SPECTRACON
3.6m PRIME FOCUS
This manual refers specifically to the operation of
the Spectracon at the prime focus of the 3.6 m telescope
using the ESO-built air-cooled solenoid attached to the
Small-Field adaptor of the telescope. The manual covers
operational, installation and maintenance aspects, this
latter in conjunction with manufacturers manuals in the
case of commercially bought electronic units. If you
discover any errors in this manual, or have any suggestions
for future editions, please notify Martin Cullum, ESO,
Geneva.
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IMPORTANT NOTES

- Before operating, read these instructions carefully
- Like any delicate scientific instrument, the Spectracon should not be subjected to excessive thermal or mechanical shock
- The system should always be adequately grounded
- When the Extra High Tension (EHT) is on, the cathode should be protected from excessive light levels
- Do not apply more than 40kV to the Spectracon
1. The Spectracon

1.1 General description

The Spectracon is an electronographic image tube which has a number of advantages over photography (either direct or with conventional image intensifiers). Among them are: linearity of response, high signal to noise ratio in the recorded image, and lack of reciprocity failure.

In the Spectracon electrons liberated from the photocathode by an optical image are accelerated through 40kV and focused by the magnetic field from a solenoid to form a high resolution electron image at the mica window. The window is only 4 microns thick and allows transmission of 75 to 80% of the electrons. These electrons are recorded on a special electron-sensitive emulsion situated in close contact with the outside surface of the mica. The resulting 'electrograph' is processed in a similar way to conventional photographic emulsions. The high silver halide content and fine grain of the nuclear research emulsions used, together with the sensitivity and low noise of the image converter account for the low-contrast detection capabilities of the Spectracon. Because the Spectracon is permanently sealed, it requires neither vacuum nor cryogenic equipment for its use at the telescope.

1.2 Spectracon tubes available

In December 1978, 5 Spectracon tubes were available on La Silla. Three of these have S.25 cathodes (approx. useful range 320 - 900 nm), one has an S.20 cathode (320 - 820 nm) and one an S.11 cathode (320 - 620 nm). The pertinent characteristics of these tubes are outlined in Table 1. The S.11 Spectracon is of low sensitivity and is not normally used for astronomical work except as a standby tube, but it
**TABLE 1**

Comparison of performance characteristics of available Spectracon tubes

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Cathode</th>
<th>Relative Sensitivity</th>
<th>Response non-uniformity</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt; 550nm</td>
<td>&gt; 700nm</td>
<td>Large scale</td>
</tr>
<tr>
<td>105</td>
<td>S.25</td>
<td>high</td>
<td>high</td>
<td>fairly good</td>
</tr>
<tr>
<td>106</td>
<td>S.20</td>
<td>fairly high</td>
<td>low</td>
<td>good</td>
</tr>
<tr>
<td>107</td>
<td>S.25</td>
<td>fairly high</td>
<td>fairly high</td>
<td>good</td>
</tr>
<tr>
<td>108</td>
<td>S.25</td>
<td>high</td>
<td>very high</td>
<td>good</td>
</tr>
<tr>
<td>81</td>
<td>S.11</td>
<td>low</td>
<td>-</td>
<td>good</td>
</tr>
</tbody>
</table>

** **: These tubes exhibit a discontinuity in the red response passing almost centrally across the short axis of the cathode. Each side of this discontinuity has the figure of merit indicated. No such effect is observable in the B or V spectral regions.
should be used preferentially for general laboratory tests, practice runs, system checkouts, etc.. The serial numbers for the Spectracons are located on the side of the black perspex film applicator housing at the rear of the tubes. An example is given below:

\[
\begin{array}{cccc}
108 & / & 70 & / \ 1030 / 25 \\
\text{tube serial number} & \text{manufacturer's type number} & \text{nominal cathode size} (10\times30 \text{ mm}^2) & \text{cathode type}
\end{array}
\]

In the text, the tubes are identified by their serial number (i.e. 108 in the above example).

1.3 Astronomical field at the prime focus of the 3.6 m telescope

All the Spectracons have a nominal cathode size of 10 x 30 mm\(^2\). At the prime focus of the 3.6 m telescope, this represents a field on the sky of:

\[
3.3 \times 10 \text{ arcminutes}^2
\]

2. Using the Spectracon

2.1 General introduction

The main items of equipment associated with the Spectracon on the 3.6 m telescope are the following:

i) The Spectracon tube and solenoid attached to the prime focus pedestal;

ii) EHT power supply located in the prime focus cage;

iii) Control chassis, also located in the P.F. cage;

iv) Constant current power supply, located in the electronics rack in the Cassegrain cage.
Details on the installation of this equipment and the necessary cable interconnections is given later in section 4. Figure 1 gives a schematic bird's-eye view of the prime focus cage and indicates where the main items are situated.

2.2 Spectracon and solenoid

The air-cooled solenoid and supporting structure is a direct replacement for the photographic plate-holder flange of the small field adaptor. The arrangement is indicated in figure 2.

As with the plate-holder, the filters are located in the central hole of the adaptor top-plate. Consequently the solenoid is provided with a lifting mechanism to enable the filter to be changed rapidly. To raise the solenoid, first make sure that the dark-slide is fully inserted. Then, slightly depressing the solenoid raising arm, release the catch on the arm handle. Raise the solenoid by means of the arm until the locking catch is felt to engage. CHECK THAT THE SOLENOID IS PROPERLY LATCHED BEFORE LETTING GO OF THE ARM HANDLE. The lowering of the solenoid is carried out similarly. When the solenoid is resting on the adaptor top-plate, press the arm down against the spring pressure until the locking mechanism is again felt to engage. NEVER ALLOW THE SOLENOID TO FALL WITHOUT SUPPORT.

To avoid the need to switch off the EHT each time the filter is changed, a dark-slide is provided to protect the cathode from accidental exposure to bright lights. A safety interlock is provided to prevent the solenoid being raised with the dark-slide open, and likewise prevent the slide being opened in the raised position. The dark-slide must, of course, be fully open when taking exposures.
Spectracon Control chassis
Adaptor electronics box
Cable termination point
Cable bridge
Light
Handset box
Plate or filter box (exchangeable)
Chair/cage handset
Intercom
Light switch
Telescope handset
Box for papers, torch, etc.

Spectracon EHT power supply
Handgrip
TV Monitor
Safe-light
Focus control box
Seat-belt storage
Plate/filter boxes (exchangeable)
Safelight switch
Spectracon and solenoid
Pedestal
Chair

Figure 1
Schematic plan-view of the prime focus cage

Footnote:—Great care should be taken when rotating the cage to avoid excessive strain being placed on the Spectracon connecting cables. Check also that the chair motor does not foul the pedestal and that the supply cables to the pedestal (at the bottom of the cage) are not entangled.
Figure 2

Spectracon support at the prime focus of the 3.6m telescope
2.3 **Switching the system on**

(It is assumed that the equipment has already been correctly installed, including the insertion of the Spectracon tube itself, as described in section 4).

