Instruction Manual

# INGENIA P3e™ Coating System

Original Instruction

**Manufacturer**

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**Please read and retain this manual to assist you in the operation and maintenance of this product. This manual is an integral part of the machine. In the event of a change of ownership, hand this manual over to the new owner.**

# Contents

| | |
|---|---|
| 1 | **Installation, Transport and Technical Data**<br>This chapter specifies the appropriate use of the INGENIA P3e™ coating system and gives all the necessary technical parameters and specifications. It also provides information on the installation and transport of the INGENIA P3e™ coating system. |
| 2 | **Safety**<br>This chapter describes the safety aspect of the INGENIA P3e™ coating system. It provides information on the remaining hazards, explains the safety precautions of the manufacturer, and explains safety regulations and warnings. |
| 3 | **Design and Function**<br>This chapter contains detailed information on the design and the function of the INGENIA P3e™ coating system. |
| 4 | **Operating Elements**<br>This chapter provides information on all control elements of the INGENIA P3e™ coating system. |
| 5 | **Operation**<br>This chapter describes how to operate the INGENIA P3e™ coating system. This covers all principle operating steps of the coating process. |
| 6 | **Leak Test**<br>This chapter describes post process options such as manual or automatic leak test. |
| 7 | **Service and Maintenance**<br>This chapter contains a description of how to maintain and service the INGENIA P3e™ coating system. |
| 8 | **Troubleshooting**<br>This chapter explains both the meaning of the different error messages and error types and the interpretation of the main error group visible on the screen of the INGENIA P3e™ coating system. |
| 9 | **Disposal**<br>This chapter explains the procedures which are to be observed when the system is to be disposed of. |

# 1 Installation, Transport and Technical Data

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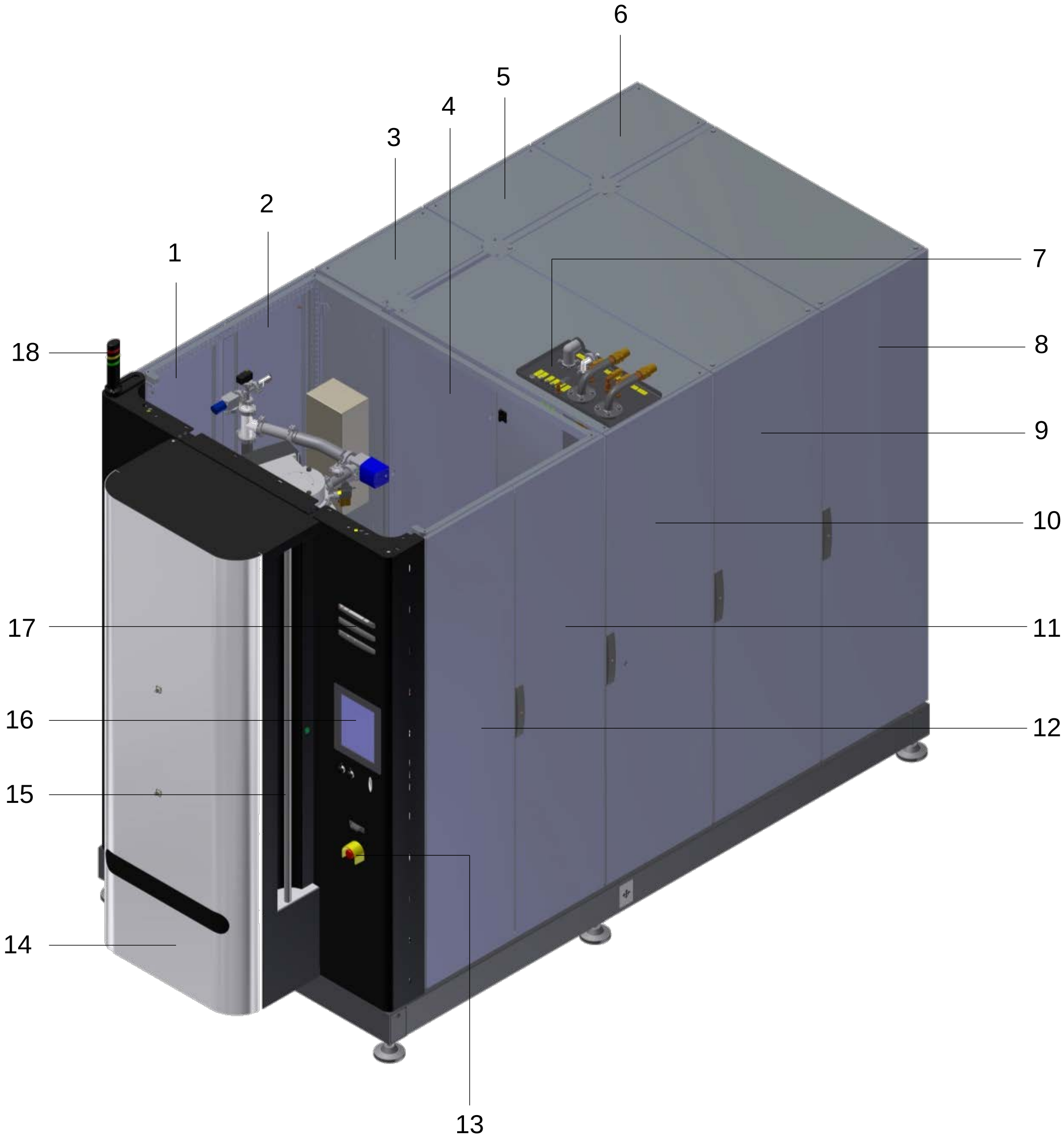
# Contents

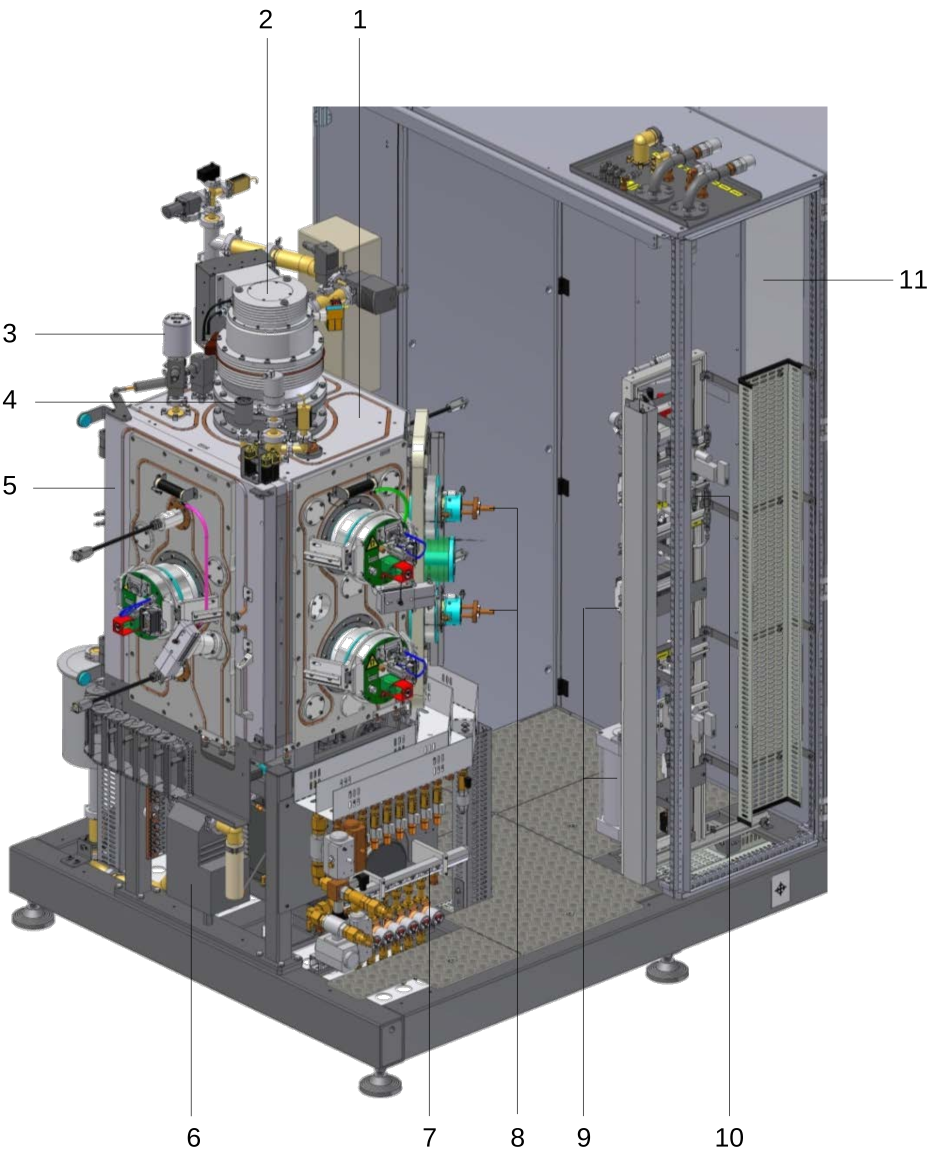
## 1.1 Important Information

### 1.1.1 System Overview



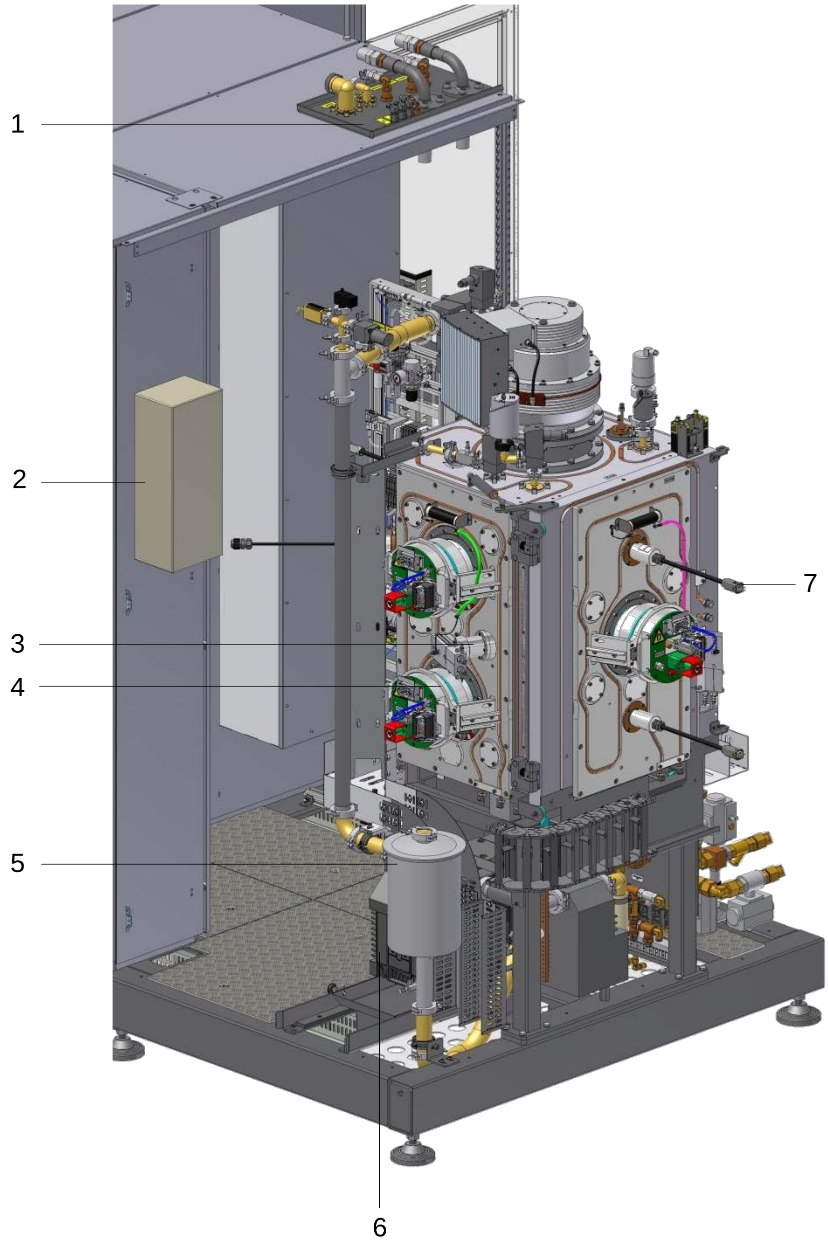
1 Door left 1
2 Door left 2
3 Power cabinet 3
4 Service door
5 Power cabinet 2
6 Power cabinet 1
7 Media platform
8 Power cabinet 4
9 Power cabinet 5
10 Cabinet for different devices
11 Door right 2
12 Door right 1
13 Emergency-off button
14 Process chamber door (incl. cover)
15 Process chamber door grip
16 Operator panel
17 Status lamps
18 Status signal

**Process chamber without the machine cover (right side):**



1 Process chamber
2 Turbo molecular pump
3 Process pressure gauge
4 Gas safety gauge
5 Process chamber door
6 Exhaust filter
7 Water battery
8 Ion sources upper, lower
9 Pneumatic distributor incl. emergency cooling and gas dilution
10 Gas distributor
11 Cooling device for power cabinet 4-5

**Process chamber without the machine cover (left side):**



1 Media platform
2 Cooling device for power cabinet 1-3
3 Trigger finger unit
4 VMS sources 1 to 6
5 Dust separator
6 Fore pump
7 Radiation heaters

**Carousel exchanging system:**

The carousel exchanging system is defined to load/unload the carousel and to place the carousel for any operation and maintenance work.

**Carousel:**

The carousel is defined to support the tools in the process chamber during the coating process.

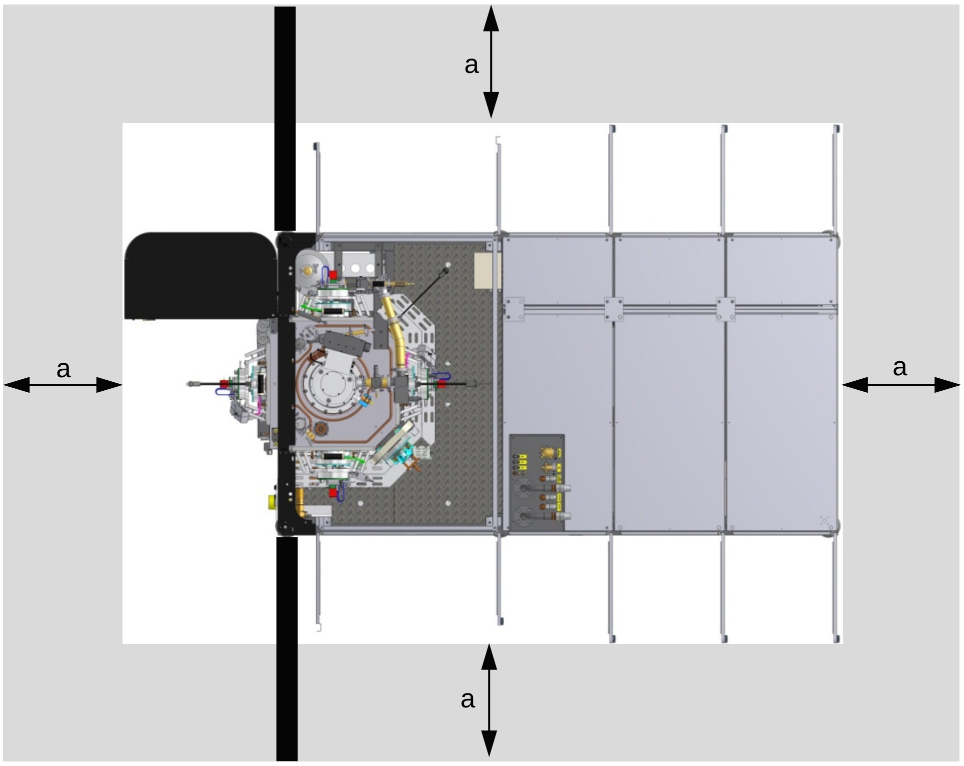
### 1.1.2 Intended Use

The intended purpose of the INGENIA P3e™ coating system is the coating of suitable substrates with various wear resistant coatings. A PVD (**P**hysical **V**apor **D**eposition) process, developed by Oerlikon Balzers is used for the deposition. The coating material is arced (cathodic) or sputter evaporated in a process chamber and a reactive gas is admitted simultaneously. The compound, e.g. titanium nitride, is deposited on the substrates as a thin, hard and extremely well adhering film. The coating can thus be applied as the last step of the tool production without distortion, loss of hardness or any influence to the microstructure of the steel.

The INGENIA P3e™ coating system allows the application of the ion plating technology for a large variety of substrates as long as they are electrically conductive.

**Any application other than the intended use is not allowed.**

### 1.1.3 Work Place for Operating Personnel




The work place of the operating personnel is around the machine. In general an emergency escaping way (a) of minimum 800mm must be guaranteed all the time.

The operator is responsible for:

- loading/unloading the coating system
- preparing the coating system depending on the process
- operating the coating system via the operating panel

The service technician is servicing the machine in the coating- and equipment room.

**More details about the danger zones for the operating personnel are in ⇨ chapter 2, "Danger Zones".**

### 1.1.4 Declaration of Conformity

**The original declaration of conformity is in the binder of the instruction manual. This certificate declares that this machine is conform with the following directive`s and standard`s.**

This machine is conform to the following directive`s:

| | |
|---|---|
| 2006/42/EC | Machine directive 2006/42/EC |
| 2006/95/EC | Low voltage directive 2006/95/EC |
| 2004/108/EC | Electromagnetic compatibility 2004/108/EC |

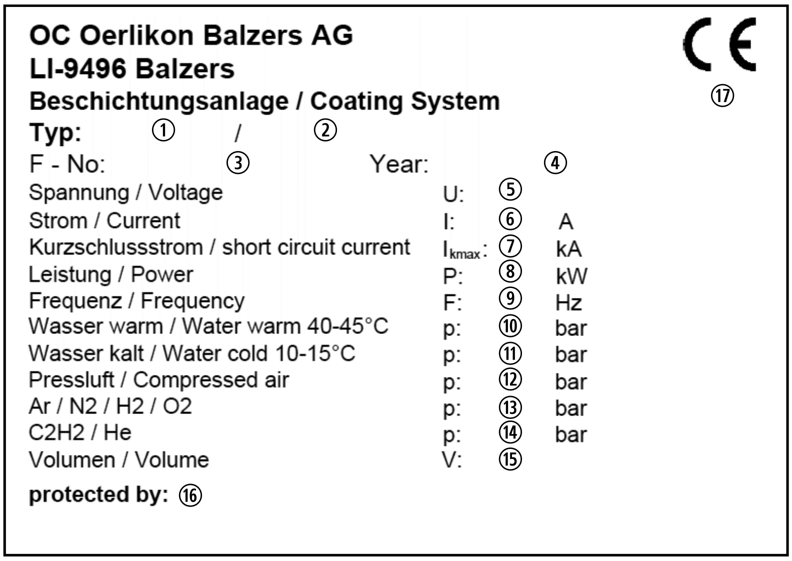
This machine is conform to the following standard`s:

| | |
|---|---|
| EN ISO 12100: 2010 | Safety of machinery - General principles for design - Risk assessment and risk reduction |
| EN ISO 13857: 2008 | Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs |
| EN 349: 2009 | Safety of machinery - Minimum gaps to avoid crushing of parts of the human body |
| EN 60204-1: 2010 | Safety of machinery - Electrical equipment of machines - Part 1: General requirements |
| EN ISO 13849-1:2008 | Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design |
| EN ISO 13850: 2008 | Safety of machinery - Emergency stop - Principles for design |
| EN 61000-6-2: 2011 | Electromagnetic compatibility (EMC) - Generic standards |
| EN 61000-6-4: 2011 | Electromagnetic compatibility (EMC) - Generic standards - Emission standard for industrial environments |
| EN 55011: 2010 | Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement |
| EN 1127-1:2011 | Explosive atmospheres - Explosion prevention and protection - Part 1 |

Additional:

| | |
|---|---|
| BGV B114 | Electromagnetic fields from the 01. June 2001 |

### 1.1.5 Type Label




| | | | |
|---|---|---|---|
| ① | Machine type | ⑨ | Frequency |
| ② | Contract number | ⑩ | Pressure of the warm water |
| ③ | Serial number | ⑪ | Pressure of the cold water |
| ④ | Year of manufacture | ⑫ | Pressure of the compressed air |
| ⑤ | Voltage | ⑬ | Pressure of Ar, $N_2$, $H_2$, $O_2$ |
| ⑥ | Current | ⑭ | Pressure of $C_2H_2$, He |
| ⑦ | Short circuit current | ⑮ | Volume of the process chamber |
| ⑧ | Power | ⑯ | Patent information of the product |
| ⑰ | Conformity marking | | |

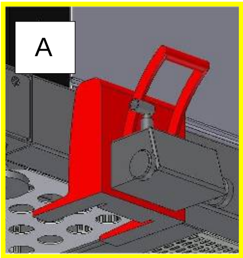
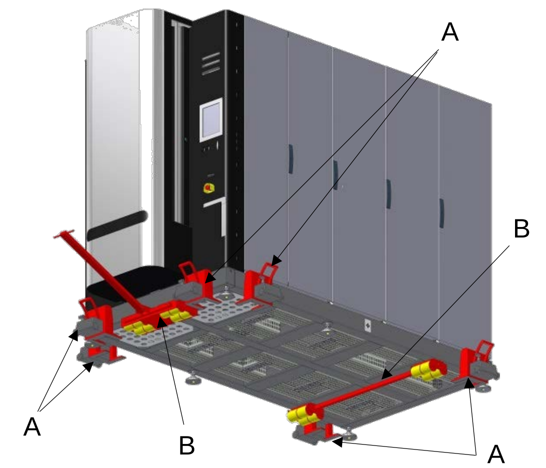
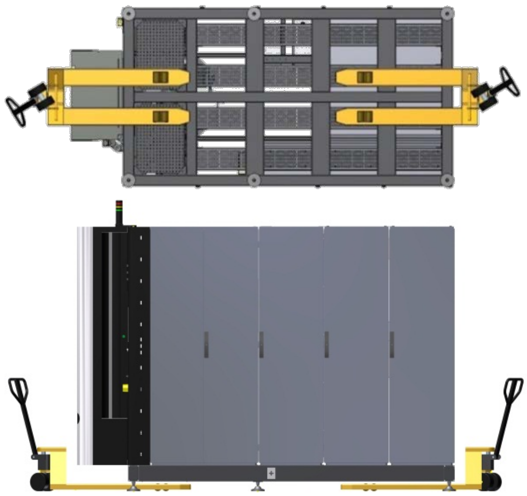
**The type label is located at the:**

- **power cabinet above the main power switch**
- **electrical box on the back side of the machine**

## 1.2 Transport

The complete machine is delivered in various packages. Only qualified personnel, defined by the manager and/or the transport company are authorized to transport the packages on site.

The in-house transportation of the machine can be done by means of three options:

| | | |
|---|---|---|
| 1. | **Using rollers:**<br>Lift the system by means of 6 hydraulic cylinders (A).<br><br><br>Position the rollers (B) underneath the coating system. | <br> |
| 2. | **Using 2 fork lifters:**<br>• min. 2 tons (each)<br>• min. 1600 mm length<br>• max. 580 mm width<br><br>For correct positioning of the fork lifters underneath the coating system ⇨ refer to the pictures beside. |  |
| 3. | **Using a forklift truck:**<br>• min. 3.5 tons<br>• min. 1700 mm length<br><br>**A passage-width of min. 3.5 m is required from entrance until to the final position.**<br><br>**In order to prevent tipping of the INGENIA P3e™ coating system the displacement of the forks has to be set to the maximum.** |  |

The after sales service engineer is authorized for unpacking the machine and packages.

**All packages are marked with the necessary information for the transport.**

## 1.3 Installation

The after sales service engineer is authorized to install the machine regarding the directive of the manufacturer. He is also responsible to:

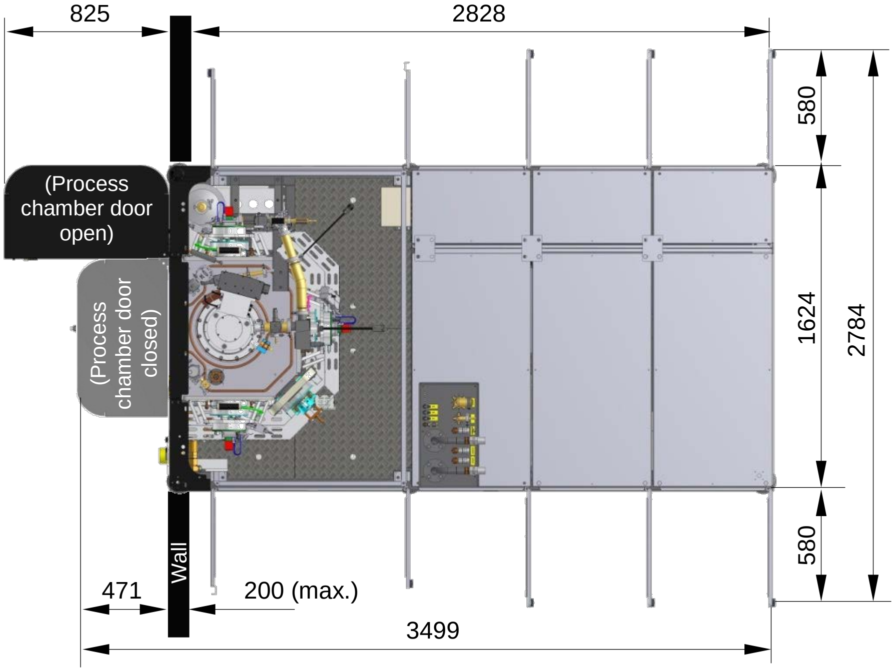
- unpack the packages and check the scope of delivery
- positioning of the coating system
- installation of the coating system
- performing the acceptance test regarding the contract

## 1.4 Technical Data

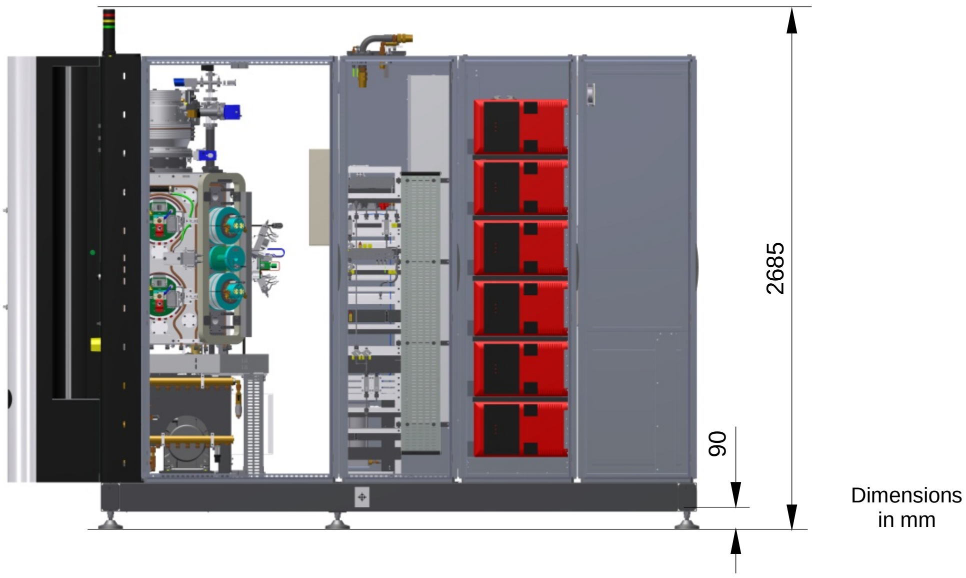
### 1.4.1 Dimension and Weight

**The structural design and the space layout conform to the standards and regulations in Switzerland. Planning and installation of the INGENIA P3e™ coating system must also comply with local safety regulations.**

**Top view:**



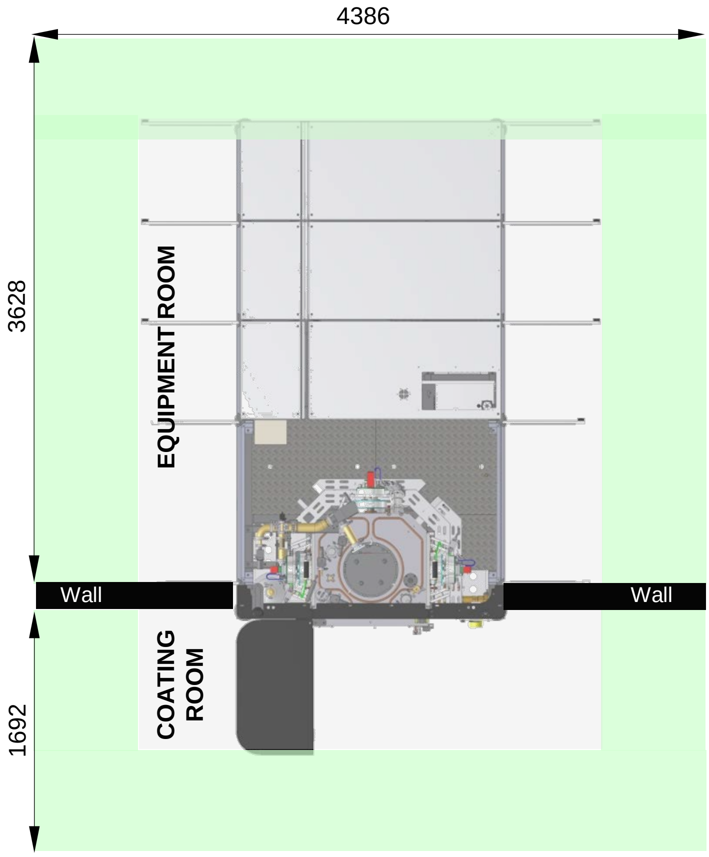

**Side view:**

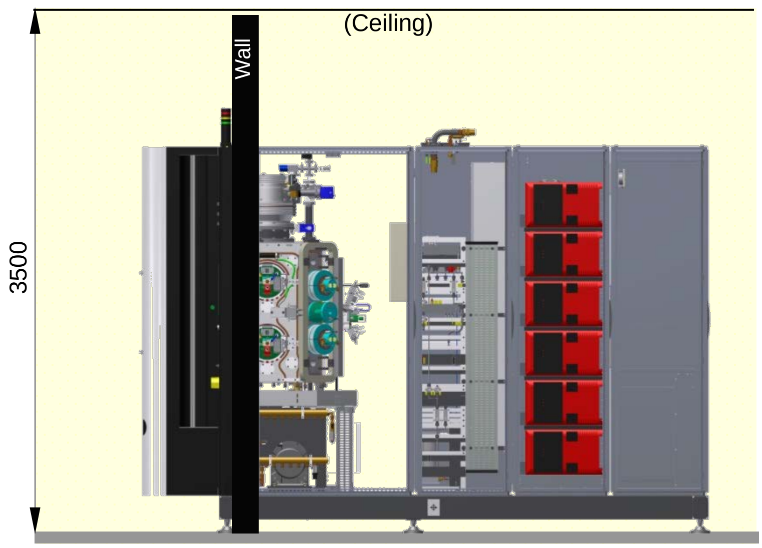


| **Pos.** | **Component** | **length** (mm) | **width** (mm) | **height** (mm) | **weight** (kg) | **volume (l)** |
|---|---|---|---|---|---|---|
| ⇨page 16 | INGENIA P3e™ process chamber (incl. all options, cover, without terminal) | 3490 | 1624 | 2675 | 3000 | 333 |
| ⇨page 9 | Carousel exchanging system | 1185 | 676 | 1160 | 200 | |
| ⇨page 9 | Carousel with dummy load | 420 | 410 | 670 | 300 | |
| **Total weight** | | | | | **3500** | |

### 1.4.2 Room Requirements

#### 1.4.2.1 Room Dimensions



### 1.4.2.2 Room Conditions

The floor in the equipment room and in the coating room must be at the same level.

- maximum floor inclination: 3.5 ‰
- floor weight bearing capacity: 1000 kg / $m^2$
- recommended: seamless urethane, water-resistant, easy to clean and dust free
- particles crumbling away from the floor, walls or ceiling must be avoided

The floor surface surrounding the machine must be level and even

**⚠ DANGER**

**Danger of explosion due to dangerous gases!**

**A too high concentration of flammable gases (and optional O2) in the coating and/or machine room can cause an explosion in connection with sparks, open fire or electrical switches, such as relays or power contactors etc. !**

**To avoid any explosive gas mixtures the customer must ensure that the area where the coating system is located is free of explosive zones.**

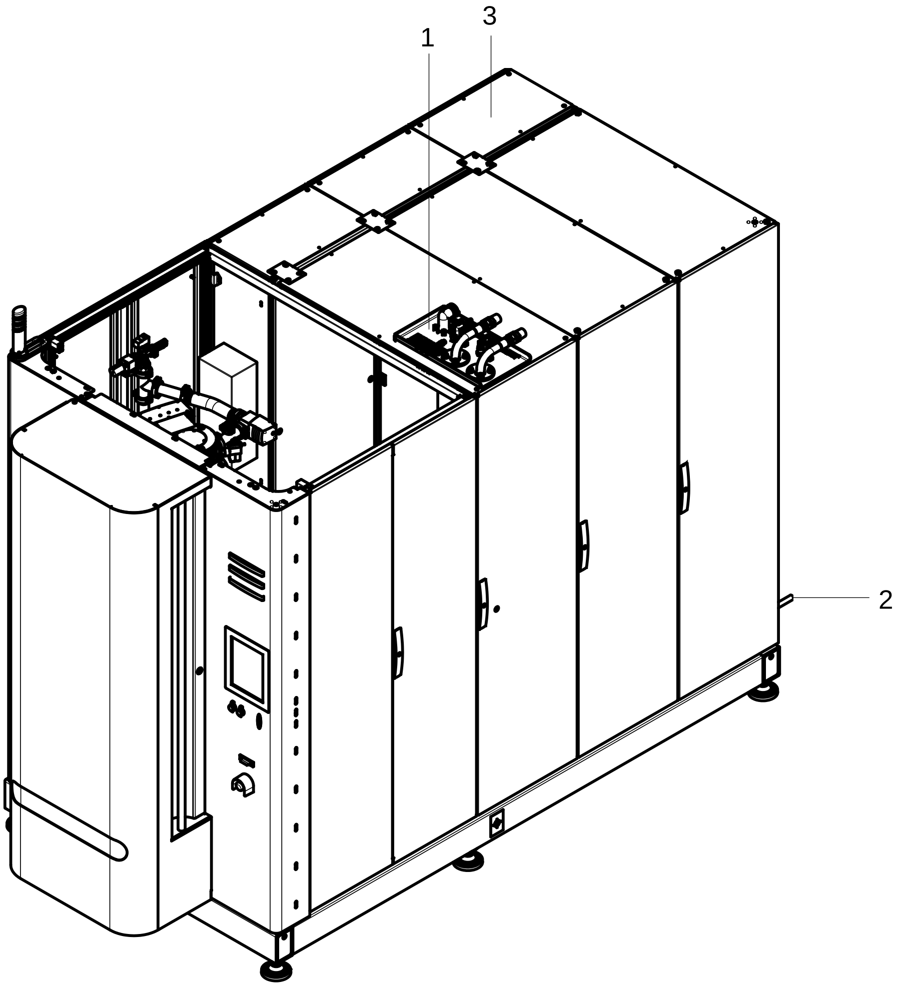
**It is the customer’s responsibility that local regulations (location, mounting, installation of the gas supply and ventilation of the room) and organizational precautions are observed.**

### 1.4.2.3 Physical Environment an Operating Conditions

| Topic | Value |
|---|---|
| **Coating room:** | |
| Ambient temperature: | 15 – 30°C |
| Air humidity | Max. 60 %, relative |
| Air quality | No oil mist from other production machines |
| | |
| **Equipment room:** | |
| Ambient temperature: | 15 – 30°C |
| Air humidity | Max. 60 %, relative |
| Generated heat of the power cabinets | All generated heat is continuously abducted by the internal cooling systems in the power cabinets. |
| Generated heat of the process chamber | approximately 4 kW |
| | |
| **Altitude:** | Electrical equipment shall be capable of operating correctly at altitudes up to 1000m above sea level. |

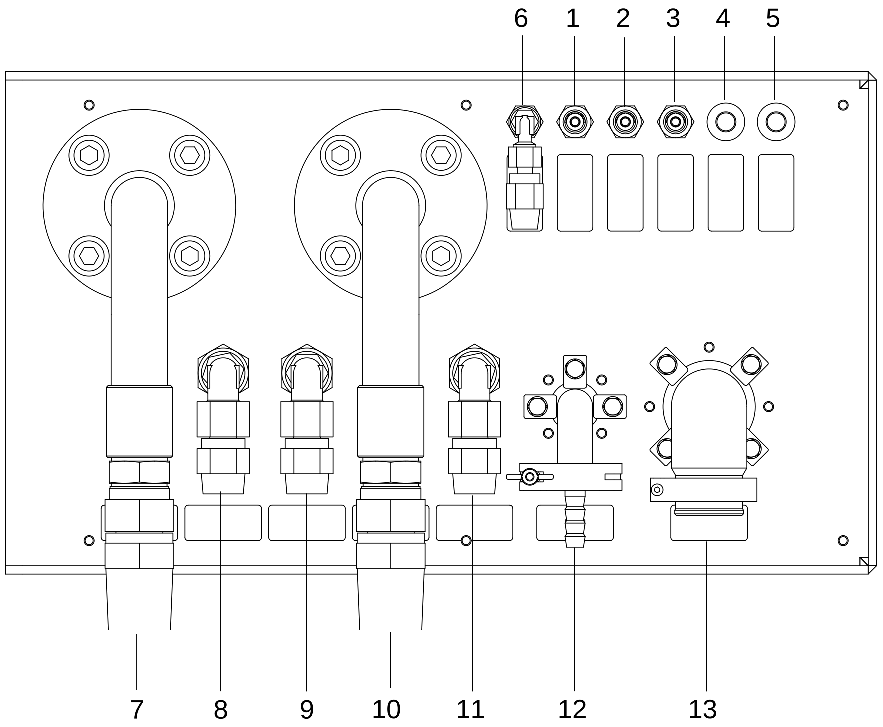
| | |
|---|---|
| **Storage condition:** | |
| Ambient temperature: | 15 – 30°C |
| Air humidity | Max. 60 %, relative |

### 1.4.3 Energy Supply




| | | |
|---|---|---|
| 1 | Media platform with following connections:<br>■ Gas supply<br>■ Water supply<br>■ Compressed air supply<br>■ Exhaust | ⇨ chapter 1.4.3.1 |
| 2 | Water drain | ⇨ chapter 1.4.4.1 |
| 3 | Electrical power | ⇨ chapter 1.4.3.10 |

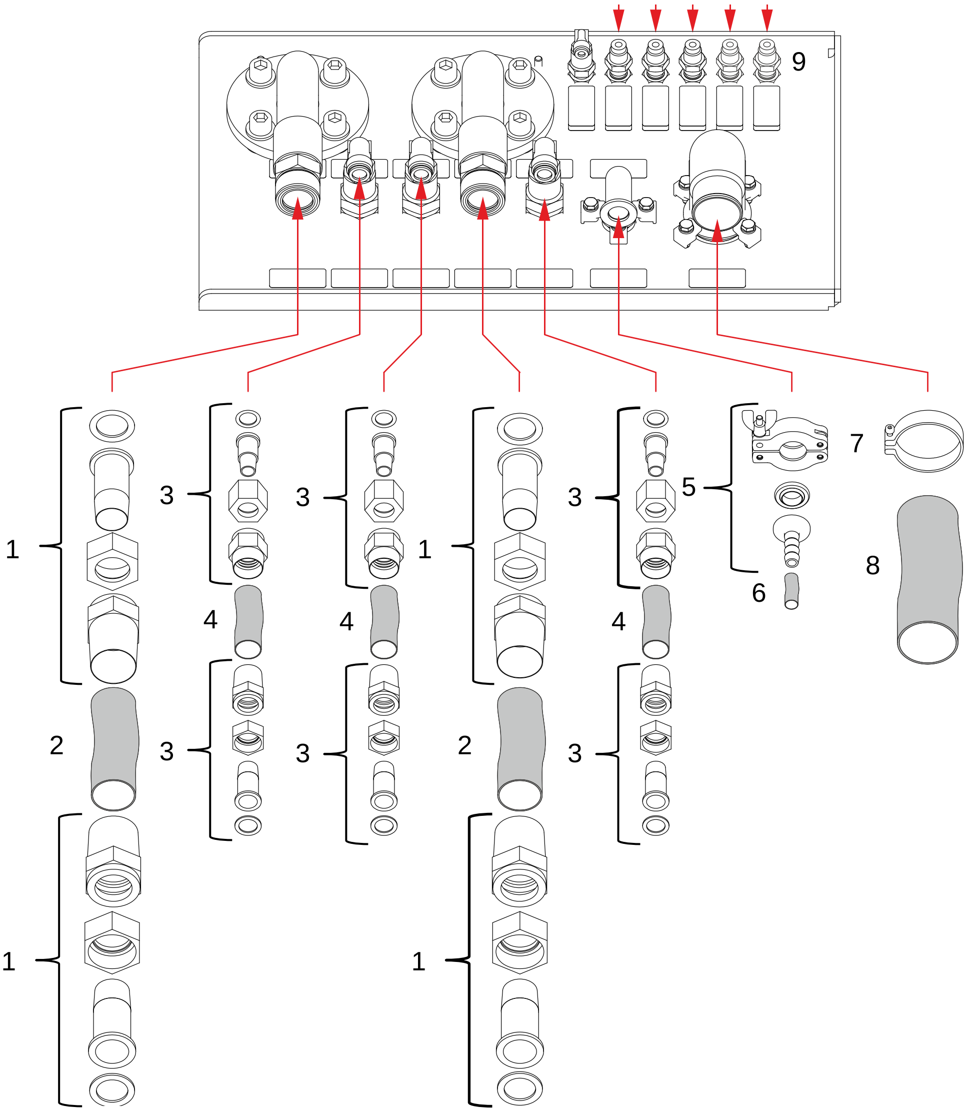
### 1.4.3.1 Media Platform




| | | |
|---|---|---|
| 1 | Argon (Ar) IN | ➪ chapter 1.4.3.3 |
| 2 | Nitrogen ($N_2$) IN | ➪ chapter 1.4.3.3 |
| 3 | Hydrogen ($H_2$) IN | ➪ chapter 1.4.3.3 |
| 4 | Oxygen ($O_2$) IN* | ➪ chapter 1.4.3.3 |
| 5 | Spare gas IN* | ➪ chapter 1.4.3.3 |
| 6 | Compressed air IN | ➪ chapter 1.4.3.2 / 1.4.3.9 |
| 7 | Warm cooling water IN | ➪ chapter 1.4.3.2 / 1.4.3.7 |
| 8 | Cold cooling water IN | ➪ chapter 1.4.3.2 / 1.4.3.6 |
| 9 | Cold cooling water OUT | ➪ chapter 1.4.3.2 / 1.4.3.6 |
| 10 | Warm cooling water OUT | ➪ chapter 1.4.3.2 / 1.4.3.7 |
| 11 | Emergency cooling water IN | ➪ chapter 1.4.3.2 / 1.4.3.8 |
| 12 | Cooling gas Helium (He) IN | ➪ chapter 1.4.3.2 |
| 13 | Exhaust OUT | ➪ chapter 1.4.3.2 |

(* Optional

### 1.4.3.2 Connections at the Media Platform



| | | |
|---|---|---|
| 1 | Sleeve joint hose union, M36x2 | B4164566ZS |
| 2 | Water hose Ø 25/37. | B2355655KN |
| 3 | Sleeve joint hose union, ½” | B4164566ZF |
| 4 | Water hose Ø 13/22 | B2355326KN |
| 5 | Centering ring DN16 ISO-KF<br>Clamping ring DN10-16 ISO-KF<br>Hose nipple DN16 ISO-KF-12<br>Hose clamp | 211-059<br>211-001<br>211-387<br>B4163102A |
| 6 | Hose (for cooling gas) | B2359257HR |
| 7 | Clamping ring, DN32-40 ISO KF<br>Centering ring Al/Vi DN32-40<br>Hose nipple DN 40 ISO-KF-40 | 211-003<br>211-087<br>211-404 |
| 8 | Reinforced PVC-hose, DN 40 | K2300054 |
| 9 | Swagelock VCR ¼” or<br><br>Swagelock tube fitting (SS-4-WVCR-6-400) | -<br><br>K4100347 |

### 1.4.3.3 Gas Specification

**⚠ DANGER**

**Danger of explosion due to contaminated gas components!**

**Serious body injury can be the consequence if not adhered to this instruction.**

- **When handling gas components (e.g. gas lines, flow controller etc.) always wear rubber gloves. Any kind of grease (e.g. Apiezon vacuum grease) or oil must not be used on all components between gas supply and process chamber.**

**⚠ DANGER**

**Danger of explosion!**

- **The customer must ensure that the pressure in the gas lines does not exceed the prescribed value for each dangerous gas. Refer to the gas specifications.**
- **For security reasons the INGENIA P3e™ coating system may only be connected to the house installation if a flashback arrestor and a stop valve for each flammable gas has been installed on the house installation connection point.**
- **Danger to the life of personnel if other or additional gases are used which are not permitted by Oerlikon Balzers!**
- **Only the following gases are permissible for the different processes in the INGENIA P3e™ coating system.**

**It is the customers responsibility that local regulations (location, mounting, maintaining, installation of the gas supply and ventilation of the room) and organizational precautions are observed.**

**The material of all gas lines (only stainless steel, except cool gas “Helium”), the connections, the gaskets and all components have to be suitable for the associated pure gas. Contaminated gas will result in system malfunction and poor coating quality. Ensure gas lines are clean.**

**Since the INGENIA P3e™ coating system uses flammable gases the system owner has to ensure, that all danger areas ("explosion protection zones") and system components are well signed by official signs and symbols and organizational precautions are observed.**

| Gas | Minimum purity | Pressure (to unit)** | Approximately consumption per batch | Minimum pressure before exchange |
|---|---|---|---|---|
| Argon (*Ar*) | 99.995 % (4.5) | 1 – 1.2 bar | 9 l | 10 bar |
| Nitrogen *($N_2$)* | 99.995 % (4.5) | 1 – 1.2 bar | 25 l | 10 bar |
| Hydrogen *($H_2$)* | 99.995 % (4.5) | 1 – 1.2 bar | 4 l | 6 bar |
| Helium (*He*) | 99.995 % (4.5) | 0.8 – 1.0 bar | 68 l | 10 bar |
| Oxygen ($O_2$) | 99.999 % (5.0) | 1 – 1.2 bar | Process dependent | 10 bar |

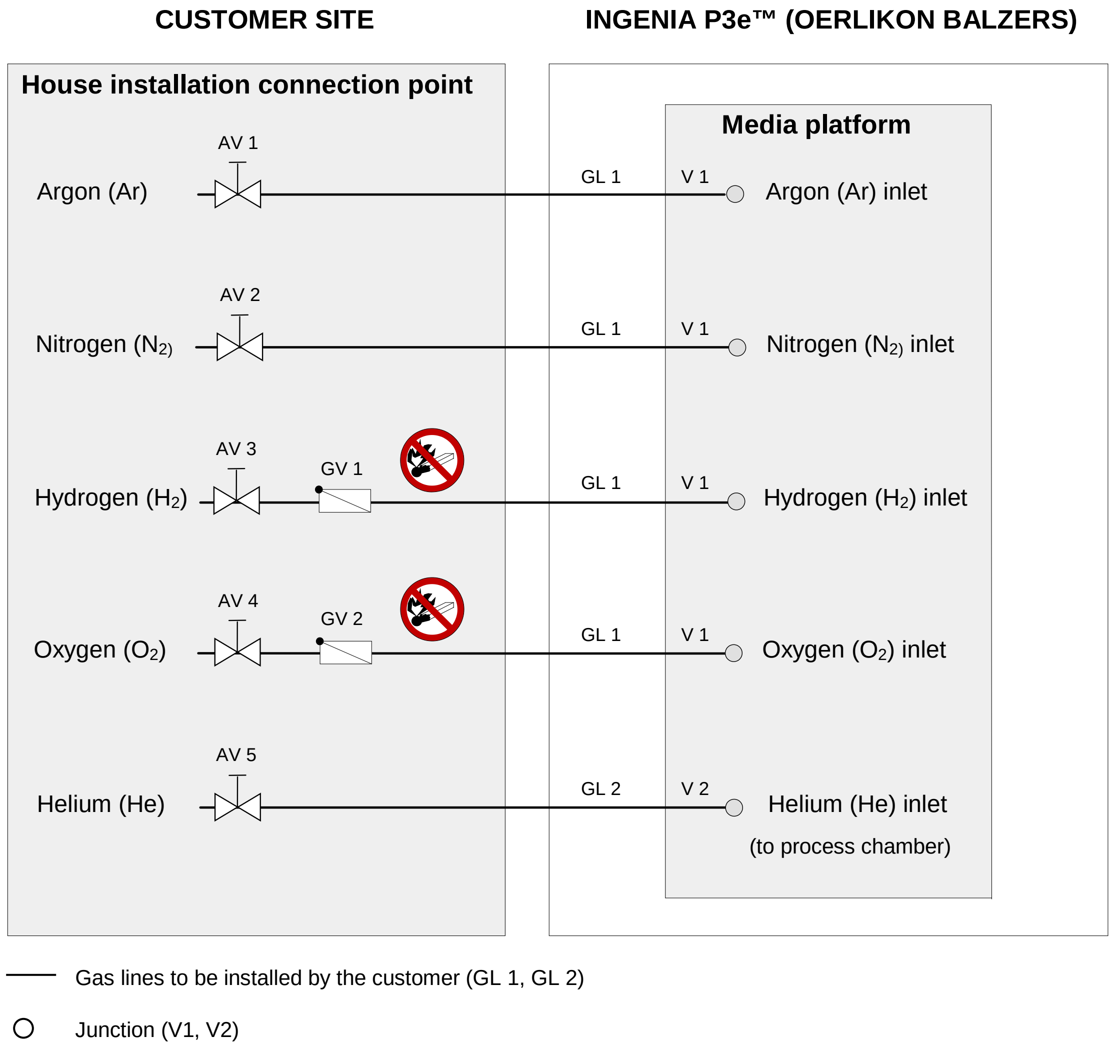
(** The pressure (**Gauge Pressure**) is zero-referenced against ambient air pressure, so it is equal to absolute pressure minus atmospheric pressure.

**Gas tube specification customer side:**

- finish in stainless, acid-proof steel tube, quality **1.4401** or **1.4404**
- chemically cleaned
- Swagelok bolts and/or TIG (tungsten inert gas) orbital welded
- leak tested with 10 bar Helium (He) for tightness and firmness

**Only qualified personnel are allowed to make the gas line connection to the machine.** **⇨ Chapter 2, “Gas safety precautions”.**

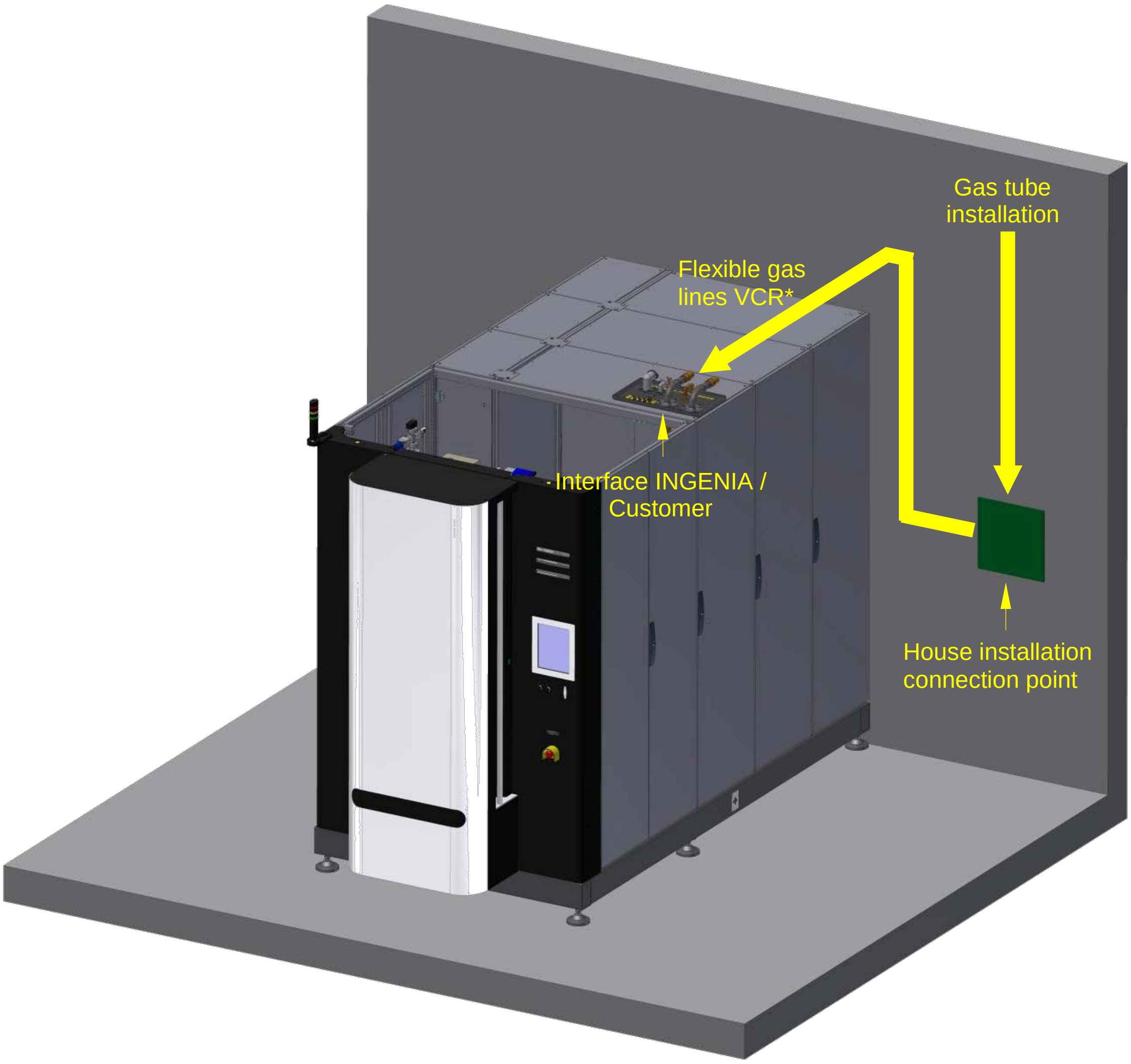
#### 1.4.3.4 Gas Supply Planning Customer Site




| | |
|---|---|
| *AV 1-5* | Stop valve |
| *GV 1* | Flashback arrestor Hydrogen (red) |
| *GV 2* | Flashback arrestor Oxygen (blue) |
| GL 1 | Gas line, www.Swagelok.com |
| GL 2 | Gas hose **Helium**, (plastic Ø 22/10) |
| V1 | Connections VCR ¼ " male or Swagelok tube fitting ¼" |
| V2 | Small flange connection, (DN16 ISO-KF) |

### 1.4.3.5 Gas Installation Customer Site

The house installation connection point has to be mounted visibly and accessible (observe the opening range of the system doors.)




(* To be ordered at Swagelok

#### 1.4.3.6 Cold Cooling Water

| Topic | Value |
|---|---|
| Hardness | < 12 mmol / l * |
| Inlet pressure at the machine | 4 to 5 bar |
| Particle filter | <25 µm |
| Inlet temperature | 10 to 15° C |
| Consumption | 17 l/min. |
| Conductivity | < 500 µS/cm |
| Chloride | < 10 mg / l |
| pH | 6.0 to 8.0 |
| Machine generated heat emission | approx. 10 kW |

*12 mmol/l = 67.20°d / 1200,00 ppm / 84.20 °e / 120,00 °f

#### 1.4.3.7 Warm Cooling Water

| Topic | Value |
|---|---|
| Hardness | < 0.1 mmol / l * |
| Inlet pressure at the water battery | 5 to 6 bar |
| Particle filter | <25 µm |
| Inlet temperature | 40 to 45 °C |
| Consumption for max. extension | 59 l/min. |
| Conductivity | < 500 µS/cm |
| Chloride | < 10 mg / l |
| pH | 6.0 to 8.0 |
| Machine generated heat emission for max. extension | approx. 80 kW |

*0.1 mmol/l = 0.56°d / 10 ppm / 0.7 °e / 1,00 °f

#### 1.4.3.8 Emergency Cooling Water and Blow Out

| Topic | Value |
|---|---|
| Inlet pressure at water battery | min. 3 to 6 bar |
| Particle filter | <25 µm |
| Inlet temperature | 10 to 30° C |
| Consumption | 25 l/min. |
| Duration of emergency cooling | min. 2h |
| Minimum required volume of water tank | $3m^3$ |

### 1.4.3.9 Compressed Air

| Topic | Value |
|---|---|
| Pressure | 6 to 7 bar (0.6 to 0.7 MPa) |
| Consumption | approximately 4.0 m3 / h |
| Feed connector customer site | Rp ¼" female |

**Compressed air purity classes (ISO 8573-1:2010):**

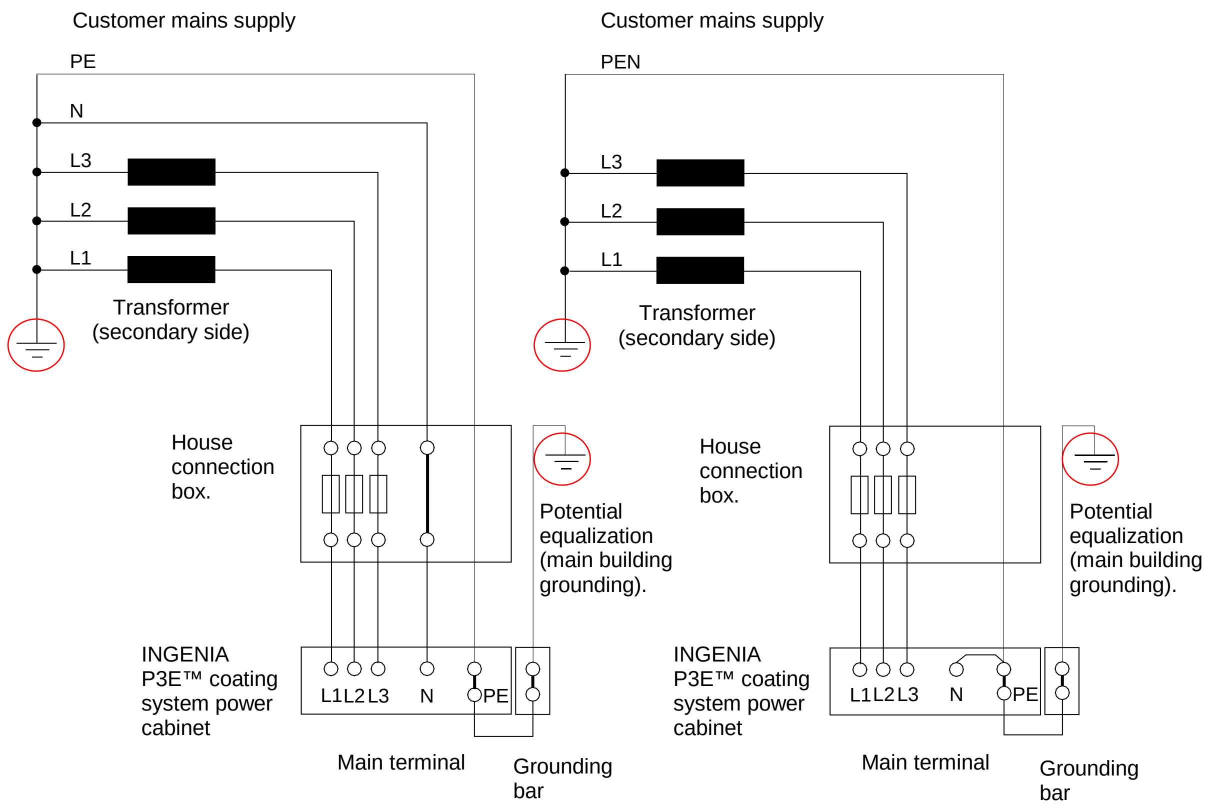
| | | | | | |
|---|---|---|---|---|---|
| **Class 1*** | Solid particles: | Particle size (µm)<br>Max. number of particles per $m^3$ | 0.1 - 0.5<br>≤ 20.000 | 0.5 – 1<br>≤ 400 | 1 – 5<br>≤ 10 |
| **Class 6*** | Humidity and liquid water: | Pressure dew point (°C) | | | ≤ +10 |
| **Class 2*** | Oil: | Total concentration: Aerosol, liquid and vapor ($mg/m^3$) | | | 0.1 |

(* Minimum required quality

### 1.4.3.10 Electrical Power

**It is the customers responsibility that local regulations (location, mounting, installation of the electrical supply) and organizational precautions are observed !**

**Variant 1:** (3L+N+PE) **Variant 2:** (3L+PEN)

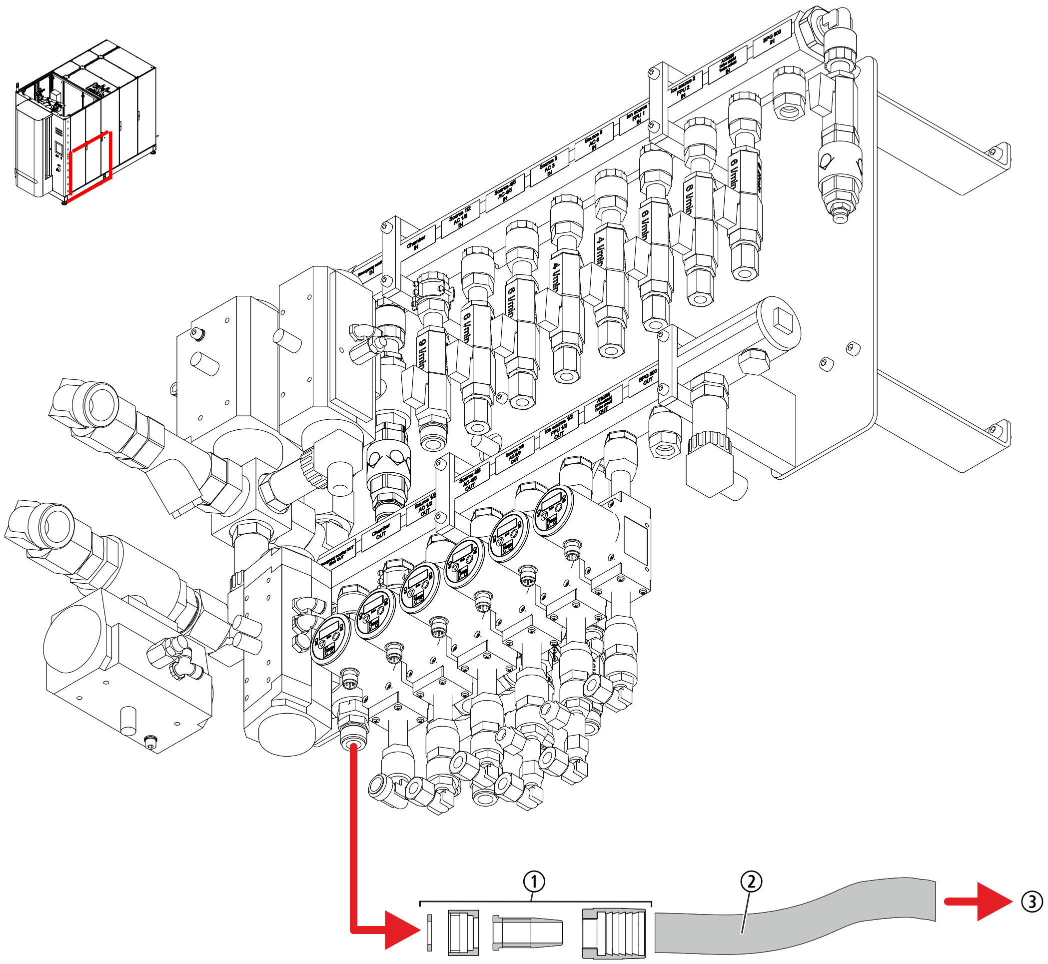



**This grounding conductor must always be attached, to protect personal !**

| Topic | Value |
|---|---|
| Voltage | 3 x 400/230V~, 3L + **N** + PE (PEN) |
| Voltage fluctuations | less than +10% / -10% |
| Power | 125kVA |
| Main fuse | recommended 3x200A for max. extension |
| Frequency | 50 or 60Hz ± 1% |
| PE / PE wire (grounding) | connect machine grounding wire to building grounding |
| Max. impedance connection lead | Zm ≤ 0.13 Ω |
| Location of the interface | On the top of the power cabinet |

### 1.4.4 Emission

#### 1.4.4.1 Water Drain




| Topic | Value |
|---|---|
| Connection to the water drain: | |
| ① Sleeve joint hose union, ½” | B4164566ZF |
| ② Water hose Ø 13/22 | B2355326KN |
| ③ To the water drain | |

**The emergency cooling water flows through the cooling channel and via water hose to the water drain. This water is clean. The outlet must be planned according local regulations.**

#### 1.4.4.2 Noise Level

| Topic | Value | Location |
|---|---|---|
| Average noise level during operation | 59 dB(A) | in the equipment room |
| Maximum noise level | 65 dB(A) | during start up in equipment room |

#### 1.4.4.3 Exhaust Outlet for Fore Pumps

- **The gas exhaust line should be separate from other systems.**
- **Oerlikon Balzers recommends that a maximum of only 5 coating systems be led into the same gas exhaust line.**
- **The gas exhaust line must lead directly outside of the coating- and equipment room.**
- **The reinforced hose must have an inside diameter of minimum 40 mm (unpressurized).**

# 2 Safety

| | |
|---|---|
| **Manufacturer** | Oerlikon Balzers Coating AG<br>LI-9496 Balzers<br>Phone 00423 / 388 4111<br>Fax 00423 / 388 5419<br>info.balzers@oerlikon.com |
| **After sales service** | Oerlikon Balzers Coating AG<br>LI-9496 Balzers<br>Phone 00423 / 388 / 4816<br>Fax 00423 / 388 / 6676<br>aftersales.balzers@oerlikon.com |

**Please read and retain this manual to assist you in the operation and maintenance of this product. This manual is an integral part of the machine. In the event of a change of ownership, hand this manual over to the new owner.**

# Contents

## 2.1 Intended Use

**The coating system must be used only for the purposes described in chapter 1!**

## 2.2 Organizational

### 2.2.1 Personnel Definition

| **Role** | **Definition** |
|---|---|
| Manager | The Manager is defined as the product owner or user. |
| Operator | The operator belongs to the operating personnel. A machine training special for the operator is mandatory. A own access level in the visualization allows him to perform his job.<br>⇨ Refer to chapter 2.2.2 “Qualifications of the Personnel” |
| Service technician | The service technician belongs to the operating personnel. A machine training special for the service technician is mandatory. The different access level in the visualization allows him more manual functions.<br><br>The maintenance may only be carried out by a qualified and electrical skilled person.<br>⇨ Refer to chapter 2.2.2 “Qualifications of the Personnel” |
| Manufacturer | The Manufacturer is defined as:<br>▪ the producer of the machine.<br>▪ every person that identifies themselves as a manufacturer by labeling the product with their name, their trademark or another identification sign.<br>▪ the person that reworks the machine.<br>▪ the manufacturer’s representative.<br>▪ the importers of the machine or other companies in the sales chain so far as their activity can include safety-related aspects. |
| After sales service engineer | The after sales service engineer is a personnel of the manufacturer and defined to:<br>▪ install the machine regarding manufactures regulations.<br>▪ support the operating personnel via hotline or remote servicing.<br>▪ support the operating personnel on site for any repair / maintenance and to install enhancements. |

**Only qualified personnel are permitted to operate the coating system!**

### 2.2.2 Qualifications of the Personnel

(See also DIN VDE 0105 or ICE 364)

Those who have been instructed by the manager on the use of the machine are considered to be qualified. They must:

- have received authorization to carry out work from the manager of the machine.
- be in possession of the relevant standards and instructions, i.e.
  - the technical data as well as instructions concerning the correct use of the system (operating conditions).
  - general and specific safety regulations.
  - all locally valid precautionary measures and requirements concerning the system installation.
- be fully acquainted with the use of maintenance tools.
- be familiar with all national regulations regarding the disposal of industrial materials, industrial resources, replacement parts and the system itself.
- know the regulations for the prevention of accidents.
- possess knowledge of first-aid and be fully acquainted with the local emergency facilities.
- be an electrical skilled person to perform electrical maintenance work.

**⚠ CAUTION**

**The manager must ensure that the above listed directives are strictly observed!**

**If an error message occurs on the control display the operator must contact the service technician immediately.**

## 2.3 General Safety Regulations

- Only authorized persons are allowed to work with the machine.
- The access to the machine for unauthorized persons is strictly forbidden.
- Service intervals have to be adhered to, and preventive maintenance should be carried out.
- Always keep this instruction manual in the vicinity of the coating system.
- Smoking and open fire in the coating- and equipment room is strictly forbidden.
- Wear safety glasses to protect you from flaking materials.
- Any unauthorized modifications on the coating system are prohibited.
- The operating personnel must report any safety related irregularity.
- The operating personnel must be involved in an overall training program. The skills of the operating personnel have to be up2date.
- The safety and operating instructions in this manual must be observed.
- The machine may only be operated with the installed safety devices.
- The statutory accident prevention regulations must be observed.
- Strictly adhere to the local accident prevention regulations.
- In order to be equipped for any emergency, it is recommended to keep a list with the necessary phone numbers and contacts.
- Do not lean a ladder to the machine for any work on the top side.
- The machine has to be always in perfect working order. Any malfunction must be corrected immediately.
- Before setting the machine into operation go through the checklists in ⇨ chapter 0 “
- Machine-Specific Safety Precautions” step by step.
  Follow the links within the list for remedy of possibly occurring problems!
- All labels at the coating machine and at the entrance to the coating- and equipment room must be clearly and visible placed. Exchange them if necessary.

## 2.4 Remaining Risks

### 2.4.1 Warning Messages in this Manual

When using technical products, remaining risks, in the worst case for the manager´s health and life, for personnel or third parties still exist. The manufacturer eliminates and reduces them primarily by means of a safe construction. They are reduced further by protective equipment and devices. The existing risks that cannot be eliminated by construction or by protective equipment are called “Remaining risks”.

The following three categories of remaining risks are used in this manual as warning messages:

| | |
|---|---|
| ⚠ DANGER | The signal word **DANGER** is in combination with the signal color red.<br>This warning level indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury. |
| ⚠ WARNING | The signal word **WARNING** is in combination with the signal color orange.<br>This warning level indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury. |
| ⚠ CAUTION | The signal word **CAUTION** is in combination with the signal color yellow.<br>This warning level indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.<br>This signal word is also used for property damage. |

When a potential hazard is activated by a trigger, damage occurs as a consequence. To prevent this, i.e. to take precautionary measures, it is necessary to identify the potential hazards and the releasing triggers and to ensure that they are kept separate.

For that reason, each potential hazard must always be considered in relation to a trigger.

All persons working with the machine should be aware of potential hazards.

**Sign and Symbols:**


Danger of hot surface


Danger of crushing


Danger for corrosive substances


Warning of dangerous electrical voltage


Warning of a danger

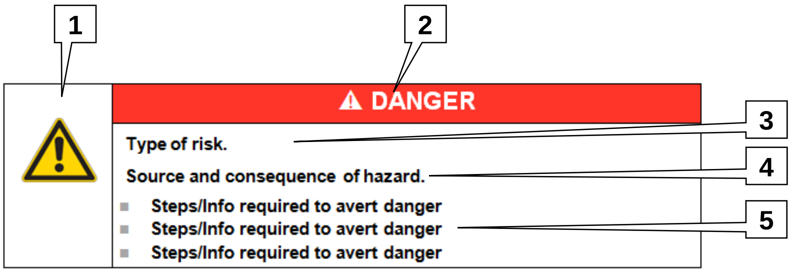

Danger of slipping


Warning of a magnetic field

Explosive atmosphere hazard warning labels


Warning of fire-promoting materials.

**Structure of a warning message:**




- **1** Symbol / pictogram
- **2** Signal word with the signal color
- **3** Type of danger
- **4** Source and consequence of hazard or description of the hazard.
- **5** Steps / Info to avert danger

### 2.4.2 Potential Hazards

The machine equipment is built, using state-of-the-art technology and can be operated safely. However, during its use potential hazards exist if:

- the machine is not operated in accordance with its intended use
- the equipment is used by unauthorized persons
- the notes and symbols regarding safety in these instructions and on the machine, and the respective signs or plates in the working area are not observed
- the gas supply and exhaust systems are not installed correctly
- other gases than the ones stated in the manual are used, or if gases are fed into the process chamber from other points than those defined in this manual.

Only authorized and trained personnel who is aware of existing potential risks as described in this manual, is permitted to operate the machine. The equipment must be kept in technically perfect condition in accordance with the guidelines and instructions stated especially in this chapter and in ⇨ chapter 7 “Service and Maintenance”. Malfunctions that affect safety must be reported and corrected immediately.

### 2.4.3 State of the Art

The machine has been built in accordance with the latest state of the art and the recognized safety rules. It fulfills the requirements specified in the latest version of the system, low voltage and EMC guidelines. However improper use may cause danger to the life and limb of the user or a third party, damage to the system and other tangible assets. All safety instructions mentioned in this manual and in the manuals of component producers have to be strictly observed.

The described process corresponds to the current state of technology and all recognized technical safety regulations. Nevertheless, a residual risk still exists regarding use of the process and the unit. This residual risk can mean danger to life and limb for people and/or impairment to the functioning capability. The unit may only be operated in an unimpaired operable condition. Defects that could impair the operational safety must be eliminated immediately.

## 2.5 Personal Safety Precautions

In general, the staff must wear suitable work clothes and protective equipment. You will find safety instruction regarding the personal protective equipment in this manual. Ensure that the following personal protective equipment is available:

- Safety glasses
  Protection against flaking materials.

- Safety gloves
  Protection against hot surfaces.
- Rubber gloves
  Protection against pollution of vacuum parts. Clean vacuum parts are important to avoid machine malfunctions.

- Breathing mask
  Protection against coating dust when working inside the chamber.

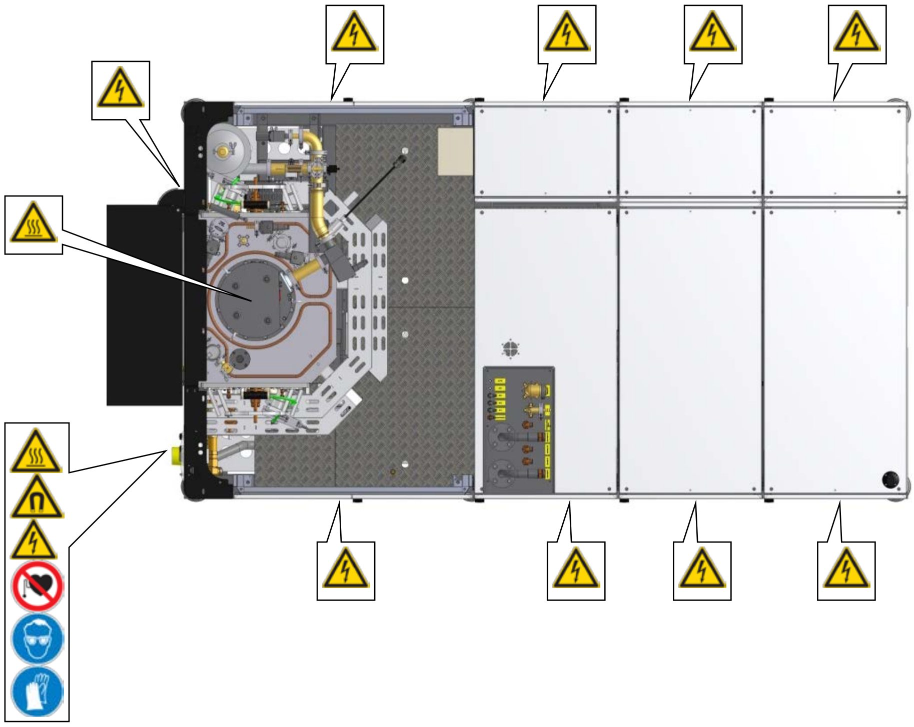
## 2.6 Machine-Specific Safety Precautions

Read this manual before start with the operation of this machine. Follow the safety precautions listed below and observe all warnings in this manual.

The safety precautions comprise:

- Warning Signs at the Machine, ⇨ in chapter 2.6.1
- Warning Signals at the Machine, ⇨ in chapter 2.6.2
- Danger Zones, ⇨ in chapter 2.6.3
- Gas Safety Precautions, ⇨ in chapter 2.6.4
- Electrical Safety Precautions and Safety Interlocks, ⇨ in chapter 2.6.5
- Power-off in an Emergency, ⇨ in chapter 2.7

### 2.6.1 Warning Signs at the Machine



| Sign | Description | Ordernumber |
|---|---|---|
|  | Hot surface | B4697902E2 |
|  | Strong magnetic field | B4697902DW |
|  | High voltage | B4697902DE |
|  | No persons with pacemakers | B4697908GA |
|  | Wear eye protection | B4697908KA |
|  | Wear safety gloves | B4697908KN |

**⚠ WARNING**

**Danger of injuries/machine faults due to non-observance of warning signs!**

**Observe warning signs at the machine!**

**Strictly observe all warning signs at the machine and take suitable precautions against possible dangers!**

**Clean dirty warning signs, replace damaged warning signs!**

### 2.6.2 Warning Signals at the Machine


**1** Warning signal red (new warning or error)
**2** Warning signal white (process is running)
**3** Warning signal green (end of process)
**4** Audible signal (in combination with the red and green warning signal)

### 2.6.3 Danger Zones

**⚠ WARNING**

**Mark danger zones, keep out of danger zones!**

**Personnel injuries caused by not-marked danger zones!**

**Danger zones are marked at the machine, see the following chapters!**

**Make sure that other persons than the operator or the service-technician keep out of this area!**

**During operation or service no other persons than the operator/ service technician are permitted to stay within the area of the machine!**

**Operators and service personnel must strictly observe subsequent safety information!**

#### 2.6.3.1 Warning Signs at Entrance

The following warning signs must be clearly and visible placed at the entrance to the coating- and equipment room:

| Sign | Description | Ordernumber |
|---|---|---|
|  | No open fire or smoking | B4697908GQ |
|  | No persons with pacemakers | B4697908GC |

**⚠ DANGER**

**Strong magnetic fields, danger to the life of personnel!**

**Danger to the life of persons with pacemakers due to strong magnetic fields in the area around the machine!**

**Persons with pacemakers must keep a distance of at least 5 meters from the machine! Strong magnetic fields surrounding the machine in an area up to a distance of 5 meters can cause pacemaker malfunctions!**

**The manufacturer does not take any responsibility for harms to the health of persons with pacemakers if this rule is not strictly observed!**


**⚠ DANGER**

**Danger of fire, danger of explosion!**

**Danger to the life of personnel due to fire and thereby caused explosion of flammable gases!**

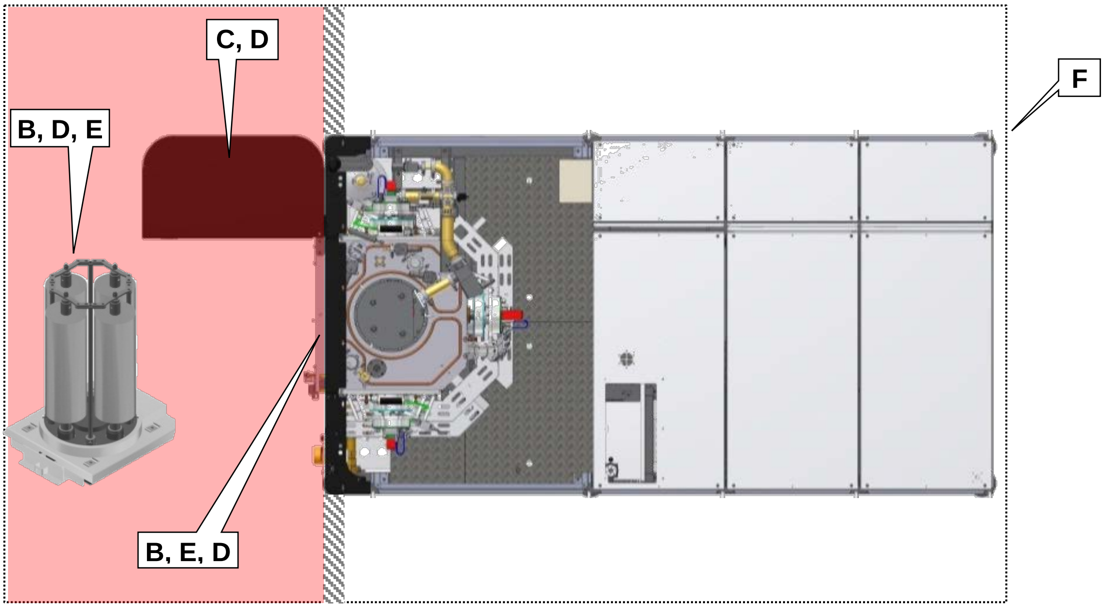
**It is the customer´s responsibility to undertake all necessary measures for fire prevention (installation of smoke detectors in the hall, providing extinguishers etc.) according to the local regulations in the country where the machine is in use!**

**Smoking and open fire in the coating room and equipment room is strictly forbidden!**

**The smoke detectors in the coating and equipment room and the extinguishers have to be checked regularly and replaced if not functioning correctly according to the instructions of the manufacturer.**

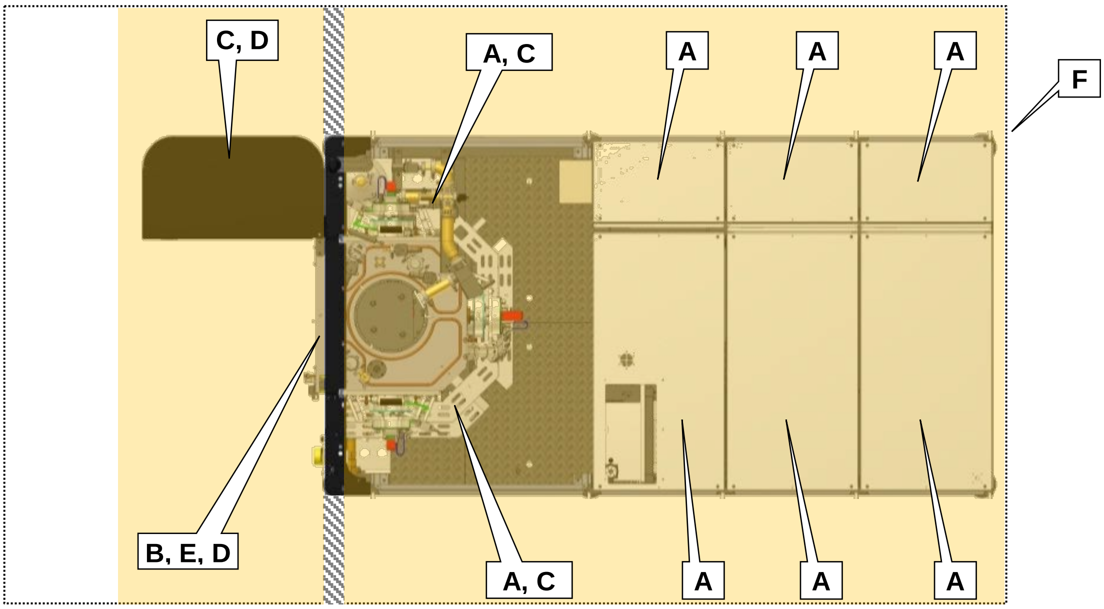
**The manufacturer does not take any responsibility for personnel harms or for machine damages if any of the above listed instructions are not observed thoroughly!**

### 2.6.3.2 Danger Zones for the Operator




| | | | |
|---|---|---|---|
| **B** | Hot surface | **E** | Flaking material |
| **C** | Strong magnetic field | **F** | ⇨ Refer to chapter 2.6.3.1 |
| **D** | Crushing | | |

### 2.6.3.3 Danger Zones for the Service Technician




| | | | |
|---|---|---|---|
| **A** | High voltage | **D** | Crushing |
| **B** | Hot surface | **E** | Flaking material |
| **C** | Strong magnetic field | **F** | ⇨ Refer to chapter 2.6.3.1 |

**⚠ DANGER**

**Dangerous voltage, electric shocks!**

**Danger of fatal electric shock when touching parts under voltage.**

**In case of any machine service the service technician is responsible to reinstall any protection or covers back to the machine.**

**When carrying out service works on electrical system equipment always use insulated tools!**

**Only qualified personnel are allowed to carry out works on electrical equipment!**

**⚠ WARNING**

**Crushing, personnel injuries!**

**There is a danger of serious injury when working on the carousel drive system. It will cause serious injury when moved unintentionally.**

**⚠ WARNING**

**Hot surfaces, burns of the skin!**

**Never touch hot surfaces of machine components, especially pumps during or immediately after operation!**

**Ensure that the parts have cooled down before starting any maintenance or service activities!**

**⚠ CAUTION**

**Harmful substances, skin contact and inhalation!**

**Beware of material flaking-off in the process chamber. During coating, the carousels and the shielding are coated.**

**Avoid producing dust during all maintenance and cleaning work in the process chamber. Wear a breathing mask with a type P3 filter, eye protectors and appropriate protective clothing. Do not eat, drink or smoke.**

**Carefully read the safety data sheets of the respective coating materials. Adhere to the safety instructions given in them.**

**When working with parts which will be exposed to vacuum, clean gloves must be used!**

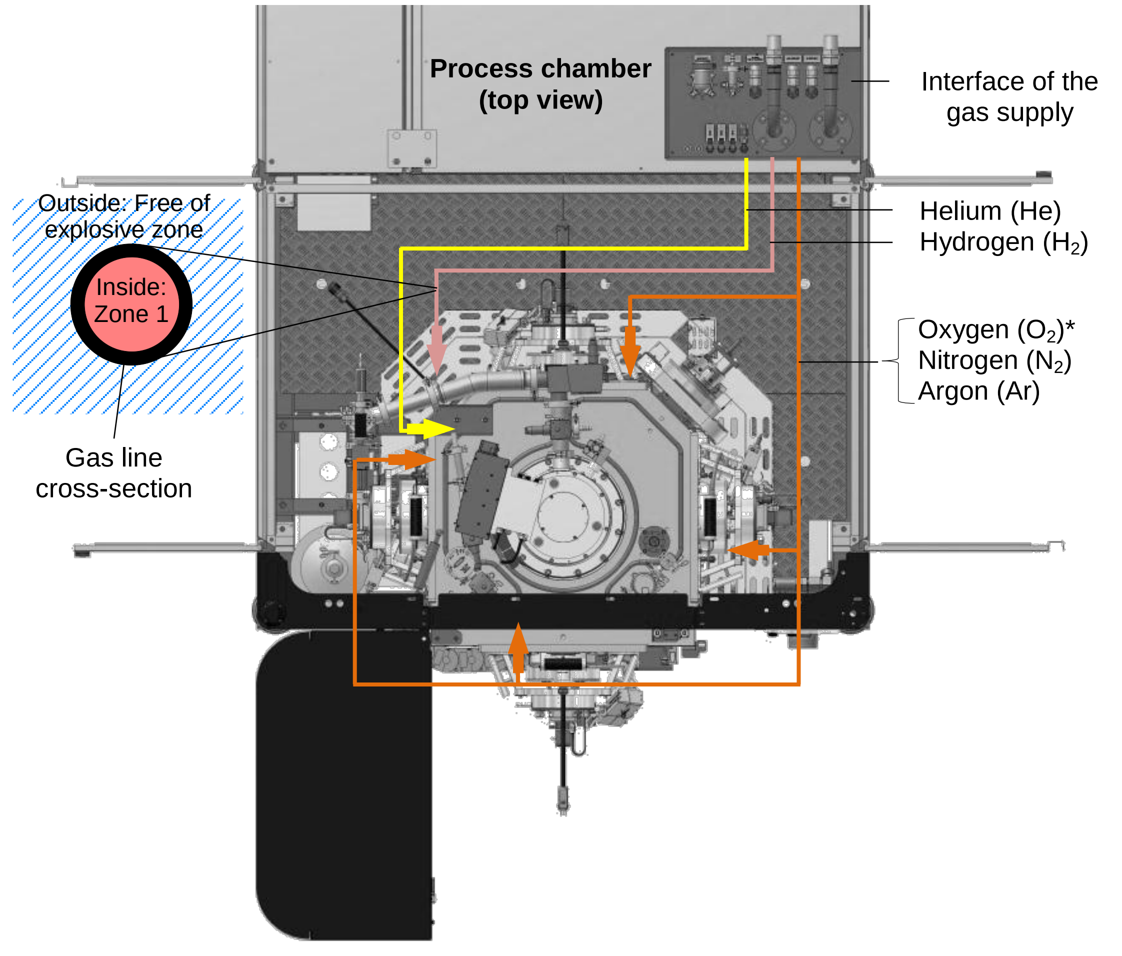
### 2.6.4 Gas Safety Precautions

The machine is using flammable gases and is not designed to be installed in explosive zones. While using the machine as the indented use, there are no special explosive zones except inside the gas lines. The gas-bearing, beginning from interface of the gas supply (top of the machine) to the process chamber was carried out as “durably technically tight” in accordance with the standard “EN 1127-1:2011” Appendix B.

**Used gas-bearing elements:**

| Elements | Leak testing interval |
|---|---|
| VCR fittings | ■ Leak test during commissioning or after disconnecting /connecting of a VCR connection of the gas system. |
| The spring less diaphragm valves (pneumatically operated, normally closed) the series SWAGELOK DN.<br>SS-DNFR4-P1-C<br>SS-DNVR4-P1-C<br>SS-BN-VCR4-2CM | ■ Automatically leak test performed by the machine. This leak test has to be performed periodically, but at least every 7 days (forced by the machine software). |
| Flow controller (MFC) for:<br>**Hydrogen** ($H_2$)<br>**Spare gas***<br>**Oxygen** ($O_2$)*<br><br>(* Optional | ■ Automatically leak test performed by the machine. This leak test has to be performed periodically, but at least every 7 days (forced by the machine software).<br>■ Annual calibration and testing at the supplier. |

**Drawing of the gas-bearing hardware:**




(* Optional

**⚠ DANGER**

**Danger of explosion!**

**Danger to the life of personnel due to inadequate/ wrong installation of auxiliary components in the safety circuit!**

**It is the manager´s responsibility to install the gas supply lines according to the local regulations in the country where the machine is in use!**

**The manager is responsible for correct installation of components which are replaced by him on site. Regular maintenance of components as per instructions in chapter "Service and Maintenance" is the customer´s duty! Before setting the machine into operation, go through the checklist in chapter 2.6.4.3 step 1 to 4. Follow the links within the list for remedy of possibly occurring problems!**

**The manufacturer does not take any responsibility for personnel harms or for machine damages if any of the points of the following checklist have not been executed, respectively if any of the instructions for remedy of problems have not been performed thoroughly!**

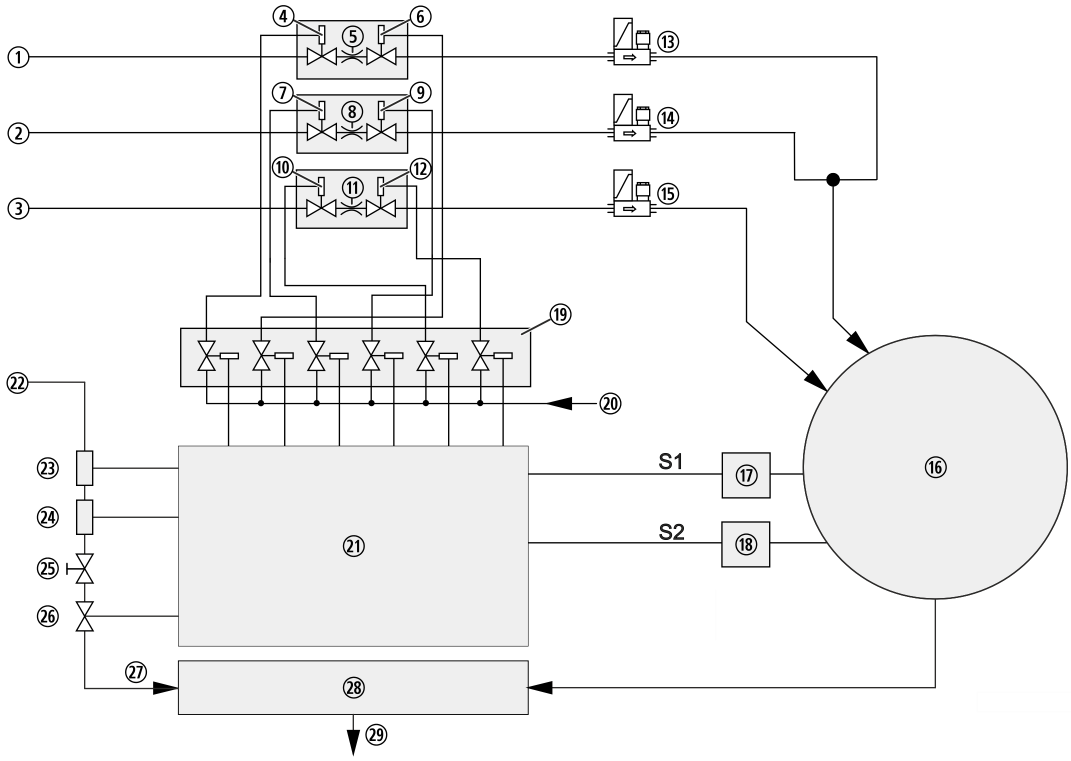
**⚠ DANGER**

**Danger of explosion!**

**Danger to the life of personnel due to leaking gas!**

**When the machine is not in use for a longer time (e.g. weekend, vacation etc.) and the process chamber is not pumped (machine status "OFF" or "stand-by"), the hand valves of the gas bottles with flammable gases have to be closed!**

### 2.6.4.1 Principle Diagram




- ① Gas supply Oxygen ($O_2$)*
- ② Gas supply spare gas*
- ③ Gas supply Hydrogen ($H_2$)
- ④ Gas safety valve Oxygen ($O_2$) V1*
- ⑤ Gas orifice Oxygen ($O_2$)*
- ⑥ Gas safety valve Oxygen ($O_2$) V2*
- ⑦ Gas safety valve spare gas V1*
- ⑧ Gas orifice spare gas*
- ⑨ Gas safety valve spare gas V2*
- ⑩ Gas safety valve Hydrogen ($H_2$) V1
- ⑪ Gas orifice Hydrogen ($H_2$)
- ⑫ Gas safety valve Hydrogen ($H_2$) V2
- ⑬ Mass flow controller Oxygen ($O_2$)*
- ⑭ Mass flow controller spare gas*
- ⑮ Mass flow controller Hydrogen ($H_2$)

(* Optional

- ⑯ Process chamber
- ⑰ Safety pressure gauge (S1)
- ⑱ Pirani pressure measurement (S2)
- ⑲ Gas terminal pneumatic valves
- ⑳ Compressed air supply gas terminal
- ㉑ Safety PLC
- ㉒ Compressed air supply gas dilution
- ㉓ Flow switch 1
- ㉔ Flow switch 2
- ㉕ Flow limiter
- ㉖ Valve for gas dilution
- ㉗ To fore pump
- ㉘ Pumping unit
- ㉙ Exhaust

**Preconditions for opening the gas safety valves (V1, V2):**

**The following explanation applies to all different flammable gases (and optional $O_2$) used in the INGENIA P3e™ coating system.**

**To admit any flammable gases (and optional $O_2$) into the process chamber all these conditions must be previously fulfilled simultaneously:**

- The pressure in the process chamber is measured (monitored) by two independent pressure sensors **(17)** and **(18).** The two switch points for the switching on sequence are pre-defined. If the two switch points are switching on in the wrong sequence, the gas safety valves (V1, V2) remain closed.
  - The pressure sensor **(17)** (CDG 025D-S) permits the gas safety valves (V1, V2) to open if the pressure in the process chamber does not exceed an absolute pressure of **2 mbar**.
  - The pressure sensor **(18)** (PCG 550) permits the gas safety valves (V1, V2) to open if the pressure in the process chamber does not exceed an absolute pressure of **2 mbar**.
- The dilution air flow through the fore pumps is measured (monitored) by two independent dilution flow meters **(23)** and **(24).** They permit the gas safety valves (V1, V2) to open if the dilution air flow through the fore pumps does not drop below the threshold.
  - The flow switch **(23)** permits the gas safety valves (V1, V2) to open if the dilution flow exceeds 61 l/min.
  - The flow switch **(24)** permits the gas safety valves (V1, V2) to open if the dilution flow exceeds 61 l/min.

**If one of the preconditions does not correspond to the requirements above, a (manual or automatic) reset of the gas security circuit is necessary. To reset the gas security, manually admit cool gas or vent the process chamber to an absolute pressure less than 2 mbar.**

### 2.6.4.2 Leak Rate Test

A leak rate test must be performed weekly for all valves of the gas supply system!

The leak test is performed automatically after each process and can only be switched of deliberately for a single process! The leak rate test can be performed with the machine software. ⇨ Refer to chapter 6 “Leak Test”.

### 2.6.4.3 Checklist for Gas Safety

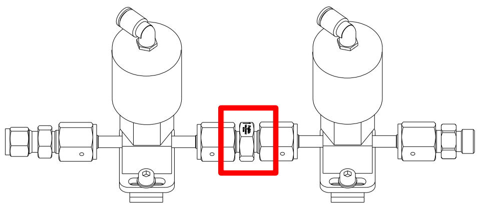
| No. | Description of task | Instructions |
|---|---|---|
| 1 | Gas orifice | ⇨ see chapter 2.6.4.4 |
| 2 | Check gas safety valves | ⇨ see chapter 2.6.4.5 |
| 3 | Check flashback arrestors | ⇨ see chapter 2.6.4.6 |
| 4 | Check exhaust gas dilution | ⇨ see chapter 2.6.4.7 |

### 2.6.4.4 Gas Orifice

**⚠ DANGER**

**Danger of explosion!**

**Danger of explosion due to non-installation of gas orifices!**



**To reduce the risk of explosion in the event of a malfunction of a mass flow controller, it is mandatory to install a gas orifice for each flammable gas line. The gas orifice is installed between the gas safety valve V1 and V2. ⇨ Refer to picture in chapter 2.6.4.1.**

**For Hydrogen ($H_2$) a gas orifice of 0.20 mm is required!**

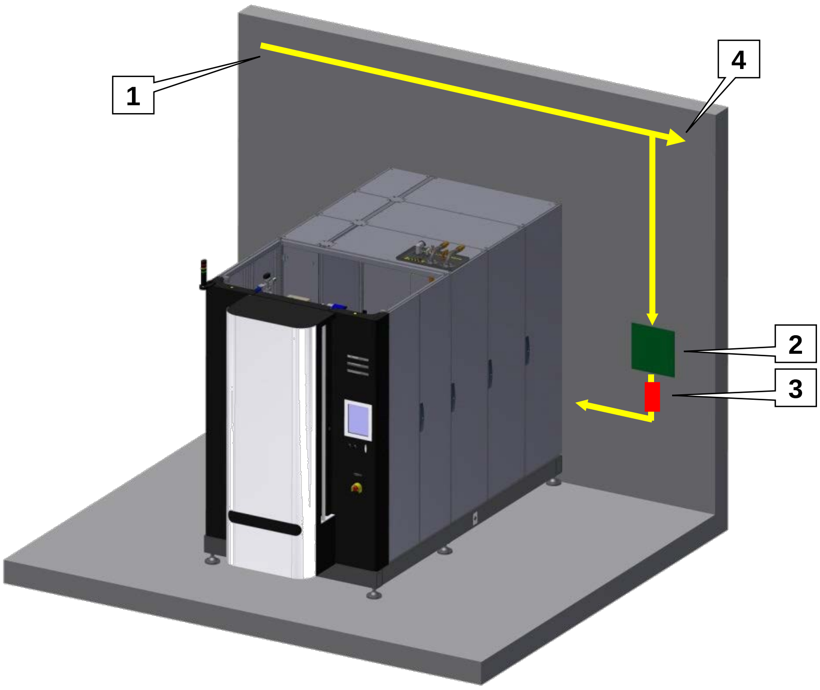
**New delivered machines are already equipped with the correct gas orifice.**

### 2.6.4.5 Gas Safety Valves

The gas safety valves must be checked for correct function and for leaks at least once a week!

The leak test is automatically performed at the end of the process and can only be switched off deliberately for a single process! ⇨ Refer to chapter 6 “Leak Test”.

### 2.6.4.6 Flashback Arrestors




| | | | |
|---|---|---|---|
| **1** | From the gas supply | **3** | One flashback arrestor for each dangerous gas |
| **2** | Stop valve | **4** | Gas supply to next coating machine |


**⚠ DANGER**

**Danger of explosion!**

**Danger to the life of personnel due to wrong installation of flashback arrestors!**

**Install the flashback arrestors according to the local regulations of the country where the machine is in use!**

**One flashback arrestor for each dangerous gas is required. The flashback arrestor must be installed after the pressure regulator and blocking valve of the gas supply to each machine.**

### 2.6.4.7 Exhaust Gas Dilution

The exhaust gas dilution prevents a dangerous concentration of gases in the rotary vane pump and the exhaust line. To use dangerous gases, e.g. Hydrogen ($H_2$), it is mandatory to use an exhaust gas dilution. ⇨ Refer to chapter 7 “Service and Maintenance”.

**⚠ DANGER**

**Danger of explosion!**

**Danger of explosion due to inadequate gas dilution!**

**The gas dilution unit is safety related. In case of maintenance or broken parts exchange them only with original spare parts from Oerlikon Balzers.**

**⚠ DANGER**

**Danger of explosion!**

**Danger of explosion due to inadequate gas dilution!**

**After the maintenance or setting of parameters for the gas exhaust dilution flow meters their correct function has to be tested.**
**⇨ Refer to chapter 7 “Service and Maintenance”.**

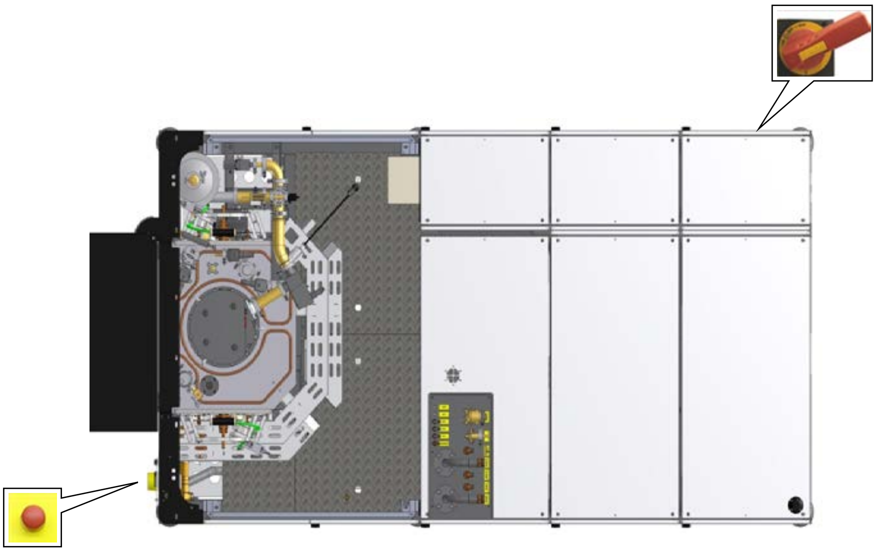
### 2.6.5 Electrical Safety Precautions and Safety Interlocks

In subsequent chapter’s descriptions of the functional principles of the electrical safety devices are given, descriptions include:

- Location of the Emergency-off Buttons⇨ see chapter 2.6.5.1
- Electrical Safety Interlock and Safety Circuit ⇨ see chapter 2.6.5.2

**Refer to the electrical schematics for further detailed information.**

### 2.6.5.1 Location of the Emergency-off Buttons



| | Description | Location |
|---|---|---|
|  | Emergency-off button | ■ Below the operator panel |
|  | Main power switch | ■ Outside the power cabinet (left side) |

**⚠ DANGER**

**Beware of dangerous voltage.**

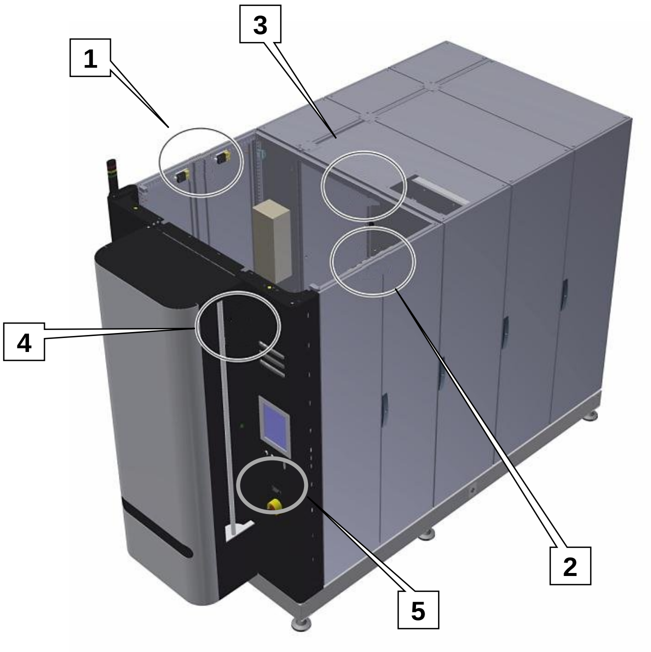
**Actuating the emergency-off button does not switch off devices that are branched to the primary side of the main power switch. This is especially the case for auxiliary devices branched to the socket units. The primary side of the main power switch is always live.**

**Devices branched to the primary side of the main power switch are:**

- **PC / PLC**
- **Power supply (+/- 15V) for the CDG 100 D.**
- **Devices connected to the UPS.**
- **Power cabinet door lights and socket unit.**

**For further information refer to customers wiring diagram.**

### 2.6.5.2 Electrical Safety Interlock and Safety Circuit




| | | | |
|---|---|---|---|
| **1** | Safety interlock – door left side | **4** | Safety interlock – process chamber door |
| **2** | Safety interlock – door right side | **5** | Button for manual substrate rotation |
| **3** | Safety interlock – service door | | |

**The visualization has different access levels for the operator and the service technician. If the electrical safety circuit is released, the service technician can release dangerous electrical units for manual operation.**

**The button for the manual substrate rotation 5 is mandatory to start the substrate rotation manually. ⇨ Refer to chapter 5 "Operation".**

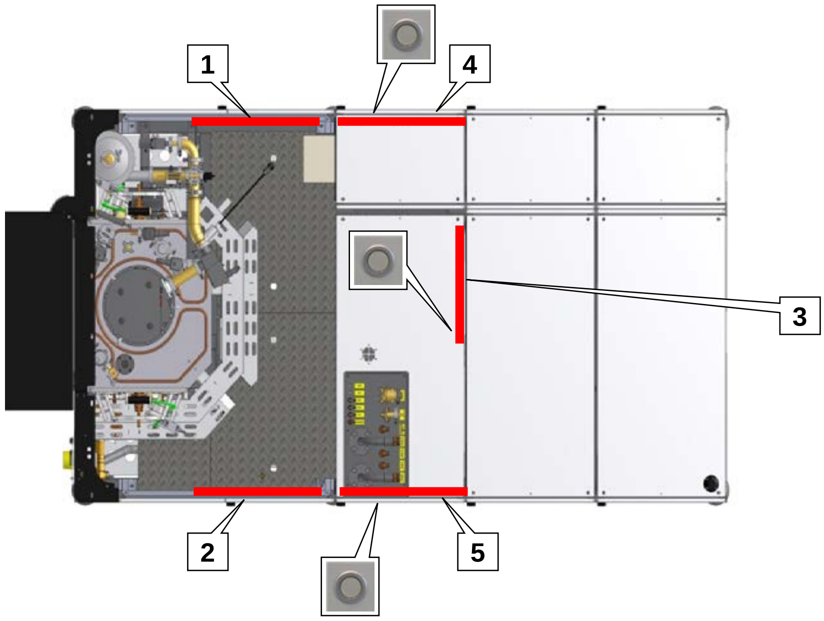
The safety interlock **1**, **2**, 3 and **4** must be closed to release the electrical safety circuit and finally to release the dangerous electrical units.

