

OCCUPATIONAL HEALTH AND SAFETY



Workplace Lighting
Security Lighting, Exit Routes



EU guidelines



- **Basic Law of the Federal Republic of Germany - GG**
- **Occupational Health and Safety Act - ArbSchG**

This law serves to ensure and improve the safety and health protection of employees at work through occupational safety measures.
- **Workplace Ordinance ArbStättV**

This ordinance serves to protect the safety and health of employees when setting up and operating workplaces. It stipulates the protection goals to be observed for the lighting.
- **Technical rules for workplaces - ASR**

The technical rules for workplaces specify the requirements of the workplace ordinance.

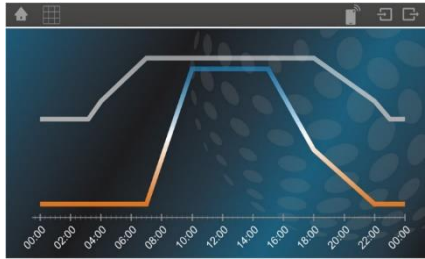
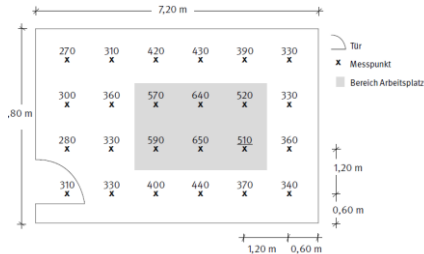
 - **ASR A3.4 Lighting and line of sight** (including emergency lighting) May 2023

The requirements of this ASR deviate in individual cases from standards, in particular from DIN EN 12464 Parts 1 and 2, which only specify the planning principles for lighting systems, but do not take the requirements for safety and health protection of the employees at work into account.
 - **ASR A2.3 Escape routes and emergency exits** (incl. safety lighting) March 2023
- **General recognized rules of technology**
 - **DIN EN 12464-1 Lighting of workplaces - Part 1: Indoor workplaces**
 - **DIN EN 12464-2 Lighting of workplaces - Part 2: Outdoor workplaces**
 - **DIN EN 1838 Emergency lighting**



- **Basic Law of the Federal Republic of Germany - GG**
- **Social Code - Statutory Accident Insurance - SGB VII**

The task of accident insurance is to prevent accidents at work and occupational diseases as well as work-related health hazards, to restore the health and ability to work of the insured by all suitable means following the occurrence of accidents at work or occupational diseases, and to compensate them or their surviving dependents with cash benefits.
- **Accident prevention regulations - DGUV regulations**
 - DGUV Regulation 1 **Principles of Prevention**
 - DGUV regulation 3 **Electrical systems and equipment**
- **Information material – DGUV information**
 - DGUV Information 215-210 **Natural and artificial lighting in workplaces**
 - DGUV Information 215-211 **Daylight in the workplace - performance-enhancing and healthy**
 - DGUV Information 215-410 **Monitor and office workstations - design guidelines**
 - DGUV Information 215-442 **Office lighting - Aid for planning artificial lighting in offices**
 - DGUV Information 215-444 **Sun protection in the office**
 - DGUV principle 315-201 **Requirements for the training of experts for the inspection and assessment of lighting in workplaces**



- **Checking the illuminance at workplaces** and ensuring that legal requirements and standards are met. Adequate lighting in workplaces reduces workplace accidents, prevents premature fatigue and improves the health and safety of employees.
- **Checking the uniformity of the lighting (Uo)** to avoid the formation of shadows, inadequate lighting and impairment of work safety.
- **Checking the safety lighting of escape routes, emergency exits and other safety-related areas**, ensuring that in the event of a power outage or other emergency situation there is sufficient light to find the safe way out.
- **Checking the color rendering index (CRI)** of demanding workplaces. A high color rendering index > 90 is always necessary when the smallest color differences have to be recognized during the activity.
- **Checking the color temperature (CCT)** and matching the light sources in the room. A color temperature of 4000K is usually recommended for workplaces. All light sources should have the same color temperature.
- **Checking the function of lighting systems with Human Centric Lighting (HCL).** The course of the color temperature and illuminance over the day is recorded and compared with the target profile.
- **Checking the flicker values (PStLM and SVM).** Flickering lighting has health effects on people and can lead to accidents at work.



