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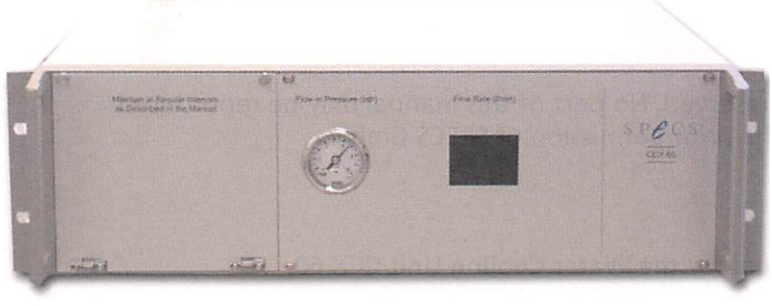

CCX 60

Water Cooling Unit

Manual

2.1

User Manual for the Water Cooling Unit CCX 60.

Version 2.1 as of 10th September 2007.

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Chapter

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Chapter

1

Introduction and Safety Instructions

This manual describes the installation, initial commissioning, normal operation, and troubleshooting of the CCX 60 Cooling Control Unit. The technical requirements are listed in section 2.5 , "Technical Specifications" on page 14.

Normally a Water Cooling Control Unit does an inconspicuous job. But the initial installation and following correct operation of the unit are very important for a safe, long, and stable operation of your X-ray source, for low noise operation of your spectrometer equipment, and for protection of your equipment from electrical and/or vacuum-related accidents. Water, high power and lethal voltages are used by the unit.

Therefore: Read this manual with care and consult it when in doubt! Do not underestimate the importance of the service instructions given here!

1.1 Overview of the Unit

The CCX 60 is a module designed for operation together with both the SPECS X-ray dual source XR-50 or X-ray monochromator source XR-50 M. The CCX 60 provides a cooling water inlet and outlet, the HV connection between the SPECS XRC1000 X-ray source power supply and the XR-50/XR-50M, and incorporates interlocks for the HV cover protection and a water flow indicator.

Inlet and outlet water lines between the water box and the X-ray source anode are contained within a plastic covered, reinforced conduit assembly. The HV and ground cables are also led through this conduit.

Finally at the end of the conduit a metallic HV cover protects the surroundings from the X-ray source anode flange which has lethal voltages up to 15 kV applied to it. Two PTFE hoses of 10 mm diameter and 8 m length and filled with cooling water provide enough electrical resistance for voltage drops down from + 15 kV at the anode to zero within the CCX 60 inner tank.

The CCX 60 also features a rotary flow meter including electronic board and display, a shutoff valve, an accumulator electrode (cathode) for deposits, a sensor for water leak detection inside the inner tank and a relay to control an external unit (e.g. chiller).

The CCX 60 cooling water box can also be attached to X-ray sources and power supplies of other manufacturers (e.g. VG, Omicron, Leybold / older SPECS RQs and XRs). In all such cases, modifications at the sources, the power supplies and/or at the CCX 60 have to be made for optimal cooperation between devices.

1.2 Safety Instructions

1.2.1 General

Before any electrical or electronic operations please consult "SPECS Safety Instructions" and follow them closely.

Some tests which may have to be carried out are hazardous. These parts are indicated by a warning label:

!Warning!

Beware! Hazardous voltages are present. Lethal high voltages up to 15 kV are applied to the X-ray source and the high voltage power supplies. Only trained, qualified personnel are allowed to carry out the installation, adjustment and repair procedures described in this manual. Make measurements only with special insulated tools rated for voltages higher than 20 kV.

1.2.2 Special Instructions

1.2.2.1 HV protection

Through the CCX 60 water cooling control unit a high voltage cable with potential up to 15 kV is present! It is important to comply with the following safety directives:

- Use only original cables, connectors, and flexible conduits from SPECS. Pay careful attention that all cables and water lines are without physical or electrical defects. In case of any doubt, the cable or the water line has to be replaced by an original SPECS part.
- Connect the X-ray source with the CCX 60 only when the power supplies are turned off.
- After switching off the power units, the operator should wait a minimum of 3 minutes before making any disconnections, from the power supplies or the X-ray source protection cover.

- Before switching on the power, the electrical and mechanical installation has to first be completed. The interlocks for vacuum, water, and HV have to be correctly activated and tested for safe and proper operation.
- Use the X-ray source only with a fully closed HV protection cover and a properly affixed conduit for the HV cable and water supply! Open slits and holes could be dangerous and violate safety regulations.
- The HV cable entrance at the back panel of the CCX 60 has to be fixed with traction relief!
- Do not operate the CCX 60 under HV with housing parts removed.

- **Never cut or obstruct the HV cable passing the CCX 60 cooling water box directly on its way from the HV power supply to the X-ray source anode!**
  A perfect screen of the HV cable protects your life, your other electronic equipment and the X-ray source!

- Never run a cooling water box, a wet conduit or/and a wet HV protection cover! Never touch any wet parts while HV power is on!
- In the event of a water leak at the source, a complete drying of the module, the protection cover, the conduit, and the cables is strongly recommended. Never run the X-ray source module with wet parts inside of the conduit!
- Never bypass or short the HV guard or the water interlock system!
- Service the CCX 60 with respect to sedimentation mud or splashed water only if the master device (e.g. XRC 1000/XRC 1000 M) has been completely switched off!
- Operating the CCX 60 with equipment other than that delivered or released by SPECS may void your warranty. In case of any doubt please contact the SPECS service department (support@specs.de).

1.2.2.2 Grounding

Correct grounding is essential for safe operation, protection of your equipment, low-noise XPS spectra, and depth profiles!

- Connect the X-ray source, the CCX 60 cooling water supply, the HV and emission suppliers to each other and to the ground connector of the electronic rack with low impedance ground cables. Large contact areas are important! A proper connection will protect the sensitive electronic equipment of your system!
- The screen of the high voltage cable has to be connected with the back side of the HV protection cover!
- Never run the CCX 60 with ground cables removed!

Chapter 2 Description of the Unit

2.1 Hardware Description

The CCX 60 water cooling control unit consists of a closed water tank situated in the center of a covered box (19" rack mount, 3 chassis units), a plastic covered, reinforced conduit to accommodate the water lines and electrical connections, and at its end a High Voltage protection cover, that is connected to the X-ray source anode.

Standard CCX 60 package consists of:

- the CCX 60 water cooling control unit with fixed mounted
  - 'HV In' cable and plug
    (connected to XRC1000 X-ray source power supply HV socket)
  - plastic covered, reinforced conduit
    including the protection cover (figure 8, page 15) and
  - the 'HV Lock' cable (connected to XRC1000 X-ray source power supply)
  - the 'Interlock' cable (and also main 24V)
    (which is connected to the XRC1000 X-ray source power supply 'Water' socket)
- external particle filter (see figure 1, page 6 and figure 14, page 26)
- four quick-fit connectors including hose clamps (see figure 1, page 6)
  - two for additional source head cooling nipples and
  - two for the chiller or tap water connection
- ground cable 1.5m
- flexible hose (see figure 1, page 6)
- three knurled head screws to mount the protection cover to the X-ray source
- two spare HV electrodes (to be mounted at anode, see figure 1, page 6)
- anti-algeon agent
- this manual.

Figure 1 **Additional parts**

(Please note that the residual water remaining inside the unit from factory testing will not affect the operation and lifetime of the unit and the X-ray source in your laboratory.)