The dangerous electrical units are:

- Power supply for bias voltage
- Power supply for pulsed bias voltage*
- Power supplies for arc current
- Power supplies for filament current
- Power supplies for radiation heaters

(* Optional

### 2.6.5.3 Acknowledge Buttons




| | Description | Location |
|---|---|---|
|  | Acknowledge buttons | ▪ located at service door (3), power cabinet 3 door (4) and cooling device door (5) |
| | Doors 1, 2, 3 | ▪ door left (1) / door right (2) and service door (3) |

The machine is equipped with three acknowledge buttons. At service-work in the internal area of the machine, the doors (1) or (2) and possible (3) are opened. In this case the power supplies for arc current (1-6) and the power supplies for bias voltage and/or pulsed bias voltage are shut down.

**Prior to leave the internal area the service door (3) must be closed and the acknowledge button belonging to it must be pressed. The button starts flashing and a time window of approx. 15 seconds in order to leave the internal area is started. The (outside) doors (1, 2) must be closed as well and the corresponding acknowledge button has to be pressed. Thus all devices are switched on again.**

**If the time of 15 sec. has elapsed and the respective acknowledge buttons were not pressed, the devices remain in “off” state and the procedure must be repeated.**

### 2.6.6 Mechanical Safety Precautions

The machine is equipped with an emergency cooling system. The emergency cooling water is active when one of the following errors occurs:

- Main power failure
- Emergency-off button is pressed
- Compressed air failure
- Cooling water failure

The emergency cooling water flows only if the warm cooling water is switched to on and one of the above events occurred. In case of switched off warm cooling water (service-work, target change or switched off system) the emergency cooling water will not be activated.

⇨ Refer to chapter 3 for more details

⇨ Refer to chapter 7 for the testing interval of the emergency cooling system

## 2.7 Power-off in an Emergency

The comprehensive safety package with an emergency stop button and the main power switch enables the machine to be shut down immediately from various states.

1. Press the Emergency-off button or turn the main power switch to “Off”.

✓ The following power supplies are switched off:

- Power supply for bias voltage
- Power supply for pulsed bias voltage*
- Power supplies for filament current
- Power supplies for arc current
- Power supplies for radiation heaters

**Devices before the main power switch are still switched on:**

- **Auxiliary devices branched to the socket units.**
- **Devices connected to the UPS.**
- **The light inside of the power cabinet.**

2. Close all the gas valves at the gas supply to the machine.

3. Check if the emergency cooling water is cooling the process chamber / arc sources.
   ⇨ Refer to chapter 2.6.6 “Mechanical Safety Precautions”.

✓ All the dangerous supplies are switched off now and the machine is cooled down by the emergency cooling water.

**Accidents and/or emergencies can happen to anyone, anywhere and at any time. Prepare yourself in advance for an accident or emergency:**

- **Check the emergency cooling system regarding the interval in chapter 7.**
- **Contact your local health safety and environment manager and evaluate any potential risks at your plant.**
- **Refresh your first aid knowledge from time to time.**
- **Contact your local fire prevention officer and prepare yourself and others with a fire prevention concept**
- **Prepare a list with contact information in case of an emergency or accident and make that list available for others.**

(* Optional

# 3 Design and Function

**Manufacturer**

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**Please read and retain this manual to assist you in the operation and maintenance of this product. This manual is an integral part of the machine. In the event of a change of ownership, hand this manual over to the new owner.**

# Contents

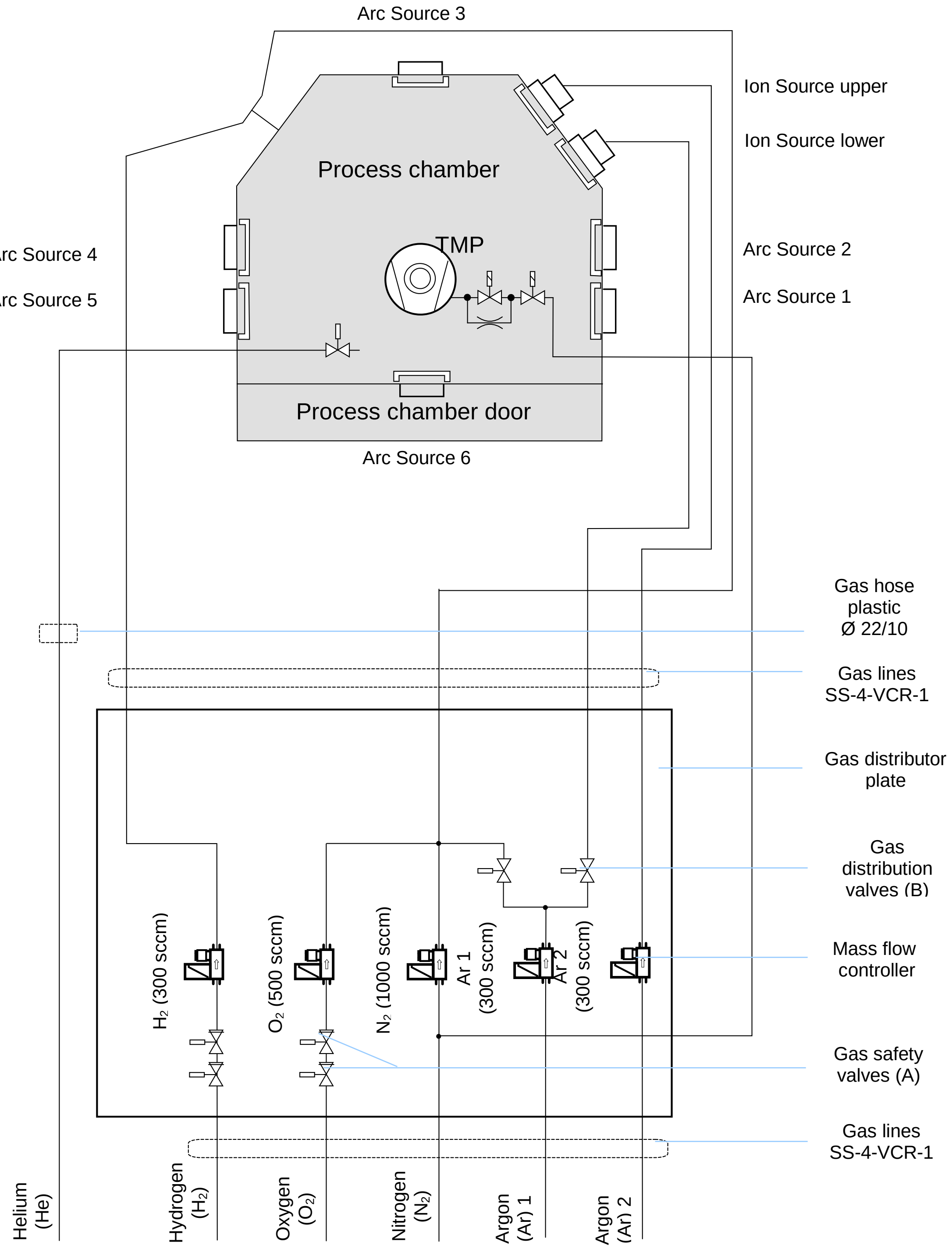
## 3.1 Gas Supply

### 3.1.1 Gases

- **Argon** (Ar) to sustain the arc during heating, etching and coating, it is admitted into the ion sources upper, lower via the arc sources or directly into the process chamber.
- **Nitrogen** ($N_2$) as reactive gas during coating is admitted either indirectly (via the sources) into the process chamber or directly into the process chamber.
- **Hydrogen** ($H_2$) as reactive gas during heating is admitted directly into the process chamber.
- **Oxygen** ($O_2$) as a reactive gas during the deposition of the layer is admitted indirectly (via the sources) into the process chamber.
- **Helium** (He) for cooling is admitted via the cooling valve through the turbo molecular pump into the process chamber.

**The set values for the mass flow controllers are generated and supplied by the PLC.**

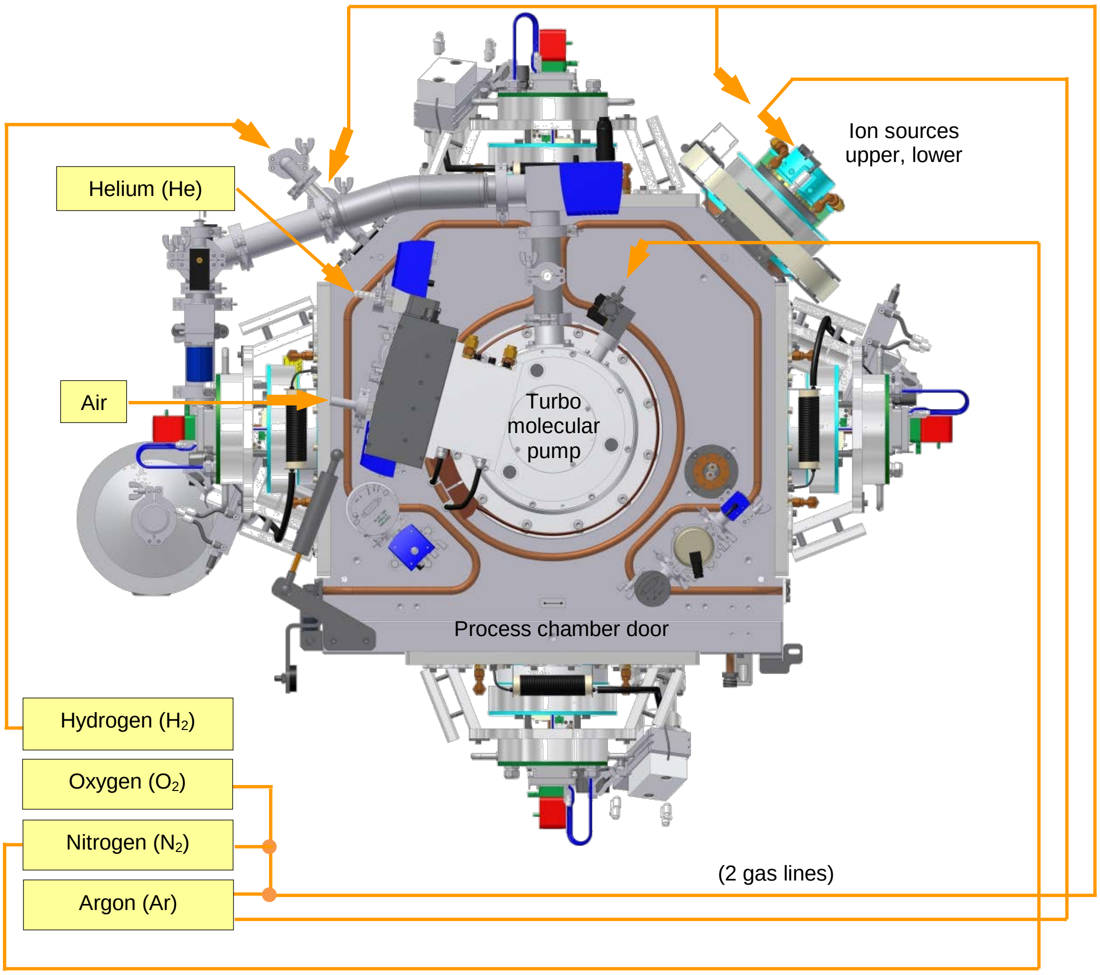
### 3.1.2 Gas Installation Diagram




**Due to the design of the pumping system the maximum flow of all gases is 1000 sccm calculated in Nitrogen ($N_2$) equivalent. Because of the heavy atom mass of Argon, the flow is additionally multiplied with factor 1.5.**

### 3.1.3 Gas Inlet Positions

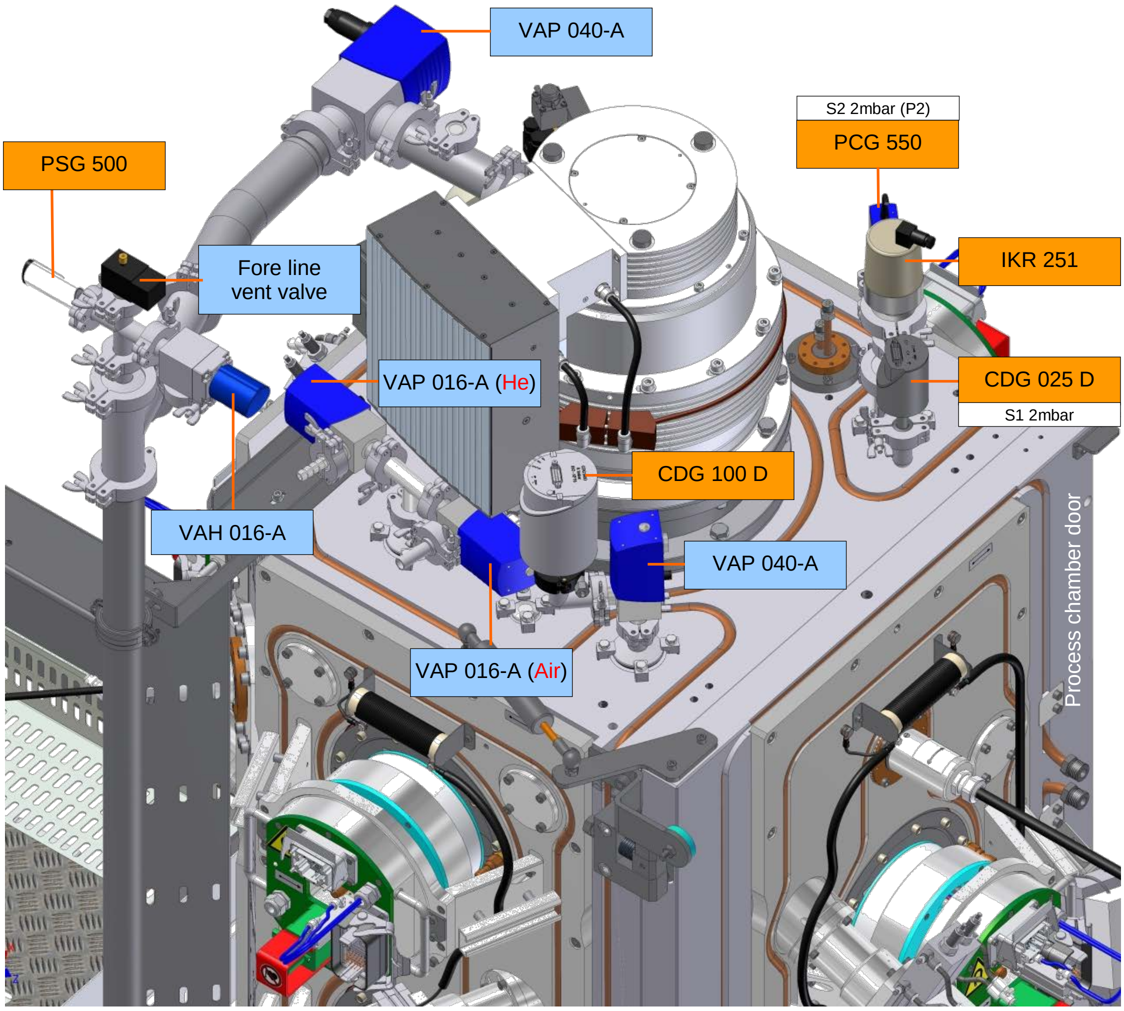
(Top view)



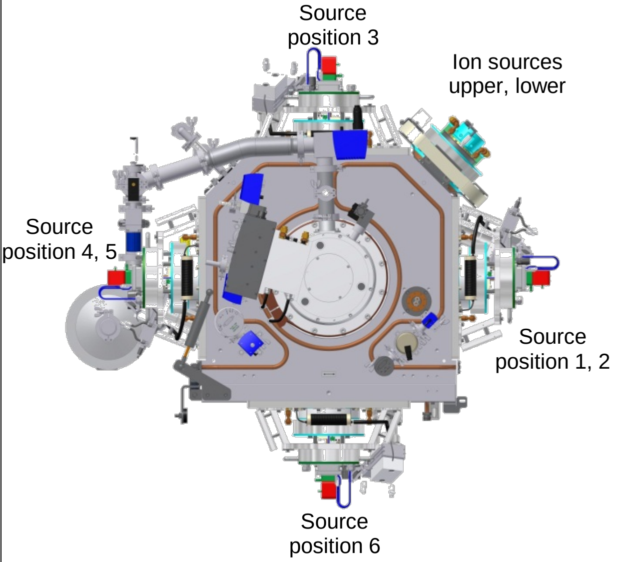

**Process gases:**
**Nitrogen** ($N_2$) introduced direct into the process chamber;
**Oxygen** ($O_2$) introduced direct into the process chamber;
**Hydrogen** ($H_2$) introduced direct into the process chamber via a separate gas line;
**Argon** (Ar) introduced direct into the process chamber or direct into the ion source lower and (via a separate gas line) into the ion source upper;
**Helium** (He) introduced through the turbo molecular pump into the process chamber.

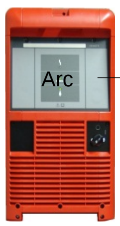
## 3.2 Pressure Measurement and Valve Positions

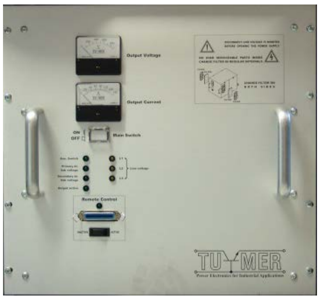
The picture below shows the locations of the valves and vacuum/process gauges.



## 3.3 Source Positions and Power Supplies

| Process chamber (top view) | Connections: | | |
|---|---|---|---|
| | Power supply position | Source position | Ion source position |
|  | Arc 1 ➔<br>Arc 2 ➔<br>Arc 3 ➔<br>Arc 4 ➔<br>Arc 5 ➔<br>Arc 6 ➔ | 1 (down) ➔<br>2 (up) ➔<br>3 (middle)<br>4 (down)<br>5 (up)<br>6 (middle) | upper<br>lower |

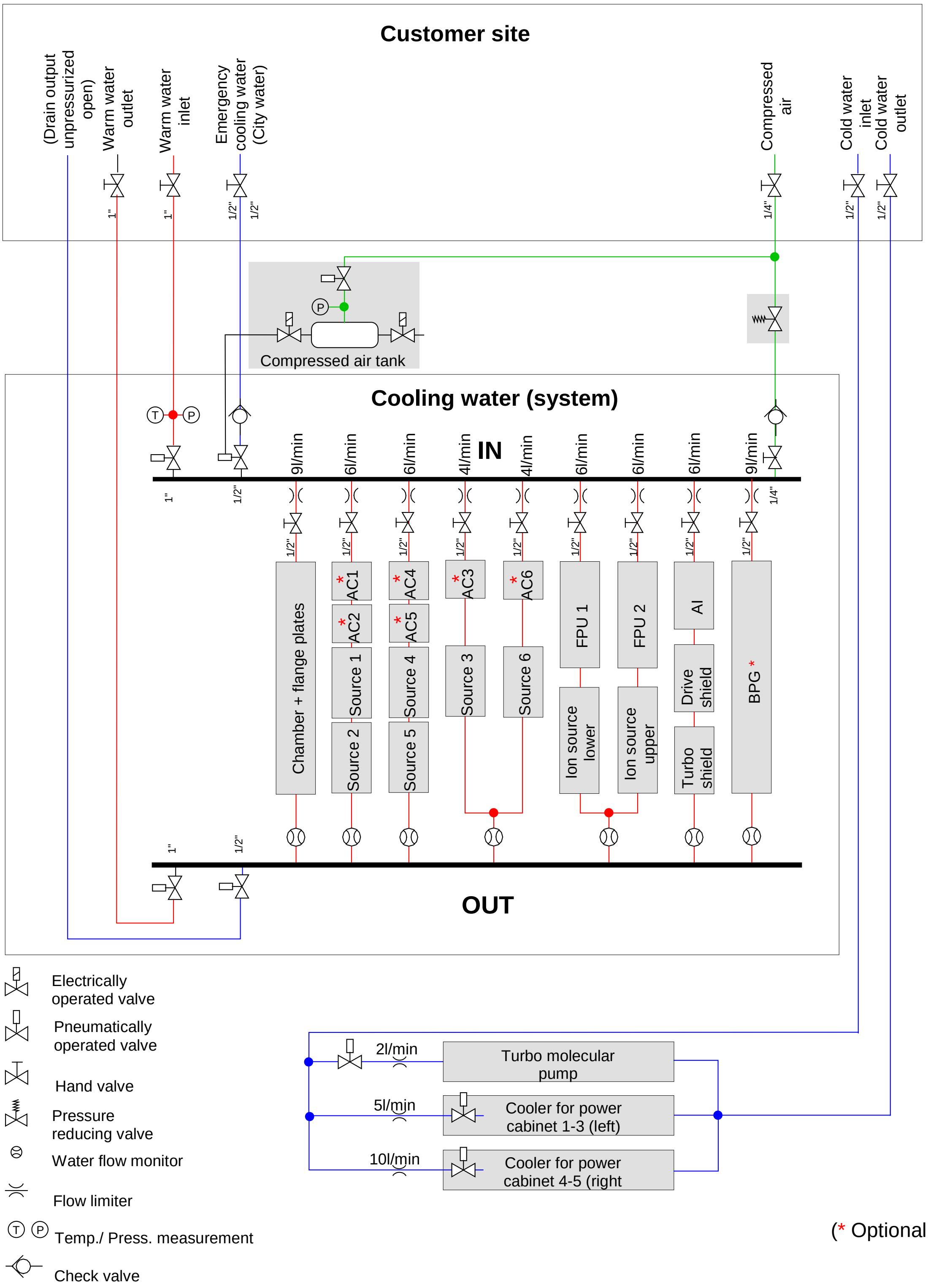
| **Power supplies for arc sources and ion source** | |
|---|---|
| 5  |  6 |
| 3  |  4 |
| 1  |  2 |

| Power supply for bias voltage | Power supply for pulsed bias voltage * |
|---|---|
|  |  |

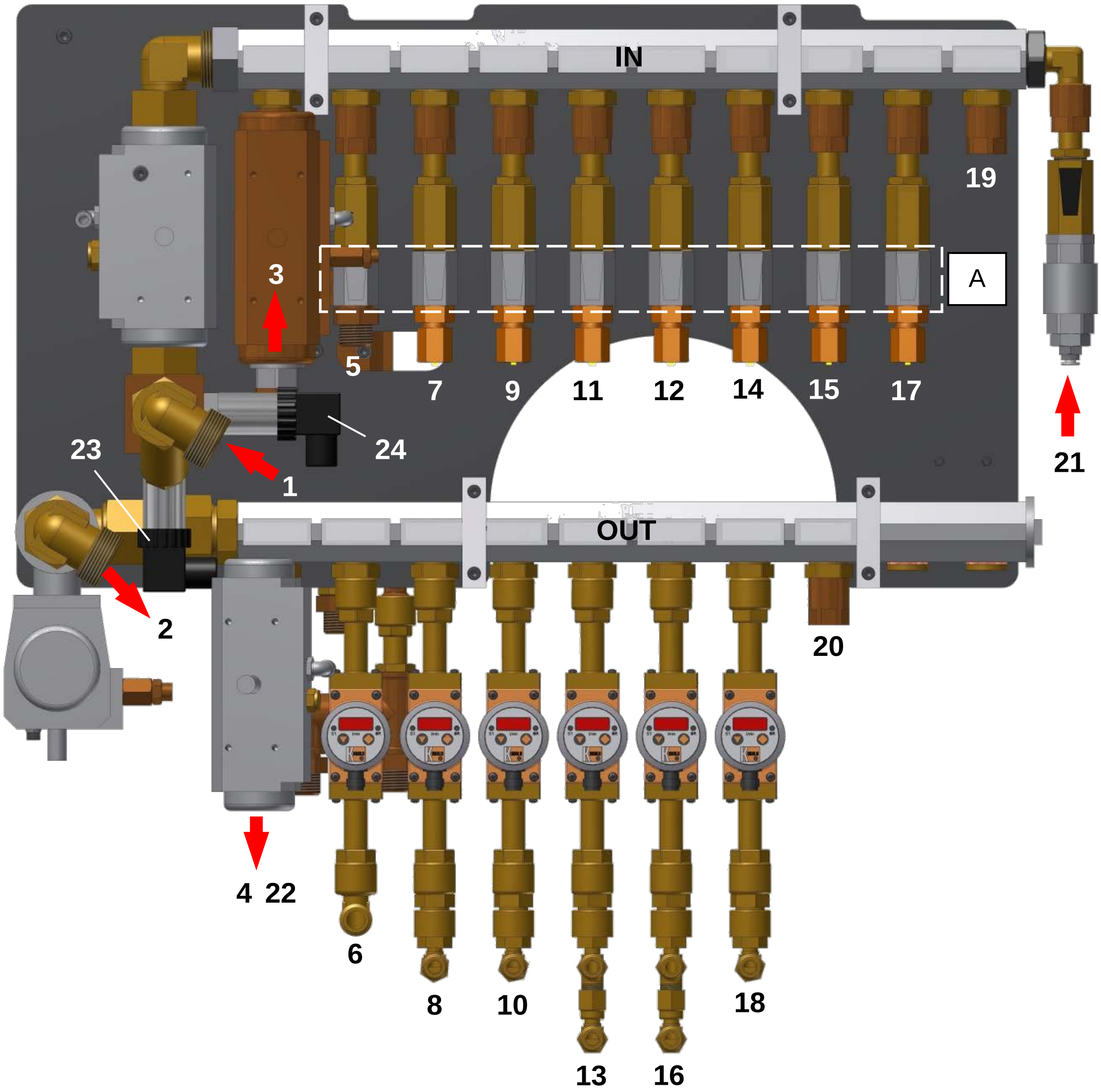
(* Optional

## 3.4 Water Supply

### 3.4.1 Water Flow Diagram



### 3.4.2 Water Battery




| | | | |
|---|---|---|---|
| 1 | *Warm cooling water **IN*** | 2 | *Warm cooling water **OUT*** |
| 3 | *Emergency cooling water **IN*** | 4 | *Emergency cooling water **OUT*** |
| 5 | *Chamber + flange plates **IN*** | 6 | *Chamber + flange plates **OUT*** |
| 7 | *Anode confinement (AC1 & AC2) / Source 1 & 2 **IN*** | 8 | *Anode confinement (AC1 & AC2) / Source 1 & 2 **OUT*** |
| 9 | *Anode confinement (AC4 & AC5) / Source 4 & 5 **IN*** | 10 | *Anode confinement (AC4 & AC5) / Source 4 & 5 **OUT*** |
| 11 | *Anode confinement (AC3) / Source 3 IN* | | |
| 12 | *Anode confinement (AC6) / Source 6 IN* | 13 | *Anode confinement (AC3) / Source 3 / Anode confinement (AC6) / Source 6 OUT* |

| | | | |
|---|---|---|---|
| 14 | *FPU1 / Ion source lower* ***IN*** | | |
| 15 | *FPU2 / Ion source upper* ***IN*** | 16 | *FPU1 / Ion source lower / FPU2 / Ion source upper* ***OUT*** |
| 17 | *Arc interrupter (AI) / Drive shield / Turbo shield* ***IN*** | 18 | *Arc interrupter (AI) / Drive shield / Turbo shield* ***OUT*** |
| 19 | *Pulsed bias generator (BPG)* ***IN **** | 20 | *Pulsed bias generator (BPG)* ***OUT **** |
| 21 | *Blow* ***IN*** | 22 | *Blow* ***OUT*** |
| 23 | *Water pressure sensor* | 24 | *Water temperature sensor* |

(* Optional

All water circuits can be closed individually with the water tabs (A).

### 3.4.3 Water Flow Values

The following table shows the max. water flow and the alarm values of each water circuit.

**Choose water flow between alarm value and max. value.**

**Water battery:**

| | **Name:** | **Nominal values:** | **Warning level:** | **Error level:** |
|---|---|---|---|---|
| 6 | *Chamber + flange plates* | 9 l/min | 8 l/min | 7 l/min |
| 8 | *Anode confinement (AC1 & AC2) / Source 1 & 2* | 6 l/min | 4.5 l/min | 4 l/min |
| 10 | *Anode confinement (AC4 & AC5) / Source 4 & 5* | 6 l/min | 4.5 l/min | 4 l/min |
| 13 | *Anode confinement (AC3) / Source 3 / Temperature sensors (TS1 & TS2) / Anode confinement (AC6) / Source 6* | 8 l/min | 7 l/min | 6 l/min |
| 16 | *Drive shielding / Ion source lower / Turbo shield / Ion source upper* | 12 l/min | 10 l/min | 9 l/min |
| 18 | *Arc interrupter (AI) / Filament power unit (FPU1 & FPU2)* | 6 l/min | 5 l/min | 4 l/min |
| 20 | *Pulsed bias generator (BPG)* | 9 l/min | 8 l/min | 7 l/min |
| 23 | *Water pressure sensor* | 5-6 bar | 6.5 bar | 8 bar |
| 24 | *Water temperature sensor* | 40-50°C | 50°C | 80°C |

**The alarm values are supervised in the visualization. The “Popup - Configuration – Water Circuit” screen contains the limit values.**

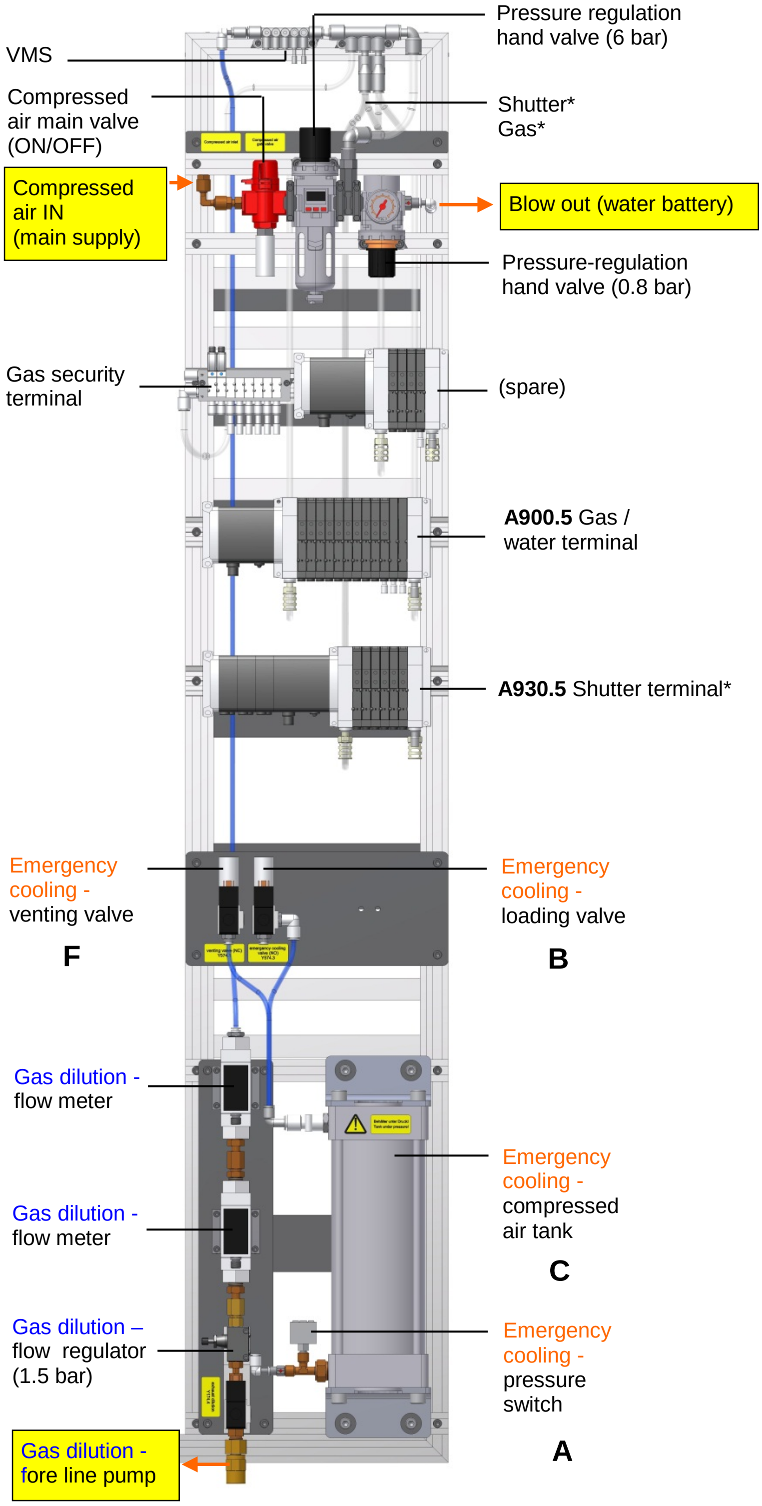
**⚠ CAUTION**

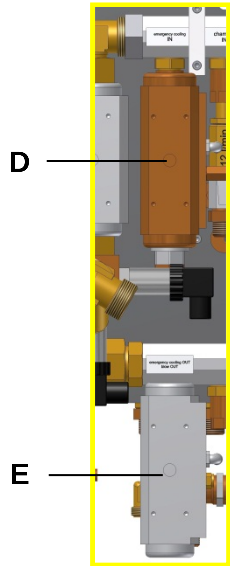
**Danger of damaging components in the coating system!**

- **Unauthorized reducing of the alarm values can lead to component damages.**

## 3.5 Pneumatic Distributor incl. Emergency Cooling and Gas Dilution

The pneumatic distributor incl. emergency cooling is located on the right side of the INGENIA P3e™ coating system (behind the process chamber).




Part of the water battery

(* Optional

**A** Pressure switch.

**B** Loading valve to switch on the emergency cooling water IN (D) valve. Power failure open (indicated by an LED on the plug).

**C** Compressed air tank.

**D** Emergency cooling water IN valve (normally closed).

**E** Emergency cooling water OUT valve (normally open).

**F** Venting valve to release compressed air from the compressed air tank. Power failure closed (indicated by an LED on the plug).

### 3.5.1 Explanation of the Emergency Cooling

The emergency cooling is immediately activated if one of the following errors occur:

- Main power failure.
- Compressed air failure.
- Cooling water failure (alarm message due to low water detection by more than 2 water source flow meters).

**The emergency cooling water flows only if the warm cooling water is switched to on and one of the above events occurred. In case of switched off warm cooling water (service-work, target change or switched off system) the emergency cooling water will not be activated.**

**Main power failure:**

If the electrical valve (B) is inactive (open) due to power failure, compressed air from the compressed air tank (C) can pass through and switch on the two emergency cooling valves IN (D) and OUT (E) (provided that the water was switched on before).

The emergency cooling water (city water) is therefore flowing until the main power comes back to the system. The emergency cooling water flow continues for max. 5 hours except if the "normal" cooling water (Operator Screen- Miscellaneous) is activated again.

**Do not re-activate the "normal "cooling water "Operator Screen – Miscellaneous" if the substrate temperature is above 200°C. (As during the switchover there would be a brief period with no cooling water flow.)**

**Compressed air failure:**

If the compressed air sensor (A) detects no compressed air, the PLC switches the electrical valve (B) to off state. Compressed air from the compressed air tank (C) can pass through and switches on the two emergency cooling valves IN (D) and OUT (E). The emergency cooling water (city water) is therefore flowing. The emergency cooling water flow time (approx.5 hours) is controlled by the software.

**Alarm message due to low water detection by (minimum) two water source flow meters:**

The PLC switches the electrical valve (B) to the off state. Compressed air from the compressed air tank (C) passes through and switches on the two emergency cooling valves IN (D) and OUT (E). The emergency cooling water (city water) is therefore flowing. The emergency cooling water flow time (approx. 5 hours) is controlled by the software.

**Error message on screen:**

Emergency water cooling has been activated.

## 3.6 Compressed Air Supply

**A900.5 Gas / water terminal:**

(Number of valve modules: 24)

| Module: | ID: | Component: | Type: | Valve pos. | Remark: |
|---|---|---|---|---|---|
| Y910.1 | Y552.1 | Fore line valve pump unit | normally closed | A | |
| | Y556.4 | Isolating valve CDG100-D | normally closed | B | |
| Y910.2 | Y546.2 | Vent valve (Air) process ch. | normally closed | A | |
| | Y546.1 | Vent valve (He) process ch. | normally closed | B | |
| Y910.21 | Y532.1 | Valve Ar to Ion Source lower | normally closed | A | |
| | Y532.2 | Valve Ar to central gas | normally closed | B | |
| Y910.22 | Y532.3 | Gas process ch. central | normally closed | A | |
| | Y574.5 | Warm water IN | normally closed | B | |
| Y910.3 | Y574.6 | Warm water OUT | normally closed | A | |
| | | Spare | normally closed | B | |
| Y910.31 | Y574.7 | Emergency cooling water | normally closed | A | |
| | Y190.7 | Cold cooling water TMP | normally closed | B | |
| Y910.4 | Y742.7 | Trigger finger 1 | normally open | A | |
| | Y752.7 | Trigger finger 2 | normally open | B | |
| Y910.41 | Y762.7 | Trigger finger 3 | normally open | A | |
| | Y772.7 | Trigger finger 4 | normally open | B | |
| Y910.5 | Y782.7 | Trigger finger 5 | normally open | A | |
| | Y792.7 | Trigger finger 6 | normally open | B | |
| Y910.51 | | Trigger finger Spare | normally open | A | |
| | | Trigger finger Spare | normally open | B | |
| Y910.52 | | Spare | Blind plug | A | |
| | | Spare | Blind plug | B | |
| Y910.6 | | Spare | Blind plug | A | |
| | | Spare | Blind plug | B | |

**Gas security terminal:**

(Number of valve modules: 4)

| Module: | ID: | Component: | Type: | Valve pos. | Remark: |
|---|---|---|---|---|---|
| | Y520.1 | Gas safety valve $H_2$ 1 | normally closed | | Safety |
| | Y520.3 | Gas safety valve $H_2$ 2 | normally closed | | Safety |
| | Y524.1 | Gas safety valve $O_2$ 1 | normally closed | | Safety |
| | Y524.3 | Gas safety valve $O_2$ 2 | normally closed | | Safety |

**A930.5 Shutter terminal:***

(Number of valve modules: 12)

| Module: | ID: | Component: | Type: | Valve pos. | Remark: |
|---|---|---|---|---|---|
| Y940.1 | Y742.2 | Shutter 1 close | normally closed | A | B742.1 |
| | Y742.3 | Shutter 1 open | normally closed | B | B742.0 |
| Y940.2 | Y752.2 | Shutter 2 close | normally closed | A | B752.1 |
| | Y752.3 | Shutter 2 open | normally closed | B | B752.0 |
| Y940.21 | Y762.2 | Shutter 3 close | normally closed | A | B762.1 |
| | Y762.3 | Shutter 3 open | normally closed | B | B762.0 |
| Y940.22 | Y772.2 | Shutter 4 close | normally closed | A | B772.1 |
| | Y772.3 | Shutter 4 open | normally closed | B | B772.0 |
| Y940.3 | Y782.2 | Shutter 5 close | normally closed | A | B782.1 |
| | Y782.3 | Shutter 5 open | normally closed | B | B782.0 |
| Y940.31 | Y792.2 | Shutter 6 close | normally closed | A | B792.1 |
| | Y792.3 | Shutter 6 open | normally closed | B | B792.0 |

**A944.5 Valve terminal (gas source position):***

(Number of valve modules: 8)

| Module: | ID: | Component: | Type: | Valve pos. | Remark: |
|---|---|---|---|---|---|
| Y946.1 | | Spare | Blind plug | A | Option |
| | | Spare | Blind plug | B | Option |
| Y946.2 | | Spare | Blind plug | A | Option |
| | | Spare | Blind plug | B | Option |
| Y946.21 | | Spare | Blind plug | A | Option |
| | | Spare | Blind plug | B | Option |
| Y946.22 | | Spare | Blind plug | A | Option |
| | | Spare | Blind plug | B | Option |

(* Optional

**Ensure maximum pressurized air input of the water blow out does not exceed the values according to the table on next page.**

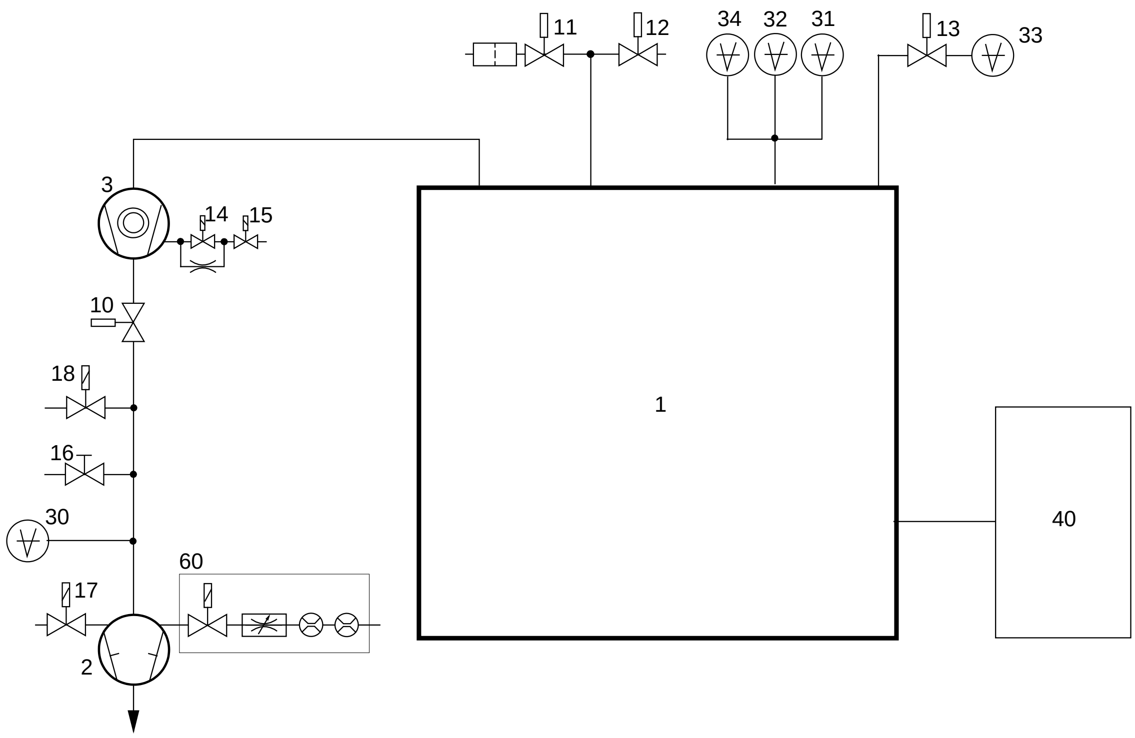
### 3.6.1 Compressed Air Reduction Valves

| Location | Nominal value | Maximal value |
|---|---|---|
| Main inlet | 6 bar | 7 bar |
| Water blow out | 0.8 bar | 1.2 bar |
| Fore line (dilution) | 6 bar | 7bar |

**The settings for the dilution of the dangerous gases (in order to adjust the flow limiter) are defined in chapter 7.**

## 3.7 Vacuum System

The diagram below shows the valves, pumps and vacuum measuring gauges of the INGENIA P3e™ coating system. On the following pages there is a brief description of each component.



### 3.7.1 The Vacuum System Components

| | | | |
|---|---|---|---|
| 1 | Process chamber | | INGENIA P3e™ coating system |
| 2 | Rotary vane vacuum pump | **M170.1** | LEYBOLD TRIVAC D65 BCS |
| 3 | Turbo molecular pump | **M190.1** | LEYBOLD MAG W 1700 IP |
| 10 | Fore line valve | **Y552.1** | INFICON VAP 040-A |
| 11 | Venting valve (Air) | **Y546.2** | INFICON VAP 016-A |
| 12 | Cool gas valve (Helium) | **Y546.1** | INFICON VAP 016-A |
| 13 | Isolating valve for CDG 100 D | **Y556.5** | INFICON VAP 040-A |
| 14 | Venting valve for the turbo molecular pump | | LEYBOLD 12133 |
| 15 | Purge valve for the turbo molecular pump | | |
| 16 | Leak detection valve | **HV1061** | INFICON VAH 016-A |
| 17 | Air inlet valve (gas ballast) | **Y174.1** | Power failure venting valve DN 10 ISO-KF-24V DC |
| 18 | Fore line vent valve | **Y550.2** | Power failure venting valve DN 10 ISO-KF-24V DC |
| 30 | Pirani gauge (turbo molecular pump, fore line pressure) | **B552.5** | INFICON PSG 500 |
| 31 | Pirani/capacitance diaphragm gauge (process chamber) | **B554.5** | INFICON PCG 550 |
| 32 | Compact cold cathode gauge | **B556.2** | INFICON IKR 251 |
| 33 | Capacitance diaphragm gauge (process) | **B558.5** | INFICON CDG100 D |
| 34 | Capacitance diaphragm gauge (safety) | **B512.1** | INFICON CDG 025 D |
| 40 | Gas distributor | | |
| 60 | Gas dilution equipment, consisting of:<br>• Solenoid valve<br>• Flow switches<br><br>• Flow limiter (adjustable) | <br><br>**Y174.4**<br>**B514.1**<br>**B514.3**<br>**PC1020** | <br><br>SMC EVT 307<br>SMC PF2A711<br>SMC PF2A711 |

The numbers in parentheses (1-60) after the designation of the equipment hereafter,
⇨ refer to the position in the vacuum diagram.

### 3.7.1.1 Process Chamber INGENIA P3e™ Coating System (1)

The process chamber: Volume = 333 liters

### 3.7.1.2 Rotary Vane Vacuum Pump TRIVAC D65 BCS (2)

| | |
|---|---|
| The fore pump is used to evacuate the process chamber from atmospheric pressure (1000 mbar) down to 0.1 mbar. It also act as backing pump for the turbo molecular pump. |  |

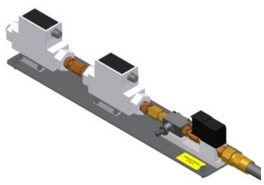
### 3.7.1.3 Turbo Molecular Pump MAG W 1700 IP (3)

| | |
|---|---|
| The operating pressure of the turbo molecular pump ranges from 0.1 mbar to approx. $1\times10^{-5}$ mbar. Its ultimate pressure depends on the backing pump system (rotary vane vacuum pump) as well as on the leak rate and degassing rate of the vacuum system.<br><br>The turbo molecular pump cannot work against atmospheric pressure, therefore the backing pumps are used to back it up whenever it is in operation. The turbo molecular pump is water cooled. | <br>Profibus operated |

| | |
|---|---|
| Run-up time | < 10 minutes (for optimum operation) |
| Cooling water requirement | 1 l/min at 10°C - 15°C |

### 3.7.1.4 Gas Dilution Equipment (60)

The gas dilution equipment prevents a flammable and/or explosive condition of dangerous gases within the rotary vane vacuum pump. It ensures a constant flow of compressed air into the rotary vane vacuum pump. If there is no flow of air, the gas safety valves for the flammable and/or explosive gas mixtures are automatically closed.



(* Optional

### 3.7.1.5 Air Inlet & Fore Line Vent Valve (17, 18)

The air inlet & fore line vent valves are provided for:

- gas ballast of the rotary vane vacuum pump **(17)**

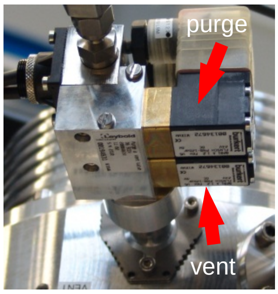
- venting the fore line with air **(18)**


### 3.7.1.6 Venting and Purge Valves for the Turbo Molecular Pump MAG W 1700 IP (14, 15)

These valves are used for:

- Venting the turbo molecular pump.

  When the turbo molecular pump is started the venting valve closes immediately. After a stop, (fault, mains failure or switch-off), the venting valve power is supplied from the drive motor of the turbo molecular pump so that venting starts at deceleration speeds of between 50% and 20%, depending on the motor configuration. The venting valve is open in the absence of electrical voltage and remains open until the next start.
- Air feed into the bearing areas (purge) of the turbo molecular pump during operation to prevent the entry of dust into those areas.




### 3.7.1.7 Fore Line Valve VAP 040 A (10)

The fore line valve VAP 040 A is a high vacuum angle valve. It is pneumatically operated. A pin serves as a position indicator. It is even with the cover in the valve closed position and clearly protrudes from the cover in the valve open position.

A spring exerts the force required for a reliable sealing pressure. This valve is tight against atmospheric pressure in both directions.

### 3.7.1.8 Valves VAP 016-A (11, 12)

Two pneumatically operated valves VAP 016-A are provided for:

- venting the process chamber with air **(11)**
- admission of Helium for cooling **(12)**

They are sealed tight against atmospheric pressure in both directions.


### 3.7.1.9 Isolating Valve for CDG 100 D (13)

The valve VAP 040-A is a high vacuum angle valve. It is pneumatically operated. A pin serves as a position indicator. It is even with the cover in the valve closed position and clearly protrudes from the cover in the valve open position.

A spring exerts the force required for a reliable sealing pressure. This valve is tight against atmospheric pressure in both directions.

Provided for:

- isolating the CDG 100 D from the process chamber **(13)**


### 3.7.1.10 Leak Detection Valve VAH 016-A (16)

The valve VAH 016-A is a high vacuum angle valve. It is manually operated. A spring exerts the force required for a reliable sealing pressure. This valve is tight against atmospheric pressure in both directions. It is provided to connect HLT leak detection equipment to the INGENIA P3e™ coating system.

### 3.7.1.11 Pirani Vacuum Gauge PSG 500 (30)

The PSG 500 vacuum gauge measures pressure on the Pirani principle: within certain limits, the thermal conductivity depends on pressure. The Pirani gauge head PSG 500 is part of a self-balancing bridge circuit which keeps its filament at a constant temperature. The voltage across the filament is converted to a pressure reading.

Useful measuring range: 100 mbar to $1\times10^{-3}$ mbar.


### 3.7.1.12 Pirani Capacitance Diaphragm Gauge PCG 550 (31)

The Pirani capacitance diaphragm gauge PCG 400 is a combination measuring gauge, consisting of a Pirani and a capacitive diaphragm sensor. Both sensors are constantly active.

At deep pressures only the signal of the Pirani sensor, and at high pressures only the signal of the capacitive diaphragm sensor will be used. Within the mixing range both signals are pressure-proportionally weighted and so the output signal is determined.

Measuring range: 1000 mbar to $1\times10^{-3}$ mbar.


### 3.7.1.13 Compact Cold Cathode Gauge IKR 251 (32)

The compact cold cathode gauge IKR 251 is a cold cathode ionization gauge working on the Penning principle: A self-sustaining gas discharge is produced with the aid of high voltage and a magnetic field. The electrons emitted by the cathode move to the anode on a spiral path which is sufficiently long to ionize the gas molecules. The resulting discharge current is related to the pressure.

The sensitivity of the gauge depends of the gas being measured; it is calibrated for Nitrogen ($N_2$).

Accurate measuring range: $1\times10^{-2}$ to approx. $1x10^{-9}$ mbar.

### 3.7.1.14 Capacitance Diaphragm Gauge CDG 100 D (33)

The capacitance diaphragm gauge CDG 100 D (process) is an absolute pressure transducer. Its measuring principle is the change of electric capacity when a membrane is deformed by a change of pressure. This measuring principle does not depend on the type of used gas.

Measuring range: $1\times10^{-1}$ mbar to approx. $1\text{x}10^{-5}$ mbar.


**This measuring gauge has to be isolated from the process chamber potential to minimize the influence of the arc plasma from inside the coating system. Therefore the measured signal of the gauge will be more stable.**

**At atmospheric pressure the membrane is exposed to the 1000 times of its maximum operating pressure and will be deformed. This deformation does not damage the device, but the zero setting will change. Therefore pump a minimum of 4h (and to a required pressure of <$1\text{x}10^{-5}$ mbar) for degassing and stabilization before re-calibration of the mechanical zero point.**

### 3.7.1.15 Capacitance Diaphragm Gauge CDG 025 D (34)

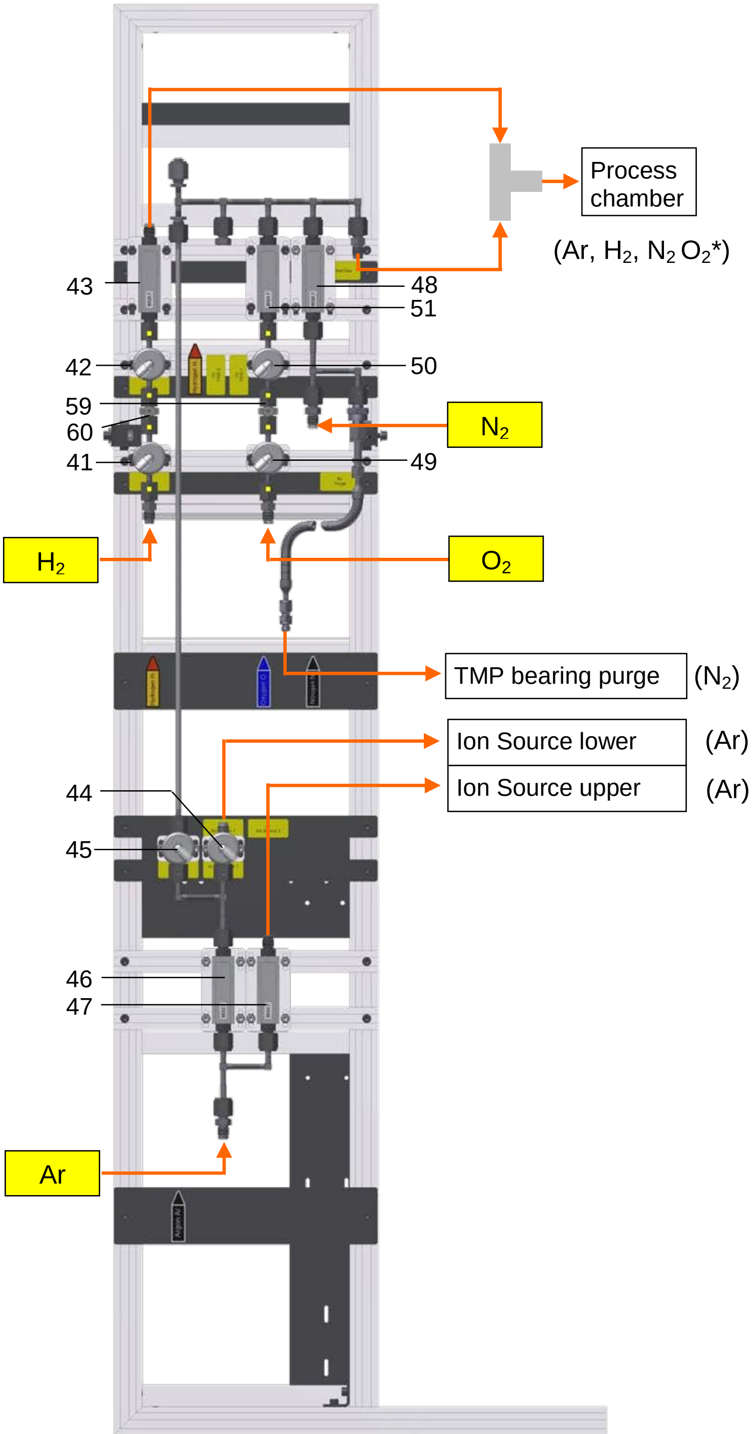
The capacitance diaphragm gauge CDG 025 D (safety) is also based on the capacitance manometer and is dedicated to initiate an internal relay, which provides two contact closures or openings as outputs. An LED provides visual “above set point” indication, and facilitates adjustment of the trip point.

Measuring range: 10 mbar to $1\times10^{-3}$ mbar (PN = 377-501)

Trip point: 2 mbar

### 3.7.1.16 Gas Distributor (40)

The gas distributor (40) is located on the right side of the INGENIA P3e™ coating system (behind the process chamber).



| | | | | |
|---|---|---|---|---|
| 41 | Pneumatic valves (normally closed) | SS-DN-VR4-P1-C | $H_2$ | **Y520.1** |
| 42 | Pneumatic valves (normally closed) | SS-DN-FR4-P1-C | $H_2$ | **Y520.3** |
| 43 | Mass flow controller (Hydrogen) | Bronkhorst F-201C-PAD-88-Z 300 sccm | $H_2$ | **B520.7** |
| | | | | |
| 44 | Pneumatic valves (normally closed) | SS-DN-VR4-P1-C | Ar | **Y532.1** |
| 45 | Pneumatic valves (normally closed) | SS-DN-VR4-P1-C | Ar | **Y532.2** |
| 46 | Mass flow controller (Argon) | Bronkhorst F-201C-PAD-88-Z 300 sccm | Ar | **B532.7** |
| 47 | Mass flow controller (Argon) | Bronkhorst F-201C-PAD-88-Z 300 sccm | Ar | **B534.7** |
| | | | | |
| 48 | Mass flow controller (Nitrogen) | Bronkhorst F-201C-PAD-88-Z 1000 sccm | $N_2$ | **B530.7** |
| | | | | |
| 49 | Pneumatic valves (normally closed) | SS-DN-VR4-P1-C | $O_2$ | **Y524.1** |
| 50 | Pneumatic valves (normally closed) | SS-DN-FR4-P1-C | $O_2$ | **Y524.3** |
| 51 | Mass flow controller (Oxygen) | Bronkhorst F-201C-PAD-88-Z 1000 sccm | $O_2$ | **B524.7** |
| | | | | |
| 59 | Orifice 0.2 mm | UJR-F-6.35-0.2 | $H_2$ | |
| 60 | Orifice 0.4 mm | UJR-F-6.35-0.4 | $O_2$ | |

### 3.7.1.17 Mass Flow Controller

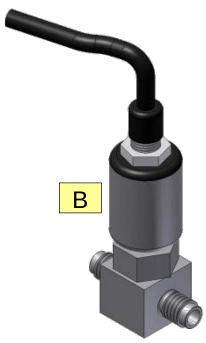
| | |
|---|---|
| The mass flow controllers are calibrated to $N_2$:<br>F-201C-PAD-88-Z 300 sccm (43, 46, 47) are used for **Hydrogen** ($H_2$) and **Argon** (Ar).<br>Useful measuring and control range: 0 to 300 sccm (rel. to $N_2$)<br>F-201C-PAD-88-Z 1000 sccm (48, 51) are used for **Nitrogen** ($N_2$) and **Oxygen** ($O_2$).<br>Useful measuring and control range: 0 to 1000 sccm (rel. to $N_2$). | <br>Profibus operated |

The operation of the mass flow controller is based on the principle of heat transfer. The temperature difference is sensed along a heated section of a capillary tube. The temperature difference is directly proportional to the gas flow. The temperature sensors are part of a bridge circuit, whose diagonal voltage is amplified to the desired signal level (e.g. 0-5 VDC).

**Ensure mass flow controller equipped with internal dust filter in the VCR-flange. There are 2 filters per mass flow controller (one at the input and one at the output). Do not use without filters to prevent dust and other particles contaminate the O-Ring of the internal valve mechanism. Leaking could be caused.**

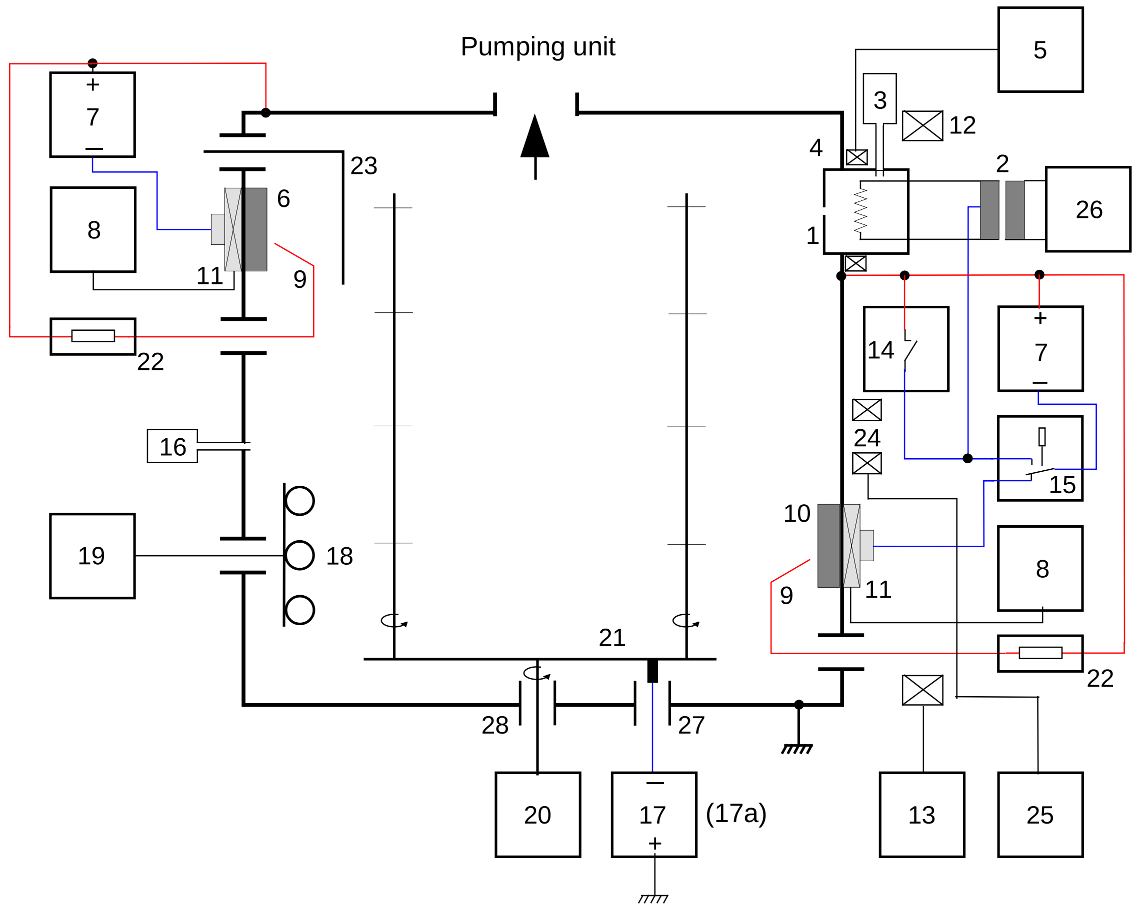
**The maximum gas flow is limited by the INGENIA P3e™ software in accordance to the vacuum components (e.g. MAG W 1700 IP turbo molecular pump).**

### 3.7.1.18 Valves SS-DNFR4-P1-C / SS-DNVR4-P1-C

| | | |
|---|---|---|
| Swagelok DN series spring less diaphragm (pneumatically operated) valve (normally closed)<br>SS-DNFR4-P1-C (female / female) (A) is provided for security cut off of the flammable and/or explosive gases.<br>SS-DNVR4-P1-C (male / male) (B) is provided for gas distribution. |  |  |

## 3.8 Process Overview

### 3.8.1 Main Components of the Process Chamber (Standard Configuration)




| | | | |
|---|---|---|---|
| 1 | Ion sources upper, lower | 2 | Transformer for filament current upper, lower |
| 3 | Argon inlet into the ion sources upper, lower | 4 | Ion source coils upper, lower |
| 5 | Power supply for the ion source coils upper, lower | 6 | Arc sources 3-6 |
| 7 | Power supplies for arc sources 1-6 and ion sources upper, lower | 8 | Power supplies for magnet system (arc sources) |
| 9 | Igniters | 10 | Arc sources 1-2 |
| 11 | Magnet system for arc sources | 12 | Focus coil |
| 13 | Power supply for focus coil | 14 | Arc interrupter (AI) |
| 15 | Switch box | 16 | Central gas inlet |

| | | | |
|---|---|---|---|
| 17<br>17a | Power supply for bias voltage or<br>Power supply for pulsed bias voltage* | 18 | Radiation heaters |
| 19 | Power supplies for heating elements | 20 | Rotary drive |
| 21 | Carousel | 22 | Igniter resistor |
| 23 | Movable shutter* | 24 | Distribution coil |
| 25 | Power supply for distribution coil | 26 | Power supply for filament current |
| 27 | Electrical feed-through | 28 | Mechanical feed-through |

(* Optional

### 3.8.1.1 Coils for the Magnetic Field

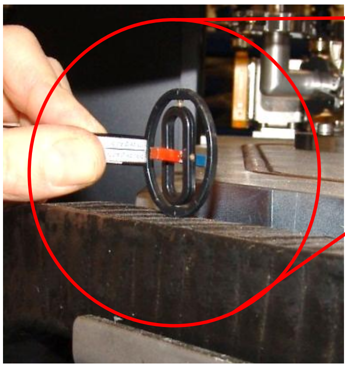
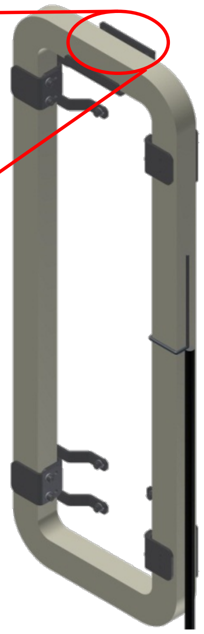
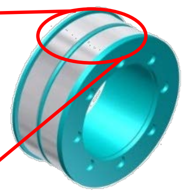
The figure below shows the direction of the magnetic fields of the focus, ionization chamber 1&2 and distribution coils in the INGENIA P3e™ coating system.

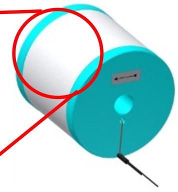
The direction of the magnetic fields can be determined by means of a magnetic field tester.

(B5147998BA)

**The following pictures are valid for a positive coil current of +2A on each coil.**

**The coils must be checked one by one. Never switch on the coil current for more than one coil at the same time (due to mutual influence).**

| | | |
|---|---|---|
| Focus coil (12) |  |  |
| Ion source coils upper, lower (4) |  |  |

| | | |
|---|---|---|
| Distribution coil (24) |  |  |

### 3.8.1.2 Power Supply for Ion Sources & Arc Sources (7)

The power supply for arc sources is used for the low voltage arc discharge during heating and etching process and as the power supply for an arc source during the coating process. For detailed information on the power supplies ⇨ refer to component binder.

| | |
|---|---|
| **FRONIUS DPS 2500 PLASMA**<br>Max. current = 250A<br>Continuous rating: 250A / 70V<br>$U_0$ = 140VDC<br>Profibus operated |  |

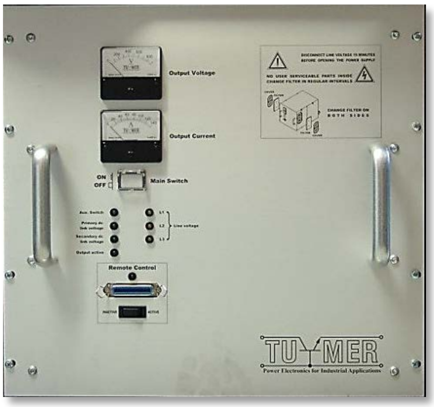
### 3.8.1.3 Power Supply for Bias Voltage (17)

The power supply for DC bias voltage is used to supply the negative voltage on the carousel (substrate) during etching and coating. For detailed information on the power supply ⇨ refer to component binder.

| | |
|---|---|
| **FRONIUS BIAS 300 PLASMA**<br>Max. voltage = 300V<br>Max. continuous rating: 30A / 300V<br>Profibus operated |  |

### 3.8.1.4 Power Supply for Pulsed Bias Voltage * (17a)

The power supply for pulsed bias voltage is used to supply the voltage on the carousel (substrate) during etching and coating. For detailed information on the power supply ⇨refer to component binder.

<table>
<tr>
<td>
Power Supply for Pulsed Bias Voltage<br>BPG 0800/40<br>
The normal operation bias voltage is:<br>
0V to 250V (max. 140A) Low voltage range<br>
0V to 800V (max. 50A) High voltage range<br>
Profibus operated
</td>
<td>


</td>
</tr>
</table>

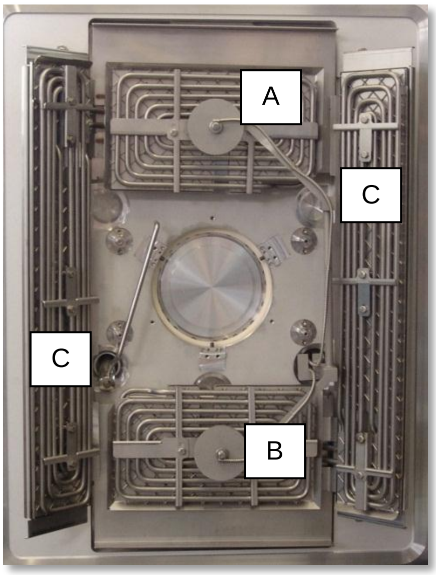
(* Optional

### 3.8.1.5 Heating Current Control Units (19)

The heating current for each individual heater is controlled and measured.

| | |
|---|---|
| **Semiconductor relay H12D4825**<br>Controllable voltages = 48V - 530V<br>Max. current = 25A |  |
| **Over current relay DIA53S72420A**<br>Max. current = 25A<br>Threshold value setting:<br>⇨ Refer to chapter 7 “Heater Current Monitoring”. |  |

### 3.8.1.6 Radiation Heaters (18)

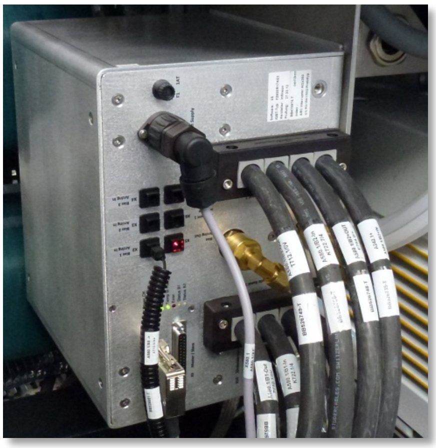
<table>
<tr><td>UP (A) / DOWN (B):<br>The radiation heaters are used to heat the substrates.<br><br>U = 400V<br>Max. power approx.= 2.6kW</td><td rowspan="2">
</td></tr>
<tr><td>MIDDLE (C):<br>The radiation heaters are used to heat the substrates.<br><br>U = 400V<br>Max. power approx.= 4.1kW</td></tr>
</table>

### 3.8.1.7 Switch Box (15)

<table>
<tr><td>The switch box is used to switch the power supplies from the ion sources upper, lower to the Arc source 1,2.</td><td></td></tr>
</table>

### 3.8.1.8 Arc Interrupter (AI) 2x250A (14)

The arc interrupter (AI) is able to shorten the power supplies for arc sources (1,2) if required.



### 3.8.1.9 Power Supply for Filament Current (26)

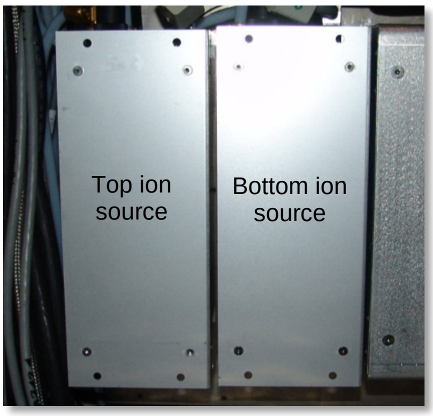
The power supply for filament current is used in heating & etching process.

Primary: 400V

Secondary: 7.0V - 0V - 7.0V; 210A

### 3.8.1.10 Filament Power Unit (FPU) (26) *

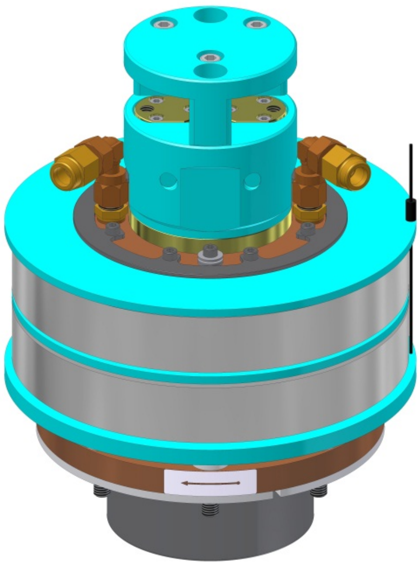
The filament power unit (FPU) supplies the filament power for the ion sources upper, lower.




(* Optional

### 3.8.1.11 Ion Source (1)

The ion source serves as the electron source for the low voltage arc discharge.
A tungsten wire coil (filament) acts as the cathode. It is heated by the filament current and emits electrons. If there is a sufficiently high gas pressure an arc can be ignited between this cathode and an anode in the process chamber.

| | |
|---|---|
| The ion source is equipped with one filament. If the filament breaks in the process an error message is displayed on the operator panel.<br><br>**Prior to switch on the filament set a sufficiently high gas flow in order to prevent any damage on the ion source.** |  |

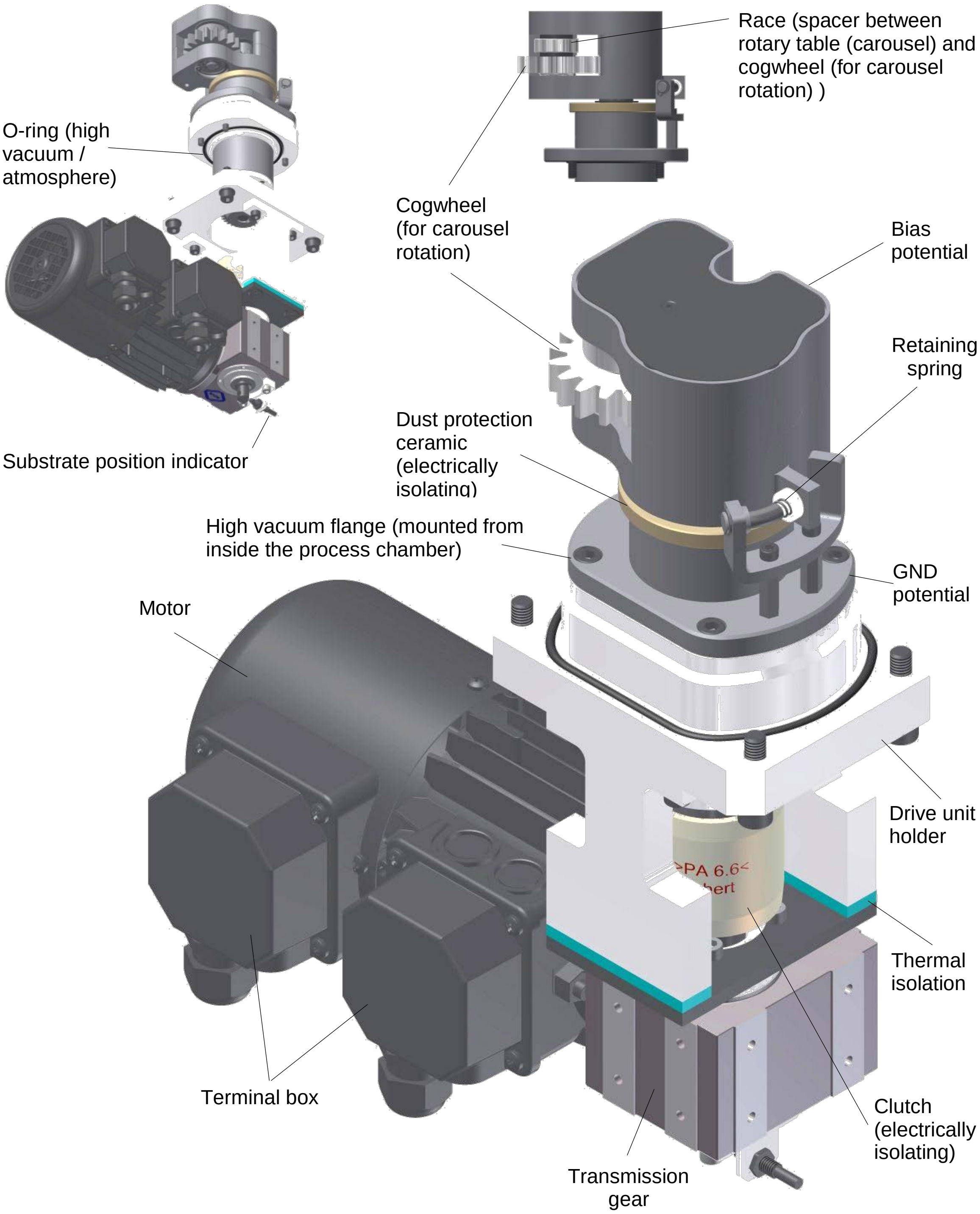
### 3.8.1.12 Movable Shutter* (23)

**The shutter in front of an arc source prevents the unused target to be coated.**

(* Optional

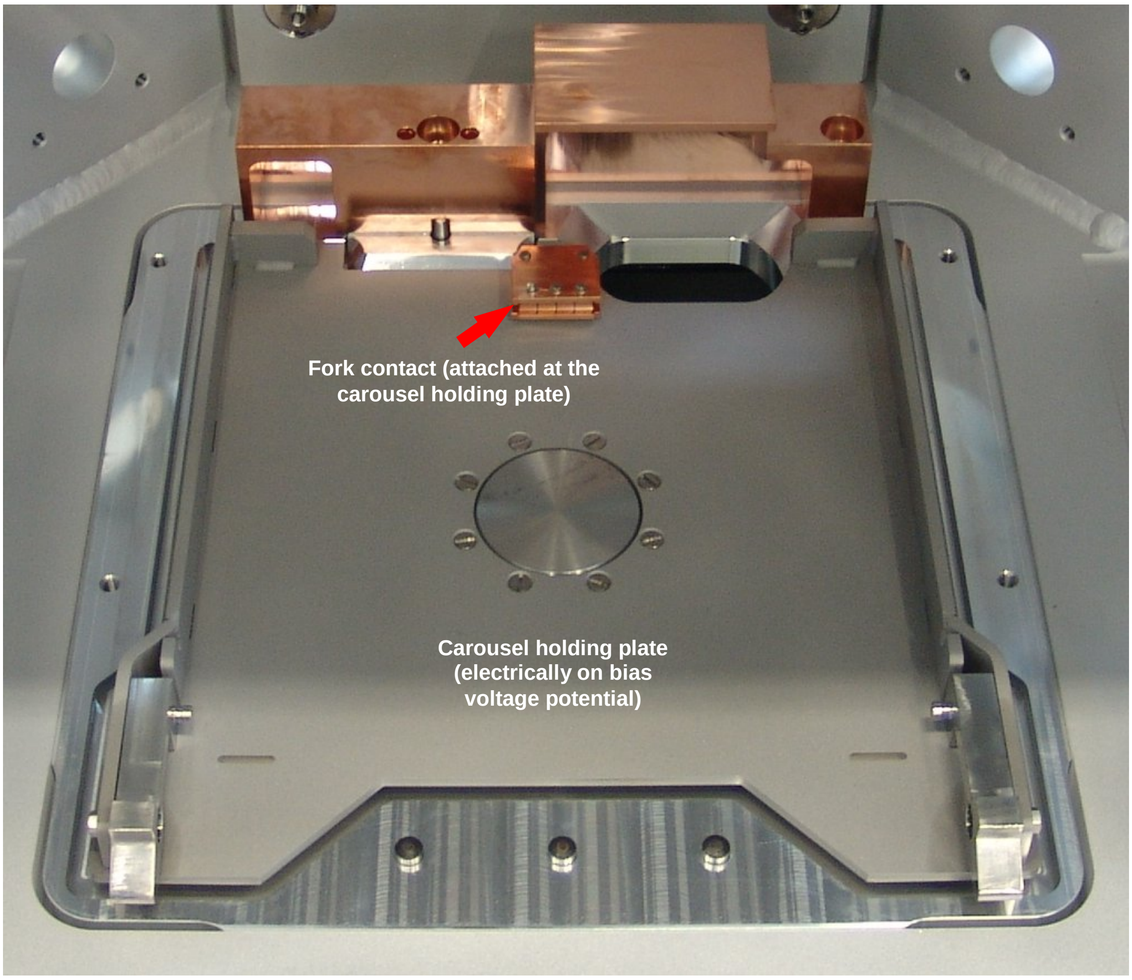
### 3.8.1.13 Rotary Feed-through (28)

The rotary feed-through extends from below the process chamber (atmosphere) into the rear area of the process chamber (vacuum).



### 3.8.1.14 Electrical Feed-through (27)

The electrical feed-through extends from below the process chamber (atmosphere) into the area of the process chamber carousel holding plate (vacuum).

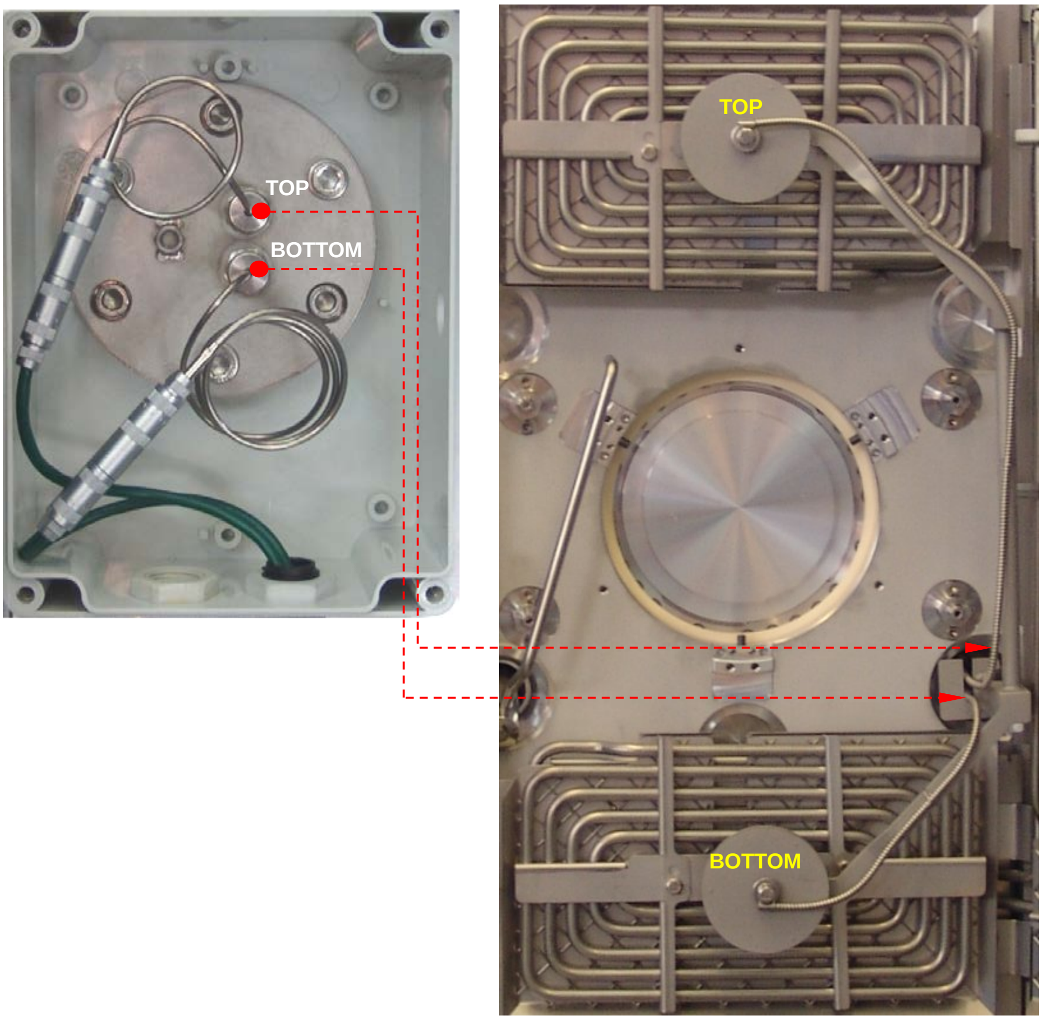



**For further details ⇨ refer to chapter 7.**

### 3.8.2 Thermocouple Positions

The thermocouple feed-through flange is located at the process chamber door (outside). There are two thermocouples (top / bottom). Both are located at the process chamber door (vacuum side).

**Flange (process chamber door)** **Stationary thermocouple device (vacuum side)**




**Between thermocouples and process chamber shielding a permanent short circuit monitoring is active.**

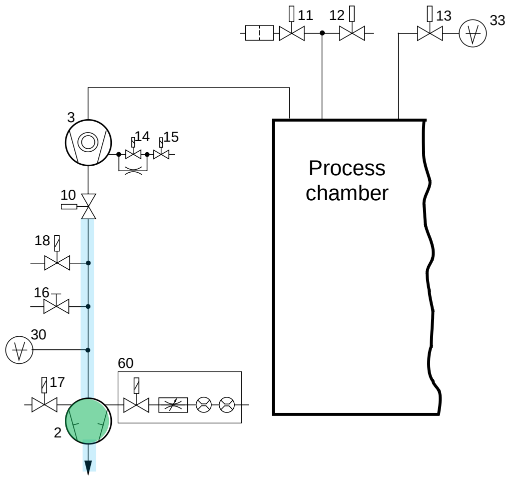
### 3.8.3 Process Modes

The following process modes are described only as an example. All parameters and values are specified in each individual process.

#### 3.8.3.1 Pumping

**Modes:**

Stdby "Stdby" is the starting point to get into different pumping status (e.g. cool, vent, pump, leak rate, etc.).




Setting the pumping system into "Stdby" mode:

- If "Stdby" has been selected in "Pump" mode, the fore line valve (10) closes and the nominal rotational speed of the turbo molecular pump (3) is set to 0% (the turbo molecular pump (3) is still rotating). In order to reduce the rotational speed of the turbo molecular pump (3) the following steps will be performed by the control software:

  The (venting/purge) valves (14) (15) opens and 1000 sccm Nitrogen ($N_2$) is admitted directly into the process chamber until the actual rotational speed of the turbo molecular pump (3) is reduced to < 70%. After that, Nitrogen ($N_2$) will be switched off and the Helium valve (12) opens until the actual rotational speed of the turbo molecular pump (3) is < 30%.
- Fore pump (2) is running.
- Vent valve (18) is closed.
- Valves (11) (12) (13) (14) (17) are closed.

The process chamber remains under vacuum.

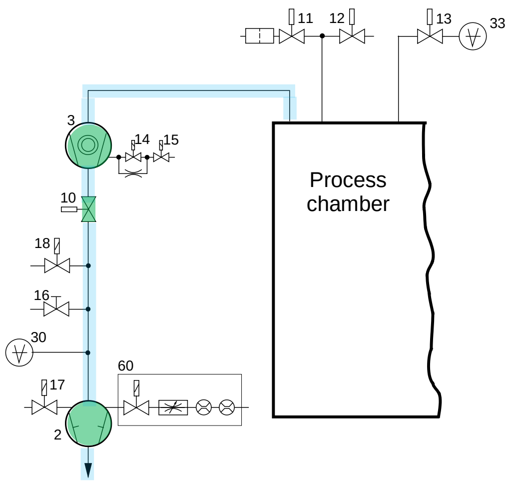
**oerlikon** balzers

**Pump**

Evacuation of the process chamber is completed in two steps.

(A) The fore line valve (10) opens and the process chamber will be evacuated through the turbo molecular pump (3) by means of the fore pump (2).

(B) As soon as the starting pressure is reached, the turbo molecular pump increases its rotational speed continuously and supports the fore pump (2) to reach the required process pressure.



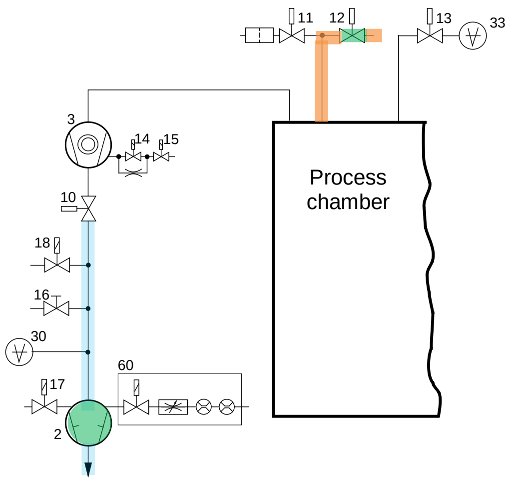

**Cool**

The turbo molecular pump (3) is switched off and the fore line valve (10) is closed (pump status “Stdby”).

Helium is admitted through the turbo molecular pump (3) into the process chamber via cool gas valve (12) to a programmed pressure (e.g. 50 to 800 mbar).

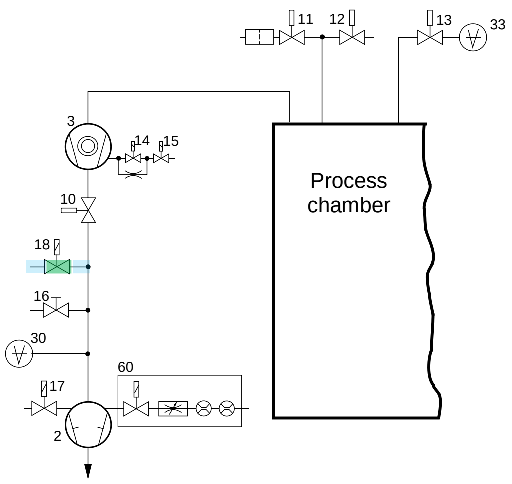
The cool gas valve (12) closes. The cooling continues until the temperature at the temperature sensors are all below the selected value (e.g. below 200°C).

The fore pump (2) is running.




**Off**

All valves are closed except the venting valve (18) for the fore line.

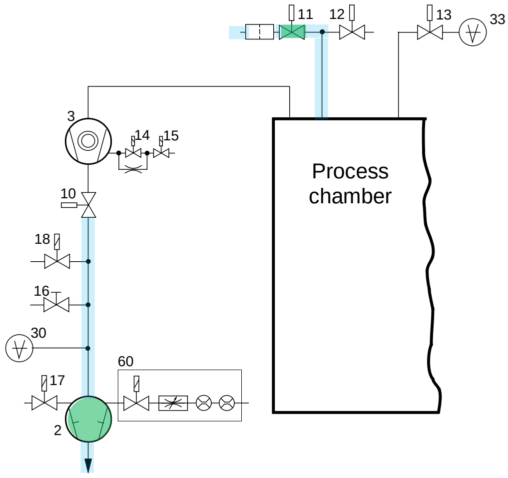


**Vent**

The turbo molecular pump (3) is switched off and the fore line valve (10) is closed (pump status “Stdby”).

Air is admitted into the process chamber via venting valve (11).

The fore pump (2) is running.




**Leak test**

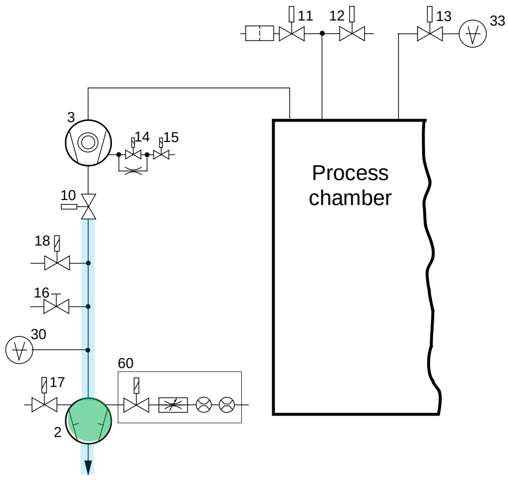
A leak test can only be performed in “Pump” mode.

If “Leak test” has been selected the nominal rotational speed of the turbo molecular pump (3) is set to 0%. The turbo molecular pump (3) decreases slowly its rotational speed.

As soon as the rotational speed of the turbo molecular pump (3) is < 50% the fore line valve (10) closes.

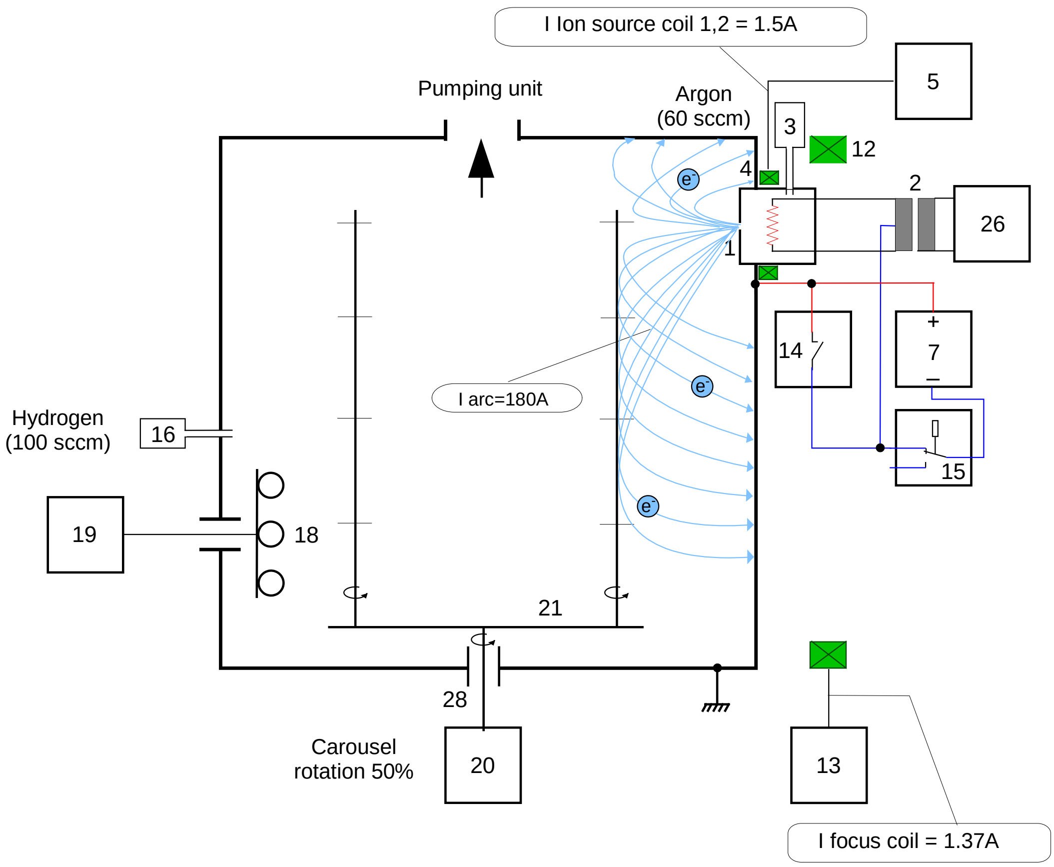
From a rotational speed of < 3% a pressure rise measurement (over a specified time) is started. The calculated pressure difference determined the leak rate.

At the end of the leak rate the pumping system is set into “Stdby” mode.



### 3.8.3.2 Heating

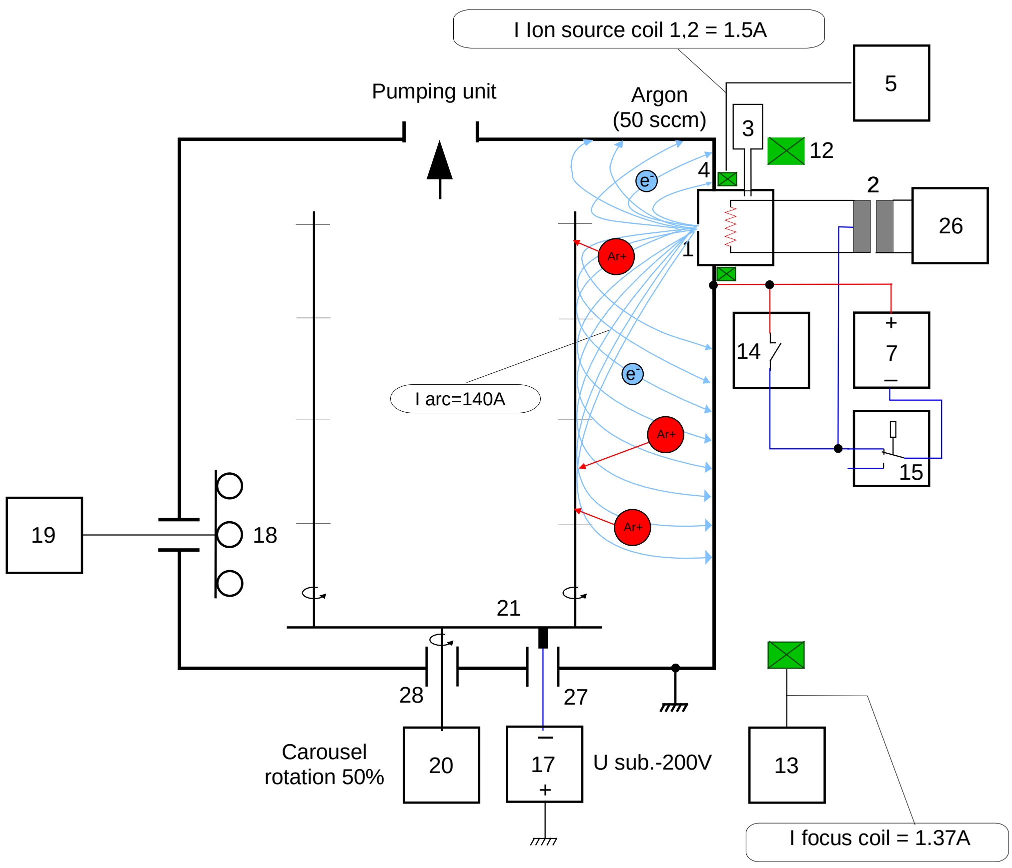
1. The carousel rotation starts (50% rotating speed). The Argon flow to ion sources upper, lower is set to 60 sccm. The filaments of both ion sources are switched on. All heaters are switched on.
2. The coils have to be set as follows:
   Ion source coils: +2A
   Distribution coil: -0.5A
   Focus coil: 0.0A
3. Ignition of the arc and regulation of the arc current to 180A.
4. The Hydrogen flow is regulated to 100 sccm.
5. The arc is switched off after the standard heating time has elapsed. The heating sequence is finished.
6. End of heating.



| | | | |
|---|---|---|---|
| 1 | Ion sources upper, lower | 2 | Transformer for filament current upper, lower |
| 3 | Argon inlet into the ion sources upper, lower | 4 | Ion source coils upper, lower |
| 5 | Power supply for the ion source coils upper, lower | 7 | Power supplies for arc sources 1-6 and ion sources upper, lower |
| 12 | Focus coil | 13 | Power supply for focus coil |
| 14 | Arc interrupter (AI) | 15 | Switch box |
| 16 | Central gas inlet | 18 | Radiation heaters |
| 19 | Power supplies for heating elements | 20 | Rotary drive |
| 21 | Carousel | 26 | Power supply for filament current |
| 28 | Mechanical feed-through | | |

### 3.8.3.3 Etching

1. The carousel rotation starts (50% rotating speed). The Argon flow to ion sources upper, lower is set to 50 sccm. The filaments of both ion sources are switched on. All heaters are switched on.
2. The coils have to be set as follows:
   Ion source coils: +2A
   Distribution coil: +0.1A
   Focus coil: +1.0A
3. Ignition of the arc and regulation of the arc current to 140A.
4. The substrate voltage (bias) regulates (ramp) to the etching voltage (-50V to -200V).
5. The arc is switched off after the standard etching time has elapsed. The etching sequence is finished.
6. End of etching.

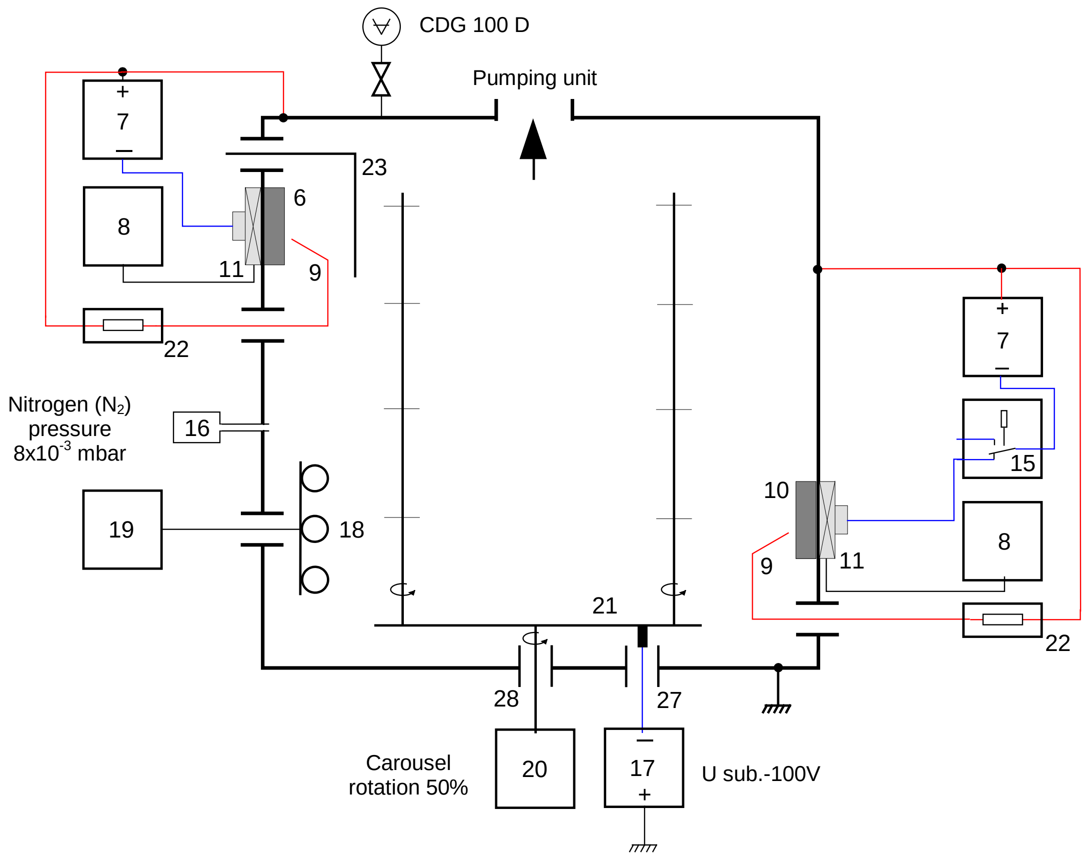


| | | | |
|---|---|---|---|
| 1 | Ion sources upper, lower | 2 | Transformer for filament current upper, lower |
| 3 | Argon inlet into the ion sources upper, lower | 4 | Ion source coils upper, lower |
| 5 | Power supply for the ion source coils upper, lower | 7 | Power supplies for arc sources 1-6 and ion sources upper, lower |
| 12 | Focus coil | 13 | Power supply for focus coil |
| 14 | Arc interrupter (AI) | 15 | Switch box |
| 16 | Central gas inlet | 17 | Power supply for bias voltage |
| 18 | Radiation heaters | 19 | Power supplies for heating elements |
| 20 | Rotary drive | 21 | Carousel |
| 26 | Power supply for filament current | 27 | Electrical feed-through |
| 28 | Mechanical feed-through | | |

### 3.8.3.4 Coating (Example BALINIT_A)

The start pressure for the “Coating“ sequence ($P_{IKR\ 251}$) ≤ $5x10^{-4}$ mbar.

1. The carousel rotation starts (50% rotating speed).
2. The Bias voltage is adjusted to –100V.
3. The turbo molecular pump rotation speed is reduced to 60%.
4. The Nitrogen (N2) pressure is set to $8x10^{-3}$ mbar.
5. The power supplies for arc sources (7) are switched on.
6. The arc sources are ignited by the igniters (9).
7. Coating continues according to the selected process time.



