UNPACKING

Carefully remove the polarimeter from the packing material. It is recommended that the box and other packing materials are retained so that, should the need arise, the polarimeter can be safely returned to the manufacturer.

Check that all parts listed below are present and that no transit damage has occurred. If any are damaged or missing then contact the supplier immediately.

CONTENTS LIST

1 Model D Polarimeter
1 Operators Manual
1 Glass Sample Tube (200mm)
1 Zero Adjust Tommy Bar
1 Plastic Dust Cover

POSITIONING THE SYSTEM

Choose a position for the system that is:
* flat and stable
* away from draughty or hot equipment like fans or heaters
* out of direct sunlight or strong ambient light
* within easy reach of a power point

Assemble the Sodium Lamp Unit in accordance with the instructions contained in the Sodium & Spectral Lamp Outfits Operators Manual.

Set the instrument up on the bench with the analyzer head facing the operator, and an illuminated sodium lamp in direct line with the axis of the instrument and about four inches from the end. Open the hinged trough of the instrument (behind the head) and remove any packaging and the adjusting key from the trough.
Focus the top eyepiece (scale telescope) to show the scale and index line. Remove a transit spring on the boss of the control wheel to allow it to engage with the scale within the head. Observing through the scale telescope turn the control wheel until the scale reads 0 on the upper scale. Without disturbing the setting, transfer the eye to the lower eyepiece (field telescope) and focus to obtain a circular disc of light. By means of the control wheel, move the scale a few degrees about the first position, observing the effect on the field. It will be observed that the field is divided into two halves rapidly changing in intensity as the control is moved, and that between the extremes of blackout of the two halves a position will be found that gives equal intensity. This is the balance position and is used in all measurements. It will be observed that a balance condition of the field can be obtained at 0° and 180°; either position may be used with equal sensitivity but for the convenience of scale reading it is preferable to use the balance at zero. At 90° and 270° the field is brightly illuminated and the two halves of the field again become of equal intensity. The sensitivity however is low and this condition should never be used in making a measurement.
Basic Operation

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Basic Operation

INTRODUCTION

The polarimeter consists basically of two polarising elements of 'Polaroid', one of which is fixed, the other capable of rotation and mounted within a graduated scale in order to measure its orientation with respect to the other. When the planes of polarisation of the two elements are mutually perpendicular no light is transmitted through the system. A thin plate of quartz is positioned to cover half the aperture of one of the elements in order to introduce a 'half shadow effect'. The effect is to cause extinction of light in one half of the field a few degrees - normally 7° - before the other half of the field reaches its extinction position. Thus a balance can be achieved where one half of the field is reducing in intensity as the other half is increasing, as the scale is rotated. The position of the scale at which the two halves are of equal intensity is the balance position and is used in all determinations. On introducing an optically active sample between the polarizing elements the balance is disturbed and it is necessary to re-balance by turning the scale. The amount by which the scale is moved is a direct measure of the optical activity of the sample.

As the Model D uses the orthodox optical system, where the half shadow effect is produced at the polariser end, the dividing line in the field remains upright at all times and it may be necessary to re-focus the field telescope after the introduction of the solution tube.

MEASURING A SAMPLE

In order to eliminate as far as possible any errors due to strain in the tube windows it is preferable to obtain first a measurement using a tube filled only with the solute, i.e. in the case of aqueous solutions, the tube being filled with water. Ensure that there are no air bubbles in the tube obstructing the light and place the tube in the polarimeter trough, and observing through the field telescope, re-focusing as necessary, adjust the analyzer by means of the control wheel to exactly match the two halves of the field. Note the scale reading as described above. Remove the sample tube and empty and refill with the sample to be measured and then replace it in the trough. The field as observed in the field telescope will be found to be no longer balanced and must be adjusted by means of the control wheel again to obtain a match. Note the scale reading, the difference between the two measurements being the sample rotation.

