Notice

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Specifications are subject to change without notice.

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Overview

The MAX300™-IG process mass spectrometer is designed for operation by users with no previous mass spectrometer experience. A quadrupole mass spectrometer comprises the MAX300™-IG's analyzer section. This device performs ionization, mass filtering, and detection of specified gas and vapor components. The enclosure includes vacuum pumps (both mechanical and turbomolecular), the quadrupole controller (QC) and the vacuum chamber. The embedded local server, mounted on the door of the enclosure, operates the mass spectrometer, performs the analysis and communicates data.

MAX300™-IG Hardware Maintenance

The vacuum chamber has five all metal sealed high vacuum ports to connect components to the chamber. The ionizer assembly, detector and turbomolecular pump use 4 1/2inch flanges to connect to the chamber. The RF (electrical) connection for the quadrupole is a 3-3/8 inch flange on the top of the chamber. A port for the vacuum gauge is on the chamber side, in line with the turbo pump. To ensure proper operation, maintenance of the mass spectrometer hardware is required.

Venting the Vacuum System

Required Tools

- (1) Flat blade screwdriver, ¼ inch

To perform maintenance on the pumps or components within the vacuum chamber, the system must be cooled down and vented.

1. With the control software, choose *Control Parameters* under the *Configuration Tab*.
2. To turn off the *Filaments, Multiplier* and *Ion Gauge,* remove the check in the boxes next to them.
3. Under *Ionizer*, note the original temperature and set the *Temperature Setpoint* to 0^{o}C.
4. Set the sample inlet valve to a stream not containing condensable components. The zero gas is usually suitable.
5. On the transfer line heater control panel, switch off the transfer line heater.
6. Unplug the heater, which is bolted to the ionizer flange and plugged into a plastic connector directly behind the ionizer, Figure 1.

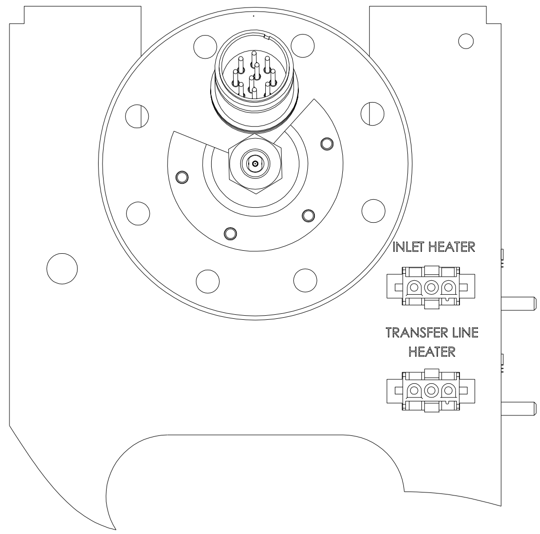

Figure 1: Ionizer Flange

7. Open *Instrument Status* and monitor the ionizer temperature.
8. When the ionizer temperature is below 100°C, remove the electronics power by unchecking the box for *Power* in the *Control Parameters* section of the *Configuration Tab*.
9. Turn off the pumps via the *Vac System & AC* switch visible in Figure 2 below.
10. Turn off the *Heater* switch also visible in Figure 2.

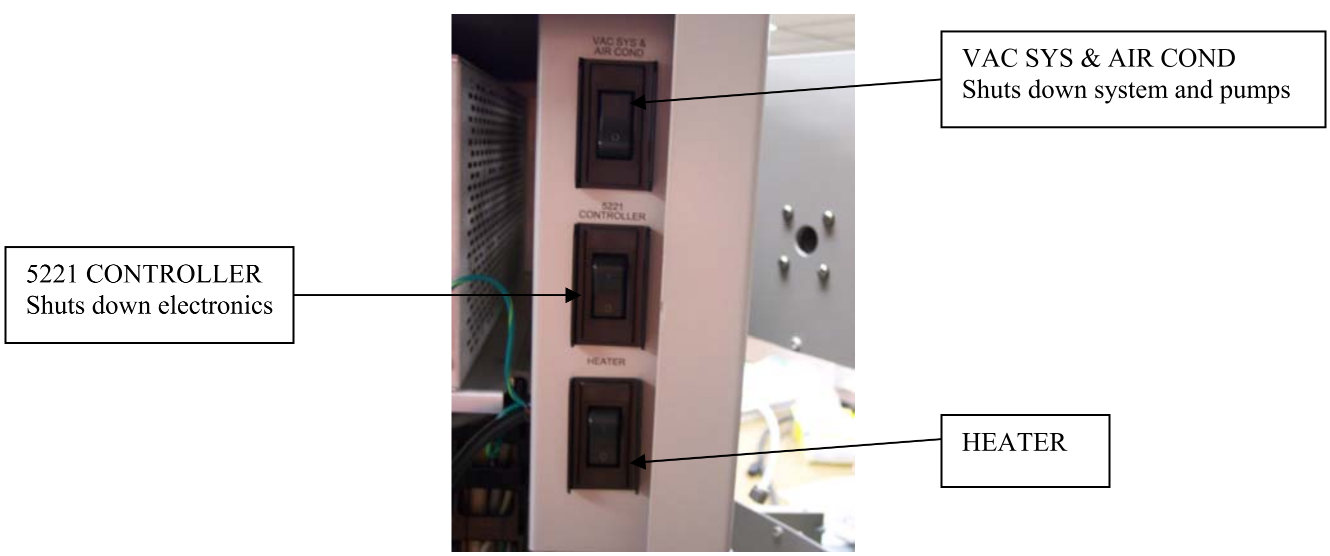

Figure 2: Enclosure Switches

Vacuum Pumps

To maintain a high level of vacuum within the chamber, a Pfeiffer Duo 2.5 mechanical pump and a Pfeiffer TMU 071 turbo pump are used. The turbo pump is connected directly to the vacuum chamber, while a mechanical (roughing; fore) pump is connected to the turbo pump. The standard system is provided with a 60 L/s (N_2) turbo pump and a 1.4 CFM rotary vane pump. Figure 3 shows the location of these components.

Note: Pump vendor and/or specifications are subject to change without notice.

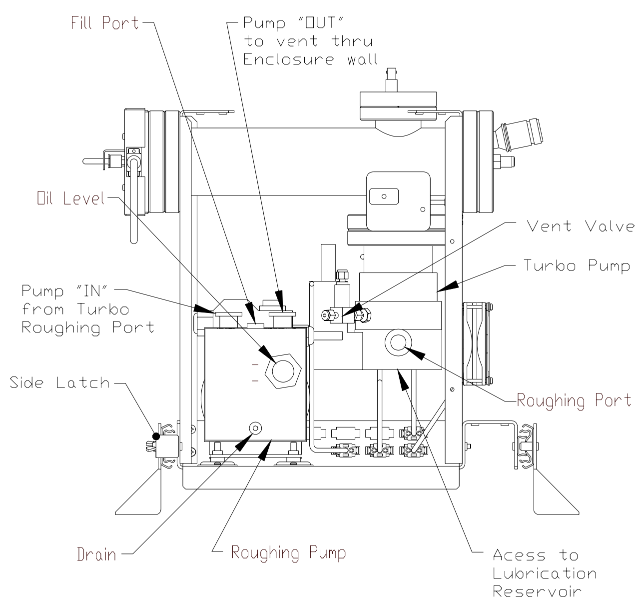

Figure 3: Pump Configuration

Note: Pump oil is considered a hazardous material and requires proper disposal procedures that conform to local regulations.