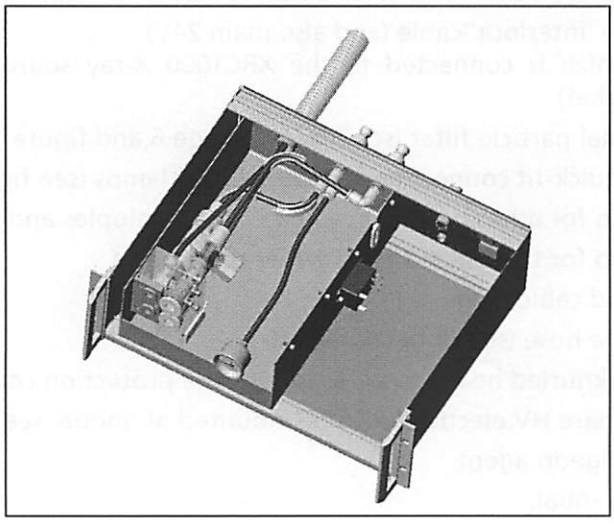


Figure 2 **Schematic of CCX60**

2.2 Water flow

In figure 3, "Water flow for CCX60 - water chiller - XR50" on page 7 or in figure 4, "CCX 60 connections" on page 9, the arrangement of the water-cooling box CCX 60 and the water pipes can be seen.

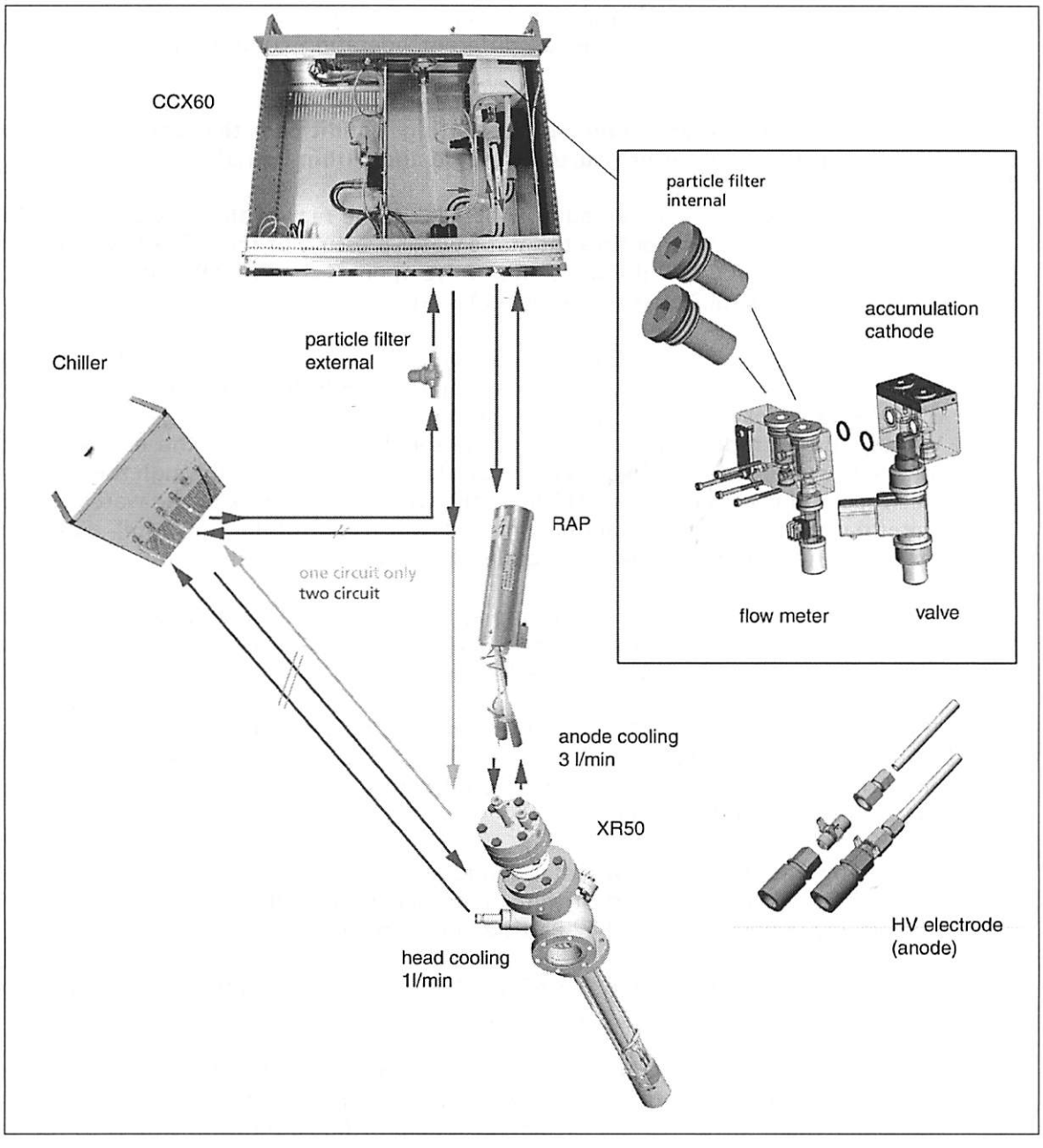


Figure 3 **Water flow for CCX60 - water chiller - XR50**

Note that a particle filter has to be installed as a standard part of the input line and there exists an internal particle filter behind the service flap as well.

If several instruments are attached to one chiller or one tap (e.g. turbo molecular pumps), the water flow rate, the heat transmission, and the water pressure have to be checked. The different water consumers have to be organized in a shunt arrangement. The conditions summarized in section 2.5 and mentioned above have to be fulfilled for stable and safe operation under all different operating conditions and loads in the different lines.

Note: Take care that under all operating conditions the water flow rate, temperature, and water pressure are stable and within limits!

The inlet for the water is marked as 'Water In' at the rear of the CCX 60. At the front panel a pressure meter monitors the static water pressure of the influx line. Within the water tank of the CCX 60 the water inlet valve opens if the WATER button of the X-ray power supply XRC1000 (or a similar device) is pushed.

After passing the valve and the cathode block, the water flows through the PTFE hose inside the reinforced conduit. The whole water line outside the CCX 60 cabinet consists of two PTFE hoses in a plastic covered, reinforced conduit.
Via an HV electrode and a quick fit connector the flow goes to the entrance of the anode's inner tube (water inlet). Via the outflow connector, and through the second HV electrode and then the reflow PTFE hose, the water returns back to the water tank. The water passes through the rotary flow meters (which control the flow rate), and goes to the cathode block and finally to the outlet directed to the Source Head.

The internal rotary flow rate meter (display visible from the front panel) has a set value of about 3.0 l/min (usual set within 3.0 - 3.5 l/min) and will enable the Operate function of the X-ray power supply via the interlock line.

The flow meter is adjustable to set the minimum flow rate of the X-ray source to be used. If the flow rate falls under the limit, the interlock protection of HV power supply will be activated. A minimum flow rate difference of about 0.1 l/min is required to change the previously set value.

For safe operation of the flow meter and to avoid blocking or reducing the water flow by particles, an external particle filter is installed. The filter box can be opened to remove any sediment (figure 14, "Particle filter" on page 26).

After leaving the outlet of the CCX 60 (marked as Source Head) the water flow can pass in serial to the cooling jacket of the X-ray source head (see figure 4, page 9).

If a second water line exists (with a flow rate in the range of turbo pump cooling), the second line should be used for head cooling (figure 3, page 7). The water flow returns to the water chiller or the closed circulation system or (in case of tap water) to the final outlet.

The water tank of the CCX 60 is completely sealed (with the exception of the top covers) to avoid water leakage to floor. A water drain allows a controlled water outlet in case of an accident.

