Operational optimisation measures for companies: Lighting

Table of content

Set daylight sensors, motion and presence sensors correctly

The lighting control is equipped with a motion and presence sensor or a daylight sensor – but the light does not switch off, even though sufficient daylight is available and nobody is present in the room.

Action

Set the daylight setpoint and the after-run time so that the lighting switches off as soon as the incoming daylight is sufficient or as soon as nobody is present in the room.

Requirement

The lighting control must have a motion sensor, presence sensor and/or daylight sensor.

What to do

1. Set the daylight setpoint correctly

- Measure the illumination level with a lux meter and compare it to the recommended values (see overleaf).
- Gradually reduce the lux setpoint on the sensor (A) until the lighting switches off at the recommended value.

2. Set the correct after-run time for the presence sensor

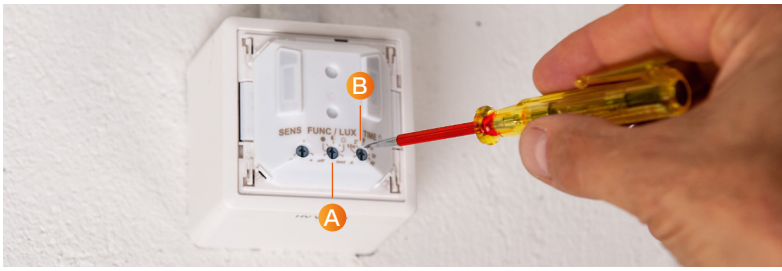
Set the time on the sensor (B) (for recommended after-run times, see overleaf).

3. Pay attention to the coverage area

The motion or presence sensor should be set so that people are detected within the desired radius. The switched luminaire must not be located within the sensor‘s coverage area. The sensor should be at least 1 metre away from the object – i.e. the person to be detected.

4. Observe and correct

Pay attention to complaints and correct the set values as necessary.



Costs – effort

- A lux meter measures the illumination level. Simple meters cost about CHF 100 from mail-order electronics vendors.
- Your own labour per room: 10 to 20 minutes.

Please note!

- Record every adjustment of the setpoints in writing.
- If there is no scaling on the controllers, a photograph of the setting is helpful; it is best to print and store this photograph.
- Safety: in areas where there is a risk of falling (e.g. staircases, ramps), the daylight setpoint should only be reduced to an extent that ensures compliance with the recommended illumination levels (100 to 150 lux).
- Install presence sensors in protected locations with unimpeded visibility. The coverage area is limited by objects such as glass partitions and furnishings.
- The installation height influences the sensor’s coverage area. As the installation height increases, the range also increases but the sensitivity of detection decreases sharply.

Additional explanations

Recommended illumination levels

Depending on the room and how it is used, different illumination levels are recommended to create optimal working and usage conditions. The illumination level is measured in lux.

Room, usage type	Illumination level, lux
Offices, administration	
Reception, simple work	300
Office, PC, workstations, meeting rooms	500
Office, storage/filing areas	300
Hospitals, care homes	
Waiting rooms and common rooms	200
Service rooms	500
Treatment rooms, operating theatres	1000
Patients' rooms, recovery rooms	100
Patients' rooms, lighting for reading	300
Therapy rooms, gymnastics and massage rooms	300
Medicinal baths	300
Laboratories and sterilisation rooms	500

Room, usage type	Illumination level, lux
Catering outlets, canteen/refectory	
Kitchen, utility/laundry room, linen room	500
Restaurant, dining rooms	200
Self-service facility, office	500
Buffet, counter	300
Cold stores	100
Schools	
Classrooms	500
Lecture halls, laboratory rooms, art/drawing rooms, workshops	500
Teaching rooms, law office, other offices, reading positions	500
Libraries, bookcases	200
Libraries, reading areas	300
Gymnasiums/sports halls, lighting class III	200–300

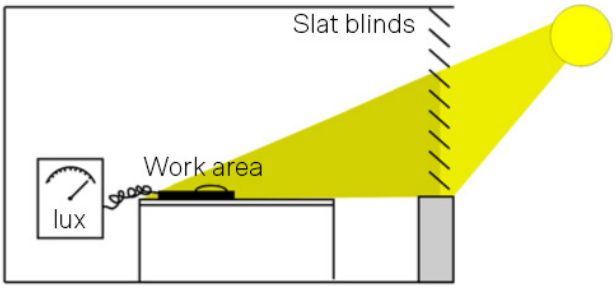
Recommended after-run times

The after-run time eliminates the annoyance of the lamp being switched on and off, and protects the lighting equipment.

- FL lamps, energy-saving lamps: 5 to 10 minutes
- LED lamps: 2 to 5 minutes

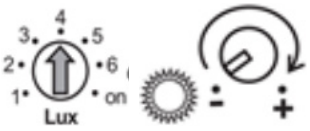
Determine the illumination level

With slat blinds, you can allow enough daylight to enter on a fine day by adjusting the slats so the appropriate illumination level is present at the workplace. Measure this with the lux meter.



Explanations of the symbols

Every manufacturer uses a slightly different designation for the potentiometers used to set the values. The most frequent symbols are:



Daylight sensor: can be identified by the word “lux” or the sun symbol.