Pump Maintenance

Turbomolecular Vacuum Pump

Required Tools

- (2) Flat Blade Screwdrivers.
- (1) Turbo pump oil wick replacement
- (1)Turbo pump service tool
- (1) Small mirror (optional)

The turbo pump oil should be changed at least every year, as recommended by Pfeiffer. Before changing the turbo pump oil, vent the vacuum system as described previously. The oil is changed by replacing a self contained oil wick, included in the spare parts kit. Remove the rubber feet from the bottom of the turbo pump by unscrewing and discarding them. Engage the holes in the plastic plate on the bottom of the pump, Figure 4, with the pins on the provided service tool and unscrew the plate. The seal is made by an O-ring and the plate should be removable by hand. Wipe the plate clean of old oil using a lint free cloth and set aside.

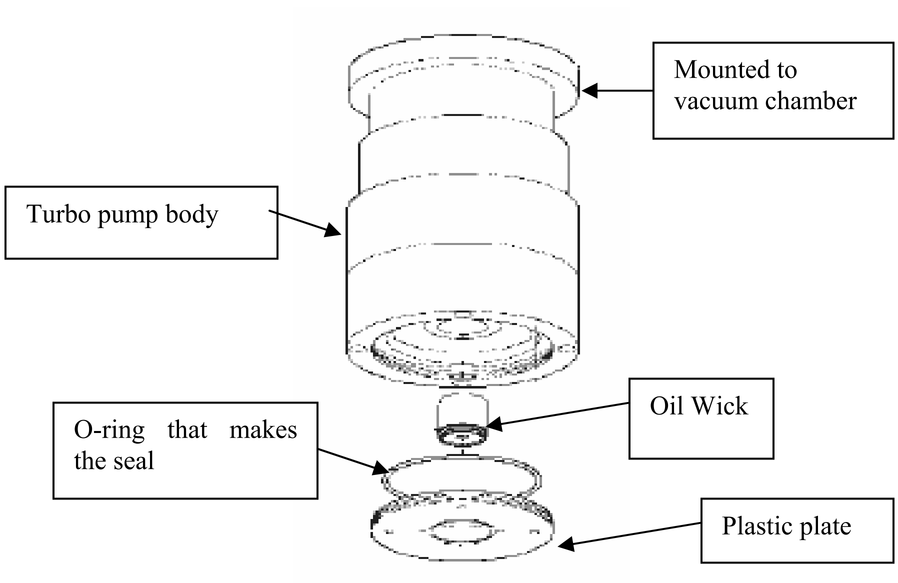

Figure 4: Turbo Pump

The lubricating oil for the pump is contained in an absorbent felt cup oil wick mounted in a plastic housing fitted into the bottom of the pump. The housing has a groove near the exposed end that can be used to pry it out of its recess. A small screwdriver is most often used for this procedure. When removing the oil wick, do not touch anything inside the turbo pump. Once the old oil reservoir is removed, wipe the old lubricant from the pump with a lint free cloth.

When inserting the new oil wick, take extreme care to not push it too far into the pump. This can result in pump failure. Insert the new oil wick into the bottom of the pump by seating it on the plastic plate until it is held in place by its O-ring. The lubricant reservoir is pre filled with the correct type and amount of oil. Do not add additional lubricant.

Screw the plastic plate back into the pump bottom. To avoid crossed threads, initially rotate this plate *counter* clockwise until a click is felt, and then reverse direction. If the plastic bottom is not properly seated, a leak could occur and result in pump failure.

For additional information or recommendations, please contact Pfeiffer directly.

Mechanical Vacuum Pump

Required Tools

- (1) Oil Catch Pan
- (1) Flat Blade Screwdriver
- (1) 5mm Hex Key (Allen Wrench)
- (~500 ml) Roughing pump oil

Extrel CMS recommends that the oil in the roughing pump for the MAX300™-IG be changed every six months or if the oil is darker than a light amber color. The rate of oil deterioration will vary depending on the application. The first step in this procedure is to vent the vacuum system as described previously.

Both the roughing pump and its oil will be hot (up to 80^{o}C). After venting the system, **disconnect the inlet line from the enclosure wall** and release the slide latch on the left side of the *VacTrac* assembly. Pull the *VacTrac* out of the enclosure far enough to place a catch pan under the drain plug of the roughing pump. The capacity of this pan should be considerably larger than the 450 ml (2 cup) capacity of the pump, shown in Figure 5.

Figure 5: Roughing Pump

Using a 5mm hex key, remove the drain plug on the front of the pump to allow the oil to drain into the catch pan. Loosening the fill plug will speed oil drainage. Once the oil has drained out of the pump, re-install the drain plug and tighten it. Note the color of the oil. If any of the following colors are present, be sure to flush out all of the old oil during the oil change:

1.) Yellow : Pump needs new oil (approximately six months of use)

2.) Dark Yellow : The oil should have been changed a few months ago. If this is the color of the oil in a six month period, there may be a slight leak in the vacuum system. Check periodically to make sure that the oil does not change in color again.

3.) Amber : A pump failure may be imminent. Check the pump oil every month.

Remove the oil fill plug located on top of the pump. Carefully pour new vacuum pump oil (appropriate for the pump and application) through the fill plug opening until the oil level in the site glass window is between the fill lines on the pump housing. Lastly, re-install the fill plug, remove the catch pan and properly dispose of the used pump oil.

Inlet Valves

The sample selection valve, the heated transfer line, and the inlet assembly deliver the sample stream to the instrument for analysis. The sample selection valve is used to select the sample stream to be analyzed while the transfer line connects the output of the desired stream to the pressure reduction system and the inlet assembly. The tee of the inlet is used to remove excess sample and decrease inlet clearing time. A small portion of the sample stream flows through the heated transfer line, into the inlet, and is admitted into the mass spectrometer. A flow switch (50 cc/min) is used to monitor for loss of sample flow at all times.

The transfer line, tee and inlet assembly can be heated to prevent condensation of stream components as the sample is transported into the mass spectrometer. The transfer line can heat the tubing from room temperature to 300°C. A heater located around the inlet heats the assembly.

The inlet requires no regular maintenance. The size of the fused silica inlet restrictor is dependent on the application. Particulates in the sample stream may clog the assembly and force it to be changed.

Changing the Inlet

Required Tools

- ¾ inch Open End Wrench
- 5/8 inch Open End Wrench
- 9/16 inch Open End Wrench
- 3/16 inch Open End Wrench
- 9/64 inch Hex Key
- Ohm Meter

The first step to changing the inlet is to properly vent and cool the vacuum system. Disconnect the *VacTrac* from the enclosure wall feed through and slide it out of the enclosure.

