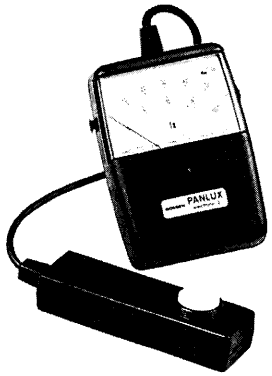
Bedienungsanleitung
Instructions for Use

GOSSEN METRAWATT CAMILLE BAUER

7905-1007Y0
2/10.94

PANLUX electronic 2



Contents

1. Description of instrument

This instrument is suited for measurement of
illumination in Lux or footcandle respectively[1)]
luminance in cd/m^2 or foot-lambert respectively[1)] (see pages 40 and 41)
also to determine exposure data for cinefilm and photographic applications (see page 30 onwards).

The meter is **colour-corrected,** i.e., its spectral sensitivity matches the eye's sensitivity curve V(λ). The correction filters are incorporated in the measuring probe. All the important kinds of light can therefore be correctly measured, without having to take correction factors into account.

The instrument has a **built-in cosine-correction facility.** Light with an oblique angle of incidence can thereby be correctly measured in accordance with the cosine law.

The instrument is easy to operate and provides highly accurate measurement.

Even the most brilliant light (daylight, spotlights) can be measured without having to use a special accessory.

Its largest measuring range reaches up to 200,000 lux respectively 20,000 footcandle.

Recessed into the rear panel of the meter unit is a support which permits the instrument to be stood up on the slant.

A sturdy flap lid leather case is provided for the meter. With the leather case opened, meter and measuring cell may remain within the case for taking measurements (see fig. on page 29).

[1)] depending on model type; for ordering numbers see last page.

2. What you need to know to use the meter (Brief Instructions)

First of all, insert the battery supplied into the compartment at the rear of the instrument. To open the compartment, turn the screw through 45° with a coin, so that the lid springs up.

2.1 Battery check

Slightly press green button **8** e.g. with a ball-point pen and verify that the meter needle indicates in the green area **6** of the scale. Repeat this check every time a new battery is fitted, and periodically to check its condition.

2.2 Prior to measurement

Use switch **2** to select measuring range. In the window **3** there appears the respective measuring range-end value 20/60/200/600/2,000/6,000/20,000/60,000/200,000 Lux resp. 2/6/20/200/600/2,000/6,000/20,000 footcandle. Instead of the last three 000 in the high measuring ranges there appears "k" (kilo) signifying "thousand".

To protect the meter against overloads, it is recommended to select first a high measuring range and then gradually go down range by range until a sufficiently large needle deflection will be produced on the scale.

2.3 Zero check

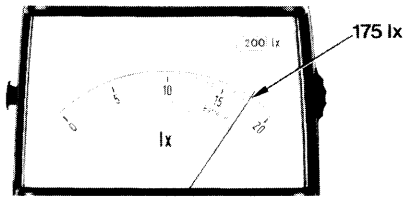
If the meter reads slightly off zero when button **4** is in the "up/off" position, turn the zero adjuster **7** with a screwdriver until the needle is exactly in line with the scale zero mark; the position of measuring range switch **2** is immaterial for this adjustment.

2.4 Measuring and reading the scales

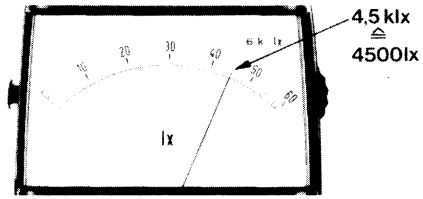
For measuring depress ON/OFF switch **4**. Read the value indicated on the lower scale, if the range you selected **3** starts with "2"; read on the upper scale, if range starting with "6" was chosen.

For reading the needle indication, you must consider the end value of the range you selected to be the end value of the scale and then compute the value indicated on the scale accordingly.

