MIN.REC	3/4/2014 11:00 AM	REC File
Nb2O5_1-lay.REC	12/17/2015 4:16 PM	REC File
Nb-Si.REC	12/18/2015 8:08 AM	REC File
Nb-Si_IS.REC	12/18/2015 3:20 PM	REC File
PUMPDOWN.REC	5/27/2014 1:41 PM	REC File

File name:

Files of type: Recipe Files (*.REC)

☐ Open as read-only

Open

Cancel

Fig. 6-7 *«Open Recipe File» dialog*

4 Select the desired process recipe

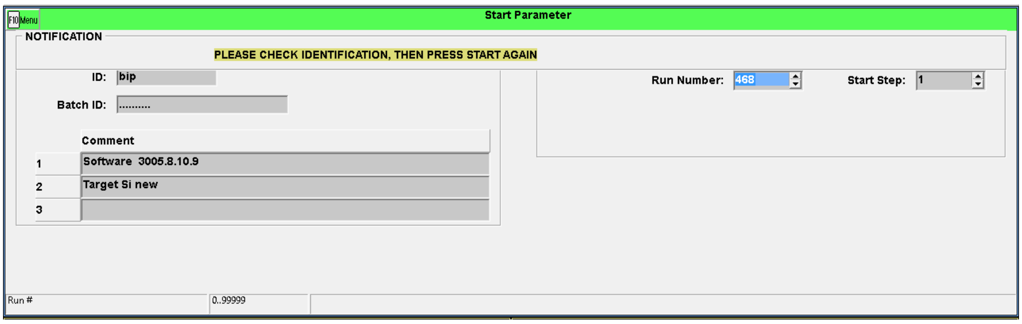
5 Click [Open]
- The selected process recipe is being loaded
- The selected process recipe is displayed in the «Recipe» screen

6.5.2 *Starting a process*

After a process recipe has been loaded, you can start the process. Proceed as follows:

1 Press **Ctrl-F1**

The «Start Parameter» screen appears. See Fig. 6-8, 🗎 133.



Start Parameter

NOTIFICATION

PLEASE CHECK IDENTIFICATION, THEN PRESS START AGAIN

ID: bip

Batch ID: ....

Run Number: 468

Start Step: 1

	Comment
1	Software 3005.8.10.9
2	Target Si new
3	

Run # 0..99999

Fig. 6-8 *«Start Parameter» screen*

2 Input the start parameters. See Tab. 6-2, 🗎 133.

Parameter	**Permitted values**	**Meaning**
ID		Identification of the user (e.g. initials)
Batch ID		Identification of the batch
Comment		For various information (e.g. software version)
Run number	0…9999	Allows input of a run number
Start Step		Specifies the start step

Tab. 6-2 *Start parameters*

3 Press **Ctrl-F1** one more time to start the process

Monitoring

During the process sequence, a number of process control commands can be activated either with the function keys or with the trackball. See Section 6.5.3 Process control commands, 🗎 134.

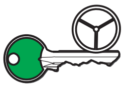
The user has several options to monitor the process via the system controller.

Process completed

After the sputtering process has ended, the KHAN system controller automatically goes to the main state «Vent» and substate «Final Vent».

In order to reload the process chamber («Reload» state), the process can be continued by pressing either the [Continue] or [Next] buttons.

6.5.3 Process control commands



The softkey bar on the bottom of the screen always shows the available process control commands. You can activate these commands either by clicking them with the trackball or by pressing the respective function key together with the **Ctrl** key.

Starting a process

Start (Ctrl-F1)
The process starts. Once the coating phase has ended, the process jumps to the «Abort» state and waits in main state «Vent», substate «Standby» (if programmed, see KHAN user's guide). The process can then be continued by actuating the [Continue] or [Next] buttons. The process jumps to the state «Final Vent».

If any conditions exist that do not permit a start (e.g. process chamber open), the process control keys are covered by a red bar and they cannot be actuated. The button is active in the «Reload» state.

Canceling a process

Once a process has been started, it can be canceled by actuating one of the following buttons:

Wait (Ctrl-F2)
The process is stopped at the end of the current main state and it branches to the substate «Wait». The process can be continued by actuating the [Continue] button. It then branches to the next main state. The current main state can be repeated by actuating the [Retry] button. The button is active in all main states except for «Reload» and «Abort».

Next (Ctrl-F5)
The current substate is aborted at once and it changes to the next substate. During the main state «Layer#», the current substate is aborted immediately, and continuation is done in «Ramp Hold» or in «Next Main Step». The button is active in «Bake», «Clean», «Layer», «Vacuum ctrl», «Partialvent 1…3», and «Vacuum Cool».

Hold (Ctrl-F6)
The current main state of the process is aborted immediately and the process branches to the substate «Wait». The process can subsequently be continued by pressing the [Continue] button. The process branches to the next main state. The same main state can be repeated by pressing the [Retry] button. The button is active in «Pump», «Bake», «Clean», «Layer», «Vacuum Cool», and «Vacuum ctrl».

Abort (Ctrl-F7)
The process is aborted at once and branches directly to the main state «Abort». The process can subsequently be continued by pressing the [Continue] button. This will branch the process to the main state «Vacuum Cool». Actuate the [Reload] button to go to the main state «Reload». The button is active in «Pump», «Bake», «Clean», «Layer», and «Vacuum ctrl».

Continuing a process

After a process has been stopped or aborted, it can be continued with the following commands:

Continue (Ctrl-F3)
The process continues at the next main state. If the «Clean» state was aborted, the process branches to the «End» state. The button is active in the substate «Wait».

Retry (Ctrl-F4)
The substates that have already been executed within the current main state are repeated. Some substates may however be omitted partially or completely. For more information, refer to the KHAN user’s guide. The button is active in the substate «Wait».

Reload (Ctrl-F8)
The process jumps to the main states «Vacuum Cool», «Vent», and «Partialvent 1…3». The button is active in the main state «Abort».

6.6 Manual control of the MSP 1200

The KHAN system controller allows you to manually control individual components of the MSP 1200. Fully manual control is only possible if the system controller is in the «Reload» state.

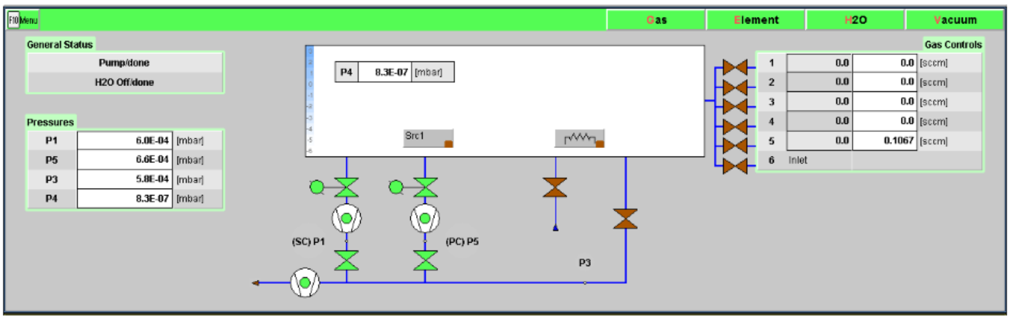
Selection

Proceed as follows to open the «Mimic» screen:

1 Press **F9** or click the [Mimic] button

Screen layout

Fig. 6-9, 🗎 136 shows the «Mimic» screen.



General Status

Pump/done

H2O Off/done

Pressures

P1	6.0E-04	[mbar]
P5	6.6E-04	[mbar]
P3	5.8E-04	[mbar]
P4	8.3E-07	[mbar]

P4 8.3E-07 [mbar]

Gas Controls

1	0.0	0.0	[sccm]
2	0.0	0.0	[sccm]
3	0.0	0.0	[sccm]
4	0.0	0.0	[sccm]
5	0.0	0.1067	[sccm]
6	Inlet		

Fig. 6-9 *«Mimic» screen*

The components shown in the control bar (green) can be selected for manual control:

Command	**Description**
[Gas]	See Section 6.6.1 «Gas Control» screen, 🗎 137
[Element]	See Section 6.6.2 «Element Control» screen, 🗎 138
[H2O]	See Section 6.6.3 «H2O Control» screen, 🗎 140
[Vacuum]	See Section 6.6.4 «Vacuum Control» screen, 🗎 141

6.6.1 «Gas Control» screen

The «Gas Control» screen is used for controlling the supply of process gas to the process chamber.

Selection

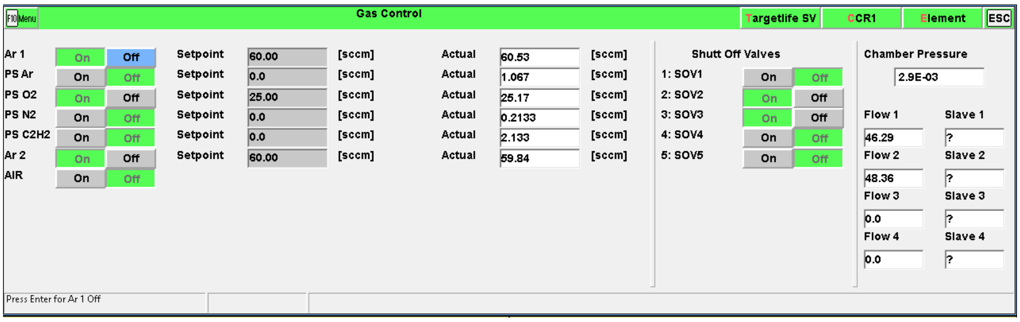
Proceed as follows to open the «Gas Control» screen:

1 Press the **F9** key to open the «Mimic» screen. See Fig. 6-9, 🗎 136.

2 Click the [Gas] button

Screen layout

Fig. 6-10, 🗎 137 shows the «Gas Control» screen. The layout of the screen depends on the system configuration.



Ar 1	Setpoint	60.00	[sccm]	Actual	60.53	[sccm]
PS Ar	Setpoint	0.0	[sccm]	Actual	1.067	[sccm]
PS O2	Setpoint	25.00	[sccm]	Actual	25.17	[sccm]
PS N2	Setpoint	0.0	[sccm]	Actual	0.2133	[sccm]
PS C2H2	Setpoint	0.0	[sccm]	Actual	2.133	[sccm]
Ar 2	Setpoint	60.00	[sccm]	Actual	59.84	[sccm]
AIR						

Shutt Off Valves
1: SOV1
2: SOV2
3: SOV3
4: SOV4
5: SOV5

Chamber Pressure: 2.9E-03

Flow 1: 46.29	Slave 1: ?
Flow 2: 48.36	Slave 2: ?
Flow 3: 0.0	Slave 3: ?
Flow 4: 0.0	Slave 4: ?

Press Enter for Ar 1 Off

Fig. 6-10 *«Gas Control» screen*

Operating elements

Operating element	**Description**
Gases	Gas inlets for argon [On]: Switches the gas inlet on [Off]: Switches the gas inlet off Setpoint: Setpoint for argon gas flow Actual: Measured argon gas flow
Shut Off Valves	Shut-off valves [On]: Opens the shut-off valve [Off]: Closes the shut-off valve
Chamber Pressure	Pressure in the process chamber
Flow 1…4	Gas inlets for oxygen. Measured oxygen gas flow from externally controlled mass flow controllers.

For more information, refer to the KHAN user's guide.

6.6.2 «Element Control» screen

The «Element Control» screen is used for controlling various components inside the process chamber.

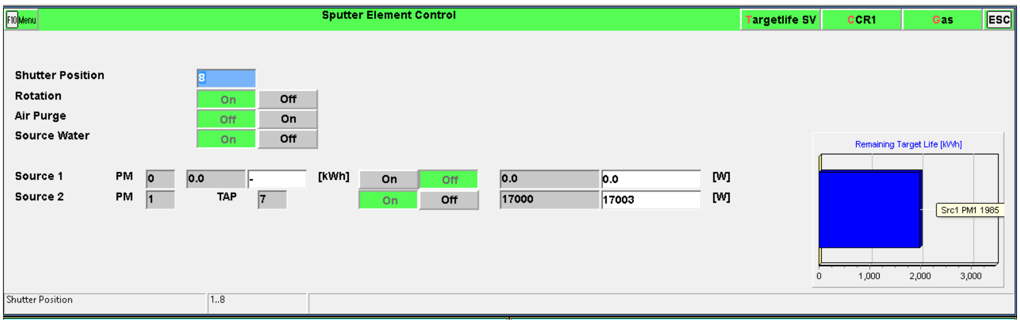
Selection

Proceed as follows to open the «Element Control» screen:

1. Press **F9** to open the «Mimic» screen. See Fig. 6-9, 🗎 136.
2. Click the [Element] button

Screen layout

Fig. 6-11, 🗎 138 shows the «Element Control» screen.



Shutter Position 8
Rotation On
Air Purge Off
Source Water On
Source 1 PM 0 0.0 - [kWh] Off 0.0 0.0 [W]
Source 2 PM 1 TAP 7 On 17000 17003 [W]
Shutter Position 1..8

Fig. 6-11 *«Element Control» screen*

Operating elements

Operating element	Description
Targetlife SV	Target life counter for cathode power supply and ion source RF power supply
CCR1	Manual control of ion source (pup up window)
[Gas]	See Section 6.6.1 «Gas Control» screen, 🗎 137
[Esc]	Back to previously selected menu
Shutter Position	Shutter position Position 1…8 1: Load/unload 2: Shutters in front of targets 3 and 4 4: Shutters in front of targets 1 and 2
Rotation	Substrate cage rotation On: Rotary drive buttons are enabled Off: Rotary drive buttons are disabled
Air Purge	Compressed air for blowing out cooling water from the selected component Off: Compressed air is switched off

Operating element	Description
Source Water	Cooling water for the sputtering sources On: Cooling water is switched on Off: Cooling water is switched off
Source 1…4	Power supplies for the sputtering sources PM: Selected Planar Magnetron (1…4, configuration dependent) TAP: Output load parameter match setting (1…7) On: Power supply is switched on Off: Power supply is switched off Gray field: Measured power White field: Setpoint for power
Remaining Target Life	Visualization of target life

For more information, refer to the KHAN user's guide.

6.6.3 «H2O Control» screen

The «H2O» screen is used for controlling the hot and cold water system.

Selection

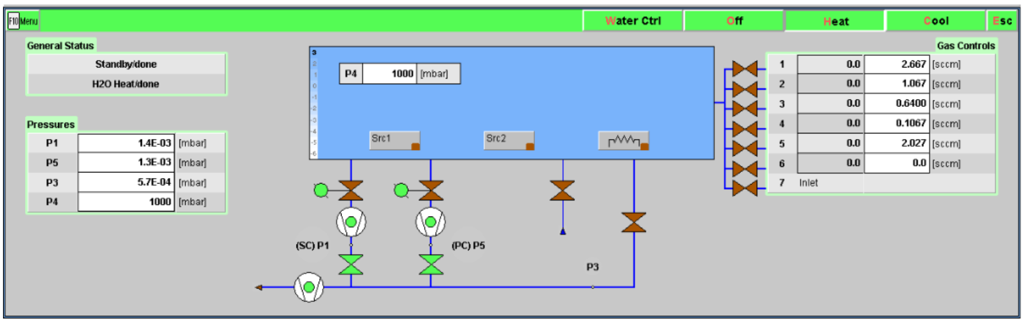
Proceed as follows to open the «H2O Control» screen:

1 Press **F9** to open the «Mimic» screen. See Fig. 6-9, 🗎 136.

2 Click the [H2O] button

Screen layout

Fig. 6-12, 🗎 140 shows the «H2O Control» screen.