After-run time: can be identified by the word TIME or the clock symbol.

Additional information

- Technical book: “Light in the home – energy-efficient lighting”, www.faktor.ch
- Efficient lighting for small businesses

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Replace old fluorescent lamps with modern LED tubes

Older lighting systems with fluorescent (FL) lamps require intensive maintenance. It is worth checking whether FL lamps can be replaced with LED tubes, especially in rooms used for long periods.

Action

Replace existing fluorescent lamps (T8 and T5) with modern LED tubes (retrofit).

Requirement

This action is especially suitable for rooms with long usage periods (over 3000 hours per year) and low requirements for visual comfort (garages, warehouses, circulation/traffic areas, production halls).

Replacing the fluorescent lamps achieves energy savings of 40 to 60 percent on lighting.

What to do

1. Determine the lamp type

The lamp type (T8 (G13) or T5) can be identified from the lamp base. Check the holder (socket), which is usually marked with this information.

2. Determine the type of ballast

- T8 lamps with a starter are equipped with a conventional ballast (CB) or a low-loss ballast (LLB).
- All T5 lamps and T8 lamps without a starter are equipped with an electronic ballast (EB).

3. Choose the right LED tube

Make sure that the LED tube you choose is suitable for the type of ballast that is installed (conventional/low-loss ballast or electronic ballast).

4. Convert part of the installation for a test

- Convert part of the lighting system (see overleaf).
- Test the new LED tubes over a small area for three to six months to examine whether the tubes prove worthwhile in practice (illumination and light quality).

5. Convert the rest of the lighting

After a successful test, you can convert the entire lighting system.

Costs – effort

- Price of LED tubes: CHF 15 to CHF 50 per tube

Your own labour:

- Systems with a conventional/low-loss ballast: 5 to 10 minutes (per luminaire)
- Systems with an electronic ballast: 15 to 20 minutes (it is mandatory for an electrician to carry out this work)

Please note!

- For the retrofit solution with LED tubes, the light quality depends on the specific product in each case. This should first be assessed by performing a test, especially for large systems. If the LED tube does not meet the requirements for light distribution and glare, it is advisable to replace the entire luminaire. This, however, necessitates larger investments. If the light colour is not adequate or if the LED tube flickers, the solution may be a different product.
- For lighting equipment that is difficult to access (e.g. in high-ceilinged halls), the use of LED tubes is particularly worthwhile because fewer lamp changes are required.

Additional explanations

Replacement for systems with conventional/ low-loss ballasts

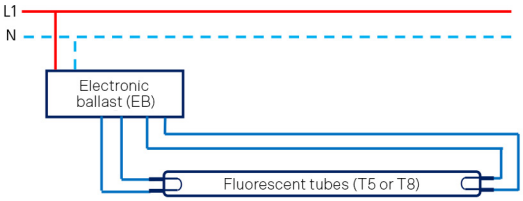
- Turn the power off
- Remove the fluorescent tubes
- Remove the old starter from the holder
- Place the new LED starter in the holder
- Insert the LED tube
- Turn the power back on

Replacement for systems with electronic ballasts

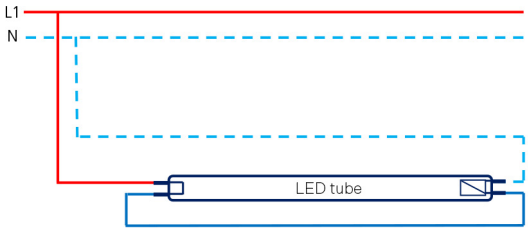
Important: it is mandatory for a specialist (electrician) to carry out this conversion.

- Remove the electronic ballast, or bridge it
- Insert the LED tube

Before



After



Assessing LED tubes

- Good products come with a manufacturer's warranty for at least three years or 30'000 operating hours.
- Energy efficiency is determined by the luminous efficacy. This should be at least 120 lm/W (calculation based on luminous flux and electrical power).
- Pay attention to the radiation angle of the LED tubes because they can cause glare.
- Design types: clear glass LED tubes are more efficient but they tend to cause more glare. Frosted glass tubes are not quite as efficient but they cause less glare.
- Choose a light colour that is appropriate for the type of usage.
  - Warm white: 2700 Kelvin – welcoming, comfortable
  - Neutral white: 4000 Kelvin – functional
  - Cool white: 6500 Kelvin – cool, technical

What does this mean: L80B10C5 = 30'000h?

The "L-B-C" value specifies the LED's lifetime (here: 30'000 hours) in more detail.

L80 = after the 30'000 hours, the lamp still delivers at least 80 percent of the original luminous flux (80–100 as a typical value)

B10 = less than 10 percent of the lamps fail due to reduced luminous flux (0–10 as a typical value)

C5 = less than 5 percent of the lamps fail completely during their lifetime of 30'000 hours (1–5 as a typical value)

Pay attention to the inrush current

The LED tube's electronics generate a short-lived inrush current peak. This is no problem for one single luminaire. However, if an entire lighting system is converted, the inrush current must be taken into account. Good-quality LED tubes often have a low inrush current. The problem can also be mitigated with an inrush current limiter or a zero-cross switch. It may be necessary to replace the existing circuit breakers and install additional relays. This makes it possible to switch the lighting on gradually. It is worth engaging an electrical installer for this purpose.

