As a result of consumers' growing environmental awareness, very low soot emissions are now also demanded for burning candles. That's why you should adopt a deliberate quality control system for the candles you produce.

In the past, reliable measurements of soot levels have hardly been possible because the devices on the market have only yielded inadequate and seldom reproducible results. We have endeavoured to provide you, as producers of candles or as testing institutes, with an extremely easy-to-use instrument to measure soot from burning candles. With our measuring unit you can conduct reproducible laboratory measurements on burning candles at any time.
More than 7 years ago, the European Committee for Standardization (CEN) in an international expert group incorporated the "Method for determining the soot index during the burning of candles", which we developed, as an integral part of the standard "Candles – Specification for sooting behaviour" DIN EN 15426.

This standard is now binding and has been officially recognised and taken over by 37 national standardization institutes. It therefore makes a major contribution to the enhanced quality and safety of candles in use. We are especially proud that our company is named in DIN EN 15426 as the manufacturer of the RMG 2.1 unit used for soot measurements.

Non-European candle producers who wish to export their candles to Europe are also obliged to test them prior to export in accordance with the requirements of DIN/EN 15426.

During the daily handling of the soot measuring unit, minor problems have arisen in individual cases. We have therefore taken your frequently asked questions as an opportunity to give detailed answers specifically on operation of the light source and the lux meter (indication instrument). We have compiled our detailed answers for you in the form of an "Operating Manual for the Soot Measuring Unit".

The RMG 2.1 soot measuring unit comprises 3 main components:

A) 2 wire mesh cylinders with baseplate, stand and centring device
B) Photometer with lux meter, light source with adapter, measuring chamber
C) Glass plates and calibration disk

The light source has an adapter which is operated using the normal power supply. The adapter works in the range of 110-230 V and 50/60 Hz.

After connection with the power supply, the measuring chamber must have been on for at least 30 minutes to enable the full light intensity to be reached. Only then is the unit ready to use.

The LM 1010 digital lux meter is a battery-powered indication instrument for precision measurements.

To conserve the battery the unit should only be switched on for the time needed to conduct the measurements. The lux meter is an instrument to quantitatively measure the incidence of light at the measuring location. It indicates values between 0 and 100,000 lux or fc (foot-candles). With the Data-HOLD function it is possible to store a current reading in the display.

**CALIBRATION**

In developing our soot measuring unit we have endeavoured to provide a measuring device which requires no maintenance and is easy to handle. This also includes the lux meter. Before it leaves the works the lux meter is calibrated by the manufacturer of the measuring instrument. No further calibration is then necessary because the brightness of the light source is subject to fluctuations owing to room temperature, relative humidity and the fading power of the cathode ray tube. The calibration of the lux meter is performed only by you. This operation is described in detail in the chapter *Continuous check of the measuring unit*. 
CHARACTERISTICS of the LM 1010 lux meter

- Precise and easy readability
- High measuring accuracy
- LSI provides high reliability and stability
  (LSI = Large Scale Integration = high density of transistors on the chip)
- Extensive possibilities for measuring different light sources
- Indication when battery power is "low"
- Automatic "O" indication, easy handling
- LCD display has low power consumption
- Good readability even with strong incidence of light

GENERAL INFORMATION

Anzeigeumfang: 3 ½ places, maximum indication value 1999
Wählbereiche: 1-100,000 Lux (3 selection ranges)

<table>
<thead>
<tr>
<th>RANGE SELECTION</th>
<th>RESOLUTION</th>
<th>ACCURACY (23°C +/- 5°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 2,000 lux</td>
<td>1 lux</td>
<td>± 4 % indicated value + 2 digits</td>
</tr>
<tr>
<td>2,000-19,999 lux</td>
<td>10 lux</td>
<td>± 4 % indicated value+ 2 digits</td>
</tr>
<tr>
<td>20,000-100,000 lux</td>
<td>100 lux</td>
<td>± 5 % indicated value + 2 digits</td>
</tr>
</tbody>
</table>