General Status

Standby/done
H2O Heat/done

Pressures

P1	1.4E-03	[mbar]
P5	1.3E-03	[mbar]
P3	5.7E-04	[mbar]
P4	1000	[mbar]

P4 1000 [mbar]

Gas Controls

1	0.0	2.667	[sccm]
2	0.0	1.067	[sccm]
3	0.0	0.6400	[sccm]
4	0.0	0.1067	[sccm]
5	0.0	2.027	[sccm]
6	0.0	0.0	[sccm]
7	Inlet		

Fig. 6-12 *«H2O Control» screen*

Operating elements

Operating element	**Description**
[Off]	Switches the hot/cold water off
[Heat]	Switches the hot water on
[Cool]	Switches the cold water on
[Esc]	Back to previously selected menu
General Status	Displays the operating state busy: Command is still being executed done: Command has been completed
Pressures	Displays the pressure values P1, P3, P4 and P5

For more information, refer to the KHAN user’s guide.

6.6.4 *«Vacuum Control» screen*

The «Vacuum Control» screen is used for controlling components in the vacuum system.

Selection

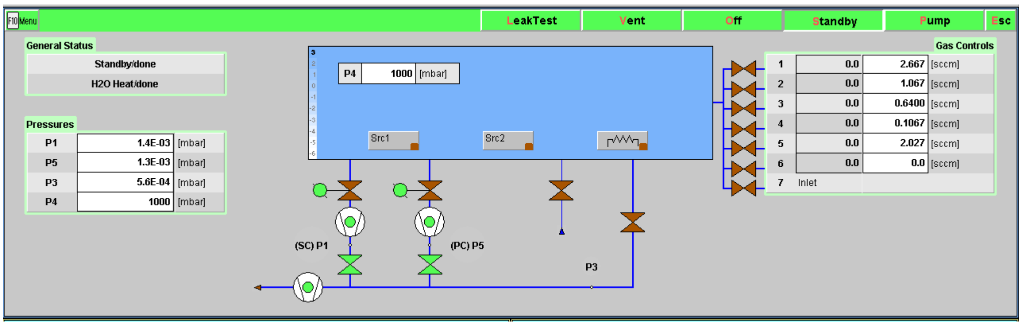
Proceed as follows to open the «Vacuum Control» screen:

1 Press **F9** to open the «Mimic» screen. See Fig. 6-9, 🗎 136.

2 Click the [Vacuum] button

Screen layout

Fig. 6-12, 🗎 140 shows the «Vacuum Control» screen.



General Status

Standby/done

H2O Heat/done

Pressures

P1	1.4E-03	[mbar]
P5	1.3E-03	[mbar]
P3	5.6E-04	[mbar]
P4	1000	[mbar]

P4 1000 [mbar]

Gas Controls

1	0.0	2.667	[sccm]
2	0.0	1.067	[sccm]
3	0.0	0.6400	[sccm]
4	0.0	0.1067	[sccm]
5	0.0	2.027	[sccm]
6	0.0	0.0	[sccm]
7	Inlet		

Fig. 6-13 *«Vacuum Control» screen*

Operating elements

Operating element	Description
[LeakTest]	Starts a leak test
[Vent]	Vents the process chamber
[Off]	Switches the pumping station off
[Standby]	Evacuates the process chamber to fore vacuum and starts the high vacuum pumps. The high vacuum valve is closed.
[Pump]	Evacuates the process chamber to process conditions. The high vacuum valve is open.
[Esc]	Back to previously selected menu
General Status	Displays the operating state busy: Command is still being executed done: Command has been completed
Pressures	Displays the pressure values P1, P3, P4 and P5

For more information, refer to the KHAN user's guide.

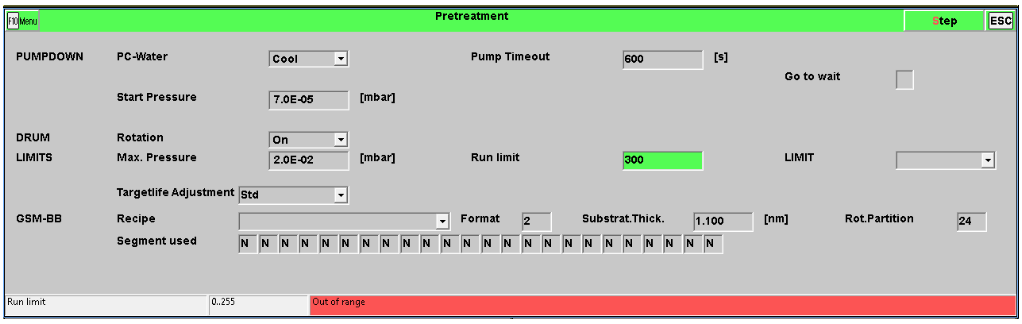
6.7 Alarm and error messages

The KHAN system controller issues a message on the screen if an error occurs. A distinction is made between the following alarm types:

- Operating errors. See Section 6.7.1, 🗎 142.
- System alarms. See Section 6.7.2, 🗎 143.

6.7.1 Operating errors

An operating error appears if an input is invalid or if a condition is not met. The error message is displayed at the bottom of the screen. See Fig. 6-14, 🗎 142.



PC-Water: Cool

Pump Timeout: 600 [s]

Go to wait ☐

Start Pressure: 7.0E-05 [mbar]

Rotation: On

Max. Pressure: 2.0E-02 [mbar]

Run limit: 300

LIMIT:

Targetlife Adjustment: Std

Recipe:

Format: 2

Substrat.Thick.: 1.100 [nm]

Rot.Partition: 24

Segment used: N N N N N N N N N N N N N N N N N N N N N N N N

Run limit | 0..255 | Out of range

Fig. 6-14 *Error message (red) caused by an input error*

Some operating errors may prevent a process start. In this case, the process control keys are covered by a red bar and they cannot be actuated. Fig. 6-15, 🗎 142 shows an example.

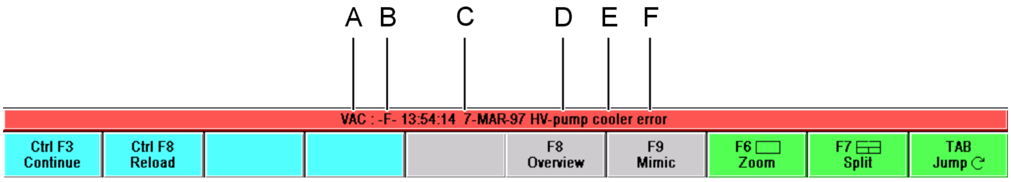
Gas Regulation module ar5 undefined
Process not startable

Fig. 6-15 *Error message (red) that prevents a process start*

A list of all error messages can be found in the KHAN user’s guide.

6.7.2 System alarms

Fig. 6-16, 🗎 143 shows an example of an alarm message.



VAC : -F- 13:54:14 7-MAR-97 HV-pump cooler error

Fig. 6-16 *Alarm message (example)*

A Cause for the alarm
B Alarm category
C Date and time
D Alarm group
E Alarm type
F Alarm state

General rules

- Alarm messages are displayed on a red background
- If several alarm messages occur at the same time, the first (unacknowledged) alarm message is displayed whereas the other messages are stored
- The **F5** button on the screen is shown in red
- The alarm message ends with the word «error»
- The hooter sounds

Cause (item A)

The alarm message starts with capital letters indicating the cause of the alarm. Examples:

- PRO = process controller
- VAC = vacuum controller

Category (item B)

The alarm category is displayed using a letter between two hyphens.

Alarm category	Letter	Hooter	Meaning
Information	-I-	Off	The error should be corrected before the process is started. A process that is already running will not be affected.
Warning	-W-	On	If a process is already running, the system will switch to the «Wait» state.
Fatal alarm	-F-	On	Starting of the process is prevented. If a process is already running, the system will switch to the «Abort» state.

NOTE:
Whether an alarm is marked with I, W or F does not only depend on the alarm type but also on the current process state.

Alarm state (item F)

The alarm message ends with the alarm state (item F):

- error = cause of the alarm is still present
- ok = cause of the alarm has been corrected

Acknowledging

An alarm message can be acknowledged by pressing the **F5** button.

If the error has not been corrected yet, the alarm message is still shown on a red background.

Clearing alarms

Once the error has been corrected, the alarm message is shown on a yellow background. The alarm state changes to «ok».

If you acknowledge the alarm message now, the alarm message disappears from the alarm line.

If there are further alarm messages in the alarm list in memory, the next unacknowledged alarm message will be displayed. If there are no further alarm messages, the **F5** button will no longer be highlighted on the screen.

Dynamic alarm

This means that an error occurs and the corresponding unit is switched off automatically. In this case, the alarm message is shown on a yellow background.

After acknowledging, a dynamic alarm message is removed from the alarm line. There is no «ok» message.

In the alarm list, dynamic alarms are shown in red color (power fail alarm).

For more information on individual error and alarm messages, please refer to the separate OEM manuals.

6.7.3 Resuming operation after an EMO

Proceed as follows to resume operation after an EMO:

1. Remove the cause of the danger
2. Make sure that the system is safe and ready for operation
3. Unlock the EMO button manually
4. Display and acknowledge the alarm messages on the screen of the GUI. See Section 6.7.2 System alarms, 🗎 143.
5. Press the Reset button at the GUI. This activates the safety circuit.
6. Continue the process with the GUI

7. Maintenance

7. Maintenance

7.1 Introduction

This chapter is for personnel with the access right «Maintenance» or higher.

7.1.1 Visual inspections

The MSP 1200 concept keeps the amount of required maintenance work to a minimum. Most of the components do not require any kind of maintenance work if you observe the stipulations for normal operating conditions. It is sufficient to make regular visual inspections. In addition, you should always listen for unusual noises and pay attention to any malfunctioning.

7.1.2 Hazard alerts

NOTE:
Read and understand Chapter 2. Safety, 🗎 23 before you perform any work described in this chapter. It is important for your personal safety!

In particular, read the following sections:

Section 2.2.5 Maintenance and service, 🗎 27

Section 2.5 Danger areas for manufacturing personnel, 🗎 32

Section 2.6 Danger areas for maintenance and service personnel, 🗎 38

Section 2.8 Lockout/tagout procedure, 🗎 50

NOTE:
Before maintenance or service work is performed to a standalone subassembly, all power and media supply lines for the subassembly must be locked out and tagged out first. If the subassembly cannot be shut down separately, the entire system must be shut down.

NOTE:
Maintenance and service work to parts that are located on top of the process chamber (e.g. rotary drive) must be performed using a twin-step stepladder.

7.1.3 OEM manuals

OEM manuals for third-party components are supplied as PDF files. These files are stored in a folder named «OEM manuals» located on the desktop of the GUI server.

7.1.4 Spare parts

Use only original spare parts for maintenance and service work. For information on spare parts, please send an e-mail to:

parts@evatecnet.com

Evatec customers can also use the following website:

http://parts.evatecnet.com

After logging into your account (user name and password required), you can access the parts list of the related Evatec system. This allows you to find product numbers for all spare parts that you want to order.

7.2 Auxiliary devices and operating materials

7.2.1 Auxiliary devices

- Step platform (Fig. 7-9, 🗎 173)

7.2.2 Operating materials

Refer to the material safety data sheets for the used operating materials and follow all directions.

7.3 Maintenance schedule

This chapter describes the specific maintenance tasks which are the responsibility of the end user. Please contact Evatec when maintenance tasks marked as «Evatec responsibility» must be performed.

OEM manuals Some instruction steps make reference to OEM manuals. These steps must be carried out as described in the relevant manuals.

Logbook Evatec recommends that a record of all performed maintenance work be kept in a logbook. This is particularly important if various different personnel are responsible for maintenance work on one system. A logbook allows the end user to keep a constant check on the type and date of performed maintenance work.

For this purpose you may copy the maintenance schedules and file them in a separate folder. The column labeled «Date & signature» allows you to keep a record of all the maintenance work performed on your system.

Maintenance contract Evatec recommends to have the entire system overhauled every two years by Evatec service technicians. Various important wear-sensitive system parts such as vacuum seals, sealing rings, ball bearings, etc. will then be replaced by new parts. Please contact your local Evatec representative for information about a customer-specific maintenance contract.

7.3.1 Process chamber

Parts requiring maintenance	Interval	Status			Action					Responsible		Remarks see	Date & signature
		Online	Standby	Off	Checking	Cleaning	Adjusting	Replacing	Overhauling	End user	Evatec		
Door seal	Every batch		X		X	X				X		Section 7.9.1, 🗎 171	
	Process dependent		X					X		X			
Sight glasses	Process dependent		X					X		X			
Shields	Process dependent			X				X		X		Section 7.9.2, 🗎 173	
Shutter	Process dependent		X					X		X		Section 7.9.3, 🗎 180	
Substrate carrier	Process dependent		X					X		X		Section 7.9.4, 🗎 181	
Optical film thickness measurement	Yearly		X		X		X			X		Section 7.9.5, 🗎 182	
	Process dependent		X					X		X			
Synchronization unit	Yearly		X		X	X		X		X		Section 7.9.6, 🗎 183	

Tab. 7-1 Maintenance schedule: Process chamber

7.3.2 Planar Magnetron sputtering source

Parts requiring maintenance	**Interval**	**Status**			**Action**					**Responsible**		**Remarks see**	**Date & signature**
		Online	**Standby**	**Off**	**Checking**	**Cleaning**	**Adjusting**	**Replacing**	**Overhauling**	**End user**	**Evatec**		
Target	Process dependent			X				X		X		Section 7.10.1, 🗎 184	

Tab. 7-2 Maintenance schedule: Planar Magnetron sputtering source

7.3.3 Vacuum system

Parts requiring maintenance	Interval	Status			Action					Responsible		Remarks see	Date & signature
		Online	Standby	Off	Checking	Cleaning	Adjusting	Replacing	Overhauling	End user	Evatec		
Leak rate	Weekly	X			X					X		Section 7.11.2, 🗎 189	
Pressure relief valve	Half-yearly		X		X					X		Section 4.7.3, 🗎 108	
	Yearly		X						X		X	Section 8.6.6, 🗎 210	
Turbomolecular pump	Yearly			X					X	X		Change oil OEM manual	
	Yearly			X					X	X		Change bearings (pump specialist!)	
Fore vacuum pump	OEM manual									X		OEM manual	
High vacuum valve	Process dependent			X					X	X		OEM manual	
Angle valves	Process dependent			X					X	X		OEM manual	
Pirani gauge	Process dependent			X				X		X		Replace poral filter, Replace measuring wire, OEM manual	
Combined vacuum gauge	Process dependent			X		X				X		OEM manual	

Tab. 7-3 Maintenance schedule: Vacuum system

7.3.4 Media supply

Parts requiring maintenance	**Interval**	**Status**			**Action**					**Responsible**		**Remarks see**	**Date & signature**
		Online	**Standby**	**Off**	**Checking**	**Cleaning**	**Adjusting**	**Replacing**	**Overhauling**	**End user**	**Evatec**		
Vent gas supply	Daily		X		X					X		Section 7.11.3, 🗎 190	
Process gas supply	Daily		X		X					X		Section 7.12.1, 🗎 191	
Compressed air	Daily		X		X					X		Section 7.13.1, 🗎 192	
Water circuit	Daily		X		X					X		Section 7.14.1, 🗎 193	

Tab. 7-4 Maintenance schedule: Media supply

7.3.5 Electrics

Parts requiring maintenance	**Interval**	**Status**			**Action**					**Responsible**		**Remarks see**	**Date & signature**
		Online	**Standby**	**Off**	**Checking**	**Cleaning**	**Adjusting**	**Replacing**	**Overhauling**	**End user**	**Evatec**		
Safety circuit	Half-yearly				X					X		Section 4.7.1, 🗎 107	
Revision checks	Half-yearly				X					X		Section 4.7.3, 🗎 108	
Discharging rod	Half-yearly				X					X		OEM manual	
Fan/filter of power rack	Process dependent				X	X				X		Replace filters. Clean fans with a vacuum cleaner.	

