



prebit
LIGHTING

LIGHT ON BOARD

PLANNING AID

In search of the perfect ones
lighting conditions on board





EDITORIAL

Imagine the most uncomfortable room you've ever had to be in. Then think about what it was that made him so uncomfortable. Either you can't immediately remember the reason for it or you actually quickly think about the light. And you are probably right about that. Because light has an enormous influence on us and our surroundings.

In addition to the fact that we naturally need light in order to be able to orientate ourselves at all and that light controls our biorhythm, it also has an impact on our well-being. Different light colours, brightness levels and contrasts have very different effects on the room atmosphere and therefore also on our mood.

However, finding the perfect lighting is not that easy. In order to know what you actually need for your rooms, it is helpful to have a basic knowledge of how light works and how it affects our environment.

This e-book provides the most important basic knowledge on the subject of light in a compact form. From the basic terms of lighting technology, quality features, brightness and color nuances to test and protection marks, you will get a feeling for how important the right lighting is - and especially on board. Because there are some maritime characteristics that have to be considered in the lighting design. Based on our long term experiences we are of course beyond this e-book always at your side with advice and action.

A handwritten signature in black ink, appearing to read "G. W. Holz". The signature is stylized with a long horizontal stroke at the end.

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THE HUMAN BEING AND THE LIGHT

What would life be without light? Light is not only vital for people, but also makes a decisive contribution to their well-being. Today's technology offers countless possibilities to create artificial light for every situation.

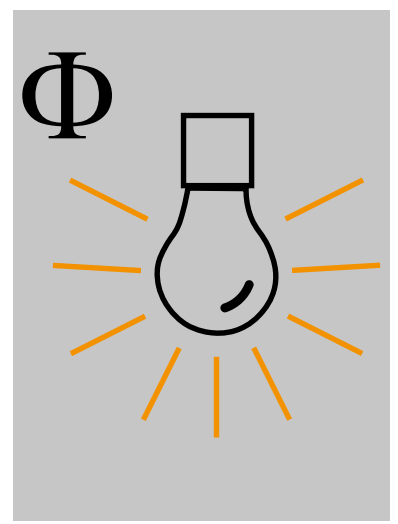
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OUR EYE

The human eye helps us to adjust to large differences in brightness. It adapts to different lighting conditions, but it takes time to do so. The eye is an extremely complex mechanism that can do a lot.

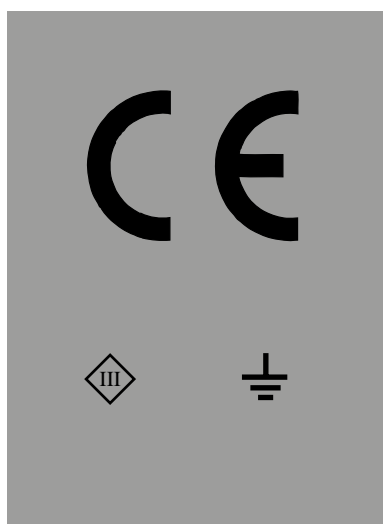
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BASIC KNOWLEDGE LIGHTING TECHNOLOGY

How long can you use a lamp? How do you find the right level of brightness? What shades of color are there? And how do you actually recognize quality? Basic know-how about lighting technology helps choosing the right lighting.

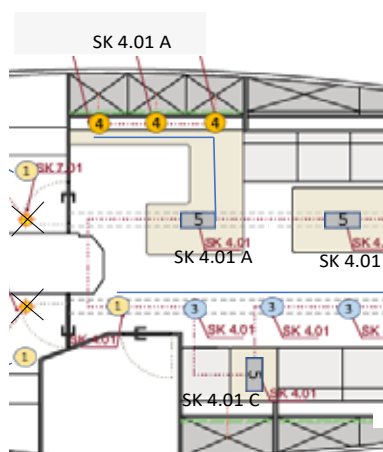
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MARK OF APPROVAL AND PROTECTION

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LIGHT PLANNING

Due to the large selection, a well thought-out lighting plan is necessary for every room. This is the only way to create an optimal lighting experience. On the one hand, of course, it is about the function, on the other hand it is also about aesthetics.

