MODEL 137 UV SPECTROPHOTOMETER
INSTRUCTION MANUAL

PREFACE

This manual has been prepared with the object of helping operators to obtain maximum performance from their instrument at all times. To maintain this performance operators should have a thorough understanding of how the instrument operates and must employ the correct operating procedures.

The information given should also help operators to diagnose elementary faults and effect simple repairs. Obscure faults, especially when misalignment of optical components is suspected, are best dealt with by contacting the Perkin-Elmer Service Department.

The very wide range of applications in the ultraviolet and visible regions precludes a complete description in a publication of this size. Many excellent text books are available and recommended, particularly for the newcomer, are :-

Determination of Organic Structures by Physical Methods, edited by E. A. Braude and F. C. Nachod, Chapter 4, Academic Press, 1955.

Treatise on Organic Chemistry, Vol. III, Applications of Infrared and Ultraviolet Spectra to Organic Chemistry, edited by H. Gilman, John Wiley and Sons, 1953.

Technique of Organic Chemistry, edited by A. Weissberger, Vol. IX, Chemical Applications of Spectroscopy Chapter V, Interscience, 1956.

Sample handling techniques are not described in any detail in this manual but are included in the publications listed above. Separate instruction sheets are available from Perkin-Elmer Limited for the accessories which have been designed for use with the Model 137 UV Spectrophotometer in special applications.

MODEL 137 UV
SPECTROPHOTOMETER
INTRODUCTION

PERKIN-ELMER LIMITED, BEACONSFIELD, BUCKS.
ENGLAND.

Fig. 1.1 The Model 137UV Spectrophotometer

1. The Perkin-Elmer Model 137UV Spectrophotometer is a dual range instrument designed for laboratory use in quantitative analysis. It is manufactured in accordance with the rigorous standards which have made Perkin-Elmer a leader in the field of spectroscopy. This instrument, developed as an absorbance recording spectrophotometer, performs throughout the ultraviolet and visible regions with high resolution. The unique coupling of an optical null absorbance system and an automatic gain control results in a simple design which is convenient to operate.

2. The Model 137UV Spectrophotometer covers two ranges; 190 to 390 millimicrons in the ultraviolet, and 350 to 750 millimicrons in the visible. Two scanning rates offer the analyst a choice of either survey or high resolution spectra. This instrument is similar in concept to Perkin-Elmer Infracord instruments and records spectra on the same 8-1/2 in. x 11 in. sheet but with a somewhat larger format, 15 x 25 centimeters, to take advantage of the available photometric accuracy of the instrument.

3. Most ultraviolet recording spectrophotometers are electronic null instruments. That is, they are dependent upon a precision potentiometer to balance the signal produced by different light levels in the two optical channels. In such instruments, the signal is intrinscially proportional to transmittance, therefore some type of electrical or mechanical component is required in order to produce the logarithmic (or absorbance) presentation that is needed for the solution of almost all analytical problems. In the Model 137UV the precise absorbance readout has been achieved by a direct technique, the optical null principle. In the optical null system, the light removed from the beam by the sample is balanced by a mechanical light attenuator in the reference beam. The attenuator is shaped so that the amount of light obscured

increases logarithmically as the attenuator is moved into the beam. Motion of the attenuator is directly proportional to the absorbance of the sample. Because the taper of the comb is changing over the absorbance range of 0 to 1.5, the rate of change of opening varies by a factor of approximately thirty from one end of the range to the other. Without any gain adjustment facility the instrument, when preset to be stable and reproducible in the region where the attenuator changed rapidly, would be sluggish and non-reproducible in the region where its change was more gradual. This problem is resolved by the use of an automatic gain control (A.G.C). It has been found that if the output of the photomultiplier anode is kept constant, the tightness of the servo system does not change. The A.G.C. system used to keep the output of the photomultiplier constant offers several additional advantages as will be discussed later in this manual.

4. Two light sources are provided with the Model 137UV, an air cooled hydrogen arc used for the ultraviolet region and a tungsten filament lamp for the visible region. It should be noted that in this instrument, the same UV source, the same fused silica dispersing material, and a similar detector are used as in the high performance Perkin-Elmer Model 350 instrument. All the aluminium mirrors are magnesium fluoride coated and stray light is not detectable anywhere on scale even at 190 millimicrons. Since these mirrors do not change with time, stray light will continue to be negligible throughout the life-time of the instrument.

5. In addition to providing performance improvements at short wavelengths, the end-on type photomultiplier used in the Model 137UV has greater sensitivity than the 1P28 in the red end of the spectrum providing good performance out of 750 millimicrons. Furthermore, the application of the end-on multiplier design makes the instrument very insensitive to sample cell orientation and other effects that tend to change the beam position on the detector.

MODEL 137 UV
SPECTROPHOTOMETER
OPERATING INSTRUCTIONS

PERKIN-ELMER LIMITED, BEACONSFIELD, BUCKS.
ENGLAND.