Tab. 7-5 Maintenance schedule: Electrics

7.4 Operating elements

7.4.1 Main switch

Fig. 7-1, 🗎 155 shows the main switch.

Fig. 7-1 *Main switch of the MSP 1200*

The main switch is located at the door of the power rack. See Section 3.7.1 Control and power rack, 🗎 87.

The main switch is used to switch the electrical supply for the MSP 1200 on and off.

Switch positions

Arrow points to green «O»
In this position the system is switched off completely.

Arrow points to the red «I»
In this position the system is switched on.

Arrow points to TRIP
After an EMO event the main switch rests in the TRIP position. In this case you first have to move the switch to RESET before you can put it back to «I».

⚠DANGER

Primary side of the main switch.

Parts inside of the supply rack may be connected to the primary side of the main switches. These parts are always live. Touching these parts will cause an electric shock. The shock may be lethal.

Prior to any work in the danger area:

- Lock out and tag out the power lines leading to the supply rack
- Ground the equipment
- Check to make sure that no one is in the danger area before you energize the supply rack again

7.5 Lockout/tagout (LOTO)

«Lockout/tagout» is a safe method to switch off machinery and equipment and to safeguard personnel from unexpected energization or startup.

- Lockout = switch off and lock
- Tagout = post a prominent tag

For general information on the LOTO procedure, refer to Section 2.8 Lockout/tagout procedure, 🗎 50. The following sections describe in detail how to lock out and tag out individual components of the MSP 1200.

7.5.1 LOTO positions

Fig. 7-2, 🗎 158 shows the LOTO positions at the MSP 1200.

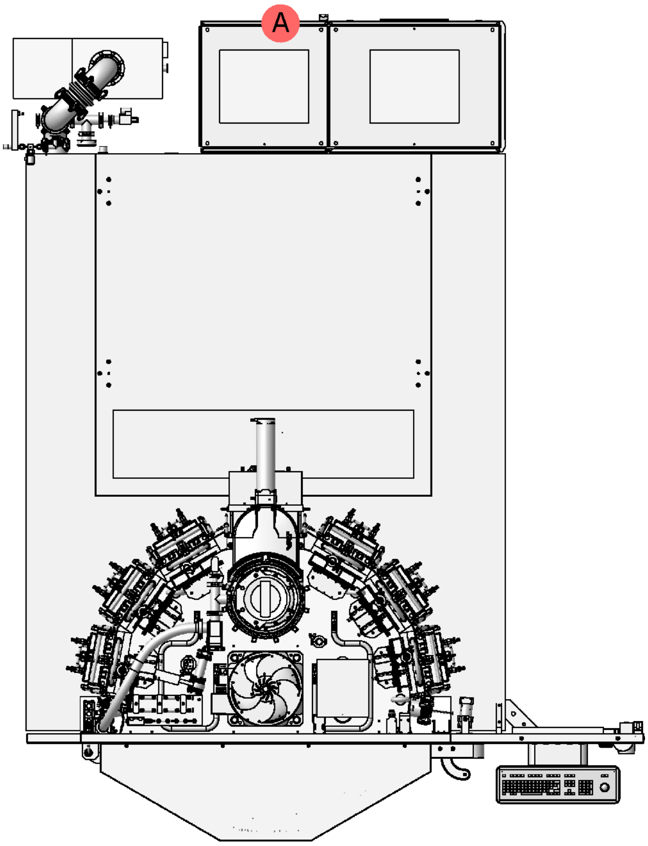


Fig. 7-2 *LOTO positions*

Item	Energy type	Component
A	Electric power	Power rack: Main switch

NOTE:
The vent gas and the process gases must be locked out using the lockable shut-off valves installed by the end user.

NOTE:
Hot and cold water must be locked out using the lockable shut-off valves installed by the end user.

7.5.2 *Locking out the main switch*

	Number of persons	1 (Maintenance)
	Special tools	None
	PPE	Padlock, lockout tag
	Location	Power rack
	System status	OFF

For maintenance and service work, you can lock the main switch in the «O» position. Proceed as follows to lock the main switch:

1 Make sure that the main switch is set to the «O» position

2 Lift the black plastic part

3 Lock the black plastic part with a padlock (rod ∅ 6…8 mm). See Fig. 7-3, 🗎 159.

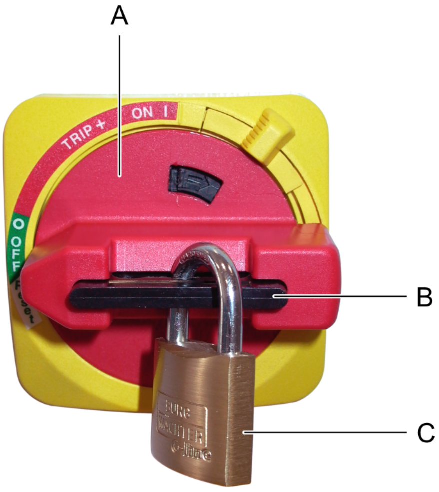


Fig. 7-3 Main switch locked in the «O» position (example)

A Main switch in the «O» position
B Black plastic part
C Padlock

4 Check to make sure that the switch cannot be moved anymore

5 Attach a lockout tag to the padlock

6 Make sure that all components of the MSP 1200 are at a complete standstill and that no system functions can be run

7.5.3 Locking out the compressed air

	Number of persons	1 (Maintenance)
	Special tools	None
	PPE	Lockout tag
	Location	Compressed air supply at the end user site
	System status	Standby

The compressed air must be locked out using the lockable shut-off valves installed by the end user. Proceed as follows:

1 Make sure that the system is idle (no process running)

2 Go to the compressed air supply at the end user site

3 Locate the required shut-off valve

4 Turn the manual shut-off valve to the closed position

5 If possible, lock the shut-off valve with a padlock

6 Attach a lockout tag to the shut-off valve

7.5.4 Locking out the gases (vent gas, process and reactive gases)

		
	Number of persons	1 (Maintenance)
	Special tools	None
	PPE	Lockout tag
	Location	Gas supply at the end user site
	System status	Standby

The vent gas and the process gases must be locked out using the lockable shut-off valves installed by the end user. Proceed as follows:

1 Make sure that the system is idle (no process running)

2 Go to the gas supply at the end user site

3 Locate the required shut-off valve

4 Turn the manual shut-off valve to the closed position

5 If possible, lock the shut-off valve with a padlock

6 Attach a lockout tag to the shut-off valve

7.6 Switching the MSP 1200 on and off

7.6.1 Switching on

	Number of persons	1 (Maintenance)
	Special tools and materials	None
	PPE	None
	Location	Power rack
	System status	OFF → Standby

Proceed as follows to switch the system on:

1 Make sure that all the EMO switches are unlocked

2 Move the main switch from the «O» position to «I». See Fig. 7-4, 🗎 162.

Fig. 7-4 *Main switch of the MSP 1200*

- The KHAN system controller starts
- The GUI displays two screens: The «Vacuum Control» mimic screen and the «Overview» screen

3 Press the Reset button at the GUI. This activates the safety circuit.

For more information, refer to the KHAN user’s guide.

7.6.2 Switching off

	Number of persons	1 (Maintenance)
	Special tools and materials	None
	PPE	None
	Location	Power rack
	System status	Standby → OFF

Proceed as follows to switch the system off:

Storing

1 Store the process on the hard disk and make the necessary backups

The system controller must be in «Process» mode in order to store a password protected process. For more information, refer to the KHAN User's Guide.

Vacuum system

2 Evacuate the process chamber. This prevents the process chamber from getting contaminated e.g. by water vapor.

For more information, refer to the KHAN user's guide.

Switching off

3 Move the system main switch from the «I» position to «O». See Fig. 7-4, 🗎 162.

Media

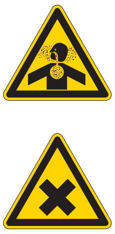
4 Close the media supply lines:

- **4.1** Close the valves for hot and cold water supply
- **4.2** Close the compressed air main valve at the media distributor
- **4.3** Lock the compressed air main valve
- **4.4** Depressurize the compressed air tank
- **4.5** Close the valves for process gas supply and close the connected gas cylinders

7.7 General cleaning instructions

7.7.1 Hazard alerts

Dust



⚠WARNING

Harmful process materials.

Depending on the process, the interior of the process chamber may be contaminated with metal dust and other harmful chemicals.

When performing any work inside the process chamber, wear a fine dust mask (P2), gloves, and protective clothing with long sleeves. Read the safety data sheets and follow all instructions.

⚠CAUTION

Particles released by Scotch Brite.

Use of Scotch Brite may release particles of the coating material into the air.

When performing any work inside the process chamber, wear a fine dust mask (P2), gloves, and protective clothing with long sleeves. Read the safety data sheets and follow all instructions.

⚠CAUTION

Distributing particles with compressed air.

When blowing out a vacuum chamber with compressed air, particles are distributed throughout the chamber. This deteriorates the ultimate pressure of the vacuum system.

Use a vacuum cleaner to remove particles from a vacuum chamber.

Solvents

⚠WARNING

Isopropanol (isopropyl alcohol, IPA).

Isopropanol is flammable and harmful.

Keep away from heat, sparks and flame. Keep the container closed. Avoid breathing vapor or mist. Avoid contact with eyes, skin and clothing. Read the safety data sheets and follow all instructions.

⚠WARNING

Unsuitable solvents.

Acetone, methanol and ethanol are unsuitable solvents. These chemicals attack seals made of nitrile and fluorocarbon rubber (e.g. Perbunan and Viton). In addition, methanol is toxic.

Avoid these solvents. Use isopropanol instead.

Sealing surfaces

⚠CAUTION

Sealing surfaces.

Sealing surfaces of vacuum components must be free from scratches. You will cause scratching if you clean sealing surfaces with hard objects (screwdrivers, steel wool, abrasive paper).

Always use a cloth moistened with alcohol to clean sealing surfaces.

7.7.2 Bead blasting of coated parts

Aluminum, copper and stainless steel parts which have been coated in the process chamber may be cleaned by bead blasting.

Hazard alerts

⚠WARNING

Dust and blasting materials.

The blasting materials and the residues from the blasting process are harmful for your lungs.

When bead blasting, wear a fine dust mask (P2), gloves, and protective clothing with long sleeves. Dispose of the collected dust as hazardous waste.

Requirements

Surface of the parts to be cleaned	Clean, dry, oil-free
Thickness of the parts to be cleaned	Min. 0.5 mm
Compressed air	Filtered, dry, oil-free
Operating pressure	Approx. 1.5 bar (0.15 MPa; 22 psi)
Blast material	Glass beads, 50…150 µm diameter
Angle of incidence	≤ 45°

NOTE:
When blasting very hard materials (e.g. molybdenum or tungsten), the blast material must be replaced. Otherwise components made from softer materials will be damaged by the hard residues.

When blasting components made from iron or non-stainless steel, the blast material must be replaced. This prevents contamination of other components with iron oxide.

How to proceed

Proceed as follows to clean parts by bead blasting:

1 Protect yourself with a fine dust mask (P2), gloves, and protective clothing with long sleeves

2 Wash the parts in clean water and dry them in a stream of compressed air

3 Protect male threads and pins on the parts by covering them with tape

4 Protect female threads and other openings on the parts by inserting screws or pins

5 Clean the parts by bead blasting. Make sure that the jet hits the surface at a shallow angle (≤ 45°). See Fig. 7-5, 🗎 167.

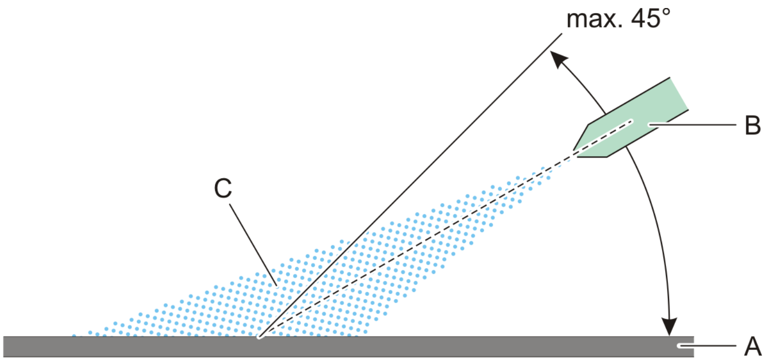


Fig. 7-5 *Bead blasting*

A Coated surface
B Nozzle
C Blast material in a jet of air

6 Blast the parts to a surface roughness of 40…80 µm (aluminum, copper) or 30…80 µm (stainless steel)

7 Clean the parts in an ultrasonic cleaner using demineralized water or alcohol

8 Rinse the parts with demineralized water

9 Dry the parts in a clean environment (temperature below 130 °C)

10 Put on clean room gloves. Mount the cleaned parts again or store them in clean plastic bags for later use.

7.8 Information on elastomer seals

There are two basic types of ring-shaped elastomer seals:

- Sealing ring: Elastomer cord whose ends have been glued or vulcanized together
- O-ring: Molded as one piece

7.8.1 Materials

Most elastomer seals are made of the following materials:

Trade name	Abbreviation	Material	Temperature range
Buna-N, Perbunan	NBR	Nitrile rubber	-30…+100 °C
Viton	FKM, FPM	Fluorocarbon rubber	-20…+200 °C
Kalrez	FFKM, FFPM	Perfluorocarbon rubber	-15…+230 °C

Tab. 7-6 *Common elastomer seal materials*

Solvents

⚠WARNING

Unsuitable solvents.

Acetone, methanol and ethanol are unsuitable solvents. These chemicals attack seals made of nitrile and fluorocarbon rubber (e.g. Perbunan and Viton). In addition, methanol is toxic.

Avoid these solvents. Use isopropanol instead.

7.8.2 Checking elastomer seals

1 Remove the seal from the sealing groove

NOTE:
Be careful not to scratch the seal or the groove. Never use hard tools (e.g. screwdriver) to remove a seal.

Visual inspection

2 Inspect the seal. It must be:
- Regular in diameter
- Free from noticeable gluing joints
- Free from any damage, such as cuts or swellings. See Fig. 7-6, 🗎 169.