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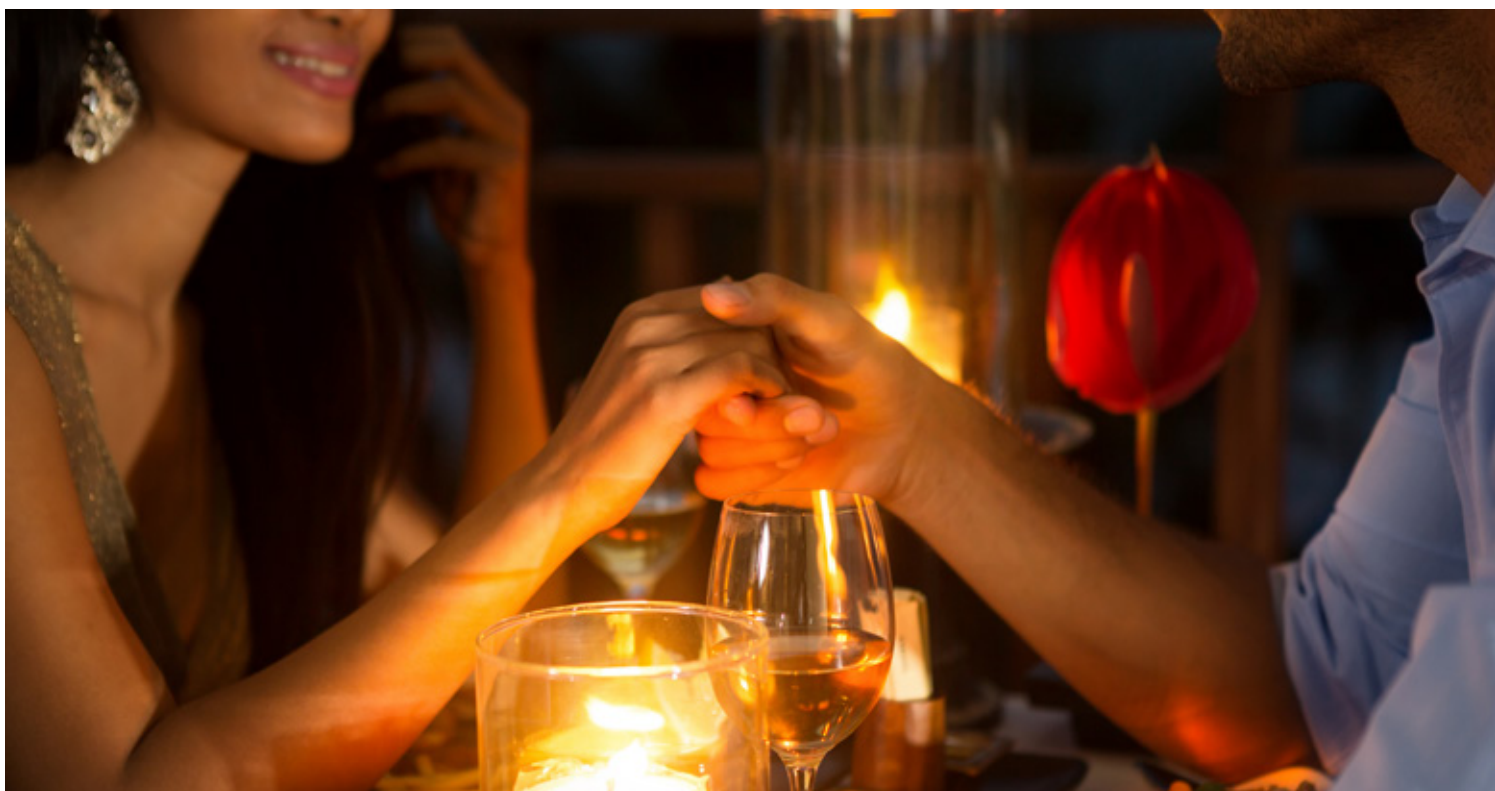
THEY SHOULD AVOID THAT

The choice of lighting options is huge. It is therefore easy to make a few mistakes when planning the light: from the placement of the luminaire, to the light color and color temperature. Some of these are easy to avoid.

LOOKING FOR THE PERFECT LIGHTING CONDITIONS

What would life be without light? Correct - not available at all. Because without light there is no life. Humans, animals and plants all need light to exist. In the past, only natural sunlight was available, but today we can no longer imagine life without artificial light sources. In the meantime, the technology has advanced so far that both light sources are cleverly interwoven in order to be able to create the most suitable lighting for us. Because light not only ensures that we can recognize our surroundings, but also makes a decisive contribution to our well-being.





THE HUMAN BEING AND THE LIGHT

We usually take light for granted so much that we only really notice it in a few situations: when the sun finally shines again in spring and it gets light earlier, or when artificial lighting manages to create a very special atmosphere in a room. More often than not, it's the lack of light that strikes us. Traveling in semi-darkness or in the dark often turns out to be a problem for people. While some animals are excellent at moving around in the dark with the help of better eyesight or other senses, we become insecure. Our wellbeing diminishes. But it's not just our mood that is shaped by the light. Light has a major effect on our body and our lives: it influences hormone balance, our health in general and also tells us whether it is day or night. Our inner clock follows the light and we shape our time accordingly.



OUR EYE

THE HUMAN EYE IS OUR MOST IMPORTANT SENSORY ORGAN, BECAUSE WE RECOGNIZE MORE THAN 80 PERCENT OF ALL ENVIRONMENTAL STIMULI WITH OUR EYES.

The human eye helps us to adjust to large differences in brightness. Anyone who has ever looked directly into a brightly lit flashlight in the dark can feel it immediately. The eye adapts to different light conditions. However, the eye needs time to get used to it:

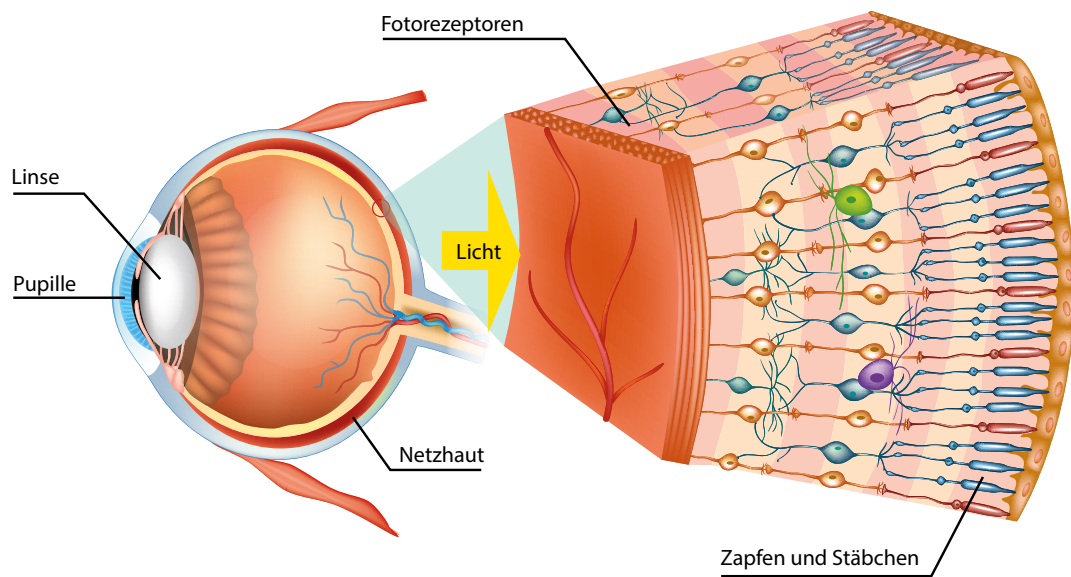
Adjusting from dark to light takes only seconds. Conversely, it can take more than 30 minutes for the eye to adjust from light to dark, for example when leaving a well-lit room into the night.

There are cones in the retina that register daylight. There are three different types of these cones for the primary colors blue, red and green. Night vision, on the other hand, is carried out by the much more light-sensitive rods, which in turn can only distinguish between brightness levels and gray tones.