OPERATING INSTRUCTIONS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

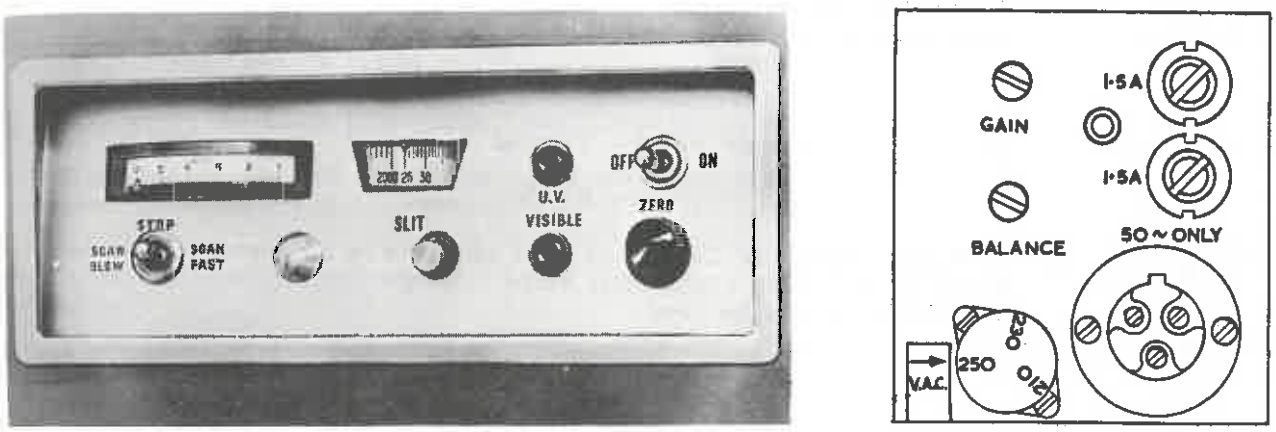


Fig. 2.1 Front and Rear Control Panels

GENERAL

1. The Model 137 UV Spectrophotometer is an extremely sensitive instrument and has been carefully set up and fully tested before leaving the factory. In order to achieve maximum performance it is essential that the following installation and operating instructions be followed carefully.

2. Operators are warned that the instrument operates from the mains voltage and no attempt to handle any component within the protective cover should be made with the power supply connected.

INSTALLATION

Preliminary

3. Note: Figure 2.1 shows the location of the controls referred to in the following instructions.

   a) Place the instrument on a firm surface

   b) Check that the power switch is set to OFF and the scanning switch set to STOP. Ensure that the penholder is pulled back from the drum.

   c) Set the voltage selector (Fig. 2.1) at the rear of the instrument to correspond with the supply to be used.

d) Connect the power supply cable between the 50 c/s ONLY socket at the rear of the instrument and the mains power supply. The three-core cable must be used and the following colour code observed:-

Red - Live

Blue or Black - Neutral

Green - Earth

e) Carefully rotate the ZERO and SLIT controls in a counter-clockwise direction until they reach their stops. These controls rotate easily and NO FORCE should be used.

Preparing Pen and Fitting Chart Paper

4. Two types of pen (not interchangeable) have been fitted to the 137 UV Spectrophotometer. The reservoir of the pen should be filled with ink as shown in Fig. 2. 2 or Fig. 2. 3. Should the pen fail to write due to a blockage in the capillary tube, it may be cleaned by using a hypodermic syringe to flush the tube with warm water (pen shown in Fig. 2. 2 or by inserting the cleaner wire supplied (pen shown in Fig. 2. 3).

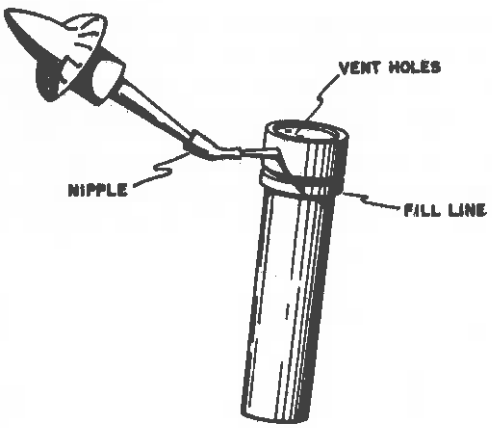


Fig. 2.2 Filling Pen Reservoir (Red Top Pen)

