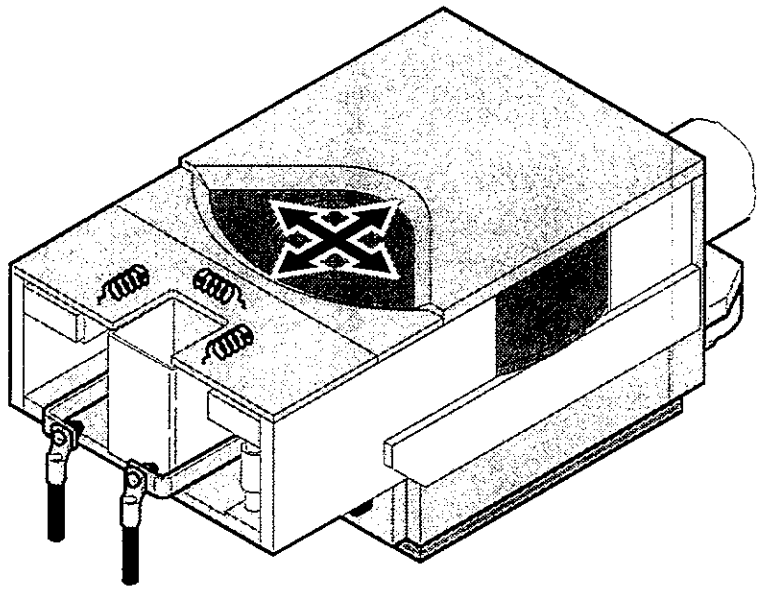
Operating Instructions

BPS

ESQ 212

Electron Beam Evaporation Source



300004546/TS1/001/01
Edition: 01/2000

1 Use and Technical Data

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1.1 Intended Use and Purpose

The ESQ 212 electron beam evaporation source is part of the EBS 300 (EBS 200) electron beam evaporation system. It is used to evaporate materials under vacuum conditions.

The ESQ 212 must be controlled by an EEC 300 (EEC 420) control unit or an appropriate follow-up module from Balzers Process Systems.

The ESQ 212 may only be used (i.e. operated) in conjunction with the following components:

	EBS 300 (current)	EBS 200 (old)
Electron beam evaporation source	ESQ 212	ESQ 212
High voltage supply unit	EHV 215	EHV 215
Filament current supply unit	EFS 200	EFS 200
Coil current supply unit	ECS 200	ECS 200
Control unit	EEC 300	EEC 420

Any use other than that stipulated above is considered inadmissible. Balzers Process Systems will assume absolutely no liability for any damage which occurs when the unit is used for purposes other than those stipulated.

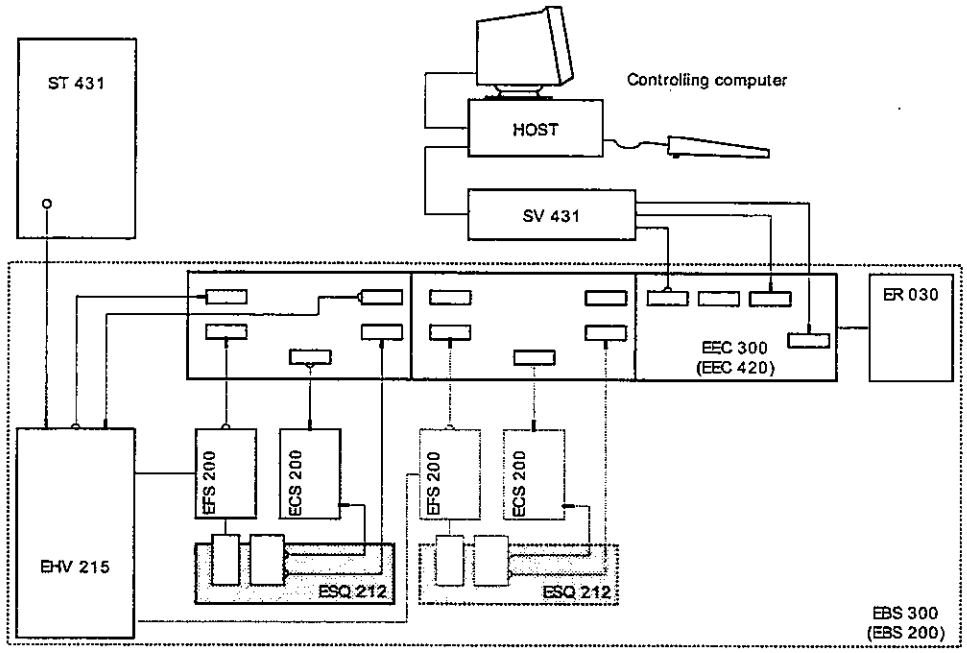

Fig. 1-1 *Control system for the ESQ 212 electron beam evaporation source*

1.2 Responsibilities

It is the end user's responsibility to make sure that every person involved in installation, operation, maintenance or service as well as disposal of the ESQ 212 electron beam evaporation source has been trained adequately for the work which he/she is to perform.

The end user and the operator must adhere strictly to the safety regulations and the safety-related notes which appear in the individual chapters of this manual. The end user of the ESQ 212 electron beam evaporation source is responsible for personnel training and safety and for the prevention of damage to equipment and material.

1.3 Dangers

The EBS 300 (EBS 200) electron beam evaporation system which is used to control and monitor the ESQ 212 electron beam evaporation source is equipped with safety devices and has been subjected to a safety check and an acceptance test.

Failure to pay attention to the safety regulations and the safety-related notes in these operating instructions will endanger:

- life and limb of the operator,
- the EBS 300 (EBS 200) electron beam evaporation system and other material and equipment incorporated in the coating system,
- the efficiency of work performed with the coating system.

Every person involved in installation, commissioning, operating and maintenance of the ESQ 212 electron beam evaporation source must read these operating instructions carefully and adhere to the safety-related notes and regulations.

Your safety is at risk !

1.4 Product Identification

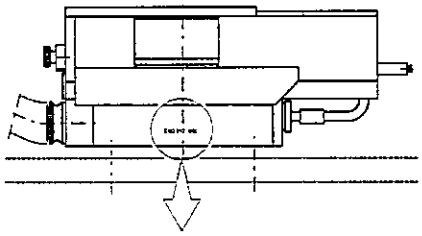

Fig. 1-2 Product identification

1.5 Performance Features

1.5.1 Operational Data

• Max. working pressure (dependent on implemented material and process)	1×10^{-3} mbar
• Max. bakeout temperature	60 °C

1.5.2 Electrical Data

• Max. evaporation power (dependent on implemented crucible)	12 kW
• Acceleration voltage	6 ... 12 kV
• Max. coil currents	±2,5 A
• Beam deflection X-direction (lateral) Y-direction (longitudinal)	 approx. 4 cm crucible radius

1.5.3 Cooling Water

• Cooling water requirements	see BB 800 851 BN
• Cooling water flow rate (dependent on implemented crucible)	approx. 14 l/min.
• Max. temperature at inlet (exception: for evaporating metals with 8 kW)	<25 °C <15 °C
• Max. cooling water pressure at unpressurized outlet	4 bar
• Nominal pressure	4 bar
• Max. water temperature for conditioning (venting)	60 °C

1.5.4 Mechanical Data

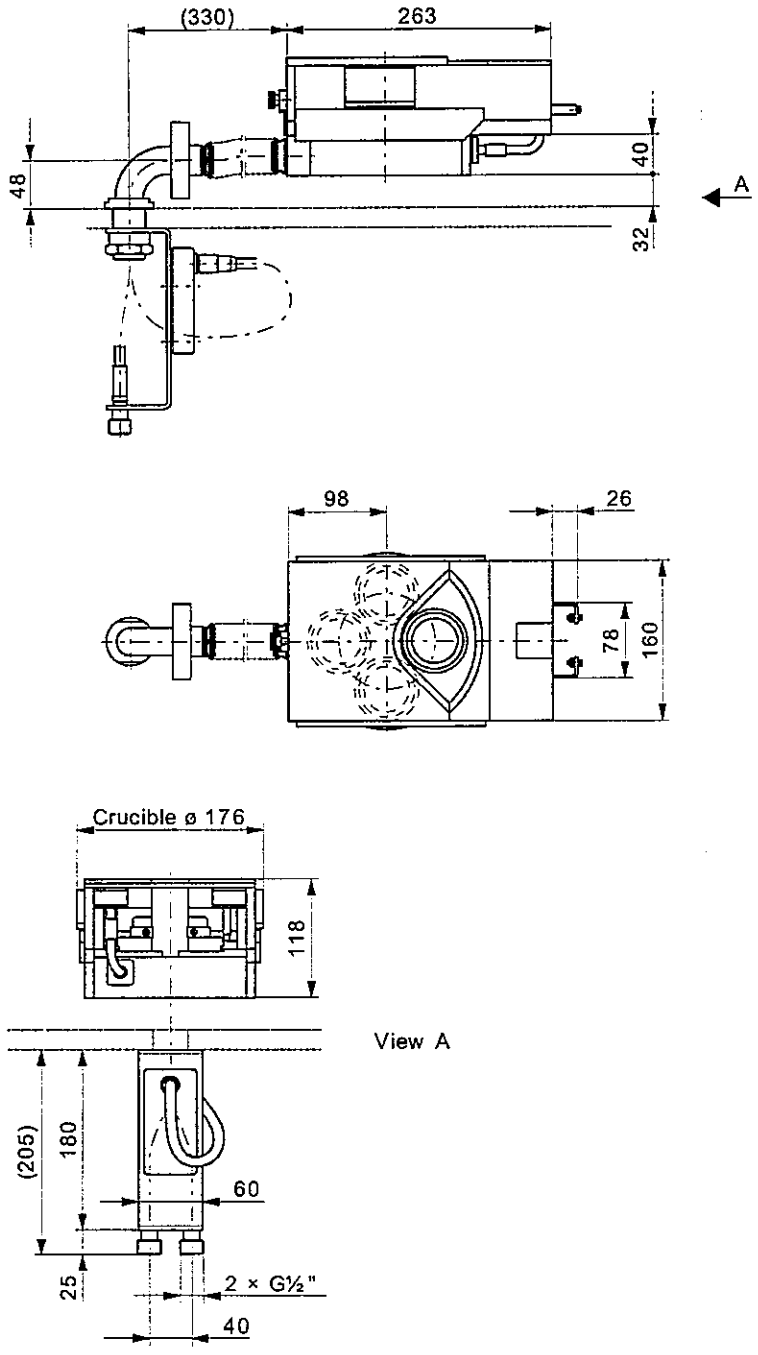

Fig. 1-3 Scale drawing (dimensions in mm)

1.5.5 Weight

• Weight	approx. 24 kg

1.6 List of Diagrams

Diagram	Diagram no.
• Plug-in p.c. board cpl.	BG 445 098 -S

2 Safety

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Chapter/Title Page

2 Safety

2.1 Compulsory Reading Material

Chapter 2 (Safety) must be read by all persons involved in commissioning and operation and by all persons who are to perform maintenance and service work on ESQ 212 electron beam evaporation sources.

End user's responsibilities

The end user (customer) is responsible for making sure that

- every person involved in commissioning, operation, maintenance or service of the ESQ 212 electron beam evaporation source has thoroughly read and clearly understood the parts of these operating instructions which are relevant for him/her, especially Chapter 2 (Safety).
- every person who works with the ESQ 212 electron beam evaporation source is technically qualified, accordingly trained and instructed and that every user has been informed about all the dangers and risks involved.

In addition, the end user and all users must observe and adhere strictly to both the safety regulations outlined in the Chapter 2 and the safety-related notes and warnings which appear in the individual chapters.

2.2 Safety Labels

The following safety labels appear in the individual chapters of this manual and are intended to draw the operator's attention to the risks involved and the various different danger levels.

⚠ DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in serious injury or death.

⚠ WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or extensive property damage.

⚠ CAUTION

Indicates a hazardous situation which, if not avoided, could result in moderate injury, property damage or product malfunctioning.

NOTE !
Identifies technical requirements that demand particular attention.

2.3 Warning and Information Labels on the Unit

The following warning and information labels are used on (in) the ESQ 212 electron beam evaporation source:

Warns of magnetic fields (for wearers of pacemakers)

Warns of dangerous levels of electrical voltage

Wear clean, lint-free gloves and use clean tools.

Protective ground (yellow / green)

Fig. 2-1 Warning and information labels

2.4 Safety Regulations

The ESQ 212 electron beam evaporation source, as an individual component, does not fulfill the VDE safety standards. Thus, additional safety measures must be taken to guarantee safety according to the VDE regulations.

- The ESQ 212 may only be operated in conjunction with vacuum systems which have a forced disconnect device on the process chamber door that disconnects the high voltage supply from the mains power when the door is opened.
- All the parts that operate on high voltage must always be touched with the grounding rod after each time the process chamber door is opened.
- If more than one electron beam evaporation source is installed in the same process chamber, all the sources must be touched with the grounding rod as described in the previous point.
- All supply and control units such as EEC 300, EHV 215, EFS 200 etc. must be turned off before any manipulations that are not part of the normal process sequence are made on the system.
- Service and repair work on the electron beam evaporation source may only be carried out by persons who have been authorized to do so by Balzers Process Systems.

2.5 Dangers

2.5.1 Danger Arising from High Voltage

⚠ DANGER

Warns of parts carrying high voltage. Touching parts carrying high voltage causes electric shock and can therefore be fatally dangerous.

The unit must be free of all voltage (idle) before maintenance and service work is carried out.

After the process chamber has been opened, ground the electron beam evaporation source in accordance with the service instructions BN 869 020 DV/A.

Voltage levels of up to 12 kV are required to operate the ESQ 212 electron beam evaporation source. For this reason, only specialists or personnel who have received specific training for the purpose are permitted to perform installation, operation and service work.

2.5.2 Dangers During Production

The ESQ 212 electron beam evaporation source does not endanger operating personnel during the actual coating process. All parts which carry dangerous levels of high voltage are screened off by the closed process chamber door.

When the process chamber is being loaded and unloaded, it is not sufficient to rely on the fact that the relevant appliances (electron beam evaporation source, glow discharge electrodes ...) have been separated from the mains.

⚠ DANGER

Residual electrical charges are a threat for the operating personnel. For this reason, prior to loading and unloading the process chamber, make sure to use the grounding rod to touch all appliances which carry dangerous levels of high voltage.

Refer to Safety Instructions BN 869 020 DV/A for relevant information.

2.5.3 Dangers During Maintenance and Service Work

Vent the process chamber and ground the electron beam evaporation source in accordance with Safety Instructions BN 869 020 DV/A prior to any maintenance or service work.

Do not remove any part of the casing or any of the protective covers until you are absolutely sure that both the ESQ 212 electron beam evaporation source and its relevant supply devices are free of all voltage. This is an additional precautionary measure which is required as supplement to all the other safety measures.

In addition, make sure to lock (with a padlock) the power switch on the EHV 215 unit. This is to ensure that no-one else can turn on the ESQ 212 electron beam evaporation source when maintenance work is in progress.

2.5.4 Danger Arising from Hot Surfaces

⚠ CAUTION

Burns will occur if the electron beam evaporation source is touched during operation.

Always wear protective gloves and appropriate working clothes with long sleeves when loading and unloading the process chamber.

2.6 Safety Concept

Balzers Process Systems only assumes responsibility and warranty when the ESQ212 electron beam evaporation source is installed by a Balzers service technician.

Balzers Process Systems must always be consulted before the ESQ 212 electron beam evaporation source is installed in an existing coating system at a later date. Such actions always require prior consent from Balzers Process Systems.

The ESQ 212 electron beam evaporation source is part of the EBS 300 (EBS 200) electron beam evaporation system. The EBS 300 (EBS 200) fulfills all the required specifications concerning safety devices for personnel protection. The system also contains all the necessary interlocks.

The norms which are applicable for the ESQ 212 electron beam evaporation source are listed below:

- EG RL 89/392/EWG i.d.F.93/44/EWG
- EN 292-1 Safety – Basic terminology, methodology
- EN 292-2 Safety – Technical principles and specifications
- EN 60204-1 Electrical equipment of machines

2.6.1 Basic Circuit Diagram of Safety Circuit

Lay the supply lines for the crucible motor via connector X5 (see Fig. 4-11) to ensure that the crucible drive operates safety.

Refer to your system-specific set of diagrams for more detailed information.

2.7 Safety Regulations for Maintenance and Service Work

The following 7 points are an abridged version of standards VDE 0104 and VDE 0105.

1. Use a rope or chain to mark off the working area making a barrier at least 1 meter away from live parts.

NOTE !
A gap of 1 meter protects against 30,000 V.

2. Mount warning devices (signs, blinking lamps (if required)) near the mains switch at a conspicuous location where they can be seen by everyone, e.g. **Danger High Voltage** or **Do not switch on; work in progress**.
3. It is essential that a second person be present to perform this work. One person must be in the vicinity of the EMERGENCY-OFF device. He/she must observe the person performing work and be ready to activate the EMERGENCY-OFF device if necessary.
4. Switch off the load break switches for the high voltage unit and make sure that no-one can switch them on again. For example, use a key to lock the main switch on the mains power unit.
5. Always use the grounding rod to discharge (ground) all live parts prior to work on high voltage equipment.
6. If measuring devices are used, make sure to switch off the high voltage in advance and perform grounding. Select the measuring range on the measuring device and then connect the measuring device. Leave the danger zone during the measuring procedure and do not touch the measuring device (e.g. if the measuring range is incorrect).
7. Remove all dismantled parts and all tools which are not required from the danger zone.

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3 Functional Description

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3.1 Generating the Electron Beam

The EFS 200 filament current supply unit generates a heating current of 0 ... 60 A (6 VDC) to supply the filament.

The filament is laid on a negative high voltage (U_{HV}) to achieve electron acceleration towards the anode (the anode is on ground). This high negative voltage is supplied by the EHV 215 high voltage supply unit.

Magnetic fields (generated by permanent magnets and coils) focus the electron beam and deflect it by 270° so that it impinges the crucible. The deflector coils are driven by the ECS 200 coil current supply unit.

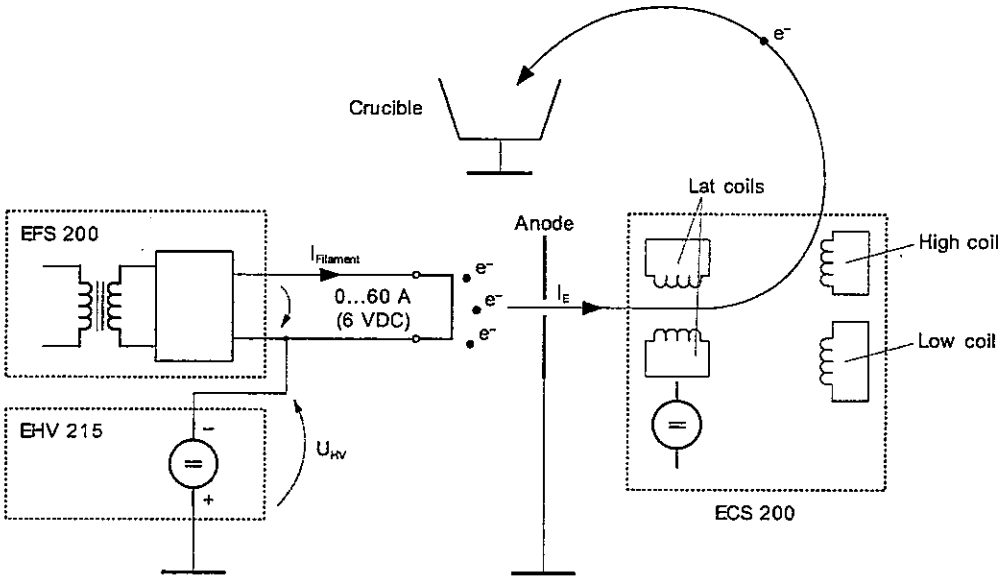


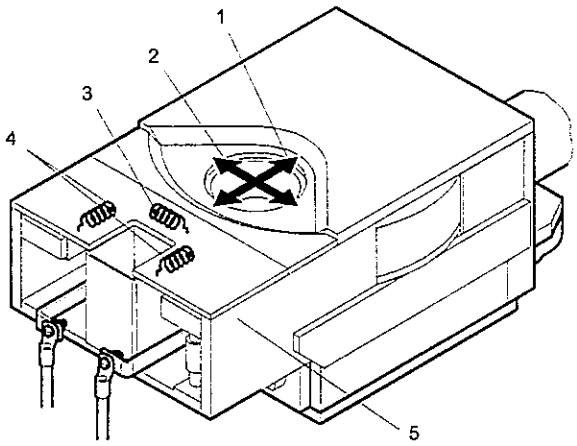
Fig. 3-1 *Block circuit diagram: generating and deflecting the electron beam*

3.2 Electron Beam Deflection

To produce high quality films, it is imperative to use electron beam sources which can be adjusted to suit the specific evaporation characteristics of the materials being used. This is accomplished in the EBS 300 (EBS 200) due to very precise, digital control of beam positioning when using both fixed and rotating crucibles; an individual sweep track can be allocated to each material.

To be able to move the electron beam in the crucible of the electron beam source, deflect it by using the following coils.

- Lat coil (Deflection in X-direction; lateral) and
- Low coil, High coil (Deflection in Y-direction; longitudinal)



1 Deflection in Y-direction
2 Deflection in X-direction
3 High coil
4 Lat coils
5 Low coil

Fig. 3-2 Deflecting the electron beam in the X-direction and in the Y-direction

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4 Installation

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NOTE !

The ESQ 212 electron beam evaporation source may only be installed by service technicians who have received specific training by Balzers Process Systems for this purpose.

