

# 99.400(-LED)

disc polarimeter



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## 1.0 General safety instructions

### Intended use: a non-medical device

This polarimeter is designed to measure the angle of rotation caused by passing polarized light through an optically active substance

### 1.1 Dangers associated with the operation

- Improper use could result in injury, malfunction or damage to property. It must be ensured that the operator informs every user of existing hazards
- Danger of electrocution. Disconnect the power to the entire lighting system before installing, adding or changing any component
- Not to be used in corrosive or explosive environments
- Avoid direct exposure of eyes to the collimated light beam or direct light from the light guides or fibres
- To avoid a hazard to children, account for all parts and keep all packing materials in a safe place

### 1.2 Photobiological safety lightsource, important safety instructions

- Avoid direct eye exposure to the light source while cover is removed

### 1.3 Disinfection and decontamination:

- Exterior casing and mechanical surfaces must be wiped with a clean cloth dampened with a disinfectant
- Soft plastic parts and rubber surfaces can be cleaned by gently wiping a clean cloth dampened with a disinfectant. Discoloration can occur if alcohol is used
- Never immerse or dip the eyepiece part or other parts into a disinfectant liquid! This will damage the component
- Never use abrasive compounds or cleaners that may damage and scratch optical coatings

- Properly clean and disinfect all possible contaminated surfaces of the polarimeter or contaminated accessories before storing for future use. Disinfection procedures must be effective and appropriate
- Leave the disinfectant on the surface for the required exposure time, as specified by the manufacturer. If the disinfectant evaporates before the full exposure time, reapply disinfectant on the surface
- For disinfection against bacteria, use a 70% aqueous solution of isopropanol (isopropyl alcohol) and apply for at least 30 seconds. Against viruses, we recommend to refer to specific alcohol or non-alcohol based disinfection products for laboratories

Before returning a polarimeter for repair or maintenance through a Euromex dealer, an RMA (return authorization form) together with a decontamination statement must be filled in! This document - available from Euromex for any reseller- must be shipped together with the polarimeter at all times

### Handle with care

- This product is a high quality optical instrument. Delicate handling is required
- Avoid subjecting it to sudden shocks and impacts
- Impacts, even small ones, can affect the precision of the instrument

### Handling the LED

**Note:** Always disconnect the power cord from your polarimeter before handling the LED bulb and power unit and allow the system to cool down approximately 35 minutes to avoid burns

- Never touch the LED/bulb with your bare hands
- Dirt or fingerprints will reduce the life span and can result in uneven illumination, lowering the optical performance
- Use only original Euromex replacement LEDs or bulbs
- The use of other products may cause malfunctions and will void warranty
- During use of the polarimeter the unit can get hot; never touch it while in operation and allow the system to cool down approximately 35 minutes to avoid burns

### Dirt on the lenses

- Dirt on or inside the optical components, such as eyepiece, optical windows, etc., affects the image quality of your system negatively
- Always try to prevent your polarimeter from getting dirty by using the dust cover, prevent leaving fingerprints on the lenses and clean the outer surface of the lens regularly
- Cleaning optical components is a delicate matter.

### Environment, storage and use

- This product is a precision instrument and it should be used in a proper environment for optimal use
- Install your product indoors on a stable, vibration free and level surface in order to prevent this instrument to fall thereby harming the operator
- Do not place the product in direct sunlight
- The ambient temperature should be between 5 to +40°C and humidity should be within 80% and 50%, preferred temperature is room temperature.
- Never use undue force when turning the knobs
- Make sure that the polarimeter system can dissipate its heat (fire hazard)
- Keep the polarimeter away from walls and obstructions for at least approximately 15 cm
- Never turn the polarimeter on when the dust cover is in place or when items are placed on the polarimeter
- Keep flammable fluids, fabric, etc. well out of the way

### Disconnect power

Always disconnect your polarimeter from power before doing any maintenance, cleaning, assembling or replacing LEDs or bulbs to prevent electric shocks



### Prevent contact with water and other fluids

Never allow water or other fluids to come in contact with your polarimeter, this can cause short circuiting your device, causing malfunction and damage to your system

### Moving and assembling

- The polarimeter is a relatively heavy system, consider this when moving and installing the system
- Always lift the polarimeter by holding the main body and base of the polarimeter
- Never lift or move the polarimeter by its focusing knobs, stage or head
- When needed, move the polarimeter with two persons instead of one

## 2.0 Introduction

- With your purchase of a NOVEX polarimeter 99.400 or 99.400 LED you have chosen for a quality product. The NOVEX polarimeter is developed for use at universities and laboratories.
- The maintenance requirement is limited when using the polarimeter in a decent manner
- This manual describes the construction of the polarimeter, how to use the polarimeter and maintenance of the polarimeter