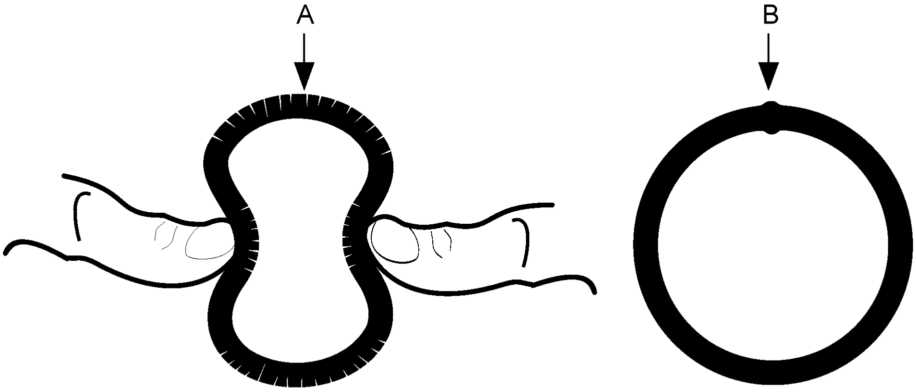


Fig. 7-6 *Inspecting a seal*

A Cuts and porous areas
B Enlargement, swelling

Cleaning

3 Pull the seal through a dry and clean cloth to remove coarse soiling

4 Pull the seal through a cloth moistened with isopropanol

Greasing (optional)

5 If the seal temperature will not exceed 100 °C, grease it as follows:

5.1 Sparingly apply vacuum grease to the seal

5.2 Pull the seal through a dry and clean cloth to cover the surface and pores of the seal with a very thin film of grease

NOTE:
Greased seals collect particles. Mount the seal immediately and don’t store it somewhere.

Inserting

6 Insert the seal

7 Check the excess of the seal in the groove. See Fig. 7-7, 🗎 170.
- Seal thickness 5 mm: Excess = 0.8 mm
- Seal thickness 6 mm: Excess = 1.1 mm

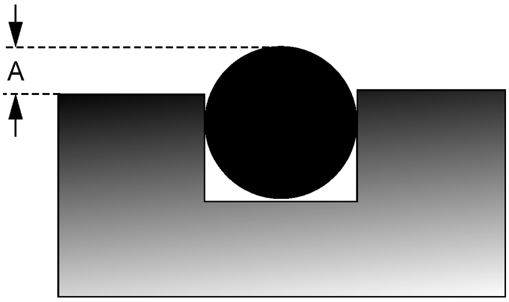
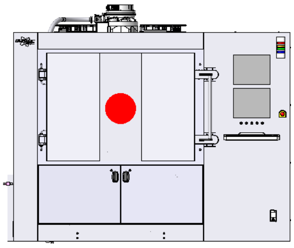


Fig. 7-7 *Excess of a seal in the groove*

A Excess

7.9 Process chamber

7.9.1 Cleaning and replacing the chamber door seal

	Number of persons	1 (Maintenance)
	Special tools and materials	Cleaning: None Replacing: Viton seal
	PPE	Protective clothing Clean room gloves Fine dust mask (P2)
	Location	Process chamber door
	System status	Standby

Cleaning

1. Before you close the process chamber, always check the seal for cleanliness, proper seat and damage (tears)
2. Wipe dirt off the Viton seal with a dust-free, lint-free cloth dipped in alcohol
3. Also inspect and clean the sealing surfaces at the process chamber door

Replacing The Viton seal is held in place by a metal frame which is screwed on to the process chamber around the door. See Fig. 7-8, 🗎 172.

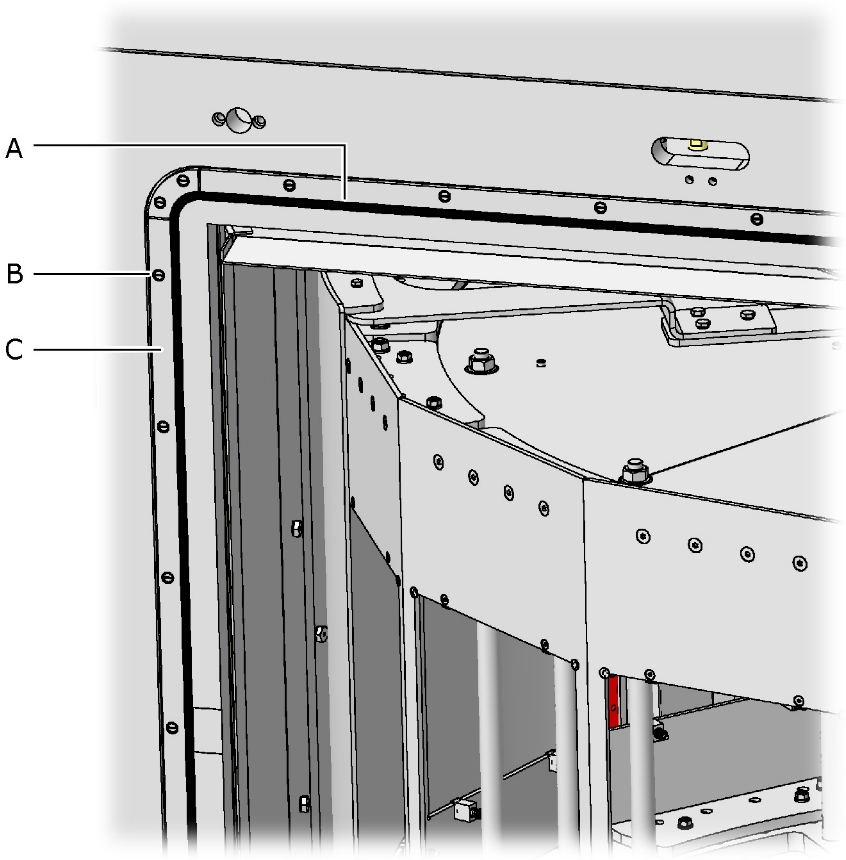


Fig. 7-8 *Chamber door sealing surface*

A Chamber door seal (Viton)
B Fixing screw
C Metal frame

Replace the chamber door seal if it is damaged. Proceed as follows:

1 Loosen all fixing screws at the inner door frame until the guide groove releases the chamber door seal

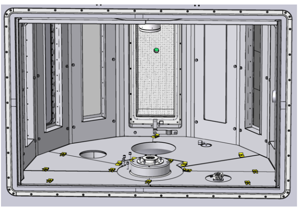
2 Remove the damaged chamber door seal

3 Place a new, clean Viton seal in the guide groove

4 Make sure the seal is seated evenly, and is not twisted or pinched

5 Tighten the metal frame to secure the chamber door seal

7.9.2 *Changing the shields*

	Number of persons	1 (Maintenance)
	Special tools and materials	Set of clean shields Bead blasting equipment
	PPE	Protective clothing Clean room gloves Fine dust mask (P2)
	Location	Process chamber walls
	System status	Standby / Off

Shields The inner walls of the process chamber are covered by protective shields. The shields must be cleaned after approximately 300 batches or if the pump-down times increase considerably.

In order to reduce downtime to a minimum, at least two sets of shields and shutters should be kept in stock:

- One set that is installed in the MSP 1200
- One clean set that can be used to replace the other one

Step platform Place a step stand or a step platform in front of the process chamber to reach the shields at the back of the process chamber more easily.

Fig. 7-9 *Step platform (example)*

Removing the chamber shields

Fig. 7-10, 🗎 174 shows the chamber shields.

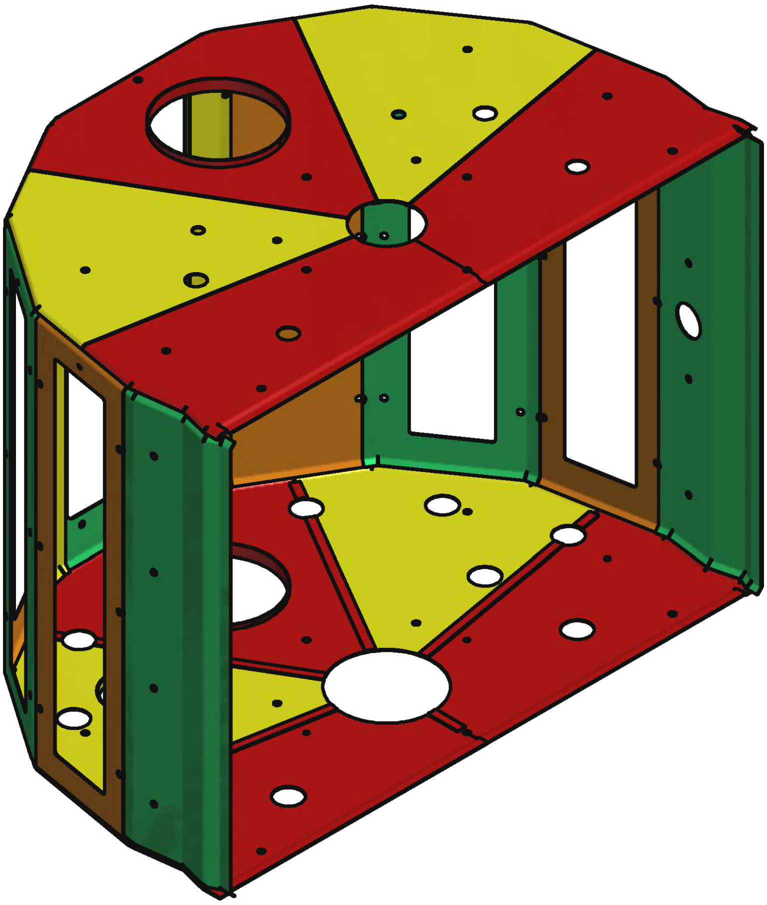


Fig. 7-10 *Chamber shields*

Proceed as follows to remove the chamber shields:

1 Open the process chamber. See Section 6.3.1 Opening the chamber door, 🗎 126. Pay attention to the hazard alerts in this reference.

2 Switch off the MSP 1200 system

3 Remove the side shields. See Fig. 7-11, 🗎 175.

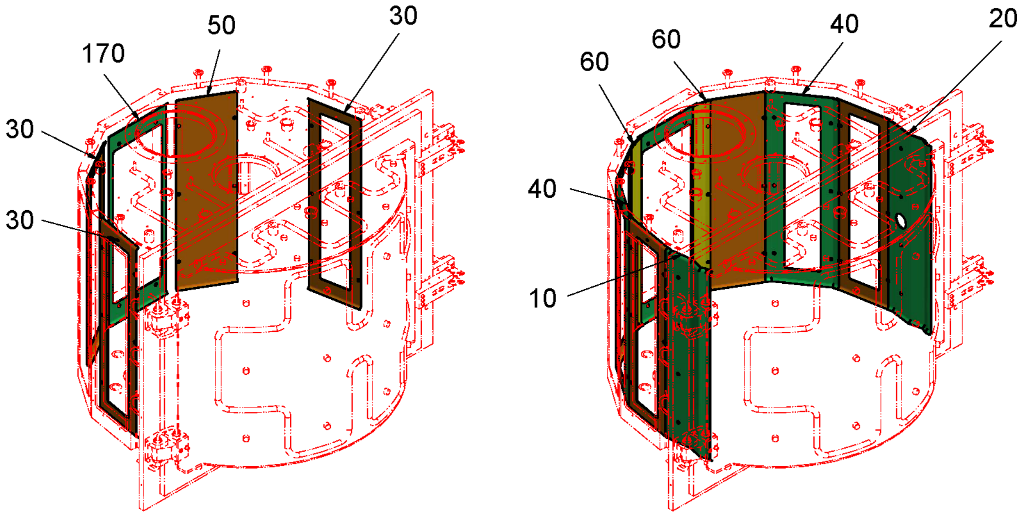


Fig. 7-11 *Removing the side shields*

4 Remove the sky shields. See Fig. 7-12, 🗎 175.

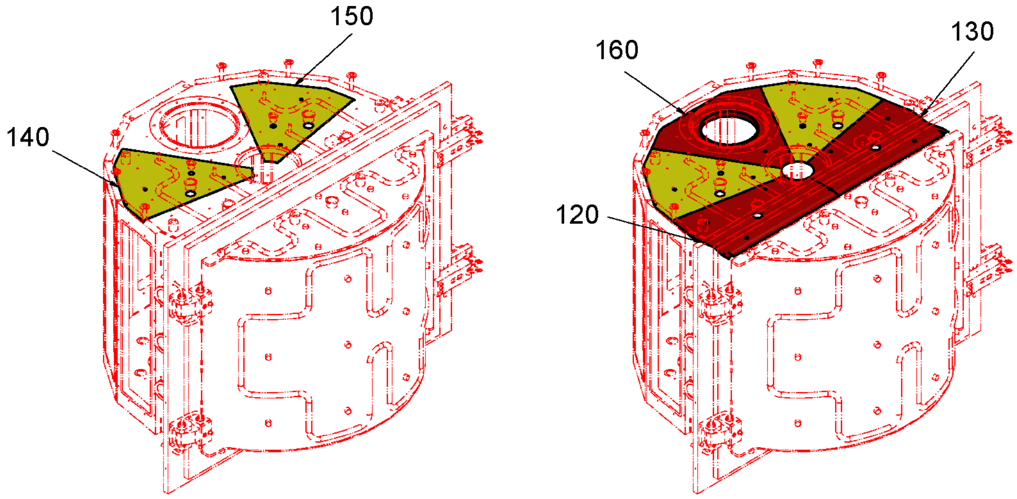


Fig. 7-12 *Removing the sky shields*

5 Remove the bottom shields. See Fig. 7-13, 🗎 175.

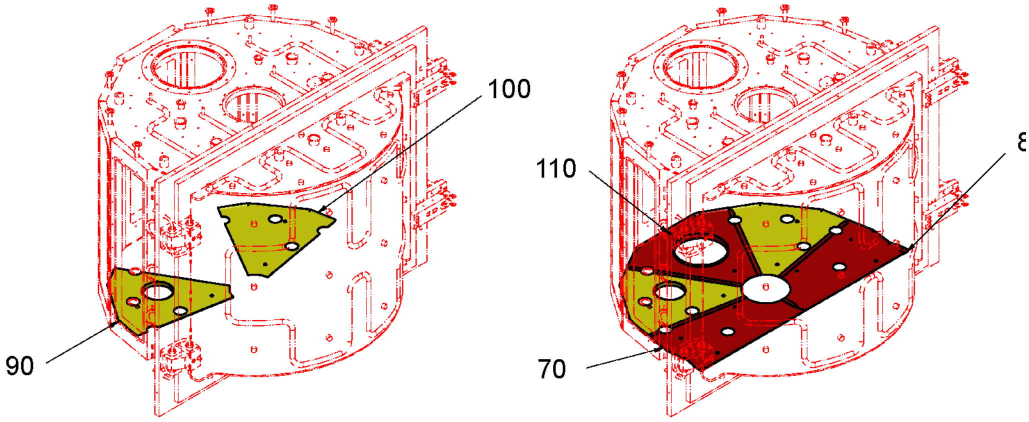


Fig. 7-13 *Removing the bottom shields*

Removing the door shields

Fig. 7-14, 🗎 176 shows the door shields.

