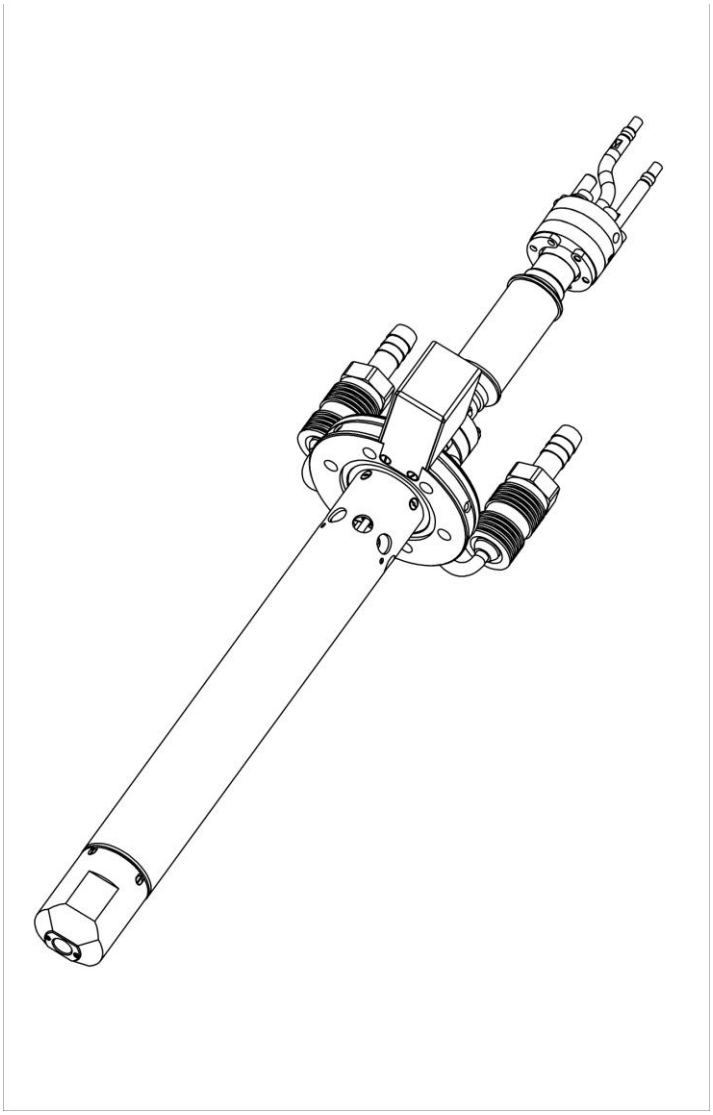
X-Ray Source RS 40B1



Operating Manual

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Contents

1. Introduction

1.1. Health and Safety Information

1.1.1. General

This equipment is a component for use with high vacuum systems. Whilst every effort has been made to eliminate hazards, its safe use is also dependant on the system to which it will be connected.

The owner of the equipment must ensure that all users are aware of the Health and Safety Information contained in this manual. If the equipment is sold or passed to another owner, this manual must be included with the equipment.

Warning:

This equipment must be installed by qualified personnel.

Warning:

It is the responsibility of the user to consider the safety requirements of hazardous materials used with this equipment and the consequence of any leakage, however caused. Consider possible reactions with materials of construction. Any equipment returned to PREVAC sp. z o.o. must have the correct Declaration of Contamination securely fastened to the outside of the packaging.

Warning:

Harmful gases may be evolved if this equipment is heated to temperatures above the maximum specified bakeout temperature.

Warning:

Do not use this equipment with positive internal pressure above the specified maximum.

Warning:

Some equipment may develop extreme hot or cold surfaces. Wear protective clothing.

Warning:

Equipment must be fully earthed to prevent dangerous electrostatic charge build-up.

Warning:

When using make sure that the equipment is connected to the cooling box and water pressure in the cooling system is proper.

Warning:

Hazardous voltages are present, therefore only persons with the appropriate training are allowed to carry out the installation, adjustment and repair works.

Warning:

The supply of the emission regulator should be automatically cut of if the pressure in chamber is above 10E-5 mbar or mains power short brakes happen.

1.1.2. HV Protection

The RS 40B1 module needs high voltages up to 15kV dangerous to life! You have to respect the following safety hints:

- Check whether your main voltage corresponds to the mains setting at the rear panel of the power supplies for the RS 40B1.
- Use only original cables, connectors, and flexible conduits from PREVAC sp. z o.o. Pay attention that ail cables and water lines are without mechanical or electrical defects. In case of doubt the cable or the water line has to be replaced by an original PREVAC sp. z o.o. part.
- Please connect the X-Ray Source only with HF low impedance cable to the power supply ground. Large contact areas are important. A proper connection will protect the sensitive electronic units of your system and in your neighborhood.
- Never run the X-ray Source without grounding cable or loosen ground connection!
- Ali shields for interlock, remote and other connections must be grounded with a proper HF performance, too!
- Operate the RS 40B1 only in case of a fully closed protection cover and properly fixed cable conduit for HV and water supply! Open slits and holes could be a danger for life and violating the regulations regarding X-ray protection!
- Do not operate the X-ray Source unless your system pressure has come below 1 x 10E-6 mbar!
- Do not operate the X-ray Source without water cooling for anode. Cooling the housing jacket limits the temperature increase of an irradiated sample during continuous operation.
- Before switching on the power units the electrical and mechanical installation has to be completed. The interlocks for vacuum, water, and HV guard have to be correctly activated and tested for safe and proper functioning.

- Never short the HV guard and water interlock system!
- Never operate the power supplies with removed housing parts!
- Connect the RS 40B1 only when the power supplies have been turned off!
- After switching off the power units the operator has to wait in the minimum 3 minutes before opening any connections, the power supplies or the X-ray Source protection cover.
- In case of wetting the RS 40B1 Source by cooling water a complete drying of the module, the protection cover, the conduit, and the cables is strongly recommended. The usage of a fan could support the operation.
- Never run a wet RS 40B1 module or wet inner parts of the conduit!
- In case of operating the RS 40B1 with other equipment than delivered by PREVAC sp. z o.o., you may loosen your warranty. In case of doubt please contact the PREVAC sp. z o.o. Service Department.