The adaptation of the visual system to changing light intensities takes place in several stages: In the first stage, the reflective narrowing or widening of the pupil takes place. When the iris is open, up to 80 times more light enters the eye than when the iris is almost closed. In the second stage, depending on the light conditions, the rods or the cones in the eye

are activated. The rods only enable black and white vision. They are the weak light receptors in the eye, which means they are activated at dusk. This is called scotopic vision or shadow vision. In bright light, the cones are more active and enable color vision. This is photopic vision or light vision.

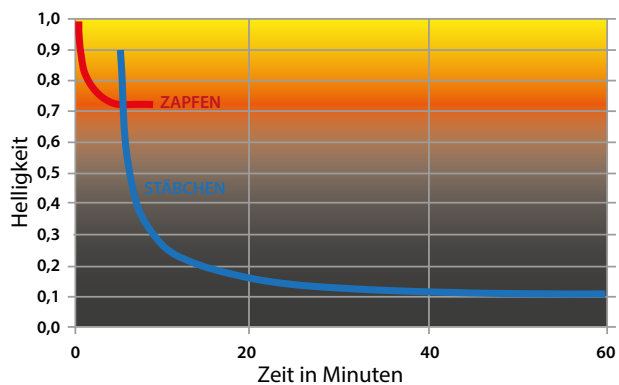
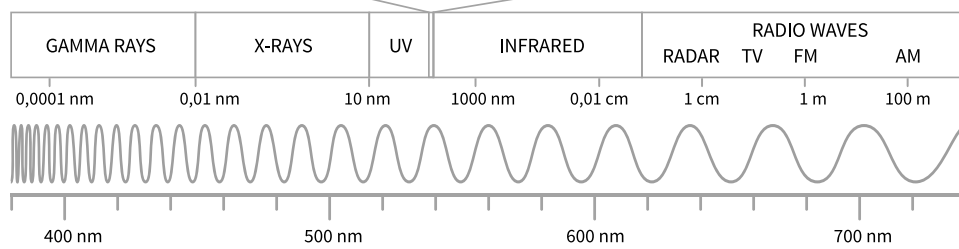
If the eye, which has been adapted to darkness, is exposed to a light source (other than red light), the ability to see at night is lost within seconds, since the rods react immediately to the light source. With its spectral curve, red light is beyond the sensitivity of rods. It has no effect on the adaptation process, so the night vision capability is retained for a long time. Other colors, with the exception of the color amber, are within the receptive range of the rods and thus affect the adaptation process more or less quickly.



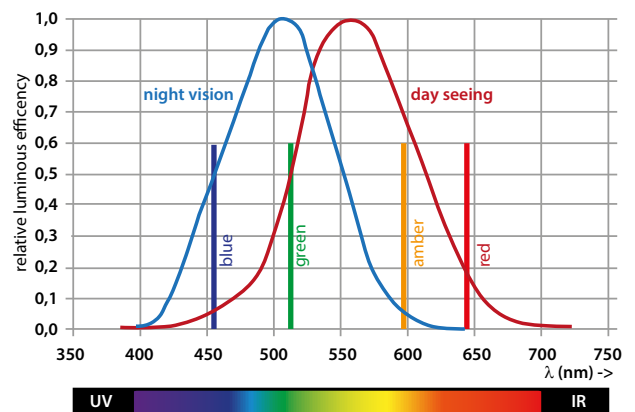
VISIBLE SPECTRUM



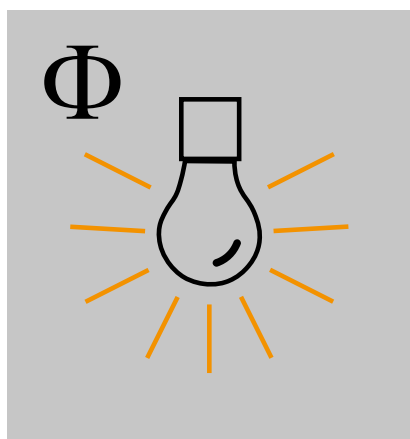
VISIBLE LIGHT



Zeitlicher Verlauf der Anpassung des Auges an die Dunkelheit.



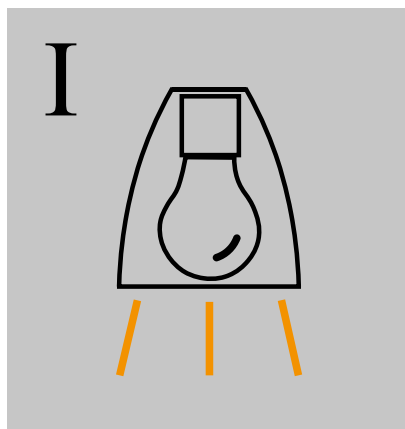
BASIC KNOWLEDGE OF LIGHTING TECHNOLOGY



LUMINOUS FLUX [Φ]

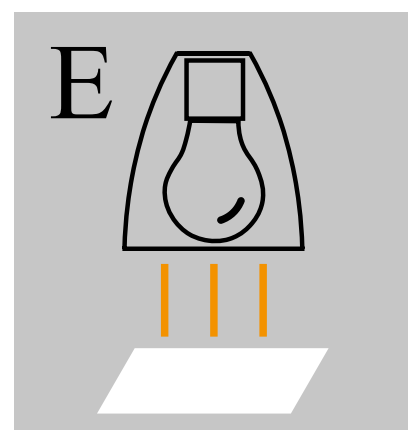
The luminous flux is given in lumens (lm) and characterizes the total light output, i.e. how much light is emitted by a light source in all directions. The value of the luminous flux is calculated or determined using special measuring devices.

The luminous flux is used as a benchmark for the overall brightness of a luminaire as perceived by the human eye. The so-called luminaire luminous flux is a particularly important value for lighting planning, since losses caused by the design of the luminaires are already taken into account here.