⚠ DANGER

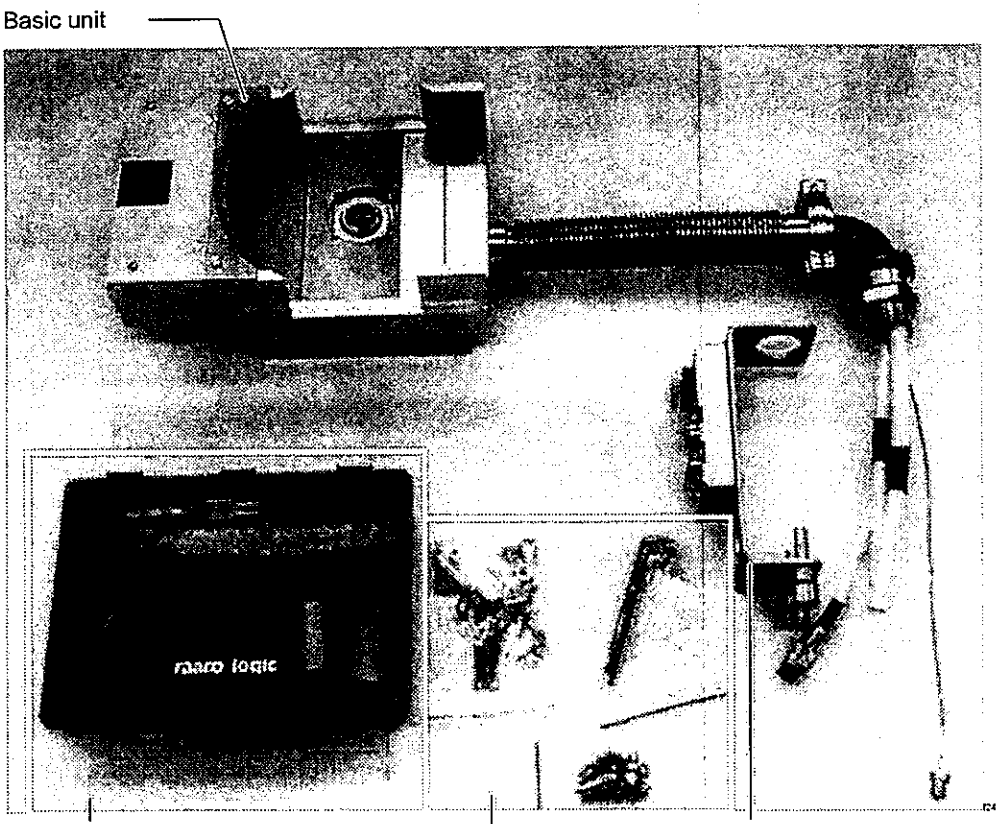
The ESQ 212 basic unit is equipped with strong permanent magnets. Persons with cardiac pacemakers should not perform any kind of installation work.

NOTE !

Wear clean, lint-free gloves and use clean tools.

4.1 Preparing the Electron Beam Evaporation Source

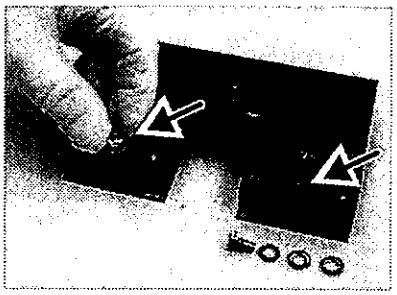
Contents of delivery - ESQ 212 basic unit



The set of tools with ordering number BN 845 758 -T is available as an accessory.

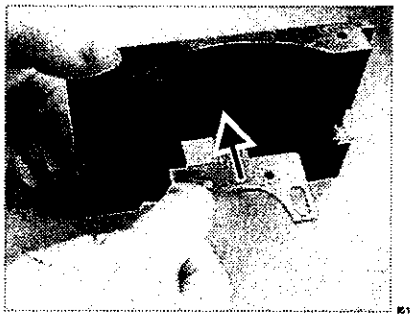
4.1.1 Mounting the Crucible

Step 1

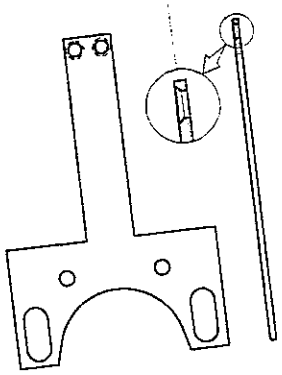


- Screw two hexagon head screws (M6×10), each with a retaining washer, and two plain washers (from the set of screws) into the back plate.

Step 2

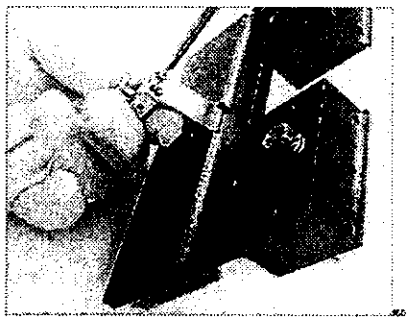


Countersinking for crucible fixation screws



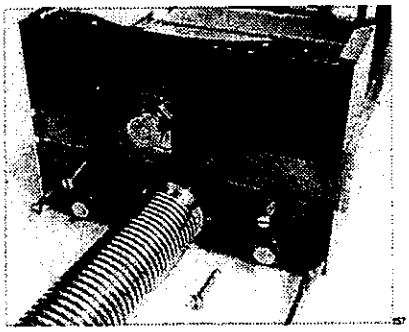
- Insert the crucible holder (from the crucible holder set) from the rear side.The countersinking for the crucible fixation screws is underneath.

Step 3



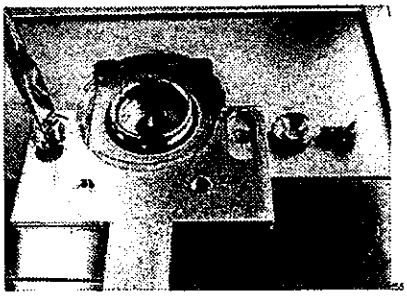
- Use two countersunk-head screws (M3×6) (from the crucible holder set) to screw on the crucible fixation.

Step 4



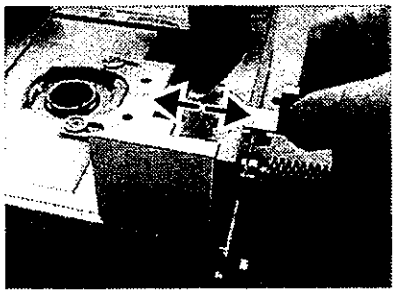
- Use six fillister-head screws (M4×25) (from the set of screws) to screw the back plate loosely onto the basic unit.

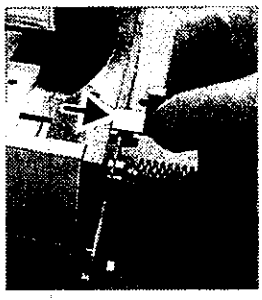
Step 5



- Use the special washers and countersunk-head screws M4×10 (from the crucible holder set) to mount the crucible holder on the basic unit. Tighten loosely.

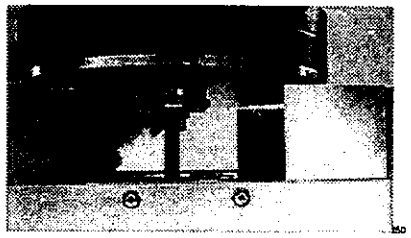
Step 6

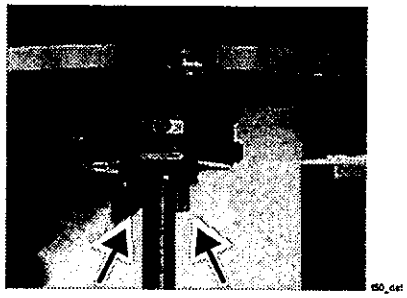




- Check the linear movability of the crucible holder; if OK, pull the crucible holder out as far it will go, otherwise loosen the countersunk-head screws slightly.

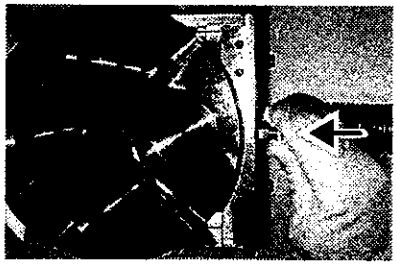
Step 7

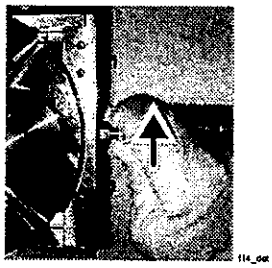




- Mount the crucible; when performing alignment, make sure that each of the both catches grips properly into the basic unit.

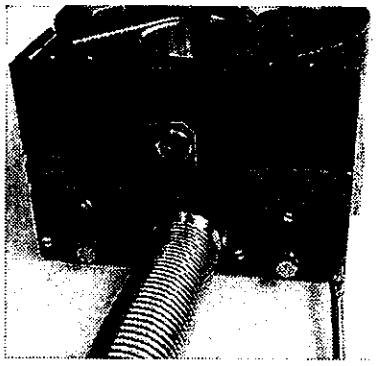
Step 8





- Push in the crucible holder completely and fasten it by turning in the knurled screw on the crucible fixation.

Step 9



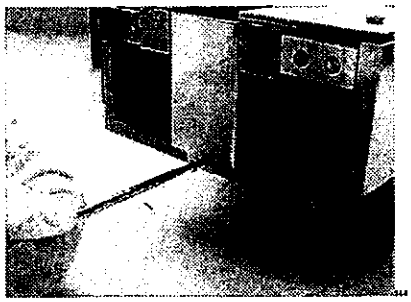
- Secure the back plate by tightening the six fillister-head screws M4×25.

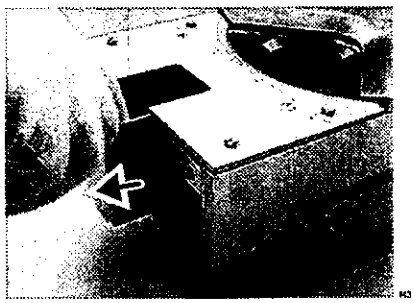
Step 10

- Mount the crucible cover and fasten it with six hexagon socket head screws M5×12 (enclosed with the crucible cover).

4.1.2 Mounting the High Voltage Feeders

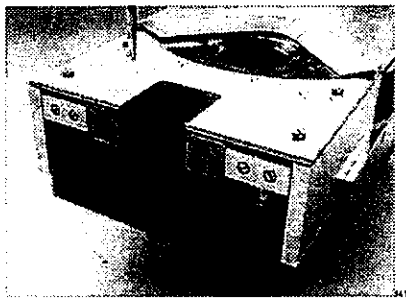
Step 51





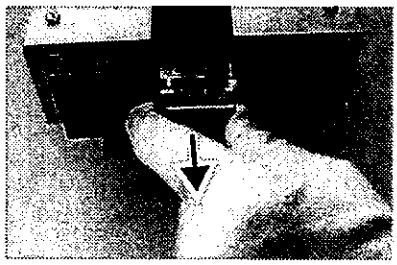
- Unscrew and remove the beam shielding.

Step 52



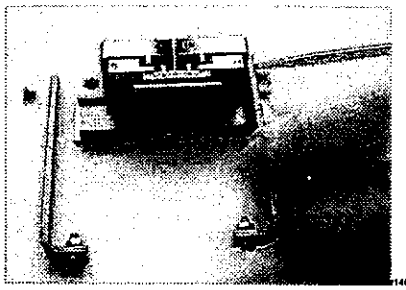
- Detach the electron beam system by turning both the eccentric screws by 1 full rotation.

Step 53



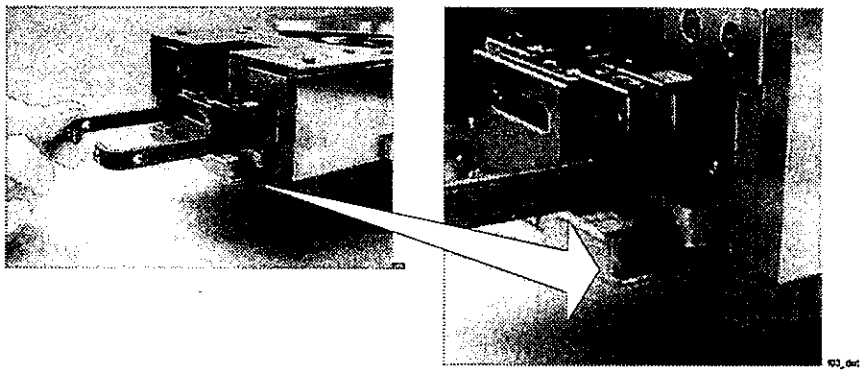
- Pull out the electron beam system.

Step 54



- Fasten the high voltage feeders to the electron beam system with the premounted countersunk-head screws.

Step 55

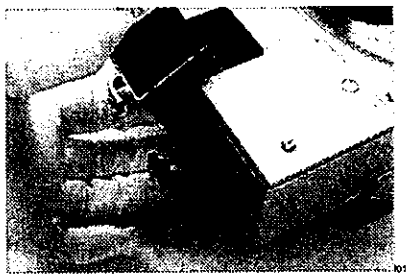


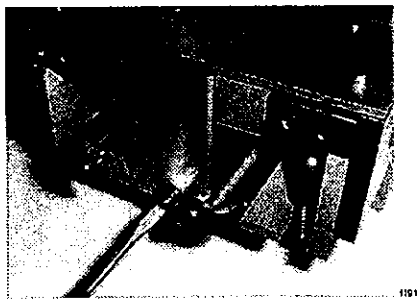
- Insert the electron beam system again and push it in as far as will go. Be careful that the guide nose on the electron beam system fits exactly into the guiding slot on the basic unit.

Step 56

- Use both the eccentric screws to remount the electron beam system.

Step 57





- Remount and screw on the beam shielding.

4.2 Installation: Electron Beam Evaporation Source in Process Chamber

Mounting the electron beam evaporation source on the support bar

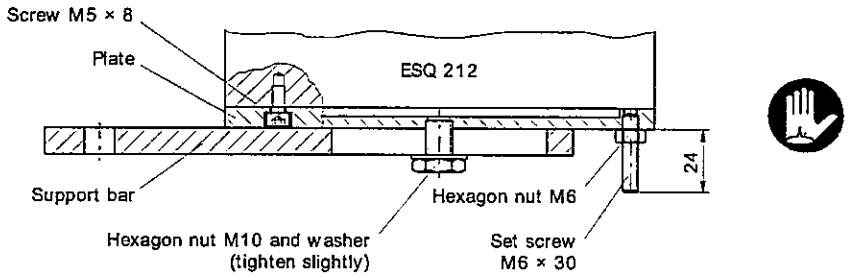


Fig. 4-1 *Electron beam evaporation source on support bar*

Installation aids:

Assembly kit, consisting of

- Plate
- Support bar
- Special blanking plugs
- Screws, set screws, nuts and washers

Procedure:

- Use the 4 screws M5×8 to mount the plate on the bottom of the ESQ 212 electron beam evaporation source.
- Place the support bar on the plate, mount the washer and hexagon nut M10 on the threaded pin (tighten the nut only slightly).
- Screw set screw M6×30 into the plate as shown in Fig. 4-1 and fix in place with hexagon nut M6. If there is adequate space, it is recommended to provide additional support for the electron beam evaporation source by mounting the second set screw.

Securing the electron beam evaporation source on the base plate of the process chamber

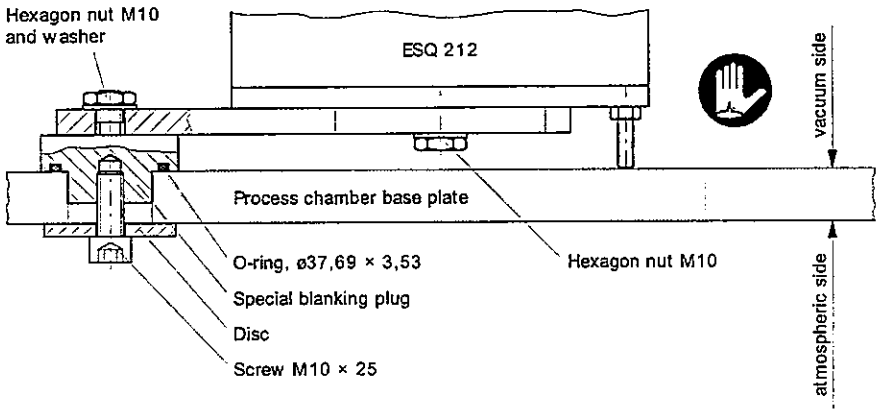


Fig. 4-2 *Electron beam evaporation source on the base plate of the process chamber*

Procedure:

- Remove one blanking plug from the process chamber base plate and replace it with the provided special blanking plug.

NOTE !
The exact mounting position of the electron beam evaporation source on the process chamber's base plate depends on the process be carried out.

- Place the electron beam evaporation source's support bar on the special blanking plug, mount the plain washer and hexagon nut M10 at the special blanking plug (tighten the nut only slightly).
- Bring the electron beam evaporation source to the required position and tighten both of the hexagon nuts M10.

4.3 Installation: EHD 110 A High Voltage Feedthrough

Mounting position for the EHD 110 A high voltage feedthrough in relation to the ESQ 212 electron beam evaporation source

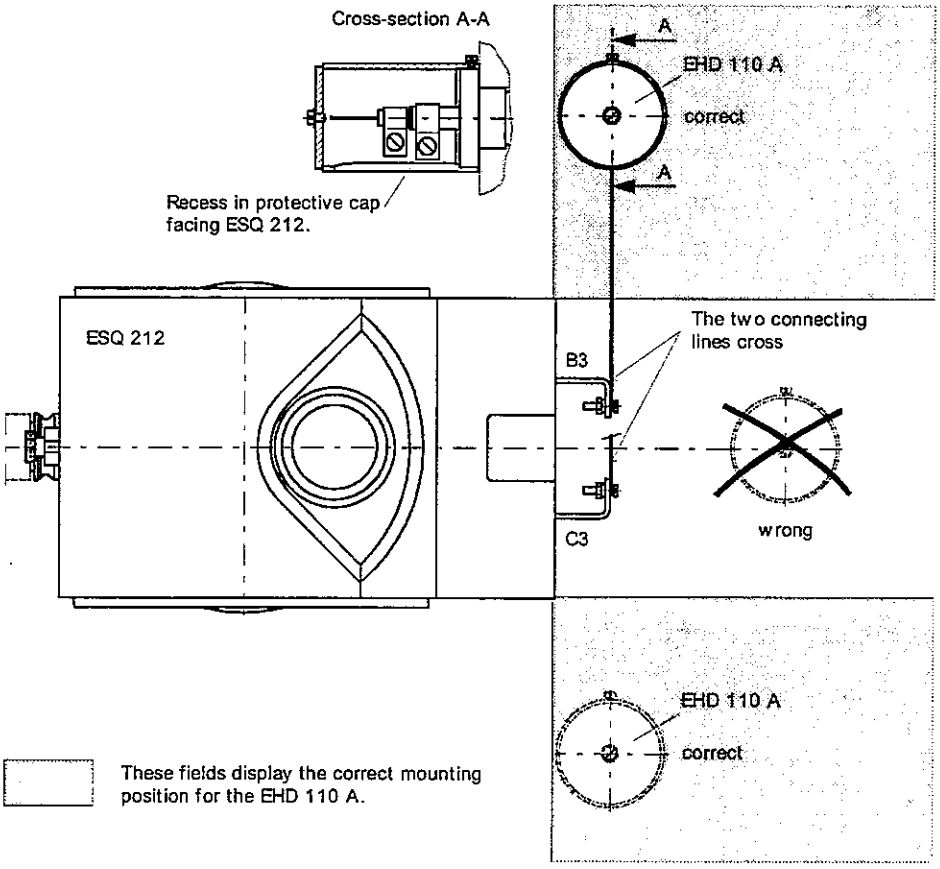


Fig. 4-3 *Mounting position for the EHD 110 A high voltage feedthrough*

Preparations:

Remove one of the blanking plugs from the process chamber's base plate either to the left or to the right of the electron beam evaporation source.

NOTE !

To prevent malfunctions which may occur due to arcing, make sure that the high voltage feedthrough is never mounted along the same longitudinal axis as the ESQ 212's electron beam system.

Mounting the EHD 110 A high voltage feedthrough in the process chamber's base plate

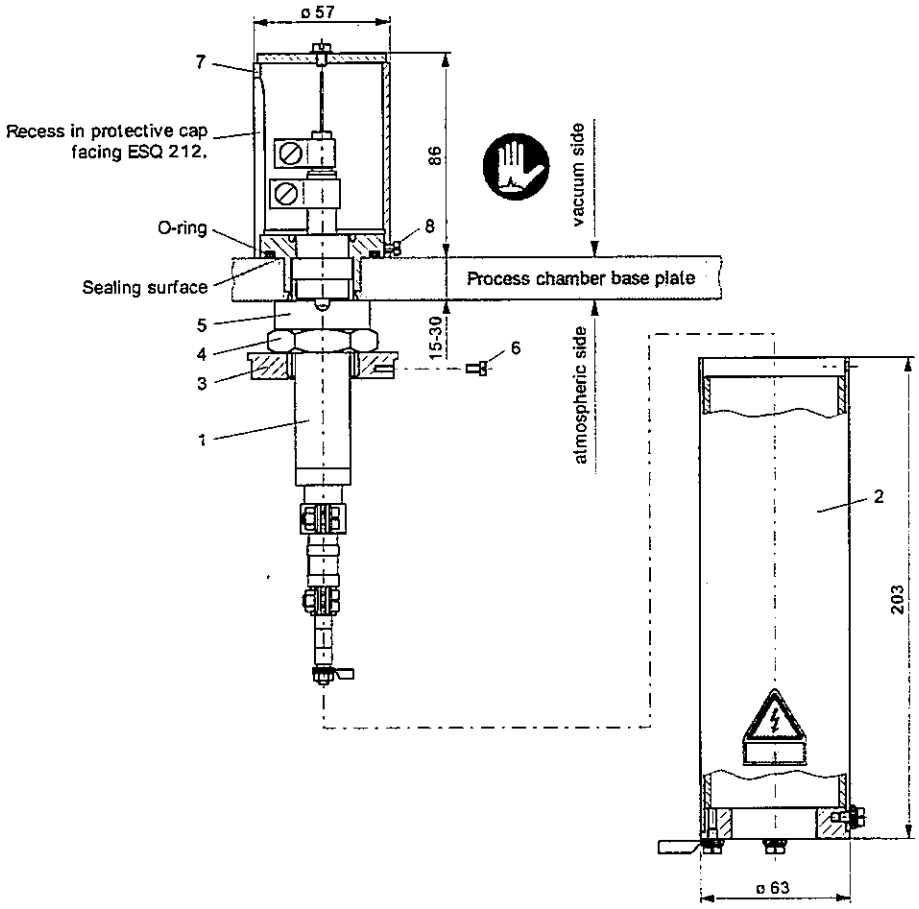


Fig. 4-4 *EHD 110 A high voltage feedthrough in the process chamber's base plate*

Procedure:

- Loosen screws (6) and remove the protective tube (2).
- Unscrew the holder for the protective tube (3) from the feedthrough corpus (1).
- Unscrew the hexagon nut (4) from the feedthrough corpus (1) and remove the spacer ring (5).
- Carefully clean the O-ring and the sealing surface.
- Insert the feedthrough corpus (1) from the vacuum side and in the opening on the process chamber's base plate. The recess in the protective cap (7) must face towards the ESQ 212's electron beam system
- Use the spacer ring (5) and hexagon nut (4) to secure the feedthrough corpus (1).
- Screw the holder for the protective tube (3) onto the feedthrough corpus (1).

