

# INSTRUCTION MANUAL FOR ADVANCED POLARIMETER (SK011)



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## INTRODUCTION

Disk Polarimeter can be used in the chemical industry, hospitals, colleges and universities and scientific research institutions, for measuring the organic substances with optical rotation. With the aid of the disk Polarimeter, the specific rotation, purity, concentration of sugar solution, turpentine oil and camphor, can be measured. For example: In the food industry: The disk Polarimeter can be used to inspect the sugar content and to measure the asyulum content of the food flavorings. In the clinic and hospital: The disk Polarimeter can be used to measure the sugar content and protein in urine. In the sugar refinery: The disk Polarimeter can be used to inspect the concentration of the sugar solution in industrial process. In the medicines and perfumery industry: The disk Polarimeter can be used to measure the optical rotation of the medicines and perfumery oil. In colleges and universities: The disk Polarimeter can be used in teaching experiments.

## SCOPE OF SUPPLY

1. Advanced Polarimeter	1 set
2. Sodium Lamp	1 Piece
3. Test Tube (100mm 200mm)	1 Piece/each
4. Test Tube Protective	4 Pieces (spare)
5. Test Tube Rubber Washer	4 Pieces (spare)
6. Small Screw Driver	2 Pieces
7. Manual	1
8. Fuse (3A)	3 Pieces

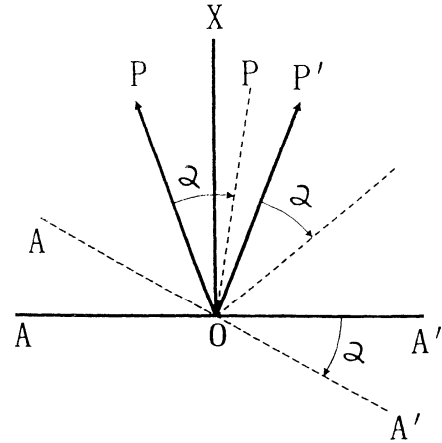
## TECHNICAL SPECIFICATIONS

1. Measuring Range of Optical Rotation	$\pm 180$
2. Division Value	$1^\circ$
3. Dial Vernier Value in Reading	$0.05^\circ$
4. Magnifying Factor of the Magnifying Glass	4times
5. Monochromatic Light Source (Sodium Lamp)	5893A $^\circ$
6. Length of Test Tube (100mm and 200mm)	1 each
7. Power Source of the Instrument	
Power Line Voltage	220V / 50Hz
Working Current	1.3A
Discharging Power	20W
Stabilization Time	about 5minutes
8. Weight of the Instrument	5 kg
9. Overall Dimensions	600×220×400(mm)

## PRINCIPLE OF OPERATION

The principle of operation of the Polarimeter is established on the basis of the polarized light. In addition, by use of the method of rotating the polarized plane of the polarization light, its measuring purpose can be attained. At the position of zero degree, AA' is Perpendicular to the center line OX.

AA' (shown in the above Figure) indicates the vibration direction of the polarization analyzer, and OP and OP' indicate the vibration directions of the polarized lights of the two halves of the viewing field. When the light beam passes through the optical rotators substance, the plane of polarization is rotated by an angle of  $\alpha$ , as shown by the dotted line in the above Figure. Now, the projections of the polarized lights of the two halves on AA' are not identical, the right half is bright, and the left half is dark. If rotating the polarization plane AA' of the analyzer by an angle of  $\alpha$  in the same direction, the illumination intensity of the viewing field can be made equal again: At this time, the rotated angle of the polarization analyzer is the optical rotation of the substance. Knowing the rotated angle (i.e. the optical rotation), the length of solution column (i.e. the length of the test tube) and the concentration, the specific optical rotation of the substance can be calculated in accordance with the following formula:



$$[\alpha]_t^{\lambda} = \frac{Q}{lC} \times 100$$

Where, Q— the rotation angle (optical rotation) measured by use of light  $\lambda$ , when the temperature is t.

l — the length of solution column (test tube), using decimeter (dm) as the unit of the length.

C— concentration, i.e. the gram quantity of the solute in 100mm of solution.