It is important that the order of switching on the equipment is respected to avoid the risk of damaging the Spectracon.

**Cassegrain cage** (telescope in Zenith position).

i) **Switch on the constant current power supply.** (HP 6265B)

This is located in one of the electronics racks in the Cassegrain cage. The main power switch of the unit is on the front panel. (Note that after switching on, the voltage indicated on the meter should be approximately 40 V and the current should be zero - do not adjust the voltage control of the power supply; the current is controlled remotely from the prime focus cage).

**Prime focus cage** (telescope in prime focus access position)

ii) **Switch on the 220 V power switch on the Control chassis**

The digital panel meter should light up.

iii) **Switch on the focus current** by means of the toggle switch on the front panel of the Control chassis. Turn the rotary switch to select 'Focus current' on the digital display and adjust the focus current to the value indicated in table II below by means of the multi-turn potentiometer. (Note: if no current is indicated on the digital display, check that the cable connections

---

**Footnote:** on the provisional version presently installed in the P.F. cage, this switch is rather inaccessible and is situated on the back panel near the left hand corner (as viewed from the front).
TABLE II

Focus currents for available Spectracon tubes
with the 3.6m P.F. solenoid

<table>
<thead>
<tr>
<th>Serial number</th>
<th>Focus current (Amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>105</td>
<td>0.773</td>
</tr>
<tr>
<td>106</td>
<td>0.772</td>
</tr>
<tr>
<td>107</td>
<td>0.757</td>
</tr>
<tr>
<td>108</td>
<td>0.756</td>
</tr>
</tbody>
</table>
have been properly installed. In particular, check the cable connection between the P.F. cage and the telescope top ring. Do not proceed further with the switching-on procedure without the focus current being registered.

The cathode of the Spectracon is cooled locally by means of several small Peltier cooling elements. The power to these is switched on simultaneously with the focus current. To check that this is functioning correctly, select 'Peltier' on the rotary switch and check that the current registered is in the range 0.5 - 0.8 Amperes.

iv) Switch on the EHT. THE EHT MUST NOT BE SWITCHED ON DIRECTLY TO 40kV. First select 'EHT' on the rotary switch on the Control chassis. Remove the protective cover from the film applicator housing at the rear end of the Spectracon tube and insert the phosphor screen into the housing. When pushed fully home, it lies within about 1 mm of the mica window. Ensure that the multi-turn potentiometer on the EHT power supply is at zero (fully counter-clockwise) and that the dark-slide is fully inserted. Press the 'Mains' and 'EHT' buttons on the power supply and proceed to increase the potential by turning the potentiometer knob at a rate NOT GREATER THAN 3kV PER 10 SECONDS. This procedure is necessary because at faster rates high potential differences can build up within the Spectracon which could result in harmful flashovers. Whilst the voltage is being raised, the phosphor screen should be carefully observed (in darkness or low ambient lighting conditions). A few slight flashes may appear with a normal tube. If, however, very bright flashes appear on the phosphor
screen, immediately lower the EHT by 2 or 3 kV. If any
glow or flashing disappears after a few minutes, continue
to raise the potential very slowly. If it still persists,
first check that no stray light is incident on the photo-
cathode. If it still persists, reduce the EHT to zero.
A possible cause of such background is faulty earthing or
EHT contact. Check in particular the electrical continuity
of the earth connection to the faceplate as described in
section 5.1.

The digital meter in the Control chassis is used to monitor
the EHT voltage. The display gives a reading of 1.000 per
10 kV. Thus the reading at 40 kV, the normal operating
potential for the Spectracon, is 4.000. VOLTAGES IN EXCESS
OF 40 kV MUST NOT BE APPLIED TO THE SPECTRACON.

Allow half an hour for the system to stabilise before making
exposures. After this time, recheck the settings of the
focus current and EHT, and make any corrections necessary.
No further adjustment should normally be needed during the
night.

Summary of the switch-on procedure

i) Turn on the Constant current power supply in the Cassegrain
cage.

ii) Switch on the power to the Control chassis in the PF. cage.
Switch on the focus current. Set the current to the value
listed in table II. Check the current to the Peltier
coolers.

iii) Switch on the EHT power supply and raise the potential
slowly to 40 kV whilst watching the phosphor screen.

./.
2.4 Observing procedure

2.4.1 System check

DO NOT EXPOSE THE SPECTRACON TO BRIGHT TWILIGHT SKY, THE MOON, PLANETS, ETC WITHOUT ATTENUATION WHEN USING BROAD BAND FILTERS. LIKewise, DO NOT EXPOSE TO STARS BRIGHTER THAN ABOUT 4th MAGNITUDE.

When the twilight sky is dark enough to permit a fair number of stars to be seen, the sky may be safely observed with the Spectracon without risk of damage. With the phosphor screen in position, open the adaptor shutter and the dark-slide. The glow on the phosphor screen should be no more than comfortably visible.

2.4.2 Field Finding

There is no direct way of viewing the Spectracon field that is adequate for identifying the star field. The most convenient way of acquiring the field is to point the telescope to a nearby standard star from the 3.6 m star catalogue (magnitude preferably 4.5 - 6) and to centre this in the Spectracon field using the phosphor screen. When centred, the night assistant corrects the telescope coordinate system (CC command). The telescope can then be positioned directly on the object field without further correction. This method has proved to work reliably and takes little time but does require observers to know the coordinates of their fields fairly accurately (± 15 arcsecs).

The most convenient way to centre the standard star in the field of the phosphor screen is to use the OFFSET mode of the telescope (a convenient value of the Offset is 10 arcseconds). With the long axis of the Spectracon field in the North-South direction, say, the telescope is shifted in steps of 10 arcsecs to the East or West until the standard star disappears off the edge of the field. It will be noted ./.
that although the resolution of the phosphor screen is very low (the star appears as a large fuzzy glow on the screen), the point where the star disappears can be seen fairly accurately. When the star image disappears, count the number of Offset steps needed to move the star back to the opposite edge of the field. Finally, move the telescope back half the number of steps found so that the star is centred in the field. It is not normally necessary to centre the star in the long axis of the field.

