FISONS Instruments

VG MICROTECH

Bellbrook Business Park
Bell Lane
Uckfield
East Sussex TN22 1QZ
UK

Tel. (national) 0825 761077
(international) +44 825 761077
Telex. 957603
Fax. +44 825 768343

OPERATING INSTRUCTIONS

REAR VIEW LEED - RVL 900

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WARNING:- **Do not open the packing before reading these instructions. Severe damage may result from mishandling.**

CONTENTS:-

INTRODUCTION

The VG Microtech Reverse View LEED optics are designed to give a low energy electron diffraction facility which can be mounted onto a single port on a vacuum chamber. The diffraction pattern is viewed from the rear of the fluorescent screen through a window in the mounting flange of the optics assembly. Two, three and four mesh versions of the optics are available as both fixed length and retractable types.

The Model 8011 Power Supply provides complete power supplies and controls for operation of either version of the optics in LEED mode over the energy range 5 to 1000 volts and in AUGER mode to 3000 volts. A remote potentiometer is provided with the 8011 Power Supply for remote control of the energy.

An optional viewing hood is available with further optional attachments for a video camera or film camera. The viewing hood contains a remote digital display so that the energy can be displayed with diffraction patterns, and recorded on photographs.

SPECIFICATIONS

Optics Assembly

Meshes : 2,3 or 4

Mounting : 200mm conflat flange (FC150)

Mounting flange to specimen spacing: 163.5mm (standard)
Other lengths greater than 163.5mm optional.

End of optics to specimen spacing: 23.5mm (2 mesh)
18.0mm (3 mesh)
13.0mm (4 mesh)

Inner screen radius : 66mm
Thickness : 2mm

Angle subtended by screen to sample : 104 degrees

Shadow projected by electron gun onto screen: 15mm diameter

Electron Gun

Model: LEG24 Electron Gun

Filament Type : Thoria coated rhenium tape. (FIL 36) ELECTRON GUN IS AN LEG 24 ~430 $ EACH

Lens Type : Simple EINZEL lens

Energy Range : 5 to 1000eV in LEED mode, to 3keV in Auger mode

Spot size : 500um at 1uA, 100eV

Filament Current : 0 to 3.2A approx.

