

VAC-CHECK[®]

Manual

(LM78)

LP101010 Rev 3.03
January 2002

As part of our continuous product improvement policy, we are always pleased to

receive your comments and suggestions about how we should develop our product range. We believe that the manual is an important part of the product and would welcome your feedback particularly relating to any omissions or inaccuracies you may discover.

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EC DECLARATION OF CONFORMITY

Spectra SensorTech Ltd.
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DECLARES THAT THE FOLLOWING PRODUCTS:

LM62, LM10 VACSCAN 100
LM63, LM10, LM4 VACSCAN PLUS 100, 200
LM61, LM10, LM4, LM9 SATELLITE 100, 200, 300
LM56 MICROVISION
LM70, LM76 MICROVISION PLUS
LM77 VISION 1000P
LM79 VISION 1000I
LM89 VISION 1000B
LM90 VISION 1000 C / E
LM78 VAC CHECK
LM80 MINILAB

ARE IN CONFORMITY WITH THE FOLLOWING EUROPEAN
DIRECTIVES:

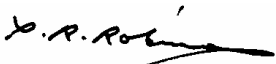
89/336/EEC ELECTROMAGNETIC COMPATIBILITY DIRECTIVE
73/23/EEC LOW VOLTAGE DIRECTIVE AS AMMENDED 93/68 EEC

THE APPLICABLE STANDARDS ARE:

EN 61326:1998 ELECTRICAL EQUIPMENT FOR MEASUREMENT,
CONTROL AND LABORATORY USE.

EN 61010-1:1993 SAFETY REQUIREMENTS FOR ELECTRICAL
EQUIPMENT FOR MEASUREMENT,
CONTROL & LABORATRY USE.

SIGNED:



T.R.ROBINSON
MANAGER OF EUROPEAN OPERATIONS
DATE: 1ST JULY 2001

Additional Installation Maintenance and Operating Instructions

In order to comply with European regulations, the following procedures must be followed :-

A) INSTALLATION

- 1) The installation procedures given in the operating and technical manuals must be followed, in addition to these instructions.
- 2) The mains power cable must conform to local regulations and must have a protective earth (PE) conductor securely connected to the power plug protective earth contact.
- 3) The short earthing braid supplied with some products must be fitted between the terminal on the RF head and one of the CF40 vacuum flange bolts.
- 4) Only cables supplied with the equipment may be used for interconnections. If extension cables are required to obtain a greater separation between control unit and RF head, or if longer serial communications cables are required, they must be supplied by Spectra SensorTech Ltd.
- 5) Cables attached to all other ancillary signal and control ports must have a length of less than 3 metres. If greater length is required, Spectra SensorTech Ltd must be contacted for technical guidance on possible EMC and safety issues.
- 6) The vacuum system on which the analyser/RF head is mounted must be earthed, to a protective earth, preferably to the same protective earth as the control unit.

B) OPERATION

- 1) The equipment is not authorised for use as a critical component in a life support or safety critical system without the express written approval of Spectra SensorTech Ltd.
- 2) All instructions given in the operating manual must be followed.
- 3) Adjustments are strictly limited to those accessible from the control panel and computer keyboard and only when running software supplied by Spectra SensorTech Ltd.

C) MAINTENANCE



WARNING-DANGEROUS VOLTAGES EXIST INSIDE THE EQUIPMENT

- 1) Maintenance functions must only be carried out by competent persons.
- 2) During the warranty period, faulty equipment must be returned to Spectra SensorTech Ltd., unless special arrangements are made.
- 3) There are no user replaceable parts in the electronic equipment. Certain components are EMC and safety critical and must not be substituted. Replacement parts are available from Spectra SensorTech Ltd.
- 4) Equipment enclosures embody certain special fastening and bonding devices that affect EMC and safety performance. These must be correctly re-fitted after servicing.

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Errata and addenda

Rev 3.01 November 2000
MKS names change only.

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Section 1.

Specification

1.1. Mechanical

VAC-CHECK®

Size: 127mm wide x 127mm deep x 159mm deep plus 34mm over analyser connector.

Weight: 2.0kg

PUP80 Power Supply

Size: 95mm wide x 70mm high x 180mm deep plus 20mm over strain relief.

Weight: 1.1kg

1.2. Electrical

Power Inlet: 100 to 120, 200 to 240 V rms 47- 63Hz 2.1A rms

Installation category (overvoltage category) II to IEC664

Fuses Internal, not user replaceable

Insulation Class I to IEC536

1.3. Environmental

Temperature range 0 to 40°C, 80%RH non condensing, operating and storage.

Pollution degree 2 to EN61010

Enclosure IP20 to EN60529

1.4. Safety

IP20 to EN60529



The protective earth conductor of the power cord must be connected to the power

source protective earth terminal.

There are no operator replaceable parts within either the PUP-80 power supply unit or the LM78 VAC-CHECK[®] unit.

Connectors

The connectors for external circuits are for use only with Spectra equipment, or equipment which has no accessible hazardous live parts.

The external circuits must comply with the requirements of EN61010-1 section 6.6.1.

Ports for connection of accessories do not carry hazardous potentials.

Do not position the PUP-80 power supply so that it is difficult to unplug the mains power cord.

Installation Category II comprises mains powered, local level appliances.

1.5. Warning labels



On the front panel refers to:

- a. Accessible hazardous voltages on analyser connector, when not mated to the analyser, which may result in a non-hazardous electric shock if touched.
- b. Tuning adjustment holes, which are not for operator use.



On the rear panel refers to the following:-

- a. Read all instructions carefully before use.
- b. The control unit and signal ports are designed for connection to Spectra

accessories via Spectra cables.

There are no accessible hazardous voltages or currents on these ports.

Spectra must be consulted before any non-Spectra cables or accessories are connected to these ports.

1.6. Ventilation

Openings in the front, top and bottom panels must not be obstructed. Allow a minimum clearance of 50mm all round. Do not exceed the maximum operating ambient temperature.

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Section 2.

Introduction

VAC-CHECK[®] is a complete quadrupole residual gas analyser (RGA) comprising of a quadrupole analyser, a VAC-CHECK[®] control unit, a low voltage power supply and the necessary interconnecting cables. As opposed to traditional RGAs the VAC-CHECK[®] incorporates all of the electronics normally found in a separate control unit and RF power supply into one extremely compact unit which fits directly onto the quadrupole analyser.

The VAC-CHECK[®] is designed to be operated from a host computer which will normally be an IBM compatible PC running the Spectra RGA for Windows software package. Complete RGA systems may comprise of one VAC-CHECK[®] and a PC, referred to as a single headed system or a number of VAC-CHECK[®] units connected to a single computer known as a multi-headed system. Three types of serial communication are available to meet the needs of the various system configurations. A range of accessories is available to connect to the VAC-CHECK[®] to further extend its operational capabilities.

This manual focuses on the VAC-CHECK[®] hardware and should be used in conjunction with the manual for the RGA for Windows operating software.

2.1. General

The VAC-CHECK[®] is a single unit incorporating all the necessary power supply and data acquisition electronics for the residual gas analyser. Power is derived from a dedicated low voltage power supply that is supplied as part of the standard package. The VAC-CHECK[®] plugs directly onto the quadrupole analyser via the connector mounted on the front panel of the unit. All external connections including the power supply and serial communications link are made via connectors mounted on the rear panel of the unit. VAC-CHECK[®] contains no user serviceable parts and the only manual adjustment is the volume control for the audio tone that is mounted on the rear panel.