Making the electrical connection to the EHD 110 A high voltage feedthrough (atmospheric side)

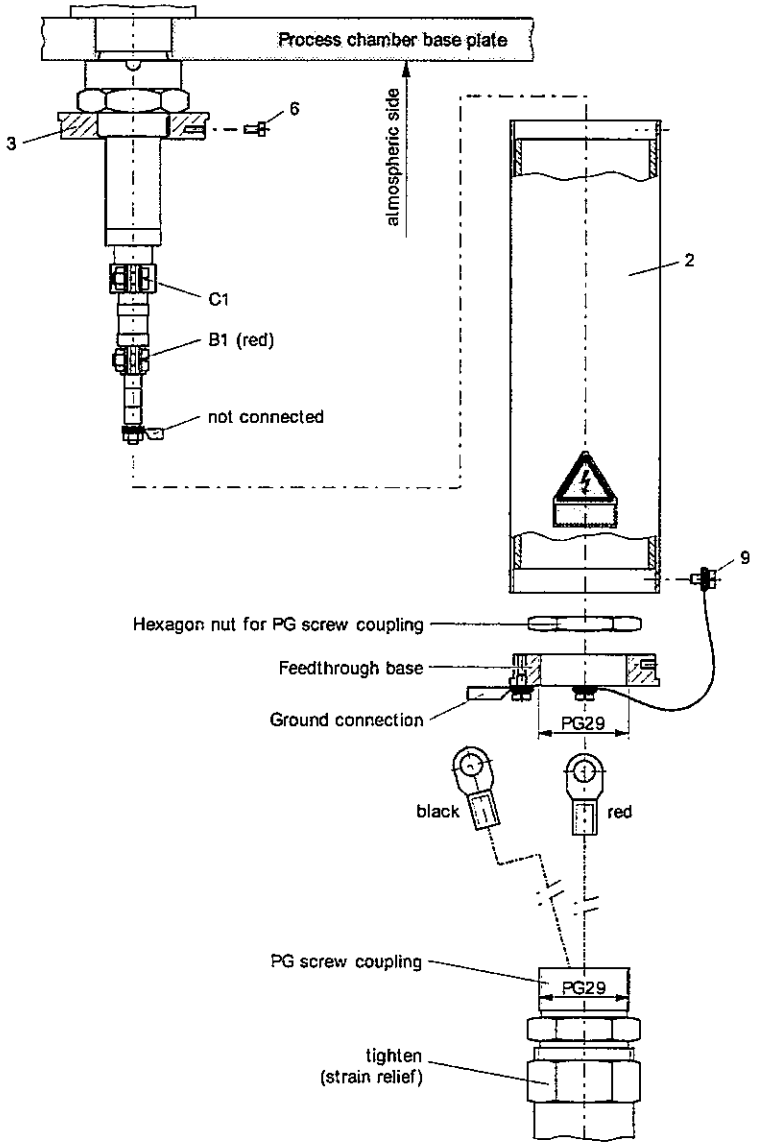


Fig. 4-5 Electrical connection for the EHD 110 A high voltage feedthrough (atmospheric side)

Procedure:

- Loosen the screws (9) and remove the feedthrough base from the protective tube (2).
- Mount the feedthrough base on the PG screw coupling.
- Connect the high current cable which is marked with the red heat-shrinkable sleeve to connection B1.
- Connect the high current cable which is marked with the black heat-shrinkable sleeve to connection C1.
- Push the feedthrough base into the protective tube (2) and fasten it with screws (9).
- Push the protective tube (2) onto the holder for the protective tube (3) and fasten it with the screws (6).
- Tighten the PG screw coupling to provide strain relief for the inserted high current cables.
- Establish the ground connection from the feedthrough base to the system ground (see Fig. 4-18).

4.4 Making Electrical Connection from EHD 110 A to ESQ 212 Electron Beam System

The way the connecting lines between the EHD 110 A high voltage feedthrough and the ESQ 212 electron beam evaporation source are laid is a decisive factor which influences the frequency of arcing.

Directions for minimizing arcs

- There must be at least >3 mm space between parts operating on high voltage and parts on ground.
- Be sure to avoid sharp edges and damaged screwdriver slots.
- Be sure to remove metal burrs.

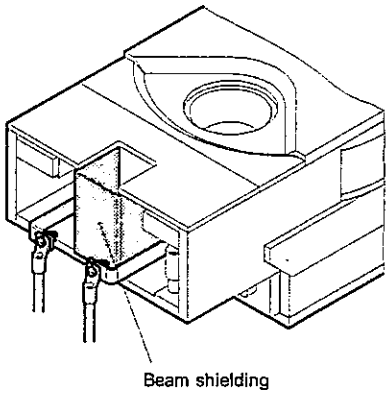


Fig. 4-6 *ESQ 212 electron beam evaporation source*

- The beam shielding must always be mounted.
- Never mount gas inlets in the vicinity of the high voltage connections.
- The high voltage connections must be screened off with covering plates so that they are not visible from any angle. Even small gaps of up to 2 mm can increase arc frequency.

Connecting the inner conductor of the EHD 110 A high voltage feedthrough with potential (vacuum side)

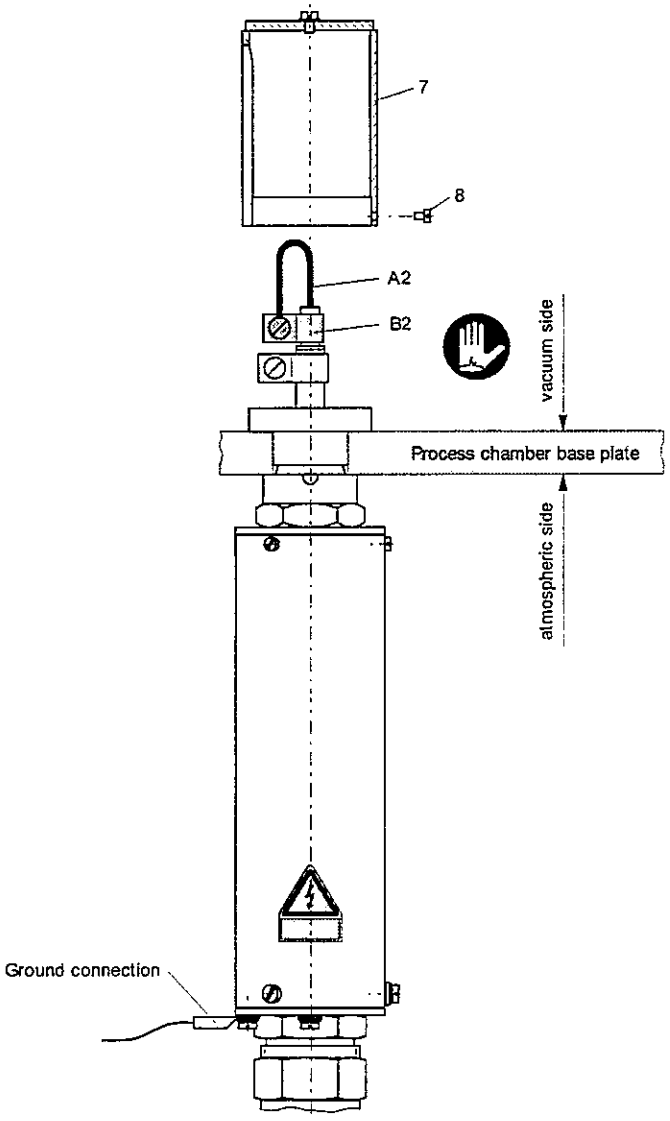


Fig. 4-7 *Potential connection of inner conductor of the EHD 110 A high voltage feedthrough*

Procedure:

- Remove the protective cap (7) by loosening the screw (8).
- Bend over the high voltage feedthrough's inner conductor (A2) and connect with B2.

Making the electrical connection from the EHD 110 A to the ESQ 212's electron beam system

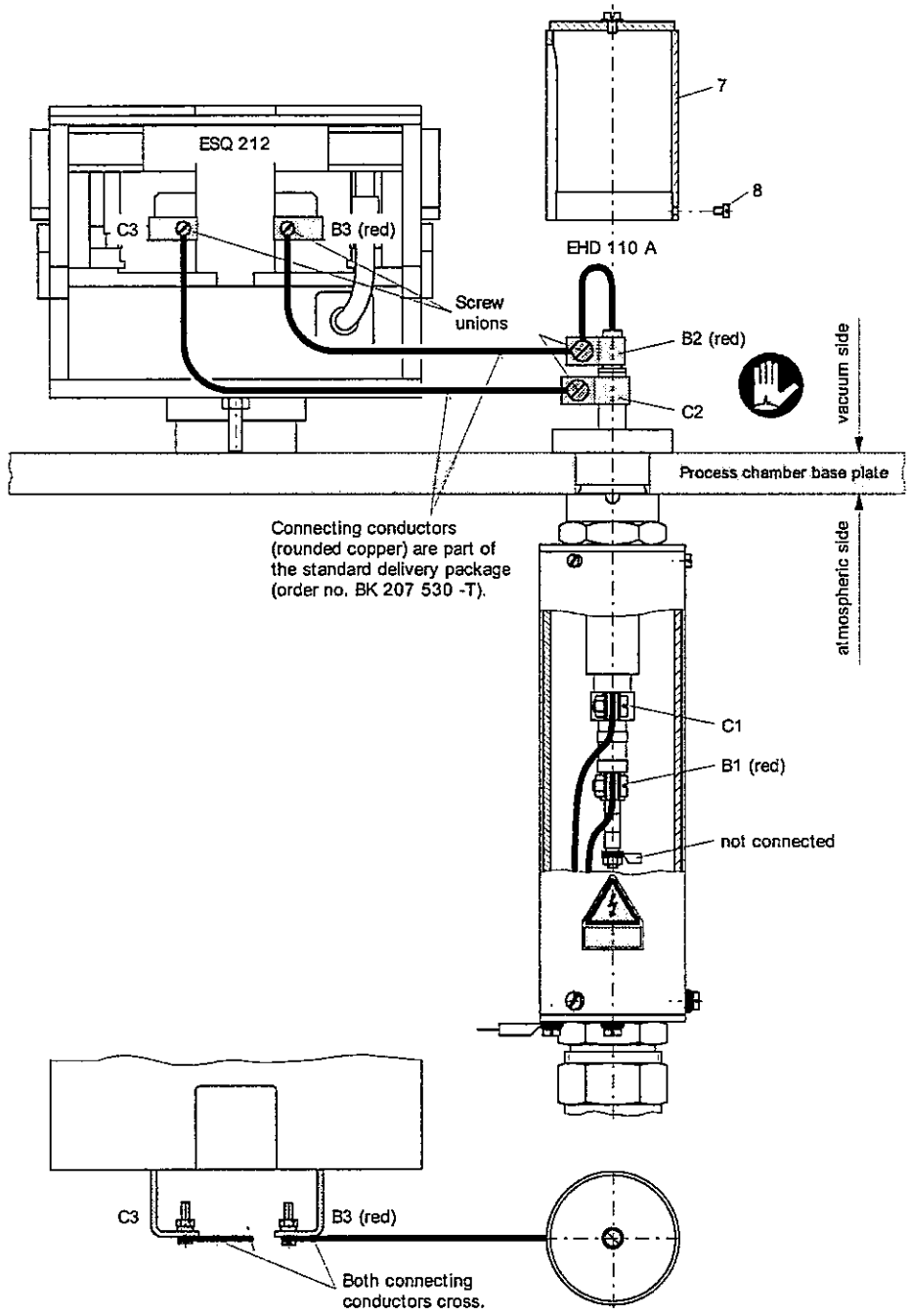


Fig. 4-8 *Electrical connection between EHD 110 A and ESQ 212 electron beam system*

Procedure:

- Bend the connecting conductors in such a way that the shortest possible link between the EHD 110 A and the ESQ 212's electron beam system can be established.

Make sure that the connecting conductors do not cross each other.

- Cut the connecting conductors to the correct length and burr them.
- Mount the supplied cable lugs over the free ends of the connecting conductors and press them on tightly or braze them.

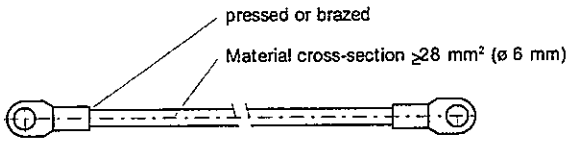


Fig. 4-9 *Connecting conductors with cable lugs*

- Connect the conductors to the EHD 110 A and to the ESQ 212's electron beam system and tighten the screw unions.

NOTE !

Make sure there is good contact at the connection points.
Be sure to include compensation for heat expansion in your calculations when connecting longer conductors.

- Mount the protective cap (7) again and tighten the screw (8).

4.5 Media Connections

4.5.1 Water and Power Connections

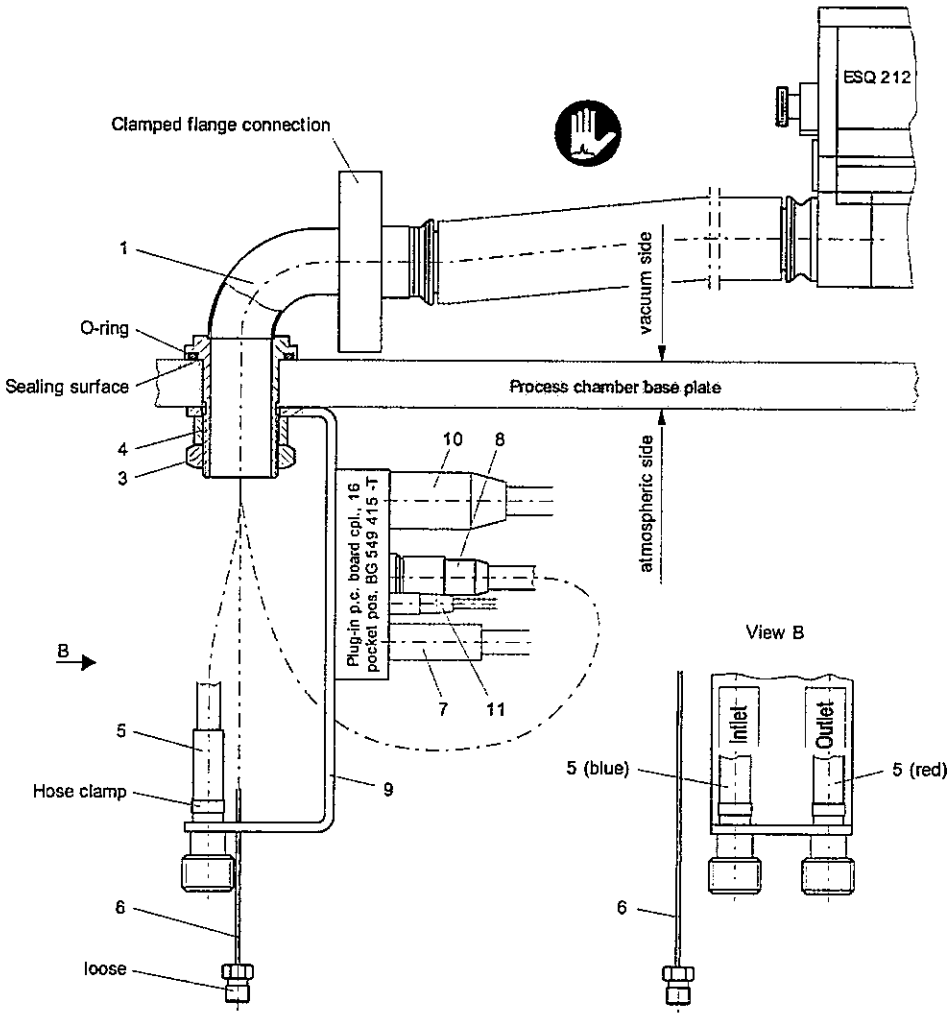


Fig. 4-10 *Water and power connections*

Procedure:

- Loosen the clamped flange connection, turn the elbow by 90° and close the clamped flange connection again.
- Loosen the hexagon nut (3) and remove the spacer ring (4).
- Remove suitable blanking plugs from the process chamber's base plate (correct location).

- Carefully clean the O-ring and the sealing surface.
- Insert the cable (8), water hoses (5) and test capillary (6) through the opening in the process chamber base plate (from the vacuum side).
- Insert the arc feedthrough (1) with O-ring through the opening in the process chamber base plate (from the vacuum side).
- Mount the bracket (9) and spacer ring (4) and secure with the nut (3).
- Plug in the cable (8) at X1.
- Push the water hoses (5) onto the hose nipples and secure with hose clamps (make sure that the connections are correct: inlet = blue, outlet = red).
- Connect the water tubes to the appropriate hose nipples (system side)

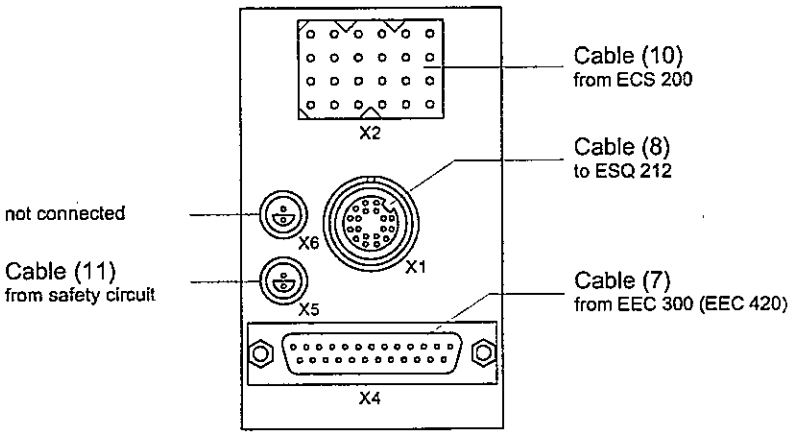


Fig. 4-11 *Electrical connection box*

- Plug in the cable (10) from the ECS 200 coil current supply unit at X2.
- Plug in the cable (11) from the safety circuit at X5.
- Plug in the cable (7) from the EEC 300 (EEC 420) control unit at X4.
- The test capillary can be used to perform a leak test to check the tightness of the ESQ 212 electron beam evaporation source mounted in the process chamber (vacuum or sniffer probe leak test).

4.5.2 HV Return Line and Protective Conductor

Mounting the HV return line feedthrough

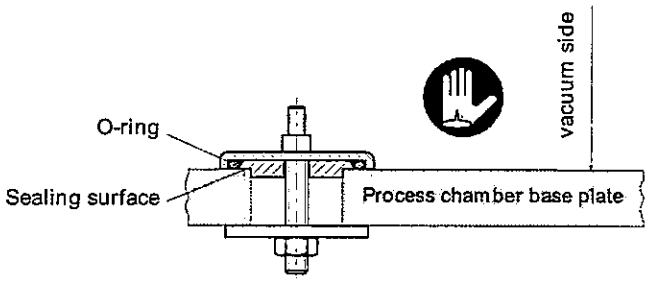


Fig. 4-12 *HV return line feedthrough*

Procedure:

- Remove a blanking plug from the process chamber's base plate close to the EHD 110 A high voltage feedthrough.
- Carefully clean the O-ring and the sealing surface.
- Insert the HV return line feedthrough through the opening (from vacuum side) and tighten.

Connecting the HV return line

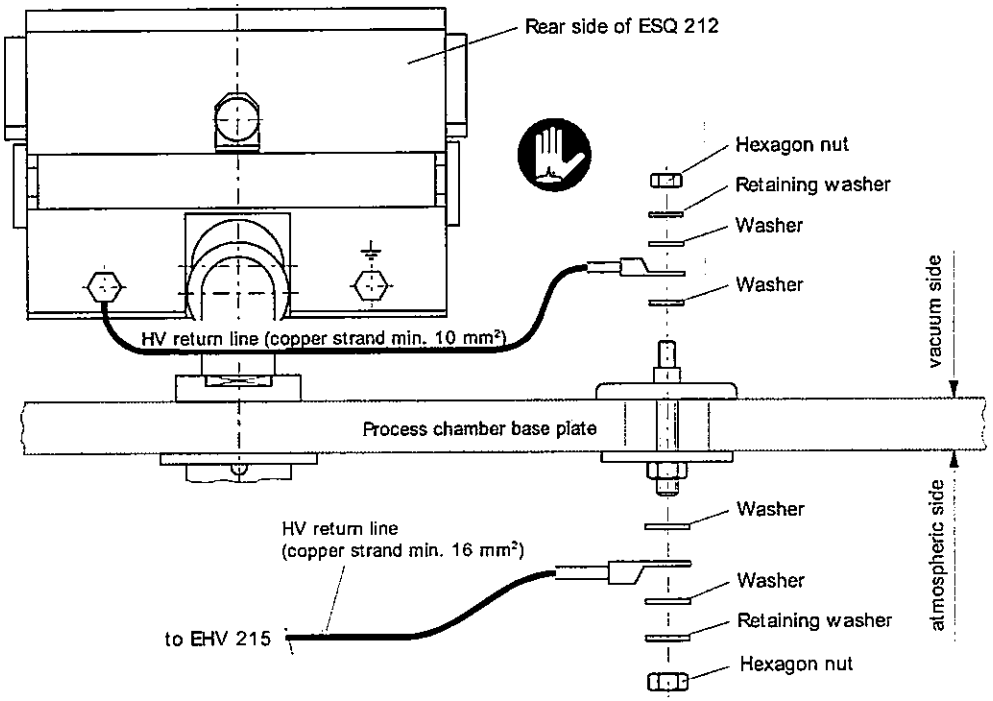


Fig. 4-13 HV return line

Procedure:

- At the vacuum side, screw the HV return line onto the rear of the ESQ 212 electron beam evaporation source and onto the HV return line feedthrough.
- At the atmospheric side, screw the return line onto the HV return line feedthrough and lead it back to the EHV 215 high voltage supply unit.