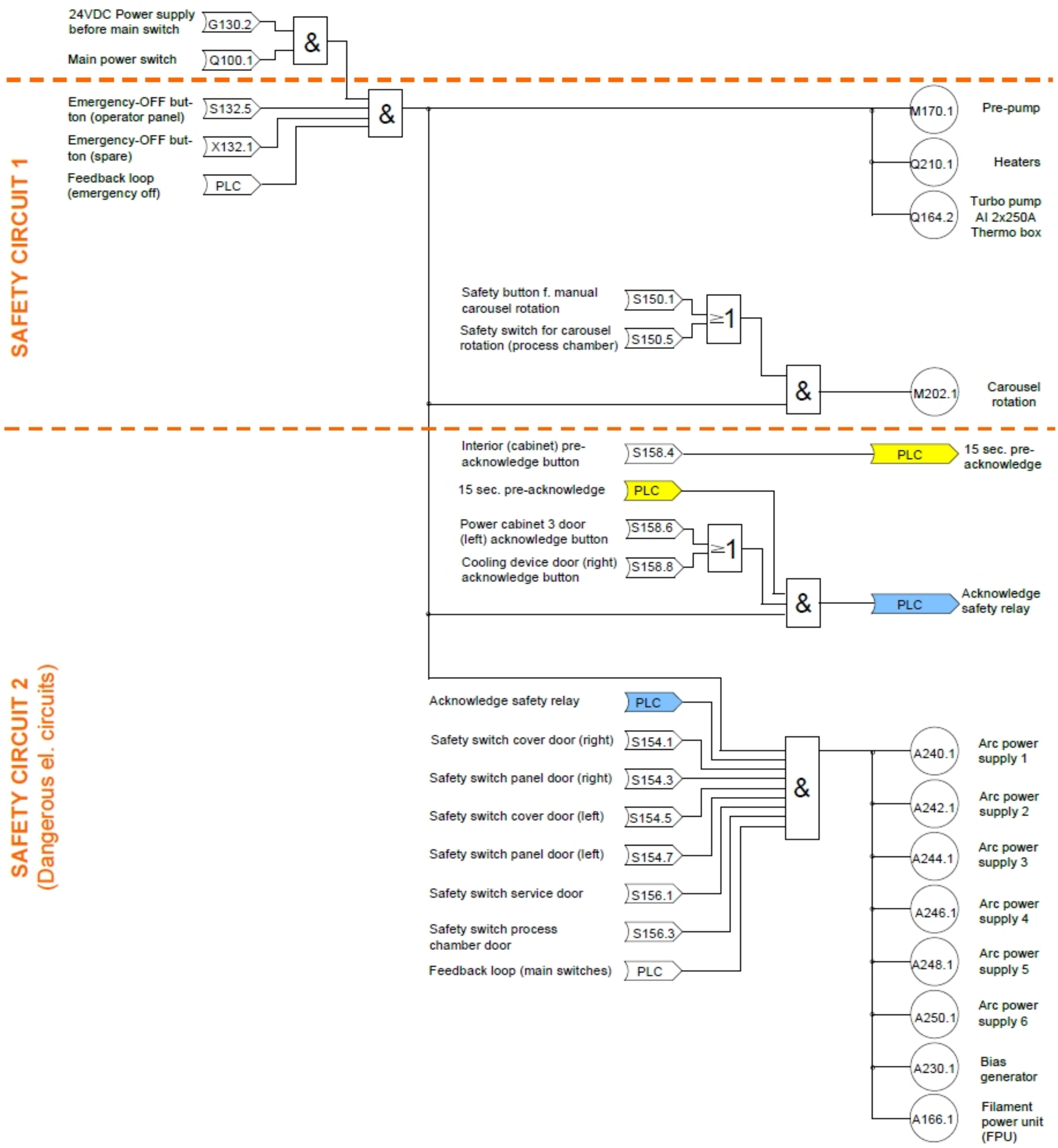
| | | | |
|---|---|---|---|
| 6 | Arc sources 3-6 | 7 | Power supplies for arc sources 1-6 and ion sources upper, lower |
| 8 | Power supplies for magnet system (arc sources) | 9 | Igniters |
| 10 | Arc sources 1-2 | 11 | Magnet system for arc sources |
| 15 | Switch box | 16 | Central gas inlet |
| 17 | Power supply for bias voltage or | 18 | Radiation heaters |
| 19 | Power supplies for heating elements | 20 | Rotary drive |
| 21 | Carousel | 22 | Igniter resistor |
| 23 | Movable shutter* | 27 | Electrical feed-through |
| 28 | Mechanical feed-through | | |

(* Optional

### 3.8.4 Safety Interlocks

#### 3.8.4.1 Principle Diagram of Safety Circuit 1 & 2

**For further details refer to customers wiring diagram.**



**Legend:**

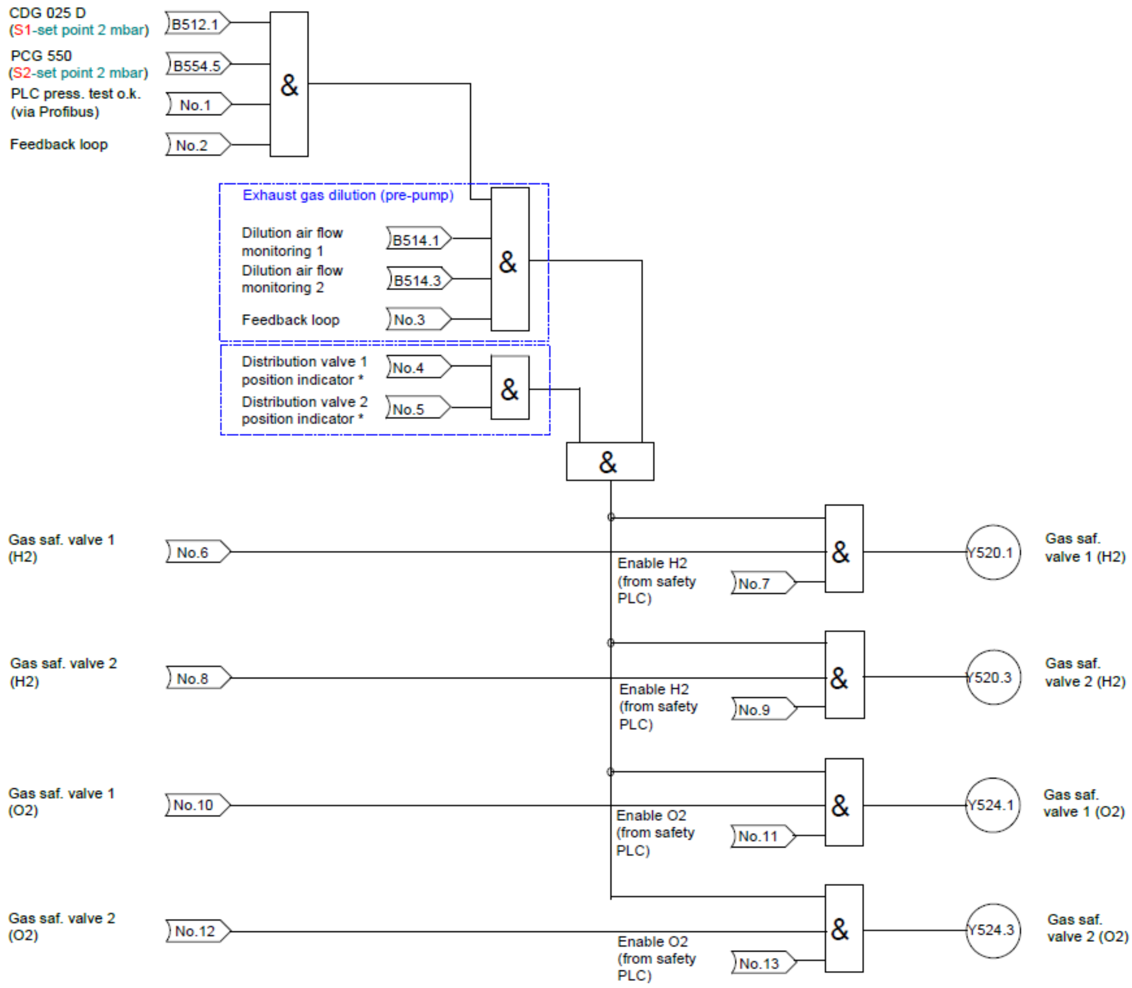
| | |
|---|---|
| **G130.2** | 24VDC Power supply before main switch |
| **Q100.1** | Main power switch |
| **S132.5** | Emergency-off button (operator panel) |
| **X132.1** | Emergency-off button (spare) |
| **PLC** | Feedback loop from safety PLC (emergency-off) |
| **S150.1** | Safety button f. manual carousel rotation |
| **S150.5** | Safety switch for carousel rotation (process chamber) |
| **S158.4** | Interior (cabinet) pre-acknowledge button |
| **PLC** | 15 seconds pre-acknowledge |
| **S158.6** | Power cabinet 3 door (left) acknowledge button |
| **S158.8** | Cooling device door (right) acknowledge button |
| **PLC** | Acknowledge safety relay |
| **S154.1** | Safety switch cover door (right) |
| **S154.3** | Safety switch panel door (right) |
| **S154.5** | Safety switch cover door (left) |
| **S154.7** | Safety switch panel door (left) |
| **S156.1** | Safety switch service door |
| **S156.3** | Safety switch process chamber door |
| **PLC** | Feedback loop from safety PLC (main switches) |

| | |
|---|---|
| **M170.1** | Fore pump |
| **Q210.1** | Heaters |
| **Q164.2** | Turbo molecular pump, Al 2x250A, thermo box |
| **M202.1** | Carousel rotation |
| **A240.1** | Arc power supply 1 |
| **A242.1** | Arc power supply 2 |
| **A244.1** | Arc power supply 3 |
| **A246.1** | Arc power supply 4 |
| **A248.1** | Arc power supply 5 |
| **A250.1** | Arc power supply 6 |
| **A230.1** | Bias generator |
| **A166.1** | Filament power unit (FPU) |

### 3.8.5 Safety PLC

#### 3.8.5.1 Principle Diagram of Gas Security

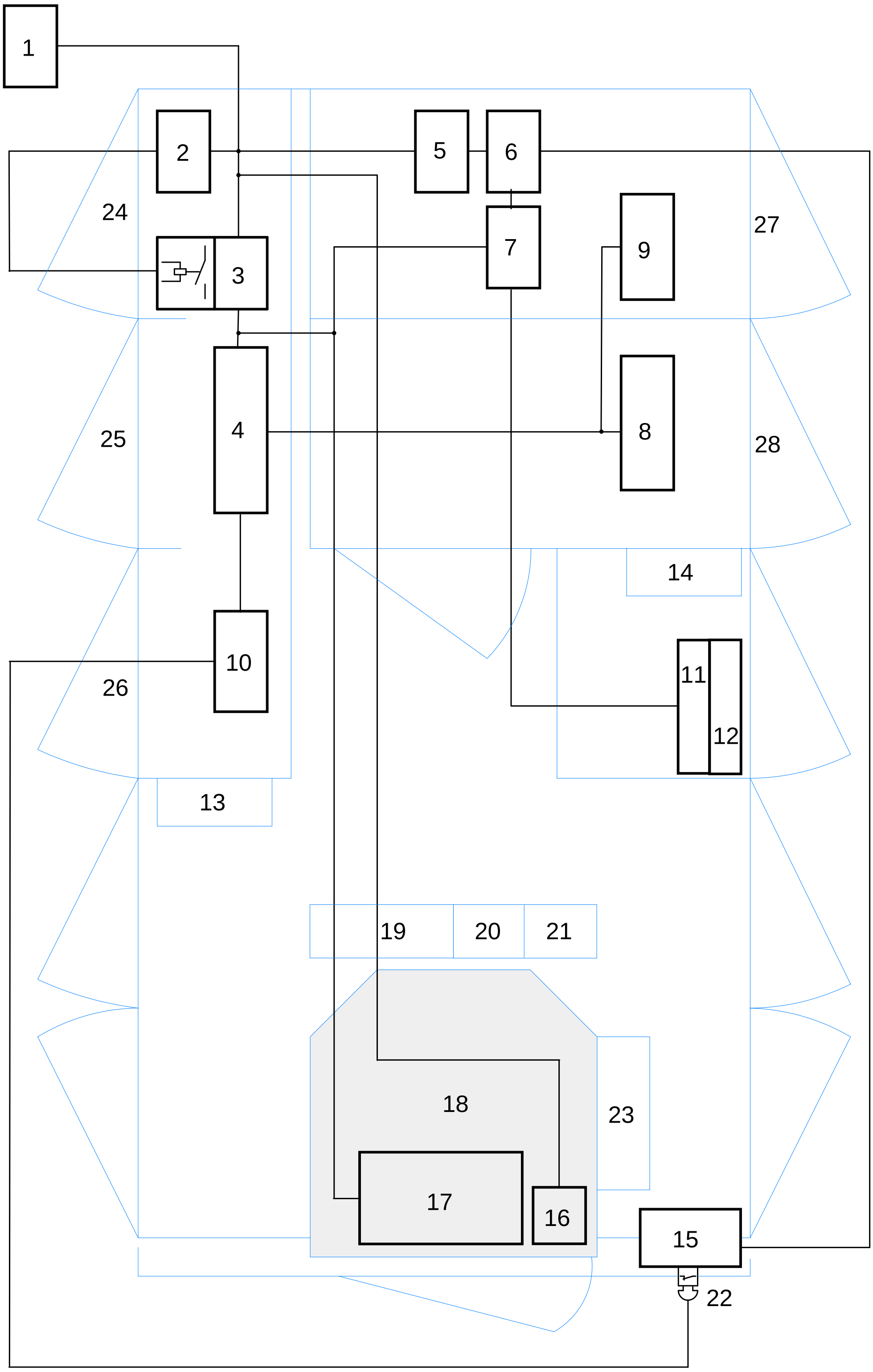
**For further details refer to customers wiring diagram.**



**Legend:**

| | |
|---|---|
| | Inputs (chamber pressure) |
| **B554.5** | PCG 550 (S2-set point 2 mbar) |
| **B512.1** | CDG025 D (S1-set point 2 mbar) |
| **No.1** | PLC press. test o.k. (via Profibus) |
| **No.2 / No3** | Feedback loop from safety PLC |
| | Exhaust gas dilution (fore pump) |
| **B514.1** | Dilution air flow monitoring 1 |
| **B514.3** | Dilution air flow monitoring 2 |
| | Decontamination (gas distribution) approx. 20 sec. |
| **No.4** | Distribution valve 1 position indicator |
| **No.5** | Distribution valve 2 position indicator |
| | Inputs (software signal) |
| **No.6** | Gas safety valve 1 (H2) |
| **No.8** | Gas safety valve 2 (H2) |
| **No.10** | Gas safety valve 1 (O2) |
| **No.12** | Gas safety valve 2 (O2) |
| | Inputs (software signal) |
| **No.7** | Enable H2 |
| **No.9** | Enable H2 |
| **No.11** | Enable O2 |
| **No.13** | Enable O2 |
| | Outputs (valves) |
| **Y520.1** | Gas safety valve 1 (H2) |
| **Y520.3** | Gas safety valve 2 (H2) |
| **Y524.1** | Gas safety valve 1 (O2) |
| **Y524.3** | Gas safety valve 2 (O2) |

### 3.8.6 Overview of Main Power and Control Units



| | |
|---|---|
| **1** | Mains 3L/N/PE |
| **2** | Power supply 24VDC |
| **3** | Main switch |
| **4** | Mains contactor |
| **5** | UPS 230VAC |
| **6** | Server |
| **7** | PLC |
| **8** | Power supplies for arc sources 1..6 and ion sources |
| **9** | Substrate supply |
| **10** | Security circuit / safety PLC |
| **11** | Pneumatic |
| **12** | Gas distributor |
| **13** | Cooling device power cabinet 1..3 |
| **14** | Cooling device power cabinet 4..5 |
| **15** | Operator panel |
| **16** | Capacitance diaphragm gauge (process) CDG 100 D |
| **17** | Pump unit |
| **18** | Process chamber |
| **19** | Arc interrupter (AI) |
| **20** | Filament supply 1 |
| **21** | Filament supply 2 |
| **22** | Emergency-off switch |
| **23** | Water distributor |
| **24** | Power cabinet 1 |
| **25** | Power cabinet 2 |
| **26** | Power cabinet 3 |
| **27** | Power cabinet 4 |
| **28** | Power cabinet 5 |

# 4 Operating Elements

**Manufacturer**

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**Please read and retain this manual to assist you in the operation and maintenance of this product. This manual is an integral part of the machine. In the event of a change of ownership, hand this manual over to the new owner.**

# Contents

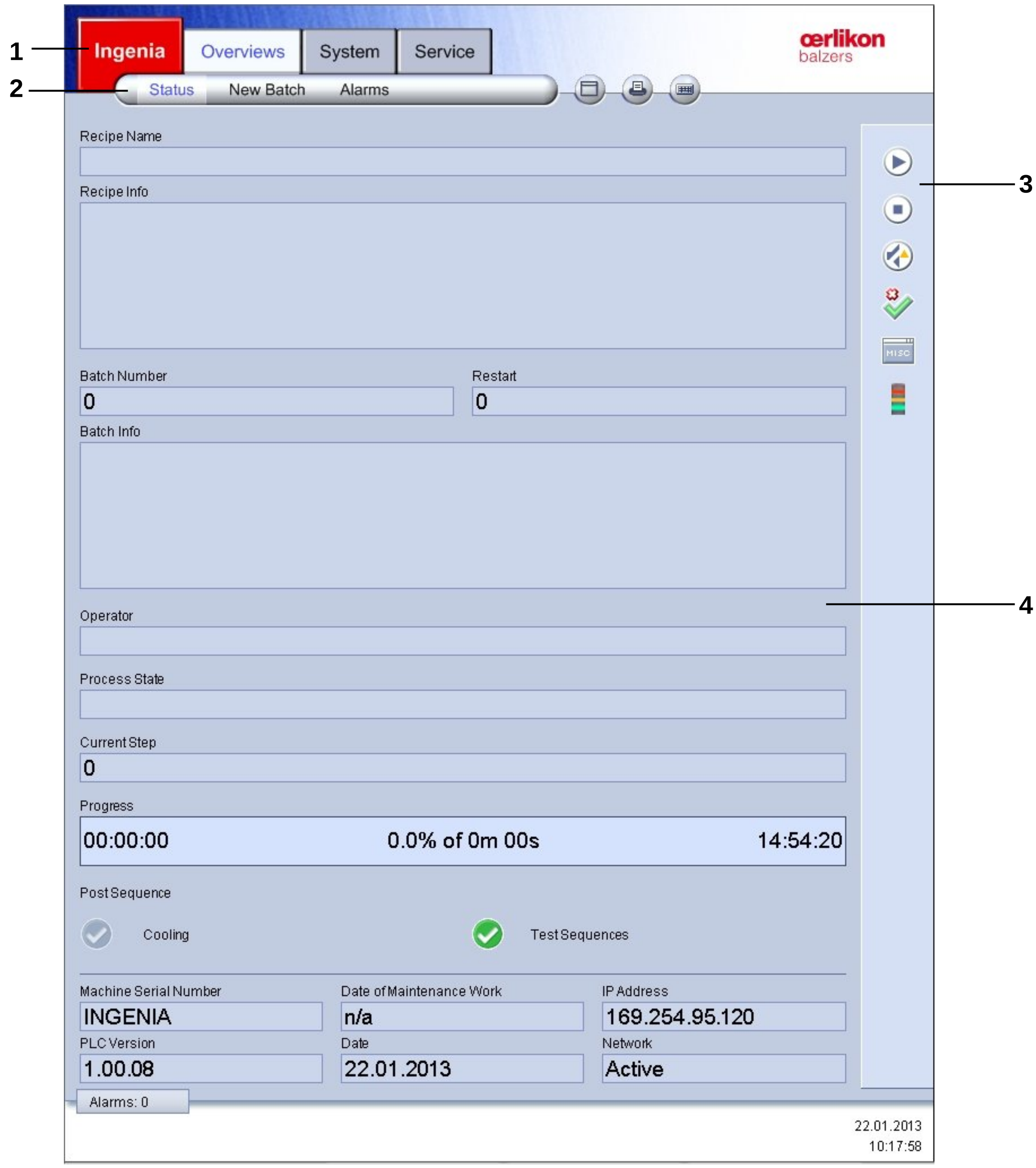
## 4.1 Operator - Control Software

The operator panel is located in front of the INGENIA P3e™ coating system. The following chapters (4.1 – 4.5) describe the screens of the operator panel.

### 4.1.1 Starting the Control Software

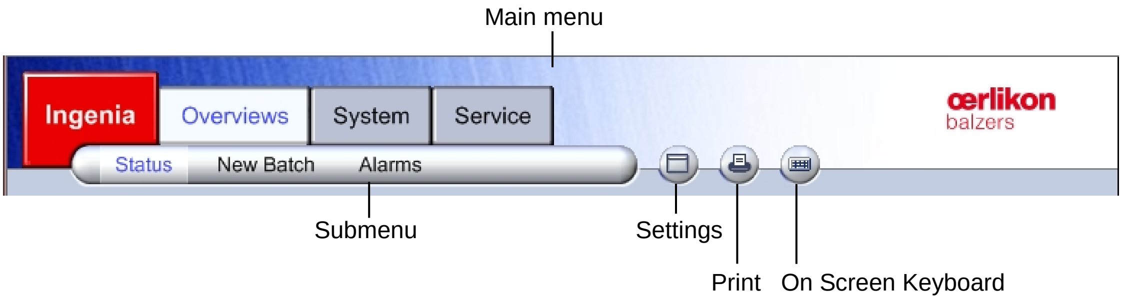
In case of an electrical power fail or due to shut down of the INGENIA P3e™ coating system, the startup procedure must be followed as described in chapter 7 “Service & Maintenance”. After startup the operator visualization in front of the machine starts automatically.

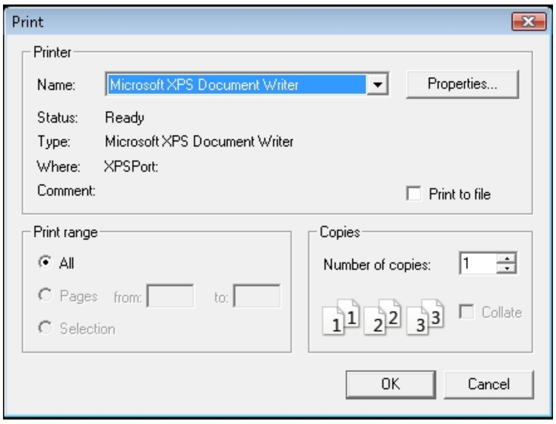
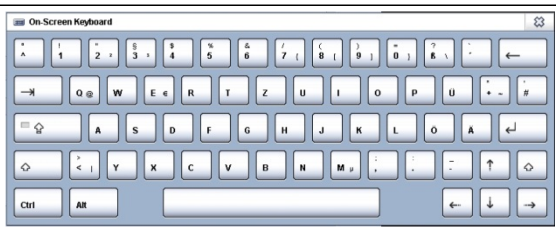
### 4.1.2 General Features of the INGENIA P3e™ Operator Screens




**1** Main menu / **2** Submenu / **3** Icon bar / **4** Main display

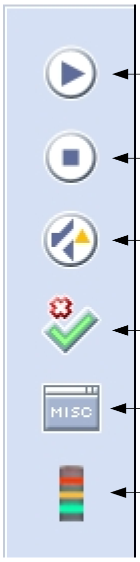
## Menus:




| | | |
|---|---|---|
|  | **Settings: ▶** |  |
|  | **Print: ▶** |  |
|  | **On Screen Keyboard: ▶** |  |

### Icon Bar:

The soft keys allow screen selection, start/stop of all processes and alarm confirmation.




Starts the selected process

Stops the actual process

Switches off the acoustic signal

Acknowledges all error messages

Opens the “Operator–Miscellaneous” screen

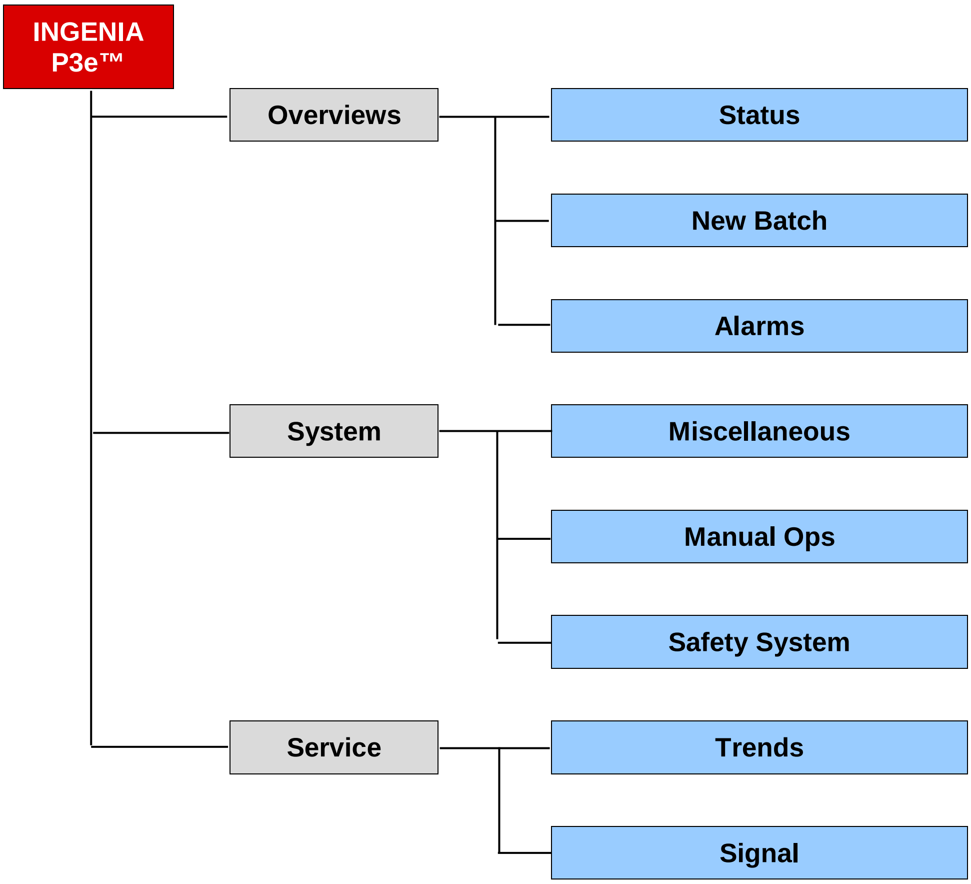
Process Status Lamps

### 4.1.3 Status Lamps

The following table shows the respective colors depending on the process status:

| | steady | flashing | steady | flashing | steady | flashing | acoustic signal |
|---|---|---|---|---|---|---|---|
| Process On<br>No active message in status line. | | | | | X | | |
| Process On<br>Active message in status line (not acknowledged). | | | | X | X | | |
| Process On<br>Active message in status line (acknowledged). | | | X | | X | | |
| Process interruption<br>Active message in status line (not acknowledged). | | X | | | | | 30s |
| Process interruption<br>Active message in status line (acknowledged). | X | | | | | | |
| Process successful terminated. | | | | | | X | |
| Process Off<br>Active message in status line (not acknowledged). | | | | X | | | |
| Process Off<br>Active message in status line (acknowledged). | | | X | | | | |

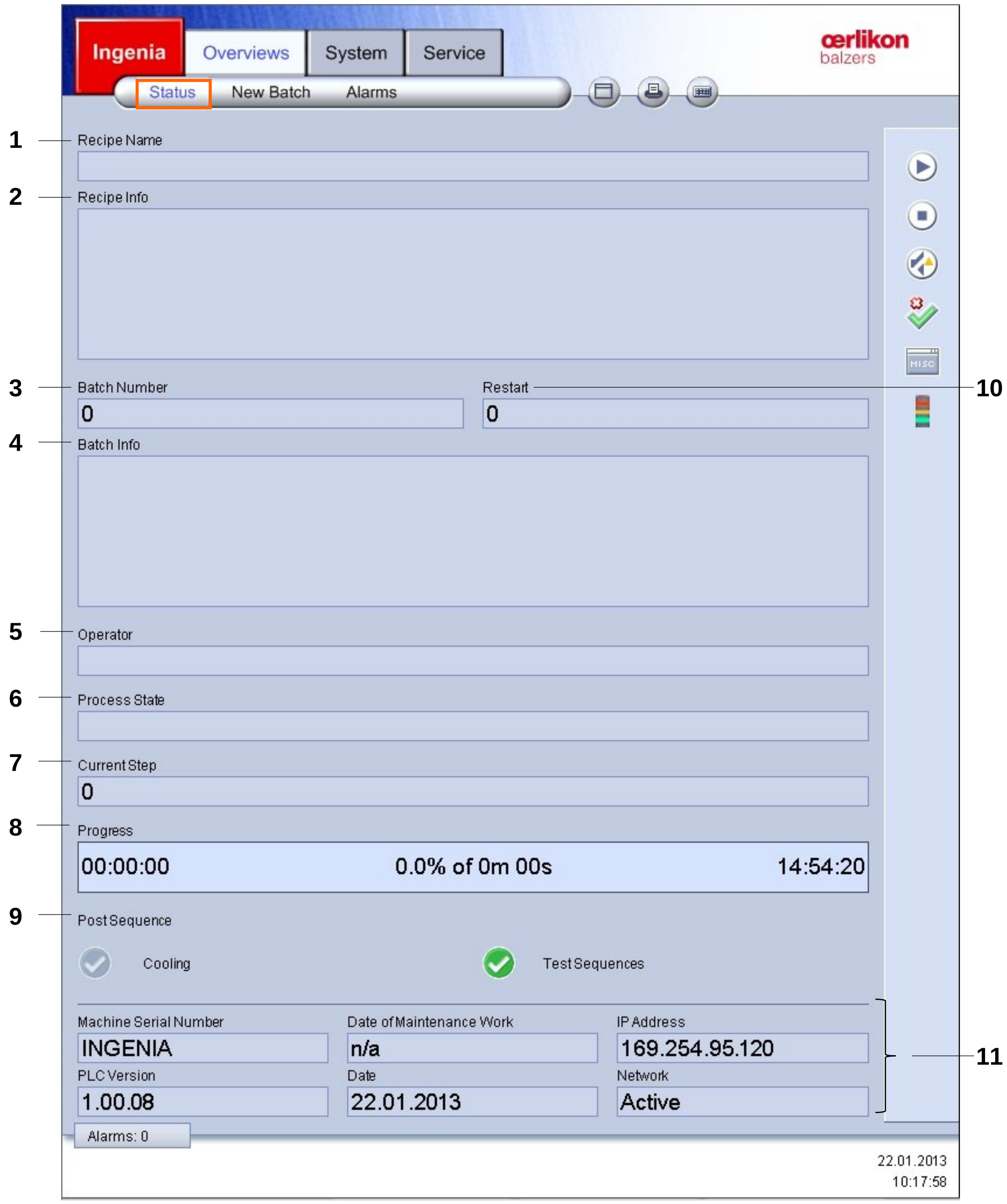
## 4.2 Operator - Screen Navigation



## 4.3 Operator - Overview Screens

### 4.3.1 Overview Screen – Status

The "Overview Screen - Status" shows the selected process parameters and enables setting the parameters for the next batch.

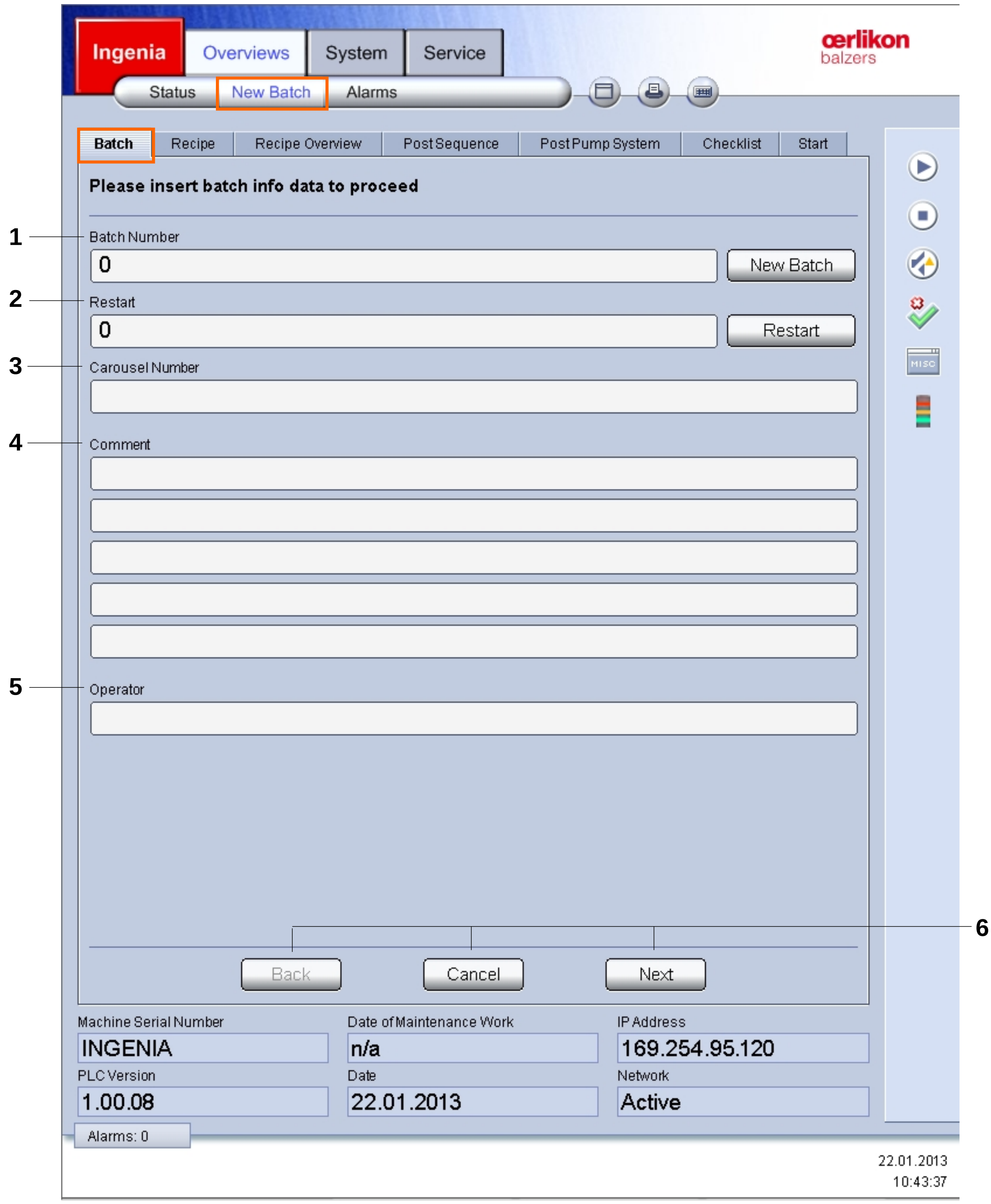


**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Recipe Name** | Recipe code. |
| 2 | **Recipe Info** | Information to the selected recipe. |
| 3 | **Batch Number** | Batch number to identify the coating process. |
| 4 | **Batch Info** | Batch specific comments. |
| 5 | **Operator** | Operator name. |
| 6 | **Process State** | Shows the process status of the machine (e.g. idle, etch, coat etc.). |
| 7 | **Current Step** | Actual process step. |
| 8 | **Process** | Actual / calculated remaining batch time. |
| 9 | **Post sequences** | Selected post process tasks. |
| 10 | **Restart** | Number of restarts. |
| 11 | **Info area** | General information of the INGENIA P3e™ coating system. |

### 4.3.2 Overview Screens – New Batch

#### 4.3.2.1 Batch

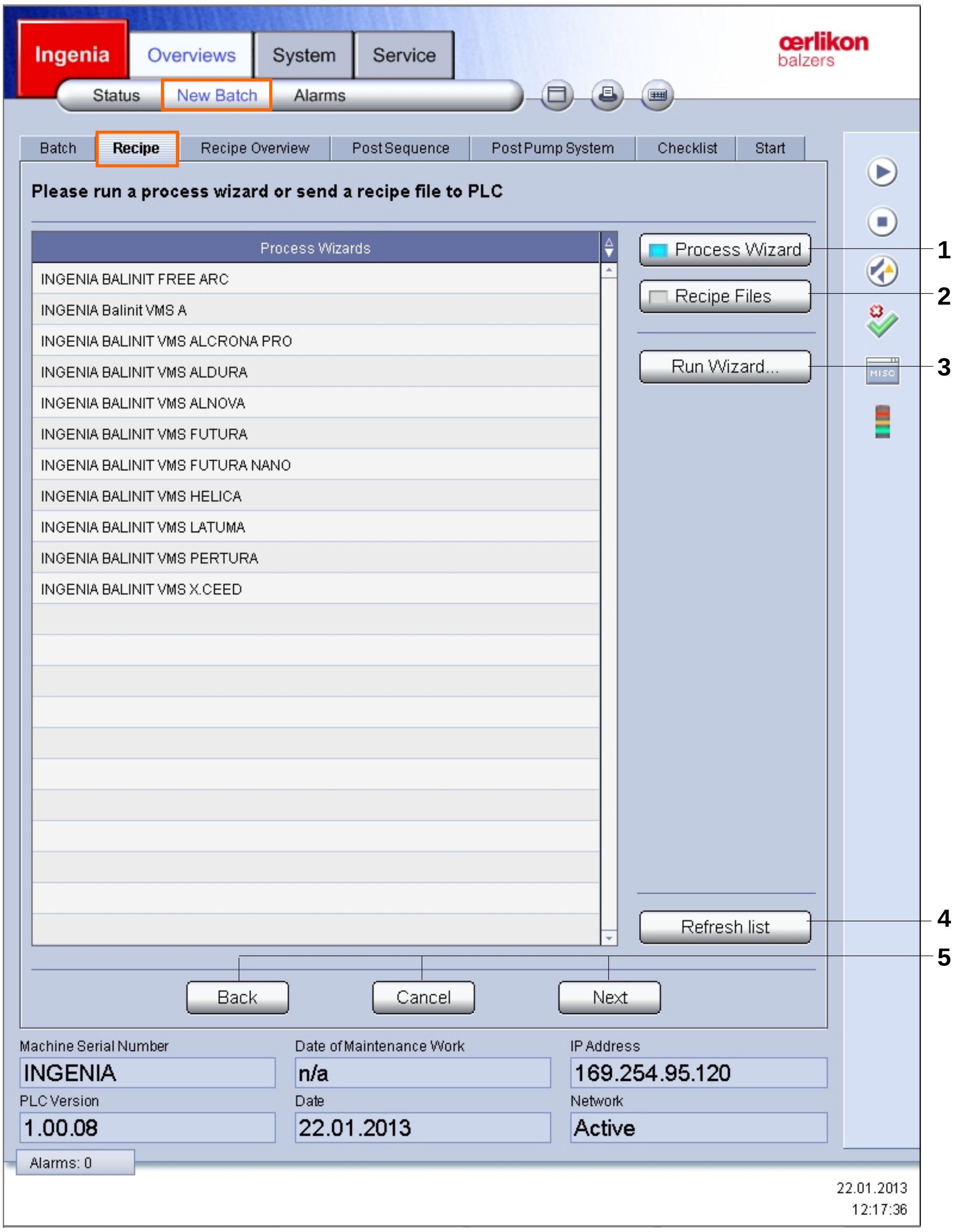


**Features of the screen:**

| | | |
|---|---|---|
| 1 | Batch Number | Batch number to identify the coating process. |
| 2 | Restart | Number of restarts. |
| 3 | Carousel Number | Individual carousel number for carousel identification. |
| 4 | Comment | Batch specific comments. |
| 5 | Operator | Operator name. |
| 6 | Back / Cancel / Next | **Next** / **Back**: (Movement from tab to tab (“Batch” → “Recipe” → etc.) and return.<br>**Cancel**: (Returns to “Overviews” / “Status” screen. |

**All batch relevant data (as parameter, data and operator specific information) are placed in different tabs (“Batch”, “Recipe”, “Recipe Overview”, “Post Sequence”, “Post Pump System” and “Checklist”). Prior to start a new batch, the operator has to enter the different data into the respective tab first.**
**The tab “Start” contains the overall system status and the START and/or STOP button.**

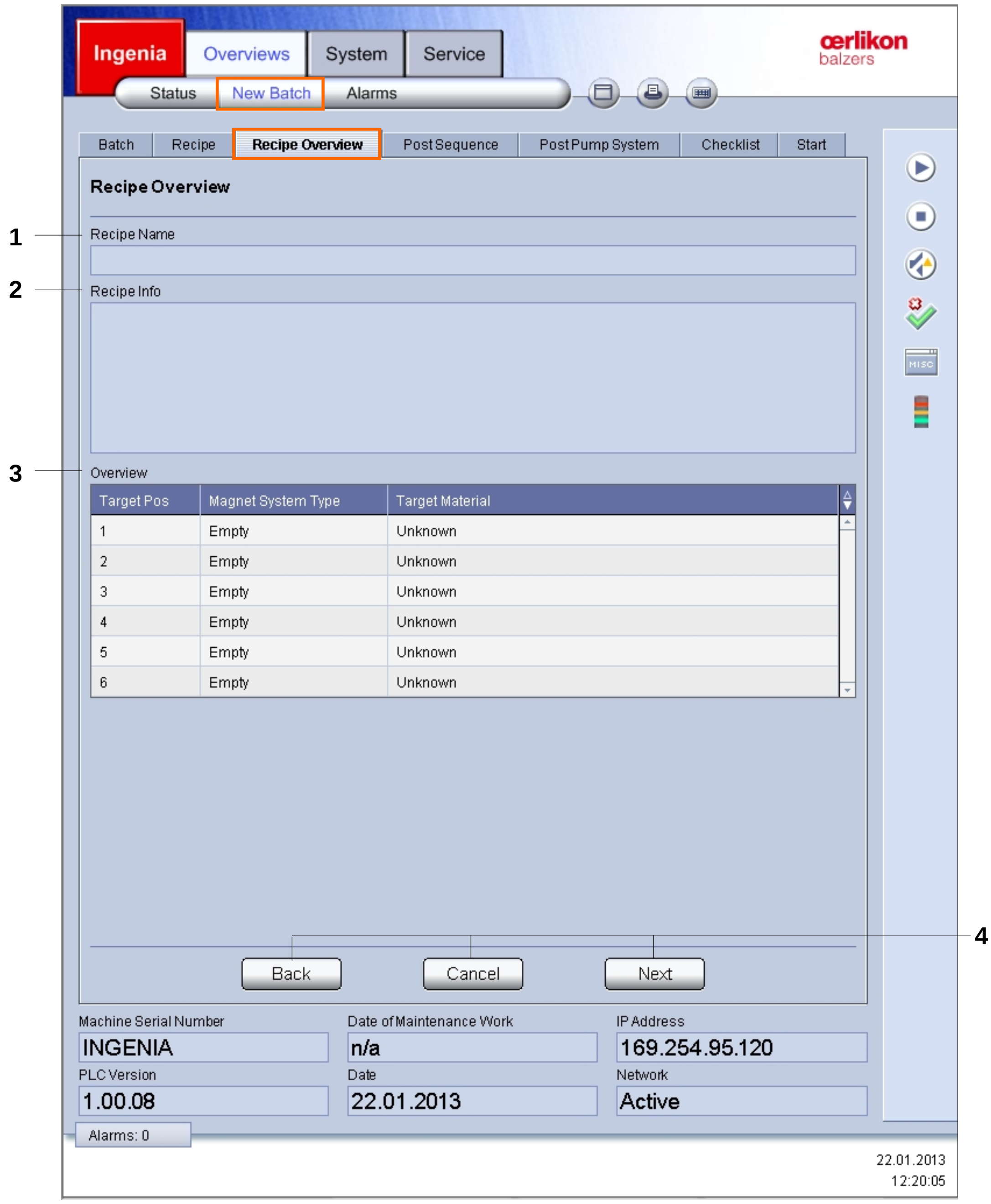
### 4.3.2.2 Recipe


Ingenia
Overviews
System
Service
oerlikon balzers
Status
New Batch
Alarms
Batch
Recipe
Recipe Overview
Post Sequence
Post Pump System
Checklist
Start
Please run a process wizard or send a recipe file to PLC
Process Wizards
INGENIA BALINIT FREE ARC
INGENIA Balinit VMS A
INGENIA BALINIT VMS ALCRONA PRO
INGENIA BALINIT VMS ALDURA
INGENIA BALINIT VMS ALNOVA
INGENIA BALINIT VMS FUTURA
INGENIA BALINIT VMS FUTURA NANO
INGENIA BALINIT VMS HELICA
INGENIA BALINIT VMS LATUMA
INGENIA BALINIT VMS PERTURA
INGENIA BALINIT VMS X.CEED
Process Wizard
Recipe Files
Run Wizard...
Refresh list
Back
Cancel
Next
Machine Serial Number
INGENIA
Date of Maintenance Work
n/a
IP Address
169.254.95.120
PLC Version
1.00.08
Date
22.01.2013
Network
Active
Alarms: 0
22.01.2013
12:17:36
1
2
3
4
5

**Features of the screen:**

| | | |
|---|---|---|
| 1 | Process Wizard | Displays a selection of wizard technologies. |
| 2 | Recipe Files | Displays a selection of recipe files. |
| 3 | Run Wizard | Starts a process wizard. |
| 4 | Refresh List | Updates the list. |
| 5 | Back / Cancel / Next | **Next** / **Back**: (Movement from tab to tab (“Batch” → “Recipe” → etc.) and return.<br>**Cancel**: (Returns to “Overviews” / “Status” screen. |

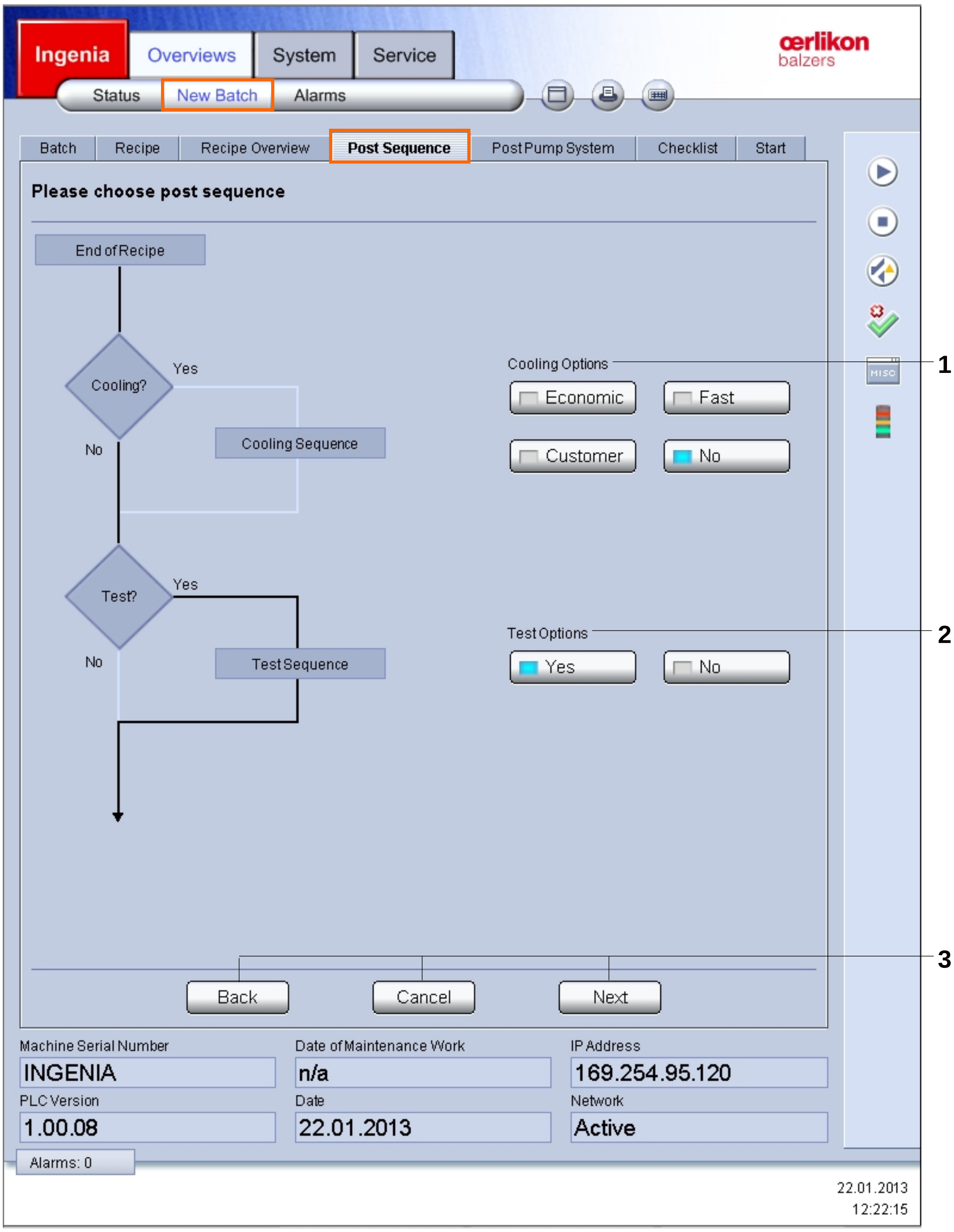
#### 4.3.2.3 Recipe Overview



**Features of the screen:**

| | | |
|---|---|---|
| 1 | Recipe Name | Recipe code. |
| 2 | Recipe Info | Information to the selected recipe. |
| 3 | Overview | Overview of the defined target material and magnet system of the sources. |
| 4 | Back / Cancel / Next | **Next** / **Back**: (Movement from tab to tab (“Batch” → “Recipe” → etc.) and return.<br>**Cancel**: (Returns to “Overviews” / “Status” screen. |

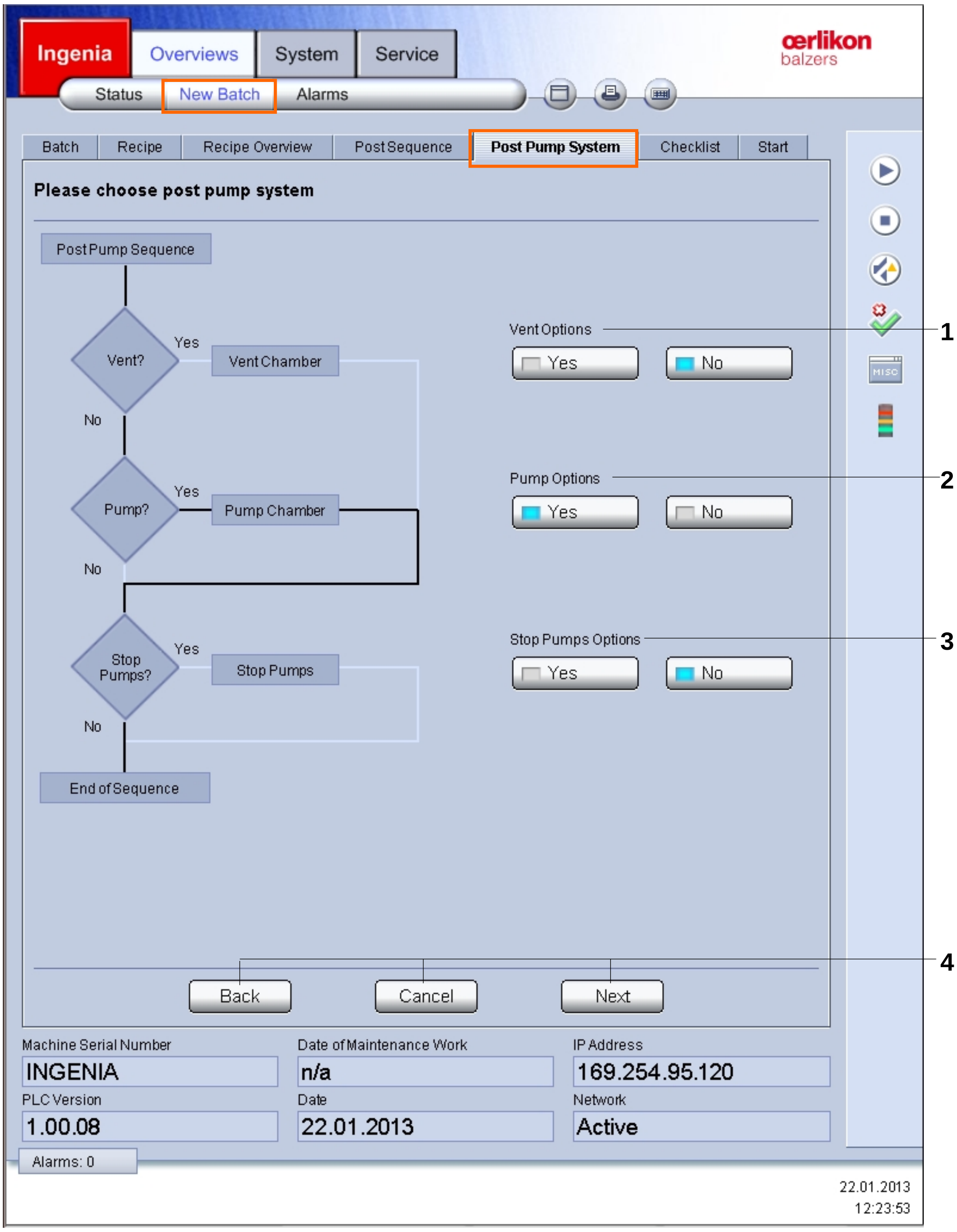
#### 4.3.2.4 Post Sequence



**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Cooling Options** | |
| | Economic; Fast; Customer; No | Selected type for the cooling sequence. |
| 2 | **Test Options** | |
| | Yes / No | Leak test sequence if required (at least a week.) |
| 3 | Back / Cancel / Next | **Next** / **Back**: (Movement from tab to tab (“Batch” → “Recipe” → etc.) and return.<br>**Cancel**: (Returns to “Overviews” / “Status” screen. |

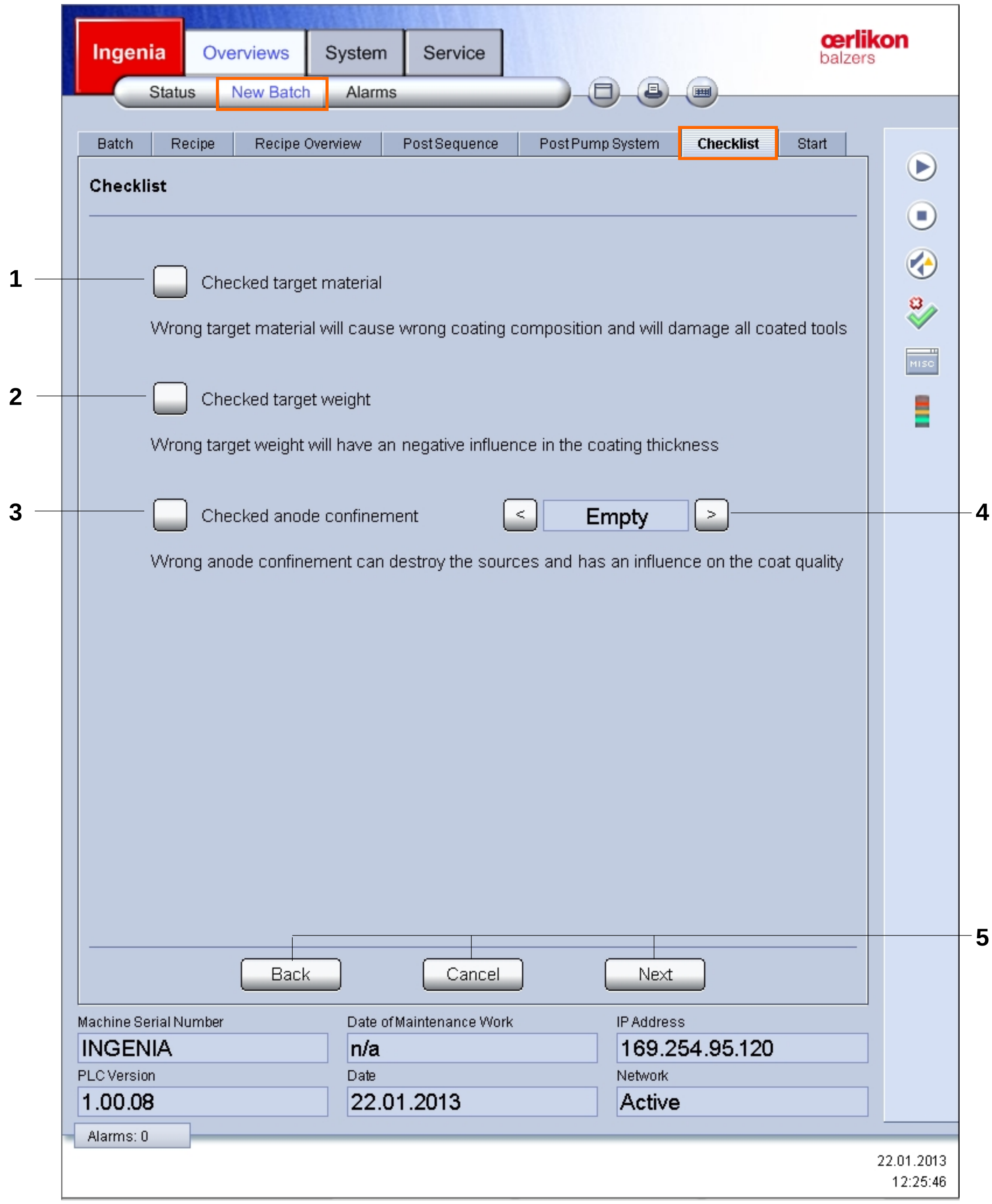
### 4.3.2.5 Post Pump System



**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Vent Options** | |
| | Yes / No | Process chamber will be vented after process if the leak rate is o.k. |
| 2 | **Pump Options** | |
| | Yes / No | Process chamber will be evacuated after process. |
| 3 | **Stop Pumps Options** | |
| | Yes / No | Switched of the pumping system if required. |
| 4 | Back / Cancel / Next | **Next** / **Back**: (Movement from tab to tab (“Batch” → “Recipe” → etc.) and return.<br>**Cancel**: (Returns to “Overviews” / “Status” screen. |

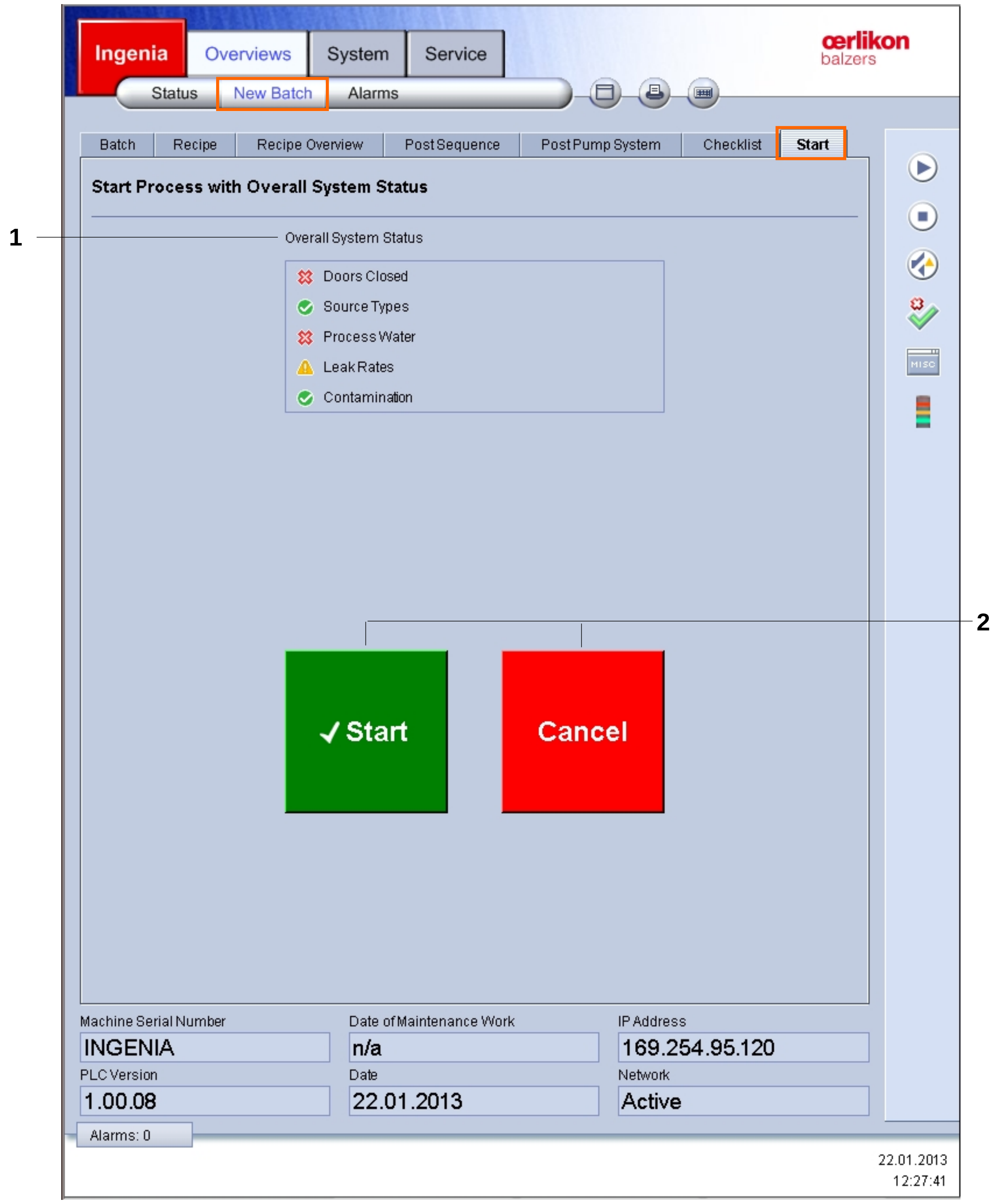
#### 4.3.2.6 Checklist



**Features of the screen:**

| | | |
|---|---|---|
| 1 | Checked target material | A click on this box confirms that the installation of the target material is correct. |
| 2 | Checked target weight | A click on this box confirms that the selected target weight agrees with the installed targets. |
| 3/4 | Checked anode confinement | A click on this box confirms that the correct anode confinement system (corresponding to the actual installed system) is installed. |
| 4 | < Empty > | Anode confinement selection. |
| 5 | Back / Cancel / Next | **Next** / **Back**: (Movement from tab to tab (“Batch” → “Recipe” → etc.) and return.<br>**Cancel**: (Returns to “Overviews” / “Status” screen. |

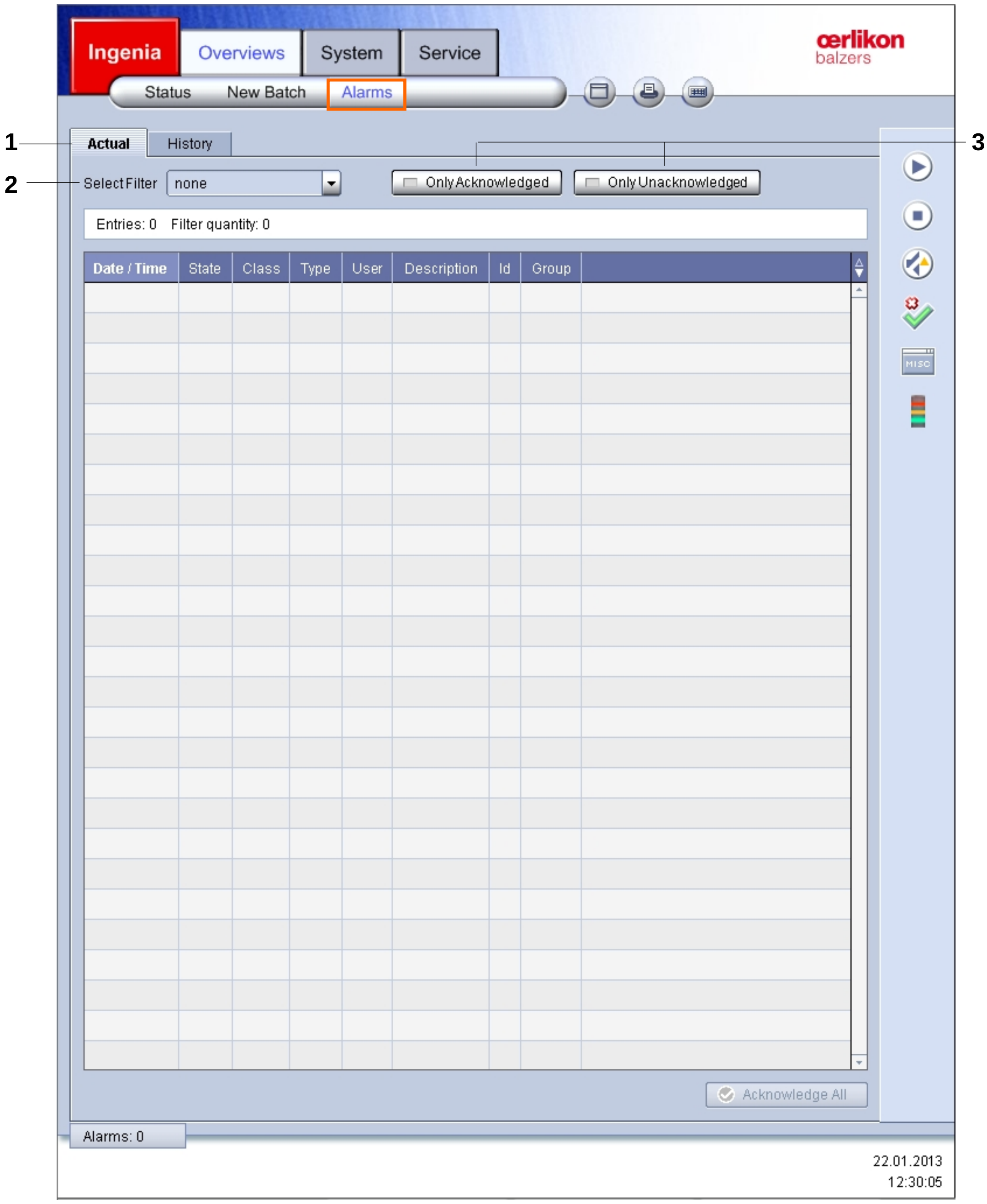
### 4.3.2.7 Start


Ingenia
Overviews
System
Service
oerlikon balzers
Status
New Batch
Alarms
Batch
Recipe
Recipe Overview
Post Sequence
Post Pump System
Checklist
Start
Start Process with Overall System Status
1
Overall System Status
Doors Closed
Source Types
Process Water
Leak Rates
Contamination
2
✓ Start
Cancel
Machine Serial Number
INGENIA
Date of Maintenance Work
n/a
IP Address
169.254.95.120
PLC Version
1.00.08
Date
22.01.2013
Network
Active
Alarms: 0
22.01.2013
12:27:41

**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Overall System Status** | Correct / incorrect system status is displayed.<br>**An incorrect status prevents a process start.** |
| | | correct status<br>Incorrect status<br>fault during the last batch |
| 2 | **Start / Stop** | Start: Starts the process (to confirm press YES on the acknowledge popup window).<br>Stop: Stops the process (to confirm press YES on the acknowledge popup window). |

### 4.3.3 Overview Screen – Alarms



**In general there are different types of alarm messages:**

**Type:**

| | |
|---|---|
|  | **Fatal error** messages are caused by severe events or failures. A running process will be automatically stopped. |
|  | **Warning** messages are alerts that may result in a fatal error. |
|  | **Event** messages contain information for operator/service personnel. |

**State:**

| | |
|---|---|
|  | A message is generated by the control system. |
|  | The generated message is pending and acknowledged. |
|  | The generated message is inactive and acknowledged. |

**Features of the screen:**

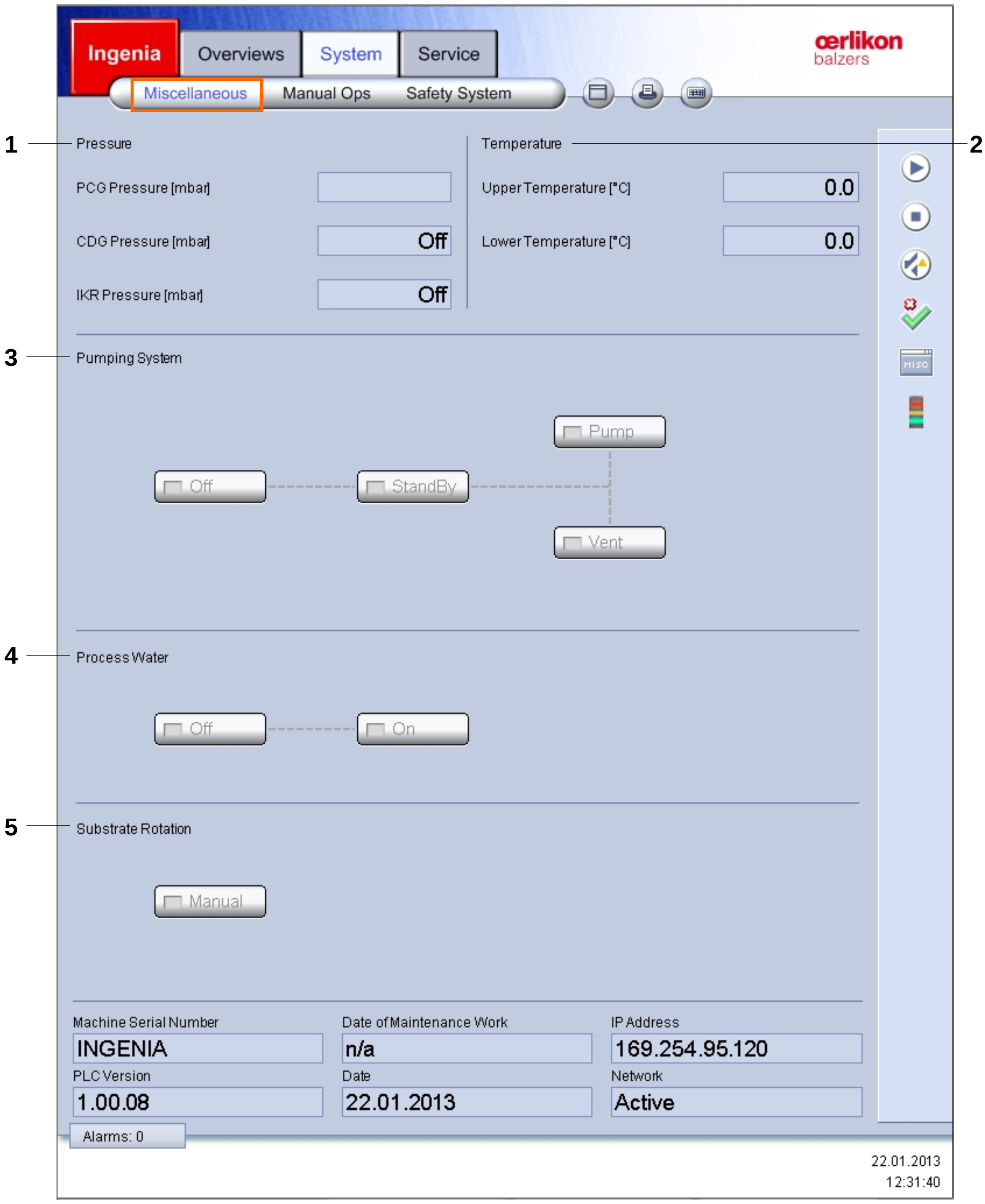
| | | |
|---|---|---|
| 1 | Actual / History | "Actual" or "History" enables switching between the old or the actual alarm messages. |
| 2 | Selected Filter | The messages can be sorted out by the type. |
| 3 | Only Acknowledged<br>Only Unacknowledged | The messages can be sorted out by acknowledged and/or unacknowledged alarms. |

**Features of the alarm screen list:**

| | |
|---|---|
| **Date** | Date of the alarm |
| **Time** | Time of the alarm |
| **State** | Status of the alarm (acknowledged or unacknowledged) |
| **Class** | Class of error |
| **Type** | Type of error |
| **User** | ID of the logged-on operator |
| **Description** | Alarm message |
| **ID** | Alarm ID e.g.: F202_001a |
| **Group** | Fault group e.g.: Fuse (F3040 is blown) |

## 4.4 Operator - System Screens

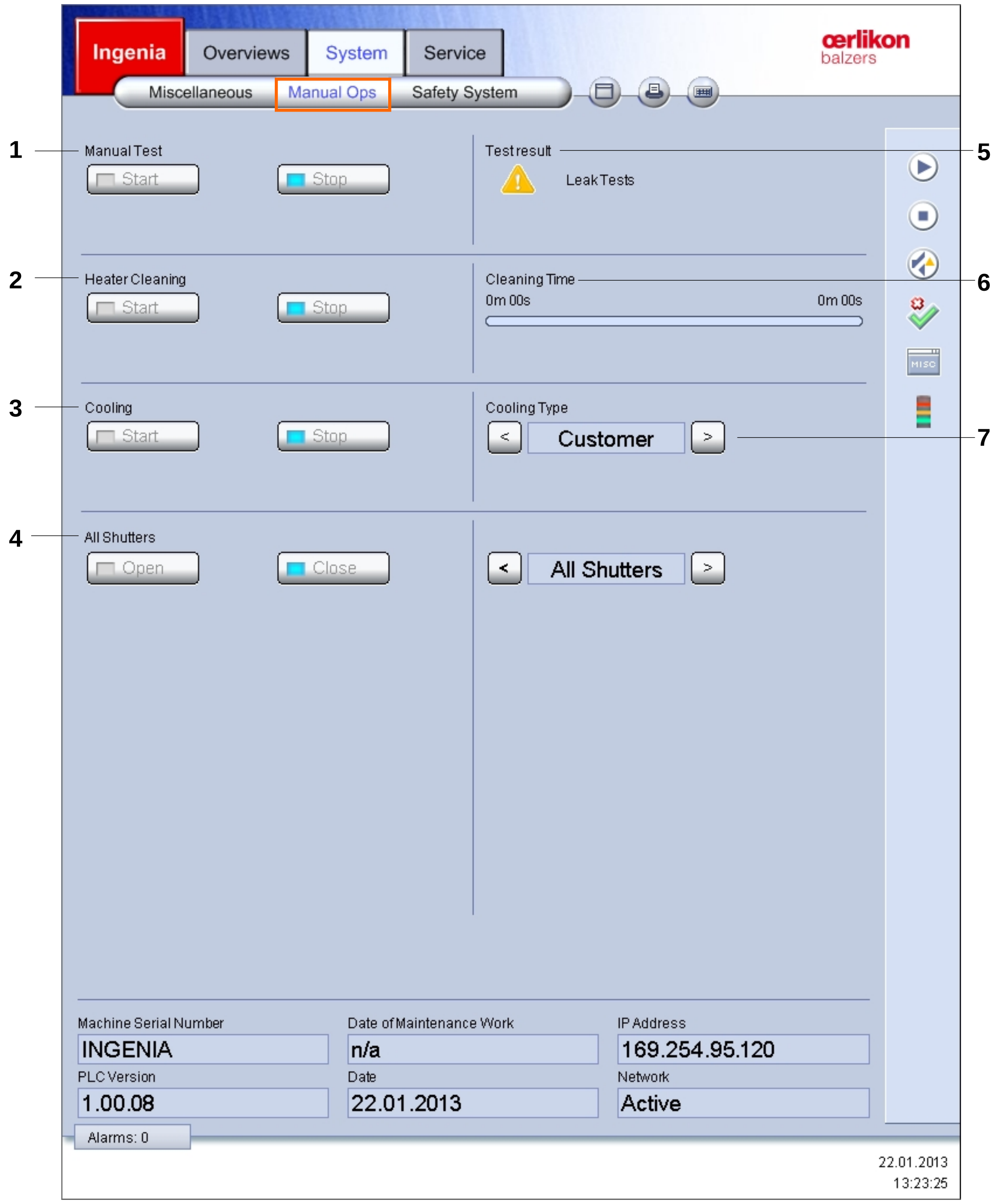
### 4.4.1 System Screen – Miscellaneous



**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Pressure** | |
| | PCG Pressure [mbar] | Actual pressure reading. |
| | CDG Pressure [mbar] | Actual pressure reading. |
| | IKR Pressure [mbar] | Actual pressure reading. |
| 2 | **Temperature** | |
| | Upper Temperature [°C] | Actual upper substrate temperature reading. |
| | Lower Temperature [°C] | Actual lower substrate temperature reading. |
| 3 | **Pumping System** | |
| | OFF / StandBy / Pump / Vent | Enables switching the pumping system into the required status (Off-Standby-Pump Syst). |
| 4 | **Process Water** | |
| | Off / On | Enables switching the process water into the required status (Water Off – Water On). |
| 5 | **Substrate Rotation** | |
| | Manual | Enables the manual substrate rotation (⇨ refer to chapter 5). |

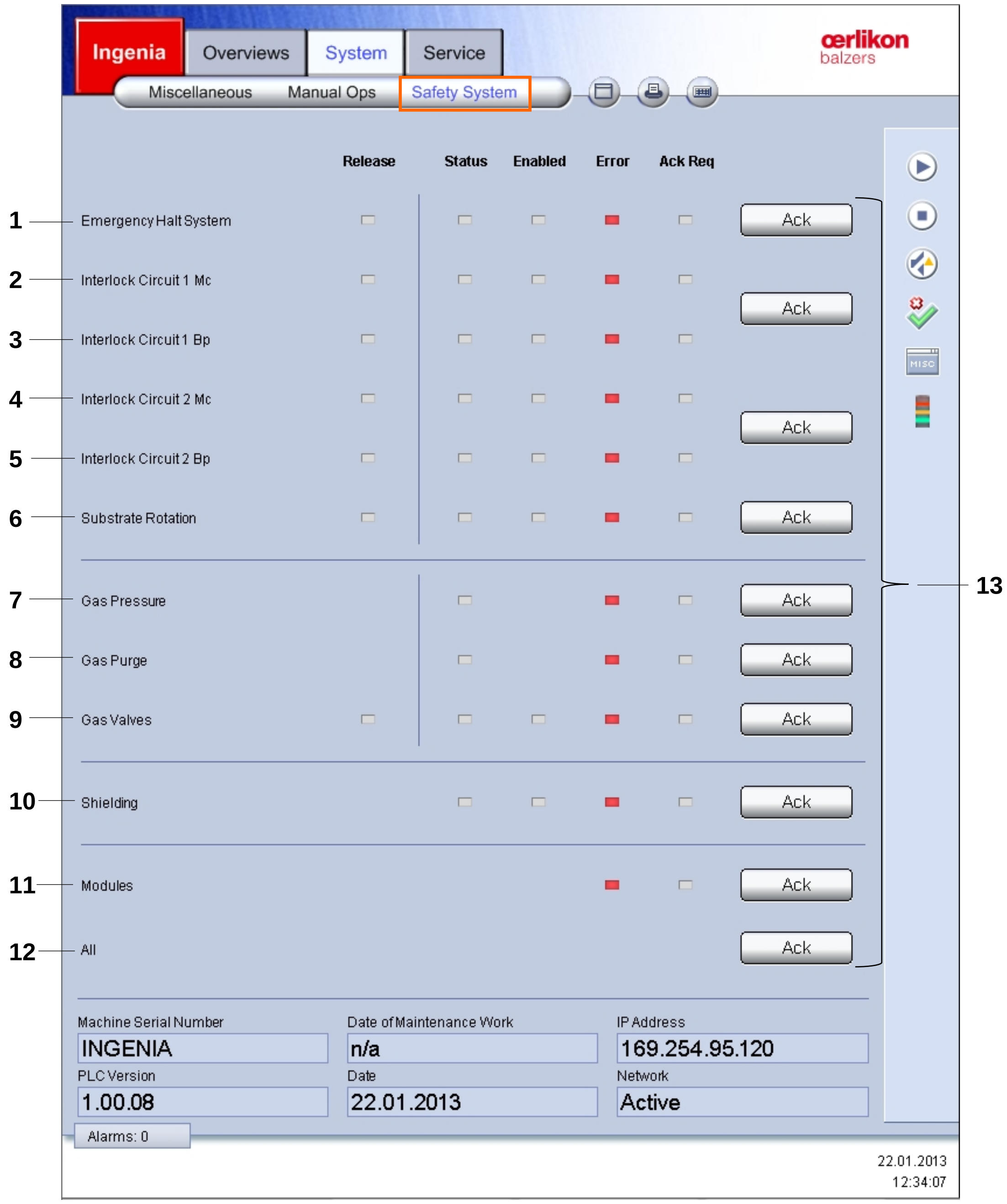
### 4.4.2 System Screen – Manual Ops



**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Manual Test** | |
| | Start / Stop | Manual start/stop of the leak and safety test. |
| 2 | **Heater Cleaning** | |
| | Start / Stop | Manual start/stop of the automatic heater cleaning. After a successful heater cleaning the start cleaning will be switched off. |
| 3 | **Cooling** | |
| | Start / Stop | Manual start/stop of the selected cooling sequence. |
| 4 | **All Shutters** | |
| | Open / Close | Manual movement of all shutters. |
| 5 | **Test Result** | |
| | Leak Tests | Visible result of the leak test. |
| 6 | **Cleaning Time** | The remaining and elapsed cleaning time is visible on the green bar. |
| 7 | **Cooling Type** | |
| | < Customer > | Selection of the respective cooling type. |

### 4.4.3 System Screen – Safety System




**Features of the screen:**

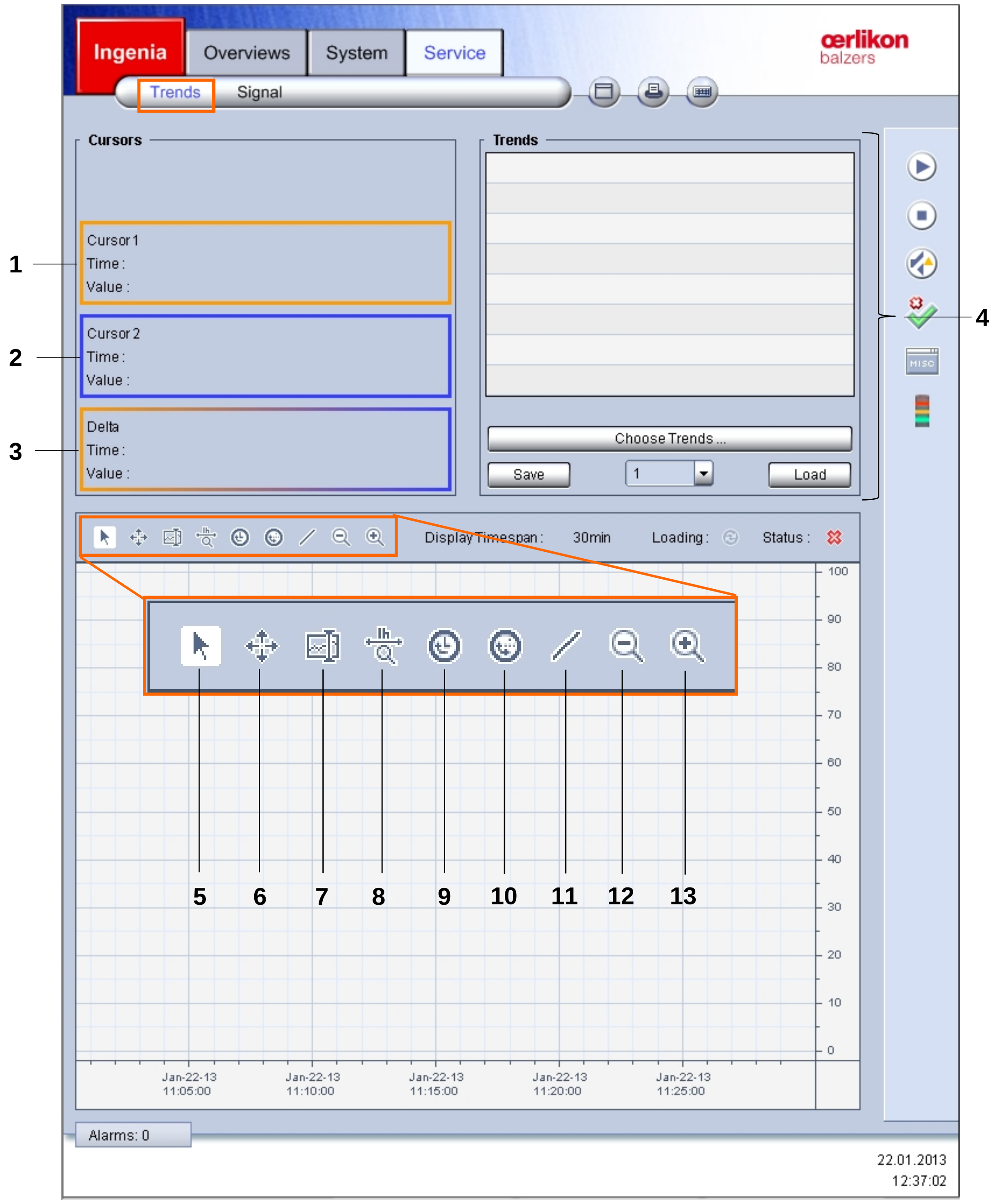
The “System Screen - Safety System” shows the status of the different safety circuits. If the safety circuit has been interrupted (e.g. by opening of a side panel) the respective “Ack” button must be clicked after closing the safety circuit (e.g. side panel closed again) in order to “activate” the safety circuit.

| | | |
|---|---|---|
| 1 | Emergency Stop (Halt) System | Status LED’s. |
| 2 | Interlock Circuit 1 Mc | Status LED’s. |
| 3 | Interlock Circuit 1 Bp | Status LED’s. |
| 4 | Interlock Circuit 2 Mc | Status LED’s. |
| 5 | Interlock Circuit 2 Bp | Status LED’s. |
| 6 | Substrate Rotation | Status LED’s. |
| 7 | Gas Pressure | Status LED’s. |
| 8 | Gas Purge | Status LED’s. |
| 9 | Gas Valves | Status LED’s. |
| 10 | Shielding | Status LED’s. |
| 11 | Modules | Status LED’s. |
| 12 | All | Status LED’s. |
| 13 | Ack | Confirmation buttons (to be pressed for 1 second). |

## 4.5 Operator - Service Screens

### 4.5.1 Service Screen – Trends

The “Overview Screen – Trends” enables displaying the stored system data of the INGENIA P3e™ coating system.



**1** Shows the selected parameter value on cursor point 1.

**2** Shows the selected parameter value on cursor point 2.

**3** Shows the time and value difference of the selected parameter between cursor point 1 and 2.

**4** Shows available trends.

**5** Normal mouse pointer.

**6** Scrolls the visible part of the graphs when dragging the mouse inside the curve display.

**7** Toggles the visibility of the curser 1 and 2.

**8** Sets the zoom of the current view to 1h.

**9** Scrolls to the current date/time.

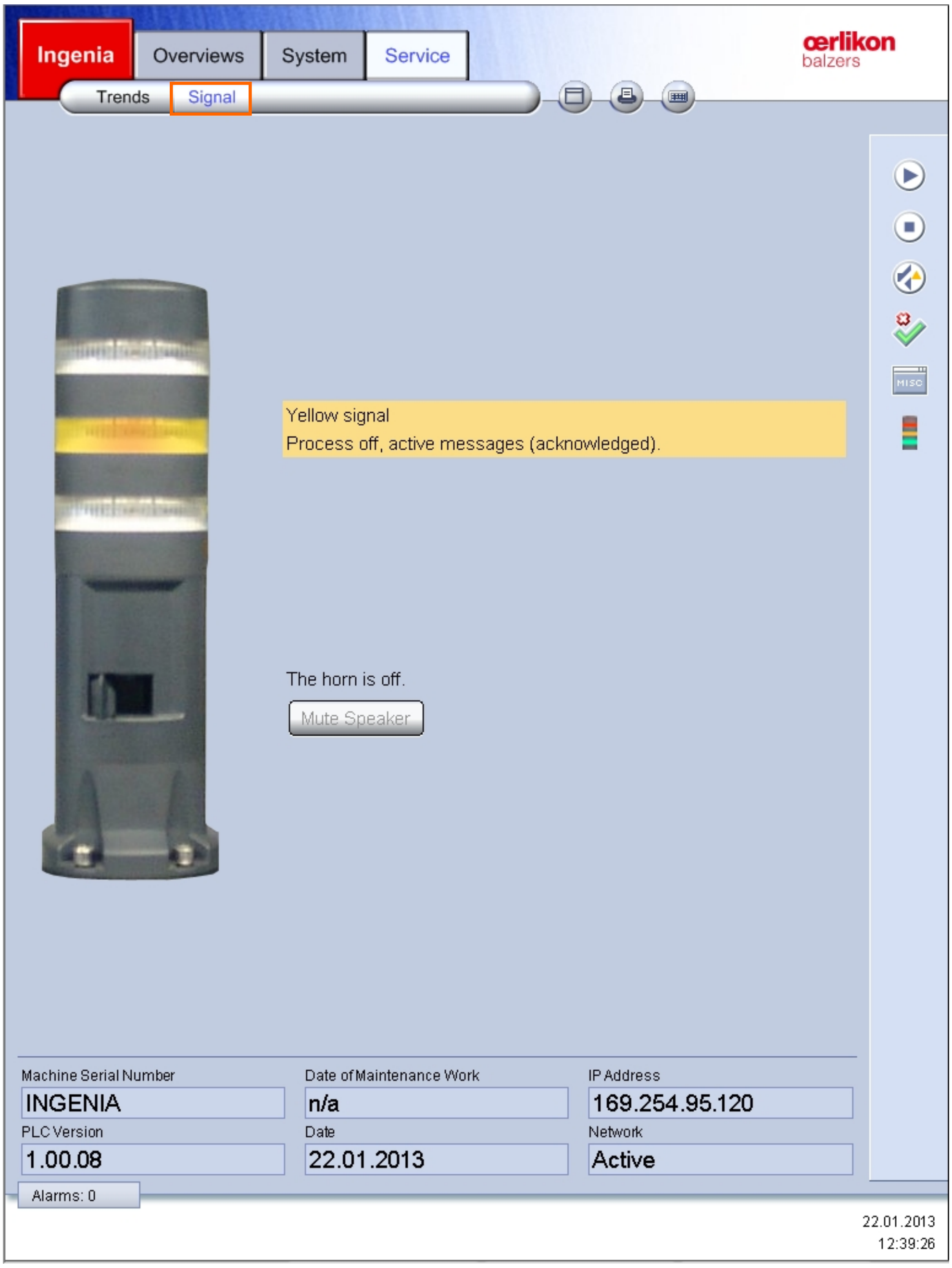
**10** Scrolls to a user-specific date/time

**11** Displays only the selected graph (all other graphs are in the background - light gray colored).

**12** Enlarges the time base.

**13** Reduces the time base.

### 4.5.2 Service Screen – Signal




The general status of the machine is displayed (e.g. errors, process successful terminated, etc.). For further details ⇨ refer to chapter 4.1.3 “Status Lamps”.

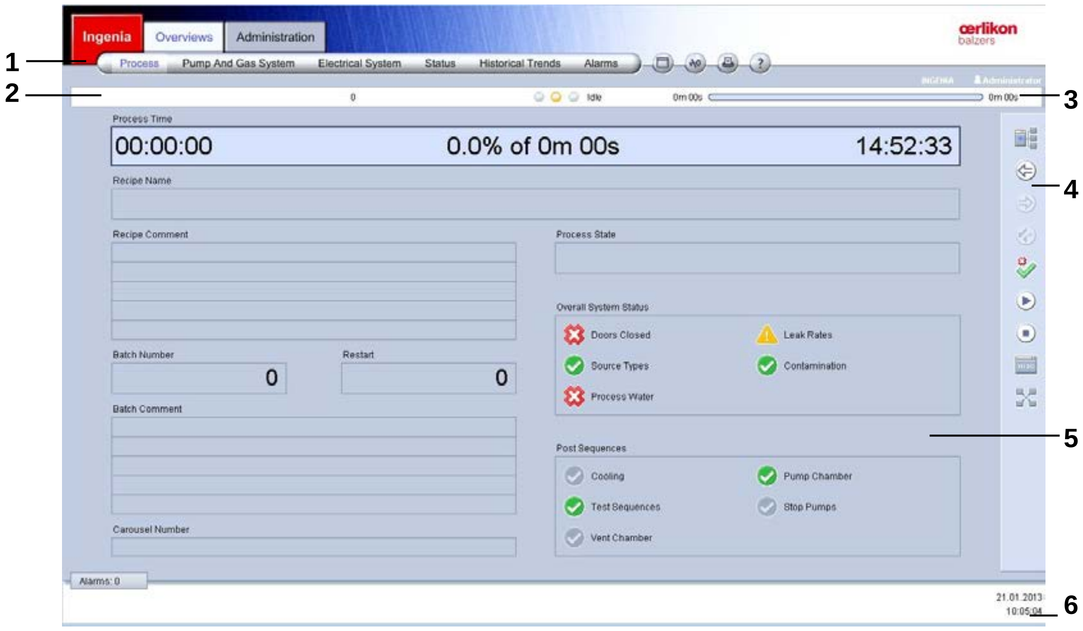
## 4.6 Service - Control Software

The service panel is located in the power cabinet 4 of the INGENIA P3e™ coating system. The following chapters describe the screens of the service panel.

### 4.6.1 Starting the Service - Control Software

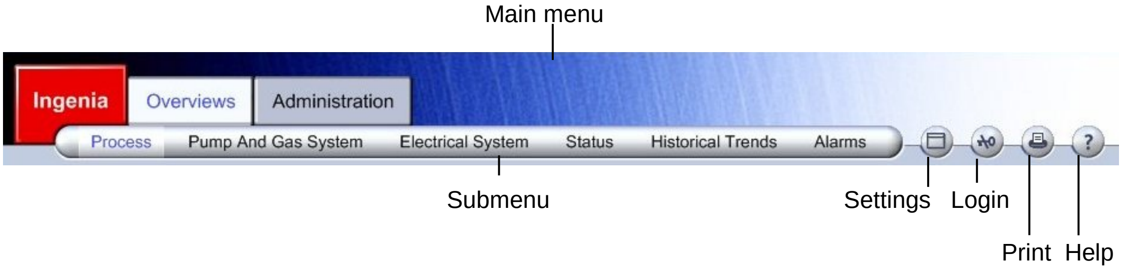
In order to start the “Service Visualization” double click the INGENIA P3e™ icon on the “Windows Desktop” or start the “Service Visualization” via “MS Windows Start Menu”.

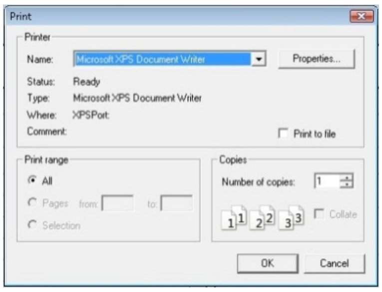
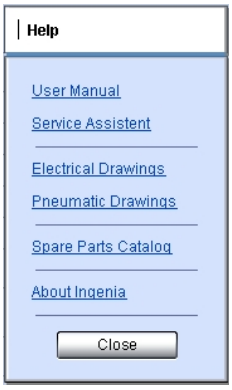
### 4.6.2 General Features of the INGENIA P3e™ Screens



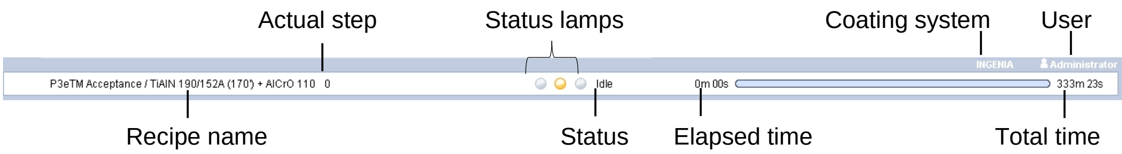

| | |
|---|---|
| **1** | Main menu |
| **2** | Submenu |
| **3** | Status line |
| **4** | Icon bar |
| **5** | Main display |
| **6** | Status line |

**Menus:**



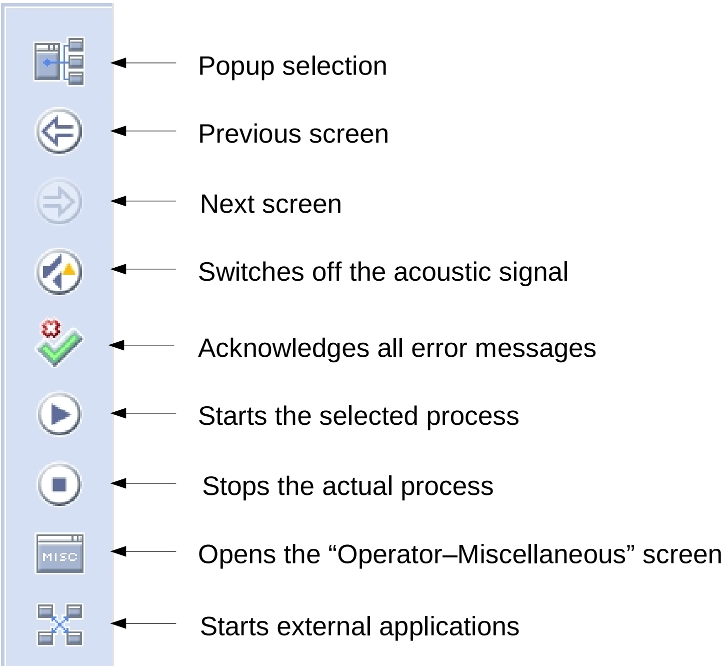

| | | |
|---|---|---|
|  | **Settings: ►** |   |
|  | **Login: ►** |   |
|  | **Print: ►** |   |
|  | **Help: ►** |   |

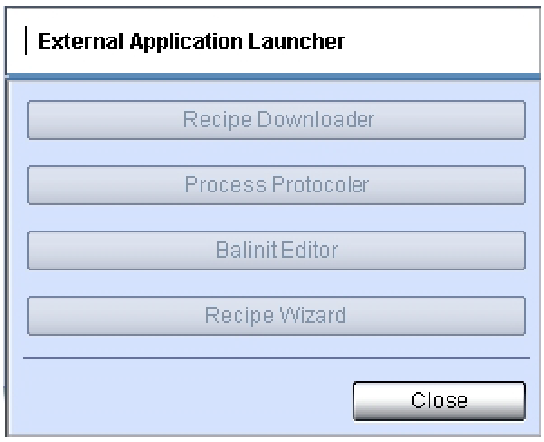
**Status Line:**




**Icon Bar:**

The soft keys allow screen selection, start/stop of all processes and alarm confirmation.



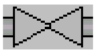
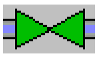
### 4.6.3 Status Lamps

The following table shows the respective colors depending on the process status:

| | steady | flashing | steady | flashing | steady | flashing | acoustic signal |
|---|---|---|---|---|---|---|---|
| Process On<br>No active message in status line. | | | | | X | | |
| Process On<br>Active message in status line (not acknowledged). | | | | X | X | | |
| Process On<br>Active message in status line (acknowledged). | | | X | | X | | |
| Process interruption<br>Active message in status line (not acknowledged). | | X | | | | | 30s |
| Process interruption<br>Active message in status line (acknowledged). | X | | | | | | |
| Process successful terminated. | | | | | | X | |
| Process Off<br>Active message in status line (not acknowledged). | | | | X | | | |
| Process Off<br>Active message in status line (acknowledged). | | | X | | | | |

### 4.6.4 Status Colors

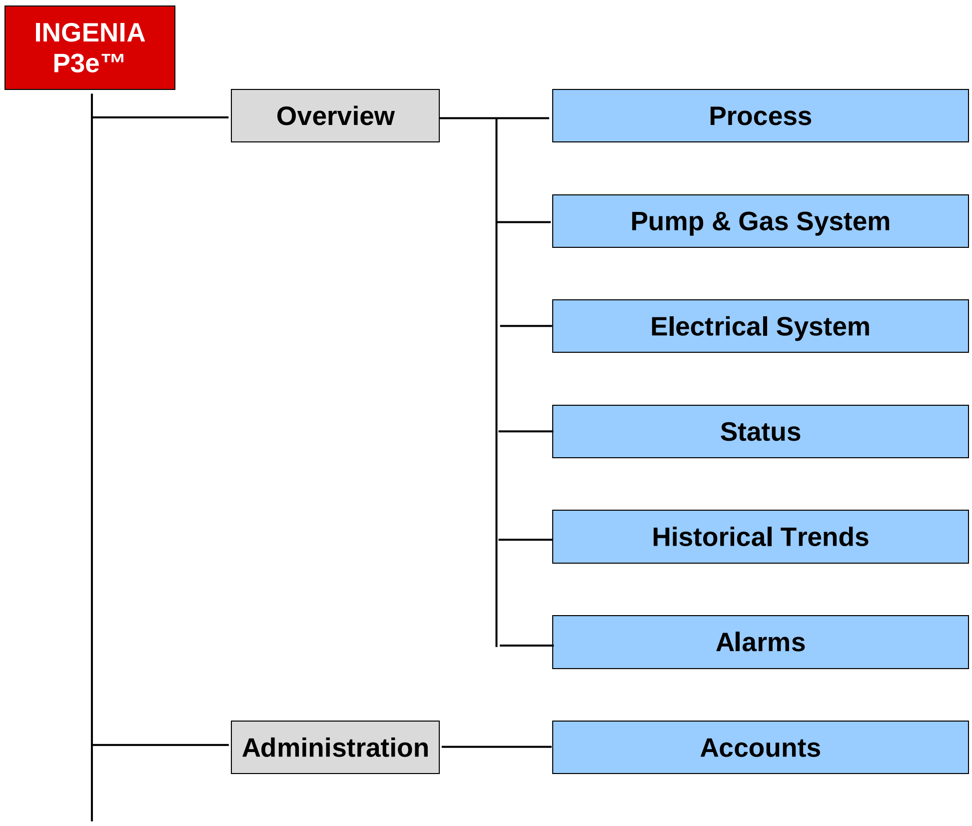
For the visualization of the function of the different vacuum components the following colors are used:

| | | |
|---|---|---|
|  | **None** | Not operating or closed. |
|  | **Green** | Operating or open. |

### 4.6.5 Display and Input Fields of the Analog Values

| | | |
|---|---|---|
|   (white colored) | Nominal values | Input of analog values possible. |
|   (blue colored) | Nominal values | Input of analog values blocked. |
|   (gray colored) | Actual values | (No input). |

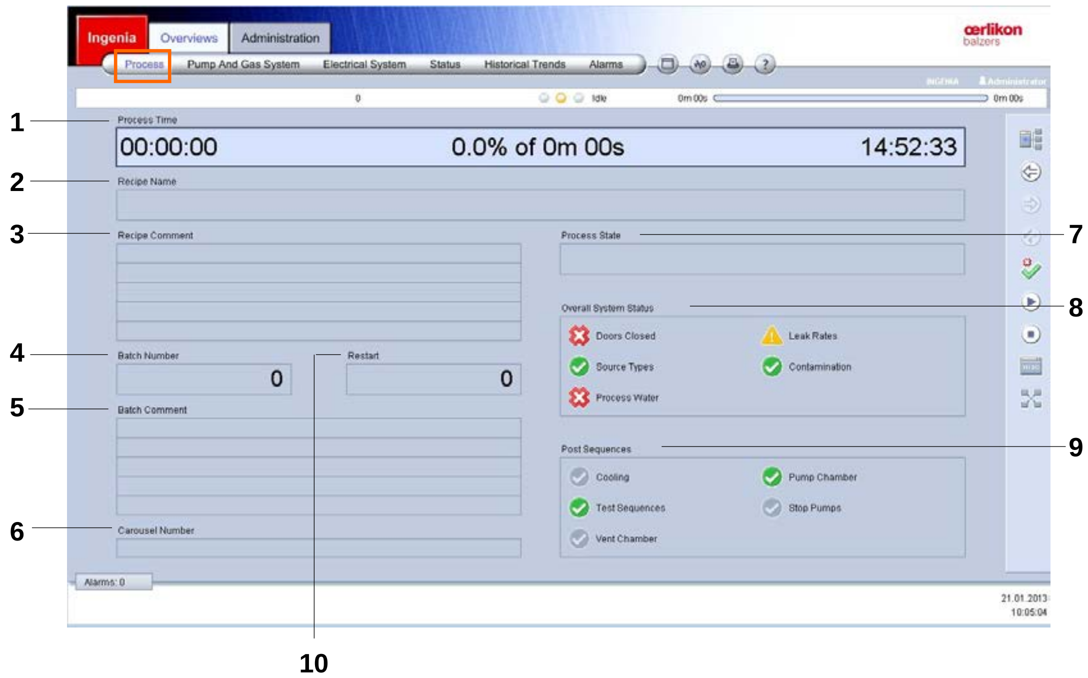
## 4.7 Service - Screen Navigation



## 4.8 Service - Overview Screens

### 4.8.1 Overview Screen – Process

The "Overview Screen - Process" shows the selected process parameters and enables setting the parameters for the next batch.

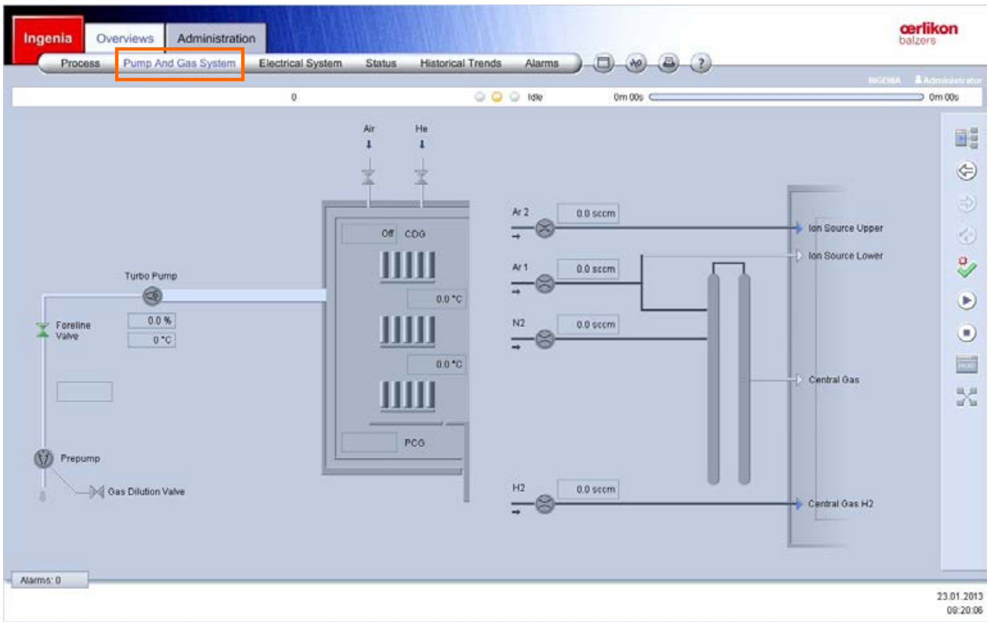



| | | |
|---|---|---|
| 1 | **Process Time** | Actual / calculated remaining batch time. |
| 2 | **Recipe Name** | Recipe code. |
| 3 | **Recipe Comment** | Recipe information. |
| 4 | **Batch Number** | Batch number to identify the coating process. |
| 5 | **Batch Comment** | Batch specific comments. |
| 6 | **Carousel Number** | Individual carousel number for carousel identification. |
| 7 | **Process State** | Shows the process status of the machine (e.g. idle, etch, coat etc.). |
| 8 | **Overall System Status** | Correct / incorrect system status is displayed. **An incorrect status prevents a process start.** |
| 9 | **Post sequences** | Selected post process tasks. |
| 10 | **Restart** | Number of restarts. |

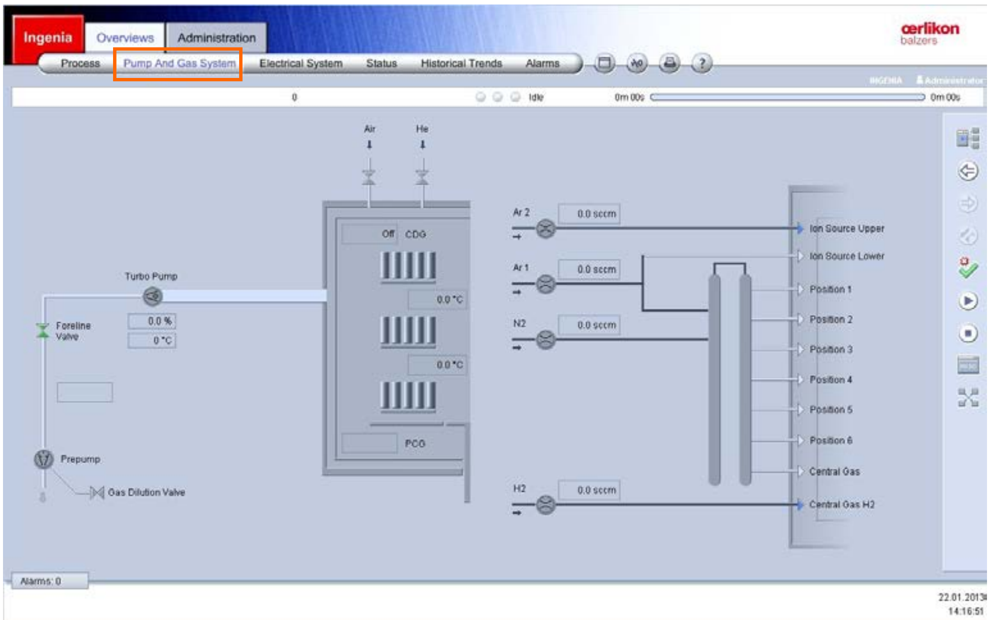
### 4.8.2 Overview Screen – Pump and Gas System

The “Overview Screen - Pump and Gas System” shows the actual pumping sequence and the actual gas flow.