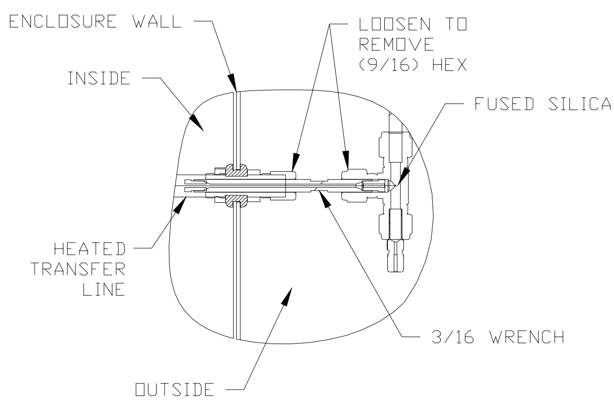

Figure 6: Inlet

The input end of the transfer line is held in place by two fitting nuts located in the external valve enclosure. Loosen the two nuts shown in Figure 6 above and carefully slide the transfer line through the fitting on the enclosure wall. A short length of the fused silica restrictor will be visible. This is the sampling point for the mass spectrometer, so be careful to not clog or contaminate this critical region.

After sliding the *VacTrac* out of the enclosure, disconnect the transfer line heater's power and thermocouple connections. The heater power connector is located on the chamber support structure just below and behind the ionizer flange. The thermocouple connector is located on the back of the transfer line temperature controller located in the same area.

Remove the inlet heater from the ionizer mounting flange. The inlet heater is attached to the flange by four (9/64 Hex Key) screws at the base of the heater that thread directly onto the flange, shown in Figure 7.

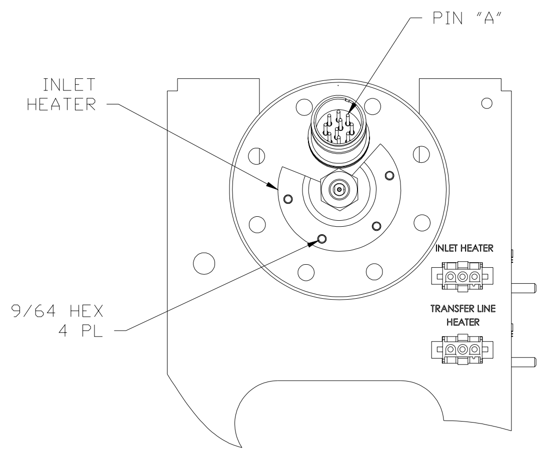

Figure 7: Inlet Mounting

Once the flange has cooled, remove the inlet by loosening the large central fitting on the ionizer flange. The hex closest to the flange (5/8 inch) is welded on. The outer hex nut (3/4 inch) can be rotated counterclockwise to loosen the fitting and remove the inlet. Be careful when loosing this fitting that the wrench does not contact the ten pin vacuum feedthrough and damage it.

Withdraw the inlet from the flange and remove the nonreusable metal gasket. A short length of the fused silica restrictor will be visible, as in Figure 8 below. Avoid clogging or contaminating this critical region.

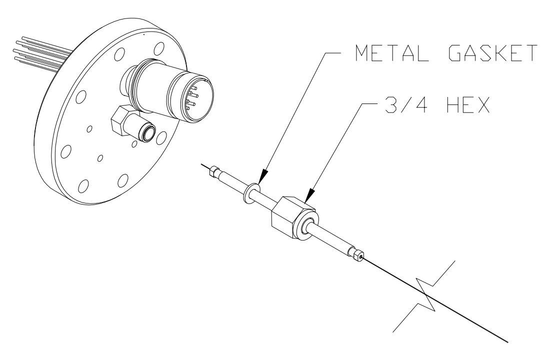

Figure 8: Inlet

Verify that the replacement inlet has a new metal gasket in place. Slide the end of the inlet into the flange fitting and tighten the nut ¼ turn past finger tight. Before finishing the installation of the sample line, check that the new inlet is not touching the ion region. Use an ohm meter to verify that pin "A" on the ionizer feedthrough is not shorted to ground. Replace the transfer line heater and thermocouple connectors. Reinstall the inlet heater onto the ionizer flange and plug its heater into the connector on the chamber support. Slide the *VacTrac* back into the enclosure and engage and lock the latch on the left side.

Thread the sampling end of the inlet through the fitting on the enclosure wall. Tighten the ¼ inch nut (9/16 hex) that secures the transfer line to the enclosure wall. Carefully insert the end of the transfer line into the sampling tee fitting until it stops and tighten the ¼ inch nut (9/16 hex) that secures it in place.

Sample Stream Rotary Inlet Valves

Sample introduction into the enclosure is performed by rotary valves. During the life of the rotary valve, a few common problems that may arise.

No flow

- A pressure of 5 PSIG above atmospheric pressure is usually sufficient to establish flow. Sampling sub atmospheric streams requires special techniques. If the sample line is not at sufficient pressure, the valve will not register flow.
- Each inlet to the rotary valve is equipped with a filter. If it becomes clogged, it should temporarily be removed. Do not operate continuously without a filter. Any particulates present in the sample will drastically shorten the valve's life.
- If the actuator loses proper alignment with the valve body, it may resemble a blocked valve.

Valve will not rotate

- May result from an improperly connected valve actuator, either the DC power cord or the *Serial COM* cable (three pin push on connector) that commands the actuator.
- A faulty valve actuator.
- A valve rotor that has seized.

Valve selects the wrong stream

- Indicates a problem with valve alignment. Refer to the *Multiposition Electric Actuator Instruction* manual for the procedure to align the valve.

- A badly scored rotor will allow "cross talk" between adjacent streams.

Analyzer Assembly

Contained within the vacuum chamber is the actual chamber assembly. This assembly consists of the ionizer, quadrupole mass filter, and detector, as in Figure 9.

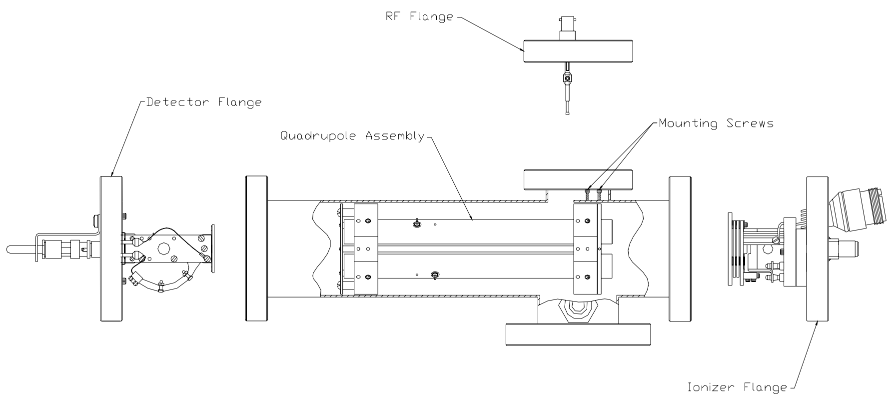

Figure 9: Analyzer Assembly

Ionizer and Filaments

The MAX300™-IG ionizer assembly, depicted in Figure 10, includes the most frequently serviced components of the ionizer into a single removable module. This module includes two filaments, the ion region and the lens stack.

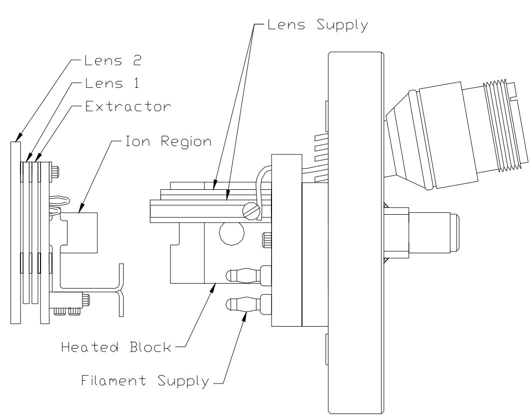

Figure 10: Ionizer

The ionizer assembly used in the MAX300™-IG has been designed for easy installation and servicing. Figure 11 below depicts the ionizer assembly mounted on the flange.