Example 1:
range **3** selected 200 lx | = 10
read on scale with end value 20 |
needle indicating on scale 17.5
Apply above factor and obtain the measuring value 175 lx



Example 2:
range **3** selected 6 klx (6000 lx) | = 100
read on scale with end value 60 |
needle reading on the scale 45.
Apply above factor 100 and obtain the measuring value 4.5 klx ≙ 4500 lx



2.5 Instructions for correct measurement

Depending on the task, the measuring probe should be:

held parallel to the surface being evaluated;
or be laid on the surface if the illumination of that surface is to be measured (e.g., workplace illumination);
or be held horizontal 0.85 m from the ground if the illumination of a room is to be measured;
or be held pointing from subject of the photograph towards the camera, if you are measuring for photography (e.g., on the stage or in a studio).

Further details are given later in these operating instructions.

When taking measurements, always ensure that the diffuser of the measuring probe **is fully exposed** and is not shaded by your hand or body. It is often advisable to lay or hold the probe at the point of measurement and to arrange the meter as far away as the connecting cable allows.

It should be borne in mind:

that artificial light sources do not reach their full output until they have been burning for some time. You should consequently, when possible, switch on some 15 minutes before measuring;

that the output from light sources is dependent on the mains voltage. Where appropriate, the mains voltage should be checked with a voltmeter.

2.6 Carrying case

In order to keep the size of the carrying case as compact as possible, the components were placed close to each other in the inside. Please position the measuring probe in the lid exactly as shown in the illustration, the case can then easily be closed.

Where convenient and desired, the meter and the measuring probe can be kept in the case when taking a measurement.

3. For the cameraman and the professional photographer

Measuring the illumination of a surface

(e.g., in reproduction and projection work)

Measurements should be made at as many places as possible, with the probe laid parallel on the surface or held parallel to it.

When reproducing flat copy, arrange the lamps to achieve the desired uniform illumination, i.e., in general so that the difference between the maximum and minimum measurement is no more than 5%.

Satisfactory projection of pictures calls for illumination values of around 60 to 140 Lux at the screen.

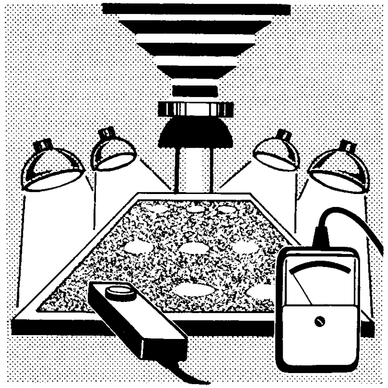


Fig. 3.1

Measurements in photographic and film studios or on stage

To check the illumination of a scene being photographed, measurements should be made at as many points as possible. The measuring probe should be held so that the surface of the diffuser is perpendicular to the line from the measuring point to the camera.