2.3 Electrical Connections

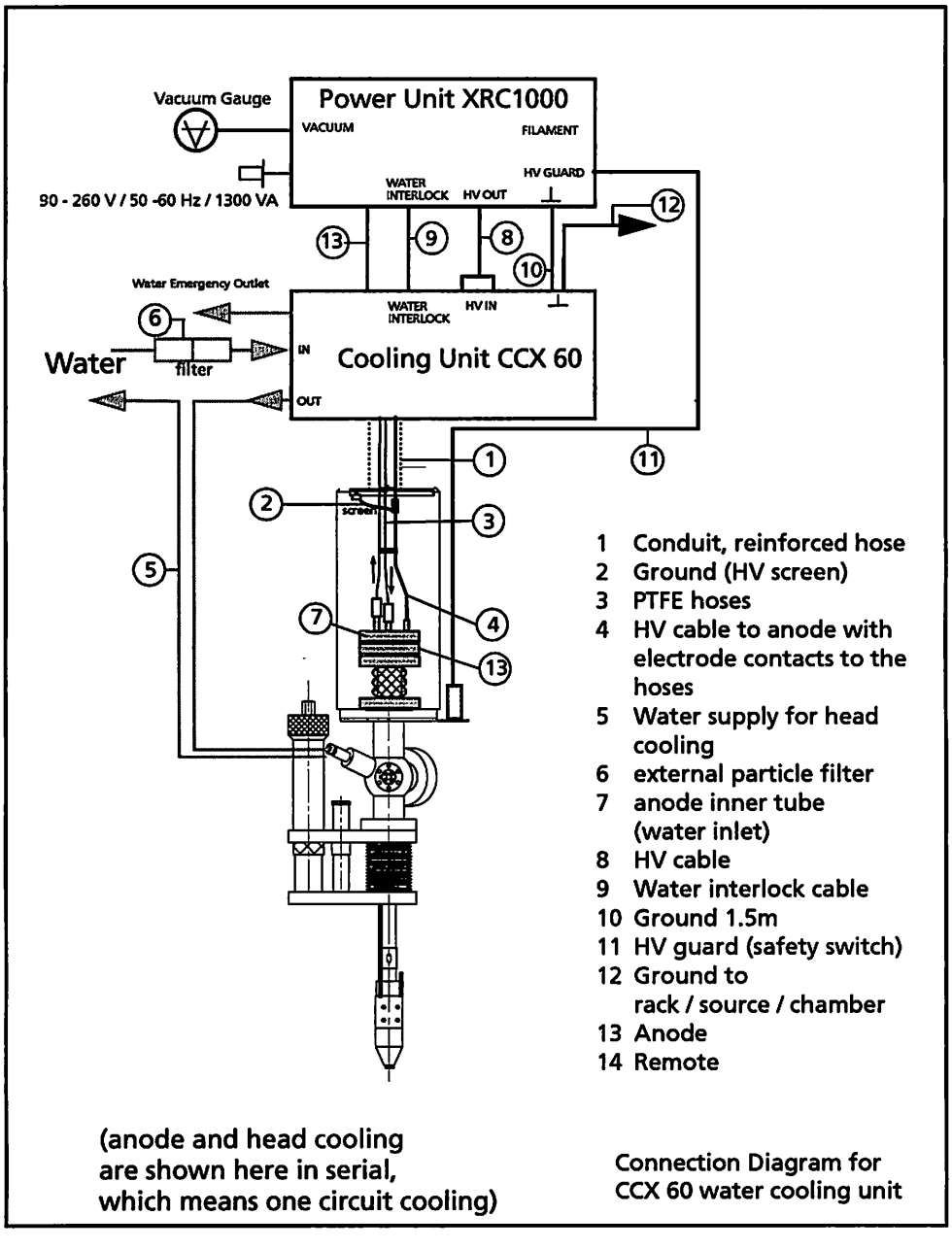


Figure 4 **CCX 60 connections**

A continuous, non-interrupted HV line represented as a red cable is found inside the CCX 60. The HV cable begins with a 20 kV high voltage plug which should be connected to the XRC 1000 X-ray source power supply or to a similar device. The HV cable makes only a short turn within the water tank to continue its way together with the PTFE hoses within the conduit. The HV cable finishes at the anode electrodes and finally in a plug to be connected to the anode inner tube (see figure 8, page 15).

A yellow/green grounding cable is situated within the protection cover. The cable makes a connection between the grounded HV cover (which is fixed to the X-ray source chassis) and the screen of the HV cable and therefore with the XRC1000 X-ray source power supply and the other end of the screen, i.e. the HV plug.

The water tank of the CCX 60 itself has a separate ground socket which should be connected to the XRC1000 X-ray source power supply, i.e. connect all ground cables to one point for all X-ray source components (XR-50 + XRC1000 + CCX 60). This point needs a good contact to the electronic rack and the system chamber.

The PTFE hoses coming from and going to the X-ray source are grounded at the accumulation electrode (cathode) located behind the front plate. This cathode is situated at the beginning of the long PTFE hoses and is working as a trap for the residue created electrolytically by the HV.

The valve control, the interlock lines as well as the power for the rotary flow meter circuit board are contained inside one cable which is connected to the XRC1000 supply ('Water').

The HV protection interlock is located on the protection housing for the X-ray source and the cable goes to the rear of the XRC1000.

The rotary flow meter is controlled by a circuit board inside the CCX 60 housing which counts the pulses generated by the wheel and therefore measures the flow rate via the frequency of these pulses. Depending on the calibrated set point, the interlock line is set to be closed or open.

During operation do not remove any installed ground connection! Note the description given in section 3.3 , "Electrical Connections" on page 19!

2.3.1 HV electrode (anode)

The HV electrode (figure 11, "HV electrodes" on page 20) inside the protection cover connect both water tubes and are made of stainless steel. This anode has the same potential as the X-ray anode and due to HV electrochemical processes these electrodes will be slowly corroded. Please check occasionally (at least within a **maintenance intervals of approx. 100 working hours**) that these electrodes are not leaky and wide enough for undisturbed water flow. Also check the electrical contacts and inspect the wires for sparking traces. Keep in mind that all parts concerning these electrodes are connected to HV during operation. (see also section 4.1.2 , "HV electrode (anode) cleaning" on page 25, "Corrosion" on page 13).

2.4 General Information

Note: SPECS recommends a closed-circuit water-cooling system for protection of the environment!

SPECS only supports the use of water as the cooling agent within the CCX 60!

Full power dissipation for the XR-50/XR-50M X-ray sources can only be obtained if the **water pressure of the cooling water is larger than 4 bar** and the flow rate is 3.0 - 3.5 l/min. The temperature should be maintained at about 20 °C (70 F).

Other X-ray sources (and older XR-50 designs) may require larger water pressures and flow rates, especially if the X-ray source head (or outer jacket) cooling is connected in serial. Consult the manual of your X-ray source if not mounting a newly manufactured SPECS XR-50 together with the CCX 60 water cooling box!

A temperature below 20 °C (70 F) will result in condensation, and flashovers to ground inside the water conduit or the HV protection cover may occur.

Higher temperatures result in overload, i.e. an evaporation of the anode material or in the worst case a cracked anode with water injection into the vacuum chamber. Normally the anode cooling and the outer jacket cooling will be performed serially (see figure 4, "CCX 60 connections" on page 9). However, if conditions do not allow a flow rate of 3.0 - 3.5 l/min, separate or cooling of the outer jacket in parallel is possible. About 1.0 l/min in this line is sufficient to maintain the specified temperature at the source head.

2.4.1 Water resistance

During operation, the anode flange and the anode inner tube are at potentials as high as + 15 kV. The net power of the anode consists of X-ray radiation and heat dissipation. The anode gross power also includes the voltage drop via the water influx and reflux lines for anode cooling. The CCX 60 water cooling box is grounded. The difference between gross and net anode power will increase with lower water resistance or higher water conductivity.

The difference between gross and net emission currents, the so-called "water current" should not exceed 10 mA at 15 kV. In this case, the cooling water in a closed circulation system must be replaced by deionized or distilled water after washing the pipes and the tank to remove all residual deposits. If the water resistance is too large, i.e. < 2 mA "water current" at 15 kV, electrochemical attacks at the anode can occur. In this case a small amount of tap water will reduce the resistivity and ensure stable operating conditions. If the "water current" exceeds the limit mentioned above for users with a tap water supply, this type of cooling should not be continued. The installation of a closed circulation system will be required!

Note: Water resistance is an important parameter for stable operation!