1.1.3. Soft X-ray Radiation Protection

Supplementary to the regulations, restrictions, codes, and rules for protection against radiation which have to be observed by the law at the operational site of the RS 40B1 PREVAC sp. z o.o. recommend the following hints:

- Cover all window flanges additionally by X-ray protection lead glass or use window flanges with lead glass are useful but normally not necessary.
- Ali flanges of the chamber attached to the RS 40B1 have to be closed by blank flanges or compact UHV components made by stainless steel. If larger components of other materials (e.g. glass) are installed consult your safety inspector for suitable measures!
- Pregnant women should announce their situation to the superior or safety inspector!

Warning:

Using acceleration voltage beneath 20kV the local dose performance of <0.1µSv/h will not be obtained or exceeded anywhere at the Source within a distance of 0.1 m. Note that the Source runs in vacuum only, i.e. if the plant itself is not passing the radiation, working with access trough a whole (open flange) is not possible. Normally stainless steal chambers and components as well as sight glasses >1.5mm thickness (DN 16CF windows) are not permeable for this kind of radiation because of the similar wall thickness like the Source body.

1.2. Application and Capability

The RS 40B1 is a new, high-intensity twin anode X-ray Source optimized for XPS (ESCA) experiments in order to produce low energy X-ray quanta. Additionally the Source can be used for excitation in Photo induced Desorption Spectroscopy (PDS).

The standard RS 40B1 is equipped with a Mg/AI twin anode and designed with two filaments, and ensures continuous operation powers of Mg/AI 300/400 W. PREVAC sp. z o.o. offers the capability of coating the anode on request with other elements or as a single anode for only Al or Mg operation.

The mounting flange size is DN 40CF. The installation of an optional linear Z-shift allows the shaped nose cone of the RS 40B1 to be positioned very close to the sample during operation while being able to retract the Source to provide space for other techniques or protecting the X-ray Source window against contamination.

The RS 40B1 module (with removed water supply and removed HV protection cover) can be baked up to 250°C allowing true UHV operation. „Quick Fit" connectors are providing safe and rapid removing of water lines and HV cable.

1.3. Specifications

Anode	Al/Mg (coating other materials on request)
Power	Mg/Al 400/600 [W]
Cross talk	< 0.35%
Magnetic filed	< 0.5 [μT] (close to sample surface)
Z - retraction	Optional stroke Z=50; Z=75 or Z=100 [mm] (also with tilt system)
Bakeout	up to 250°C
Water cooling	3.5 ÷ 5 [bar] and 3.5 [l/min]

1.4. Basic Dimensions

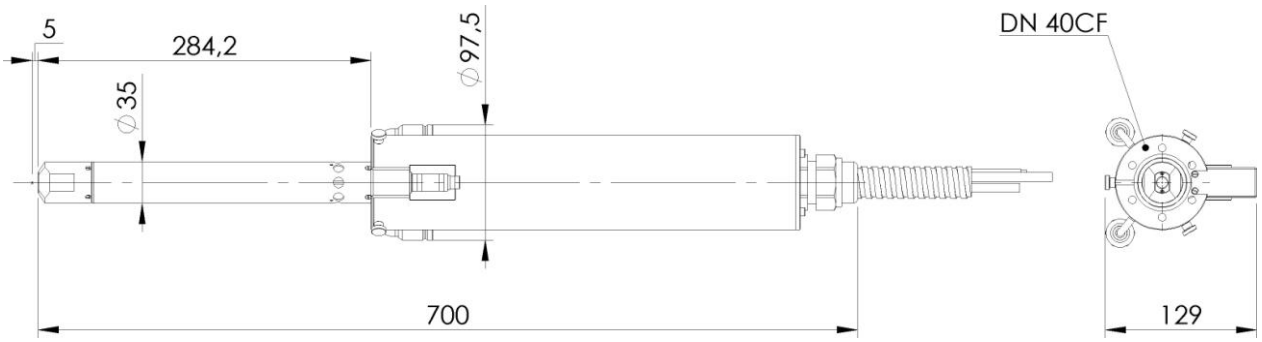


Fig.1 Dimensions of X-ray Source RS 40B1 (in mm)

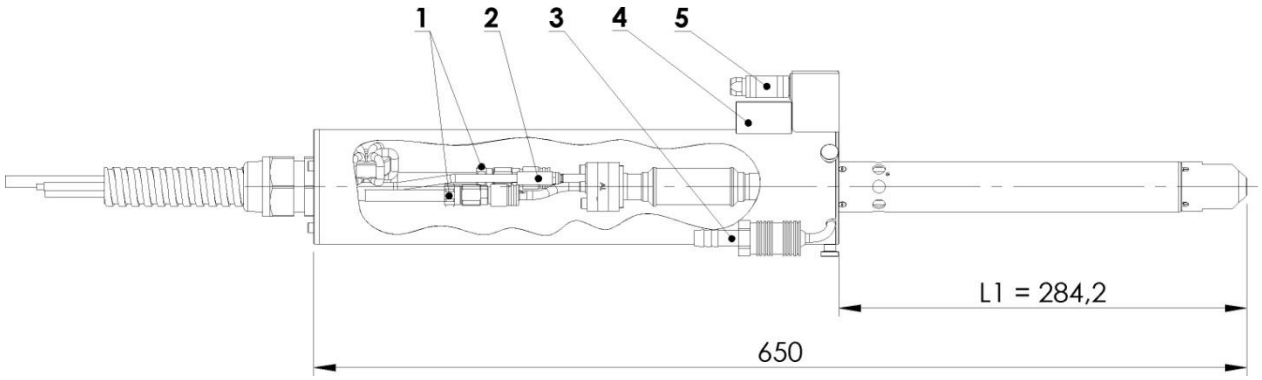


Fig.2 Construction of X-ray Source RS 40B1

1 - Water cooling quick connect (anode cooling)

2 - HV connector

3 - Water cooling quick connect (main frame cooling)

4 - Safety switch (interlock)

5 - Cathode and power interlock

L1 - Vacuum side length

2. Description

2.1. Basic Principles – Soft X-ray Radiation Protection

If solid state material is bombarded by high energy electrons (> some keV) an ionization process of electron core levels occurs. If these vacancies are refilled by electrons from energetically higher levels characteristic X-ray radiation or Auger electrons will be generated. Besides these two processes also radiation with continuous frequency spectrum (Bremsstrahlung) will be produced by retarded electrons.

