RFICP 140 ION SOURCE MANUAL
With
Molybdenum Two-Grid µ-Dished Collimated 14-cm High Uniformity Ion Optics

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KRI®

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LEGEND OF SYMBOLS

Warning:
Danger of High Voltage Personal Injury

Warning:
Indicates death, serious injury, or property damage can result if proper precautions ar not taken.

Caution:
Indicates some injury or property damage may result if proper precautions are not taken.

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1. SAFETY

To prevent damaging the ion optics, certain precautions must be observed. The guides to operation for the ion source and the controller should be read before attempting operation or ion source maintenance.

Maintenance and troubleshooting should be carried out by personnel familiar with high voltage procedures. If there are applicable safety procedures for the laboratory in which this equipment is installed, these procedures should also be followed.

Operation involves high voltage at the ion source and within the enclosures of the controller. Maintenance should not be attempted without assuring that the controller is disconnected from any power source, and that it cannot be accidentally reconnected while such work is being carried out. It should also be kept in mind that stored energy sources can exist within the controller even after it has been disconnected from a power source. Work with a safety cover removed or work within a controller enclosure should therefore be attempted only after the absence of stored energy has been verified, preferably by grounding the parts being worked on.

> **Warning:**
> The ion source will remain hot for some time after operating the ion source, even though the venting procedures were followed. Care should be taken to prevent injury from contact with the ion source hardware.

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2. INSPECTION AND INSTALLATION

This section describes how to install the Kaufman & Robinson, Inc. (KRI®) RFICP 140 Ion Source with molybdenum two-grid µ-dished optics. Information on unpacking and inspection, physical description, hardware inventories, and installation is provided to assist in the successful use of this ion source.

2.1 Unpacking and Inspection

Prior to shipment the ion source was inspected, tested, and shipped free of physical defects. As soon as the equipment has been unpacked, a visual in-spection should be made to determine if there has been any damage during shipment. If any damage has occurred, contact both KRI® and the shipping company to report the damage (see Warranty, Section 5). Retain packing materials in case equipment must be returned to KRI®.

Caution:
All ion source arware was cleaned prior to shipment. Use clean, lint-free gloves while handling compnents to prevent contamination.

2.2 Physical Description

2.2.1 Ion Source

The assembled ion source consists of two major sections, the matching isolation assembly and the ion source assembly. These two assemblies are shipped as one unit.

The matching isolation assembly is made up of capacitors, inductors, feedthroughs, and support hardware that is mounted on the atmospheric side of a 12-inch Conflat® flange. It provides a fixed matching network between the rf power supply and the ion source, as well as isolating the beam and accelerator power supplies from the rf in the ion source.

The ion source assembly is made up of the outer cylinder assembly, the ion optics assembly, and the dielectric discharge chamber. The ions are generated in the discharge chamber by an inductively coupled radiofrequency discharge. The ions are then accelerated into a collimated ion beam by ion optics having precisely aligned grids. A torque wrench is included for carrying out maintenance on the ion optics.

2.2.2 Power Supplies

The power supplies and their connections to the ion source are indicated in the simplified schematic diagram of Figure 2-1. The rf supply energizes the rf coil. This coil is shown displaced from the discharge chamber in Figure 2-1, but actually surrounds the discharge chamber. The beam supply is attached to the screen grid and the accel supply is attached to the accelerator grid. Both the vacuum chamber and the rack in which the power supplies are mounted should separately be connected to earth grounds. To assure correct operation, a ground connection is also provided between the power supplies and the vacuum chamber through the cables.

2.2.3 Neutralizer

The information on the neutralizer is provided separately and depends on the type of neutralizer used.

2.3 Ion Source Installation

2.3.1 Installation in Vacuum Chamber

A drawing of the installed ion source is shown in Figure 2-2. The dimensions of the major components of the ion source are indicated in this figure. A matching portion of a user-supplied vacuum chamber with a 12-inch Conflat® flange is also indicated. The end view of the matching-isolation end of the installation is shown in Figure 2-3. The normal orientation of the matching-isolation assembly is with the rf connector at the top and the gas connection at the bottom. Except for the neutralizer, all of the electrical, gas, and water connections for the ion source are shown in Figure 2-3.

2.3.2 Electrical Connections

The beam, accelerator, and rf power supplies (see Figure 2-1) are connected with cables to the screen-grid, accelerator-grid and rf connectors shown in Figure 2-3.

The fan connections for this cable are not visible in Figure 2-3, but should be readily apparent from the terminals on the cable and fan.

2.3.3 Gas Connection

The gas connection is shown in Figures 2-2 and 2-3. It requires a user-supplied matching female VCR fitting. If the user is not familiar with the special cleanliness and operation requirements for ion source gases, KRI® Tech Note TN-04 should be consulted. KRI® personnel can also be contacted to answer questions in this area.

2.3.4 Water Cooling

Water cooling can be supplied through the two 1/4” tubes, 6.35mm (0.25in) diameter, shown in Figure 2-2. Any reliable connections to these tubes (such as the Swagelok® connections shown in Figure 2-3) can be used. Water cooling is required for sustained, high power operation (above 500W rf power). Operation at lower power, or short duration operation at higher power does not require water cooling. For short-term operation at higher powers, water cooling is required if any point on the Conflat® flange attached to the matching isolation assembly exceeds 60°C. If water cooling is required, a flow of 2 liters/minute (approximately 0.5 gallon/minute) should be used at a water temperature of 20°C or cooler.

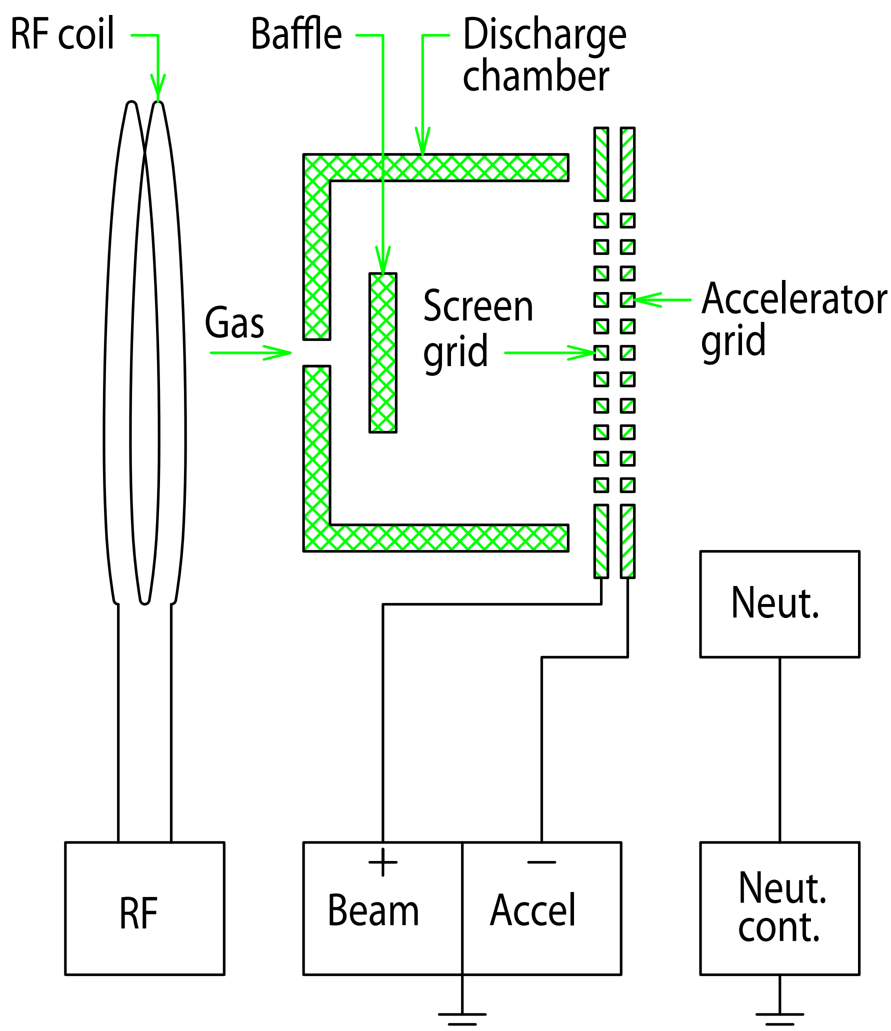

Figure 2-1. Simplified schematic diagram of assembled RFICP 140 Ion Source.

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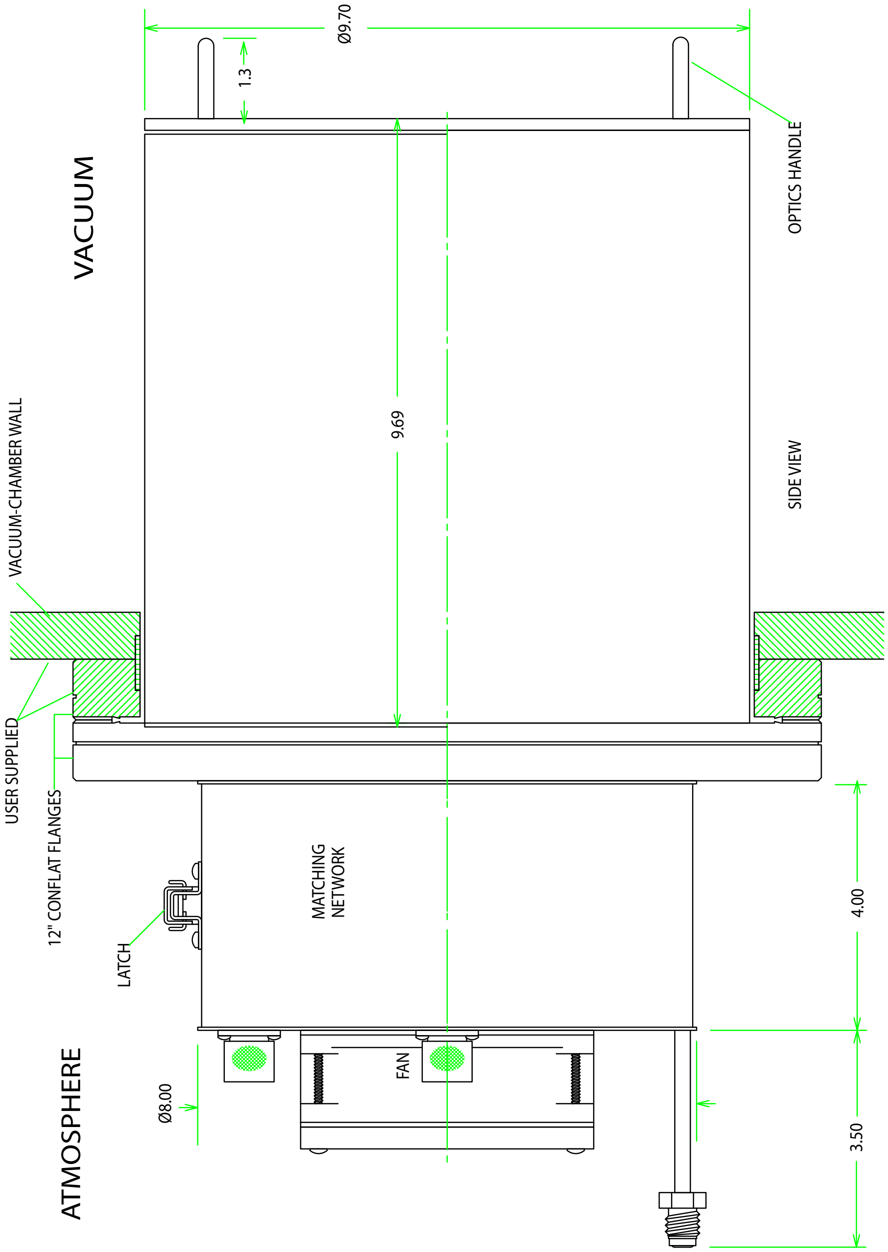

Figure 2-2. RFICP 140 ion source side view, interface control drawing.