2.4.3 Focus run

Before commencing observing, it is desirable to carry out at least one focus run to check the zero point for the telescope optical focus. This is done by taking a series of short exposures at different telescope focus settings of a star of convenient magnitude. The procedure of film loading and exposing is described in later sections. After development of the strip, the optimum focus position can readily be found. The optical thicknesses of the standard filters are known and the correct focus offset for any filter can be found from Table III for the square Spectracon U, B and V filters and the 'Clear' filter supplied for the Small-Field adaptor, and on the list to be found in the 3.6 m Control room for the remainder of the Small-Field adaptor filters. (See also the section on filters below).

For reference, the focus position for the B and V filters was found during the initial calibration run for Spectracon no. 108 to be around 5000 - 5100 (digital readout value). Note that an increased value corresponds to a reduced distance between the focal plane and the primary mirror, and that each numerical step corresponds to a movement of the focal plane of 2 microns. To recheck the focus from night to night, or even during the night if there has been a significant temperature change during observations, a single
## TABLE III

Spectracon filter offsets

<table>
<thead>
<tr>
<th>№</th>
<th>Filter</th>
<th>Focus offset (mm)</th>
<th>Change to focus readout relative to the Clear filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clear (small-field adaptor filter)</td>
<td>0.00</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>V</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>B</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>U</td>
<td>+0.06</td>
<td>+30</td>
</tr>
</tbody>
</table>
focus run with steps of 50 - 100 on the digital readout has been found to be sufficient for most conditions. The smaller figure is to be preferred in cases of good seeing. When unknown filters are being used for the first time, or other instrument changes have been carried out that might affect the focal position, a larger step size, for example 300, might be found desirable followed, if necessary, by a second 'fine' focus run with smaller steps to interpolate between the two best exposures of the first run. Note that although in normal use only six exposures per strip of emulsion can be made, it is often advantageous in the case of focus runs to offset the star image along the length of the cathode between successive exposures, without advancing the emulsion, thus increasing the number of test images per film strip. In this way it is quite possible to take up to 10 exposures per frame or 60 exposures on a single strip. Normally, however, 6 to 12 exposures will be found adequate for a precise determination of focus.

A particular problem encountered when carrying out focus runs with broad-band filters is that of finding a catalogue star that is sufficiently faint to permit an integration time long enough to average out short-term seeing effects, which can produce asymmetric images and hence make it difficult to compare the resulting image sizes reliably, but without making the star density too great. A 10th magnitude star (at the limit of the SAO catalogue), with L4 emulsion and a B or V filter, and with an integration time of 5 seconds usually gives satisfactory, although not ideal, images. A star 2 magnitudes fainter, if such a star can be found easily, with an integration time twice as long would give better images for evaluation. Alternatively, a filter of narrower bandwidth and known offset could be used instead.
Once the optimum optical focus has been found in this way, set the telescope focus to this setting and then adjust the adaptor TV focus for best picture quality on the monitor in the cage. The control for this is to be found on the adaptor control box attached to the top-plate of the adaptor next to the Spectracon solenoid mounting.

2.4.4 Filters

The filters for the Spectracon are the same size as those used for prime focus photography with the small-field adaptor, i.e. 65 mm diameter and 10 mm thick. The filter holders, however, are different. The complete list of photographic filters, and their relative focus offsets, is to be found in the 3.6 m control room. The main filters of interest for use with the Spectracon in this list are: Clear, Red, Infrared, and a series of narrow-band interference filters. Note that the photographic U, B and V filters are not blocked in the red and are unsuitable for use with the Spectracon. If it is required to use any of these filters, they should be transferred to the special Spectracon filter holders beforehand.

Three special filters for UBV photometry are available in Spectracon filter holders numbers 5, 6 and 7. The transmission curves for these filters are tabulated in table IV. They are identifiable as being composed of square glass elements.

2.4.5 Field flattener

To correct the curved image plane at the prime focus, a field flattener lens is oiled onto the Spectracon faceplate. This is attached before the Spectracon is inserted into the solenoid as described in section 4.3.1 of this manual. Two such field flatteners are available. /.
<table>
<thead>
<tr>
<th>FILTER No. 5 (V)</th>
<th>FILTER No. 6 (B)</th>
<th>FILTER No. 7 (U)</th>
</tr>
</thead>
<tbody>
<tr>
<td>nm</td>
<td>T(%)</td>
<td>nm</td>
</tr>
<tr>
<td>460</td>
<td>0</td>
<td>350</td>
</tr>
<tr>
<td>476</td>
<td>0.6</td>
<td>355</td>
</tr>
<tr>
<td>478</td>
<td>1.6</td>
<td>360</td>
</tr>
<tr>
<td>480</td>
<td>3.8</td>
<td>365</td>
</tr>
<tr>
<td>490</td>
<td>32</td>
<td>370</td>
</tr>
<tr>
<td>500</td>
<td>59</td>
<td>375</td>
</tr>
<tr>
<td>510</td>
<td>69.5</td>
<td>380</td>
</tr>
<tr>
<td>520</td>
<td>73</td>
<td>385</td>
</tr>
<tr>
<td>530</td>
<td>73.5</td>
<td>390</td>
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<tr>
<td>540</td>
<td>72</td>
<td>395</td>
</tr>
<tr>
<td>550</td>
<td>69</td>
<td>400</td>
</tr>
<tr>
<td>560</td>
<td>64</td>
<td>405</td>
</tr>
<tr>
<td>570</td>
<td>58</td>
<td>410</td>
</tr>
<tr>
<td>580</td>
<td>50</td>
<td>415</td>
</tr>
<tr>
<td>590</td>
<td>41.5</td>
<td>420</td>
</tr>
<tr>
<td>600</td>
<td>35.5</td>
<td>425</td>
</tr>
<tr>
<td>610</td>
<td>27.5</td>
<td>430</td>
</tr>
<tr>
<td>620</td>
<td>20</td>
<td>435</td>
</tr>
<tr>
<td>630</td>
<td>14.5</td>
<td>440</td>
</tr>
<tr>
<td>640</td>
<td>9.5</td>
<td>450</td>
</tr>
<tr>
<td>650</td>
<td>6.3</td>
<td>460</td>
</tr>
<tr>
<td>660</td>
<td>4.6</td>
<td>470</td>
</tr>
<tr>
<td>670</td>
<td>2.4</td>
<td>480</td>
</tr>
<tr>
<td>680</td>
<td>1.4</td>
<td>490</td>
</tr>
<tr>
<td>690</td>
<td>0.7</td>
<td>500</td>
</tr>
<tr>
<td>700</td>
<td>0.4</td>
<td>510</td>
</tr>
<tr>
<td>710</td>
<td>0.1</td>
<td>520</td>
</tr>
<tr>
<td>720</td>
<td>0</td>
<td>530</td>
</tr>
<tr>
<td>730</td>
<td>1.4</td>
<td>540</td>
</tr>
<tr>
<td>740</td>
<td>1.6</td>
<td>550</td>
</tr>
<tr>
<td>750</td>
<td>2.2</td>
<td>560</td>
</tr>
<tr>
<td>760</td>
<td>2.2</td>
<td>570</td>
</tr>
<tr>
<td>770</td>
<td>0</td>
<td>580</td>
</tr>
</tbody>
</table>
These are anti-reflection coated for two spectral ranges, namely 'blue' and 'red', with a crossover point at around 550 nm.