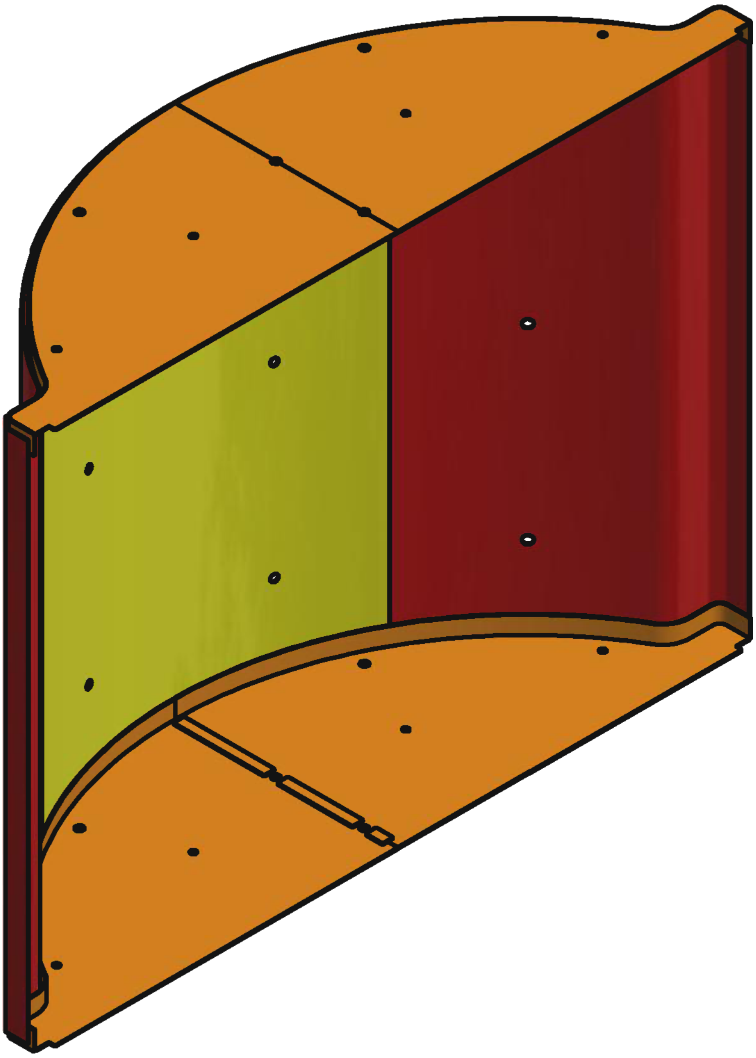


Fig. 7-14 *Door shields*

Proceed as follows to remove the door shields:

6 Remove the door shields 40. See Fig. 7-15, 🗎 177.

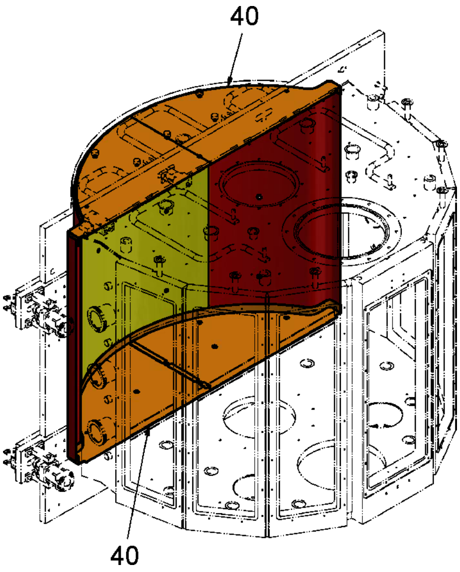


Fig. 7-15 *Removing door shields 40*

7 Remove the door shields 30. See Fig. 7-16, 🗎 177.

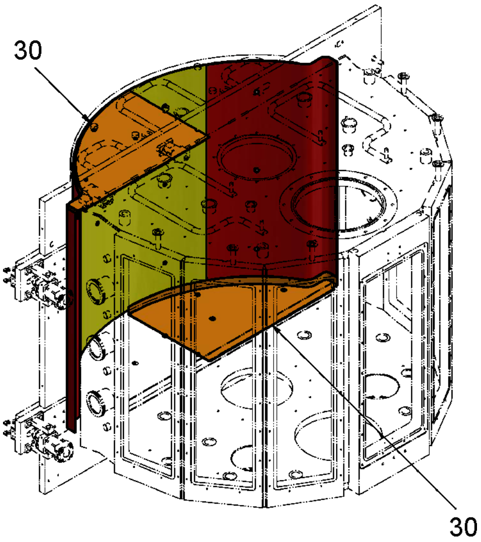


Fig. 7-16 *Removing door shields 30*

8 Remove the door shield 20. See Fig. 7-17, 🗎 178.

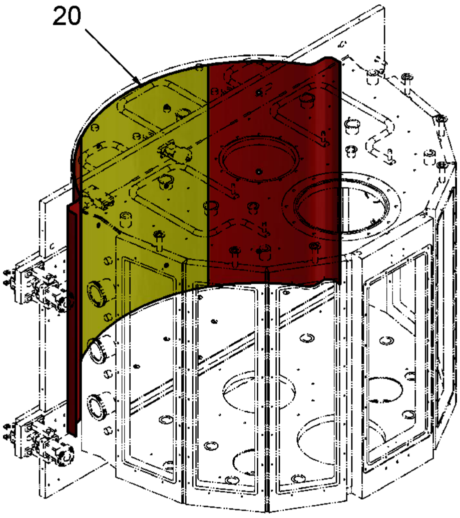


Fig. 7-17 *Removing door shield 20*

9 Remove the door shields 10. See Fig. 7-18, 🗎 178.

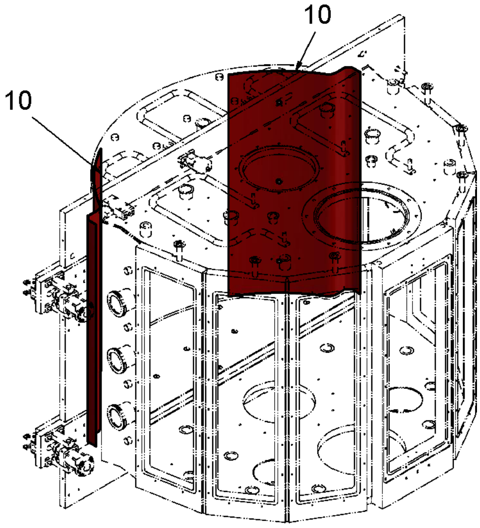


Fig. 7-18 *Removing door shields 10*

Cleaning the interior

10 Clean the interior of the process chamber and of the chamber door using a vacuum cleaner

Mounting the clean door shields

11 Mount the door shields 10. See Fig. 7-18, 🗎 178.

12 Mount the door shield 20. See Fig. 7-17, 🗎 178.

13 Mount the door shields 30. See Fig. 7-16, 🗎 177.

14 Mount the door shields 40. See Fig. 7-15, 🗎 177.

Mounting the clean chamber shields

15 Mount the bottom shields. See Fig. 7-13, 🗎 175.

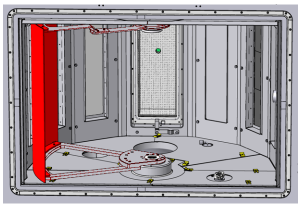
16 Mount the sky shields. See Fig. 7-12, 🗎 175.

17 Mount the side shields. See Fig. 7-11, 🗎 175.

Cleaning the shields

18 Clean the shields by bead blasting. See Section 7.7.2 Bead blasting of coated parts, 🗎 166. Pay attention to the hazard alerts in this reference.

7.9.3 Changing the shutter front panel

	Number of persons	1 (Maintenance)
	Special tools and materials	Clean shutter front panel Bead blasting equipment
	PPE	Protective clothing Clean room gloves Fine dust mask (P2)
	Location	Process chamber
	System status	Standby / Off

The shutter front panel must be replaced after approximately 200 batches (if a material mix was not applied).

In order to reduce downtime to a minimum, at least two shutter front panels should be kept in stock: One front panel which is installed in the MSP 1200, and one front panel which is clean and can be used to replace the other one.

Proceed as follows to change the shutter front panel:

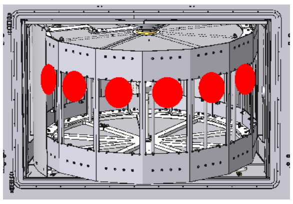
Changing the shutter front panel

1. Open the «Element Control» screen. See Section 6.6.2 «Element Control» screen, 🗎 138.
2. Shutter Position: Move the shutter to position «3»
3. Source Water: Click [Off] to switch off the water supply
4. Open the process chamber. See Section 6.3.1 Opening the chamber door, 🗎 126. Pay attention to the hazard alerts in this reference.
5. Switch off the MSP 1200 system
6. Remove the front panel of the shutter
7. Mount a clean replacement front panel

Cleaning the shutter front panel

8. Clean the front panel by bead blasting. See Section 7.7.2 Bead blasting of coated parts, 🗎 166. Pay attention to the hazard alerts in this reference.

7.9.4 Cleaning the substrate carriers

	Number of persons	1 (Maintenance)
	Special tools and materials	Bead blasting equipment
	PPE	Protective clothing Clean room gloves Fine dust mask (P2)
	Location	Substrate cage
	System status	

The substrate carriers are coated by the process and must be cleaned after approximately 150 batches or if the layer peels off the substrate carrier.

In order to reduce downtime to a minimum, at least two sets of substrate carriers should be kept in stock: One set which is installed in the MSP 1200, and one set which is clean and can be used to replace the other one.

Fig. 7-19, 🗎 181 shows a typical substrate carrier.

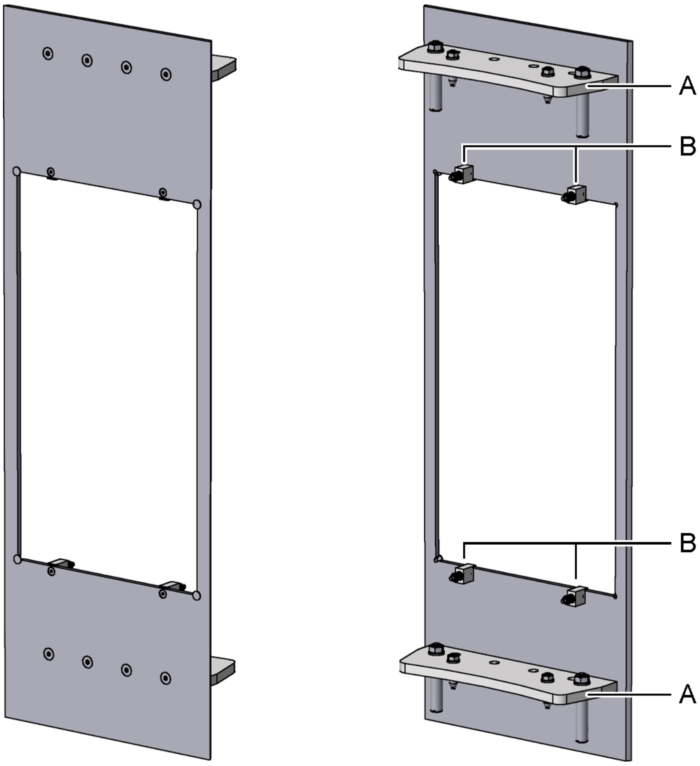


Fig. 7-19 *Substrate carrier (left: Front side, right: Back side (facing the substrate cage))*

A Cage support
B Substrate fixing

1 Remove substrate fixings and cage supports from the substrate carriers

2 Clean the substrate carriers by bead blasting. See Section 7.7.2 Bead blasting of coated parts, 🗎 166. Pay attention to the hazard alerts in this reference.

7.9.5 *Optical film thickness measurement*

Inspect the optical film thickness measurement system. Readjust it if necessary. Adjust the dot by using the positioning screws to position the glass fiber cable as desired.

Replace the window for film thickness measurement whenever it is dirty, or after one year of use. Refer to Fig. 7-20, 🗎 182 and proceed as follows:

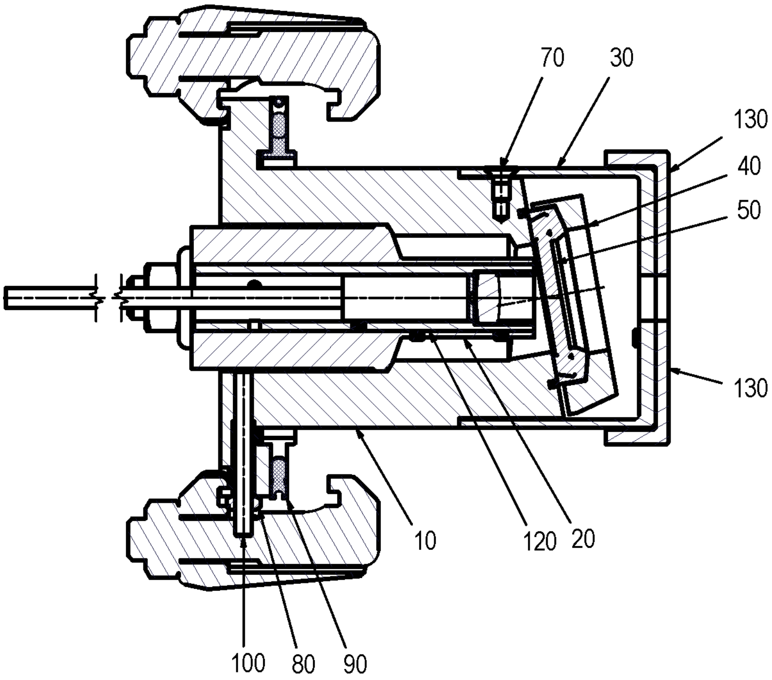


Fig. 7-20 *Optical film thickness measuring unit*

1 Vent the process chamber. For this, click the [Vent] command button in the «Vacuum Control» screen. See Section 6.6.4, 🗎 141.

2 Remove the three slotted screws (item 70)

3 Remove the evaporation protection (item 30)

4 Remove the collar ring (item 40)

5 Replace the window (item 50)

6 Clean the Viton seal with a lint-free cloth. Check it for damage and replace if necessary

7 Reassemble by repeating the above steps in reverse order

8 Readjust the dot after replacing the window

7.9.6 *Synchronization unit*

The film thickness measurement and the substrate cage rotation are synchronized by having a light barrier monitor the speed of rotation of the substrate cage.