Protective conductor for standard systems

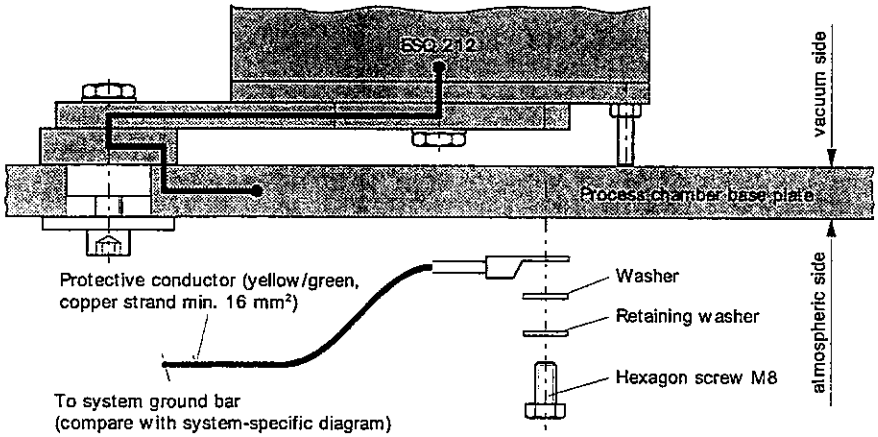


Fig. 4-14 Protective conductor for standard systems

The ESQ 212 electron beam evaporation source is grounded by its attachment to the process chamber's base plate.

- Screw the protective conductor to the atmospheric side of the process chamber's base plate and lead it to the system's ground bar.

Protective conductor connection for special systems

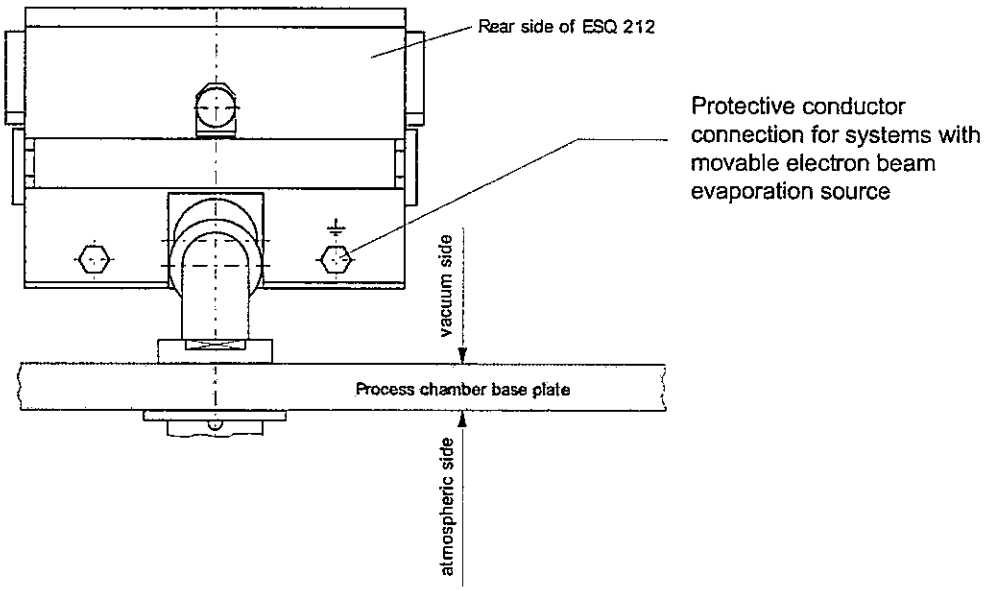
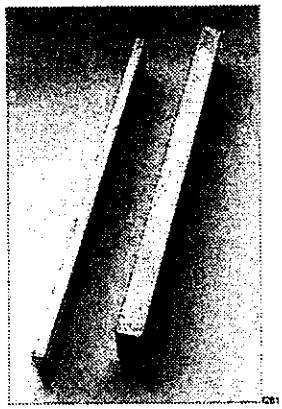


Fig. 4-15 Protective conductor connection for special systems

4.6 Mounting Magnet Shunts

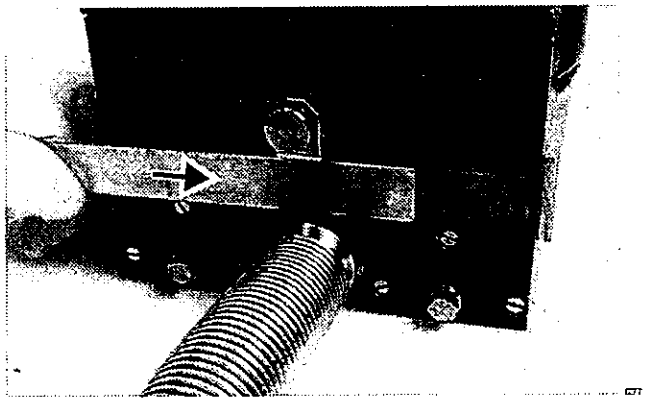
Magnet shunts are used to alter the magnet field.



The following general rule is applicable but is dependent on the particular high voltage and the beam focus (i.e. it is process-specific):

- No magnet shut is used for high voltage levels of 8 to 12 kV.
- A magnet shunt is used for high voltage levels of 6 to 8 kV.

Only experiments can determine the type of magnet shunt that should be used.



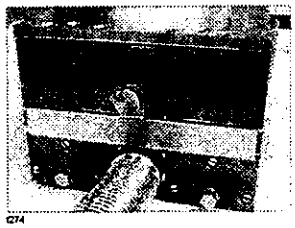


Fig. 4-16 Magnet shunt (provided in set of accessories)

4.7 Covering the Electron Beam Evaporation Source

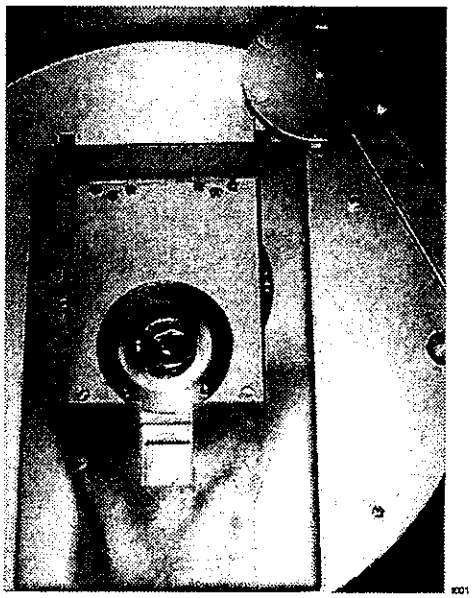


Fig. 4-17 *Example of covering plates installation*

Important directions

- The high voltage connections must be completely screened off with covering plates so that they are not visible from any angle. Even small gaps of up to 2 mm can increase arc frequency
- Mount the covering plates so that it is impossible to touch any parts on high voltage without first removing these covering plates.

4.8 System Grounding and Wiring

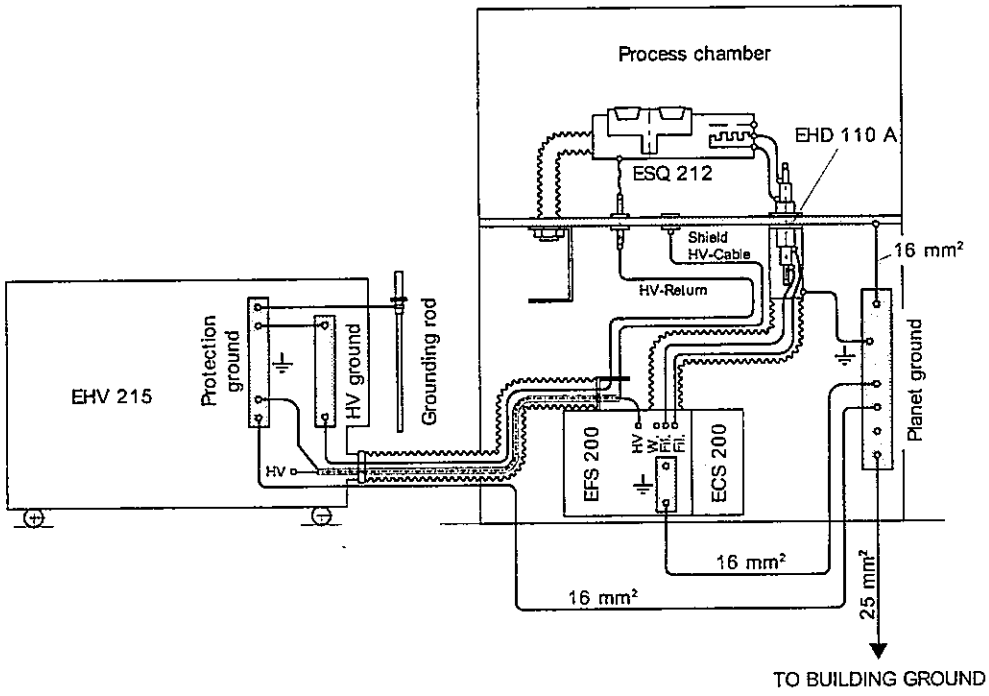


Fig. 4-18 *General grounding diagram (the valid grounding diagram for your system is included in the set of diagrams for the system)*

⚠ DANGER

The system is only safe to operate when it has been correctly installed according to the pertinent regulations. Particular care must be taken in laying the safety ground lines and the high voltage cable.

To prevent malfunctions and for safety reasons it is important that the connection of the protective conductors be checked before the system is started. The relevant grounding diagram for your system must be used for this purpose.

The general grounding diagram above does not show the layout of the wiring. The current carrying conductors in the source load circuit must be laid parallel to each other and as close together as possible.

4.9 Configuring Electron Beam Evaporation Source at EEC 300 (EEC 420)

The configuration of the electron beam evaporation source must be entered or altered at the EEC 300 (EEC 420) control unit after the source has been installed or the crucible type has been changed (see separate operating instructions).

5 Maintenance

Table of Contents Chapter 5

NOTE !

Service work on the ESQ 212 electron beam evaporation source may only be performed by service technicians who have received specific training for this purpose (trained or instructed by Balzers Process Systems).

⚠ DANGER

- **Vent the process chamber and ground the electron beam evaporation source according to the BN 869 020 DV/A Safety Instructions prior to any maintenance work.**
- **If performing maintenance work do not remove any part of the casing or any of the protective covers until you are absolutely certain that both the ESQ 212 electron beam evaporation source and its relevant supply devices are free of all voltage (idle). This is an additional precautionary measure which is required as supplement to all the other safety measures.**
- **In addition, make sure to lock (with a padlock) the power switch on the EHV 215 unit. This is to ensure that no-one else can turn on the ESQ 212 electron beam evaporation source when maintenance work is in progress.**
- **Prior to commencing work, find out about any possible contamination. Pay attention to the relevant regulations and observe the protective measures when handling contaminated parts.**

⚠ DANGER

The ESQ 212 basic unit is equipped with strong permanent magnets. Persons with cardiac pacemakers should not perform any kind of maintenance work.

⚠ WARNING

Prior to maintenance work, let the system cool down to avoid the risk of burns.

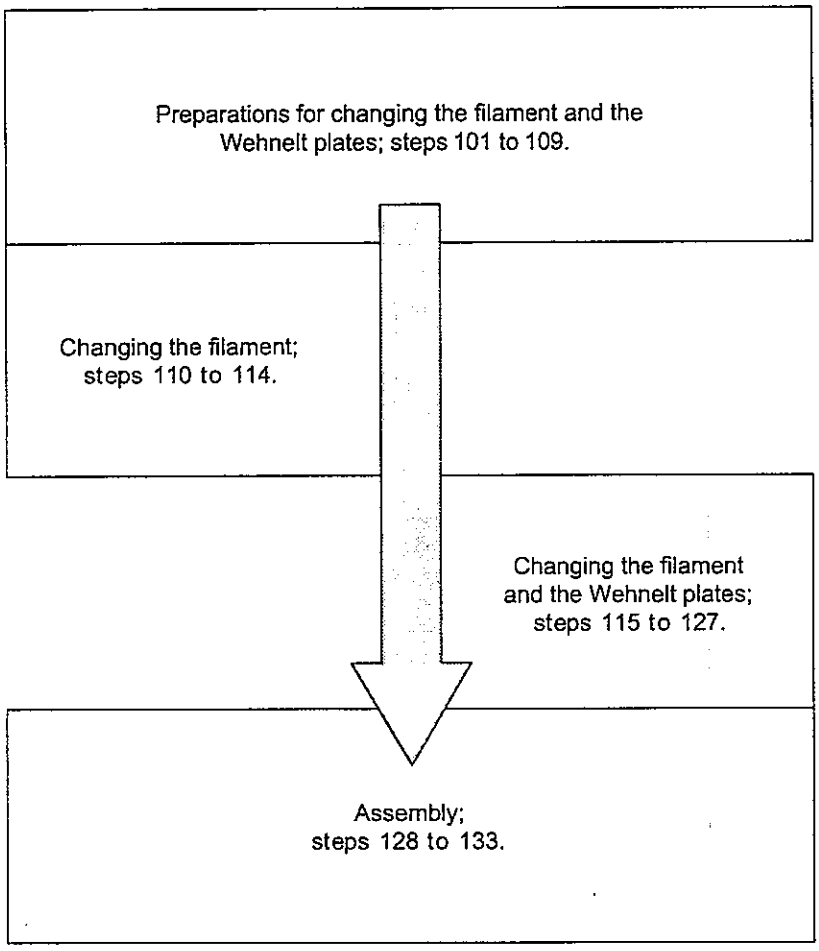
NOTE !

Wear clean, lint-free gloves and use clean tools.

5.1 Maintenance Work on the Mounted Electron Beam Evaporation Source

5.1.1 Changing the Filament and / or the Wehnelt Plates

Production downtime can be kept to a minimum when one preassembled, replacement electron beam system is always available for each of the installed electron beam evaporation sources.



Preparations

Step 101 Turn off the high voltage supply and make sure the system is completely free of all voltage (idle).

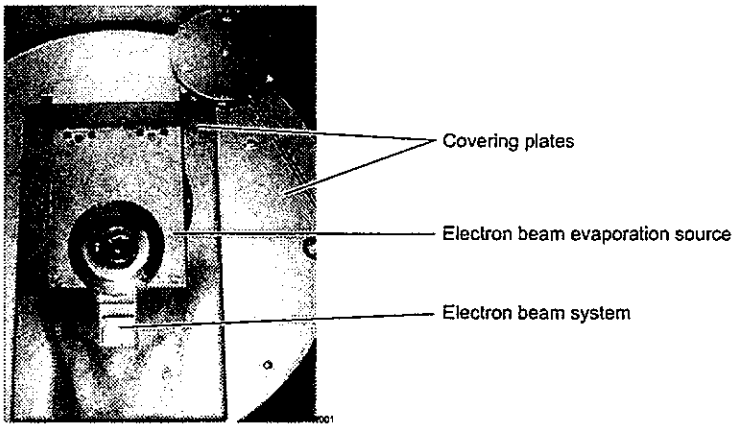
⚠ DANGER

Beware of parts carrying high voltage. Touching parts carrying high voltage causes electric shock and can therefore be fatally dangerous.

The ESQ 212 electron beam evaporation source is considered free of all voltage when the following conditions have been met:

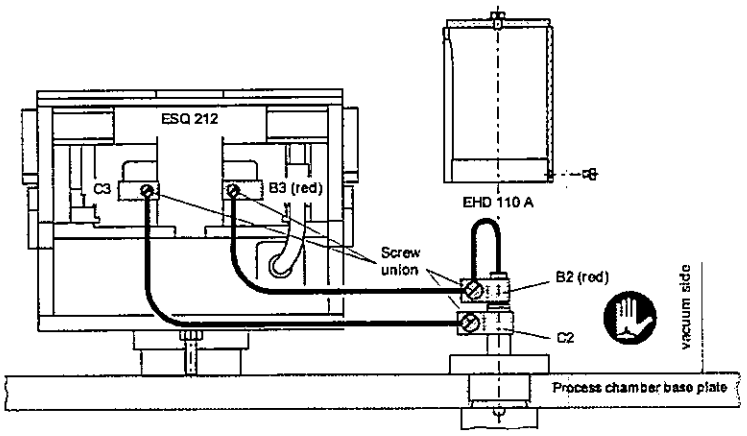
- The mains switch (power switch S1) on the EHV 215 is turned off.
- The safety cut-outs (building side) for the EHV 215's control and power circuit are switched off.
- The high voltage capacitor has discharged (at least two minutes must have elapsed since the safety cut-outs were switched off).
- All parts operating on voltage have been grounded (touched with the grounding rod).

Step 102



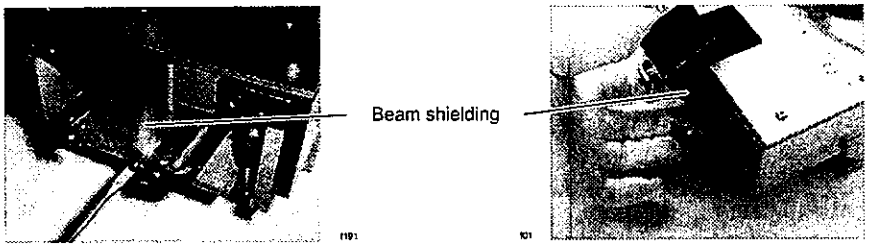
- Remove the covering plates until the side of the electron beam evaporation source which accommodates the electron beam system is easily accessible.

Step 103



- Detach both of the connection conductors between the EHD 110 A and the electron beam system (slacken screw unions).

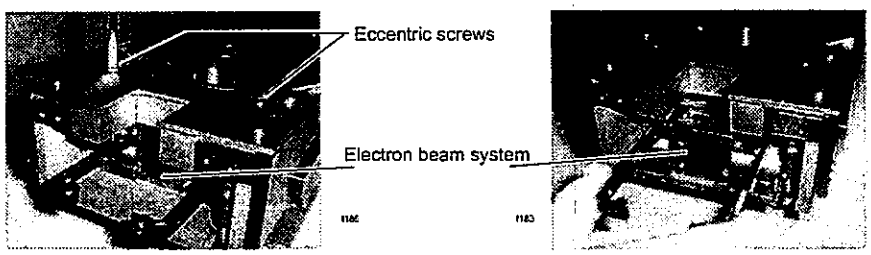
Step 104



- Loosen the screws and remove the beam shielding.

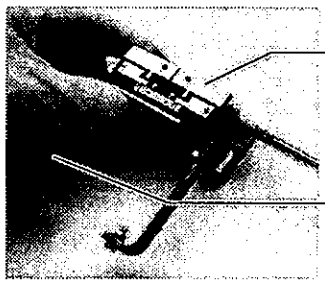
  The screws are treated with molybdenum disulphide; do not clean.

Step 105



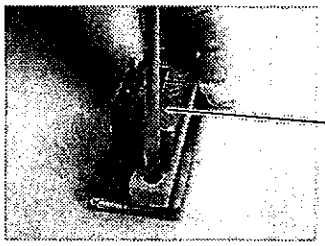
- Detach the electron beam system by turning both the eccentric screws by one full rotation and by pulling it out.

Step 106



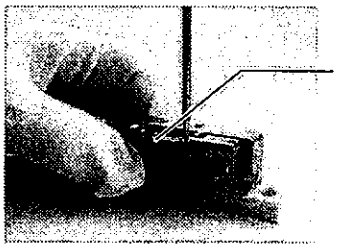
- Remove the high voltage feeders from the electron beam system.

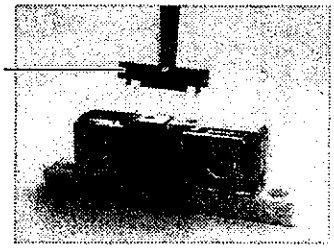
Step 107



- Unscrew the cathode block.

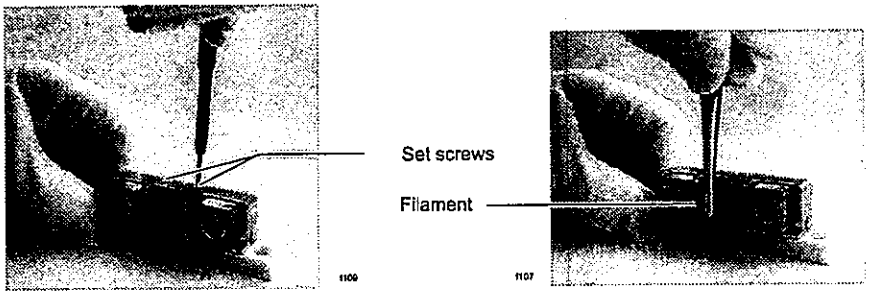
Step 108





- Loosen the screws and remove the upper Wehnelt bar.

Step 109



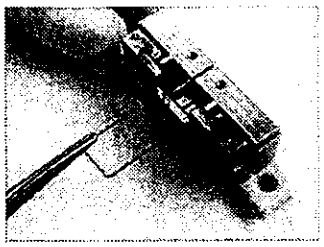
- Loosen the filament by turning both the set screws by 3 full rotations and then remove it (a special screw driver and tweezers are part of the set of tools BN 845 758 -T).

Continue at Step 110 if you want to replace only the filament.

If there is scorching on the Wehnelt plates or if the edges of the Wehnelt plates facing the filament are broken off, then, in addition to the filament, the plates themselves must be replaced. In this case, continue at Step 115.