2.4.2 Water quality / Closed circulation system (Chiller)

If a closed circulation system is utilized:

- SPECS recommends the use of deionized / distilled water for closed circulation systems to get optimal water resistances.
- Follow the instructions made by the manufacturer or supplier of the closed circulation system! Respect the safety instructions!
  Note: Manufacturers of such closed circulation systems often recommend tap water! These conflicting recommendations require a customer decision. Usually a mixture with a conductivity in the recommended range will work.
- Incorporate the control of the closed circulation water-cooling system into the X-ray source interlock system!
- Inspect the water level and quality! Refill or replace water if necessary!
- Wash and clean the chiller and the water lines. If there is too much water conductivity, perform some cleaning cycles with tap water before refilling deionized or distilled water!
- SPECS recommends the use of an **anti-algeon** to suppress biological activity. For the same reason the use of dark, non-transparent water pipes is advised.

See also section 2.4.6 , "Closed circulation water-cooling systems" on page 13!

2.4.3 Water Quality / Tap water

While cooling with low temperature tap water (10 - 14 °C), the cooling effect on the main body of the X-ray source module can be felt. However, depending on the surroundings, low temperatures can force water condensation and flashover to ground inside the water conduit or the protection cover. The recommended temperature for cooling the X-ray source is 15 - 22° C. Higher temperatures result in overload, i.e. an evaporation of the anode material or worst case a cracked anode with water injection into the vacuum chamber.

If tap water is utilized as the cooling agent:

- Water polluted by suspended particles can not be utilized without a filter.
- Water polluted by coloured additions should not be used for cooling the XR-50 module.
- Salt water (also with lower concentration) cannot be utilized for reasons of reduced water resistance and increased electrochemical activity!

Note: Never use polluted or contaminated tap water for X-ray source module cooling!

2.4.4 Contamination of Water pipes

The water pipes can become contaminated on both the inner and outer walls. The main electrochemical corrosion would likely happen at the anode electrodes (see "HV electrode (anode)" on page 10, "Corrosion" on page 13 ,"Maintenance" on page 23). The main reason for contamination along the inner surfaces are particles and chemical

compounds in solution (forced by electrochemical processes, caused by the applied HV). They are deposited as sediments.
Contaminants that are biological in nature are a second reason. This process will be intensified if longer periods of X-ray source inactivity takes place.

Do not forget to add few drops of anti-algeon agent! Avoid contact with anti-algeon! Irritations of skin and mucosa are possible.

Note: If the X-ray source is taken out of operation for a longer period, remove the water hoses from the X-ray source module to avoid sedimentation. Remove (blow out) the water from the water pipes inside the source head and anode!

The water hoses can also be contaminated on the outer walls. Under extreme situations the voltage drop which normally occurs via the inlet and outlet from the anode water supply can be from the contaminants on the outer walls. Shorts to the grounded cover plate of the X-ray source can develop. Parts of the PTFE water hoses can inflame and melt.

Note: If such an incident occurs, the total replacement of the water hoses within the conduit between X-ray source module and water cooling box is strongly recommended! Consult SPECS! Replace the "Quick Fit" connectors (see figure 16, "'Quick Fit' water coupling types'' on page 28)! Restart the water-cooling with care!

2.4.5 Corrosion

The inner tube of the anode (i.e. water inlet part: exactly the pipes where the water comes in and out), the X-ray anode itself and especially the HV electrodes (anode) can corrode because of their connection to + 15 kV anode voltage. Electrochemical corrosion of the metal parts causes decomposition.
Please check the above described parts occasionally. Replace the anode inner tube, the HV electrodes and the "Quick Fit" connectors to avoid water leakages and flow reduction.
The X-ray anode itself can not be checked from its water side visually. Normally their lifetime which is limited by consecutive evaporation of the active thin layer (i.e. Zr, Mg, Al the layers on top to achieve the excitation) is shorter than dangerous corrosion.

2.4.6 Closed circulation water-cooling systems

Especially during high power operations (> 300 W) check the cooling temperature which should be lower than 22 °C. Note that blocked filters, hoses, fittings and especially the cathode block, where the most sedimentation is stored, can reduce the water flow dramatically. This can result in temperatures at the anode where the active material will be evaporated.

Therefore it is strongly recommended to tune the water flow meter settings to a level not below 3.0 l/min.

2.5 Technical Specifications

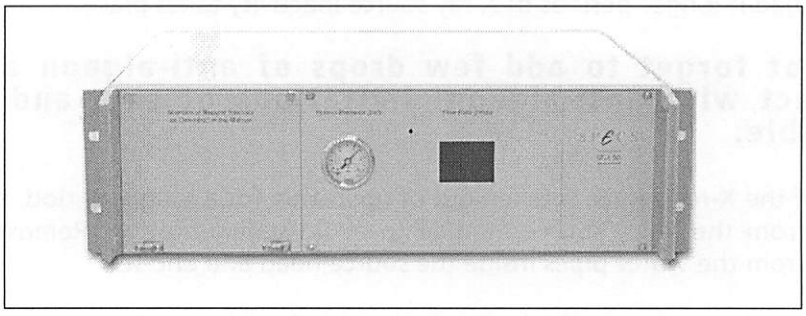


Figure 5 **Cooling Control Unit CCX 60 (front view)**

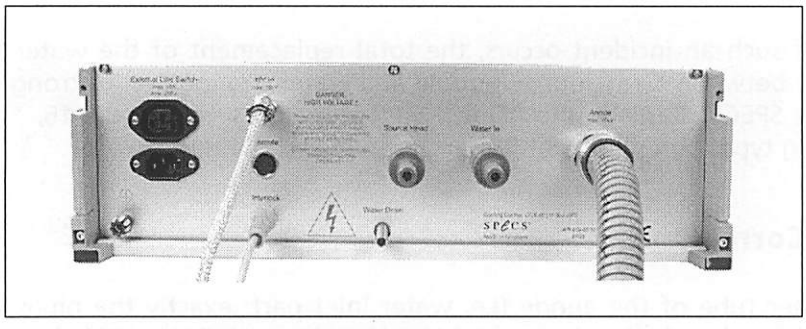


Figure 6 **Cooling Control Unit CCX 60 (rear view)**

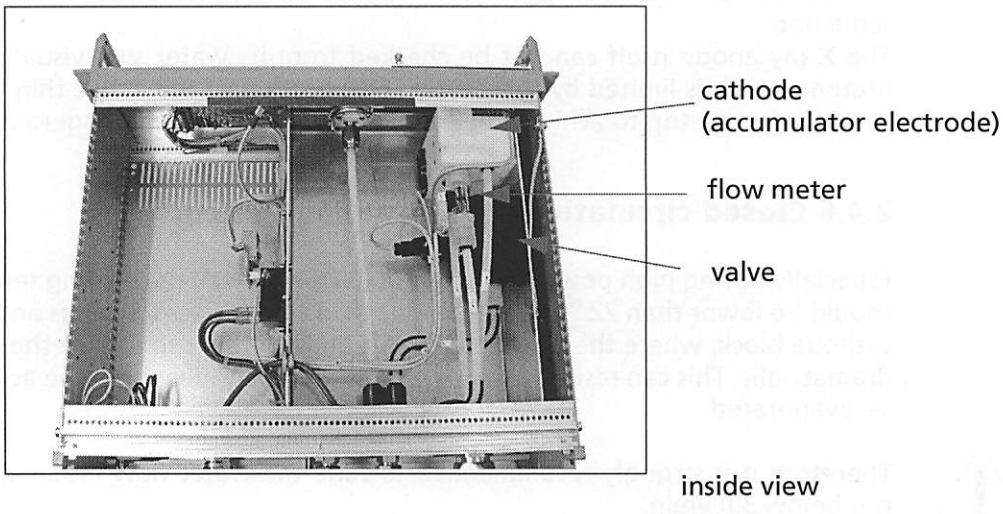


Figure 7 **Cooling Control Unit CCX 60**

Size / Height:	19" rack mount, 3 chassis units (134 mm)
Depth:	360 mm chassis (+150 mm space for cable)
Weight:	14 kg (with conduit and HV-cover, unfilled)
HV limit:	15 kV
Water pressure measurement:	mechanical meter, up to 10 bar
Water Interlock:	5-pin DIN plug
Water drain:	1 cm above ground level of the tank
Operating water pressure:	3.5 to 8 bar (higher than 4 bar recommended)
Power:	no mains consumption
Flow rate measurement:	rotary flow meter with magnetic pulse counting electronics and display
Particle filter:	arranged outside at input water line, notice flow direction in case of de-installation