Replace the window of the light source whenever it is dirty, or at least annually. Refer to Fig. 7-20, 🗎 182 and proceed as follows:

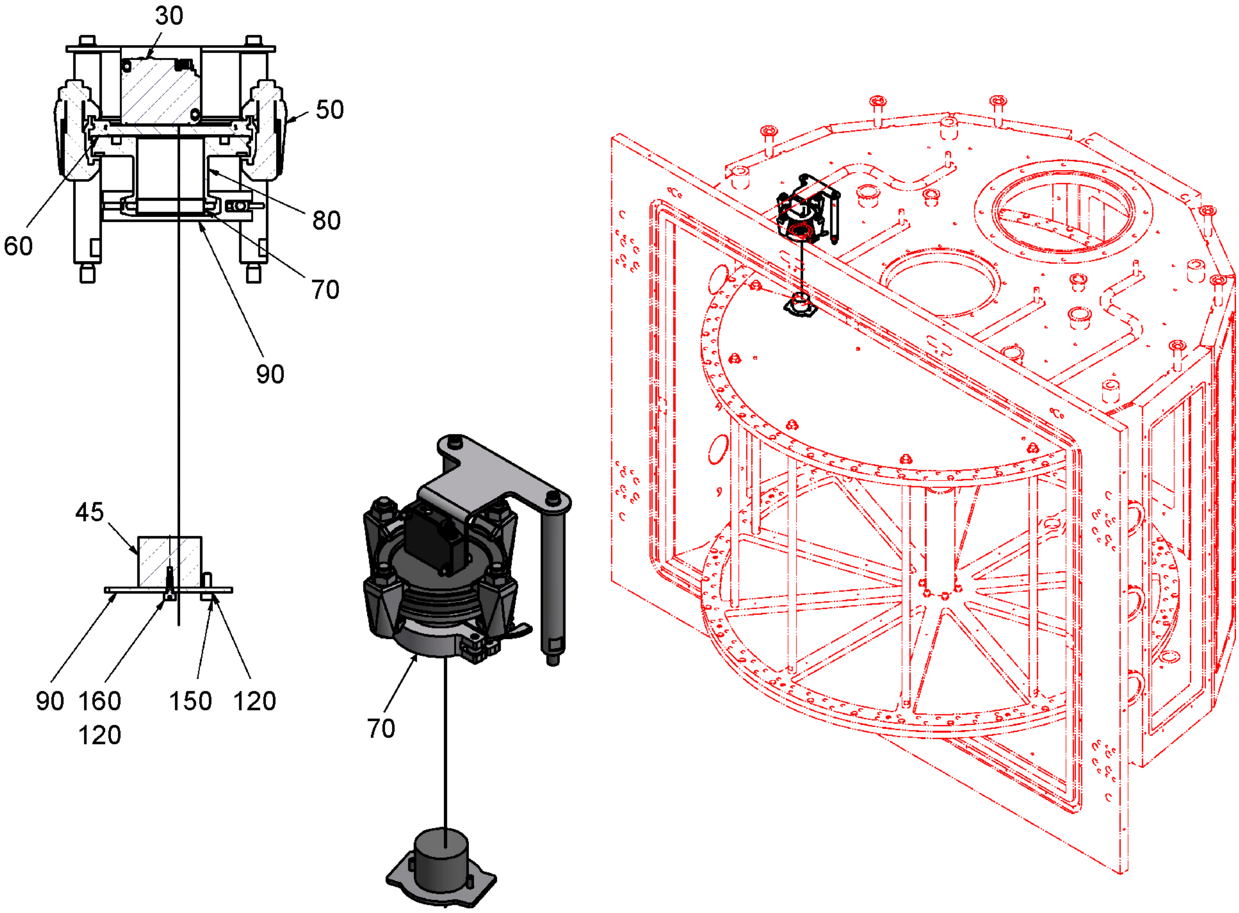


Fig. 7-21 *Synchronization unit (located at the top of the process chamber)*

1 Remove the clamping ring (item 70) from the window holder

2 Replace the window (item 90)

3 Clean and inspect the Viton seal for damage. Replace if necessary.

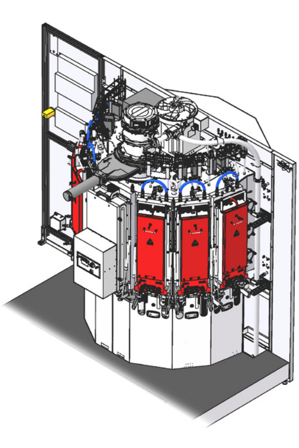
4 Reassemble by repeating the above steps in reverse order

Replace the mirror if it is very dirty (approximately every six months). Use an aluminum mirror.

NOTE:
Silver coated mirrors are not suitable; they would be unusable after a few batches.

7.10 Planar Magnetron sputtering sources

7.10.1 Replacing the targets

	Number of persons	1 (Maintenance)
	Special tools and materials	Targets Clean clamping frames Clean anode frame parts
	PPE	Protective clothing Clean room gloves Fine dust mask (P2)
	Location	Chamber back side
	System status	Standby / Off

The targets of the Planar Magnetron sputtering sources are consumed by the process and must be replaced when they are used up.

The intervals for cleaning are process specific and must be determined by the end user.

Proceed as follows to replace the targets:

Preparations

1. Open the «Element Control» screen. See Section 6.6.2 «Element Control» screen, 🗎 138.
2. Source Water: Click [Off] to switch off the water supply
3. Vent the process chamber. For this, click the [Vent] command button in the «Vacuum Control» screen. See Section 6.6.4, 🗎 141.
4. Air Purge: Blow out the water circuits for the sputtering sources whose targets you wish to replace. Blow out for at least 5 minutes.
5. Switch off the MSP 1200 system

Folding down the PM

The sputtering sources are equipped with a flap mechanism and can be folded down for maintenance and service. Proceed as follows:

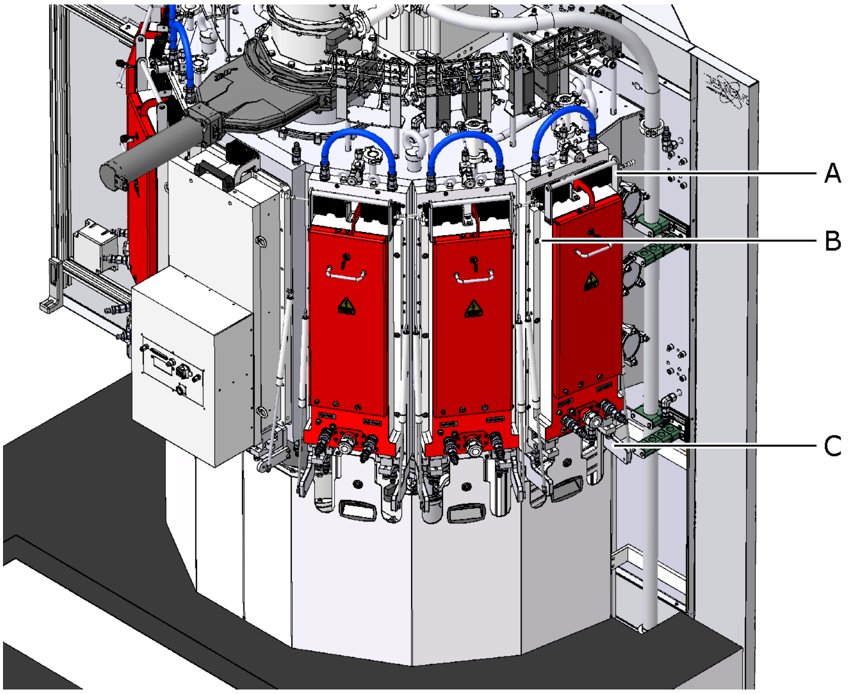


Fig. 7-22

Sputtering sources in standard position

A Handle
B Fixing screws (6 screws for each sputtering source)
C Flap mechanism

6 Remove the fixing screws (item B) at both sides of the sputtering source

7 Hold the sputtering source at the handle (item A) and fold it down

Replacing the target

Fig. 7-23, 🗎 186 shows an exploded view illustration of the Planar Magnetron sputtering source.

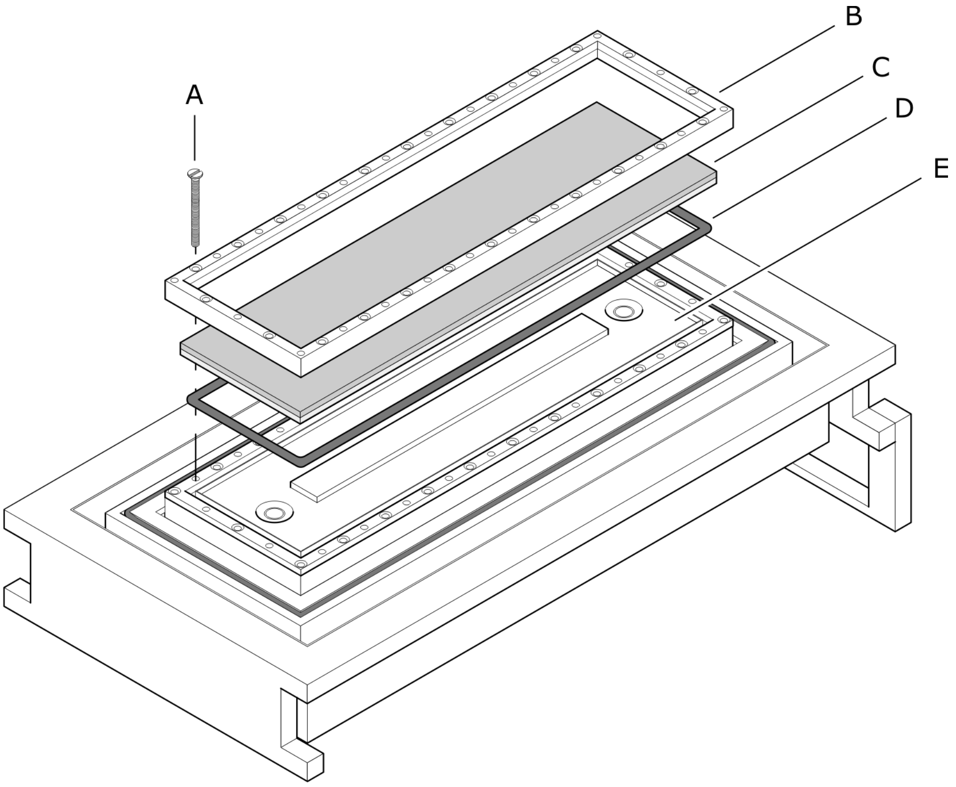


Fig. 7-23

Planar Magnetron sputtering source

A Fixing screws
B Clamping frame
C Target
D Viton seal
E Cooling plate

8 Remove the 24 fixing screws (item A) holding the clamping frame

9 Remove the clamping frame (item B)

10 Remove the target (item C)

11 Clean the Viton seal (item D) with a vacuum cleaner and a lint-free cloth

12 Use vacuum grease to lubricate the Viton seal

13 Place a new target on the Viton seal

14 Replace the clamping frame with a clean one

15 Mount the 24 fixing screws for the clamping frame. Tighten the screws crosswise and in steps.

Cleaning the anode frames

The anode frames must be cleaned whenever targets are replaced. The anode frame consists of six parts, each one mounted with two fixing screws. Proceed as follows:

16 Replace the fixing screws from the six parts of the anode frame

17 Replace the parts of the anode frame with a clean set

18 Mount the clean anode frame parts with the fixing screws

NOTE:
Make sure that the anode frame is parallel to the target. The distance between the sealing surface of the PM and the anode frame should be in the range 2.5 … 3 mm.

Folding up the PM

19 Hold the sputtering source at the handle and fold it up

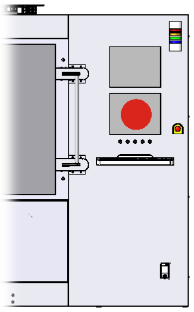
20 Mount the fixing screws at both sides of the sputtering source. Tighten the screws crosswise and in steps.

Cleaning

21 Clean the clamping frames and the anode frame parts by bead blasting. See Section 7.7.2 Bead blasting of coated parts, 🗎 166. Pay attention to the hazard alerts in this reference.

7.11 Vacuum system

7.11.1 Checking the pumpdown time

	Number of persons	1 (Maintenance)
	Special tools and materials	None
	PPE	None
	Location	GUI / process chamber
	System status	Standby

Proceed as follows to check the pumpdown time:

1 Condition the processing chamber for at least 20 minutes with hot water while evacuating it

2 Vent the process chamber with dry nitrogen gas

3 Open the process chamber door (90° opening angle) and keep it open for at least 5 minutes

4 Close the process chamber door and pump down the process chamber

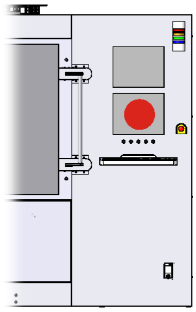
5 Cool the process chamber walls with cold water

Tab. 7-7, 🗎 188 lists typical pressure values as a function of the pumping time.

Pumpdown time	**Pressure**
10 minutes	$\leq 5 \times 10^{-4}$ mbar
20 minutes	$\leq 1 \times 10^{-4}$ mbar
40 minutes	$\leq 5 \times 10^{-6}$ mbar
8 hours or more (ultimate pressure)	$< 1 \times 10^{-6}$ mbar

Tab. 7-7 *Pumpdown time and pressure*

7.11.2 Measuring the leak rate

	Number of persons	1 (Maintenance)
	Special tools and materials	None
	PPE	None
	Location	GUI / process chamber
	System status	Standby

Proceed as follows to measure the leak rate:

1 Evacuate the process chamber for at least 8 hours. See Section 7.11.1 Checking the pumpdown time, 🗎 188.

2 Click [Vacuum] > [LeakTest]

The leak rate is being measured and displayed on the screen.

- If the leak rate exceeds 5 × 10^{-5} mbar l/s, the process chamber needs to be cleaned
- Searching for leaks: See Section 8.6.2 Searching for leaks, 🗎 203.

For more information, refer to the KHAN user’s guide.

7.11.3 Checking the vent gas supply

	Number of persons	1 (Maintenance)
	Special tools and materials	None
	PPE	None
	Location	Nitrogen gas supply
	System status	Standby

Perform the following checks daily:

1 Read the pressure gauge at the nitrogen gas tank

2 Adjust the pressure at the pressure reducer if necessary

Further information on the vent gas supply:

- Section 1.6.6 Vent gas, 🗎 19
- Section 3.5.1 Vacuum diagram, 🗎 76

7.12 Process gas supply

7.12.1 Checking the process gas supply

	Number of persons	1 (Maintenance)
	Special tools and materials	None
	PPE	None
	Location	Gas tanks
	System status	Standby

Perform the following checks daily:

1 Read the pressure gauge at the gas tank

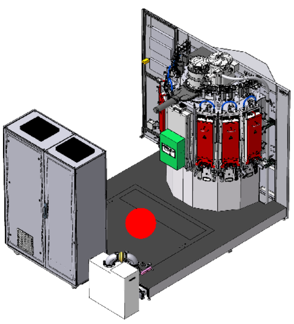
2 Adjust the pressure at the pressure reducer if necessary

Further information on the process gas supply:

- Section 1.6.4 Process gases, 🗎 18
- Section Process gas diagram, 🗎 86

7.13 Compressed air system

7.13.1 Checking the compressed air supply

	Number of persons	1 (Maintenance)
	Special tools and materials	None
	PPE	None
	Location	Media battery
	System status	Standby

The KHAN system control automatically checks the system for a sufficient supply of compressed air.

In addition, perform the following checks daily:

1 Lift the cover at the system platform to access the media battery

2 Read the compressed air pressure gauge at the media battery

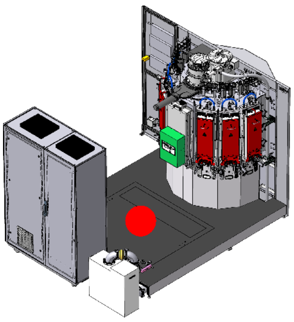
3 Adjust the pressure at the pressure reducer if necessary

Further information on the compressed air system:

- Section 1.6.7 Compressed air, 🗎 20
- Section Compressed air diagram, 🗎 82

7.14 Water circuit

7.14.1 Checking the water supply

	Number of persons	1 (Maintenance)
	Special tools and materials	None
	PPE	None
	Location	Media battery
	System status	Standby

The KHAN system control automatically checks the system for a sufficient supply of hot and cold water.

In addition, perform the following checks daily:

1 Check all water pipes visually for leaks or corrosion

2 Check the state of the water flow meters
- Green LED must be on
- Red alarm LED must be off

3 If there is no temperature display, check the temperature of the hot water supply by touching the feed pipe with the palm of your hand

4 Read the water pressure gauge at the water battery

5 Adjust the water pressure using a pressure reducer at the end user site if necessary

⚠	**⚠CAUTION**
	Water pressure. Excessive water pressure can damage the targets. The static water pressure at the sputtering sources must never exceed 2 bar.

Further information on the water circuit:

- Section 1.6.8 Water supply, 🗎 20
- Section Water diagram, 🗎 83

8. Service

8. Service

8.1 Introduction

This chapter is for personnel with the access right «Service» or higher.

8.1.1 Hazard alerts

NOTE:
Read and understand Chapter 2. Safety, 🗎 23 before you perform any work described in this chapter. It is important for your personal safety!