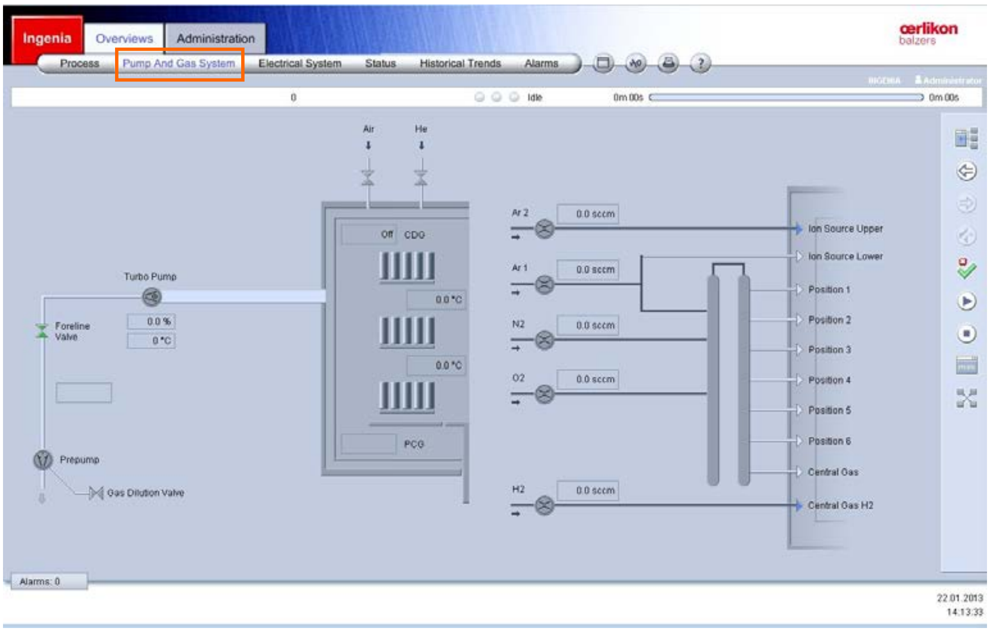
**Variant 1: (Ar 1; Ar 2; $H_2$; $N_2$)**



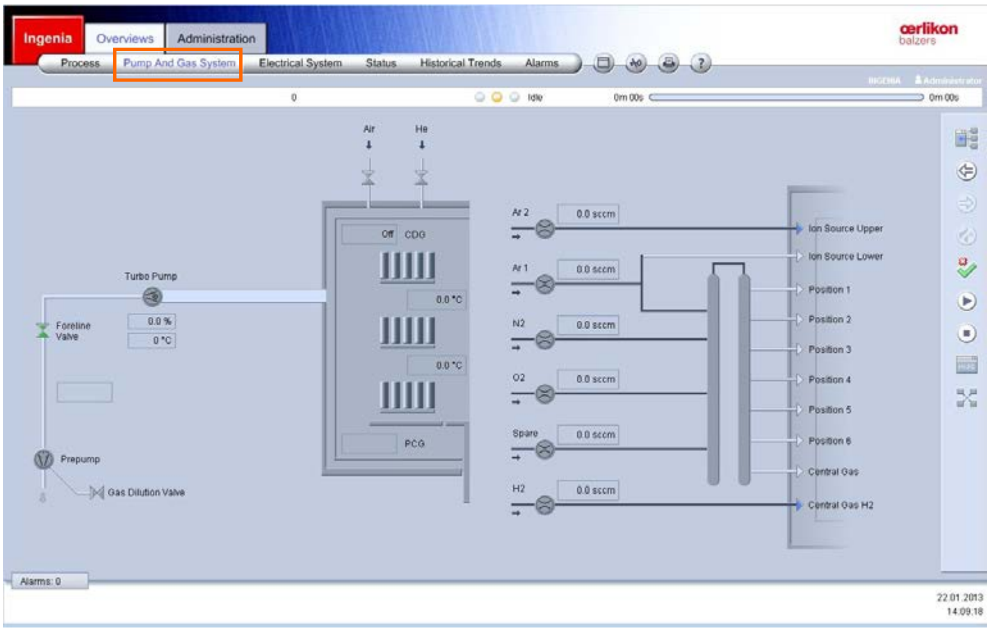

**Variant 1a: (Ar 1; Ar 2; $H_2$; $N_2$)**



**Variant 2: (Ar 1; Ar 2; $H_2$; $N_2$;$O_2$)**




**Variant 3: (Ar 1; Ar 2; $H_2$; $N_2$;$O_2$; Spare)**

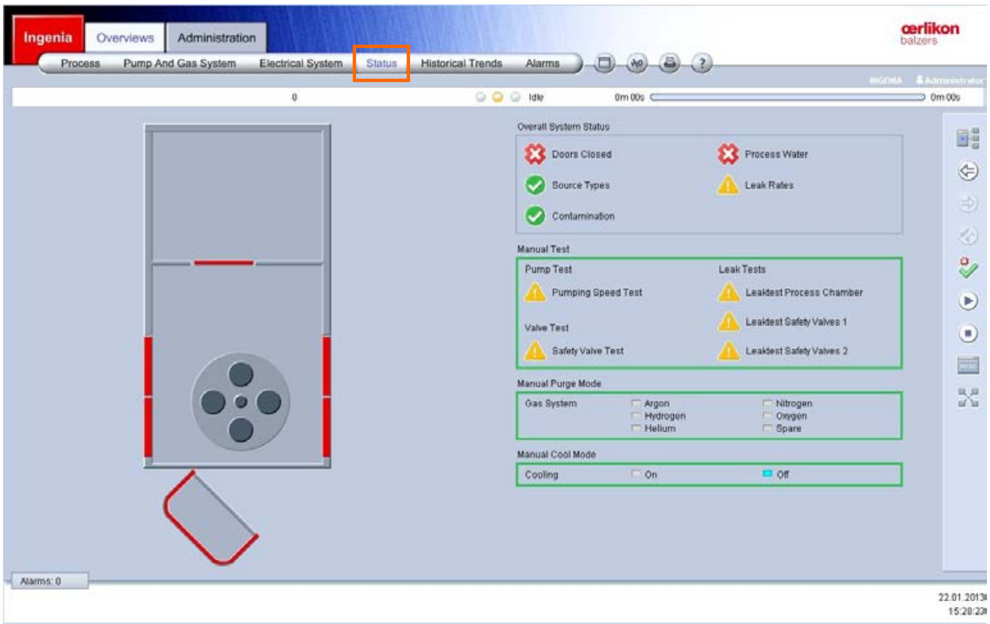


## 4.8.3 Overview Screen – Electrical System (Arc)


The “Overview Screen – Electrical System” (Arc) shows the actual values of:

- Ion sources (upper, lower)
- Arc sources (1-6)
- Bias voltage

### 4.8.4 Overview Screen – Status



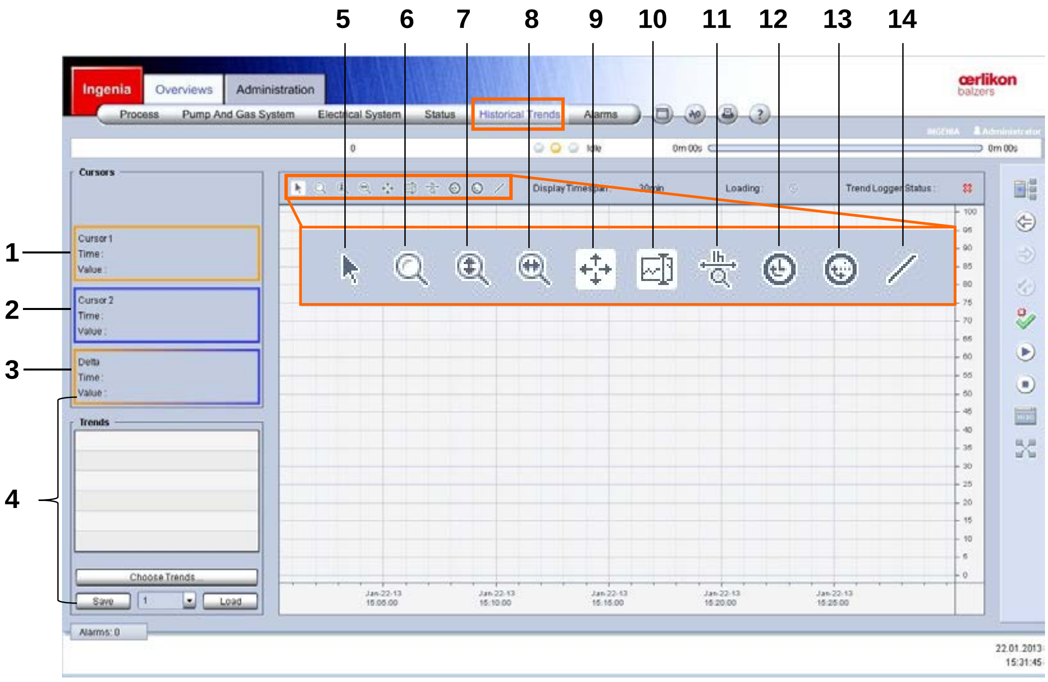

The “Overview Screen – Status” shows the overall system status:

- Process chamber door and all other doors of the INGENIA P3e™ coating system closed
- Source types
- Contamination
- Process water
- Leak rates

| Manual Tests | Manual Purge Mode | Manual Cool |
|---|---|---|
| **Leak tests:**<br>• Leak test process chamber<br>• Leak test safety valves 1<br>• Leak test safety valves 2 | **Gas system:**<br>• Argon (Ar)<br>• Hydrogen ($H_2$)<br>• Helium (He)<br>• Nitrogen ($N_2$)<br>• Oxygen ($O_2$)<br>• Spare | **Cooling:**<br>• On / Off |

### 4.8.5 Overview Screen – Historical Trends

The “Overview Screen – Historical Trends” enables displaying the stored system data of the INGENIA P3e™ coating system.




**1** Shows the selected parameter value on cursor point 1.

**2** Shows the selected parameter value on cursor point 2.

**3** Shows the time and value difference of the selected parameter between cursor point 1 and 2.

**4** Shows available trends.

**5** Normal mouse pointer.

**6** Depressing and holding the left mouse button and moving the mouse enables to zoom in a selected area.

**7** Depressing and holding the left mouse button and moving the mouse enables to zoom in the vertical range.

**8** Depressing and holding the left mouse button and moving the mouse enables to zoom in the horizontal range.

**9** Scrolls the visible part of the graphs when dragging the mouse inside the curve display.

**10** Toggles the visibility of the curser 1 and 2.

**11** Sets the zoom of the current view to 1h.

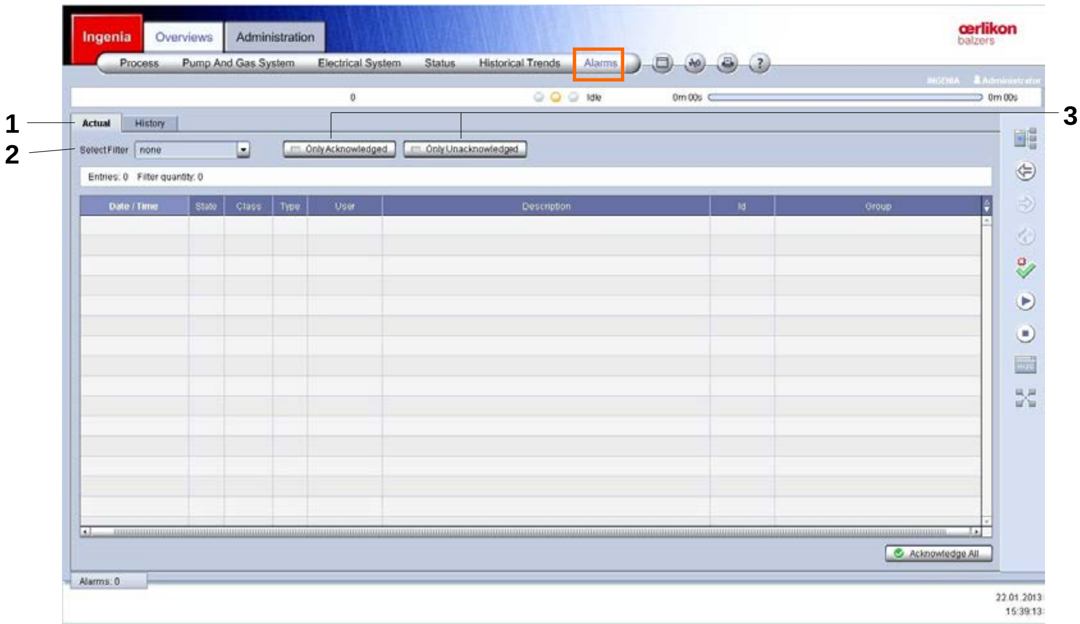
**12** Scrolls to the current date/time.

**13** Scrolls to a user-specific date/time.

**14** Displays only the selected graph (all other graphs are in the background - light gray colored).

## 4.8.6 Overview Screen – Alarms

The “Overview Screen – Alarms” shows alarm messages.




“Actual” or “History” enables switching between the old and/or actual alarm messages.

**In general there are different types of alarm messages:**

**Type:**

| | |
|---|---|
|  | **Fatal error** messages are caused by severe events or failures. A running process will be automatically stopped. |
|  | **Warning** messages are alerts that may result in a fatal error. |
|  | **Event** messages contain information for operator/service personnel. |

**State:**

| | |
|---|---|
|  | A message is generated by the control system. |
|  | The generated message is pending and acknowledged. |
|  | The generated message is inactive and acknowledged. |

**Features of the screen:**

| | | |
|---|---|---|
| 1 | Actual / History | “Actual” or “History” enables switching between the old or the actual alarm messages. |
| 2 | Selected Filter | The messages can be sorted out by the type. |
| 3 | Only Acknowledged<br>Only Unacknowledged | The messages can be sorted out by acknowledged and/or unacknowledged alarms. |

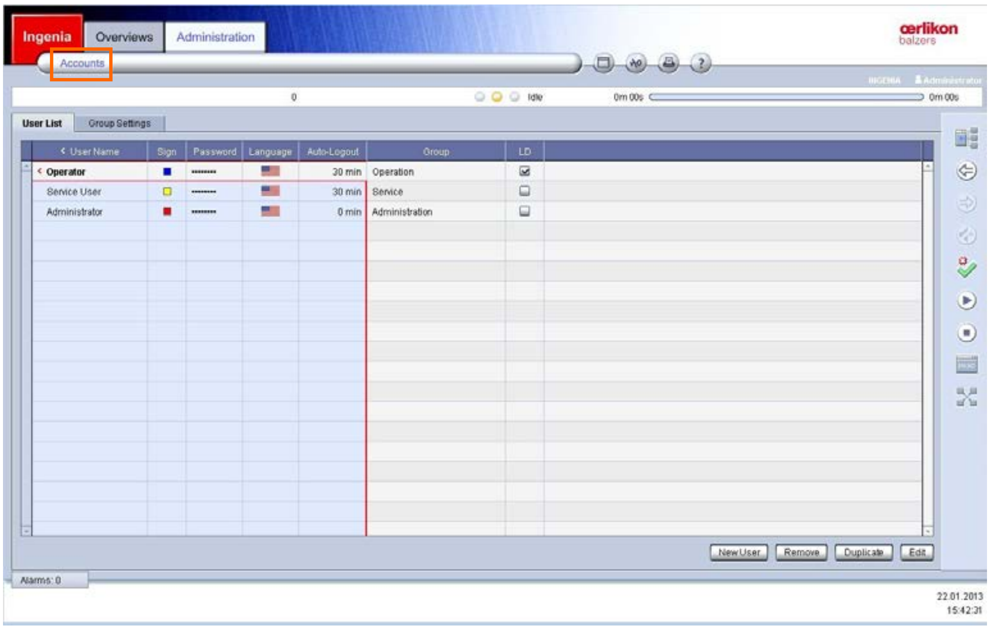
**Features of the alarm screen list:**

| | |
|---|---|
| **Date** | Date of the alarm |
| **Time** | Time of the alarm |
| **State** | Status of the alarm (acknowledged or unacknowledged) |
| **Class** | Class of error |
| **Type** | Type of error |
| **User** | ID of the logged-on operator |
| **Description** | Alarm message |
| **ID** | Alarm ID e.g.: F202_001a |
| **Group** | Fault group e.g.: Fuse (F3040 is blown) |

## 4.9 Service - Administration Screen

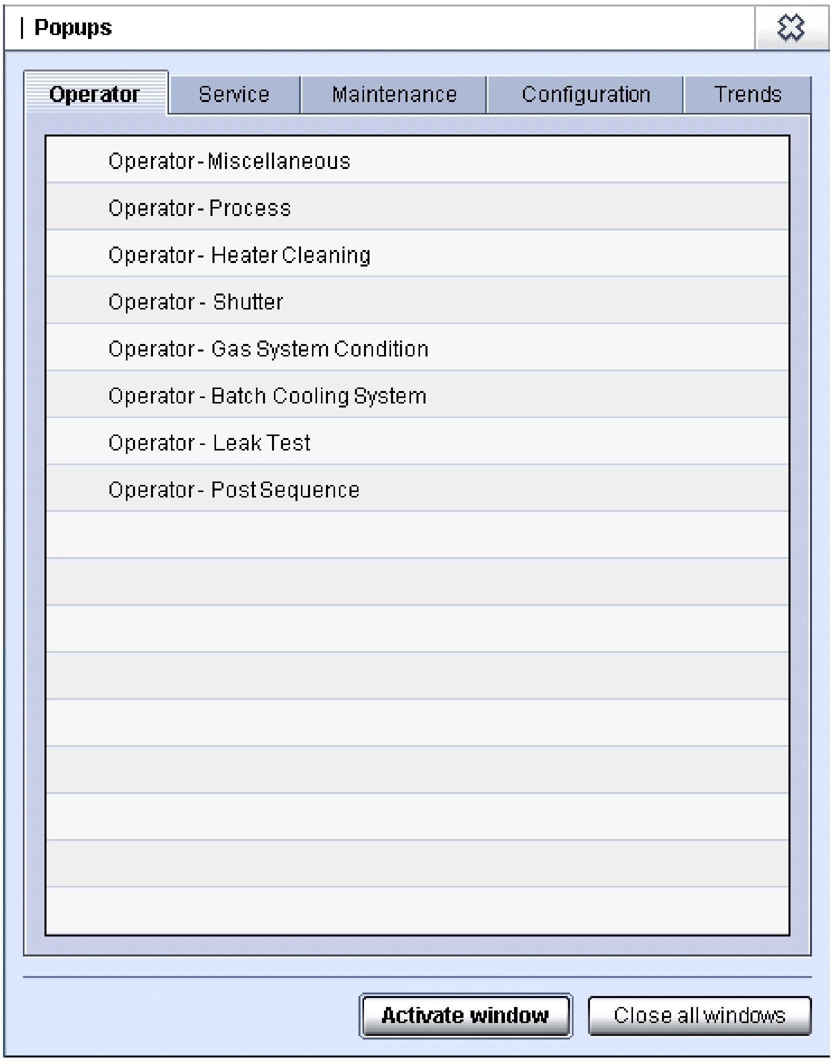
### 4.9.1 Administration Screen – Accounts

The “Administration Screen – Accounts” is used to administrate the user profiles to add or remove individual user names and groups.



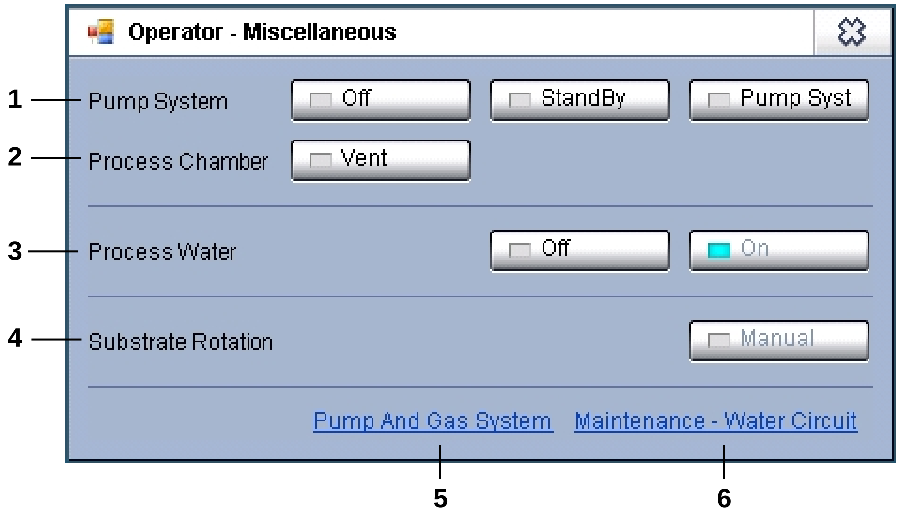
## 4.10 Service - Popups

### 4.10.1 Popup - Operator




| | |
|---|---|
| **Activate window:** | Opens the selected popup. |
| **Close all windows:** | Close all popups. |

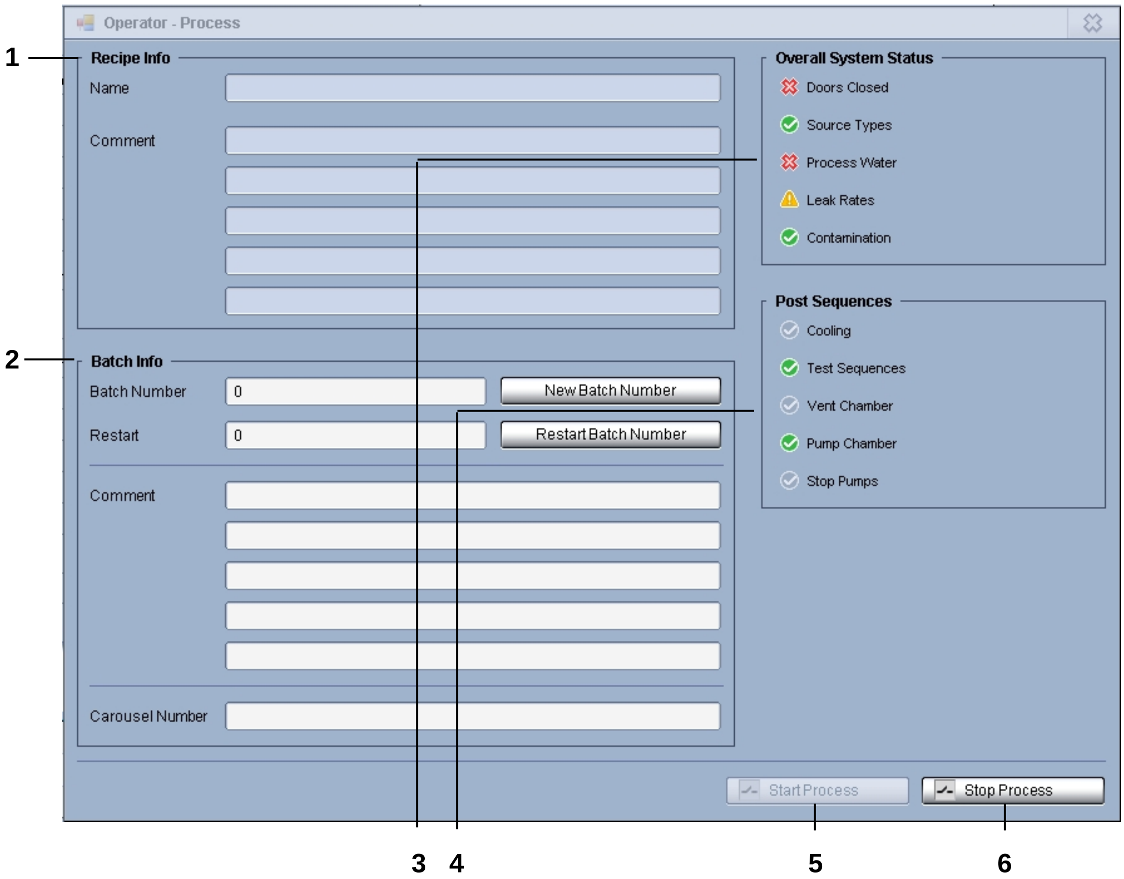
### 4.10.1.1 Popup - Operator - Miscellaneous




**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Pump System**<br>Off<br>Standby<br>Pump Syst | Enables switching the pumping system into the required status (Off-Standby-Pump Syst). |
| 2 | **Process Chamber**<br>Vent | Enables switching the pumping system into the required status (Vent). |
| 3 | **Process Water**<br>Water Off<br>Water On | Enables switching the process water into the required status (Water Off – Water On). |
| 4 | **Substrate Rotation**<br>Manual | Enables the manual substrate rotation. |
| 5 | **Pump And Gas System** | Clicking on this hot link opens the "Overview Screen – Pump and Gas System". The actual pumping sequence and the actual gas flow are displayed. |
| 6 | **Maintenance – Water Circuit** | Clicking on this hot link opens the "Popup - Maintenance - Water Circuit".<br>The different water circuits for the complete INGENIA P3e™ coating system are displayed. |

### 4.10.1.2 Popup - Operator - Process




**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Recipe Info** | |
| | Name | Recipe code. |
| | Comment | Information to the selected recipe. |
| 2 | **Batch Info** | |
| | Batch Number | Batch number to identify the coating process. |
| | Restart | Numbers of restarts |
| | Comment | Batch specific comment. |
| | Carousel Number | Individual carousel number for carousel identification |

| | | |
|---|---|---|
| 3 | **Overall System Status** | correct status<br>Incorrect status<br>fault during the last batch |
| 4 | **Post Sequences** | ⇨ Refer to “Popup - Operator - Post Sequence”. |
| 5 | **Start** | Starts the process (to confirm press button for 3 s).<br>**Only active if logged in as operator.** |
| 6 | **Stop** | Stops the process (to confirm press button for 3 s). |

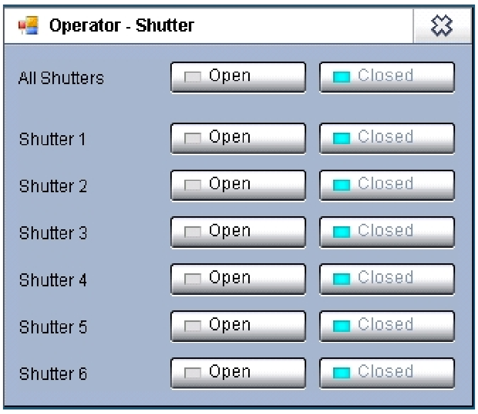
#### 4.10.1.3 Popup - Operator - Heater Cleaning


**Precondition for the automatic heater cleaning: Process chamber is vented, process chamber door and all other doors of the INGENIA P3e™ coating system are closed.**

**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Last Cleaning (days)** | Time interval since the last heater cleaning. |
| 2 | **Start Cleaning/ Stop Cleaning** | Manual start/stop of the automatic heater cleaning. After a successful heater cleaning the start cleaning will be switched off. |
| 3 | **Cleaning Time** | The remaining and elapsed cleaning time is visible on the green bar. |

#### 4.10.1.4 Popup - Operator – Shutter*

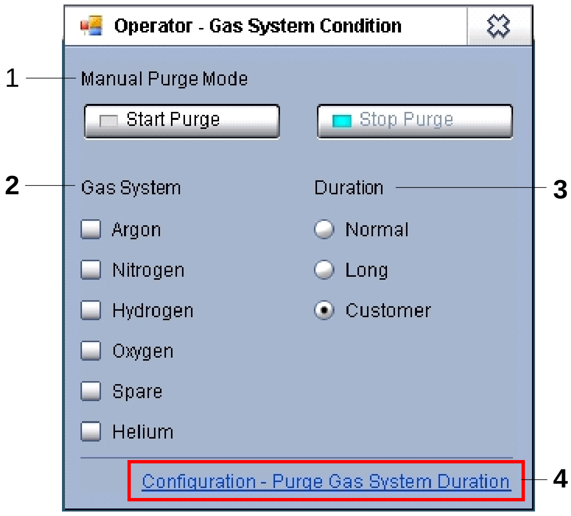



The “Popup - Operator - Shutter” serves to manually open and close the shutters being used.

**During a running process the buttons are inactive to prevent manual manipulation.**

(* Optional.

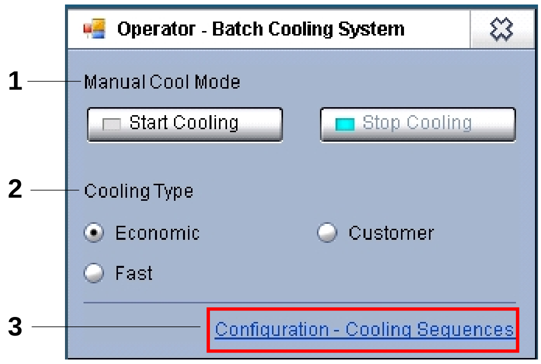
### 4.10.1.5 Popup - Operator - Gas System Condition




**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Manual Purge Mode**<br>Start Purge / Stop Purge | Manual start/stop of the selected gas system. |
| 2 | **Gas System** | Selection of the respective gas type (it is possible to select more than one gas). |
| 3 | **Duration** | Selection of the respective duration.<br>**Normal** 5 minutes (purge / evacuation time)<br>**Long** 10 minutes (purge / evacuation time)<br>**Customer** optional minutes. |
| 4 | Configuration – Purge Gas System Duration | Clicking on this hot link opens the “Popup – Configuration – Purge Gas System Duration”.<br>The nominal values of the respective gas type and purging duration are displayed. (The customer value could be changed if required). |

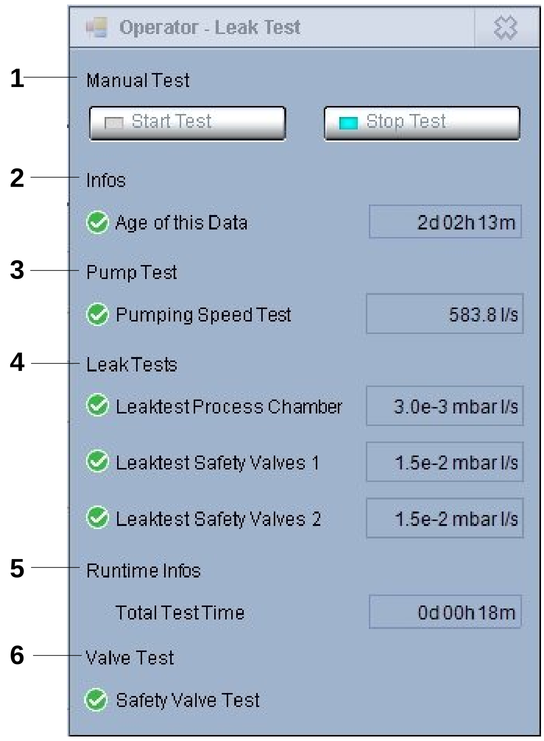
### 4.10.1.6 Popup - Operator - Batch Cooling System




**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Manual Cool Mode**<br>Start Cooling / Stop Cooling | Manual start/stop of the selected cooling type. |
| 2 | **Cooling Type** | Selection of the respective cooling type. |
| 3 | Configuration – Cooling Sequences | Clicking on this hot link opens the “Popup – Configuration – Cooling Sequences”.<br>The nominal values for the different cooling types are displayed. |

### 4.10.1.7 Popup - Operator - Leak Test



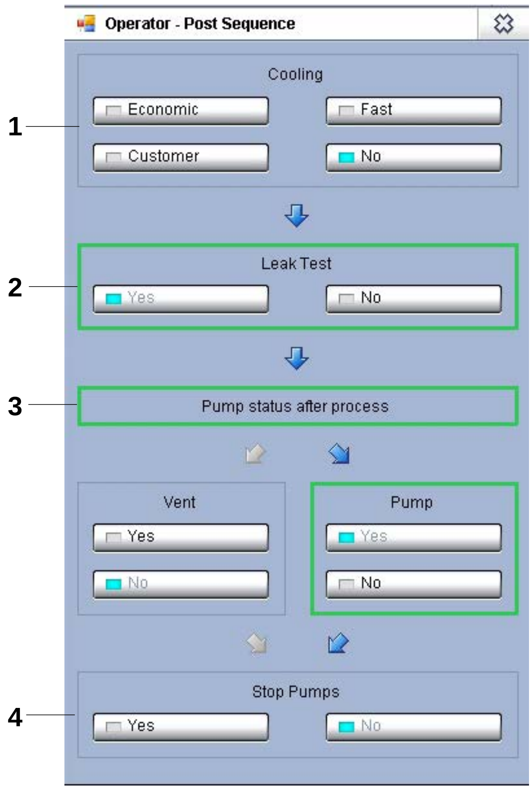

**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Manual Test**<br>Start Test / Stop Test | Manual start/stop of the selected leak test (type). |
| 2 | **Infos** | Time since the last leak test. |
| 3 | **Pump Test** | Shows the pumping speed of the coating system. |
| 4 | **Leak Tests** | Shows the leak test values. |
| 5 | **Runtime Infos** | Complete leak test duration. |
| 6 | **Valve Test** | Shows the status of the safety valve test. |

**A leak test must be performed at least once a week otherwise it is not possible to start a process anymore.**

### 4.10.1.8 Popup - Operator - Post Sequence

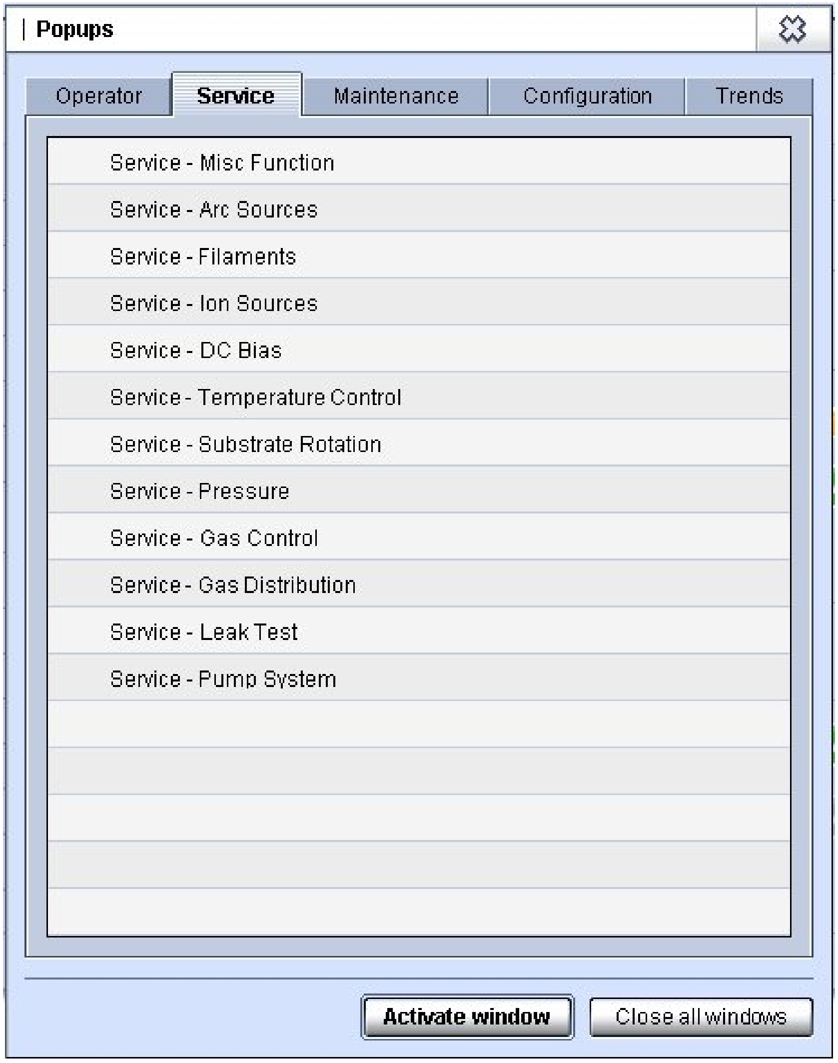
The “Popup - Operator - Post Sequence” serves to select and display the post process tasks.



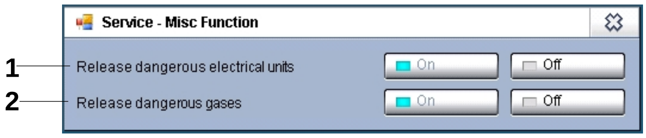

**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Cooling**<br>Economic; Fast; Customer; No | Selected type for the cooling sequence. |
| 2 | **Leak Test** | Leak test sequence if required (at least once a week). |
| 3 | **Pump status after process**<br>Vent / Pump (Yes / No) | Process chamber will be vented / evacuated after process if the leak rate is o.k. |
| 4 | **Stop Pumps**<br>(Yes / No) | Stop pumps if required. |

### 4.10.2 Popup - Service



#### 4.10.2.1 Popup - Service - Misc Function

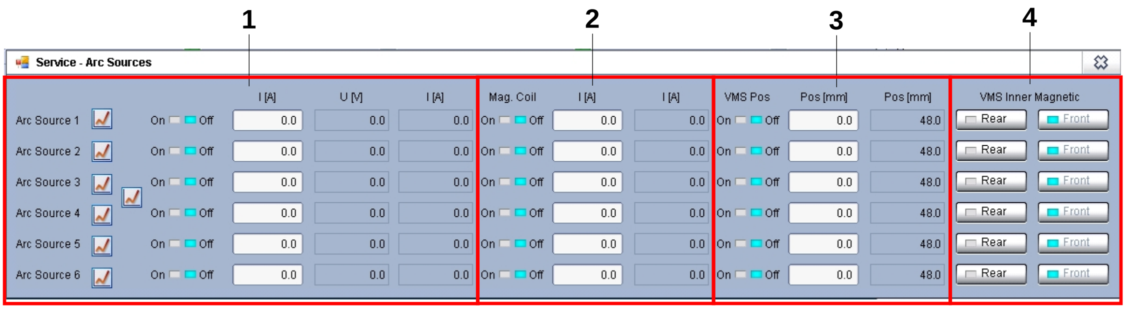



**Features of the screen:**

| | | |
|---|---|---|
| 1 | Release dangerous electrical units (ON / Off) | Connects / disconnects electrical supplies (bias generator, source supplies, heaters etc.). |
| 2 | Release dangerous gases (ON / Off) | Opens / closes gases (Hydrogen, Oxygen*). |

(* Optional.

### 4.10.2.2 Popup - Service - Arc Sources

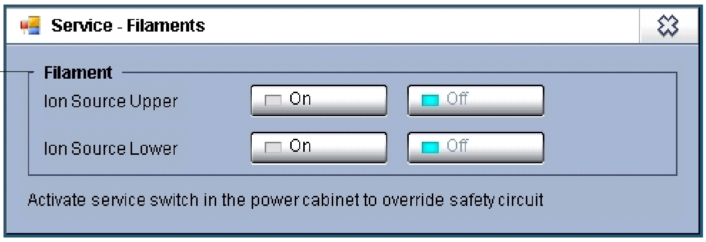



**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Source 1-6** | |
| | I [A] | Nominal value for the current of each Arc source. |
| | U [V] | Actual voltage of each Arc source. |
| | I [A] | Actual current of each Arc source. |
| 2 | Mag. Coil | Indicates if the magnetic coils are on/off. |
| | I [A] | Nominal value for the current of each source magnetic system. |
| | I [A] | Actual current of each source magnetic system. |
| 3 | VMS Pos. | Indicates if the VMS source magnetic system is moving. * |
| | Pos [mm] | Nominal position of each VMS source magnetic system. * |
| | Pos [mm] | Actual position of each VMS source magnetic system. * |
| 4 | VMS Inner Magnetic | Actual position of each inner magnetic core (Rear / Front). |

### 4.10.2.3 Popup - Service - Filaments

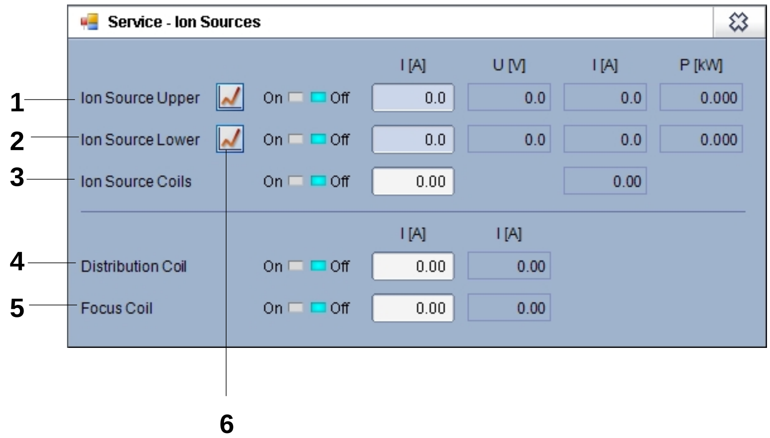
1




**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Filament**<br>Ion source Upper<br>(ON / Off) | Manual switching On / Off the filament of the upper ion source. |
| | Ion source Lower<br>(ON / Off) | Manual switching On / Off the filament of the lower ion source. |

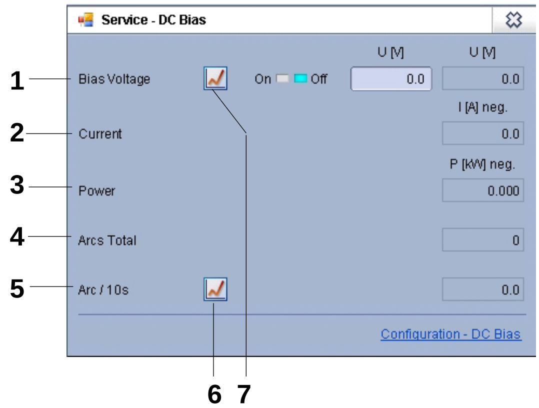
### 4.10.2.4 Popup - Service – Ion Source




**Features of the screen:**

| | | |
|---|---|---|
| 1 | Ion source Upper (On / Off) | Indicates if the upper ion source is on/off. |
| | I [A] | Nominal current of the upper ion source. |
| | U [V] | Actual voltage of the upper ion source. |
| | I [A] | Actual current of the upper ion source. |
| | P [kW] | Actual power of the upper ion source. |
| 2 | Ion source Lower (On / Off) | Indicates if the lower ion source is on/off. |
| | I [A] | Nominal current of the lower ion source. |
| | U [V] | Actual voltage of the lower ion source. |
| | I [A] | Actual current of the lower ion source. |
| | P [kW] | Actual power of the lower ion source. |
| 3 | Ion Source Coils (On / Off) | Indicates if the ion source coils are on/off. |
| | I [A] | Nominal current of the ion source coils. |
| | I [A] | Actual current of the ion source coils. |
| 4 | Distribution Coil (On / Off) | Indicates if the distribution coil is on/off. |
| | I [A] | Nominal current of the distribution coil. |
| | I [A] | Actual current of the distribution coil. |
| 5 | Focus Coil (On / Off) | Indicates if the focus coil is on/off. |
| | I [A] | Nominal current of the focus coil. |
| | I [A] | Actual current of the focus coil. |
| 6 | Ion source chart | Actual curves of the ion sources (current / voltage). |

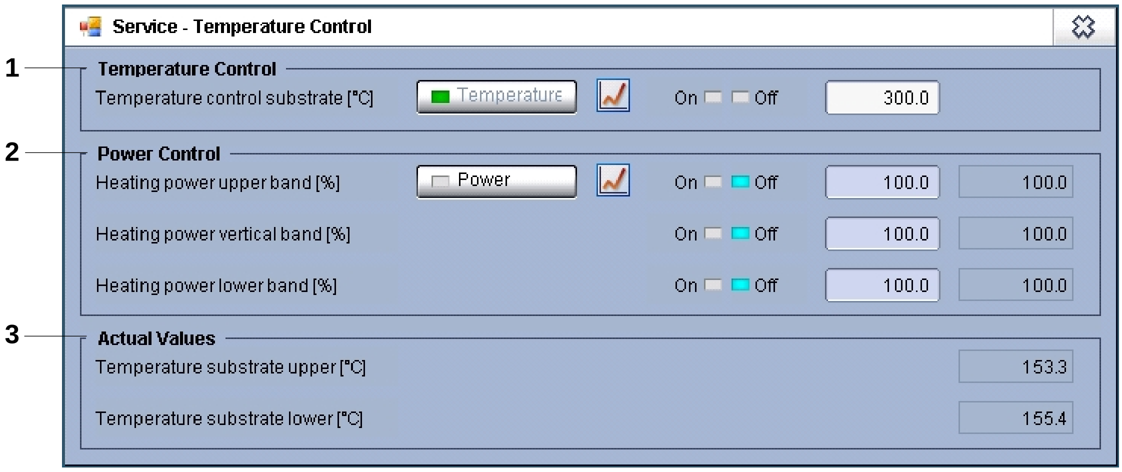
## 4.10.2.5 Popup - Service - DC Bias




**Features of the screen:**

| | | |
|---|---|---|
| 1 | Bias Voltage (On / Off) U [V] | Nominal and actual bias voltage. |
| 2 | Current I [A] neg. | Actual bias current. |
| 3 | Power P [kW] neg. | Actual bias power. |
| 4 | Arcs Total | Total number of arc's. |
| 5 | Arc / 10s | Number of arc's per 10 seconds. |
| 6. | Bias arcing chart | Actual curves of the arcing rate. |
| 7. | DC bias chart | Actual and nominal curves (bias voltage / current). |

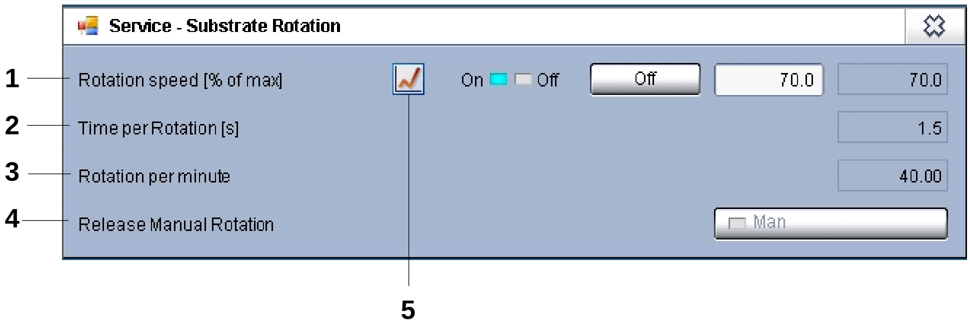
### 4.10.2.6 Popup - Service - Temperature Control




**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Temperature Control**<br>Temperature control substrate [°C] | Temperature controlled mode.<br>Nominal temperature values for the temperature controlled mode. |
| 2 | **Power Control**<br>Heating power upper band [%]<br>Heating power vertical band [%]<br>Heating power lower band [%] | Power controlled mode.<br>Nominal / actual power of the upper heater band.<br>Nominal / actual power of the vertical heater band.<br>Nominal / actual power of the lower heater band. |
| 3 | **Actual Values**<br>Temp substrate upper [°C]<br>Temp substrate lower [°C] | <br>Actual upper substrate temperature.<br>Actual lower substrate temperature. |

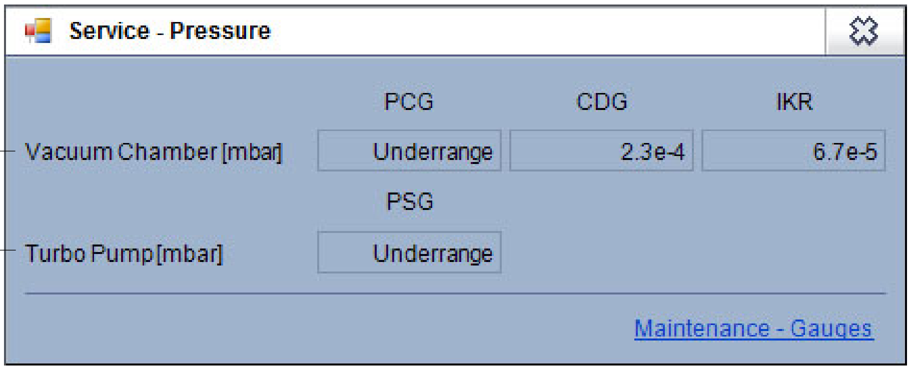
### 4.10.2.7 Popup - Service - Substrate Rotation




**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Rotation speed [% of max]** | Nominal / actual values of the carousel revolutions in % of the maximum. |
| 2 | **Time per rotation [s]** | Duration of each rotation in seconds. |
| 3 | **Rotations per minute** | Number of rotations per minute. |
| 4 | **Release Manual Rotation** | Enables the manual substrate rotation (⇨ refer to chapter 5). |
| 5 | **Rotation speed chart** | Actual curve of the carousel rotation speed. |

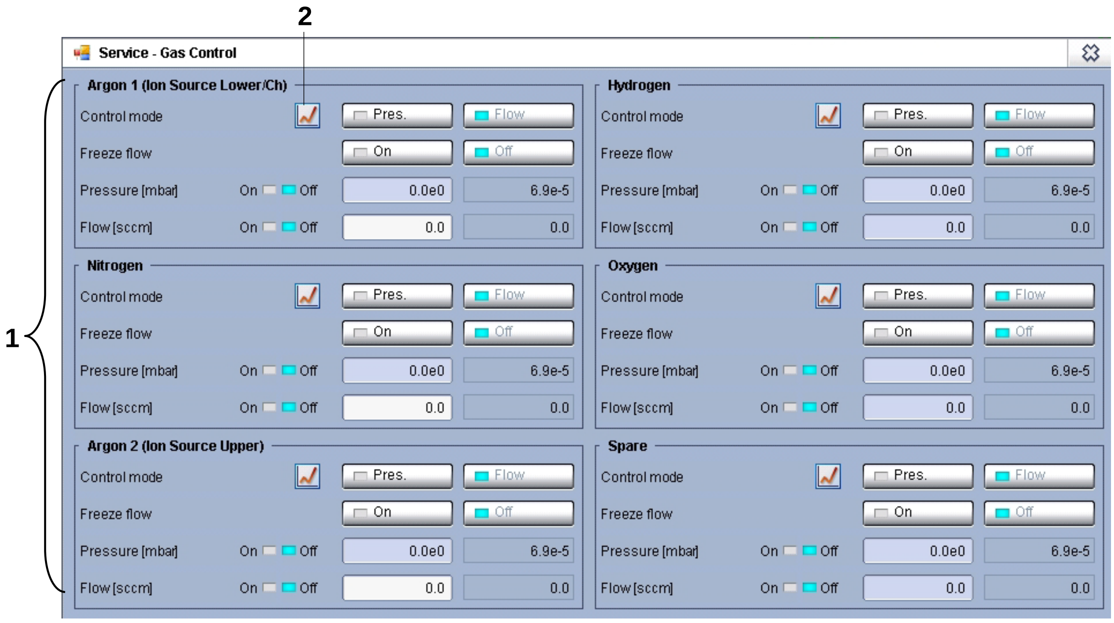
### 4.10.2.8 Popup - Service - Pressure

1
2



**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Vacuum Chamber [mbar]** | Actual pressure reading of different vacuum gauges (PCG 550; CDG 100 D; IKR 251). |
| 2 | **Turbo Pump [mbar]** | Actual pressure reading of the vacuum gauge (PSG 500) at the turbo molecular pump. |

### 4.10.2.9 Popup - Service - Gas Control



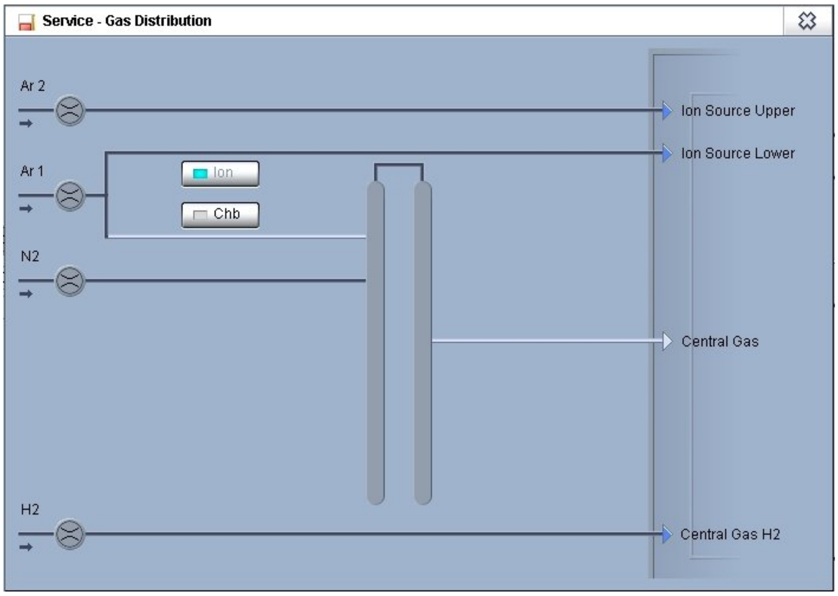

**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Ar 1 / $N_2$ / Ar 2 / $H_2$ / $O_2$ / Spare** | |
| | Control mode | Choice between "Pressure Control" and "Flow Control" mode of the Argon 1 (Ar) / Nitrogen ($N_2$) / Argon 2 (Ar) / Hydrogen ($H_2$) / Oxygen ($O_2$) and Spare gas. |
| | Freeze flow | Keeps the actual flow of Argon 1 (Ar) / Nitrogen ($N_2$) / Argon 2 (Ar) / Hydrogen ($H_2$) / Oxygen ($O_2$) and Spare gas constant. |
| | Pressure [mbar] | Nominal pressure of Argon 1 (Ar) / Nitrogen ($N_2$) / Argon 2 (Ar) / Hydrogen ($H_2$) / Oxygen ($O_2$) and Spare gas pressure.<br>Actual pressure of the coating system. |
| | Flow [sccm] | Nominal flow of Argon 1 (Ar) / Nitrogen ($N_2$) / Argon 2 (Ar) / Hydrogen ($H_2$) / Oxygen ($O_2$) and Spare gas flow. |
| 2 | **Pressure / flow regulation chart** | Nominal and actual curves of the pressure or flow regulation. |

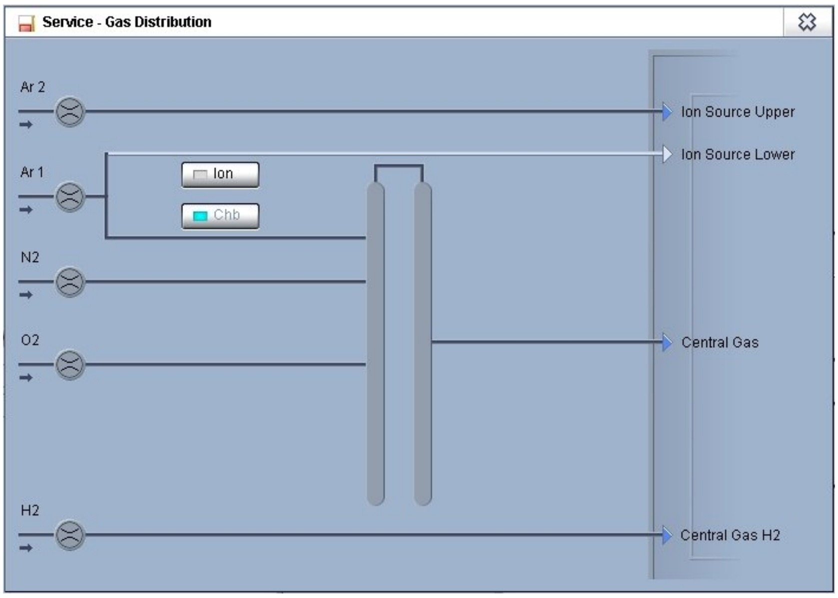
### 4.10.2.10 Popup - Service - Gas Distribution

The “Popup - Service - Gas Distribution” is used for selection of the gas inlet position.

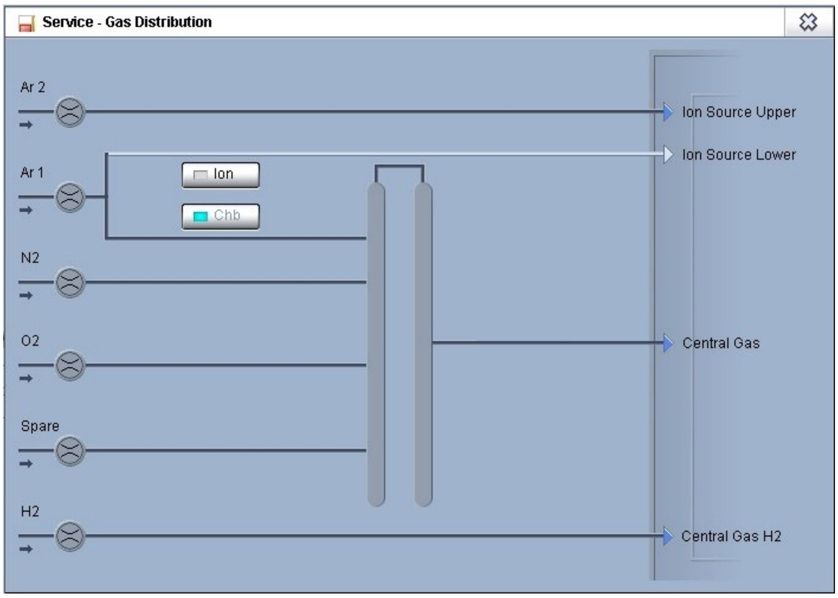
**Variant 1:**



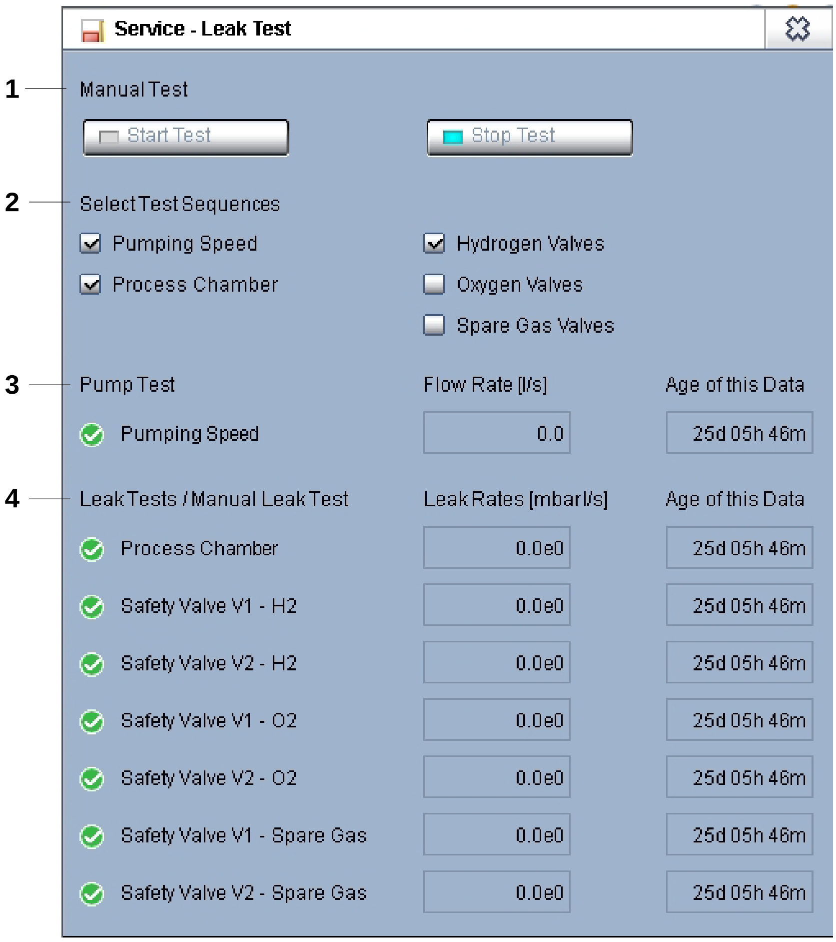

**Variant 2:**



**Variant 3:**


Service - Gas Distribution
Ar 2
Ar 1
N2
O2
Spare
H2
Ion
Chb
Ion Source Upper
Ion Source Lower
Central Gas
Central Gas H2

### 4.10.2.11 Popup - Service – Leak Test

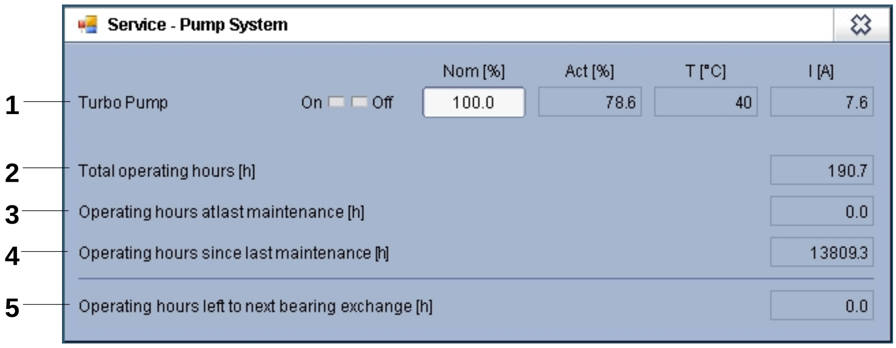



**Features of the screen:**

| | | |
|---|---|---|
| 1 | Manual Test | Start / stop of the manual test. |
| 2 | Select Test Sequences | Selection of the test routines. |
| 3 | Pump Test | Actual measurement of pumping speed and time since last test. |
| 4 | Leak Tests / Manual Leak Test | Actual leak rate values and time since last test. |

### 4.10.2.12 Popup - Service - Pump System

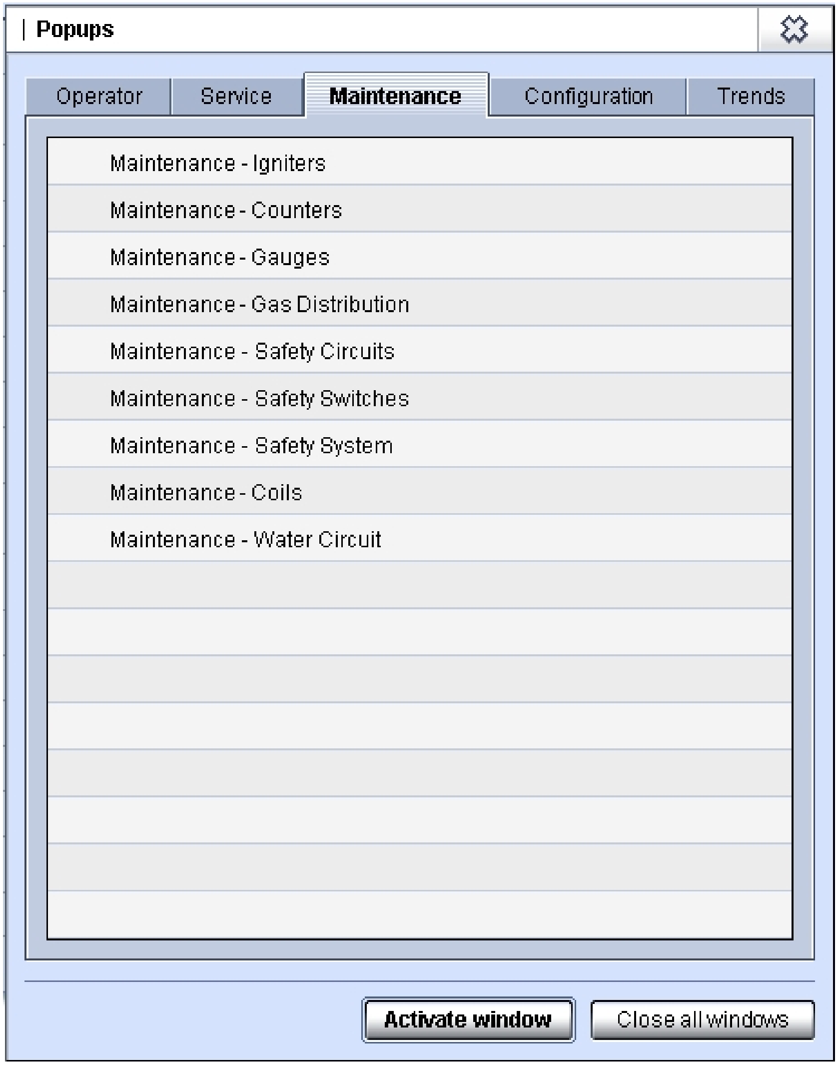
**Changes on these parameters will influence the pumping speed.**



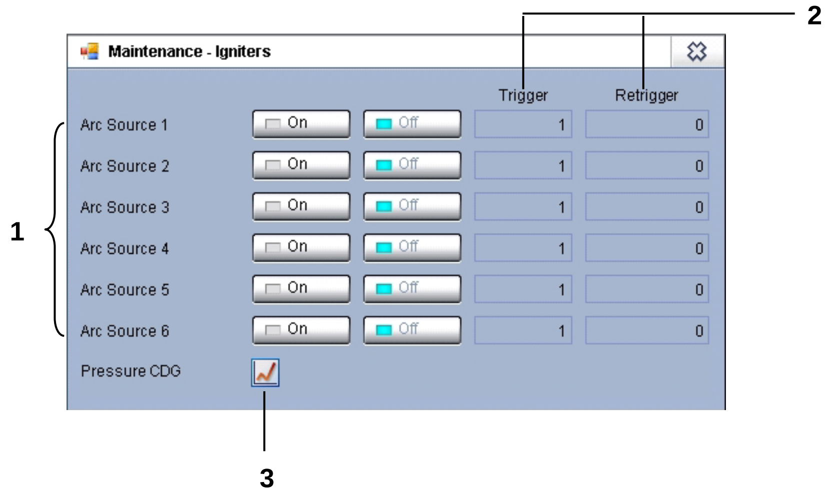

**Features of the screen:**

| | | |
|---|---|---|
| 1 | Turbo Pump | Nominal / actual values [%] of the turbo molecular pump frequency.<br>Actual temperature [°C] and current I [A] of the turbo molecular pump. |
| 2 | Total operating hours [h] | Total operating hours of the turbo molecular pump. |
| 3 | Operating hours at last maintenance [h] | Operating hours when the last (turbo molecular pump) maintenance was performed. |
| 4 | Operating hours since last maintenance [h] | Operating hours since the last (turbo molecular pump) maintenance. |
| 5 | Operating hours left to next bearing exchange [h] | Operating hours until the bearings must be replaced. |

### 4.10.3 Popup - Maintenance



### 4.10.3.1 Popup - Maintenance - Igniters



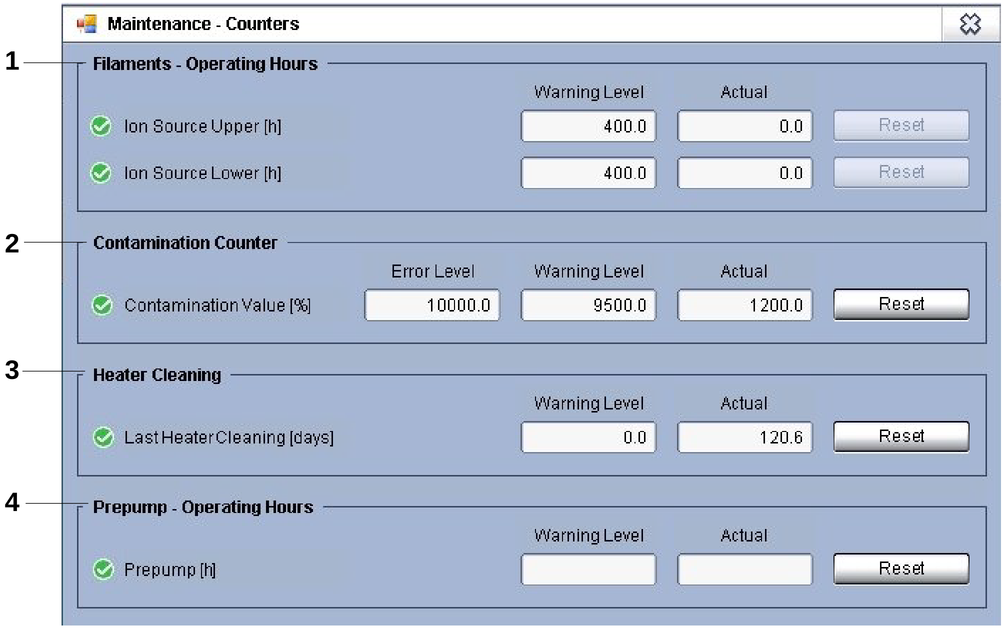

This screen is used to manual operate the igniter finger for leak detection.

**System pre-condition: “Pump” and all target’s mounted!**

**Features of the screen:**

| | | |
|---|---|---|
| 1 | Arc Source 1 to 6 | Starts / stops mechanical movement (approx. 5 second cycle time) of the igniter finger (simulated ignition without ignition current). |
| 2 | Trigger / Re-Trigger | Counts the movements. |
| 3 | Pressure CDG | Actual curve of the CDG 100 pressure. **Helps to visualize the influence of the igniter finger to the pressure signal.** |

### 4.10.3.2 Popup - Maintenance - Counters




**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Filaments – Operating Hours**<br>Ion source Upper [h]<br>Ion source Lower [h] | <br>Nominal / actual time.<br>Nominal / actual time. |
| 2 | **Contamination Counter**<br>Contamination value | <br>It shows the contamination value of each recipe. This value determines the maintenance cycle. |
| 3 | **Heater Cleaning**<br>Last heater Cleaning [days] | <br>Time interval since the last batch cleaning. |
| 4 | **Prepump – Operating Hours**<br>Prepump [h] | <br>Operating hours of the fore pump. |

### 4.10.3.3 Popup - Maintenance - Gauges


**Features of the screen:**

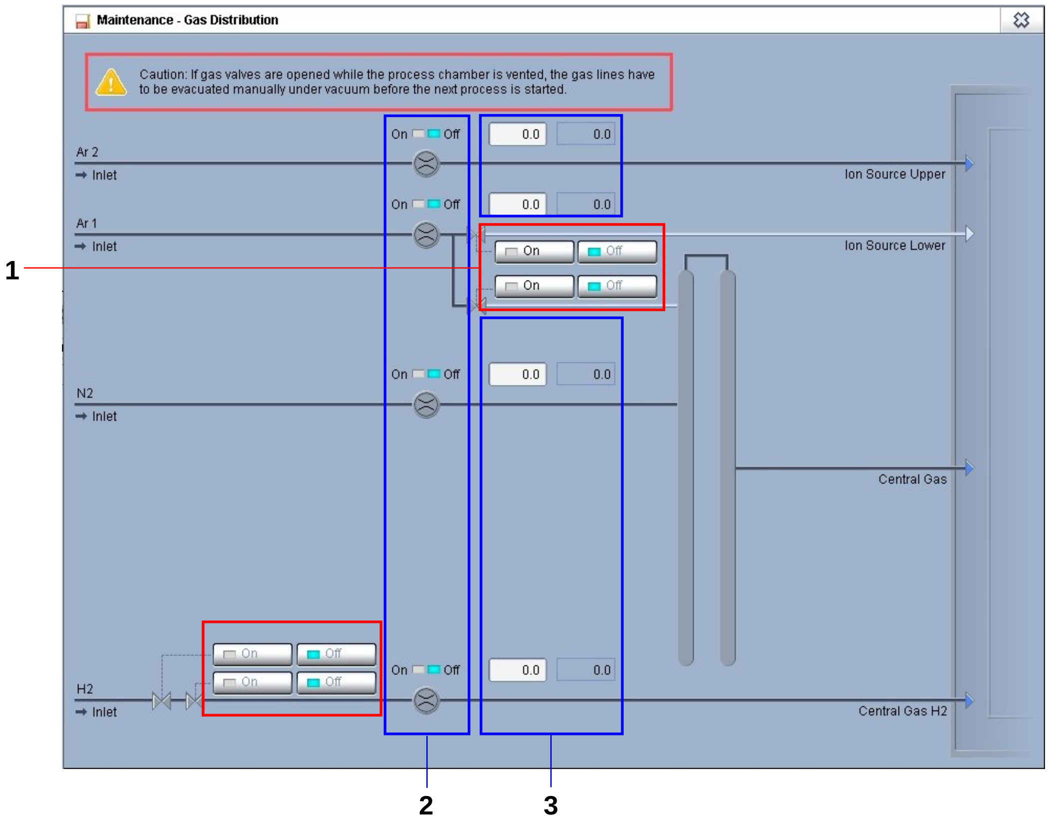
| | | | |
|---|---|---|---|
| 1 | **Gauges** | | |
| | PCG Process Chamber<br>IKR Process Chamber<br>PSG Turbo Pump<br>CDG Process Chamber | | PCG = PCG 550<br>IKR = IKR 251<br>(PSG Turbo Pump = PSG 500 Turbo Molecular Pump = TMP)<br>CDG Process Chamber = CDG 100 Process Chamber |
| | | Pressure [mbar] | Actual pressure. |
| | | Voltage [V] | Actual output voltage. |
| | | Active | (green) = gauge on. |
| | | Starting up | Start-Up (yellow flashing) = start delay for switching on the gauge. |
| | | Underrange | Under range (yellow) of the gauge. |
| | | In Range | In Range (green) = gauge is in correct measuring range. |
| | | Error | Error in gauge. |
| | | Overrange | Over range (yellow) of the gauge. |

| | | | |
|---|---|---|---|
| 2 | **CDG Process Chamber** | | |
| | Zero point voltage (Offset) [V] | | Software zero point.<br>Difference between actual output voltage (CDG 100 D) and actual output voltage PLC. |
| | Time since last auto calibration | | Time in days, hours, minutes and seconds (0d 02h 15m 49s). |
| | Leakrate of CDG Isolating Valve | | Indication of the tightness of the CDG 100 D isolating valve. |

### 4.10.3.4 Popup - Maintenance – Gas Distribution

**Return all nominal values to zero and set the softkeys to “Off” after using.**

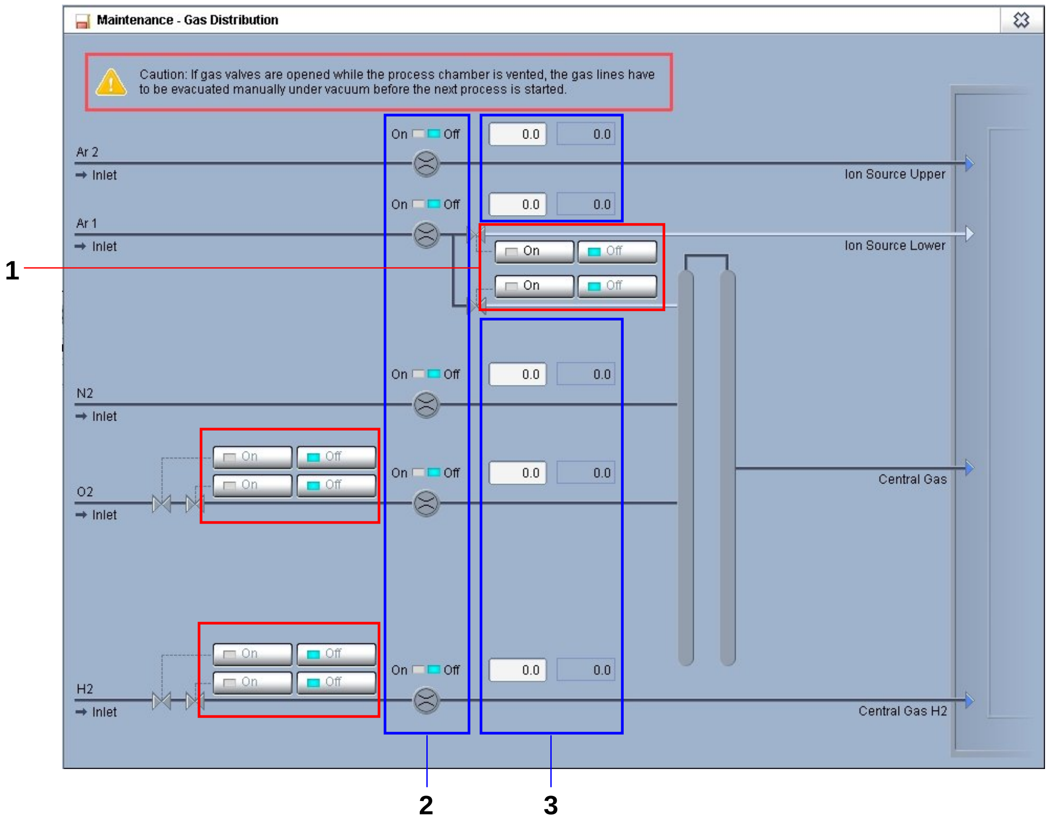
**Variant 1:**




**Features of the screen:**

| | | | |
|---|---|---|---|
| 1 | | ON / OFF | Manual open/close of the gas valves (**Ar 1**; **$H_2$; Central gas**). |
| 2 | | ON / OFF | On/Off status of the mass flow controllers. |
| 3 | | | Nominal / actual gas flow for the mass flow controllers. |

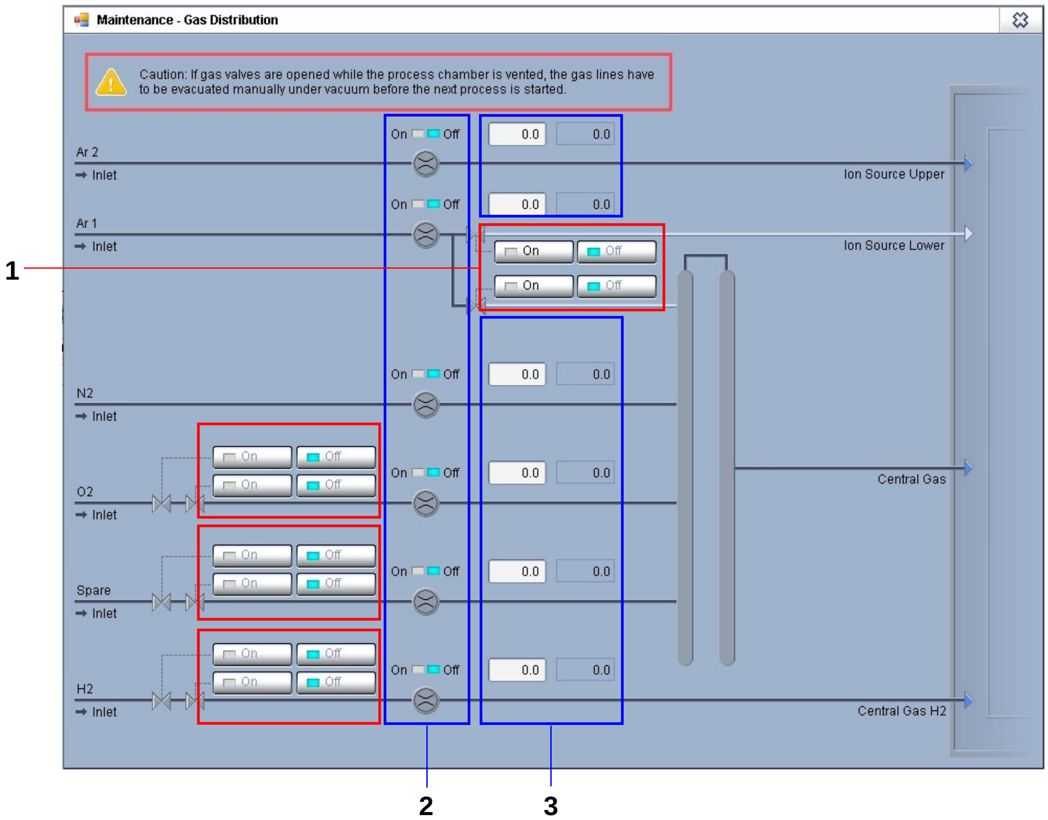
**Variant 2:**




**Features of the screen:**

| | | | |
|---|---|---|---|
| 1 | | ON / OFF | Manual open/close of the gas valves (**Ar 1**; **$H_2$; $O_2$; Central gas; Position 1-6**). |
| 2 | | ON / OFF | On/Off status of the mass flow controllers. |
| 3 | | | Nominal / actual gas flow for the mass flow controllers. |

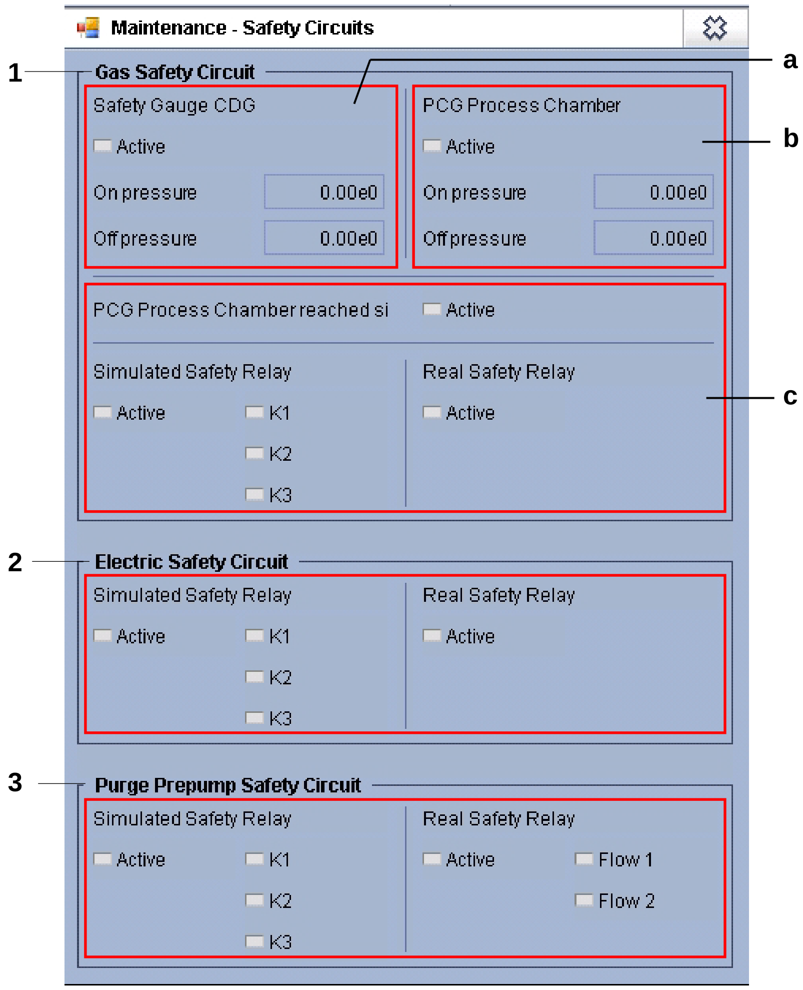
**Variant 3:**




**Features of the screen:**

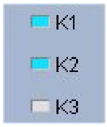
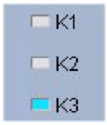
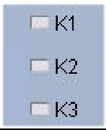
| | | | |
|---|---|---|---|
| 1 | | ON / OFF | Manual open/close of the gas valves (**Ar 1**; **$H_2$**; **$O_2$**; **Spare; Central gas; Position 1-6**). |
| 2 | | ON / OFF | On/Off status of the mass flow controllers. |
| 3 | | | Nominal / actual gas flow for the mass flow controllers. |

### 4.10.3.5 Popup - Maintenance – Safety Circuits




**Features of the screen:**

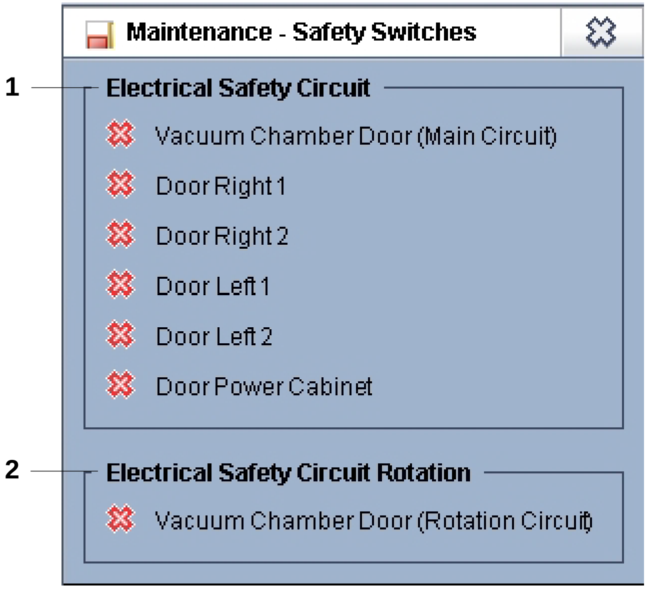
| | | | |
|---|---|---|---|
| 1 | **Gas safety circuit** | | Visualization of the gas safety circuit function. |
| a | Safety Gauge CDG | | Process chamber pressure measurement (CDG 025D-S). |
| | On pressure | | When the gauge switches to on the actual value is stored. |
| | Off pressure | | When the gauge switches to off the actual value is stored. |

| | | | |
|---|---|---|---|
| b | PCG Process Chamber (P2) | | Process chamber pressure measurement (PCG 550). |
| | On pressure | | When the gauge switches to on the actual value is stored. |
| | Off pressure | | When the gauge switches to off the actual value is stored. |
| c | PCG process chamber reached simulated | | Software simulation of the “Safety Relay” function. |
| | Simulated Safety Relay | <br><br> | Software simulation of the “Safety Relay” function.<br>K1, K2 (blue colored) = Safety Relay “**On”**. All safety circuits are o.k.<br>Feedback control loop is o.k. *<br><br>K3 (blue colored) = Safety Relay “**Off”**. One or more of the safety circuits are not closed.<br>Feedback control loop is o.k. *<br><br>K1, K2, K3 (grey colored) = Safety Relay “**Off”**.<br>Feedback control loop is not o.k. * |
| | Real Safety Relay | | Actual safety relay component in the power cabinet. |
| 2 | **Electric safety circuit**<br>**(**Simulated Safety Relay | | Visualization of the electrical safety circuit function.<br>(K1…K3 function as described above). |
| | Real Safety Relay | | Actual safety relay component in the power cabinet. |
| 3 | **Purge Prepump Safety Circuit**<br>**(**Simulated Safety Relay | | Visualization of the fore pump safety circuit function.<br>(K1…K3 function as described above). |
| | Real Safety Relay | | Actual safety relay component in the power cabinet. |

* In every "dangerous voltage” components e.g.: arc power supply, bias voltage supply, etc. there is a main power contactor. An auxiliary contact mounted on this contactor serves to loop a control signal from the “Safety Relay” and feed back to the “Safety Relay”. Thus making the “feedback control loop”.

For further information concerning the safety circuits ⇨ refer to chapter 2 - “Safety”.

#### 4.10.3.6 Popup - Maintenance - Safety Switches

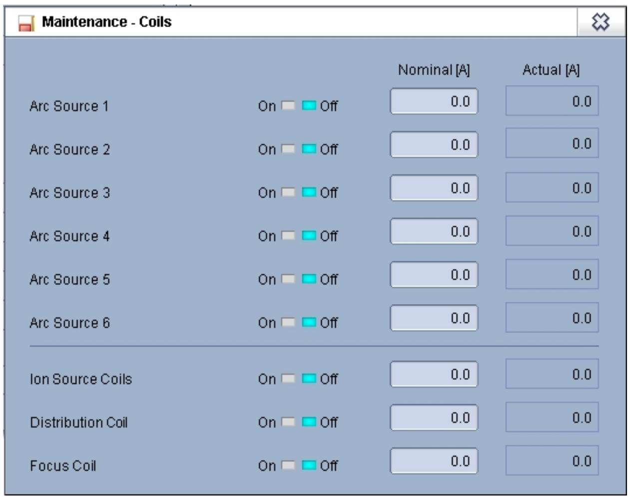



(Vacuum Chamber Door = Process Chamber Door)

**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Electrical Safety Circuit** | Actual door status (open / closed). |
| 2 | **Electrical Safety Rotation** | Actual status of the (front) door (open / closed). |

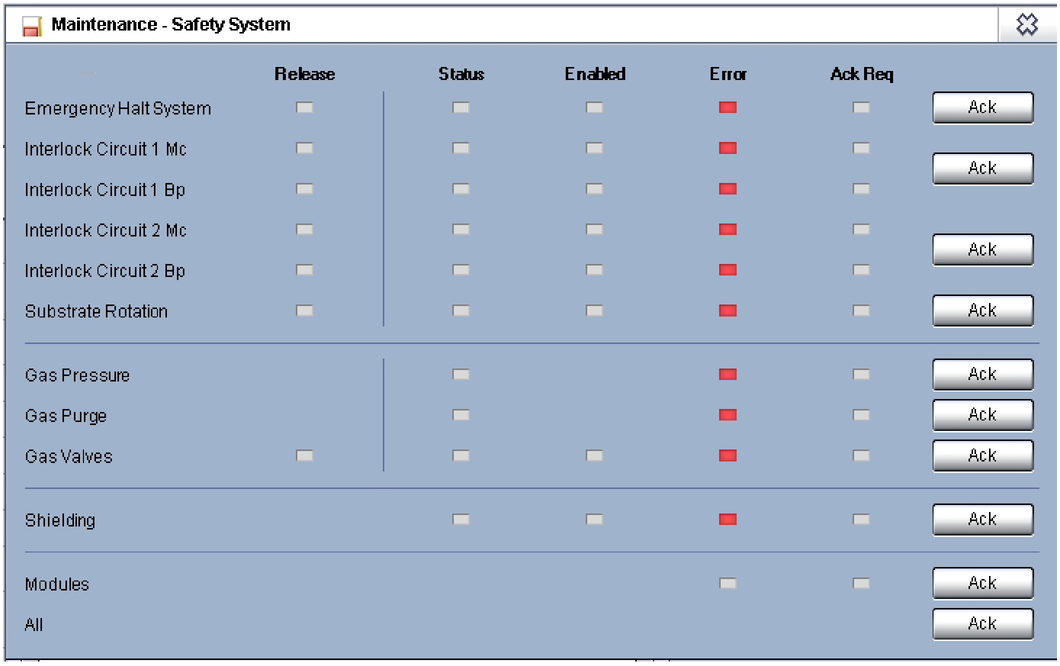
### 4.10.3.7 Popup - Maintenance - Coils




**Features of the screen:**

The “Popup - Maintenance - Coils” is used to test the coil current supplies. For further information ⇨ refer to chapter 7.24 “Testing the CCS with any Coil Magnetic System (Optional)”.

### 4.10.3.8 Popup - Maintenance – Safety System

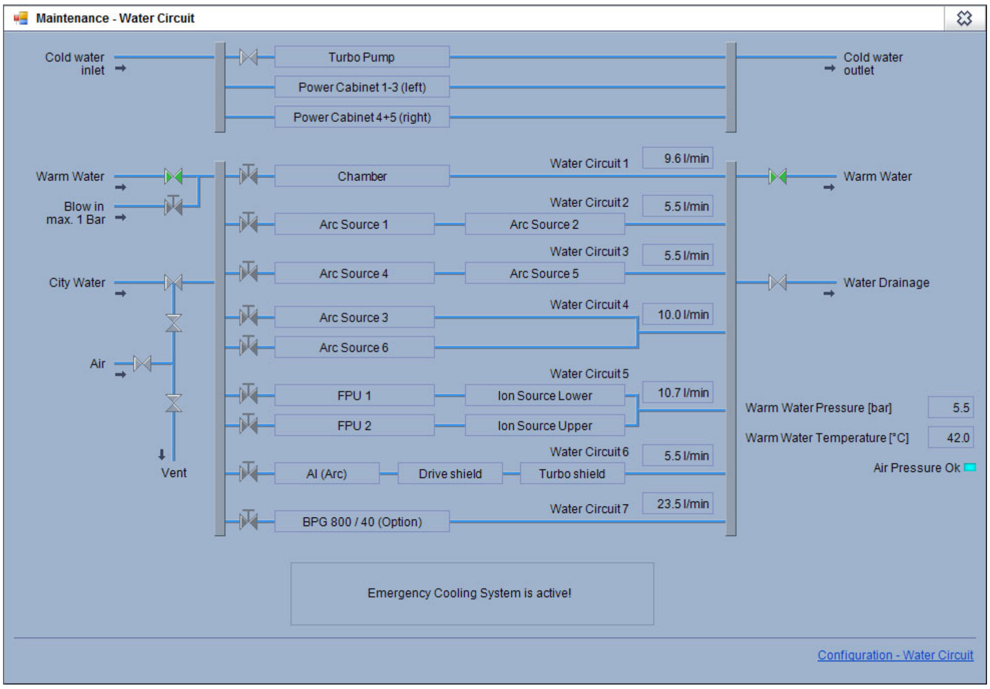



**Features of the screen:**

The “Popup - Maintenance - Safety System” shows the status of the different safety circuits.

If the safety circuit has been interrupted (e.g. by opening of a side panel) the respective “Ack” button must be clicked after closing the safety circuit (e.g. side panel closed again) in order to “activate” the safety circuit.

## 4.10.3.9 Popup - Maintenance - Water Circuit

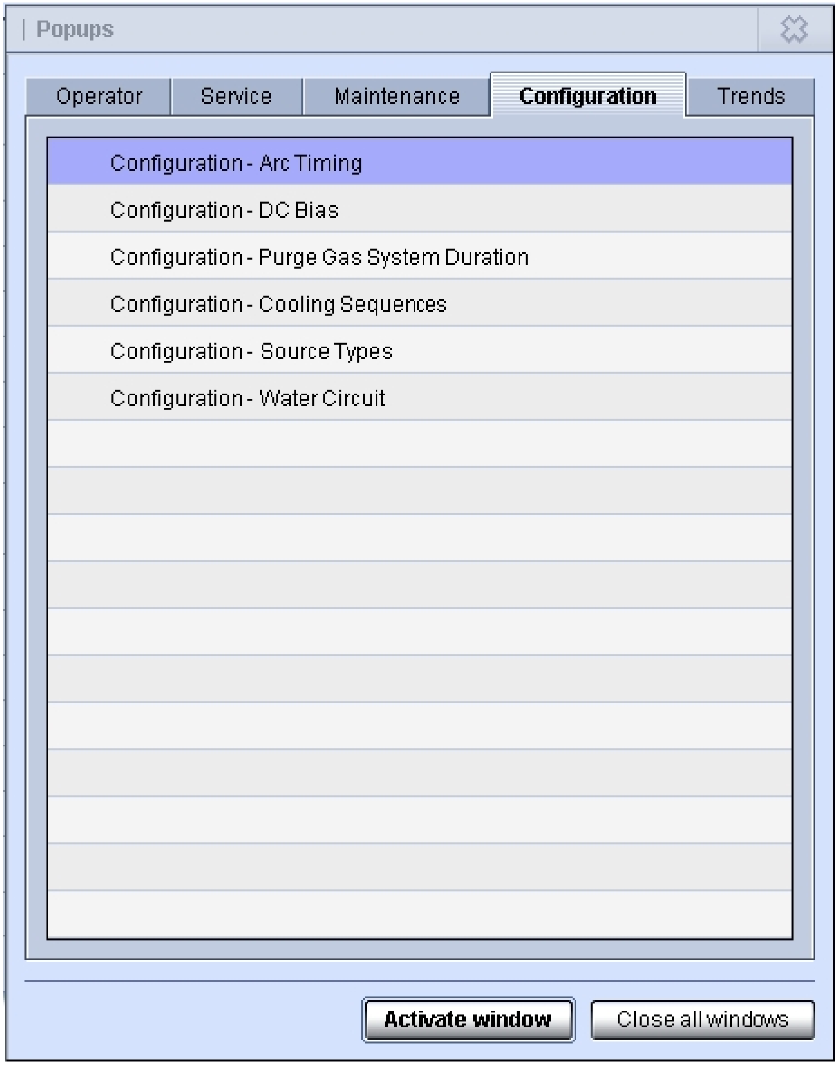



**Features of the screen:**

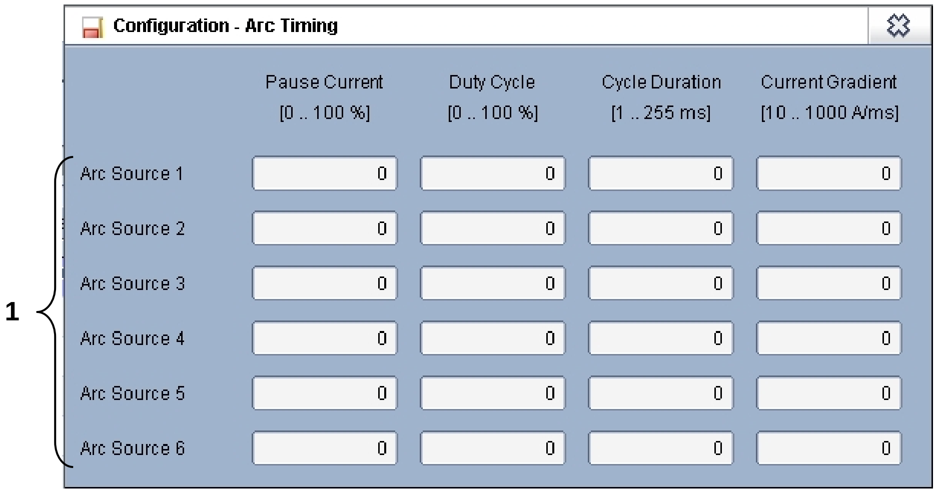
The “Popup - Maintenance - Water Circuit” shows the different water circuits for the complete INGENIA P3e™ coating system.

| | |
|---|---|
| **Cold water inlet / outlet** | For turbo molecular pump.<br>For power cabinet 1-3 (left) and 4+5 (right). |
| **Warm Water inlet / outlet**<br>**Blow in (max. 1 bar)** | For process chamber; arc source 1-6; FPU 1,2; Ion source upper, lower; Arc interrupter (AI); drive shield; turbo shield; pulsed bias (BPG 800 / 40). |
| **City Water**<br>**Air**<br>**Vent** | City water inlet (for emergency cooling).<br>Compressed air inlet (for blowing out the water circuits 1-7)<br>Deactivating of the emergency cooling water by releasing the compressed air. |
| **Water Drainage** | For emergency cooling and blowing out the water circuits 1-7. |
| **Warm Water Pressure [bar]** | Shows the actual inlet pressure. ⇨ Refer to chapter 1.15.3.3 “Warm Cooling Water (Water Battery)”. |
| **Warm Water Temperature [°C]** | Shows the actual inlet temperature. ⇨ Refer to chapter 1.15.3.3 “Warm Cooling Water (Water Battery)”. |
| **Air Pressure o.k.** | Main compressed air inlet pressure o.k. |

### 4.10.4 Popup - Configuration

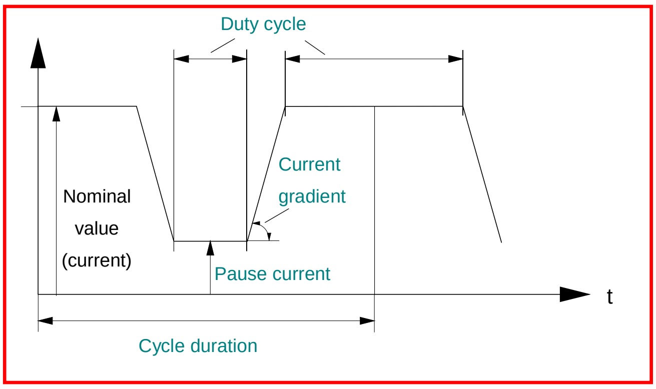


### 4.10.4.1 Popup – Configuration – Arc Timing (for DPS 2500)*




**Features of the screen:**

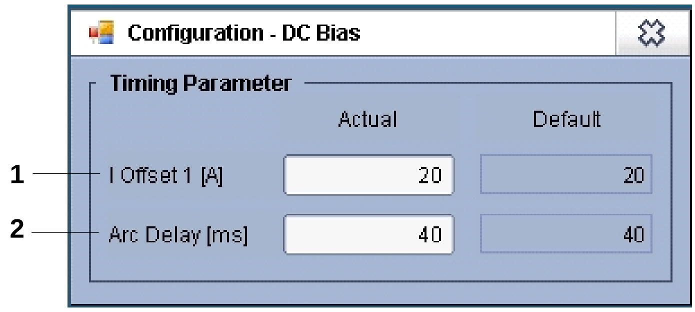
| | | |
|---|---|---|
| 1 | **Arc Source 1-6** | |
| | Pause Current [0...100%] | Pulse parameter |
| | Duty Cycle [0...100%] | Pulse parameter |
| | Cycle Duration [1...255 ms] | Pulse parameter |
| | Current Gradient [10...1000 A/ ms] | Pulse parameter |




(* Optional

### 4.10.4.2 Popup - Configuration – DC Bias

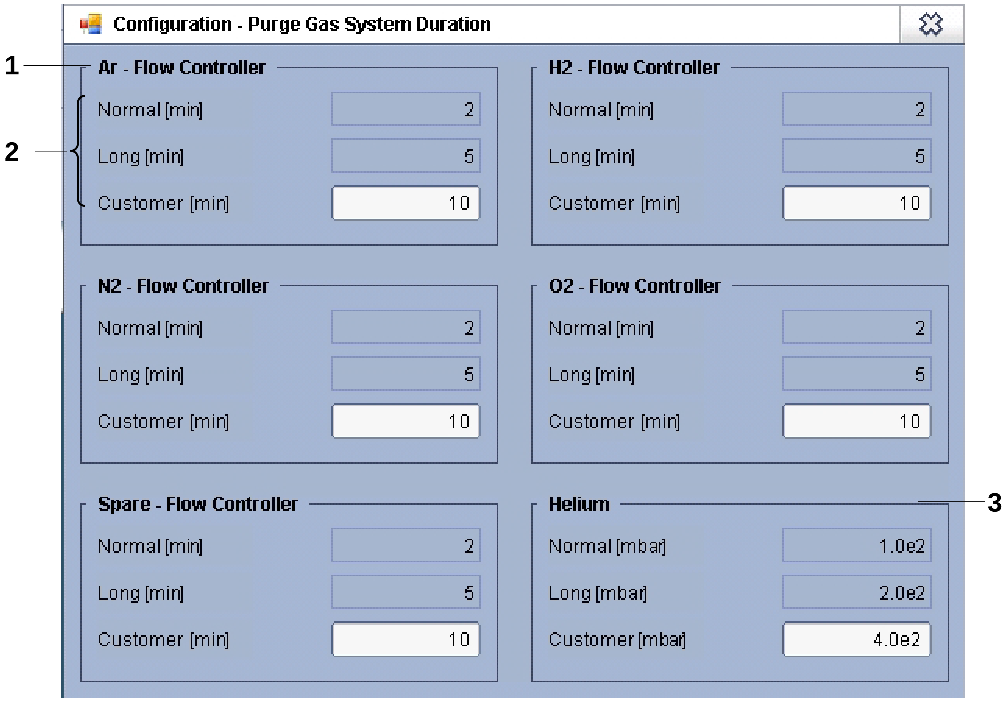
Depending on the customer configuration of the INGENIA P3e™ coating system the software selects automatically the respective "Bias Configuration Screen".




**Features of the screen:**

| | | |
|---|---|---|
| **1** | **I Offset 1 [A]** | Arc detection level (static) |
| **2** | **Arc Delay [ms]** | Bias off delay after an arc |

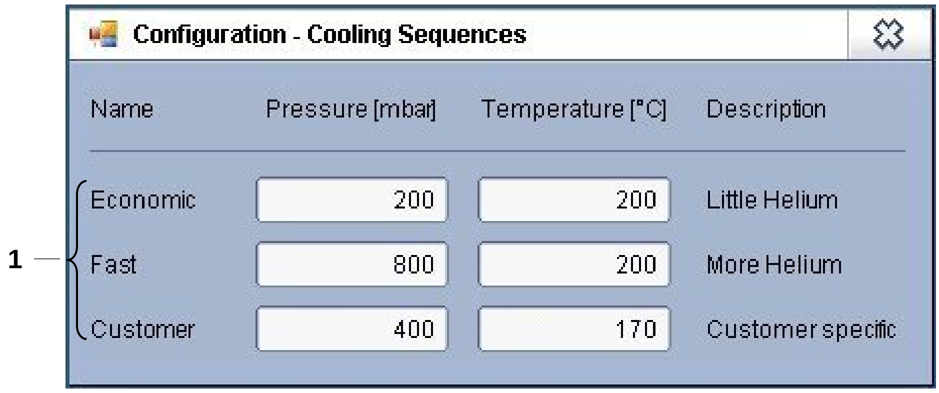
### 4.10.4.3 Popup – Configuration - Purge Gas System Duration




**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Gas types:** | Selection of the respective gas type.<br><br>**Ar:** 400 sccm<br>**$N_2$:** 500 sccm<br>**Spare** depending on the mass flow controller<br>**$H_2$:** 400 sccm<br>**$O_2$:** 500 sccm |
| 2 | **Purge time:** | Selection of the respective duration.<br><br>**Normal** 5 minutes (purge / evacuation time)<br>**Long** 10 minutes (purge / evacuation time)<br>**Customer** “custom” (purge / evacuation time) |
| 3 | **Helium** | Because there is no mass flow controller, the purge function is pressure controlled.<br><br>**Normal** 100 mbar process chamber<br>**Long** 200 mbar process chamber<br>**Customer** “custom” mbar process chamber |

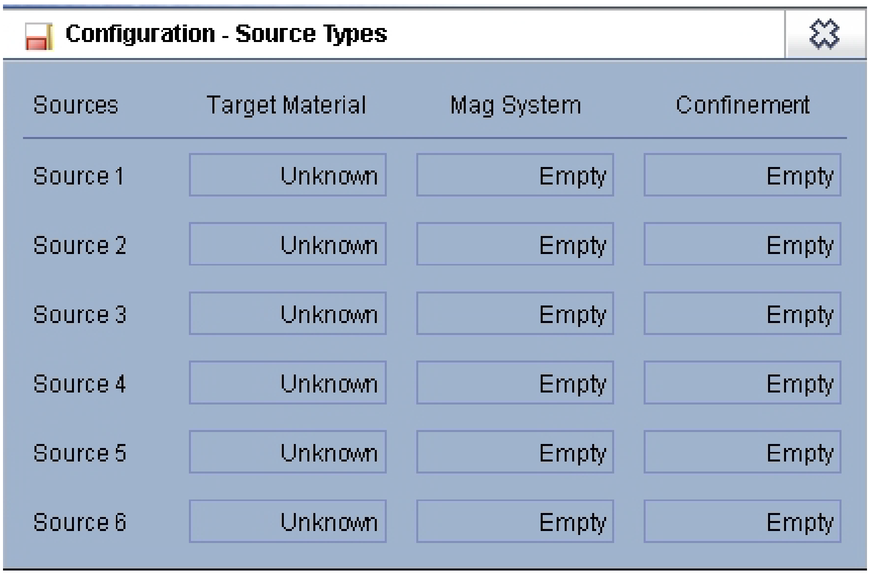
#### 4.10.4.4 Popup – Configuration – Cooling Sequences




**Features of the screen:**

| | | |
|---|---|---|
| 1 | **Cooling Sequences:**<br>**Economic; Fast; Customer** | |
| | Pressure [mbar] | Nominal pressure value during cooling step. |
| | Temperature [°C] | Nominal temperature value after cooling step. |

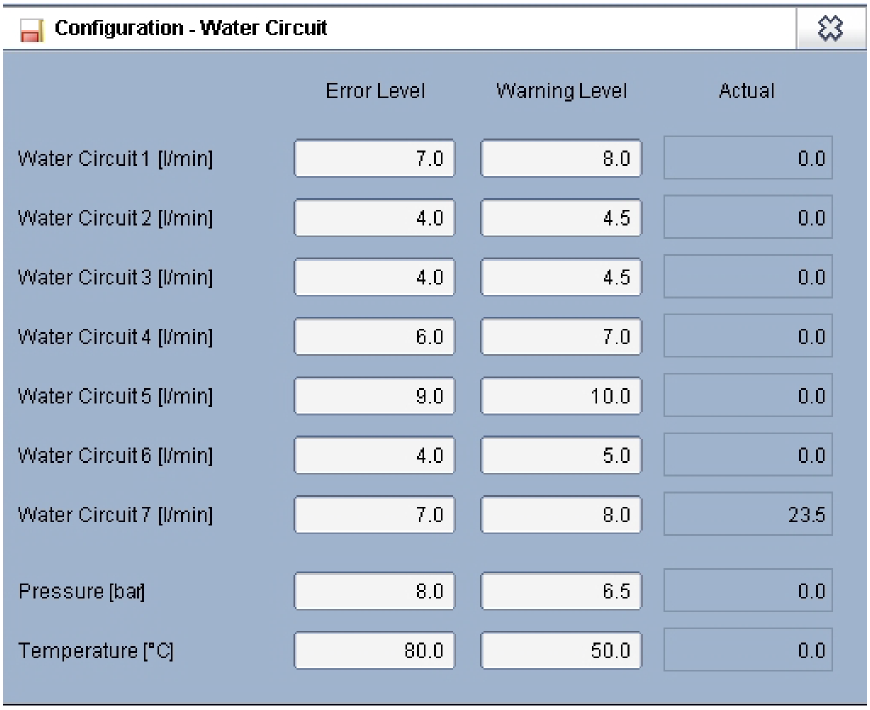
### 4.10.4.5 Popup – Configuration – Source Types




**Features of the screen:**

The “Popup - Configuration – Source Types” shows the specified target material, mag system and confinement type (predefined in the loaded recipe) for each source.

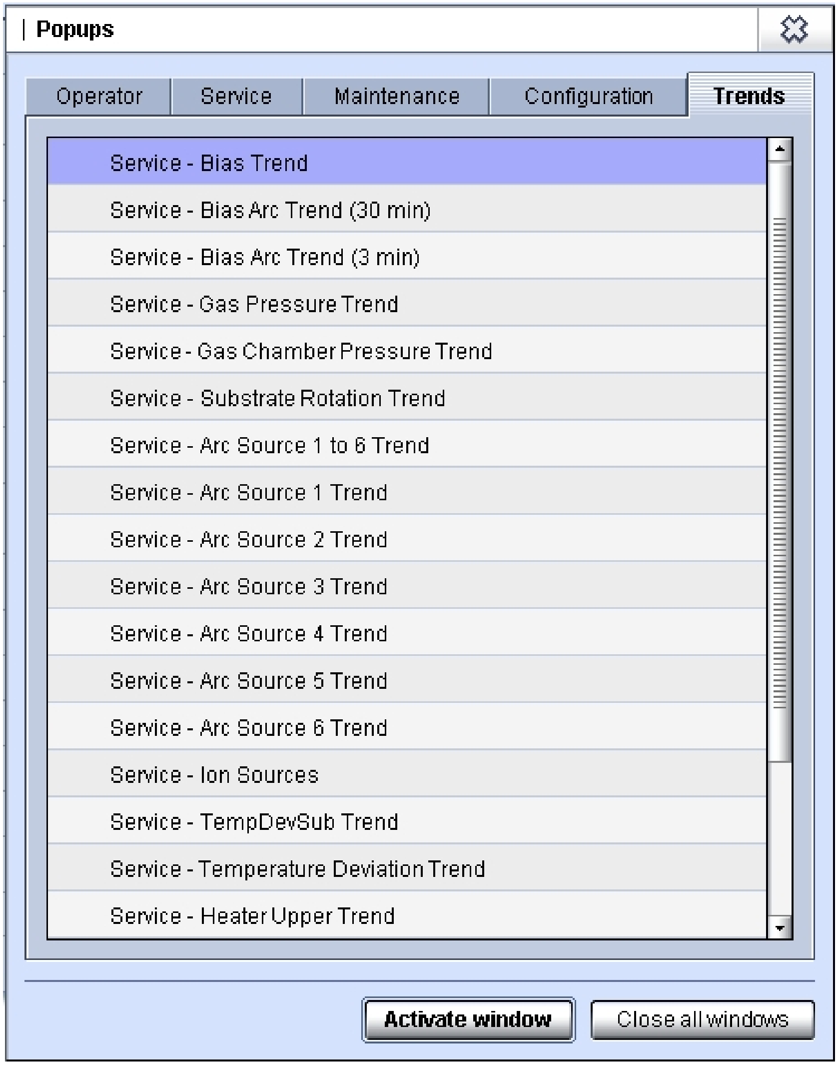
### 4.10.4.6 Popup – Configuration – Water Circuit




**Features of the screen:**

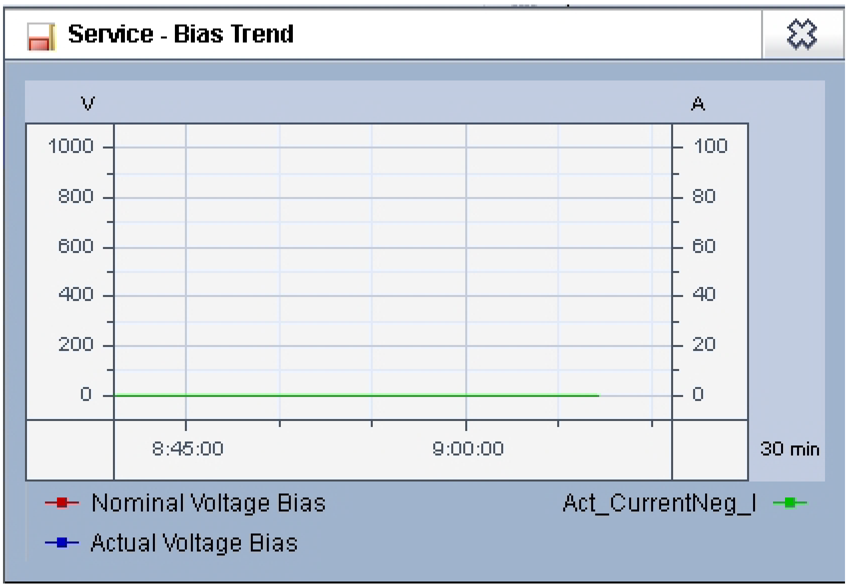
The “Popup - Configuration – Water Circuit” shows the defined error, warning and actual flow values (levels) of the water circuits 1-7.

