

UV Illumination Chamber for Standardized Investigations

User Manual



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1. General description

1.1. Basic device

The illumination chambers are equipped with four exchangeable tubular lamps and related electronics. They are intended to be used for the illumination of flat samples. They feature several control and display instruments for UV power, temperature, and timing.

Samples should be placed on the metal table under the central axis of the lamps. The light shows a homogeneous distribution along this axis and within a few centimetres to both sides (see appendix “Measured data”). Special reflectors are mounted to the lamps in order to optimize the homogeneity.

Function	Components
Illumination	<ul style="list-style-type: none"> • Four exchangeable UV tubular lamps with reflectors • Related electronics • Power adjustment via potentiometer • Observation of light intensity with UV photodiode, display of light intensity • Liner with reflection foil
Environment parameters	<ul style="list-style-type: none"> • Measurement and display of temperature in chamber • Fans in back side of housing • Optional: Measurement and display of humidity
Sample positioning	<ul style="list-style-type: none"> • Metal table
Experiment control	<ul style="list-style-type: none"> • Timer

1.2. Options

1.2.1. Transmission measurement system according to DIN 52980

The transmission measurement system enables measurements according to the German standard DIN 52980 „Photocatalytic activity of surfaces – Determination of the photocatalytic activity by means of the decomposition of methylene blue.”

Function	Components
Transmission measurement	<ul style="list-style-type: none"> • Stabilised red LED (659 nm, FWHM 22 nm)) • Photodiode with noise suppression of environment light • Bracket for positioning • Control electronics and cables
Options	<ul style="list-style-type: none"> • Measurement system with sample container, peristaltic pump, flow cell and mounted bracket with the diodes

1.2.2. Data logger for recording of measured data and environment parameters

For the automating of experiments a data logger can be integrated into the illumination chamber. The data logger records measured data and environment parameters on a connected PC or storage device.

Function	Components
Control of experiments	<ul style="list-style-type: none"> Data logger with USB output
Optional outputs	<ul style="list-style-type: none"> Output of measured data via analog outputs at the rear side of the chamber
Options in combination with rotary disk	<ul style="list-style-type: none"> Synchronisation of rotary disk with experiments (by means of light guards) Control and display instruments for velocity of rotation, clocking of rotary disk, UV light intensity, intensity of laser diode, sensitivity of photodiodes, temperature, and humidity Automated data recording

Notes:

- The data logger can be used in combination with the software „PhotoKat“ to determine the photocatalytic activity of samples. For more information see the description of the software.
- We also deliver the recording software “TracerDAQ” of the datalogger supplier with the data logger. More comprehensive versions of the software can be provided by us or the data logger supplier.

1.2.3. Recording and evaluation software „PhotoKat“

To obtain the data from the datalogger and to evaluate the measurements with respect to the photocatalytic activity we offer a specific software solution:

Function	Components
Software for recording and evaluation	<ul style="list-style-type: none"> Display of the transmission curve, display of several curves Possibility to subtract a dark measurements curve Input of required data for calculating the photocatalytic activity Calculation of the specific photocatalytic activity see also the separate user manual

1.2.4. Magnetic stirrer and temperature stabilisation in MB test solution

The standard DIN 52980 specifies that the test solution has to be stirred and the temperature has to be stabilised. A magnetic stirrer and a Peltier cooling unit are available for these purposes.

Function	Components
Stirring of methylene blue (MB) solution	<ul style="list-style-type: none"> Magnetic stirrer
Temperature stabilisation	<ul style="list-style-type: none"> Temperature sensor in test jar Peltier cooling unit with power supply, controller, and heat sink Closed-loop temperature stabilisation (23°C ± 2°C)

1.2.5. Rotary disk

The optional rotary disk allows for the simultaneous illumination of a larger number of samples. Here, the continuous rotation guarantees an equal illumination of all samples in the timely average.

Function	Components
Sample positioning	<ul style="list-style-type: none"> Rotary disk with anti-slip surface or with flat slots (e.g. for 12 flat samples with an area of 5x5 cm² each) maximum weight on the disk: about 3 kg
Additional options	<ul style="list-style-type: none"> Lifting platform for height adjustment

The rotary disk is powered by means of a separate power supply. The voltage converter is integrated in the revolving stage. The cable can be guided into the chamber through the opening in the rear side of the housing.