2.2. General Information

The main advantage of a twin or dual anode is that the simple alternative operation with two different excitation energies enables a rapid distinction of Auger electron lines from photoelectron structures in a X-ray Source excited spectrum.

The most commonly employed anode materials in XPS are Al and Mg which are producing Kα½ radiation lines at energies of 1486.6 eV and 1253.6 eV, respectively. The natural line width is lower than 1 eV and sufficient to determine the binding energies of core levels within 0.2 eV.

The anode and its water inner tube are interchangeable.

The minimum distance between the center of the anode face and the sample is about 14mm.

2.3. X-Ray Source Voltages and Currents

This document deals with different voltages, currents, and powers of the X-ray Source. For a better understanding a block diagram is depicted below showing the Source voltages and currents which are described below in details.

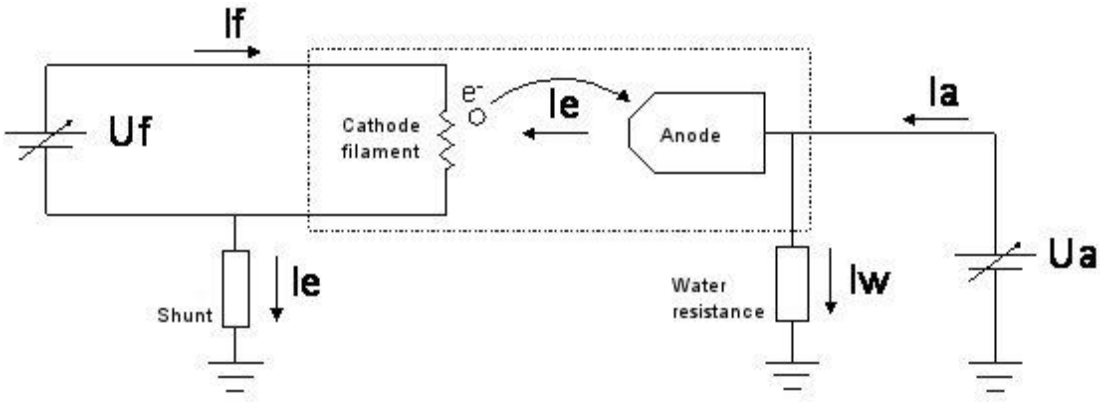


Fig.3 X-Ray Source Voltages and Currents

2.4. Vacuum Conditions

The design of the Source fully meets the UHV requirements. The parts exposed to vacuum consist exclusively of high quality stainless steel, very pure copper, tungsten and alumina. The water-cooled outer jackets limits the temperature increase of an irradiated metallic sample during continuous operation to 3 K in comparison to ambient temperature.

During operation at max. power (400 W) a temperature increase at the X-ray Source Cu head of max. 30K was observed under regular cooling conditions. Therefore the efficient cooling will avoid intensive desorption from the walls.

The RS 40B1 could work satisfactorily in the pressure range below 1 x 10E-5 mbar. Nevertheless, better vacuum conditions in the 10E-8 mbar range or better are strongly recommended to prevent contamination of the X-ray window and the volume around the anode behind. Good vacuum conditions will prevent oxidation of the filaments while in use, ensure a longer lifetime of anode and window, reduce the risk of spark - overs between the anode and grounded parts, and enables a longer availability of the X-ray Source at full intensity.

2.5. Al Window

The radiation aluminum window (standard thickness 2 μm) suppresses the Bremsstrahlung and prevents the input of stray electrons generated by the filament from entering the electron energy analyzer. Additionally the X-ray window works as a separation between the main chamber and anode volumes.

Warning:

Replace strong perforated X-ray windows because of stray electrons and enlarged portions of Bremsstrahlung.

The Al window can be destroyed if a larger pressure difference between the volumes before and after the window occurs.

Besides the anode degradation the contamination of the X-ray window from both side is the main reason for X-ray Source intensity reduction. Therefore any dirty processes (e.g. sputtering, deposition, desorption) in the immediate vicinity other Al window must be avoided in the chamber where the X-ray Source is flanged on.

The retraction of the X-ray Source from the sample during ion bombardment by a z-shift reduces the deposition rate at the Al-window in orders of magnitude.

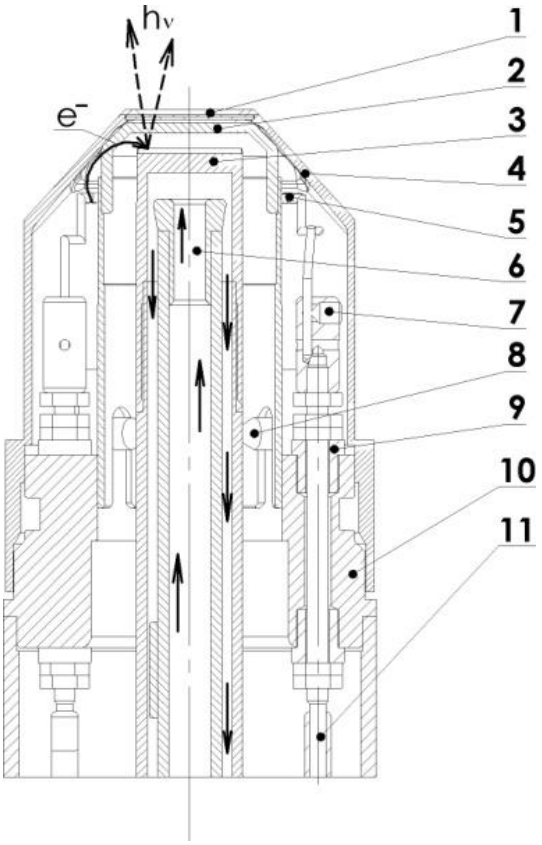
The installation of a shutter just before the X-ray window and operated by remote control or by hand is an alternative tool for protection.

The window can be contaminated as well from the inner side by deposition of anode and filament material or bypass line pump oil. In consequence of accidents (e.g. emergency venting, excessive 02 inlet, turbo molecular pump breakdown) the material deposition or oil contamination can be enlarged.