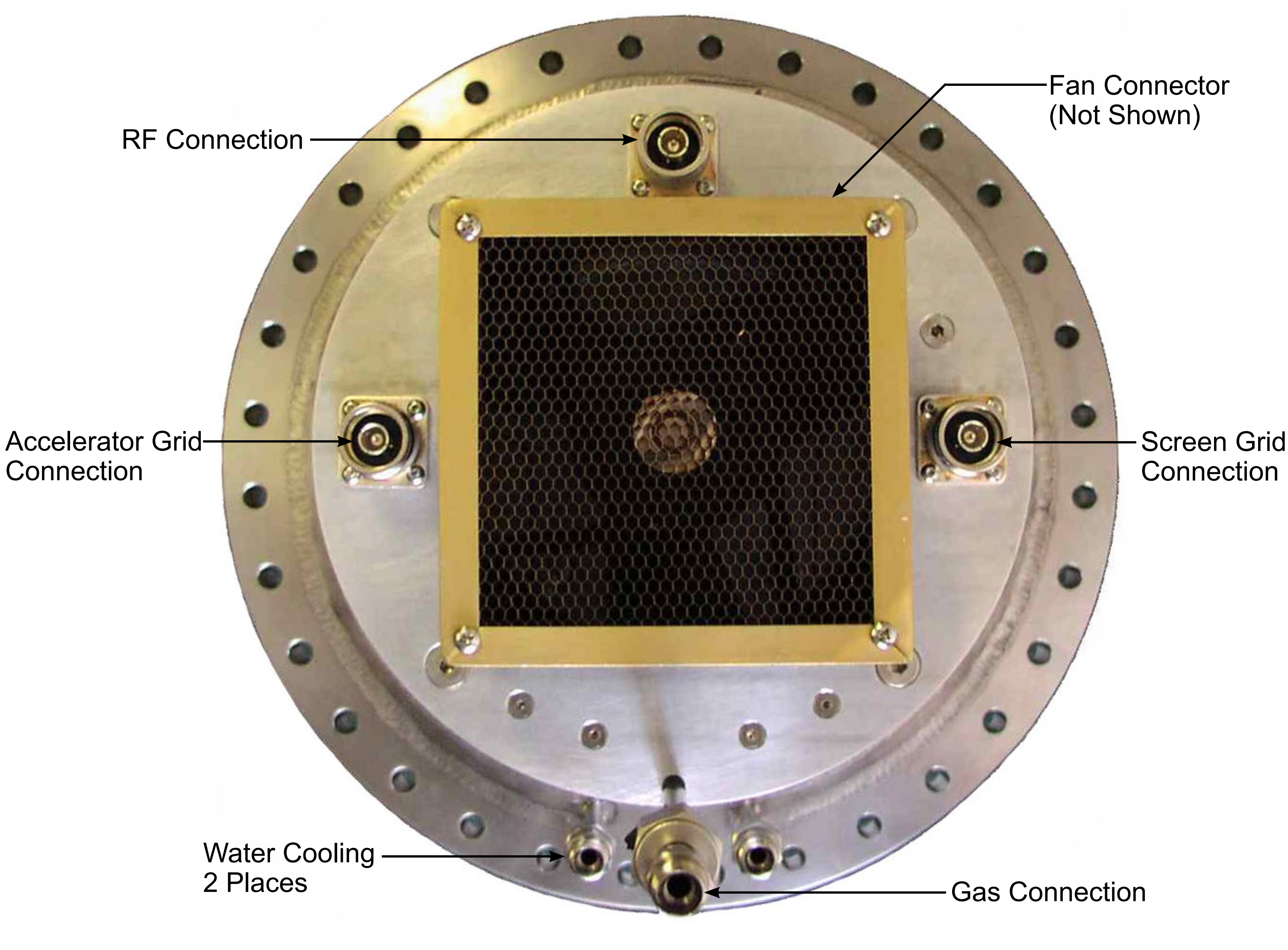

Figure 2-3. Back view of matching isolation assembly.

3. OPERATION

The performance of different ion sources will vary slightly. This is due to small differences in construction, errors in the different measurements, impurities present, or details of the particular installation. The performance presented in this section should therefore be used as only a guide.

3.1 Gas Flow

Table 3-1 should be used as a guide for choosing the correct argon flow at various background pressures in the vacuum chamber. The optimum gas flow can vary from the values shown. If there is excessive high-voltage arcing during operation, the gas flow could be either too high or too low. For oxygen, the gas flow should be about 25% greater.

Table 3-1 Argon gas flow in sccm.

Pressure, Torr	Ion beam current, mA							
	100	200	300	400	500	600	700	800
0.5×10^{-4}	18	22	26	31	37	43	50	56
1.0×10^{-4}	16	20	24	29	35	41	47	54
1.5×10^{-4}	14	18	22	27	33	39	45	52
2.0×10^{-4}	12	16	20	25	31	37	43	50
2.5×10^{-4}	10	14	18	23	29	35	41	48
3.0×10^{-4}	8	12	16	21	27	33	39	45
3.5×10^{-4}	6	10	14	19	24	31	37	43

The pressures in Table 3-1 were obtained with an ion gauge calibrated for air and corrected for argon.

3.2 Maximum Ion Beam Current

The maximum ion beam current is the *maximum* value that can be obtained without the direct impingement of energetic ions on the accelerator grid. This current is a function of the beam and accelerator voltages. The maximum ion beam currents and their corresponding beam and accelerator voltages are shown in Table 3-2 for operation with argon. Exceeding the maximum beam current for a given combination of beam and accelerator voltages will drastically reduce the grid lifetime. Exceeding this maximum can be indicated by a rise in accelerator current and excessive arcing.

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The ion beam currents listed in Table 3-2 are the *maximum* values for the corresponding beam and accel voltages. Lower values are permissible and would result in a decrease in the approximate rf discharge power.

Table 3-2 Maximum argon ion beam current

Beam, V	Accel,(-)V	Ion beam current, mA	Approx. rf power, W
100	15	15	70
200	30	45	100
300	45	110	170
400	60	150	220
500	75	200	280
600	90	225	310
700	105	290	390
800	120	330	440
900	135	440	600
1000	150	490	670
1100	165	550	760
1200	180	620	870

Electron backstreaming is the backward flow of electrons from the neutralizer to the discharge chamber and results in a false indication of ion beam current. To prevent electron backstreaming, the µ-dished molybdenum ion optics used on this ion source should not be operated with an accelerator voltage less than 15% of the beam voltage used. Note that the accelerator grid presents a negative barrier to prevent electron backstreaming. Although the accel-supply display may not show a negative sign, the voltage supplied to the accelerator grid is negative of ground.

Operation with accelerator voltages greater than 15% of the beam voltage is possible. Such operation permits an increase in maximum ion beam current for a given beam voltage, but also results in more beam divergence and some reduction in accelerator-grid lifetime. Contact KRI® personnel for further information on such operation.

3.3 Accelerator Current

The accelerator current for normal operation increases with ion beam current, accelerator voltage, and background pressure. The accelerator current for the operating conditions shown in Table 3-2 can therefore range from a couple of milliamps to tens of milliamps. In practice, changes in accelerator current are often more important than the absolute level. A gradual increase in accelerator current with no change in operating conditions can indicate insulators are being coated and maintenance should be carried out soon on the ion optics. If a new operating condition is being established, a rapid increase in accelerator current, often accompanied by frequent ion optics arcs, can indicate an excessive ion beam current is used and the new operating condition should be compared to Table 3-2.

3.4 Startup and Operation

To start and operate the KRI® RFICP 140 Ion Source, use the following steps:

1. Start the neutralizer and set the emission current equal to the ion beam current that will be used. See the neutralizer manual for details of the neutralizer operation.

   Depending on details of the installation and operating condition, the ac-tual emission may be less than the set point for emission until the ion beam is present.

2. Increase the gas flow to at least 30 sccm for starting. The value of 30 sccm may depend on the pumping capacity for the vacuum chamber, and may have to be greater for a very high pumping capacity.

3. Turn on the beam voltage and increase it to about 300 V. The accelera-tor voltage should remain at zero.

4. Set the forward power on the rf generator to 300 W.

5. Enable the forward rf power. At this point a discharge should be es-tab-lished and be evident from a low (<50 W) rf reflected power. If a dis-charge is not established, as indicated by a high (up to 200 W) re-flected power, try increasing the gas flow up to double the value from Table 3-1 or increasing the beam voltage to a maximum of 400 V.

   As soon as a discharge is established, turn off the beam power and set the gas flow to the value from Table 3-1. (If necessary, the gas flow can be varied with the ion source not operating in order to find the background pressure for a given gas flow.)

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If the ion source was exposed to atmosphere or was not operated for a long time, the inclusion of a warm up step at this point in the startup sequence can be helpful in reducing initial arcing. If this step is used, al-low the ion source and ion optics grids to warm up for 5 minutes at the rf power required for the subsequent operating condition. If that power is not known, estimate it by using 1.5 W/mA. For example, if the beam is to be at 300 mA, use 450 W for the warmup power.

6. Set the beam voltage to the value selected from Table 3-2.

   If a current limit is available for the beam supply, it should be set at a value well above the desired operating current.

7. Set the accelerator voltage to the value selected from Table 3-2. This value should be 10% or more of the beam voltage. If the beam voltage is 600 V, then the accel voltage should be equal to, or more than, 0.10 × 600, or 100 V.

   If a current limit is available for the accelerator supply, it should be set at the same value as beam supply, or as close to it as possible.

8. Turn on the beam and accel supplies at approximately the same time to start generating an ion beam.

9. Increase or decrease the rf forward power to increase or decrease the beam current to the selected value.

10. To turn off the ion source, first turn off the rf power supply, then the beam and accel power supplies and the gas flow. The neutralizer can be turned off last, turning off its power supply (or supplies) and gas flow.

Refer to the power supply manuals for automatic startup and shut down sequencing.

3.5 Ion Beam Profiles

Argon ion beam profiles are shown in Figures 3-1 through 3-3 for the operating conditions shown in Table 3-2. These profiles were obtained at 20 cm with a screened probe and corrected for charge exchange.