Emission Current : 0 to 1000 microamps

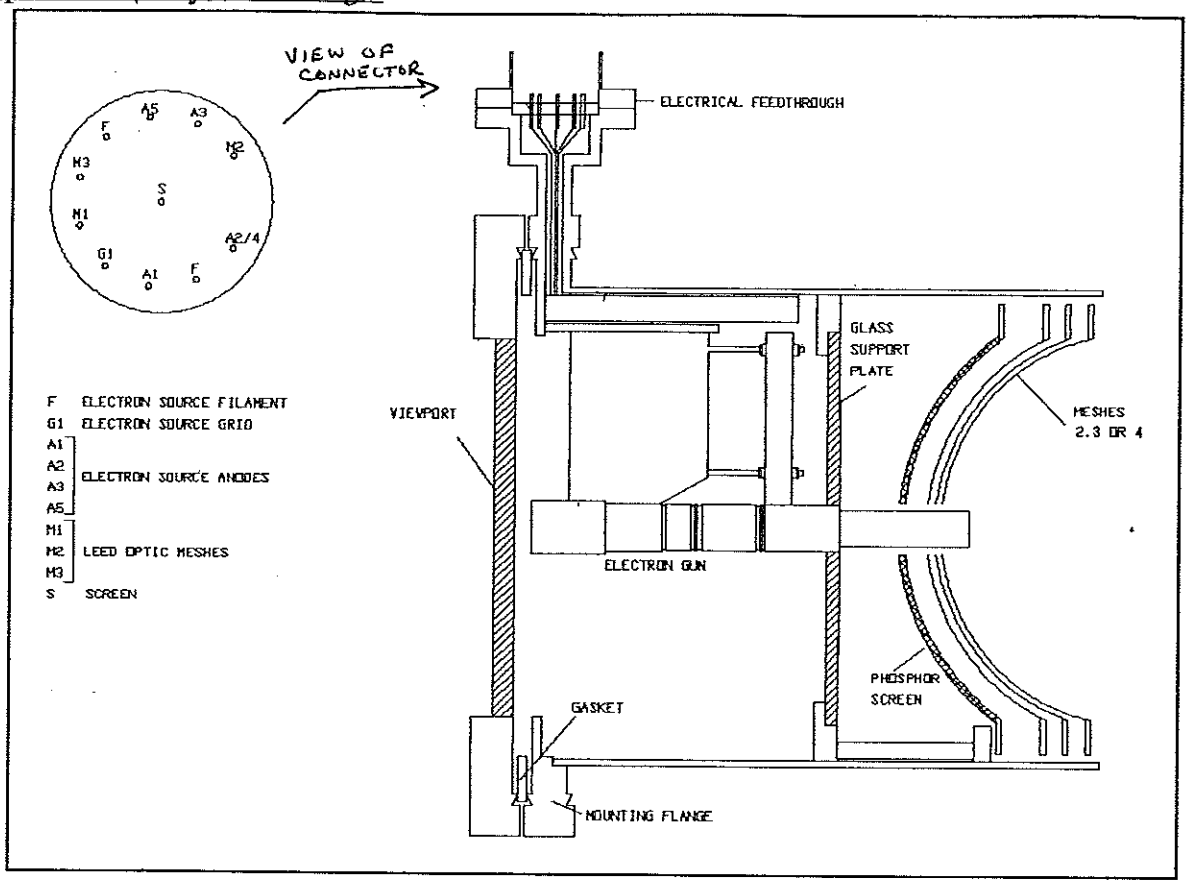
Model 8011 Power Supply

Dimensions 19" (rack mounting) x 13mm x 45.5mm (approx.)

Mains Supply 240Vac or 120 Vac switchable 50/60Hz

MECHANICAL DESCRIPTION

Optics Assembly- fixed length



A general view of the Rear View LEED optics is shown. The optics assembly is mounted on a single 200mm conflat double-sided flange and includes two main components : the electron gun and mesh assembly. Four long rods attached to the mounting flange provide support for the whole assembly. Bolted to the end of the four rods is a mounting ring, which holds a flat glass plate. The mesh assembly is supported from the mounting ring by means of three shorter rods.

The mesh assembly consists of either two, three or four concentric spherical sector meshes and a spherical sector glass screen, mounted on the mesh mounting ring. The glass screen has a fluorescent phosphor coating. The electron gun is located inside the gun mounting tube which is attached, by means of a support strut and flat mounting plate, to two of the main support rods. The end of the gun projects through a hole in the flat glass plate and through a hole in the centre of the screen and meshes.

A mu-metal cylinder surrounds the gun and optics to provide shielding from stray magnetic fields and electrons. All the electrical connections for the optics and electron gun are made through an 11 pin feedthrough located on the mounting flange. When the optics assembly is fitted to a vacuum chamber a viewport is fitted to the outside of the mounting flange. The viewport is held in place by bolts which pass through both the viewport and the mounting flange.

INSTALLATION

General

The Rear View LEED optics assembly is designed to fit onto a standard 200mm conflat flange on a vacuum chamber.The vacuum system should be arranged so that the sample can be held at the centre of curvature of the LEED optics.

It is important to protect the meshes of the LEED optics from dust. After removing the packaging, the optics assembly should be held with its axis horizontal to prevent dust from settling on the meshes. The plastic bag should NOT be removed until the last possible moment.