1.2.6. Optics and electronics for simultaneous reflection, haze, and transmission measurements

An optics/electronics package with red laser diode and three photodiodes can be integrated into the illumination chamber. It allows for the simultaneous detection of light reflected and scattered on a sample's surface as well as the transmission through transparent samples.

Function	Components
Reflection, haze, and transmission measurement	<ul style="list-style-type: none"> Red laser diode and three photodiodes for simultaneous measurement of reflection, haze, and transmission Adjustable intensity Adjustable signal amplifications

1.2.7. Climate control, watering

In some cases it is important to create and maintain specific climatic conditions.

Function	Components
Climate control	<ul style="list-style-type: none"> Humidity control by means of nebuliser including basin, ventilator, and power supply Plexiglass partitioning system for spreading of humidity in chamber Splash guard Temperature stabilisation
Weathering	<ul style="list-style-type: none"> Liquid basin Connectors for watering and de-watering Tubes for watering and de-watering

1.2.8. Further Options

Function	Components
Humidity display	<ul style="list-style-type: none"> Measurement and display of relative humidity
Observation of interior room	<ul style="list-style-type: none"> Webcam for observation of interior room (with UV filter)
Sample container	<ul style="list-style-type: none"> On request
Methylene blue solution	<ul style="list-style-type: none"> Different concentrations on request

2. Operating controls

In the basic configuration all operating controls of the illumination chamber are placed on the right operation panel (see figure 1).

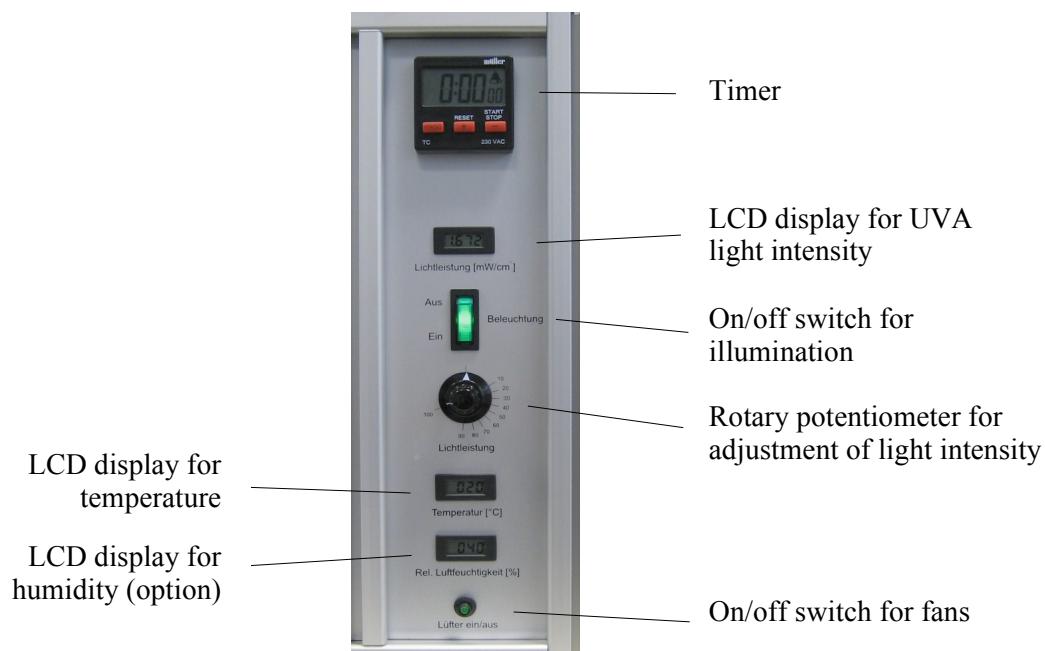


Figure 1: Operating controls

Any operating controls for additional functions are placed on the left operation panel. This panel's design depends on the chosen configuration.

3. Operating instructions

3.1. Main switch and use of timer

The main switch is placed besides the power plug on the rear side of the illumination chamber. After switching the main switch the UV lamps can be activated on the right operation panel.