Energetic ions passing between the ion source and the target can have charge-exchange interactions with background neutrals, which results in energetic neutrals and low-energy charge-exchange ions. Because momentum loss is a much

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slower process than charge exchange, the energetic neutrals retain most of the original ion energies and can do most of the processing that the ions would have done. The profiles are therefore corrected to include the energetic neutrals.

3.6 Ion Beam Profile Variation

The two-grid microdished optics used on this ion source have been designed to give a collimated, uniform ion beam over a large region in the center of the ion beam. Collimation and uniformity depend on details of discharge-chamber and ion optics operation, as well as the interactions between these components. It is not possible to generate an ion beam with a high degree of both collimation and uniformity over the complete range of ion source operation. The best collimation and uniformity for this combination of ion source and ion optics are found at the operating conditions given in Table 3-2.

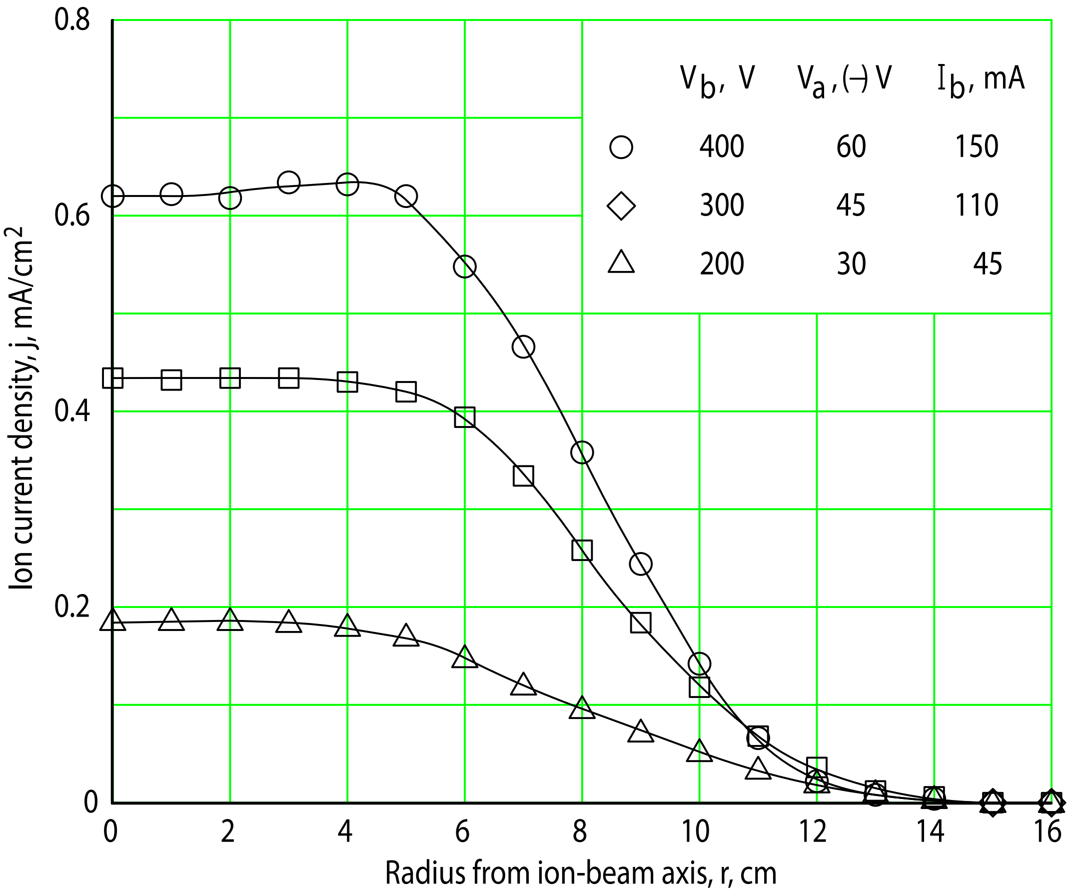

Figure 3-1. Argon ion beam profiles at a source-probe diestance of 20cm. Beam supply/accelerator supply voltages: 200/30, 300/45 and 400/60 V.

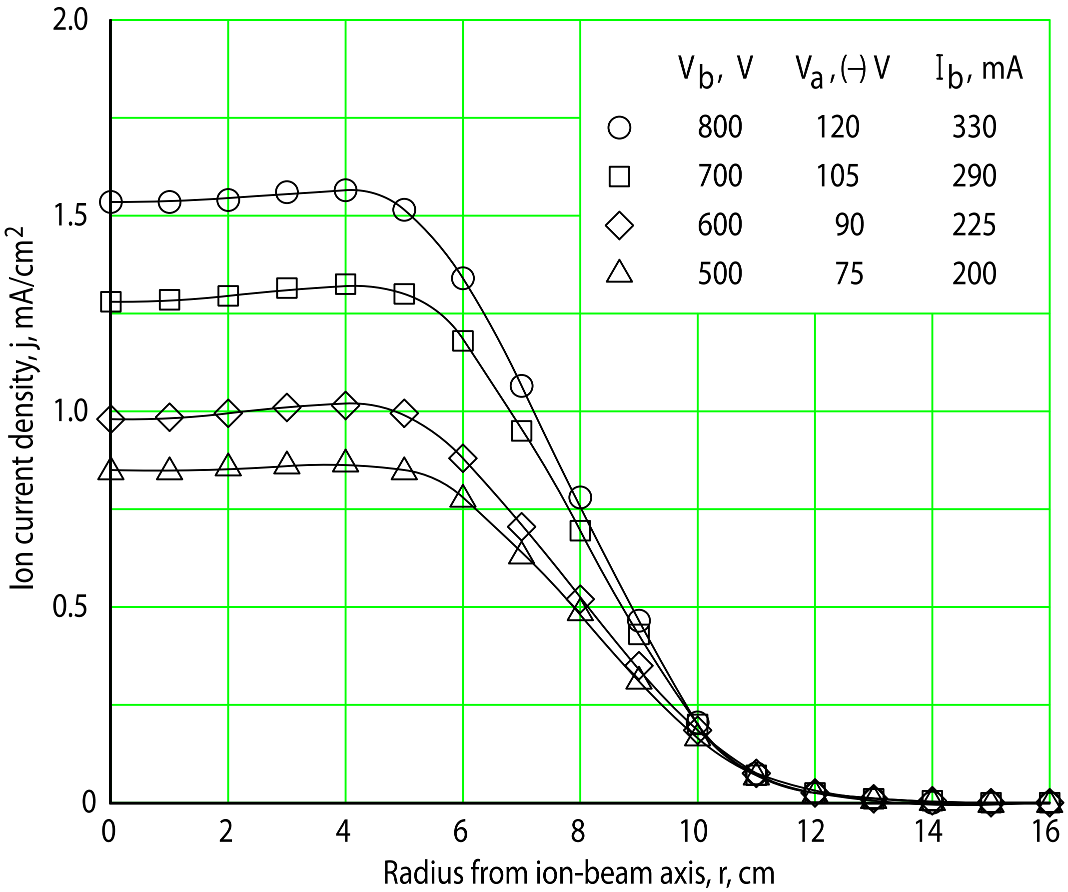

Figure 3-2. Argon ion beam profiles at a source-probe diestance of 20cm. Beam supply/accelerator supply voltages: 500/75, 600/90, 700/105, and 800/120 V.

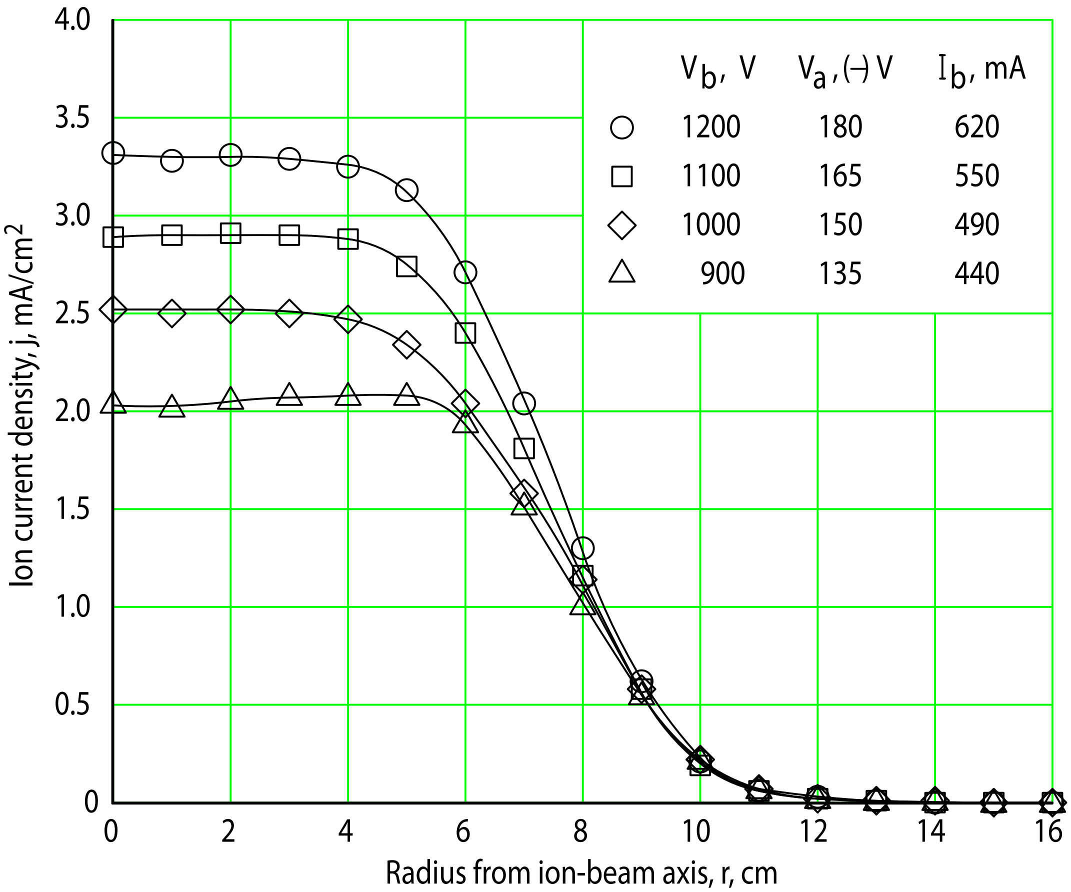

Figure 3-3. Argon ion beam profiles at a source-probe diestance of 20cm. Beam supply/accelerator supply voltages: 900/135, 1000/150, 1100/165, and 1200/180 V.

4. MAINTENANCE

Maintenance of the ion source should be carried out in an environment that is both clean and protected from accidental damage. Both the dielectric discharge chamber and the ion optics grids are fragile and easily damaged.