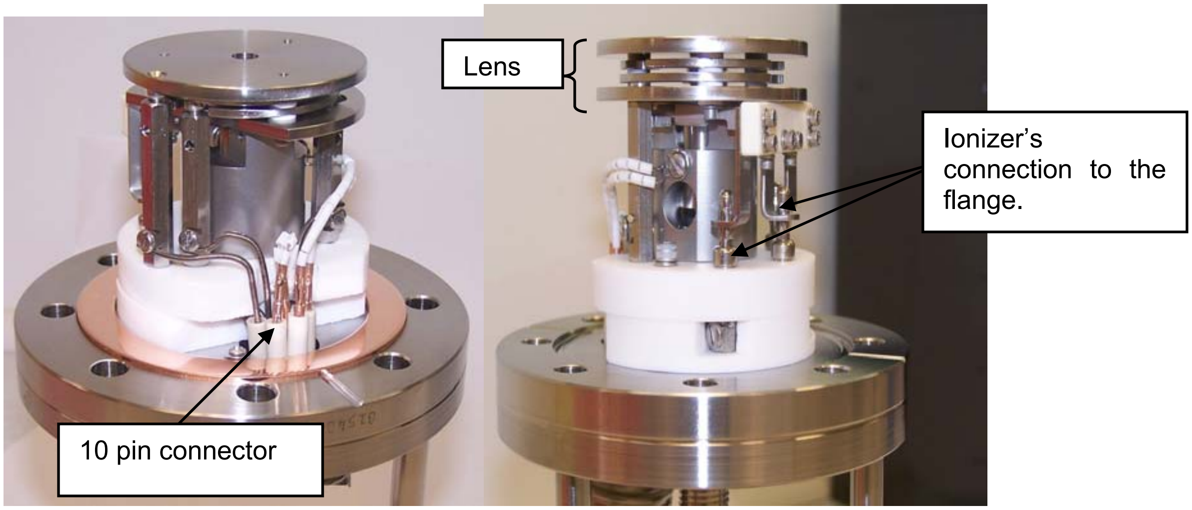

Figure 11: Ionizer Assembly Mounted on Flange

Tungsten or Yittra coated Iridium are available as the filament material. Two filaments are present in the assembly, located on each side of the ion volume. Only one filament is used at a time. When Filament 1 has reached the end of its useful life, Filament 2 will automatically be put into effect. However, the system will NOT transition automatically from Filament 2 to Filament 1. If both filaments have burned out, the entire ionizer assembly must be replaced.

Note: Because the ionizer may be hot, caution should be taken when removing the ionizer assembly from the vacuum chamber.

Changing the Ionizer Assembly

The first step in changing the ionizer assembly is to vent the vacuum system. Following this, disconnect the ionizer connection cable and remove the inlet. It may be convenient (though not required) to remove the ionizer's inlet tube by loosening the large central fitting on the ionizer flange, Figures 12 and 13. The hex closest to the flange (5/8 inch) is welded on. The outer hex nut (3/4 inch) can be rotated counter clockwise to loosen the fitting and remove the inlet. Be careful when loosening this fitting that the wrenches do not contact the ten pin vacuum feedthrough and damage it. Set the inlet aside where it will stay clean.

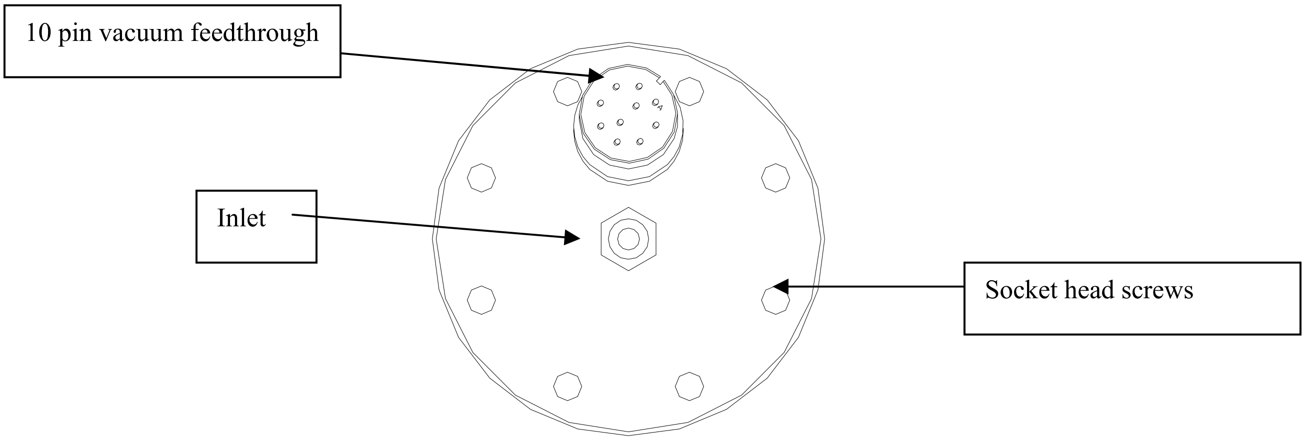

Figure 12: Ionizer Flange

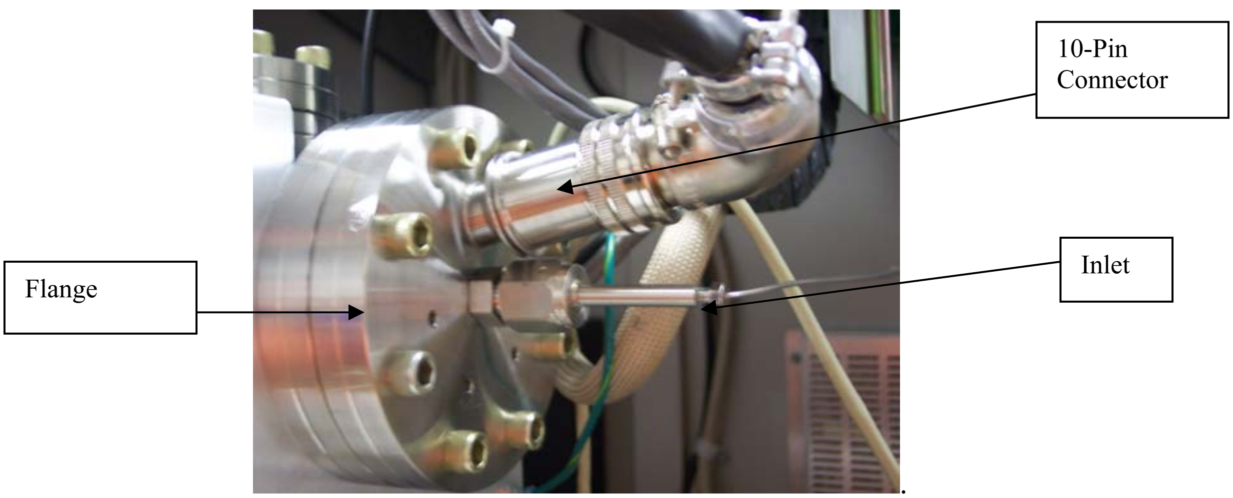

Figure 13: Ionizer flange with Inlet and 10-pin Connector

The ionizer flange is held to the chamber with eight socket head screws (1/4 inch hex key). Remove the flange and set it on a clean work surface. Remove and discard the nonreuseable copper gasket.