Procedure

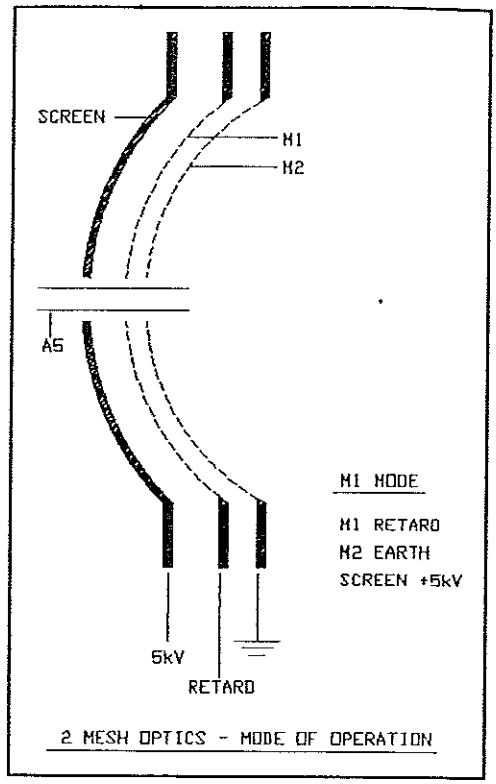
1.Insert the optics assembly into the port in the vacuum chamber. The optic is shipped from the factory with a new gaskets already in place.
2.Ensure that the bolt holes on the viewport and on the mounting flange are in line.
3.Insert bolts through the holes in both the viewport and the mounting flange, into the holes in the chamber flange. Tighten the bolts.
4.Pump down the system and bake at 180 degrees C for at least 8 hours to reach a pressure better than 10E-8mb.
5.Connect the interconnection lead to the Rear View LEED optics and the 8011 Power Supply.
NB. Take care not to bend the pins on the 11 pin feedthrough,
which are easily deformed. If necessary the position of the plug guide may be adjusted by loosening the two screws with an Allen key.
6.If the optional viewing hood, with remote digital energy display, is fitted connect the 15-way plug to REMOTE on the rear panel of the 8011 Power Supply.
7.If required, connect the ENERGY remote potentiometer by inserting the jack plug into the socket on the front panel of the 8011 Power Supply.
8.Ensure that the 8011 is set to the correct local Voltage. Connect the mains lead to the 3 pin socket on the rear panel of the 8011 Power supply and to the mains supply.

MESH OPERATING MODES

Two, three and four mesh versions of the Rear View LEED optics are available. In operation, a negative potential close in value to the accelerating energy of the electron gun, is applied to one of the meshes. This has the effect of preventing inelastically scattered electrons from reaching the screen. The other meshes are earthed. (In the case of four mesh optics, the two central meshes are connected together by an internal link and behave as one mesh).

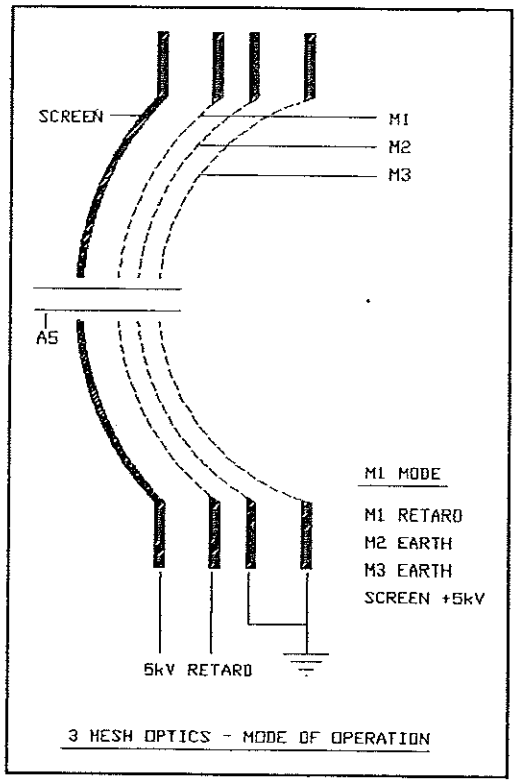
Two Mesh Optics

The connections for a two mesh optic is shown (right). The mesh closest to the screen, M1, is at the retard potential (slightly higher than the electron gun energy) and the mesh closest to the sample, M2, is earthed. The screen is at a potential of approximately + 5kV. It is field penetration from the screen voltage which allows the diffracted electrons (which have the highest energy being elastically reflected) to pass through the retarding mesh.