Fig. 2.3 Filling Pen Reservoir

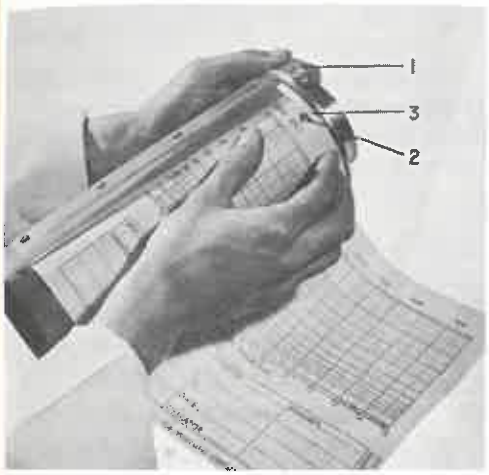
NLY socket at
y. The three-core
erved:-

unter-clockwise
s rotate easily and

37 UV Spectrophoto-
nown in Fig. 2. 2 or
ry tube, it may be
ater (pen shown in
2. 3).

Pen Reservoir

5. As the pre-printed chart papers are cut to exactly the right size, no difficulty should be experienced in fitting a fresh chart in a matter of seconds. Hold the chart drum firmly in both hands and remove it from the instrument by lifting it straight up. Figures 2. 4 and 2. 5 show the correct manner in which the chart drum should be held. To insert the chart paper under the clamping spring, depress the locking lever on the side away from the chart. Adjust the paper so that the index lines on the chart and the drum coincide and so that the top of the paper is flush with the underside of the drum cap. Release the locking lever.



1. Lever
2. Index Line (Drum)
3. Index Line (Paper)

Fig. 2.4 Fitting Chart Paper

Fig. 2.5 Securing End of Chart Paper

6. The drum should then be rotated in the hands whilst the paper is smoothed down to ensure that it is free from wrinkles. To secure the end of the chart paper, depress the locking lever with the right thumb as shown in Fig. 2. 5 and guide the paper beneath the clamping spring. Release the locking lever. Check that the twelve-position selector on the base of the drum is set to the N (normal) position, then slide the drum back into the instrument, lining up the engaging pin in the instrument with the hole in the base of the drum.

FUNCTIONS OF CONTROLS

Sample Tray Knob

7. In the clockwise position (pointer horizontal) this knob locks the lid of the sample tray and opens the detector shutter. In the counter-clockwise (pointer vertical) position the knob releases the lid of the sample tray and closes the detector shutter.

Off-On Switch

8. This is the main power switch of the instrument; it should be set to ON approximatel fifteen minutes before it is desired to use the instrument to enable the electronic circuits to warm up.

U.V. and Visible Indicator Lamps.

9. The red (U. V.) and green (VISIBLE) indicator lamps show the range in which the instrument is operating. The colours correspond with the scale markings on the drum collar. From its fully counter-clockwise position the drum rotates through

approximately 360° to cover the ultraviolet region and through a further 360° to cover the visible region.

Scan Switch

10. This is a three-position switch. In the centre, STOP, position the drum is released. When moved to the left, SCAN SLOW, position the instrument scans either the complete ultraviolet or the complete visible region (as selected by the rotational setting of chart drum) from short to long wavelengths in eight minutes. In the right, SCAN FAST, position the instrument scans the complete selected region in two minutes.

Zero Control

11. The ZERO control provides a manual means of controlling the intensity of the sample beam and is used for setting zero absorbance. When the control is turned in a clockwise direction the comb in the sample beam is moved out of the beam and the pen moves upscale.

Slit Override Control

12. The purpose of the SLIT override is to make it possible to widen the slits at any particular wavelength to an opening greater than normally provided by the slit cam, thereby providing more light energy. Turning the knob clockwise opens the slits. The SLIT override should always be adjusted from a narrow to a wide slit opening to eliminate possible backlash in the mechanical system.

CAUTION: Do not force the SLIT override knob beyond its limits in either direction. Although there is a mechanical stop on the slit override cam, the mechanical advantage of the system could result in stretching the drive cables.

13. The SLIT override is used principally in differential analysis. In this type of analysis, the absorption of the liquid that is used to dissolve the sample is compensated by placing a cell with this same solvent in the reference beam. The full scale energy tends to go down at those wavelengths where the solvent absorbs strongly. The energy can be retrieved at the expense of resolution. When using the slit override, care should be taken to ensure that the A.G.C. limits are not exceeded at any wavelength. When it is desired to resume scanning with a normal slit programme, reset the SLIT override control to 25.

14. The slit control dial, located above the SLIT override control on the instrument control panel, is calibrated in microns of slit width to provide a means for reproducing a particular slit width rather than furnish an accurate indication of slit widths. For instance, if on two different occasions the dial was set at exactly 200, the slit widths would be identical within one per cent but would not necessarily be precisely 200 microns in width.

CAUTION The SLIT override control should not be adjusted to give a wide slit width whilst scanning the visible region unless there is high absorption in both sample and reference beams. If this caution is not observed the detector may be seriously damaged.