If samples shall be illuminated without any timer program, the *Start/Stop* button of the timer has to be pressed. The used timer allows to select special timer programs. The timer's user manual can be found in the appendix.

3.2. Adjustment of illumination

The lamps are switched on and off by means of the on/off switch on the right operation panel. The desired intensity can be adjusted by means of the rotary potentiometer. The UVA light intensity measured by a calibrated photodiode is displayed on the LCD display in units of mW/cm^2 .

The UV light distribution in the plane of the sample disk is shown in the appendix "Measured data". The maximum value (100%) can be adjusted to up to $6 \text{ mW}/\text{cm}^2$.

Notes:

- 1) *The lamp intensity will decline after an operation period of about 1,000 h.*
- 2) *The lamps require a warm-up period of about 15 minutes before they emit the maximum light intensity. Please switch on the lamps in due time before your experiment.*
- 3) *The scale of the rotary potentiometer gives a rough orientation for the intensity adjustment. Please note that the lamp characteristics is not linear. Thus, the actual intensity values should be taken from the LCD display.*

3.3. UV photodiode

A calibrated photodiode is integrated into the illumination chamber to monitor the light intensity (see figure 2). It is protected by a plastic fitting. The position of the photodiode can differ for different chamber configurations.

In the basic device the photodiode can be placed at three different positions at the metal table along the central axis of the lamps. One of these positions can be chosen in order to avoid an obstruction by a sample. There are three fitting holes in the table (see figure 3). The photodiode can be mounted by sliding it through a hole and fixing it with the black clip.

If the rotary disk is used the UV photodiode is placed with a screw fixation on the mounting rod. The height of the photodiode should be adjusted to the height of the sample's surface. In this case the photodiode is calibrated in that way that the displayed UV light intensity refers to the average intensity irradiated on a thin sample during a full round-trip of the disk. If the height of the samples is changed the photodiode should be shifted.



Figure 2: UV photodiode in plastic fitting with fixation clip. Further, a temperature sensor is mounted to the clip (not mounted in the photo).

Notes:

- 1) *The photodiode is calibrated for the installed lamp type with wavelengths in the UVA range. The displayed values are only correct for this lamp type. If you use other lamps in the illumination chamber a re-calibration has to be made with a UV light meter.*
- 2) *The UV photodiode requires a lead-time of about 1 minute before it measures correctly.*

3) *In order to maintain a safe function of the photodiode and a correct measurement the photodiode must be protected against dust and electrostatic charge.*