*Finger tightening is adequate for most threaded parts that must be removed and refastened during ion source maintenance. A wrench should, in most cases, be used only when a thread sticks. One exception is the baffle in the discharge chamber, where **only** finger tightening should be used during reassembly after maintenance. Another exception is in the assembly of the ion optics, where the use of a torque wrench (provided) is necessary to provide sufficient tightness for normal operation without, at the same time, over-tightening and damaging expensive ion optics grids.*

Alignment grooves are used to assist in the circumferential alignment of parts. Most alignment grooves are in the outer cylindrical surfaces of parts, but the alignment groove in the outer cylinder is at the ion optics end of the cylinder.

4.1 Ion Optics Maintenance

Indication of need for maintenance: Frequent current overloads (arcs) are observed in the ion optics, usually involving both the beam and accelerator supplies.

Contra-indication of need: These arcs are avoided or greatly reduced if a longer discharge chamber warmup is used, or if a gradual conditioning to higher beam and accel voltages is used. (A warmup or gradual conditioning may be helpful if the ion optics have been exposed to atmosphere for a long time, are new, have recently undergone maintenance, or have been operat-ed for a long time at lower voltages.)

Access to the ion optics will depend on the details of the installation. If there is adequate access to the ion optics without removing the ion source from the vacuum chamber in which it is installed, the ion source can be left in the vacuum chamber. If there isn't adequate access, the ion source will have to be removed from the vacuum chamber first.

The assembled ion optics, installed on the ion source, are shown in Figure 4-1. The alignment groove is shown at the top.

4.1.1 Removal of Ion Optics From the Ion Source

Before removing the ion optics, place the ion optics support jig shown in Figure 4-2, on the work surface where the maintenance will be performed. (The support jig prevents damage to the screen grid and simplifies the assembly and reassembly.) The ion optics can then be separated from the ion source after removing the two ¼-20×¾ screws shown in Figure 4-1. Place the ion optics on the support jig, with the alignment groove at the same circumferential location as alignment hole shown in Figure 4-2, so that the two alignment pins slide through the ion optics support as shown in Figure 4-3.

4.1.2 Removal of Sputter Cover

Remove the six 6-32×¾ socket flat-head screws and the sputter cover held on by these screws (Figure 4-3) to expose the 6-32 nuts, lock washers and insulators shown in Figure 4-4.

4.1.3 Removal of the Ion Optics Support

Remove the six 6-32 nuts, lock washers, and 6-32MM white insulators from the 6-32 socket flat-head screws that hold the ion optics together. Note that there are holes in the maintenance jig to insert a 5/64 inch Allen wrench to hold the 6-32 screw when removing these 6-32 nuts. This can be accomplished by sliding the ion optics and jig near the edge of the work surface, so that the Allen wrench can be inserted from the below. After the nuts, lock washers and insulators are removed, the ion optics support can be lifted off to expose the accelerator support shown in Figure 4-5.

4.1.4 Removal of the Accelerator Support

Remove the six white ball insulators (Figure 4-5). The white ball insulators have a nominal diameter of 5.7mm (.224 inches), and are used to align and maintain the proper distance between the ion optics support and the accelerator support. After, the accelerator support can be removed.

4.1.5 Removal of the Accelerator Grid

Removal of the accelerator support exposes 12 more white ball insulators, 12 partially exposed white ball insulators, and the accelerator grid (Figure 4-6). The white ball insulators are used here to help maintain proper distances between grids to insure efficient operation of the ion source. Remove the accelerator grid to continue.

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4.1.6 Removal of the Screen Grid

After the previous step, the screen grid and 24 white ball insulators are exposed. (Figure 4-7). Note the location of the ball insulators for reassembly. Removing the ball insulators and the screen grid exposes the screen support and six flat hed socket screws shown in Figure 4-8.

4.1.7 Cleaning Ion Optics Components

Grids: The material to be removed depends on the operating environment for the ion source. If buildup material is not lightly adhered to the grid, a soft brush may remove it, or ultrasonic cleaning may be effective. If buildup material is strongly adhered, chemical cleaning may be effective.

Very light (low pressure) grit blasting may be used within the beam area to remove adherent deposits, but it is easy to destroy the grids with excessive pressure. For the areas of the grids in contacts with their supports, no cleaning should be necessary. Further, any roughening of these areas on the grids can adversely affect the sliding motions due to thermal expansion and contraction that must take place between the grids and their supports.

Cleaning of the grids in etching applications can often be simplified by the proper selection of materials close to the substrates being etched. Aluminum is easy to remove chemically. On the other hand, deposits of sputtered stainless steel can be very difficult to remove.

A rinse in deionized or distilled water is recommended after cleaning.

Ion Optics Support: For the area of the ion optics support facing the accelerator support, no cleaning should be necessary. This surface should not be roughened. As long as this area is protected from damage while the rest of the support is cleaned, there should be no restriction on the type of cleaning used on the rest of the support. For example, grit blasting will not only clean the exterior surface, but will also provide a surface texture that will reduce the generation of particulates from subsequent deposition on that surface.

Sputter Cover: The sputter cover described in Section 4.1.2 can be cleaned in the same manner as the exterior surface of the ion optics support.

4.1.8 Ion Optics Reassembly

In general, reassembly is done in the reverse order described above for disassembly and shown in Figures 4-1 through 4-8. There are, however, some special considerations.

Proper orientation is obtained by rotating parts until the alignment grooves are all in the same circumferential location. The seating of the ball insulators completes the alignment of parts as the ion optics are assembled. If there is uncertainty about the screen and accelerator grids, each grid has its part number inscribed near the alignment notch.

Do not re-use ball insulators! The ball insulators (Figures. 4-6 through 4-8) may appear clean, but will have small conducting bands on the exposed portions, which will result in frequent arcing when replaced (as they will be) in other than their exact previous locations. Chemical cleaning of the ball insulators will result in less arcing than if they were not cleaned, but more arcing than if new insulator balls were used. For the highest re-liability, always use new, clean ball insulators. The 6-32MM insulators between the sputter cover and the ion optics support are less likely to cause arcing, but their cost is small and cost-effective maintenance should in-clude their replacement. Because of the need to replace insulators, the ion optics should not be taken apart after operation unless maintenance is required.

Replace the helical spring lock washers if there is any significant flattening when compared to new lock washers. The 6-32 nuts are initially installed using finger tightening. If any unusual resistance is felt when installing the nuts on to the screws, then the screws and nuts should be replaced.

When tightening the six 6-32 nuts, it is necessary to use a tightening sequence and a torque wrench. Failure to follow this procedure can result in misalignment or even permanent damage to the ion optics. The criss-cross tightening sequence used is indicated in Figure 4-9. First use this pattern to tighten to about 1.0 inch-pound (approximately 1.15 cm-kg). Then use the same pattern to tighten to 2.0 inch-pounds (approximately 2.30 cm-kg). A torque wrench is supplied with the ion source, use it! Ac-cess to both ends of a 6-32×¾ screw is obtained by sliding the ion optics as shown in Figure 4-4 close to the edge of the work surface. When using the torque wrench, it is important to turn only the torque wrench, while holding the Allen wrench in a fixed location to prevent over torquing.

The ion optics used on this ion source can provide repeatable precision alignment after maintenance and reassembly, but following the simple procedure described above is necessary for this precision realignment.

If the ion optics are not going to be used immediately in an ion source, store them where they will be protected against accidental damage or atmospheric particulates.

4.2 Discharge Chamber Maintenance

Indication of need for maintenance: The need can be shown by (a) the rf discharge power has increased 20% or more compared to the same operat-ing condition with a clean discharge chamber or (b) there is excessive flak-ing of the deposited material within the discharge chamber. The excessive flaking can be observed visually or indicated by either excessive ion optics arcing or excessive particulates on the work pieces.

Depending on the operating environment for the ion source, the inside of the chamber can become coated with either an insulating or conducting layer. If a conducting layer is deposited, the rf discharge power to maintain a given ion beam current will increase with increased operating time. This is the basis of the above cleaning recommendation if the rf power has increased by 20% or more.

4.2.1 Remove Ion Optics

If the ion optics have not already been removed, they should be removed to provide access to the discharge chamber - see Section 4.1.1.

4.2.2 Remove Discharge Chamber Retainer

Figure 4-10 shows the inside of the ion source after the ion optics have been removed. Six 6-32×3/16 screws must be removed before removing the dis-charge chamber retainer. The discharge chamber can then be removed.

4.2.3 Cleaning the Discharge Chamber

After the discharge chamber is removed from the ion source, the baffle disk should be removed from its four supports to provide access to all in-terior surfaces of the discharge chamber. The baffle disk and its four sup-ports are shown in Figure 4-11, but the baffle disk is transparent and may not show clearly in the photograph. The 6-32 screws can be cut away with a small hand power tool if the nuts have seized onto the screws. Because the dis-charge chamber and baffle are easily broken, only finger-tightening should be used when reassembling the baffle in the discharge chamber.

Either insulating or conductive deposits on the inside of the discharge cham-ber can cause flaking problems. If the coating is lightly adherent, abrasive pads such as Scotch-Brite or Bear-Tex along with abrasive cleaner can be used. If the material is strongly adherent, chemical removal is recommended.

Cleaning of the discharge chamber in etching applications can be simplified by the proper selection of materials close to the substrates or targets being etched. Aluminum is easy to remove chemically. It is also relatively easy to remove with abrasive pads. Graphite has a low sputter yield and a little carbon can usually be removed by hand - especially if it is mixed in with other materials that are lightly adherent. Carbon, by itself, can also be removed by operating the ion source for a short time on oxygen. On the other hand, deposits of sputtered stainless steel can be very difficult to remove from the inside of the discharge chamber.

4.2.4 Reinstalling the Discharge Chamber

The inside of the ion source with the discharge chamber removed is shown in Figure 4-11. The small opening at the rear of the discharge chamber must go over the end of the gas line isolator assembly on the axis of the ion source. (The gas line isolator assembly is also shown in Figure 4-11.) The rim of the discharge chamber fits inside the discharge chamber spac-er and is held between the spring fingers shown in Figure 4-11 and the reinstalled discharge chamber retainer.

All six 6-32×3/16 screws that hold the discharge chamber retainer in place cannot be installed at the same time unless the retainer is correctly oriented, with the inside flange facing you and the alignment groove in it circumferentially aligned with the other alignment grooves.

Only finger tighten the 6-32×3/16 screws in the discharge chamber retainer. If you over tighten these screws you can damage the ion source by preventing normal relative motion due to thermal expansion or by having a screw seize during the next disassembly.

4.3 Other Maintenance

4.3.1 Gas Line Isolator Assembly

This assembly contains a ceramic isolator that is easily broken. In the unlikely event that maintenance is required, a wrench should be used close to the Conflat® flange, as indicated in Figure 4-12. Because this assem-bly carries the gas flow and should not leak, as well as it being cooled by the flange with which it is in contact, the use of a wrench is necessary and appropriate.

An indication of isolator failure would be persistent current overloads of the ion beam supply that are not corrected by performing maintenance on the ion optics and the discharge chamber. Initially, the current overloads may occur only at the highest beam voltages, but as the isolator degrades, the overloads will occur at lower voltages. A supporting indication of isolator failure would be an etched appearance of the end of the assembly that is inside of the discharge chamber together with deposition on the back side of the baffle. A possible cause of isolator failure could be the use of gas line tubing that has not been cleaned on the inside surfaces. If the user is not familiar with the special cleanliness and operation requirements for ion source gases, KRI® Tech Note TN-04 should be consulted. KRI® personnel can also be contacted to answer questions in this area.