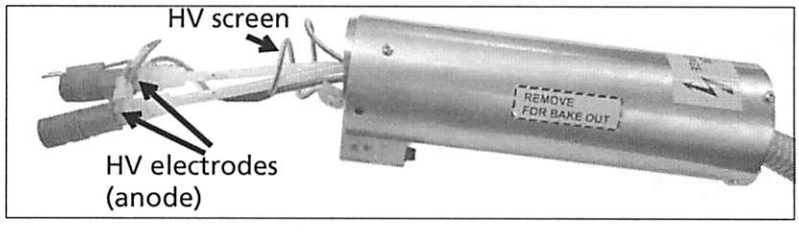


Figure 8 **Protection cover (water and HV connection to x-ray)**

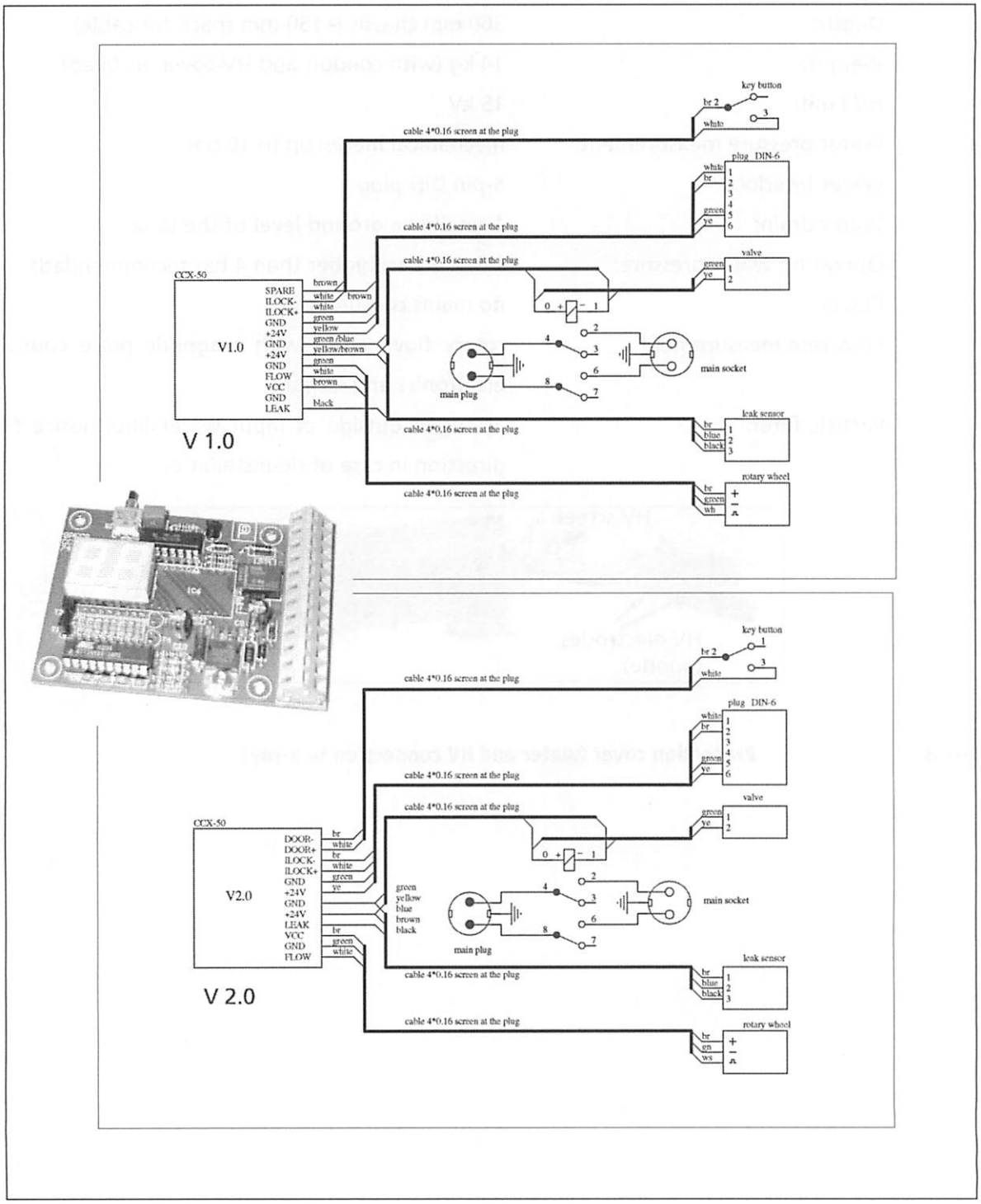


Figure 9 Connections to the CCX 60 circuit board

Chapter 3 Installation

3.1 Installation of the CCX 60 Water Cooling Box

It is very much recommended to install the CCX 60 at bottom of a 19" electronic rack in which the XRC 1000 or another X-ray source power supply is situated. The position at bottom is suggested because in case of any water accident no other electronic equipment will be harmed!
Please connect a hose to the DRAIN outlet in case of a water leak inside the tank. Lead the outflow of this hose away from the rack!

It is also recommended to arrange the supplying water pipes and the grounding cable in such a manner that the CCX 60 device can be pulled out of the rack for service operations (e.g. adjustment of flow meter).

3.2 Water Connections

For normal connections please refer to figure 3, page 7 (two water lines / one water line for anode and head in serial).

Full power dissipation of the X-ray source can only be obtained if the pressure of the cooling water is between 4 and 8 bar and the flow rate is larger than 3.0 l/min.

1. Connect the CCX 60 to the water chiller, to a closed circulation system or tap water supply. The water connection should also be fit with an additional shut-off valve.
2. Remove the 3 screws at the rear of the protection cover (not on the cylindrical part, figure 10, page 18) to push the water connectors and the HV cable outside the cylindrical housing.
3. The inlet and outlet of the anode cooling water (both are inside the plastic covered, reinforced conduit) should be carefully checked and connected to the correct tube pipe connections (shroud plug and socket). Arrows at the water connectors of the anode water flange and on the hoses show the direction the

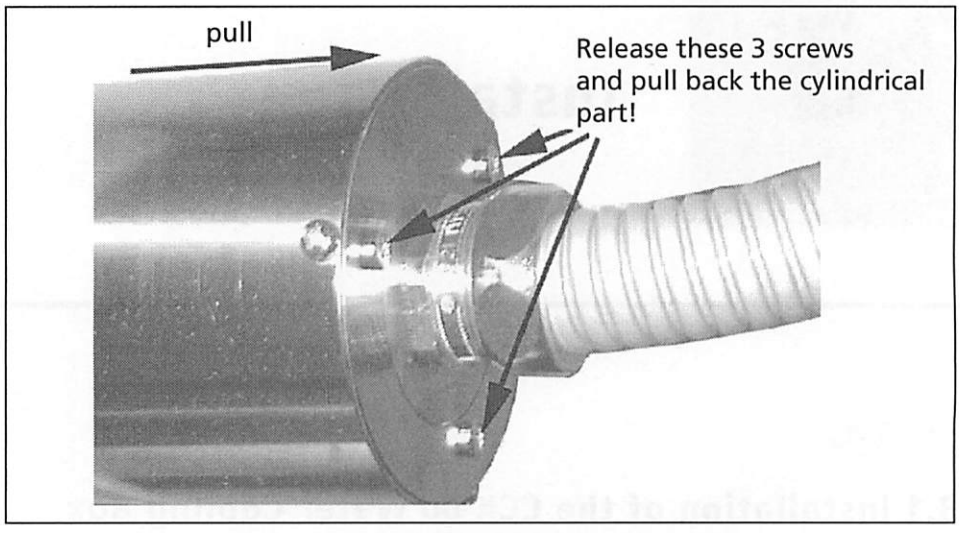


Figure 10 **Fixing and Removal of the Protection Cover**

water flows from the unit into the anode, and back from the anode into the cooing unit.