2 MESH OPTICS - MODE OF OPERATION

Three and Four Mesh Optics



3 MESH OPTICS - MODE OF OPERATION

For three mesh optics (left), the mesh closest to the screen (M1) is at a retarding potential. The middle gird (M2) and the mesh closest to the sample (M3) are both earthed. The screen is at approximately +5kV.

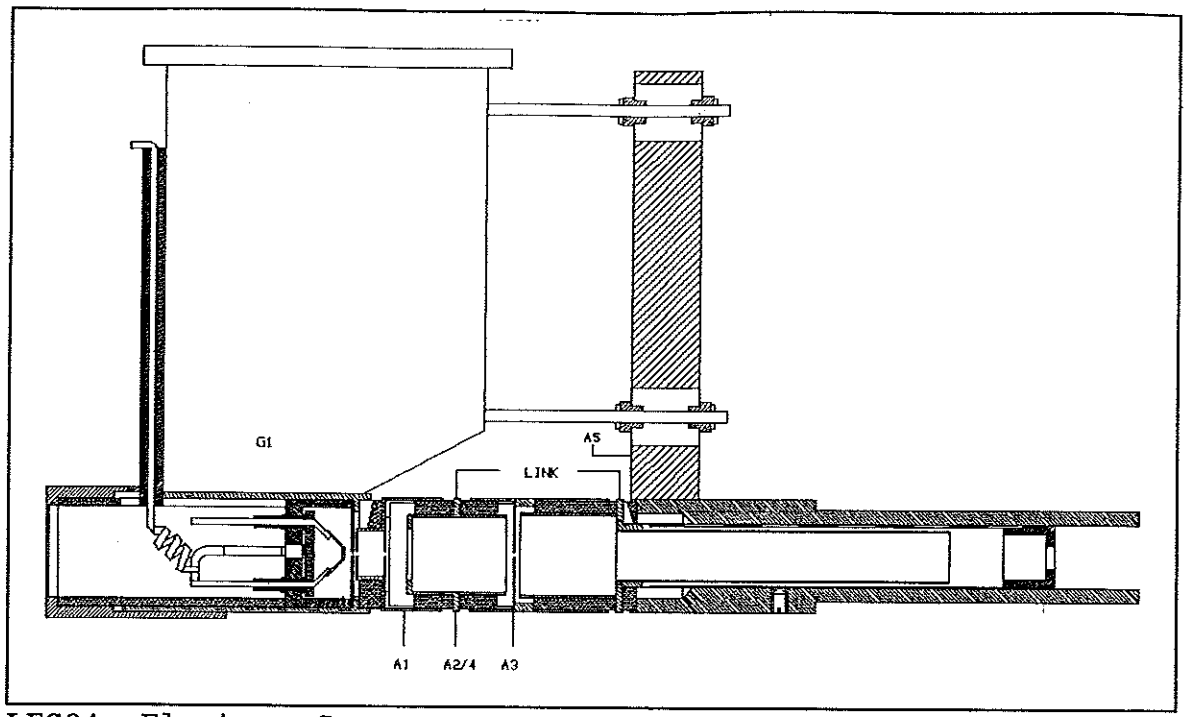
The retard potential which is applied to M1 is adjusted using the MESH BIAS control of the 8011 Power Supply.

Four mesh optics are operated in the same way as three mesh optics, the central two meshes being connected together by an internal link. This composite mesh is referred to as M2. (For constructional purposes the two meshes are designated M2a and M2b moving outwards from the screen.)

VIEWING HOOD (Optional)

The optional viewing hood is designed to make photographic recording of diffraction patterns easier. The viewing hood is held in place by a flange which slides over the viewport of the optics assembly. The viewing hood has two windows positioned at right-angles to each other. One window is used for viewing the diffraction pattern and the other window is used for mounting a camera (using a suitable adaptor). The operator may choose which window is used for each purpose. The lever on the outside of the hood selects the position of a mirror inside the viewing hood. In position 1 the mirror is held flat against the side of the viewing hood so that light from the viewport travels directly to the window opposite. In position 2 the mirror is held at 45 so that the light is reflected from the viewport into the side window. A digital display inside the viewing hood enables the beam energy to be displayed with the diffraction pattern, and recorded on photographs. Connection must be made to the 8011 Power Supply through the 15 way socket and connecting cable. The potentiometer controls the brightness of the digital display. The small toggle switch laterally inverts the digital display so that the energy can be read when the display is reflected by the mirror into the side window.