Front Panel Meter

15. This meter gives an indication of the photomultiplier dynode voltage on an arbitrary scale. During normal operation the reading will be between 25 - 30 and 94 - 100 (the limits of the control of the A. G. C. unit). A low reading indicates high energy and consequently low noise. The normal readings at zero absorbance should be between

55 and 65 throughout the ultraviolet range and at the ends of the visible range. In the centre of the visible range the reading will be somewhat lower. The reading will rise with absorption in either beam; with a sample of 1.5 absorbance the meter reading will rise from approximately 60 to approximately 90.

Gain Control.

16. The GAIN control is located on the small panel at the rear of the instrument and controls the gain of the amplifier which drives the pen. Adjustment may become necessary due to ageing of electronic components.

Balance Control

17. This control, which is situated on the same panel as the GAIN control, provides a method of compensating for the effects of random electrical pick-up which would otherwise result in an erroneous signal to the pen servo. The pen balance should be such that, with no light in either the sample or reference beams, the pen will remain stationary at mid-scale.

A.G.C. Gain Control.

18. On the side of the A. G. C. sub-unit chassis is a pre-set control for adjusting the gain of the A. G. C. system. This control is normally set so that the sub-unit is operating as near as is possible to the centre of its control range. Before the instrument leaves the factory the control is carefully adjusted to its correct position and should seldom need resetting. Should readjustment be thought necessary, reference should be made to the procedure detailed in Paragragh 34.

Coaxial Socket for External Recorder.

19. The coaxial socket on the rear panel is provided for the connection of an external recorder. When the pen position read-out accessory is fitted, a signal appears at the socket, varying from 10mV at zero absorbance to zero at 1.5 absorbance.

OPERATING PROCEDURE

Preliminary Steps.

20. The following preliminary steps should be taken before attempting to record a spectrum:-

Fig. 2.6 Correct Way to Rotate Drum Manually

a) Fill the pen reservoir with ink and fit a chart paper (ultraviolet or visible as required) to the drum as described in paragraphs 4, 5 and 6 of these instructions.

b) Check that the sample tray knob is in its clockwise position to ensure that the detector shutter is open.

c) Manually turn the drum to the start of the range required (190 mμ ultraviolet or 350 mμ visible) holding the drum as shown in Fig. 2.6. NOTE: The scan switch must always be in the STOP position when the drum is manually operated.

d) Switch the OFF/ON switch to ON. The front panel meter will initially read full-scale and then return to a lower value as the instrument warms up. (If the meter stays at maximum, check that the sample tray knob is turned fully clockwise, thus opening the detector shutter).

N. B. When scanning between 190 and 195 mμ the meter will swing due to the atmospheric absorption bands.

e) The GAIN and BALANCE control setting should be checked at least once daily and the ZERO control setting should be checked before every spectrum is run. If adjustment is necessary, the procedures detailed below should be followed.

Zero Absorbance Adjustment.

21. With no sample in the instrument the ZERO control should be rotated clockwise from its fully counter-clockwise position until the pen reaches zero absorbance.

Gain Adjustment.

22. For normal operation the GAIN control should be set so that there is no "dead spot" in the pen response. (With the correct setting, however, there will be a noticeable overshoot of the pen for displacements of 0.1 absorbance or greater).

N. B. Between the extremes of control of the A. G. C. unit there is a change in loop gain of approximately 2:1. Gain adjustments should be carried out with a reading of approximately 60 on the front panel meter.

23. The setting of the GAIN control should be checked as follows :-

a) Note the Absorbance scale reading. Move the pen a small amount manually (about 0.1 Absorbance units) and observe the manner and position of its return. An incorrect GAIN setting should be corrected as indicated below:-

b) Gain too high - pen over-shoots original position on return by more than 0.02 absorbance units. Turn GAIN control counter-clockwise.

c) Correct gain - pen returns quickly to original position with less over-shoot than 0.02 absorbance units.

d) Gain too low - pen moves sluggishly and does not return to original position (thus indicating "dead spot"). Turn GAIN control clockwise.

24. The correct gain setting is partly a subjective matter. However, it is apparent that if the gain is considerably higher or lower than necessary, instrument accuracy will suffer. In general the above procedure should be repeated until the gain is high enough for no "dead spot" to be measurable but no higher.

IMPORTANT. Following adjustment of the GAIN control, the BALANCE control should be rechecked.

Balance Adjustment

25. The following is the correct procedure for setting the BALANCE control:-

a) Close the detector shutter by turning the sample tray knob in a counter-clockwise direction.

b) Manually move the pen holder slowly to the middle of the absorbance scale. The pen should remain steady or should move with a drift smaller than 0.3 absorbance units per minute.

c) If incorrect balance is observed, adjust the BALANCE control until correct balance is obtained.

Slit Override Adjustment.

26. Normally, when the instrument is being used to scan the entire wavelength range, the SLIT override should be set to give a reading of 25 on the control panel scale. When a special slit setting is required, e.g. for differential analysis, refer to the instructions given in paragraph 35.