Warning:

Any visible coloration of the Al X-ray window is a bad sign for thin films deposited which reduce X-ray intensity distinctly! Replace contaminated X-ray windows! Use Z - retractor or shutter to protect the window during ion bombardment or other dirty processes in the chamber!

2.6. Source Head RS 40B1



1.	Al window
2.	Barrier blocking
3.	Anode
4.	Outer shield
5.	Cathode filament
6.	Water cooling injection
7.	M2 screw
8.	Centering bush (insulator)
9.	Ceramic bush
10.	Frame
11.	Cathode connection

Fig.4 Source head

2.7. Bakeout Procedure

With all cables and water pipes disconnected and with a removed protection cover the RS 40B1 can be baked up to 250 °C. In order to avoid temperature differences in the anode or the inner cooling tanks of the Source it is recommended to remove (to blow out) all the water from the anode inner tube and the water-cooled outer jacket before the bakeout starts. This operation can prevent the formation of micro leakages.

Warning:

Homogeneous bakeout is essential for stable operation and long lifetime of anode and whole X-ray Source.

2.8. Water Cooling

Warning:

PREVAC sp. z o.o. recommends for protection of environment to utilize closed circulation water-cooling system.

PREVAC sp. z o.o. supports for the RS 40B1 only the use of water as the cooling agent.

Full anode power dissipation of the X-ray Source can only be obtained if the pressure of the cooling water is larger than 3.5 bar and the rate of the flow is about 2.5 ÷ 3.5 l/min. The temperature should stay below 22°C. Lower temperature than room temperature will force the water condensation and therefore flashover to ground inside the water conduit or the protection cover. Higher temperature results in overload, i.e. an evaporation of the anode material or worst case in a cracked anode with water injection into the vacuum chamber

Normally the anode cooling and the outer jacket cooling will be performed serial. If the environment do not allow to get the cooling conditions of 2.5 ÷ 3.5 l/min a separate cooling of the outer jacket is possible. About 1 l/min in this line is enough to get the specified temperature limit of the Source head.

2.9. Water Resistance

During X-ray Source operation the anode flange and the anode inner tube are contacted to max. + 15 kV. The anode net power consists of X-ray radiation and heat dissipation. The anode gross power includes in addition the voltage drop via water inflow and reflow lines for the anode cooling. The water cooling box is grounded.

The difference between gross and net anode power will increase as much lower the water resistance or as much higher the water conductivity.

The difference between gross and net emission currents (so-called „water current") should not exceed 10 mA. In other cases the cooling water in the closed circulation system must be replaced against deionized or distilled water after washing the pipes and the tank carefully from remains.

If otherwise the water resistance is too large (< 2 mA „water current" at 15kV, e.g. application of clean, pure pipes and distilled water) sparks between anode and water line as well as enforced electrochemical attacks at the anode inner tube (especially at the „Quick Fit" pipe connections) can occur. Under these circumstances a small amount of NaCl or the addition of top water will reduce the resistively and ensure stable conditions.

If the „water current" exceeds the limit mentioned above for RS 40B1 users with tap water supply it is obvious that this type of cooling couldn't be continued. The installation of a closed circulation system is indispensable.

Warning:

Water resistance is an important parameter for stable operation!

2.10. Circulation Diagram

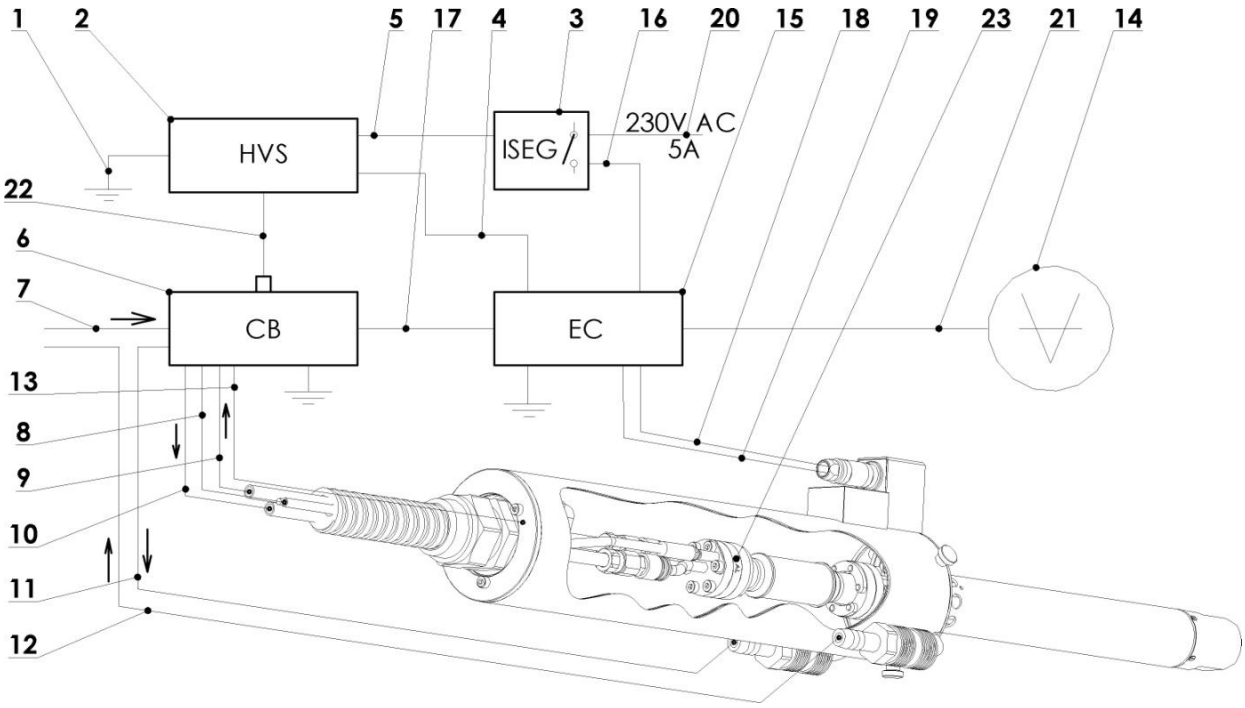
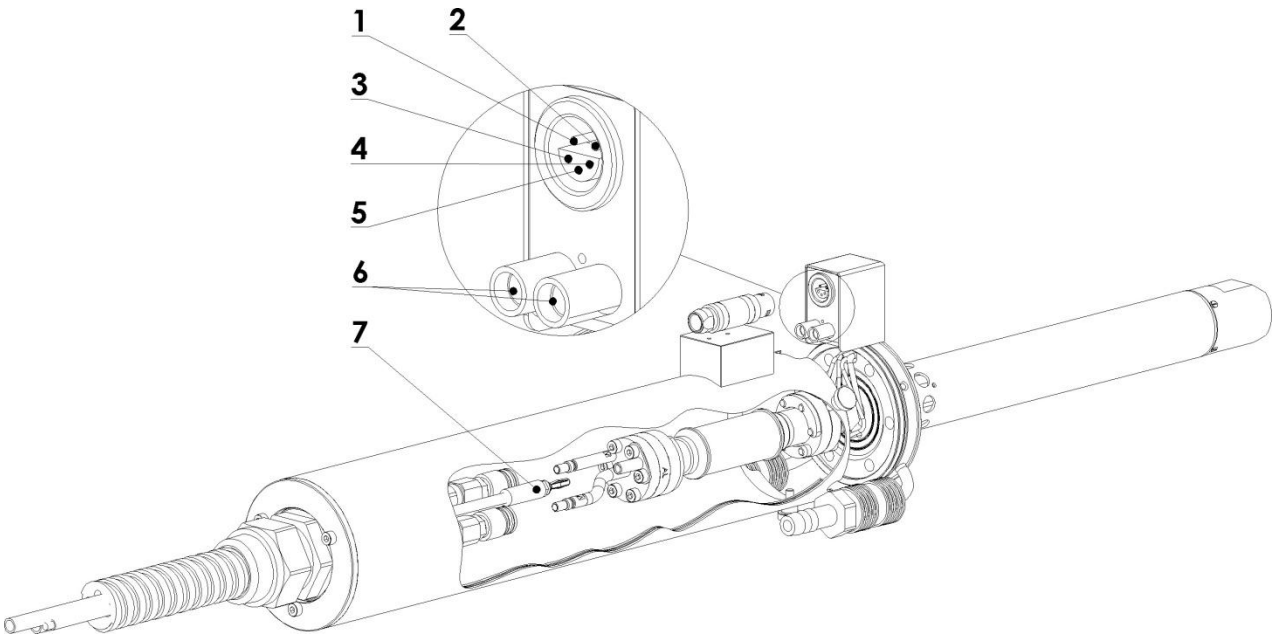