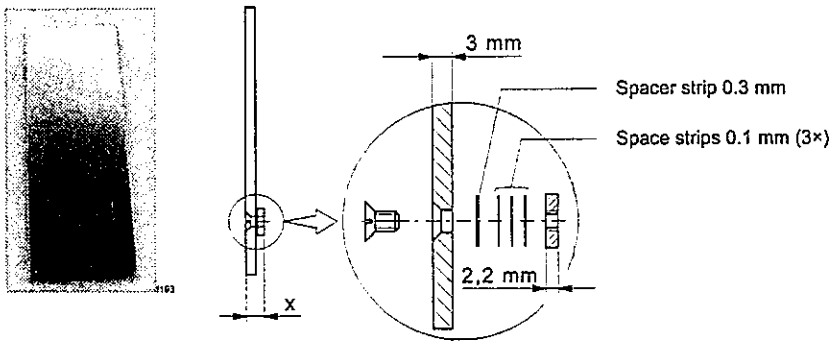
Changing the filament

Step 110



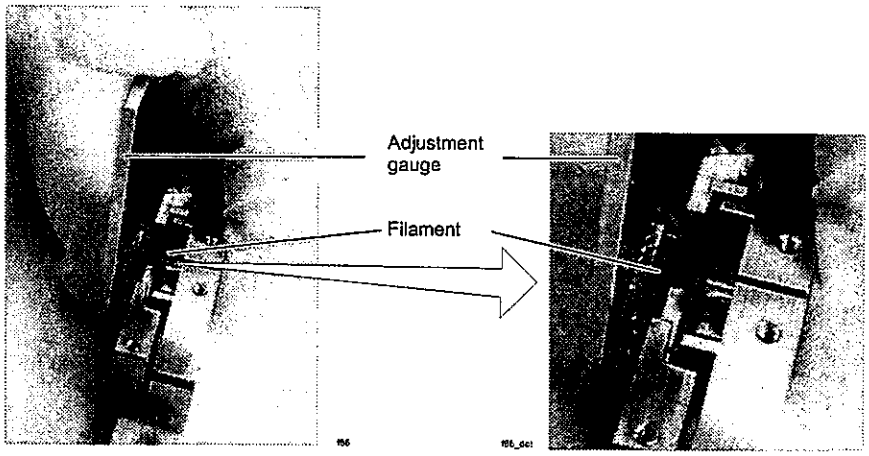
- Mount the new filament (included in the set of accessories for the basic unit).

Step 111



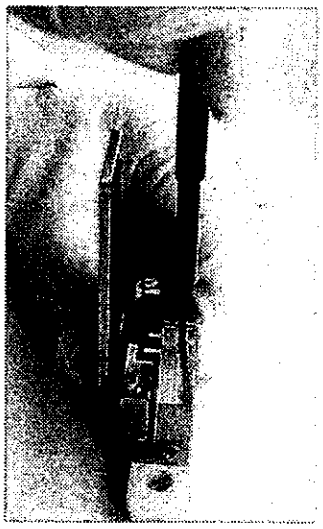
- If necessary, insert or remove spacer strips to adjust the dimension of "x" at the adjustment gauge (included in set of tools BN 845 758 -T) to 5.5 mm.

Step 112



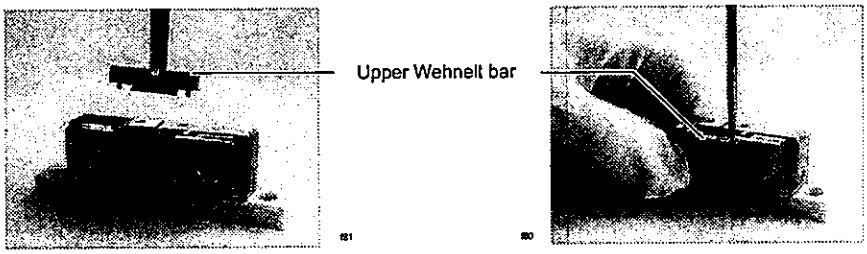
- Mount the adjustment gauge and position the filament so that it lies against the gauge along its entire length.

Step 113



- Screw on the filament. Remove the adjustment gauge.

Step 114

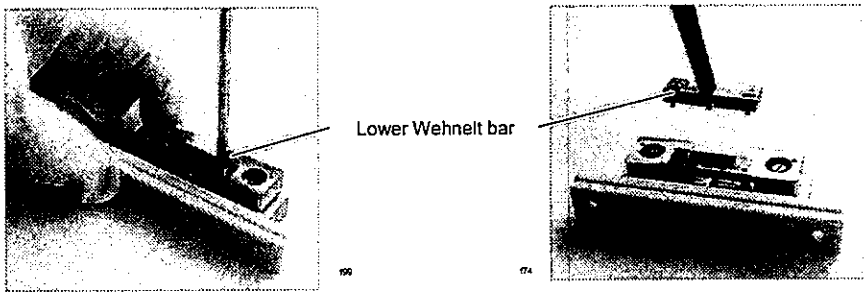


- Mount the upper Wehnelt bar again and tighten the screws.

Continue at Step 128 for the assembly procedure.

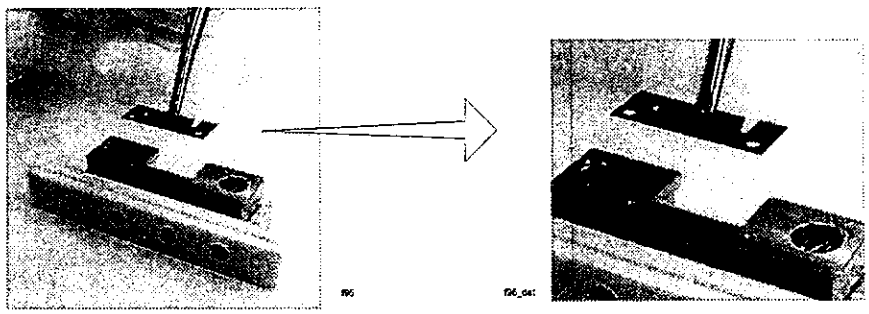
Changing the filament and the Wehnelt plates

Step 115



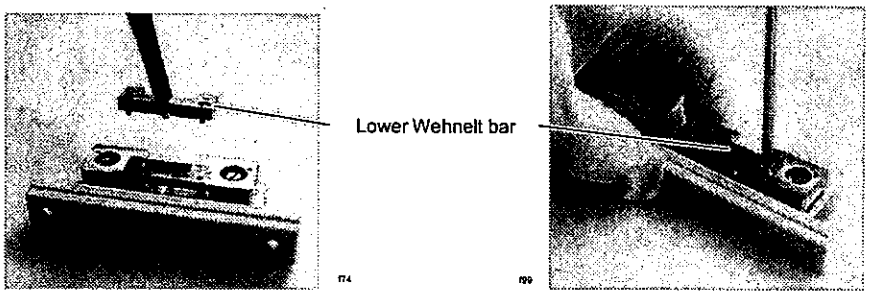
- Loosen the screws and remove the lower Wehnelt bar.

Step 116



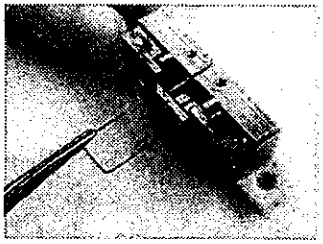
- Replace the lower Wehnelt plate (included in the set of accessories for the basic unit).

Step 117



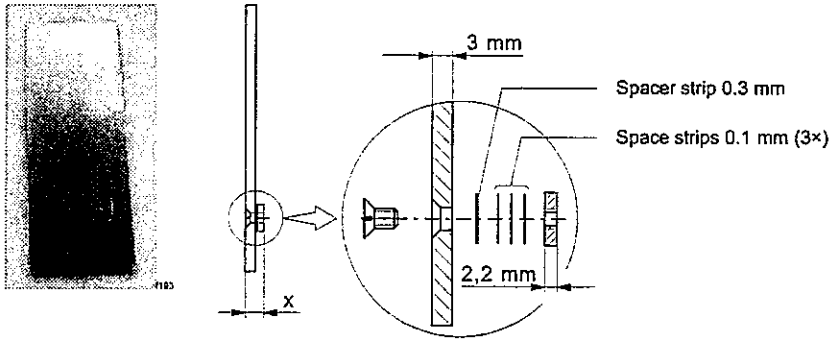
- Mount the lower Wehnelt bar and tighten the screws.

Step 118



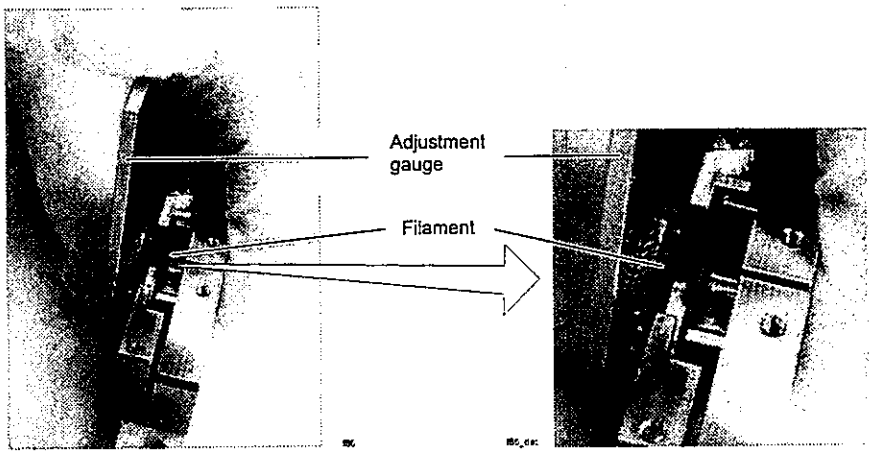
- Mount the new filament (included in the set of accessories for the basic unit).

Step 119



- If necessary, insert or remove spacer strips to adjust the dimension of "x" at the adjustment gauge (included in set of tools BN 845 758 -T) to 5.5 mm.

Step 120

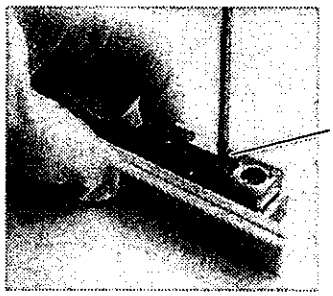


- Mount the adjustment gauge and position the filament so that it lies against the gauge along its entire length.

Step 121

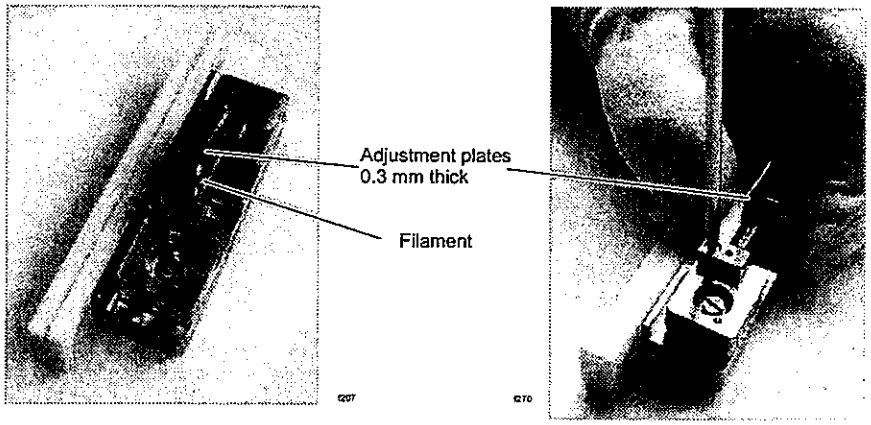
- Screw on the filament. Remove the adjustment gauge.

Step 122



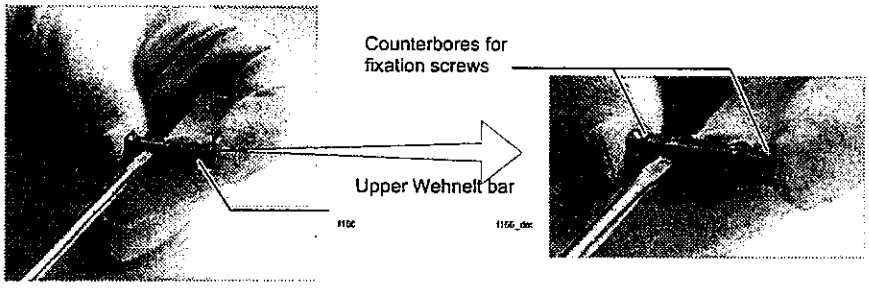
- Loosen the lower Wehnelt bar slightly.

Step 123



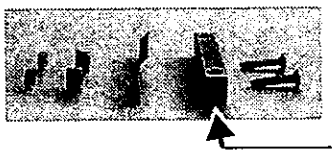
- Center the lower Wehnelt plate; insert the adjustment plates 30×18×0.3 mm (included in the set of accessories for the basic unit) between the Wehnelt plate and the filament and use the screws to tighten the Wehnelt bar. Remove the adjustment plates.

Step 124



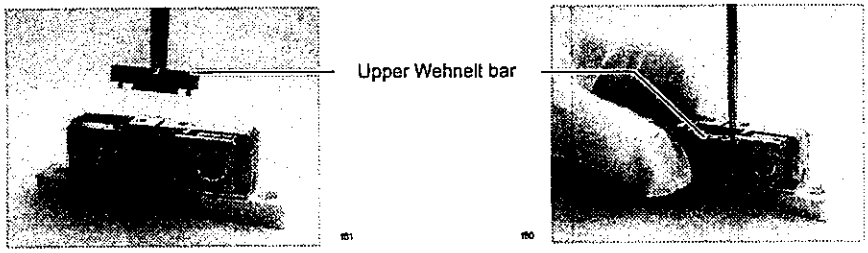
- Loosen the upper Wehnelt plate.

Step 125



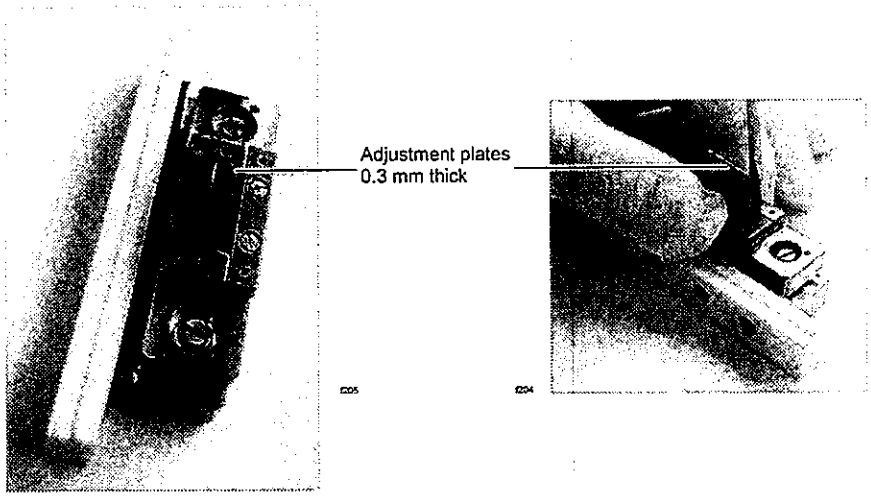
- Replace the upper Wehnelt plate (included in the set of accessories for the basic unit) and tighten slightly. The counterbores for fixation screws for the complete upper Wehnelt bar are underneath.

Step 126



- Mount the upper Wehnelt bar again and tighten the screws.

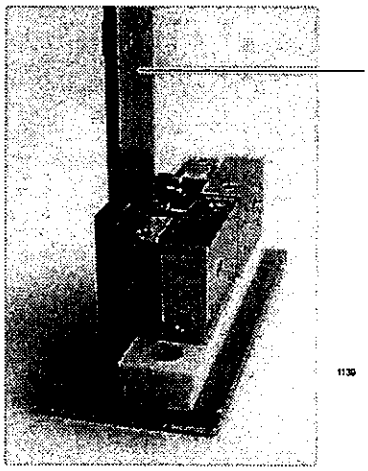
Step 127

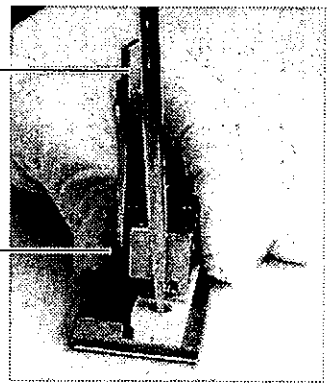


- Center the upper Wehnelt plate; insert the adjustment plates 30×18×0.3 mm (included in the set of accessories for the basic unit) between the Wehnelt plate and the filament and use the screws to tighten the Wehnelt bar. Remove the adjustment plates.

Assembly

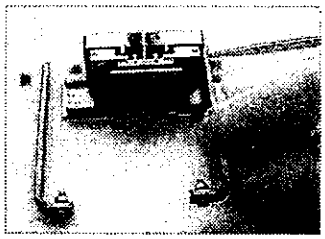
Step 128





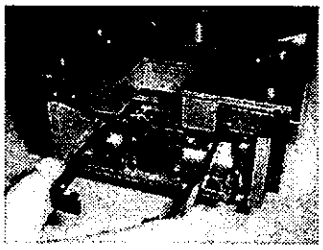
- Mount the cathode block, insert the adjustment gauge between the anode plate and the cathode block, press the cathode block against the anode plate and tighten the screws. Remove the adjustment gauge.

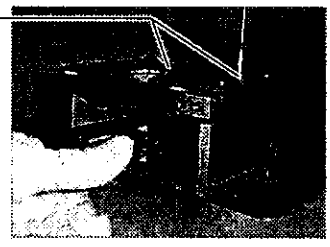
Step 129



- Reattach the high voltage feeders to the electron beam system.

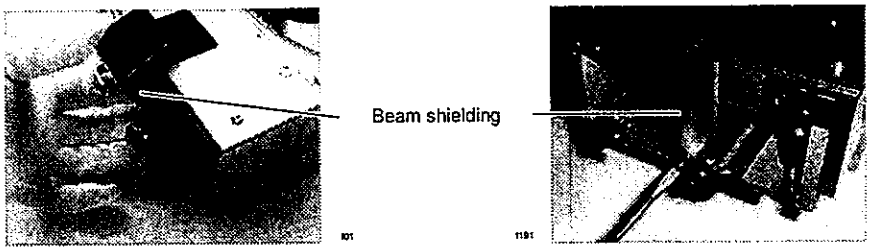
Step 130





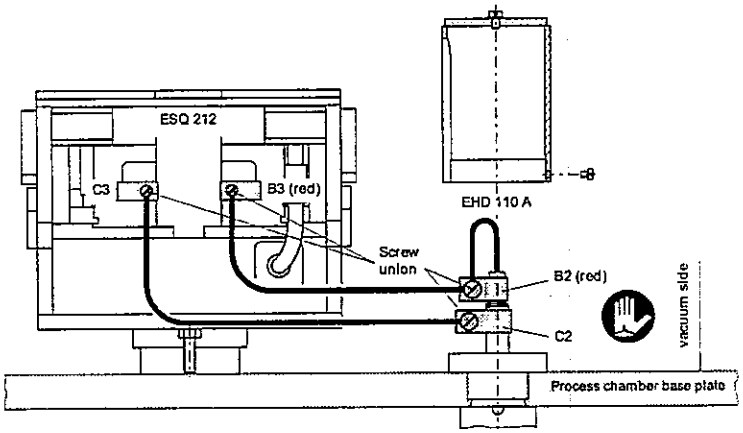
- Insert the electron beam system again, push it in as far as possible and attach it using both the eccentric screws.

Step 131



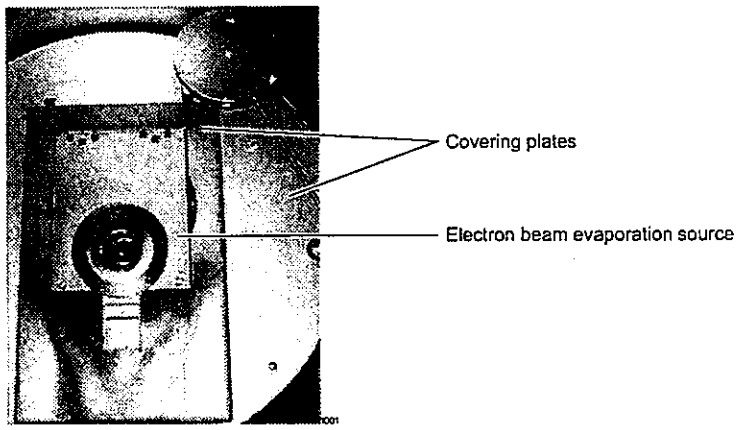
- Mount the beam shielding again and tighten the screws.

Step 132



- Reattach both connecting conductors between the EHD 110 A and the electron beam system.

Step 133

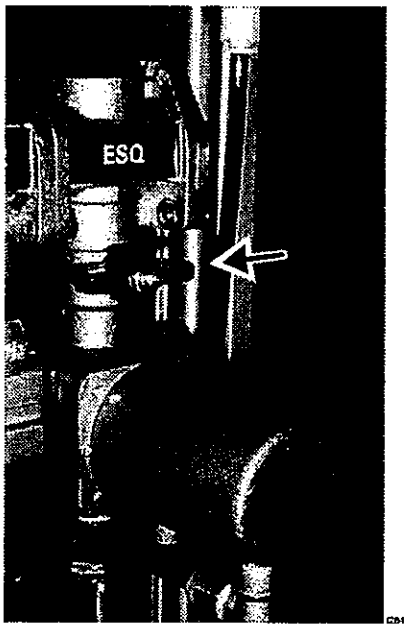


- Mount the covering plates again.

5.1.2 Changing the Crucible

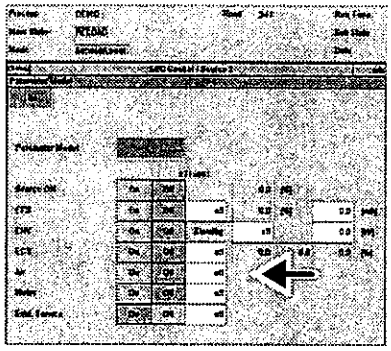
Removing the crucible

Step 151



- On the water battery close the shut-off taps for the cooling water supply to the ESQ 212 and for the cooling water runback from the ESQ 212 (refer to system-specific diagram for cooling water).

Step 152



- Blow the cooling water out of the ESQ 212.
  - Set "Air On" at the EEC 300 control unit.
  - After approx. three minutes set "Air Off".

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Sales Mgr
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supply and make sure the system is completely free of

⚠ DANGER

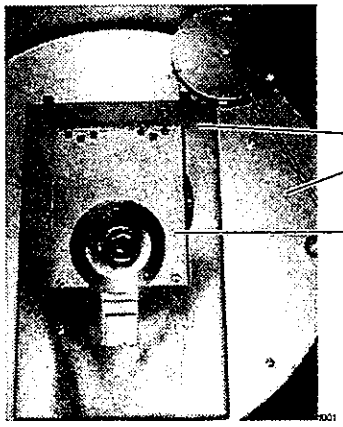
ing high voltage. Touching parts carrying high ic shock and can therefore be fatally

am evaporation source is considered free of all
conditions have been met:

er switch S1) on the EHV 215 is turned off.