LUMINOUS INTENSITY [I]

Since the value of the luminous flux is not sufficient for good lighting planning, the luminous intensity must also be considered. This indicates the distribution of the luminous flux per solid angle and is measured in candela (cd). It therefore describes a property of the light source that is completely independent of the viewer's position. Not only the total emitted luminous flux is interesting, but also the possible focus in one direction. If a lamp bundles the light, it appears brighter than one that radiates all around. The luminous intensity distribution can be represented graphically using a polar diagram.



ILLUMINANCE [E]

In order to describe how much light hits a surface, the illuminance is determined from the quotient of the luminous flux values and the illuminated surface.

The result is a value that is given in lumens per square meter (lx). The illuminance can be calculated in every virtual plane in the room or with the help of a special lux meter. The level of use to be measured depends on the situation in question: For example, the horizontal lighting surface is important for a desk, and the vertical for shelves.

HOW LONG CAN YOU USE A LAMP?

How long it takes until a lamp has to be replaced is usually specified in hours; for LEDs and similar light sources with a plug-in base, this is done with the rated service life L.

LEDs slowly lose their brightness over time and generally do not go out all at once. The rated service life therefore indicates the time after which the luminous flux has fallen to a certain value. With regard to general lighting, the values L80 or L70 are decisive, which means that an LED reaches its average rated service life when 70 percent of the luminous flux of the new value is still available.

The dwindling of the luminous flux or a total failure depend on various factors: on the one hand on the forward current and on the other hand on the temperature inside the LED. If it is a module, i.e. a light source in a more complex system, the electrical wiring as well as the ambient and operating temperature must also be examined, among other things.

Default-lightbulb	Halogen-lightbulb	energy saving lamp	LED
	Lumen		
90 Lumen 15 W	140 Lumen 10 W	250 Lumen 5 W	100 Lumen 1-1,5 W
220 Lumen 25 W	320 Lumen 20 W	400 Lumen 7 W	320 Lumen 3-3,5 W
420 Lumen 40 W	600 Lumen 35 W	600 Lumen 9 W	600 Lumen 5,5-7 W
715 Lumen 60 W	910 Lumen 50 W	900 Lumen 11 W	900 Lumen 8-10 W
930 Lumen 75 W	1450 Lumen 75 W		1400 Lumen ~14 W
	1800 Lumen 90 W		1800 Lumen ~18 W

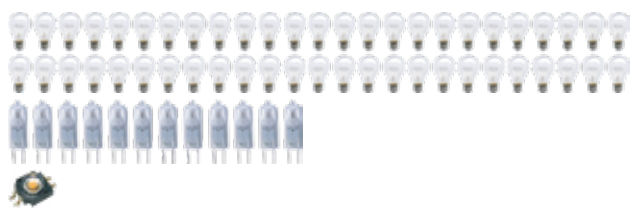
Light source comparison

At a time when rooms were mainly illuminated with incandescent bulbs, watts were sufficient as an indication of brightness. This changed with the introduction of the LED as a light source.

In order to be able to compare the brightness of light sources with each other, the term lumen is used. The LED luminous flux lumen is the unit for the total light that a light source radiates into the room. It thus describes the amount of light.

A 25 watt light bulb emits an LED luminous flux of approx. 200 lumens. This corresponds to 8 lumens per watt. With an LED as the light source, the balance sheet looks much more energy-efficient. Only one LED of approx. 2 to 3 watts is required for the same brightness. An LED achieves 100 lumens from 1 watt.

The table above gives you the opportunity to compare different lamps with each other.



Lifespan

Permanently installed LEDs shine for well over 50,000 hours. After that they are not broken, only their luminosity decreases. During this time you would have had to replace around 50 light bulbs or twelve halogen lamps.

RECOGNIZE QUALITY

How can you tell if the lighting is good? What are the quality features that indicate whether the light source is of high quality? To do this, it must first be clarified which requirements must be met for our vision. Because different situations call for different lighting conditions: driving at night requires a different light than reading in bed or working at a desk.

In order not to neglect both health and well-being, there are three important points to consider when making your choice:

On the one hand, there is the visual performance: What does the lighting have to be like so that the eye is able to recognize what is supposed to be recognized? Visual performance is influenced by the lighting level and the limitation of direct and reflected glare.

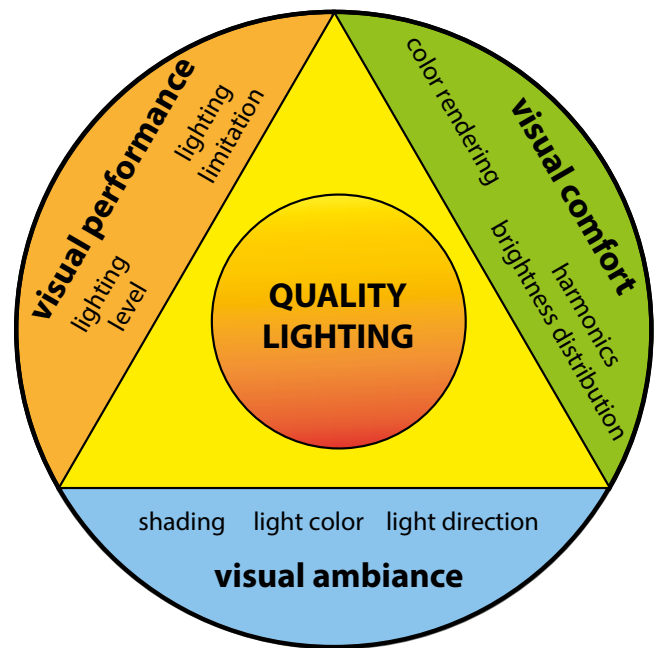
Visual comfort must not be neglected either: What does the lighting have to be like so that what needs to be seen can be seen without effort? Visual comfort is guaranteed by good color rendering and harmonious brightness distribution.

On the other hand, there is the visual ambience: What mood should be created by the light so that the greatest possible well-being is created? The ambience is determined by the color and direction of the light and the modelling.

So, the most important characteristics to look for when choosing lighting are: a level of lighting that suits the situation,

a harmonious brightness distribution, limitation of direct aperture and reflection, freedom from flickering, light direction and modeling to recognize structures, light color and color rendering, the possibility of changing the lighting level and light color.