Additional information

- Technical book: "Light in the home – energy-efficient lighting", www.faktor.ch
- Efficient lighting for small businesses

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Adjust the illumination level to actual requirements

How can you optimise a room's lighting – and at the same time save at least 30 per cent on electricity costs? Here are some suggestions and tips to shed some light on the matter.

Action

Adjust the light level to the room's utilisation. Install presence and motion sensors where applicable.

Requirement

Only dimmable lighting systems can be adjusted to the specific use of the room. Other ways of lowering consumption, such as switching off individual light fixtures, are in most cases a poor compromise.

Needs-based lighting adapted to usage will cut electricity costs by at least 30 per cent.

What to do

1. Determine the illumination level (setpoint value as per SN EN 12464-1)
Use the table to determine the right illumination level for the room.

2. Determine the electrical power (setpoint)
Using the SIA table, determine the recommended (maximum) electrical output (W/m^2) for the room.

3. Measure the current illumination level (actual value)
Measure the actual illumination level (lux) in the room. You need a lux meter to do this.

4. Calculate the current electrical power (actual value)
Based on the existing lighting (light fixtures, light sources), calculate the installed electrical power per square metre.

5. Compare the actual values to the setpoint values
If there is a discrepancy between the actual values and the setpoint values, adjust the lighting.

Costs – effort

Work involved: approx. 1 hour per room

Material costs:

- Lux meter, approx. CHF 100
- Motion sensor, approx. CHF 50 to CHF 100
- Presence sensor, approx. CHF 100 to CHF 150

Please note!

- If you replaced an old lighting system (e.g. FL tubes) with a new system (LED), a 1:1 replacement may result in the room being overlit because the luminous efficacy of LEDs is greater.
- Retrofittable light sources with integrated presence and daylight sensors are available; depending on the preset, these can dim the light or turn it off entirely.

Additional explanations

Determine the specific power

You can determine the currently installed electrical power per square metre (W/m²) as follows:

1. Calculate the total power of the lighting

- Count the light fixtures in the room.
- Determine the electrical power per light fixture. This includes the light sources (bulbs, etc.) and control devices.
- You can now calculate the total power of the lighting. Example: Six light fixtures, each with two 36W FL tubes = 432W
  Plus six 12W control devices = 504 W

2. Determine the room's area

Example: 8m (length) x 6m (width) = 48m²

3. Calculate the specific power (W/m²)

Example: 504 W/48m² = 10,5 W/m²

Assess the situation

A: The room is overlit.

The illumination level (lux) is currently too high.

- Dim the lights. If this is not possible, check whether other light sources can be used. However, this usually also changes the light distribution.

B: The room is underlit.

The illumination level (lux) is currently too low.

- Use more efficient light sources (e.g. LED instead of FL tubes). However, this usually also changes the light distribution. Consider adding to or replacing the lighting system.

C: The room is lit inefficiently.

The illumination level is correct but the specific power of the lighting (W/m²) is too high.

- Consider switching to a more efficient light source or replacing the light fixtures.
- Optimise the lighting control by using presence, motion or daylight sensors to ensure that the lighting operates only when people are present or when insufficient natural light is available.

Assessment

Standard SIA 387/4:2023: Electricity demand for lighting provides the basic principles for assessing the specific power consumption. This standard contains the maximum permitted specific power (in W/m²) and the value for an optimised lighting system.

Room usage	Illumination level, lux	Specific power, W/m²	Full-load hours, h/a
Reception	300	3,3–5,1	3150–4100
Individual/shared office	500	6,2–9,7	350–1400
Open-plan office	500	4,9–7,6	1100–1950
Classroom	500	5,5–8,6	400–1300
Lecture hall	500	4,9–7,6	850–1700
Gymnasium, sports hall	200–300	5,6–8,8	1100–2250
Locker room	200	2,8–4,4	150–850
Sales area	300	7,5–11,6	4000
Patient room	100	3,4–5,3	800–1550
Hospital ward	300	6,2–9,7	4550–5750
Laboratory	500	6,4–9,9	400–1350
Kitchen	500	6,2–9,7	1700–2500
Restaurant	not specified	2,9–4,6	1600–2650
Canteen	200	2,6–4,1	900–1500
Circulation area	100	1,8–2,7	250–1400
Staircase	100	1,8–2,7	250–1400
Carpark (not public)	75	0,6–0,7	480–1600
Warehouse/storage area	200–300	2,9–3,9	2000–4000

The full-load hours listed in the table can be taken as the basis for assessing the period for which the lighting is turned on.

Additional information

- Standard SIA 387/4: 2023, Electricity in buildings – Lighting: Calculation and requirements
- SN EN 12464-1 Light and lighting – Lighting of work places – Part 1: Indoor work places
- Technical book (de): Licht im Haus – Energieeffiziente Beleuchtung, www.faktor.ch
- Efficient lighting for small businesses

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