- The safety cut-outs (building side) for the EHV 215's control and power circuit are switched off.
- The high voltage capacitor has discharged (at least two minutes must have elapsed since the safety cut-outs were switched off).
- All parts operating on voltage have been grounded (touched with the grounding rod).

Step 154

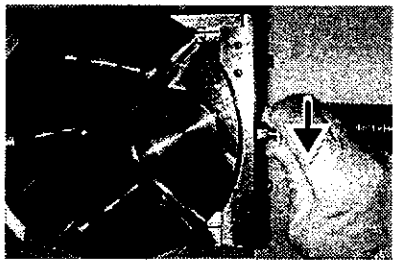


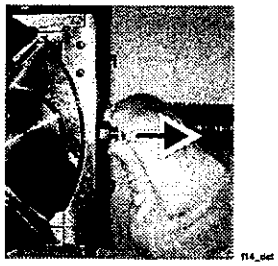
- Remove the covering plates until the crucible at the electron beam evaporation source is easily accessible.

Step 155

- Loosen the screws and remove the crucible cover.

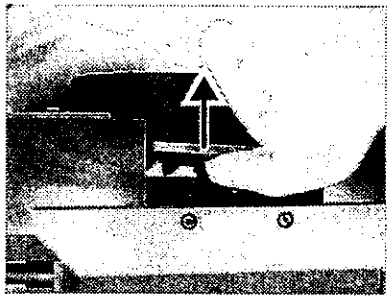
Step 156





- Loosen the crucible fixation and pull the crucible holder out as far as it will go.

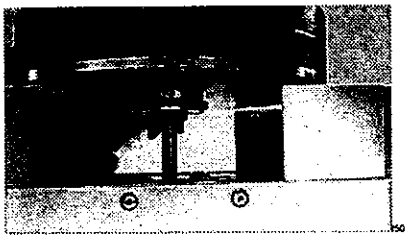
Step 157

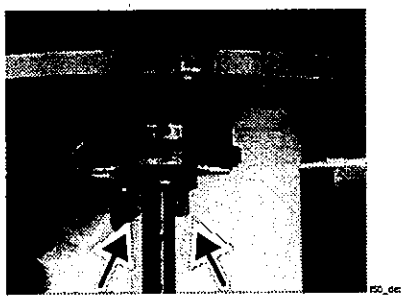


- Lift off the crucible (do not tilt it).

Mounting the crucible

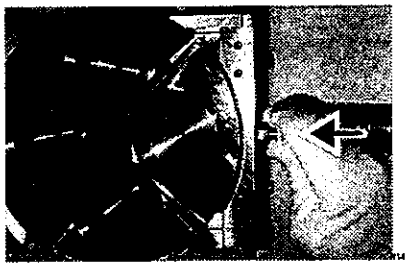
Step 158

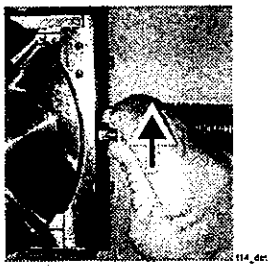




- Mount the crucible; when performing alignment, make sure that each of the both catches grips properly into the basic unit.

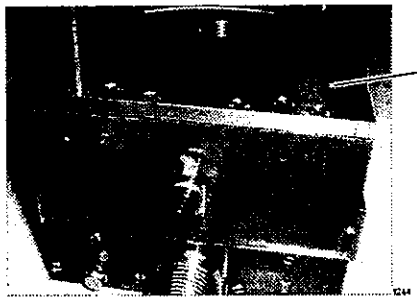
Step 159





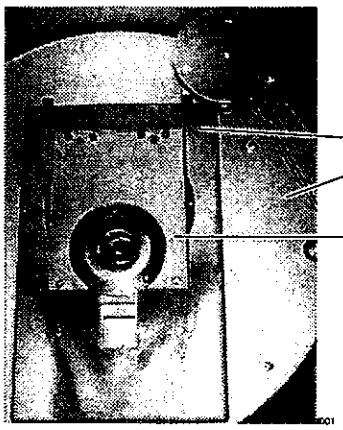
- Push in the crucible holder completely and fasten it by turning in the knurled screw on the crucible fixation.

Step 160



- Mount the crucible cover and tighten the screws.

Step 161



- Mount the covering plates again.

Step 162

- On the water battery reopen the shut-off taps for the cooling water supply to the ESQ 212 and for the cooling water runback from the ESQ 212.

NOTE !
The crucible configuration must be altered at the EEC 300 (EEC 420) control unit after the crucible type has been changed (see appropriate operating instructions).

5.1.3 Changing Individual Modules in a 4-Pocket Modular Crucible

Removing the crucible cover

Step 601 On the water battery, close the shut-off taps for the cooling water supply to the ESQ 212 and for the cooling water runback from the ESQ 212 (see procedure description in Chapter 5.1.2, step 151).

Step 602 Blow the cooling water out of the ESQ 212 (see procedure description in Chapter 5.1.2, step 152).

Step 603 Turn off the high voltage supply and make sure the system is completely free of all voltage (idle).

⚠ DANGER

Beware of parts carrying high voltage. Touching parts carrying high voltage causes electric shock and can therefore be fatally dangerous.

The ESQ 212 electron beam evaporation source is considered free of all voltage when the following conditions have been met:

- The mains switch (power switch S1) on the EHV 215 is turned off.
- The safety cutouts (building side) for the EHV 215's control and power circuit are switched off.
- The high voltage capacitor has discharged (at least two minutes must have elapsed since the safety cutouts were switched off).
- All parts operating on voltage have been grounded (touched with the grounding rod).

Step 604

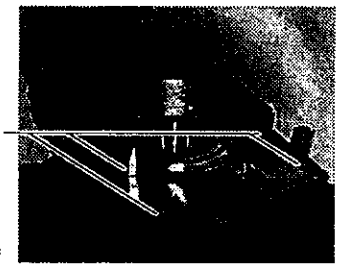
601

- Remove the covering plates until the modular crucible at the ESQ 212 electron beam evaporation source is easily accessible (see procedure description in Chapter 5.1.2, step 154).

Step 605

Screws without ventilation holes

Screws with ventilation holes

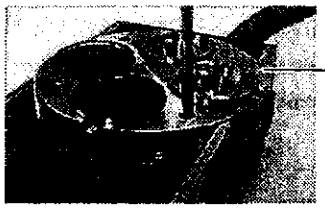


- Remove the crucible cover.

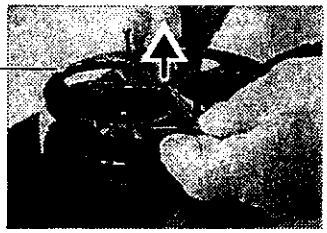
The screws are treated with molybdenum disulphide; do not clean.

Changing a crucible module

Step 606



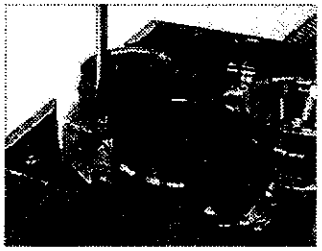
Holding-down plate

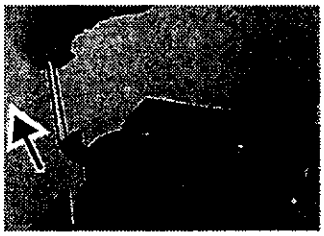


- Loosen the screws in the holding-down plate for the crucible module and then remove the plate .

The screws are treated with molybdenum disulphide; do not clean.

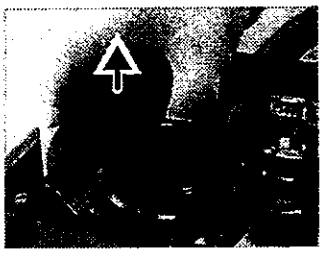
Step 607





- Loosen the screws in the both of the strips which are used to hold down the appropriate crucible module and then remove the holder strips.

Step 608

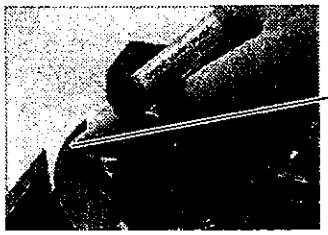


- Lift the crucible module out of the crucible.

Step 609

- Use a clean, lint-free cloth to wipe dry and remove any water residue in the modular crucible.

Step 610

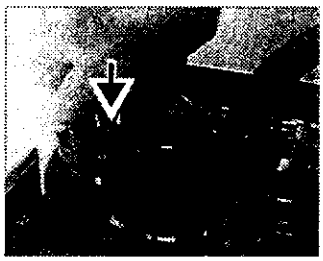


- Use a small amount of Ultratherm 2000 to lubricate the sealing surface between crucible module and modular crucible.

Step 611

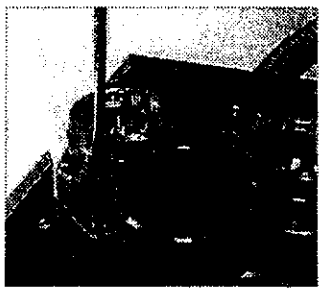
- Fit the replacement crucible module with an O-ring.
  - Use a small amount of Ultratherm 2000 to lubricate the new O-ring.
  - Insert the O-ring into the sealing groove of the replacement crucible module. Make sure that there are no kinks.

Step 612



- Place the replacement crucible module in the modular crucible. Be careful not to tilt it. Press the crucible module down as far as it will go.

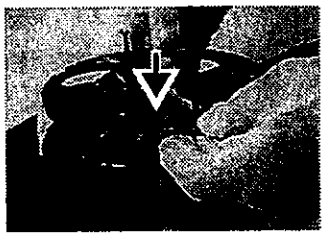
Step 613



- Screw down the replacement crucible module using both holder strips.

Step 614 If necessary, replace further crucible modules (follow the instructions in steps 607 to 613).

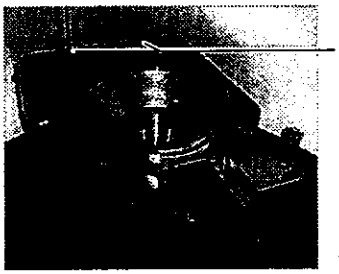
Step 615

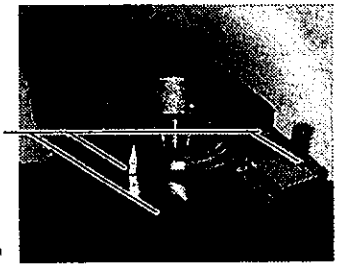


- Replace the holding-down plate for the crucible module and screw it down.

Mounting the crucible cover

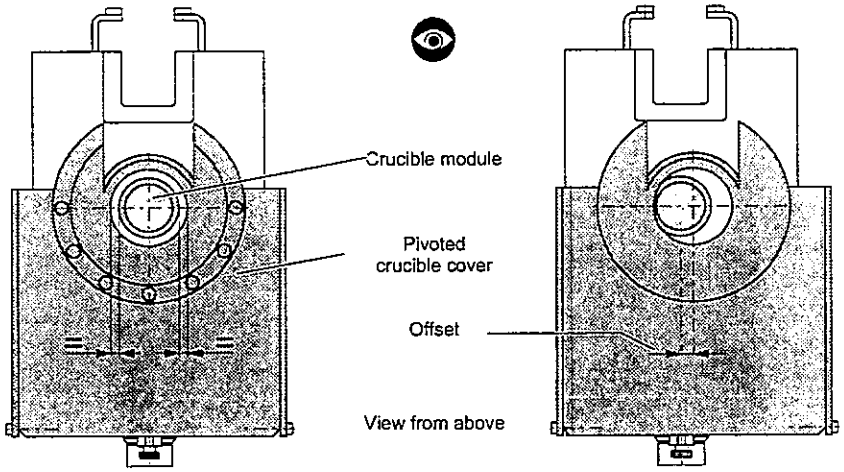
Step 616





- Mount the complete crucible cover and screw it down.

Step 617



- Make a visual check to inspect the position of the pivoted crucible cover with regard to the crucible module.

✓ Opening in pivoted crucible cover concentric to crucible module

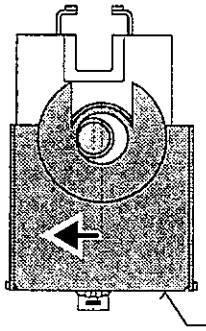
✗ Opening in pivoted crucible cover not concentric to crucible module

If you need to adjust the alignment of the pivoted crucible cover, continue with step 618.

If the pivoted crucible cover is positioned correctly, continue with step 625.

Aligning the crucible cover

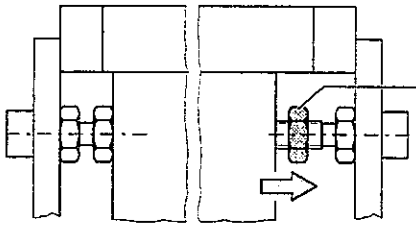
Step 618



Rear side

Example:
move pivoted crucible cover
to the **left**.

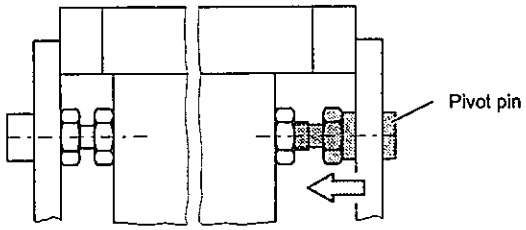
View of rear side



Lock nut

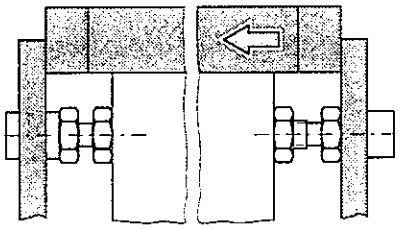
- Loosen the lock nut (counterclockwise) at the right-hand side by at least half of the offset range.

Step 619



- Screw in the pivot pin (clockwise) at the right-hand side by at least half of the offset range.

Step 620



- Push the pivoted crucible cover to the left as far as it will go.

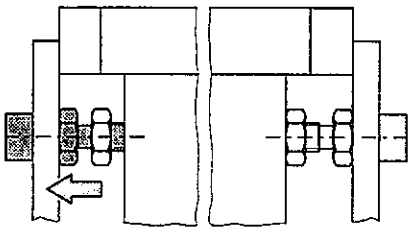
Step 621 Make a visual check to inspect the position of the pivoted crucible cover with regard to the crucible module (see procedure description in step 617).

Repeat steps 618 to 621 if you need to move the pivoted crucible cover further to the left.

If you have moved the pivoted crucible cover too far to the left, screw out the pivot pin (counterclockwise) at the right-hand side again until it reaches the required position.

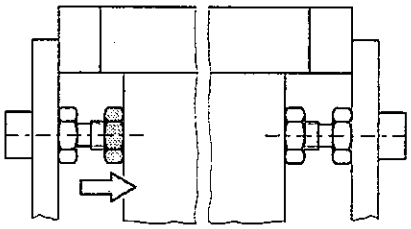
If the pivoted crucible cover is positioned correctly, continue with step 622.

Step 622



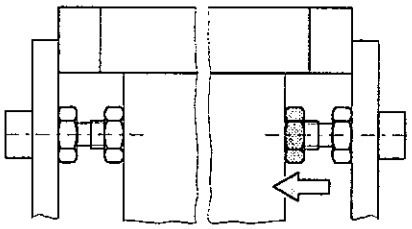
- Screw out the pivot pin (counterclockwise) at the left-hand side carefully and as far as it will go.

Step 623



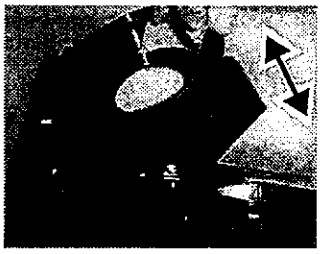
- Screw in the lock nut (clockwise) at the left-hand side as far as it will go.

Step 624



- Screw in the lock nut (clockwise) at the right-hand side as far as it will go.

Step 625



Check for easy opening/closing

- Check: The pivoted crucible must open and close easily and without hinderance.

Step 626 Remount the covering plate (see procedure description in Chapter 5.1.2, step 161).

Step 627 On the water battery, open the shut-off taps for the cooling water supply to the ESQ 212 and for the cooling water runback from the ESQ 212 (see procedure description in Chapter 5.1.2, step 162).

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6 Service

Table of Contents Chapter 6

NOTE !

Service work on the ESQ 212 electron beam evaporation source may only be performed by service technicians who have received specific training for this purpose (trained or instructed by Balzers Process Systems).

⚠ DANGER

- **Vent the process chamber and ground the electron beam evaporation source according to the BN 869 020 DV/A Safety Instructions prior to any service work.**
- **If performing service work do not remove any part of the casing or any of the protective covers until you are absolutely certain that both the ESQ 212 electron beam evaporation source and its relevant supply devices are free of all voltage (idle). This is an additional precautionary measure which is required as supplement to all the other safety measures.**
- **In addition, make sure to lock (with a padlock) the power switch on the EHV 215 unit. This is to ensure that no-one else can turn on the ESQ 212 electron beam evaporation source when service work is in progress.**
- **Prior to commencing work, find out about any possible contamination. Pay attention to the relevant regulations and observe the protective measures when handling contaminated parts.**

⚠ DANGER

The ESQ 212 basic unit is equipped with strong permanent magnets. Persons with cardiac pacemakers should not perform any kind of service work.

⚠ WARNING

Prior to service work, let the system cool down to avoid the risk of burns.

NOTE !

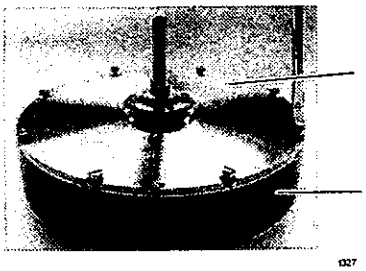
Wear clean, lint-free gloves and use clean tools.

6.1 Service Work on Mounted ESQ 212 Electron Beam Evaporation Source

6.1.1 Cleaning the Crucible

Step 201 Remove the crucible by following the instructions in Chapter 5.1.2, steps 151 to 157.

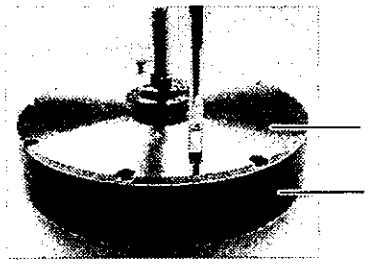
Step 202

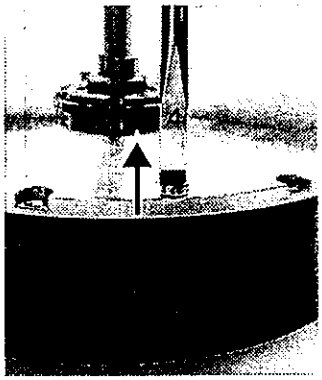


- Slacken and remove the screws in the top part of crucible.

  The screws are treated with molybdenum disulphide; do not clean.

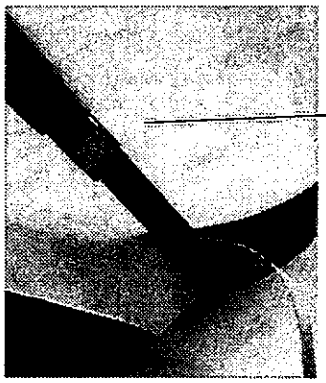
Step 203

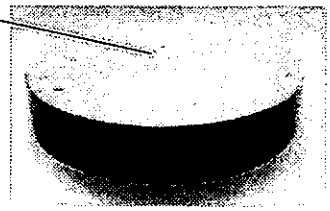




- Remove the top part of crucible (use two of the previously slackened screws to raise it).

Step 204

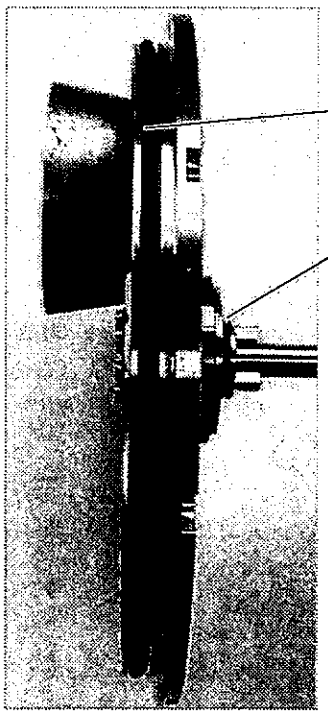




- Cover up the lower side of the top part of the crucible (at least the sealing surfaces and the tapped holes).

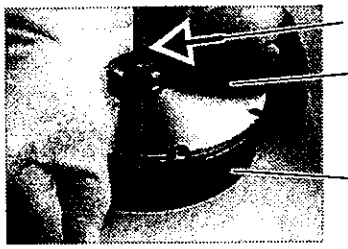
Step 205 Clean the top part of the crucible
(e.g. by brushing, sandblasting, wet blasting, ...).

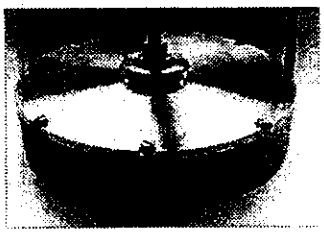
Step 206



- Replace the O-rings in the bottom part of the crucible and lubricate slightly with FU 090 vacuum grease (included in the set of accessories for the basic unit).

Step 207





- Mount the bottom part of the crucible on the top part of the crucible (the crucible hole over the narrow carrier is assigned crucible number 1 for the control system), press it on and tighten the screws crosswise.

Step 208 Install the crucible by following the instructions in Chapter 5.1.2, steps 158 to 162.

6.1.2 Replacing the Permanent Magnets

Strong external electromagnetic field influence can weaken the magnetic field from the permanent magnets used to deflect the electron beam. The permanent magnets must be replaced if the electron beam cannot be sufficiently deflected in the longitudinal direction (return any old magnets to BPS).