To change from one to the other during the night is not recommended and necessitates the waste of a fair amount of observing time. It is best to arrange the observing programme so that only one flattener is used on any one night. For UBV photometry the 'blue' flattener should be used for all colours.

Do not forget to open both the adaptor shutter and the dark-slide during an integration. Do not open the dark-slide except when making exposures as stray light reaching the cathode can cause emulsion fog, even when the emulsion is not in contact with the mica window. During exposures it is advisable to keep the brightness of the TV monitor in the P.F. cage down to a minimum and preferably reduce to zero between guiding corrections. In addition, all lights in the dome should be turned off and the windows of the control room covered.

Although the nuclear research emulsion is relatively insensitive to incident light, it would nevertheless be recommended to try and avoid direct moonlight shining on the emulsion when changing films etc.

2.4.6 Taking and exposure

With the phosphor screen and cover removed, and with the dark-slide shut (IN), insert a loaded film applicator (see section 3.2 for details of film loading) into the film applicator housing of the Spectracon. This operation can conveniently be carried out in the light of a red or amber safelight, or a torch with a suitable filter. Note that
a locating pin permits insertion in one orientation only. The applicator is retained by leaf springs extending from the applicator housing, and may be removed by gently lifting the springs. Take care not to scratch the film when inserting or withdrawing the applicator.

The applicator should be inserted with the knob fully withdrawn, secured by the locking screw, and in the farthest counter-clockwise position (position 1). To take an exposure, release the locking screw and push the aluminium knob gently forward until the limit of mechanical movement is reached. The locking screw should then be tightened. TAKE CARE NOT TO TURN THE KNOB WHILST PUSHING AND ON NO ACCOUNT FORCE THE MECHANISM IF IT APPEARS STIFF TO OPERATE.

At the end of an exposure the locking screw should be released, the aluminium knob withdrawn, and the locking screw retightened. At this point the knob can be rotated to the next frame, at which point a mechanical indent can be felt. The cycle can then be repeated for the next exposure. Note that the film advance mechanism only engages when the knob is in the retracted position. Before advancing the film, therefore, rotate the knob lightly to feel if the advance mechanism is engaged.

2.4.7 Maximum exposure times

The maximum exposure time at the prime focus of the 3.6 m telescope depends on a number of factors. These are principally:—the filter bandwidth, the night-sky brightness, the emulsion used, the cathode sensitivity, and the maximum tolerable density for plate measurement.

As a rough guide, for B or V filter band exposures with a dark (moonless) sky, the sky density with an S.25 cathode in a 1 hour exposure with L4 emulsion can be expected to be about 1D (diffuse) or 1.5D (specular).
The thermionic background of the Spectracon is normally negligible and with no light incident on the cathode, the emulsion can be left in contact with the mica window for long periods of time without producing any significant background signal.

2.4.8 Flat field exposures

To aid plate reduction, it is often advantageous to take some flat field exposures in the colours observed to give a map of the cathode non-uniformities. Such exposures can be of particular value in the red and infrared regions where marked local variations are often found that are strongly colour dependent.

A convenient way to take flat field exposures, that can be carried out during the daytime (with the dome shut!), is to point the telescope at part of the inside surface of the dome which is free from structural irregularities. The small dome lights situated around the walls of the observing floor provide a suitable source of diffuse illumination. Do not use the main dome lights for broad-band flat field calibrations.

With broad-band filters an exposure time of about 1 minute should produce acceptable densities for measurement with L4 emulsion.

2.5 Switching off

At the end of a night's observing, the system should be switched off in the reverse order of switching on:

i) First, shut the dark-slide, remove any film applicator and protect the mica window by means of the applicator housing cover.
ii) Reduce the EHT slowly to zero by turning the potentiometer on the EHT power supply. This should be done over a period of 1.5 - 2 minutes. Then switch off the EHT and main power switches on the power supply.

iii) Switch off the focus current at the Control chassis and then the main power switch.

iv) Remove any loose objects from the cage that might be damaged if the telescope were moved during the day-time.

v) Move the telescope to the zenith and turn off the constant current power supply in the Cassegrain cage.

3. **Film handling and processing**

3.1 **Introduction**

The emulsions used with the Spectracon are electron-sensitive nuclear research emulsions. They are laid down on a thin polyester film base ('Mylar' or 'Melinex') 50 microns (2 mil) thick. This is dimensionally stable and is flexible enough to present little risk of damage to the mica window as long as a few elementary precautions are observed.

The most suitable types of emulsion for the Spectracon are G5 and L4 emulsion produced by Ilford Ltd. These types have been shown experimentally to produce a linear exposure/density relationship and, particularly in the case of L4, good signal-to-noise ratio. The selection of the emulsion most appropriate for an application is usually straightforward. G5 is 'faster' than L4 by a factor of about 4 (i.e., G5, when developed, produces an optical density about 4 times greater than L4 for a given exposure). However, L4 has a much finer grain and, although slower, gives a
higher signal-to-noise ratio than G5 for the same exposure. In addition, the storage capacity of L4 is greater and an image can be integrated for a longer time than with G5 thus permitting a better ultimate low-contrast detection. It may be useful to use G5 where quick visual analysis is required (e.g. for test exposures) or occasionally when the record on L4 would be insufficiently dense for accurate microdensitometer analysis such as when recording a very narrow optical bandwidth.

A few basic points about these emulsions are:

1) Normal photographic emulsions have a protective gelatin supercoat. However, to enhance their response to electrons, electronographic emulsions are not protected in this way and are consequently abrasion sensitive. Care should therefore be taken not to touch or brush against the emulsion surface.

2) Because of their high sensitivity, these emulsions become fogged over a period of many months by cosmic rays. It is thus preferable to order small quantities at regular intervals, and use them when they are fresh. Optimum storage conditions are at +10 C and about 50% relative humidity. DO NOT FREEZE THE PLATES. Naturally the plates should be stored in complete darkness and REMOTE FROM ANY RADIOACTIVE SOURCES OR IONISING RADIATION.