Normal Operating Procedure.

27. Having carried out the preliminary steps described in the previous paragraphs the operator may now insert the sample to be analysed. The sample tray MUST BE LOCKED (knob pointer horizontal) before attempting to record a spectrum. When starting from the 190 mμ position the ultraviolet range may be scanned in either 2 minutes or 8 minutes by selecting either SCAN FAST or SCAN SLOW. At the end of the ultraviolet range (390 mμ) the scan will automatically stop and the scan switch should be set to the STOP position.

28. To re-scan the ultraviolet range the drum should be manually rotated in a counter-clockwise direction to the beginning of the range.

29. To scan the visible range the drum should be manually rotated, (with the scan switch set to STOP) to the start of the visible range at 350 mu. The visible range may then be scanned in either 2 minutes or 8 minutes by selecting either SCAN FAST or SCAN SLOW.

N.B. When the drum is rotated between ranges a loud click will be heard as the rotary and slit arm solenoids operate.

30. The return to the beginning of either range, or the setting to any particular wavelength, must always be accomplished by manual rotation of the drum with the scan switch set to the STOP position. A particular wavelength should always be approached by a clockwise rotation of the drum to eliminate backlash in the mechanical system.

31. The Model 137 UV Spectrophotometer is not fitted with switches to stop the servo motor when the pen reaches the limit of its travel. Instead, the friction wheel and the pen quadrant are specially designed to slip without causing wear. Slipping will occur if a sample of more than 1.5 absorbance is being analysed and this may be accompanied by some noise. The noise, however, is quite normal and does not indicate a fault in the instrument.

Test Run (Benzene Vapour and UV I_o)

32. Figure 2.7 shows a typical benzene spectrum and a UV I_o line recorded by a standard model 137 UV Spectrophotometer. Similar spectra, recorded immediately after the installation of the instrument, should be comparable with the test spectra within the limits of the specification in the following respects:-

1) Wavelength accuracy 2) Resolution 3) Stray light 4) I_o flatness
5) Noise

If the spectra do not agree within the specified limits some adjustment may be necessary and the Perkin-Elmer Service Department should be contacted.