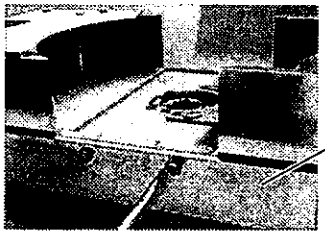
⚠ CAUTION

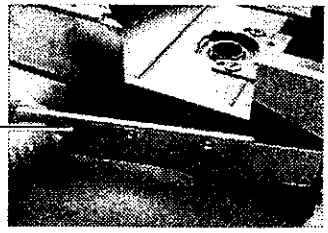
The high field strengths can alter the calibration of or damage electronic devices and measuring instruments situated close to the magnets. Take special care to keep magnetized magnets at a safe distance from computers, monitors and all magnetic data carriers (e.g. floppys, cheque cards, audio and video tape etc.). This also applies to pacemakers.

Removing the permanent magnets

Step 251 Remove the crucible by following the instructions in Chapter 5.1.2, steps 151 to 157.

Step 252

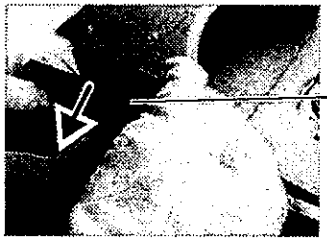




- Slacken and remove both the screws on both sides of the ESQ 212 and remove the auxiliary pole shoes.

  The screws are treated with molybdenum disulphide; do not clean.

Step 253



The magnetic attraction makes it difficult to separate the pole shoe from the basic unit.

- Remove the pole shoe at magnetic north side.

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VDMA

Declaration of Contamination of Vacuum Equipment and Components

The repair and/or service of vacuum equipment and components will only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delay. The manufacturer could refuse to accept any equipment without a declaration.
This declaration can only be completed and signed by authorized and qualified staff.

1. Description of Vacuum Equipment and Components

- Equipment type/model: _____
- Code No.: _____
- Serial No.: _____
- Invoice No.: _____
- Delivery date: _____

2. Reason for Return

_____

3. Condition of the Vacuum Equipment and Components

- Has the equipment been used?
  yes ☐ no ☐
- What type of pump oil/liquid was used?
- Is the equipment free from potentially harmful substances?
  yes ☐ (go to Section 5)
  no ☐ (go to Section 4)

4. Process related Contamination of Vacuum Equipment and Components:

- toxic	yes ☐	no ☐
- corrosive	yes ☐	no ☐
- explosive*)	yes ☐	no ☐
- biological hazard*)	yes ☐	no ☐
- radioactive*)	yes ☐	no ☐
- other harmful substances	yes ☐	no ☐

*) Vacuum equipment and components which have been contaminated by biological explosive or radioactive substances, will not accepted without written evidence of decontamination!

Please list all substances, gases and by-products which may have come into contact with the equipment:

Trade name Product name Manufacturer	Chemical name (or Symbol)	Dangerous material class	Measures if spillage	First aid in case of human contact
1.				
2.				
3.				
4.				
5.				

5. Legally Binding Declaration

I hereby declare that the information supplied on this form is complete and accurate. The despatch of the contaminated vacuum equipment and components will be in accordance with the appropriate regulations covering Packaging, Transportation and Labelling of Dangerous Substances.

Name of organisation or company: _____

Address: _____ Post code: _____

Tel.: _____

Fax: _____ Telex: _____

Name: _____

Job title: _____

Date: _____ Company stamp:

Legally binding signature: _____

Order No.: 2121

Copies: Page 1 (white) to manufacturer or representative - Page 2 (yellow) attach to consignment packaging securely - Page 3 (blue) copy for file of sender

11

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e-mail:documentation@leyboldvac.de

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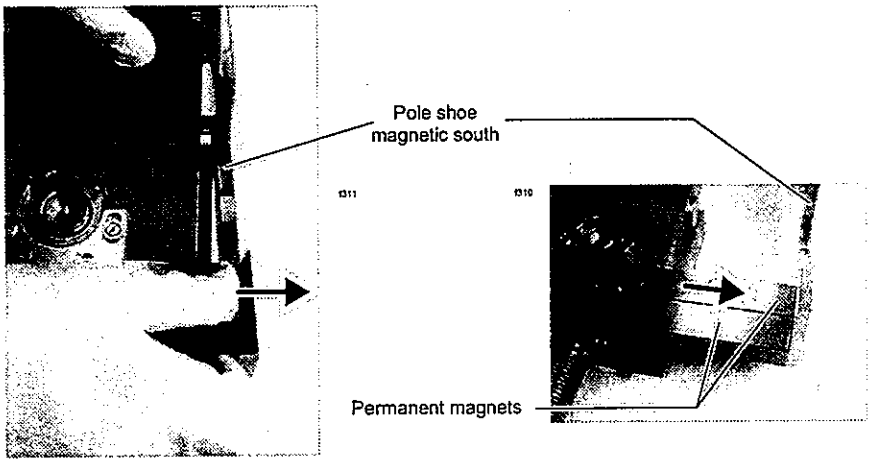
Step 254

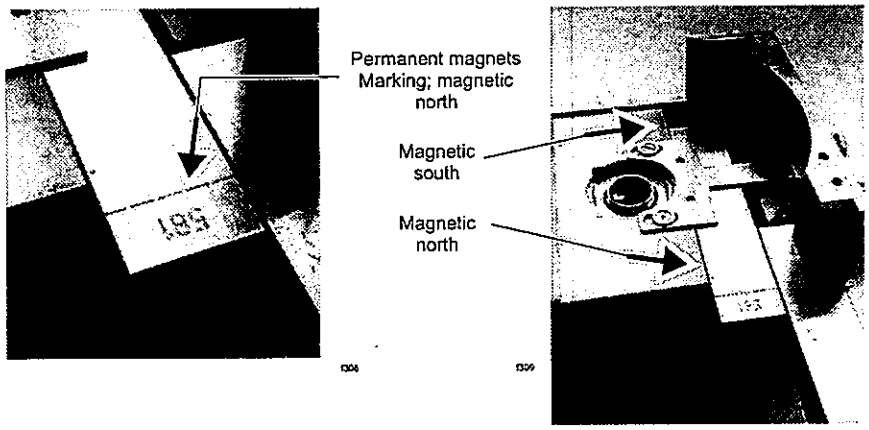


- Remove the pole shoe at magnetic south; both the permanent magnets remain attached to the pole shoe as a result of the magnetic attraction.

Installing the permanent magnets

Step 255 Remount the pole shoe at magnetic south and screw on together with the auxiliary pole shoe.

Step 256



- Install new permanent magnets. Pay attention to the magnetic polarity of the permanent magnets.

Step 257 Remount the pole shoe at magnetic north and screw on together with the auxiliary pole shoe.

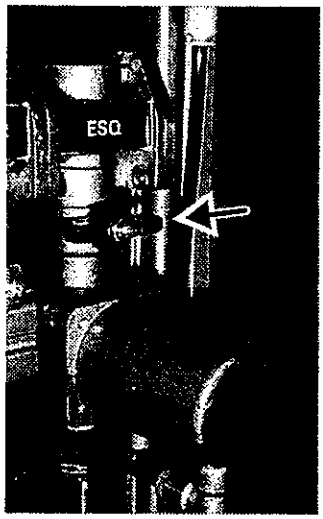
Step 258 Mount the crucible by following the instructions in Chapter 5.1.2, steps 158 to 162.

6.2 Service Work on Removed ESQ 212 Electron Beam Evaporation Source

6.2.1 Removing the ESQ 212 from the Process Chamber

Refer to Chapter 4 for further information on this topic.

Step 301

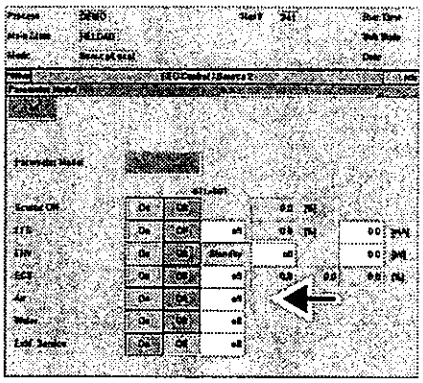


At the factory site close the shut-off tap for the cooling water supply to the system.

OR

On the water battery close the shut-off taps for the cooling water supply to the ESQ 212 and for the cooling water runback from the ESQ 212 (refer to system-specific diagram for cooling water).

Step 302



- Blow the cooling water out of the ESQ 212.
  - Set "Air On" at the EEC 300 control unit.
  - After approx. three minutes set "Air Off".

Step 303 Turn off the high voltage supply and make sure the system is completely free of all voltage (idle).

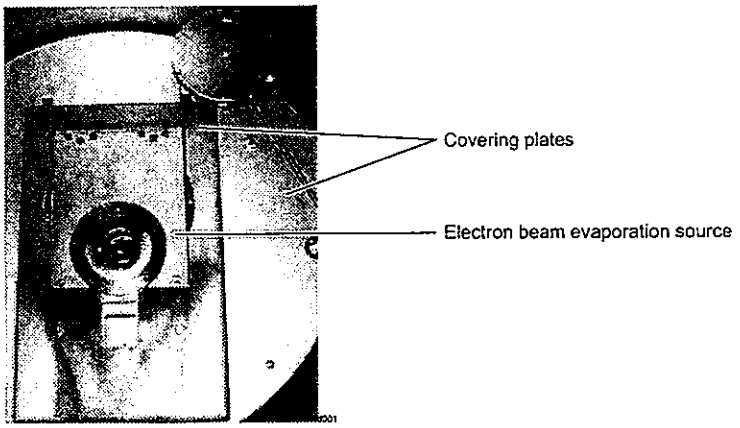
⚠ DANGER

Beware of parts carrying high voltage. Touching parts carrying high voltage causes electric shock and can therefore be fatally dangerous.

The ESQ 212 electron beam evaporation source is considered free of all voltage when the following conditions have been met:

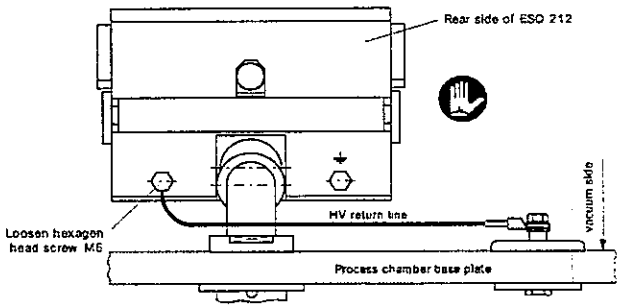
- The mains switch (power switch S1) on the EHV 215 is turned off.
- The safety cutouts (building side) for the EHV 215's control and power circuit are switched off.
- The high voltage capacitor has discharged (at least two minutes must have elapsed since the safety cutouts were switched off).
- All parts operating on voltage have been grounded (touched with the grounding rod).

Step 304



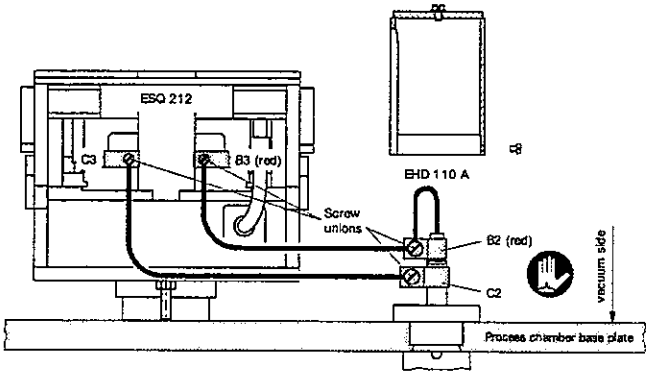
- Remove the covering plates.

Step 305



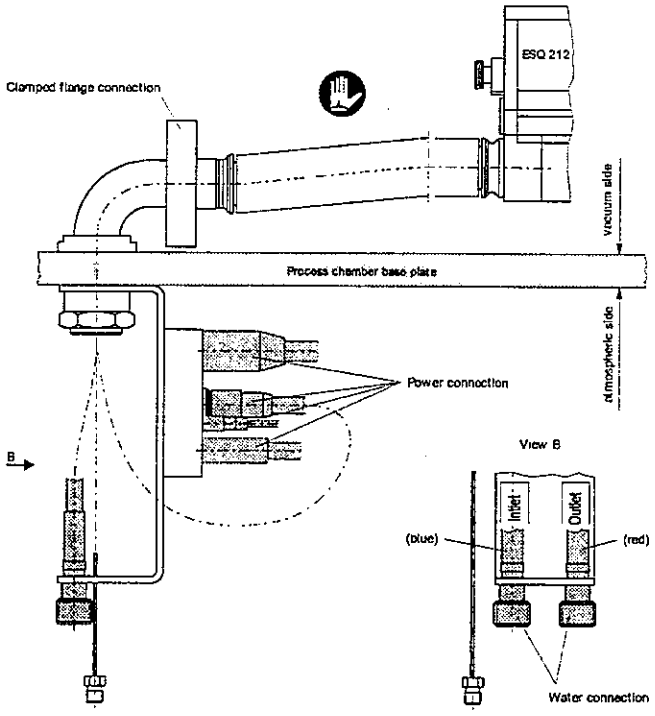
- Disconnect the HV return line from the ESQ 212.

Step 306



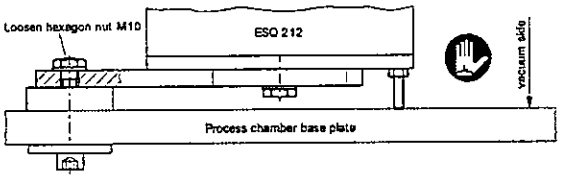
- Detach both of the connection conductors between the EHD 110 A and the electron beam system (slacken screw unions).

Step 307



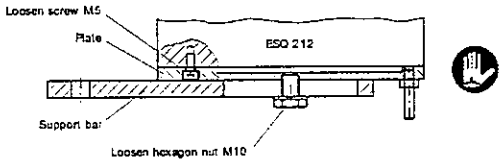
- Dismantle media connections (water and power supply lines).

Step 308



- Detach the ESQ 212 from the process chamber base plate and lift it out of the process chamber.

Step 309



- Detach the ESQ 212 from the support bar and the plate.

6.2.2 Replacing the Shaft Seals

NOTE !
Do not damage the sealing surfaces.

Step 401 Remove the ESQ 212 from the process chamber by following the instructions in Chapter 6.2.1.

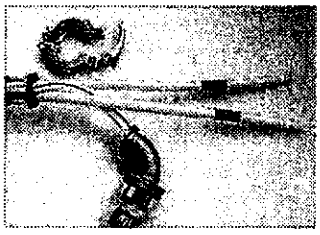
Step 402 Remove the crucible by following the instructions in Chapter 5.1.2, steps 155 to 157.

Removing the upper shaft seal

Step 403

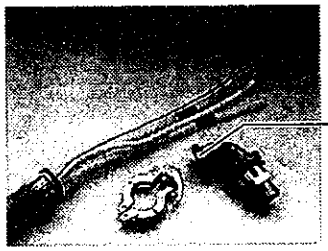
- Slacken and remove the clamped flange connection.

Step 404



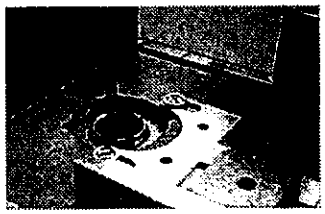
- Pull each water hose separately out of the feedthrough.

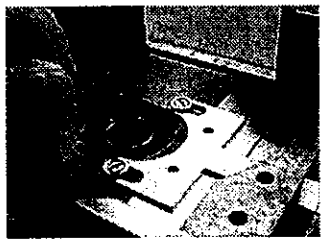
Step 405



- Pull the feedthrough off the remaining media connections and shield the feedthrough sealing surface with a protecting cover.

Step 406

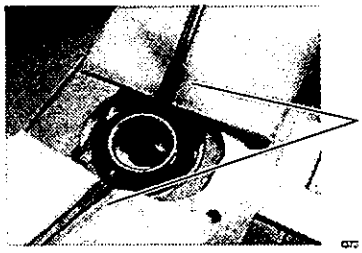


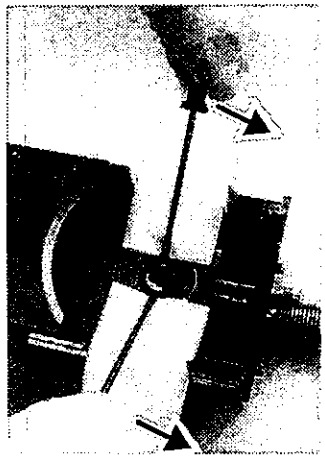


- Detach and remove the plate.

  The screws are treated with molybdenum disulphide; do not clean.

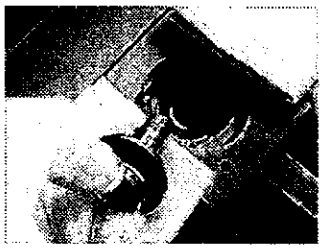
Step 407

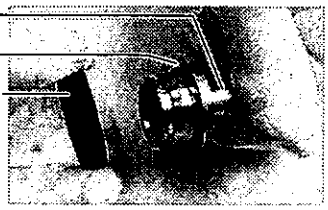




- Lift the shaft out of the sliding seat as shown in the above illustration.

Step 408

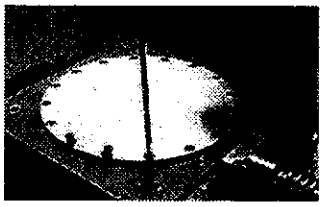




- Take out the shaft and remove the upper shaft seal along with its spacer ring.

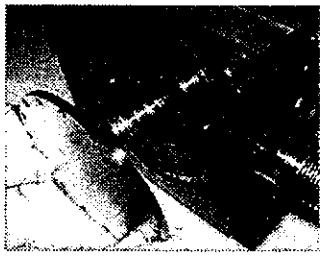
Removing the lower shaft seal

Step 409



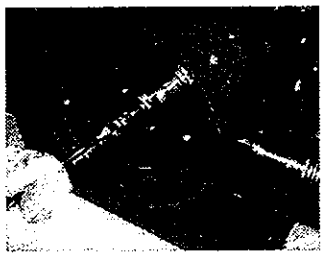
- Turn the ESQ 212 upside down (i.e. by 180°) and slacken and remove the screws on the flange.

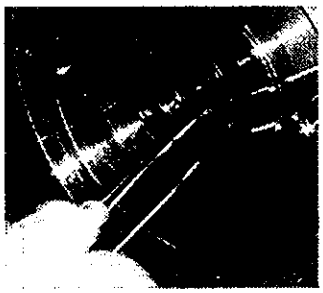
Step 410



- Turn the ESQ 212 onto its side (i.e. by 90°) and remove the flange with the seal.

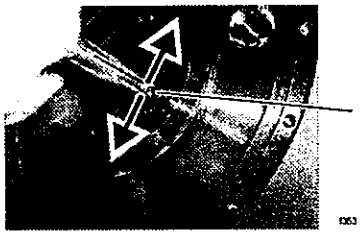
Step 411



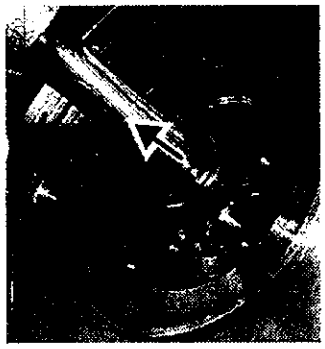


- Detach and remove the plate.

Step 412



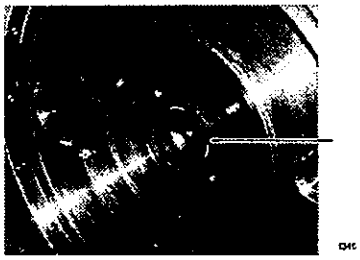
Open out the special tool



- Use the special tool (included in the set of accessories for the basic unit) to remove the lower shaft seal.

Mounting the lower shaft seal

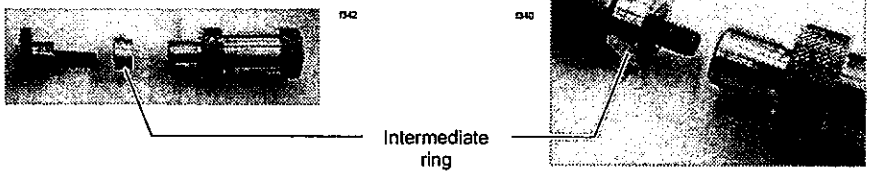
Step 413



Shaft seal, Viton
ø14/24 × 7 mm

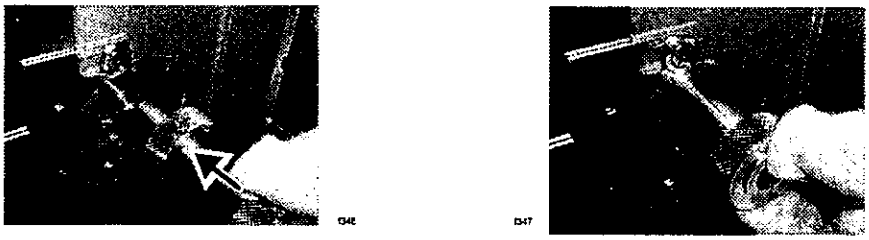
- Insert the new lower shaft seal (included in the set of accessories for the basic unit) manually.

Step 414



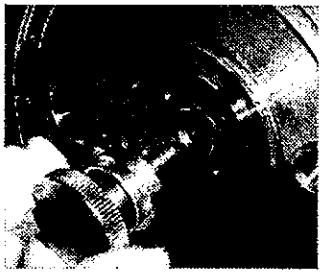
- Unscrew the special tool (included in the set of accessories for the basic unit) and take it apart. Place the intermediate ring upside down on the threaded part of the tool.

Step 415



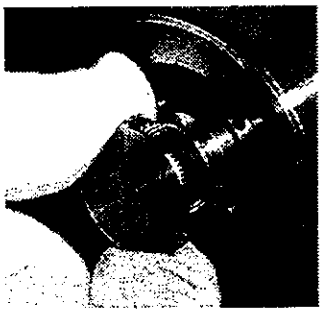
- Insert the special tool into the bore hole as shown in the above illustration.

Step 416



- Insert the threaded part of the tool into the bore hole from the opposite side as shown in the above illustration.