Fig.5 Circulation Diagram

1 - ground,	13 - ground of shield the X-Ray Source,
2 - HV supply,	14 - vacuum gauge,
3 - switch voltage,	15 - emission controller,
4 - common ground,	16 - switch enable signal for the high-voltage,
5 - HVS power,	17 - switch enable signal for water,
6 - unit of power and cooling,	18 - switch enable signal for the shield plug,
7 - the cold water from the refrigerator ,	19 - cathode power supply,
8 - HV cable,	20 - electricity power supply,
9 - water outlet from the anode,	21 - the mains, switch enable signal for the vacuum,
10 - water inlet to the anode,	22 - HV cable,
11 - water inlet to the frame ,	23 - anode.
12 - the return of warm water to the refrigerator,	

2.11. Electrical Connections of The X-Ray Source



1. Safety cut-out switch (electric circuit on the housing)
2. Safety cut-out switch (electric circuit on the housing)
3. Cathode Mg
4. Cathode AL
5. Joint Cathode
6. Safety contacts
7. HV plug (anode power supply)

Fig.6 Electrical Connections

2.12. Water Quality / Closed Circulation System

If a closed circulation system is utilized some hints should be followed:

- PREVAC sp. z o.o. recommend the use of deionized water for closed circulation systems to get correct water resistances.
- Follow strictly the instructions made by the manufacturer or supplier of the closed circulation system! Respect the safety instructions!
- Incorporate the control of the closed circulation water-cooling system into the X-ray Source interlock system!
- Inspect sometimes the water level and quality to all appearances! Refill or replace water, if necessary!
- Wash and clean the box and the water lines, if too much water conductivity, resp. „water current" was observed! Make some cleaning cycles with tap water before refilling deionized water!
- PREVAC sp. z o.o. recommends the use of an anti-algeon agent to suppress proliferate biological activity. For the same reason the use of dark, non-transparent water pipes is advised.

2.13. Water Quality / Tap Water

If tap water is utilized as the cooling agent some additional hints should be followed:

- Water polluted by suspended particles can not be utilized without particle filter.
- Water polluted by colored additions should not be used for cooling the RS 40B1 module.
- Salt water (also with lower concentration) cannot be utilized for reasons of reduced water resistance and increased electrochemical activity!

Warning: Never utilize polluted or contaminated tap water for X-ray Source module cooling! In case of doubt consult the local authority and water supplying company!

2.14. Contamination of Water Pipes

The water pipes can be contaminated either on inner and outer walls. The main reason for contamination along the inner surfaces are particles and soluted chemical compounds deposited as sediments as well as biological origin. This process will be intensified if longer periods of X-ray Source inactivity take place.

Do not forget to add few drops of anti-algeon agent!

Warning:

If the X-ray Source will taken out of operation for a longer period, remove the water hoses from the RS 40B1 module to avoid intensive sedimentation! Remove (Blow out) the water from the water pipes inside the module!

The water hoses could also be dirty at its outer walls depending from the purity level in the laboratory.

Under extreme situations the voltage drop which normally occur via the inflow and outflow anode water supply can be established alongside the sediments. Shorts to the grounded cover plate of the X-ray Source could be developed. Parts of the plastic water hoses can be inflamed and melt.