LEG 24 ELECTRON GUN



LEG24 Electron Gun

The LEG24 electron gun is operated over an energy range of 5 to 1000V for Low Energy Electron Diffraction. Acceleration is achieved by the filament being at a negative potential with respect to earth. The acceleration potential, or beam energy, is varied by the ENERGY control of the 8011 Power Supply and may be displayed on the digital meter. The emission current is controlled by varying the potential applied to the gun grid, G1, within the range [ENERGY - (0 to 200V)].

Focus is by means of a simple Einzel lens arrangement. A constant potential of +600V relative to the filament is applied to the first anode A1, to ensure that there is sufficient emission current. The focus voltages applied to A2/A4 and A3 are slaved to the Energy power supply so that the focus is maintained over a large energy range. The zero offsets of the focus voltages are set using two potentiometers accessible at the front of the 8011 Power Supply. These controls are useful for maintaining focus at low beam energies. The gains are user controlled by potentiometers on the front panel.

MODEL 8011 POWER SUPPLY

Front Panel

The functions of the front panel controls are described briefly.

POWER

The mains power is switched on by depressing the white button. The LED illuminates when the mains power is switched on. Pressing the button a second time will turn power off.

Interruption to mains power will reset the control to off.

DIGITAL PANEL METER

The DPM may be switched to read operational parameters as required.It will also display the target current in the range 0 to 3.999uA. In order to measure the target current the sample must be electrically conducting and isolated from earth.

FILAMENT CURRENT

The heater current through the filament is variable in the normal operating range of 2.2 to 3.2A, using the potentiometer. The value of the filament current may be displayed on the Digital Panel meter.

The filament is switched on and off by the black button. An LED indicates that the filament is on.

EMISSION

The emission of the electron gun is controlled by varying the potential applied to the grid of the electron gun, in the range [ENERGY - (0 to 200V)], using the front panel potentiometer. The value of the resultant emission current may be displayed on the DPM meter.

MESH

The MESH control adjusts the retarding potential applied to the optic retarding mesh This control may be adjusted to optimise the diffraction pattern which appears on the screen.

ENERGY

The accelerating energy applied to the filament of the electron gun is variable in the range -5 to -1000V. The energy may be varied using either the potentiometer on the front panel or the remote potentiometer which is supplied with the 8011 Power Supply. When the jack plug is inserted in the front panel socket the front panel potentiometer is disabled and the energy is controlled by the remote potentiometer.

The energy control may also be transferred to a rear panel input by means of the button labelled 'computer select'.

HV ON RESET

The EHT supply to the screen (approx. +5kV) and the energy supply to the electron gun are controlled by this button.

RANGE

This button provides switching of the Gun energy range between 0-1keV and 0-3keV. It works in conjunction with the HV ON RESET button in that pressing the HV ON RESET

button selects the voltage range pre-set by the RANGE button. The range selected is indicated by LEDs.

At power up, the range defaults to 1keV. The 3keV range is selected for AUGER applications.

FOCUS

The two focus controls vary the potential of elements A2/A4 and A3 relative to the Kinetic Energy. It is therefore possible to keep the gun in focus over a larger energy range. A3 acts as a condenser lens and will also vary the total gun current.

* HV MUST BE SWITCHED OFF BEFORE CHANGING RANGES. RANGE CHANGE WITH HV ON HAVE NO EFFECT.

Rear Panel

MAINS

The 3 pin mains socket is located at the lower left hand side of the rear panel. The unit may be switched between 240 and 120 volt operation by an adjacent switch.