The lighting level in particular plays an important role in how easily the eye can perform a visual task. The decisive factors here are the illuminance and the reflection properties of the illuminated environment.



When planning the lighting, it is important to remember that dark surfaces reflect less light than light surfaces: white walls, for example, reflect 85 percent of the light, while natural wood paneling only reflects up to 35 percent. The lower the reflection, the more difficult the task for our eyes, which is why the illuminance has to be correspondingly higher.

Illuminance is measured in lux (lx). It is the most important value when it comes to planning lighting – whether indoors or outdoors. The number and type of lights depend on it, and so does the energy required.



BRIGHTNESS: THE RIGHT LEVEL

The right amount of brightness is of great importance: too high contrasts leave the eye tired quickly, as it takes some effort to adapt to a different light situation. On the other hand, the surroundings leave too little contrast quickly become monotonous. Harmony is the keyword here:

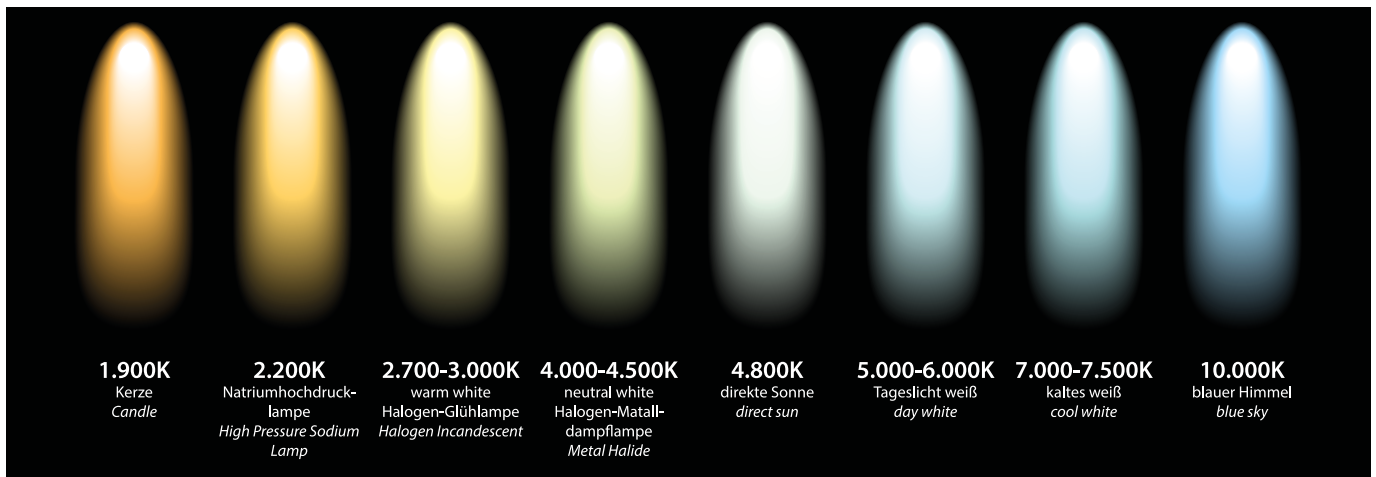
The optimal distribution of light. In order to be able to experience things in their three-dimensionality, you need the right distribution of light and shadow. This allows us to fully grasp our surroundings. If shapes and surface structures are clearly recognizable, a pleasant lighting climate is created. It's not just about aesthetics, but also about orientation in space: distances can only be correctly assessed with the help of light and shadow.

Diffuse light without shadows appears monotonous and creates an uncomfortable feeling due to a lack of orientation. Individual, strong light sources, on the other

hand, create extreme shadows in which nothing can be seen. Therefore, the best results are achieved with a combination of diffuse light, such as indirect lighting on walls and ceilings, and directed light from direct luminaires and downlights.

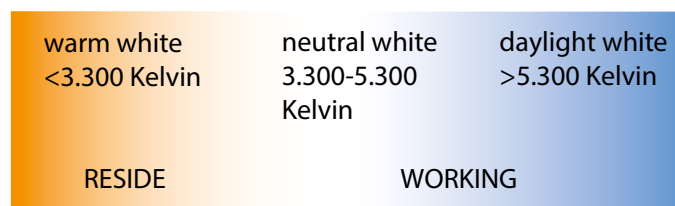
HOW BRIGHT IS WHAT?

Candle	~ 12 lm
60W incandescent lamp	~ 700 lm
35W halogen lamp	~ 500 lm
11W energy-saving lamp	~ 620 lm



COLOR NUANCES OF LIGHT

THE LIGHT COLOR OF A LAMP IS DESCRIBED BY THE COLOR TEMPERATURE IN KELVIN (K).



Of course, not only light and shadow are important for human vision and well-being, but also the colors of the light. From warm to cool, the light can have very different effects on perception.

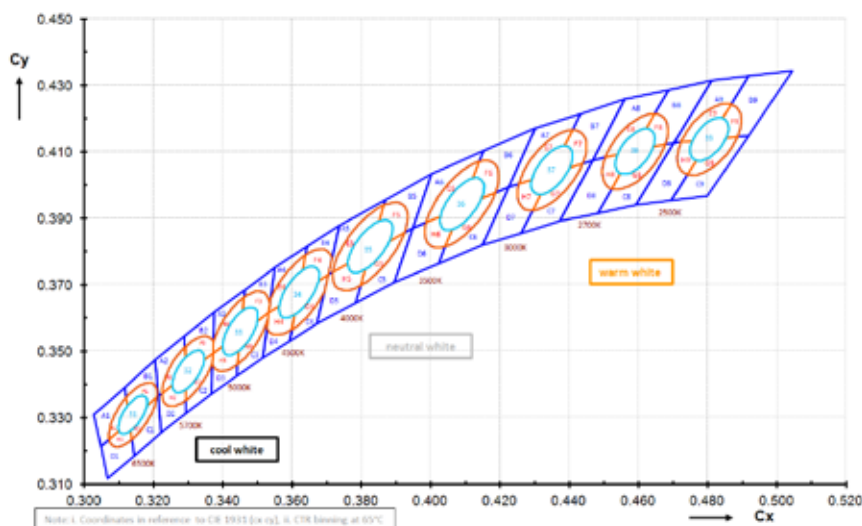
Each illuminant has its own colour, the light colour. This is measured by the color temperature Kelvin (K), which was originally a unit of temperature. The following always applies: the higher the value of the temperature, the cooler the light. Common light sources with color temperatures of up to around 3,300 Kelvin produce warm, more yellow-reddish light, 3,300 to 5,300 Kelvin describe a neutral white light color, while everything over 5,300 Kelvin corresponds to daylight.