In particular, read the following sections:

Section 2.2.5 Maintenance and service, 🗎 27

Section 2.5 Danger areas for manufacturing personnel, 🗎 32

Section 2.6 Danger areas for maintenance and service personnel, 🗎 38

Section 2.8 Lockout/tagout procedure, 🗎 50

NOTE:
Before maintenance or service work is performed to a standalone subassembly, all power and media supply lines for the subassembly must be locked out and tagged out first. If the subassembly cannot be shut down separately, the entire system must be shut down.

NOTE:
Maintenance and service work to parts which are located on top of the process chamber (e.g. rotary drive) must be performed using a twin-step stepladder.

8.1.2 OEM manuals

OEM manuals for third-party components are supplied as PDF files. These files are stored in a folder named «OEM manuals» located on the desktop of the GUI server.

8.1.3 Spare parts

Use only original spare parts for maintenance and service work. For information on spare parts, please send an e-mail to:

parts@evatecnet.com

Evatec customers can also use the following website:

http://parts.evatecnet.com

After logging into your account (user name and password required), you can access the parts list of the related Evatec system. This allows you to find product numbers for all spare parts that you want to order.

8.2 Auxiliary devices and operating materials

See Section 7.2 Auxiliary devices and operating materials, 🗎 148.

8.3 Provisions for handling of heavy components

8.3.1 Manual lifting of components

⚠WARNING

Heavy components.

Improper handling of heavy components may cause serious contusions and fractures.

Two or more persons are required for manual lifting of components that are heavier than 44.5 N (4.5 kg). Wear working gloves and stable footwear.

The following components must be lifted by two persons
- UPS (optional)
- Sputtering source
- Plasma source
- High vacuum valve
- Substrate cage
- GSM 1101

8.3.2 Mechanical lifting of components

⚠WARNING

Heavy components.

Improper handling of heavy components may cause serious contusions and fractures, or even lead to death.

Use suitable equipment to lift and transport heavy components. Wear stable footwear. Always keep a safe distance to suspended loads. Never stay under a suspended load!

The following components must be lifted mechanically
- Fore vacuum pump (1x)
- Turbomolecular pump (2x)
- Rotary drive
- Power supplies

8.4 Reading electrical diagrams

Components in electrical systems are marked with a combination of key letters and numbers. You can use these numbers to locate the respective component in an electrical diagram.

Example A component is labeled **Y1303** (Fig. 8-1, 🗎 198).

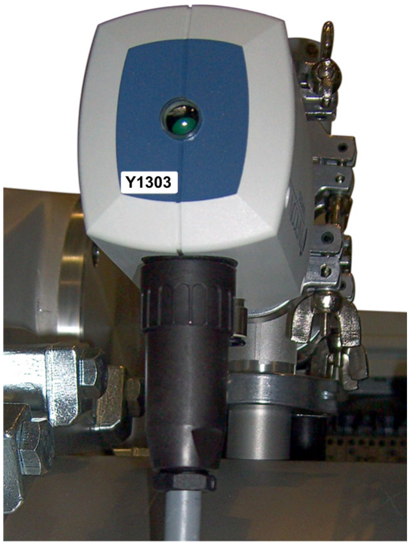


Fig. 8-1 *Component labeled Y1303*

The label on the component displays the following information:

Type of component
The first letter indicates the type of component. In the above example, the key letter **Y** denotes that the component is an electromechanical component (solenoid valve). The significance of other letters is explained in Tab. 8-1, 🗎 199.

Sheet in electrical diagrams
The following three digits indicate the specific electrical diagram showing the respective component. In the above example, this is the electrical diagram with the sheet number **130**. See Fig. 8-2, 🗎 200 (red box).

Column in electrical diagram
The last digit indicates the column in the electrical diagram that is relevant for the component. In the above example, this is column **3**. See Fig. 8-2, 🗎 200 (green box).

NOTE:
Safety-relevant electrical diagrams are marked with the index «SD».

Key letter	**Meaning**
A	General structural components or assemblies (printed circuit board, plug-in board, rack module)
B	Transducer (sensor, temperature sensor, tacho generator, microphone, loudspeaker, optical sensor, Hall probe)
C	Capacitor
D	Digital or digital/analog assembly
E	Various components (e.g. lighting equipment)
F	Protective device (fuse, surge arrester, circuit breaker)
G	Power supply (generator, mains unit, battery, charging unit)
H	Indicator device (signal light, LED, monitor, loudspeaker)
K	Relay
L	Coil
M	Motor (electric motor, fan)
N	Analog element (operational amplifier, impedance transformer, function generator, electronic switch)
P	Measuring equipment (measuring unit, counter, clock, test point, analog or digital recording equipment)
Q	Power circuit breaker
R	Resistor (fixed or variable resistor, potentiometer, thermistor)
S	Switch (pressure switch, switch, rotary switch, push-button, key panel)
T	Transformer (mains transformer, isolating transformer)
U	Modulator (optocoupler)
V	Semiconductor or tube (diode, transistor, triac, tube)
W	Transmission components (telephone wire, coax cable, dipole or parabolic aerial, glass fiber line)
X	Connection (terminal block, connector, cable connections, soldering strip)
Y	Electromechanical components (brake, clutch, solenoid valve, lifting drive, printer)
Z	Filter (crystal filter, high pass filter, band pass filter, low pass filter)

Tab. 8-1 *Key letters for components in electrical diagrams*

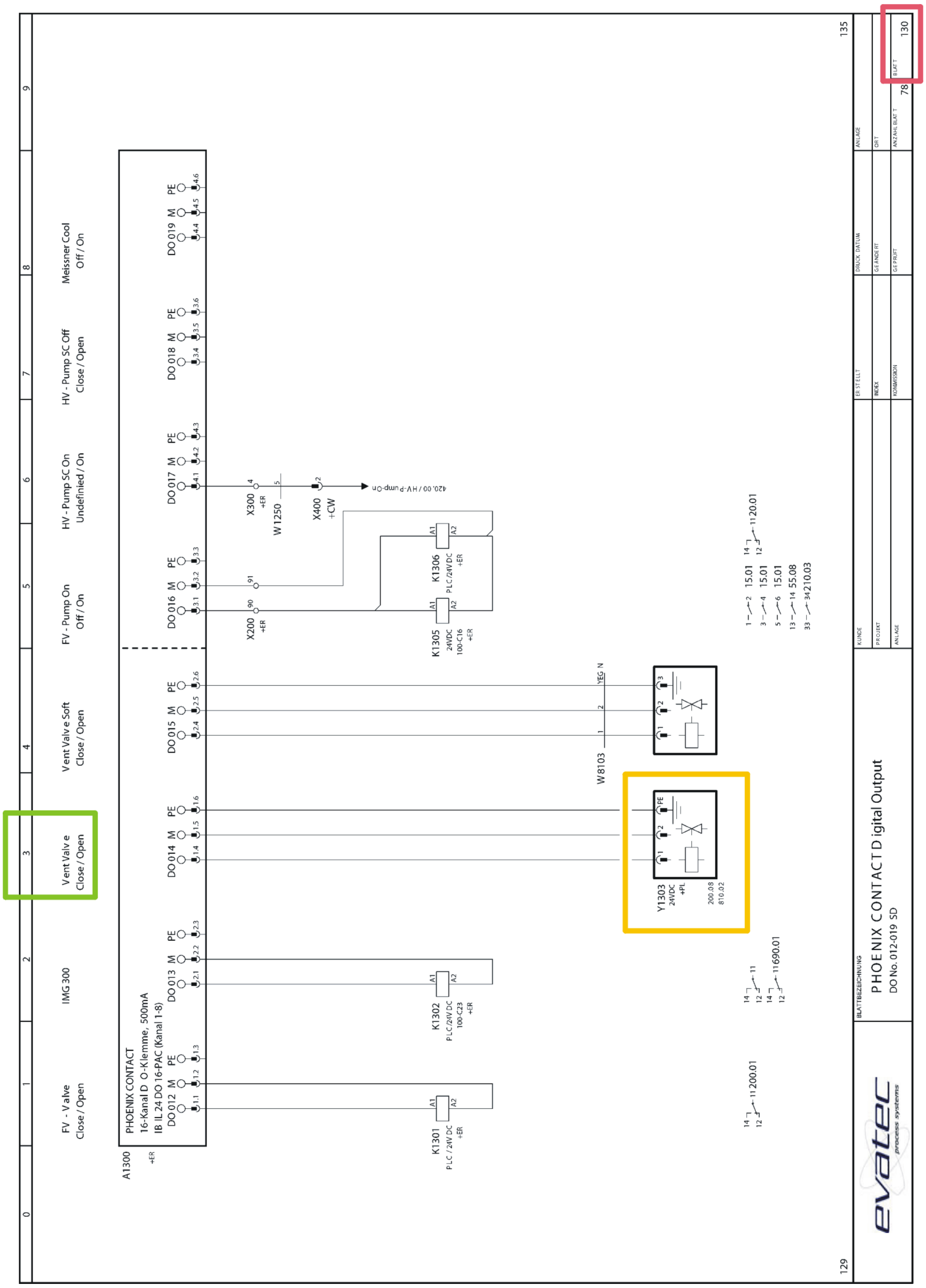


Fig. 8-2 Electrical diagram (example)

8.5 *Prerequisites for operation*

You must perform the following preparatory work prior to operation:

1 Conclude all installation work and check the system.
See Section 4. Installation, 🗎 93.

2 Switch the system on. See Section 7.6.1 Switching on, 🗎 162.

3 Make sure that all electrical components are switched on and ready for operation:
- Switches, circuit breakers, power supplies and control units in the electrical racks and boxes
- Pumping stations
- GUI and other system control components

4 Activate the operating media by opening the appropriate stop cocks and valves
- Process gas (argon, oxygen)
- Vent gas (nitrogen)
- Compressed air
- Cooling water and hot water

5 Check if the gas pressures are adjusted correctly. See Section 1.6 Installation data, 🗎 13.

6 Check if the water pressure is adjusted correctly. See Section 1.6 Installation data, 🗎 13.

8.6 Vacuum system

8.6.1 Theory: Tightness of vacuum systems

Leak rate

No vacuum chamber is perfectly tight. If the pumping valve of a vacuum chamber is closed, the pressure in the vacuum chamber will increase as time goes on. This increase in pressure is approximately linear, i.e. it is proportional to the time.

The proportional constant q is called the leak rate. It is a measure for the tightness of the vacuum chamber. If Δp is the pressure increase in mbar, Δt the period of time in seconds (s), and V the volume of the vacuum chamber in liters (l), we find:

$$q = \Delta p \bullet V / \Delta t$$

For the leak rate q, a unit of mbar • l/s is normally used.

Leak types

The increase in pressure inside of a closed vacuum chamber has three different causes:

- Real leaks: The vacuum chamber is not fully tight, so gas from the outside is flowing into the vacuum chamber
- Virtual leaks: Gas is trapped in cavities inside of the vacuum chamber, e.g. in the threaded hole for a screw. Gas from these cavities is flowing to the interior of the vacuum chamber. In contrast to real leaks, virtual leaks become depleted after pumping for a sufficiently long time.
- Desorption: If a vacuum chamber is opened, volatile substances will attach to the chamber walls. Typical examples are water vapor from the air or alcohol which has been used for cleaning the chamber walls. This process is called adsorption. If the chamber is being pumped down, these substances detach from the chamber walls and migrate into the vacuum. This process is called desorption. The desorption can be accelerated by baking out the vacuum chamber, meaning that the adsorbed substances are removed after pumping for a sufficiently long time.

Vented screws

⚠CAUTION

Virtual leaks.

Gas that is physically trapped may become the source of a virtual leak. When a vacuum chamber is pumped down, the trapped gas may cause a small but continuous flow of gas into the chamber. As a result, the specified pumpdown curve and ultimate pressure cannot be reached.

Use vented screws in vacuum chambers. A vented screw contains a drilling along the entire screw. The drilling relieves trapped gas pockets immediately.

8.6.2 *Searching for leaks*

	Number of persons	1 (Maintenance)
	Special tools and materials	Helium leak detector
	PPE	Protective clothing
	Location	Vacuum system
	System status	Standby

Before searching for leaks, read the theory described at the beginning of Section 8.6 Vacuum system, 🗎 202.

Proceed as follows to search for leaks:

1 Vent the process chamber with dry nitrogen gas

2 Connect the helium leak detector to a vacant flange

3 Pump down the process chamber

4 Bakeout the process chamber. This will ensure that the increase in pressure in the subsequent measurement is caused by real leaks only.

5 Make sure that the ultimate vacuum has been reached

6 Switch the MSP 1200 to STANDBY
- The high vacuum pendulum valve closes

7 Perform the leak search as described in the OEM manual for the used helium leak detector

8.6.3 *For vacuum pump*

Pay attention to the following hazard alerts when performing service work to the fore vacuum pump:

⚠DANGER

Mains voltage.

The fore vacuum pump is connected to the mains supply. Touching live parts will cause an electric shock. The shock may be lethal.

Prior to any work in the danger area:
- Lock out and tag out the main power supply
- Ground the equipment
- Check to make sure that no one is in the danger area before you switch the main power supply on again

⚠WARNING

Automatic start of the fore vacuum pump.

The unexpected automatic start of the fore vacuum pump may cause serious injuries to your hands.

Make sure that the fore vacuum pump is locked out and tagged out before you perform any work to it.

⚠CAUTION

Hot fore vacuum pump.

The fore vacuum pump may heat up to exceed temperature levels of 80 °C. Touching the fore vacuum pump may result in burns.

Wear protective gloves and protective clothing with long sleeves. Do not put inflammable objects (e.g. cleaning cloths) onto the fore vacuum pump.

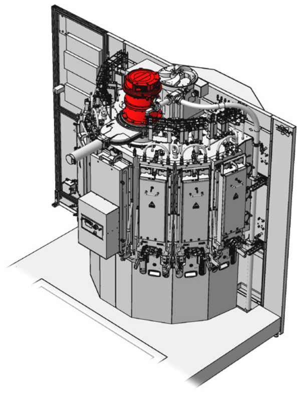
⚠CAUTION

Mixed up fore vacuum pump connections.

A fore vacuum pump will generate overpressure if you mix up its input flange and output flange. The vacuum system may become contaminated with pump oil.

During and subsequent to the pump mounting procedure, check to make sure that the flanges are connected correctly.

8.6.4 Servicing a high vacuum pump

	Number of persons	2 (Service)
	Special tools and materials	Crane
	PPE	Protective clothing Clean room gloves Fine dust mask (P2)
	Location	High vacuum pumps
	System status	OFF

Procedure

Proceed as follows to service a high vacuum pump:

1 Vent the process chamber

2 Bring the high vacuum pump to the recommended status.
Refer to the OEM manual for the high vacuum pump.

3 Switch off the MSP 1200.
See Section 7.6.2 Switching off, 🗎 163.

4 Lock out and tag out the electrical power.
See Section 7.5.2 Locking out the main switch, 🗎 159.

5 Perform the service work as described in the OEM manual for the high vacuum pump

6 Mount all removed components in reverse order

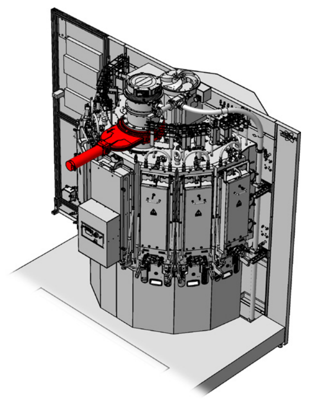
Replacing the pump

If the high vacuum pump must be replaced, pay attention to the following hazard alerts:

	⚠ **WARNING**
	Heavy, large component: High vacuum pump. ◆ High vacuum pump PC: 50 kg Improper handling of heavy components during dismounting and mounting may result in serious contusions and fractures. Secure all parts prior to dismounting and mounting work. Use suitable equipment to lift and transport heavy components.