REMOTE

A 16 pin 'D' plug connects the remote DPM display of the viewing hood attachment to the internal DPM circuitry.

AUGER PRE-AMP

This socket provides power to the pre-amp in AUGER applications.

AUX

The auxiliary input for the DPM (millivolts). This input is used primarily for AUGER energy display.

RAMP

External input to the unit for AUGER energy scan drive to the retard mesh.

MOD

Modulation input for AUGER applications.

TARGET

Sample current monitoring input.

COM

Rear panel input to the gun energy control selected by the computer select switch. (0-10V input gives 0-1000V output)

BNC OPTIC CONNECTIONS

The remaining connectors are all inputs to the LEED optic through cable No.CE000011D as follows:-

H	Heater (filament)
A1	First Anode
G1	Grid (Emission control)
F	Focus (Lens Element)
A2/A4	Second Anode
SC	Screen
MESH	Retard Potential (active mesh)
EARTH	Earth connections (inactive meshes)
E	System ground
A5	Earthed gun element

LEED OPTIC OPERATION

Initial Settings

Before switching on the 8011 Power Supply set the controls as follows:-

1. Set the FILAMENT CURRENT control to minimum (fully anti-clockwise).
2. Set the ENERGY control to minimum (fully anti-clockwise).
3. Set the GRID control to maximum (fully clockwise).
4. Set the MESH BIAS control to maximum (fully clockwise).
5. Set the FOCUS control to maximum (fully clockwise).

Operation

NOTE:- Special care should be taken whenever the filament of the electron gun is replaced or the filament has been exposed to air for a long period of time. In either of these circumstances it is recommended that the vacuum system is baked before running the filament. Particular attention should be paid to steps 6 to 9 to ensure adequate degassing and activation of the filament, which may take up to four hours to complete.

1. Check that the pressure of the vacuum system is less than 1x10E-8 mbar.
2. Switch on the main supply by depressing the white button. The LED should illuminate.
3. Wait for one minute for the electronics to stabilise.
4. Switch on the filament control by pressing the black button. The LED should illuminate.
5. Switch the DPM to read filament current.
6. Slowly turn the FILAMENT CURRENT control clockwise to increase the filament current, while observing the pressure of the vacuum system. If the pressure increases suddenly, do not increase the filament current until the pressure starts to recover. Avoid large pressure bursts, greater than half an order of magnitude, as the thoria coating may be blown off the surface of the filament. Ensure that the pressure is less than 5x10E-8mbar before continuing.
7. When the filament current reaches 2A, as displayed on the meter, switch on the EHT. (HV) Switch the meter to read ENERGY (Beam Energy)
8. Turn the ENERGY control clockwise slowly until the digital ENERGY meter reads 1000eV. Switch the meter to read EMISSION CURRENT.
9. Increase the filament current slowly, while continuing to monitor the pressure, until the emission current just reaches a plateau or a maximum of 0.5mA (or the filament current reaches 3.2 A). Operation at high filament currents will significantly shorten the life of the filament. Therefore it is advisable to run the filament on the 'knee' of the plateau.

In normal operation a suitable emission current should occur at a filament current in the range 2.2 to 2.6A. However it may be necessary to increase the current up to 3.2A in order to activate a new filament. The emission current will increase as the filament current is increased, although the relationship may not be linear. During activation, the emission current may be seen to increase and then subsequently decrease when the filament current is

held steady. Once
the filament has been activated the filament current can be adjusted back to run at a lower current. A new filament may have unstable emission over the first few minutes and need some time to stabilise.

Under no circumstances should the filament current be increased to above 3.2A.

10. If the sample is conducting and isolated from earth, the target current can be displayed on the digital meter. As there is a 15V bias on the sample when measuring target current, the energy of the beam will be affected. The target current can be reduced by turning the EMISSION control anticlockwise to reduce the emission current.

11. To set up the optics initially, turn down the energy of the gun to 100eV and set the grid, focus, A2 and Mesh controls fully clockwise. Using the focus control, set a sample(target) current of 2 microamps. A LEED pattern should now be visible and the spots may be focused using the A2 potentiometer. The Grid control will change the gun emission and can be used for optimising the spot size. The mesh control adjusts the retarding voltage and is used to reduce the background glow on the screen caused by secondary electrons from the sample.