For lighting planning, it is essential to know and understand which light color a lamp emits:

When a piece of iron is heated, it begins to glow above a certain temperature and thus emits light. This light is initially glowing red and changes to yellow to white light as the temperature increases. Physically, this effect is defined as the temperature of a black body, the so-called Planck radiator. If this effect is visualized on a scale, the distribution of the light color becomes clear. Lamps can thus be compared and classified.

Warm white lamps are used in the lighting design to create a cozy atmosphere. Neutral white light sources emit a white light and are also perceived as neutral by the human eye. Most office spaces are illuminated with this light. Daylight white light sources are used as bright white, technical light, such as in outdoor lighting and wherever strong contrasts are desired.

However, the specification of the light color says nothing about the color rendering. Light of the same color temperature can have different compositions in its



spectrum, because colors are reflected differently and also perceived differently by the human eye. It is therefore important not to use too many LEDs from different manufacturers.

Special features of LEDs

The light color of LEDs can vary within a batch, so they are checked again after production and sorted into different tolerance classes, the so-called bins. That this is done carefully is an important feature of quality.

If you want to determine the color deviations more precisely, you can use the MacAdam ellipses, also known as SDCM (Standard Deviation of Color Matching). In a color diagram, they show areas

where our eyes cannot see any difference from the center of the ellipse.

Effect of light color on the body

Conventional LEDs often have a high blue light spectrum, the so-called blue peak. This has a strong effect on the eyes, concentration and biorhythm. If the amount of blue light is too high, the excess blue light absorbed will scatter. This scattered light then appears diffuse. This means that the shape and color of the objects are slightly distorted. Excessive amounts of blue light can overstimulate the retinal cells in the eye. Occasionally, eye problems and concentration disorders can occur.

WHAT DOES THE COLOR TEMPERATURE MEAN?

The color temperature (light color) is given in Kelvin [K] and determines how light is perceived.

ww - warm white	2300-3300 K
nw - neutral white	3,300-5,300 K
cw - cool white/daylight	5,300-8,000 K



The color rendering index

The Color Rendering Index (CRI), also known as the Color Rendering Index (Ra), describes the color fidelity of light sources. It is an index for the naturalness of the colors. The higher the designated color rendering index, the more natural the colors are rendered and the more pleasant they are perceived. The value can be between 0 and 100. A maximum index of 100 means ideal color rendering, as achieved by daylight, sunlight or incandescent light.

While natural daylight can reproduce all colors that are visible to humans, light sources differ in their color rendering properties.

The CRI or Ra value is the calculated mean value from the comparison of the light source used with natural light (Ra = 100). Color charts according to DIN 6169 are used for its assessment. While the first eight test colors were sufficient for color

assessment in the days of the incandescent lamp, the increased number of alternative light sources made it necessary to increase the number to 14 or 24 reference colors. In particular, the Ra9 value (saturated red) plays an important role in color assessment. A color rendering index of Ra = 100 is considered ideal. It should not be below Ra 80 indoors.

Good color rendering plays an important role in many areas of everyday life. Graphic designers and architects, for example, need light sources with color rendering that is as true to nature as possible. Light sources with a high CRI or Ra value are also important in the commercial and private sectors. Natural-looking foods not only increase the enjoyment in the dining room, but also increase the impulse to buy in the supermarket, when meat shines in a rich red and salad in fresh green.

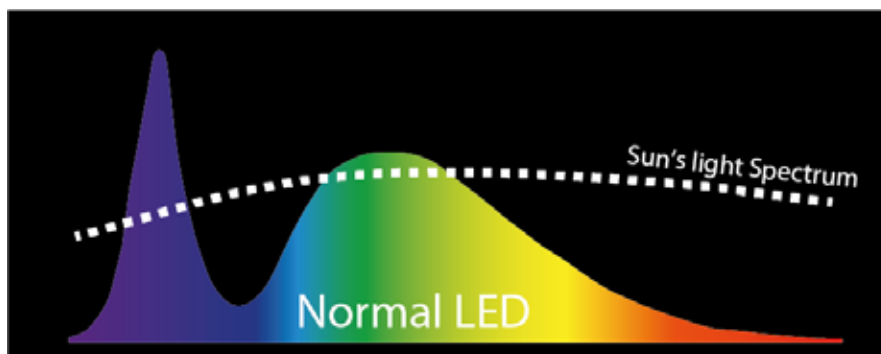
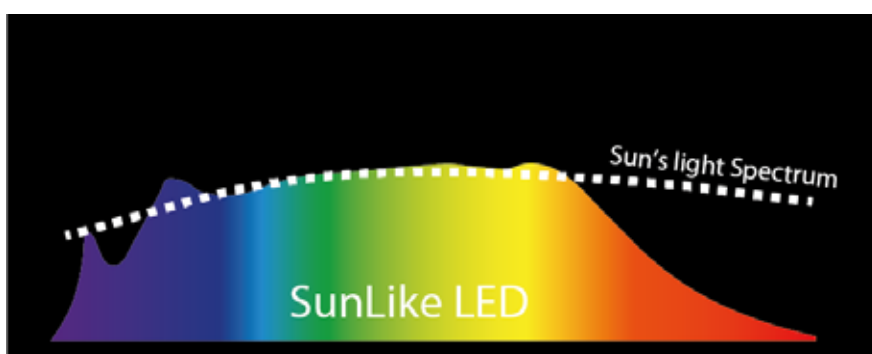
R _a	quality	application
90 - 100	outstanding	best color rendering
80 - 89	very good	very good



Light like sunshine

The SunLike technology is an innovative full-spectrum LED whose light almost corresponds to that of sunlight and which is perfectly tuned to the human biorhythm.