## 3.0 Construction of the polarimeter

The names of the several parts are listed below and are indicated below

<b>A.</b> Eyepiece with focusing ring	<b>F.</b> Lamp cover
<b>B.</b> Vernier scale	<b>G.</b> Sample and measuring tube
<b>C.</b> Rotating wheel	<b>H.</b> Cover lid of measuring tube
<b>D.</b> Stand arm	<b>I.</b> LED
<b>E.</b> On/off switch	



## 4.0 Functions of the polarimeter

The stand consists of a stand arm (D), sample and measuring tube (G) and illuminator (F). Hold the polarimeter at the stand arm when it should be moved

### 4.1 Sample and measuring tube

The sample and measuring tube is equipped with an eyepiece (A) with focusing ring, and built in side lenses to read the scales

### 4.2 Package content

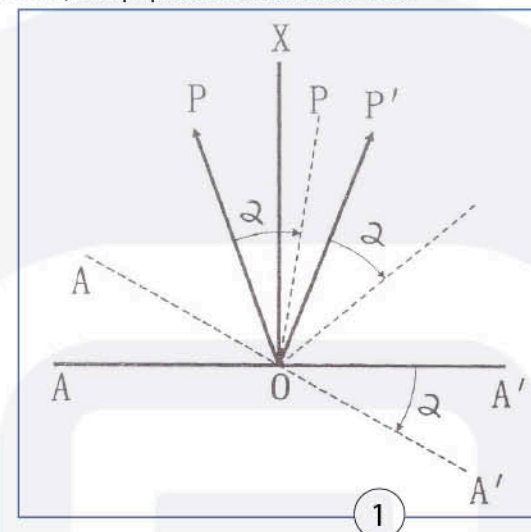
The standard package content is:

1 x Polarimeter	2 x Sodium Lamp (LED version only 1)
2 x Test tubes (1 x 100 and 1 x 200 mm)	4 x Spare cover glass
8 x Rubber washers	1 x Small screwdriver
1 x Dustcover	3 x Spare fuses 3,15 Amp.

### 4.3 Operating principle

The operating principle of the polarimeter is based on polarized light and the method of rotating the polarized plane of the polarized light. At the position of zero degree rotation, AA' is perpendicular to the centerline OX

- AA' (shown in fig. 1) indicates the vibration direction of the polarization analyzer
- OP and OP' indicates the vibration directions of the polarized lights of the two halves of the field of view
- 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 fig. 1
- Now the projections of the polarized lights of the two halves on AA' are not identical, the right one is bright and the other one is dark
- By rotating the polarizing plane AA' of the analyzer by an angle of  $\alpha$  in the same direction, the illumination intensity of the two halves can be equalized. The rotated angle of the polarization analyzer equals the optical value of the substance



Knowing the rotated angle (optical value), the length of the substance column (length of test tube), the specific optical rotation of the substance can be calculated with the following formula:

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

- Were Q is the rotation angle (optical value), measured by use of light  $\lambda$ , when the temperature is t
- Were l is the length of the substance column (test tube), using decimeter (dm) as unit
- Were C is the concentration, the gram quantity of the substance in 100 mm. tube solution

From the above formula, we can see that the rotation angle  $Q$  is in direct proportion to the substance column (the tube) length  $i$  and the concentration  $C$

$$Q = [\alpha] l C$$

Also the optical rotation has relations with the temperature. As for most substances,  $\lambda = 589.3 \text{ nm}$ . (Sodium light) or  $546.1 \text{ nm}$  (LED light) can be used in the measurement. When the temperature rises with  $1^\circ\text{C}$ , the optical rotation will reduce by  $0.3\%$ . Thus, for the measurement with higher requirements, it should have been better to do the measurement at a working circumstance of  $20^\circ\text{C}$ ,  $\pm 2^\circ\text{C}$

## 5.0 Preparing the polarimeter for use

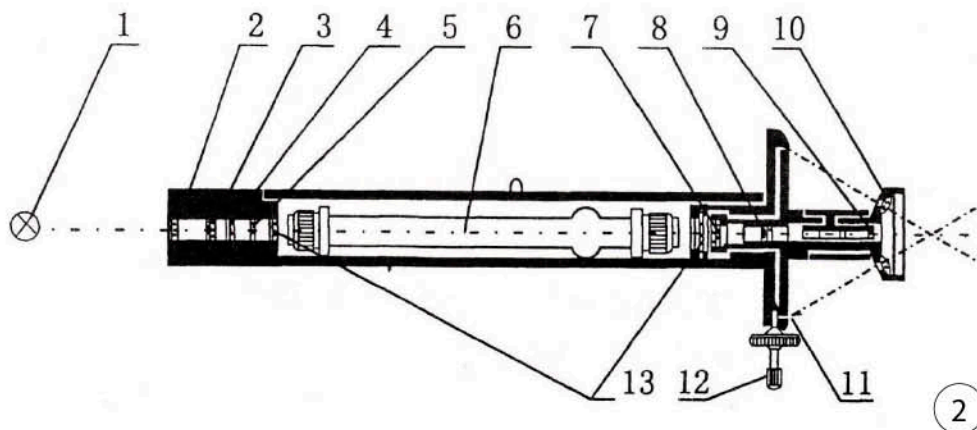
- Remove the packing and put the polarimeter on a flat table
- Connect the power cable to the mains supply
- Switch on the polarimeter with switch (E). Sit comfortably down behind the polarimeter and take a relaxed position while viewing through the eyepiece (A)