READING THE SCALE

The scale seen in the scale telescope is divided at 1° intervals from 0 to 360°. Adjacent to 0 and below the main scale is the International Sugar Scale (I.S.S) that may be used directly in the evaluation of sugar solutions.
The micrometer drum is employed to sub-divide the angular and I.S.S. scales and itself carries two scales, angular on the left, sub-divided at intervals of .05°, and I.S.S. on the right, subdivided at intervals of 0.1. The index marker is at the top of the aperture for both scales. It will be noted that movement of the drum from 0 to 1.0 will cause the line seen in the scale telescope to transverse exactly one scale division respectively for the I.S.S. and angular scales.

In use, the field is set in the field telescope for balance as described above and the scale is observed in the scale telescope. In all probability the index line will lie between two scale divisions. Rotate the micrometer drum knurled disc to bring the index line coincident with a scale line. The true reading is then the scale line concerned plus the drum reading indicated on the appropriate scale, e.g.

First examination shows index line between 17° and 18° upon the angular scale. Turn the micrometer drum to bring the index line coincident with the scale 17° division. The drum then reads .75 on the left hand scale. True determination is therefore 17.75°.

It will be noted that since the I.S.S. divisions are closer than those of the angular scale, it is possible that the drum may be so positioned when the index line is coincident, with no I.S.S. divisions visible on the drum scale. For this reason, when making a measurement on the I.S.S., first bring the drum to 0 and then advance it to bring the index line into coincidence with the first scale division encountered. It must also be observed that the I.S.S. divisions on the drum scale are in a positive sense, therefore, if a measurement is taken on the negative side of the I.S.S. the drum reading must be subtracted from the coincident I.S.S. reading.

The micrometer drum does not act as a fine control to the field observed in the field telescope and does not influence it in any way. It serves only to sub-divide the scale once a balance has been obtained.
To obtain accurate results, great care must be exercised in filling the tube and ensuring that the end windows are not strained thus causing erroneous results. Remove both end caps of the tube and detach the glass windows which must be carefully cleaned. The ends of the tube must now be cleaned and dried. Place one window over the end of the tube and replace the cap. Carefully screw the cap down until the first resistance appears. Do not screw any further. Invert the tube, and ensuring that the open end is dry, pour in the sample carefully until a meniscus appears bulging above the tube end. The window may now be slid from the side over the tube end with one movement and centralised without tilting. The cap may then be screwed down exactly as with the other end.

This procedure can, with little experience, be perfected so that the tube is left completely filled and with no air bubble. The tubes are supplied with a bubble trap that enables any air bubble formed to be taken out of the field of view.

It is not essential that the instrument reads zero with no sample, any error can be taken into account when the rotation is evaluated since the measurement is essentially a difference in the two setting positions. Small errors, up to $\frac{1}{2}^\circ$ angular, may be corrected by the micrometer drum as follows:

With no sample in the trough, set the field to a precise match observed in the field telescope. Set the micrometer drum to read zero and observe the scale in the scale telescope. Grasp the micrometer drum knurled disc and with the other hand slacken the clamp knob. The drum scale is now released from the knurled disc. Turn the knurled disc until the index line coincides with 0 on the scale seen through the scale telescope. Ensure that the drum still reads zero, if not bring it to this position by moving it through the rectangular aperture in the sleeve. Hold the knurled disc stationary and re-tighten the clamp knob against it. Check the balance and that the scale and drum read zero.

For errors of greater than $\frac{1}{2}^\circ$ or if the drum divisions are becoming obscured by the sides of their aperture the optical elements must be adjusted to bring the error within the scope of the micrometer drum adjustment. These zero errors may be corrected by inserting the tommy bar provided into the holes in the analyzer mount. This is situated at the analyzer head end of the trough and rotates with the circle.

The circle should be brought to read zero and held in that position by the control knob. Ensure that the corresponding scale on the drum also reads zero. Rotate the analyzer mount by means of the tommy bar until the field is matched.

The half shadow may be easily adjusted to suit requirements. Small variations may be made by turning the knurled sleeve on the polariser tube.

It will be found necessary to adjust the zero position on the scale after altering the half shadow angle.