The ionizer assembly is held in place by spring loaded electrical connections. It can be removed by grasping the last lens and pulling the module straight from the flange. The new module is installed by inserting the central ion region into the flange mounted heated block, aligning the electrical connections and pushing it in place. If the assembly is properly installed, no gap should be visible between the fixed part of the ionizer block and the innermost plate of the ionizer. The total height of the assembly can be measured from the vacuum side of the flange and should be 2.50 inches (63.5 cm). If this dimension is more than 2.54 inches (64.67 cm), lens 2 will short to the quadrupole rods.

Using a new 4-1/2 inch copper gasket, install the ionizer flange onto the vacuum chamber. A threaded hole on one side of the electrical feedthrough, visible in Figure 14, can be used to hold the copper gasket in place. Install the bolts on the flange finger tight.

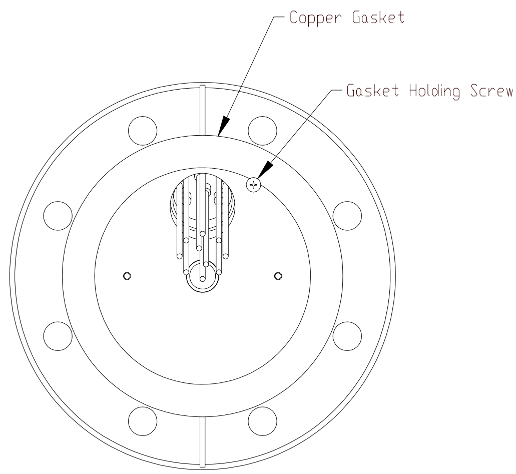

Figure 14: Reinstalling Ionizer Flange

Note: Never reuse a copper gasket. A scratch undetectable to the eye may be present and result in a vacuum chamber leak.

Use an ohm meter to verify proper installation of the ionizer before tightening the ionizer flange bolts. The filaments, thermocouple and heaters will read low resistance when measured. Check all the pins for shorts to ground (the chamber) and to each other. Also check for a short between lens 2 and either of the quadrupole connections on the top of the chamber. If the quadrupole has been removed for service, postpone this step until it has been reinstalled. Figure 15 below depicts the wiring for the ten pin vacuum feedthrough. Table 1 shows the function of each pin.

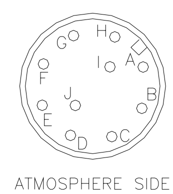

Figure 15: Inlet Flange 10 Pin feedthrough wiring

Table 1: 10-Pin Vacuum Feedthrough

Pin	Function
A	Thermocouple (+)
B	Extractor
C	Filament 1
D	Filament Common
E	Filament 2
F	Lens 2
G	Heater
H	Thermocouple (-)
I	Heater
J	Lens 1

When all the electrical tests have passed, tighten the flange bolts in a cross pattern to keep the flanges parallel, prevent leaks, and keep the copper gasket from becoming warped.

Quadrupole Mass Filter

The mass filtering device used in the MAX300™-IG is a quadrupole. This component is located directly behind the ionizer and utilizes the vacuum chamber as both its enclosure and mounting structure. The quadrupole is comprised of four 3/4in (19mm) stainless steel rods and provides a mass range of 2 to 300 amu.

Quadrupole Removal

Required Tools

- (1) 1/8 inch (3 mm) Flat Blade Screwdriver
- (1) ¼ inch Hex Key
- (1) 5/64 inch "Allen" or Hex key
- (1) Pair Lint Free or Nylon Gloves

Note: When handling any clean vacuum chamber components, lint free or nylon gloves must be worn.

Note: The following procedure should be read in its entirety before attempting to remove the quadrupole assembly.

Before removing the quadrupole, the vacuum system must be vented. Slide the *VacTrac* assembly out of the enclosure by disconnecting the inlet line from the enclosure wall and releasing the slide latch on the left slide of the *VacTrac* assembly. Disconnect the RF cables from the feedthrough flange on the top of the vacuum chamber shown in Figure 16 by pushing down, rotating ~1/4 turn counterclockwise and then pulling. The RF connection flange assembly can then be detached from the vacuum chamber (1/4 inch hex key).

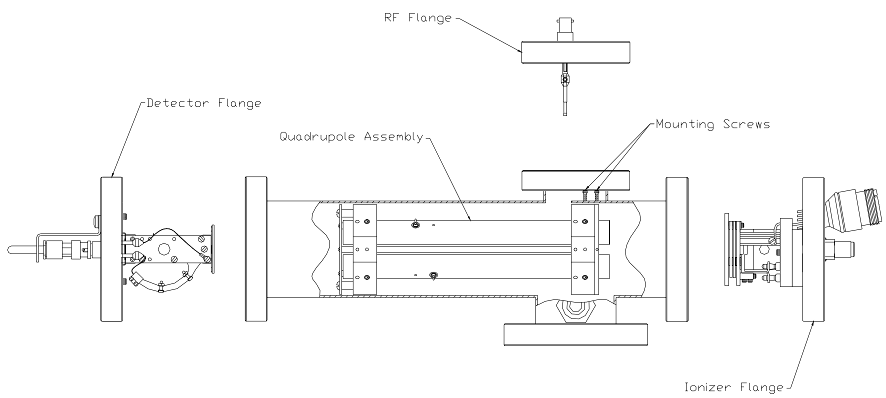

Figure 16: Quad Assembly and Vacuum Chamber

The quadrupole can be removed from either the ionizer end or detector end of the vacuum chamber. The detector end is nearest the wires that connect opposite poles. If the ionizer has also been removed for routine maintenance, the quadrupole can be pulled out the front of the chamber. If not, the assembly may be removed from the rear by detaching the detector mounting flange. In both cases, a ¼" hex key is required.

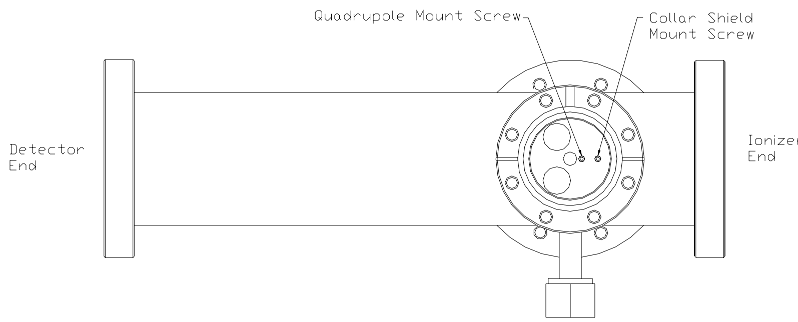

Figure 17: Quadropole RF Connector Port

When looking down through the RF connector port of the chamber, as in Figure 17, the two 2-56 socket head screws (5/64 inch hex key) that secure the quadrupole mass filter assembly into the vacuum chamber are visible. By removing the collar shield screw and the quadrupole mount screw, the assembly can be pulled out of the chamber and placed in a clean area (a few Kimwipes placed on a level surface).

Note: do not force the quadrupole through the chamber! If it gets stuck, gently slide the assembly side to side and up and down until it is easily removed.