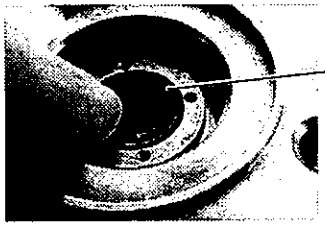
Step 417

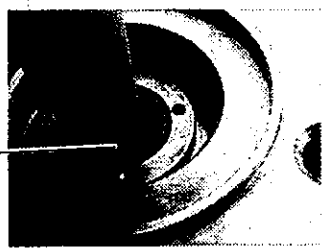


- Press the lower shaft seal into the seat by screwing in the threaded part of the tool. Remove the special tool.

Step 418 Turn the ESQ 212 upside down (i.e. by 90°)

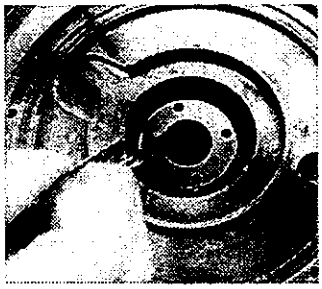
Step 419

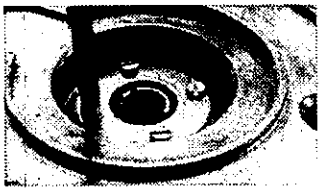




- Fill the lower shaft seal with waterproof Arcanol grease (included in the set of accessories for the basic unit). Grease the inside of the shaft seal slightly with Ultratherm 200. Use rubber gloves for this procedure.

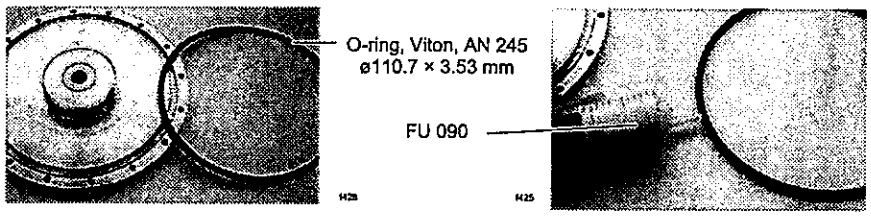
Step 420





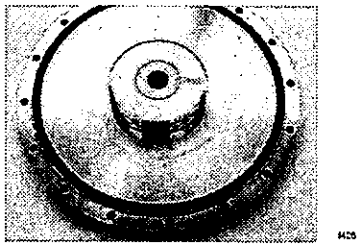
- Insert the disk and screw it on.

Step 421



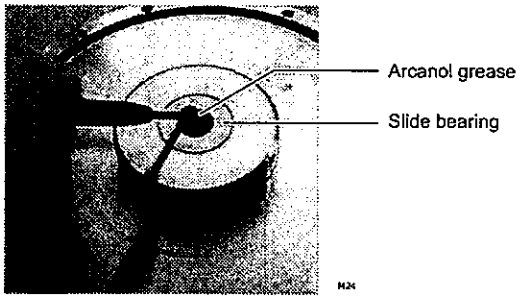
- Use FU 090 vacuum grease (included in the set of accessories for the basic unit) to slightly lubricate the new flange O-ring.

Step 422



- Insert the O-ring.

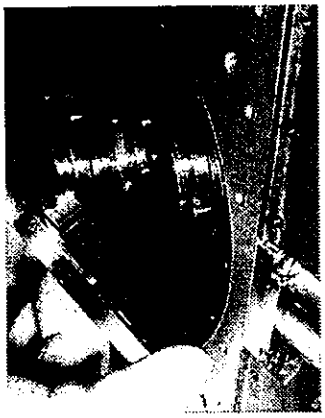
Step 423



- Lubricate the inside of the slide bearing slightly with waterproof Arcanol grease.

Step 424 Turn the ESQ 212 onto its side (i.e. by 90°).

Step 425



- Insert the flange and seal.

Step 426

- Turn the ESQ 212 upside down (i.e. by 90°)

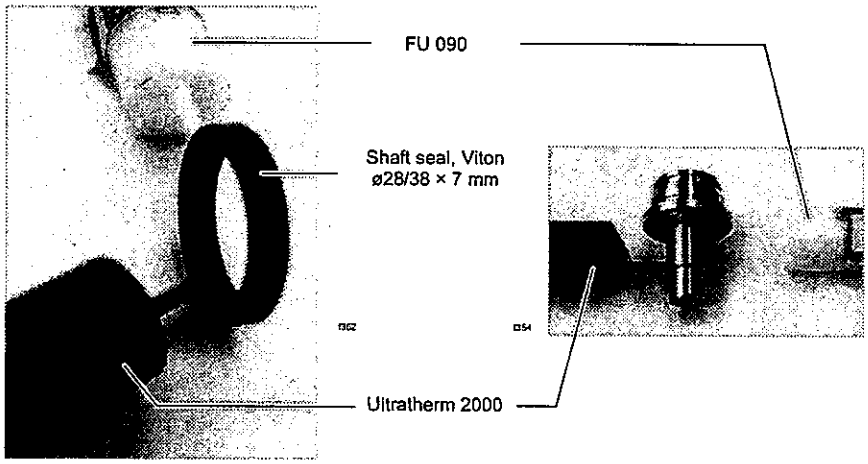
Step 427

- Distribute the grease on the O-ring by turning the flange clockwise and anticlockwise. Tighten the flange screws crosswise.

Mounting the upper shaft seal

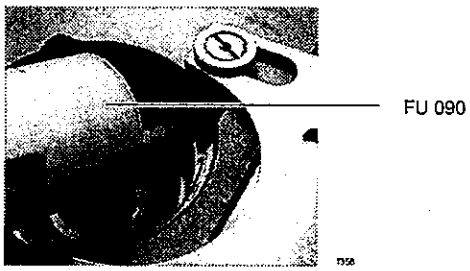
Step 428 Turn the ESQ 212 back to its normal position (i.e. by 180°).

Step 429



- Grease the new upper shaft seal (included in the set of accessories for the basic unit) and the shaft slightly.

Step 430

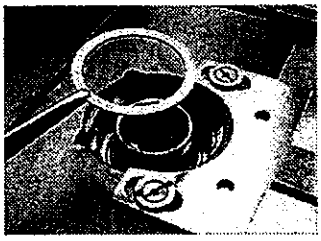


- Grease the bore hole for the ball bearing slightly.

Step 431

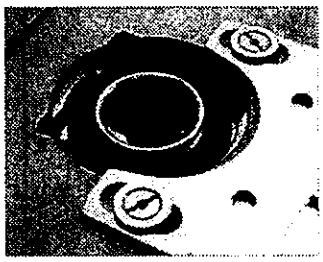
- Insert the shaft and push it in as far as it go. Pay attention to the wedge alignment.

Step 432



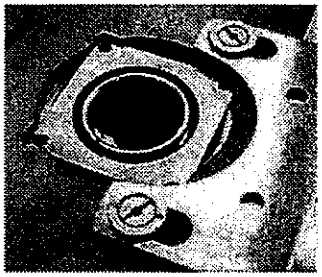
- Insert the spacer ring.

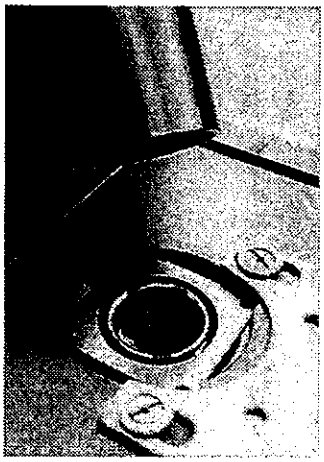
Step 433



- Insert the upper shaft seal with the sealing lips facing downwards.

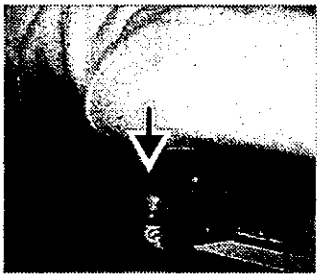
Step 434





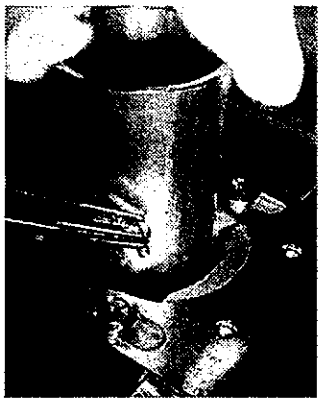
- Insert the plate loosely and mount the piece of piping (ø40×2×60 mm, included in the set of tools BN 845 758 -T).

Step 435



- Use the pipe to push in the upper shaft seal and the mounted plate as far as they will go.

Step 436



- Insert the screws and fasten the plate by tightening the screws crosswise. Do not remove the piping until you have finished tightening the screws.

Step 437

- Push the capillary and the electrical connection through the feedthrough. Push the water tubes individually through the feedthrough. Remount the clamped flange connection.

Step 438 Install the crucible by following the instructions in Chapter 5.1.2, steps 158 to 160.

Step 439 Mount the ESQ 212 by following the instructions in Chapter 6.2.1 in the reverse order.

6.2.3 Replacing the Crucible Drive for 1 to 16 Pocket Crucible Positioning

The crucible drive is one individual unit consisting of

- the motor,
- the gear train and
- the positioner pc board.

NOTE !
Do not damage the sealing surfaces.

Step 501 Remove the ESQ 212 from the process chamber by following the instructions in Chapter 6.2.1.

Step 502 Remove the crucible by following the instructions in Chapter 5.1.2, steps 155 to 157.

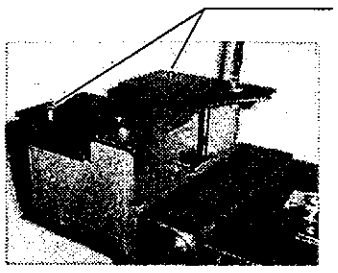
Step 503 Remove the electron beam system by following the instructions in Chapter 5.1.1, steps 104 and 105.

Step 504 Remove the permanent magnets by following the instructions in Chapter 6.1.2, steps 252 to 254.

Step 505 Remove the feedthrough by following the instructions in Chapter 6.2.2, steps 403 to 405.

Step 506 Remove the shaft by following the instructions in Chapter 6.2.2, steps 406 to 408.

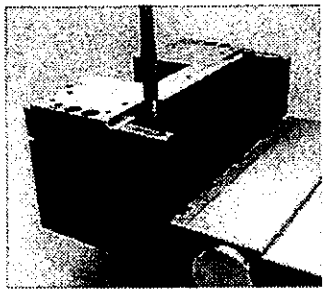
Step 507

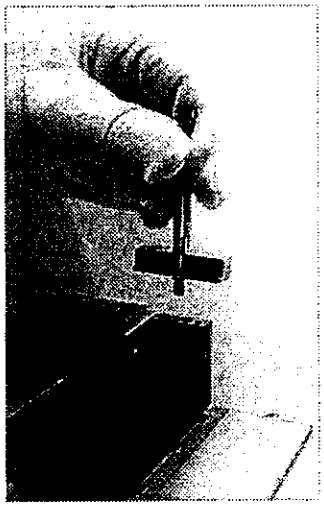


Screws with ventilation holes

- Detach and remove the cover.
  The screws are treated with molybdenum disulphide; do not clean.

Step 508

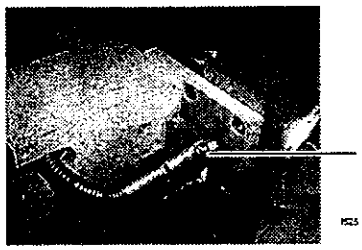


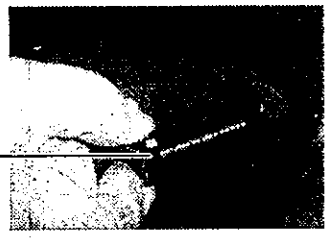


- Remove the eccentric screws.

Step 509 Turn the ESQ 212 onto its side (i.e. by 90°).

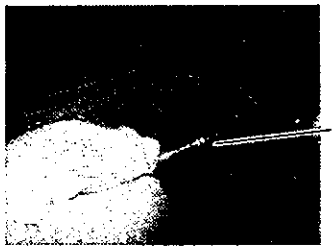
Step 510





- Slacken the square plate and push it back.

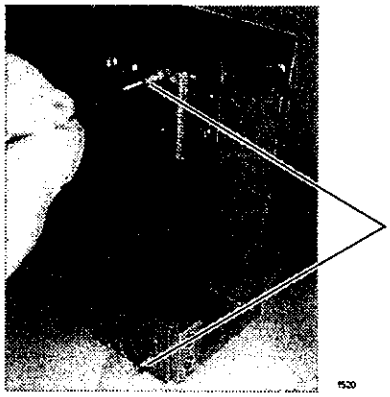
Step 511



- Pull out the antikink protection.

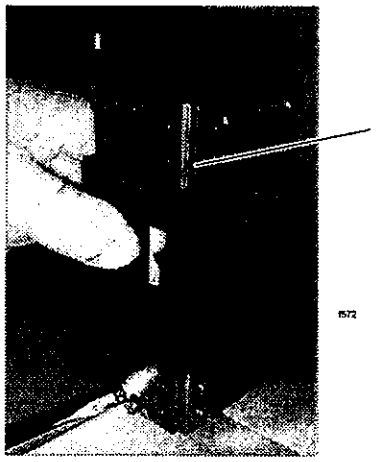
  Use vacuum grease FU 090 (included in the set of accessories for the basic unit) to lubricate the new O-ring slightly.

Step 512



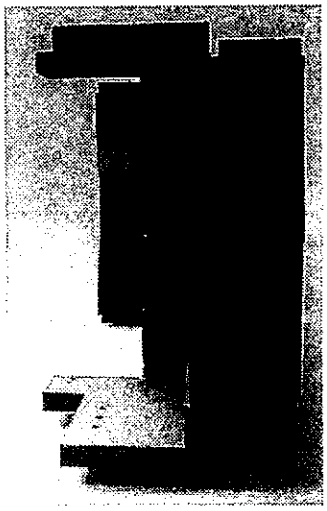
- Slacken and remove the bolts.

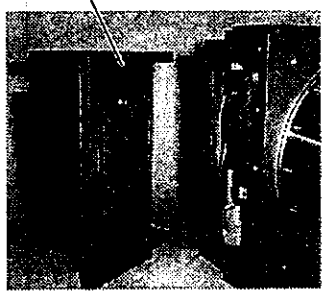
Step 513



- Hold the lateral coil and slacken the screws. Pull out the electrical power connector. Remove the lateral coil together with the electrical connection part.

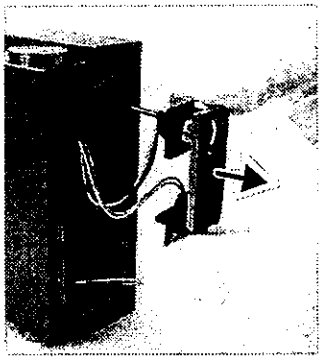
Step 514





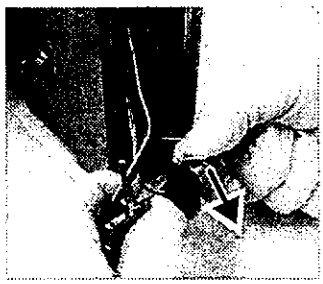
- Detach and remove the base plate.
  Lubricate the new O-ring slightly with vacuum grease FU 090.

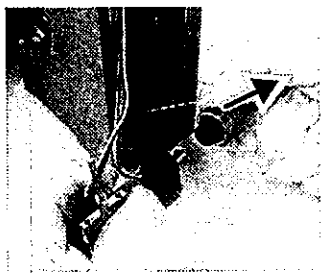
Step 515



- Pull out the electrical connection part.

Step 516





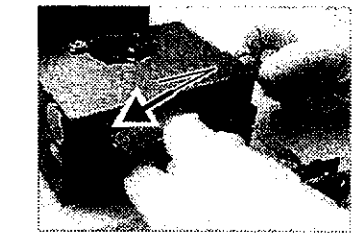
- Pull the longitudinal coil's electrical plug connector apart (bayonet catch).

Step 517 Turn the ESQ 212 back to its normal, upright position (i.e. by 90°).

Step 518

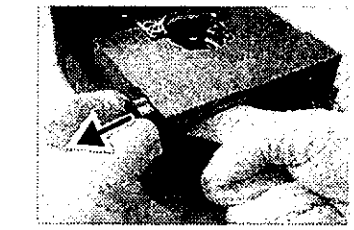
- Push out the longitudinal coil and remove one of the caps.

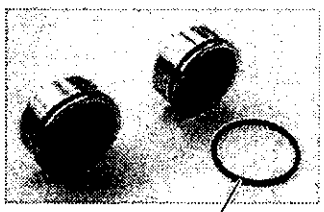
Step 519



- Take out the longitudinal coil.

Step 520

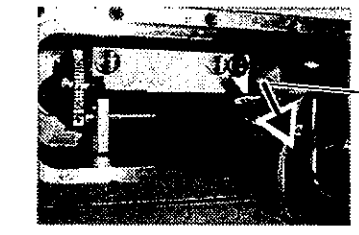




O-ring, Viton, AN 022
ø25.12 × 1.78 mm

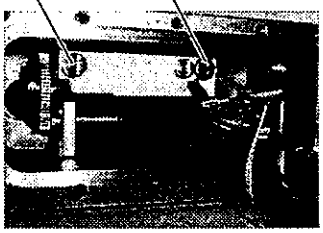
- Remove the other cap.
  Lubricate the new O-ring slightly with vacuum grease FU 090.

Step 521



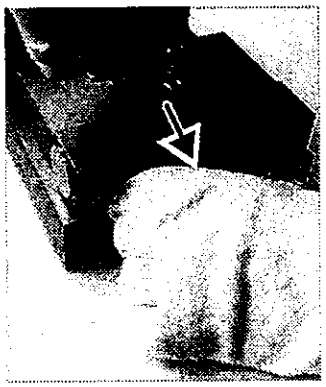
Fixation

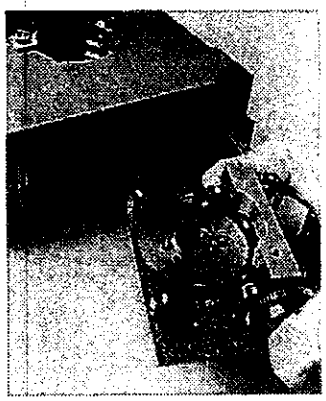
Protective ground



- Disconnect the plug connector for the protective ground and detach the crucible drive.

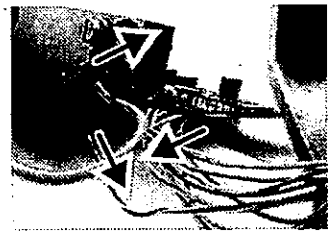
Step 522





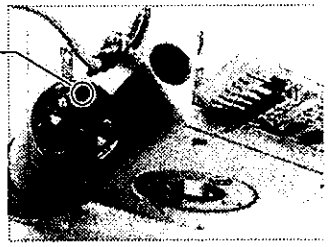
- Remove the crucible drive.

Step 523



- Disconnect the electrical connections leading to the crucible drive.

Step 524

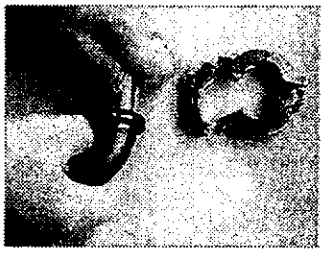


- Connect the new crucible drive. Pay attention to the polarity.

Step 525 Mount the new crucible drive by following the instructions in the reverse order.

Step 526 Mount the shaft by following the instructions in Chapter 6.2.2, steps 429 to 436.

Step 527



- Push the capillary and the electrical connection through the feedthrough. Push the water tubes individually through the feedthrough. Remount the clamped flange connection.

Step 528 Install the permanent magnets by following the instructions in Chapter 6.1.2, steps 255 to 257.

Step 529 Mount the electron beam system by following the instructions in Chapter 5.1.1, steps 130 and 131.

Step 530 Mount the crucible by following the instructions in Chapter 5.1.2, steps 158 to 160.

Step 531 Mount the ESQ 212 by following the instructions in Chapter 6.2.1 in the reverse order

7 Troubleshooting

Malfunction	Cause	Error elimination
The crucible is destroyed by the evaporation material	The beam spot is too close to the edge of the crucible	Check position of the beam spot
	Cooling is insufficient	Check water throughput (approx. 14 l/min., depending on crucible)
	Focusing is too strong	Enlarge beam spot, sweep
	Power level is too high	Reduce power
Arcs occur at high evaporation rate	Poor shielding at high voltage connections	Check the covers (see Chapter 4.7)
Arcs occur at high pressure levels	The degassing rate for the evaporation material is too high	Degas at reduced power
Evaporation material "spits" too much	Beam power density is too high	Defocus beam spot, reduce power, sweep
	Contamination	Clean crucible
Crucible rotation blocked	Material splashes between crucible and cover shields	Clean
Beam spot is asymmetrical	Electron beam system is wrongly adjusted	Adjust filament and Wehnelt plates (see Chapter 5.1.1)
	High voltage is incorrectly connected	Check high voltage connections (see Chapter 4.4)
	Filament bent	Replace filament (see Chapter 5.1.1)
Electron beam can not be sufficiently deflected	Incorrect setting at EEC 300 (EEC 420) control unit	Refer to the Instructions for the respective control unit
	Magnet field too weak	Adjust magnet shunt (see Chapter 4.6) Replace permanent magnet (see Chapter 6.1.2)
Error at cooling water circuit	Water has penetrated the drive area	Replace the shaft seals (see Chapter 6.2.2)

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8 Disposal

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⚠ DANGER

Prior to commencing work, find out about any possible contamination. Pay attention to the relevant regulations and observe the protective measures when handling contaminated parts.

8.1 General Information

The various components and evaporation materials which exist subsequent to dismantling the ESQ 212 electron beam evaporation source are divided into the following categories for disposal purposes:

- Evaporation materials
- Components that were in direct contact with the evaporation materials / process gases during ESQ 212 operation
- Other ESQ 212 components

8.2 Disposal of Evaporation Materials

Evaporation materials that are radioactive, toxic, corrosive or microbiological must be disposed of correctly in accordance with the appropriate regional regulations.

All other evaporation materials must be separated into relevant categories and brought to the appropriate depot for recycling.

8.3 Disposal of Components that are Contaminated with Evaporation Material / Process Gases

If the used evaporation materials are radioactive, toxic, corrosive or microbiological then the components must be disposed of correctly in accordance with the appropriate regional regulations.

Otherwise separate the components into relevant categories and bring them to the appropriate depot for recycling.