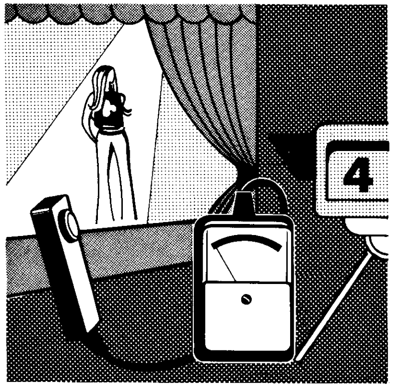


Fig. 3.2

Exposure table for daylight photography

Measured illumination		f-numbers for DIN 18 film					
		Shutter speed in sec.					
lx	fc	1/8	1/15	1/30	1/60	1/125	1/250
45	4.3	**1**					
57	5.4	1.13					
72	6.8	1.27					
90	8.5	**1.4**	**1**				
115	10.5	1.6	1.13				
145	13.5	1.8	1.27				
180	17	**2**	**1.4**	**1**			
230	21.5	2.2	1.6	1.13			
290	27	2.5	1.8	1.27			
360	34	**2.8**	**2**	**1.4**	**1**		
450	43	3.2	2.2	1.6	1.13		
570	54	3.6	2.5	1.8	1.27		
720	68	**4**	**2.8**	**2**	**1.4**	**1**	
900	85	4.5	3.2	2.2	1.6	1.13	
1 150	105	5	3.6	2.5	1.8	1.27	
1 450	135	**5.6**	**4**	**2.8**	**2**	**1.4**	**1**
1 800	170	6.3	4.5	3.2	2.2	1.6	1.13
2 300	215	7.1	5	3.6	2.5	1.8	1.27
2 900	270	**8**	**5.6**	**4**	**2.8**	**2**	**1.4**
3 600	340	9	6.3	4.5	3.2	2.2	1.6
4 500	430	10	7.1	5	3.6	2.5	1.8
5 700	540	**11**	**8**	**5.6**	**4**	**2.8**	**2**
7 200	680	12.5	9	6.3	4.5	3.2	2.2
9 000	850	14.5	10	7.1	5	3.6	2.5
11 500	1 050	**16**	**11**	**8**	**5.6**	**4**	**2.8**
14 500	1 350	18	12.5	9	6.3	4.5	3.2
18 000	1 700	20	14.5	10	7.1	5	3.6
23 000	2 150	**22**	**16**	**11**	**8**	**5.6**	**4**
29 000	2 700	25	18	12.5	9	6.3	4.5
36 000	3 400	29	20	14.5	10	7.1	5
45 000	4 300	**32**	**22**	**16**	**11**	**8**	**5.6**
57 000	5 400	36	25	18	12.5	9	6.3
72 000	6 800	41	29	20	14.5	10	7.1
90 000	8 500	**45**	**32**	**22**	**16**	**11**	**8**
115 000	10 500	51	36	25	18	12.5	9
145 000	13 500	58	41	29	20	14.5	10

The above lx and fc values and the f-numbers are listed in 1/3 increments.

The **contrast ratio** is the ratio $\frac{\text{main light + fill-in light}}{\text{fill-in light only}}$

The main light and fill-in light are measured from the most important subject in the scene, pointing in the direction giving the highest reading with all the lamps switched on. The main light should then be switched off and the fill-in light should be measured from the subject in the direction of the camera.

Depending on the photographic or filming task concerned, the are certain limits which the contrast ratio should not exceed if a well-balanced result (on slide, paper or film) is to be achieved.

If, on the other hand, soft lighting without any contrast is required, (e.g., "high key" photography), the lamps should be arranged so that identical readings are obtained at different points of the subject and background. This can be particularly important in colour photography.

Lighting effects – Illumination

Very attractive results can be obtained by lighting effects, i.e., by deliberately and dramatically increasing or reducing contrasts. In such instances greater contrasts are permitted, but they should not be overdone, otherwise the film will not be able to cope with them.

Using the instrument as an exposure meter to determine stop and shutter-speed

The image-forming light is measured in the usual way from the major subject in the picture. The illumination is indicated in Lux. The stop and shutterspeed can be obtained from the table on pages 32 and 33 or from the CALCULATOR, which you are advised to acquire.

The image-forming light is generally the main light, but bright lateral light can also be important to the measurement. In this case the mean value of the two measurements should be used.

CALCULATOR

When used in conjunction with the CALCULATOR (see page 42), the illumination meter constitutes a highly accurate exposure meter.

Most manufacturers of film for professional purposes provide information about exposure data derived from illumination measurements.

4. For lighting and illumination technicians

Illumination measurements are necessary when planning and installing lightind installations for which checking and monitoring will be required in order to define illumination conditions for reasons relating to health, physiological, psychological or safety aspects. Areas of application, terms used, tasks, requirements and practical guidelines are largely covered by DIN Standards. Here ase a few definitions:

General lighting:

Uniform illumination of a room, producing roughly the same conditions of visibility in all parts of the room.

General working-area lighting:

General illumination with a specific relationship between lighting fittings and certain work-places (for definition of work-place see DIN 33400).

Individual work-place lighting:

Illumination of individual work-places in addition to the general lighting.

The following examples may be quoted of applications of illumination measurements using the meter:

planning and installation of lighting installations and their monitoring with respect to ageing, pollution and profitability;
indoor lighting by daylight (DIN 5034);
checking safety lighting (according to German regulations the minimum illumination should be 1 Lux);
street and vehicle lighting for traffic and transportation facilities (DIN 5044);
testing vehicle headlights (DIN 5037);

gymnasia (DIN 18032, part 1);
stadium lighting (DIN 67526);
lighting of building sites, railway sidings, airport aprons and other outdoor areas;
floodlighting of buildings, towers and chimneys;
lighting of greenhouses and nurseries.