This natural light spectrum with an extremely high CRI - without blue peak - currently offers the best light quality. The model for the development was the natural light of the sun. With the help of the SunLike LEDs, it is now possible for the first time to imitate almost the entire spectrum of natural sunlight. The result is a particularly healthy light with a CRI > 95. Colors and structures of objects appear as in natural light.



LUMENS/WATT COMPARISON

	benchmarks
Incandescent lamp	~ 10lm/W
Halogen lamp	~ 20 lm/W
Energy saving lamp	~ 70-90 lm/W
LED lamp	~ 60-170 lm/W



"With a candle
not the way
important,
light."

ANTOINE SAINT-EXUPÉRY

A romantic dinner table setting. In the foreground, a lit candle in a glass holder glows warmly. Next to it is a wine glass filled with a golden liquid. In the background, two hands are clasped together, suggesting intimacy. The overall atmosphere is warm and intimate, with soft lighting from the candle and other sources in the background.

andle, it's
x that's
it's the

DIM2WARM TECHNOLOGY

THE SPECIAL WAY TO DIM LEDS

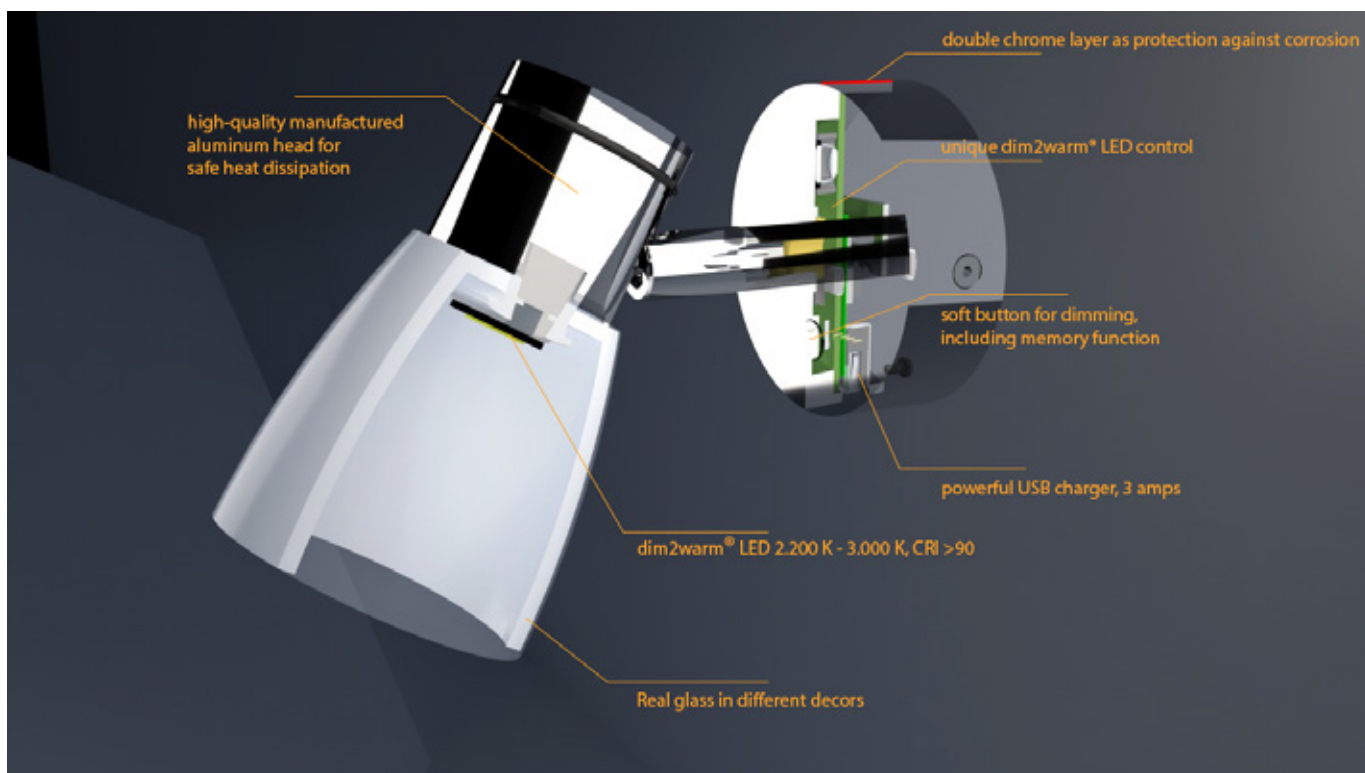
The ability to dim is still an important option for most customers when purchasing a light. If conventional light bulbs are dimmed, the color temperature drops and the light appears warmer. Since it was previously only possible to reduce the brightness when dimming an LED, the light was weaker, but also appeared a bit cooler. With the brand new dim2warm® technology, prebit has developed different lights with warm tone dimming. A high-quality color temperature control ensures that the light actually has a warmer color temperature (from 3000 to 2200 K). This new series of lights creates a particularly beautiful, gently dimmed LED light and ensures a cozy feel-good atmosphere - like an incandescent or halogen lamp. It calms our senses. This is how dim2warm® from prebit conjures up the coveted cozy atmosphere in the living room - like in the glow of a candle.

The special highlight: The very high RA value of >90.



3.000 K

2.200 K



QUALITY AND FINISH

High humidity, UV radiation and salt quickly cause severe corrosion damage or material damage to the lights on your yacht. Normal lights from the living area are therefore rarely suitable. Because a seagoing yacht places different demands on the lighting and its materials: stainless steel, brass or aluminum are often used here, and UV-stable materials such as acrylic glass are used in the plastics sector.

Unlike normal lights used in living areas, chrome-plated surfaces are provided with a double chrome-nickel layer to counteract corrosion. The potting materials used must be UV-resistant, and electronic components such as circuit boards are given a special coating to protect them from moisture. In principle, the lights on board are voltage-stabilized and equipped with an EMC filter to prevent any interference in the radio network.