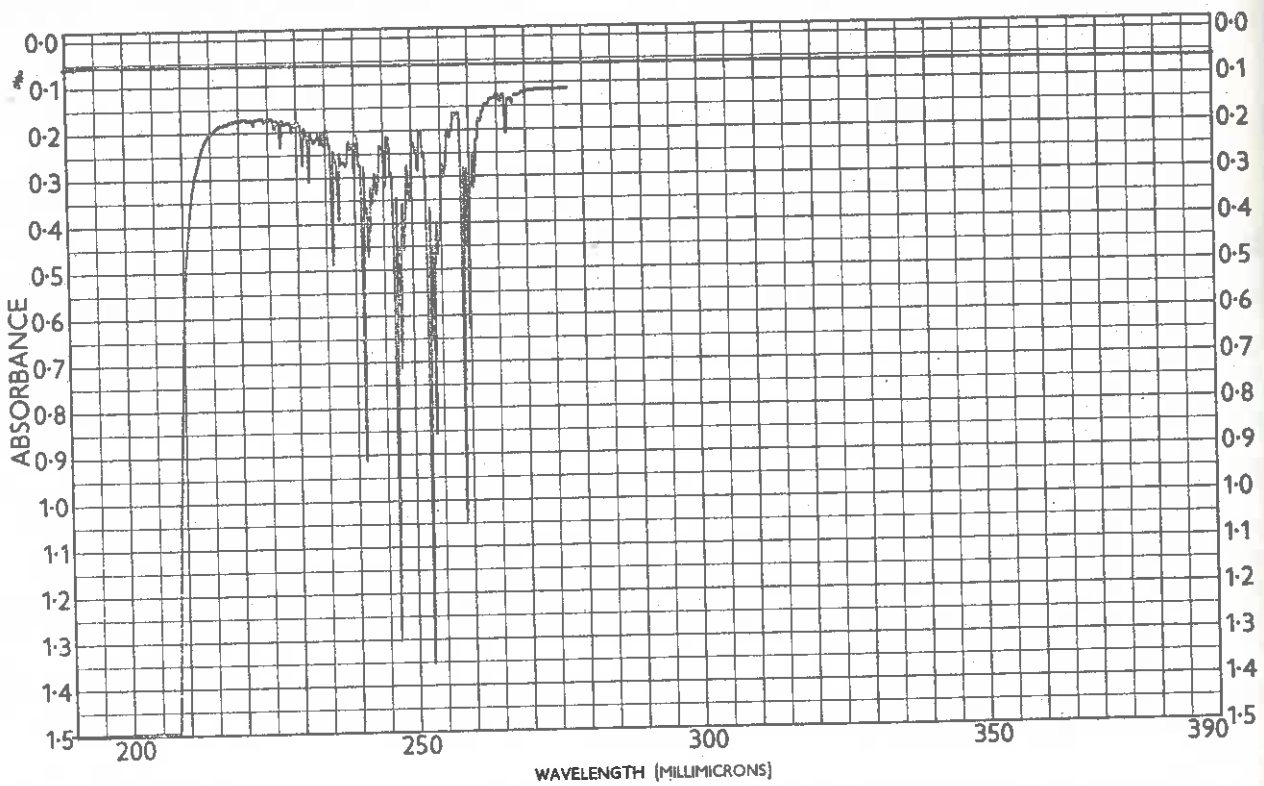


Fig. 2.7 Typical Benzene Spectrum and UV I_o

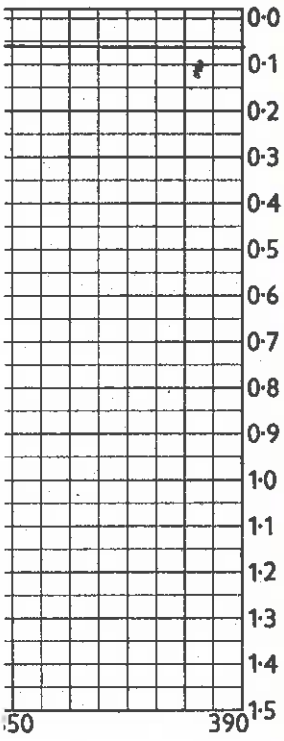
y particular
the drum with
ould always be
in the mechanical

to stop the servo
friction wheel and
Slipping will occur
ay be accompanied
licate a fault in the

ecorded by a
ecorded immediately
e test spectra

) I_o flatness

t may be necessary



33. To record the spectra proceed as follows:-

a) Carry out the preliminary steps as detailed in paragraph 20 of this section.

b) Use a micro-syringe to inject a tiny droplet of benzene on to the ground glass side of a 1 centimetre cell. It is most important to avoid handling the cell with bare hands as fingerprints will considerably affect the spectrum produce If more than a tiny droplet of benzene is visible in the cell, blow gently acros the mouth of the cell to accelerate vaporisation. Seal the cell and insert it into its mount and place in position in the sample compartment. Close and lock the sample compartment.

c) Set the drum to the start of the ultraviolet range 190mμ. Switch to SCAN SLOW.

d) The instrument will now automatically record the spectrum of benzene vapour if the correct volume of benzene has been injected into the cell, cut off will commence at about 208mμ. Too small an amount will be indicated by a cut off below 208mμ and too large an amount by a cut off above 208mμ.

e) The instrument will automatically stop scanning at the end of the ultraviolet range and the scan switch should be set at STOP position. Rotate the drum manually back to the start of the ultraviolet range and remove the 1cm. cell from the sample compartment. The ZERO control should now be adjusted to bring the pen down to approximately 0.1 absorbance units, and with no sample in either beam and the sample tray cover closed and locked, switch the SCAN switch to SCAN FAST. The instrument will now automatically record the UV I_o line and will stop at the end of the ultraviolet range.

f) When the instrument has stopped scanning, move the SCAN switch to STOP. The chart paper may now be removed and the benzene spectrum and the I_o line compared with the typical spectra shown in Fig. 2.7.

g) The ZERO control on the front panel should be adjusted to move the pen to the ZERO absorbance position before normal operation commences.

SPECIAL OPERATING PROCEDURES

A.G.C. Gain Control

34. This control enables the A. G. C. unit to be set to operate within its range of control. It is set at the factory to be correct for normal use of the instrument. However, under special conditions of use, some adjustment may be necessary. Such conditions are when abnormally low or high energy reaches the detector.

Abnormally low energy, e. g. when there is high absorbance in the reference cell and it is undesirable to increase the slit width. Under these conditions the front panel meter may reach its maximum (about 95 on the scale). The A. G. C. Unit cannot furthe increase the sensitivity of the instrument and the pen response will become sluggish.

Turn the A. G. C. control clockwise until the meter pointer comes back on the scal

Abnormally high energy, e. g. when working with wide slit widths in the visible region. Under these conditions the front panel meter may reach its minimum (about 25 on the scale). The A. G. C. unit will be unable to reduce the instrument's sensitivity further and the pen may tend to go into oscillation (hunting).

Turn the A. G. C. gain control counter-clockwise until the meter pointer comes aw

from minimum.

NOTE: If the A. G. C. reading becomes abnormally high under normal operating conditions, particularly in the short wavelength region of the ultraviolet range, the sources should be checked for low emission. The sources may be checked visually for blackening of the glass envelope or by substitution.