4.3.2 RF Feedthroughs

Figure 4-11 shows the inside of the ion source after the ion optics and discharge chamber have been removed. The two larger feedthroughs carry the rf power to the ion source. There should be no reason to tighten these connections in normal use. However, if they are tightened for some reason, the center conductors in these feedthroughs are made of copper and the threads on both sides of the Conflat® flange are very easy to strip.

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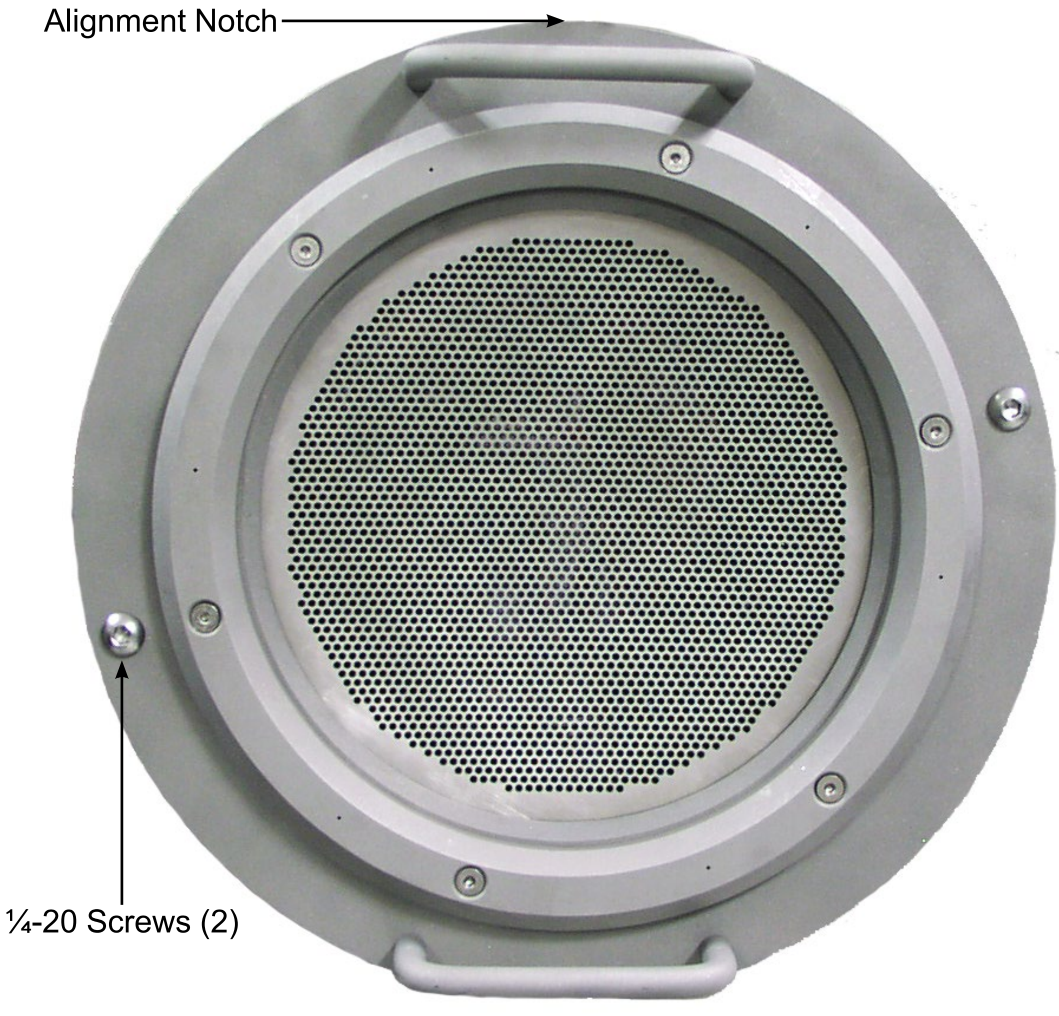

Figure 4-1. Ion optics attached to source.

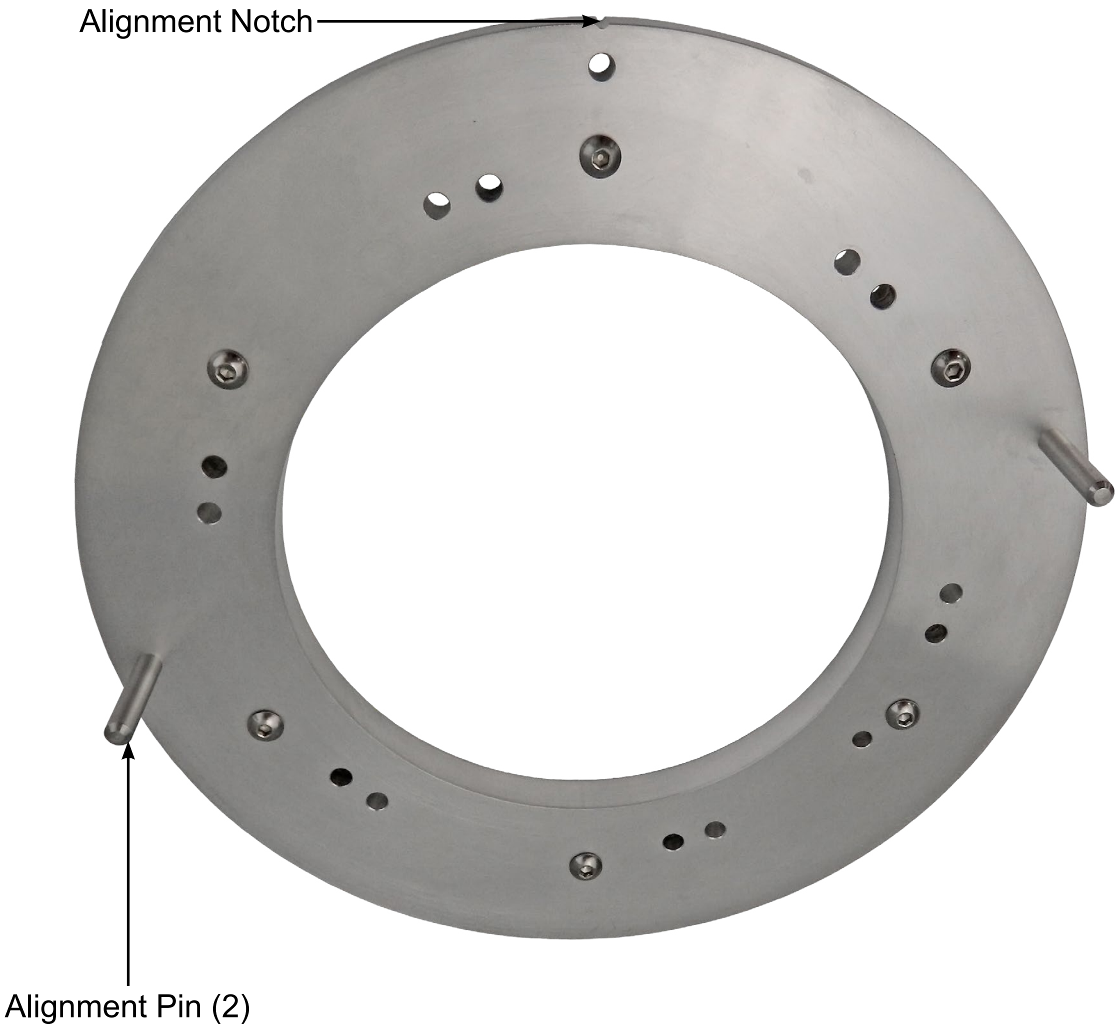

Figure 4-2. Ion optics suppor jig.

Figure 4-3. Molybdenum two-grid shallow dished optics, placed on support jig to start disassembly.

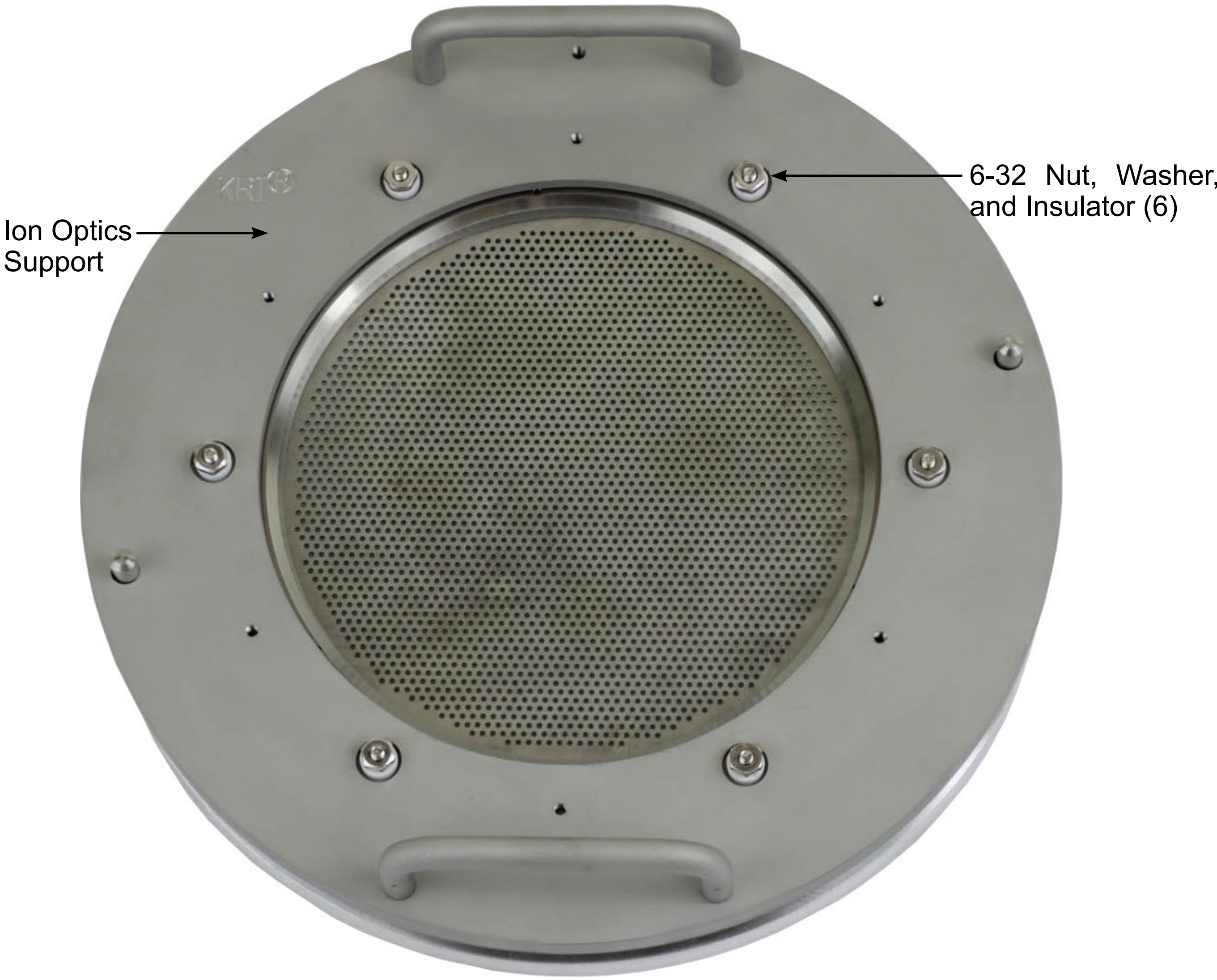

Figure 4-4. Ion optics with sputter cover removed.