2.2. User interface

Please refer to Figure 1 for the arrangement of the connectors on the rear panel. The pin numbers are marked on the various connectors.

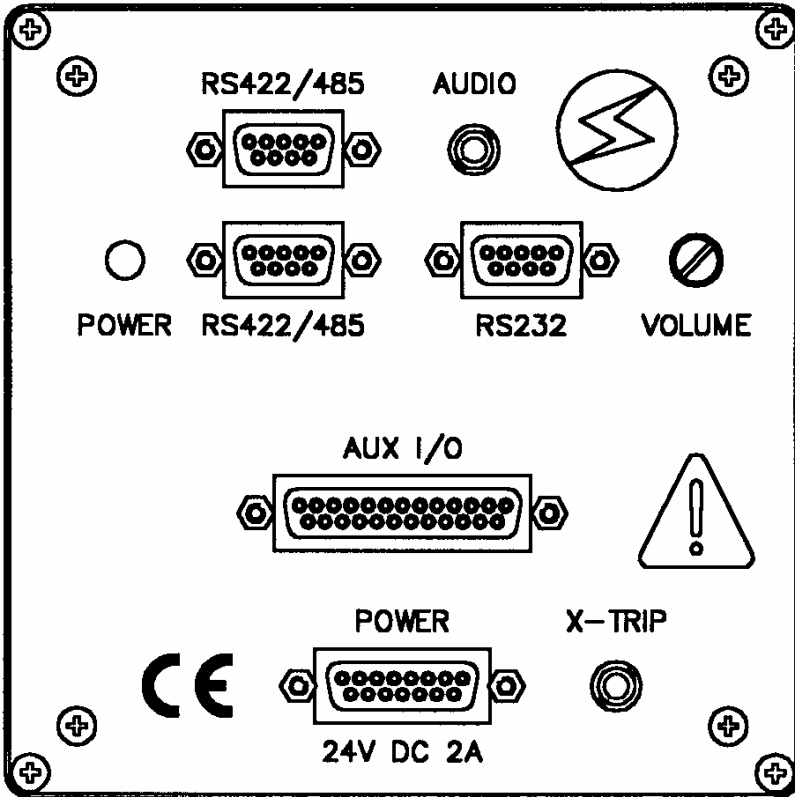


Figure 1 Rear panel arrangement

2.2.1. Power connector

This is a 15-way D-Type socket labelled **POWER** on the rear panel of the unit to connect to the low voltage power supply unit.

Pin connections are:-

| | | |
|-----------------|-------------------|--------------------------|
| 1, 2, 3 | (joined together) | +24 volts DC |
| 9,10,11 | (joined together) | 0 volts (24 volt return) |
| Connector Shell | | functional earth |

The power input is 24 volts DC \pm 10%, 2 Amps max.

The current drawn depends on the mass range and whether a filament is on or off.

The primary power circuit is galvanically isolated from the system ground. The maximum common mode voltage is 60V DC or Peak AC, current limited to 2mA.

2.2.2. Power indicator

The power indicator is a 3mm LED labelled **POWER** on the rear panel of the unit. This will be illuminated when power is applied to the unit.

2.2.3. RS232 connector

This is a 9 way D-Type socket labelled **RS232** on the rear panel of the unit. It is used to connect the VAC-CHECK[®] to the host computer when the RS232 interface is being used.

Pin connections are:-

| | | |
|-------|---------|---------------|
| Pin 2 | TXD | transmit data |
| Pin 3 | RXD | receive data |
| Pin 5 | 0 volts | |

Pin 4 (DSR), pin 6 (DTR) and pin 8 (RTS) are joined together to ensure that comms ports which require DTR and RTS to be asserted will function if DSR is asserted.

2.2.4. RS422/485 In socket

This is a 9 way D-Type socket labelled **RS422/485** and situated immediately to the right of the Power LED on the rear panel of the VAC-CHECK[®]. For RS422 this connector is used to connect to the host computer. In RS485 which is a daisy chaining system this connector should be used to connect to the preceding unit in the system or to the host computer if the VAC-CHECK[®] is the first unit in the chain.

The RS485 port can operate in either half or full duplex. The separate receive and transmit lines may be connected together under software control.

This connector is linked internally pin to pin to the RS422/485 plug.

Pin connections are:-

| | | | |
|-------|---------|-------|---------|
| Pin 1 | 0V | Pin 8 | TXD (-) |
| Pin 4 | RXD (-) | Pin 9 | TXD (+) |
| Pin 5 | RXD (+) | | |

2.2.5. RS422/485 Out plug

This is a 9 way D-Type plug marked **RS422/485** and situated immediately to the left of the audio connector on the rear panel of the VAC-CHECK[®]. For RS422 this connector is not used. In RS485, which is a daisy chaining system, this connector should be used to connect to the RS485 In socket of the next unit in the system.

This connector is linked internally pin to pin to the RS422/485 In socket.

Pin connections are:-

| | |
|-------|---------|
| Pin 1 | 0V |
| Pin 4 | RXD (-) |
| Pin 5 | RXD (+) |
| Pin 8 | TXD (-) |
| Pin 9 | TXD (+) |

2.2.6. Audio output

This is a 3.5mm Jack socket mounted on the rear panel and labelled **AUDIO**. It is used to connect headphones, wireless headsets or an external speaker so that audio tones generated in some of the modes can be heard. e.g. Leak checking tone and audio alarms. The minimum load impedance should be 8 ohms and the power handling is 2 watts max.

2.2.7. Aux. I/O connector

The Aux. I/O connector is a 25 way D-Type socket mounted on the rear panel of the unit and labelled **AUX I/O**. It is used to connect accessories such as a Remote Vacuum Controller, analogue output module, analogue input module and Valve Controller. The Aux. I/O connector can also be used to provide alarm output signals and process trip signals.

| Aux. I/O Connector Pin Assignment | | |
|------------------------------------------|----------------------------------------|------------|
| Pin | Description | Notes |
| 1 | Not used | |
| 2 | Alarm for peak jump channel 2 | see note 1 |
| 3 | Alarm for peak jump channel 4 | see note 1 |
| 4 | Alarm for peak jump channel 6 | see note 1 |
| 5 | Alarm for peak jump channel 8 | see note 1 |
| 6 | Alarm for peak jump channel 10 | see note 1 |
| 7 | Alarm for peak jump channel 12 | see note 1 |
| 8 | Used by analogue output module | |
| 9 | Used by analogue output module | |
| 10 | 0V Digital (for alarms) | |
| 11 | 0V Analogue (for analogue I/O) | |
| 12 | -15V | |
| 13 | +15V | |
| 14 | Alarm for peak jump channel 1 | see note 1 |
| 15 | Alarm for peak jump channel 3 | see note 1 |
| 16 | Alarm for peak jump channel 5 | see note 1 |
| 17 | Alarm for peak jump channel 7 | see note 1 |
| 18 | Alarm for peak jump channel 9 | see note 1 |
| 19 | Alarm for peak jump channel 11 | see note 1 |
| 20 | Used by analogue output module | |
| 21 | Used by analogue output module | |
| 22 | +5V | |
| 23 | Analogue output, 0 to +5V full scale | |
| 24 | Analogue input 2, 0 to +10V full scale | see note 2 |
| 25 | Analogue input 1, 0 to +10V full scale | see note 2 |

note 1 These outputs are TTL levels. When the output is in the Alarmed state i.e. the partial pressure is greater than the high alarm setting the output will be at logic 1. When the channel is not Alarmed the output is at logic 0.

note 2 Two analogue input channels are available which can be monitored in the channel modes (e.g. Peak Jump and Multi-Trend). The 0 to 10 volt input will be represented as 0 to full scale on the screen. These inputs are often used with a thermocouple to track partial pressures and temperature changes.