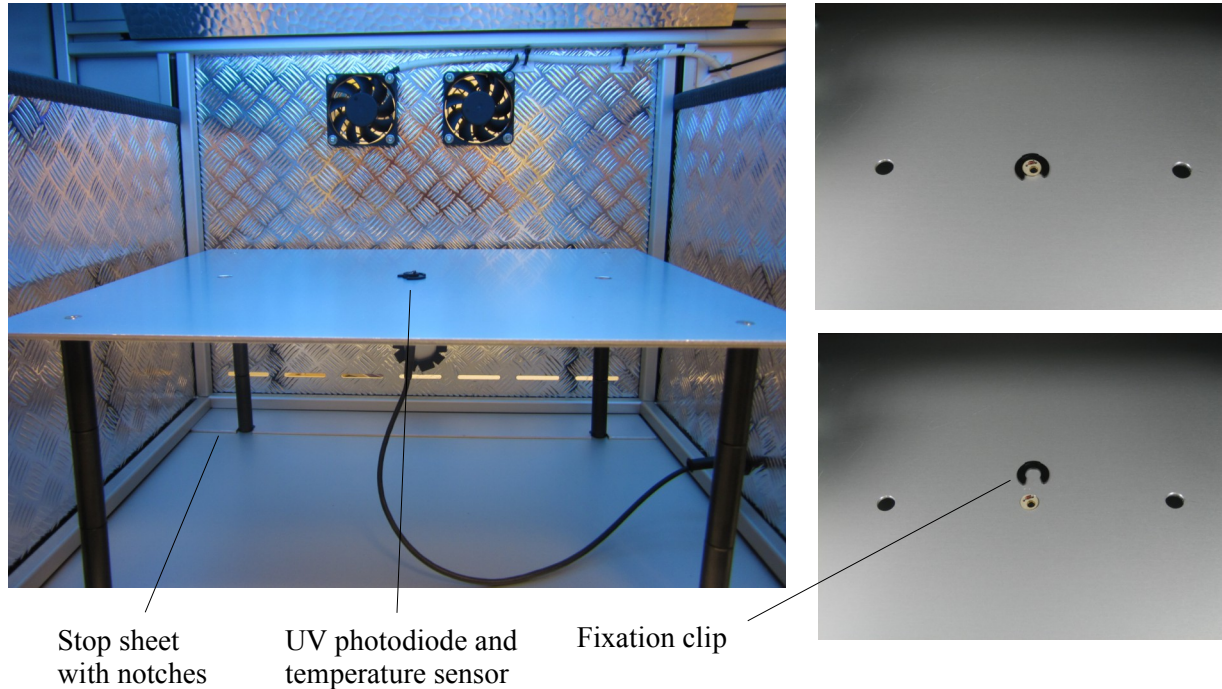


Figure 3: Fixation of UV photodiode on metal table

3.4. Temperature stabilisation, fans

The heat radiation of the tubular lamps leads to a rise of temperature in the illumination chamber. That is why fans have been integrated on the rear. The fans rotate with constant velocity. In that way they stabilise the temperature in the chamber.

If samples can be disrupted by the air flow the fans can be switched off with the on/off switch on the right operation panel. The green LED shines if the fans are active.

3.5. Table, sample positioning

In the basic configuration, the device is delivered with a simple metal table (see figure 3). In the back of the chamber there is a stop sheet with two notches. The table should be placed in the position where the rear legs stand in the notches. In this position the homogeneous area of the lamps is best utilised if the samples are placed in the centre line of the table.

Notes: If you move the table please consider that the photodiode might be fixed to it.

3.6. Exchange of lamps

The illumination chamber is usually delivered with 4 lamps according to the description in section 5.2. The lamps can be exchanged with other lamps with other spectral characteristics.

The exchange can take place through the front door or more easily after detaching the right side of the housing. For that purpose, the sample area should be free, e.g. the table should be removed in order to have more space for turning the lamps inside the chamber. The lamps must be turned in their fitting until they can be moved downwards with a slight force. In the same way the new lamps can be assembled into the fitting.

4. Selected options

(depending on the specific configuration the following descriptions might change)

4.1. Transmission measurement



Figure 4: Components for transmission measurement with a flow cell

The transmission measurement is performed with a separate electronics with its own power supply (wall power supply). The signal cable must be connected to the LEMO connector marked with “Signal IN“. The transmission measurement is described in a separate manual.

Note: If you perform the measurements inside the chamber you can guide the signal cable to the electronics through the opening in the rear side of the housing.

4.2. Sample container and measurement system

For an easy performance of a continuous measurement we have equipped a round sample container (diameter: 80 mm, height: 45 mm) with a top frame which carries tube connectors and a UV transmittive glass cover. The container accepts samples with an area of 50x50 mm².

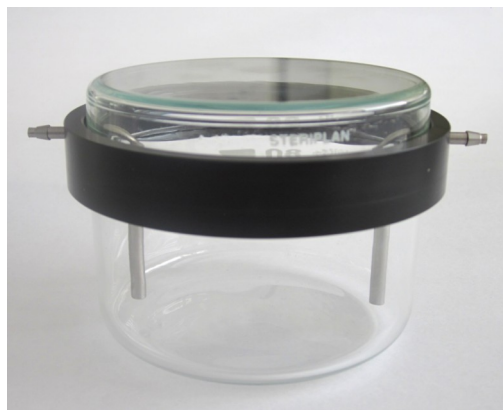


Figure 5: Sample container with tube connectors and glass cover

Note: The absorption of the chosen UV glass cover at a wavelength of 365 nm is about 11%.

The test solution in the container can be circulated through a flow cell by means of a peristaltic pump to which the bracket for the transmission measurement can be connected. We have selected tubes which do not absorb methylene blue and which are stable against UV illumination.

More information about the measurement system can be found in the specific user manual.