Warning:

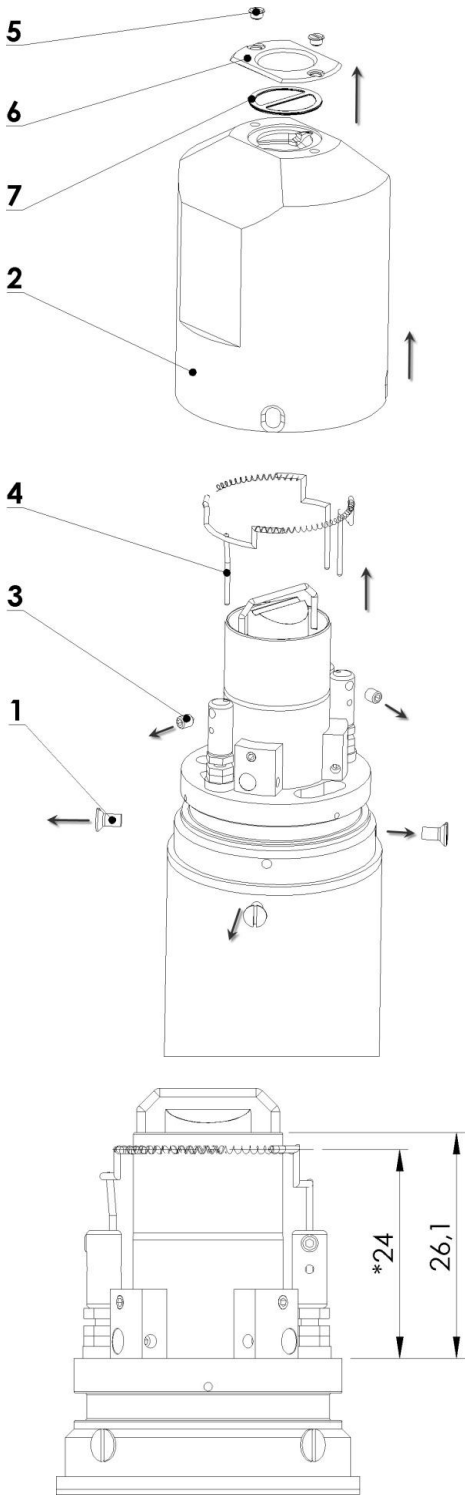
If such an very rare incident had occurred the total replacement of the water hoses within the conduit between RS 40B1 module and water cooling box is strongly recommended! Consult PREVAC sp. z o.o. in case of such an incident! Replace the „Quick Fit" connectors! Organize the restart of the water-cooling with very much care!

2.15. Use of a Z-Retractor

The installation of a Z - retractor between the RS 40B1 and the chamber flange offers the ability to move the whole Source from its position for XPS into a parking position for other operations (e.g. ion bombardment, sample annealing, desorption, transfer, approach for other modules and methods).

3. Parts Replacement

3.1. Cathode Replacement



Fallow below steps to replace the cathode:

A. Put the RS 40B1 in vertical position and unscrew four bolts (1).
B. Carefully slide up the cover housing (2).
C. Measure the distance * of the old cathode, unscrew the three screws M2 (3), carefully remove the old cathode (4) and replace with a new retaining the previously measured distance.
D. Unscrew the two screws M2 (5),
(if you replace only the window, skip steps A ÷ C),
E. Remove the window lock.
F. Remove window and replace with new ones.

Fig.7 Stages of the exchange of the cathode and / or aluminum windows

3.2. Anode Replacement

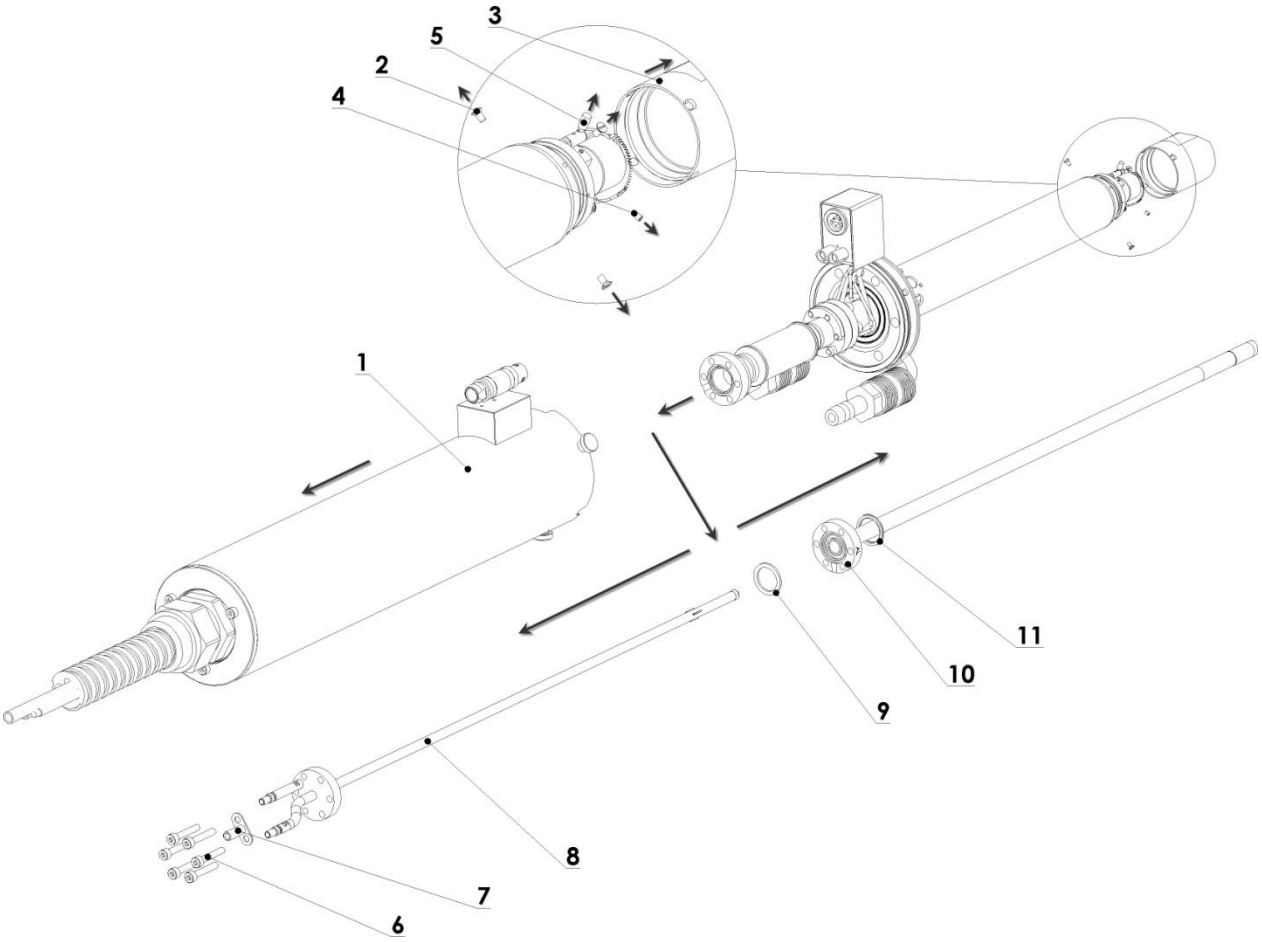


Fig.8 Stages of the exchange of anodes

Fallow below steps to replace the anode:

A. Remove the cover (1), disconnecting the connectors for water cooling and removing the lamp from the chamber.
B. Place the lamp RS 40B1 upright and unscrew the four screws (2).
C. Carefully slide the cover (3).
D. Remove one of three push pins M2 (4) and slide the insulator (5). The other two insulators leave without unscrewing the pins. They will ensure proper alignment of the new anode.
E. Unscrew the six screws M4 (6), remove the socket connection (7) and gently pull together with the lamp body injection system (8), anode (10) and copper gaskets (9 and 11).

Take care when replacing the gasket with new gasket (11) - between the anode and the insulator is special gasket !!!

F. The end of the anode must be set in a characteristic way with respect to the geometry of the cathode.

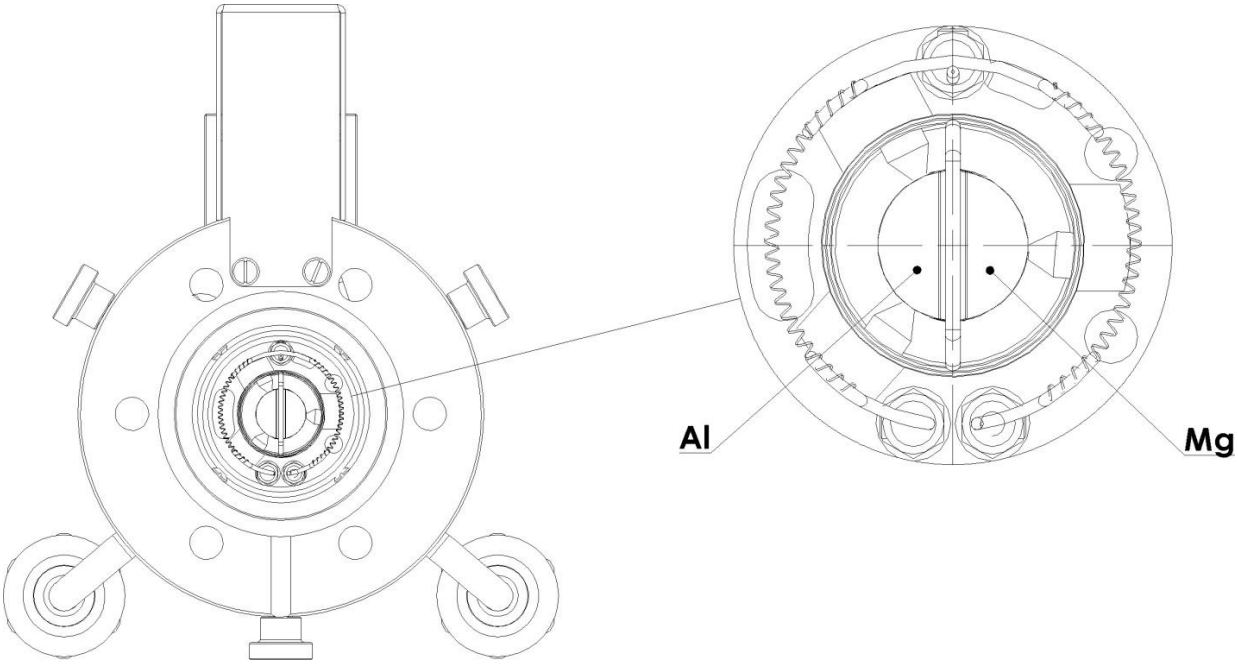
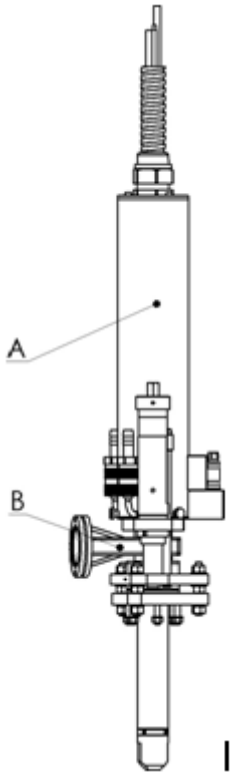


Fig.9 View for The cathode and anode after removing the outer casing

4. X-Ray Source RS 40B1 HP version

To use X-ray Source to high pressure application (up to 1mbar) differential pumping is required.

Pumping flange size DN 40CF should be connected using bypass to UHV chamber.



A - X-ray Source; B - Manipulator with port DN 40CF to differential pumping;

Fig.10 X-ray Source with special Manipulator

5. Quick Start

For easy and safety start please follow below steps:

1. Install the X-Ray Source on UHV system.
2. Bakeout chamber and X-ray Source before use.
3. Connect the cooling system hoses and HV conduit to the X-Ray Source.
4. Ground the HV power supply, emission regulator and cooling box.
5. Connect the interlock system (Water interlock, X-Ray cover interlock, Vacuum interlock and HV common interlock (HV Power supply interlock)
6. Connect the HV power supply and ISEG Power switch.
7. Insert the HV plug to the socket on rear panel of HV power supply – the click must be noticed.
8. Run the cooling system and switch on the Cooling Box.
9. Check the pressure. The pressure level in vacuum chamber should be below 5×10E-9 mbar.
10. Switch on the emission regulator on stand-by mode. All interlock LEDs on front panel should shine. Cathodes are preliminary formed and there is no necessity for additional preparing. When starting the X-ray Source for the first time set emission regulator on stand-by mode for about 30 min. for each cathode.
11. Switch on the HV Power Supply.
12. Switch on the ISEG Power switch.
13. (Only on first start) Raise high voltage in rate about 1 kV/min. If vacuum worsen it is necessary to interrupt raising voltage as long as vacuum stop going down. Vacuum in the chamber shouldn't be worst than 3 x 10E-8 mbar. Continue raising voltage to value +15 kV. After receiving voltage +15 kV wait about 30 min.
14. Set voltage on 10 kV on HV Power Supply.