From the above formula; we can see that the rotation angle Q is in direct

Proportion to the solution column (the tube) length L and the concentration C,

$$\text{i.e. } Q = [\alpha] l C$$

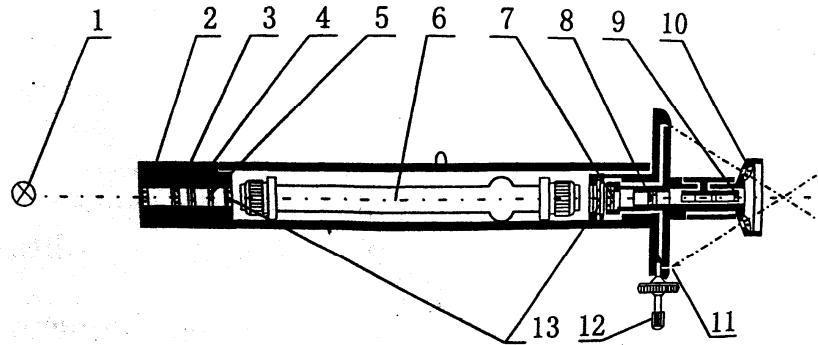
Also, the optical rotation has relations with the temperature. As for most substances,  $\lambda=589.3\text{nm}$  (sodium light) can be used in the measurement, when the temperature rises by  $1^{\circ}\text{C}$ , the optical rotation will reduce by 0.3%. Thus, for the measurement with higher requirements, it is better to make the measurement under a working circumstance of  $20 \pm 2^{\circ}\text{C}$ .

## CONSTRUCTION

### PRINCIPLE OF THE INSTRUMENT (See Fig.1)

1. Light Source(Sodium Light)
2. Collector lens
3. Color Filter
4. Polarizer

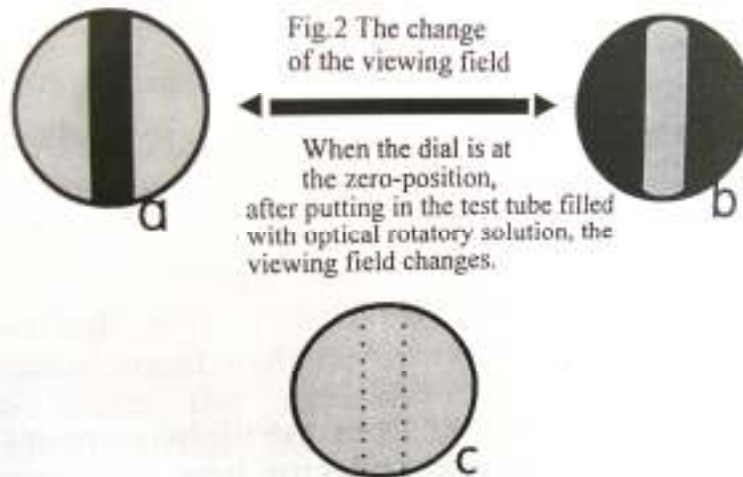
5. Half-wave Plate
6. Test Tube
7. Polarization Analyzer
8. Object Lens
9. Eye Lens
10. Magnifying Glass
11. Dial Vernier
12. Dial Rotary Hand-wheel
13. Protective Plate.



**Fig .1 System diagram of the instrument**

After the light coming from the light source (1) has been projected on the collector lens (2). Color filter (3), and Polarizer (4), it becomes a plane linear polarized light, and after the polarized light passes through the half-wave plate(5) and is decomposed into normal light and abnormal light, a triplex view-aspect will occur in the viewing field. The test tube (6) containing the optically active substance is put into the sample chamber for measurement. Since the solution has optical activity, the plane-polarized light is rotated by some angle, so that the polarization analyzer (7) can play a role of analysis. Observing through the eye lens (9), we can see a mid-bright (or dark) and left/right-dark (or bright) triplex viewing field of unequal intensity of illumination (see Fig.2a and fig.2b).

Rotate the dial rotary hand-wheel (12) so as to drive the dial (11) and the polarization analyzer (7), until the illumination intensity of the viewing field (dark viewing field) becomes equal (see Fig.2c). Then, the angle of dial rotation can be read out from the magnifying glass (see Fig.3).

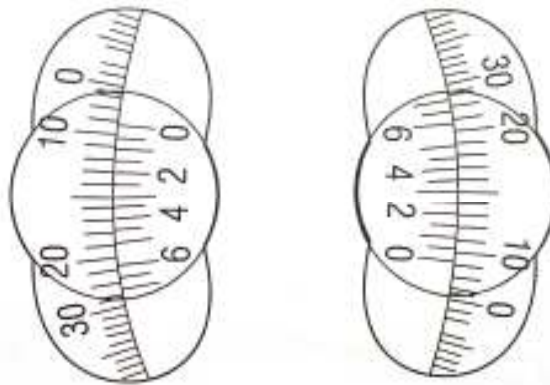


After rotating the polarization analyzer, the illumination intensity becomes equal, i.e. the zero-position viewing field before putting in the solution.