3) The emulsion can be handled under a fairly bright safelight such as the Ilford 902S safelight at present on La Silla. With this, the emulsions may be handled under direct illumination at a distance of about 80 cm with a 25W bulb.
3.2 Loading the film applicator

The emulsion is delivered stuck down to glass support plates. Inspect the emulsion under the safelight. If there are any embedded particles or scratches, do not use those areas of emulsion **. Also, do not use the emulsion from the extreme edges of the plate - leave a border of 5 to 10 mm. Place the plate, emulsion side uppermost, on the cutting board and, using a sharp knife, cut a strip of film 30 mm wide and 100 mm long, i.e. long enough to wrap around the rubber roller of the film applicator. It is recommended to remove one corner of the strip (e.g. the top right hand corner) to identify the sequence and orientation of the exposures after development as indicated in figure 3. Lift up one edge of the strip from the glass support with a knife blade and gently peel off the strip, without straining the emulsion, with a pair of tweezers. Handle the film by the ends only and avoid all contact with the rest of the film. Turn the aluminium knob of the applicator to position '1' and attach the beginning of the strip (with the cut corner) to the adhesive pad on the rubber roller. Take care to align the film correctly with the edges of the roller. Wrap the film around the roller, turning the applicator knob as necessary, and fix the other end of the film also to the adhesive pad, ensuring that the film is not creased. Rub the ends of the film with the tips of the tweezers to ensure that the strip is securely attached to the adhesive pad.

** Footnote:— At the present time (Jan 79) Ilford are experiencing great difficulties in producing nuclear emulsions which are free of blemishes and embedded particles. In consequence, it is often found that large areas of plates, sometimes even complete plates, are unusable. If in doubt, it is better to play safe and reject suspect emulsion than to risk damage to the mica window.
Note: When cutting the emulsion strip, always make sure the knife used is sharp and in any case REPLACE THE BLADE BEFORE EACH OBSERVING RUN. A blunt knife will not cut cleanly and may leave protruding edges that could rupture the mica window of the Spectracon.
Under the safelight, check carefully once again the surface of the film. Look particularly for embedded particles on the emulsion surface and for any protruding points along the edges of the strip. **DO NOT USE THOSE FRAMES OF THE STRIP CONTAINING SUCH IMPERFECTIONS.**

Check also the synchronism of the rubber roller rotation: When the applicator knob is turned from one extreme position to the other, the roller should rotate through 180° so that at mid-travel the film join (at the adhesive pad) is central within the applicator body. At no time should it be possible for this pad to come in contact with the mica window.

Return the applicator knob to position '1' and place in the special storage box until required for use. It is a good idea to seal the box with a strip of masking tape to avoid confusion between exposed and unexposed films. The unusable frames can also be marked on this tape.

### 3.3 Processing

It is preferable to develop the films within 12 hours of exposure to minimise the possibility of the latent image fading.

Processing techniques are generally similar to normal photographic methods.

First, carefully remove the film strip from the applicator roller. This is best carried out using a pair of tweezers, using the forefinger of one hand to retain the adhesive pad. Attach two small film clips to the ends of the strip and slip these clips under the retaining springs at each side of the special plate developing cradles so that the film strip is suspended loosely across bottom of the cradle. Process as follows:-
i) Develop for 5 minutes in Kodak D-19 with continuous agitation. (20 C)

ii) Stop bath, $\frac{1}{2} - 1$ min.

iii) Fix for 5 - 10 minutes in F5 fixer.

iv) Wash for 30 mins. in running water **.

v) Rinse, $\frac{1}{2} - 1$ minute in distilled water and Kodak photoflo at the recommended concentration.

vi) Hang up vertically in a dust free environment to dry.

When the films are dry, the normal practice is to label the strips using small self-adhesive labels, and mount them between glass plates for protection as indicated in figure 4.

3.4 Packaging of L4 and G5 emulsion

When the nuclear research emulsions are packed by the manufacturers, it is done in a way avoiding all contact with the emulsion surface to eliminate the possibility of contact fog marks. Cardboard spacers are used to separate adjacent emulsion surfaces as shown in figure 5. In addition, the emulsion surface is always facing inwards so that the packing material does not come into contact with the emulsion. After using the emulsion ALWAYS REPLACE THE REMAINING PLATES IN THIS MANNER. If necessary, keep a used glass backing plate to protect unused plates when repacking them. Do not let either the packing material or another plate touch the emulsion surface.

** Footnote:- During the Spectracon run in December 1978, the 3.6 m deionising plant was not working and the filter used to remove impurities from the main water supply left a fine deposit on the films which was subsequently difficult to remove. At that time, therefore, it was found best to wash the films in a series of baths of distilled water.
Finished exposure showing the normal labelling and mounting procedure
Cardboard spacer

Emulsion surface on the inside

**Figure 5**

Packing of Nuclear Research emulsions
(sometimes packed with 4 plates together)
4. **Installation**

4.1 **Generalities**

The components needed for operation of the Spectracon on the 3.6 m telescope are the following:

i) Spectracon tube (manufactured by Photon Tubes Ltd., formerly Instrument Technology Ltd.),

ii) Solenoid and mounting (ESO built),

iii) Control chassis (ESO built),

iv) EHT power supply (WALLIS model R603/05/N),

v) Constant current power supply (H.P. model 6265B),

vi) Cables and interconnections.

After a normal instrument changeover, only items i) and ii) will need to be installed, the three chassis and cabling remaining permanently on the telescope. To install the Spectracon in such circumstances only sections 4.2 and 4.3 are relevant. If, on the other hand, any of the ancillary equipment has been removed since the previous Spectracon run, the succeeding sections should be consulted.

4.2 **Mounting the solenoid on the P.F. pedestal**

i) Remove the brass support ring for the photographic plate holder by removing the six socket head screws.

ii) With the solenoid locked in the raised position on the mounting bracket, locate the two dowel pins in the foot of the bracket in the corresponding holes in the base-plate of the bracket which is attached to the adaptor (see figure 2) and secure by means of the two screws. Lower the solenoid and check that when locked in the lower position, the solenoid location disc, below the dark-slide, enters the central hole in the adaptor without restriction. If not, the base-plate must be realigned as described in section 4.5.
Check also the dark-slide movement and the correct functioning of the interlock mechanism.

iii) Connect the solenoid supply cable to the 8-pin Burndy connector at the end of the overhead cable bridge. Push the EHT cable that emerges from the bridge into either one of the holes in the top of the EHT junction box (slacken the gland nut if necessary). When pushed fully home, a slight increase in mechanical resistance should indicate that a good electrical contact has been made. Tighten the gland nut to secure the cable. Attach the earth lead to the adjacent green terminal post.

4.3 Insertion of the Spectracon tube

4.3.1 Attachment of the field flattener
(for removal, see section 4.6)

In the event of any confusion between the two field flattening lenses, the 'red' lens will be seen to give a slightly yellowish cast to a white object viewed in transmission.

