FLUKE®
Biomedical

Nuclear Associates 07-621

Precision Photometer

Users Manual

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Section 1
General Information

1.1 Introduction

This manual describes the operation of the Precision Photometer (Model 07-621). Please read it completely to understand the capabilities of your instrument.

There are two operating controls: Measure for taking a reading, and Range to adjust the meter display to the light level being measured.

One turret is supplied for two types of measurements. In one position, illuminance may be measured in units of lux. In the other position, luminance is measured in units of candela/m^2 (Nit).

1.2 Measure Control

Depress and hold this control (right side of meter) to turn the meter on and display a light reading. If you fail to obtain a reading, depress the Range control repeatedly until numbers appear on the display. (Keep the Measure control depressed when doing this, in order to see the result in the display.)

The display may show the following signals:

Display	Description	Significance
	Three decimal points only displayed	Overrange reading. Adjust Range.
000, 001 or 01	Zero or very low reading	Underrange reading. Adjust Range
9.62 X 1000	Good reading	Display reads in 1,000s, i.e., 9620
LO BAT 9.62	Good reading	Change batteries soon

When the Measure control is released, the display will freeze and show the last reading for about 5 seconds. This feature allows viewing a reading when taking measurements in difficult viewing situations.

1.3 Range Control

This control sets the readout range of the digital display. Each time Range is depressed, the meter reads the next higher range until it reaches the highest range. Then the Range control will recycle .the meter to the lowest (most sensitive) range.

The table below explains how the ranges work. The arrows signify the action when Range is depressed.

When the 1000 indicator is lit on the display, the reading shown is in thousands. For example, a display of 6.43 $^{X}_{100}$ is 6,430. Similarly, a display of 0.43 $^{X}_{1000}$ becomes 430 (this reading could have been displayed more accurately on range 2).

Range No.	Display	Meaning
	00.1 to 99.0	As shown
	001 to 990	As shown
	0.01^{X}_{1000} to 9.99^{X}_{1000}	10 to 9990
	00.1^{X}_{1000} to 99.9^{X}_{1000}	100 to 99900
	001^{X}_{1000} to 999^{X}_{100}	1000 to 999000

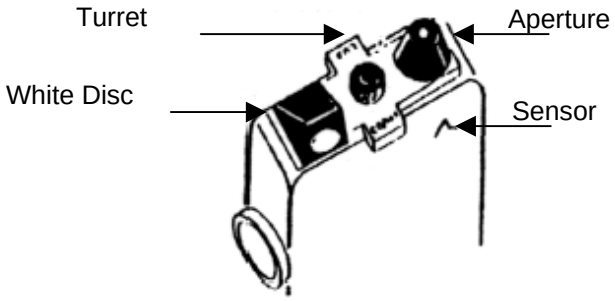
The readings above are in units of lux or candela per square meter (Nit), depending upon turret position.

Once a range is selected, the meter will maintain that range whether Measure is depressed or not (measure need not be depressed to change ranges). No damage will occur if the meter is switched to a sensitive range under strong illumination.

Since there are 5 ranges, depressing Range four times in quick succession has the effect of selecting the next more sensitive range.

1.4 Mode Of Measurement

The turret on top of the instrument has two light receptors. The proper receptor is positioned over the light sensor for the desired type of measurement. The positions of the light receptors can be changed by loosening the turret thumbscrew, reversing the turret, and re-tightening the thumbscrew.



For lux measurements, the white disc is used. Place it over the light sensor. The location of the light sensor is designated by a mark (^) on the instrument housing.

For candela/m^2 (Nit) measurements, place the clear aperture over the sensor.

If you have positioned the turret correctly, the measurement selected will also be indicated on the turret tab closest to the front of the instrument.

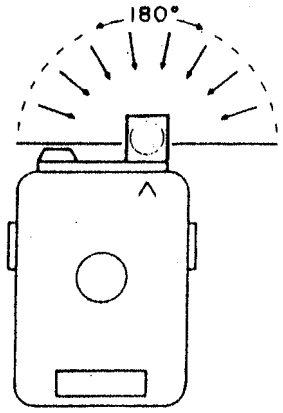
Whichever position of the turret is chosen, the digital display will be calibrated in the corresponding unit of measurement. Proper measuring technique is also necessary for accurate measurements, see Section 1.5.

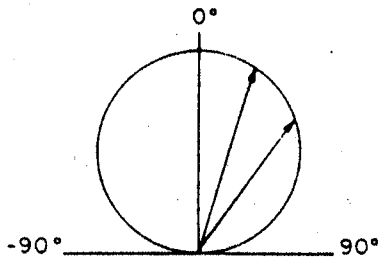
1.5 Measuring Technique

Illuminance--Lux

This is the amount of light energy incident upon a surface. The surface is defined by the geometric plane of the white disc on the triangular head. Light sources within the (180°) hemisphere in front of the white disc will be sensed according to the cosine law.

For best accuracy, do not block light sources in the 180° hemisphere. The orientation of the white discs for lux measurements is designed to minimize the effect of the operator's presence on the reading.