Quadrupole Collar Shield Disassembly

Required Tools

- (1) Pair Lint Free or Nylon Gloves
- (1) 1/8 inch (3mm) flat blade screwdriver

Once removed from the vacuum chamber, a partial disassembly of the quadrupole is necessary before cleaning. Place the quadrupole on a clean, level working surface before beginning the disassembly procedure.

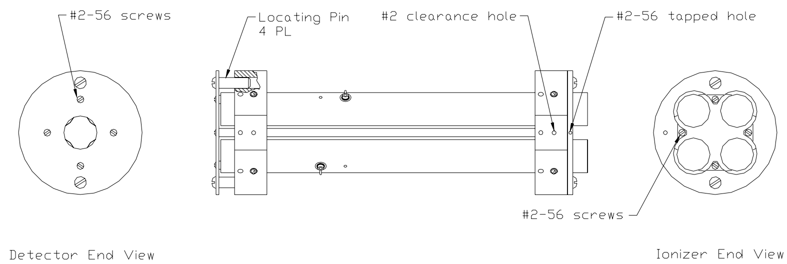

Figure 18: Quadropole Collar Shield

Using the flat blade screwdriver, remove the four 2-56 pan head screws used to secure the ionizer end collar shield plate, visible on the right of Figure 18. Remove the collar shield by sliding the remaining components out of the detector end of the mass filter assembly. This is best performed by grasping the remaining collar shield plate and gently pulling. Locating pins are incorporated into the detector end plate to limit rotation of the assembly with respect to the quadrupole. These pins will pull out of the mass filter collar without any additional disassembly. (To clean the shield rod assembly, it is convenient to remove the four shield rods from the detector end by removing the remaining four pan head screws.) The wires connecting opposing poles can be left in place.

Note: **Under no circumstances** should the screws holding the quadrupole rods to the ceramic collars be removed, adjusted or checked for tightness.

Quadrupole Cleaning

Required Tools

- (1) ¾ - 1" Dia. bottle brush with the wire "knot" removed from the end and the handle covered in plastic.
- (~5) Cotton Swabs
- Small amount of Pumice
- Small amount of "Alconox"
- Hair Dryer
- (2) "Kimwipes"
- (1) Pair Powder-free Latex Gloves
- A source of clean tap water
- Distilled water (most convenient in a lab style "wash bottle")

Visible deposits will usually be confined to the first ¾ in (2 cm) at the ionizer end of the assembly, furthest from the wires that connect opposing poles.

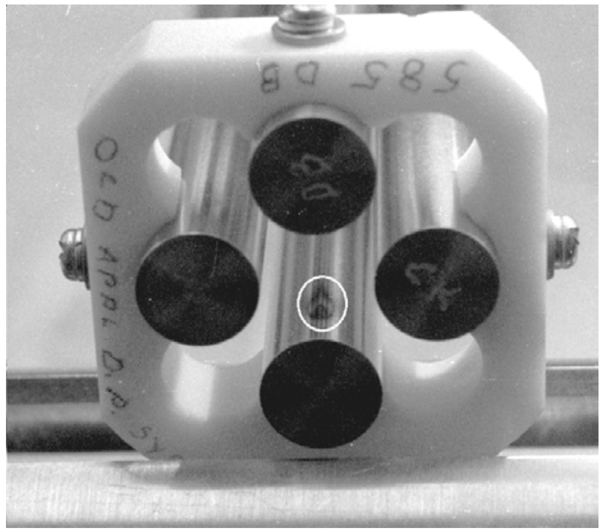

Figure 19: Visible Deposits

The highlighted area in Figure 19 above shows visible deposits on one of the poles. A similar deposit is present on the opposite pole. The most effective way of removing deposits from the quadrupole is to scrub the affected area with a cotton swab and paste of 95% pumice:5% "Alconox". Confine this scrubbing motion to the circumference of the poles, avoiding scrubbing in a longitudinal direction. **It is very important to avoid scratching the quadrupoles.**

When the deposits have been removed, the quadrupole will require a general overall scrubbing using the pumice/alconox paste. Use a brush of 3/4 to 1 inch diameter inserted along the axis of the assembly. This brush should have the wire knot at the end removed and the handle covered in plastic. Clean the inside of the quad by *rotating* the brush.

Rinse the assembly thoroughly in tap water followed by distilled water. Watch for the formation of a uniform, continuous film of water. Formation of individual droplets indicates the presence of a hydrocarbon film and will require the assembly to be cleaned again. When cleaning is completed, dry completely with an oven or hair dryer and place on a clean Kimwipe for reassembly.

Quadrupole Reassembly and Vacuum Chamber Installation

Required Tools

- (1) 5/64" Hex Wrench
- (1) Pair Lint Free or Nylon Gloves
- (1) New 3 3/8" Copper Gasket
- (1) New 4-1/2" Copper Gasket
- (1) 1/4" Hex Key
- (1) 1/8" Flat Blade Screwdriver

With the quadrupole cleaned, the collar shield assembly will be re-attached and the quad installed into the vacuum system. An ohmmeter will verify that nothing is shorted to ground before the system is pumped back down.

To re-attach the collar shield assembly, slide the detector end plate with the rods attached into the quadrupole from the detector end. The locating pins must fit into the holes of the ceramic mounting collars as shown in Figure 20 below.

Use the four 2-56 pan head screws to attach the ionizer end plate to the free ends of the shield rods at the ionizer end of the quad. Be sure to orient this plate properly. The recessed area faces outward and the threaded hole in the edge is aligned with the pair of holes in one of the corners of the ceramic collar.

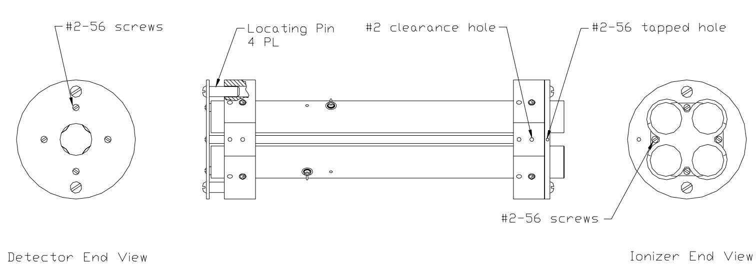

Figure 20: Locating Pins of Quadropole

When this is completed, the quadrupole assembly can be inserted into the vacuum chamber. Be sure the ionizer end will face the ionizer and the detector end will face the

the end nearest wires connecting opposite poles. Also, rotate the quad assembly so the threaded hole in the edge of the ionizer end plate is on top.

As noted previously, the quadrupole is secured within the vacuum system by two screws. One screw engages the ceramic mounting collar and one threads into the collar shield rod assembly. The quad assembly should be slid far enough into the chamber so the holes in the chamber for these screws line up with the matching holes in the quad assembly. This can be observed by looking into the RF connection flange mounting port on top of the vacuum system.

A bird's eye view depicting the location of these holes is shown in Figure 21. Two 2-56 socket head screws with lock washers and the 5/64" hex wrench will be needed to secure the assembly.