## 4.10.5 Popup – Trends

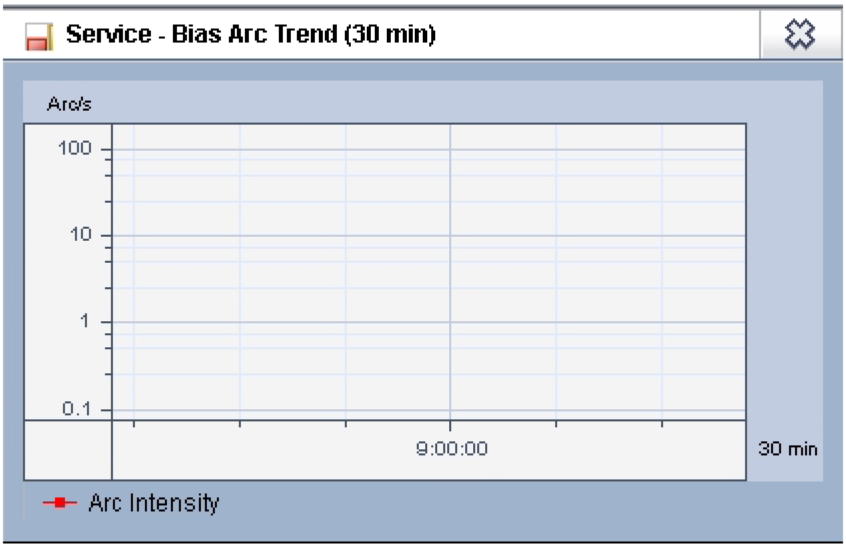


#### 4.10.5.1 Popup – Trends – Service Bias Trend

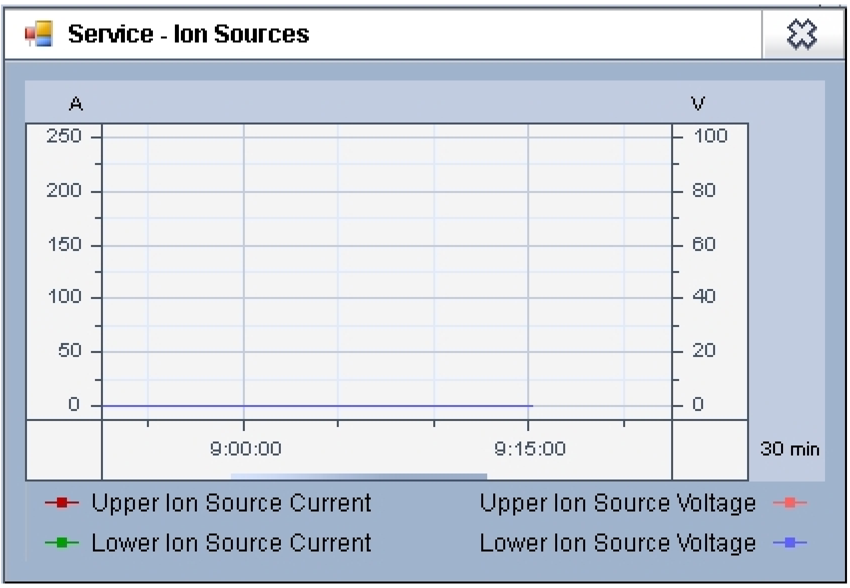
(Some examples:)




#### 4.10.5.2 Popup – Trends – Service Bias Arc Trend (30 min)



#### 4.10.5.3 Popup – Trends – Service Ion Sources



# 5 Operation

**Manufacturer**

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**Please read and retain this manual to assist you in the operation and maintenance of this product. This manual is an integral part of the machine. In the event of a change of ownership, hand this manual over to the new owner.**

# Contents

## 5.1 Process Control and Operation

### 5.1.1 Production Steps

| **Job** | **Action** | **Responsible** |
|---|---|---|
| *Incoming inspection (tools, etc.)* | Material coatability<br>Preparatory treatment process<br>e.g.<br>• Cleaning<br>• Vacuum degassing<br>• Micro blasting<br>• Stripping | Quality assurance |
| *Intermediate control (tools, etc.)* | Sufficient result of<br>• cleaning<br>• preparatory treatment (visual check) | **Operator** |
| *Process chamber preparation* | According to Operating Manual | **Operator** |
| *Loading the carrousel* | According to Operating Manual | **Operator** |
| *Loading the system* | According to Operating Manual | **Operator** |
| *Starting the process* | According to Operating Manual | **Operator** |
| *Batch protocol* | Handling | **Operator** |
| *Unloading the system* | Coating quality (visual check) | **Operator** |
| *Unloading the carrousel* | According to Operating Manual | **Operator** |
| *Post treatment* | Post treatment process<br>e.g.<br>• Brushing<br>• Micro blasting<br>Corrosion protection | Quality assurance |
| *Outgoing inspection* | Visual Control<br>Coating thickness<br>Coating adhesion | Quality assurance |

### 5.1.2 Status Lamps

The actual status of the INGENIA P3e™ coating system is indicated at the operator panel and above the coating system (left side) with three status lamps. Additional to an “Error”, “Warning” or “End of Process” an acoustic signal is audible.

The table (chapter 4) shows the respective colors depending on the process status:

**If the red alarm lamp is lit the operator must contact the service engineer.**

### 5.1.3 Switching on the System

**To switch on or off the system is the service engineer’s job. It is therefore forbidden for any other persons to switch on or off the system via the main switch.**

**If an emergency-off button has been pressed by the operator, the service engineer has to be alerted to switch on the system again.**

### 5.1.4 Process Preparation Equipment

#### 5.1.4.1 Carousel Exchanging System

The carousel exchanging system is used to transport and store the carousel.

The carousel exchanging system is used to prepare carousels for the next process (loading/unloading of substrates and checking the correct rotation (counter clockwise) of the spindles, function of the flickers etc.).

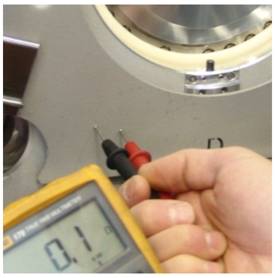
### 5.1.5 Non-conductive Coatings

Whenever working with non-conductive coatings such as Oxide coatings the following points have to be taken into account:

#### 5.1.5.1 In General

Maximum 4 non-conductive coating processes may be carried out in series. The fifth process must be an electrically conductive (e.g. TiN).

After each non-conductive coating process the shielding must be checked by means of an Ohm meter within a distance of approx. 1cm. If the resistance of the shielding is higher than 250 Ω an electrically conductive process must be performed or the shielding sandblasted.



#### 5.1.5.2 Heating with Plasma (Ion Source)

The substrate may not be heated up with a standard heating process. A previously electrically non conducting coated carousel is completely electrically isolated i.e. the whole arc current flow is via the substrates and will heat them up excessively.
In worst case the carousel and the shielding will bend and jam.

**Heat only with radiation heaters until the process temperature is reached before igniting the arc. Use this procedure also for restarts.**

#### 5.1.5.3 Carousel, Shielding and Fixtures

Fixtures, carousel and shielding with non-conductive coating have a high electrical resistance and so a low electrical conductivity. Therefore these coated fixtures and carousels may not be used in processes for standard Balinit coatings which are generally produced with DC BIAS.

At least 50% of the carousel must be uncoated (conductive). This can be handled with either new tools or with blasted dummy trees.

**Do not use non-conductive fixtures (e.g. Oxide coated) for standard Balinit coatings with DC Bias. Always sandblast them prior to use.**

## 5.2 Batch to Batch Tasks

**⚠ CAUTION**

**Danger of crushing!**

- **Be careful when closing the process chamber door. Due to its weight it may cause injury.**
- **Open and close the process chamber door only by means of the process chamber door grip.**

**Danger of burns due to hot components!**

- **There is a danger of burns when touching carousel and substrates during unloading.**

**Wear heat resistant gloves and protective clothing with long sleeves.**

**Beware of material flaking-off in the process chamber. During coating, the carousels and the shielding are coated!**

- **During all maintenance and cleaning work in the process chamber, avoid creating dust. Wear a breathing mask with a type P3 filter, eye protectors and appropriate protective clothing. Do not eat, drink or smoke.**
- **For further safety precaution ⇨ refer to corresponding material safety data sheet.**

**Working Rules:**

**The following working rules have to be followed when working at opened process chamber:**

- Always wear eye protectors.
- Always wear a clean overall/coat and clean lint-free gloves when working with components exposed to vacuum. Do not touch items with bare hands.
- When cleaning the process chamber, always wear a breathing mask that is equipped with a P3 protection filter.
- Use a vacuum cleaner with a metal nozzle to remove loose coating layers and dust.

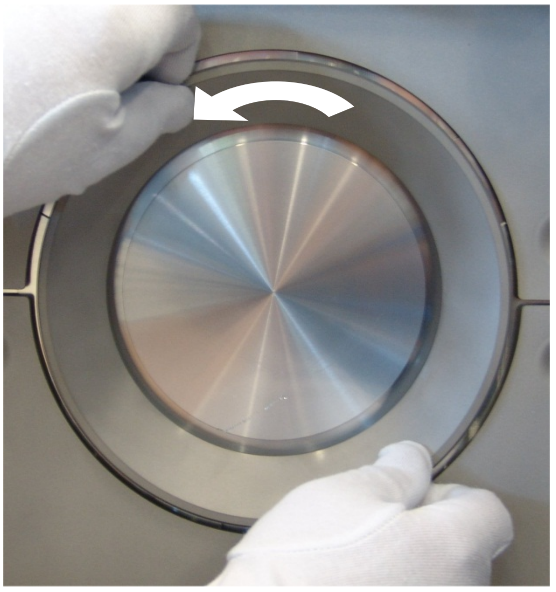
**Never blow out the process chamber with compressed air. Particles would be distributed throughout the entire process chamber.**

- Avoid all contamination caused by oil, grease, water and solvents.
- Use only clean work tools (not greasy or oily).
- Wipe surfaces only with clean, lint-free cleaning paper.

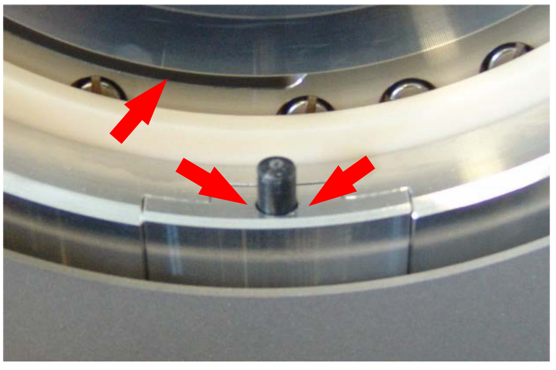
1. Check the shutters in the closed position *.
2. Thoroughly wire brush the heaters and trigger fingers.
3. Thoroughly vacuum clean the process chamber, process chamber door and heaters.
4. Open the shutters *.
5. Remove the confinement rings.

a. Turn the confinement rings carefully counter clockwise until to the limit stop and remove them from the sources.

b. Remove any loose coating flakes from the confinement rings by using a wire brush to prevent short circuit between the confinement rings and the sources.



6. Carefully vacuum clean the target and ceramic insulator area on each source.
7. Check all ceramic insulators if they are o.k.
   In case of a brocken pin, continue with chapter 5.2.1, else go to 5.2.2.



(* Optional

**When replacing the confinement rings follow the correct sequence.**

**A new (or sandblasted) confinement ring must be inserted into source position 1. The other confinement rings are rotated to the next position. The last confinement ring goes to sandblasting.**

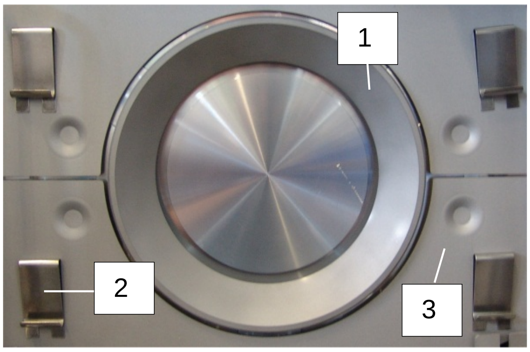
| | | |
|---|---|---|
| A new or sandblasted confinement ring… | goes to… | source position 1 |
| the confinement ring from the source position 1… | goes to… | source position 2 |
| the confinement ring from the source position 2… | goes to… | source position 3 |
| the confinement ring from the source position 3… | goes to… | source position 4 |
| the confinement ring from the source position 4… | goes to… | source position 5 |
| the confinement ring from the source position 5… | goes to… | source position 6 |
| the confinement ring from the source position 6… | goes to… | sandblasting |

### 5.2.1 Exchanging the Complete Ceramic Insulator Set if Required

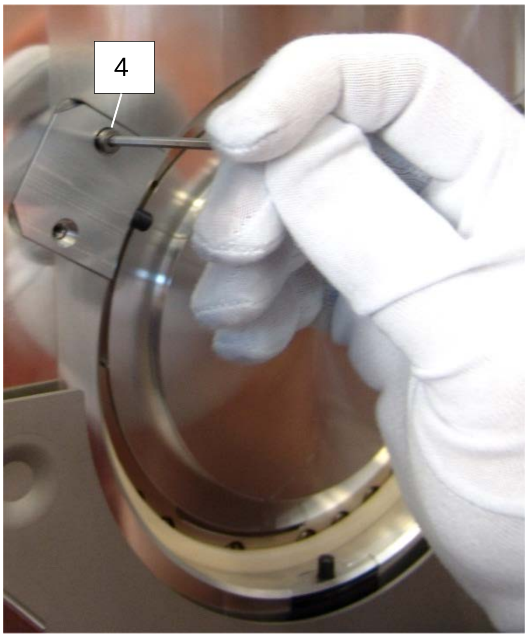
If a ceramic insulator is broken the complete ceramic insulator set must be replaced with a new one.

**Ensure the water is switched off.**

1. Ensure the confinement ring (1) has already been removed.
2. Remove the clips (2) in order to remove the protective shields (3) in the area of the source where the broken ceramic insulator must be replaced.

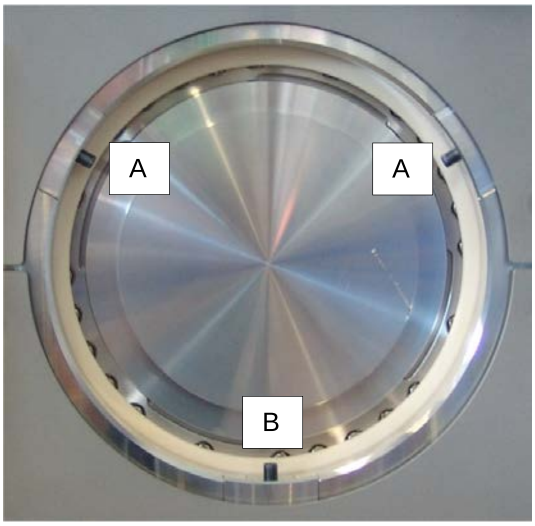



3. Carefully vacuum clean the insulator area.
4. Replace the complete ceramic insulator set with a new one by unscrewing the two screws (4).

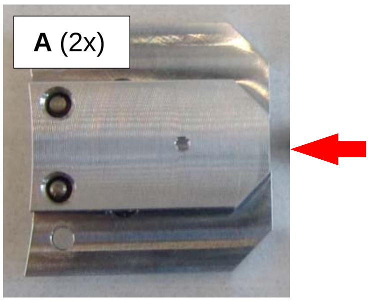



**Due to the influence of the gravitational force it became necessary to use two different ceramic insulator sets (A, B).**

The ceramic insulator sets must be placed to there dedicated position (A, B). The picture beside shows the respective position at the source.

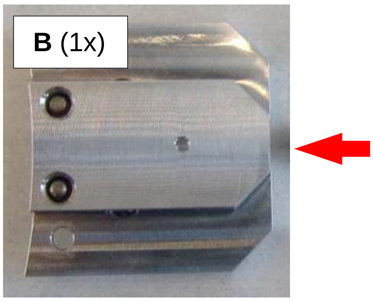



**Set A:** (The flexibility of the ceramic pin is limited to 1.6mm.)

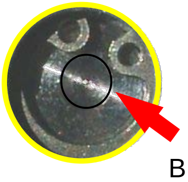



Ceramic insulator set spring-loaded 1.6
BB 534 249-T

**Set B:** (The flexibility of the ceramic pin is limited to 0.6mm.)




Ceramic insulator set spring-loaded 0.6
BB 534 248-T



Blind hole

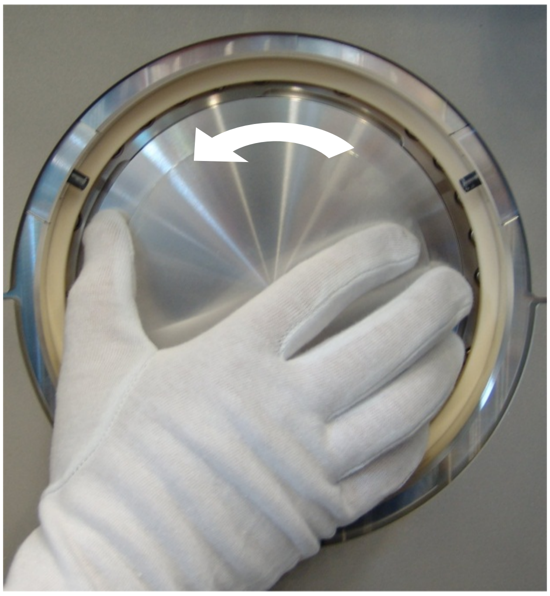
### 5.2.2 Exchanging / Checking Targets

⇨ Refer to the information displayed in software screens for target selection information.

**Oerlikon Balzers strongly recommends that if a target is removed for an extended time a used target is installed to protect the cooling plate.**

| | ⚠ CAUTION |
|---|---|
| | **Danger of damaging the cooling plate!**<br>■ **Never try to pump or switch on the water without targets.** |

**Ensure the water is off ("Popup - Operator – Miscellaneous"; Process Water "Off").**



1. Use clean gloves to turn the target counter clockwise and remove the target.
2. Carefully vacuum clean the bayonet fitting of the cooling plate.

**Used targets that are contaminated by another target material during the process or new targets must be cleaned by means of a free arcing process (contained in the wizards).**

**For all different target materials a free arcing process is available.**

3. Weigh each target.

**The weight classes for the target ages are defined in the respective "INGENIA P3e™ Wizards". If the target weight is lower than the minimum, waste the target.**

4. Replace each target (turn it fully clockwise).

**All targets of the same material must be in the same weight group.**

**The targets with the lowest weight must be placed always on source position 6 and 3.**

**Use the feed through cover in place of the carousel when free arcing.**

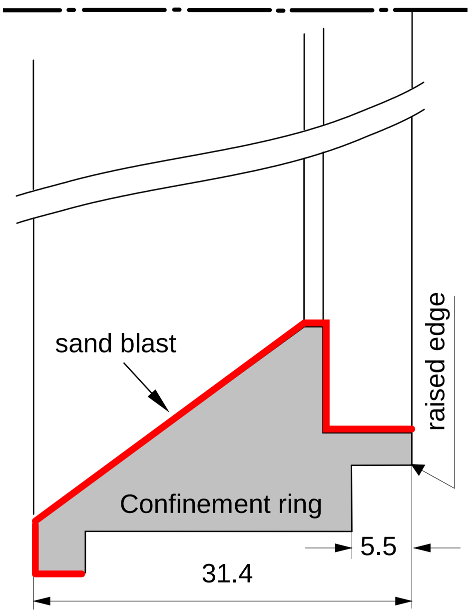
### 5.2.3 Confinement Rings Sources 1 to 6

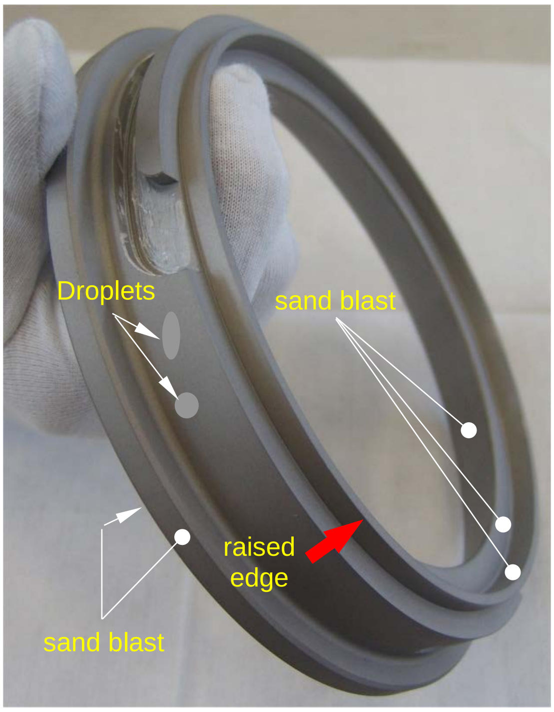
1. Check confinement rings for maximum wear.

   New confinement rings have a width of **31.4mm** (incl. the raised edge). The minimum width for a used confinement ring is **29.4mm**. If the raised edge becomes smaller or even removed by sand blasting, the confinement ring must be replaced with a new one.

2. Check confinement rings for (metallic) droplets and broken areas.

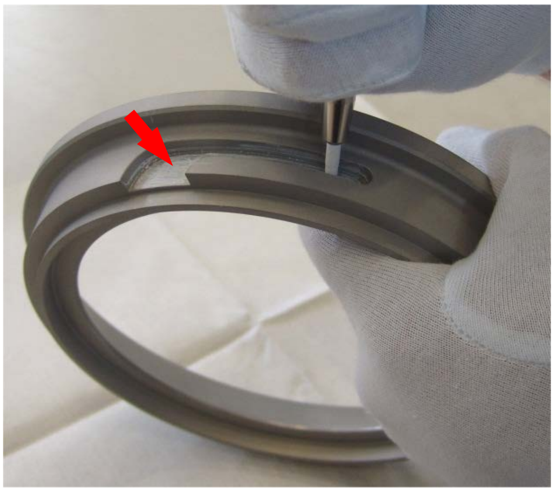
   Droplets must be removed by means of a grinder. If there are visible broken areas, the confinement ring must be replaced with a new one.




3. **New or sand blasted rings:**
   Treat the three grooves with the Bornitride rod where the ceramic insulators make contact with the confinement ring.

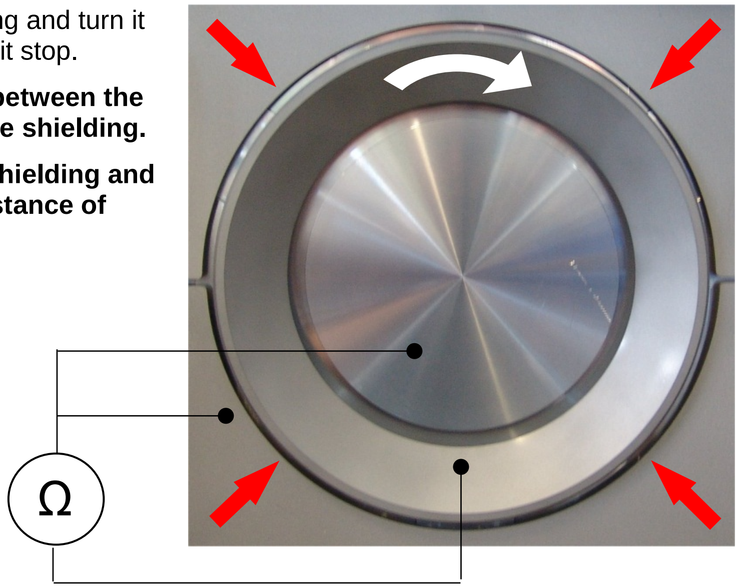
**Press down firmly the lead holder (K4300105) containing the special Bornitride rod (BB525029) to achieve a good adhesion on the confinement ring.**



4. Mount the confinement ring and turn it (clockwise) until to the limit stop.

**Visually check the gap between the confinement ring and the shielding.**

**Between target and/or shielding and confinement ring a resistance of >100 kΩ is permissible.**




### 5.2.4 Resistance Check of the Shielding in the Process Chamber

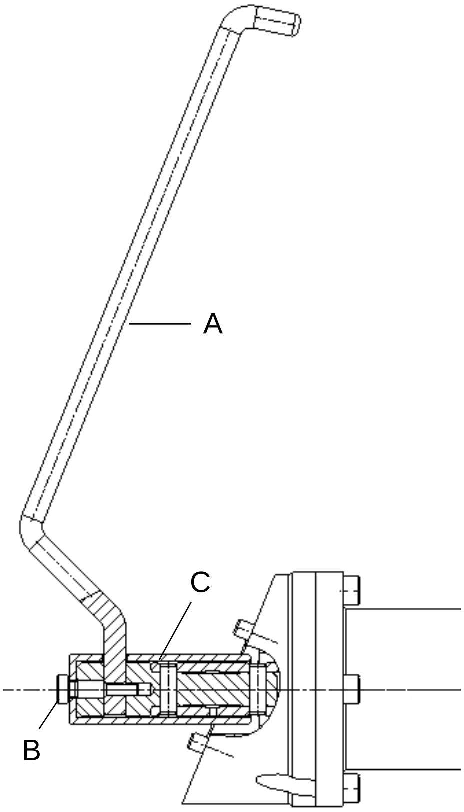
1. Open the process chamber and check (with Ohm meter) the resistance of the shielding within a distance of approx. 1cm.

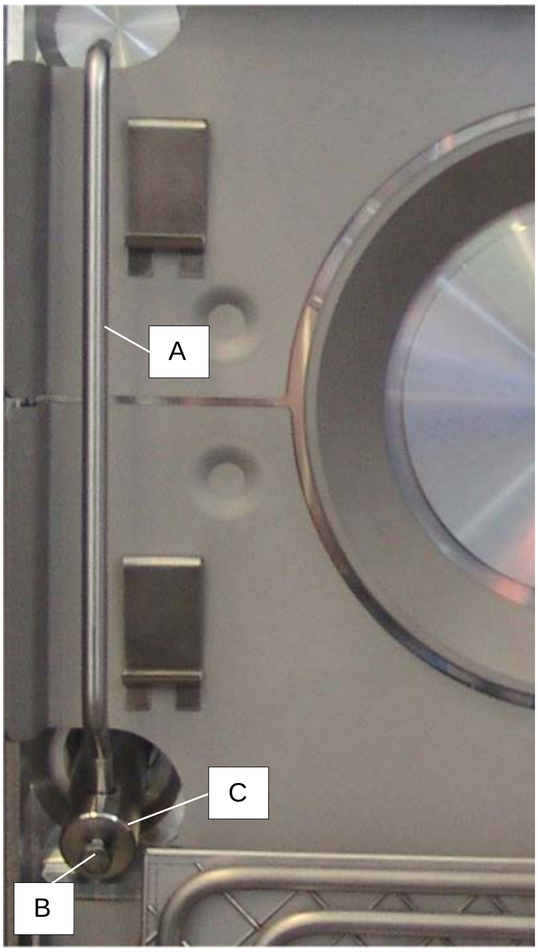
**If the resistance of the shielding is higher than 250Ω replace the shielding with a sandblasted or new one.**

### 5.2.5 Trigger Finger Assembly

(if required)

1. Remove the trigger finger assembly (A) incl. sleeve (C) by unscrewing the hexagon screw (B).




2. Sand blast the trigger finger (A) and the sleeve (C).
3. Clean the trigger finger (A) and the sleeve (C) with Isopropanol.
4. Clean the hexagon screw (B) with Isopropanol and treat it with a mixture of graphite powder and Isopropanol.
5. Reassemble the trigger finger assembly.

#### 5.2.5.1 Testing the Trigger Finger

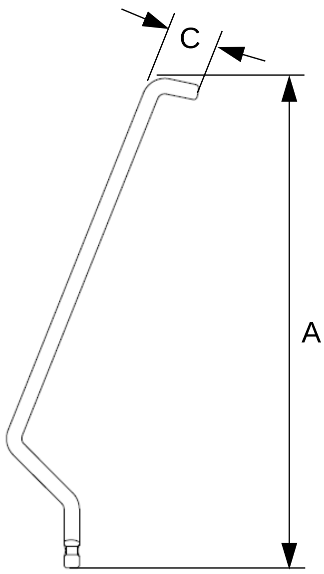
1. Move the trigger finger carefully towards the target (manually) and check if the trigger finger does not touch the shielding or part of the arc source (except the target surface).

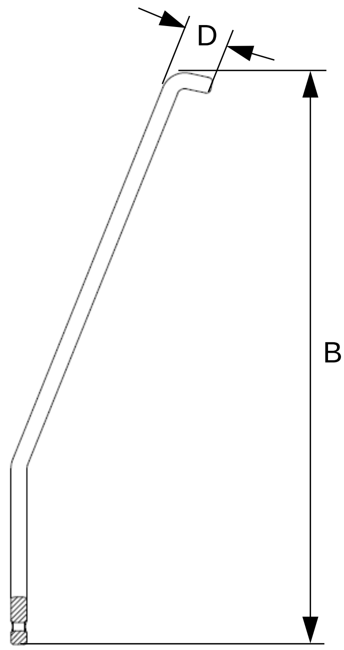
**If the trigger finger touches any parts (shielding, confinement ring etc.) except the target surface, the trigger finger must be bended or replaced with a new one.**

### 5.2.5.2 Dimension, Location and Wear of the Trigger Finger

Pay attention to the different length of the trigger finger.

| | | | | |
|---|---|---|---|---|
| | **Location:** | Process chamber door / rear process chamber wall | **Location:** | Left process chamber wall / right process chamber wall |
| | **Source position:** | 3; 6 | **Source position:** | 1; 2; 4; 5 |
| | **Mounting position:** | vertical | **Mounting position:** | horizontal |
| | **Parts No.:** | BB534258 | **Parts No.:** | BB534227 |
| | **Length (A):** | 254.5 mm | **Length (B):** | 288.6 mm |
| | **Length (C):** | 28 mm | **Length (D):** | 24 mm |




**Due to wear the trigger finger length (C, D) is shortened after a certain time.**

**If the trigger finger length (C) is shorter than 25 mm, the trigger finger must be replaced with a new one.**

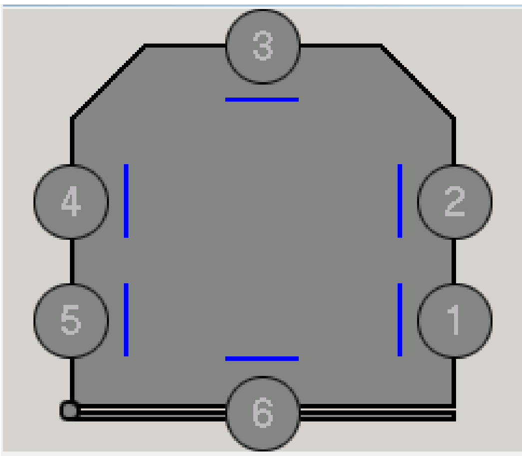
**If the trigger finger length (D) is shorter than 21 mm the trigger finger must be replaced with a new one.**

### 5.2.6 Shutter Installation (Optional)

Depending on the process the shutters for the sources 1 to 6 must be installed.

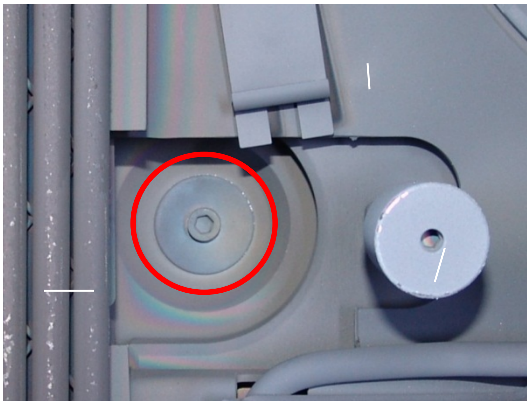
**Overview of the locations where the shutters must be installed.**

Source 6:
(process chamber door)
Sources 4 & 5:
(process chamber, left side)
Source 3:
(process chamber, back side)
Sources 1 & 2:
(process chamber, right side)




**Ensure all shutters are switched to "Close" position (Operator visualization – System/Manual/Ops - Close).**

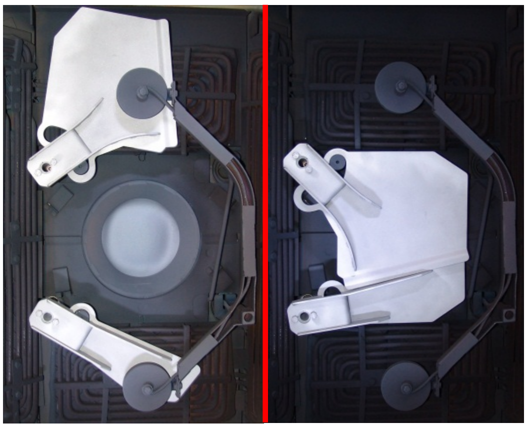
1. Remove the (upper/lower) coating protections for the shutter connections of the source 6 (process chamber door) and store them on a safe place.



2. Mount the lower ...

3. …and the upper shutter.

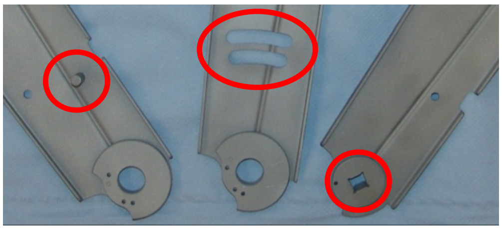
4. Check the open and closed position.

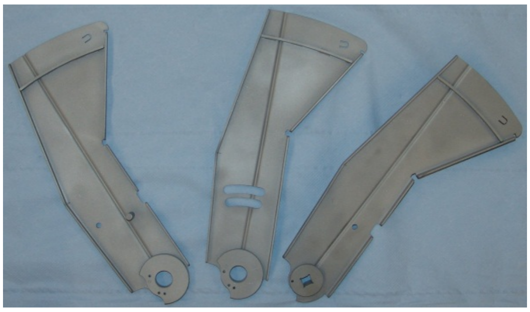


5. Remove the (upper/lower) coating protections for the shutter connections of the sources 4 & 5 (process chamber, left side) and store them on a safe place.

6. Insert a copper sleeve into the shutter connections.

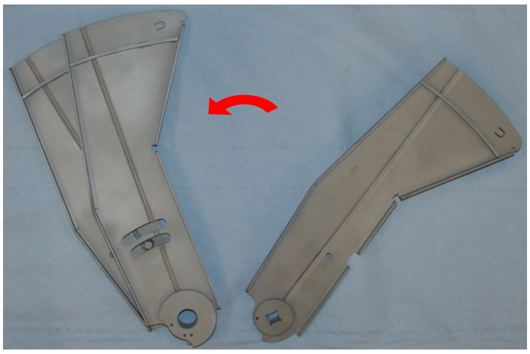
7. Lay the "U" (upper) shutter plates in correct order…





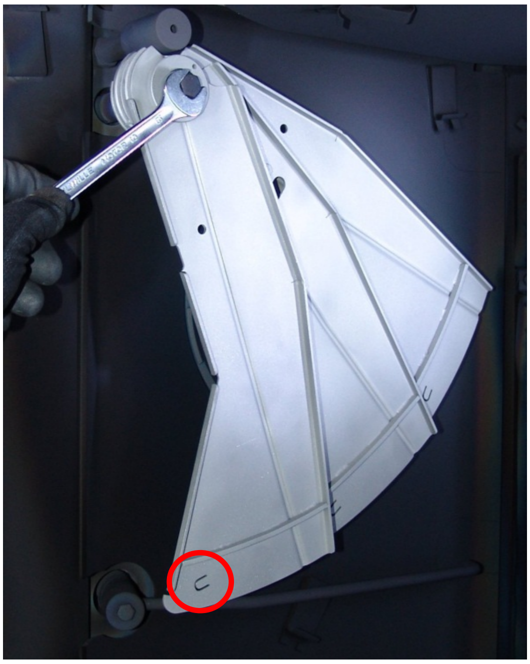
8. …and stack one by one as shown in the picture beside.

**Note the different distinctive features.**

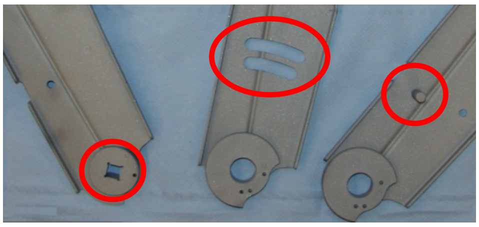


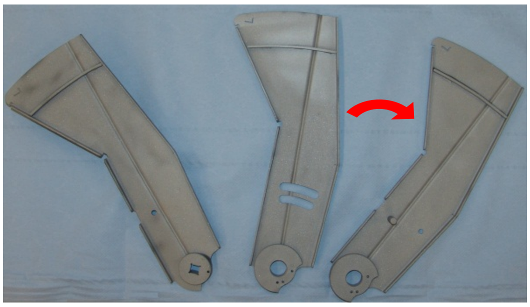
**All “U” (upper) shutter plates stacked.**

9. Mount the “U” (upper) shutter plates.



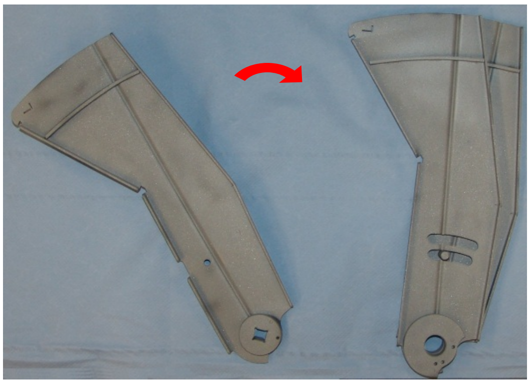
10. Lay the “L” (lower) shutter plates in correct order…



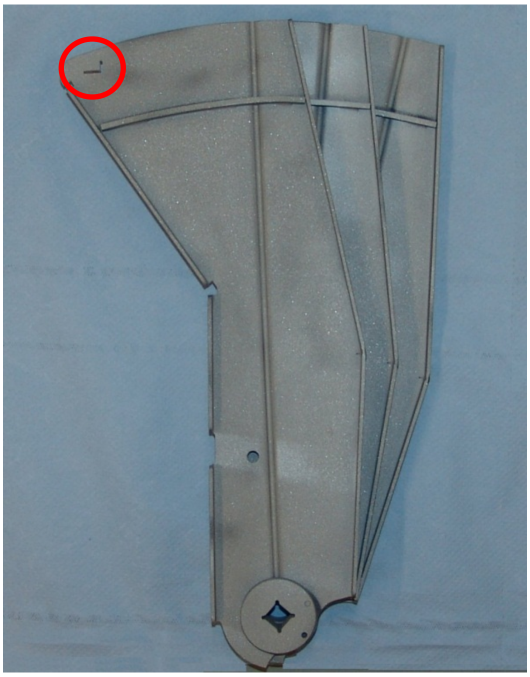


11. …and stack one by one as shown in the picture beside.

**Note the different distinctive features.**

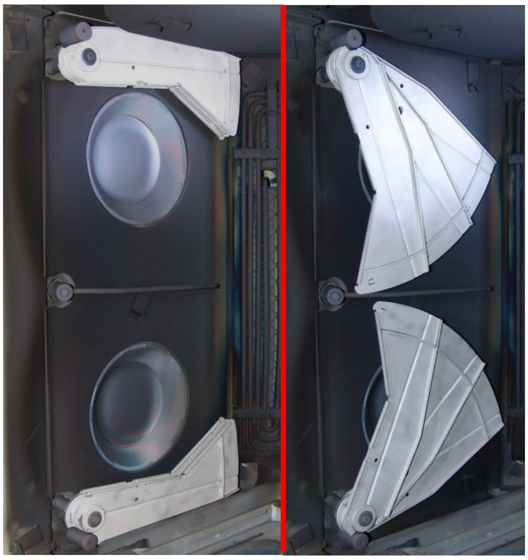


**All “L” (lower) shutter plates stacked.**



12. Mount the “L” (lower) shutter plates.

13. Check the open and closed position.



**Continue with the shutter plates for source 3 (same installation as source 6) and for sources 1 & 2 (same installation as sources 4 & 5).**

14. Close the process chamber and open all shutters via the visualization.
15. Open the process chamber and check the resistance >250 kΩ (with Ohm meter) between shutters and shielding for each source.

**In case of a lower resistance inform the service technician (⇨ Refer to chapter 7).**


16. Close the process chamber and close all shutters via the visualization.
18. Open the process chamber and check the resistance >250 kΩ (with Ohm meter) between shutters and shielding for each source.

**In case of a lower resistance inform the service technician (⇨ Refer to chapter 7).**

## 5.3 Batch Preparation

### 5.3.1 Loading the Carousel Spindles

**Ensure that the fixtures are clean (dust free) before using.**

**In all cases, tools with the larger diameter must be placed in the upper level or in the middle (for 3 or 4 level loading). Small tools on lower levels.**

**⚠ CAUTION**

**Danger of slight injuries, or damage to equipment due to tipping carousel spindles!**

- **Never move the carousel exchanging system (incl. fully loaded carousel) without prior installed top securing ring.**

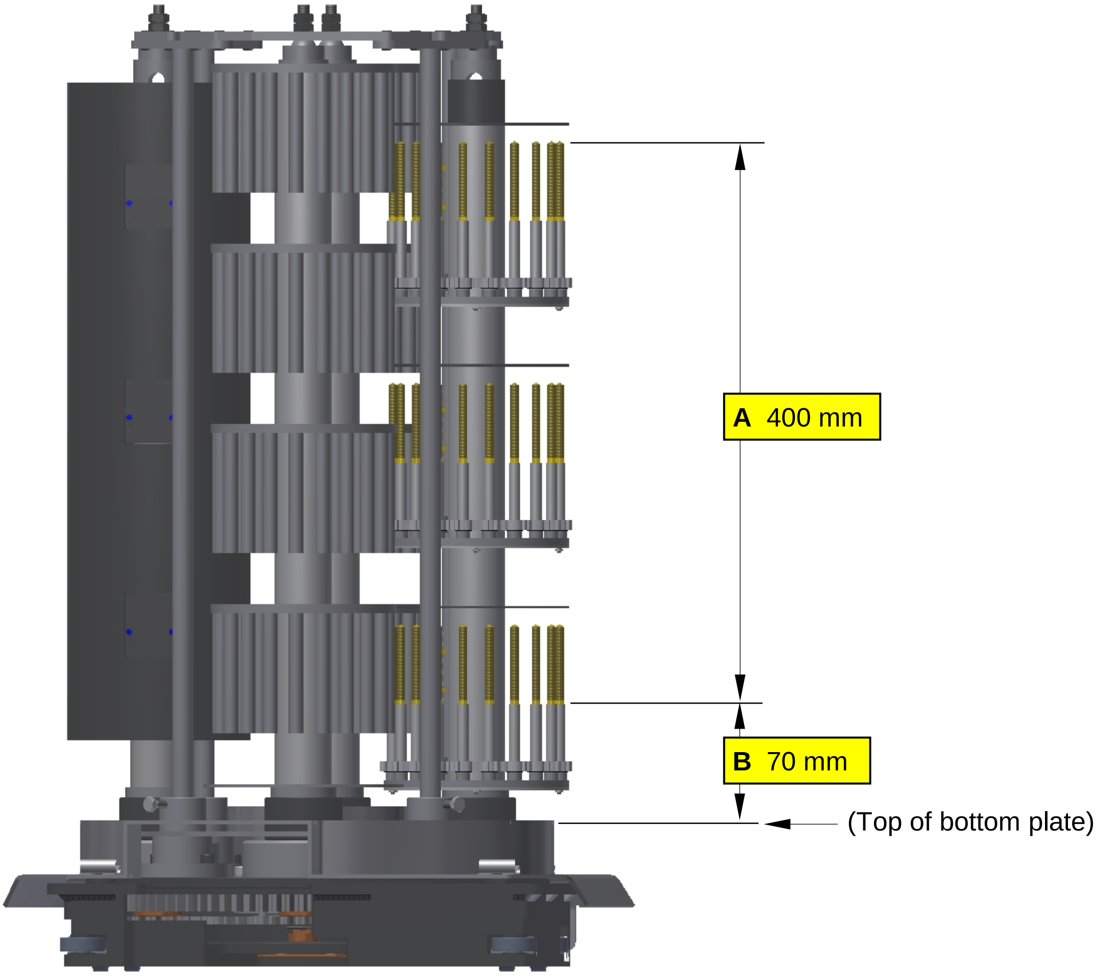
**The spindles must be loaded with the carousel placed on the carousel exchanging system.**

**⚠ CAUTION**

**Danger of poor coating quality!**

- **When working with parts which will be exposed to vacuum, clean gloves must be used.**

### 5.3.1.1 Usable Coating Height




| Position: | Size (mm): | Remark: |
|---|---|---|
| **A** | 400 | Coating surface with defined coating thickness. |
| **B** | 70 | Coating thickness not defined (fixturing / masking zone). |

**⇨ Refer also to the wizard description.**

**The coating thickness is dependent on the type of tool, type of fixture, double/triple rotation, uniform / mixed batches, and loading density.**

#### 5.3.1.2 Loading Capacity - Dimensions, Weights of Substrates

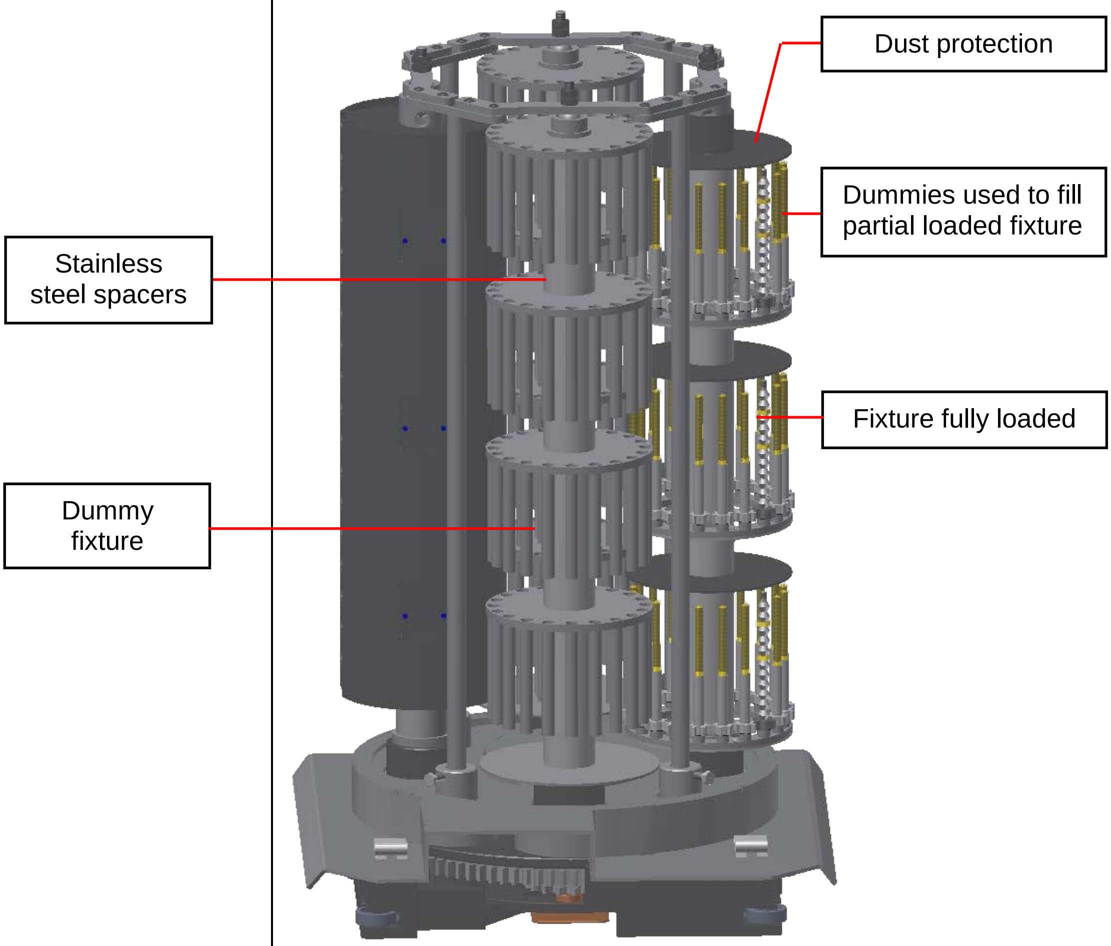
**4 Spindle carousel:**

| | |
|---|---|
| Maximum weight of the batch (loaded carousel) | 200 kg (e.g. 4 x 50kg) |
| Maximum bearing load (per spindle) | 50 kg |
| Maximum spindle ∅ | 135 mm |
| Maximum loading height | 400 mm |
| Maximum coating range measured from top of the collar of the bottom plate. | 70 mm – 470 mm |

**Maximum weight of one spindle is limited to 50 kg. A complete batch is limited to 200 kg ! Take care for a balanced load.**

**The loaded spindle (coating height) can be coated either in the INGENIA P3e™, RCS or INNOVA coating system.**

### 5.3.1.3 Rules for Spindle Loading

| | |
|---|---|
| *Partially loading* | If the carousel is only partially loaded with substrates to be coated, the carousel has to be loaded with dummies.   |
| *Shank type substrates* | Shank type substrates must be loaded with neighboring substrates. If there are no neighboring substrates, dummies made of general purpose steel (AISI 1009 or similar) must be used. |
| *Symmetrical loading* | The magnetic field, and therefore the arc stability, is influenced by the substrates and their position in the process chamber. Consideration should be given to evenly loading the carousel in regards to weight distribution. For this reason, symmetrically loading is recommended. |

### 5.3.1.4 Correct Heating / Overheating

**If possible each level should be loaded by substrates of similar size.**

**Small HSS tools should be loaded on the lower levels.**

**A cover plate (disc) should be placed above the top of the highest tools. This helps to prevent overheating and the deposition of dust. (Recommended distance from the top of the highest tools to the cover plate is calculated by the substrate diameter (x 1.5) – (x 2).**

**Carousels and planetary fixtures must be fully loaded, if necessary by loading additional dummies.**

### 5.3.1.5 Mounting the Flickers and Checking the Substrate Rotation

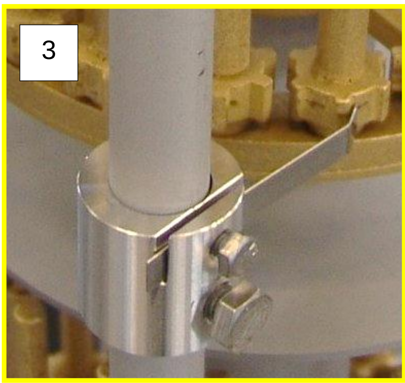
**⚠ CAUTION**

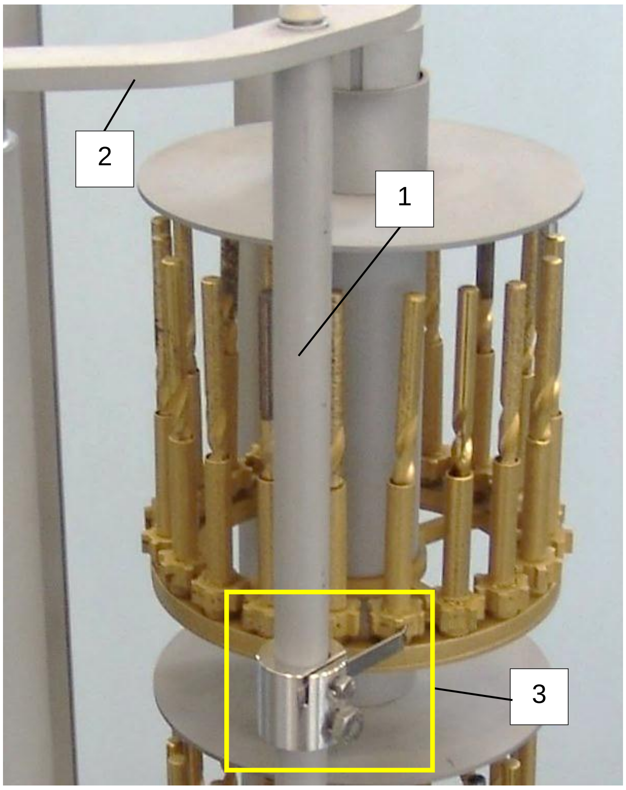
**Danger of crushing your fingers in the cogwheel mechanism!**

- **Be careful when rotating the carousel.**
- **Rotate only by pushing the carousel above the base plate.**

**Mounting the flickers:**

1. Mount the flickers (3) onto the flicker rods.
2. Attach and secure the flicker rods (1).
3. Mount the top securing ring (2).
4. Adjust the flickers (3).



**Checking the substrate rotation:**

The substrate rotation can be checked manually (by hand) or automatically.

**Manual rotation:**

If the carousel is placed e.g. on the carousel exchanging system, the substrate rotation can be checked by hand.

Pushing the carousel in the “counter clockwise direction” rotates the carousel on its central axis. Substrate holders arranged as "planets" rotate additionally on their own axis.

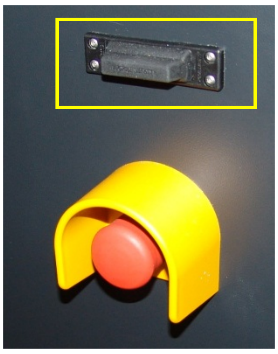
**Automatic rotation:**

The substrate rotation can also be checked with the carousel placed in the INGENIA P3e™ coating system (open process chamber door).

Clicking the button “Manual” in the “System Screen – Miscellaneous” enables the automatic substrate rotation for approx. 2 minutes.

Within this time the operator can push the “Release Manual Rotation” button in order to rotate the carousel in a low speed.

**This button is located at the front right side of the coating system.**



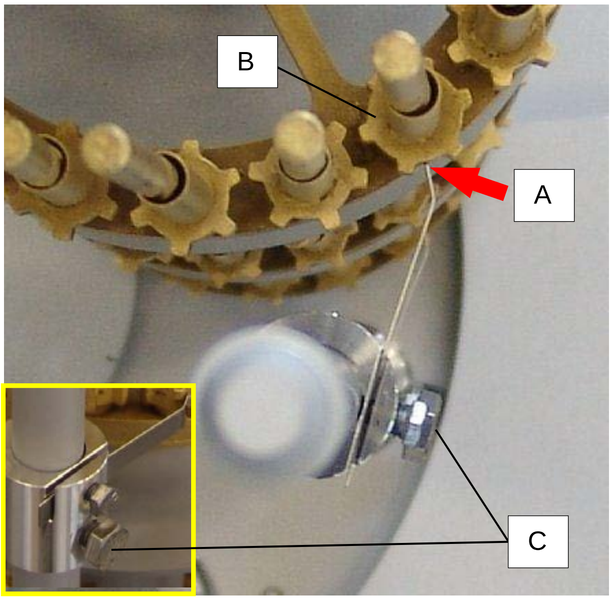
### 5.3.1.6 Adjustment of the Flickers

The flickers must be adjusted with the carousel mounted on the “Carousel Exchanging System”.

**Substrate holders arranged as ”planets” rotate on their own axis. Additional rotation is effected by a flicker attached to a flicker post which can be adjusted to the height of the individual level. Adjustment and operation of the flickers has to be checked carefully. Exchange damaged flickers.**

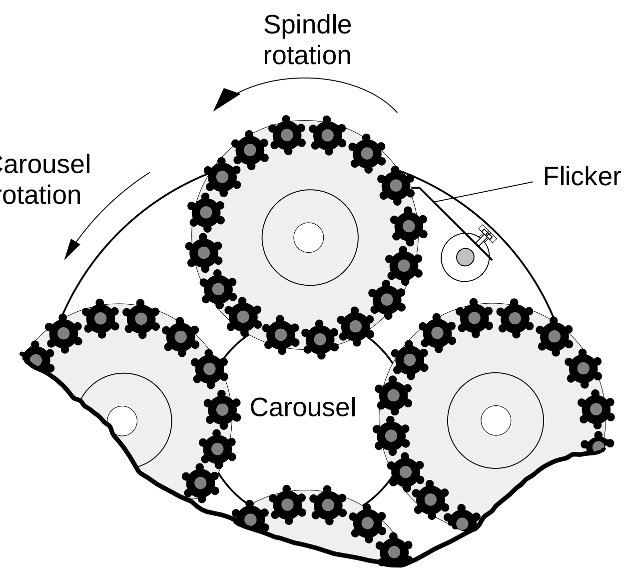
1. Adjust each flicker (A), so that it is in soft contact with the cogwheel (B) of the fixture, by tightening screw (C).
2. Rotate the carousel several times and ensure all flicker functions correctly.

**The flicker should only turn the cogwheel.**




**If the spring pressure of the flicker is too strong this will cause the cogwheel to spin or to break the flicker or can lead to arcing during a process.**

**Spindles on the carousel rotate anti clockwise. Ensure the flickers are mounted as shown. Otherwise the flickers will be damaged.**



### 5.3.2 Loading the System

**⚠ CAUTION**

**Danger of crushing!**

- **Be careful when closing the process chamber door. Due to its weight it may cause injury.**
- **Open and close the process chamber door only by means of the process chamber door grip.**

**Beware of material flaking-off in the process chamber!**

- **Wearing of eye protectors obligatory when working with open process chambers and in the coating room.**

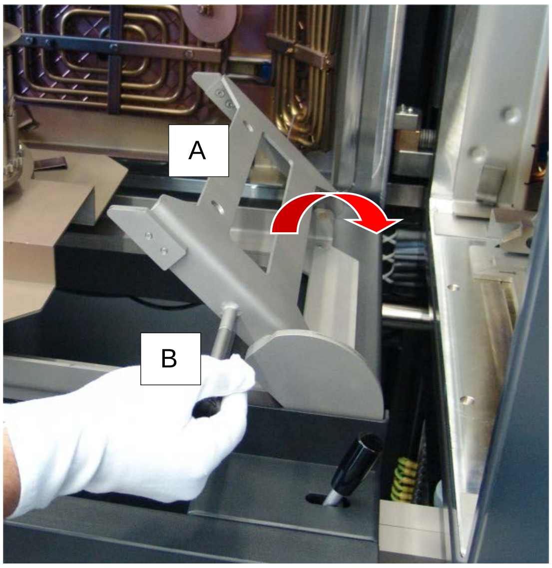
**Danger of poor coating quality!**

- **When working with parts which will be exposed to vacuum, clean gloves must be used.**

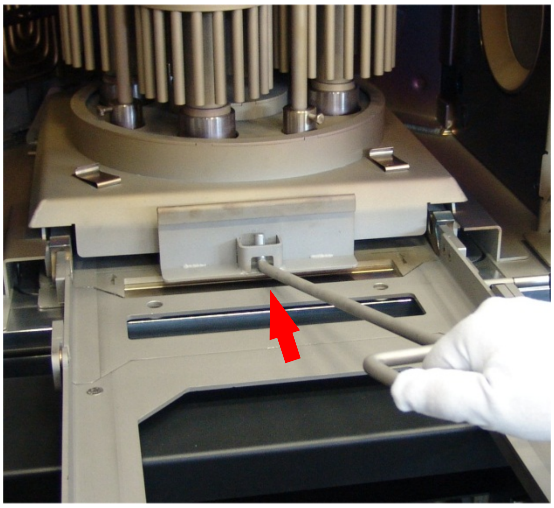
1. Vent and open the process chamber.
2. Push the carousel exchanging system slowly into the process chamber until it is mechanically engaged and therefore secured (in position).

3. Lower the bridge (A) of the carousel exchanging system towards the process chamber by means of the lever (B).

**Ensure the carousel exchanging system is in correct position and therefore the bridge is unlocked.**

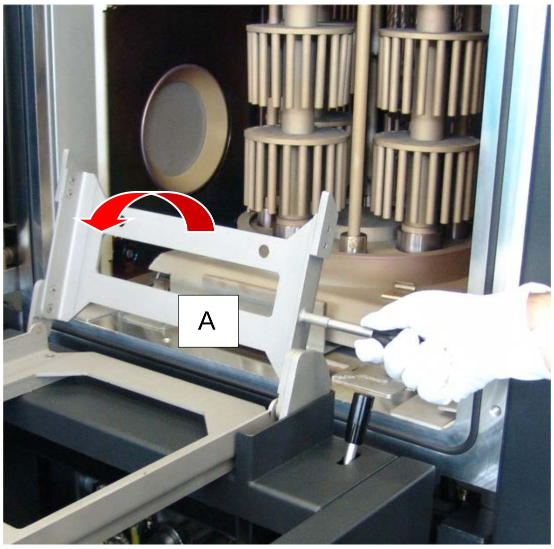



4. Push in the carousel by means of a special hook (located on the carousel exchanging system) until to the stop.

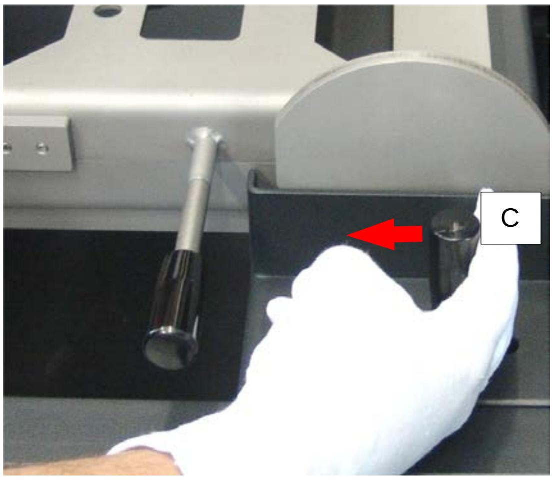


5. Lift the bridge.

**The carousel is automatically secured by two retaining clamps after removing the bridge.**



6. Unlock the carousel exchanging system by means of the lever (C) and pull it slowly out of the process chamber.




7. Clean and check the O-ring and the process chamber door sealing surface with alcohol and close the process chamber door.

### 5.3.3 Preparing the Next Batch

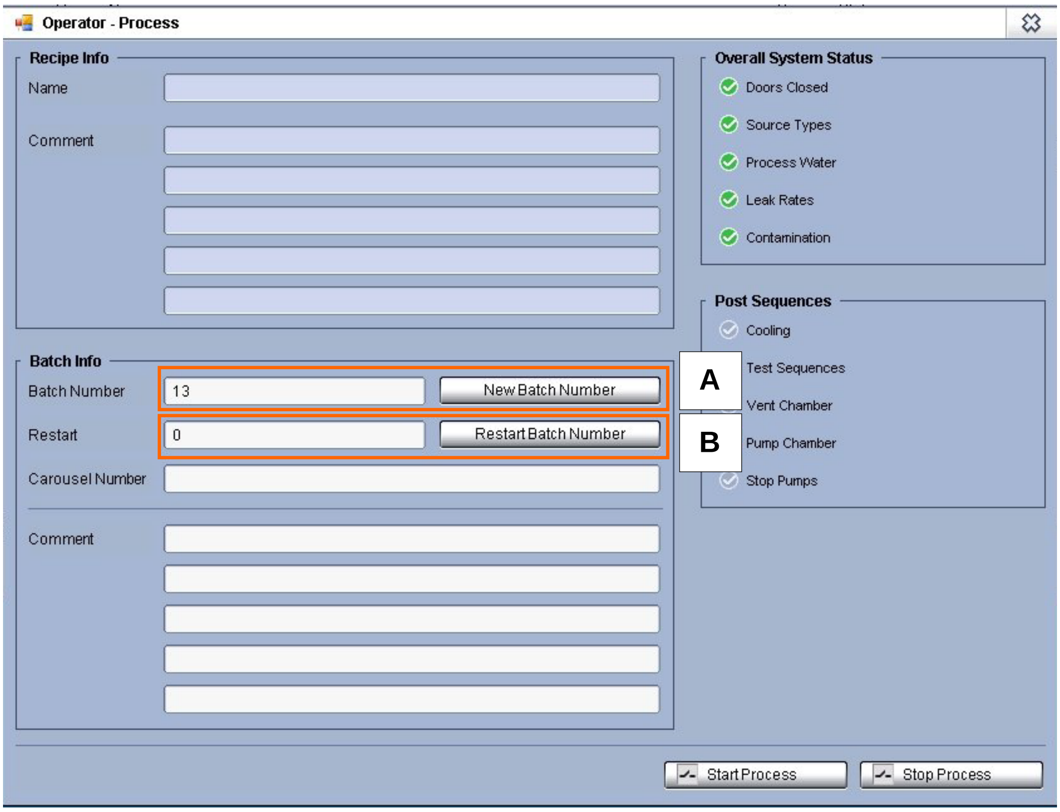
**Ensure the maintenance of optional hardware has been performed. ⇨ Refer to the option manuals.**

1. Clean the O-ring and sealing surface of the process chamber door.
2. Close the process chamber door.

## 5.4 Starting a Batch

### 5.4.1 Creating a “New Batch Number” and/or “Restart Batch Number”

1. Click on “Start Process” (in the icon bar). The “Popup - Operator - Process” screen opens.




2. Click on “New Batch Number” (A) in order to increase the (existing) batch number by one and selecting a new process (recipe). ➩ Refer to next page.

3. If a previous process has been interrupted and a restart is desired, then click on “Restart Batch Number” (B) in order to increase the (existing) restart number by one and starting the process.

**If “Restart Batch Number” (B) was selected, the information concerning the recipe remains available.**

**Prior to start a new process after a completed batch (without any errors) it must be clicked on “New Batch Number” (A).**

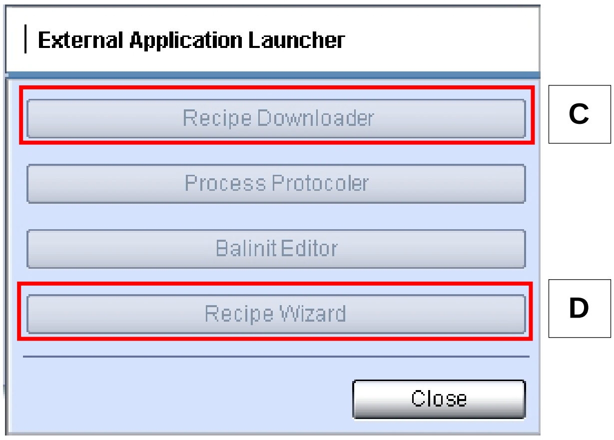
**If “New Batch Number” (A) was selected, the information concerning the recipe is deleted and a new recipe must be loaded prior to start the next process.**

### 5.4.2 Selecting a Process

1. Click on "Recipe" (in the icon bar) in order to open the "External Applications Launcher".

2. Click on "Recipe Downloader" (C) in order to start the "Recipe Downloader" program (⇨ refer to next page).

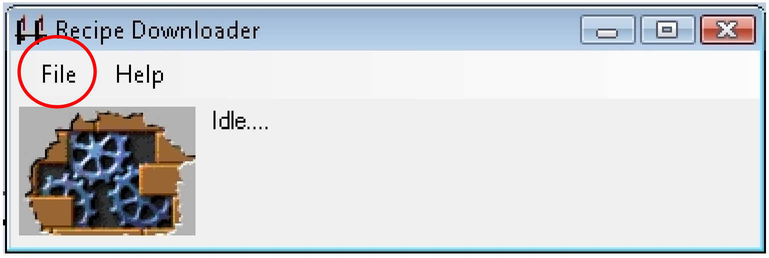
**Currently the "Recipe Downloader" is started directly via the desktop icon in the MS Windows.**



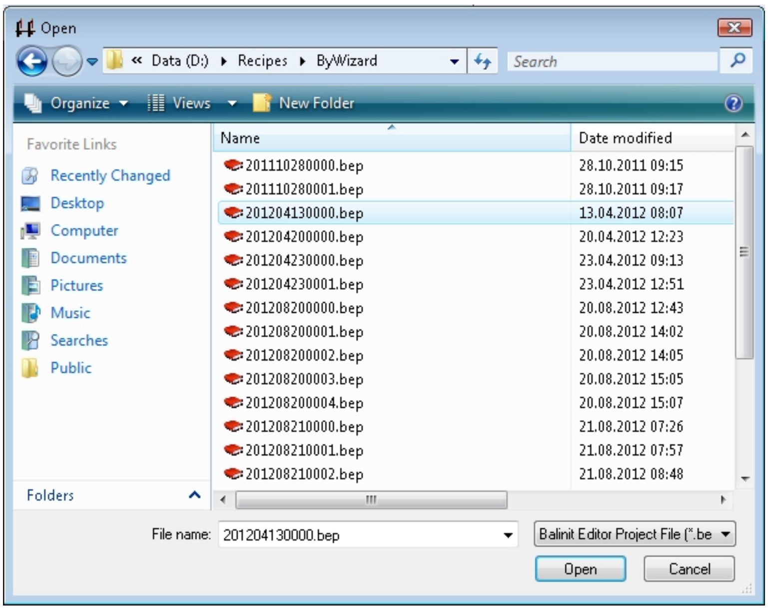

| | |
|---|---|
| **Recipes Downloader (C)** | Select a customized / special recipe. |
| **Recipe Wizard (D)** | Select a recipe wizard<br>(e.g. BALINIT A, FUTURA…)<br>(⇨ refer to "Users Manual INGENIA P3e™ Wizards"). |

#### 5.4.2.1 Recipes Downloader

1. Click on “**File**” in the “Recipe Downloader” and select “Send File”.

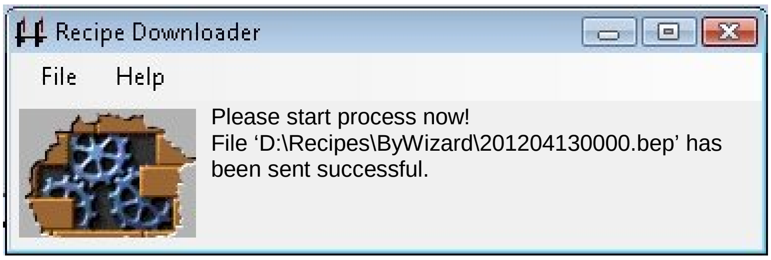



**A new window “Select Binary Recipe Data File” will be opened.**




2. Select the desired recipe and click “Open” button.

**The recipe will be sent to the PLC.**




3. Click on (“**X**”) in the “Recipe Downloader” screen to return to the visualization.

### 5.4.2.2 Recipes Wizard

For the correct use of the recipes wizard ⇨ refer to Users Manual “INGENIA P3e™ & INNOVA Wizards” BD 802 238 BE.

### 5.4.3 Starting the Selected Process

**If the INGENIA P3e™ coating system is prepared (targets, recipe or wizard loaded, batch to batch maintenance etc.) and the "Overall System Status" is reached ("Popup - Operator - Process") the process can be started.**

A click on "Start Process" (in the icon bar) opens the "Popup - Operator - Process" screen. When clicking "Start Process" a popup appears ("**Do you really want to start the process?**"). By clicking "YES" the process starts.

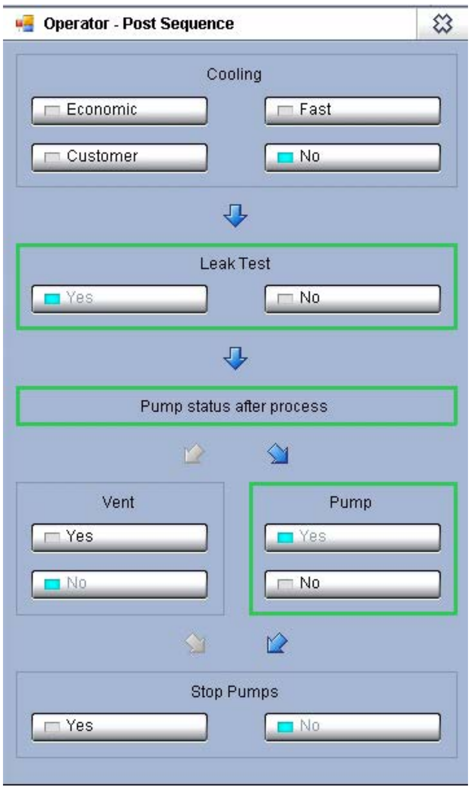
#### 5.4.3.1 Post Process Options

"Post Sequence" activities such as "Cooling", "Leak Test", etc. can be selected by the operator.

Click the box "Post Sequences" in the "Popup - Operator - Process" screen.

**The "Operator – Post Sequence" screen will be opened.**

In this screen the operator can program the following steps for the machine when the coating sequence has been finished:



| | | |
|---|---|---|
| 1. | **Cooling-Sequences:** | Select between 4 programmed Cooling-Sequences: Economic, Fast, Customer, No (no cooling).<br>**Values can be defined in the "Popup – Configuration – Cooling Sequences" screen.** |
| 2. | **Leak Test-Sequence:** | “Yes” or “No” can be selected. |

**If the leak rate test has not been performed within 7 days, a lake rate test is recommended prior to start the next batch.**

**If the automatic leak test failed, the service engineer has to be informed.**

| | | |
|---|---|---|
| 3. | **Vent-Sequence:** | Process chamber will be vented automatically, provided that the leak rate is o.k. Otherwise the process chamber remains under vacuum in order to perform leak detection. |
| 4. | **Pump-Sequence:** | System will automatically pump down (e.g. over night). |
| 5. | **Stop Pumps:** | System will automatically shut down the pumping units (e.g. over weekend). |

**The post process selections will be stored for the following processes.**

### 5.4.4 Process Interruptions

#### 5.4.4.1 Error Messages

In general there are two types of error messages:

| | |
|---|---|
| **Information messages:** | Example: Venting completed or leak rate too high etc. |
| **Process interruptions:** | The operator has to inform the service engineer or production manager. |

The operator can only cancel the **audible alarm** by clicking the alarm icon at the top of the screen.

For more information ⇨ refer to chapter 8.1 “Error Messages”.

#### 5.4.4.2 Emergency-off

The emergency-off should be used in the event of life threatening situation or if a severe malfunction of the system has occurred.

**If the emergency-off button (located on the left of the operator panel) is pressed, the complete system is shut down.**

**In the event that the emergency-off button was pressed the Service Engineer or Production Manager must be informed. He will make a decision how to proceed.**

**After activation, the emergency-off button remains in a “pressed-in” position and must be pulled back prior.**
**After pulled back of the emergency-off button, the safety PLC has to be released with the acknowledge button in the visualization.**

#### 5.4.4.3 Manual Stop of the Process

A click on “Stop” (in the icon bar) opens a warning popup (“**Do you really want to stop the process ?**”). When clicking “Yes” the process will stop immediately.

**In the event that “Yes” has been clicked, the service engineer or production manager must be informed.**

## 5.5 Finishing a Batch

### 5.5.1 Opening and Unloading the System

**⚠ CAUTION**

**Danger of crushing!**

- **Be careful when closing the process chamber door. Due to its weight it may cause injury.**
- **Open and close the process chamber door only by means of the process chamber door grip.**

**Danger of burns due to hot components!**

- **There is a danger of burns when touching carousel and substrates during unloading.**
- **Wear heat resistant gloves and protective clothing with long sleeves.**

**Beware of material flaking-off in the process chamber During coating, the carousels and the shielding are coated!**

- **Wearing of eye protectors obligatory when working with open chambers and in the coating room.**

The last step of the automatic process is the automatic or manual venting of the process chamber.

**⚠ CAUTION**

**Risk of damaging coated tools!**

- **Never vent the process chamber at substrate temperature higher than 200 °C**

1. Vent the process chamber if it is not done automatically according the process steps.
2. Wait until the PCG 550 (“Overview Screen – Pump and Gas System”) is stabilized at atmospheric pressure (chamber vented).
3. Fully open the process chamber door.

**If the process chamber door sticks firmly during opening, the O-ring of the process chamber (door seal) must be slightly greased with Apiezon.**

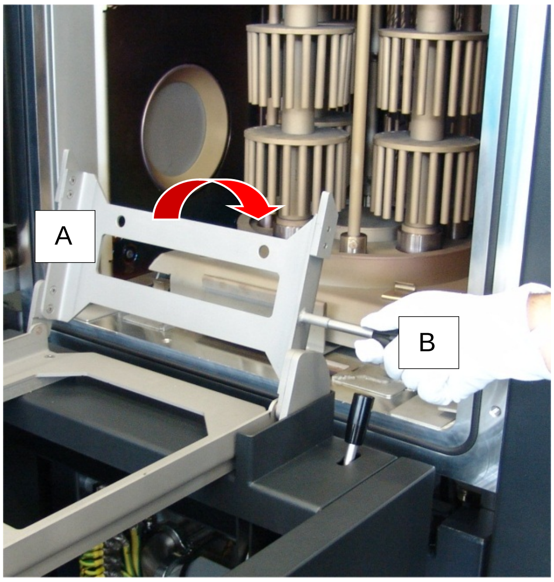
**Take care of the sealing surface (process chamber door).**

4. Push the carousel exchanging system slowly into the process chamber until it is mechanically engaged and therefore secured (in position).

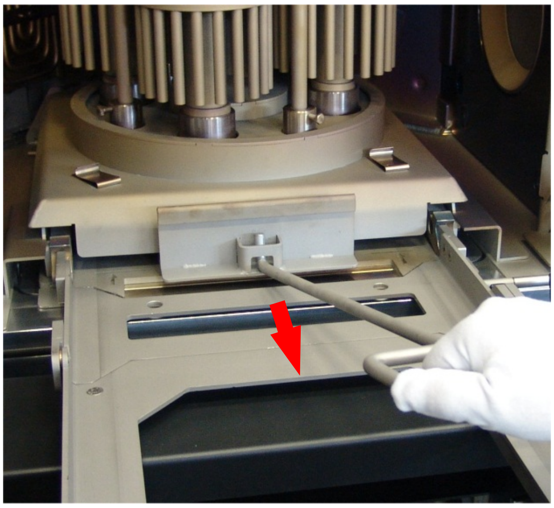
**Pay attention to the locking device.**

5. Lower the bridge (A) of the carousel exchanging system towards the process chamber by means of the lever (B).

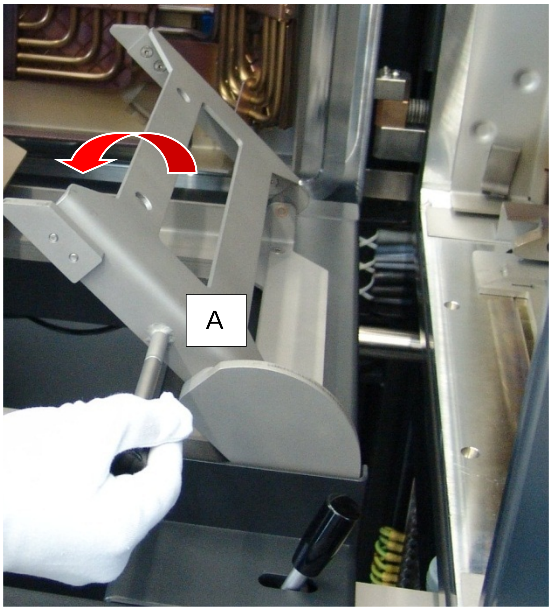
**Ensure the carousel exchanging system is in correct position and therefore the bridge is unlocked.**




6. Pull out the carousel by means of a special hook (located on the carousel exchanging system).

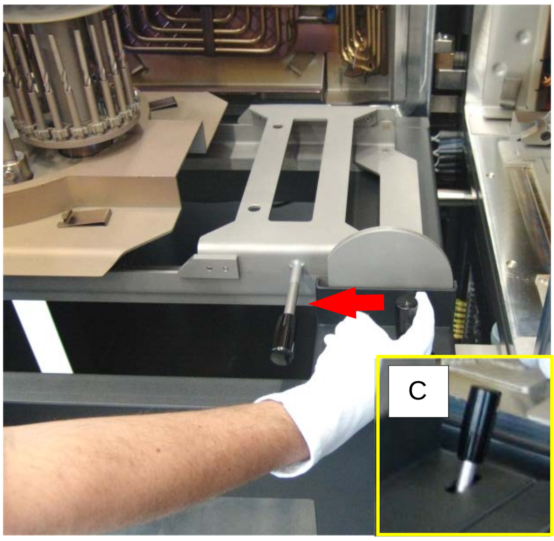


7. Lift the bridge (A) of the carousel exchanging system.




**The bridge is automatically securing the carousel on the carousel exchanging system**.

8. Unlock the carousel exchanging system by means of the lever (C) and pull it slowly out of the process chamber.




9. Vacuum clean all residual dust inside the process chamber, clean and check the O-ring and the process chamber door sealing surface with alcohol and close the process chamber door.

10. Move the carousel exchanging system to the loading/unloading site.

11. Step on the two parking brakes.

12. Check the rotation of the spindles and flicker function by turning (counterclockwise direction) the carousel manually.

**All substrates that did not correctly rotate and / or have color, flaking problems must be removed and Quality Control informed.**

13. Thoroughly vacuum clean all residual dust from the carousel and prepare the carousel in accordance with the operating Instructions.

### 5.5.2 Batch Counting Carousel

Due to the use of different carousels the coating system does not count the number of batches (for each carousel) automatically. Therefore the operator must count the sum of batches per carousel manually in order to perform the cleaning according the scheduler.

**Definition of batch counting:**

| Batch condition (3-way rotation) | Counted as (…) batches |
|---|---|
| Aborted batch (< 2µm) | = 0 |
| Every successful or aborted batch (< 6µm) | = 1 |
| Every successful or aborted batch (> 6µm) | $= \frac{\text{Coating Thickness } (\mu m)}{4}$ |

## 5.6 Longer Production Stop

**The gas supply must be closed (isolated from the coating system) if the system has been shut down for a longer production stop (such as service, weekend, etc.) >1 day !**
**It is the service engineer's responsibility to close the gas supply. Therefore inform the service engineer for closing the gas supply.**

# 6 Leak Test

**Manufacturer**

Oerlikon Balzers Coating AG
LI-9496 Balzers
Phone 00423 / 388 4111
Fax 00423 / 388 5419
info.balzers@oerlikon.com

**After sales service**

Oerlikon Balzers Coating AG
LI-9496 Balzers
Phone 00423 / 388 / 4816
Fax 00423 / 388 / 6676
aftersales.balzers@oerlikon.com

**Please read and retain this manual to assist you in the operation and maintenance of this product. This manual is an integral part of the machine. In the event of a change of ownership, hand this manual over to the new owner.**

# Contents

## 6.1 Leak Detection

A leak can be detected by

- using a Helium leak detector;
- analyzing the composition of the residual gases in the process chamber using a quadrupole mass spectrometer.

### 6.1.1 Automatic Calculation of the Leak Rate

During the leak test sequence the control software determines the leak rates by measuring the increase of the pressure using the CDG 100 D.

**Abbreviations:**

**LR** Leak rate [mbar l/s]

**$P_1$** Pressure at the beginning of the measurement in [mbar]

**$P_2$** Pressure at the end of the measurement in [mbar]

**V** Volume of the process chamber in [l]. The volume of the process chamber is approximately 333 l

**t** Duration of measurement in [s]

**The leak rate is calculated with:**

$$LR = \frac{(p_2 - p_1) \cdot V}{t} \quad \text{[mbar l/s]}$$

**It is possible that a leak occurs in a range where it's not possible to use a quadrupole mass spectrometer (⇨ refer to operating instructions of quadrupole mass spectrometer) Therefore Oerlikon Balzers recommends to use a Helium leak detector that can be connected to the fore vacuum line hand valve.**

### 6.1.2 Manual Start of Leak Test Sequence (Operator)

The operator leak test sequence is performed automatically after a process (if required). This leak test can also be performed manually as follows:

1. Open the “Popup - Operator - Leak Test”.
2. Start the leak test sequence as soon as the pressure in the process chamber is <5x10$^{-5}$ mbar (IKR 251).

**If the leak rate is in range it will be indicated by tick marks.**

**An operator leak test must be performed at least once a week otherwise it is not possible to start a process anymore.**

### 6.1.3 Manual Start of Leak Test Sequences (Service)

1. Open the “Popup – Service – Leak Test”.
2. Select one or more of the 5 leak test options.
3. Start the leak test sequence as soon as the pressure in the process chamber is <5x10$^{-5}$ mbar (IKR 251).

**As a result the actual leak rate value will be displayed. If the value is out of range, an alarm will be displayed.**

### 6.1.3.1 Explanation of the Leak Test Sequences

1. The pumping unit evacuates the process chamber to a pressure < $1x10^{-5}$ mbar or max. 10 minutes.

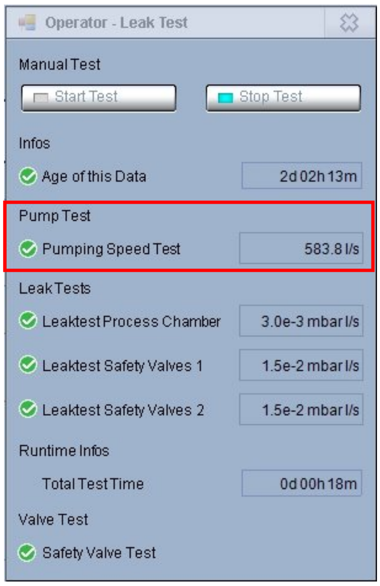
2. 
   - **TMP Flow rate test:**
     The machine stays in the pumping mode and $N_2$ is admitted into the process chamber. By means of the pressure monitoring of the CDG 100 D the flow rate of the pumping system will be calculated.
   - **Process chamber leak test (incl. substrate rotation):**
     The turbo molecular pump is shut down and the fore line valve is closed. All valves and the Argon (Ar), Nitrogen ($N_2$), Hydrogen ($H_2$) and Oxygen ($O_2$) mass flow controllers are closed and the carousel rotates at 50% rotation speed.
   - **$H_2$ safety valve 1 leak test:**
     The turbo molecular pump is shut down and the fore line valve is closed. The Hydrogen ($H_2$) mass flow controller and safety valve 2 are open. All other valves and the Argon (Ar), Nitrogen ($N_2$) and Oxygen ($O_2$) mass flow controllers are closed.
   - **$H_2$ safety valve 2 leak test:**
     The turbo molecular pump is shut down and the fore line valve is closed. The Hydrogen ($H_2$) mass flow controller and safety valve 1 are open. All other valves and the Argon (Ar), Nitrogen ($N_2$) and Oxygen ($O_2$) mass flow controllers are closed.
   - **$O_2$ safety valve 1 leak test:**
     The turbo molecular pump is shut down and the fore line valve is closed. The Oxygen ($O_2$) mass flow controller, the safety valve 2 and all valves for the sources are open. All other valves and the Argon (Ar), Nitrogen ($N_2$) and Hydrogen ($H_2$) mass flow controllers are closed.
   - **$O_2$ safety valve 2 leak test:**
     The turbo molecular pump is shut down and the fore line valve is closed. The Oxygen ($O_2$) mass flow controller, the safety valve 1 and all valves for the sources are open. All other valves and the Argon (Ar), Nitrogen ($N_2$) and Hydrogen ($H_2$) mass flow controllers are closed.

3. 1000 sccm Nitrogen ($N_2$) is admitted into the process chamber (for 10 minutes). With the help of the CDG 100 D pressure the pumping speed value of the turbo molecular pump is calculated.

The pumping speed value of the turbo molecular pump is visible in the "Popup - Operator - Leak Test".

Minimum permissible turbo molecular pump pumping speed...

**= 500 l/s**




4. The pressure increase in the process chamber is measured by a CDG 100 D over a time of 5 minutes. The leak rate value is visible in the "Popup – Operator – Leak Test".

Maximum permissible leak rate for process chamber inclusive...

- substrate rotation
- Hydrogen ($H_2$) gas safety valve 1
- Hydrogen ($H_2$) gas safety valve 2
- Oxygen ($O_2$) gas safety valve 1
- Oxygen ($O_2$) gas safety valve 2

**= 3x10$^{-3}$ mbar l/s**

### 6.1.3.2 Explanation of the System Test

Depending on the size of a leak, the leak test stops at pressure and/or time limit.

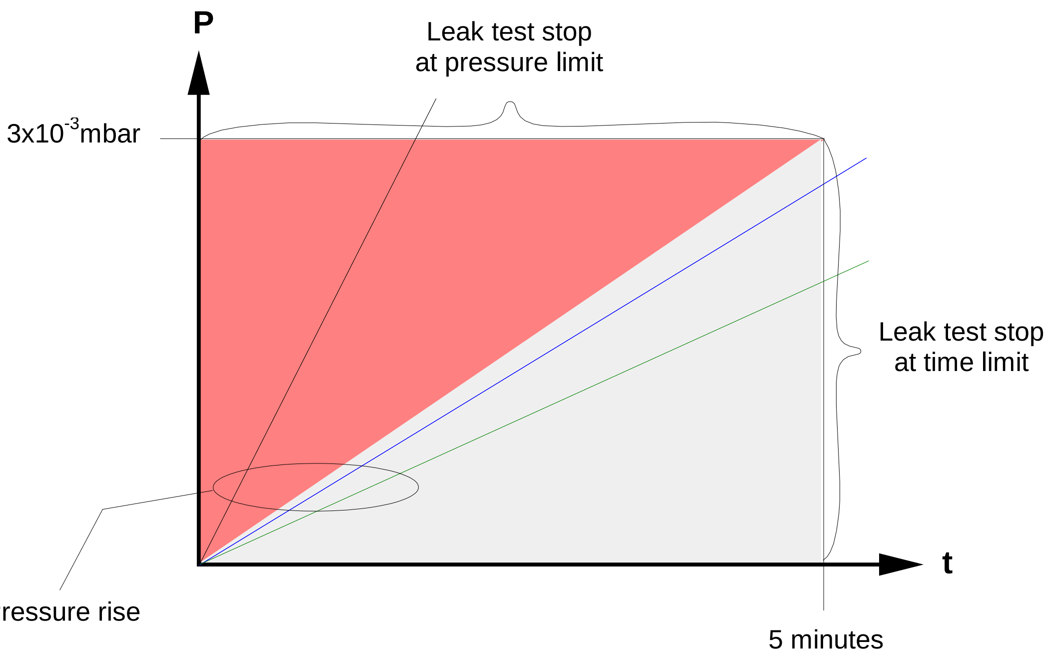
5. **< $3x10^{-3}$ mbar**
   (Leak test stop at time limit)

   If the pressure in the process chamber is lower than $5x10^{-3}$ mbar after 5 minutes, the leak test stops.

   **> $3x10^{-3}$ mbar**
   (Leak test stop at pressure limit)

   If the pressure in the process chamber is higher than $5x10^{-3}$ mbar in a time less than 5 minutes, the leak test stops before the elapsed time of 5 minutes.

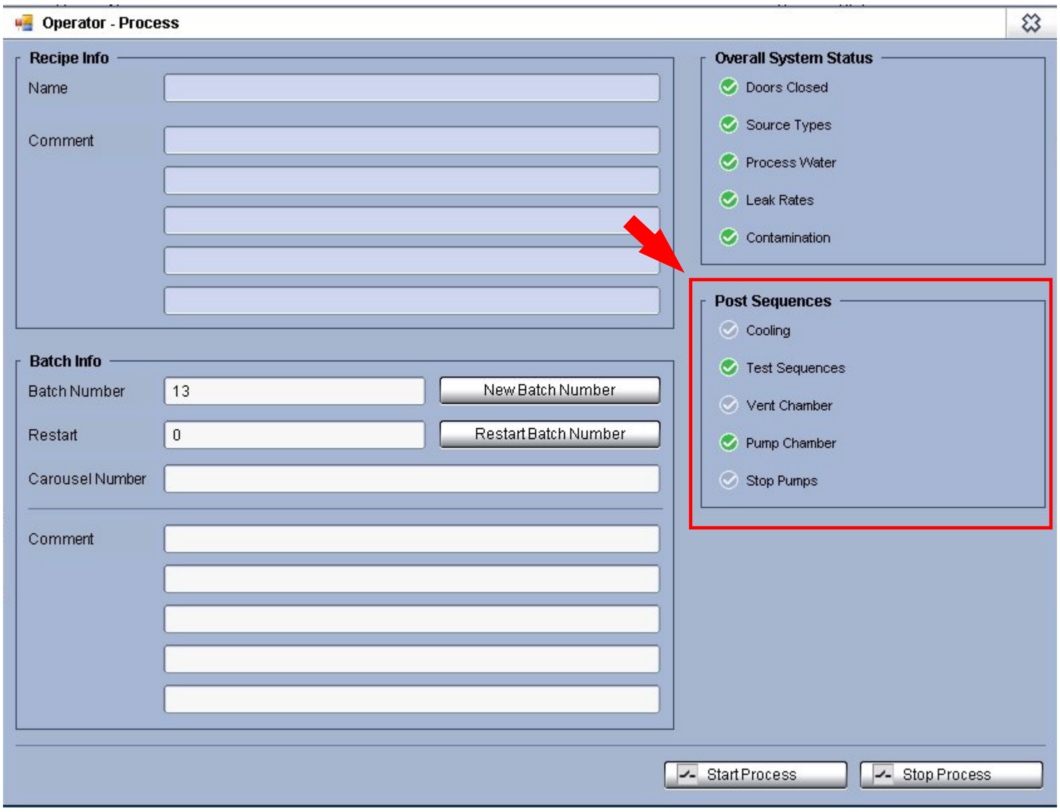
   The start pressure, end pressure and leak rate will be displayed.



### 6.1.4 Automatic Leak Test (After Coating Process)

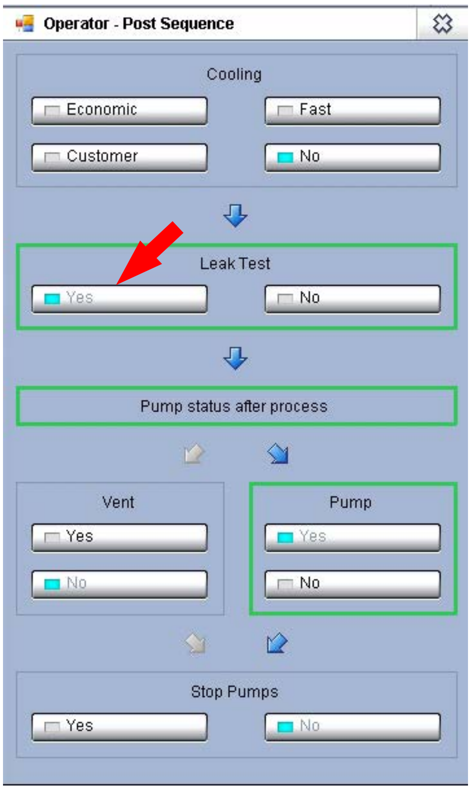
The automatic leak test is performed at the end of the coating process if selected in the "Operator – Post Sequence" screen.

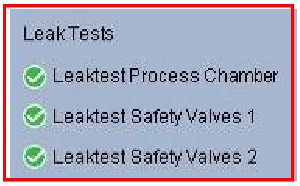
1. Click the box "**Post Sequences**" in the "Popup - Operator - Process" screen.




**The "Operator – Post Sequence" screen will be opened.**

2. Click the “**Yes**” button in the “Operator – Post Sequence” screen for a “Leak Test” sequence after coating process and select one or more leak test options by clicking.



### 6.1.5 Type of Leaks

The type of leaks can be divided into three categories. The most common positions for these leaks are:

| Air leaks | Water leaks | Gas leaks |
|---|---|---|
| Heaters | Ion sources | Argon mass flow controller |
| O-ring of the process chamber door | Sources | Nitrogen mass flow controller |
| Sources | | Cool gas valve |
| Igniter | | Hydrogen mass flow controller |
| Shutter feed-through | | Oxygen mass flow controller |

### 6.1.6 Leak Detection Method

The method of leak detection depends on the minimum pressure $P_m$ which can be attained in the process chamber in spite of the leak:

- $p_m > 1 \times 10^{-3}$ mbar
- $p_m < 1 \times 10^{-3}$ mbar

### 6.1.7 Leak Detection for: $p_m > 1 \times 10^{-3}$ mbar

#### 6.1.7.1 Air Leak

A big air leak can be located by using alcohol: A drop of alcohol on the leak results in a decreased pressure reading (PSG 500 or PCG 550).

**The alcohol can freeze and thereby close the leak temporarily.**

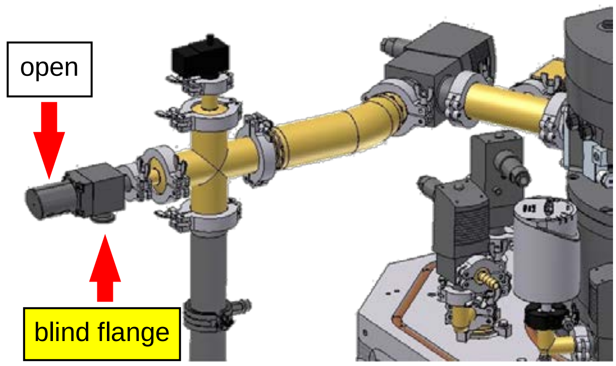
#### 6.1.7.2 Water Leak

Water leaks can be detected by closing and opening the outlet valve on the corresponding water circuit. The changing water pressure causes an equivalent change of pressure (IKR 251 or CDG 100 D) in case of a water leak.
The location of large leaks can be detected by the traces which the water leaves on the surface. At the ion sources, defect or corroded welding seam could cause water leakage. Large leaks result in a gray-white deposit in the ion sources.

**If the weld seams are defect, the condition of the cooling water should be checked. The warm water for the ion sources must:**
**- be softened**
**- have specific conductivity as described in chapter 1.**
**- not contain Cl.**

#### 6.1.7.3 Connection Point for the Helium Leak Detector

Follow the instructions of the make / type of Helium leak detector being used.




**After leak detection close always the intake side of the hand valve by means of a blind flange and open the valve.**

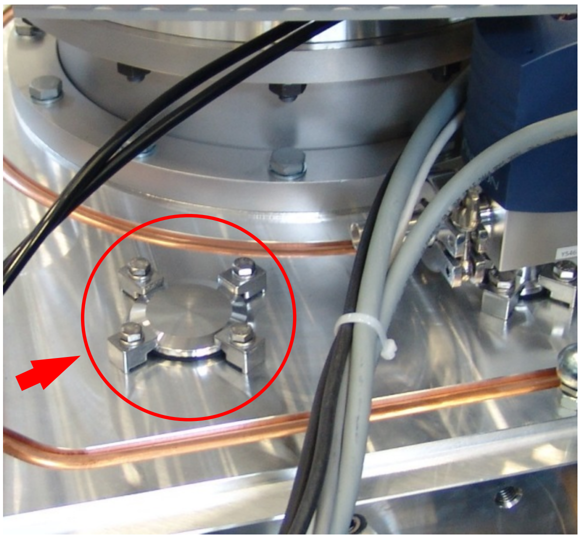
**A closed hand valve with an open intake side could leak after a certain time caused by loss of spring tension of the valve.**

### 6.1.7.4 Connection Point for the Quadrupole Mass Spectrometer

Follow the instructions of the make / type of quadrupole mass spectrometer being used.

**Working at high pressure can damage the quadrupole mass spectrometer. (⇨ Refer to operating instructions of quadrupole mass spectrometer for the allowed start pressure).**

(On top of the process chamber)



⇨ Refer to operating instructions of quadrupole mass spectrometer.

### 6.1.7.5 Leak Detection with a Quadrupole Mass Spectrometer

**⚠ DANGER**

**Beware of high voltage on internal components of quadrupole mass spectrometer!**

- **Danger of fatal electric shock when touching high voltage components.**

**⚠ CAUTION**

**Danger of damaging components of the quadrupole mass spectrometer!**

- **Before working with the quadrupole mass spectrometer:**
- **Check the pressure in the process chamber. (Working at high pressure can damage the quadrupole mass spectrometer).**
- **Let the quadrupole mass spectrometer warm up.**
- **(⇨ Refer to operating instructions of quadrupole mass spectrometer for the allowed working pressure and warm up time).**
- **For successful leak detection, patience and careful work are essential.**

1. Connect the quadrupole mass spectrometer analyzer to the chamber flange.
2. Evacuate the process chamber to the required start pressure**.**
3. Switch on the quadrupole mass spectrometer. (⇨ Refer to operating instructions of quadrupole mass spectrometer.)

**It takes some experience to correctly interpret a scan. (⇨ Refer to quadrupole mass spectrometer operating instructions for guide lines).**

### 6.1.7.6 Procedures of Leak Detection:

**⚠ WARNING**

**Hazardous heights!**

- **When working on top of the process chamber always stay on a step ladder because of the high drop.**

**⚠ WARNING**

**Beware of moving parts!**

- **Care must be taken when leak detecting in the area underneath the process chamber, when the substrate rotation is on.**

1. Select the “Leak test” mode of the quadrupole mass spectrometer.

**Avoid drafts in the coating room (close doors and windows, switch off air conditioning).**

**For the initial rough location of the leak, Helium (He) should be used at a higher flow. Then use a lower flow to pin-point the actual position of the leak.**

**Work from the top to bottom of the system because Helium (He) is much lighter than air.**

2. Probing with Helium (He) at:
all blind flange connections, ion sources, “CDG 100 D” isolation valve, gas inlets, PCG 550 connection, IKR 251 (remove the electronics unit), PSG 500 Air inlet, vacuum pressure switch (CDG 025D-S) connection, sources, igniters, heaters, valves and gauges of the pumping unit, process chamber door O-ring, carousel, thermocouple feed-through and shutter feed-through.

**Work slowly as it may take time for the Helium (He) to be detected.**

**When a leak is detected by the quadrupole mass spectrometer allow the reading to drop before further testing. This drop can be accelerated when removing Helium (He) with compressed air.**

**The electronics unit of the IKR 251 must be removed to protect it from a Helium (He) plasma discharge.**

3. Switch off the filament of the quadrupole mass spectrometer before venting the process chamber.

4. Remove the quadrupole mass spectrometer before loading the next batch.

### 6.1.7.7 Detection of an Air Leak in a Gas Line

1. Close the gas supply at the main valve.
2. Blind flange the gas capillary at the gas line.
3. Evacuate the gas line.

**Avoid drafts in the coating room (close doors and windows).**

4. Use Helium (He) at a low flow.
5. Probing with Helium (He) at: gas lines, flanges and the mass flow controllers.

**Work slowly because it may take time for the Helium (He) to be detected.**

6. Remove the quadrupole mass spectrometer or Helium (He) leak detector prior to the next process.

### 6.1.7.8 Leak Detection for the VAP 016 P

– A leak in the Helium (He) cool gas inlet valve can be detected by closing the bottle. Then removing the gas line connection to the valve and introducing Helium (He).

**Ensure the gas line is purged prior to a process.**

– A leak in the air venting inlet valve can be detected with the use of Helium (He).

### 6.1.7.9 Leak Detection for the VAP 016 P "CDG 100 D" Isolation Valve

If a leak is detected in the valve connection or the valve itself and it has to be disassembled the CDG 100 D will be vented and therefore on reassemble a minimum pumping time of 4 hours is required before the Zero point adjustment can be made.

# 7 Service and Maintenance

**Manufacturer**

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**Please read and retain this manual to assist you in the operation and maintenance of this product. This manual is an integral part of the machine. In the event of a change of ownership, hand this manual over to the new owner.**

# Contents

oerlikon balzers

## 7.1 General Safety Information

**Only qualified personnel may maintain and service the INGENIA P3e™ coating system. During all maintenance and service work on this system, adhere to the safety regulations given in this chapter.**

**⚠ DANGER**

**Beware of high - and dangerous voltage components!**

- **Danger of fatal electric shock when touching high voltage components.**

**⚠ DANGER**

**Danger of explosion by handling gas components!**

- **Serious body injury can be the consequence if not adhered to this instruction.**
- **After handling gas components (e.g. gas lines, flow controller etc.) always check the function and the tightness of the gas system.**
- **Only technically qualified and authorized personnel are permitted to perform service work on the gas equipment.**
- **We strongly recommend that all safety components must be ordered by Oerlikon Balzers.**

**⚠ DANGER**

**Danger of explosion due to contaminated gas lines!**

- **Serious body injury can be the consequence if not adhered to this instruction.**
- **When handling gas components (e.g. gas lines, flow controller etc.) always wear rubber gloves. Any kind of grease (e.g. Apiezon vacuum grease) or oil must not be used on all components between gas supply and process chamber.**

**⚠ DANGER**

**Danger of a remote control of the coating system!**

- **In case of service measures on the coating system unplug the remote connection to prevent operation of the system via remote control.**

**⚠ WARNING**

**Danger of crushing from carousel drive system!**

- **There is the danger of serious injury when working on the carousel drive system. It will cause serious injury when moved unintentionally.**

**⚠ WARNING**

**Beware of using non-original replacement parts!**

- **The use of non-original replacement parts may cause fatal injury and serious equipment damage.**
- **Always use original replacement parts for maintenance and service work.**

**All of the required maintenance work on the INGENIA P3e™ coating system is listed in the maintenance schedules. The listed test and maintenance periods are minimum binding standards for normal operation of the system.**

**⚠ CAUTION**

**Danger of crushing!**

- **Be careful when closing the process chamber door. Due to its weight it may cause injury.**
- **Open and close the process chamber door only by means of the process chamber door grip.**

**Danger of burns due to hot surfaces!**

- **Ensure that the radiation heaters have cooled down before starting any maintenance or service activities.**

**⚠ CAUTION**

**Beware of material flaking-off in the process chamber. During coating, the carousels and the shielding are coated!**

- **During all maintenance and cleaning work in the process chamber, avoid creating dust. Wear a breathing mask with a type P3 filter, eye protectors and appropriate protective clothing. Do not eat, drink or smoke.**
- **Carefully read the safety data sheets of the coating materials being used. Adhere to the safety instructions given in them.**

**The process time, and therefore the production efficiency of the INGENIA P3e™ coating system, is in direct relationship to the cleanliness of the INGENIA P3e™ components and the substrates to be coated. With regards to the above, all maintenance and repair activities shall be accomplished under clean conditions and by qualified personnel only.**

**⚠ CAUTION**

**Danger of poor coating quality!**

- **When working with parts which will be exposed to vacuum, clean gloves must be used.**

## 7.2 Working Rules

**The following working rules have to be followed when working at opened process chamber:**

- Always wear eye protectors.
- Always wear a clean overall/coat and clean lint-free gloves when working with components exposed to vacuum. Do not touch items with bare hands.
- When cleaning the chamber, always wear a breathing mask that is equipped with a P3 protection filter.
- Use a vacuum cleaner with a metal nozzle to remove loose coating layers and dust.

**Never blow out the process chamber with compressed air. Particles would be distributed throughout the entire process chamber.**

- Avoid all contamination caused by oil, grease, water and solvents.
- Use only clean work tools (not greasy or oily).
- Wipe surfaces only with clean, lint-free cleaning paper.
- The application of vacuum grease on seals, feed-through, etc. shall be limited to a minimum.
- When removing grease or oil from component surfaces, limit the use of solvents to an absolute minimum.