The Spectracon Faceplate should be clean and dust-free, and the electrical contact between the faceplate and the tube body should be effective. (See section 5.1 on maintenance procedures). Using a dropper bottle put a small globule (2 or 3 drops) of immersion oil (Cargille type 'B') in the centre of the faceplate with the tube body held vertically. Carefully place the field flattener on top of the oil with the FLAT side towards the faceplate. Press the flattener down firmly to spread the oil. Check that there are no bubbles in the oil film and that the whole area of the lens is covered. The lens should now be sufficiently well attached to remain in place when the Spectracon is inverted.
4.3.2 Insertion of the Spectracon

Before inserting the Spectracon, remove any piece of tape securing the cover of the film applicator housing. DO NOT REMOVE THE COVER. Raise the solenoid mounting and lock in the upper position. Depress the dark-slide interlock pin that projects from the lower flange of the solenoid and open the dark-slide. Gently lower the Spectracon into the solenoid until it reaches the bottom. Then, using a lens tissue or a piece of fluffless cloth, centre the field flattener lens on the Spectracon faceplate from the dark-slide aperture in the base of the solenoid. When correctly centered, the Spectracon will descend a few more millimeters and the field flattener will rest on the foam cushioning ring as indicated in figure 6.

There is no special orientation of the Spectracon in the solenoid but it is usually most convenient to have the long axis of the cathode aligned either N-S or E-W.

When the Spectracon is inserted and oriented correctly, pass the Spectracon EHT cable through the tongued retaining ring (tongue towards the Spectracon). The tongue is pushed down beside the applicator housing on the opposite side to the EHT cable. Then pass the second retaining ring over the EHT cable (recess towards the Spectracon) and pass over the 4 threaded rods that extend from the solenoid. The first ring should be centred in the recess of the second. Place the 4 springs on the threaded rods and screw down the knurled nuts until the springs are compressed to about two-thirds of their original length. KEEP THE MICA WINDOW COVERED THROUGHOUT THIS ENTIRE OPERATION.

Shut the dark-slide and lower the solenoid. Push the Spectracon EHT lead into the free hole in the EHT junction box and tighten the gland nut. Connect the earth wire to the adjacent terminal post. Before operation, check that the earth connection is effective right up to the Spectracon itself.
Figure 6

Location of the field-flattener

- Dark-slide
- Field Flattener (oiled to Spectracon faceplate)
- Spectracon tube
- Foam cushioning
- Solenoid body
Remove the applicator housing cover and inspect the mica window. Any dust on the mica should gently be blown off. NO OTHER CLEANING EXERCISE SHOULD BE ATTEMPTED. DO NOT DIRECT A 'DUST-OFF' SPRAY AT THE MICA WINDOW.

Replace the cover until the Spectracon is required for use.

4.4 Installation of the chassis and cables

The three chassis used with the Spectracon can normally be left permanently in place on the telescope. If they have been removed, proceed as follows:

The HP 6265B power supply is installed in one of the electronics racks in the Cassegrain cage. (Originally at the top of the rightmost rack). Connect the 220 V power cable and the output cable (S6) to the 8-pin Burndy socket in the signal cable distribution panel leading to the prime focus cage. An extension cable will be needed for S6.

The Control chassis and EHT power supply are mounted in the prime focus cage on the projecting mounting brackets provided on the top wall of the cage. Figure 1 shows the relative positions. This operation should be tackled before the cage is mounted on the telescope. The related electrical interconnections are sketched in figure 7. Cable S5 connects to the constant current power supply in the Cassegrain cage via the 28-pin male Burndy socket (A) in the electrical distribution box in the cage PBXUL. Cables S4 and S1 are routed over the cable bridge to the solenoid and EHT junction box respectively.

A complete list of cables is given in table V.
Figure 7

Schematic cable layout
### TABLE V

#### Cable List

<table>
<thead>
<tr>
<th>Cable No.:</th>
<th>Function</th>
<th>Cable type</th>
<th>Source</th>
<th>Destination</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S1</strong></td>
<td>EHT supply</td>
<td>high voltage coaxial</td>
<td>Wallis EHT supply</td>
<td>EHT junction box</td>
<td>Wallis special EHT</td>
</tr>
<tr>
<td><strong>S2</strong></td>
<td>EHT monitor</td>
<td>Scr. twisted-pair</td>
<td>Wallis EHT supply</td>
<td>Control chassis</td>
<td>Lemo F0302</td>
</tr>
<tr>
<td><strong>S3</strong></td>
<td>220V supply</td>
<td>3 x 1.0mm²</td>
<td>220VAC outlet</td>
<td>Control chassis</td>
<td>Swiss 10 Amp</td>
</tr>
<tr>
<td><strong>S4</strong></td>
<td>Solenoid supply</td>
<td>8 x 0.5mm²</td>
<td>Burndy Plg.12.M</td>
<td>Solenoid lead</td>
<td>Burndy Plg.8.F</td>
</tr>
<tr>
<td><strong>S5</strong></td>
<td>Output and control of HP 6265B</td>
<td>8 x 0.5mm², scr.</td>
<td>TIUX1, skt.A</td>
<td>Control chassis</td>
<td>Burndy plg.8.F</td>
</tr>
<tr>
<td><strong>S6</strong></td>
<td>HP 6265B output and control</td>
<td>8 x 0.5mm², scr.</td>
<td>output lead, HP6265B</td>
<td>Cass. distrib. panel</td>
<td>Burndy plg.8.M</td>
</tr>
</tbody>
</table>

#### Cable No.: S1
- **Function**: EHT supply
- **Cable type**: high voltage coaxial
- **Length**: 4.5m
- **Source**: Wallis EHT supply
- **Destination**: EHT junction box
- **Connector**: Wallis special EHT

#### Cable No.: S2
- **Function**: EHT monitor
- **Cable type**: Scr. twisted-pair
- **Length**: 1.0m
- **Source**: Wallis EHT supply
- **Destination**: Control chassis
- **Connector**: Lemo F0302

#### Cable No.: S3
- **Function**: 220V supply
- **Cable type**: 3 x 1.0mm²
- **Length**: 1.5m
- **Source**: 220VAC outlet
- **Destination**: Control chassis
- **Connector**: Swiss 10 Amp

#### Cable No.: S4
- **Function**: Solenoid supply
- **Cable type**: 8 x 0.5mm², scr.
- **Length**: 2.6m
- **Source**: Burndy Plg.12.M
- **Destination**: Burndy Plg.8.F

#### Cable No.: S5
- **Function**: Output and control of HP 6265B
- **Cable type**: 8 x 0.5mm², scr.
- **Length**: 1.6m
- **Source**: TIUX1, skt.A
- **Destination**: Control chassis
- **Connector**: Burndy plg.8.F