Slit Override Adjustment

35. Under normal conditions, when operating in either the UV or VIS wavelength range, the SLIT override control should be set at 25, as indicated on the dial above the SLIT control. It should be adjusted only when the A. G. C. meter approaches closer than two divisions to its maximum for a wavelength span greater than 3 to 4 mμ. (Its maximum is the reading obtained when the sample tray shutter is closed. For convenience, the reading two divisions below this maximum will be referred to as "Max-minus-two"). The SLIT override adjustment should be opened only to the point at which the A. G. C. meter registers less than max-minus-two across the entire scan of the wavelength being used.

The SLIT override is adjusted as follows:

a) Set the scanning switch to RESET.

b) Insert the basic sample into the sample beam and the reference sample into the reference beam.

c) Close and lock the sample compartment.

d) Lift the pen from the chart paper.

e) Manually turn the chart drum while observing the A. G. C. meter. Scan to the first point in the spectrum at which the meter registers over max-minus-two.

f) Open the slit width by turning the SLIT control knob clockwise until the A. G. C. meter reads below max-minus-two.

g) Continue to scan the balance of the spectrum manually across the entire wavelength range while observing the A. G. C. meter. The slit width must be further increased if the meter registers over max-minus-two at any other point in the spectrum.

h) Scan the spectrum on either the fast or the slow scan as desired.

NOTE: After a particular scanning operation with the slit override specially adjusted has been completed the SLIT override control should be reset to 25.

Variable Drum Setting

36. The base of the chart drum has a twelve-position selector which permits changing of the setting of the drum relative to the wavelength scale of the instrument, (Fig. 2. 8). By using the selector tab to turn the selector in either direction any of the settings may be selected. This facility enables small regions of the spectrum to be scanned a number of times and each scan to be displayed on the same chart.

NOTE: There is only one setting at which the wavelength scale on the chart paper corresponds with that on the instrument. This setting is marked N on the selector plate.

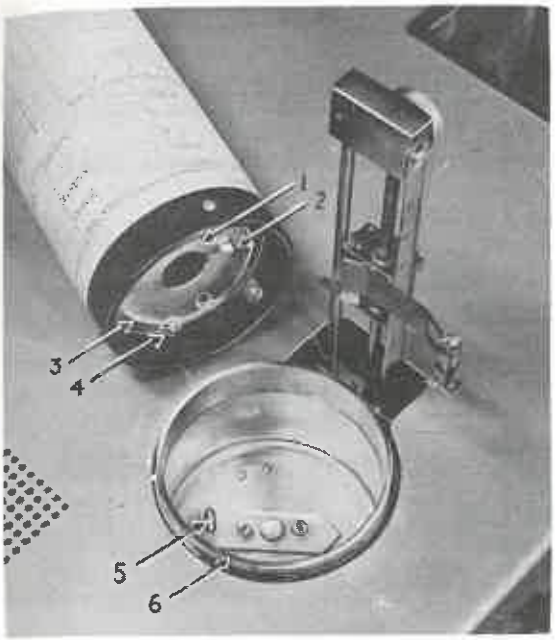


Fig. 2.8 Chart Drum Selection Mechanism

1. Selector
2. Tab
3. Drum Base Plate
4. Index Pin
5. Engaging Pin
6. Wavelength Scale

Manual Scanning

37. Manual scanning is useful when it is desired to scan a wavelength range rapidly to determine the wavelengths of major absorption bands. With the SCAN control in the STOP position the pen may be pushed against the chart paper and the chart drum rotated manually whilst held as shown in Fig. 2.6. In this way any wavelength range may be scanned as rapidly as desired.

Flushing with Dry Nitrogen

38. Absorption by atmospheric oxygen normally does not affect absorbance readings in excess of the tolerances required for routine analysis. There may be occasions, however, when particularly accurate information is required in the wavelength region at which oxygen absorbs strongly (190 - 195 mμ). On such occasions it is possible to reduce the concentration of oxygen to relatively insignificant levels by flushing the optics with dry nitrogen. The following is the recommended procedure for flushing:-

a) Attach a 3/16-inch I.D. tube from the dry nitrogen source to the fitting at the rear of the right-hand side of the instrument.

b) Open the regulator valve at the nitrogen source and adjust to give a flow to the instrument at not more than 5. p.s.i.

c) After approximately 5 minutes reduce the pressure to 1 p.s.i. and maintain this flow during measurements.

CAUTION: Completely reproducible results will only be obtained when all the oxygen has been removed from the system and this may necessitate flushing for considerably longer than five minutes.

39. Due to the very high absorption coefficients obtaining in the ultraviolet, especially below about 210 mμ, any accumulation of organic vapours in the sample path will

lead to energy loss and reduction in instrument performance. These may arise from solvent spilled in the sample tray, or, during the first few months of the life of the instrument, from evaporation of residual solvent in paint films etc. The condition is indicated by abnormally high A. G. C. meter readings at the shorter wavelengths and is cured by flushing the instrument with dry air or nitrogen (steps 31(a) and (b) are sufficient). It is recommended that this procedure be carried out at least once a week by operators who regularly work below 210mμ.