**When working on the electrical system (such as adjustments, calibrations etc.) check the actual customers wiring diagram for correct component designations.**

# 7.3 Prerequisites

## 7.3.1 Auxiliary Consumable, Material

### 7.3.1.1 Operating Media

| Equipment | Operating medium | Part. No | |
|---|---|---|---|
| TRIVAC D65 BCS rotary vane vacuum pump | LVO 400 oil | K2500066 | 1l |

**For an oil change a quantity of 4 liter is needed!**

**Use Leybold LVO 400 oil for the rotary vane vacuum pump.**

### 7.3.1.2 Cleaning Agents, Lubricants and Consumables

| Description | Part. No |
|---|---|
| Alcohol: Isopropanol (purity 99.9 %)<br>**(**Propan-2-ol.$(CH_3)_2CHOH$**)** | - |
| Apiezon grease (25g) | B 8010 070 28 |
| Hand pads (224 x 158 mm) (Scotch Brite) | B 5639 247 |
| Lint free cleaning paper | B6126173 |
| Graphite powder (25g) (purity 99.9%) | K2500033 |
| Graphite powder (1000g) (purity 99.9%) | K2500057 |
| $MoS_2$ powder (50g) | B0127117 |
| Electrical contact grease (Metalon HT) | K2500024 |
| Plastic tool for cleaning the pendulum valve* | K4300048 |
| Pads for cleaning the pendulum valve* | K4300049 |
| Gas leak detector spray<br>(e.g. "Controlit", Maag Technik AG) | - |
| Clean gloves (handling substrates) | B6137164N2 |
| Clean heat resistant gloves | B6137168 |
| Boron nitride rod | BB525029 |

#### 7.3.1.3 Special Tools Supplied

| Description | Chapter | Part. No | Qty |
|---|---|---|---|
| Torque wrench 10-50 Nm | **7.21.3** | K5700043 | 1 |
| Ratchet adaptor | **7.21.3** | B5712234DC | 1 |
| Open-end wrench insert 17 | **7.21.3** | B5712262 | 1 |
| Adjustable face spanner wrench 40-80 Ø4 | **7.10.1** | K5700000 | 1 |
| Pliers 445 130 A0 | **7.14** | K5700030 | 1 |
| Torque screw driver 20 - 120 Ncm | **7.11.3** / **7.13** | B5721908 | 1 |
| Fork wrench, cr-v-st, vcr, 22 x 24 | general use | N5702347GC | 1 |
| Flat wrench, vcr 30 x 32 | general use | N5702358GC | 1 |
| Flat wrench, vcr 36 x 41 | general use | N5702362GC | 2 |
| Steel wire brush | **5.2** | B6101104V | 1 |
| BN-rod and holder | **5.2.3** | BB525047-T | 1 |
| Magnetic field sensor | **3.8.1.1** | B5147998BA | 1 |
| Fork wrench, vcr, 24 x 27 | general use | N5702351GC | 1 |
| Screw driver | general use | K5700038 | 1 |
| Screw driver insert, size no.2 | general use | K5700039 | 1 |
| Screw driver insert, size no.3 | **7.12** / **7.13** / general use | B5721930AE | 1 |

## 7.4 Maintenance Schedule

### 7.4.1 Process Chamber and Components

Cleaning of the process chamber and specific components is based on the number of batches. The recommended number of batches for cleaning the process chamber is **80 batches**. In addition there are time based maintenance tasks. Maintenance intervals might vary when running custom processes.

**Run an A3 process (incl. all available leak rates) with a carousel filled with dummies after 80 batch cleaning.**

# *DAILY MAINTENANCE PLAN AND CHECKS*

| Name & Type | Activity | System Status | Interval | Check | Clean | Calibrate | Change | Reference | Responsibility |
|---|---|---|---|---|---|---|---|---|---|
| Process gases | Check each process gas for minimum pressure and replace if necessary. ⇨ Refer to chapter 1.4.3.3 "Gas Specification". | | daily | | | | | Chapter 1 & Chapter7 | Serv |
| Process chamber | Check the leak rate of the INGENIA P3e™ coating system. | | daily | | | | | Chapter 7 | Oper |
| Heaters | Clean the heaters with a wire brush. | vent | after process | | | | | Chapter 7 | Oper |
| Process chamber (Internal) | Sandblast confinement rings and trigger finger. | vent | 1 after each process | | | | | Chapter 5 & Chapter 7 | Oper |

# WEEKLY MAINTENANCE PLAN AND CHECKS

| Name & Type | Activity | System Status | Interval | Check | Clean | Calibrate | Change | Reference | Responsibility |
|---|---|---|---|---|---|---|---|---|---|
| Rotary vane vacuum pump<br>TRIVAC D65 BCS | Check the oil level. | Pump/stby | weekly | | | | | Chapter 7 | Oper |
| | Check for loss of oil in the exhaust hose. | Pump/stby | weekly | | | | | | Oper |
| Capacitance diaphragm gauge<br>CDG 100 D<br>(process) | Perform a zero adjustment if necessary. | Pump | weekly | | | | | Chapter 7 | Serv |
| Heater | Perform automatic heater cleaning. | Vent | weekly | | | | | Chapter 4 | Oper |
| Gas safety valves | Check the leak rate of the INGENIA P3e™ gas safety valves. | | weekly | | | | | Chapter 7 | Oper |

# 80 BATCH MAINTENANCE AND CHECKS

| Name & Type | Activity | System Status | Interval (batches) | Check | Clean | Calibrate | Change | Reference | Responsibility |
|---|---|---|---|---|---|---|---|---|---|
| Process chamber<br>(Internal) | Sandblast all protective shields, shutters, ion source shielding, gas distribution, igniters, tubes*. | Off | 80 | | | | | Chapter 5 &<br>Chapter 7 | Oper |
| Ion sources | Check diameter of ASBN orifice replace if necessary. | Off | 80 | | | | | Chapter 7 | Serv |
| Emergency-off buttons | Check proper function. | On | 80 | | | | | Chapter 7 | Serv |
| Angle valve VAP040-A<br>(Fore line valve / isolating valve for CDG 100 D) | Disassemble and clean. (If there is a second set available, replace). | Off | 80 | | | | | Chapter 7 | Serv |
| Exchange filaments | Replace both filaments with new ones and check filament current. | Off | 80 | | | | | Chapter 7 | Serv |
| Conditioning process chamber | TiN process after cleaning for conditioning | coating | 80 | | | | | Chapter 7 | Serv |

(* Optional

# 80 BATCH MAINTENANCE FOR CAROUSELS

| Name & Type | Activity | System Status | Interval (batches) | Check | Clean | Calibrate | Change | Reference | Responsibility |
|---|---|---|---|---|---|---|---|---|---|
| Carousel | Sandblasting retainers, flicker posts, tubes, clips, top cover, 2nd cover, sleeves and flicker post holders incl. screws.<br>Cleaning the race tracks and carbide balls with Isopropanol.<br>Treating the race tracks with a mixture of graphite powder and Isopropanol. | - | 80 | | | | | Chapter 5 | Oper |
| Carousel | Check and clean ceramic pins of the carousel (floating) shielding. | | | | | | | Chapter 7 | Oper |
| Carousel | Check the diameter of the (retainer) balls. | | | | | | | Chapter 7 | Oper |

**Wipe off the dust and other particles with Isopropanol after sandblasting.**

# 160 BATCH MAINTENANCE AND CHECKS

| Name & Type | Activity | System Status | Interval (batches) | Check | Clean | Calibrate | Change | Reference | Responsibility |
|---|---|---|---|---|---|---|---|---|---|
| Compact cold cathode gauge IKR 251 | Clean IKR 251* | Off | 160 | | | | | Chapter 7 | Serv |

**(* A new IKR 251 must be cleaned for the first time after 80 batches.**

# 1/2 YEARLY MAINTENANCE PLAN AND CHECKS

| Name & Type | Activity | System Status | Interval | Check | Clean | Calibrate | Change | Reference | Responsibility |
|---|---|---|---|---|---|---|---|---|---|
| Rotary vane vacuum pump<br>TRIVAC D65 BCS | Replace oil.<br>Replace internal demister (filter) and clean pumping housing. | Off | ½ yearly | | | | | Chapter 7 | Serv |
| Dust separator<br>AS30-60 | Exchange and clean the dust separator. | Off | ½ yearly | | | | | Chapter 7 | Serv |
| Exhaust filter<br>AR40-65 | Replace filter and clean filter housing. | Off | ½ yearly | | | | | Chapter 7 | Serv |
| Water battery | Check emergency cooling for proper operation (loss of power, water and compressed air).<br>Check tightness of the fittings.<br>Close each water tap individually to generate an alarm message. | Stby & water On | ½ yearly | | | | | Chapter 3 | Serv |
| Compressed air | Check compressed air connections for tightness. | | ½ yearly | | | | | | Serv |
| Angle valve<br>VAP016-A<br>(Venting valve / cool gas valve) | Disassemble and clean (before assembly check with leak detector) | Vent | ½ yearly | | | | | Component binder | Serv |
| Ion sources | Clean ion sources. | Off | ½ yearly | | | | | Chapter 7 | Serv |

# *YEARLY MAINTENANCE PLAN AND CHECKS (Part 1)*

| Name & Type | Activity | System Status | Interval | Check | Clean | Calibrate | Change | Reference | Responsibility |
|---|---|---|---|---|---|---|---|---|---|
| Process chamber | Check for mechanical tightness of all connections and screws | Vent | 1 year | | | | | Chapter 7 | Serv |
| Pulsed bias supply | Clean dust filters | Off | 1 year | | | | | | Serv |
| Computer | Compress data files and delete only if necessary. | Pump/stby | 1 year | | | | | | Serv |
| Arc source power connection | Apply a thin film of electrical contact grease (Metalon HT). | | 1 year | | | | | Chapter 7 | Serv |
| Pressure flow test | Perform an automatic flow test and analyze it. | Pump | 1 year | | | | | Contact Oerlikon Balzers after sales department | Serv |
| Rotary feed-through | Disassembling, cleaning, changing the shaft seal, checking the bearings. | Off | 1 year | | | | | Chapter 7 | Serv |

# *YEARLY MAINTENANCE PLAN AND CHECKS (Part 2)*

| Name & Type | Activity | System Status | Interval | Check | Clean | Calibrate | Change | Reference | Responsibility |
|---|---|---|---|---|---|---|---|---|---|
| Electrical connections (incl. AI 2x250, FPU,…) | Check for mechanical tightness of all connections | Power Off | 1 year | | | | | Chapter 7 | Serv |
| Battery of the PLC | Replace with new battery | On | 2 years | | | | | Chapter 7 | Serv |
| Carousel loading platform | Check for proper operation<br>Check for mechanical tightness of all connections and screws | On | 1 year | | | | | | Serv |
| Water battery | Clean the inlet filter (warm & cold water) | Water Off | 1 year | | | | | | Serv |
| Mass flow controller area | Vacuum and wipe clean | Vent | 1 year | | | | | | Serv |
| Mass flow controller Bronkhorst F-201C-PAD-88-Z | Replace with calibrated MFC's | Vent | 1 year | | | | | Contact Oerlikon Balzers after sales department | Serv |
| Capacitance diaphragm gauge CDG 100 D (process) | Replace with calibrated CDG 100 D | Vent | 1 year | | | | | Contact Oerlikon Balzers after sales department | Serv |

# YEARLY MAINTENANCE PLAN AND CHECKS (Part 3)

| Name & Type | Activity | System Status | Interval | Check | Clean | Calibrate | Change | Reference | Responsibility |
|---|---|---|---|---|---|---|---|---|---|
| Electrical safety circuits (Eden safety switch) | Check for proper operation (open/close cover doors) | Pump | 1 year | | | | | Chapter 2 | Serv |
| Gas safety circuit | Check for proper operation | Pump | 1 year | | | | | Chapter 2 | Serv |

# TIME BASED MAINTENANCE PLAN AND CHECKS

| Name & Type | Activity | System Status | Interval | Check | Clean | Calibrate | Change | Reference | Responsibility |
|---|---|---|---|---|---|---|---|---|---|
| Turbo molecular pump MAG W 1700 IP | Rotor exchange | Vent | 80000h * | | | | | Contact Oerlikon Balzers after sales department | Serv |

(* Observe the alarm message on the INGENIA P3e™ screen. ⇨ Refer also to chapter 4 “Popup - Service - Pump System” screen.

## 7.5 Cleaning the System

**⚠ CAUTION**

**Beware of material flaking-off in the process chamber. During coating, the carousels and the shielding are coated!**

- **During all maintenance and cleaning work in the process chamber, avoid creating dust. Wear a breathing mask with a type P3 filter, eye protectors and appropriate protective clothing. Do not eat, drink or smoke.**
- **Carefully read the safety data sheets of the coating materials being used. Adhere to the safety instructions given in them.**

**⚠ CAUTION**

**Danger of crushing!**

- **Be careful when closing the process chamber door. Due to its weight it may cause injury.**
- **Open and close the process chamber door only by means of the process chamber door grip.**

### 7.5.1 Sandblasting Rules

The following points have to be taken into account when sandblasting any parts of the INGENIA P3e™ coating system:

- Any sealing surfaces and threads must be covered prior to sandblasting.
- The sandblasting system may only be used for stainless steel.
- The sandblasting media may only be used for stainless steel. Use $AL_2O_3$ media with 250-350 µm grain size at max. 4bar. A contamination with e.g. Zinc, Tin, Silicone or any organic material must be prevented. The distance between blasting nozzle and shielding should be approx. 100 – 150 mm.
- For a longer lifetime all parts must be sandblasted as distortion-free as possible.
- Sandblasted parts must be cleaned with compressed air, Isopropanol and a lint free cloth before assembling.

### 7.5.2 Chamber Walls

**Protect the process chamber from contamination !**
**Comply with the “working rules” (⇨ refer to chapter 7.2).**

1. Remove the inner protective shields.
2. Thoroughly clean all interior surfaces of the process chambers with a vacuum cleaner.
3. Remove loose coating using the vacuum cleaner.

**In order to sustain the thermal balance of the process chamber, the chamber walls must be coated in black color (AP3 process). Do not clean the process chamber with Scotch Brite or grinding paper.**

## 7.6 Cleaning O-rings and Sealing Surfaces

### 7.6.1 Cleaning Materials

- Lint-free cleaning paper (B6126173)
- Scotch Brite (B5639247)
- Clean gloves (B6137164N2)
- Isopropanol (purity 99,9)

**When working with solvents adhere to local regulations.**

### 7.6.2 Cleaning of Sealing Surfaces

Stainless steel and aluminum sealing surfaces must be free of scratches.

Remove scratches using Scotch Brite. Polish the sealing surface afterwards. Scratches from polishing material (Scotch Brite) must follow exactly the sealing surface and be a closed circuit. No scratch must cross the sealing surface. Finally clean the surface with a lint-free cleaning paper and Isopropanol.

### 7.6.3 Cleaning O-rings

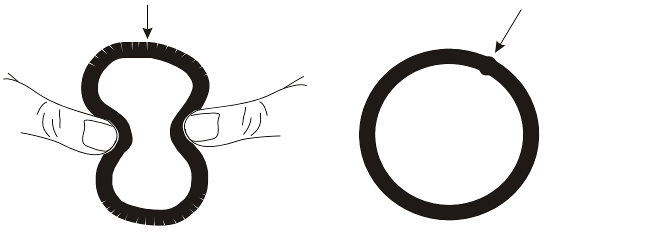
All O-rings used for the INGENIA P3e™ coating system must be made of Viton.

**Viton is chemically resistant against Isopropanol, but will be attacked by Ethanol (ethyl alcohol) and Acetone (dimethyl-ketone, propanone).**

### 7.6.4 Visual Inspection of O-rings

**O-rings must be:**

- clean,
- constant in diameter,
- free of noticeable gluing joints,
- free of any damage (cuts, porous areas).




**Proceed as follows to clean the O-rings from oil, fat, particles, dust, talc or other dirt:**

- Pull the O-ring through a dry and clean cleaning paper to remove coarse particles.
- Pull the O-ring through an Isopropanol soaked cleaning paper to remove tiny particles and grease.
- Check O-ring for damage.
- Sparingly apply vacuum grease to the O-ring (Apiezon).
- Pull the O-ring through your fingers to cover the surface and pores with a very thin film of grease. After this treatment the O-ring easily fits in the groove, moves and turns easily (maintaining a constant diameter). Moreover, the sealing surface will be moistened.

**Slightly greased O-rings collect particles. Therefore assemble as soon as possible.**

### 7.6.5 Cleaning of the O-ring Groove

- Remove the O-ring. Be careful not to damage or scratch the sealing surface, the groove or the O-ring. Never use sharp tools like screwdrivers etc. A plastic or wood O-ring removal tool should be used.
- Clean the groove with an Isopropanol soaked cleaning paper.

## 7.7 Cleaning the Compact Cold Cathode Gauge IKR 251

**⚠ DANGER**

**Danger of cleaning agents!**

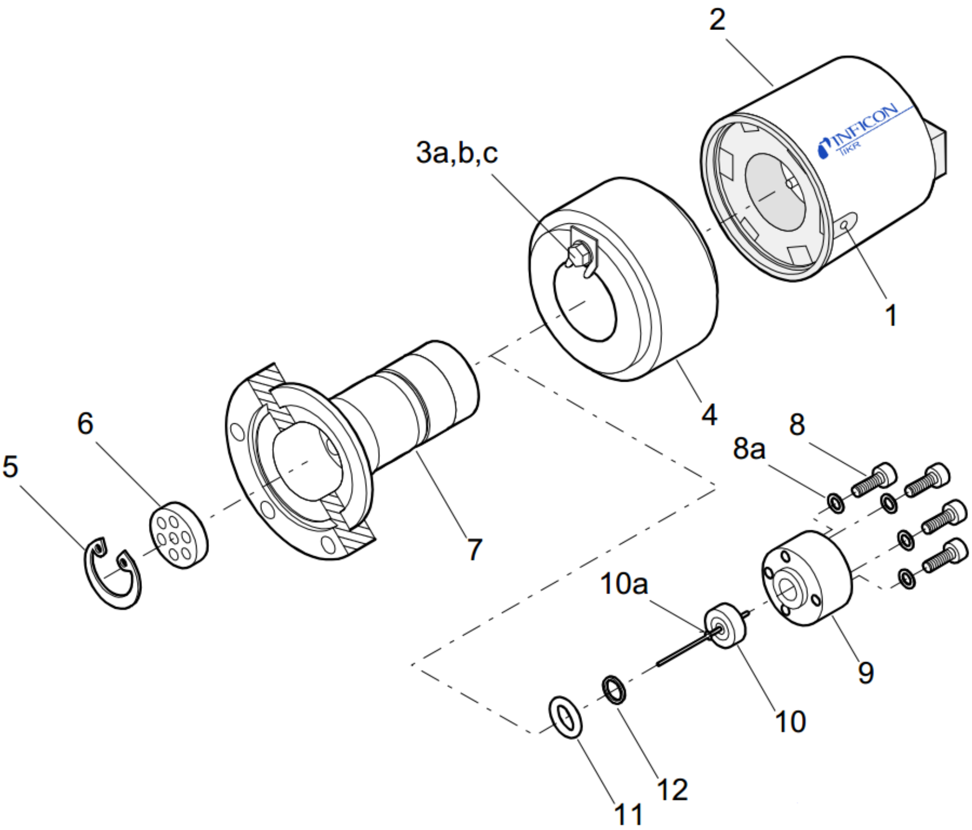
- **Cleaning agents can be detrimental to health and environment.**
- **Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.**

**Tools / material required:**

- Allen key 1.5 mm
- Allen key 3.0 mm
- Open-end wrench 7.0 mm
- Pliers for circlip
- Scotch Brite
- Tweezers
- Isopropanol
- Mounting tool for ignition aid
- Ignition aid
- FPM seal (11) for anode feed-through

### 7.7.1 Disassembling the Gauge

Overview diagram:




**Do not touch these parts (5;6) (10;11;12) with bare hands.**

1. Vent the process chamber.
2. Disconnect the supply/measurement connector of the gauge.
3. Remove the gauge from the process chamber.
4. Unfasten the hexagon socket set screw (1) on the side of the electronics unit (2).
5. Remove the electronics unit.

**The cover of the electronics unit cannot be removed.**

6 Unfasten the hexagon head screw (3) on the magnet unit (4) and remove the magnet unit.

**The magnetic force and the tendency to tilt make it more difficult to separate the magnet unit and the measuring chamber (7).**

7. Remove the circlip (5) as well as the polarity insert (6) from the measuring chamber.
8. Remove the four (or two) hexagon socket screws (8) incl. lock washers (8a) on the back of the measuring chamber.
9. Carefully remove the following items in this order: pressure piece (9), complete anode (10), FPM seal (11) incl. support ring (12).

**The parts can now be cleaned or replaced.**

### 7.7.2 Cleaning the Gauge

1. Using Scotch Brite rub the inside walls of the measuring chamber and the polarity insert to a bright finish.

**The sealing surfaces must only be worked concentrically.**

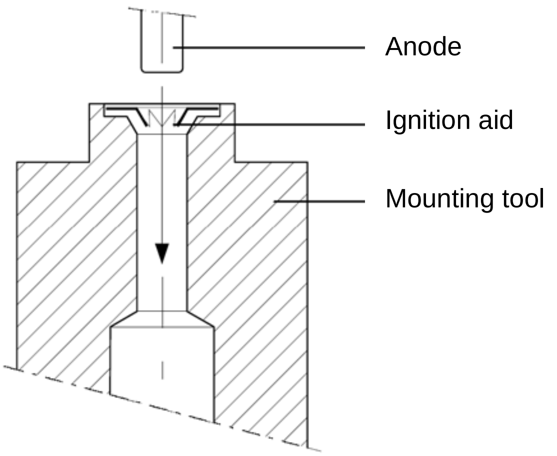
2. Rinse the measuring chamber and the polarity insert with Isopropanol.
3. Allow both to dry.

#### 7.7.2.1 Cleaning or Replacing the Anode

1. Remove the old ignition aid (10a) with tweezers.
2. Using Scotch Brite rub the anode pin to a bright finish.

**Do not bend the anode. Do not carry out mechanical work on the ceramic part.**

3. Rinse the anode with Isopropanol.
4. Allow the anode to dry.
5. Insert a new ignition aid (10a) into the mounting tool.
6. Carefully press the anode (clean or new) centered and parallel to the tool axis into the ignition aid and insert it to a depth of approx. 15 mm. The final positioning is established after the anode is installed.



## 7.7.3 Reassembling the Gauge

1. Insert the FPM seal (11) with the support ring (12) centered into the measuring chamber. The sealing surface, seal, and ceramic part must be clean.
2. Carefully insert the anode (10) incl. ignition aid (10a) into the measuring chamber.
3. Carefully place the pressure piece (9) on the measuring chamber and tighten it uniformly with the four (or two) hexagon socket screws (8) incl. lock washers (8a) until the stop position is reached.
4. Position the ignition aid (10a) by pushing the mounting tool over the anode pin until the mechanical stop is reached.
5. Remove the particles in the measuring chamber with dry Nitrogen (be careful to hold the measuring chamber with the flange pointing downwards).
6. Slide the polarity insert (6) into the measuring chamber up to the mechanical stop.
7. Place the circlip (5) snugly fitting on the polarity insert.

**Visually check if the anode pin is centered over the middle hole of the polarity insert (max. eccentricity = 0.5 mm).**

8. If possible perform a leak test (leak rate $<10^{-9}$ mbar l/s) with a leak detector.
9. Mount the magnet unit (4) and lock it with the hexagon head screw (3).
10. Carefully slide the electronics unit (2) on the magnet unit until the mechanical stop is reached.
11. Fasten the electronics unit (2) by means of the socket head set screw (1).
12. Replace the gauge to the process chamber.
13. Connect the supply/measurement connector of the gauge.

## 7.7.4 Adjusting the Gauge

**The gauge is factory-calibrated and requires no maintenance. It must be replaced in the event of a defect.**

### 7.7.5 Cleaning of a Mounted O-ring

- Clean the surroundings of the O-ring from particles and dust. Use a vacuum cleaner and Isopropanol soaked cleaning paper.
- Clean the O-ring with an Isopropanol soaked cleaning paper.

### 7.7.6 Replacing the Process Chamber Door O-ring

- Using a plastic or wood tool along the perpendicular groove behind the O-ring and grasp the O-ring. Then remove the O-ring from the groove.
- Wipe the groove off with an Isopropanol soaked cleaning paper.
- Apply a thin layer of vacuum grease on the new O-ring.
- Insert the new O-ring in the groove. Make sure the new O-ring is seated evenly and is not twisted.
- After installation clean the O-ring with an Isopropanol soaked cleaning paper.

## 7.8 Maintenance of the Pumping Unit

Select the “Popup - Operator - Miscellaneous” and mouse click “Off” (“Pump System”).

### 7.8.1 Exchanging and Cleaning the Filter Insert of the Dust Separator (AS 30-60)

The filter insert of the dust separator has to be exchanged and cleaned on half yearly maintenance.

(⇨ Refer to Leybold Operating Instructions.)

#### 7.8.1.1 Exchanging the Filter Insert

1. Take off the blanking flange (A) and the small flange adapter (B) on top of the dust separator and lift off the lid.

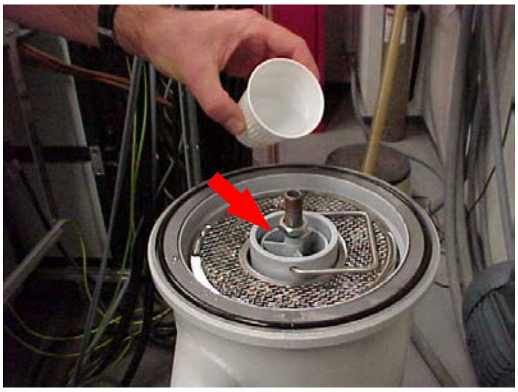

2. Pull out the filter insert and exchange it with a new (spare) one.

3. Before re-insert the filter, moisten the outer walls of the filter with LVO 100 oil.

4. Wipe off the excessive oil.

5. Re-insert the filter and pour some LVO 100 oil over the top of the filter insert (250ml).

**Ensure that all O-rings and sealing surfaces are clean and treated with a little vacuum grease.**

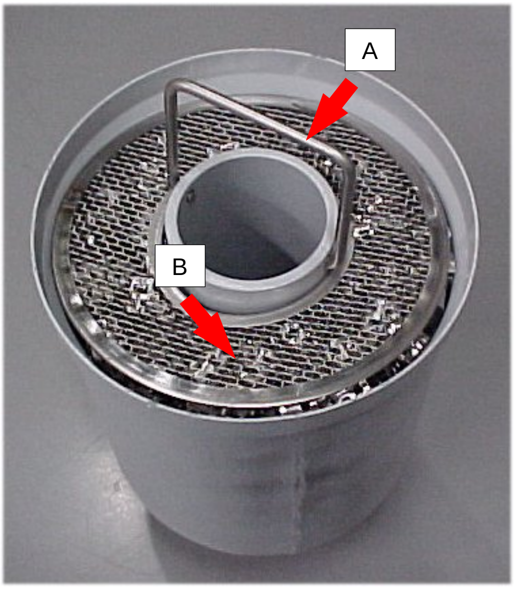


6. Reinstall the adapter and the blanking flange.

**Do not over tighten the thread.**

### 7.8.1.2 Cleaning the Filter Insert

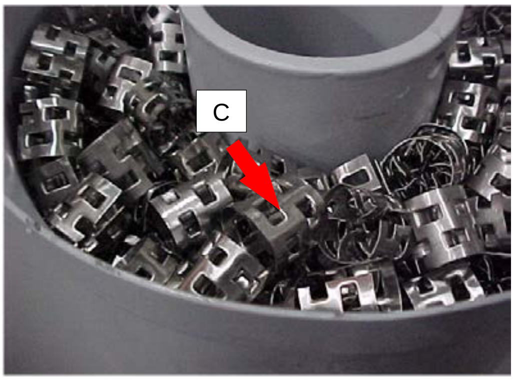
1. To clean the filter insert remove the insert carrier (A) and the mesh disc (B) from the dirty filter insert.




2. Oerlikon Balzers recommends to empty the container and clean the metallic filter pieces (C) in a ultrasonic bath.

**Use ultrasonic bath for cleaning with Isopropanol only.**
**Do not clean with water !**

3. Clean the container, carrier and the mesh disc with Isopropanol.




4. Re-assemble all parts and keep the complete filter insert in a clean place as spare for the next maintenance exchange.

### 7.8.1.3 Replacing the Exhaust Filter Element (AR 40-65)

The exhaust filter element has to be replaced with a new one every half year.

⇨ Refer to the Leybold Operating Instructions.

**Whenever replacing the filter elements, the oil must also be changed.**

**When changing the oil in the rotary vane vacuum pump, the oil in the exhaust filter element must also be changed.**

### 7.8.2 Changing the Demister (Filter) in the Rotary Vane Vacuum Pump

**⚠ CAUTION**

**Danger of burns due to hot surfaces!**

- **Pump in operation is hot and some surfaces could reach a temperature higher than 60°C. There is a risk of burn by touching.**

The demister (filter) in the rotary vane vacuum pump must be changed every half year to avoid any oil loss in the rotary vane vacuum pump.

(⇨ Refer to Leybold Operating Instructions.)

**When replacing the demister (filter), the oil must also be changed.**

**When changing the oil in the rotary vane vacuum pump, the oil in the exhaust filter AR 40-65 must also be changed.**

**Ensure that the pumping system is “OFF”, the turbo-frequency is on zero and the fore line is vented.**

**For any work on the rotary vane vacuum pump Oerlikon Balzers recommends to pull out the pump system from underneath the process chamber.**

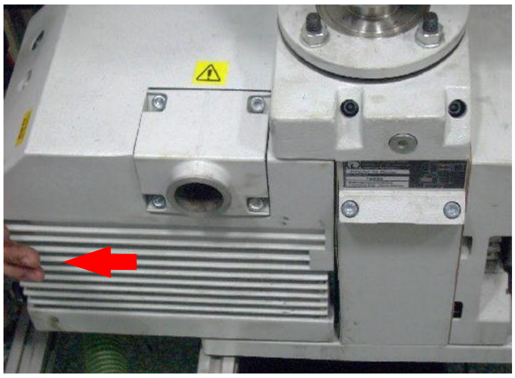
1. Remove the fuses for the fore pumps.
2. Switch off the compressed air to the machine.
3. Drain the oil.


4. Remove the exhaust filter AR 40-65.
   (⇨ Refer to chapter 7.7.3).

5. Remove the gas dilution (for the newer types of gas dilution remove the hose).

6. Remove the 6 long Allen key bolts mounted in the deep holes.

7. Remove the pumping housing of the rotary vane vacuum pump.



8. Remove the demister (filter) cover and clean it with Isopropanol.

9. Remove the (old) demister (filter).

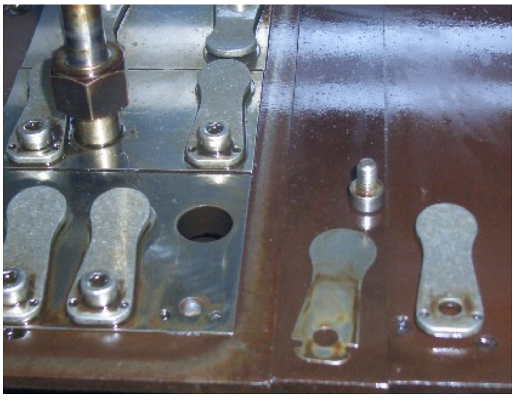
**The demister (filter) in the photo is broken which will lead to bad pumping speed.**

10. Thoroughly clean the pumping housing and all accessible parts from sludge and oil residues.

**Use a clean lint-free cleaning paper.**

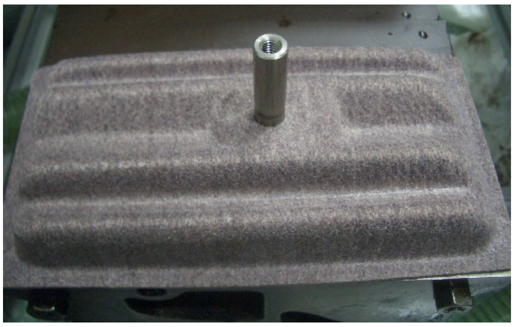
11. Check if the 7 valves are ok.

**A broken valve leads to bad pumping speed.**



12. Clean the sealing surfaces with Scotch Brite and then with Isopropanol.

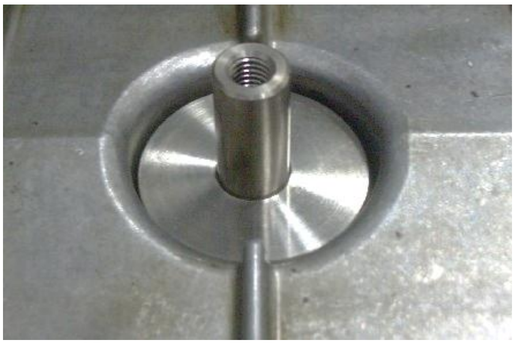
13. Mount a new demister (filter).



14. Mount the cleaned cover.

15. Mount a new O-ring.

16. Mount the sealing washer.



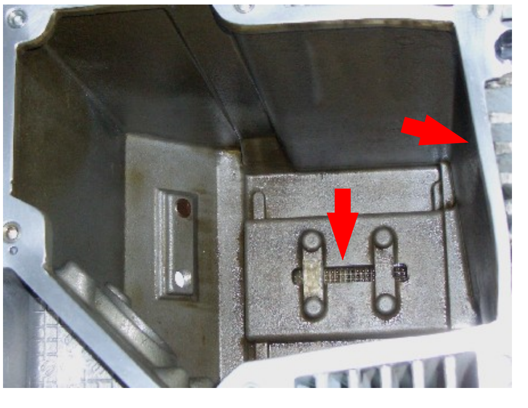
17. Mount the spring, the washer and tighten the screw.

18. Mount a new oil tank seal.

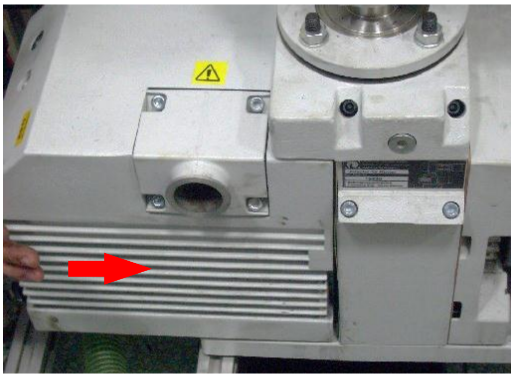
19. Remove all remaining oil and clean the oil tank housing with Isopropanol.

20. Clean the sealing surfaces with Scotch Brite and then with Isopropanol.

**Ensure that the sight glass is clean.**



21. Re-assemble the pumping housing of the rotary vane vacuum pump.



22. Fill in fresh N62 oil up to two thirds of the sight glass, (use the gas dilution hole to fill in the oil).

23. Remount the gas dilution.

24. Remount the exhaust filter AR 40-65.

25. Switch on the compressed air to the machine.

26. Replace the fuses for the fore pumps.

27. Check the oil level after the pump has run for a couple of hours, the level of the oil should be in the middle of the sight glass.

### 7.8.3 Changing the Filter Elements of the Exhaust Filter AR 40-65

**Ensure that the pumping system is “OFF” and the fore line is vented.**

1. Drain the oil from the exhaust filter AR 40-65 and remove the exhaust hose.

2. Loosen the screw for the oil return pipe.at the exhaust filter AR 40-65 (approx. 1 turn).

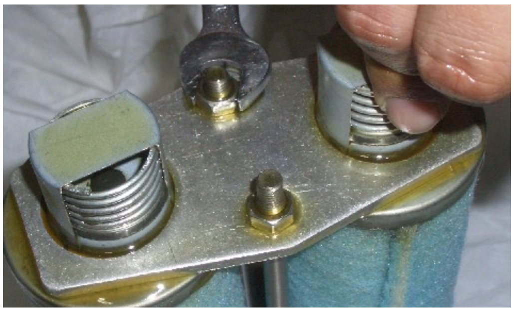
**Do not remove the screw.**

3. Remove the screw and the sealing washer for the oil return pipe on the rotary vane vacuum pump.

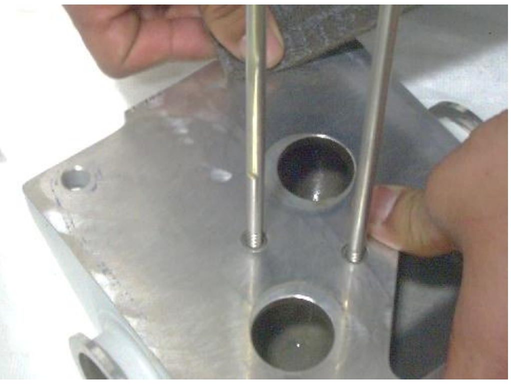
4. Remove the clamp, the centering ring with the O-ring and then the filter housing.

5. Remove the four screws and pull out the top of the filter housing incl. the two filter elements.

6. Remove the two nuts, the bridge and the two filter elements.



7. Clean the sealing surfaces with Scotch Brite and then with Isopropanol.



8. Mount two new filter elements.

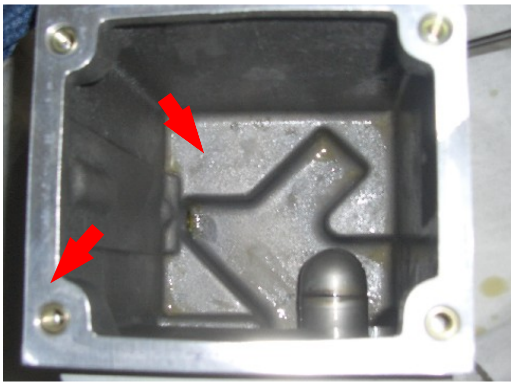
**Ensure they are centered over the holes.**

9. Remount the bridge and the two nuts.

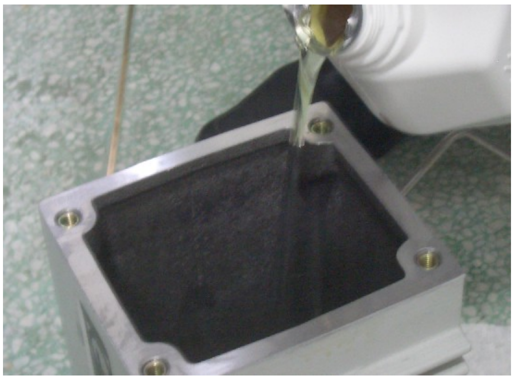
**Do not over tighten the nuts.**

10. Remove all oil from the filter housing and clean it inside.

11. Clean the sealing surfaces with Scotch Brite and then with Isopropanol.



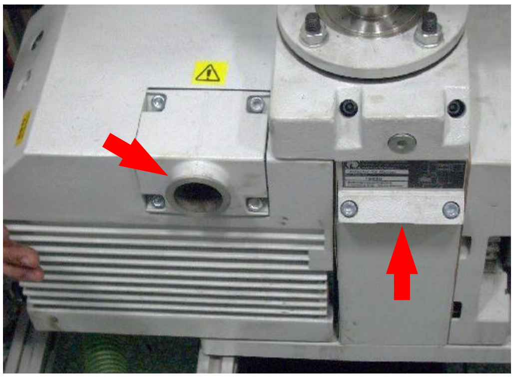
12. Refill with N62 oil up to the “floating valve” (approximately 300ml).



13. Mount a new seal.

14. Insert the top of the filter housing incl. the two filter elements and tighten the 4 screws.

15. Clean the sealing surface for the oil return pipe and the filter housing using Isopropanol.



16. Clean the O-ring and mount the filter housing on the pump using the clamp.

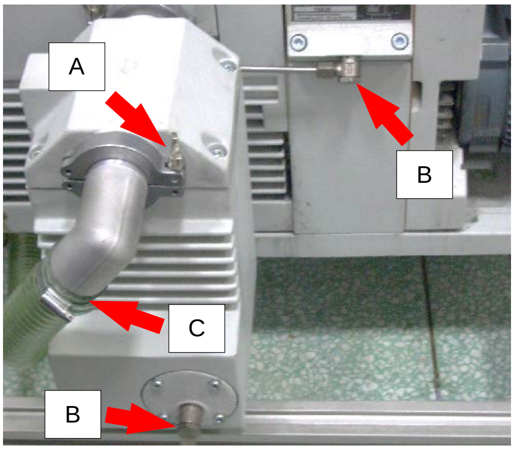
**Do not tighten the clamp yet.**

17. Clean the O-rings on the screw and sealing washer.

18. Remount the oil return pipe with the sealing washer and screw.

**Do not tighten the screw yet.**

19. Adjust the angle of the filter housing and tighten the clamp (A).
20. Now tighten the screws (B) for the oil return pipe on the filter housing and on the pump.
21. Remount the exhaust hose (C).



## 7.9 Carousel Maintenance

This is an example for the 4 spindle carousel. Use the same workflow also for other types.

**All screws must be stainless steel, cleaned with Isopropanol and treated with a mixture of $MoS_2$ and Isopropanol before use.**

**Consumables:**

- $MoS_2$ powder
- Graphite powder
- Isopropanol
- Cleaning gloves

**Spare parts:**

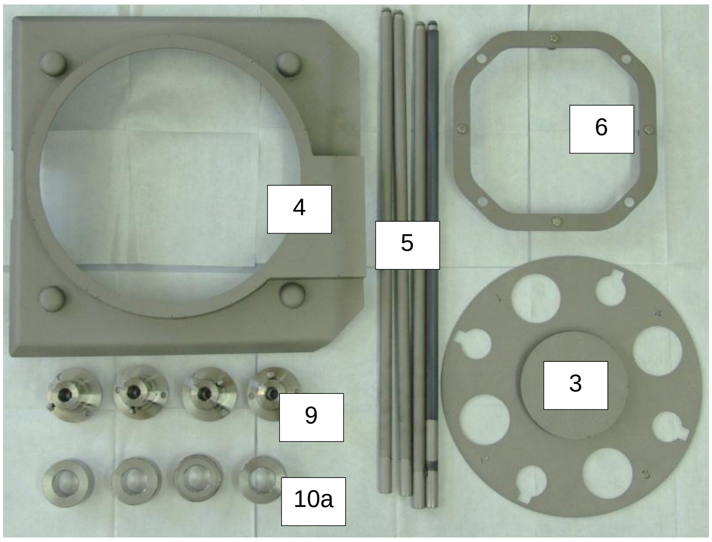
- 4 new special screws M6 X 20 (BB489337) (11)
- 8 new screws M6 X 16 (N3059339X) (24)
- 16 new screws M4 X 6 (N3052249X) (C)
- 16 new screws M5 X 8 (N3052289X) (D)

### 7.9.1 Sandblasting the Carousel

Coated surfaces of the carousel must be sand blasted to guarantee constant coating quality, adequate pumping time and protection of the tools from overheating.

**Sandblast:**

- Retainer ring (6)
- Flicker posts (5)
- Sleeves (10a)
- Top cover (4)
- $2^{nd}$ cover (3) (top part)
- Flicker post holders (9) incl. screw (11)




**During blasting leave the screw in place to protect the thread during blasting.**

**Do not sandblast:**

- Flicker holders (A) and flickers (B)

**After sandblasting, ensure that all parts of the carousel are free of residual sand and also clean with Isopropanol.**

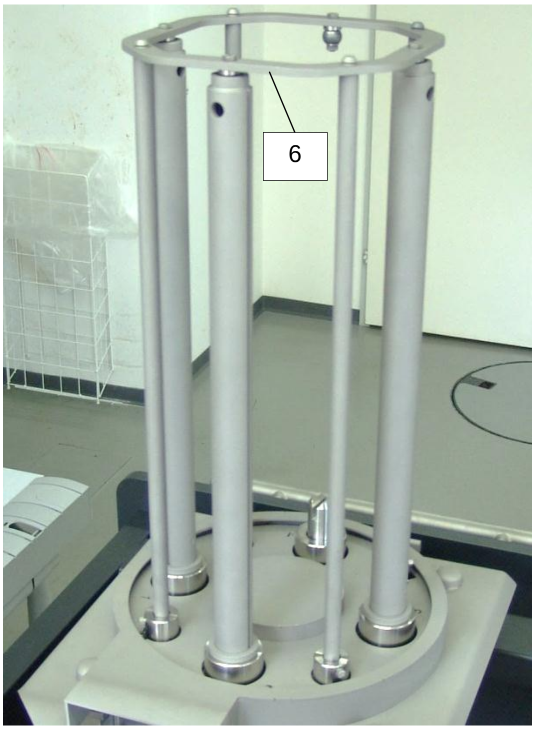
### 7.9.2 Disassembling the Carousel

**Removing retainers, flicker posts (flicker holders & Flickers), tubes and covers:**

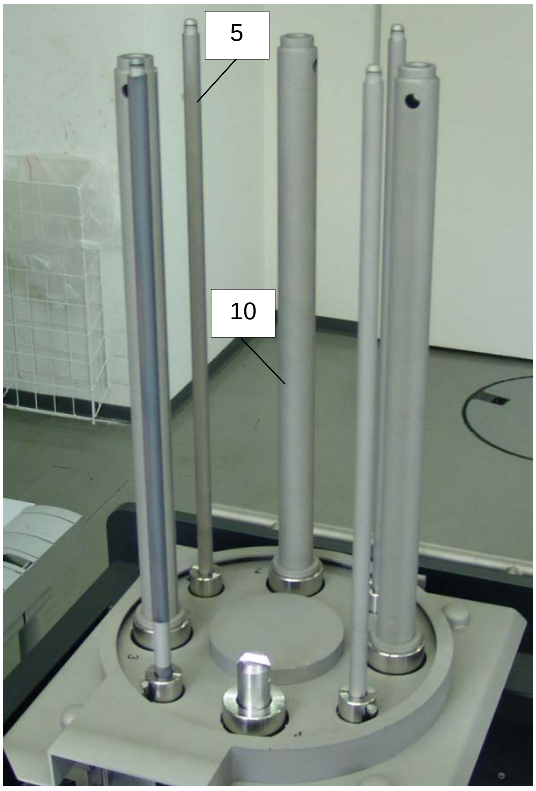
1. Remove the retainer ring (6).

**Check the diameter of the (retainer) balls (min. Ø=17.5mm). If the ball is worn out, remove it prior to sandblast.**

**Cover the balls for sandblasting.**

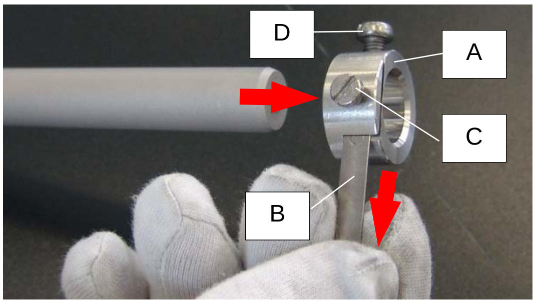



2. Remove all flicker posts (5) and tubes (10).

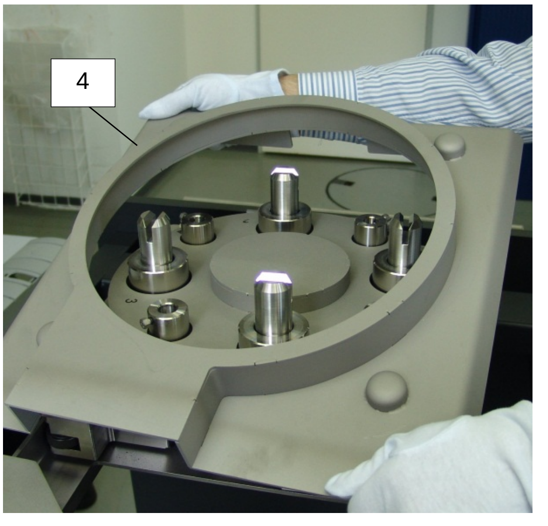


3. Remove the flicker holders (A) and flickers (B) from the flicker post, (do not sandblast them) by unscrewing the screws (C, D).

**On re-assembly replace the screws with new ones.**



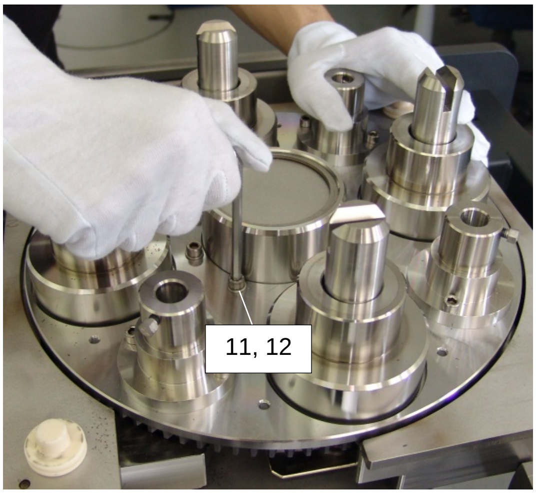

4. Remove the top cover (4).




5. Remove the 2nd cover (two-part) (3).

**Removing the upper section from the lower section:**

1. Remove 8 screws (11) incl. washers (12)…

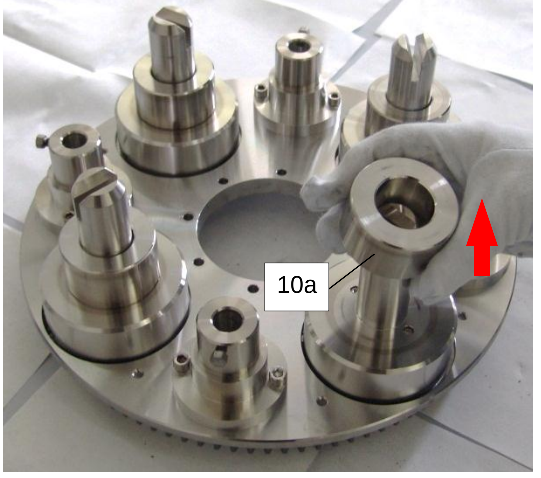



2. …and lift the complete upper section (2).

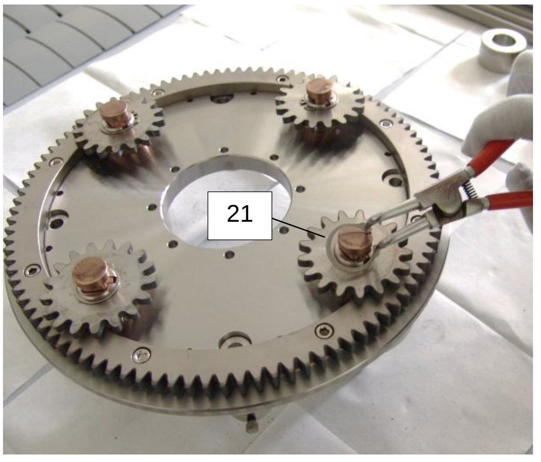
**Disassembling a spindle bearing:**

This explanation shows the disassembling of only one spindle bearing. This workflow must be repeated for all 4 spindle bearings.

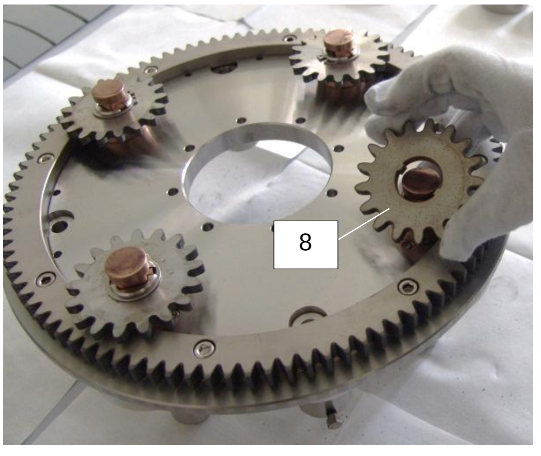
1. Pull out the sleeve (10a).



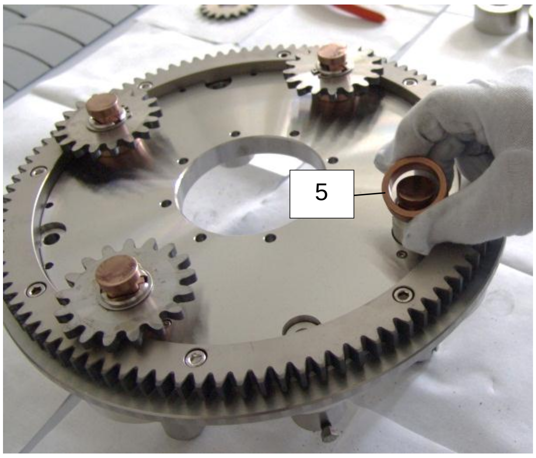

2. Turn over the upper section and remove the retaining ring (21),...



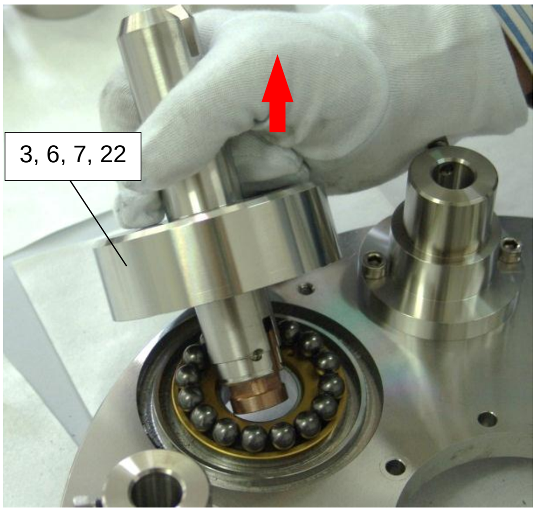

3. …the cogwheel (8)…



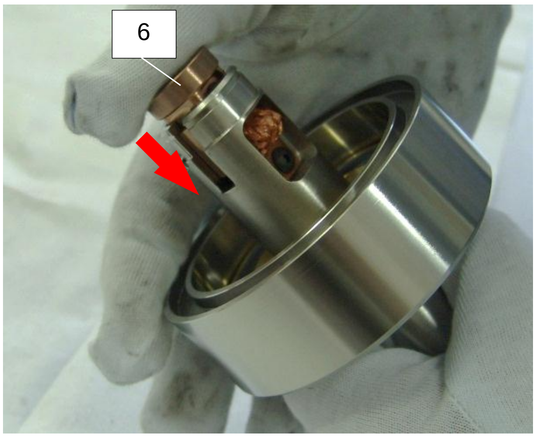
4. …and the distance ring (5).



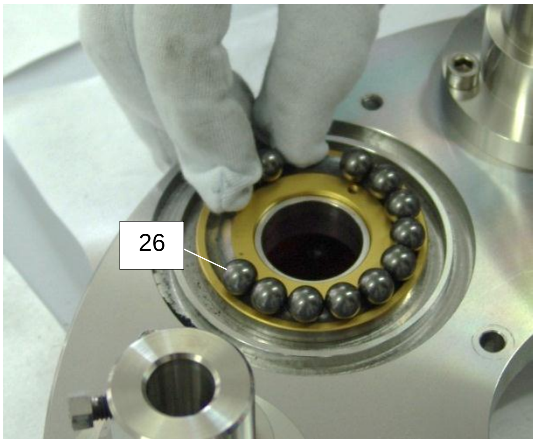

5. Turn over the upper section and lift the spindle support assembly (3, 6, 7, 22).



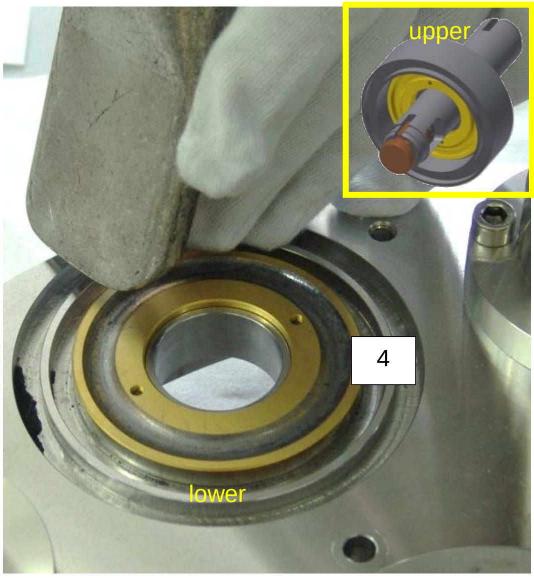

6. Check the spring pressure and/or the movement of the copper brush (6) (max. 2mm).
7. Check the abrasive wear of the copper brushes (6).



8. Remove the 16 carbide balls (26).

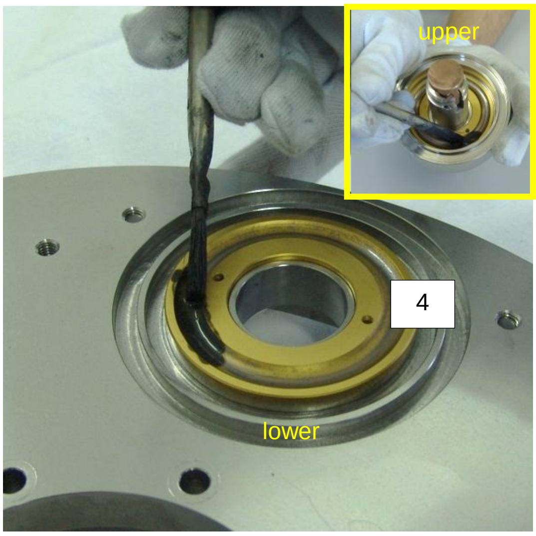



9. Vacuum the (upper & lower) race tracks (4) and clean them thoroughly with an Isopropanol soaked cleaning paper.




10. Treat the (upper & lower) race tracks (4) with a mixture of graphite powder and Isopropanol.

The picture beside shows the correct amount of lubrication.

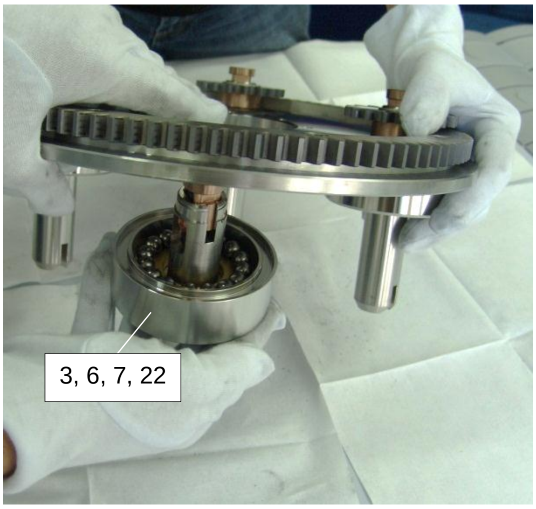


11. Clean all 16 carbide balls with Isopropanol.

**Exchange the bearing balls with new ones if required.**

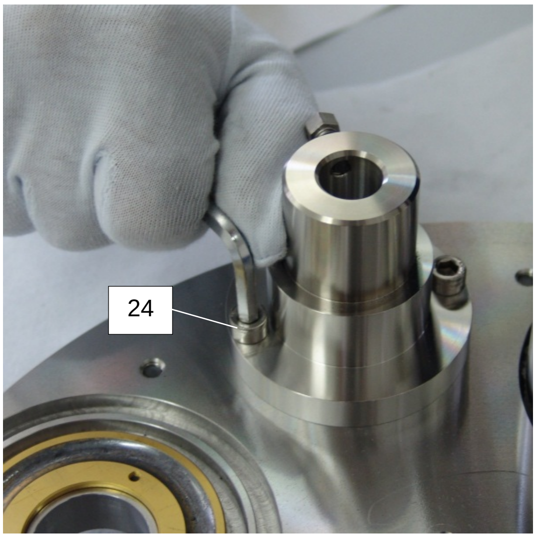
12. Insert all 16 carbide balls into the spindle support (one space is free).

13. Place the spindle support assembly (3, 6, 7, 22) as shown in the picture beside and check for smooth rotation.



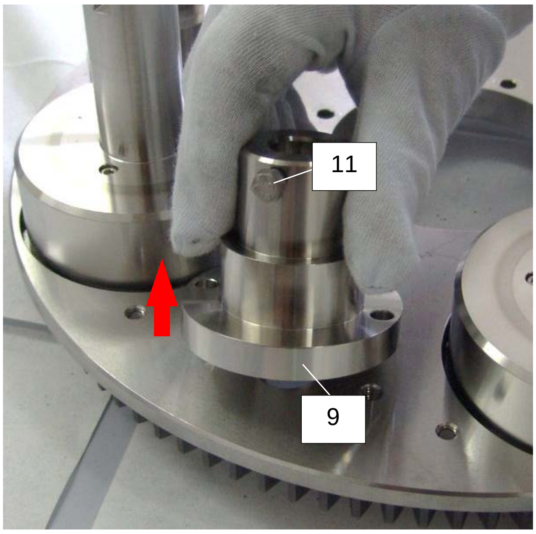

**Removing the Flicker post Holder:**

1. Unscrew 2 screws (24) and…



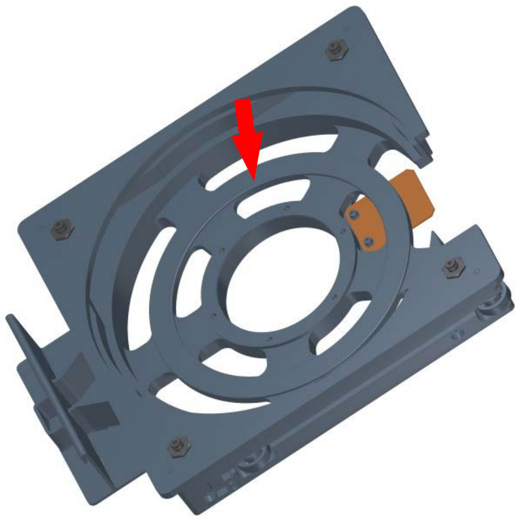
2. …remove the flicker post holder (9) incl. screw (11).

**Leave the screw (11) in place to protect the thread during blasting. After blasting replace the screw with a new one.**




**Checking the contact ring in the lower section:**

1. Check visually the abrasive wear of the contact ring.
2. If necessary clean it with the vacuum cleaner.

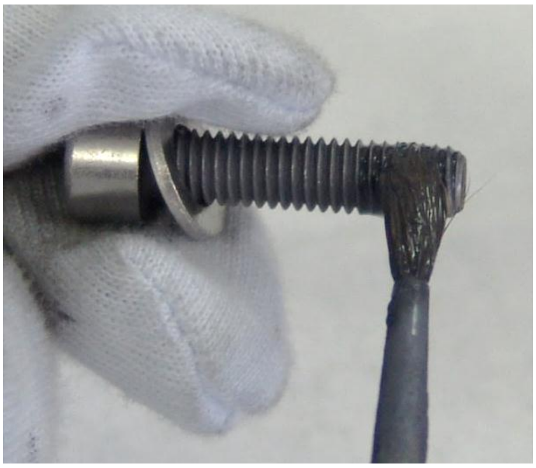


### 7.9.3 Sandbloasting

1. Sandblast retainers (6), flicker posts (5), top cover (4), 2nd cover (top part) (3), sleeves (10a) and flicker post holders (9) incl. screws (11).

**All sand-blasted parts must be wiped with Isopropanol.**

**All screws and bolts used on the carousel must be stainless steel. When installing, they must always be cleaned with Isopropanol and treated with a mixture of $MoS_2$ and Isopropanol.**

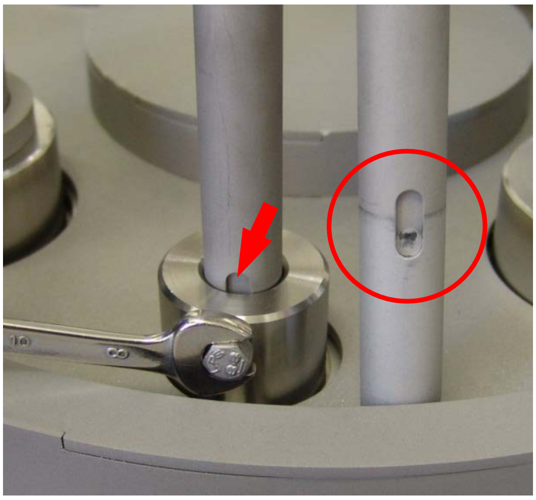


### 7.9.4 Assembling the Carousel

1. Re-assemble the carousel in reverse order.

**On re-assembling:**

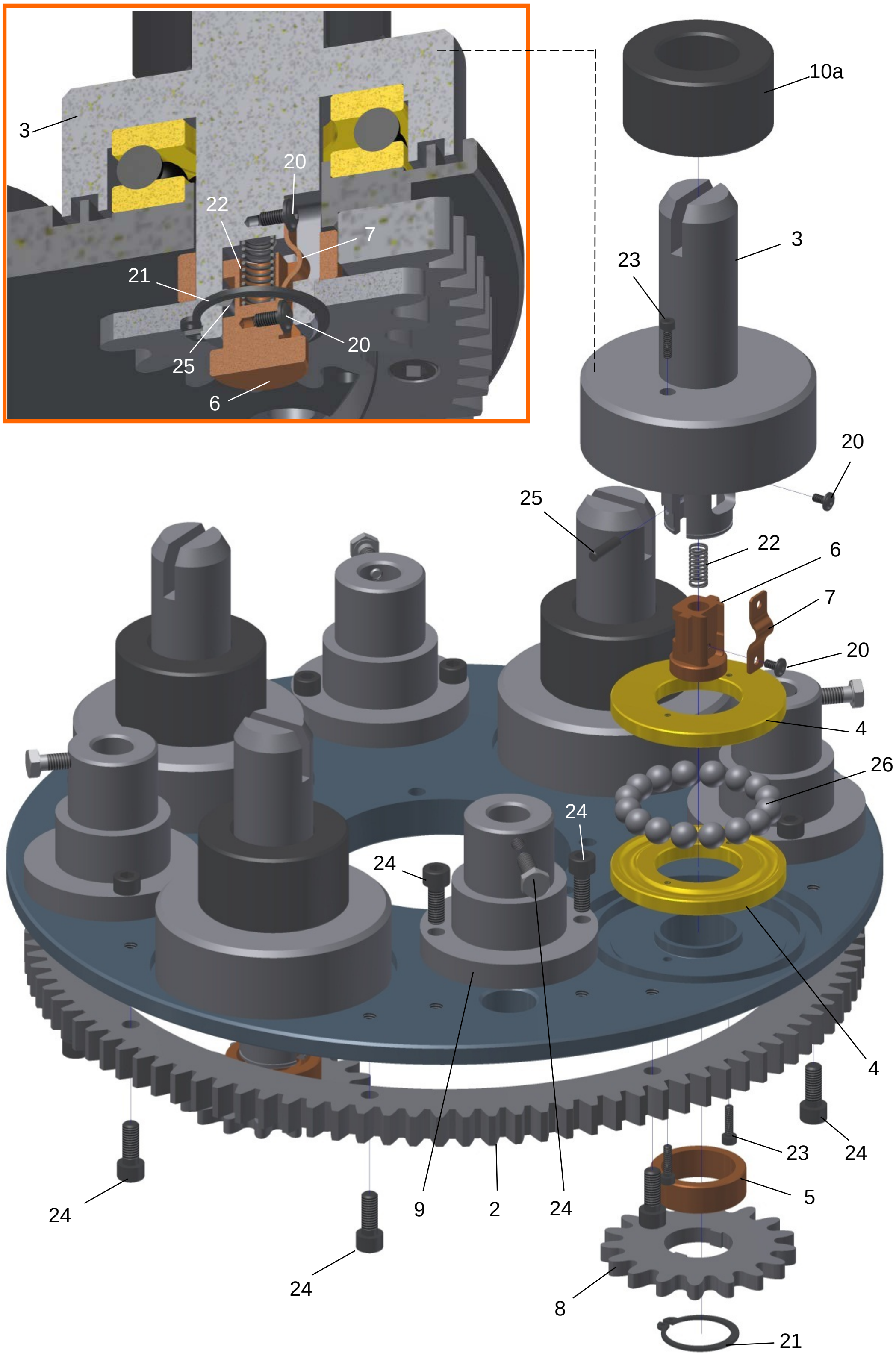
Ensure that the flicker posts are inserted correctly as shown in the picture beside.



2. Manually rotate the carousel and check for smooth operation.
3. Heat and coat the carousel in a short Balinit® A process.

   This Balinit® A layer reduces the outgassing from the carousel and the next sand blasting will be much faster.

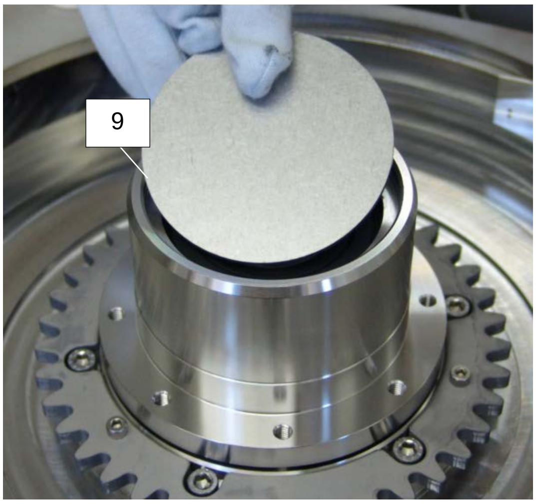
#### 7.9.4.1 Overview Picture of the Upper Section



### 7.9.5 Disassembling the Central Bearing

1. Remove the upper retaining ring (21).

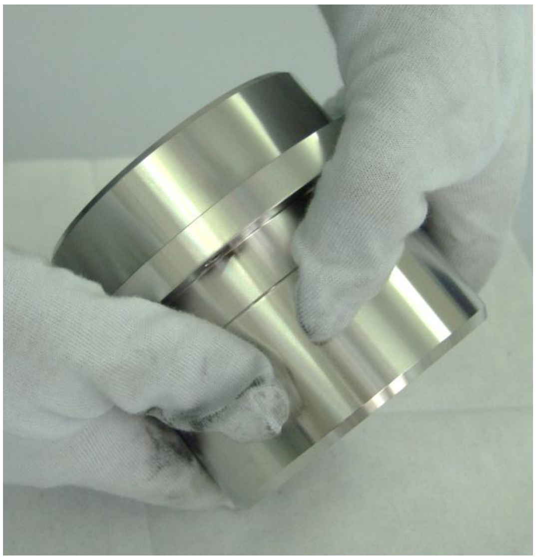

2. Remove the cover (9).



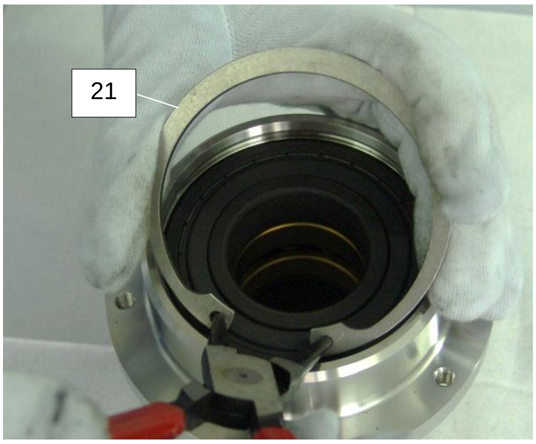

3. Remove the retaining ring (20).

4. Pull out the central bearing assembly from the crankshaft (7).

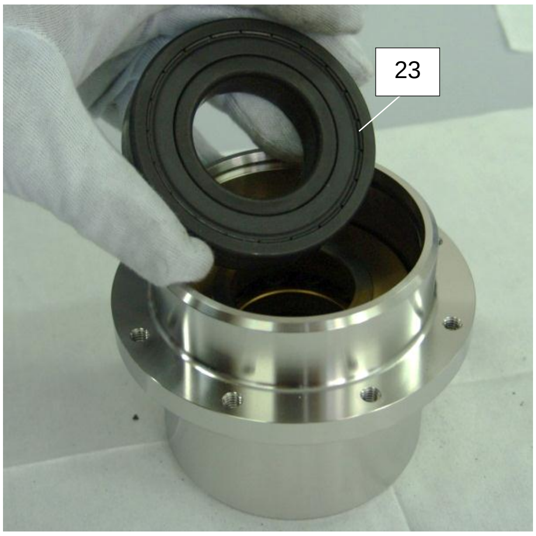

5. Turn over the central bearing assembly.



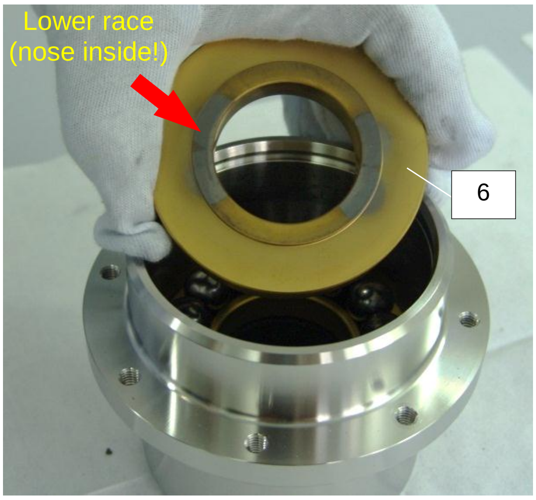
6. Remove the lower retaining ring (21).



7. Remove the radial bearing (23),…




8. …the axial bearing (lower race) (6),…




9. …the 12 carbide balls (24),…

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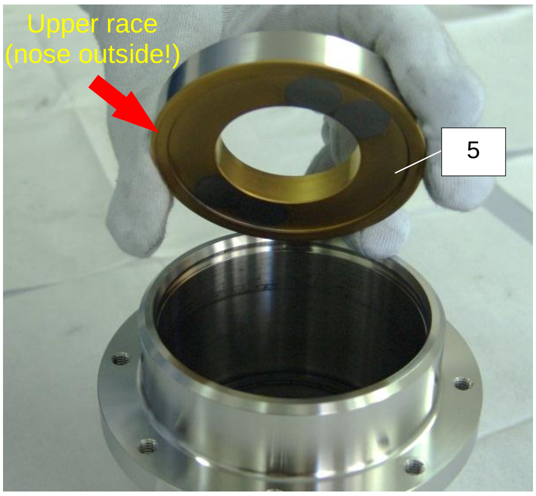
balzers

10. …and the axial bearing (upper race) (5).

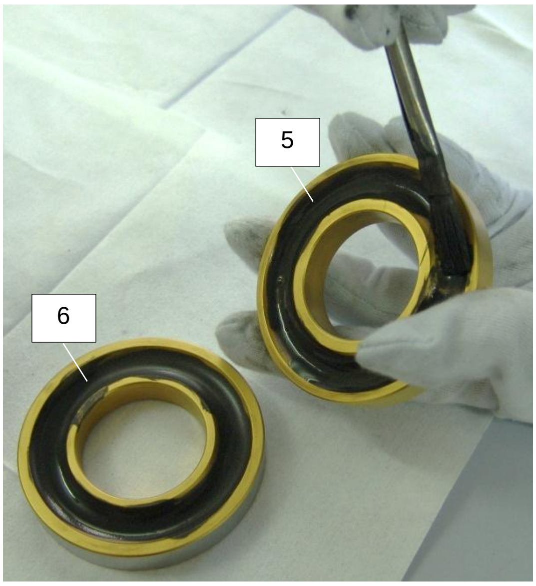
11. Clean the housing with an Isopropanol soaked cleaning paper.




12. Clean the (upper & lower) race tracks (5, 6) thoroughly with an Isopropanol soaked cleaning paper.

13. Treat the (upper & lower) race tracks (5, 6) a mixture of graphite powder and Isopropanol.

    The picture beside shows the correct amount of lubrication.

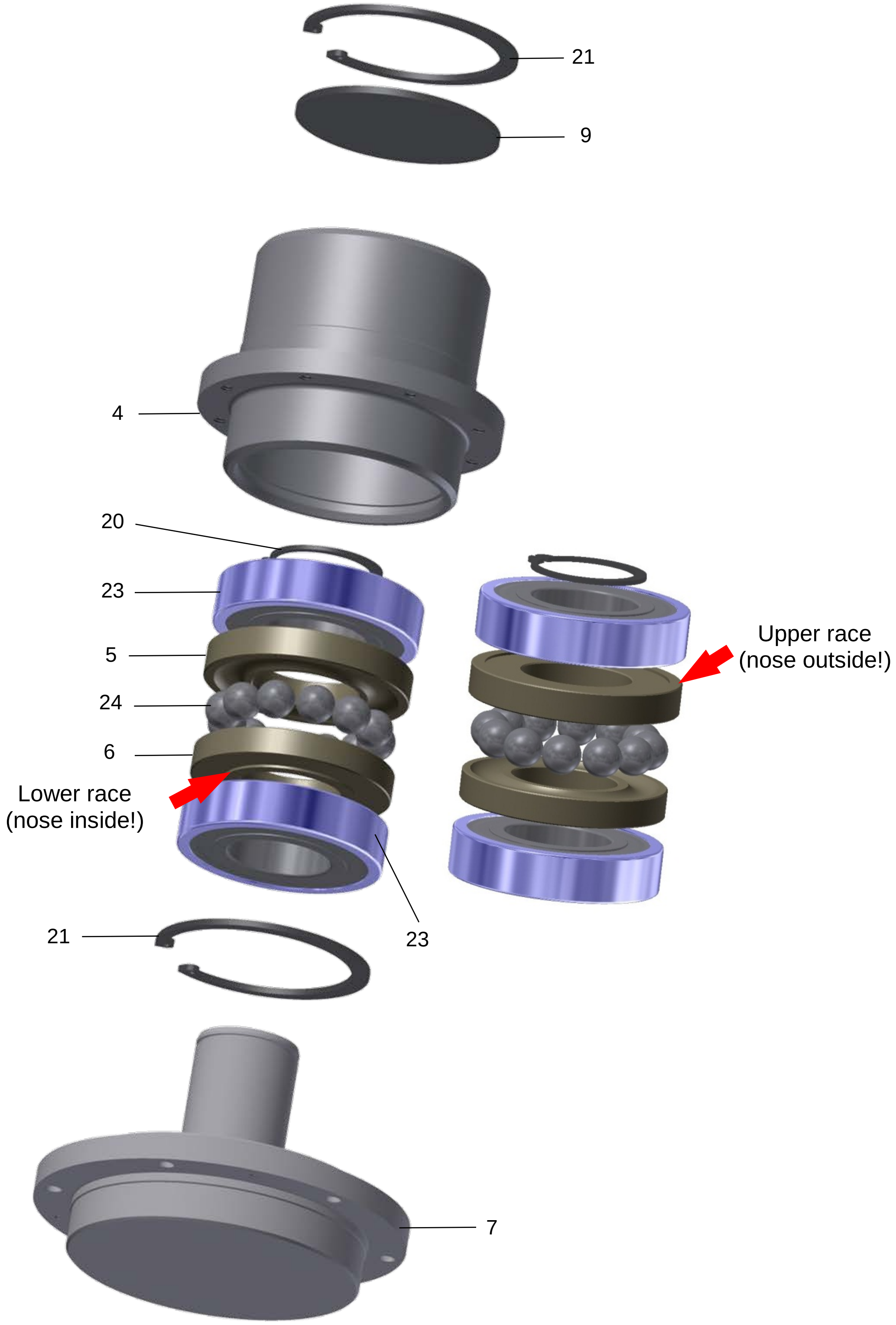



14. Re-assemble the central bearing in reverse order.

15. Manually rotate the carousel and check for smooth operation.

16. Run a A1 process for conditioning the carousel.

#### 7.9.5.1 Overview Picture of the Central Bearing



## 7.10 Maintenance of the Heaters

**⚠ CAUTION**

**Beware of material flaking-off in the process chamber. During coating, the carousels and the shielding are coated!**

- **During all maintenance and cleaning work in the process chamber, avoid creating dust. Wear a breathing mask with a type P3 filter, eye protectors and appropriate protective clothing. Do not eat, drink or smoke.**
- **Carefully read the safety data sheets of the coating materials being used. Adhere to the safety instructions given in them.**

**⚠ CAUTION**

**Danger of crushing!**

- **Be careful when closing the process chamber door. Due to its weight it may cause injury.**
- **Open and close the process chamber door only by means of the process chamber door grip.**

**Danger of burns due to hot surfaces!**

- **Ensure that the radiation heaters have cooled down before starting any maintenance or service activities.**

### 7.10.1 Cleaning or Removing the Heaters / Temperature Measuring Assembly

Heaters must be removed (only) in case of a defect.

**Oerlikon Balzers recommends to keep one complete heater set (externally leak tested) on stock to minimize costs and machine downtime.**

**Care must be taken not to damage the thermocouple connection in front of the heaters (process chamber door side).**

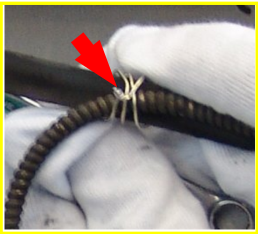
**Two persons are required to remove heaters.**

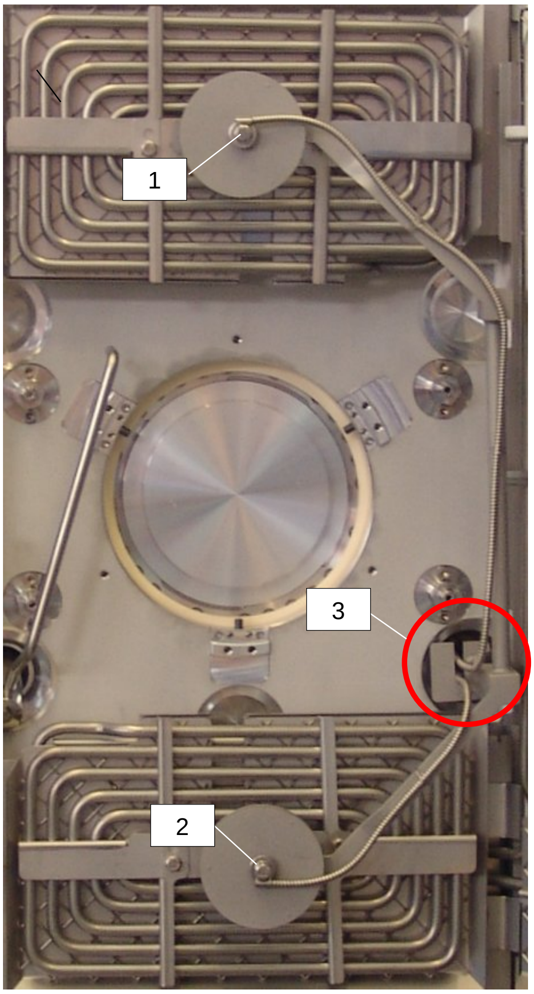
**For removing the heaters from the process chamber a special tool is supplied to open the ring.**

1. Remove the shielding around the heaters (horizontal, vertical).

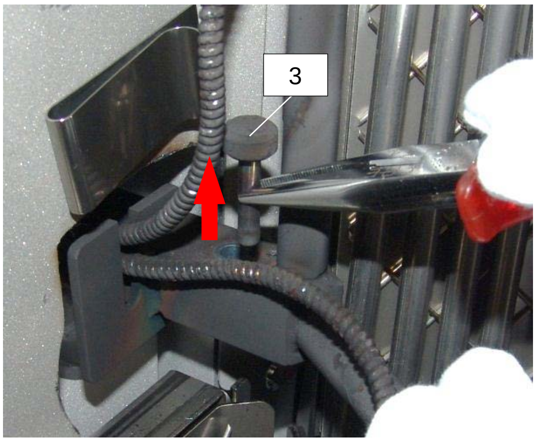
**Prior to remove the respective heater, the thermocouple assembly has to be removed first.**

2. Unscrew the thermocouples (1, 2), untie the thermocouple wire from the rod…

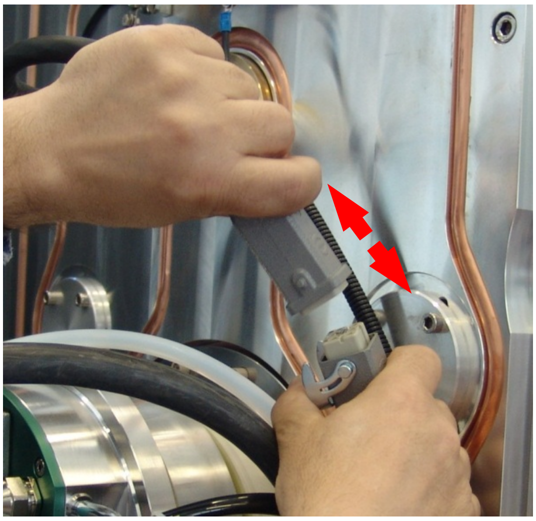




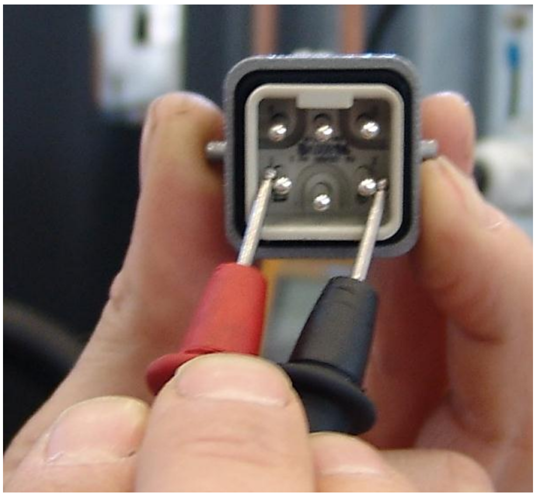
3. …and lift the bolt (3) in order to remove the rod.




4. Unplug the heater…



5. …and measure the resistant of the heating coil by means of an Ohm meter on pin 1 & 2 (approx. 60 Ω).…

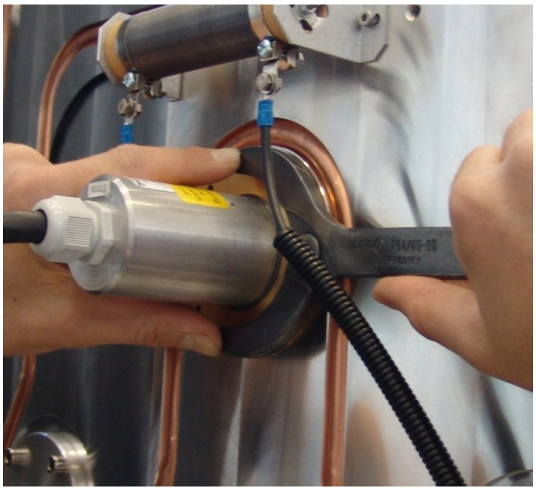


6. …and pin 3 & 4 (approx. 40 Ω).

**If the resistance is too high (>1 kΩ) the heating coil is broken.**

**The resistance, measured from plug (pin 1, 2, 3, 4) to the heat reflector must be (>100 kΩ).**

7. Unscrew the heater from the process chamber.

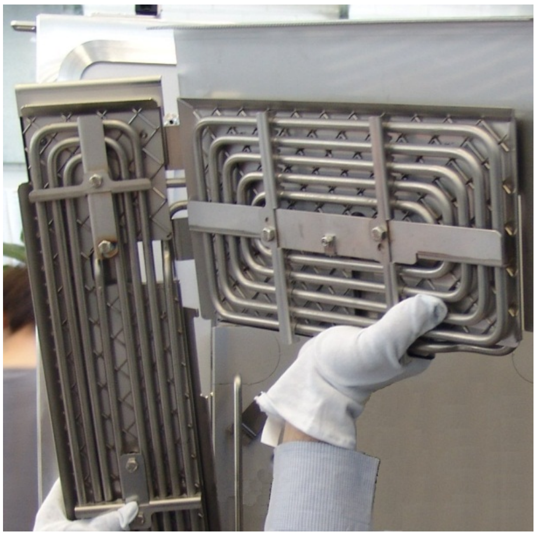


8. Remove the threaded ring.

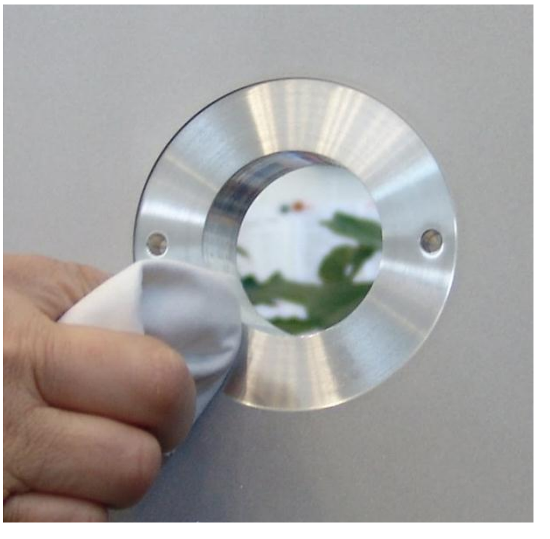
9. Remove the Heater and put it on a desk.

10. Wire brush the heater.

**Do not sandblast the heater.**



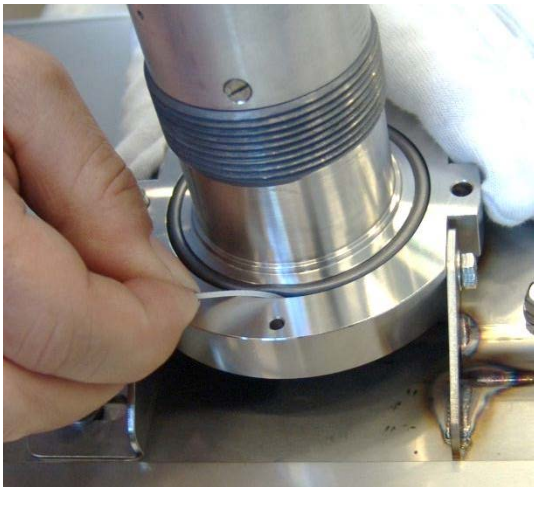
11. Clean the sealing surface (inside the process chamber) with an Isopropanol soaked cleaning paper.



12. Prior to remove, moisten the O-ring of the heater with Isopropanol and wait for a few minutes.

13. Remove the O-ring from the heater by means of a TY-Rap.

**Be careful not to damage or scratch the sealing surface.**



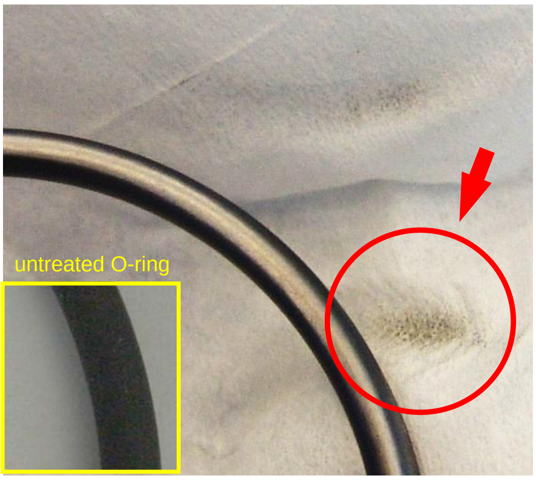
14. Clean the sealing surface with an Isopropanol soaked cleaning paper.

15. Use a new O-ring and treat it sparingly with **dry** $MoS_2$.

16. After treatment of the O-ring, carefully rub off the excessive $MoS_2$ (powder) by means of a dry cleaning paper.

**The picture beside shows the approximate residual amount of $MoS_2$ on the cleaning paper.**

**Consider, too much of $MoS_2$ on the O-ring leads to a leak.**

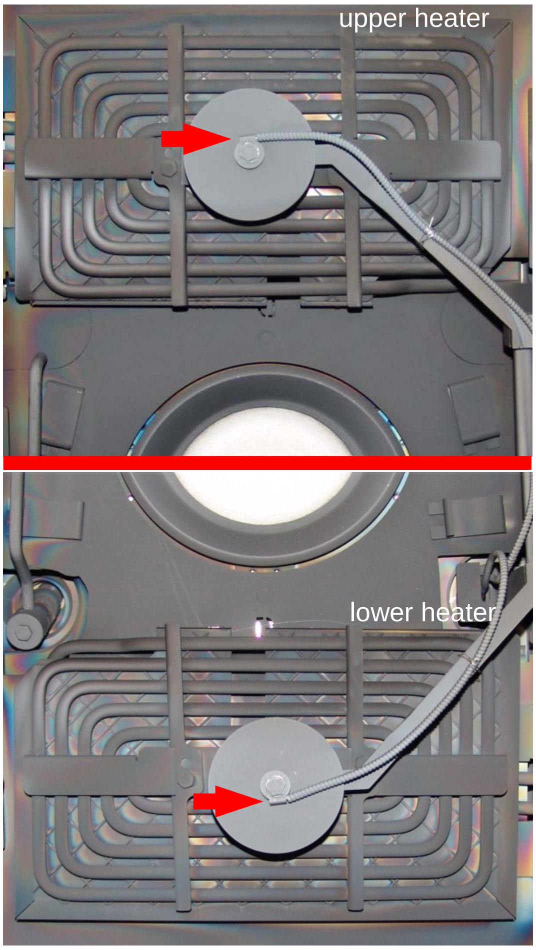



17. Insert the “new” O-ring onto the heater.

18. Reinstall the heater incl. shielding into the process chamber.

19. Install the upper thermocouple on the top of the screw.

**Ensure that the thermocouple is attached as shown in the picture beside. A wrong position (e.g. below the screw at the upper measurement) will lead to a faulty temperature measurement.**




20. Install the lower thermocouple on the bottom of the screw.

**Ensure that the thermocouple is attached as shown in the picture beside. A wrong position (e.g. above the screw at the lower measurement) will lead to a faulty temperature measurement.**

21. Perform a complete leak test with the next batch.

22. Run a AP3 process.

**In order to sustain the thermal balance of the process chamber, the heaters must be coated in black color (AP3 process).**

## 7.11 Ion Source

During use the inner diameter of the orifice in the ion source will be enlarged, by sputtering. Check the diameter as per the maintenance schedule. If the inner diameter exceeds **15 mm** the orifice must be exchanged preventively.

| | **⚠ DANGER** |
|---|---|
| | **Beware of high - and dangerous voltage components.**<br>■ **Danger of fatal electric shock when touching high voltage components.** |

⇨ Refer also to explosion drawings BB 525 341-Z and BB 525 138-Z.

### 7.11.1 Checking of the Orifice Ø13

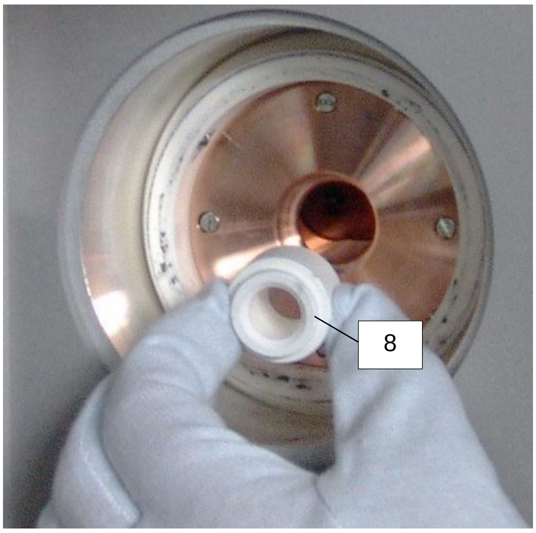
1. Vent the system and open the process chamber.
2. Check the inner diameter (13 mm) of the orifice (8) in the ion source by means of a 14.5mm “GO-NO GO” gauge. If the gauge fits into the opening, the orifice (8) must be replaced with a new one.


**Do not remove the orifice if not necessary ! The ceramic material is sensitive to mechanical shocks.**

## 7.11.2 Inserting of a new Orifice Ø13

1. In case of a material defect or too much enlargement of the inner diameter the orifice (8) must be replaced.
2. Prior to pull out the shielding (9) loosen it carefully by means of a circular motion.
3. Pull out the shielding (9).


4. Replace the orifice (8) with a new one.




**The ceramic material (orifice) is sensitive to mechanical shocks. Do not sandblast it !**

5. Push back the shielding (9).

**When pushing back the shielding pay attention to a click (a low contact pressure.)**

### 7.11.3 Replacement of the Tungsten Filament

**⚠ CAUTION**

**Danger of poor coating quality!**

- **When working with parts which will be exposed to vacuum, clean gloves must be used.**

**⚠ CAUTION**

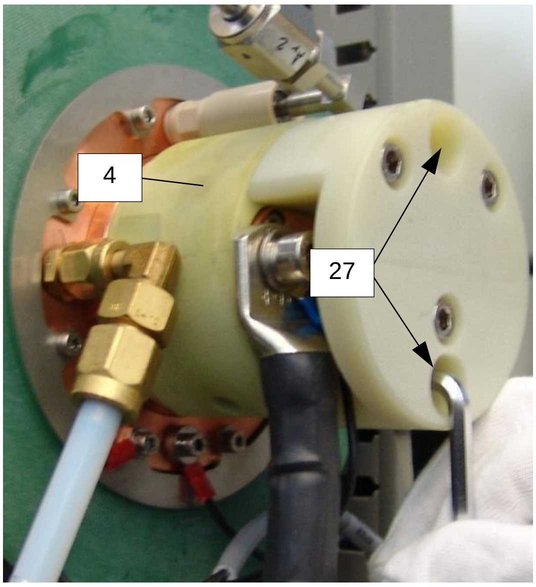
**Danger of flooding the process chamber and surrounding area !**

- **Always blow out the water circuit before removing the filament holder of the ion source.**

1. Vent the system.
2. Blow out the water circuit of the ion source.

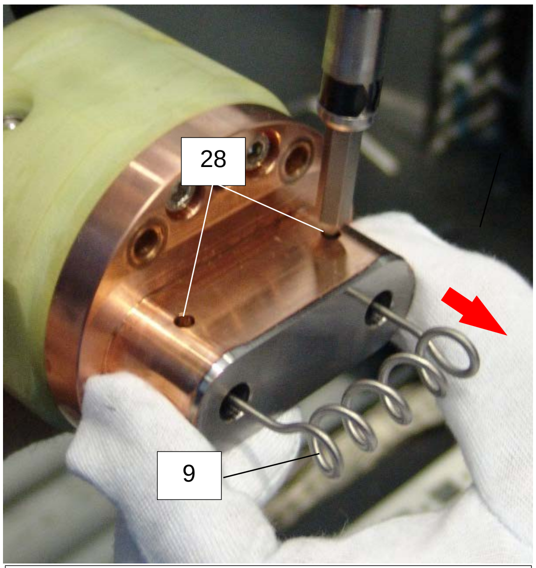
**Remember the “Emergency cooling water OUT /Blow OUT” valve closes after 15 minutes after activation.**

3. Open the ion source by removing 2 screws (27) and lift the filament holder assembly (4).

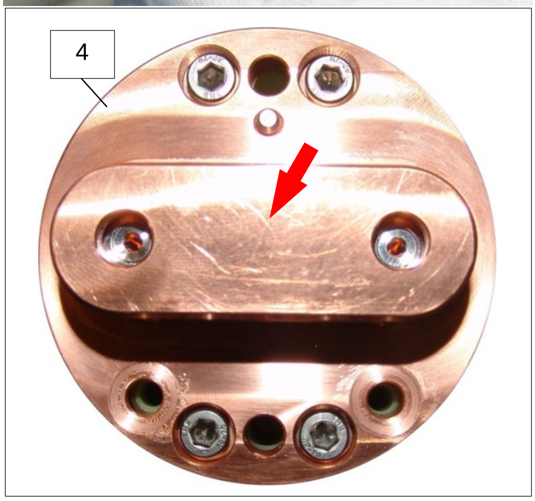


4. Loosen the 2 setscrews (28) and pull out the filament (9).

**Loosen the setscrews (28) only so far until the filament can be pulled out easily.**

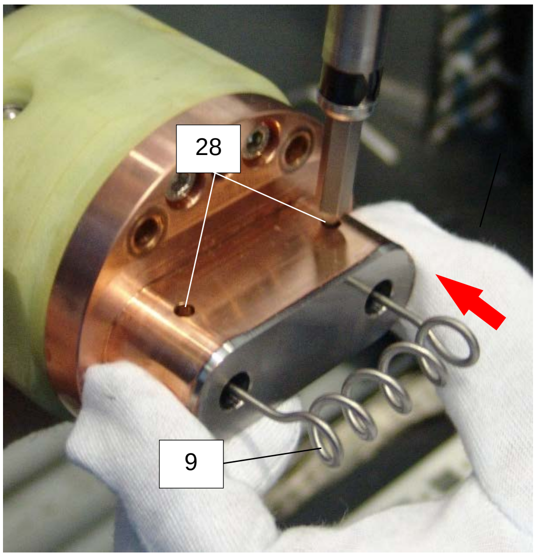



5. Clean the coated surface (remove tinsels) at the top of the filament holder assembly (4) (see arrow) by means of Scotch Brite and Isopropanol.

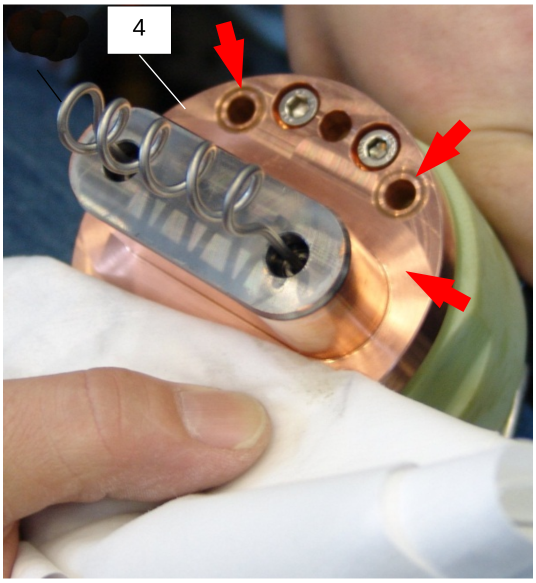



6. Clean a new filament (9) with Isopropanol.

7. Push in the new filament (9) (until to the stop) and tighten the setscrews (28) by means of a **torque screw driver** (120 Ncm).



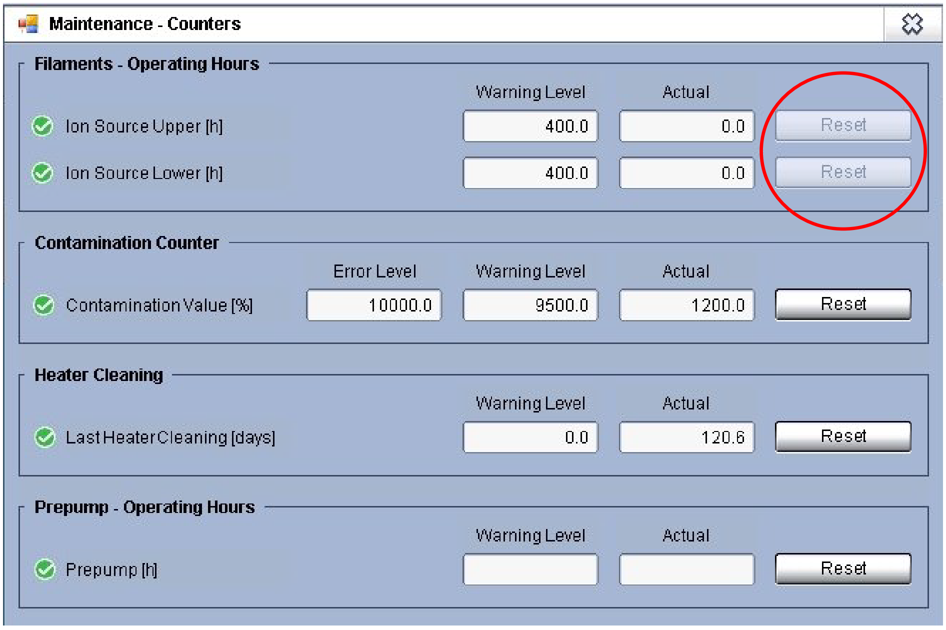
8. Clean the sealing surfaces of the filament holder assembly (4) with an Isopropanol soaked cleaning paper and check the sealing surface (see arrows) for scratches.




9. Close the ion source by replacing the filament holder assembly (4) and screw in the 2 screws (27).

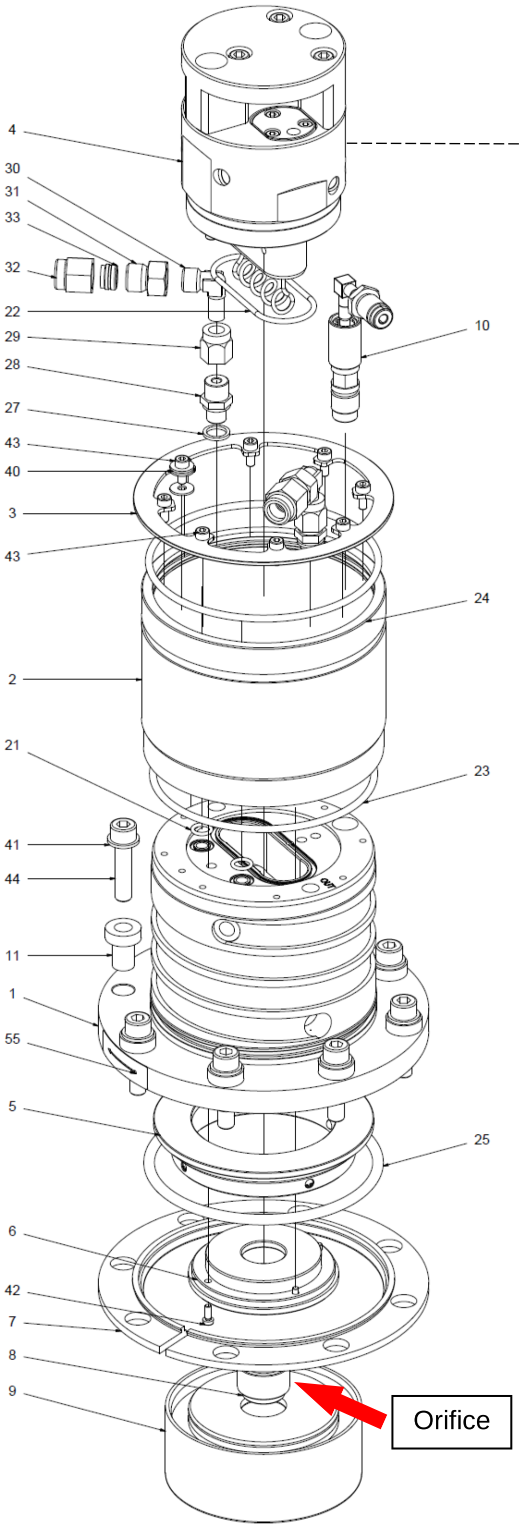
10. Reset filament counter to zero “Popup - Maintenance - Counters”.

(Only in function if the process chamber door is open).

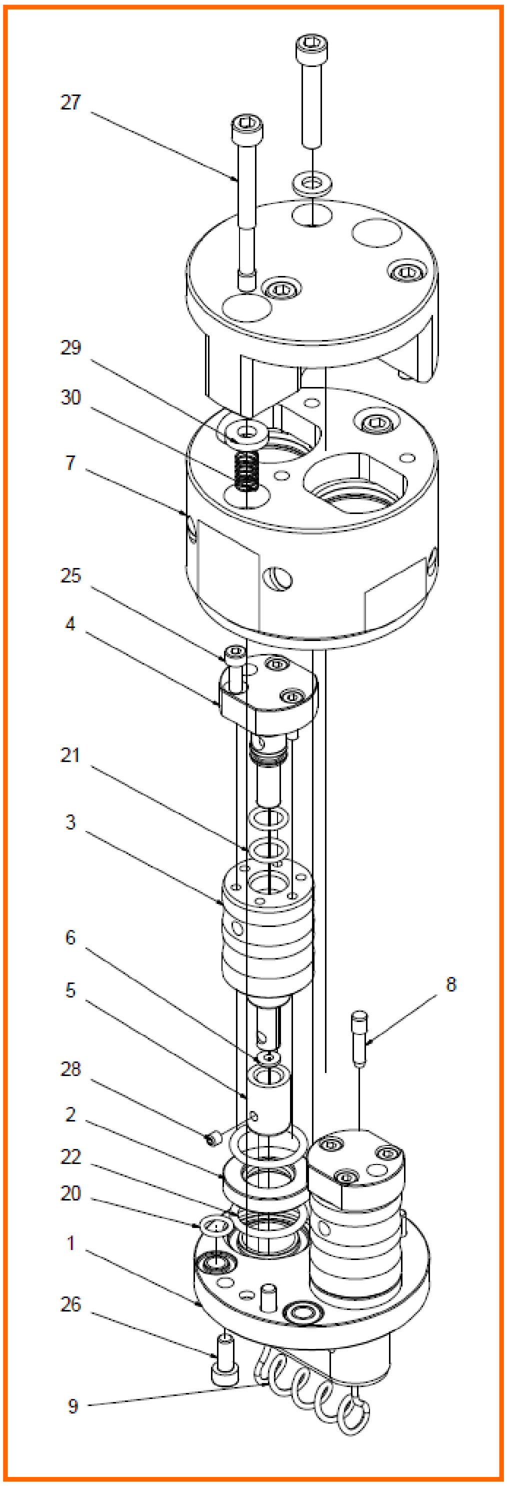


### 7.11.3.1 Explosion Drawing of the Ion Source

**BB 525 341-Z**



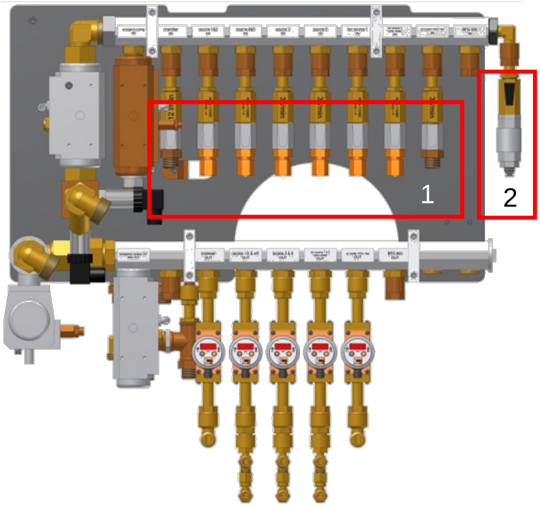

**BB 525 138-Z**



## 7.12 Disassembling of the Arc Sources

(Only to be performed when the Aluminum oxide rings (insulating rings) are either burnt, cracked or a leak is detected).