### **CONSTRUCTION OF THE INSTRUMENT**

For easy operation, the optical system of the instrument should be mounted on the base frame in an inclination of 20°. The light source uses 20W sodium lamp (the wave length  $\lambda=589.3\text{nm}$ ).The current limited of the sodium lamp is mounted at the bottom of the base frame so external current limited is not needed. The polarizers of

the instrument are all polyvinyl-alcohol artificial polarizing discs. The triplex viewing-aspect uses Laurent quartz slab device (half-wave plate). By rotating the polarizer; the shadow angle of the triplex viewing field can be adjusted. (When leaving the factory, the above-mentioned shadow angle is regulated to about  $3.5^\circ$ ). In order to eliminate the eccentric difference, the Instrument uses a Double-Vernier in reading, the dial is divided into 360 divisions and each division indicates  $1^\circ$ . The Vernier is divided into 20 divisions which are equal to 19 divisions of the dial, and the Vernier can be used to obtain a direct reading to the extent of  $0.05^\circ$  (see Fig.3). The dial and the polarization analyzer are fixed integrally. The hang-wheel (12) can be used to make coarse and fine rotation. Two pieces of magnifying glasses (the magnifying factor is 4 times) are mounted in front of the Vernier window, which can use in reading.



Q= $9.30^\circ$  Fig.3

## METHOD OF OPERATION

### 1. PREPARATIONS:

1. Compound the solutions to be measured and then have the solution stabilized.
2. Pour the solution to be measured into the test tube for measurement. *Caution: The screws at the both ends of the test tube should not be screwed in too tightly (usually screw down the screws with hand conveniently until no water leak occurs), so as to prevent the protective plate from producing strain which may cause the illumination change of the viewing field and affect the accuracy in measurement.* Then, wipe the remaining liquid at the both ends clean.
3. Connect the power source, and turn on the sodium lamp for about 10 minutes. Only when the lamp gives out yellow sodium light, the observation can be made.
4. Check for the zero-position of the dial. If the zero-position is not correct, you may unscrew the four connecting screws in the dial's cover, so to rotate the dial's shell for correcting the zero-position (only  $0.5^\circ$  below can be corrected) or you may add or subtract the error value.

### 2. MEASUREMENT

1. Open the cover of the lens cone, and put the test Tube into the lens cone for measurement. Then, close the cover of the lens cone and have the bulb part of the test tube to be upward, so that the air bubbles can be stored in the bulb part and the observation and measurement will not be affected.
2. Adjust the viewing field screw, until the triplex viewing aspect in the viewing field becomes distinct.
3. Rotate the dial hang-wheel until the illumination of the viewing field (the dark viewing field) becomes identical.

4. Read out the angle rotated by the dial through the magnifying glass.
5. According to the formulas described above, calculate the specific gravity, concentration, purity and content of the substance.

#### **MAINTENANCE OF THE INSTRUMENT**

1. The instrument should be positioned at a place with circulation of air. Appropriate temperature, and lower humidity, so as to prevent the optical parts and polarizing discs from being moistened and mildewed, and avoid affecting the performance of the instrument.
2. The time for continuously using the sodium lamp tube should not exceed 4 hours. When the sodium lamp tube is being used for a long period of time, the electric fan must be used, or the sodium lamp should be turned off for 10-15 minutes so as to get it cooled before using it again. If the lamp tube could only give out red light and could not give out yellow light, it usually means that this is caused by too low an input voltage (less than 220V). In such a case, you should think of a way to increase the voltage up to about 220V.
3. After being used, the test tube should be rinsed and cleaned with water or distilled water, and should be wiped clean and stored up.
4. Never use unclean and hard cloth or paper to wipe the optics, so as to prevent the surfaces of the optics from being scared.
5. The instrument should be covered with a plastic cover, so as to avoid the invasion of the dust.
6. When being Packed, the instrument, sodium lamp tube the test tube, and so on should be placed at the assigned positions, so as to avoid being crushed.
7. Never disassemble and assemble the instrument at will, especially for those who know little about the measuring accuracy of the instrument will be affected. If there is some trouble or something wrong with the instrument, the instrument for repair, so that the lifetime and measuring accuracy of the instrument can be guaranteed.