Measuring repetition: ± 2 %
Measuring cycle: 0.2 measurements/second
Light sensor: 1 silicon photo-diode with filter
Working temperature/humidity: -10 °C to 40 °C / max. 70 % RH
Storage temperature/humidity: -10 °C to 50 °C / max. 80 % RH
Over-input: indication "1" (2,000 lux – 20,000 lux)
Indication "OVER" (100,000 lux)

Dimensions: 130 x 72 x 30 mm
Weight: 170 g
Energy source: a 9V block battery, current approx. 2mA
Accessory: 9V block battery

CONTROL AND DISPLAY ELEMENTS:

1. LCD display
2. Selection of measuring range
3. ON/OFF SWITCH, HOLD function
MEASUREMENTS:
1. Switch the unit on and move the slide switch (3) to "ON".
2. Select a suitable measuring range using the slide switch (2).
3. If the overflow indication "1" appears immediately, switch to a higher measuring range.
4. The display shows the light intensity in lux. Please note when taking the readings in the ranges 20,000 and 100,000 that the value indicated must be multiplied by 10 (20,000 range) or 100 (100,000 range). If the display shows a leading "0", switch to a lower measuring range to increase the indication accuracy.
5. If you select the HOLD position, you will store the current value in the display. When the HOLD function is activated, this will be indicated by the text "HOLD" above the measured value indication. If you select the "ON" position, the unit will return to the current measured value indication. (Text "HOLD" is extinguished)
6. After the completion of your measurements, push the slide switch (3) back to "OFF".

REPLACING THE BATTERIES:
1. Replace the 9V block battery when you see the following symbol in the left hand section of the display panel.
2. Switch the lux meter off. Open the battery compartment on the rear of the unit and remove the old battery.
3. Now connect the new battery with correct polarity using the 9V battery clip.
4. Insert the battery properly in the battery compartment and close it with the casing cover.

CAUTION: Do not store the lux meter in very damp or overheated rooms.

GENERAL REMARKS
• During all measurements care must be taken to ensure that the cover of the measuring chamber is properly closed. The measuring chamber is properly closed when the two green marker points are opposite one another.
• The glass plates must be held by the edges so that no fingerprints appear on the glass plate.
• The light intensity of the light source will fluctuate slightly and so it is useful to measure the sooted and cleaned glass plate in quick succession as fast as possible.
• Since the light intensity of the light source fades over time, it should always be switched off after use (e.g. overnight/at weekends).
• In order to avoid mix-ups, it is useful to mark the glass plates permanently and clearly with a diamond-tipped pen. Do not use a felt-tip pen! When you clean the plate, the colour may run and this will falsify the measuring results.
• To document the check of the lux meter during operation, it is advisable to keep a test journal in which you collect the values for the light intensity and inner absorption (see paragraph on Initial operation, item 2).
INITIAL OPERATION

1. Determining the limit for light intensity

Connect the lux meter to a suitable power source and let it run for at least 30 minutes. Switch the indication instrument on by pressing the ON button and use the range button to select the setting at which a value can be read off (in the measuring range up to 20,000 lux do not forget to multiply by 10!)

If the measured value is stable (fluctuations only in the last number), the value is noted as the "new light intensity" and is kept next to the unit. This value may not be below 1,500 lux in a new unit. During operation, the light intensity may not fall below 50% of the value originally recorded. If this should be the case, we recommend purchasing a new light source.

2. Determining the limits for the inner absorption of the measuring chamber

A glass plate is placed in the measuring unit ready for operation, the cover is carefully closed and the value shown in the display is noted. Then, a calibration disk is laid on the glass plate, the cover is closed again and the value appearing in the display is also noted. The inner absorption is calculated as:

\[
\text{value} \frac{\text{glass plate} + \text{calibration disk}}{\text{glass plate}}
\]

This value is also noted and is kept next to the unit as the "new inner absorption". During operation, the inner absorption may not deviate by more than 10% from the original value.