#### Cable No.: S6
- **Function**: HP 6265B output and control
- **Cable type**: 8 x 0.5mm², scr.
- **Length**: 3m
- **Source**: output lead, HP6265B
- **Destination**: Cass. distrib. panel
- **Connector**: Burndy plg.8.M

#### Cable link between the Cass. cage distrib. panel and P.F box PBUX1
- **Source connector**: Burndy skt.8.P
- **Destination connector**: Burndy skt.26.M

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>focus -</td>
</tr>
<tr>
<td>2</td>
<td>focus +</td>
</tr>
<tr>
<td>3</td>
<td>gnd/Peltier -</td>
</tr>
<tr>
<td>4</td>
<td>Peltier +</td>
</tr>
<tr>
<td>5</td>
<td>defl. X -</td>
</tr>
<tr>
<td>6</td>
<td>defl. X +</td>
</tr>
<tr>
<td>7</td>
<td>defl. Y -</td>
</tr>
<tr>
<td>8</td>
<td>defl. Y +</td>
</tr>
<tr>
<td>9 - 12</td>
<td>no connection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>focus -</td>
</tr>
<tr>
<td>2</td>
<td>focus +</td>
</tr>
<tr>
<td>3</td>
<td>ground</td>
</tr>
<tr>
<td>4</td>
<td>remote prog.</td>
</tr>
<tr>
<td>5</td>
<td>remote prog.</td>
</tr>
<tr>
<td>6</td>
<td>not used</td>
</tr>
<tr>
<td>7</td>
<td>not used</td>
</tr>
<tr>
<td>8</td>
<td>not used</td>
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<td>5</td>
<td>21</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
</tr>
</tbody>
</table>

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**Notes**:
- Table entries include details such as pin numbers, functions, and connector types.
- The table includes a list of cables and their specifications, including type, length, source, destination, and connector details.

---

**Legend**:
- **Source connector**: Burndy skt.8.P
- **Destination connector**: Burndy skt.26.M
4.5 **Alignment of the solenoid support base-plate**

If the solenoid does not locate properly in the central hole of the adaptor, the base-plate will need to be realigned as follows:

i) Detach the solenoid from the base-plate and remove the central screw attaching the base-plate to the adaptor. Replace the solenoid.

ii) Slightly loosen the two remaining screws attaching base-plate to the adaptor, and lower the solenoid so that it sits correctly in the central hole of the adaptor. Tighten the two screws and recheck the movement of the solenoid. As the solenoid is lowered, the solenoid location disc, below the dark-slide, should fall neatly into the receiving hole.

iii) When correctly aligned, fully tighten the two base-plate fixation screws. Remove the solenoid and replace the third central screw. Replace the solenoid.

4.6 **Removal of the field flattener**

To remove the field flattener lens from the Spectracon faceplate, hold the Spectracon firmly with one hand and grasp the field flattener with the other. **Rotate** the field flattener whilst pulling it away from the faceplate. Keep rotating and pulling in this way until the contact is broken. This operation cannot be hurried and normally takes several minutes. **DO NOT USE ANY TOOL TO TRY AND LEVER OFF THE FIELD FLATTENER.**

When exchanging the lenses, it is often sufficient simply to add another globule of immersion oil to the centre of the faceplate without cleaning off the old oil first. If, however, this fails to produce a good optical contact, the immersion oil must be completely removed with perchlorethylene before starting again from scratch as described in section 4.3.1.
Note that in removing the oil with solvent, some of the electrically conducting paint, that connects the faceplate to the Spectracon body, is invariably removed at the same time. After cleaning the faceplate in this way therefore, the continuity of the earth connection should be checked and, if necessary, replaced as described in section 5.1.

5. **Maintenance**

5.1 **The Spectracon tube**

Routine maintenance of the Spectracons consists of the following operations:

i) Blow off any dust from the mica window. 'Dust-off' spray, although convenient, should be used with great care because of the risk of liquid freon being expelled. This would leave marks on the mica window that would be impossible to remove. If such a spray is used, do not shake the tin, always keep the tin vertical, and direct the nozzle away from the instrument at first to expel any liquid freon in the outlet. In any case, DO NOT DIRECT THE NOZZLE DIRECTLY AT THE MICA WINDOW.

**No other cleaning of the mica should be necessary and none should be attempted.**

Always keep the mica window covered when not in use.

ii) The outer casing of the Spectracon is coated with a conducting paint, which connects electrically to a transparent conducting coating on the faceplate window. This prevents charging and subsequent corona discharge in front of the photocathode.

Check with a resistance meter that there is some detectable electrical contact between the faceplate and the tube body. This should always be checked after removing immersion oil from the faceplate with a solvent.
In the event of there being no detectable contact, the appropriate surfaces of the tube body should be painted with 'DAG' solution (colloidal graphite) to re-establish the integrity of the path. Pay particular attention to the surface marked 'X' in figure 8 although be careful not to paint the faceplate itself as this could make it difficult to get a good optical contact with the field flattener.

5.2 Film applicators

At the end of each observing run, the film applicators should be inspected for correct functioning. Pay particular attention to the following points:

i) That the synchronisation of the rubber roller is correct, i.e. that at no time is it possible for the adhesive pad to come into contact with the mica window.

ii) That the adhesive pad is adequately sticky. If necessary replace by adding a new strip of double-sided Scotch tape over the old strip.

iii) That there is no significant mechanical friction in the spring-loaded axial movement of the roller that could endanger the mica.
Figure 8

- Spectracon tube
- Faceplate
- Surface 'X'
5.3 The solenoid

The solenoid provides a uniform axial magnetic field for focusing the photoelectrons from the Spectracon cathode. At 40 kV operating potential, the nominal field strength for single-loop focus of the Spectracon is $7.5 \times 10^{-3}$ Tesla (75 Gauss). Because of the close proximity of the cathode to the front end of the solenoid, an internal mu-metal screen is used for field shaping.

The solenoid has three windings. The connections are identified in table VI. The focus winding has a nominal resistance of 33 ohms. In addition there are two orthogonal deflection windings which have a resistance of about 2 ohms. These latter are not normally used but can be linked up for special applications such as time resolved photometry etc.

To reduce thermionic emission, the vicinity of the cathode is cooled by means of 6 small Peltier cooling elements (Cogie type FC-07-32-05). The mounting of these can be seen in the mechanical drawings. It is important to observe the polarity of the connections to these elements as a reversed connection could destroy them. Note that the negative lead to the Peltier elements also serves as a ground lead for the solenoid. (Note also that the connections to the original water cooled solenoid used on the 1.0 and 1.52 m telescopes are identical to the 3.6 m solenoid with the exception of the additional connection to the Peltier elements on the latter).