2.2.8. Volume control

This controls the volume of the audio tone generated by the external speaker in the Leak Check and Peak Jump Alarm modes. Note that in the Leak Check mode it is the frequency (pitch) of the audio tone which increases with increasing signal not the

volume.

The volume control should be turned clockwise to increase the volume and turned anti-clockwise to decrease the volume.

2.2.9. External trip

The external trip connector is a 3.5mm Jack socket mounted to the right of the Power connector on the rear panel and labelled **X-TRIP**.

The external trip feature is used to protect the filaments and electron multiplier from exposure to high pressures. It allows an independent total pressure gauge or a signal from a vacuum control system to be connected to the VAC-CHECK[®]. It is the most effective of the trips available and we would always recommend its use. The external trip input can be driven in three ways.

1. Uncommitted relay contact

This is a low voltage (+5V, 1mA) contact. The contact should be closed for normal operation, open to trip the filaments or if the protective equipment is switched off.

2. Open collector TTL drive

The output transistor should be on for normal operation, open for trip or if the protective equipment is turned off.

3. Totem pole TTL drive

The signal should be low for normal operation, high for a trip condition or if the protective equipment is switched off.

The external trip circuitry is galvanically isolated from the system ground. The maximum common mode voltage is 60V DC or peak AC, current limited to 2mA.

Section 3.

Installation

This section deals with getting the equipment you have just bought out of its box and installing it on your system. If you have any questions or experience any difficulties, contact your local representative who will be able to help you.

3.1. Unpacking and inspecting

3.1.1. Unpacking

When you receive the VAC-CHECK[®] carefully check each item before removing the foam packaging and plastic wrapping to ensure that no physical damage has occurred during shipment. Also make sure all items have been received by checking against the enclosed packing slip.

CAUTION

Do not open the vac-formed envelope at this stage

3.1.2. Inspecting for visual damage

If there has been obvious damage during shipment or if there are items listed on the packing slip as shipped which are not in the box, immediately contact your local sales/service representative.

CAUTION

Most insurance claims for shipment damage must be placed within 7 days from the date of delivery - in WRITING. So don't let your VAC-CHECK[®] get buried in its box.

CHECK IT OUT !!

3.1.3. Inspecting the analyser

Please note that the warranty does not cover cleaning of the analyser.

CAUTION

**The analyser is both fragile and very easily contaminated by the slightest touch from your fingers or undesirable surfaces.
Please handle the analyser our way.**

3.1.4. Removing the analyser cover

The analyser is shipped in a vac-formed envelope for protection. Carefully remove the tape and unfold the envelope to allow access to the analyser.

Hold the analyser **ONLY** at the vacuum flange

If you have to set the analyser down for a moment, carefully return it back to the plastic envelope for protection.

DO NOT LEAVE THE ANALYSER IN THIS CONDITION.

The rules of gravity are known to deviate from the norm around unattended analysers and it can easily fall of and smash if the work surface is bumped. It will also collect dust, which will give a very strange mass spectrum!

3.1.5. Inspecting the analyser

Hold the analyser with the quadrupole and ioniser structure vertically up. Carefully inspect all the observable insulators for damage.

Look at each lead from the flange to its termination point to ensure that it does not touch any other element of the analyser.

But note, the less you adjust or change, the lower the possibility of breaking something.

3.1.6. Replacing the analyser cover

To avoid possible damage to the analyser now is the time to put it back in its plastic envelope. Simply reverse the instructions in section 3.1.4. **Removing the analyser cover.**

3.2. Installing the analyser

3.2.1. Checking the vacuum chamber dimensions

The vacuum chamber in which you intend to mount the analyser must have a 2.75 inch UHV Conflat® flange fitted with a tube of 35.0mm (1.378 ") minimum inner diameter inclusive of a good welded joint.

The distance from the end of the analyser to its mounting flange depends on the type of analyser. Refer to the table below:

| Analyser Type | Length |
|----------------------|---------------|
| 100 amu | 155mm (6.1") |

The table above assumes the analyser is fitted with a standard ion source.

There must be at least the distance given above free of obstructions inside the vacuum chamber. If your chamber does not have that much room or only a small flange you should use a specially designed adapter so that the analyser can be mounted outside the chamber. Please contact your local representative for assistance.

3.2.2. Checking the system pressure

Quadrupole analysers cannot be operated at pressures higher than 1×10^{-4} torr and

for dual (faraday and electron multiplier detectors) the multiplier should not be used at pressures above 2×10^{-6} torr. If you intend to monitor a sputtering or plasma etching process, remember that, if the analyser is mounted directly in the chamber, you will not be able to switch on the unit while at sputtering pressures.

CAUTION - A worse problem is that sputtering is meant to 'throw' materials around corners. If the quadrupole analyser extends into the 'throw area' of the sputtering deposition, it will rapidly become coated and cease to function properly. Turning off the power to the Quad during sputtering or etching will not prevent this contamination. It is most important to ensure that the analyser is shielded from his type of contamination.

Remember the warranty does not cover cleaning of the analyser.

We do, however, supply High Pressure Adapters (HPAs) for just these types of applications.

3.2.3. Mounting the analyser

The standard 2-3/4" Conflat® flange on the analyser can be sealed to the vacuum chamber with either a copper gasket or a Viton® gasket with a square cross section. Which one you choose depends on the ultimate pressure you expect in your system.

If it is not already clean then clean the gasket with suitable solvent and dry it. Remove the analyser from its shipping cover by following the instructions in section

3.1.4. Removing the analyser cover. Slip the gasket over the quadrupole structure and set it in the grooves of the flange surface.

Carefully insert the analyser into the vacuum chamber ensuring that you do not allow the leads to touch the walls of the vacuum chamber. Make sure the gasket does not slip part way out of its slot as you push the two flanges together.

Rotate the flange until the locating key on the feedthrough housing tube is as close to 11 o'clock as the bolt holes will allow. This will ensure that the VAC-CHECK® is in its preferred position, although it can be mounted in any orientation.

Bolt the feedthrough flange to the vacuum chamber flange using the torque appropriate for the gasket material used.

Please do not throw the plastic envelope or the two-piece foam packing surrounding it away. If at a future date you need to return the analyser for service it is vital it is shipped in its original packaging to avoid potentially very expensive damage.

3.3. Connecting the VAC-CHECK[®]

3.3.1. Installation

Rotate the locking ring on the stainless steel RF/analyser connector so that the slot lines up with the keyway on the connector tube. Hold the VAC-CHECK[®] unit so that the keyway lines up with the locating key on the analyser flange.

Gently slide the VAC-CHECK[®] unit on to the analyser. TAKE GREAT CARE the pins on the vacuum feedthrough are easily damaged. DO NOT force the VAC-CHECK[®] unit on to the analyser.

When all of the pins are engaged, push the VAC-CHECK[®] firmly onto the analyser to ensure electrical continuity. The last 3mm (1/8") is important. When correctly fitted the front face of the stainless steel RF/analyser connector should butt up against the analyser flange.