Indoor lighting using artificial light (DIN 5035)

This Standard applies to the artificial lighting of indoor areas; where relevant, it can also cover the artificial lighting of areas out of doors, provided they serve the same purpose as the corresponding indoor areas. The Standards Commission have worked in close collaboration with all interested parties in an attempt to establish minimum lighting requirements which are technically acceptable but at the same time do not place excessive financial demands on the user. In conjunction with ASR 7/3, this Standard represents the recognized obligatory specification, the appplication of which satisfies the stipulations of German workplace regulations ArbStättVo of March 1975, § 7, para. 3.

The following definition appears in part 1 of DIN 5035 with the sub-title "Terms and general requirements":

Illumination rating:

Illumination ratings for indoor areas are 20/50/100/200/300/500/750/1,000/1,500/2,000 Lux.

The illumination rating is related to an average aged-condition of the installation.

The illumination rating, which is assigned to a particular kind of room or activity, is related to the difficulty of the visual task. This presupposes that the influence of this illumination value on visibility is not affected by outside influences, such as direct glare, reflected glare, reduced contrast, unsuitable lamp-colour or colour rendering.

The allocation of a specific illumination rating to a visual task is related to persons with normal eyesight. A sight defect which cannot be fully corrected by aids to vision can be wholly or partially compensated by a higher illumination level.

Illumination at a workplace

A rated illumination of **at least 200 Lux** should be provided at permanently-occupied workplaces in buildings, unless operational or physiological/optical requirements call for a deviation. In rooms or areas of rooms which are regular stopping-places for employees, a rated illumination level of **at least 100 Lux** is required.

Minimum planning values

When planning an installation, the value of the rated illumination should be multiplied by a planning factor of at least 1.25.

Irrespective of the state of ageing of the lighting installation, the arithmetical mean value of the illumination at the workplaces must not be less than 0.8 times the rated illumination.

At no time must the illumination at a workplace fall below 0.6 times the value of the rated illumination.

Part 2 of DIN 5035 bears the sub-title "Guideline values for workplaces" and includes a comprehensive table, stipulating the illumination, colour of light, colour-rendering properties and degree of limitation of direct glare for the nature of the room of the activity. A further column gives important information concerning special lighting-installation requirements, e.g., when supplementary individual workplace lighting is advisable or even necessary.

5. Technical data

Measuring ranges	0 . . . 20/60/200/600/2,000/6,000/20,000/60,000/200,000 lx or 0 . . . 2/6/20/60/200/600/2,000/6,000/20,000 fc
Accuracy	With incandescent lamplight and a perpendicular angle of incidence of the light, the max. error of the reading is 3.5 % related to the end value of the scale. At all angles of incidence the integral cosine error is less than 3 %. Additional deviations with other kinds of light are max. ± 3 %.
Light-collecting area of diffuser	approx. 20 mm diam.
Scale length	approx. 64 mm
Case	plastic
Power supply	battery 9 V (26.5×17.5×48.5 mm) 6 F 22 DIN 40871 (IEC 6 F 22)
Dimensions	meter: approx. 79×110×35 mm probe (incl. diffuser): approx. 32×105×29 mm lead: 1.5 m long carrying case approx. 90×170×75 mm
Weight	with carrying case approx. 0.55 kg
Accessories	Luminance attachment and CALCULATOR (see pages 40 to 42)

6. Accessories

By separate accessories the instrument can be used for additional tasks.

6.1 Luminance attachment

This is an accessory for measuring luminance.

The luminance attachment measures the reflected light, i.e., the brightness of a surface, in an aperture angle of ε 1/10* = 20° or, depending on the exposure-meter definition, a measuring angle of 16°.

The luminance attachment screws onto the measuring probe of the illumination meter.