4.3. Data logger

The data logger ME-RedLab-1008 (Meilhaus) writes the clock time and up to eight measured data with a resolution of 12 bit into a register. Depending on the chosen options e.g. the following data can be logged on the different channels:

Channel	Measured value
0	Measured voltage of light transmission
1	UV light intensity
2	Temperature
3	Humidity

The USB signal output of the data logger is on the rear side of the housing.

The following figure 6 shows a pattern which was recorded with the software TracerDAQ. The header contains information about the duration of the measurement, the sampling rate, etc.. The table below the header displays the measured data of CHANNEL0 following a sequential number and the date and time. The file can be saved when the measurement is completed. During the measurement the data can be displayed in the graphical interface.

```
Header Size: 7
Version: 2
Sampling Interval: 10
Sampling Rate: 0,1
Sample Count: 8
Device Serial Number: 0
Sample Number; Date/Time; CHANNEL0; Events
1; 06/29/2011 07:23:43.721 PM; 2,1221; DAQ Start
2; 06/29/2011 07:23:53.721 PM; 2,1123
3; 06/29/2011 07:24:03.721 PM; 2,1123
4; 06/29/2011 07:24:13.721 PM; 2,1221
5; 06/29/2011 07:24:23.721 PM; 2,1221
6; 06/29/2011 07:24:33.721 PM; 2,1123
7; 06/29/2011 07:24:43.721 PM; 2,1123
8; 06/29/2011 07:24:53.721 PM; 2,1319; DAQ Stop
```

Figure 6: Typical recording pattern of the data logger

4.4. Software “PhotoKat”

To obtain the data from the data logger and to evaluate the measurements with respect to the photocatalytic activity we offer a specific software solution. For more details you can check the separate user manual of the software.

4.5. Rotary disk

By means of a continuous rotation of a rotary disk it is possible to achieve an equal illumination of a big number of samples in the timely average. In the usual configuration the rotary disk is equipped with an anti-slip surface (figure 7).

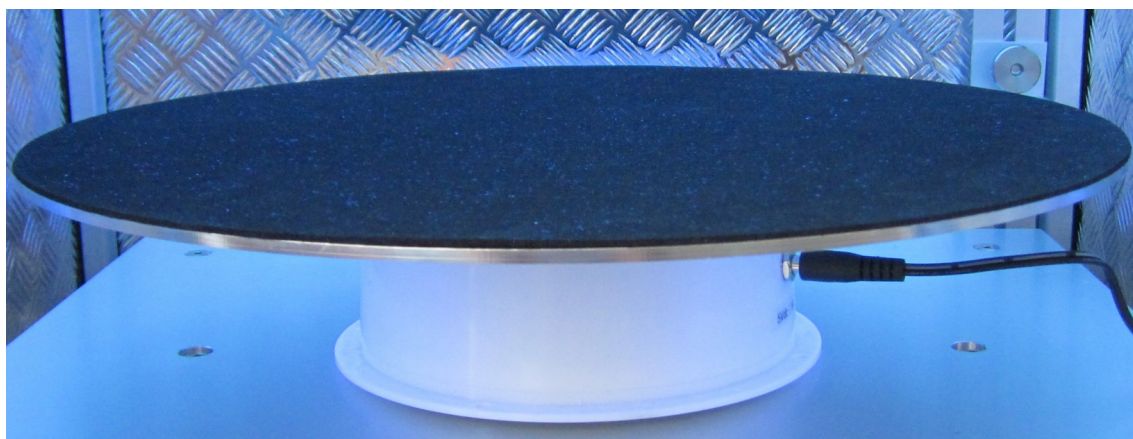


Figure 7: Rotary disk with anti-slip surface for flexible positioning of samples and containers.

Optionally the disk can bear flat slots for a stable positioning of flat samples (figure 8).