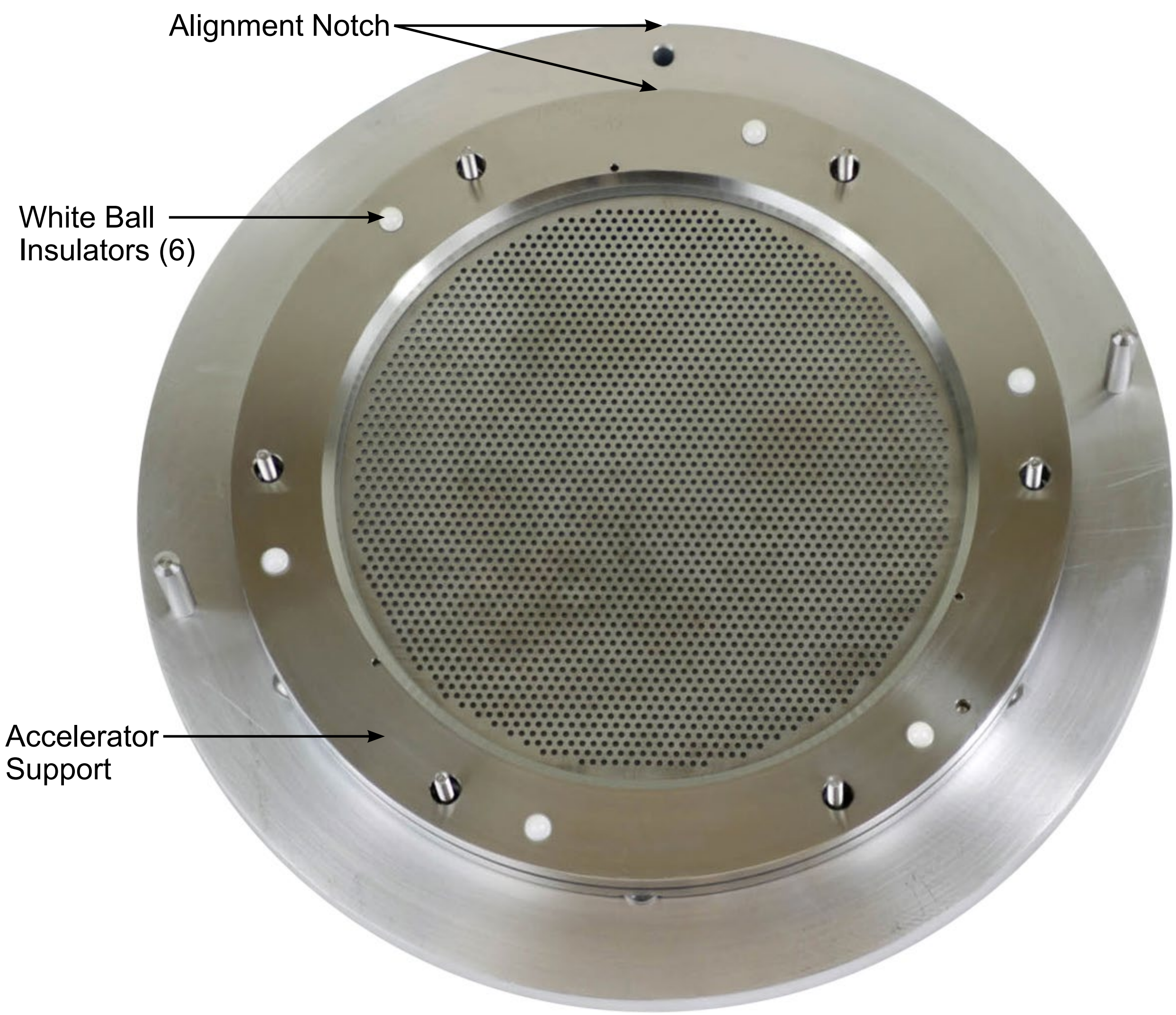

Figure 4-5. Ion optics with support plate removed.

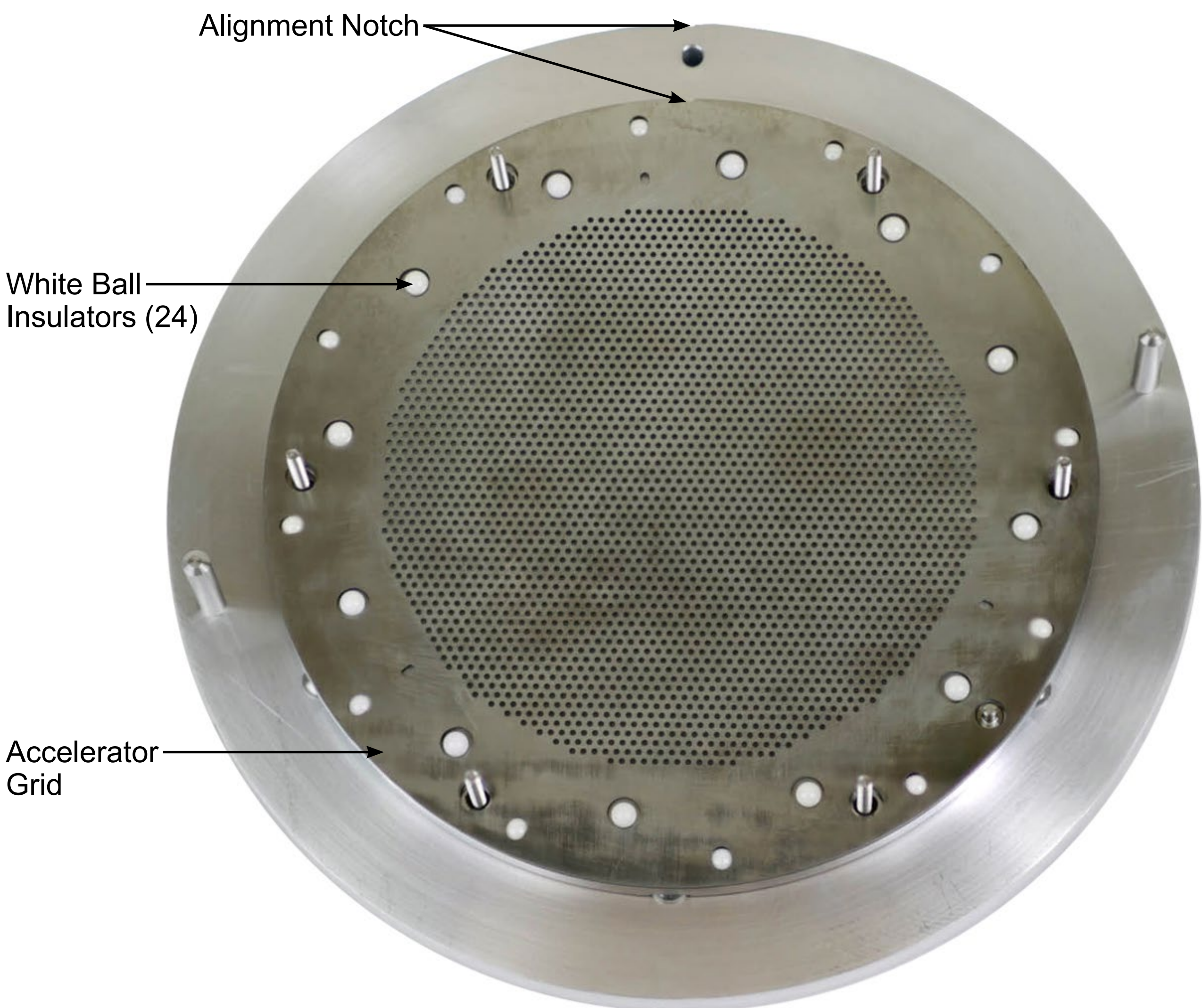

Figure 4-6. Ion optics with accelerator support removed.

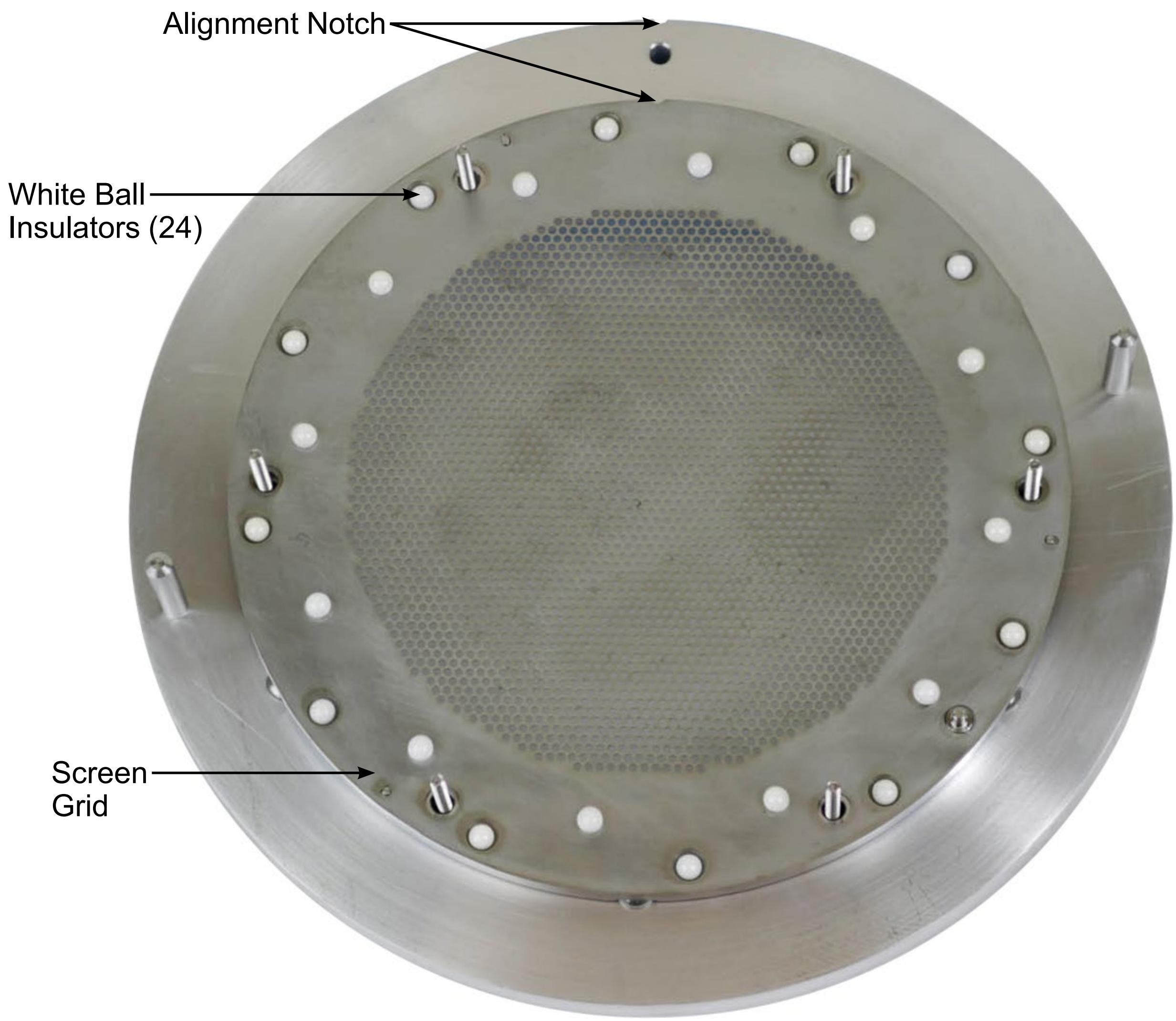

Figure 4-7. Ion optics with accelerator grid removed.