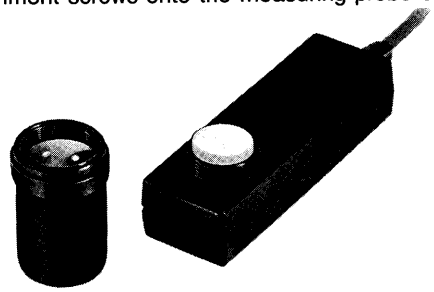


Fig. 6.1

*) According to DIN 5032: "The tenth-angle ε 1/10 in a plane through the optical axis is the angle within which the sensitivity is equal to or greater than 1/10 of the sensitivity when light is incident in the optical axis".

The value in lux (lx) or in footcandle (fc) respectively measured by the device, multiplied by the factor printed on the bottom of the luminance attachment, gives the luminance in candela per square metre (cd/m^2) or in foot-Lambert (fL) respectively.

Meters with lux-scale:
factor 10, i.e. indicated value 1 lx ≙ 10 cd/m^2.

Meters with footcandle-scale:
factor 30, i.e. indicated value 1 fc ≙ 30 fL.

The following measuring ranges are thus available:

Meters with lux-scale:
0 . . . 200/600/2,000/6,000/20,000/60,000/200,000/600,000/2,000,000 cd/m^2.

Meters with footcandle-scale:
0 . . . 60/180/600/1,800/6,000/18,000/60,000/180,000/600,000 fL

6.2 CALCULATOR

The CALCULATOR is an exposure-calculating disc about 160 mm in diameter, on which the measured values from the digital meter are set and the corresponding shutter-speed/stop combinations can be read off.

In addition to that you can conveniently read off the corresponding values of Lux (lx) and footcandle (fc), Candela/m^2 (cd/m^2) and footlambert (fL) directly.

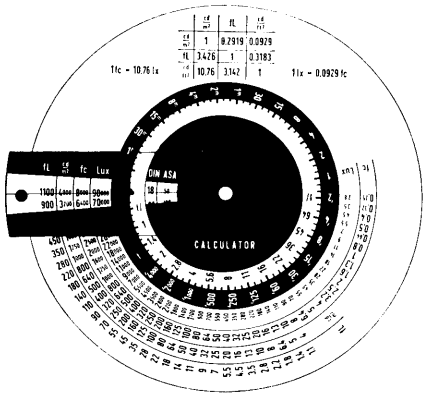


Fig. 6.2

7. Some theory

(Details in DIN 5031)

The illumination indicates the intensity with which a surface is illuminated; its unit of measurement is the Lux (abbreviated lx). According to its definition, a light source with a luminous intensity of 1 Candela (abbr. cd) generates an illumination of 1 Lux at a distance of 1 metre. 1 Candela is 1/60 of the luminous intensity emitted 1 cm^2 of a black body (cavity radiator), at right angles to the surface, at the solidification point of platinum (2045 K or 1772°C).

Another common unit of illumination, particularly in England and America, is the footcandle. This represents the illumination at a distance of 1 foot from a light source of 1 cd. The Lux and footcandle are related as follows:

1 footcandle = 10.76 Lux
1 Lux = 0.0929 footcandle

In American literature the unit metercandle will also be encountered. This is identical to the Lux.

For perfect measurements the light must be evaluated according to the eye's sensitivity, in accordance with the internationally agreed spectral-sensitivity curve (λ) of the light-adapted eye. This curve represents the mean value determined on a large number of human subjects.

The silicon photo-cell used in the meter has been matched to the spectral sensitivity of the eye with a correction filter. It almost fully achieves the V(λ) curve (see Fig. 7.1) and evaluates the light in nearly the same way as the eye does.

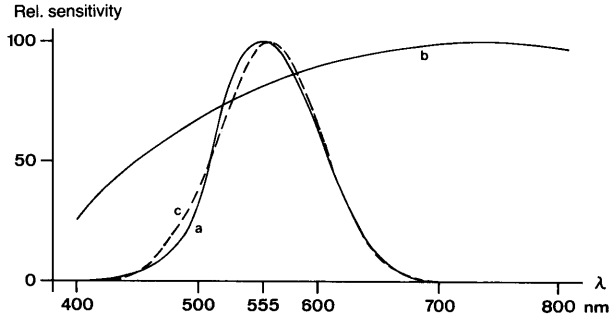


Fig. 7.1

Relative spectral sensitivity (mean values)

a. Eye V(λ)
b. Silicon photo-cell without filter
c. Meter's measuring probe

The digital meter can be used to make correct measurements of all the major kinds of light, i.e., from incandescent lamps, fluorescent lamps, mercury-vapour and sodium-vapour lamps, etc., as well as natural daylight.