Finally, rotate the locking ring to lock the VAC-CHECK[®] in place. You will not be able to do this if the VAC-CHECK[®] is not pushed fully onto the analyser.

3.3.2. Electrical connections

The serial communications link between the VAC-CHECK[®] and host computer may conform to either RS232, RS422 or RS485 and this will determine which of the connectors is used.

RS232 Using the cable supplied connect the 9 way D-Type plug to the 9 way D-Type socket labelled **RS232** on the rear panel of the VAC-CHECK[®]. The other end of the cable should be connected to the host computer.

RS422 Using the cable supplied connect the 9 way D-Type plug to the 9 way D-Type socket labelled **RS422/485** on the rear panel of the VAC-CHECK[®]. The other end of the cable should be connected to the host computer.

RS485 The cable from the preceding VAC-CHECK[®] in the daisy chain should be connected to the 9 way D-Type socket labelled **RS422/485** on the rear panel of the VAC-CHECK[®]. The cable to the next unit in the daisy chain should be connected to the 9 way D-Type plug labelled **RS422/485** on the rear panel of the VAC-CHECK[®].

Insert the 15 way D-Type socket on the output lead of the power supply unit into the

15 way D-Type plug labelled **POWER** on the rear panel of the VAC-CHECK[®]. Attach the line cord to the power supply. The power supply will automatically set itself to operate with the local line voltage.

When the power is switched on the LED on the rear of the VAC-CHECK[®] will illuminate.

Care should be taken in routing and securing all cables. Avoid running any of the cables next to mains power cables.

3.3.3. Baking

The VAC-CHECK[®] should not be exposed to temperatures above 40°C so it should be removed from the analyser during baking. The analyser may be baked up to 250°C but care should be taken to avoid exposing the ceramic feedthrough to sudden changes in temperature. Other instruments in the Spectra range may be run hot. If you need this facility please contact your local Spectra facility for advice.

CAUTION

The Electron Multiplier (SEM) MUST NOT be operated at temperatures above 50°C.

With dual (faraday and electron multiplier) detector instruments serious damage will be caused to the electron multiplier if it is operated at temperatures above 50°C.

In this case only the faraday detector should be used NOT the multiplier.

No damage is caused to the multiplier by high temperatures provided it is not switched on.

The only remedy when a multiplier has been damaged due to being operated at higher temperatures is to replace it.

THIS IS AN EXPENSIVE REPAIR.

Section 4.

Analyser maintenance

4.1. General overview

The quadrupole analyser is the front end of your mass-spectrometer, it produces electrical signals which when presented to your electronics enable them to display in a meaningful fashion the content of either your vacuum system or of some other "interesting" gasses introduced via an inlet.

Spectra provide a range of analyser configurations, utilising various ion source, filter and detector designs as appropriate for particular applications. Before embarking on any analyser maintenance you are advised to ensure you know exactly which analyser options you have. If you are in any doubt please contact your local Spectra facility, ask for the service department and have the serial number of the analyser ready. The serial number is engraved on the analyser flange and will begin with the letters "LM".

The analyser can be broken down into four separate areas by virtue of their function.

4.1.1. The ion source or ioniser

This is located at the top (furthest from the flange) of your analyser and its function is to take a representative sample of molecules and atoms from your vacuum chamber, convert them into ions and present them to the quadrupole filter. The exact construction will depend upon which source option is fitted.

4.1.2. The quadrupole filter

This is the centre section of your analyser. Its function is to take the ion beam generated in the source and separate the various ions by their mass to charge ratio (m/e) and present the single selected m/e to the collector. Again the exact construction will depend on which type of filter is fitted.

4.1.3. The collector

This area of your quadrupole analyser is "hidden" inside the flanged housing. Its function is simply to convert the filtered ion beam presented by the quadrupole filter into a small electrical current which can be passed to the electronics for amplification and subsequent

display to the outside world.

4.1.4. The flanged housing

This is the only part of your analyser that you will see under normal operating conditions. Comprising of an industry standard 2.75" Conflat® flange with an electrical feedthrough which carries the various supplies and signals to and from the quadrupole analyser.

Figure 3 later in this section shows an exploded view of a typical analyser where you can see all the above mentioned parts. Remember, though, due to the variety of analyser options your particular model may not be exactly the same as this.

4.1.5. Maintenance of your analyser

Most, if not all, quadrupole analysers have areas of inherent weakness requiring periodic maintenance. This should be viewed as similar to automobiles, which from time to time require oil changes etc. to protect the performance of the engine. Just like the automobile the frequency with which this work has to be carried out depends upon many factors such as the number of miles driven, the climate, the average length of journey and the speed at which the vehicle is usually driven.

Similarly with quadrupole analysers the type and cleanliness of the vacuum system, the hours of operation and the type and size of sample being analysed play a large part in determining the maintenance frequency. Apart from these considerations there are times when the analyser will require maintenance and these are when "accidents" happen i.e. when someone vents the vacuum system to air when the filament is still switched on or when someone forgets to turn on the water cooling for the oil diffusion pump etc. These occurrences only vary in the magnitude of the disaster that ensues.

Routinely there is only one area of the analyser that requires any maintenance. This is the ion source. The ion source contains two filaments, only one of which will be in use at any one time. The filament is heated to approximately 2000 deg K at which temperature it emits electrons which are used to produce the ions required by the quadrupole filter. At this high temperature there are two deleterious effects.

The filament material slowly evaporates and condenses upon the surrounding surfaces. This effect is extremely slow but would require from time to time the cleaning of the surrounding source plates and ceramics and the replacement of the filaments.

The second effect is similar to the first except that the vacuum under which the source is operating has either a high oxygen or water content. Then instead of metal being deposited upon the surrounding source plates a layer of metal oxides is deposited. These,

being insulators, have a far more noticeable effect upon the performance of the source and therefore a more frequent cleaning program should be undertaken.

CAUTION

THE QUADRUPOLE FILTER IS VERY ACCURATELY ALIGNED BY SKILLED PERSONNEL USING SPECIALIST TOOLS AND JIGS. UNDER NO CIRCUMSTANCES SHOULD ANY OF THE SCREWS HOLDING THE RODS IN POSITION BE LOOSENED. IF THEY ARE, WE GUARANTEE THAT THE ANALYSER WILL NOT WORK. THE ONLY REMEDY WOULD BE A FACTORY RE-BUILD. IF YOU ARE IN ANY DOUBT PLEASE CONTACT YOUR LOCAL SERVICE CENTRE BEFORE PROCEEDING ANY FURTHER.

4.2. Failed filaments

The filament status is constantly monitored by the power supply electronics and the operating software. This is done by measuring the flow of electrons emitted by the hot filament, referred to as the emission current, and flowing to the ion source cage. This is normally maintained at a fixed value of 1mA. The current flow through the filament is increased until the value of emission current is reached. If, however, the control electronics reaches the limit of its filament current supply capability and the emission current has still not reached 1mA a filament fail condition will exist. In the vast majority of cases this will be due to a blown filament, more correctly described as an open circuit filament. There are conditions such as a heavily contaminated ion source which will result in a filament fail when the filament is not open circuit. So, checking that the filament is open circuit is worth doing before going to the trouble of removing the analyser from your vacuum system.

4.3. Ohmmeter analyser checks

There are a number of circumstances when carrying out some simple checks with an ohmmeter can be well worth while. If you suspect a failed filament or want to check for shorts following some maintenance, a lot of time can be saved by performing some simple checks.