## 6.0 Working with the polarimeter

Please read the following instructions to achieve the best results

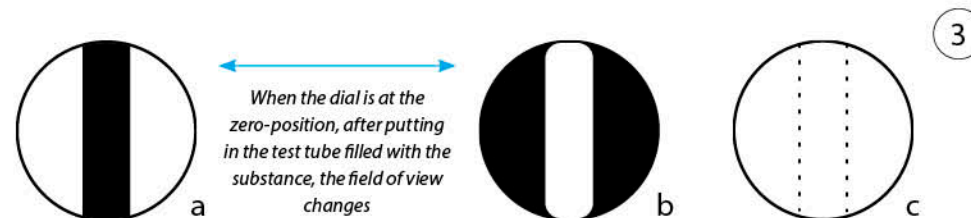
### 6.1 System diagram of the polarimeter

1. Light source with sodium or LED lamp	8. Object lens
2. Collector lens	9. Eye lens
3. Colour filter	10. Magnifying glass
4. Polarizer	11. Vernier dial
5. Half-wave plate	12. Rotating wheel
6. Test tube	13. Protective plate
7. Polarization analyzer	



## 6.2 Use of the polarimeter

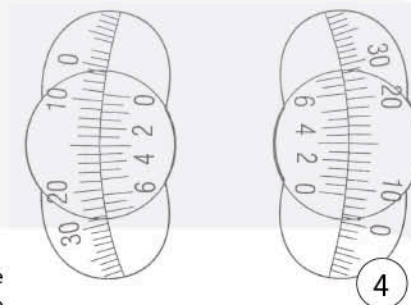
After the light coming from the light source (1) has been projected on the collector lens (2), colour filter (3) and polarizer (4) it becomes plane, linear polarized light. After the polarized light passes through the half-wave plate (5) and is decomposed into normal – and abnormal light, a triplex view-aspect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



The change of the field of view

Rotate the rotary wheel (12) in order to drive the dial (11) and the polarization analyzer (7), until the illumination intensity of the field of view becomes equal (fig. 2 c). Then, the angle of dial rotation can be read out from the magnifying glass (Fig.4)

For easy operation, the optical system of the instrument should be mounted on the base frame at an inclination of  $20^\circ$ . The light source uses  $20\text{W}$  sodium lamp (wavelength  $\lambda=589,3 \text{ nm}$ ) or LED lamp (wavelength filter  $\lambda=589,3\text{nm}$ ). 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 field of view can be adjusted. In order to eliminate the eccentric difference, the instrument uses double vernier scales for 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. 4). The dial and the polarizing analyzer are fixed integrally. The hang-wheel (12) can be used to make coarse- and fine rotation. Two pieces of magnifying glasses (factor  $4\times$ ) are mounted in front of the vernier windows, for optimum reading



$Q = 9.30^\circ$





## 6.3 Measurement of a sample

- Prepare the sample solution to be measured and leave it to stabilize for about 5 minutes
- Pour the solution into the test tube, without having air included. Close the test tube by screwing the cap onto it, beware not to tighten the cap too fast, for strain in the cover glass may effect the measurement
- Turn on the instrument with the switch (E) and leave the lamp glowing for about 10 minutes to reach the full wavelength
- Open the cover (H) and put the test tube into the holder (G)
- Make sure the scale is at the zero position
- Focus the field of view by means of the focusing ring on the eyepiece
- Rotate the wheel (C) until the brightness of the left and right field of view are exactly the same
- Read out the rotation angle, and use this digit in the formula on page 4 to obtain the required value

## 7.0 Maintenance and cleaning

Always place the dustcover over the polarimeter after use to avoid dust entering the instrument

### 7.1 Maintenance of the stand

Dust can be removed with a brush. In case the instrument is really dirty the surface can be cleaned with a non-aggressive cleaning product

### 7.2 Changing the sodium bulb (not applicable for LED version)



**Caution:**

Always remove the power cable from the mains supply before changing the bulb!

- Remove the lamp cover (F)
- Make sure the sodium lamp is cool to the touch and kindly pull it out of its socket
- Put in the new lamp and beware the center pin (black) is pointing in the right way to fit its socket