The **lighting of workplaces** and the **safety lighting of escape routes, emergency exits** and other **safety-relevant areas** must be checked for compliance with legal requirements and standards. This prevents workplace accidents and premature fatigue, improves employee health and safety, and ensures safe exit from work in the event of a power outage or other emergency situation. **Workplaces can be found everywhere!**

- **Industry**

Chemistry, metal, plastic, rubber, electrical, wood, paper, ceramics, textiles, leather, food and beverages, building materials, power plants, automobiles

- **Healthcare Facilities**

Hospitals, nursing homes and retirement homes, medical practices

- **Trade**

Sales rooms, bakeries

- **Service**

Laundries and dry cleaning, restaurants and hotels, hairdressers and cosmetics

- **Schools, Sport and Culture**

Kindergartens, play schools, training centers, sports facilities, theaters, concert halls, cinemas, museums, trade fair and exhibition halls

- **Transportation**

Railway systems, airports, jetties, parking lots, parking garages

- **Agriculture**

WORKPLACE LIGHTING

GENERAL AREAS AND OFFICES – MINIMUM VALUES – ASR A3.4

Work areas, workplaces, activities	Minimum value of illuminance lx	Minimum value of color rendering index Ra	Remark
General areas, activities and tasks			
Canteens, kitchenettes, self-service restaurants, break rooms, waiting rooms, lounges, washrooms, bathrooms, toilets, changing rooms, entrance halls	200	80	
Rooms for physical compensatory exercises (sports rooms, fitness rooms, sports halls)	300	80	
First aid rooms	500	90	Ev $\geq$ 175 lx
Building technical systems, switchgear rooms	200	60	
Control rooms, control rooms, control rooms	500	80	Ev $\geq$ 175 lx
Color check, control	1000	90	
Laboratories, measuring stations	500	80	Ev $\geq$ 175 lx
Kitchens	500	80	
Reception desk, counter, concierge desk	300	80	
Offices and office-like work areas			
Filing, copying	300	80	
Writing, reading, data processing	500	80	Ev $\geq$ 175 lx
Technical drawing (hand drawing)	750	80	Ev $\geq$ 175 lx
Archive	200	80	

Source: DGUV Information 215-210

WORKPLACE LIGHTING

TRAFFIC AREAS - MINIMUM VALUES – DIN EN 12464-1

Type of space, task or activity	Minimum value of illuminance lx	Minimum value of color rendering index Ra	Remark
Airports			
Arrival and departure halls, baggage claim, waiting areas, luggage storage rooms	200	80	
Traffic areas, escalators, moving walkways	150	80	
Informationsschalter, Check-in-Schalter	500	80	Screen workplace
Information desk, check-in desk	500	80	Vertical lighting is important.
Areas of security clearance	300	80	Screen workplace
Air traffic control tower	500	80	Screen workplace dimmability daylight glare windows reflections
Aircraft hangars for testing and repairs, engine testing areas, measuring areas in aircraft hangars	500	80	
Railway facilities			
Platforms and passenger underpasses	50	40	
Counters and station halls	200	40	
Ticket and baggage counters and offices	300	80	
Waiting rooms	200	80	

WORKPLACE LIGHTING

EMERGENCY LIGHTING - MINIMUM VALUES - DIN EN 1838 / ASR A2.3

Security lighting	Minimum value of illuminance lx	Minimum value of color rendering index Ra	Remark
First aid points	≥ 5	≥ 40	within 2 m
Fire fighting or alarm systems	≥ 5	≥ 40	within 2 m
Escape routes	≥ 1	≥ 40	along the center line, uniformity $\leq 40:1$, at least 50% still within 0.5 m left and right of center
Anti-panic lighting *	$\geq 0,5$	≥ 40	free floor space, excluding edge area 0.5 m, uniformity $\leq 40:1$
Workplaces with particular risks	≥ 15 and ≥ 10 % of the maintenance value	≥ 40	Maintenance value related to the visual task
Measuring height DIN EN 1838 ≤ 2 cm ASR A2.3 ≤ 20 cm			

* in Germany, they are usually designed like escape routes (1 lx)