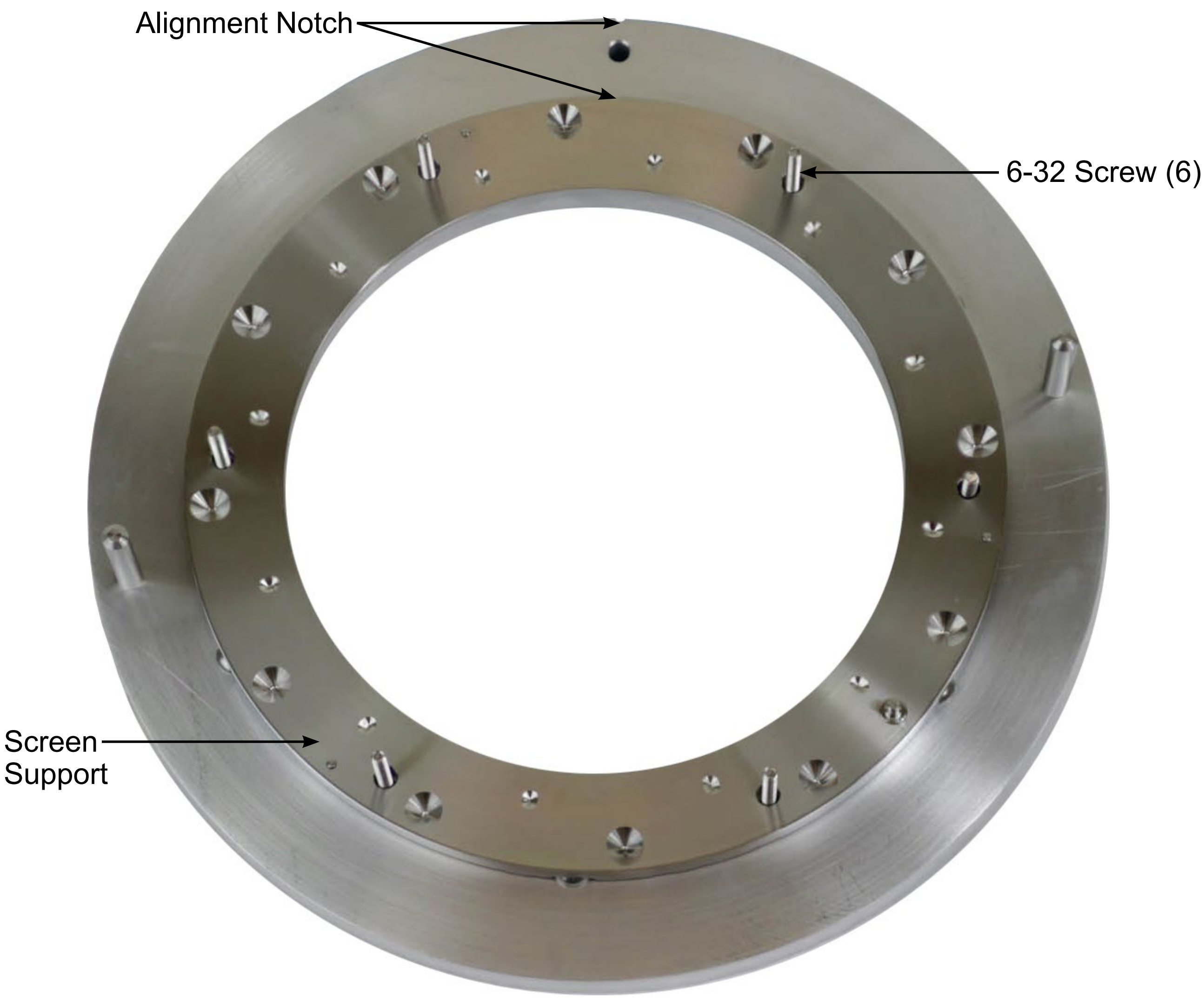

Figure 4-8. Ion optics with screen grid removed.

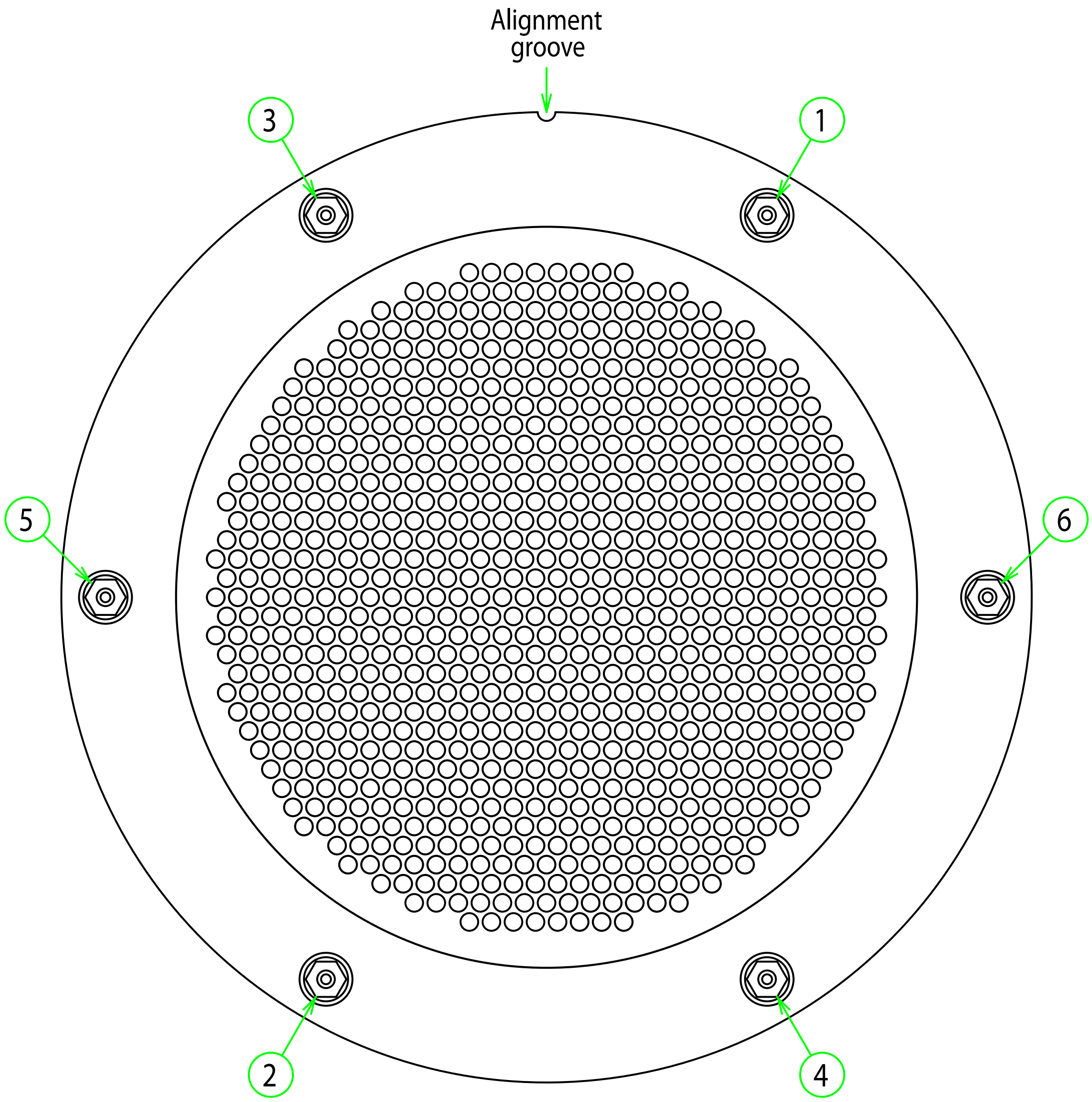

Figure 4-9. Tightening sequence.