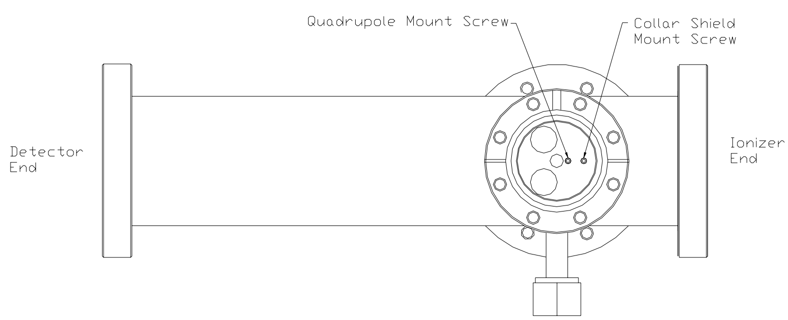

Figure 21: RF Connection Flange – Bird's Eye View

The RF connection flange assembly should then be installed onto the vacuum chamber with a new 3-3/8" copper gasket. The spring loaded contacts of the RF connection flange must make contact with the quadrupole rods, not the collar shield end plate or chamber. The vacuum feedthroughs on this flange, when properly installed, are offset toward the *detector* end of the chamber. Initially leave these screws finger tight.

Use the ohmmeter to check the continuity between the feedthrough contacts on the flange and the quadrupole rods and check for shorts to the chamber. Either the ionizer or the detector flange will have to be removed to accomplish this. Once verified that the electrical connections are correct, finish tightening the RF flange screws. The securing socket head screws (1/4" hex key) should be tightened in a crossing pattern that keeps the flanges parallel to each other.

If the ionizer mounting flange was removed, it should be re-installed using a new 4-1/2" copper gasket. The securing socket head screws will require a 1/4" hex wrench. Use the ohmmeter to check that the ionizer lenses are isolated from one another, the vacuum chamber and the quadrupole. If the detector mounting flange was removed, it will need to be re-attached using a new 4-1/2" copper gasket and the 1/4" hex key for the securing socket head screws. Position the detector mounting flange so that the HV feedthrough is towards the *back* of the vacuum chamber. Use the ohmmeter to check that the detector connection feedthrough(s) are isolated from both the vacuum chamber and the quadrupole rods.

Detector

Two different detector options are offered. The standard detector is the faraday plate. This component, located directly after the quadrupole, collects the signal of the ions. An optional electron multiplier detector assembly is available for increased dynamic range. It is recommended that the standard faraday detector be wiped off occasionally, especially for dirty applications. Figure 22 below shows the faraday detector.

Figure 22: Faraday Detector

Electron Multiplier Removal and Replacement

Required Tools

- 1/4" Hex Key
- 3/32" Hex Key

Note: a "ball end" type is most convenient.

- (1) 4-1/2" Copper Gasket
- Pair Lint Free or Nylon Gloves

- #2 Phillips Screwdriver

Instruments equipped with the optional electron multiplier detector will require replacement of this component after the required gain can no longer be achieved. When this occurs, the vacuum system must first be vented. After venting, disconnect the inlet line from the enclosure wall and release the slide latch on the left slide of the *VacTrac* assembly and extend the *VacTrac* out of the enclosure. Remove the connection cables on the detector flange (the multiplier HV cable, and the preamp cable). The preamp assembly is detached using the Phillips screwdriver to remove the two preamp securing screws. Figure 23 shows the preamp assembly.

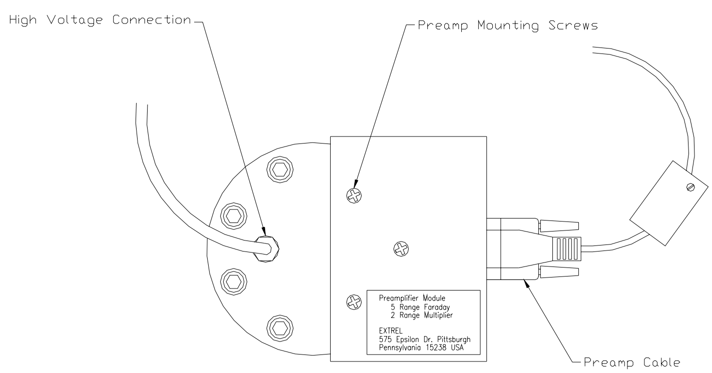

Figure 23: Preamp Assembly

The detector mounting flange can be detached from the vacuum chamber by removing the securing socket head screws using a 1/4" hex key. Discard the old copper gasket.

Note: Care must be taken when removing this flange to not damage the detector assembly as the securing screws are removed. Support the flange as the last screw is taken out and pull the assembly straight back from the vacuum chamber.

The replacement multiplier is a completely assembled multiplier with all the wires attached and the extended faraday plate installed. Remove the old detector assembly and install the new one on the flange. Place the detector mounting flange onto a clean level working surface to begin the replacement procedure.

The electrical connections can be pulled straight off the flange feedthroughs. The multiplier is held to the flange with two 4-40 screws that can be removed with a 3/32" hex key.

Install the new multiplier onto the flange in the same orientation as the old one using the 4-40 screws and connect the wires to the flange feedthroughs by pushing the connectors straight on. Refer to Figure 24 to verify that the wiring is correct.

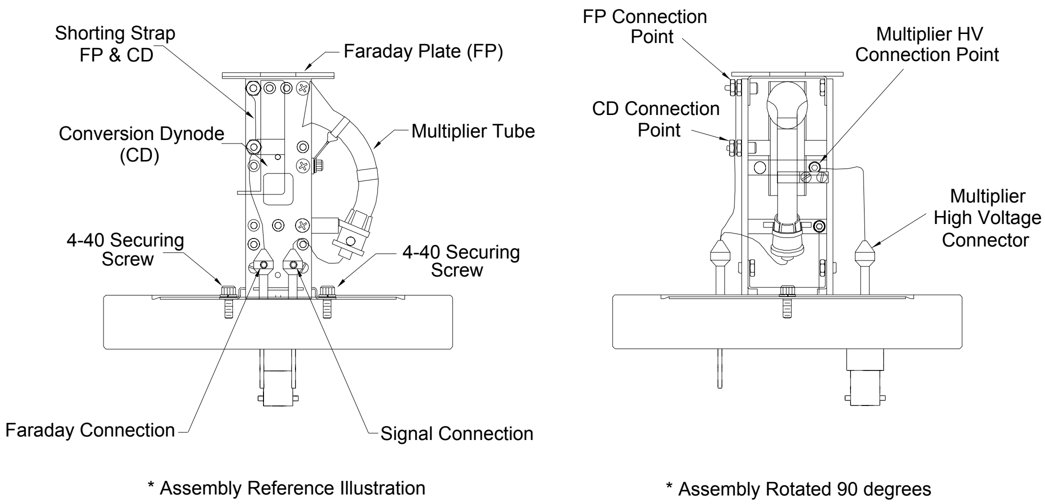

Figure 24: Multiplier Flange

Install the detector flange onto the vacuum chamber using a new 4-1/2" copper gasket in the same orientation it was originally. There are two threaded holes on the flange that can be used to hold the copper gasket in place. Initially tighten the bolts finger tight. Use an ohm meter to verify that each of the three detector electrical leads is isolated from each other, from ground and from the quadrupole.

Note: It is normal for the high voltage connection to show 80 megohms when measured to ground.

Once verified that the wiring is correct, tighten the flange bolts in a cross pattern. Start the turbo and roughing pump. When both are working correctly, attach the preamp to the flange and re-install the preamp and multiplier HV cables.