In carrying out these checks we can legitimately accept two ranges of meter readings as possibly acceptable and anything outside these ranges as being a definite fail. Any

readings less than 1 ohm we can take as a short and any reading above 5 Meg Ohm (5×10^6 ohms) as being open circuit. The following assumes that the analyser is still on the vacuum system and goes through all the possible tests.

Tools required:-

Ohmmeter with leads

Please refer to Figure 2 for the analyser pin numbers.

4.3.1. Checking for shorts

1. Attach the first meter lead to pin 1 of the analyser feedthrough.
2. Connect the second meter lead to the analyser flange, you should have a short circuit. If not you have a serious problem or more likely a faulty meter/meter leads.
3. Connect the second meter lead to pins 2 to 12 on the analyser feedthrough in turn.
Each one should give an open circuit. If not you have a short to earth.

There are basically two types of short to earth; an internal short between one part of the analyser and an earthed part of the analyser, or more commonly a short between part of the analyser and the vacuum chamber. In either case remove the analyser from the vacuum chamber and repeat the test. If the result is the same then you have an internal short and should contact your local Spectra facility and tell them which pins are shorting together. Otherwise you have a short to the vacuum chamber, check the dimensions of the vacuum chamber around the quadrupole analyser or try refitting the analyser in a slightly different orientation. Repeat the ohmmeter test before pumping down the vacuum chamber. Remember that the ion source gets very hot during operation and the stainless steel components will expand slightly. Sometimes a short will only develop when the analyser has been run for a while and is up to temperature.

4. Attach the first meter lead to pin 2 of the analyser feedthrough. Connect the second meter lead to pins 3 to 12 on the analyser feedthrough in turn. Each one should give an open circuit. Now attach the first meter lead to pin 3 and check to pins 4 to 12. Proceed around the feedthrough until all possible connections have been checked. All pins should show open circuit to all other pins EXCEPT pin 4 to pin 8 and pin 8 to pin 10 which should show short, see the next section. If any of the pins do show short to another pin contact your local service centre with the results of your testing and they will advise you how to proceed.

4.3.2. Checking filaments

If you suspect a blown filament, for instance the control unit shows filament fail, carry out the following test before removing the analyser from the vacuum system.

Connect meter lead one to analyser feedthrough pin 8 which is the common connection to both the filaments.

Connect the second meter lead to pin 4 (Filament 1). You should have a short circuit, the resistance of the filament is about 0.5 ohms when it is cold.

Now connect the second meter lead to pin 10 (Filament 2) again your meter should indicate a short circuit.

If either or both filaments are blown the meter will indicate an open circuit and the filaments should be replaced.

If the meter reading suggests that the filament is good but the control unit shows a filament fail the most likely cause would be a break down in electrical continuity. Examine the RF/analyser connector on the front of the RF power supply, check that none of the gold sockets are pushed out of place.

4.4. Changing filaments

Analysers are fitted with dual, independently replaceable, self-aligning filaments. Each filament consists of a semi-circular plate into which is fitted two small insulated feedthroughs. The filament wire is attached between these feedthroughs on the underside of the filament plate. The filaments are identical eliminating the need to maintain any particular orientation. The assembly consisting of filament plate, two feedthroughs and the filament wire form what we refer to as the “filament”. Changing filaments is probably the most common maintenance procedure that has to be undertaken with quadrupole analysers but the analyser has been designed to make the task as quick and easy as possible.

The basic procedure for changing filaments is the same for all types of ion source. The procedure describe below relates to a standard radial ion source. Procedures for the enclosed ion source and the PVD ion source are outlined later in this section.

4.4.1. Tools required

Here is a list of the tools and equipment you will require. We recommend that you assemble the following items before you start. Remember that the instrument was supplied with a tool kit which contained some of the things you will need.

A small jewellers screwdriver (2mm)

A pair of tweezers

A small pair of smooth jawed needle nosed pliers
A pair of clean cotton gloves
A clean bench on which to work
An Ohmmeter
A clean container in which to put small parts
Replacement filament(s)
Some method of holding the analyser securely in an upright position (a small bench vice is ideal).
A pen and paper on which to make notes and sketches

4.4.2. Removal of the filaments, general

This relates to all ion sources except the enclosed and PVD ion source.

1. Remove the analyser from the vacuum system making sure that you do not touch the exposed internal surfaces and place it on the bench in an upright position. Make sure that everything is stable and not likely to fall over, the use of a small bench vice is recommended.
2. The filaments are located on the very top of the analyser and are retained by two M2x6 pan head screws. The electrical connections are made via two barrel connectors, one to each filament.
3. Hold one of the barrel connectors firmly with your pliers slacken the outermost screw undoing it 4 or 5 turns.
4. Now hold the threaded part of this screw lightly with your tweezers just behind the head of the screw. Undo the screw fully and lift it away (with the washer if fitted) and place it into your container.
5. Loosen but do not remove the screw at the other end of the barrel connector. Remove the barrel connector and place it in your container.
6. Repeat the above for the other filament.
7. Loosen the two M2x6 pan head screws that hold the filaments in place so that 3-4mm of thread is showing and remove the filaments.

It is worthwhile at this stage checking to see if the source requires any attention especially if the filament(s) have broken because of an over pressure situation in your vacuum system. With the filaments removed you have a clear view of the source cage where the signs to look for are powdery deposits of tungsten oxides. These will vary in colour but may be brown, blue, canary yellow or white depending upon the precise circumstances which led to their formation. If these oxides are present it is

recommended that you refer to the section on source removal and cleaning before proceeding any further.

4.4.3. Filament plate design

The following does not apply to enclosed and PVD ion sources.

Due to new ion source designs and a desire to keep the filaments interchangeable between the different ion source types the design of the filament plate was changed at the beginning of 1995. The modification increased the diameter of the central hole formed when the two filament plates are placed together on the repeller assembly of the ion source.

With the older type of filament plate this central hole is approximately 3.5mm (1/8inch) in diameter. On the newer type the central hole is approximately 6mm (1/4inch) in diameter.

These newer filaments may be used as direct replacements for all types of ion source. However, for the UHV/radial open ion source and the cross beam ion source an additional filament screening plate needs to be fitted. This is supplied with the replacement filaments. If you are removing older type filaments and replacing them with the newer type you will have to fit the filament screening plate. To do this:

1. remove the two M2x6 pan head screws that hold the filaments in place
2. position the screening plate centrally on the ion source with the two fixing tabs over the holes which take the M2x6 screws which hold the filaments in position
3. refit the two M2x6 pan head screws that hold the filaments in place leaving 3 to 4mm of thread exposed.

Fitting the filament screening plate in this way means that in future the filaments can be removed and the screening plate will remain in position.

4.4.4. Fitting of new filaments, general

The fitting of new filaments is simply the reversal of the procedure for removing them. Care should be exercised at all stages to ensure that no shorts are introduced and that the analyser is kept clean.

1. Place the filaments into the top of the source ensuring that the filament wire does not touch any part of the source and thus potentially causing damage.
2. With a gloved hand gently hold the two filament plates together and tighten the

two M2x6 pan head screws that retain the filaments.

3. Place the barrel connector over the filament leg adjacent to the wire connection but do not tighten the screw at this stage.
4. Replace the small screw (and washer if needed) through the wire connection and screw into the barrel connector to locate the barrel connector in the right orientation.
5. Holding the barrel connector firmly with your pliers tighten both screws.
6. Repeat the above for the second filament.
7. Check with your ohm meter for shorts.
8. Replace the analyser into your vacuum housing and again check for shorts or grounding to the outer vacuum housing see section 4.3. **Ohmmeter analyser checks.**

You are now ready to pump down and continue operation of your quadrupole.