CONTINUOUS CHECK OF THE MEASURING UNIT

Before daily use, the light intensity and the inner absorption of the measuring unit must be checked.

1. When the unit is ready for use, switch the indication instrument on by using the ON button and select the measuring range with the range button such that a measured value can be read. If the measured value shown is stable (fluctuations only in the last number), the value is noted in the test journal and compared with the "new light intensity" of the unit. The current value must be at least half as great as the new value.

2. To measure the inner absorption, place a suitable glass plate within the holder on the light source, close the cover, read the value shown and notes it in the test journal. Then, lay a calibration disk on the glass plate, close the cover again, read this value as well and note it in the test journal. The current inner absorption is calculated as:

\[
\frac{\text{value} \text{glass plate} + \text{calibration disk}}{\text{glass plate}}
\]

This value may not deviate by more than 10% from the new value of the inner absorption.

If the current values for light intensity and inner absorption are OK, soot measurements can take place. If the value of the light intensity is too low, the light source must be replaced.
SOOT MEASUREMENT

Wire mesh cylinder
- Candles with a diameter smaller than 70 mm (incl. tea lights):
  - small cylinder (ø 230 mm)
- Candles with a diameter of between 70 and 120 mm:
  - large cylinder (ø 300 mm)

Burning cycles
- In general: The soot measurement starts immediately after the candle has been lit; where there are a number of cycles, the candle burns at the start of the 2nd and 3rd cycles for a 5-minute burning phase without the glass plate.
- Tea lights burn until they self-extinguish.
- Candles with a weight of less than 40 g burn down to a residual height of 10 mm.
- Candles with a weight exceeding 40 g and a diameter of less than 70 mm burn 2x4 hours with a break of at least 1 hour between the cycles and a 5-minute burning phase at the start of the 2nd cycle. The 2nd cycle may possibly have to be terminated earlier with a residual height of 10 mm.
- Candles with a weight exceeding 40 g and a diameter equal to or greater than 70 mm burn 3x4 hours with a break in each case of at least 1 hour between the cycles and in each case a 5-minute burning phase without the glass plate at the start of the 2nd and 3rd cycles.

Arrangement
- Place the candle to be tested in the centre (use centring rod) below the wire mesh cylinder which corresponds to the candle diameter.
- The distance between the candle surface and the glass plate on the wire mesh cylinder should be 180 mm.
- The gap between the lower rim of the wire mesh cylinder and the surface the candle is positioned on must be at least 50 mm. If it is less than this, the candle must be placed on a stand which has a maximum of 1/3 of the diameter of the wire mesh cylinder.
- The distance between the upper edge of the candle burning dish and the glass plate adjusted to 180 mm before each cycle. During the cycle, the distance may grow to 240 mm, but if it becomes greater it must be changed during the burning cycle.
- A tea light is placed on a stand to ensure that the distance from the upper edge of the tea light to the glass plate is 50 mm.
- At the end of each burning cycle, the glass plate (Caution! HOT) or the cylinder with the glass plate must be removed and only replaced centrally above the candle after the next burning phase.
- At the end of the last burning cycle, the glass plate should cool off for about 15 minutes before the soot index is measured.

Determining the soot index
- Place the sooted glass plate, with the sooted side facing up, in the holder on the light source, carefully close the cover and read and note the value shown on the display of the indication instrument.
- Remove the glass plate, clean with water and a little washing up liquid, dry with a lint-free cloth and measure again. Note this value as well.

The soot index is calculated as follows: soot index \( R_i = 100 \times \left\{ 1 - \frac{\text{value glass plate sooted}}{\text{value glass plate cleaned}} \right\} \)

\( R_i \) divided by the burning time in hours yields the soot index per hour \( R_i / h \)

If these instructions are followed, you will have no problems when working with our RMG 2.1 soot measuring unit. Should you have any further questions, we will be glad to help you with advice and support. Please, simply contact us.