12. In cases where the user is uncertain whether the optics is operating correctly or the sample is too contaminated to give a pattern, a sample of freshly cleaved mica will be certain to give a diffraction pattern above 150eV although it will not be possible to observe a sample current. Mica is an insulator.

Precautions

1. Turn the EHT off before switching off the mains power.

2. Turn the filament down slowly to zero before switching off.

3. Do not allow the meshes or the screen to be contaminated by evaporated or sputtered material.

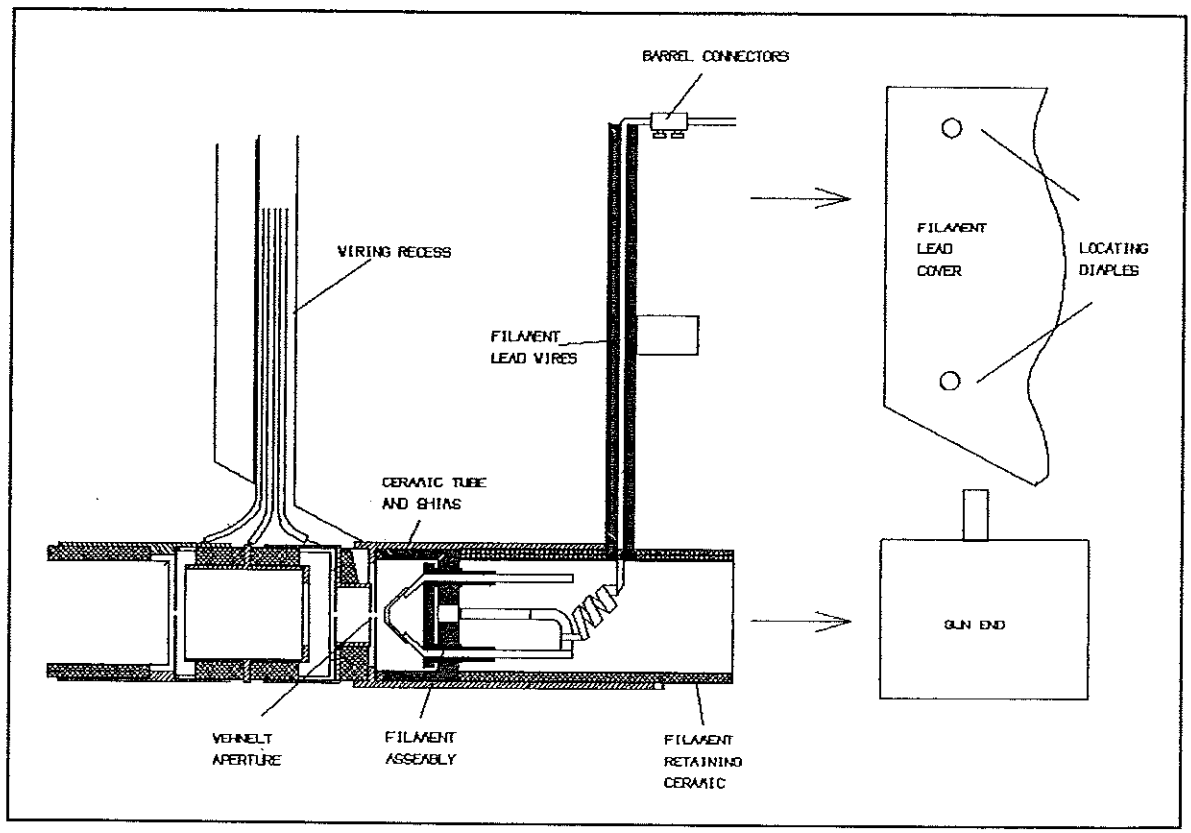
4. Take care when admitting gas to the vacuum system:-

   a) allow 20 minutes for the filament to cool before admitting gas.

   b) admit only clean, dry, dust free gas.