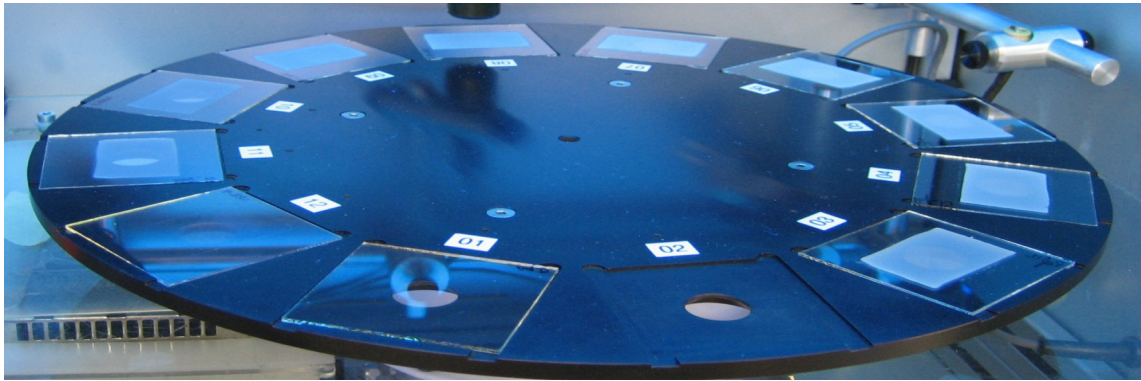


Figure 8: Rotary disk with 12 slots. Here, eleven thin glass plates with different coatings are lying in the slots (Position 02 is left blank). The samples have a size of 5x5 cm²

4.6. Humidity control

The illumination chamber can be equipped with humidity control based on a nebuliser. Then a plexiglass plate is integrated that guides the humid air in the chamber. The humidity is detected with a sensor on the opposite side wall. The control activates the nebuliser whenever the relative humidity falls below an adjustable limit. The nebuliser is switched off again when the limit is exceeded.

4.7. Weathering (watering and de-watering)

If the chamber is equipped with the optional weathering system a liquid basin and connectors for watering and de-watering are integrated. A special timer enables the simulation of particular weather situations. An example is shown in figure 9.

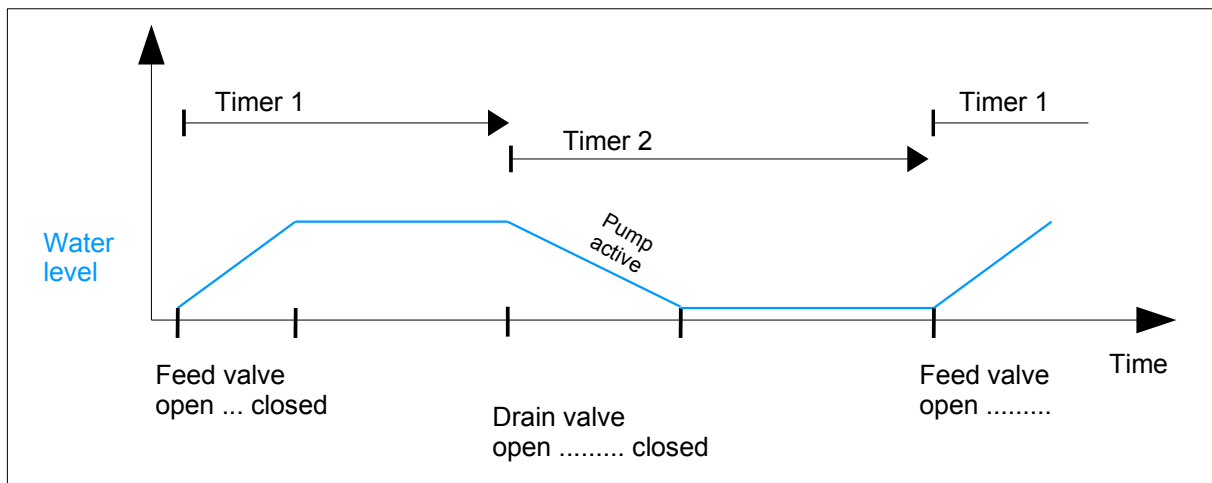


Figure 9: Weathering system: Timing and corresponding valve control.