1. Select the “Popup - Operator - Miscellaneous”.
2. Vent the system by clicking “Vent” (“Process Chamber”).
3. Switch off the process water by clicking “Off” (“Process Water”).
4. Blow out the water:
   a) close all water taps (1)
   b) open the compressed air inlet (2)
   c) open the water tap for the relevant source slowly
   (blow out for approx.30 sec.)
   d) close compressed air (2)
   e) close the water tap (1).

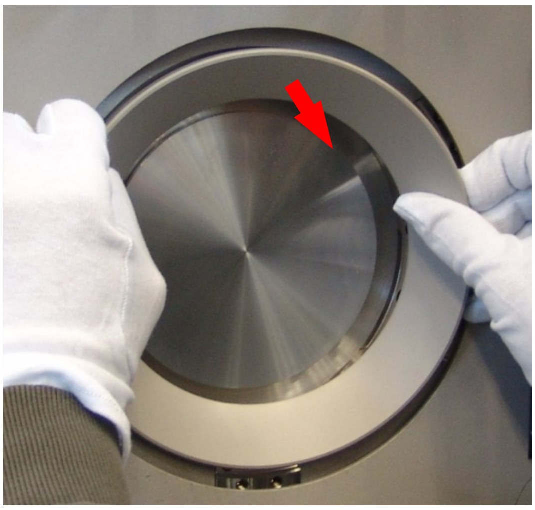



**Remember the “Emergency cooling water OUT /Blow OUT” valve closes after 15 minutes after activation.**

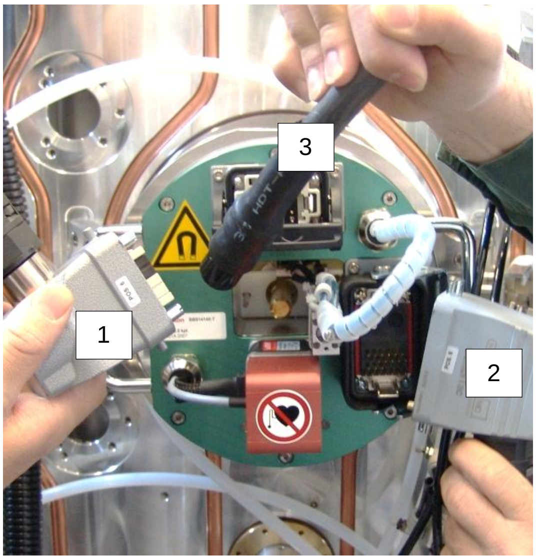
5. Open the process chamber and check (with Ohm meter) the resistance of the shielding within a distance of approx. 1cm.

**If the resistance of the shielding is higher than 250Ω replace the shielding with a sandblasted or new one.**

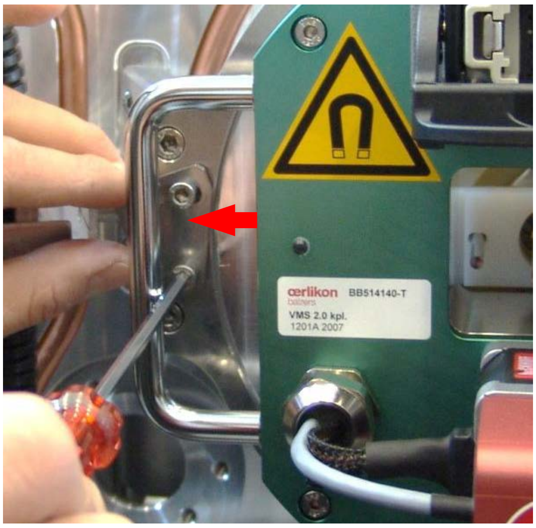
6. Remove the confinement ring.



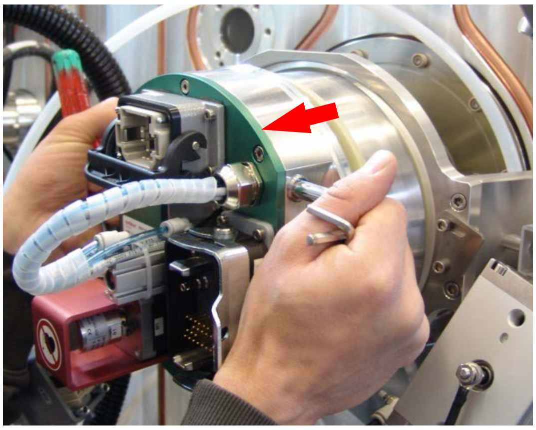
7. Plug off the following connectors:
   - Control signals (1)
   - VMS control (2)
   - ARC current (3)



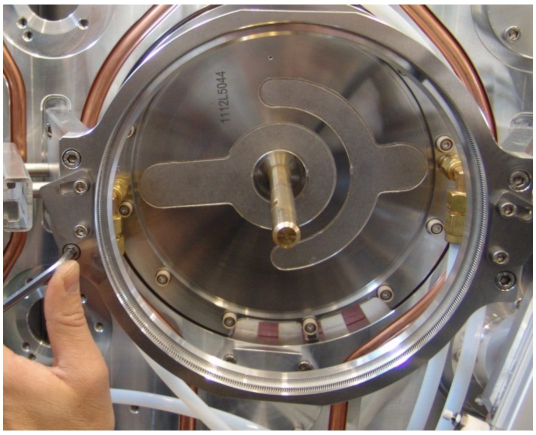

8. Loosen the screws for the locking plates (left and right side) and move the locking plates in outer position.



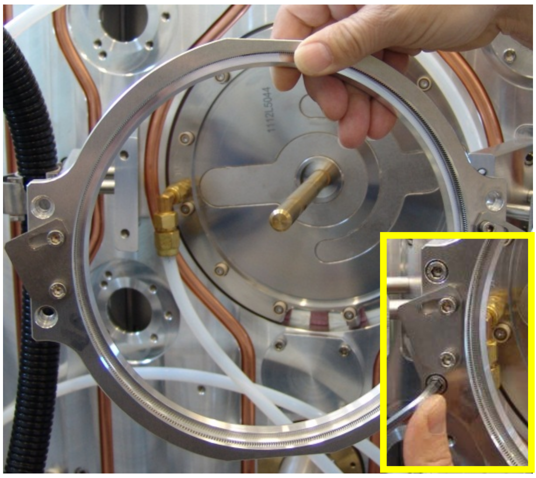
9. Pull out the magnetic system.



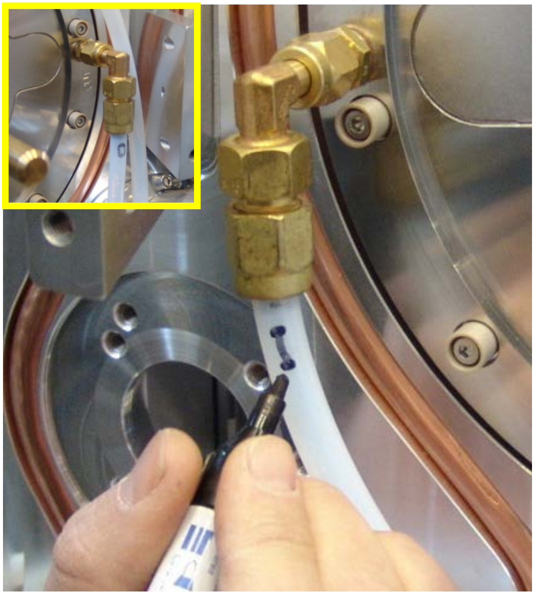
10. Unscrew the 4 screws in order to remove…



11. …the magnetic system bracket.

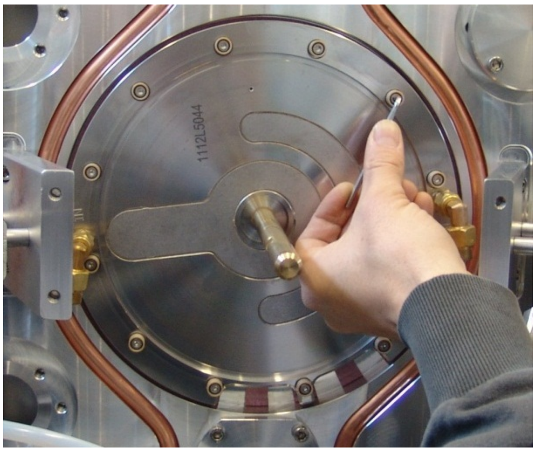


12. Mark the water hoses (IN / OUT) by means of a water resistant pen.

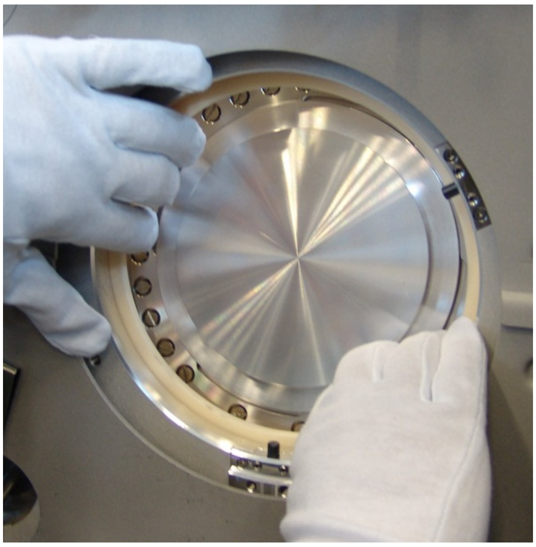


13. Disconnect the two water hoses.

14. Loosen the complete cooling plate assembly by screwing out 12 screws incl. insulators.



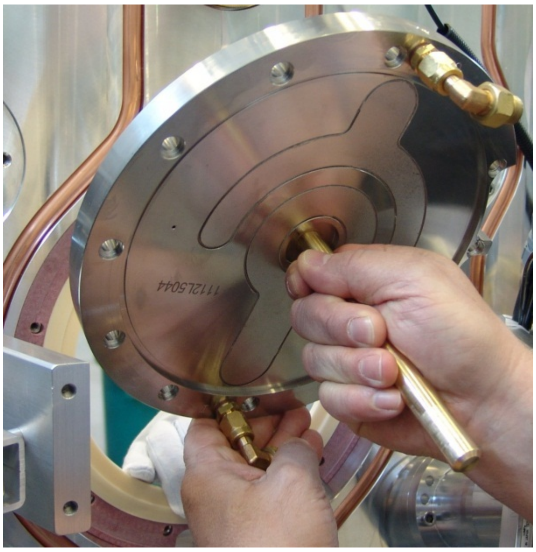
**For removing the cooling plate assembly two persons are required. One person is holding the insulating ring (incl. pressure insulator) in place from inside the process chamber.**



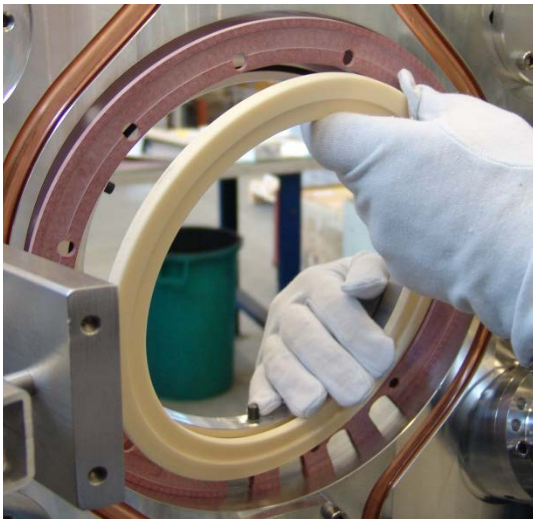
15. Take out the cooling plate assembly and place it in a box or pipe.

**Don’t rest it on the high current connection.**

**If the insulating ring is stuck, spray a little Isopropanol and let it work for approx. 3 minutes.**

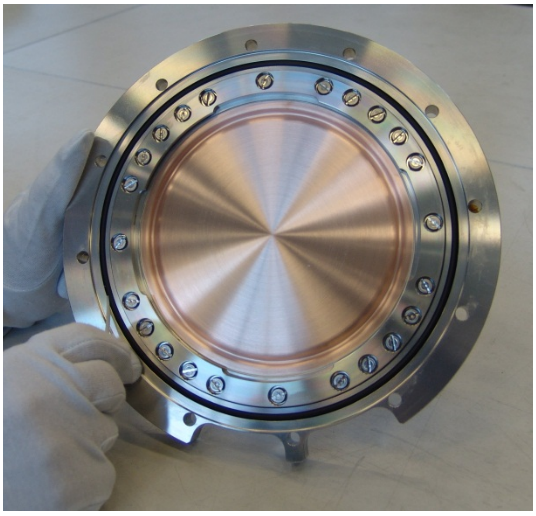


16. Remove the insulating ring and the pressure insulator.



17. Check the sealing surface for dust or scratches.

18. Clean the cooling plate and sealing surface with Isopropanol and replace the O-ring with a new one treated with Apiezon.

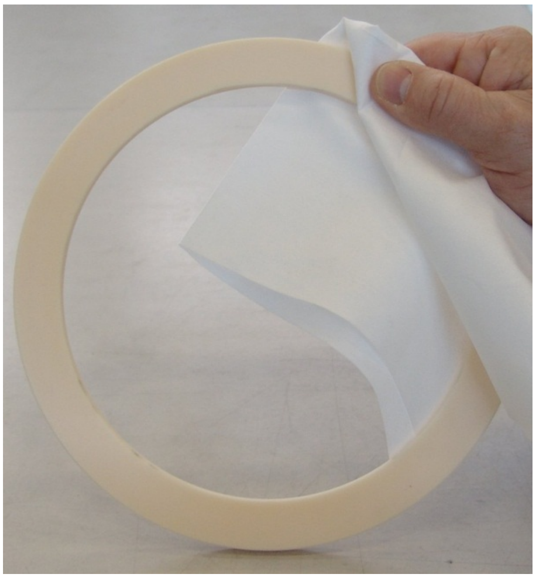


19. Check the sealing surface incl. O-ring for rough particles (such as loose coatings), dust or scratches.

20. Clean the sealing surface incl. O-ring with Isopropanol…

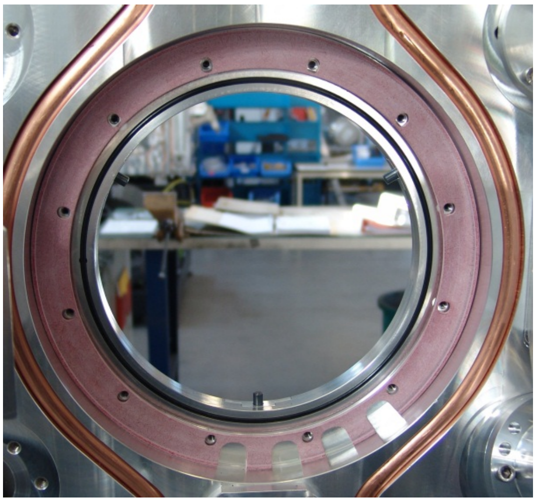
21. …and apply a thin film of Apiezon to the O-ring.

22. Remove possible coatings from the insulating ring by means of Scotch Brite and clean it with Isopropanol.

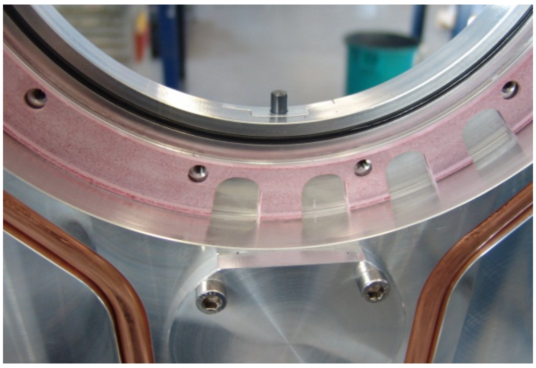


## 7.13 Assembling of the Arc Sources

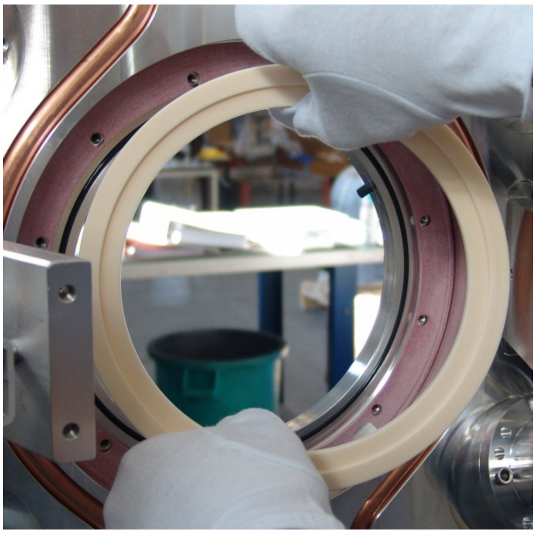
1. Insert the pressure insulator (gloves are not required, no vacuum part).



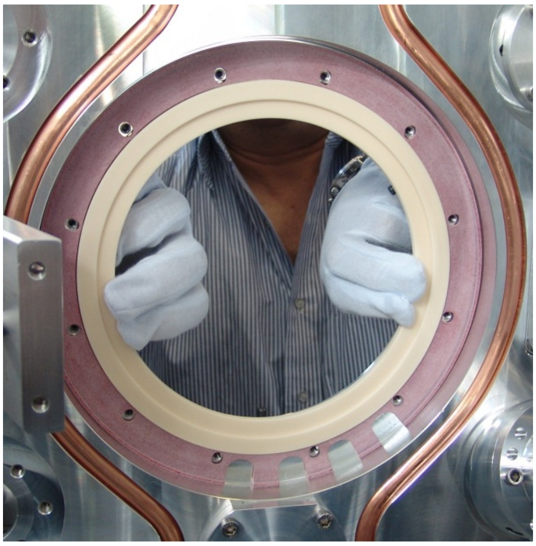
**Consider the installation position.**



2. Insert the insulating ring.

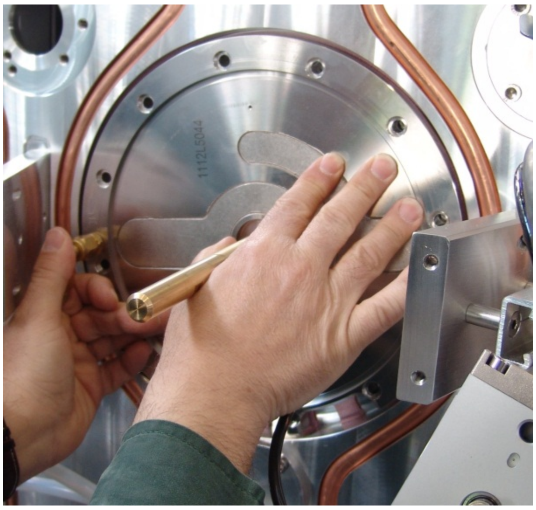


**One person is holding the insulating ring (incl. pressure insulator) in place from inside the process chamber.**



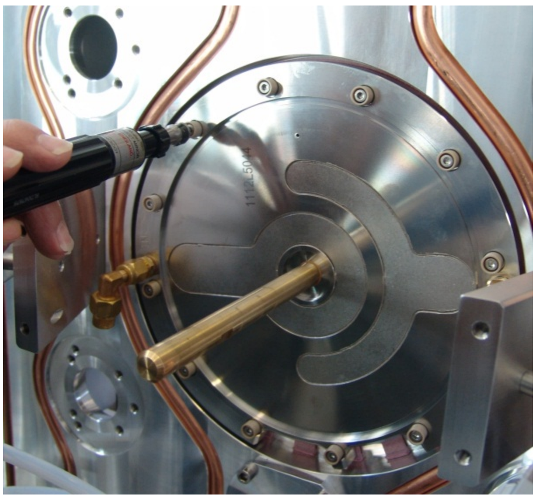
3. Replace the cooling plate assembly.

**Consider the installation position.**



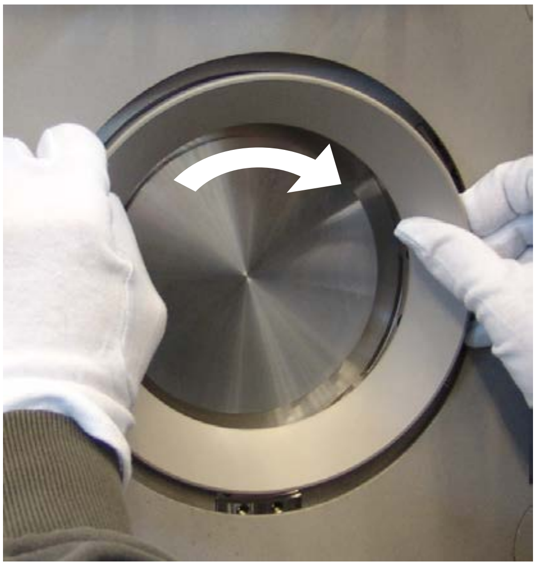
4. Tighten the 12 screws of the cooling plate.

**On reassembly tighten the screws of the cooling plate (crosswise) by means of a torque screw driver (120 Ncm).**



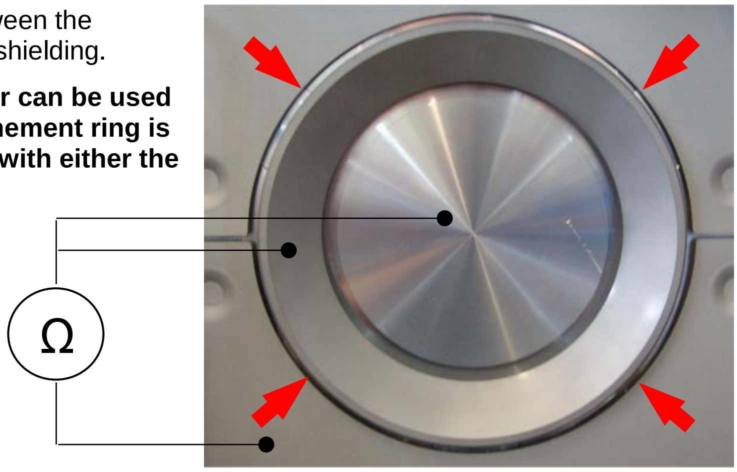
5. Complete the source (reversed order of disassembly).

6. Mount the confinement ring and turn it (clockwise) until to the limit stop.



7. Visual check the gap between the confinement ring and the shielding.

**If required an Ohm meter can be used to ensure that the confinement ring is not in electrical contact with either the target or the shielding.**

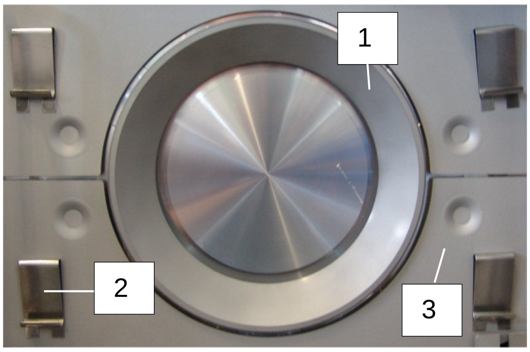



8. Replace all protective shields.

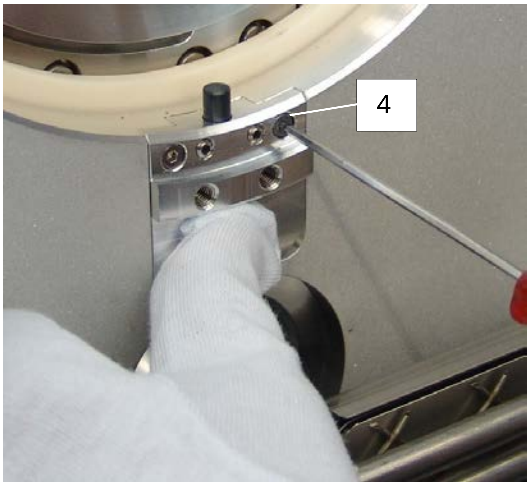
9. Oerlikon Balzers recommends to perform an automatic leak test in the coating system to confirm the tightness of the installed arc source.

## 7.14 Replacing of Broken Ceramic Insulators

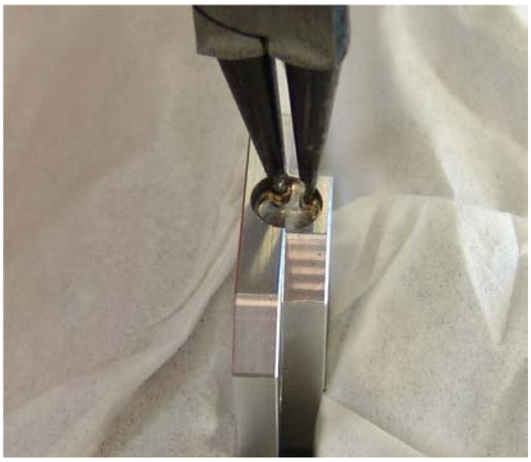
1. Ensure that the confinement ring (1) has already been removed.
2. Remove the clips (2) in order to remove the protective shields (3) in the area of the source where the broken ceramic insulator must be replaced.




3. Carefully vacuum clean the insulator area.
4. Remove the complete ceramic insulator set by unscrewing the two screws (4).




5. Remove the snap ring by a round nosed plier and shake out the parts.

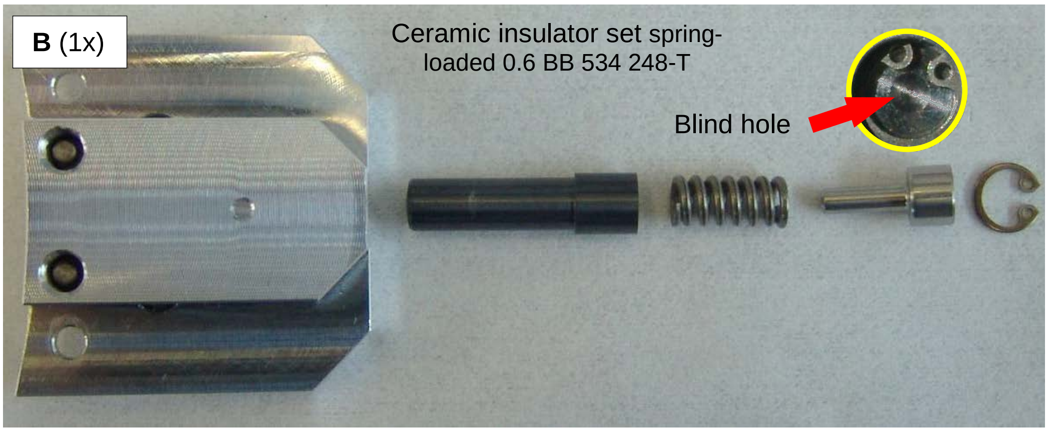


**Due to the influence of the gravitational force it became necessary to use two different ceramic insulator sets (A, B).**

**The ceramic insulator sets must be placed to there dedicated position (A, B). The pictures below show the different ceramic insulator sets and the respective position at the source.**

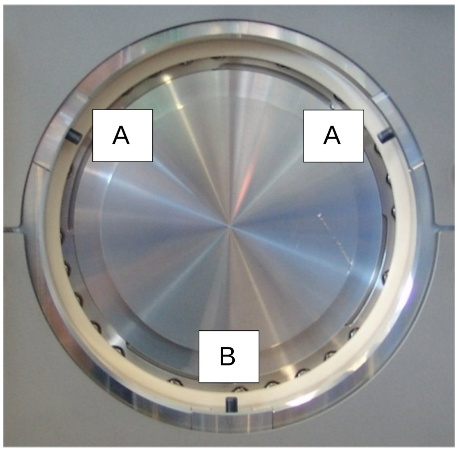
(The flexibility of the ceramic pin is limited to 1.6mm.)


(The flexibility of the ceramic pin is limited to 0.6mm.)




6. Replace the broken ceramic insulator with a new one.
7. Re-assemble the complete ceramic insulator set and put it back to its position.

**Pay attention to the dedicated positions (A, B) of the ceramic insulator sets.**

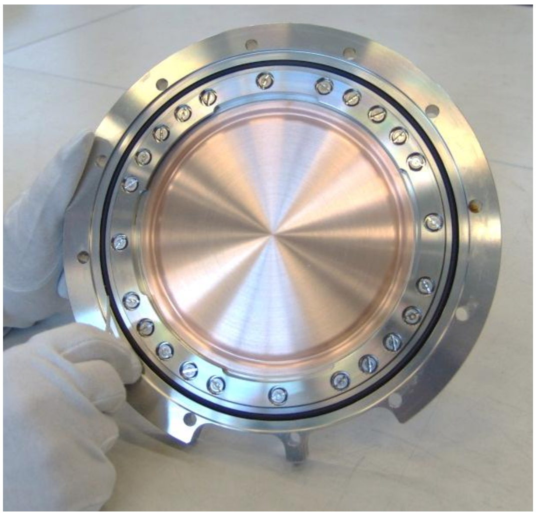


## 7.15 Exchanging Copper Membrane or Bayonet Ring of the Cooling Plate

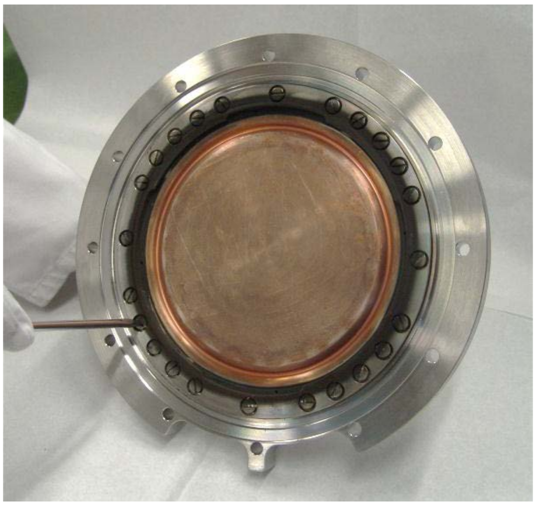
The KI160 cooling plate enables the exchange of the copper membrane and/or the bayonet ring if required.

**Ensure that the water is switched off.**

1. Remove the cooling plate from the process chamber.
2. Remove the O-ring by means of a Ty-rap.

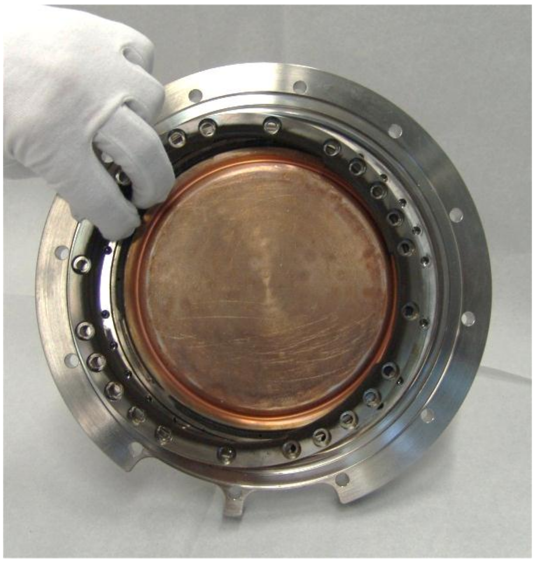


3. Remove all screws.



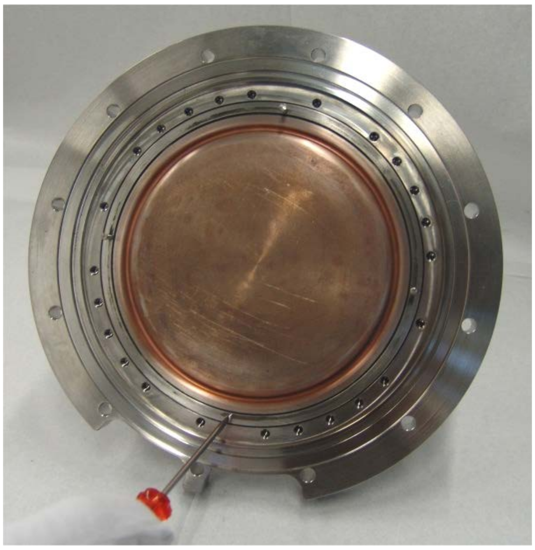
4. Remove the bayonet ring.

**For removing the coating the bayonet ring can be placed into the stripping solution.**



5. Use the delivered screws M2x8 (Spare Parts KI160-membrane) to remove the copper membrane.

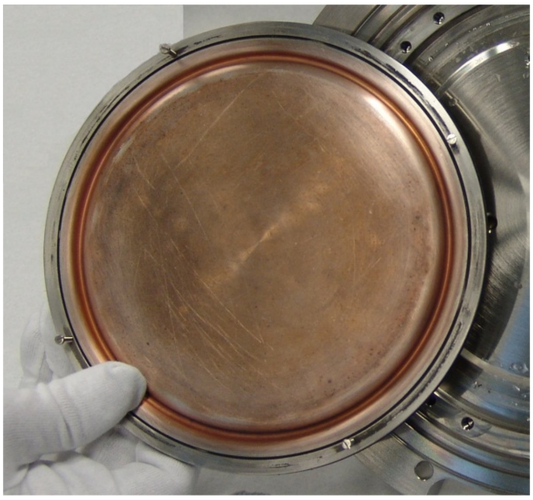
**Use the screws as a handle to lift up the copper membrane.**



6. Remove the coating from the upper side of the copper plate by means of Scotch Bride.

**A clean copper plate simplified the removing and placing of the targets.**

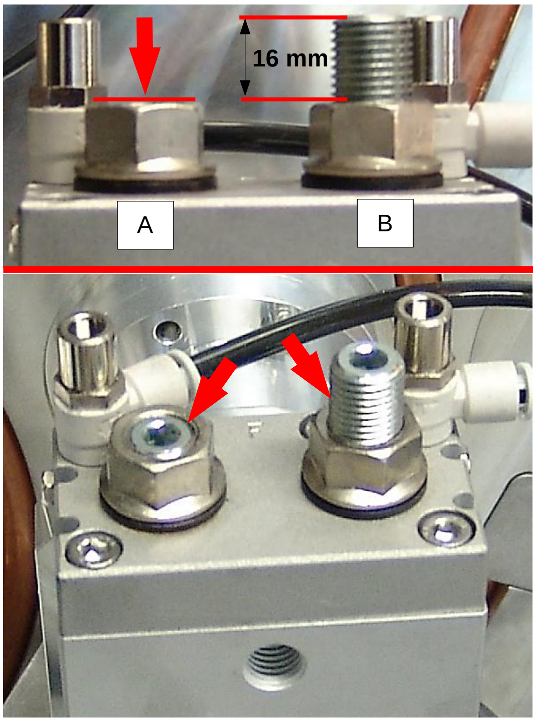
7. Clean or replace the damaged parts and mount them in reverse order.



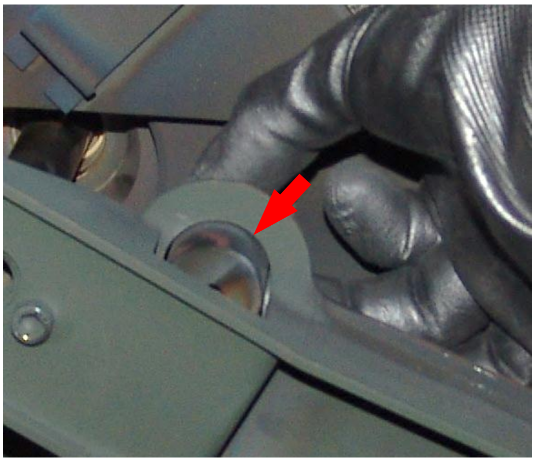
## 7.16 Adjustment of the Shutter Movement (Optional)

In case of a low resistance (<250 kΩ) between shutters and shielding caused by e.g. misaligned shutters, the respective shutter movement and/or limit stop position must be re-adjusted.
Re-adjust the respective shutters one by one.

1. Close all shutters via visualization.
2. Set the limit stops at the cylinder (outside the process chamber) as follows:
   - The 1st setscrew top edge should be aligned to the level of the nut top edge (A). Re-adjust it if necessary.
   - The 2nd setscrew top edge should have a distance of 16 mm to the nut top edge (B). Re-adjust it if necessary.



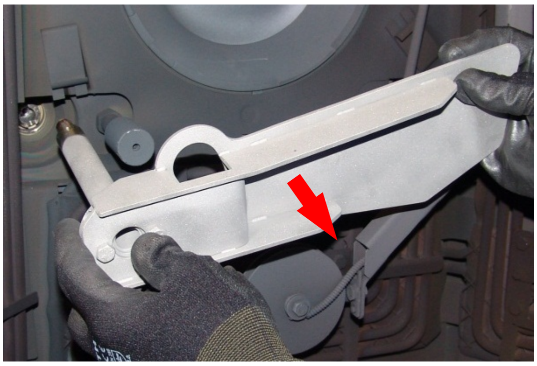

3. Open the shutter via visualization.
4. Check if the sleeve at the limit stop position (inside the process chamber) has a minimal allowance (free to rotate).



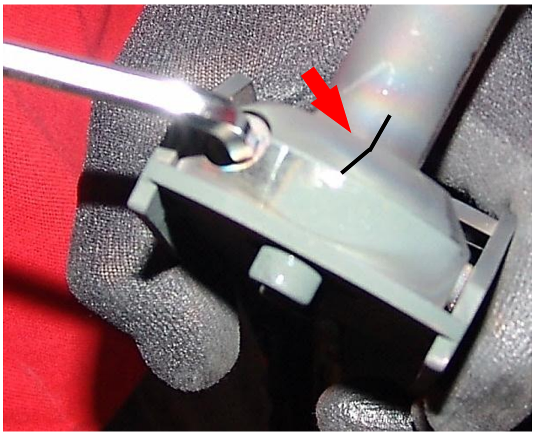
**If it is o.k. proceed with step 9 otherwise continue with step 5.**

5. Unscrew and…

…remove the shutter.

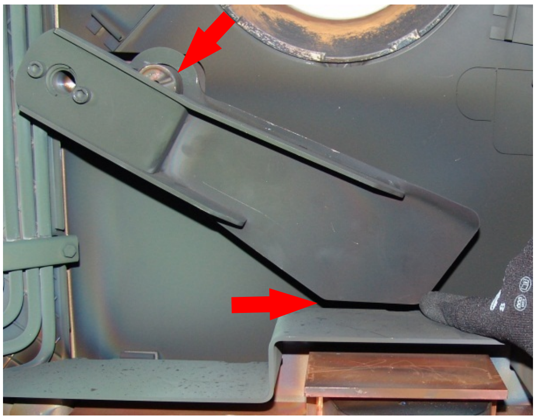


6.
- Mark the position of the axis to the shutter plate.
- Loosen the clamping screw.
- Slightly twist the position of the axis to the shutter plates only as much as necessary.
- Tighten the clamping screw.

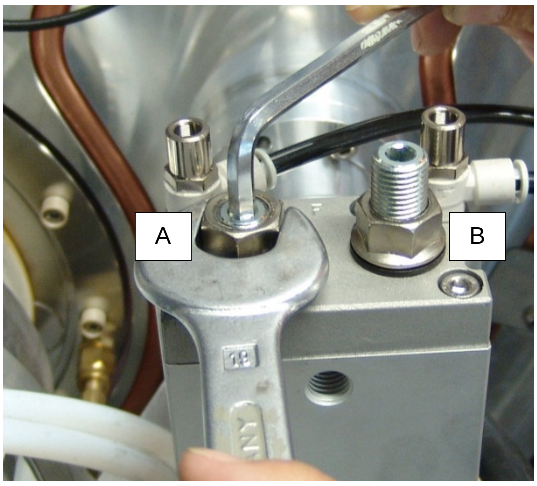


**Remove the positioning mark after re-adjustment using Isopropanol.**

7. Replace the shutter and check visually the limit stop positions.
8. Close and open the shutter via visualization.



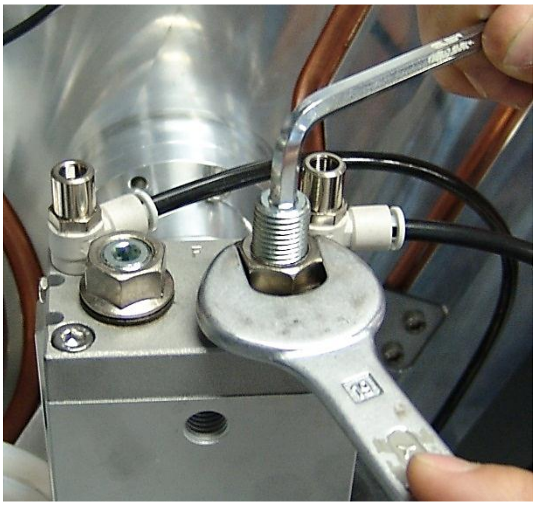
9. Readjust the “open” limit stop position by screwing in one of the set screws (A) or (B).




**Depending on the mounting position of the respective shutter (left or right side next to the source) the set screw (A) or (B) will change the “open” limit stop position.**

10. Close the shutter via visualization.

11. Re-adjust the “closed” limit stop position by screwing in the 2nd set screw…



…until the sleeve at the limit stop position (inside the process chamber) has a minimal allowance.

**On sources with two different shutter plates (upper and lower plate, see picture beside) must be ensured that both plates always close smoothly and tight.**

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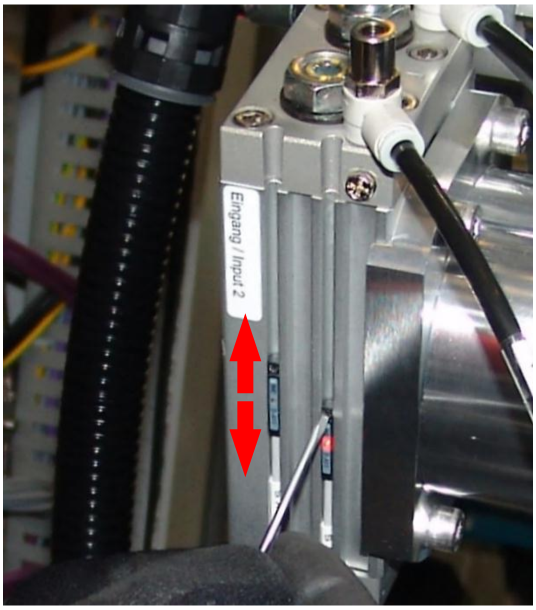
12. Check the resistance >250 kΩ (with Ohm meter) between shutters and shielding in open and closed position (on each source).

13. Re-adjust the position indicators for open/closed position of each previous re-adjusted shutter.

**The position indicator “LED” should lit approx. 10-15° before the shutter is in its limit stop position.**

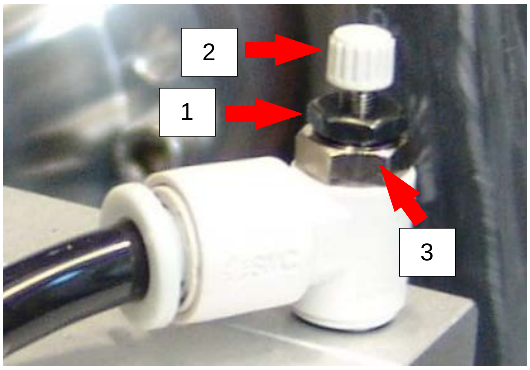


## 7.17 Adjustment of the Igniter Movement

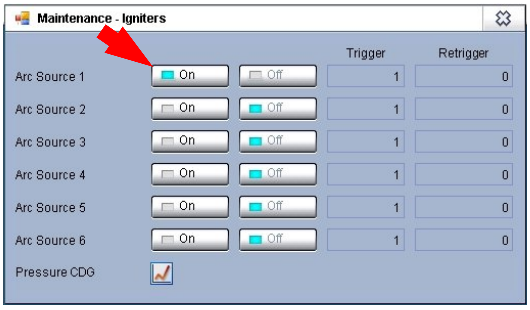
For a better overview the adjustment of the igniter movement has to be performed one after the other.

1. Loosen the lock nuts (1) and completely close the adjusting screws (2) at the compressed air inlets of the cylinder.

**Do not loosen the nut (3) (attachment of the compressed air connection).**

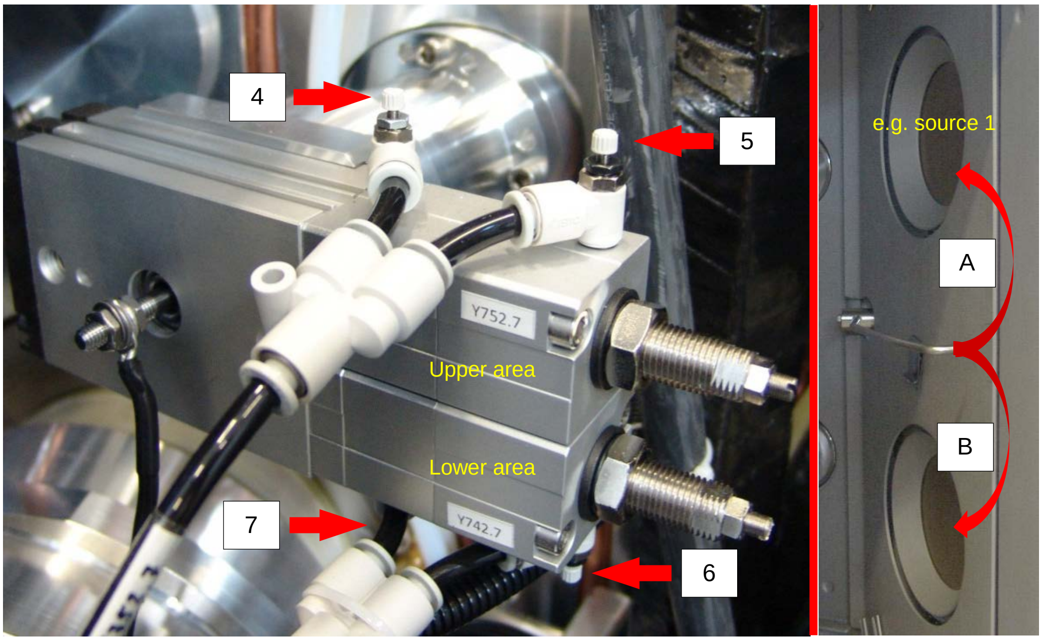



2. Open the “Popup - Maintenance – Igniters”.
3. Click “Arc Source 1” to “On” in order to start movement (A) of the igniter finger (source 1) (simulated ignition without ignition current).




**The igniter finger moves eleven times and stops on its parking position. After that an error message is visible on screen. For a further movement the error message must be acknowledged first and the respective “Arc Source” has to be set to “On” again by a click.**

**The upper area of the cylinder is responsible for movement (A), the lower area for movement (B).**




4. Open the adjusting screw (4) “ignition movement” (2 turns) and the adjusting screw (5) “return movement” (4 turns). After that tighten the lock nuts (1) by hand carefully.

**The igniter finger starts moving in (A) direction (if priviously selected) and back to its start position. For movement (B) the same procedure has to be performed with the adjusting screws (6 and 7) after starting the igniter finger movement of the respective source.**

**For sources 3 & 6 there is only one movement direction (A). Therefore only the screws (4 & 5) in the upper area of the cylinder have to be adjusted.**

5. Watch the movement of each igniter finger for a while.

**If one of the igniter fingers sticks at the target surface sporadically, then a readjustment of the respective cylinder will be necessary.**

## 7.18 Disassembling / Assembling of the Rotary Feed-through

### 7.18.1 Precondition

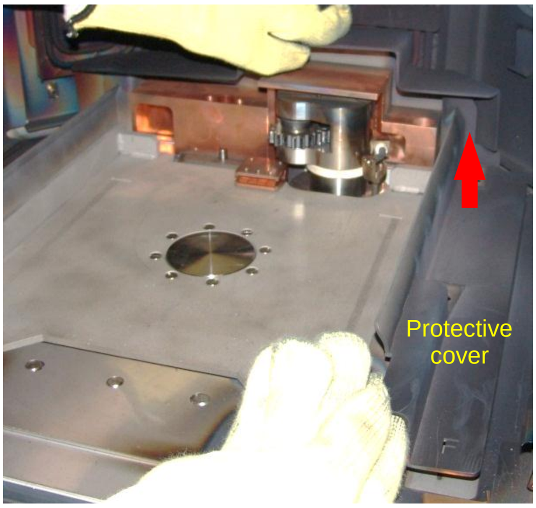
1. Select the “Popup - Operator - Miscellaneous”.
2. Vent the system by clicking “Vent”.
3. Open the process chamber.

### 7.18.2 Exchange of the Shaft Seal

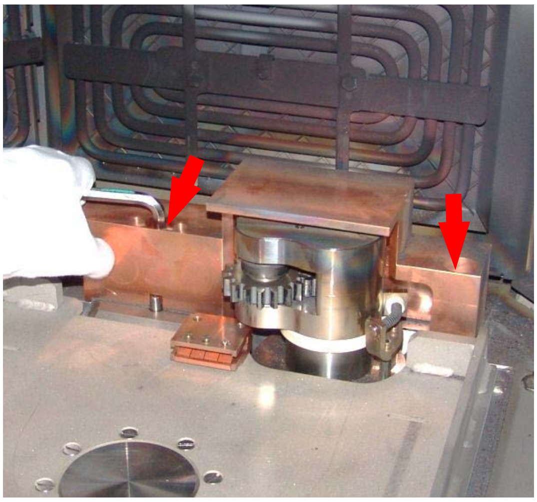
1. Blow out the water circuit of the drive shield (*Arc interrupter (AI) / Drive shield / Turbo shield).*

**Remember the “Emergency cooling water OUT /Blow OUT” valve closes after 15 minutes after activation.**

2. Remove the protective cover of the process chamber base plate.



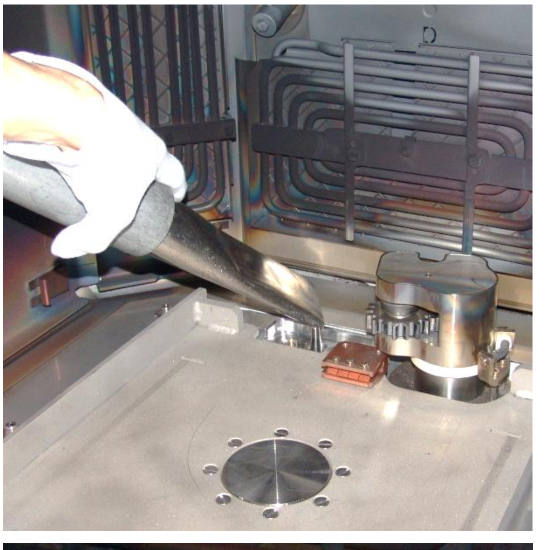

3. Remove the 2 Allen screws…



4. …and take out the drive shield.

5. Carefully vacuum clean the area around the rotary feed-through.

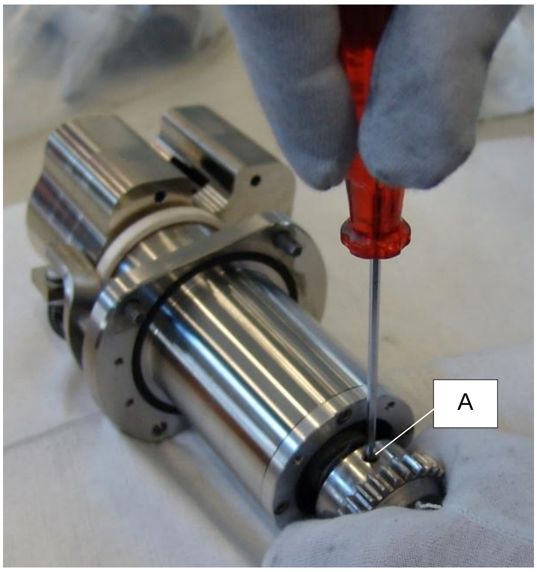
**Be careful not to damage or scratch the sealing surface.**



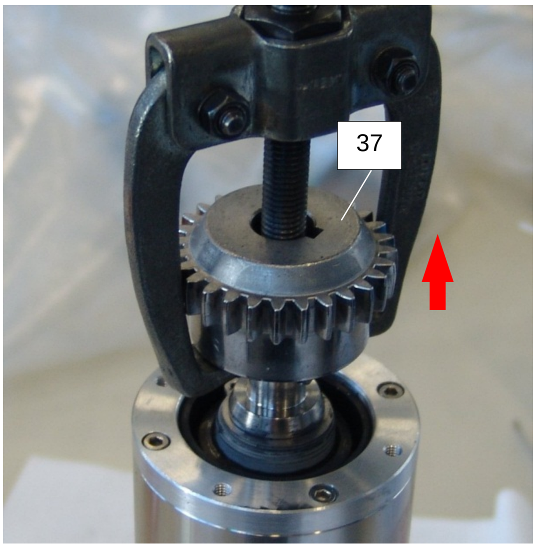
6. Remove the 4 Allen screws (53) around the rotary drive…

7. …and lift out the complete rotary feed-through assembly from the process chamber.

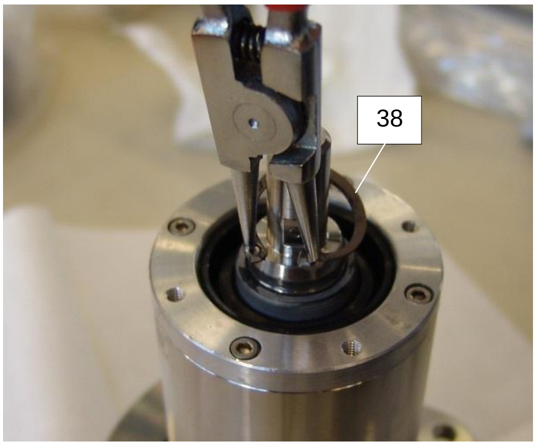
8. Unscrew the set screw (A).



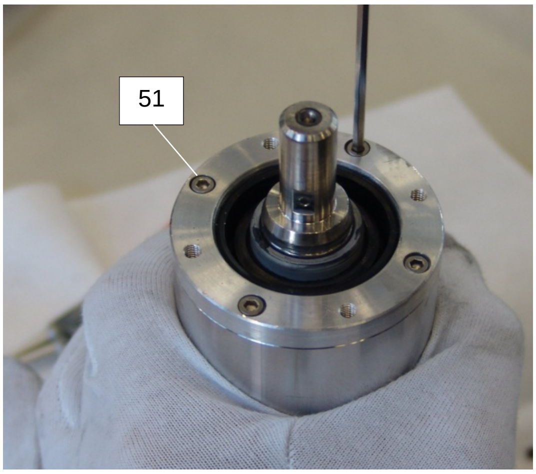

9. Remove the cog wheel (37) by means of a pulling unit.



10. Remove the retaining ring (38).



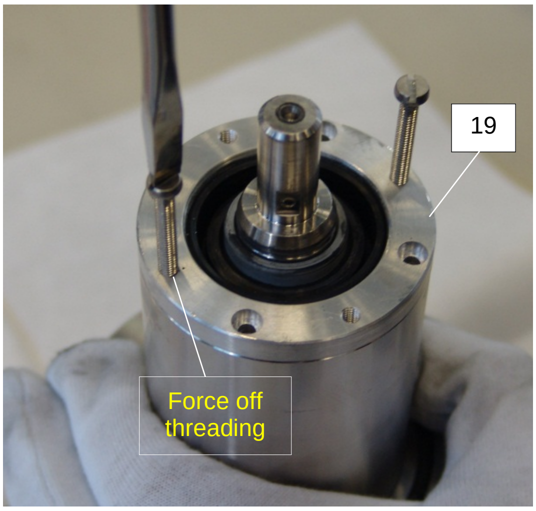

11. Unscrew 4 Allen screws (51).



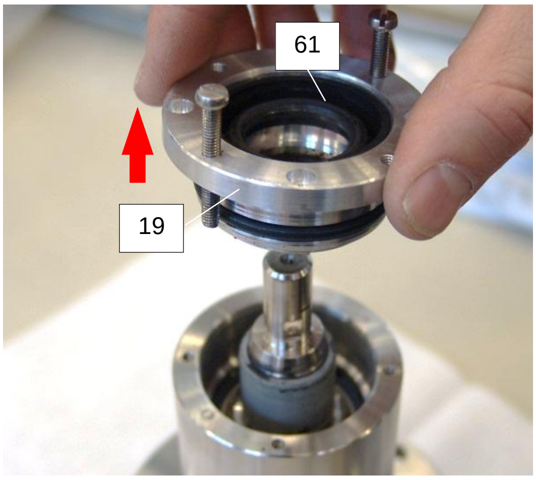

12. Pull out the ring (19).

**If the ring cannot be removed easily (e.g. due to the shaft seal force), then use (at least) 2 screws as ejector screws by screwing in them into the force off threading's.**

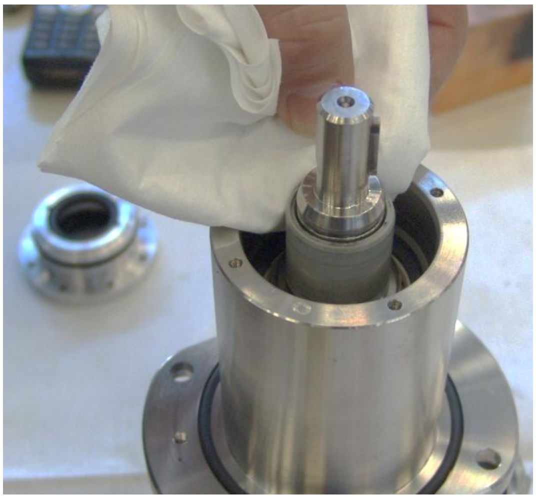
**Be careful not to damage or scratch the sealing surface.**



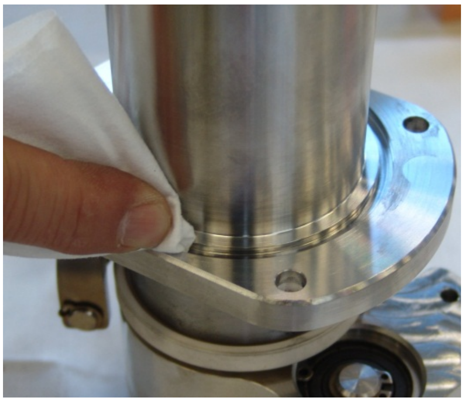
13. Remove the ring (19) containing the shaft seal (61).

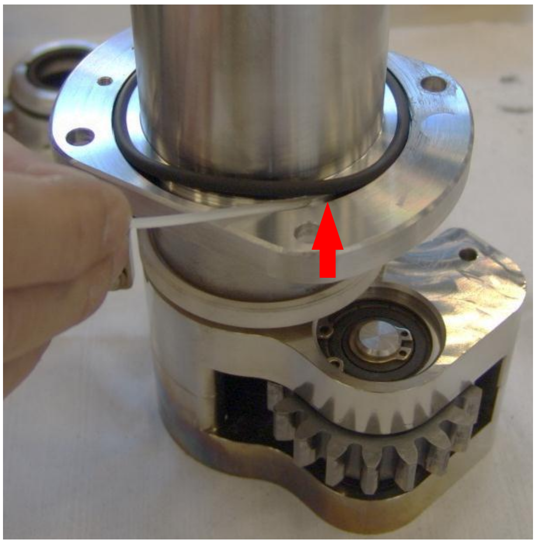



14. Clean the shaft seal area with Isopropanol.



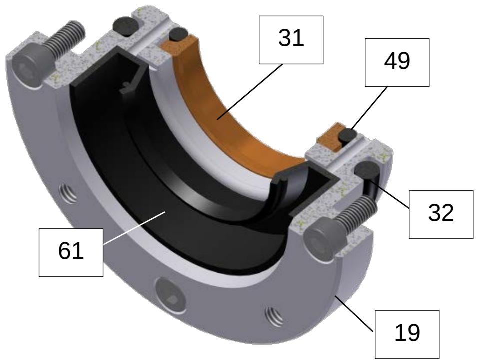
15. Remove the O-ring from the rotary feed-through assembly and clean the surface with a lint-free cleaning paper and Isopropanol.

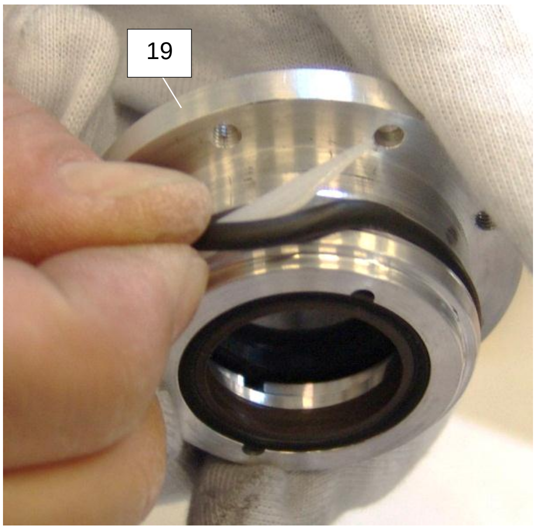




16. Remove the shaft seal (61) and O-rings (32; 49) from the ring (19).

**Be careful not to damage or scratch the sealing surface.**



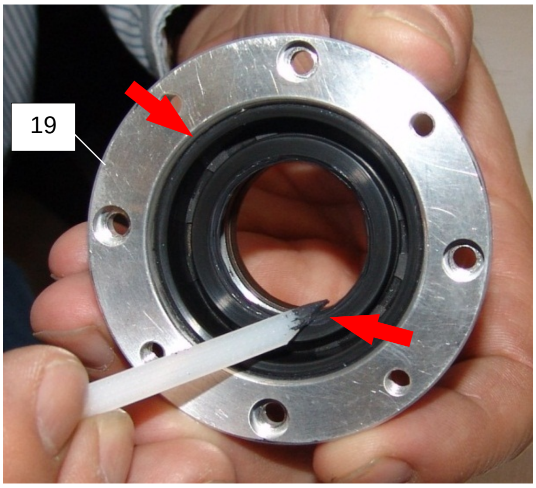

17. Clean the ring (19), the dust protection ring (31) and the O-rings (32; 49) with Isopropanol.

18. Sparingly apply vacuum grease (Apiezon) to the O-ring (32).

19. Insert a new shaft seal (61) into the ring (19) and replace the O-ring (32).

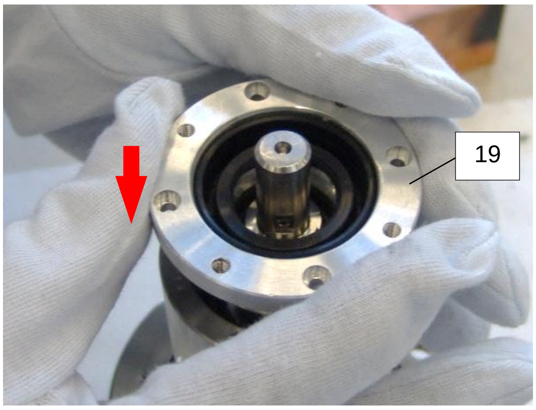
20. Prior to replace the ring (19):

- Sparingly apply vacuum grease (Apiezon) to the outer diameter of the shaft seal (61).
- Slightly grease the shaft seal (61) with FM 090 (214-239) as shown in the picture beside. **Only grease the shaft seal on the high pressure side.**




21. Replace the ring (19) containing the shaft seal (61) into the rotary feed-through assembly and screw it on with the 4 Allen screws (51).

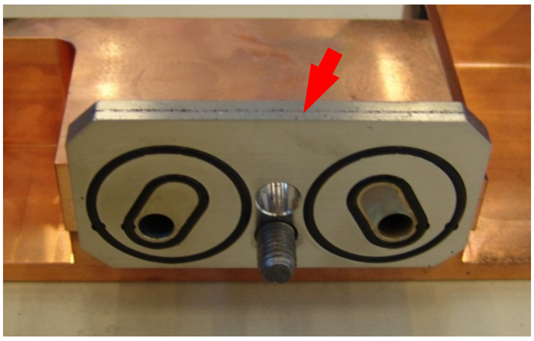
**Be careful not to damage or scratch the sealing surface.**



22. After replacing slightly grease the shaft seal (61) again with FM 090 (214-239) grease as shown in the picture beside.

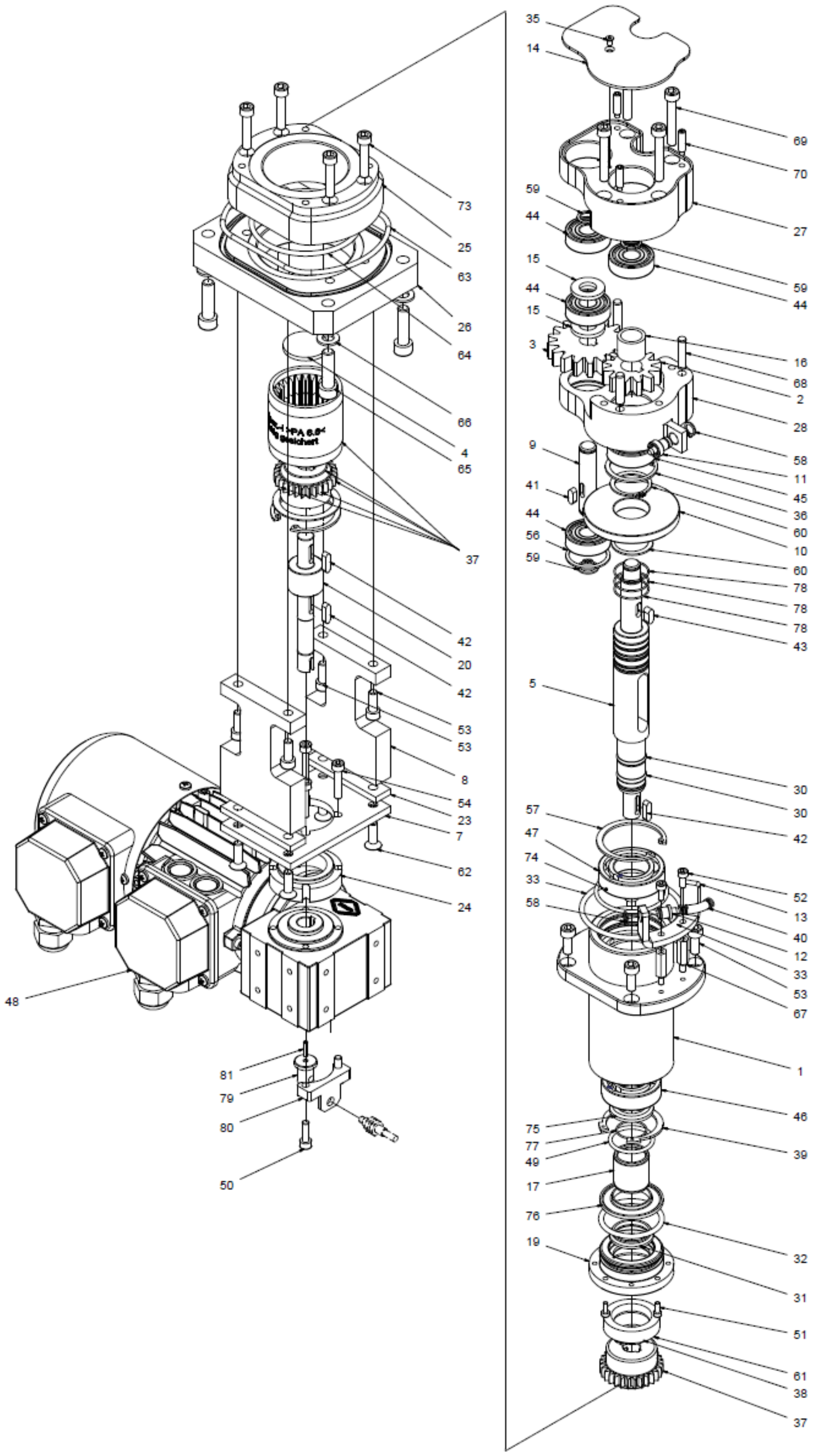
23. Replace the retaining ring (38) and the cogwheel (37).

24. Prior to replace the drive shield, check the O-rings and sealing surface and wipe those with an Isopropanol soaked cleaning paper.



25. Re-assemble the complete rotary feed-through assembly (incl. protective cover and drive shield) in reverse order.
26. Switch on the cooling water circuit of the drive shield (*Arc interrupter (AI) / Drive shield / Turbo shield).*
27. Check for a water leak on the drive shield.
28. Pump down the coating system and check the pressure (without carousel rotation) ($<1x10^{-5}$ mbar).
29. Start the carousel rotation and check the pressure again ($<1x10^{-5}$ mbar).

### 7.18.2.1 Explosion Drawing BB534401-Z (Rotary Feed-through)



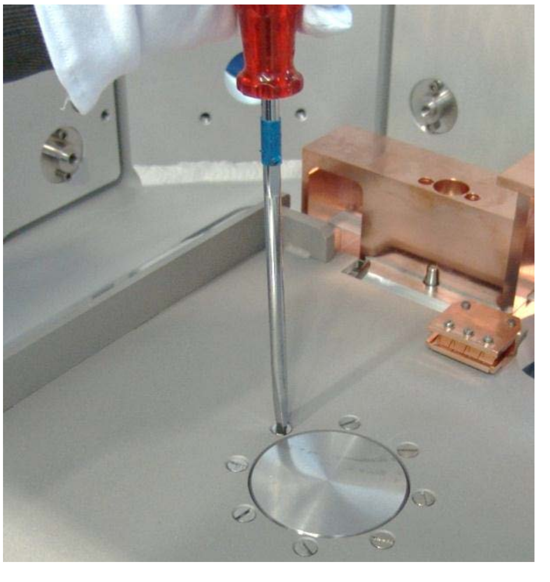
## 7.19 Disassembling / Assembling of the Fork Contact

(Necessary if the fork contact is worn).

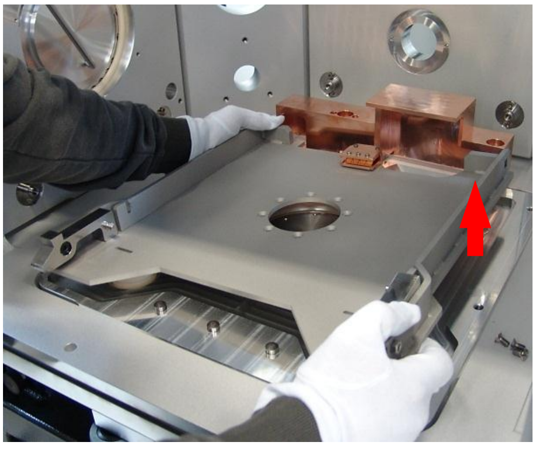
### 7.19.1 Precondition

1. Select the “Popup - Operator - Miscellaneous” and vent the process chamber (mouse click).
2. Open the process chamber.
3. Remove the protective cover of the process chamber base plate.

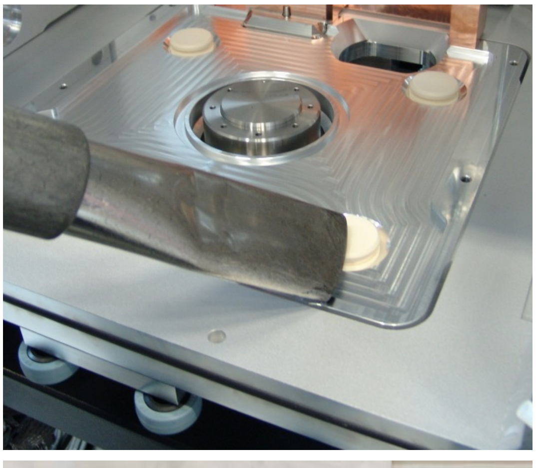
4. Unscrew 8 countersunk screws…



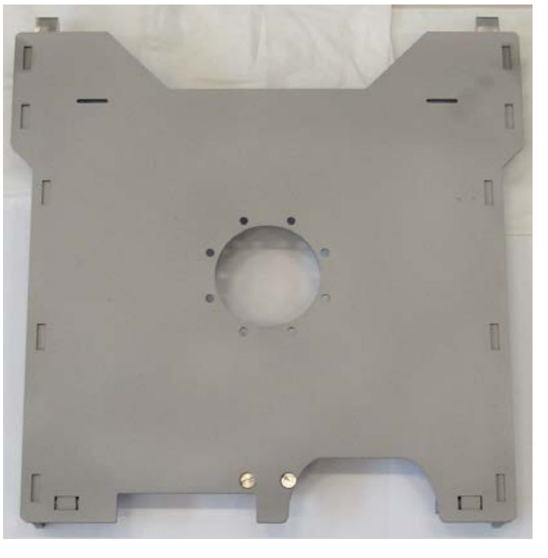
5. …in order to remove the carousel holding plate (incl. fork contact).



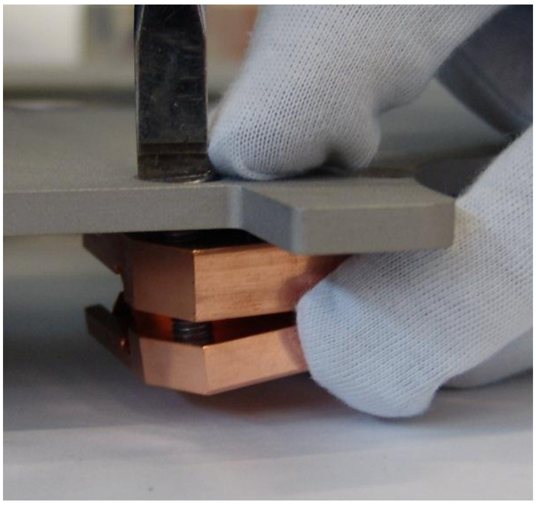
6. Carefully vacuum clean the area around the process chamber base plate.



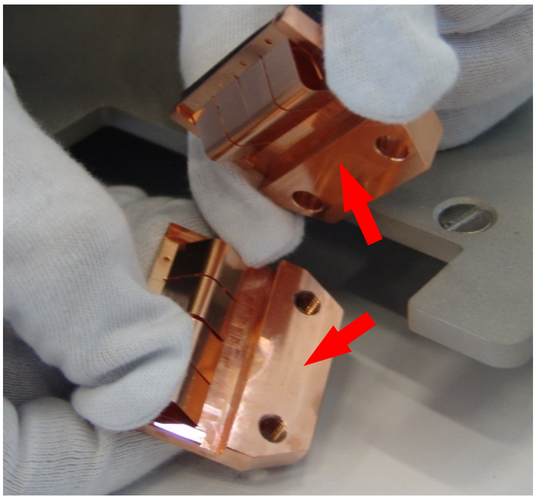
7. Turn over the carousel holding plate and place it on a clean work table.



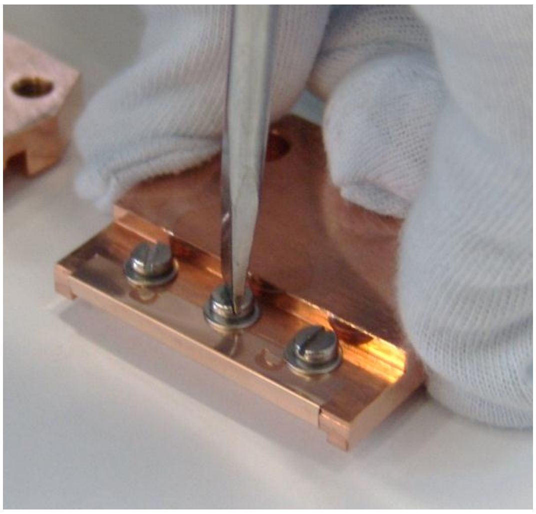
8. Unscrew the fork contact.



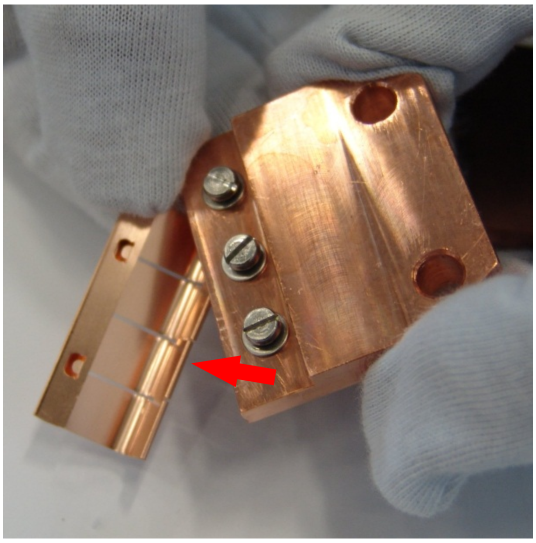
**After removing the 2 screws, the fork contact divides into two halves.**



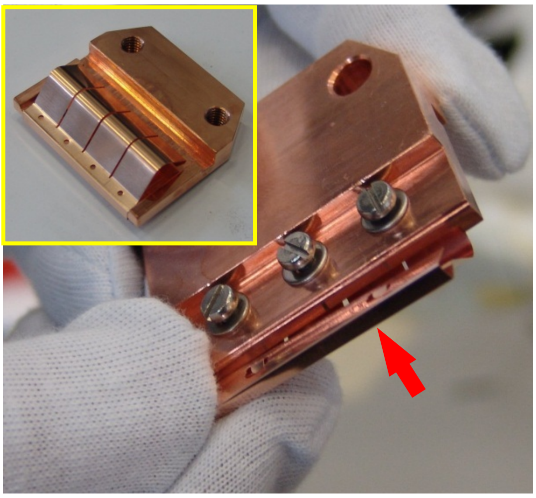
9. Unscrew the 3 screws (on both halves) and…



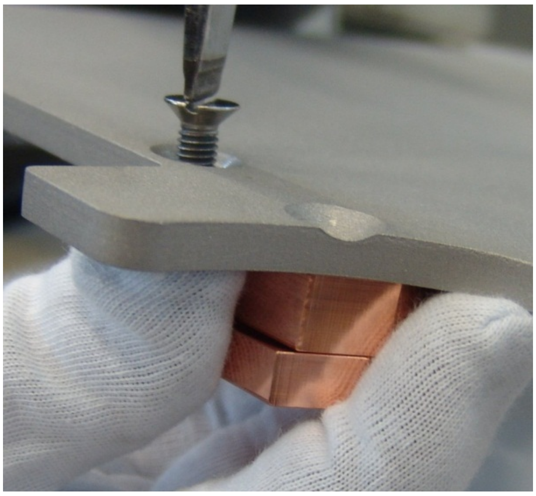
10. …replace the contact springs…



11. …with new ones.



12. Screw on the fork contact.



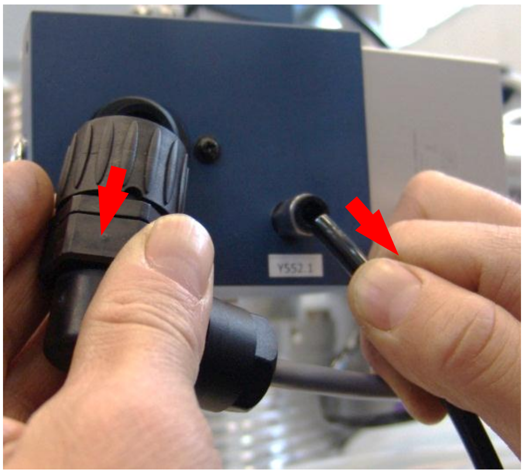
**Re-assemble the carousel holding plate (incl. fork contact) in reverse order.**

## 7.20 Cleaning the Fore Line Valve & Isolating Valve for CDG 100 D (VAP 040-A)

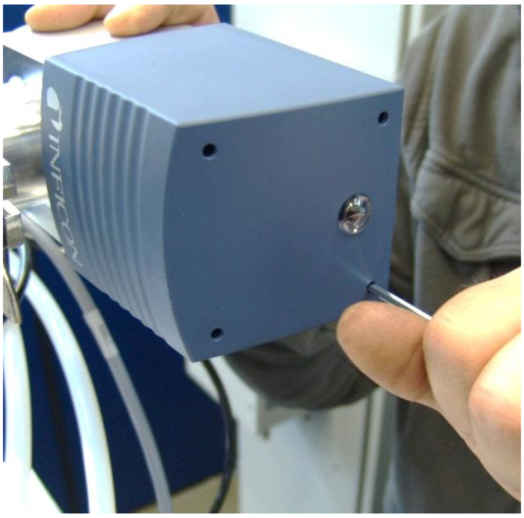
1. Select the “Popup - Operator - Miscellaneous” and vent the process chamber (mouse click).
2. After venting the process chamber, switch “Off” the pumping system (mouse click).

**Wait until the fore vacuum line is completely vented.**

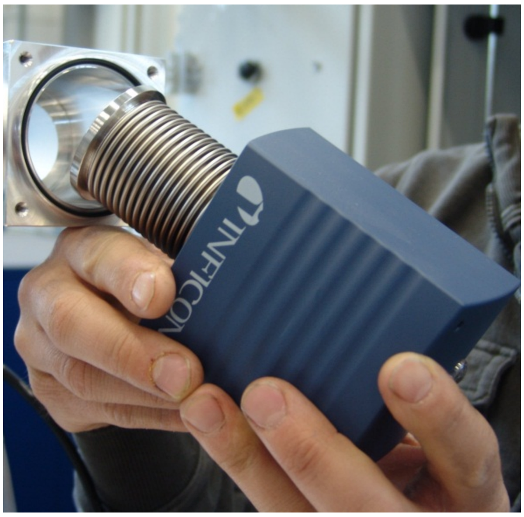
3. Disconnect the compressed air hose and the plug for the limit switch indicator from the valve.



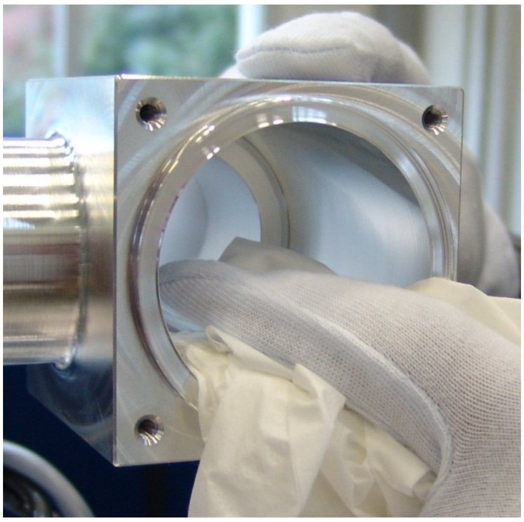
4. Remove the 4 screws by means of a 3 mm Allen key…



5. …and carefully remove the flange (including the bellow).
6. Remove the O-ring.

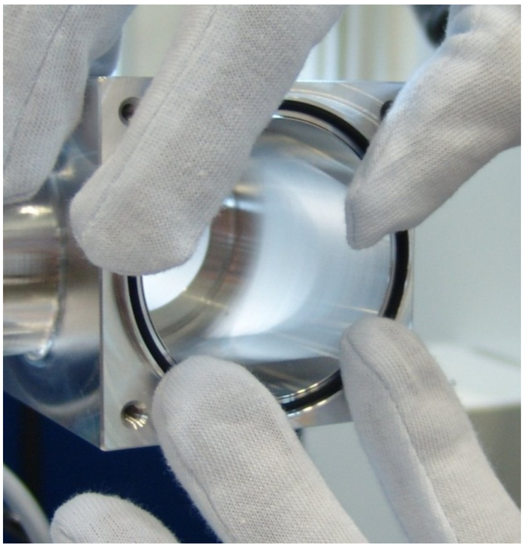


7. Clean the complete valve housing (inside) and the sealing surfaces with an Isopropanol soaked cleaning paper.

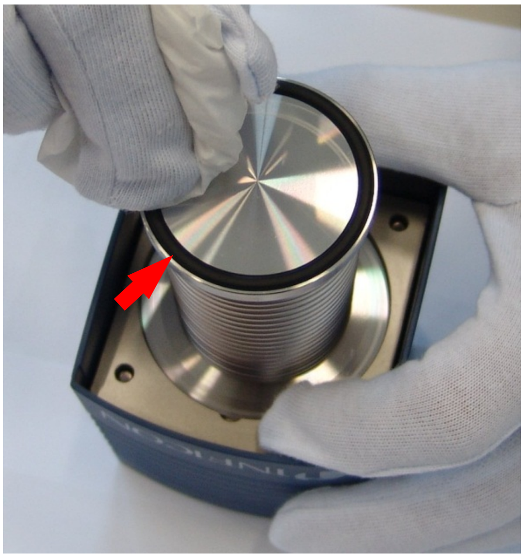


8. Clean the outer O-ring with Isopropanol and mount it to the valve housing.

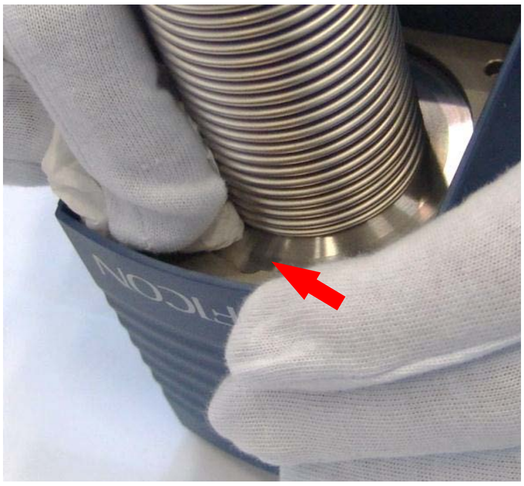
**Be carefully not to drop the O-ring.**



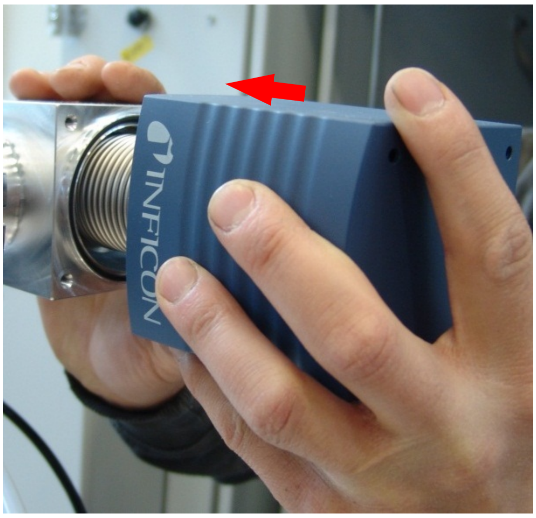
9. Clean the O-ring…



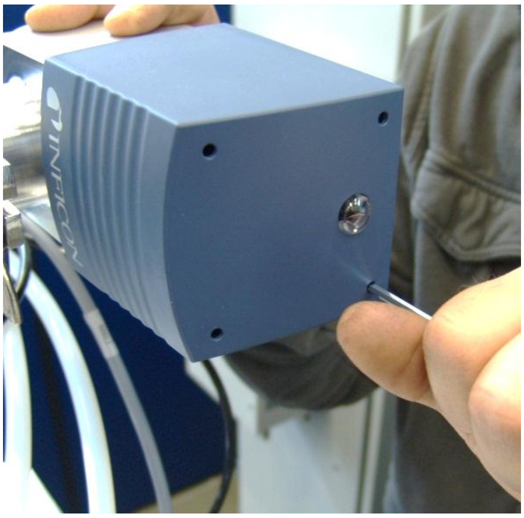
10. …and sealing surface with an Isopropanol soaked cleaning paper.



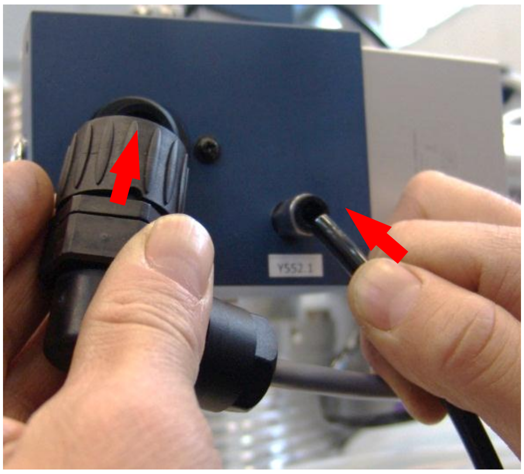
11. Carefully attach the flange (including the bellow) to the housing.



12. Screw in the 4 screws by means of a 3 mm Allen key.




13. Connect the compressed air hose and the plug for the limit switch indicator to the valve.



14. Switch pumping system to “Stby“ and wait for a view minutes.

**Red position indicator (visible in the middle of the valve cover) indicates valve is open.**

15. Check if the fore vacuum pressure (in the fore line) is < 2x10$^{-3}$ mbar.

16. Switch pumping system to “Pump“.

17. Check if the fore vacuum pressure (in the process chamber) is < 2x10$^{-3}$ mbar.

**For further details according angle valve VAP 040-A ⇨ refer to component binder.**

## 7.21 Turbo Molecular Pump MAG W 1700 IP

### 7.21.1 Preconditions

1. Vent the process chamber.
2. Switch pumping system to “Off” (wait until the turbo molecular pump rotation is on 0% and the fore line is vented).
3. Close the cold cooling water on the main inlet valve.
4. Turn main switch to “Off”.
5. Make sure that the area around the turbo molecular pump is clean and there is no dust. If necessary clean the area around the turbo molecular pump MAG W 1700 IP first.

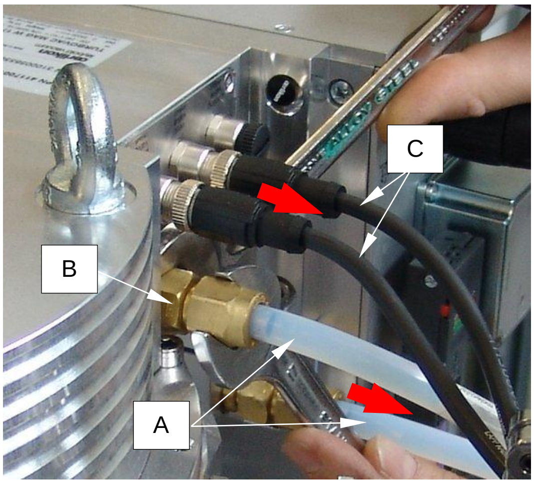
**⚠ DANGER**

**Beware of high - and dangerous voltage components!**

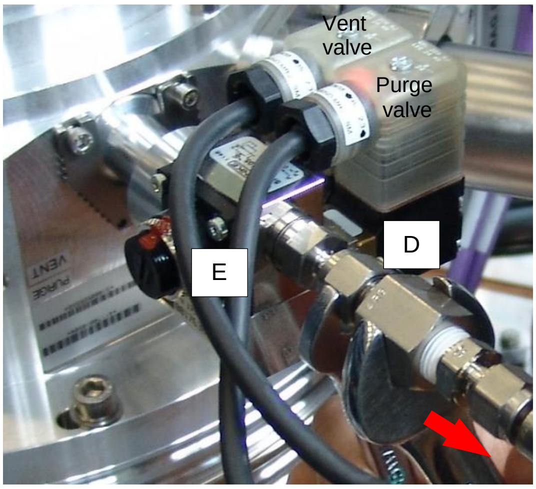
- **Danger of fatal electric shock when touching high voltage components.**
- **Ensure that the machine and main power is switched off.**

### 7.21.2 Removing the Turbo Molecular Pump MAG W 1700 IP

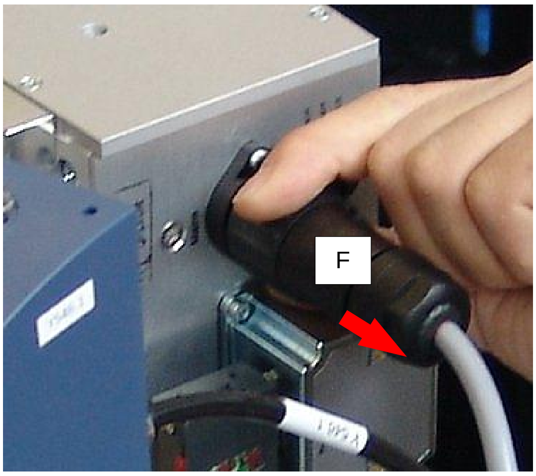
1. Disconnect and label both, the inlet and the outlet cooling water hoses of the turbo molecular pump MAG W 1700 IP (**on the water battery**). Hold the outlet into a tub and blow out the hoses with compressed air until no water is inside of the hose.
2. Close the Nitrogen ($N_2$) hand valve of the gas supply.
3. Disconnect (and label if necessary) the water hoses (A) (inlet and outlet).
4. Remove both attachment fittings (B) and screw them into the new pump.
5. Disconnect both control cables (purge & vent valve) (C).



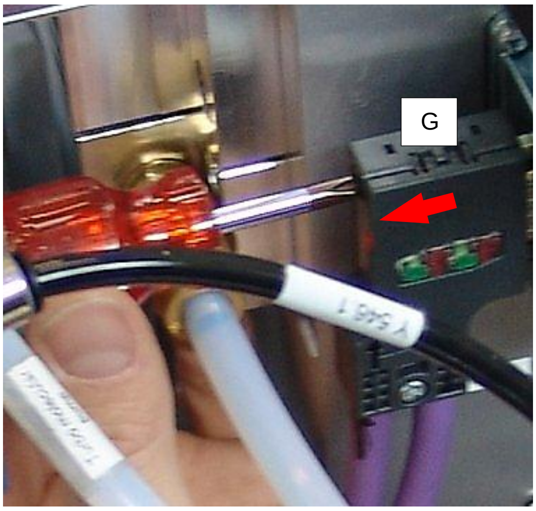
6. Disconnect the purge connection (D) and both control cables of purge & vent valve (E).



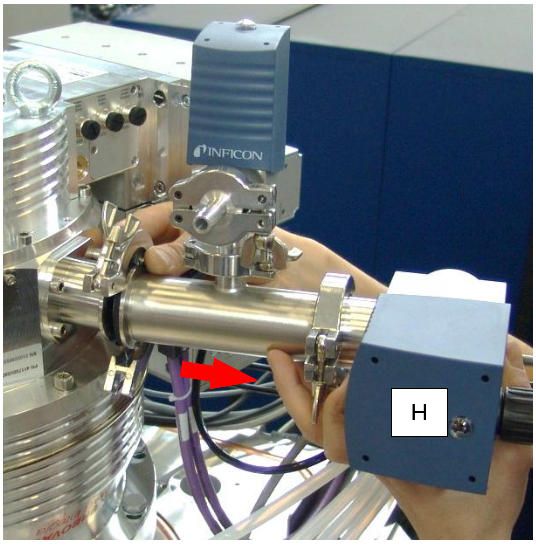

7. Unplug the main power connector (F).



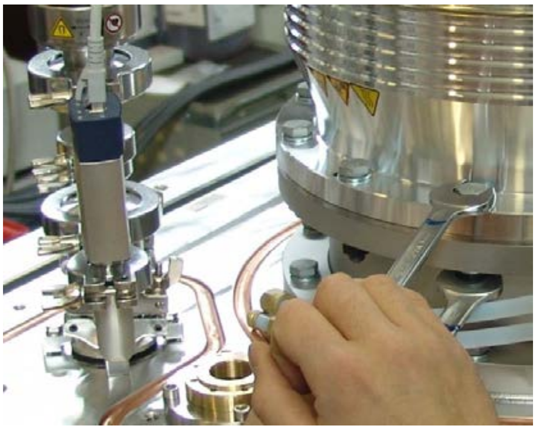

8. Disconnect the Profibus connector (G).



9. Remove the fore line valve (H) (incl. T-fitting and cool gas valve) from the turbo molecular pump MAG W 1700 IP and put the assembly on a safe place on top of the process chamber.




10. Remove the 12 screws (M10x50) from the turbo molecular pump MAG W 1700 IP symmetrically and keep the screws on a clean place.



**If available, use a crane to move the turbo molecular pump MAG W 1700 IP (40 kg) from the INGENIA P3e™ to a table.**

**If not, a minimum of two persons are necessary for moving the turbo molecular pump MAG W 1700 IP:**

**One person is above on the machine and raises the pump with a rope or chain which is fixed on the ring bolts located on the side of the turbo molecular pump MAG W 1700 IP.**

**The second person is on the backside of the machine and helps to raise the turbo molecular pump MAG W 1700 IP and ensures the pump will not be damaged, especially the sealing surfaces.**

**Be careful when putting the turbo molecular pump MAG W 1700 IP on a table, in order not to damage the high vacuum sealing surface.**

11. Remove the covers and plastic blind screws from the “new” turbo molecular pump MAG W 1700 IP and attach them to the previously removed “old” turbo molecular pump MAG W 1700 IP.

12. Mark inlet and outlet of the cooling water on the new turbo molecular pump MAG W 1700 IP (same as old turbo molecular pump).

13. Store the “old” turbo molecular pump MAG W 1700 IP secure in the original package from Leybold Vacuum so that the device cannot be damaged during the transport.

### 7.21.3 Mounting the new Turbo Molecular Pump MAG W 1700 IP

1. Check the “new” turbo molecular pump MAG W 1700 IP for any damage.

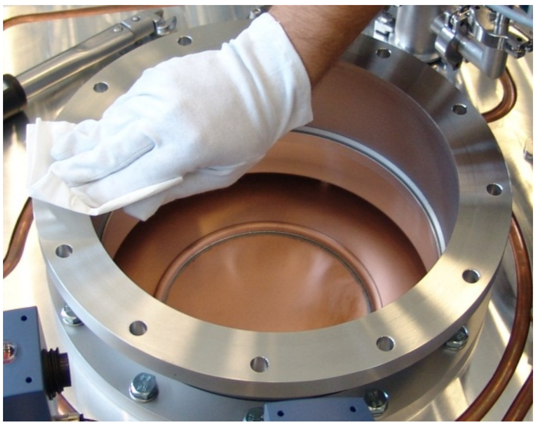
2. Especially, check the blank centering flange on the turbo molecular pump MAG W 1700 IP.
   - are any visible scratches ?
   - is the flange well-polished ?

3. Set the correct Profibus address. ⇨ Refer to chapter 7.25 “Profibus Address Settings”.

4. Clean the (new) O-Ring (DIN 250 ISO) with Isopropanol.

5. Clean the high vacuum flange on the turbo molecular pump MAG W 1700 IP with an Isopropanol soaked cleaning paper and check it for damage or scratches.

6. Clean the sealing surface of the flange with an Isopropanol soaked cleaning paper and check it for damage or scratches.

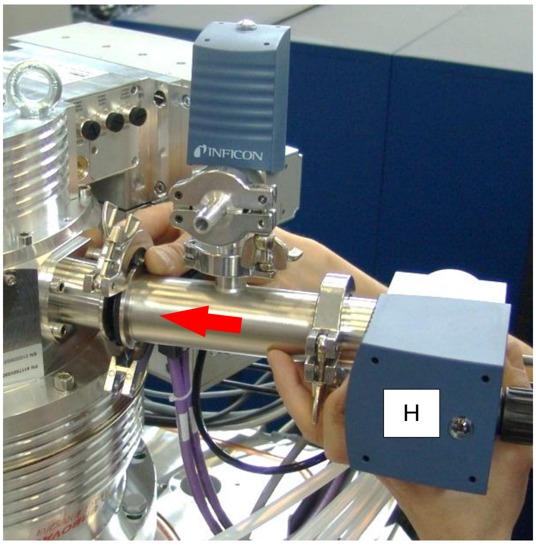


7. Lift the turbo molecular pump MAG W 1700 IP with a crane (or 2 persons) to the process chamber (from above downward) by means of a rope or chain.

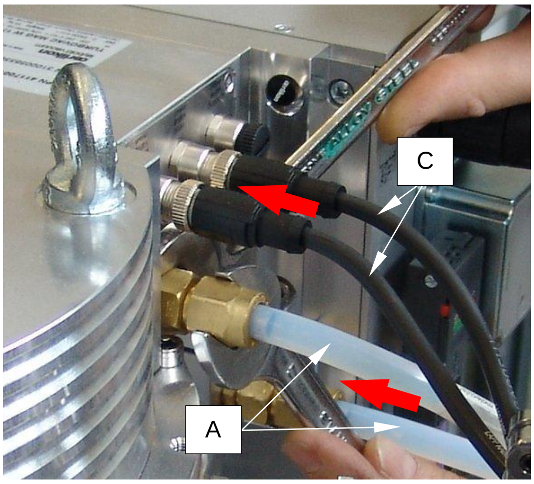
8. Attach the pump with the 12 screws (M10x50) by means of the torque wrench (35Nm) and tighten the screws symmetrically.

**Use the torque wrench, adjust it to 35Nm (delivered with the INGENIA P3e™ coating system).**

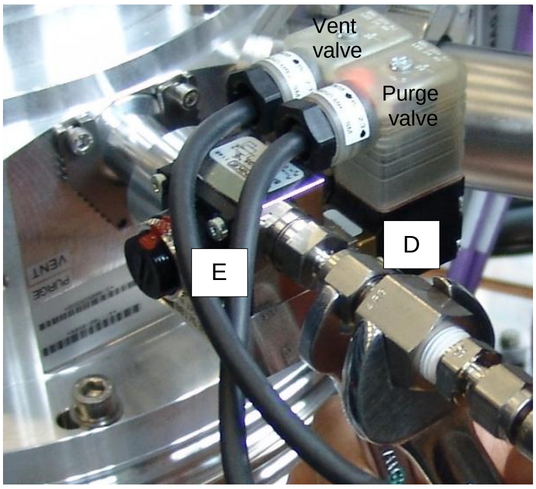
9. Mount the fore line valve (H) (incl. T-fitting and cool gas valve).



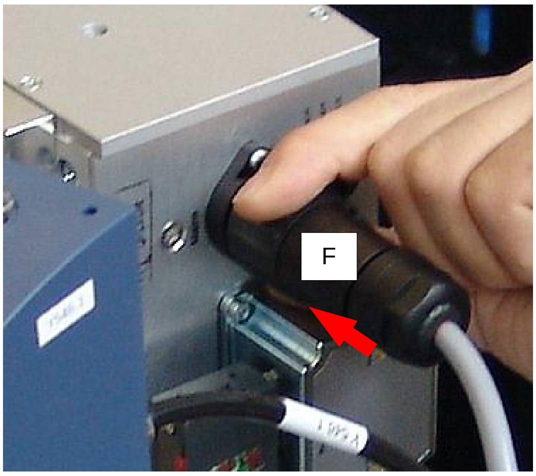

10. Reconnect the water hoses (A) (inlet and outlet) and both control cables (purge & vent valve) (C).



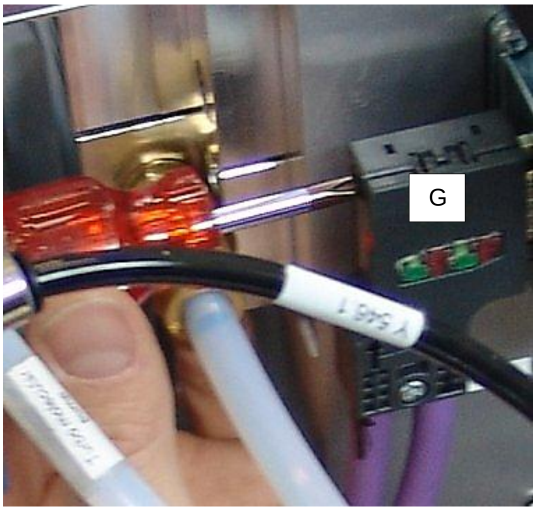
11. Reconnect the purge connection (D) and both control cables of purge & vent valve (E).




12. Plug in the main power connector (F).




13. Connect the Profibus connector (G).




14. Reconnect both, the inlet and the outlet cooling water hoses of the turbo molecular pump MAG W 1700 IP (**on the water battery**).

15. Open the Nitrogen ($N_2$) hand valve of the gas supply.
16. Open the cold cooling water on the main inlet valve.
17. Turn main switch to “On”.
18. Test the pumping system.
19. Check for water leaks during pumping.

## 7.22 Gases

### 7.22.1 Evacuating the Gas Supply for He, Ar, $N_2$, $H_2$, and $O_2$

The pressures of all gas supplies must be checked daily.

**⚠ DANGER**

**Danger of explosion due to flammable gases surrounding the complete coating system!**

- **A too high concentration of flammable gases in the coating and/or machine room can cause an explosion in connection with sparks, open fire or electrical switches, such as relays or power contactors etc. !**
- **To avoid any explosive gas mixtures the customer must ensure that the area where the coating system is located is free of explosive zones.**
- **It is the customer's responsibility that local regulations (location, mounting, installation of the gas supply and ventilation of the room) and organizational precautions are observed.**

**⚠ CAUTION**

**Danger of process interruption!**

- **Never change any INGENIA P3e™ coating system process gas during a coating process!**

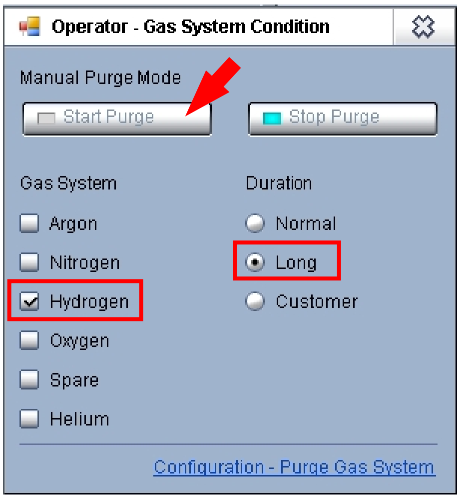
**For each gas the purging / evacuation sequence is nearly the same. An example with Hydrogen ($H_2$) is described on next page.**

### 7.22.2 Gas System Condition

#### 7.22.2.1 Purging / Evacuation Sequence Example with Hydrogen

1. Select the “Popup - Maintenance - Miscellaneous”, click on “Pump” (wait until the turbo molecular pump reaches 100%).
2. Close the Hydrogen ($H_2$) hand valve of the respective gas supply.
3. If a pressure regulator is installed, close it to prevent excessive pressure.
4. Select the “Popup - Operator – Gas System Condition".
5. Select “Hydrogen” and “Long”.
6. Click on “Start Purge” to evacuate the gas line.

**The mass flow controller is opened. Additionally the gas safety valves in case of a flammable gas Oxygen (O2) and the gas line will be evacuated for 5 minutes.**




7. Open the Hydrogen ($H_2$) hand valve and set the pressure regulator (if installed) to 1.0 –1.2 bar.
8. Check the gas connections with a gas leak detector spray for leaks.
9. Repeat steps 5 and 6 to purge the gas lines.

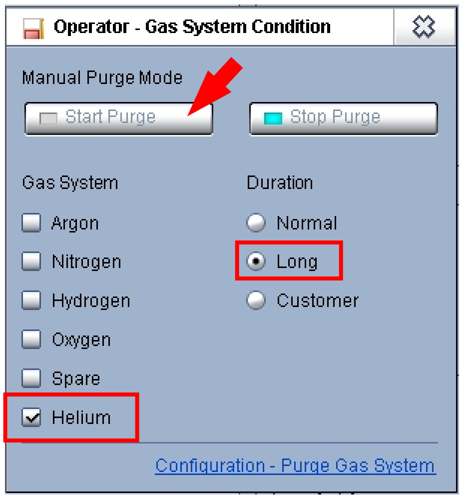
**For Argon (Ar), Nitrogen ($N_2$) and Oxygen ($O_2$) the purging / evacuation sequence has to be performed in the same way.**

### 7.22.2.2 Purging Sequence Example with Helium

**If the Helium (He) gas hose has been contaminated with air, it must be purged with Helium.**

1. Open the Helium (He) hand valve.
2. Set the pressure regulator to 0.8 – 1.0 bar (if installed).
3. Select the “Popup - Operator – Gas System Condition".
4. Select “Helium” and “Long”.
5. Click on “Start Purge” in order to purge the gas hose.