4.5. In-situ source cleaning

Sometimes it is possible to clean the ion source without removing it from the analyser. For the user who has the necessary equipment available it is usually worth trying this method before removing/replacing the ion source. However, it is only likely to be successful where the source is contaminated with loose or alcohol soluble deposits.

4.5.1. Tools required

- A small jewellers screwdriver (2mm)
- A pair of tweezers
- A small pair of smooth jawed needle nosed pliers
- A pair of clean cotton gloves
- A clean bench on which to work
- An Ohm meter
- A clean container in which to put small parts
- Replacement filament(s)
- Ultra-sonic bath
- Measuring cylinder (see text below)
- Iso-propyl-alcohol
- Heat gun
- Some method of holding the analyser securely in an upright

position (a small bench vice is ideal).

A pen and paper on which to make notes and sketches

4.5.2. Cleaning the source

Remove the analyser from the vacuum chamber, place it on the bench in an upright position (the use of a small bench vice is recommended) remove the filaments as described in section **4.4.2. Removal of the filaments.**

Insert the analyser into the measuring cylinder so that the knife-edge side of the flange rests on the lip of the cylinder. Note the level which the ion source comes to on the measuring cylinder before removing the analyser and filling the measuring cylinder with sufficient iso-propyl-alcohol to cover the ion source.

Note: the measuring cylinder should be of a diameter and length to accommodate the analyser. The exact size will vary depending on the analyser type.

Put the measuring cylinder into the ultra-sonic bath for 10 to 15 minutes.

Remove the analyser and allow any excess alcohol to drain off. Keep the analyser inverted (feedthrough upper most) until it is dry. Do not let any alcohol run down the analyser into the flange assembly, it will get onto the multiplier and seriously damage it. Check the condition of the ion source. A second or third wash may be required.

Note: the ultra sonic bath may loosen some of the screws in the ion source take care note to throw these away when discarding the alcohol.

After the final wash remove the analyser and dry it using the heat gun.

Check all the screws in the ion source are tight, re-fit any which may have come out.

Re-fit the analyser in the vacuum chamber.

4.6. Cleaning or replacing the ion source

Generally the analyser design permits the removal of the ion source as one complete assembly, which can be replaced or dismantled for cleaning. The ion source automatically aligns on the main analyser assembly allowing it to be easily replaced without the need for any special jigs. The following description relates to the standard radial ion source any deviations from this due to other ion source design are described in later sections. The differential ion source cannot be removed in the manner described below, instead you should contact your local Spectra facility.

4.6.1. Tools required

Once again you are advised to get the necessary tools together before you start this job. It really does make life simpler.

- A small jewellers screwdriver (2mm)
- A pair of tweezers
- A small pair of smooth jawed needle nosed pliers
- A 0.89mm (0.035") Allen key
- A pair of clean cotton gloves
- A clean bench on which to work
- A source alignment jig
- 4 pieces of straight clean wire (NOT tinned or insulated) 1mm (0.04") dia. 25mm (1") long
- An Ohmmeter
- A clean container in which to put small parts
- Replacement filament(s)
- Replacement source parts if necessary
- A set of replacement ceramics is highly desirable if none are cracked and essential if any are broken
- Some method of holding the analyser securely in an upright position, a small bench vice is ideal.
- A pen and paper on which to make notes and sketches

4.6.2. Removing the ion source

1. Remove the analyser from the vacuum system, place it on the bench in an upright position (holding the analyser in a small bench vice is recommended) and remove the filaments as described above.
2. Locate and remove the three very small socket set (Allen) screws that clamp the focus/extraction, source and repeller supply leads to their respective plates.
3. Locate and remove the two very small socket set screws that are positioned at the base of the source assembly.

The source is now free from the rest of the assembly and can be removed and placed onto the bench. Before proceeding any further you should make a sketch that defines the positions of the barrel connectors for the source and focus/extraction plates and the position of the repeller and source mounting plate relative to these so that when you come to reassemble the source you will have a clear idea of how the various plates fit together.

4.6.3. Standard radial source dismantle

The following section applies to the dismantling of the Standard Radial ion source with a mesh repeller. As each of the plates is removed note its orientation and place it on the bench in the same orientation, it makes life much easier when you come to re-assemble the source.

1. Place the source assembly onto the source alignment jig making sure that the three cut-outs are aligned and taking care not to damage any of the source plates on the spigot in the centre of the jig.
2. Remove the four M1.6x10 screws, the M1.6 stainless steel washers and the 1mm thick ceramic washers that are equi-spaced around the repeller plate (topmost plate).
3. Remove the repeller plate which includes the repeller cage.
4. Remove the four exposed 1mm thick ceramic washers and lift away the source plate which includes the source cage.
5. Remove the 1mm thick ceramic washers then remove the focus/extraction plate.
6. Remove the four remaining ceramic washers and remove the 2mm diameter insulator tubes to leave just the source collar on the jig.

You now have a completely disassembled source ready for cleaning.

4.6.4. Standard source re-assembly

1. Place the source alignment jig flat on the bench and put the source collar on top making sure all the cut-outs are aligned properly. Insert into the four tapped holes the 25mm long pieces of wire, these will help to line up the ceramics as you build up the source.
2. Place the four 2mm diameter ceramic tubes over the wires followed by four 1 mm thick ceramic spacers, one to each wire.
3. Place the focus/extraction plate over the ceramic tubes making sure the barrel connector is in the right place.
4. Place four 1mm thick ceramic spacers over the top of the focus/extraction plate.
5. Place the source plate over the ceramic tubes, again making sure the barrel connector is in the right place, followed by four more ceramic spacers.
6. Fit the repeller plate and four 1mm thick ceramic washers.

7. Carefully remove one of the wires and replace with a M1.6x10 pan head screw and the M1.6 stainless steel washer which should be screwed down but not tightened, repeat this for the remaining three wires.
8. Check that all the plates and ceramics are seated properly before tightening the screws fully. Be careful not to over-tighten because you will break the ceramic spacers.
9. Remove the source assembly from the jig and place on a non-conducting surface. Check with your Ohm meter that there are no shorts between any of the plates. If you do have any shorts correct them before continuing any further.

You are now ready to fit the filaments and fit the ion source on to the analyser.