	⚠ **WARNING**
 	High vacuum valve. Automatic movements of the high vacuum valve may cause serious contusions and fractures. Before dismounting the high vacuum pump, lock out and tag out the electrical system. Cover the open end of the high vacuum valve with a blank flange.

8.6.5 Servicing a high vacuum valve

	Number of persons	2 (Service)
	Special tools and materials	Crane
	PPE	Protective clothing Clean room gloves Fine dust mask (P2)
	Location	High vacuum valves
	System status	OFF

Procedure

Proceed as follows to service a high vacuum valve:

1 Vent the process chamber

2 Bring the high vacuum pump to the recommended status.
Refer to the OEM manual for the high vacuum pump.

3 Switch off the MSP 1200.
See Section 7.6.2 Switching off, 🗎 163.

4 Lock out and tag out the electrical power.
See Section 7.5.2 Locking out the main switch, 🗎 159.

5 Perform the service work as described in the OEM manual for the high vacuum valve

6 Mount all removed components in reverse order

Replacing the valve

If a high vacuum valve must be replaced, pay attention to the following hazard alerts:

⚠WARNING

Heavy, large component: High vacuum valve.

- High vacuum valve PC: 120 kg

Improper handling of heavy components during dismounting and mounting may result in serious contusions and fractures.

Secure all parts prior to dismounting and mounting work. Use suitable equipment to lift and transport heavy components.

⚠WARNING

High vacuum valve.

Unintended movement of the high vacuum valve is possible if the compressed air is switched on again. This may cause serious contusions and fractures.

Always switch on electric power before the compressed air for the high vacuum valve is switched on. Never reach into the high vacuum valve!

8.6.6 Overhauling the pressure relief valve

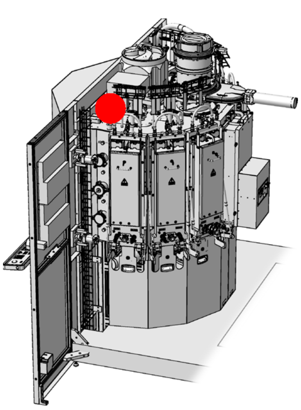
	Number of persons	1 (Maintenance)
	Special tools and materials	O-ring
	PPE	Clean room gloves
	Location	Top of process chamber
	System status	Standby

Fig. 8-3, 🗎 210 shows an exploded view illustration of the pressure relief valve.

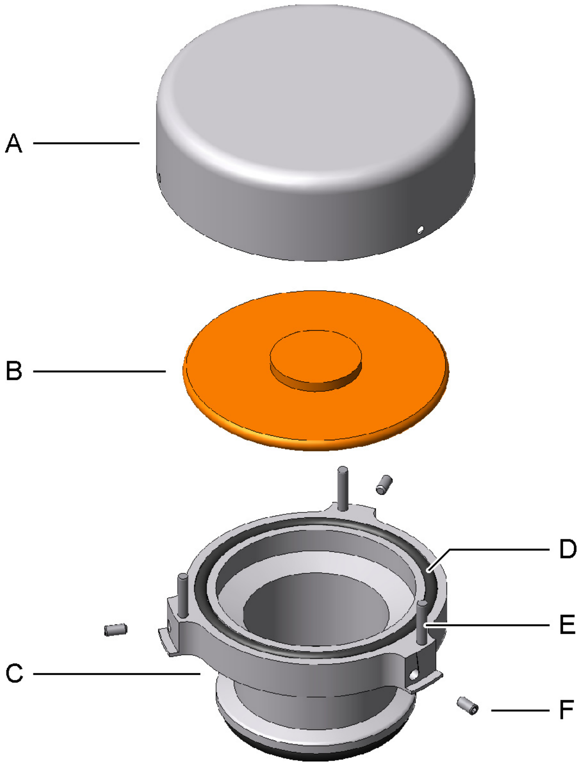


Fig. 8-3 *Pressure relief valve*

A Top cover
B Sealing plate
C Body housing with flange
D Viton O-ring
E Guide pins
F Grub screw

Functional principle

In case of overpressure, the sealing plate is lifted from the O-ring, allowing gas to escape.

NOTE:
The pressure relief valve only functions properly if installed in the upright position (opening directed upwards).

Replacing the O-ring

The O-ring must be replaced every year. Proceed as follows:

1 Vent the process chamber. For this, click the [Vent] command button in the «Vacuum Control» screen. See Section 6.6.4, 🗎 141.

2 Remove the three grub screws (item F) and take off the top cover

3 Lift off the sealing plate (item B)

4 Pull the O-ring (item D) out of the guide groove and remove it.

NOTE:
Make sure not to scratch the sealing surfaces. Do not use pointed tools to grasp the O-ring!

5 Clean the sealing surfaces (sealing plate and guide groove) with a clean cloth dipped in alcohol

6 Place a new O-ring in the guide groove. Make sure that the O-ring is seated evenly.

7 Place the sealing plate on the O-ring and make sure it is seated properly. There must be not gap between the sealing plate and the O-ring.

8 Put the top cover in position and mount it with the grub screws

9. Storage, disposal

9. Storage, disposal

9.1 Storage

This chapter is for personnel with the access right «Service» or higher.

9.1.1 Deactivating the system

1 Switch the system off. See Section 7.6.2 Switching off, 🗎 163.

2 Blow out all water circuits. For this purpose, use compressed air at a pressure of $p < 1.5$ bar (0.15 MPa; 22 psi). This protects the water circuit from corrosion. In addition, this measure protects the water circuit from damage caused by freezing when the temperature drops below 0 °C.

3 Blow out the compressed air circuit with compressed air. This removes any condensation water.

4 Switch off the mains and disconnect the system from the mains supply

5 Disconnect all media supply lines

6 Cover the system with plastic sheeting to protect it from dust

9.1.2 Storage conditions

The MSP 1200 may only be stored in its original packing units. The storage environment must fulfill the following conditions:

Temperature	10…50 °C
Relative humidity	30…80 % (non-condensing)

Tab. 9-1 Storage conditions

9.2 Disposal

9.2.1 Personnel qualifications

Knowledge of mechanical procedures and waste material is a prerequisite for correct system dismantling and the separation of system waste products.

When material which is defined as dangerous by the 91/689/EEC guidelines is to be disposed of, the end user requires additional knowledge in the following fields:

- Risks and dangers
- Disposal regulations
- Regulations for accident prevention
- First aid measures

9.2.2 Safety regulations

Read the safety chapter of this document before you dispose of the system. Adhere to all the hazard alerts and read all safety data sheets.

9.2.3 Statutory basis

Responsibilities

The end user is responsible for proper disposal of the MSP 1200 in keeping with the relevant regulations. The end user must hand over the system to either a licensed private or public disposal company or he/she must recycle the unit himself or dispose of it in accordance with the pertinent regulations.

NOTE:
If the end user hands over the MSP 1200 to a disposal company then he/she must also forward a copy of the Operating Instructions to the company in question. The Operating Instructions contain important information which is required for system disposal.

Obligation to register

Companies that dispose of and recycle their own waste material must be officially licensed to do so and are subject to official supervision. They can, under certain circumstances, be exempted from the obligatory license, provided that they are in a position to meet the demands for protection of the environment. These companies are obliged to register. For further information contact the departmental office competent for environmental protection.

Environmental statutes

Waste material must be recycled or disposed of in a manner which does not present a health hazard. Use only procedures and methods which do not cause damage to the environment. In particular, make sure that:

- Air, water and ground are not contaminated
- Flora and fauna are not endangered
- Irritation from noise and obnoxious odors does not occur
- Environment and landscape are not damaged

Sorting

Subsequent to dismantling the system, you must sort the individual system parts into their respective waste categories. Do this in accordance with the classifications contained in the current European Waste Catalog (EWC) or other similar statutes. The EWC catalog is valid for all waste material. It makes no difference if the waste material is destined for disposal or recycling.

Administration of waste material

Adhere to the official administration and handling plans which outline the procedure for dealing with waste material. These plans comprise the following:

- Type, amount and origin of waste material
- General technical regulations
- Special arrangements for specific waste products
- Suitable regions for dumping grounds and other disposal installations

The plans also include the following information:

- Natural persons and legal entities who have authorization to deal with waste material
- The estimated costs for recycling and disposal
- Measures which can be implemented to rationalize collection, sorting and handling of waste material
- Identification labels for hazardous waste

9.2.4 Disposal: Coating materials

⚠CAUTION

Coating materials.

The coating materials used in the process may be harmful.

Wear protective gloves and protective clothing with long sleeves. Read the safety data sheets and follow all instructions.

Return coating materials which are still in their closed original packaging to the supplier. Fill out and enclose a contamination declaration form.

Used coating materials must be brought to a specialized hazardous waste disposal company in accordance with local stipulations.

9.2.5 Disposal: Pump oil

⚠CAUTION

Pump oil.

Pump oil is harmful for the environment.

Pump oil and oil contaminated parts must not come into contact with the drinking water supply. Dispose pump oil as hazardous waste according to the regulations even if only small amounts are involved.

Return pump oil which is still in closed original containers to the supplier. Fill out and enclose a contamination declaration form.

Pump oil in opened containers as well as used pump oil must be classified as «oil-water-mix» and brought to a specialized hazardous waste disposal company.

9.2.6 Disposal: Other assemblies and components

The components of the MSP 1200 comprise the following materials:

Material	**Examples**
Metals and alloys	◆ Aluminum (housing, cover plates, etc.) ◆ Copper (electric lines) ◆ Steel (profiles, fixation equipment such as screws, etc.) ◆ Stainless steel (process chamber)
Glass	◆ Glass (sight glasses, panes used in display instruments)
Synthetic material and rubber	◆ Synthetic material (command elements, tubing, casing, wheels, etc.) ◆ Rubber seals, silicon tubing
Composite material	◆ Electrical material (cables, motors, components) ◆ Electronic material (printed circuit boards, PC, monitor, printer)
Packaging	◆ Wood (packing cases) ◆ Styrofoam (padding material) ◆ Plastic (foil) ◆ Iron (nails, wire)

Tab. 9-2 *Materials used in the MSP 1200*

10. Appendix

10.1 Glossary

Anode	Positive pole of a unit that is operated with direct current.
bar	Pressure unit. This unit is obsolete and has been replaced by Pa. 1 bar = 10^5 Pa = 0.1 MPa
Baratron	Vacuum gauge (capacitance manometer) for gas-type independent measurements.
Cathode	Negative pole of a unit that is operated with direct current.
DI water	Deionized water. Water that has been purified from minerals by an ion exchange process. DI water may still contain uncharged impurities such as organic compounds.
EMO	Emergency-off. If triggered, the EMO circuit shuts down potentially hazardous components. EMO buttons are red with a yellow collar.
EMS	Emergency-stop. If triggered, the EMS circuit stops the movement of a particular component. EMS buttons are red. The collar (if present) is not yellow.
End user	Legal term for the system owner. The end user is responsible for the installed system, especially for the safety and training of the personnel.
GFCI	Ground fault circuit interrupter. An electrical wiring device that disconnects a circuit whenever it detects a difference in current between the live conductors and the neutral conductor. Such an imbalance may be caused by current flowing through the body of a person who is grounded and accidentally touching the energized part of the circuit. GFCI devices are designed to disconnect quickly enough to prevent lethal electric shocks, e.g. within 25 milliseconds if the leakage current exceeds 5 mA. Also known as RCD (residual current device).
GUI	Graphic user interface. The interface used for communication between the user and the system controller. Consists of a screen, a keyboard and a pointing device (mouse or trackball).
Inert gas	Chemically non-reactive process gas, e.g. the noble gas argon.

IPA	Isopropyl alcohol. Also known as isopropanol or 2-propanol. A colorless, volatile, and extremely flammable solvent. IPA is an excellent cleaning agent for many applications.
KHAN	System controller for the MSP 1200.
LOTO	Lockout/tagout. Safety procedure which ensures that a component is isolated from energy. The LOTO procedure must be performed in order to protect employees servicing the equipment.
mbar	Pressure unit. This unit is obsolete and has been replaced by Pa. 1 mbar = 10^2 Pa = 1 hPa
MFC	Mass flow controller. Used to control the flow of process gases.
MPa	Megapascal. Pressure unit. 1 MPa = 10^6 Pa = 10 bar = 145 psi
MPG	Combined vacuum gauge (Pirani and cold cathode ionization) for operating range 1×10^{-9} mbar to 1000 mbar.
MSDS	Material safety data sheets. Suppliers of chemicals generally include safety data sheets with delivered chemicals. The safety data sheets contain all safety related information on the delivered materials. MSDS can also be found on the Internet.
OEM	Original equipment manufacturer. Original manufacturer of a component which is delivered together with the MSP 1200.
Pa	Pascal. Pressure unit. 1 Pa = 1 N/m^2 = 10^{-2} mbar = 10^{-5} bar = 7.50 mTorr
PM	Planar Magnetron. The sputtering sources used in the MSP 1200. The PM is equipped with a permanent magnet assembly that is positioned behind the target.
PPE	Personal protective equipment. PPE includes all clothing and other work accessories designed to create a barrier against workplace hazards. It must be worn during potentially hazardous work in order to prevent injuries or illness. Typical examples include gloves, safety goggles, face shield, respirator, hearing protectors, hard hat, work boots, fall protection. The PPE must conform with the national standards and laws.
psi	Pressure unit. This unit is obsolete and has been replaced by MPa. 14.5 psi = 1 bar = 0.1 MPa

RCD	Residual current device. See GFCI.
RGA	Residual gas analyzer. Used to determine the partial pressure of residual gases.
sccm	Standard cubic centimeters per minute. Gas flow in cm^3/min at standard conditions (20 °C, 1013 hPa).
slm	Standard liters per minute. Gas flow in l/min at standard conditions (20 °C, 1013 hPa).
Substrate	Part which is coated during a process run.
Torr	Pressure unit. This unit is obsolete and has been replaced by Pa. 1 Torr = 1.333 mbar = 133.3 Pa
TPR	Vacuum gauge (Pirani) for operating range 5×10^{-4} mbar to 1000 mbar.
UPS	Uninterruptible power supply. Used to supply components with power during a power failure. The UPS can supply power for a short time only.
Vacuum (in mbar)	A region in which gas is present at a low pressure. Usually, we distinguish between rough vacuum ($10^{3} \ldots 1$ mbar), fine vacuum ($1 \ldots 10^{-3}$ mbar), high vacuum ($10^{-3} \ldots 10^{-7}$ mbar), and ultrahigh vacuum ($p < 10^{-7}$ mbar).
Vacuum (in Pa)	A region in which gas is present at a low pressure. Usually, we distinguish between rough vacuum ($10^{5} \ldots 10^{2}$ Pa), fine vacuum ($10^{2} \ldots 10^{-1}$ Pa), high vacuum ($10^{-1} \ldots 10^{-5}$ Pa), and ultrahigh vacuum ($p < 10^{-5}$ Pa).
Valve	A component which controls the flow or pressure of a gas. Typical examples: Shut-off valve, metering valve, non-return valve, pressure relief valve.
Voltage sag	A drop in the mains voltage for durations from half-cycle to a few seconds. Also known as voltage dip.

11. Index