SPECIFICATION

40. The following specification represents the maximum production limits permitted in the manufacture of the Model 137UV Spectrophotometer (Measurements and calibrations are made in an ambient temperature of about 70°F). The performance of each instrument will be equal to, or better than, the figures given below.

1) Chart Presentation:- Ordinate - Linear Absorbance (0 to 1.5A), 15 cm. scale.

Abscissa - Linear Wavelength, 25 cm. scale.

2) Wavelength Range:- Ultraviolet Region (UV) 190mμ - 390 mμ.

Visible Region (VIS) 350 mμ - 750 mμ.

3) Wavelength Accuracy:- A wavelength reading on the chart wavelength scale is not different from the wavelength actually being scanned by the instrument by more than .05 mμ in the UV, 1 mμ in the VIS from 350 - 650 mμ and 2 mμ in the VIS from 650 - 750 mμ.

4) Wavelength Reproducibility:- The wavelength readings registered on the chart wavelengt scale are identical to within 0.3 mμ in the UV and 0.5 mμ i the VIS. from one run to the next.

5) Photometric Accuracy:- The readings on the absorbance scale indicate the true value of absorbance within .01 absorbance units between 0.0 and 1.0 absorbance. Between 1.0 and 1.5 absorbance the tolerance is 1% of the reading.

6) Photometric Reproducibility:- Absorbance readings do not differ by more than 0.005 absorbance units from one run to the next.

7) Noise:- The average peak-to-peak noise signal of the instrument is not more than .005A at 1.0A with the slits set on their normal programme, i.e. slit override dial set at 25.

8) Resolution:- Resolution is 0.2 mμ at 210 mμ, 0.4 mμ at 390 mμ., 1.5 mμ at 600 mμ.

9) I_o Flatness:- The zero absorbance line is flat to within .04A in each range.

10) Stray Light:- The energy signal due to scattered light picked up by the detector is not more than 1% at 200 mμ and not more than 0.1% of Full Scale Energy at 210 - 390 mμ in the UV range and 390 - 740 mμ in the VIS range.

11) Slit Override:- The slit override adjustment gives approximate slit openings from 25 μ to 2000 μ.

may arise from
the life of the
The condition is
avelengths and is
and (b) are
east once a week by

limits permitted in
ements and calibra-
rmance of each

1.5A), 15 cm. scale.

n. scale.

mμ.

ı.

velength scale is not
y being scanned by
in the UV, 1 mμ in
in the VIS from 650 -

on the chart wavelengt
n the UV and 0.5 mμ i

e indicate the true
bance units between
0 and 1.5 absorbance

by more than 0.005
next.

of the instrument is not
ts set on their normal
et at 25.

mμ at 390 mμ.,

ithin .04A in each

ght picked up by the
nμ and not more
) - 390 mμ in the UV
nge.

proximate slit

12) Servo Response:- The pen moves from zero to full scale in 0.8 seconds with a maximum signal to the servo motor.

13) Power Requirements:- 200 - 250 Volts A.C. 50 cycles/sec. 250 Watts.

14) Scan Time:- Either selected wavelength range may be scanned in two or eight minutes.

15) Sample Area:- $10\frac{1}{2}$" x $4\frac{1}{2}$" x $5\frac{3}{4}$" high. Beam separation about 3.5 inch

16) Sampling:- The cell holder will take standard rectangular cells (10 mm wide) up to 40 mm long and standard cylindrical cells (20 mm bore) up to 70 mm long. Special rectangular cells of 100 mm path length can be accommodated in a special mount.

17) Monochromator:- Littrow type, 60° fused silica prism, f/5 aperture, 203 mm. focal length. Curved bilateral exit slits are used in conjunction with straight entrance slits. Slit height 12 mm.

18) Sources:- Air cooled hydrogen lamp for the U.V. range. Tungsten filament lamp for the VIS range. Changeover automatic with range change.

19) Detector:- End-on UV transparent photomultiplier.

20) Overall Dimensions:- 32" x 18" x 18" high, overall, (81 x 46 x 46 cm.)

21) Weight:- Approximately 120lb. (55kg.)

NOTE: The specification for photometric accuracy does not take into account the effect of stray light and, for the most accurate results, stray light must be measured and allowed for. For an absorption band of 1.0 absorbance units, 0.1% stray light can cause the apparent absorbance to differ from the true value by up to 0.5%, while 1% stray light can cause a deviation of up to 5%.

It should be particularly noted that stray light between 350 and 390 mμ is significantly greater when using the VISIBLE range than with the UV range due t the low emission of the tungsten lamp in this region. This effect may cause a difference in absorbance value between the two ranges, especially for strong bands, and quantitative work should be carried out in the UV range in this region.