The space between the coil and the inner lining of the solenoid is filled with expanded vermiculite granules to minimise heat transfer to the Spectracon.

No routine maintenance of the solenoid should be necessary except for occasional checking of the integrity of the cable connections and cleaning out any surplus immersion oil that
may have accumulated inside the central aperture.

WHEN THE SOLENOID IS MOUNTED ON THE PEDESTAL WHEN THE LATTER IS OFF THE TELESCOPE ON THE LOADING PLATFORM, THE END OF THE SOLENOID SHOULD BE PROTECTED WITH THE GREY PVC COVER PROVIDED TO PREVENT ACCIDENTAL DAMAGE TO THE FOUR THREADED RODS.

Table VI

Solenoid connections

<table>
<thead>
<tr>
<th>Burndy pin no.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>focus coil -</td>
</tr>
<tr>
<td>2</td>
<td>focus coil +</td>
</tr>
<tr>
<td>3</td>
<td>ground/Peltier -</td>
</tr>
<tr>
<td>4</td>
<td>Peltier +</td>
</tr>
<tr>
<td>5</td>
<td>X deflection -</td>
</tr>
<tr>
<td>6</td>
<td>X deflection +</td>
</tr>
<tr>
<td>7</td>
<td>Y deflection -</td>
</tr>
<tr>
<td>8</td>
<td>Y deflection +</td>
</tr>
</tbody>
</table>

5.4 EHT power supply (Wallis model R603/05/N)

For a circuit description, consult the manufacturer's maintenance manual.

This unit provides a highly stable, low current supply to the Spectracon internal voltage divider. In normal use the current drawn is roughly 15 μamps or less. The output is NEGATIVE as the rear end of the Spectracon is operated at ground potential.

Two modifications to the standard power supply have been made:
i) A voltage monitor output on the rear panel (S2) has been added. This output is taken, via a multi-turn trimming potentiometer and series resistor for short-circuit protection, from the output of the feedback amplifier (IC1 on the main amplifier board), thus providing a stable signal directly proportional to the output EHT voltage. The output impedance of the monitor is around 100 Kohm and only very low currents should be drawn to avoid false readings. The output is connected to the digital panel meter in the Control chassis via a source selector switch.

ii) The output voltage of the supply has been limited to about 42 kV by the incorporation of a resistor in the output line of the reference voltage circuit (IC3 on the main amplifier board) in series with the front panel potentiometer. This resistor has a nominal value of 9 Kohm although the actual value was selected on test.

Note that the two Wallis supplies presently on La Silla have been IDENTICALLY CALIBRATED and are therefore interchangeable in the event of breakdown without the need to refocus the solenoid in the lab. The focus currents listed in table II have been found with a monitor output voltage of 4.000 Volts. Do not, therefore, change unnecessarily the monitor output calibration which is at present set to 1.00 V per 10 kV.

If the calibration of the monitor output of one of the units has been changed for any reason, it should be recalibrated to be the same as the second Wallis supply. This can be done by setting both units in turn to give the same output voltage (e.g. 10 or 20 kV), as measured for example with the DANA digital voltmeter and EHT probe supplied for the IDS, and ./.
regulating the monitor screw-driver adjustment on the rear panel of the supply to be calibrated to give the same monitor output voltage as the second unit.

**WARNING:** THIS OPERATION IS EXTREMELY HAZARDOUS AND SHOULD BE ONLY CARRIED OUT BY COMPETENT PERSONNEL AND WITH GREAT CARE. TAKE POSITIVE PRECAUTIONS TO PREVENT CORONA AND FLASHOVERS DURING SUCH MANIPULATIONS.

5.5 **Constant current power supply** (HP 6265B)

For a description of the supply and circuit details, consult the manufacturer's manual.

The power supply provides the highly stable current needed to maintain the electronic focus of the Spectracon. This should not deviate from the nominal value by more than 0.25% if the resolution of the image is not to be impaired.

The unit is used in 'remote resistance programming of the output current' mode as described in section 3-40 of the manufacturer's manual. The remote control potentiometer (P1) and fixed range resistor(s) (R2), both 20 ppm/C components, are located in the Control chassis in the prime focus cage. These are linked to the power supply by cables S5 and S6, together with the telescope cable link as shown in figure 7. The rear connections of the power supply are shown in figure 9. A high stability resistor is connected between terminals A4 and A6 of the supply for protection in the event of the remote programming link becoming open circuited. It should be noted that in remote current programming mode, the front panel current adjustment controls are disabled.
Figure 9

Rear output connections for H.P. 6265B power supply
5.6 Control chassis

This chassis serves three purposes:

i) Monitor and control of the constant current supply.

ii) Monitor of the EHT supply.

iii) Supply and monitor of the current to the Peltier cooling elements.

A schematic circuit layout is given in figure 10. Complementary information on the HP 3465A digital voltmeter, used as monitor display, and the Stabpac 30 power supply used for the Peltier elements, is given in the manufacturer's documentation for these units. The digital voltmeter front panel switch should be left permanently 'ON', and the range switches set to read D.C. Volts on the 20 V range.

5.6.1 Focus current control and monitor circuit

The control of the HP 6265B power supply is discussed in section 5.5. The current from the supply is passed through a high stability (20 ppm/C) resistor of 1 ohm which is in series with the solenoid focus winding. The value of this resistor is identical to within the required tolerances to those in similar units that will be supplied later to permit chassis interchangeability without recalibration. A mains-operated relay is included in the current circuit to cut off the current to the coil when the chassis is powered off**1. A ground link on the rear panel is provided to earth the solenoid circuit. The solenoid should be grounded at one point only to avoid earth-loop problems**2.

** Footnote: 1. Not on the provisional chassis installed in Dec. 78. 2. At the time of writing (Jan 79), the solenoid is effectively grounded within the solenoid itself due to a short circuit to ground at a point in the focus winding. Whilst this fault persists, therefore, (which is otherwise inconsequential) do not ground the focus current circuit elsewhere.
5.6.2 **EHT monitor**

This is a direct connection, via the monitor selector switch (Sw2), to the EHT monitor output of the Wallis supply described in section 5.4.

5.6.3 **Peltier supply** (Oltronix Stabpac 30, MB 32-0.95)

The six Peltier elements, in series, produce a potential difference of about 10 V at 0.6 Amps current, the normal operating value. The precise value is not critical and can lie in the range 0.5 to 0.8 Amps.

A series limiting resistor (R3) and a 1 ohm monitor resistor (R4) are in series with the Peltier elements. The current is adjusted by means of a programming resistor (R5) and the potentiometer control on the power supply itself. The Peltier current is switched off simultaneously with the focus current by means of the front panel toggle switch Sw1.