Photoreceptors in the eye

- **Cones** (R, G, B) are responsible for color vision
- **Rods** are responsible for night vision
- **Retinal ganglion cells** are connected to the pineal gland and synchronize the internal clock

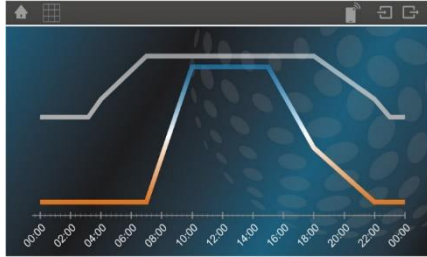


Circadian Rhythm (24h) is controlled by hormones

- | | | | |
|-------------------|---------------------|----|--------------------------|
| ▪ Evening: | Melatonin ++ | => | Fatigue, Metabolism -- |
| ▪ 3 h Morning: | Cortisol ++ | => | Awakening, Metabolism ++ |
| ▪ During the day: | Serotonin ++ | => | Mood ++, Power ++ |

WORKPLACE LIGHTING

HUMAN CENTRIC LIGHTING - COLOR TEMPERATURE, BRIGHTNESS



Biological influence of light on humans depending on the course of the day.

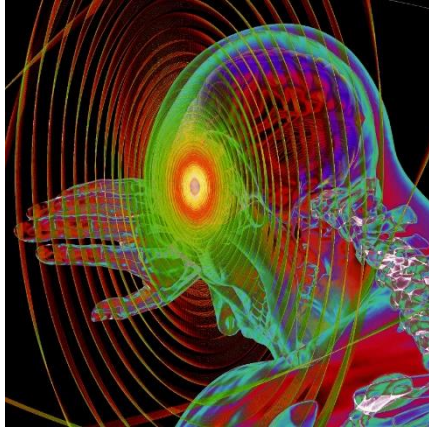
- Activation and increase in concentration
- Increase in motivation
- Reduction of fatigue
- Initiation and optimization of recovery phases
- Improvement of the mood
- Strengthening the immune system

Kurvenwerte		
Uhrzeit	Farbe	Helligkeit
03:10	2700 K	55 %
04:00	2700 K	68 %
07:00	2700 K	100 %
10:00	6500 K	100 %
15:00	6500 K	100 %
18:00	4220 K	100 %
22:00	2700 K	68 %
23:00	2700 K	55 %

Example of a melanopically effective daytime course of lighting -
Source: Trilux

Adjustment of **color temperature** and **brightness** to the natural daily routine, or to achieve a desired effect. **Verification** of the light control function with **MAVOSPEC BASE / MAVOSPEC LITE**, computer and **Excel macro for data logging**.





Temporal Light Artefact (TLA) an undesired change in visual perception induced by a light stimulus (Temporal Light Modulation, TLM) whose luminance or spectral distribution fluctuates with time.

Effects on humans

- **Photosensitive epilepsy** – flashing lights stimulate epileptic seizures
- **Stroboscopic effect** – dangerous when working with rotating machinery
- **Migraine or severe headache** often associated with nausea and visual disturbances
- **Increased repetitive behavior** among persons with autism
- **Asthenopia** (eye strain), including fatigue, blurred vision, conventional headache, decreased performance on sight-related tasks
- **Other:** panic attacks, anxiety, increased heart rate, dizziness
- **Also:** interference with machine vision and imaging devices (video & security cameras, bar code scanners etc.)

Ecodesign requirements for light sources

EU Regulation 2019/2020 since 1.9.2021

Limits **PstLM** ≤ 1, **SVM** < 0,4



PstLM = short-term light modulation measures visible flicker – 0.3 Hz up to 80 Hz

SVM = stroboscopic visibility measure assesses the strobe effect which can occur in conjunction with moving objects – 80 Hz bis 2000 Hz

WORKPLACE LIGHTING

REQUIREMENTS FOR THE MEASURING EQUIPMENT

Lighting of workplaces – Part 1: indoor workplaces DIN EN 12464-1

Lighting of workplaces – Part 2: outdoor workplaces DIN EN 12464-2

Technical guideline for workplaces - Lighting - ASR A3.4 – Employers Liability Insurance Association DE