FILAMENT REPLACEMENT

CAUTION:- The filament is thoria coated. Thoria is harmful if ingested. Observe local regulations for disposal of old filament.



General

The filament of the electron gun can be replaced through the window in the mounting flange of the optics assembly, after removing the viewport. It is not normally necessary to dismount the gun from the optics assembly or to remove the assembly from the chamber. However, it is usual to replace the copper gaskets at the same time as the filament, in which case the assembly must be removed from the chamber for a short time.

NOTE If the optics assembly is removed from the chamber, access to the electron gun can be improved by sliding the cylindrical shield forwards. The screws holding the shield to the mesh support ring must first be removed. This will not affect the mounting of the meshes themselves.

PRECAUTIONS

Cleanliness

It is important to protect the meshes of the LEED optics from dust. If the optics

assembly is removed from the chamber to change the gasket, it should be held horizontally to prevent dust settling on the meshes. If the optics remain outside the chamber for more than a few seconds, the front of the optics should be covered with a clean polythene bag.

Screw Threads

Screws and screw threads inside the vacuum may become tight after bakeout, and may seize if forced. If any difficulty is experienced turning screws, the screw thread should be lubricated with a little isopropyl or methyl alcohol.

PROCEDURE

Filament Removal

1. Unscrew the bolts around the mounting flange of the optics assembly. Remove the viewport and the copper gasket. It is not necessary to remove the optics assembly from the chamber and this may be the best way of protecting the optic meshes from dust. The assembly may be retained by replacing two of the bolts (diametrically opposite each other).

2 Loosen all four screws on the two barrel connectors. Slide the barrel connectors along the wire to release the filament legs.

3 Remove the filament lead cover by sliding it toward the rear. It may be necessary to pull the sides of the cover away from the gun mount in order to disengage the locating dimples.

4 Pull the end cap from the rear of the gun mount.

5 Take out the filament retaining ceramic.

6 Bend the retaining tag to one side

7 Remove the filament assembly by sliding backwards from the rear of the gun.

8 The filament assembly is spaced back from the G1 aperture by a ceramic tube and shims. Remove the tube and shims. The old shims should be discarded and replaced by the new set supplied with the replacement filament.

9 Re-insert the ceramic tube and new shims.

Filament insertion

Extreme care should be exercised when handling the filament assembly, especially when inserting it into the gun mount. The filament ribbon is very fragile and easily damaged.

1 Examine the new filament. Check that the filament ribbon is undamaged and that the thoria coating is intact. Check also that the spot welds holding the filament leads are secure.

2 Bend the filament leads to match the old filament. If necessary cut the lead wires to the same length as the old filament.

3 Carefully insert the new filament assembly into the gun mount and make sure that it is fully seated.

4 Fix the filament in place by bending the retaining tag over the ceramic insulator.

5 Replace the filament retaining ceramic. It may be necessary to adjust the filament leads slightly to clear the ceramic. Ensure that the leads do not short together.

6 Refit end cap (push fit).

7 Slide the filament lead cover back into place ensuring that the gun wires are retained in the recess in the gun mount.

8 Slide the barrel connectors over the filament wires and tighten. To secure, check that the leads and barrel connectors cannot touch each other or the gun mount.

9 Check electrically that the filament has continuity and does not short to the wehnelt.

Gasket Replacement

1. Carefully lift the optics assembly from the vacuum chamber, holding it horizontally to prevent dust settling on the meshes.

2. Remove the copper gasket which is located between the mounting flange and the chamber flange, and replace it with a new gasket.

3. Replace the optics assembly into the vacuum chamber.

4. Replace the viewport, using a new copper gasket between the viewport and the mounting flange.

5. Replace the flange bolts and tighten.

6. Check again for electrical continuity of the filament by connecting a meter to the two pins on the electrical feedthrough, marked F in the general assembly diagram (refer to MECHANICAL DESCRIPTION section).

Filament Degassing

After fitting a new filament, it must be degassed **very** carefully. Refer to the section entitled OPERATION.