Vacuum Gauge

An ionization pressure gauge is installed above the turbo pump. This device allows the user to monitor the pressure in the ionizer region of the vacuum chamber through the control computer software. The ionization type vacuum gauge requires no regular maintenance. It has a spare filament built in that is selectable with a switch labeled *Filament Select*. When both filaments have burned out the gauge must be replaced.

Remaining Components in the Enclosure

In addition to the vacuum system components, the controlling electronics are also mounted in the enclosure, including the Quadrupole Controller (QC), the preamplifier and the card cage with its modules.

Resonating the Quadrupole Power Supply ("QC")

Required Tools

- Voltmeter capable of reading 10 VDC (analog type preferred)
- Flat Blade Screwdriver
- #1 Phillips Screwdriver

Whenever the quadrupole has been removed from the vacuum chamber for cleaning, the quadrupole power supply will need to be resonated after the system is running again. This will indicate if a problem has occurred when the quadrupole was re-installed into the vacuum system as well as insure optimum performance of the instrument. The resonating procedure can be performed as soon as the system is running to validate installation. For optimum performance it should be repeated after the system has been running several hours and all components have reached thermal equilibrium. Figure 25 below depicts the quadrupole controller.

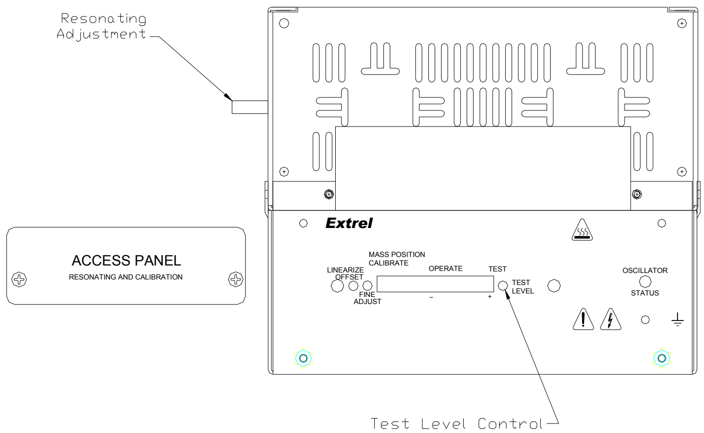

Figure 25: Quadrupole Controller (QC)

Note: Instruments located in a "Hazardous" area will have to be verified as non hazardous for this procedure to be performed.

Using the controlling software, set the instrument to scan some small mass window (10 amu) in the range where the instrument is most often used.

To resonate the QC:

- Remove the access plate from the front of the QC labeled *Resonating and Calibration*
- Locate the switch on the front of the QC labeled *Test – Operate* and place it in the *Test* position.
- Connect the voltmeter to the test points on either side of the switch. The positive lead connected to the right test point and the negative lead to the left one. The scale should be zero to 10 volts DC.
- Use a small screwdriver to rotate the control labeled *Test Level* to the full clockwise position.
- The voltmeter should now show an indication of a few volts.
- Using a flat blade screwdriver, slowly turn the Lucite rod (resonating adjustment) located on the side of the QC using a flat blade screwdriver until the indication on the voltmeter is maximized.
- Disconnect the voltmeter.
- Return the *Test Level* control to its full counter clockwise position.

- Return the *Test – Operate* switch to the *Operate* position.
- Install the access panel on the front of the QC.

Note: Be sure not to turn the Lucite rod a full turn. The slit in the rod should be approximately 45° from vertical.

Data System

Data system (embedded server) maintenance consists mostly of file management and checking that the cooling fans are operating and air flow is not obstructed. The embedded server is mounted on the inside of the door of the MAX300™-IG with the cooling fans along the bottom edge.

Air Conditioner

The only regular maintenance required on the air conditioning unit is regular cleaning of the external air filter to maintain sufficient air flow.

- **Compressor:** Requires no maintenance. It is hermetically sealed and properly lubricated for years of satisfactory operating service.
- **Refrigerant Loss:** Recharging ports are provided for the ease and convenience of reputable refrigeration repair service personnel to recharge the air conditioner. Consult a local directory for commercial air conditioning maintenance establishments.
- **Fans and Motors:** All bearings, shafts, etc. are lubricated for the life of the motor. The condenser blower and the evaporator blower are thermally protected to prevent over temperature conditions.
- **Condenser and Evaporator:** The coils are constructed of copper tubes with mechanically bonded aluminum fins. While no maintenance is ordinarily required, the fins should be checked for the accumulation of dirt and debris. Periodic cleaning of dirt and debris from the outside fin surface may be required to maintain operating performance. Care must be taken during cleaning to prevent damage to the coil fins.

Note: Operation of this air conditioning unit in areas containing airborne caustics or chemicals can rapidly deteriorate filters, condenser coils, blowers and motors.

- **Priming of Drain Hose:** To prevent passage of vapors up the drain hose into the enclosure, inject approximately 30 cc of water into the **lower** opening of the air conditioner from **inside the enclosure**. This procedure will only need to be done once during installation of the instrument. Excessive drainage from the drain hose may indicate ambient air is entering the enclosure. Check the integrity of the gasket seals for the enclosure. Avoid frequent opening of the enclosure door.
- **Condenser Inlet Filter:** Proper maintenance of the inlet filter is required to assure normal operation of the air conditioner. If filter maintenance is delayed or ignored, the maximum ambient temperatures under which the unit is designed to operate will be decreased.

As the compressor operating temperature increases above normal due to a dirty or clogged inlet filter (or plugged condenser coil), the air conditioner's compressor will stop operating. This is caused by actuation of the thermal overload cut-out switch located on the compressor housing. As soon as the compressor temperature has dropped to within the switch's cut-in setting, the compressor will restart automatically.

It is recommended that power to the air conditioner be disconnected when abnormally high compressor operating temperatures cause automatic shut-down of the unit. Clogged or dirty filters cause a reduction in cooling air flow across the surface of the compressor and condenser coil. Continued operation under the above conditions will damage and shorten compressor life.

Note: The air conditioner will last longer if the filters are kept clean.

Filter Removal and Installation

- Locate the air filter on the back of the air conditioner unit.
- Slide the filter out by pulling it to the left.
- Flush the filter with warm soapy water from the exhaust side to the intake side. Do not use solvents. After flushing, allow filter to drain completely before re-installing.
- Slide the filter back into the slot.

It is impossible to recommend a filter cleaning interval due to the variety of air quality conditions. The amount and nature of airborne dust/dirt particles differ per location. It is recommended that when a fine layer of dust or lint is visible on the surface of the filter, it be removed and cleaned.

Do not run the air conditioner for extended periods of time with the inlet filter removed. Dust or lint particles can plug the fins of the condenser coil, giving the same reaction as a plugged filter. Because the condenser coil is not visible through the filter opening, it should be protected with a clean filter.

Startup

Upon completion of all necessary hardware maintenance, the MAX300™-IG may be started up. To facilitate this:

- Verify that all vent valves are tightly sealed.
- Check that all connections have been made.
- Verify that the electronics are turned off.
- Start the turbo and roughing pumps by turning on the *Vac System & Air Conditioner* and *Heater* power switches.
- Wait until the green LED on the turbo pump power supply illuminates (5-10 minutes).
- Switch on the electronics via the *5221 Controller* switch.
- The SmartStart software program should begin.