Normally the middle pipe connection at the anode inner tube flange means water into the anode.

Note: Pay attention to the flow direction at the anode water flange. Mistakes can result in damage of the anode due to reduced cooling and damage of the flow meter if this faulty state lasts minutes or longer.

4. The rate of water flow should not be set below the factory set point value of about 3.0 l/min (usual set within a 3.0 - 3.5 l/min range). Operation at maximum power cannot be safely achieved at lower flow rates. Overload can result in an evaporation of the anode material or worst case, a cracked anode with water injection into the vacuum chamber.
5. A) Connect the anode water outlet at the rear panel of the CCX 60 to one of the water connectors of the XR-50 main housing. The other water connector at the source body should be connected to the reflux flange of the closed circulation system or the water outlet (Please refer to figure 3, page 7 and figure 4, page 9).

   OR

   B) Connect the second water line (at least 1.0 l/min) of the closed circulation system to the source body (head cooling) connections (shroud plug and socket) (Please refer to figure 3, "Water flow for CCX60 - water chiller - XR50", page 7).

There is no specifically required direction of the water flow in the XR-50 main chassis (jacket cooling).

3.3 Electrical Connections

For typical connections refer to figure 4, "CCX 60 connections", page 9.

Mind the safety instructions given on page 2!
Warning: It takes 3 minutes for the unit to completely power down. When turning off the unit, wait at least 3 minutes before disconnecting any cables from the power supply or the X-ray source!

No special power cable is necessary for the CCX 60 unit. The power for the electronic board is provided by the 'Interlock' cable to the 'WATER' socket at the rear of the XRC1000 high voltage supply.

1. The high voltage unit has to be connected either to a vacuum controlled power line or in case of the XRC1000 supply at least the vacuum interlock at the rear of the unit should be connected to a vacuum gauge (see item 3 below). Using the vacuum interlock will switch off the high voltage and the filament current, if the chamber pressure is over the set limit.
2. The high voltage line between the cooling unit and the anode (red cable) is the most critical connection. Careful installation is therefore necessary. Incorrect cabling as well as physical damage can destroy the electronics or anode (worst case: water penetration into the chamber)!
   - The connection of the HV cable (anode) to the HV plug is fixed with screw. Check also the electrical contacts of the HV electrodes (figure 11, page 20) between the hoses and the quick-fit connectors and look at the wires, hoses and inner insulation (PTFE foil) of the protection cover for sparking traces. Keep in mind that the X-ray anode, the HV electrodes as well as the water inside the PTFE hoses are at HV during operation.
   - The shield of the high voltage cable (anode side) has to be connected to the back side of the cover plate of the source (see figure 4, page 9).

A perfect connection of the high voltage cable protects your life, your electronic equipment and the XR-50 source!

3. The safety interlock for the cooling water (coming from the Cooling Control Unit CCX 60), the safety HV-cover switch (of the X-ray source) and the vacuum interlock have to be plugged into their respective sockets ("WATER", "HV-GUARD" and "VACUUM") at the rear panel of the X-ray power supply.

Because the vacuum interlock is not part of the SPECS x-ray source equipment, pin 1 and 2 at the vacuum interlock socket have to be activated by a vacuum interlock unit, e.g., a vacuum gauge. Do not permanently use the shorten vacuum interlock plug, which is a part of the shipment from SPECS

4. The external line switch (max. 10A / 250V) is controlled by the 'Water' button of the XRC1000 X-ray source power supply and can be used to switch an external unit, e.g. a chiller.

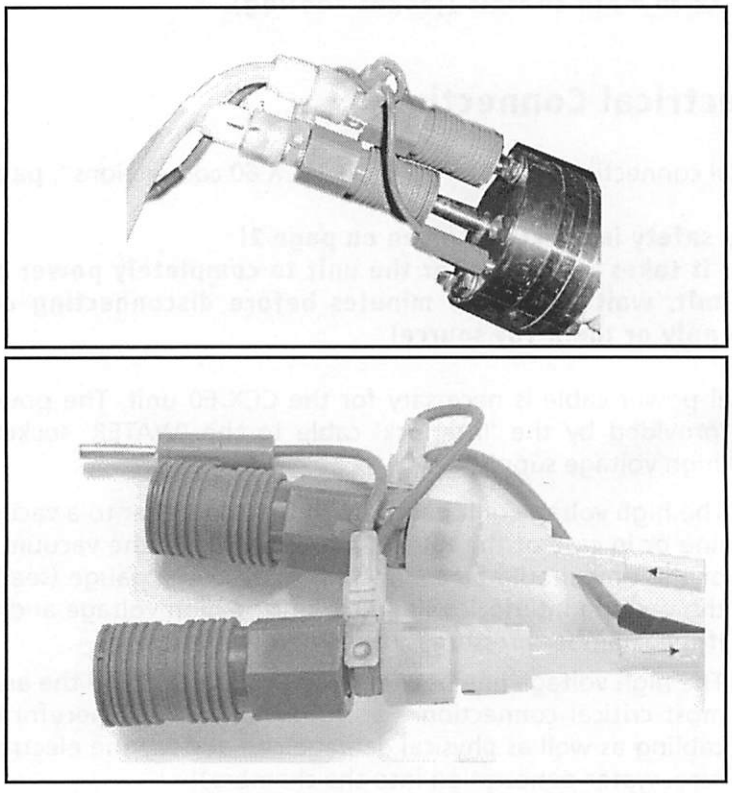


Figure 11 **HV electrodes**

3.4 Initial Operation

If water connections and electrical connections are completely prepared please perform an initial operational check of the whole system.

3.4.1 Initial unstable water flow

Pressing "Water" at XRC 1000/XRC 1000 M or similiar device should result in LED activity of the flow meter display. If all is perfect, a flow rate above 3.0 l/min will be indicated. Because the pipes have to be filled initially with water during the described test rapid flow rate changes will result. These changes will switch off water flow unintentionally by the internal valve. Under these conditions please repeat the start-up two or more times with the result so to get stable water flow without bubble noise and/or noticeably stronger pipe shakes.

3.4.2 Flow meter display shows value < 0.5 l/min

If the flow meter display shows values < 0.5 l/min with a capable water chiller or other supply and the flow is not reduced within X-ray source XR 50/XR 50 M or CCX 60 by any blockade check the flow direction!

3.4.3 Flow meter display shows "LL"

If the flow meter display indicates "LL", the splash water sensor at bottom of CCX 60 tank was triggered as result of a probable water leakage. Switch off the master power supply (e.g. XRC 1000/XRC 1000M) and open the door located at front left side. Check bottom of tank if water really has leaked. If water was found please open the top cover of CCX 60 and the two top covers of the inside tank to find the reason for the leakage. Consult SPECS GmbH in Berlin (support@specs.de) for further diagnosis and repair.

3.5 Bakeout procedure

For bakeout the HV cover together with the water pipes and the HV cable have to be removed from the X-ray source module (see figure 10, "Fixing and Removal of the Protection Cover", page 18).
In order to avoid temperature differences in the anode or the cooling tanks of the source head it is recommended to remove (blow out) all 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.

Find a safe, clean and dry place for the HV cover and parts of the conduit.

Chapter 4 Maintenance

4.1 Routine Cleaning

Recommendation: every 100 - 200 working hours

Note the comments given in section 2.4 , 'General Information" on page 11!