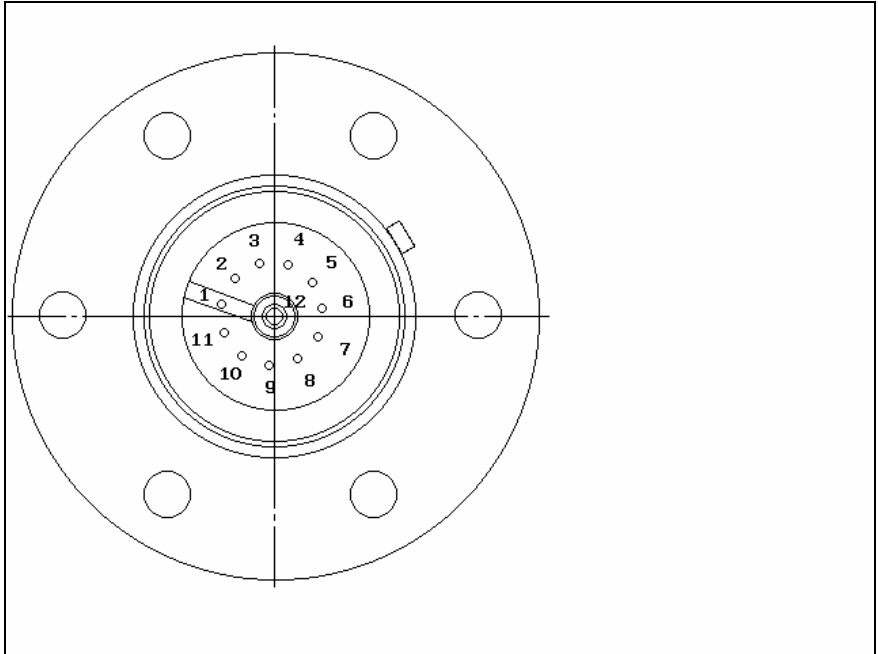


Figure 2 Analyser pin configuration

| Figure 2 Pin Descriptions | |
|----------------------------------|----------------------------------|
| Pin | Connection |
| 1 | Earth |
| 2 | Source plate |
| 3 | Electron Multiplier |
| 4 | Filament 1 |
| 5 | Extraction plate |
| 6 | Suppressor plate |
| 7 | R.F.1 |
| 8 | Repeller plate / filament common |
| 9 | no connection |
| 10 | Filament 2 |
| 11 | R.F.2 |
| 12 | Collector |

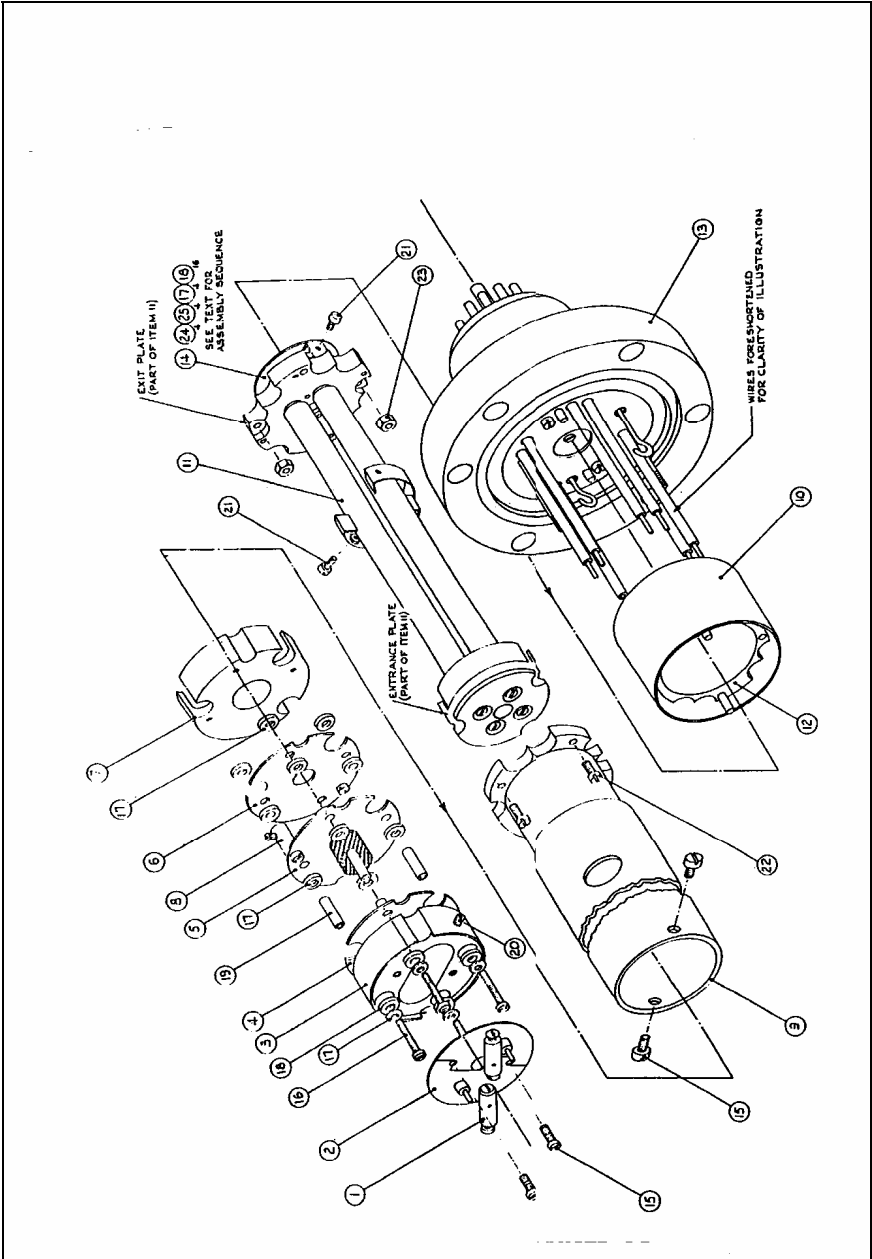


Figure 3 Exploded analyser assembly

| Figure 3 Item Descriptions | |
|-----------------------------------|-------------------------------|
| Item | Description |
| 1 | Barrel connector (Filament) |
| 2 | Filament plate |
| 3 | Source repeller block |
| 4 | Repeller plate |
| 5 | Source plate inc. source cage |
| 6 | Focus/extraction plate |
| 7 | Exit plate |
| 8 | Barrel connector |
| 9 | Support tube |
| 10 | Suppressor screen |
| 11 | Quadrupole filter assembly |
| 12 | Collector housing |
| 13 | Conflat® flange assembly |
| 14 | Multiplier assy. |
| 15 | Screw (M2x4) |
| 16 | Source screw (M1.6x12) |
| 17 | Washer (M1.6 flat) |
| 18 | Ceramic washer (source) |
| 19 | Ceramic tube (source) |
| 20 | Grub screw (M2) |
| 21 | Screw (M1.6x4) |
| 22 | Screw (M1.6x10) |
| 23 | Nut (M1.6) |