To measure light with an oblique angle of incidence, it is necessary for the evaluation by the receiver to be free from cosine error.

What does "free from cosine error" mean?

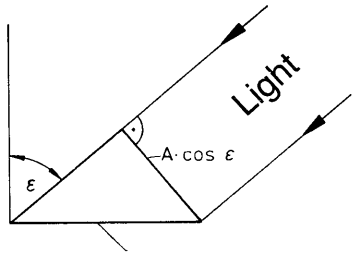


Abb. 7.2

Let us assume that light falling on a receiving surface A has an illumination E_0. If the light is incident at an angle ε, the cross-section of the light-beam striking the receiving surface is reduced to A · cos ε. The illumination E (ε) with an angle of incidence ε is consequently:

$$E(\varepsilon) = E_0 \cdot \cos \varepsilon.$$

On the digital meter, the cosine correction is achieved by a special diffuser projecting slightly from the cell housing.

What does luminance mean?

Although projection is usually undertaken with reference to the illumination, the luminance is of particular importance. This is the lighting quantity which is perceived by the eye, and expresses the brightness of a surface. The luminance in a particular direction is the luminous-intensity density of the light-emitting surface, i.e., the quotient of the luminous intensity J in the direction concerned and the apparent area A · cos ε.

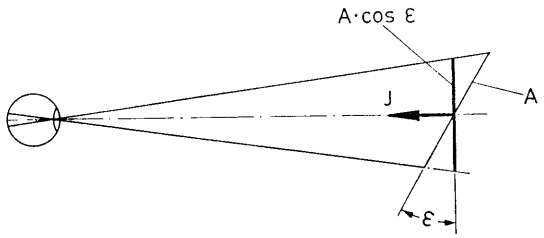


Fig. 7.3

The unit of luminance is the Candela per square centimetre (cd/cm^2), or of lesser luminancs cd/m^2.

This used to be known as "Apostilb" (1 asb = 0.31831 cd/m^2).

Terms also known outside Germany include:

1 fL (foot-Lambert) = 3.426 cd/m^2

1 cd/ft^2 (Candela per square foot) =10.76 cd/m^2

8. If you want to know more

The measuring probe consists essentially of a silicon photo cell, the correction filters and the diffuser.

An operational amplifier (light/voltage converter) converts the short-circuit current of the photo cell into a proportional voltage. The advantage of this method of measurement being that it has a low temperature dependance and produces linear scale characteristics. A second operational amplifier (voltage/current converter) converts the voltage into a current which will be directly indicated by the meter movement.

Block diagram

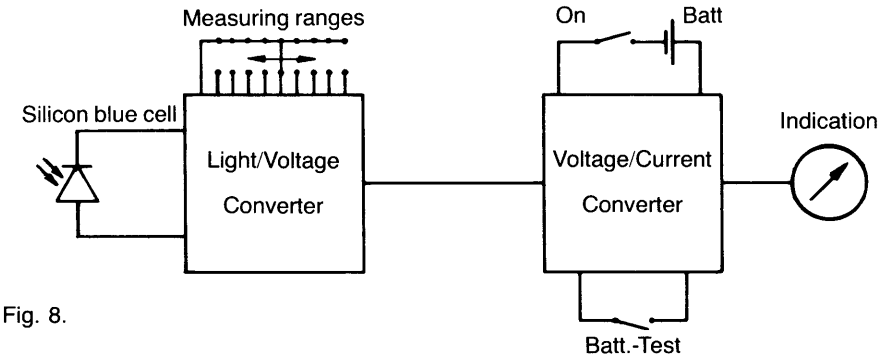


Fig. 8.