Check your water quality (SPECS recommend the use of an **anti-algeon** to suppress biological activity)!

4.1.1 Cathode cleaning

The material that has been corroded by electrochemical processes will be deposited somewhere in the circulation line if no special effort for its accumulation is made. The CCX 60 is equipped with an easy to open service panel. Behind the panel an accumulation cathode is placed, where the water coming and going to the source is grounded.

Two threaded bushings allow one to clean the cathode block via the front side panel (see figure 12, page 24). Note that this panel has an interlock switch! Opening the service panel activates the HV interlock line.

This sedimentation effect is accelerated after the X-ray source has been taken out of operation for a longer period. The sediments should be physically removed as well as possible to guarantee effective cooling of the anode (see figure 12, "Cleaning of cathode and internal particle filter", page 24).

The cathode should be cleaned after every 100 working hours!

- Switch off the X-ray supply!
- Open the service panel!
- Remove the two cathode socket head cap screws and the two internal particle filter (see figure 12, page 24)!

- Clean the filter, cathode screws and the cathode PTFE block with a wipe/tip and clean water.
- If water drops into the tank, please note that the water leak sensor inside the tank may disable the HV.
- Close the cathode block and service panel.
- Run the water and check that no leak was created. Do not forget that the panel interlock opens the interlock chain if you re-open the panel again!

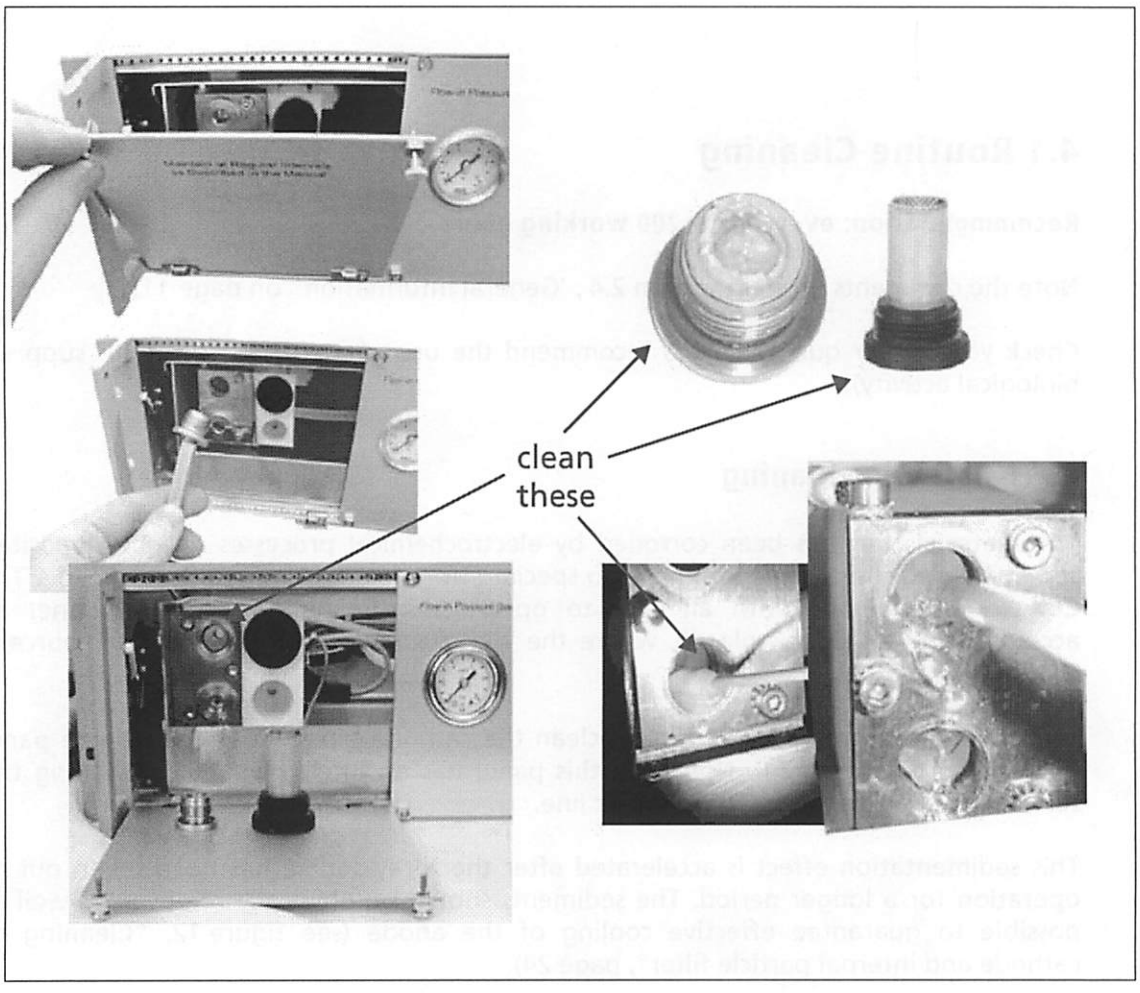


Figure 12 **Cleaning of cathode and internal particle filter**

4.1.2 HV electrode (anode) cleaning

The other places to be cleaned are the HV electrodes and the inner part of the anode (at the water inlet). The **HV electrodes (anode)** and the water inlet part can also be checked if the X-ray source is prepared for bakeout or is checked at least as often as the cathode, i.e. **after 100 working hours** (see figure 13, "HV electrode (anode) cleaning", page 25)!

- Switch off the X-ray supply.
- Open the protection cover of the X-ray source (figure 10, page 18)!
- Disconnect the HV line and the water hoses (pull the quick connector body towards the hoses).
  Do not bend the PTFE hoses (support the cover by hand as long as not disconnected) to avoid crumbling the hose wall.
- Disassemble the quick connector - HV electrode (anode) and hose fitting and clean all parts with tissues / water (figure 13, page 25).

Note that one spare set HV electrodes (anode) was supplied with the unit. If you doubt that the electrodes are leaky or too corroded please change them!

- Assemble all parts (perhaps using new PTFE tape) and **check that all connector parts are not leaky** (e.g. open the protection cover after few minutes water flow again and check for water drops and humidity).
- Tighten all screws of the protection cover.