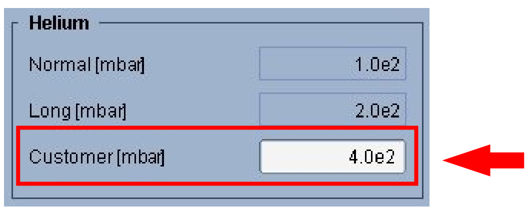
**Consider the purging takes a view minutes.**

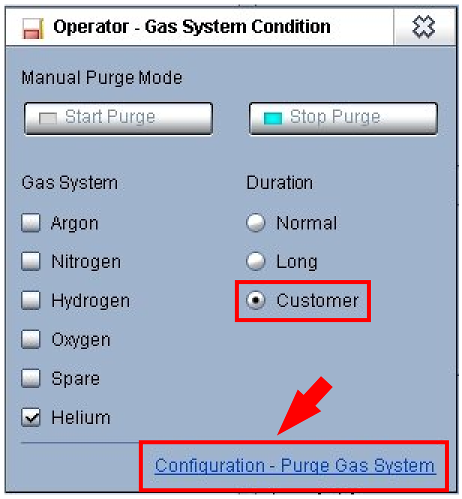



**For long gas lines, the purging duration can be changed in the “Popup - Configuration – Purge Gas System Duration".**

**Prior to set a customer specified value, the “Duration” mode must be changed to “Customer” in the “Popup - Operator – Gas System Condition".**

“Configuration – Purge Gas System Duration"



### 7.22.3 Replacing an (Old or Defective) Mass Flow Controller

1. Close the main valves of **all** dangerous gases.
2. Evacuate the gas lines of **all** dangerous gases. ⇨ Refer to chapter 7.22 ”Gases”).
3. Remove the old or defective mass flow controller from the coating system.

| | ⚠ WARNING |
|---|---|
| | **Danger of explosion!**<br>■ **For Oxygen ($O_2$) gas use only factory sealed mass flow controllers labeled as suitable for Oxygen $O_2$.** |

4. Open the packaging of the delivered mass flow controller and remove the protection covers from the threads. Install the new mass flow controller and plug in all cables.

**For assembling ⇨ refer to chapter 1.15.2.9 “Correct Assembling of the Swagelok VCR Fittings”.**

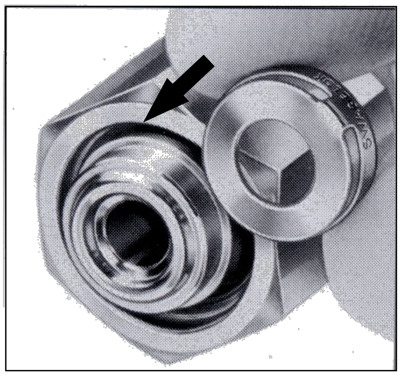

5. Program the Profibus address of the flow controller. ⇨ Refer to chapter 7.23 “Electrical Adjustments and Parameter Settings”.
6. Open the main valves of all dangerous gases.
7. Check the gas connections with a gas leak detector spray for leaks.
8. Purge the gas line at which the mass flow controller has been exchanged. ⇨ Refer to chapter 7.22 ”Gases”.
9. At the end of the next batch run the leak test for the process chamber and all installed gases.

**For correct function, the mass flow controllers need to be heated up after power on for minimum 30 minutes.**

**Correct Assembling of the Swagelok VCR Fittings:**

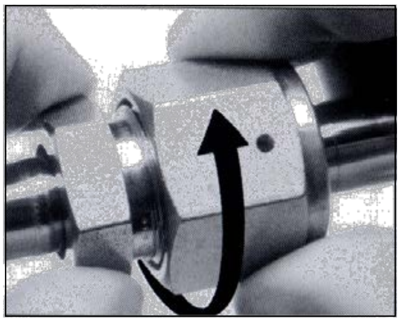
**A gasket must not be used twice. Always use a new gasket every time you open a connection.**

1. From the side of the VCR fitting, guide the gasket retainer over the retainer diameter of the fitting until the gasket is seated.

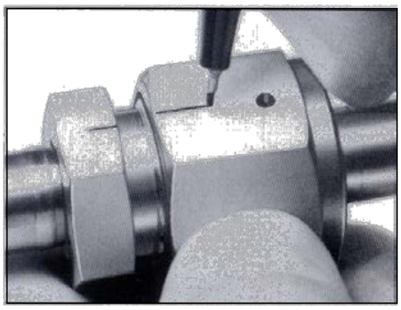


**Use only gaskets without a grid.**

2. To assemble the connection, hold the male nut or body hex stationary. Tighten the female nut finger-tight.

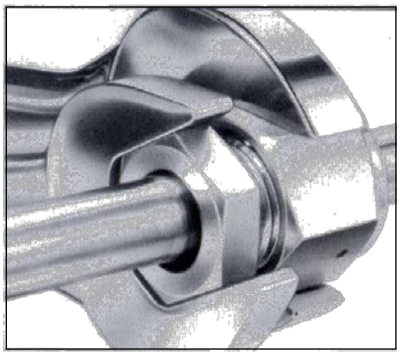


3. Mark both the female nut and the male nut or body hex.



4. Hold the male nut or body hex stationary with a backup wrench. Tighten the female nut 1/8 turn past finger-tight.

**Excessive over-tightening will damage the gasket and possibly cause system leakage.**



**For more information ⇨ refer to** [www.Swagelok.com](http://www.Swagelok.com) .

# 7.23 Electrical Adjustments and Parameter Settings

## 7.23.1 PSG 500

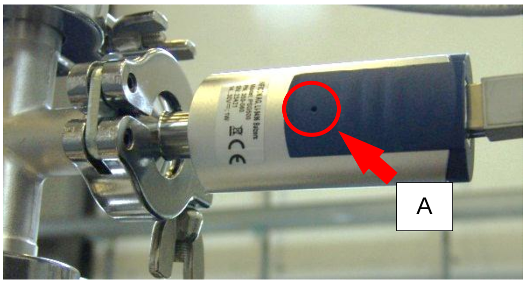
### 7.23.1.1 General

**Long-term run and soiling can lead to a zero shift.**

### 7.23.1.2 Zero Adjustment

A calibration is required in case of an error message, maintenance or if a new gauge is used.
⇨ Refer also to the component description.

1. Switch the pumping system to OFF (Wait until the turbo molecular pump reaches 0% and the fore pump is switched off).
2. Open the hand valve to vent the fore line.
3. Ensure that the PSG 500 is plugged in. Leave the gauge vented for 10 minutes to stabilize.
4. Press the button (A) by means of a special pin (<1.1mm) for less than 2 seconds to set the atmospheric pressure point.




5. Close the hand valve at the fore line and switch the pumping system to “Pump” (wait until the turbo molecular pump reaches 100%).
6. Press the button (A) for less than 2 seconds to set the vacuum pressure point.

### 7.23.2 PCG 550

#### 7.23.2.1 General

**Long-term run and soiling can lead to a zero shift.**

#### 7.23.2.2 Zero Adjustment

A calibration is required in case of an error message, maintenance or if a new gauge is used.
⇨ Refer also to the component description.

1. Switch the pumping system to "Vent" (Wait until the process chamber is completely vented).
2. Install and connect the (new) PCG 550 (if required).
3. Ensure that the PCG 550 is plugged in. Leave the gauge vented for 10 minutes to stabilize.

**If for any reason the power supply was interrupted the PCG 550 must be allowed to warm up for 10 minutes prior to adjustment.**

4. Briefly push the "ADJ" button (by means of a special pin <1.1mm) to perform an automatic zero adjustment (at atmospheric pressure).


5. Pump the process chamber to < $1x10^{-4}$ mbar and wait for 2 minutes for stabilization of the PCG 550.
6. Briefly push the "ADJ" button again to perform a zero adjustment (in high vacuum).

### 7.23.2.3 Threshold Adjustment

A calibration is required in case of an error message, maintenance or if a new gauge is used.
⇨ Refer also to the component description.

1. Select the “Popup - Maintenance - Gauges”.
2. Perform the adjustment of SP1 (set point 1):

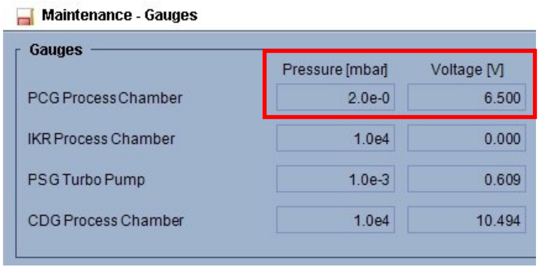
   Push and hold the “SP1” button (by means of a special pin <1.1mm) to increase/decrease the “Threshold” to a nominal value of 6.5V.


3. **For changing the counting direction:**

   Release the “SP1” button, push and hold it again.

**The value (displayed in voltage) is visible in the “Popup - Maintenance - Gauges”.**

2 mbar ≈ 6.5V




4. Perform the same adjustment of SP2 (set point 2):

   Push and hold the “SP2” button (by means of a special pin <1.1mm) to increase/decrease the “Threshold” to a nominal value of 6.5V.


5. **For changing the counting direction:**

   Release the “SP2” button, push and hold it again.

**The value (displayed in voltage) is visible in the “Popup - Maintenance - Gauges”.**

2 mbar ≈ 6.5V

**If no button is pressed within 5 seconds the gauge switches back to Measuring mode automatically.**

### 7.23.3 CDG 100 D

#### 7.23.3.1 General

**The permanent power supply for the CDG 100 D will energize the internal heater all the time (except main power failure). This ensures to keep the CDG 100 D at its designated working temperature of 100°C.**

**If for any reason this power supply was interrupted the CDG 100 D must warm up for 2 hours before a process can be started.**

#### 7.23.3.2 Zero Adjustment

An “Auto Zero Calibration” (within a limited range) will be performed by means of the control software as soon as the pressure in the process chamber reaches 1.0E-5 mbar (after 2 minutes delay) or 5.0E-6 mbar (after 30 sec. delay).

A manual zero adjustment is necessary when:

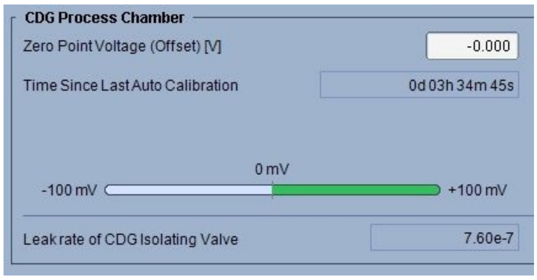
- the CDG 100 D has been vented or
- the “Zero Point Voltage” is ≥ 0.070V.

**While the gauge is being heated and/or ≥ 50% of the Full Scale the zero function is locked.**

1. Pump to < $5x10^{-5}$ mbar ($P_{IKR\ 251}$) and wait for 2 hours for stabilization of the CDG 100 D.
2. Adjust the “Zero Point Voltage” of the CDG 100 D by briefly pressing the “ZERO” button by means of a special pin (<1.1mm) and check if “Zero point voltage” = 0.000.

**The “STATUS” LED flashes green if the zero adjustment has failed.**

“Popup - Maintenance - Gauges“

### 7.23.4 CDG 025D-S

#### 7.23.4.1 General

**If for any reason the power supply was interrupted the CDG 025D-S must be allowed to warm up for 15 minutes prior to adjustment.**

#### 7.23.4.2 Zero Adjustment

A calibration is required in case of an error message, maintenance or if a new gauge is used.
⇨ Refer also to the component description.

1. Pump the process chamber to < $5x10^{-4}$ mbar and wait for 15 minutes for stabilization of the CDG 025D-S.
2. Press the “ZERO” button by means of a special pin (<1.1mm) to perform a zero adjustment (in high vacuum).


**The LED “RUN” is flashing until the automatic adjustment is finished.**

### 7.23.4.3 Threshold Adjustment

A calibration is required in case of an error message, maintenance or if a new gauge is used.
⇨ Refer also to the component description.

**Precondition:**

The process chamber must be pumped down to < $5x10^{-4}$ mbar.

**Adjustment settings for CDG025-S:**

**SP1** = 2.0 mbar Setpoint 1
**SP2** = 2.0 mbar Setpoint 2

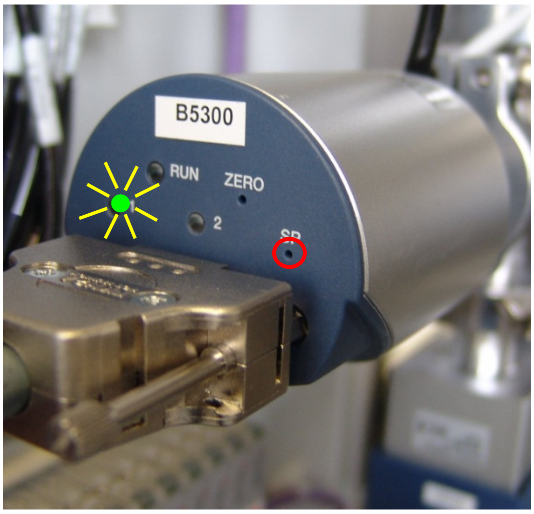
1. Connect a digital voltmeter (DVM) to X512.1 pin 2 (+) and 12 (-).

**1V = 1mbar, (2V = 2mbar) …**

2. Perform the adjustment of set point 1:

   Press the “SP” button once by means of a special pin (<1.1mm) to start the “Threshold” adjustment. LED 1 starts flashing.

**The gauge changes to Adjustment mode. The digital voltmeter (DVM) shows the lower threshold.**




**If no button is pressed within 10 seconds the gauge switches back to Measuring mode automatically.**

3. LED RUN = ON, LED 1 = flashing.

   Press the “ZERO” button
   (step by step = fine) or (hold = coarse) by means of the special pin to increase/decrease the “lower Threshold” value (see DVM).

   **For changing the counting direction:**

   Ensure that LED 1 is still flashing (“Adjustment mode”)

   Push the “ZERO” button once and wait approx. 5s (LED RUN expires briefly).

   Press the “ZERO” button within 5s to increase/decrease the “lower Threshold” value (see DVM).

4. Release the “ZERO” button for > 10 seconds to switch back the gauge to measuring mode automatically.

**The “upper Threshold” is set 1% (full scale) higher than the ”lower Threshold” automatically.**

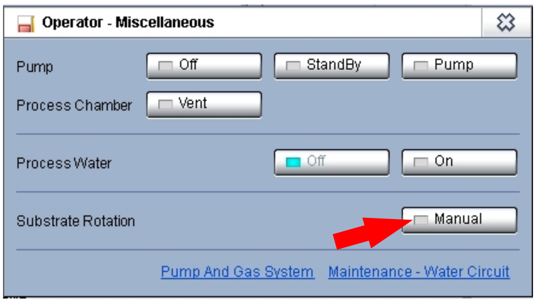
5. Perform the same adjustment with set point 2:
Press the button “SP” twice by means of a special pin (<1.1mm) to start the “Threshold” adjustment. LED 2 starts flashing.

6. Repeat steps 3…4.

### 7.23.5 Substrate Rotation Indicator

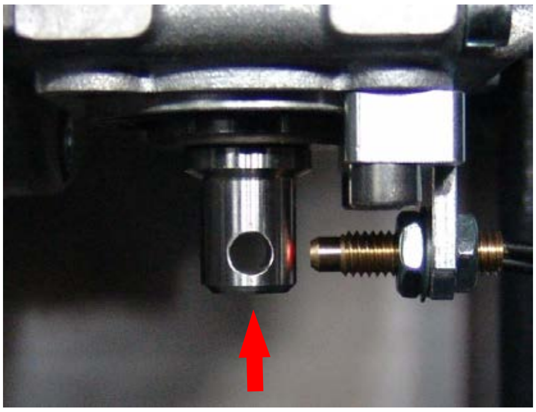
After exchange of a defective sensor with a new one, the new sensor must be programmed prior to run the next process. The sensor is located below the process chamber visible from front of the machine.

1. Select the “Miscellaneous” screen and set the “Substrate Rotation” to “Manual”.




2. Move the substrate rotation into position “Reflection” by depressing the button “Enable manual function” (front of machine).

**In the position “Reflection” the hole in the shaft faces towards the front of machine (i.e. the beam of light of the sensor is reflected).**

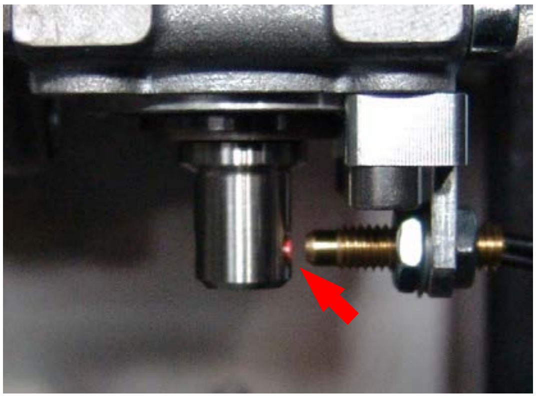


3. Set the programming unit into “static teach-in” mode:
   Press the “SET” button (4) of the programming unit approx. 2s until the green LED (2) begins to flash (see picture on next page).
4. While the substrate rotation is in position “Reflection”, press the button (4) once.

5. Move the substrate rotation into position "Hole" by depressing the button "Enable manual function" (front of machine).

**In the position "Hole" the hole in the shaft faces towards the sensor (i.e. the beam of light of the sensor is not reflected).**

**The "static teach-in" mode is active for approx. 1 minute. After elapsing, steps 3 and 4 must be repeated.**



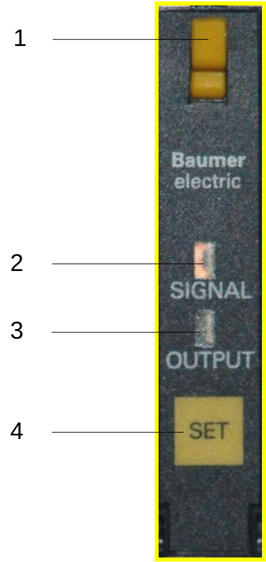
6. Press the button (4) once.

7. For checking the programming, close the process chamber door and set the rotation speed to 80%.

8. Turn the substrate rotation and check if the green LED (2) flashes when the indicator (hole) passes the sensor.

**Programming unit located in the electrical box:**

1 Locking lever
2 LED signal reserve / soiled lens indicator (green)
3 LED output indicator (yellow)
4 Teach-in button (SET)




### 7.23.6 DVZ-Water Flow Meter

In the INGENIA P3e™ coating system the measured water flow values are transmitted via an analog signal from the water flow meter to the PLC system. The alarm values are supervised in the PLC. The limit values are visible in the "**Popup-Configuration-Water Circuit**" screen.

If one of the water flow meters (on the machine) does not work properly, replace it with a new one and send the defective water flow meter back to Oerlikon Balzers.

A new water flow meter (delivered from Oerlikon Balzers) has already been pre-adjusted and programmed for application in the INGENIA P3e™ coating system. Therefore it is not necessary to change any values in the water flow meter.

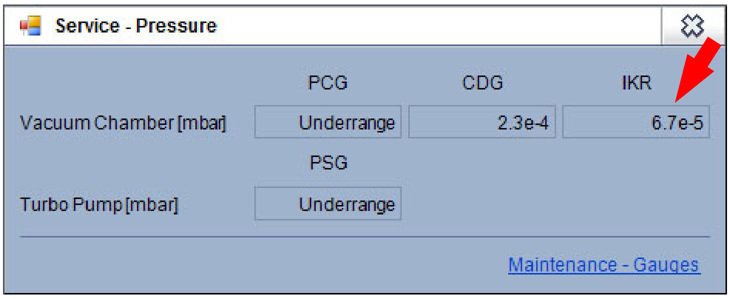
### 7.23.7 Filament Current Check and Adjustment

**The filaments have to be adjusted every time the filaments have been changed to new ones. Always change booth filaments.**

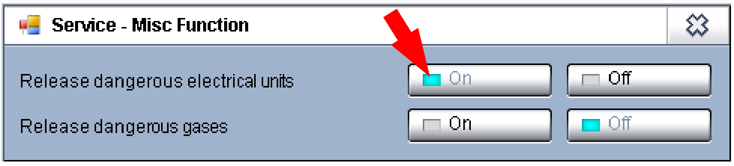
1. Prepare the process chamber for a batch (batch maintenance).
2. Load a carousel with dummies.

**Ensure that the water is “ON”.**

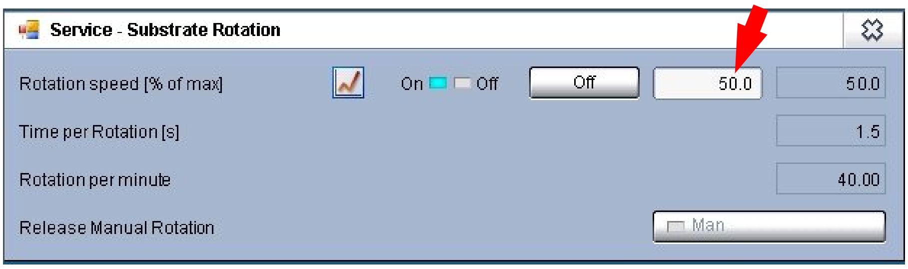
3. Put in the loaded carousel into the process chamber and pump down.
4. Wait until the IKR 251 pressure is below 4x10$^{-4}$ mbar.



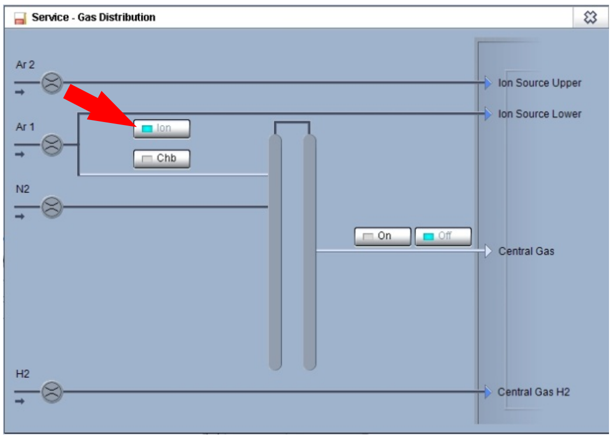

5. Select the “Service – Misc Function” screen and set ”Release dangerous electrical units” to ON.




6. Select the “Service – Substrate Rotation” screen and set the “Rotation speed” to 50%.

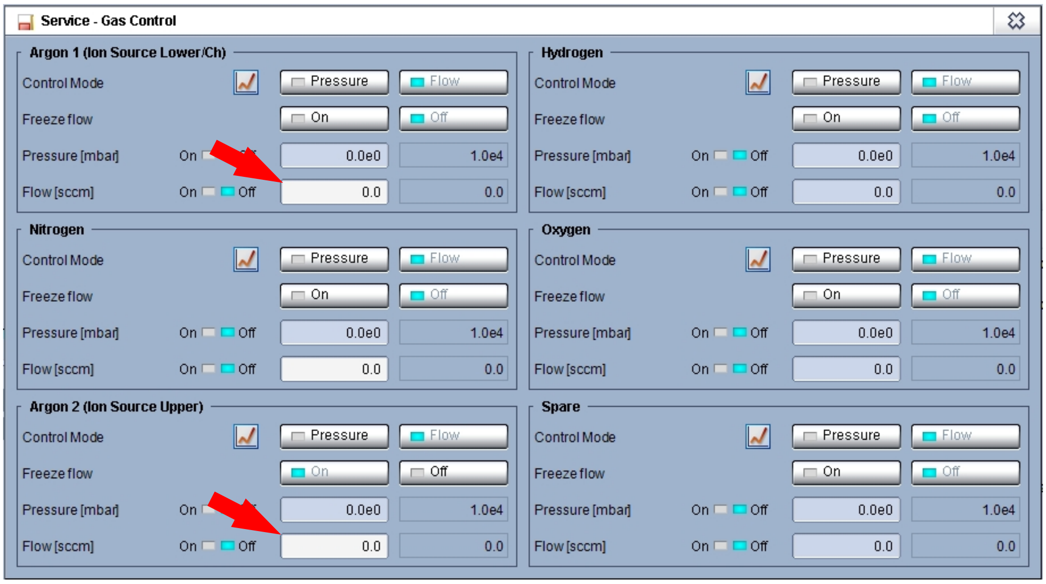


7. Select the "Service – Gas Distribution" screen and set **Ar 1** to Ion1



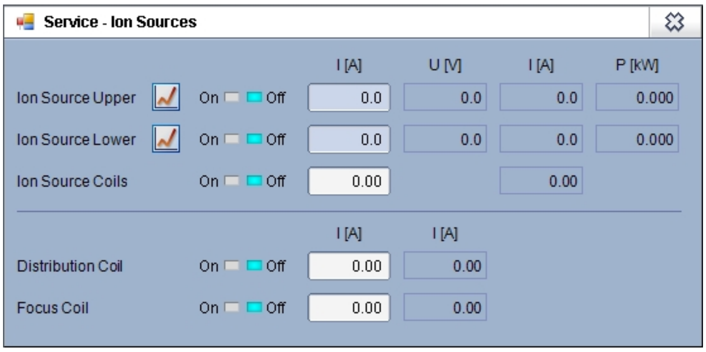

8. Select the "Service – Gas Control" screen and set
**Ar 1** (ion source lower)
Control mode to "Flow"
Enter a nominal flow of 60 sccm.

**Ar 2** (ion source upper)
Control mode to "Flow"
Enter a nominal flow of 60 sccm.




9. Wait until the Ar gas-flows are stable on 60 sccm.

10. Select the “Service – Ion Sources” screen.




11. **“Ion Source Coils”**

    Enter a nominal value of 1.5 A

12. **“Focus Coil”**

    Enter a nominal value of 1.37 A

13. **“Ion Source Upper”**

    Enter a nominal value of 80 A
    Wait until the plasma has ignited and the current is stable on 80 A.
    Enter a nominal value of 200 A.

14. **“Ion Source Lower”**

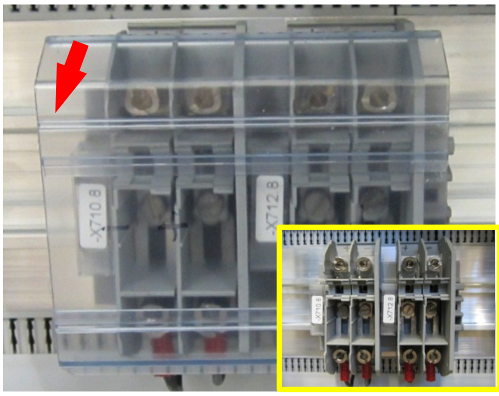
    Enter a nominal value of 80 A
    Wait until the plasma has ignited and the current is stable on 80 A.
    Enter a nominal value of 200 A.

**Ensure that both ion sources have a stable plasma current of 200 A.**

15. Remove the cover for the measuring points for the filament adjustment.

    (Power cabinet, left side of the machine).

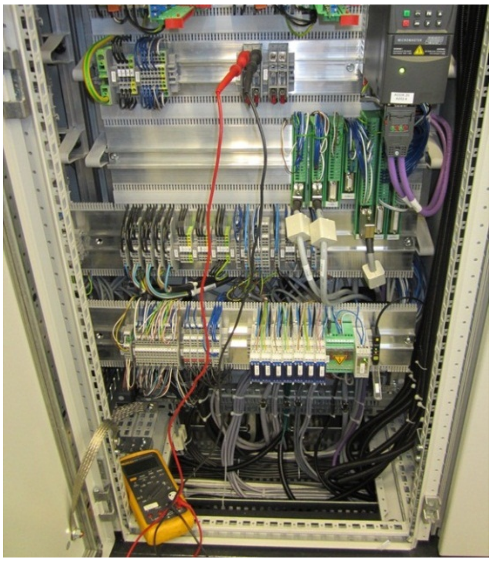
**For detailed information, ⇨ refer to customers wiring diagram.**




16. Connect a DVM (Digital Volt Meter) on terminal **X710.8**.

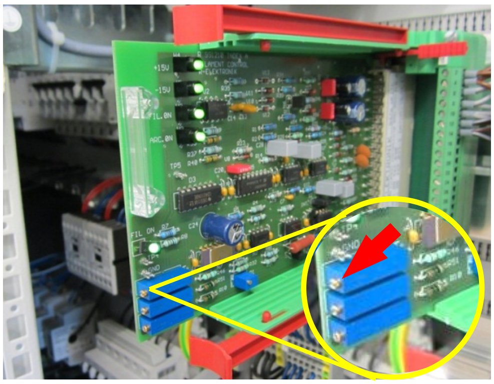
    Ensure that the polarity (**+** and **–)** is connected correctly.

**⇨ Refer to customers wiring diagram for the correct board which has to be adjusted.**



**The following adjustment has to be performed only if the deviation of the measured voltage value on X710.8 and/or X712.8 is more than -8.5V or less than -7.5V, otherwise continue with step 15.**

17. Adjust the voltage to **-8 V** (negative voltage) by adjusting the potentiometer P4.

18. Repeat the measuring and adjustment for the second filament.

    Connect a DVM (Digital Volt Meter) on terminal **X712.8**.

    Ensure that the polarity (**+** and **–)** is connected correctly.

    ⇨ **Refer to customers wiring diagram for the correct measuring point and for the correct board which has to be adjusted.**

19. Select the “Popup - Service – Ion Source”.

    **“Ion Source Upper”**

    Enter a nominal value of 5 A

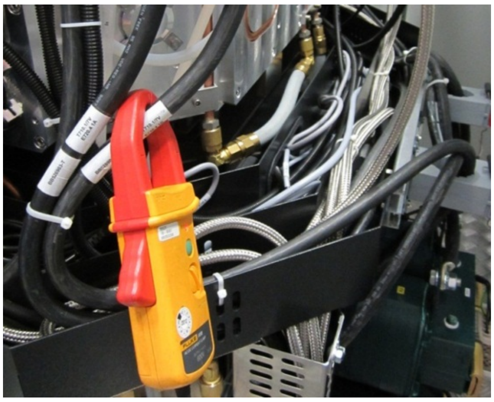
    **“Ion Source Lower”**

    Enter a nominal value of 5 A

    **Ensure that both ion sources have a stable plasma current of 5 A.**

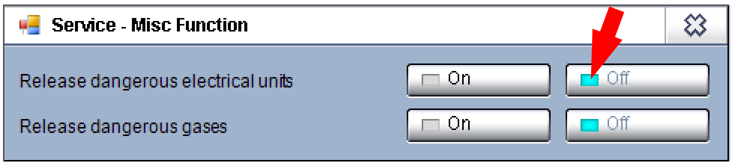
20. Check the filament current on both filaments (should be approx. 180 A (AC)) by using a **True RMS Clamp meter.**

    **Ensure that the True RMS Clamp-meter is calibrated and the correct adjustment is done (AC-current).**



21. Switch off the process by clicking “Stop” (in the icon bar) and “YES” in the warning popup.

18. Select the “Service – Misc Function” screen and set ”Release dangerous electrical units” to OFF.

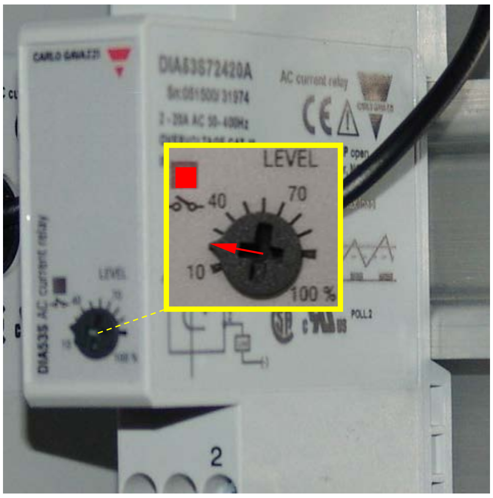



### 7.23.8 Heater Current Monitoring

**Adjustment settings for heater current monitoring:**

| Position: | Adjustment settings: |
|---|---|
| Process chamber door horizontal 1 | 25% |
| Process chamber door horizontal 2 | 25% |
| Process chamber door upper | 15% |
| Process chamber door lower | 15% |
| Process chamber back | 25% |

**LED ON current o.k.**
**LED OFF current too low.**



### 7.23.9 Rotary Feed-through

System preconditions: **Stby**



#### 7.23.9.1 Frequency Inverter Settings

**Before starting to program a Micromaster 420 frequency inverter set the correct Profibus address.**

**Set the system precondition for the frequency inverter as shown as follows.**

1. Disconnect the Profibus cable (for rotary feed through only).
2. Press **P** until **r0000** appears.
3. **Unlock of the parameter entry and reset of the frequency inverter:**

| **Press** | until address appears | **Press** | to show the parameter | **Press** | to change parameter to | **Press** (store) |
|---|---|---|---|---|---|---|
| ▲ ▼ | **P 0010** | **P** | XXXX | ▲ ▼ | **30** | **P** |
| ▲ ▼ | **P 0970** | **P** | XXXX | ▲ ▼ | **1** | **P** |
| ▲ ▼ | **P 0003** | **P** | XXXX | ▲ ▼ | **3** | **P** |
| ▲ ▼ | **P 0010** | **P** | XXXX | ▲ ▼ | **1** | **P** |

4. **Parameter setup:**

| **Press** | until address appears | **Press** | to show the parameter | **Press** | to change parameter to | **Press** (store) |
|---|---|---|---|---|---|---|
| ▲ ▼ | **P 0100** | **P** | XXXX | ▲ ▼ | | **P** |
| ▲ ▼ | **P 0304** | **P** | XXXX | ▲ ▼ | | **P** |
| ▲ ▼ | **P 0305** | **P** | XXXX | ▲ ▼ | | **P** |
| ▲ ▼ | **P 0307** | **P** | XXXX | ▲ ▼ | | |
| ▲ ▼ | **P 0308** | **P** | | | | |
| ▲ ▼ | [illegible] | | | | | |
| | | | | | | |

5. **Store of the values into the EEPROM:**

| **Press** | until address appears | **Press** | to show the parameter | **Press** | to change parameter to | **Press** (store) |
|---|---|---|---|---|---|---|
| ▲ ▼ | **P 0971** | **P** | XXXX | ▲ ▼ | **1** | **P** |

(Wait a view seconds until the values are stored and P 0971 is clearly visible.)

6. **Lock of the parameter entry:**

| **Press** | until address appears | **Press** | to show the parameter | **Press** | to change parameter to | **Press** (store) |
|---|---|---|---|---|---|---|
| ▲ ▼ | **P 0003** | **P** | XXXX | ▲ ▼ | **1** | **P** |

7. Press **Fn** until **r0000** appears then press **P** until **0.00** is displayed.

8. Connect the Profibus cable.

**Adjustment settings**
**Rotary Feed-through:**

| Press | until address appears | Press | to show the parameter | Press | to change parameter to | Press (store) |
|---|---|---|---|---|---|---|
| ▲ ▼ | P0010 | P | XXXX | ▲ ▼ | 30 | P |
| ▲ ▼ | P0970 | P | XXXX | ▲ ▼ | 1 | P |
| | | | | | | |
| ▲ ▼ | P0003 | P | XXXX | ▲ ▼ | 2 | P |
| ▲ ▼ | P0010 | P | XXXX | ▲ ▼ | 1 | P |
| ▲ ▼ | P0100 | P | XXXX | ▲ ▼ | 0 | P |
| ▲ ▼ | P0304 | P | XXXX | ▲ ▼ | 230 | P |
| ▲ ▼ | P0305 | P | XXXX | ▲ ▼ | 1.4 | P |
| ▲ ▼ | P0307 | P | XXXX | ▲ ▼ | 0.25 | P |
| ▲ ▼ | P0308 | P | XXXX | ▲ ▼ | 0.7 | P |
| ▲ ▼ | P0310 | P | XXXX | ▲ ▼ | 50 | P |
| ▲ ▼ | P0311 | P | XXXX | ▲ ▼ | 1360 | P |
| ▲ ▼ | P0335 | P | XXXX | ▲ ▼ | 0 | P |
| ▲ ▼ | P0640 | P | XXXX | ▲ ▼ | 150 | P |
| ▲ ▼ | P0700 | P | XXXX | ▲ ▼ | 6 | P |
| ▲ ▼ | P1000 | P | XXXX | ▲ ▼ | 6 | P |
| ▲ ▼ | P1080 | P | XXXX | ▲ ▼ | 0 | P |
| ▲ ▼ | P1082 | P | XXXX | ▲ ▼ | 50 | P |
| ▲ ▼ | P1120 | P | XXXX | ▲ ▼ | 10 | P |
| ▲ ▼ | P1121 | P | XXXX | ▲ ▼ | 2 | P |
| ▲ ▼ | P1300 | P | XXXX | ▲ ▼ | 1 | P |
| ▲ ▼ | P3900 | P | XXXX | ▲ ▼ | 1 | P |
| | | | | | | |
| ▲ ▼ | P0003 | P | XXXX | ▲ ▼ | 3 | P |
| ▲ ▼ | P0701 | P | XXXX | ▲ ▼ | 0 | P |
| ▲ ▼ | P0702 | P | XXXX | ▲ ▼ | 0 | P |
| ▲ ▼ | P0703 | P | XXXX | ▲ ▼ | 29 | P |
| ▲ ▼ | P0731 | P | XXXX | ▲ ▼ | 52.2 | P |
| ▲ ▼ | P1210 | P | XXXX | ▲ ▼ | 1 | P |
| ▲ ▼ | P1211 | P | XXXX | ▲ ▼ | 3 | P |
| ▲ ▼ | P1215 | P | XXXX | ▲ ▼ | 1 | P |
| ▲ ▼ | P2000 | P | XXXX | ▲ ▼ | 50 | P |
| ▲ ▼ | P2040 | P | XXXX | ▲ ▼ | 1000 | P |
| | | | | | | |
| ▲ ▼ | P0210 | P | XXXX | ▲ ▼ | 230 | P |
| ▲ ▼ | P1240 | P | XXXX | ▲ ▼ | 0 | P |
| ▲ ▼ | P1254 | P | XXXX | ▲ ▼ | 0 | P |
| | | | | | | |
| ▲ ▼ | P0971 | P | XXXX | ▲ ▼ | 1 | P |
| | | | | | | |
| ▲ ▼ | P0003 | P | XXXX | ▲ ▼ | 1 | P |

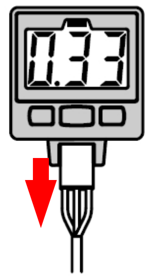
### 7.23.10 Compressed Air Pressure Switch

The digital pressure switch is located:

- close to the compressed air tank
- at the compressed air inlet hand valve

When a new digital pressure switch has been installed the following parameters must be programmed.

**If the sensor gets stuck in any these menus, simply disconnect and reconnect the power to reset the sensor.**



#### 7.23.10.1 Basic Parameter Settings for Air Pressure Emergency Cooling (ISE30A: B576.1)

Put the sensor into “Setup mode” by pressing “**S**” for more than three seconds.

**Adjustment settings:**

| **Parameter**<br>Change with “**S**” | **Settings**<br>Change with “▲ ▼” |
|---|---|
| **F0**<br>Uni | bAr |
| **F1**<br>ou1<br>1ot<br>P_1<br>H_1<br>CoL | HYS<br>1_P<br>4.5<br>0.5<br>SoG |


On completion press “**S**” for more than 3 seconds to get back into measurement mode (actual values are displayed).

## 7.23.10.2 Basic Parameter Settings for Air Pressure Supply (SE35: B576.2)

**Unit setting:**

Start in the measurement mode (actual values are displayed). Put the sensor into “Indication unit mode” by pressing ▼ three times.

| **Display**<br>in turn | **Setting**<br>Change with “▲ ▼” |
|---|---|
| Uni | bAr |

Press “S” briefly to return to measurement mode.

**Threshold setting:**

Start in the measurement mode (actual values are displayed). Put the sensor into “Threshold setting mode” by pressing “**S**” three times.

| **Display**<br>in turn | **Setting**<br>Change with “▲ ▼” |
|---|---|
| P_ | 4.5 |

Press “S” briefly to return to measurement mode.

**Adjustment settings:**

Put the sensor into “Setup mode” by pressing “**S**” for more than three seconds.

| **Parameter**<br>Change with “**S**” | **Settings**<br>Change with “▲ ▼” |
|---|---|
| Su | on (Switch Output) |
| CoL | SoG (Indication Color) |
| rES | 3.0 (Response Time) |
| oPE | HYS (Operation Mode) |
| H | 0.5 (Hysteresis) |
| oUt | no (Output Type) |
| PoU | nrn (Power Saving Mode) |
| Pin | oFF (Security Code Input) |
| diS | (Indication Mode) |

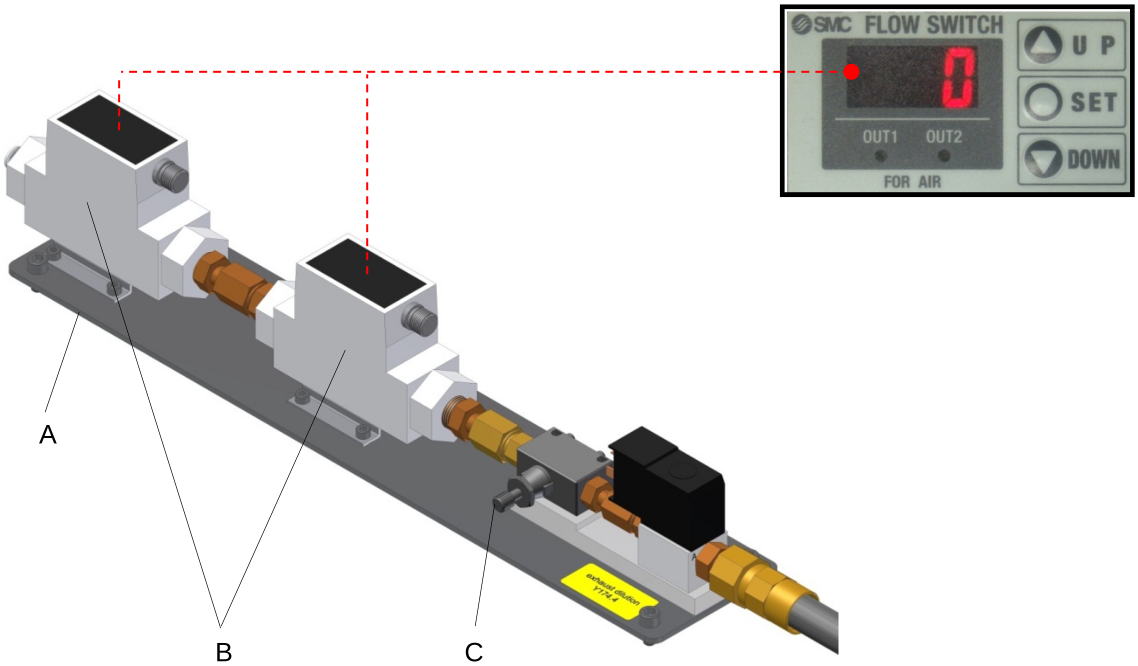
On completion press “**S**” for more than 3 seconds to get back into measurement mode (actual values are displayed).

### 7.23.11 Checking and Setting of the Dilution Flow

<table>
<tr><td rowspan="2"></td><td>⚠ DANGER</td></tr>
<tr><td>Danger of explosion!<br>▪ A too low gas dilution may cause an explosive gas mixture in the exhaust.<br>▪ Therefore, a defective dilution component must be replaced with a new one and tested as described below.<br>▪ It is forbidden to run the INGENIA P3e™ coating system with a defective dilution system.</td></tr>
</table>

The gas dilution equipment (A) is installed on the pneumatic distributor frame (right side behind the process chamber).

In case of any changes on the gas dilution equipment the correct function must be tested prior to start the next batch.




System preconditions: **Pump**

1. Release dangerous gases. ⇨ Refer to chapter 4.10.2.1 “Popup - Service - Misc Function”.

2. Reduce the actual flow below the alarm value (<55 l/min) of P_1; P_2 by means of the flow regulator (C). ⇨ Refer to chapter 7.23.11.1 “Parameter Setup for the Dilution Flow Switch”.

**The actual flow is displayed on the flow switches (B).**

3. Check if an error message appears in the list box in the visualization.

**If there is no error message the service engineer or production manager must be informed.**

4. Adjust the flow limiter (C) back to the nominal value (65 l/min).

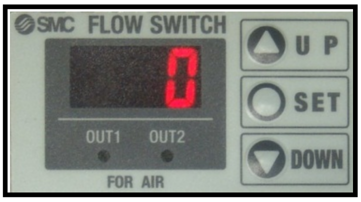
5. Acknowledge the error message.

**The error message disappears.**

### 7.23.11.1 Parameter Setup for the Flow Switch

When a new flow switch has been installed the following parameters must be programmed.

| **Press** (pushbutton) | until…is displayed | **Press** (pushbutton) |
|---|---|---|
| SET (>2 sec) | d_ 1 | SET |
| ▲UP | U_ 1 | SET |
| ▲UP | o 10 | SET |
| ▲UP | o20 | SET |
| ▲UP | 1_P | SET |
| ▲UP | 2_P | SET |
| | Anr | SET |
| | actual flow | |
| SET (quick) | F_ 1 | SET |
| | P_ 1 | (OUT1, ON) |
| ▲UP/▼DOWN (set values) | 61 | SET |
| | P_2 | (OUT1, OFF) |
| ▲UP/▼DOWN (set values) | 55 | SET |
| | P_3 | (OUT2, ON) |
| ▲UP/▼DOWN (set values) | 100 | SET |
| | P_4 | (OUT2, OFF) |
| ▲UP/▼DOWN (set values) | 90 | SET |
| | actual flow | |



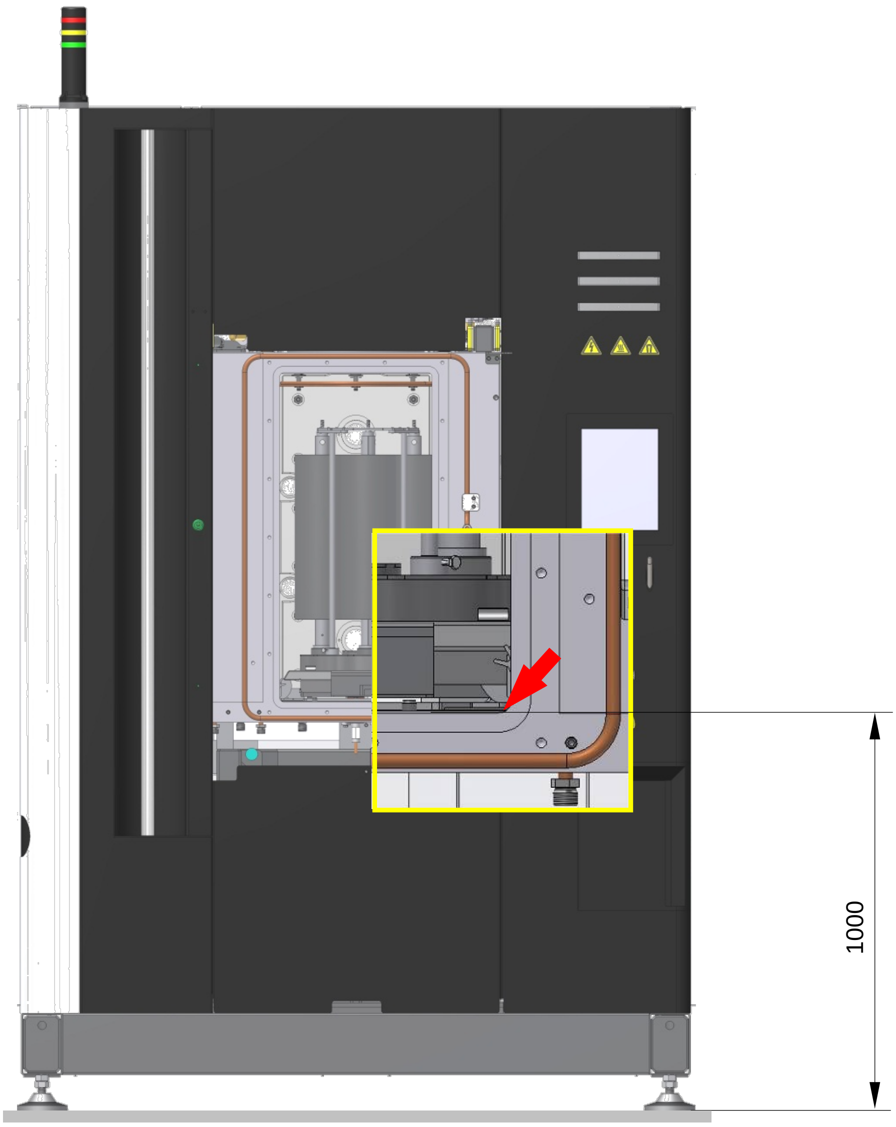
## 7.24 Mechanical Adjustments

### 7.24.1 Aligning of the INGENIA P3e™ Coating System

**A correct height adjustment is necessary that the carousel exchanging runs smoothly without getting wedged.**

The distance from the floor to the bottom surface of the process chamber is exactly 1000 mm.

Check the distance and correct it if necessary. The remaining frame posts must be adjusted accordingly for an even level of the complete INGENIA P3e™ coating system.

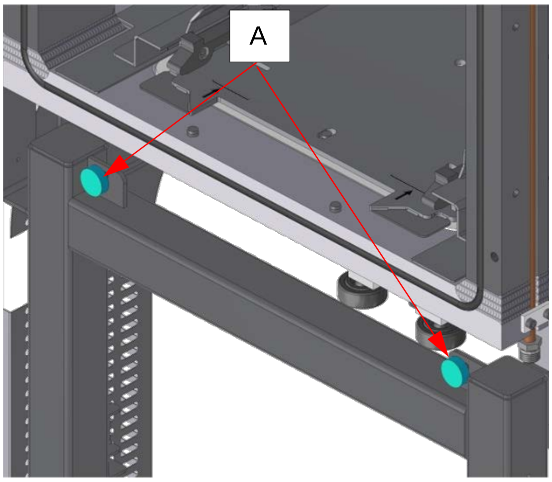


### 7.24.2 Checking the Limit Stops of the INGENIA P3e™ Coating System

**Ensure the INGENIA P3e™ coating system has been aligned previously.**

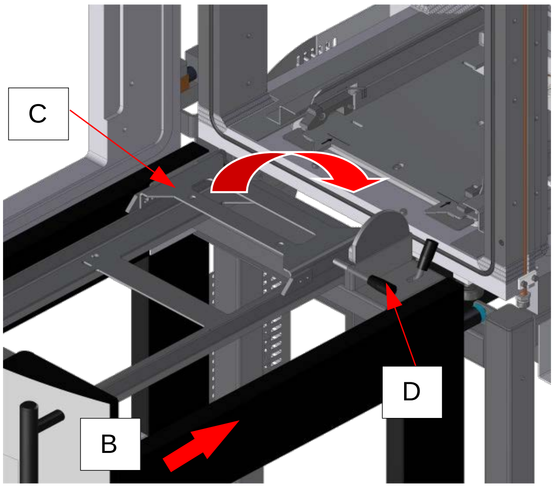
Actually each INGENIA P3e™ coating system was correctly adjusted (limit stop adjustment performed) for the use of the carousel exchanging system. But, in case of any problems with the park position of the carousel exchanging system (e.g. none engage possible, etc.), the two rubber pads (located underneath the process chamber) must be readjusted.

1. Remove the carousel exchanging system from the process chamber.
2. Loosen the counter-nuts and screw in (clockwise direction) the two rubber pads (A).

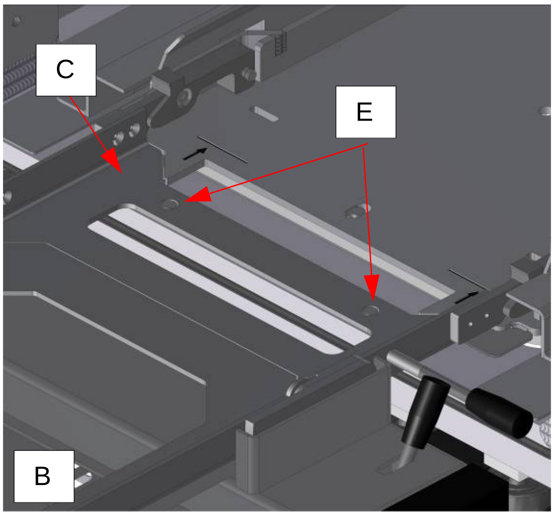



3. Push in the carousel exchanging system (B) until it is engaged.
4. Lower the bridge (C) of the carousel exchanging system (B) towards the process chamber by means of the lever (D).

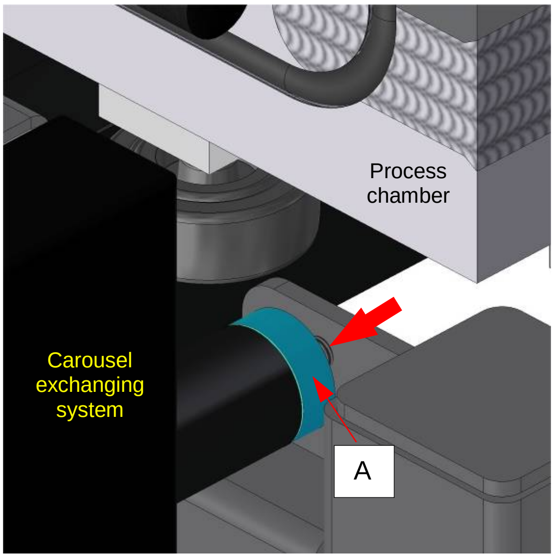
**Ensure the carousel exchanging system is engaged and therefore the bridge is unlocked.**



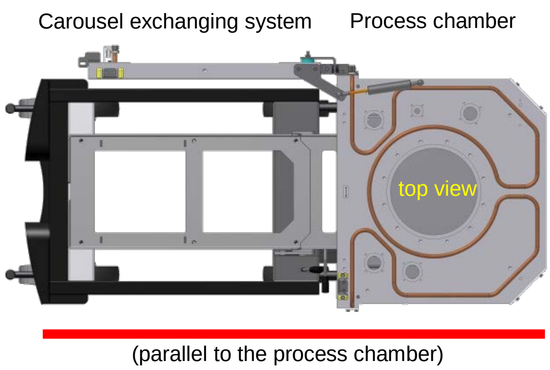
**If the carousel exchanging system (B) is in correct position, the bridge (C) will fit into the pins (E).**




5. Turn both rubber pads (A) toward the carousel until to the stop.




6. Check if the carousel exchanging system is correctly aligned (parallel to the process chamber).




7. Secure both rubber pads (A) by means of the counter-nut.

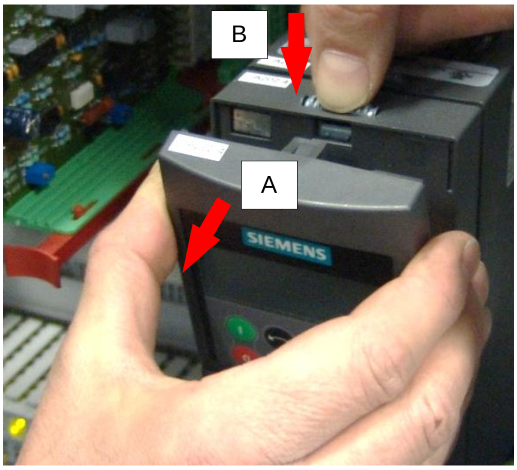
## 7.25 Profibus Address Settings

### 7.25.1 Micromaster 420 Frequency Inverter for the Rotary Feed-through

1. Remove the operator panel of the Micromaster 420 frequency inverter (A) by depressing the button (B).

**The operator panel is necessary for programming the frequency inverter. It can be omitted after programming (not necessary for operation).**

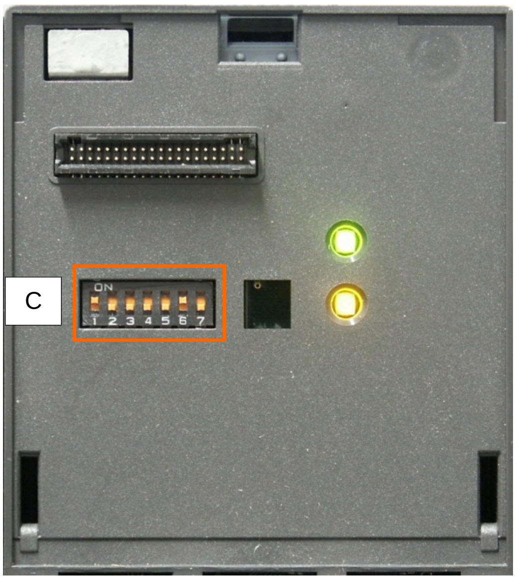
**Profibus address: 20**




2. Set the correct Profibus address with the binary address switches (C).

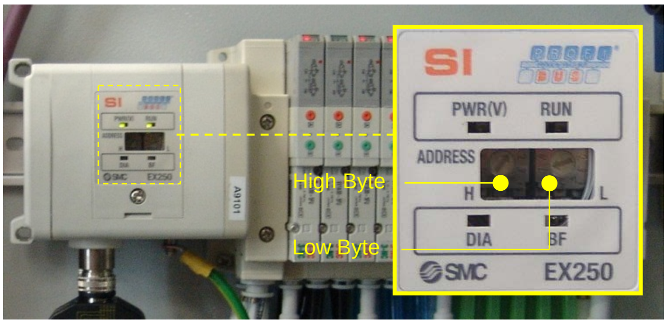
**The picture shows an example of address 33 (binary 1+32).**

| Switch: | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Status: | **ON** | OFF | OFF | OFF | OFF | **ON** | OFF |
| Binary: | 1 | 2 | 4 | 8 | 16 | 32 | 64 |



### 7.25.2 SMC EX250

Set the correct Profibus address (Hex-Code) by turning the DIL-Switches “High Byte” and “Low Byte”.




**High Byte stands for integer multiple and**
**Low Byte for the rest.**

**Profibus address: 28 (water / gas)**

**Profibus address: 30 (shutter)**

### 7.25.3 Turbo Molecular Pump MAG W 1700 IP

Set the correct Profibus address (Hex-Code) by turning the DIL-Switches “High Byte” and “Low Byte”.


**High Byte stands for integer multiple and Low Byte for the rest.**

**The switch steps are close together. Therefore check the correct position again.**

**Profibus address: 38 (HEX)**

**Note that this address is in hexadecimal (HEX) code.**
**For more information ⇨ refer to the manual of the turbo molecular pump.**

### 7.25.4 Fronius Bias and Source Generators (DPS 2500)

**The Profibus plug must be removed first in order to get access to the DIL-Switches.**

Set the correct Profibus address by turning the DIL-Switches.

**Upper DIL-Switch (factor x1)**
**Lower DIL-Switch (factor x10)**

**Source 1 DPS 2500 Profibus address: 46**

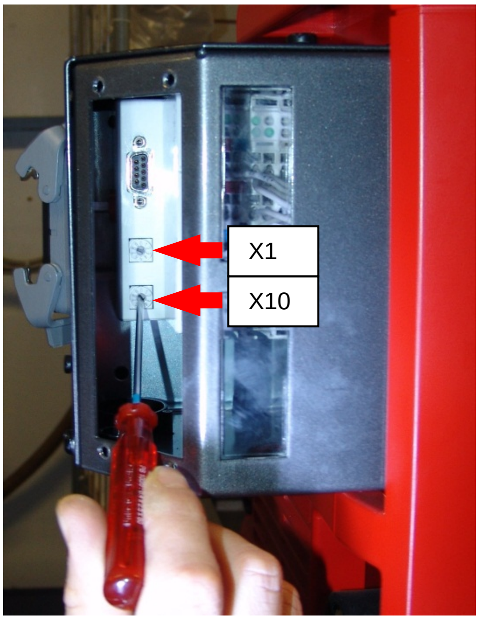
**Source 2 DPS 2500 Profibus address: 48**

**Source 3 DPS 2500 Profibus address: 50**

**Source 4 DPS 2500 Profibus address: 52**

**Source 5 DPS 2500 Profibus address: 54**

**Source 6 DPS 2500 Profibus address: 56**




### 7.25.5 Pulsed Bias Generator (BPG 800)

**The Profibus plug must be removed first in order to get access to the DIL-Switches.**

Set the correct Profibus address by turning the DIL-Switches.

**Left DIL-Switch (factor x1)**
**Right DIL-Switch (factor x10)**

**Profibus address: 42**


(* Optional

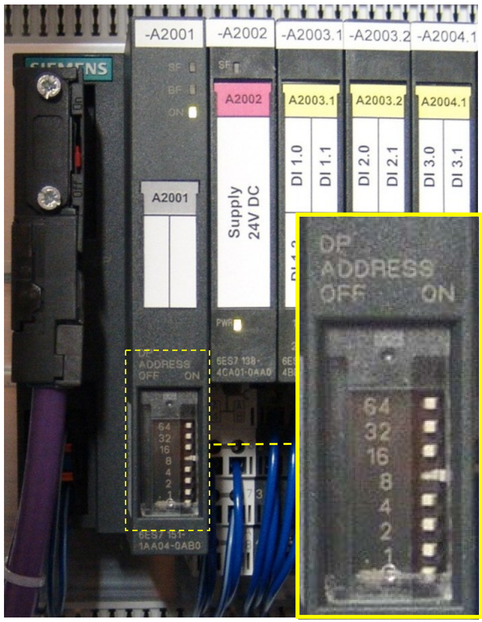
### 7.25.6 ET 200S

Set the correct Profibus address with the address switches.

**This example shows the address 8**.

**Power cabinet 1 (safety I/O's)**
**Profibus address: 16**

**Power cabinet 2**
**Profibus address: 12**



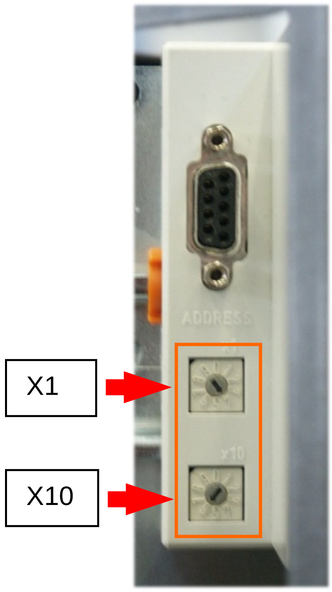

### 7.25.7 Control Unit VMS

**The Profibus plug must be removed first in order to get access to the DIL-Switches.**

Set the correct Profibus address by turning the DIL-Switches.

**Upper DIL-Switch (factor x1)**
**Lower DIL-Switch (factor x10)**

**Profibus address: 14**




(* Optional

### 7.25.8 Programming the Mass Flow Controller

**Profibus Address Example 68:**

In order to program a two-digit number, a sequence must be obeyed.
First program the "tens" column **(example value: 6)**
and then the "ones" column **(example value: 8)**.

1. Set the mass flow controller into "programming mode":

**Ensure that the gas lines of all dangerous gases are evacuated**

a) Pull out the connector (B).

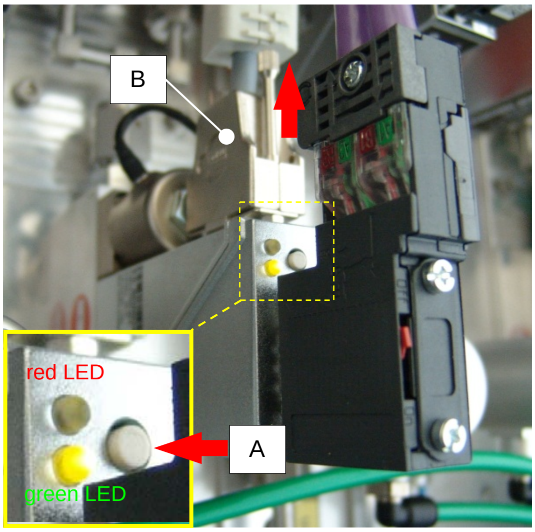
b) Press the button (A)
**and keep it pressed**.

c) Replace the connector (B).

**Action:**

- red LED flashes fast
- green LED flashes fast
- both LED's flash fast

d) now release the button immediately




2. Program the tens column **(example value: 6).**

**For programming the tens column the green LED must be observed.**

Press and hold the button, count **6 flashes** and release the button.

3. Program the ones column **(example value: 8)**.

**For programming the ones column the red LED must be observed.**

Press and hold the button, count **8 flashes** and release the button.

4. Check the correct programming by pressing the button (A) shortly three times.

**Mass flow controller Profibus addresses:**

Nitrogen ($N_2$) → **60**;
Argon 1 (Ar1) → **62**;
Argon 2 (Ar2) → **64**;
Hydrogen ($H_2$) → **66**;
Oxygen ($O_2$) → **68**

## 7.26 Testing the VMS

1. Select the “Service Screen – Miscellaneous Functions” and set “Release dangerous units” to “On”.

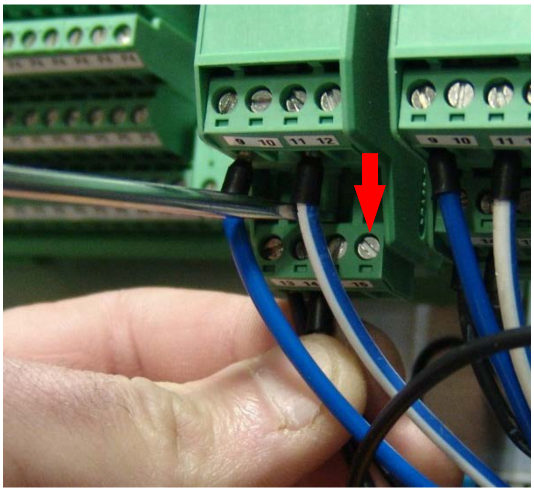
**All VMS move to their park position (positioning noise audible). If no error message occurs the VMS have been correct installed and are therefore ready for the process.**

2. Perform a test batch using the VMS hardware.

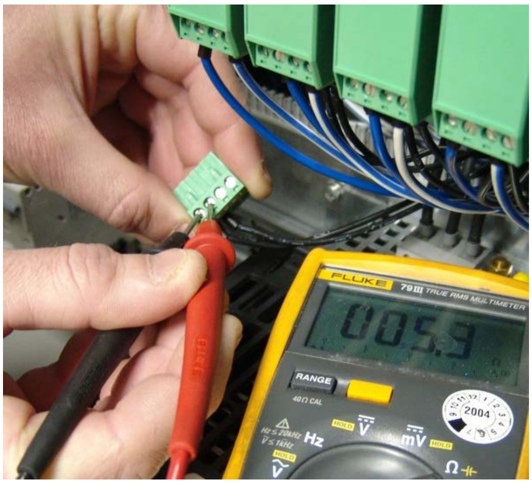
## 7.27 Testing the CCS with any Coil Magnetic System (Optional)

Measurement of the coil resistance and coil current and determination of the magnetic field direction.

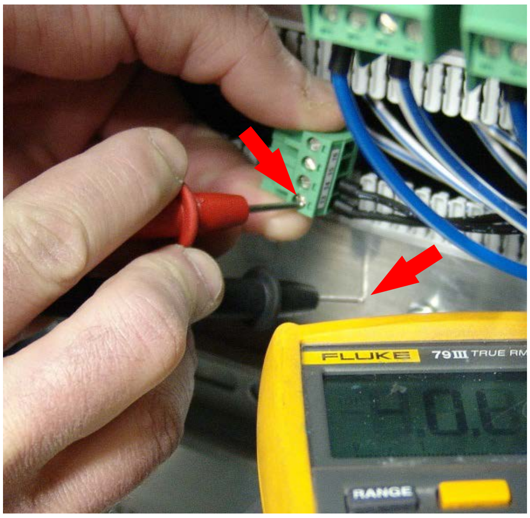
1. Pull out the terminal (pin 13-16) of the module 1 (connecting leads for coil 1).



2. Measure the resistance of the coil 1 (pin 13-14), approx. 4-7 Ω.



3. Measure the resistance of the coil (pin 13 & pin 14) against GND (high impedance).

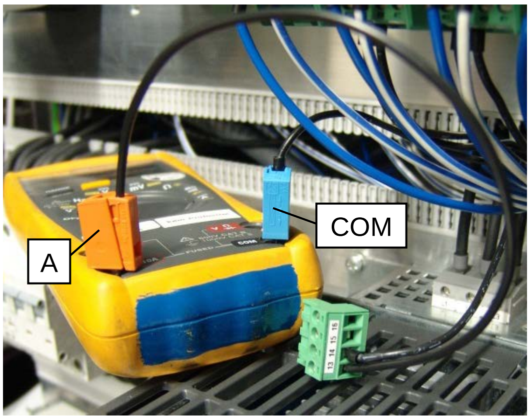



4. Turn main switch to “On”.

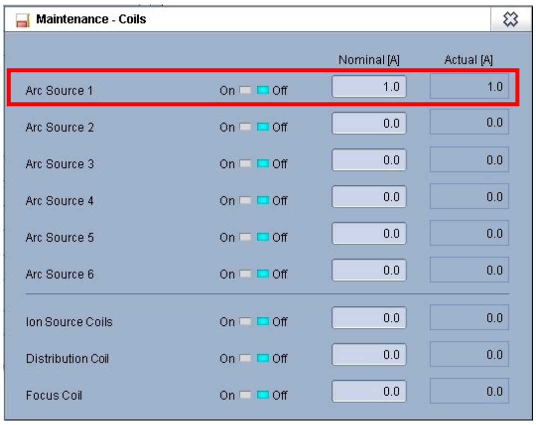
**Ensure that the fuses F148.5 and F148.6 are switched on.**

5. Prepare the current measurement:

- Disconnect the wire (pin 13) from the terminal and connect it to COM of the Ampere meter.
- Connect an additional wire from terminal pin 13 to the Ampere meter (A).
- Plug in the terminal into the module.

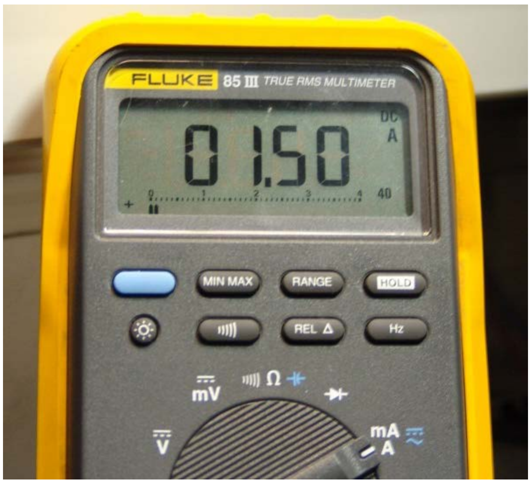



6. Select “Popup - Maintenance - Coils” and set the coil current to 1.0A.



7. Check if the Ampere meter shows 1.0A (± 50mA DC) for source coil 1.

**If the calibration is out of the limit, the unit can be sent back to BHQ for calibration or replaced with a new one.**




8. Check the direction of the magnetic field by means of a magnetic field tester. The north pole (blue) shows toward the center of the target.

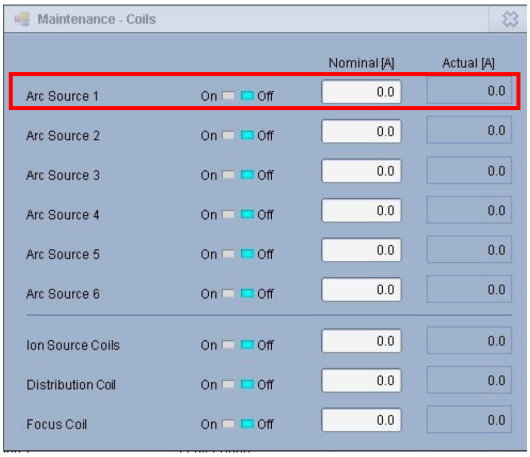
9. Select “Popup - Maintenance - Coils” and set the coil current to -1.0A.

10. Check if the Ampere meter shows -1.0A (± 50mA DC) for source coil 1.


**If the calibration is out of the limit, the unit can be sent back to BHQ for calibration or replaced with a new one.**

11. Check the direction of the magnetic field. The south pole (red) shows toward the center of the target.

12. Select "Popup - Maintenance - Coils" and set the coil current to 0A.




13. Check if the Ampere meter shows 0A for source coil 1.

14. Repeat step 1-13 for modules and coils 2-6.

## 7.28 Manual Starts

### 7.28.1 Manual Start of Radiation Heating

System preconditions:

- **Pump** (Carousel loaded with fixtures or dummies.)
- **CDG 100 D pressure** < 5x10$^{-4}$ mbar
- **Process water:** ON

**This work flow should not be used to heat manually for long terms. It is only a function test for all essential components.**

| | |
|---|---|
| 1. | Select the “Popup - Service - Misc Function”.<br>• Set “Release dangerous electrical units” to **ON**.<br>• Set “Release dangerous gases” to **OFF**. |
| 2. | Select the “Popup - Service - Substrate Rotation”.<br>• Set “Rotation speed” to **50 %.** |
| 3. | Select the “Popup - Service - Temperature Control”.<br>• Select “Temperature”.<br>• Enter a nominal value of **450**°C. |
| 4. | Switch off the process by clicking “Stop” (in the icon bar) and “YES” in the warning popup. |

### 7.28.2 Manual Start of Plasma Heating

System preconditions:

- **Pump** (Carousel loaded with fixtures or dummies.)
- **CDG 100 D pressure** < 5x10$^{-4}$ mbar
- **Process water:** ON

**This work flow should not be used to heat manually for long terms. It is only a function test for all essential components.**

| | |
|---|---|
| 1. | Select the “Popup - Service - Misc Function”.<br>• Set “Release dangerous electrical units” to **ON**.<br>• Set “Release dangerous gases” to **ON**. |
| 2. | Select the “Popup - Service - Substrate Rotation”.<br>• Set “Rotation speed” to **50 %**. |
| 3. | Select the “Popup - Service - Gas Distribution”.<br>• Set **Ar 1** to “**Ion**”. |
| 4. | Select the “Popup - Service - Gas Control”.<br>“Argon 1 (ion source Lower/Ch)”<br>• Switch “Control mode” to “**Flow**”.<br>• Enter a nominal value of **60** sccm.<br>“Argon 2 (ion source Upper)”<br>• Switch “Control mode” to “**Flow**”.<br>• Enter a nominal value of **60** sccm. |
| | **Wait for stabilized flow values !** |
| 5. | Select the “Popup - Service – Ion source”.<br>“Ion Source Coils”<br>• Enter a nominal value of **2.0**A<br>“Distribution Coil”<br>• Enter a nominal value of **-0.5**A<br>“Focus Coil”<br>• Enter a nominal value of **0**A<br>“Ion source Upper, Lower”<br>• Enter a nominal value of **180**A |
| 6. | Select the “Popup - Service - Gas Distribution”.<br>• Switch “Central Gas” to “**ON**”. |
| 7. | Select the “Popup - Service - Gas Control”<br>“Hydrogen”<br>• Switch “Control mode” to “**Flow**”.<br>• Enter a nominal value of **10** sccm<br>(value gradually increase up to 100 sccm within **10** minutes). |
| 8. | Switch off the process by clicking “Stop” (in the icon bar) and “YES” in the warning popup. |

### 7.28.3 Manual Start of Plasma Etching

System preconditions:

- **Pump** (Carousel loaded with fixtures or dummies.)
- **CDG 100 D pressure** < 5x10$^{-4}$ mbar
- **Process water:** ON

**This work flow should not be used to heat manually for long terms. It is only a function test for all essential components.**

| | |
|---|---|
| 1. | Select the “Popup - Service - Misc Function”.<br>• Set “Release dangerous electrical units” to **ON**.<br>• Set “Release dangerous gases” to **ON**. |
| 2. | Select the “Popup - Service - Substrate Rotation”.<br>• Set “Rotation speed” to **50 %**. |
| 3. | Select the “Popup - Service - Gas Distribution”.<br>• Set **Ar 1** to “**Ion**”. |
| 4. | Select the “Popup - Service - Gas Control”<br>“Argon 1 (ion source Lower/Ch)”<br>• Switch “Control mode” to “**Flow**”.<br>• Enter a nominal value of **50** sccm.<br>“Argon 2 (ion source Upper)”<br>• Switch “Control mode” to “**Flow**”.<br>• Enter a nominal value of **50** sccm. |
| | **Wait for stabilized flow values !** |
| 5. | Select the “Popup - Service – Ion source”.<br>“Ion Source Coils”<br>• Enter a nominal value of **2.0**A<br>“Focus Coil”<br>• Enter a nominal value of **1.0**A<br>“Distribution Coil”<br>• Enter a nominal value of **0.1**A |
| 6. | Select the “Popup - Service - DC Bias / Pulsed Bias”<br>Enter a nominal value of **50**V. |
| 7. | Select the “Popup - Service – Ion source”<br>“Ion source Upper, Lower”<br>• Enter a nominal value of **140**A |
| 8. | Select the “Popup - Service - DC Bias / Pulsed Bias”<br>Value gradually increases up to 200V within **3** minutes. |
| | **In case of arcs the bias voltage must be slightly reduced. After stabilization slowly increase the value again.** |
| 9. | Switch off the process by clicking “Stop” (in the icon bar) and “YES” in the warning popup. |

### 7.28.4 Manual Start of Coating (Arc)

System preconditions:

- **Pump** (Carousel loaded with fixtures or dummies.)
- **CDG 100 D pressure** < $5x10^{-4}$ mbar
- **Arc source 1-6:** VMS, Titan-targets
- **Process water:** ON

| | |
|---|---|
| 1. | Select the “Popup - Service - Misc Function”.<br>• Set “Release dangerous electrical units” to **ON**.<br>• Set “Release dangerous gases” to **ON**. |
| 2. | Select the “Popup - Service - Substrate Rotation”.<br>• Set “Rotation speed” to **50 %**. |
| 3. | Select the “Popup - Service - Gas Distribution”.<br>• Switch “Ar1” to “**Chb**”. |
| 4. | Select the “Popup - Service – Pump System”.<br>• Set “Rotation speed” to **60 %** and wait until the actual rotation speed is reduced to the nominal value (approx. 2-3 minutes.). |
| 5. | Select the “Popup - Service - Gas Control”<br>“Argon”<br>• Switch “Control mode” to “**Flow**”.<br>• Enter a nominal value of **100** sccm<br><br>“Nitrogen”<br>• Switch “Control mode” to “**Pressure**”.<br>• Enter a nominal value of **0.035** mbar<br>(value changes automatically to **3.5E-2** mbar). |
| 6. | Select the “Popup - Service – Arc Sources”.<br>“Mag. Coil (1-6)”<br>• Enter a nominal value of **0.5**A.<br>“VMS Pos” (1-6)”<br>• Enter a nominal value of **48** mm.<br>“VMS Inner Magnetic (1-6)”<br>• Switch to “**Front**” |
| 7. | Select the “Popup - Service - DC Bias / Pulsed Bias”<br>Enter a nominal value of **50**V. |
| 8. | Select the “Popup - Service – Arc Sources”.<br>“Arc Source (1-6)”<br>• Enter a nominal value of **100**A |

| | |
|---|---|
| 9. | Select the “Popup - Service - DC Bias / Pulsed Bias”<br>Value gradually increases up to 100V within **3** minutes. |
| | **In case of arcs the bias voltage must be slightly reduced. After stabilization slowly increase the value again.** |
| 10. | Switch off the process by clicking “Stop” (in the icon bar) and “YES” in the warning popup. |
| 11. | Select the “Popup - Service – Pump System”.<br>• Set “Rotation speed” to **100 %** and wait until the actual rotation speed reaches the nominal value (approx. 2-3 minutes). |

## 7.29 Shut off and Start up the INGENIA P3e™ Coating System

In case of a longer production stop (>1 day) the INGENIA P3e™ coating system should be shut off as follows:

**⚠ CAUTION**

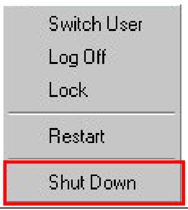
**Danger of damaging components and malfunction of the control system!**

- **Only qualified personal may open the control system and/or install/uninstall software.**
- **Do not copy or install any software from one coating system to the other.**

**⚠ CAUTION**

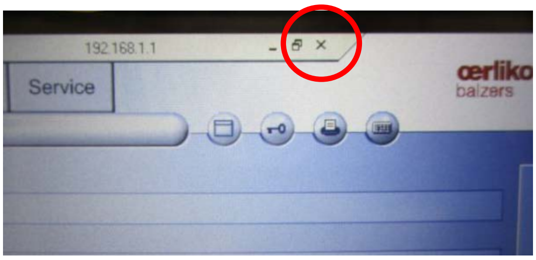
**Danger of malfunction of the control system!**

- **Turn off the PC only via the "WINDOWS ™" function (Start / Shut Down).**
- **Do not use the main switch or the reset button.**

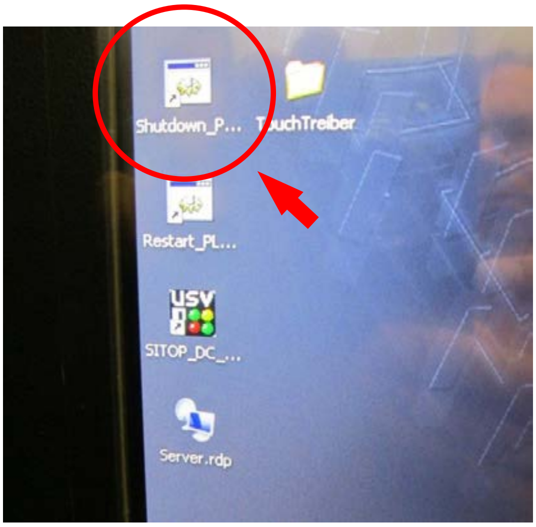



### 7.29.1 Shut off

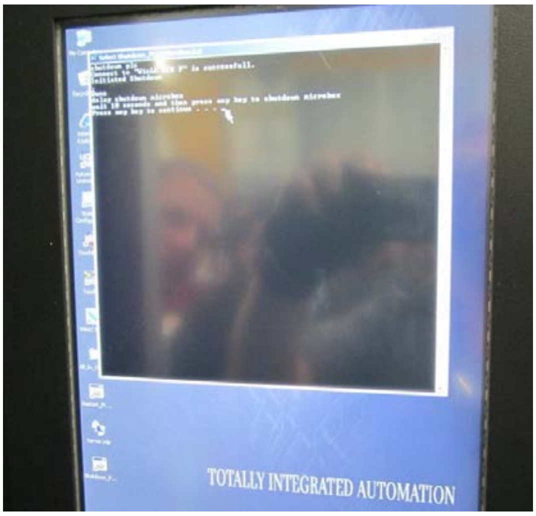
1. Ensure that the INGENIA P3e™ coating system is pumped down.
2. Go to "Stand-by".
3. Check if the temperature in the process chamber is below 200°C.
4. Shut off the water via the software and check if the water is switched off.
5. Switch off the pumping system via the software and wait until the pumps are off.
6. Select the front screen and shut down the visualization program by using "**x**".



7. Shut down the Microbox via the front screen by using “Shutdown_PLC” icon.



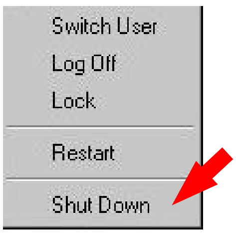

8. Wait until the Microbox is shut down.




9. Go to the service screen, located in the power cabinet.

10. Close all open programs incl. the visualization program.

11. Shut down the server PC from the menu (the reason for shutdown the server PC must be commented).





12. Wait until the server PC was completely shut down (approximately 10 minutes).

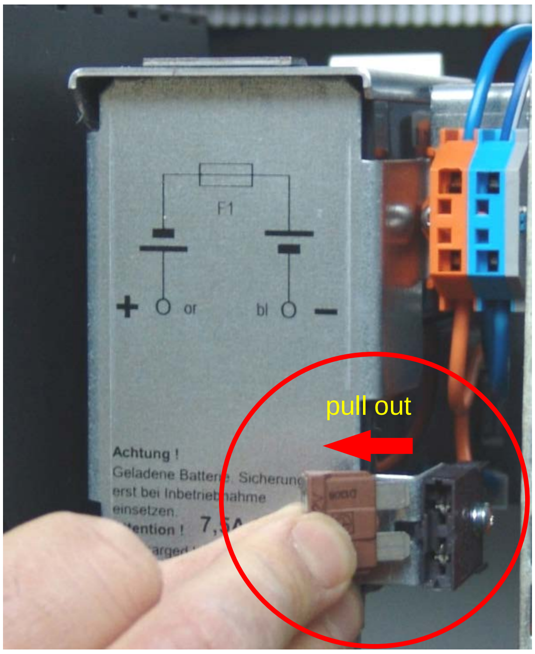
13. Shut down the UPS by pressing “0”.

14. Shut down the complete INGENIA P3e™ by the main switch.

(Main switch to “OFF”)

15. If the INGENIA P3e™ shall be off for more than 1 week, remove the fuse of the small UPS (for the Microbox) to ensure that the battery capacity is not zero after a certain time (this is not required for a shut off during a weekend).

**Prior to remove the battery, check if the Microbox is completely shut down.**




**The INGENIA P3e™ is now completely “OFF” (except for the parts which still have electrical power when the main switch is “OFF” e.g. CDG 100D etc.).**

16. Close the hand valves of the gas supply.

**The coating system is isolated from the gas supply.**

### 7.29.2 Start up

**After installation of the INGENIA P3e™ coating system, power failure or after shut off the control system the following “startup” sequence must be observed.**

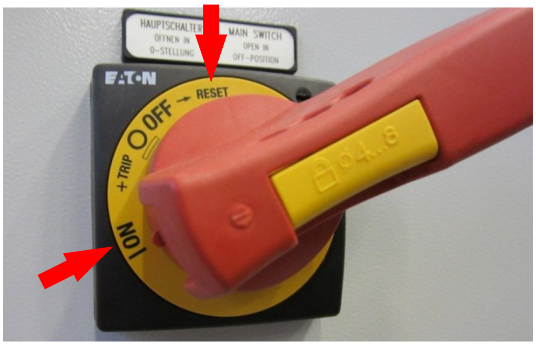
1. Ensure that the fuse for the small UPS (for the Microbox) is installed (if it was removed).


2. Ensure that the emergency stop is not pushed in.


3. Start the main power using the main switch on the power cabinet.

   The handle must be pushed back to “RESET” and then “slowly” pushed to “I ON”

**If this was done too fast the machine will not start.**

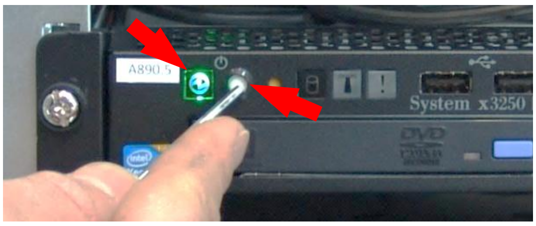



4. Start the UPS (Uninterruptible Power Supply) by pushing the “I” button.

**Wait until the UPS has started and the LED for voltage is on.**


**The “power supply” LED on the server starts flashing (fast).**
**Wait until the LED is flashing with lower frequency (approx. 1 minute).**

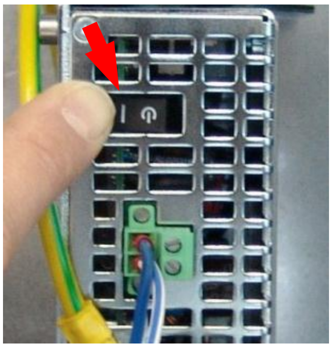
5. Push the power button (e.g. by means of a pen) in order to start the server.



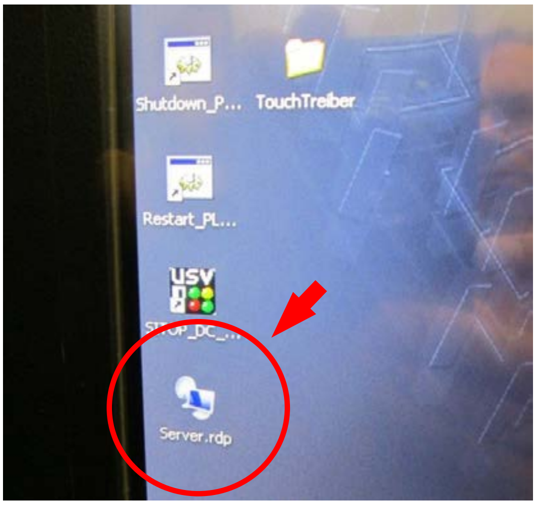

6. Wait until the server starts up and the screen appears (approx. 5 minutes).

**The Microbox starts up automatically.**

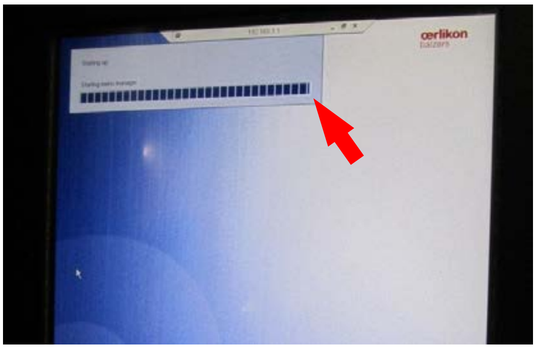
7. If the Microbox is not starting up within 5 minutes, start the Microbox manually by pushing this button (see picture beside).



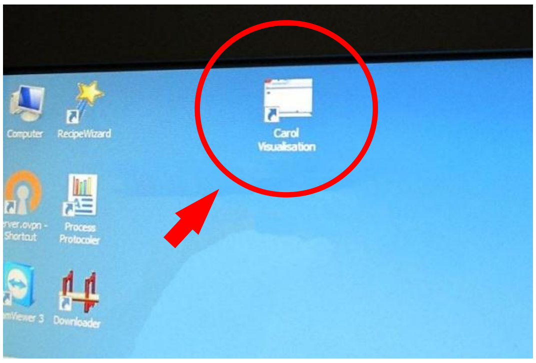
8. Go to the front screen and start the visualization by clicking “Server.rdp”.



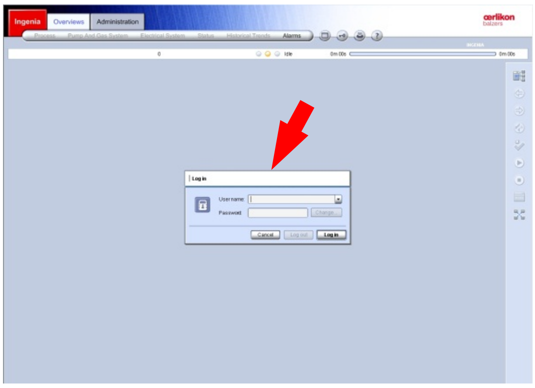

9. Wait until the visualization on the front screen is loaded.




10. Go to the server screen and click on “Carol Visualization”.



11. Wait until the visualization is started completely and log in (no password required).



12. Select the “Maintenance Safety System” screen and acknowledge the alarms.

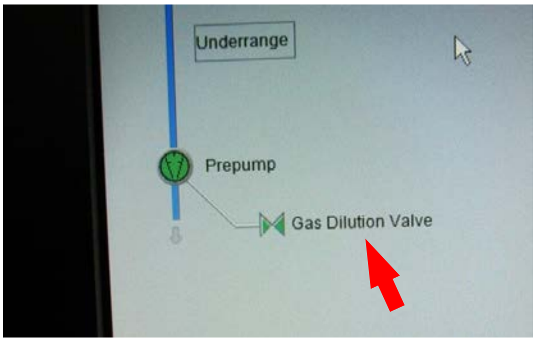
13. Open the door; press the acknowledge button beside the inner door.


14. Close the door and press the flashing acknowledge button (must be done within approx. 15 seconds).

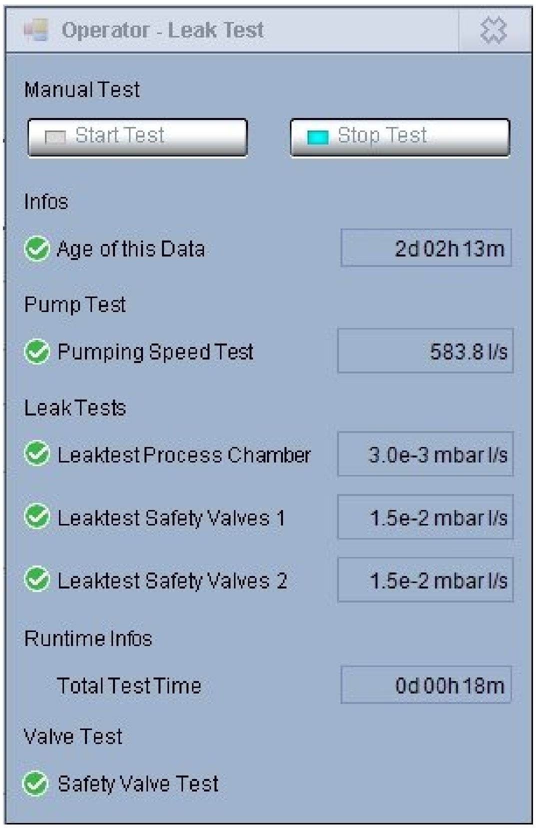

**After reset, the lamp of the acknowledge button glows constantly.**

15. Acknowlede the alarm.
16. Switch on the water (ensure that targets are installed).
17. Open the hand valves of the gas supply.
18. Switch on the pumping system (Stand-by).
19. It can happen that an alarm is visible and the pumps are prevented from starting. In this case vent the system to a pressure of min. 20 mbar and pump down to get the set-points for the gas-safety.

**The fore pump is starting and the gas-dilution valve opens to dilute the fore-pump for safety reason.**




20. Pump down and start an operator leak test to ensure that the safety valve test has been performed.



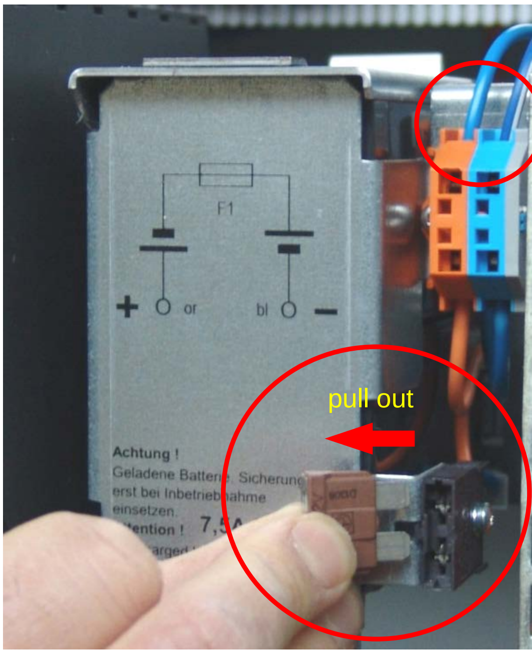

**The INGENIA P3e™ is now ready to be used.**

## 7.30 Replacing the Battery in the PLC

In order not to lose the PLC program, the battery module for the PLC must be replaced with a new one every two years.

1. Remove the fuse (F1).
2. Remove the two wires (notice the connections).
3. Remove the battery module from the mounting rail and replace it with a new one.

**Order number K5200332.**



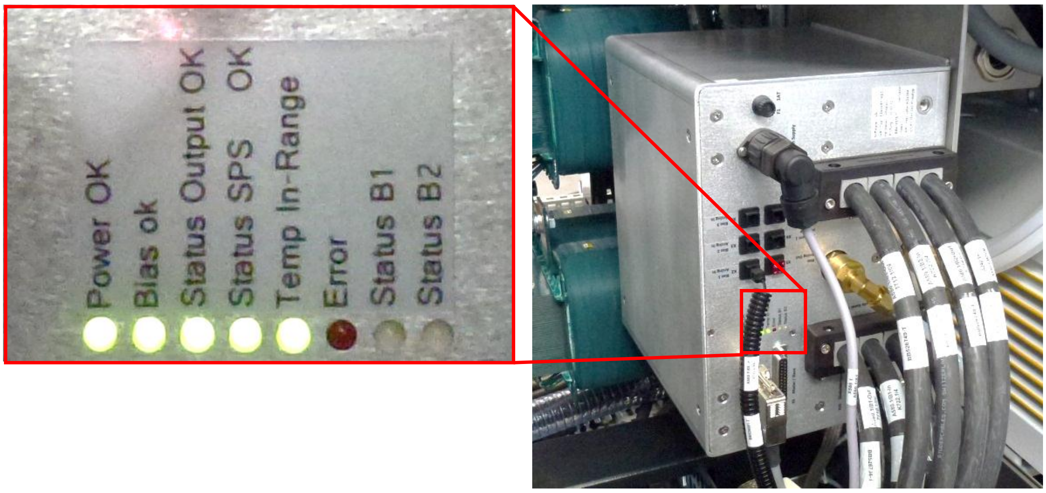
# 7.31 Arc Discharge Interrupter AI 2x250

## 7.31.1 Status Verification

1. Open the 1st door on the left side (to get access to the AI 2x250).
2. Check the LED’s on the AI 2x250.

**The following LED’s are switched on (green):**
**Power OK; Bias OK; Status Output OK; Status SPS OK; Temp In-Range.**

(SPS = PLC)




**If one of the (green) LED’s is not lit or if the “Error” or one of the “Status” LED’s (B1/B2) is lit, then contact Oerlikon Balzers field service for assistance.**

### 7.31.2 Fiberoptics Function Test

For testing the fiberoptics from the bias generator to the AI 2x250 box perform the following steps:

1. Pull out the fiberoptics and check the front surface of the connector.

   Connector o.k. (flat surface).

   Connector defective (it has to be replaced with a new one).

2. Close the door and press the ACKNOWLEDGE buttons.

3. Perform “Manual Start of Plasma Etching” and check the error message (via the service screen).

The plasma etching mode stops immediately and the following error message appears:

**ArcPS2: Arc voltage too low (AI arc mode) F309_0018**

**If the plasma etching continuos without any interruption then contact Oerlikon Balzers field service for assistance.**

## 7.32 Internet Connection for Service Assistance

The installation should be carried out and supported by the local EDP (Electronic Data Processing) department.

### 7.32.1 Remote Control Requirements for TeamViewer

The server of the coating system requires an internet connection (e.g.: ISDN, ADSL, DSL, etc.). The customer is free to select the best available local offer for the internet connection.

The customer (EDP) has to install the actual client version of TeamViewer software (www.teamviewer.com). This client version is licence free.

**⚠ CAUTION**

**Unauthorized access to the coating system and/or company network !**

**The EDP department (customer) has to permit the connection via TeamViewer.**

**For the process of decision making we recommend to consult the "Security Statement" of the webpage (www.teamviewer.com).**

**⚠ CAUTION**

**Virus and Trojans attack !**

**With a new coating system the customer will get a free license of NOD 32 (www.eset.com) for three years. After the elapsed time it is recommended to extend the license by the customer.**

**For the correct and regular update of the NOD 32 the EDP department (customer) is responsible.**

**For further assistance please consult the WEB page of NOD 32.**

### 7.32.2 Connection via Oerlikon Balzers Network

This kind of data communication is only used for the Oerlikon Balzers network. The installation must be carried out and supported by the local EDP (Electronic Data Processing) department taking into consideration the safety regulations for the factory Local Area Network (LAN).

**The TCP/IP address must be given to the Oerlikon Balzers salesman before the INGENIA P3e™ system is delivered.**

| | ⚠ CAUTION |
|---|---|
| | **Do not use the network interface card with IP addresses 192.168.1.2. and 192.168.1.1 ! This address is already used in the INGENIA P3e™ coating system (connection between INGENIA P3e™ and PLC).** |

**In case of any problems or if you require further assistance please contact the local network provider.**

### 7.32.3 Virus Scanner

The INGENIA P3e™ coating system comes equipped with a 3 year licensed virus scanner to protect the software of the coating system.

**The E-mail address of the local EDP (Electronic Data Processing) department must be provided during system installation for licensing the virus scanner.**

Oerlikon Balzers strongly recommends to extend the license of this virus scanner when expired. Your EDP will receive an E-Mail as reminder prior to the expiration.

## 7.33 General Maintenance

### 7.33.1 Yearly Maintenance

#### 7.33.1.1 Electrical Connections

**⚠ DANGER**

**Beware of dangerous voltage!**

- **High Voltage on the internal equipment of the power cabinet may result in serious body injury or death by touch.**
- **Turn the main power switch (located on the power cabinet door) to position "0" (off) and press the emergency-off button (located in the power cabinet) to carry out the maintenance work on these components.**

1. Yearly clean the internal equipment of the power cabinet and the distributor panels with a vacuum cleaner.
2. Check tightness of all electrical connections. (Pull carefully on each wire by means of a small flat nose pliers.)

### 7.33.2 80 Batch Maintenance

**Due to safety regulations it is necessary to check all safety relevant devices every 80-batch cleaning.**

#### 7.33.2.1 Emergency-off Test

For the emergency-off test keep the INGENIA P3e™ coating system in "Stand by", press the emergency-off button and verify if the main switches K160.5 and K162.5 were tripped. Then reset the main switch.

The emergency-off button is located in front of the machine. (⇨ Refer to INGENIA P3e™ manual chapter 2.4.3.)

# 8 Troubleshooting

**Manufacturer**

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**Please read and retain this manual to assist you in the operation and maintenance of this product. This manual is an integral part of the machine. In the event of a change of ownership, hand this manual over to the new owner.**

# Contents

## 8.1 Error Messages

Error messages are displayed in the message window “Alarms” and/or “Overview Screen – Alarms”.

**In general there are different types of alarm messages:**

**Type:**

| | |
|---|---|
| | **Fatal error** messages are caused by severe events or failures. A running process will be automatically stopped. |
| | **Warning** messages are alerts that may result in a fatal error. |
| | **Event** messages contain information for operator/service personnel. |

**State:**

| | |
|---|---|
| | A message is generated by the control system. |
| | The generated message is pending and acknowledged. |
| | The generated message is inactive and acknowledged. |

In all cases the error message has to be acknowledged on the operator panel. After acknowledgement the state of the message changes.

Error messages are displayed in the “Overview Screen – Alarms”:

| Date / Time | State | Class | Type | User | Description | Id | Group |
|---|---|---|---|---|---|---|---|
| 07.01.2013 11:25:41 | | Error | | | Water: TempSensor error (accumulated) | F305_0010 | Error list - Temperature sensor |

### 8.1.1 Explanation of the Error Types

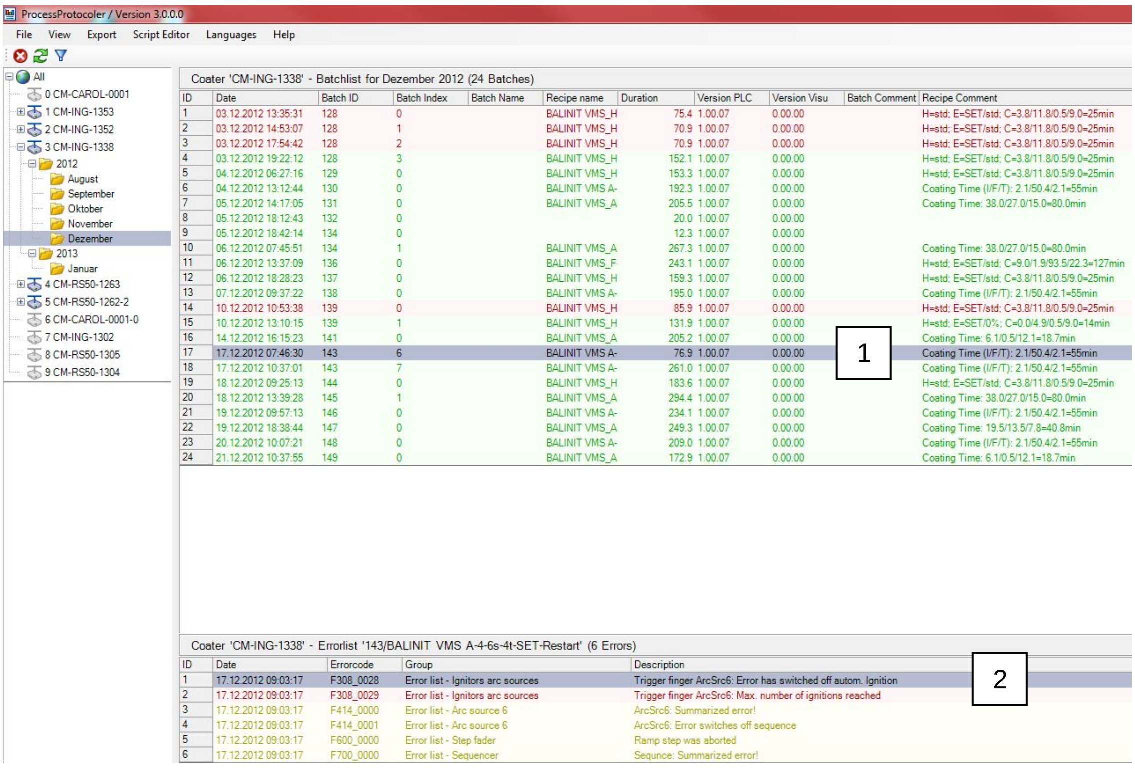
The errors occurring in the INGENIA P3e™ coating system are subdivided into 3 error groups:

| | |
|---|---|
| $1^{st}$ error group<br>**F1XX_XXXX – F4XX_XXXX** | This error group displays “specific” errors in regards to hardware, normally a check or calibration of the specified hardware will resolve the problem.<br>If an error occurs in the $1^{st}$ group then it’s possible that also errors in the $2^{nd}$ and $3^{rd}$ group are generated. |
| $2^{nd}$ error group<br>**F5XX_XXXX – F7XX_XXXX** | This error group describes possible errors in the customers own recipes. The reason for such an error message can also be a follow on errors from the first error group.<br>**Note**: If an error message is only generated from the $2^{nd}$ error group, the reason will be usually in the customers recipe. |
| $3^{rd}$ error group<br>**F9XX_XXXX** | Error management, control of the acoustic alarm, alarm lights, password-queries, statistic, version number etc. |

**Always try to eliminate errors from the $1^{st}$ group first, then continue with the $2^{nd}$ and last with the $3^{rd}$ group until all errors are eliminated.**

## 8.1.2 Quick Access to the Error List in the Process Protocoller

1. After opening the process porotocoller the batch list is displayed.
2. A click on any batch in the batch list (1) opens the error list (2) of the selected batch.




For further details please contact the service department.

## 8.1.3 Error List

The Error List will be implemented in the next version.

# 9 Disposal

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# Contents

## 9.1 Disposal

### 9.1.1 General Notes

**Components and operating media of the INGENIA P3e™ coating system must be disposed of in accordance with the local regulations where the system is operated.**

**⚠ DANGER**

**Danger of serious body injury or death due to process chamber tipping!**

- **There is a danger of the process chamber tipping (forwards) due to the high center of gravity. Therefore the process chamber door must be always mechanical secured.**

After dismantling the INGENIA P3e™ coating system, the components and operating media must be divided into the following categories:

- Operating media.
- Components which contain operating media or which had contact with operating media.
- Other components.

**⚠ CAUTION**

**Beware of operating media and components contaminated with harmful substances!**

- **Contact with contaminated operating media and components may be harmful to your health.**
- **Wear protective clothing, oil-proof gloves, eye protectors and a breathing mask with a type P3 filter when opening vacuum lines, valves, or pumps containing harmful gases or other harmful substances, and when disposing exhaust condensation or filters.**
- **For further safety precaution ⇨ refer to corresponding material safety data sheet.**

### 9.1.2 Operating Media

Operating media for the INGENIA P3e™ coating system in unopened original containers may be returned to the supplier.

Operating media in opened original containers and used operating media must be designated "oil-water mixture" and disposed of as hazardous waste in accordance with local regulations.

Consumables containing operating media (filter cartridges, cleaning rags, etc.) must also be disposed of as hazardous waste.

### 9.1.3 Components

All components of the INGENIA P3e™ coating system must be recycled or disposed depending on the material according to the local regulations:

- Aluminum
- Steel
- Stainless steel
- Precious metal
- Copper
- Plastic
- Electronics or electrical parts
- Batteries

Components contaminated with operating media must be thoroughly cleaned before they are recycled or disposed of.

### 9.1.4 Target Materials and Process Gases

**Target Materials**

Precious metals or target materials can be recycled. Other target materials must be disposed of in accordance with the material safety data sheets and local regulations.

**Process Gases**

Dispose of the process gases in accordance to the safety data sheet and the local regulations.