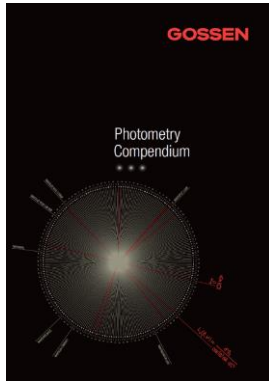
Technical guideline for workplaces – Emergency lighting, optical safety guidance systems - ASR3.4/3 – Employers Liability Insurance Association DE

	illuminance		glare luminance, 1° ... 5° 0.05 cd/m² ... 1000 cd/m² class B, DIN 5032-7 factory calibration	color temperature (CCT) color rendering index (CRI) [flicker]	flicker PStLM, SVM
Emergency lighting - DIN EN 1838					
	safety-, anti-panic- and surrogate lighting at least 0.5 ... 1 lx accuracy ≤ 10% MAVOLUX 5032 B USB		safety signs luminance + contrast accuracy ≤ 10%	color rendering index (CRI)	
Measuring device	MAVOLUX 5032	MAVO MONITOR	MAVO SPOT	MAVOSPEC LITE	MAVOPAD



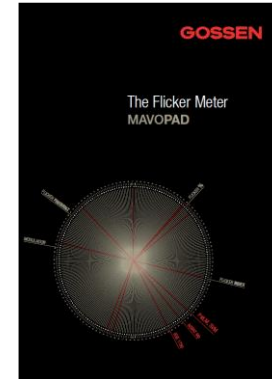
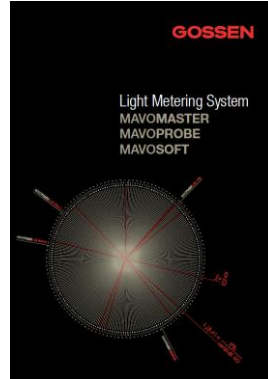
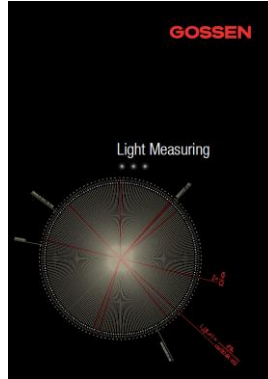
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BACKGROUND INFORMATION - COMPENDIUM, CATALOGS, FOLDER



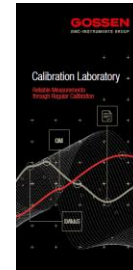
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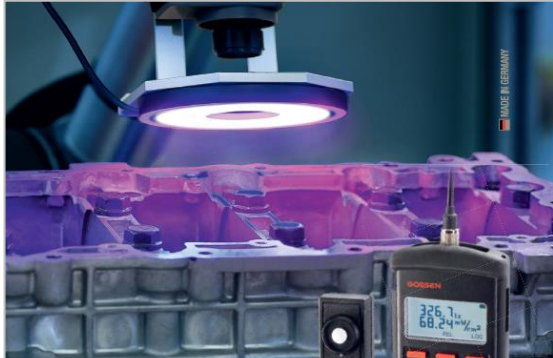
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HCL - LICHT FÜR MEHR LEISTUNG

Tageslichtähnliche Beleuchtung für optimale Arbeitsplätze – Mavospec Base

Der Einsatz von LEDs mit steuerbarer Farbtemperatur und Intensität eröffnet für Human Centric Lighting vollkommen neue Möglichkeiten. Dabei spielt die zeitliche Betrachtung von Farbtemperatur und Beleuchtungsstärke neben Spektrum, Farbwiedergabe, Farbort und Flicker eine wesentliche Rolle.

Verifizieren Sie die optimale Funktion Ihrer Beleuchtung. Mavospec Base ermittelt alle relevanten Faktoren, qualifiziert Ihr Licht mit höchster Präzision und stellt die Ergebnisse auf dem Farbdisplay klar und verständlich dar. Mit dem Data-Logger Makro für Excel wird Ihr Licht dabei auch im zeitlichen Verlauf registriert. So haben Sie die Basis für einen effizienten Funktionsnachweis – Tag für Tag und bei allen Lichtquellen.

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Icons: Lux, cd/m², LED, CCT, CRI, Flicker, PPF, x, y, u', v', TM-30-15

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Thank you for your attention!

If you have any further questions or suggestions, please contact:



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