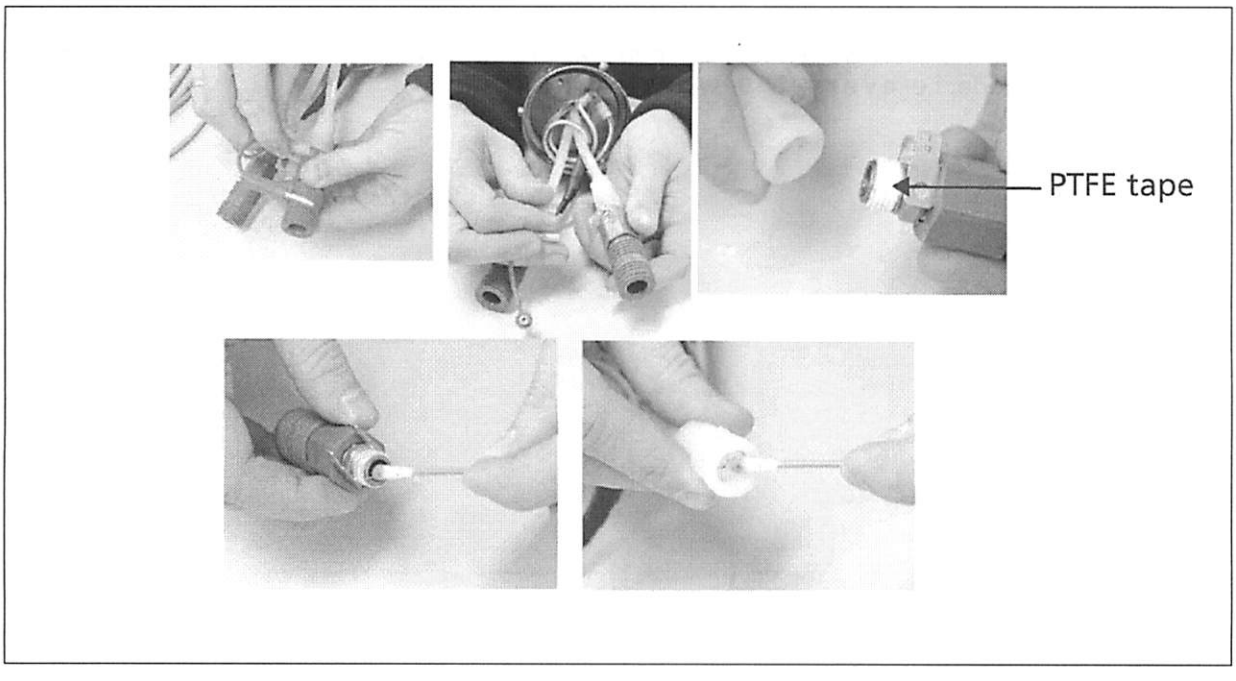


Figure 13 **HV electrode (anode) cleaning**

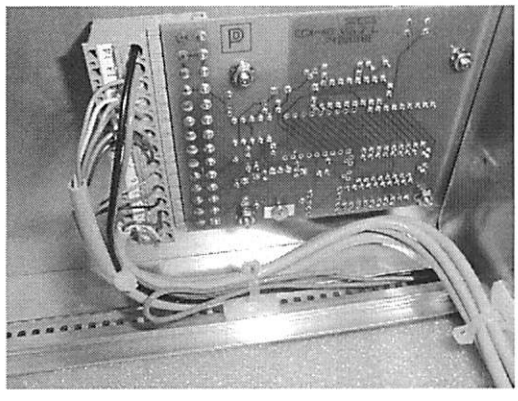
4.1.3 Clean the external particle filter

Switch off the water line. Turn the housing to open the filter, pull the grid and clean it with tap water. Note the flow direction if you disconnect.

Figure 14 **Particle filter**

Because this filter is very easy to open you should clean it within as often as the cathode and anode, i.e. **every 100 working hours**.

4.2 Flow Meter Adjustment



Adjust the rotary flow meter by pressing the button above flow display to set a flow rate of > 3.0 l/min.

behind front

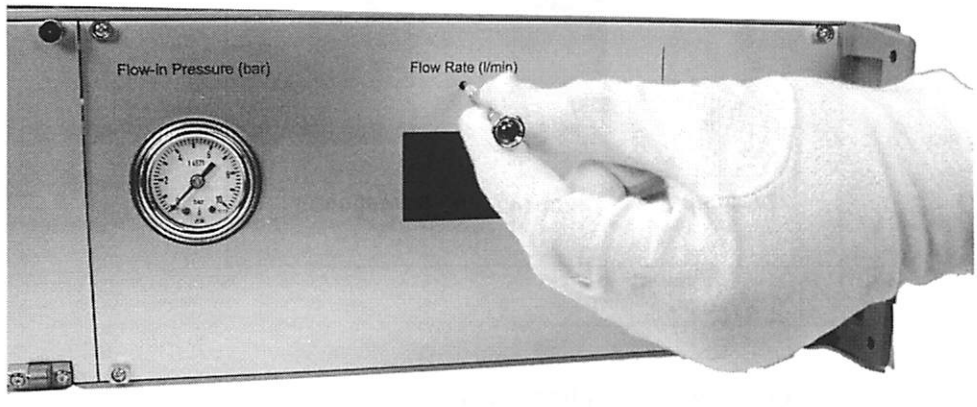


Figure 15 **Electronic board for adjusting the rotary flow meter**

Set point instructions:

- Before switching 'Water' on at XRC1000 press the push-button at circuit board (see figure 15, page 27)! Keep the button pressed while the unit powers up (indicated by display activity).
- The display blinks and shows the currently pre-stored set rate.
- Increase or decrease the set rate using the push-button (long push).
  You can toggle between up and down direction when you release the push-button and push it again.

- Save the set flow rate with three button presses.
- Check that the circuit is working by disconnecting the water connections at all or by a test while changing the flow rate.

Be careful during the final test! If the limits do not react correctly the source, the vacuum in your equipment can be affected, e.g. anode evaporation because of bad cooling with the consequence that water can penetrate into the vacuum chamber.

4.3 Spare parts

Figure 16 **'Quick Fit' water coupling types**

- HV electrode (anode, shipment includes one spare set)
- cathode socket head cap screw (on request)

Please contact SPECS (support@specs.de) for prices and delivery time!

4.4 Troubleshooting: Water interlock not working

Note that the XRC1000 device waits a few seconds for interlock reaction before the water will be switched off by the internal valve. After water flow has stopped, the "Water" button LED will blink. You have to confirm this situation by pressing this button. Pressing the button opens the valve once more.

1. Check first the following interlocks, sensors and conditions:
   - protection cover interlock (Connected? Cable and switch ok? HV plug connected correctly to XRC1000?)
   - vacuum interlock for XRC 1000 X-ray supply
     (Interlock plug: pin 1- pin 2 shorted?)
   - flow rate (Higher than the set rate?, see section 4.2 , 'Flow Meter Adjustment" on page 27)
   - water pressure (See the front side panel pressure meter and check your chiller or tap line!)
   - service panel interlock (Panel is closed? Is the interlock behind the panel closed, when the panel is locked?)
   - water inside the tank, i.e. the leak water sensor detects water inside the tank, display will show "LL" (Open the service panel and check for water drops and humidity!)
   - opposite flow direction will be indicated by flow rate < 0.5 l/min, reconnect pipes correctly!
2. After bake out or prior to first operation air bubbles will go through the tubes. The interlock will switch off. Try several times to start the water flow to remove the air.
3. Check the water tubes to and from CCX 60. No bends or loose connections?
4. Check the water connectors to the anode and source body (head cooling). The connectors should snap to the fittings, otherwise they are closed.
5. Check the rotary flow meter (section 4, 'Maintenance" on page 23).
6. Check the signals of the flow meter going to the circuit board (figure 9, "Connections to the CCX 60 circuit board", page 16).
7. Check the output of the circuit board (interlock cable).
8. For diagnostic purposes, try to shorten the part of the water line where you expect the malfunction.

4.5 Repair at SPECS

SPECS offers a complete cleaning, overhaul and testing of your CCX 60 on request. This service includes the installation of new PTFE hoses, HV/ground cables, if necessary!

Important Safety Information:

- **Note that products returned to SPECS for repair or maintenance must be free of hazardous substances (e.g. radioactive, toxic, caustic or microbiological), or otherwise, the hazard has to be declared (section 4.6 , 'Health and Safety Declaration" on page 30).**

4.6 Health and Safety Declaration

Health and Safety Declaration for used Vacuum Equipment and Components

The repair and / or service of vacuum equipment / components can only be carried out if a correctly completed declaration has been submitted.

1. Description of components

Type: _____

Serial No: _____

2. Reason for return _____

3. Equipment condition

Has the equipment ever come into contact with the following (e.g. gases, liquids, evaporation products, sputtering products ...)

		Yes	No
•	toxic substances ?	☐	☐
•	corrosive substances ?	☐	☐
•	microbiological substances (incl. sample material) ?	☐	☐
•	radioactive substances (incl. sample material) ?	☐	☐
•	ionising particles/radiation (α, β, γ, neutrons....) ?	☐	☐

	Yes	No
Is the equipment free from potentially harmful and hazardous substances ?	☐	☐

4. Decontamination Procedure

Please list **all harmful substances, gases and by-products** which have come into contact with the vacuum equipment / components during the decontamination methode used.

SUBSTANCE	DECONTAMINATION METHODE

5. Legally Binding Declaration

Organization: _____

Address: _____

_____

Phone / Fax: _____

Name / Position: _____

I hereby declare that the information supplied on this form is complete and accurate.

Date: _____ Signature: _____ Company stamp:

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LF

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