4.7. Standard ion source drawings

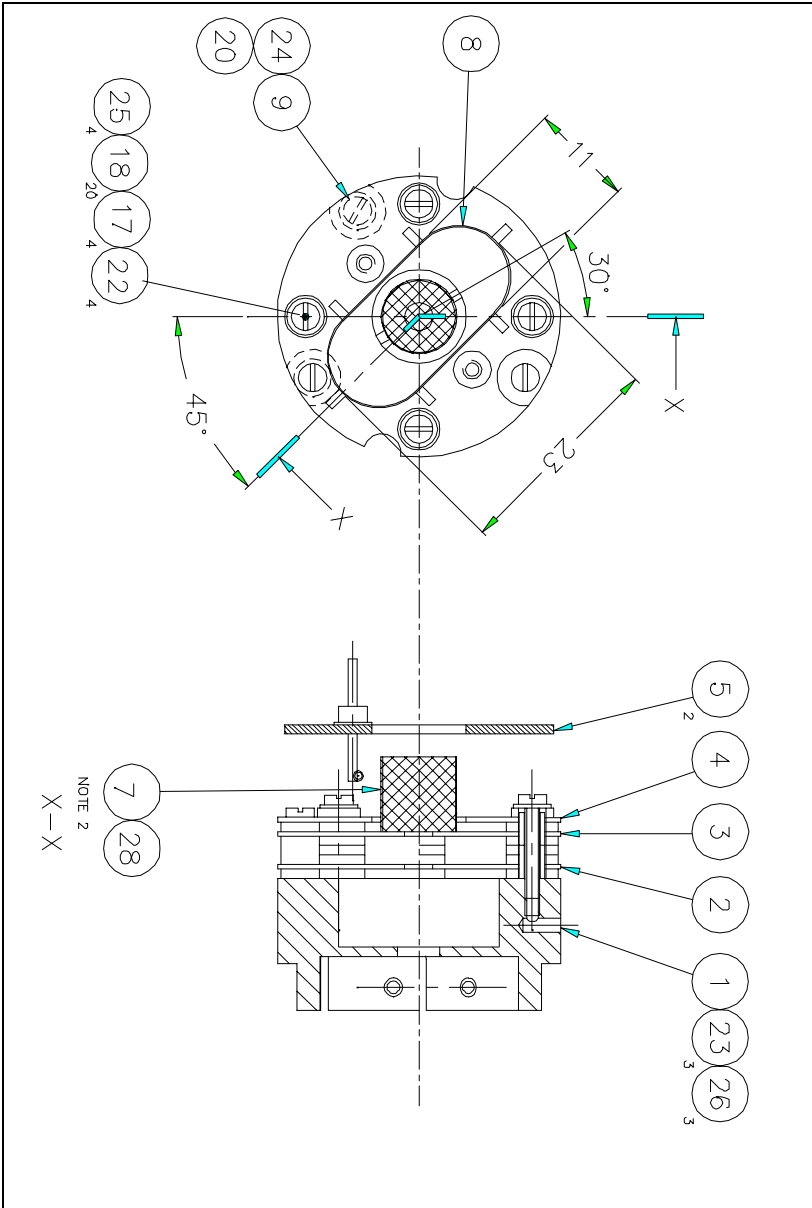


Figure 4 Standard open ion source (1)

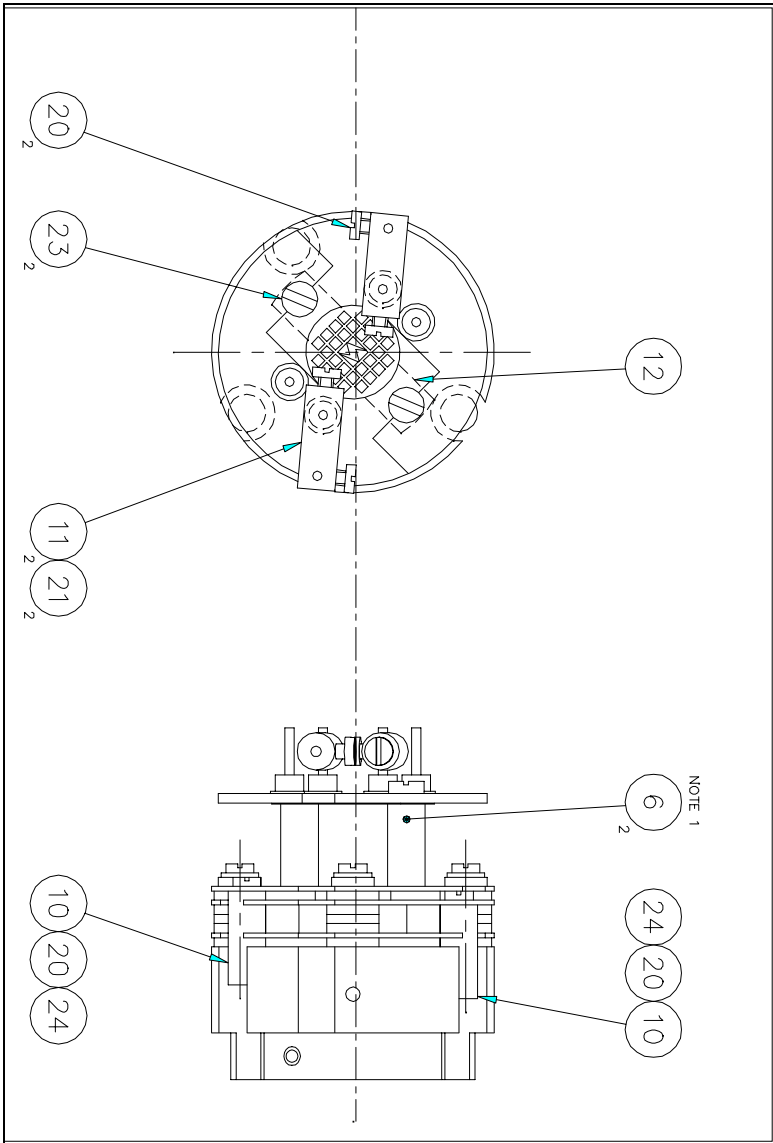


Figure 5 Standard open ion source (2)

| Standard Ion Source Item Descriptions | |
|----------------------------------------------|-----------------------------|
| Item | Description |
| 1 | Source Mounting Ring |
| 2 | Focus/Extraction Plate |
| 3 | Source Plate |
| 4 | Repeller Plate |
| 5 | Filament |
| 6 | Filament Support Spacer |
| 7 | Source Cage Support |
| 8 | Repeller Grid |
| 9 | Connector |
| 10 | Connector |
| 11 | Filament Connector |
| 12 | Filament Screen |
| 17 | Ceramic Spacer 1mm Pink |
| 18 | Ceramic Spacer 1mm White |
| 19 | Ceramic Tube 2.8mm Diameter |
| 20 | Screw M1.6 x 3 |
| 21 | Screw M1.6 x 4 |
| 22 | Screw M1.6 x 10 |
| 23 | Screw M2 x 4 |
| 24 | Screw M2 x 3 Socket Head |
| 25 | Washer M1.6 Plain |
| 28 | Stainless Steel Mesh |

Appendix 1.

Health & safety clearance form

1. This form must be used when returning analysers and other equipment for service.
2. A completed copy of this form should be faxed or sent by post to ensure that we have this information before we receive the equipment.

A further copy should be handed to the carrier with the equipment.

3. Failure to complete the form or comply with the procedure will lead to delays in servicing the equipment.

RETURNS FORM

Please complete the form and fax or send by first class post to the appropriate Spectra facility. Fax numbers and addresses can be found on the inside front page of this manual. Please ensure that we have this information before we receive the equipment. A copy should also be given to the carrier.

**FAILURE TO COMPLETE THIS FORM OR COMPLY
WITH THE PROCEDURE WILL LEAD TO DELAYS IN
SERVICING THE EQUIPMENT**

Please Complete The Following

Our RMA number:

Customer P.O. No.

Customer Bill To Address:

Company
Department
Address

City
Zip/Postal Code

Customer Return To Address (if different from above):

Company
Department
Address

City
Zip/Postal Code

User's Name:

Phone No.:

Equipment Shipped

Item 1:

Serial No.:

Item 2:

Serial No.:

Item 3:

Serial No.:

Please describe the system fault in detail:

Details of all substances pumped or coming into contact with the returned equipment.

Chemical names:

Precautions to be taken in handling these substances:

Action to be taken in the event of human contact or spillage:

I hereby confirm that the only toxic or hazardous substances that the equipment specified above has been in contact with are named above, that the information given is correct and that the following actions have been taken:

1. The equipment has been securely packaged and labelled.
2. The carrier has been informed of the hazardous nature of the consignment.

Signed:

Title:

Date:

Phone No.