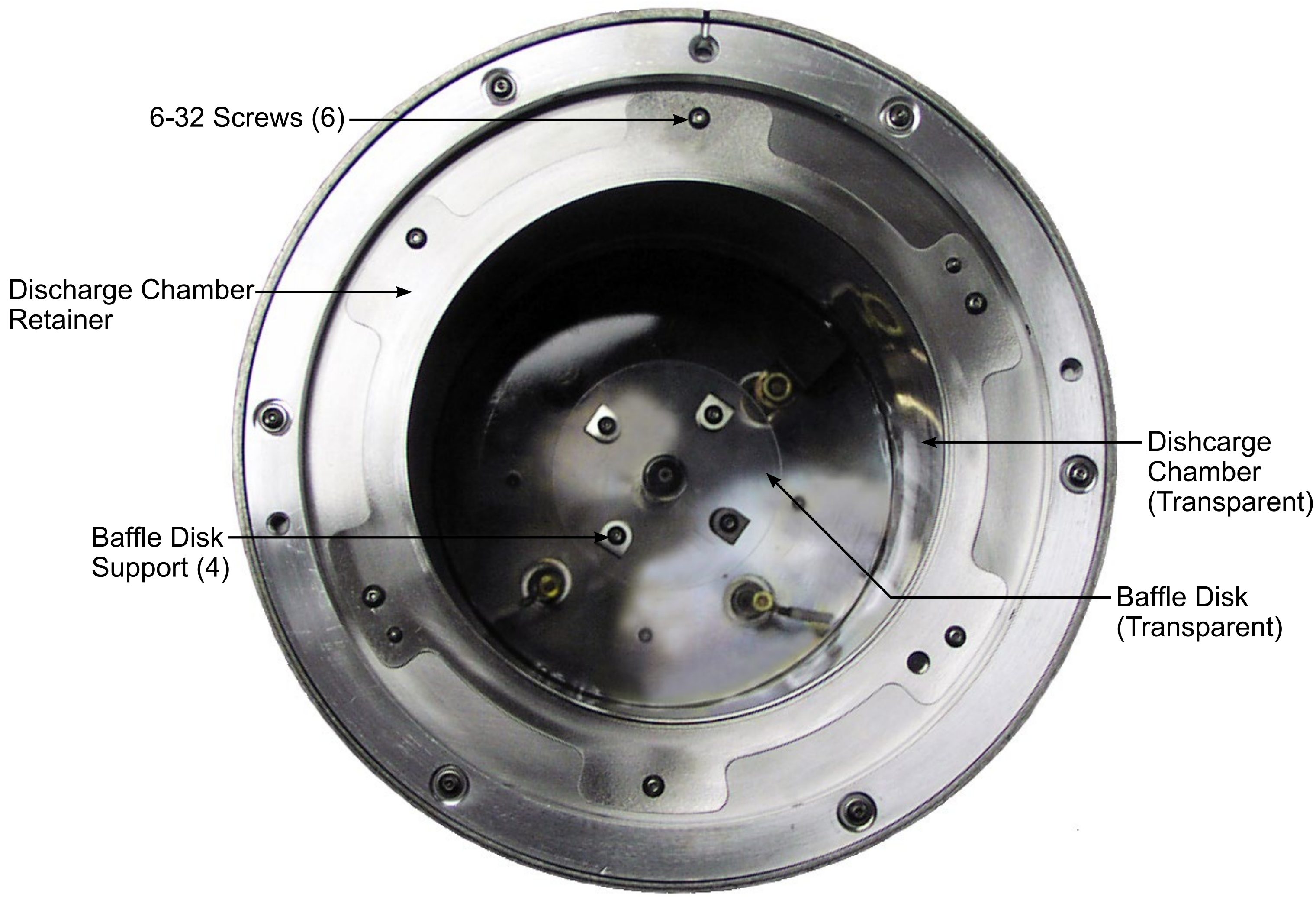

Figure 4-10. Ion source with ion optics removed.

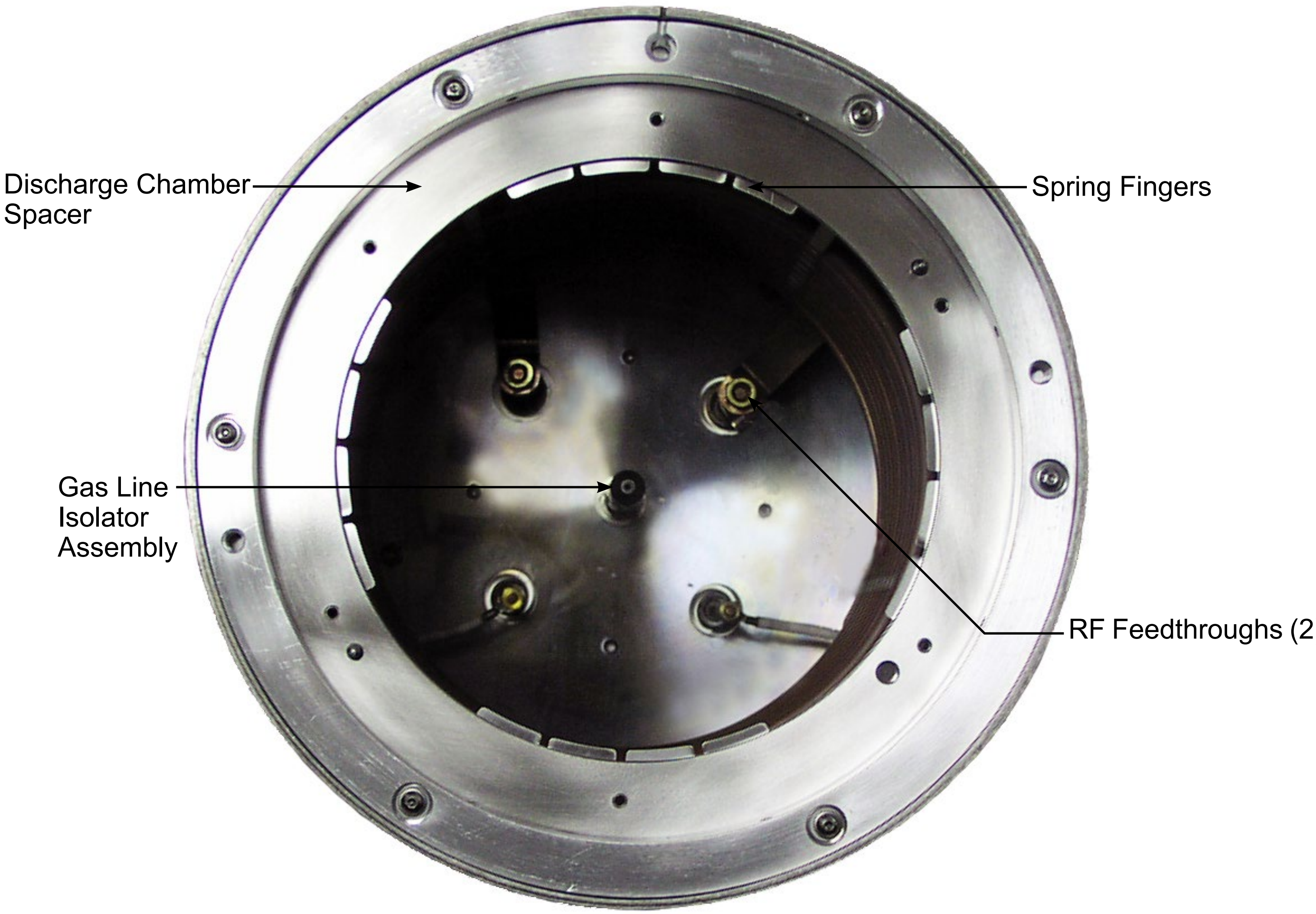

Figure 4-11. Ion source with ion optics, discharge chamber retainer, and discharge chamber removed.

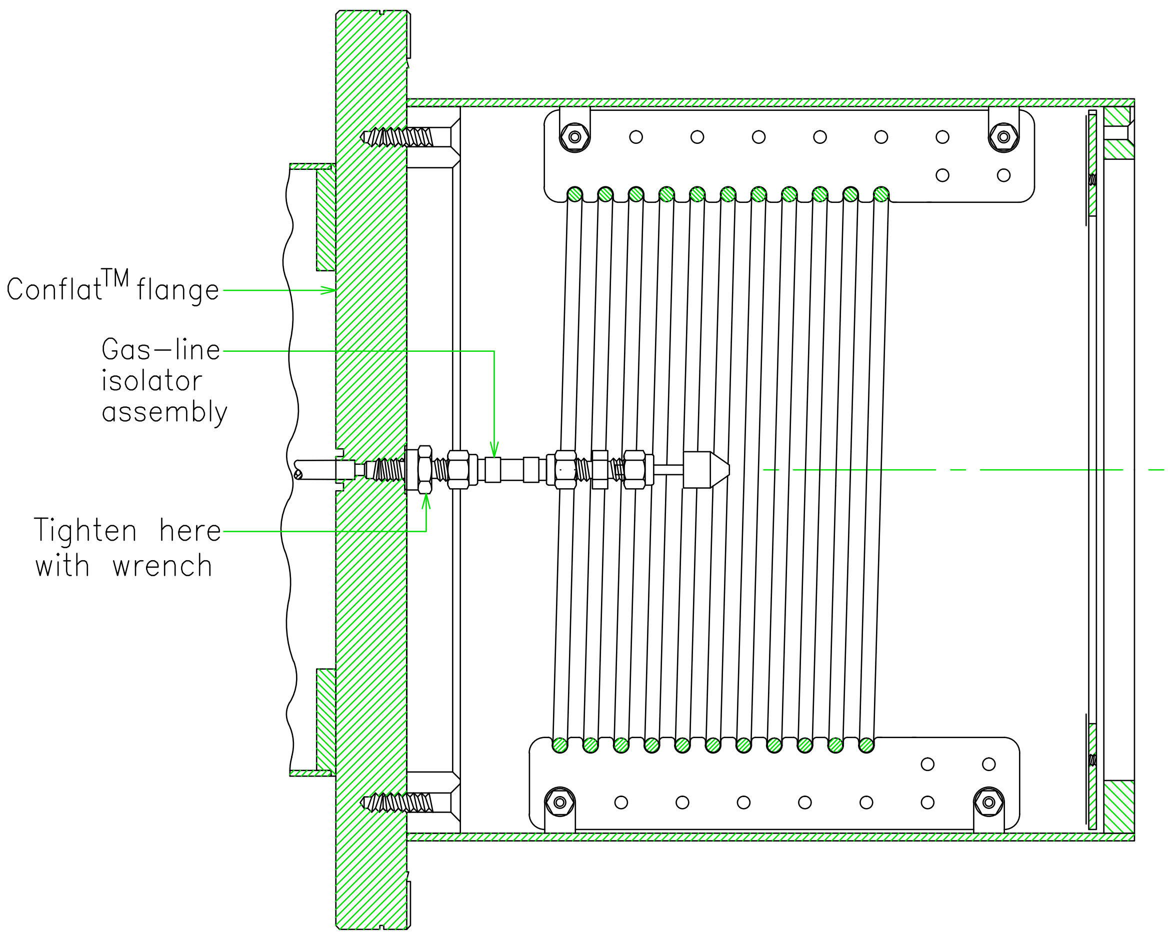

Figure 4-12. Cross section of the ion source shown in Figure 4-10, showing the gas line isolator assembly.

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Tel: 970-495-0187, Fax: 970-484-9350, Internet: www.ionsources.com

5. WARRANTY

The Model RFICP 140 Ion Source is warranted for one year against manufacturer defects in materials or workmanship. The warranty for the controller of that ion source is described in the manual for that controller. The warranty for the neutralizer and its controller is described in the manual(s) for that equipment. This year starts with the date of shipment to the end user, provided in the event of OEM purchase that date of shipment is not later than three months after the original shipment from KRI™, and also provided the equipment has been operated and maintained according to the procedures described herein. KRI™ will service and at its option repair or replace defective parts, free of charge during the one-year warranty period, at the KRI™ facility. This warranty excludes failures or defects resulting from misuse or unauthorized modification. The warranty does not cover expendable parts, which are as follows:

Dielectric discharge chamber
Ion optics grids
Alumina insulators (including ball insulators used in the ion optics)
Gas-line isolator

This warranty supersedes all other warranties expressed or implied. KRI™ assumes no liability for damages or loss of production. Report defects or problems to KRI™ immediately. For return of equipment for repair, contact KRI™ to arrange for a return materials authorization (RMA) number prior to shipment of the equipment to KRI™ facilities.

For service or repair, contact KRI™ at:

Kaufman & Robinson, Inc.
1330 Blue Spruce Drive
Fort Collins, CO 80524
Tel: (970) 495-0187
Fax: (970) 484-9350

Please include the following information relating to the defect and the item to be returned:

Product
Serial Number