5. Technical data (Basic device)

5.1. Dimensions

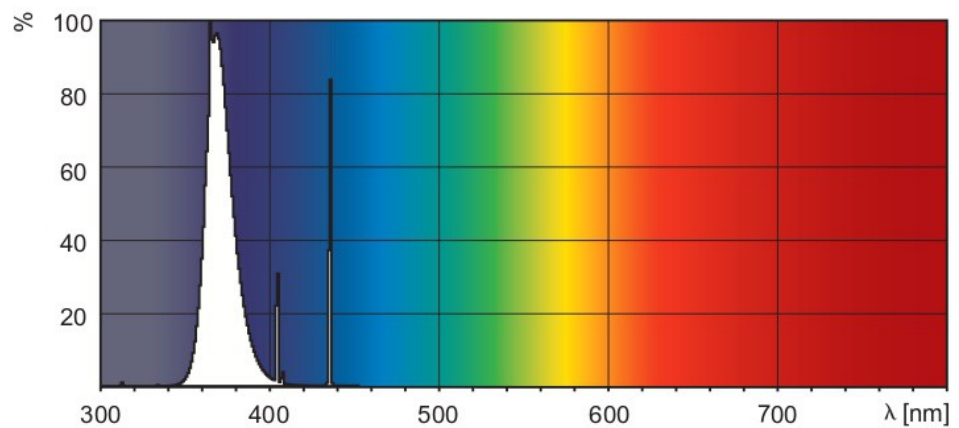
Outer dimensions (w x d x h): 680 x 400 x 480 mm³ without stands, 680 x 400 x 514 mm³ with stands

5.1.1. Metal table

Table dimensions (w x d x h): 365 x 305 x 152 mm³
 Distance of table surface to lamps: 203 mm

5.2. UV lamps

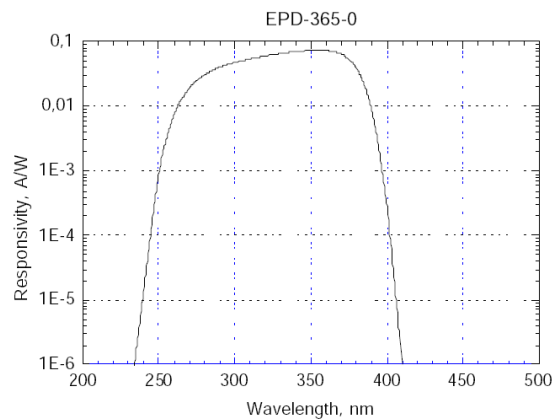
UV light source: Philips Actinic BL TL-D 18W/10, G13 fitting, 600 mm
 (example) Spectral curve (Irradiation maximum: ~370 nm):



Total light intensity (UV-A): 4 x 5,2W
 Ratio of UV-B / UV-A: < 0,1%
 UVA adjustable range: 5-100%

5.3. UV photodiode

UV photodiode: Type: Epigap EPD-365-0/1.4
 Spectral sensitivity curve:



5.4. Accessories

Temperature sensor: N4148 (integrated in plastic fitting of UV photodiode)

Humidity sensor: Type HU1015NA
(Option) The sensor works in a temperature range up to 50°C.
Tolerance: 25-90% at 25°: < ±5% RH
out of this range: < ±10% RH
Response time: about 5 min (important in case of re-calibration)

Timer: Type: Müller TC 24.21

6. Safety


The device has left our factory in a faultless state. Please only store and operate the system in dry environments in order to maintain this state.



Please note, that the device includes lamps with a high UVA contingent. Thus, you should absolutely avoid long-term irradiation of your skin.

Power consumption: max. 1 A, AC 220-240 V

Label

PhotoKat-Illumination 01-2009
AC 220-240V / 2.5A ~ 50/60Hz
MRC Systems GmbH Made in Germany 

7. Contact

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8. Appendix: Measured data

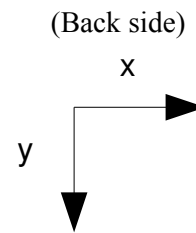
8.1. Light intensity / homogeneity on metal table

Device no.

Distance lamp/surface: 203 mm

x- and y values in mm (x axis parallel to lamp axis)

(0,0) denotes the centre below the lamps
which is usually also the centre of the table



Light intensity in mW/cm²

	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300
0																
20																
40																
60																
80																
100																
120																
140																
160																

The measurement was performed 45 minutes after switching on the lamps with the integrated UV photodiode after a calibration with the spectrometer EPP2000 CXR.