15. Switch over the emission regulator on operate mode.
16. Set required voltage on HV Power Supply (max. 15 KV).
17. Set required emission current on emission regulator (max. 23 mA for Mg anode, 33 mA for Al anode). When raising value of emission current vacuum shouldn't be worst than 3 x 10E-8 mbar.

Warning:

All described above steps have to be done very scrupulous and carefully because presents hazardous voltages are dangerous for health and live.

6. Liability and Warranty

The equipment is made of quality materials and built with good craftsmanship. Warranty for the equipment as delivered and initially installed is one year from the final installation acceptance. The customer cannot use the instrument in any part before the acceptance agreement is approved. Any deviation from the full acceptance should be noted carefully on the agreement form and the warranty of accepted components will start at the time of partial acceptance. Conditions of warranty are applicable to the country of first delivery only (country of subsequent and/or final destination is excluded from PREVAC's sp. z o.o. warranty).

PREVAC sp. z o.o. will either replace or, at their option, repair such parts of the equipment, which within the warranty time may have defects or imperfections.

The warranty does not include:

A. Normal wear and tear and the need for regular maintenance.
B. Furnishing of supplies, consumables or accessories.
C. Items not purchased through PREVAC sp. z o.o. or damages caused by items not purchased through PREVAC sp. z o.o.
D. Damages caused by the customer's failure to provide continually a suitable installation environment for the equipment with all facilities described by the PREVAC sp. z o.o. "Site preparation guide".
E. Damages caused by the customer's use of the equipment for other than the purpose for which it was designed.
F. Damages caused by the customer's improper use of the equipment or supplies in conjunction with the equipment.
G. Damages caused by the customer's physical, mechanical or electrical alteration of the equipment or transportation after its initial installation.
H. Natural disaster, including but not limited to fire, flood, water, earthquake, wind and lightening.
I. The customer's contamination of vacuum enclosure parts thereof and vacuum pumps.

Upon PREVAC's sp. z o.o. request the dismounting of parts to be replaced or repaired and the remounting of replacement parts or repaired parts may be made by the customer without cost to the PREVAC sp. z o.o., provided such work is of a reasonable extent and the customer has personnel competent to do such work. For replaced or repaired parts PREVAC sp. z o.o. give one-year warranty from date of receipt of such parts by the customer.

For standard parts, PREVAC sp. z o.o. gives the same warranties as for the basic instrument, the warranty periods to be counted from the date of acceptance of these parts.

PREVAC's sp. z o.o. liability for defects or nonconformity's shall not exceed the price plus transportation costs of the defective part.

PREVAC sp. z o.o. makes no implied warranties, whether of merchantability, fitness for purpose or otherwise. Consequential losses and/or damages are excluded from warranty. The remedies stated herein are exclusive.

PERFORMANCE

All figures quoted by PREVAC sp. z o.o. for performance are given in good faith and PREVAC sp. z o.o. cannot accept any liability except in respect of any figures specifically guaranteed in his tender.

DOCUMENTS AND INFORMATION

Technical documents, such as drawings, descriptions, illustrations and the like, and all weight data, shall serve as an approximate indication only, provided they have not expressly been specified as binding. PREVAC sp. z o.o. reserves the right to make alterations considered necessary.

Customer shall:

A. Keep all technical drawings and other detailed descriptive materials supplied by PREVAC sp. z o.o. and marked the property of PREVAC sp. z o.o., in locked files,
B. Disclose information of proprietary or confidential nature supplied by PREVAC sp. z o.o. only to such customer's employees who are required to know the same for the use of the equipment, and
C. Not make any technical drawings and other detailed descriptive materials supplied by PREVAC sp. z o.o., or any part thereof, available to a third party for copying or any other use without PREVAC's sp. z o.o. written consent in each particular case.

RETURNING GOODS FOR REPAIR

Before returning your device for repair to PREVAC sp. z o.o.:

A. Contact the PREVAC sp. z o.o. service department to get RMA number (ZR#)
B. Send the Declaration of Contaminations, which was delivered to customer. The Declaration document is ready for download from PREVAC sp. z o.o. web page www.prevac.eu as well.
C. Send the product suitably packaged with carriage and insurance paid.

D. Mark the RMA number on the outside of the package in such a way that it is visible and clearly legible.

DAMAGE OR LOSS IN TRANSIT

Loss or damage to goods in transit shall be reported by the customer PREVAC sp. z o.o. and preferably to the carriers as soon as possible after the customer knows the occurrence. The customer upon receipt shall inspect all goods.

FORCE MAJEURE

The delivery time shall be reasonably extended, if hindrances occur which, despite PREVAC's sp. z o.o. due care, they cannot avoid, such as, but not limited to, epidemics, natural catastrophes, mobilization, war, riots, labor conflicts, serious breakdowns, accidents, official measures, shortage of materials, transport difficulties.

GENERAL CONDITIONS

Without prejudice to the provisions of any agreement between PREVAC sp. z o.o. and the customer the supply of equipment and services by PREVAC sp. z o.o.is subject to the following general conditions.

A. General Conditions for the Supply of Plant and Machinery No. 188, prepared under the auspices of the United Nation's Economic Commission for Europe, Geneva, March 1953,
B. Addendum to General Conditions under a) above, issued by the Federations of the Mechanical Engineering Industries in Denmark, Finland, Norway and Sweden in 1972,
C. Additional Clauses for Supervision of Erection of Plant and Machinery Abroad No. 188 B, prepared under the auspices of the United Nation's Economic Commission for Europe, Geneva, April 1964.

In case of conflict between the provisions of any agreement between PREVAC sp. z o.o. and the customer and the general conditions under A. ÷ C. above, the provisions of the agreement shall thus prevail.

7. List of figures