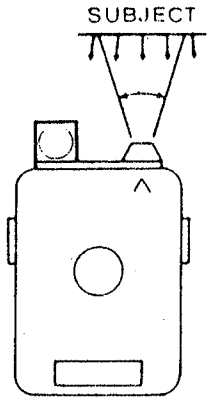


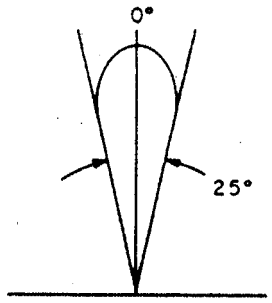


COSINE LAW: RELATIVE SENSITIVITY VERSUS ANGLE OF INCIDENT LIGHT

Luminance--candela/m^2

Luminance is the photometric brightness of sources or of light reflected from objects. Photometers read the overall luminance in approximately a 25° field of view, as shown below.





RELATIVE SENSITIVITY VERSUS ANGLE

When attempting luminance readings, avoid casting shadows upon the subjects when those subjects are reflecting objects (i.e., not light sources).

Conversion factors are shown below for other units of measurement.

cd/m2 = Candela/m^2 = Nit

lux = footcandles x 10.8

footcandles = .093

cd/m^2 (Nit) = footlamberts x 3.43

footcandles = $\frac{cd}{m^2}$ x .292

1.6 Optional Equipment: Fiber-Optic Probe (Model 07-634)

This (optional) attachment is designed for use with Model 07-621 Photometer. It reads brightness of self-luminant objects such as diffuse lighting screens, video monitors, signs, etc. Small areas (3 mm or 1/8 inch) can be measured and otherwise inaccessible areas can be reached.

Each probe is calibrated to be compatible with the photometer. Only use it with the meter that has been calibrated with the probe. Recalibration is recommended when it is desired to make calibrated measurements with another probe/photometer combination. The calibration unit of luminance measurements with the probe is footlamberts. Mount the probe on the meter by first removing the turret supplied. Place the probe's turret flat on top of the meter and tighten the thumbscrew snugly, but do not over-tighten. To use, hold the Fiber-Optic probe against the surface to be measured, and operate the photometer according to its instructions.

If the front of the probe is not flush with the surface, background light may distort the reading.

Things to Avoid: Do not bend the probe sharply or force it beyond the point to which it easily bends. Avoid scraping the tip of the probe and scratching the fibers. Do not attempt to loosen the threaded portion of the probe or the locking ring; otherwise, calibration will be affected.

1.7 Batteries

Four 1.5V, Type A- 76 alkaline button cells, or silver oxide types, MS-76, 10L 14, RW-42, 357.

When the batteries are weak, the LO BAT signal on the display will light after the Measure control is released. If LO BAT stays lit with the display, change the batteries. If LO BAT light intermittently, it is only a warning.

To change the batteries, loosen the battery door screw with a coin. Handle the new batteries with tissue paper to avoid corrosion of the contacts. Replacement battery types are listed under Specifications.

Cold temperatures may temporarily cause the battery voltage to drop, thereby lighting LO BAT.

If the instrument will not operate, clean all batteries and contacts, as most problems are caused by poor electrical connections. Also observe proper battery polarity (+, -).

1.8 Specifications

Capabilities: Illuminance in lux; luminance in cd.m^2 (Nit).

Readout: Three-digit LED display.

Range: 00.1 to 999000.

Accuracy: Within 7% ± 2 digits of full-scale range for 2500°k to 5400°k light sources.

Sensor: Silicon photodiode with photometric filter

Spectral Response: Close match to CIE photoptic response curve

Batteries: 1.5V, Type A-76 alkaline button cells, or silver oxide types, MS-76, 10L 14, RW-42, 357.

Size: 10 x 7 x 2.5 cm

Weight: Approx. 4 oz. (110g).

Recommended Operating Conditions: 5°C to 40°C (41°F to 104°F), maximum 95% relative humidity, non-condensing.

Supplied with: Case, neck cord.

1.9 Suggested Viewbox Procedure

Viewboxes should be checked for uniformity on a semi-annual basis. Each viewbox should be checked in relation to the other viewboxes in the panel. Take a 12-inch ruler, and attach it to the photometer using a rubber band, so that the aperture receptor for luminance is at the 9-inch mark. There should be a 9-inch reproducible distance when taking readings. Before taking any measurements on a viewbox, the ambient room lighting should be the same as when radiographs are being read. When testing uniformity from one viewbox to another, place the end of the ruler at the center of the viewing panel, and take a reading. Follow the same procedure at each of the view boxes. The luminance of each of the viewboxes should not deviate from one to the other by more than 15%.

When checking the uniformity of a single viewbox, visually divide the viewing panel into four quadrants. Place the end of the ruler at the center of each of the quadrants, and take a reading. The readings from each of the four quadrants should not deviate by more than 15%.

If the viewboxes do not meet this criteria, they should be dismantled and cleaned. Once this is done, repeat the test. If the results are the same, then all of the light bulbs should be replaced. The typical viewbox luminance should be approximately 1500 Nit. Viewboxes used for viewing mammograms should have a luminance of approximately 3500 Nit.

1.10 Routine Cleaning

CAUTION

Do Not Immerse the Model 07-621 Precision Photometer in liquid. The unit is not waterproof. Liquid could damage the circuits. The unit should be kept clean and free from dirt and contamination. The unit may be cleaned by wiping it with a damp cloth, using any commercially available cleaning or decontamination agent.

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