When selecting your LEDs, you should also make sure that you only use those that are also suitable for use in living areas. It is important here that the color rendering in particular has a particularly high value, so that

the surroundings on board are rendered in true colour. In order to withstand the extreme conditions at sea, the LED units are firmly connected to the lamp body. This prevents contact problems and ensures safe operation, even if the lights are exposed to vibrations from the engine or heavy seas. The particularly strong connection has another advantage: it ensures significantly better heat dissipation of the LEDs. As a result, they can achieve a service life of well over 50,000 hours - a value that could never be achieved with retrofit LEDs.

TEST MARKS AND PROTECTION MARKS

CE? IP20? WHAT DO THE LETTERS AND ACTUALLY MEAN?
NUMBERS ON THE BULBS?

W

ith the CE marking, manufacturers and importers confirm that their product meets the applicable guidelines and protection goals of the EU regulation.

The CE seal is not a seal of quality or test mark, but a label that the manufacturer is responsible for applying.

CE

The "Ingress Protection" IP numbering system is used to indicate that the luminaire is sufficiently mechanically protected against foreign bodies and moisture. The different numbers indicate the extent to which they prevent intrusion. For example, a light with the value IP 20 protects against foreign objects up to 12 millimeters long, but not against moisture, while a light with the value IP 65 not only does not let dust through, but also water.

IP20

...

IP68

protection classes

Each lamp must be equipped in such a way that users are protected against electric shock.

According to DIN EN 60598-1, lights are divided into the following three protection classes:

Protection class I

protects against excessive contact voltage by insulating live parts and by connecting accessible metal parts to the protective conductor (earth).



Protection class II

Here, live parts are provided with additional protective insulation. The connection of a protective conductor is neither intended nor permitted.



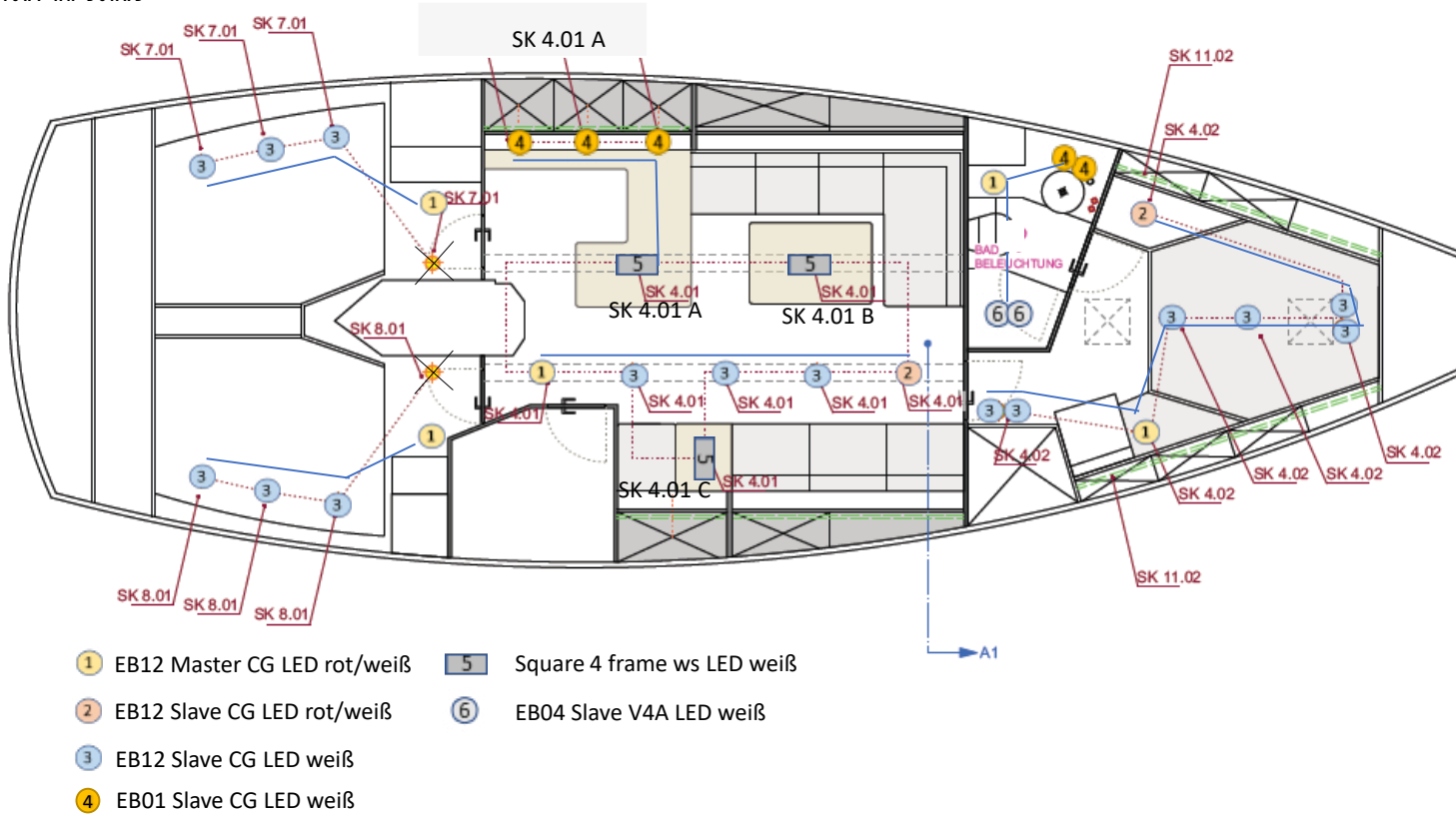
Protection class III

Luminaires in this highest protection class are operated on a safety extra-low voltage (<50V) that is harmless to humans.



TYPES OF PROTECTION

1st code number Protection against foreign objects and contact		2nd code number protection against water	
0 unprotected		unprotected	
1 protected against solid foreign bodies >50 mm		protected against dripping water	
2 protected against solid foreign bodies >12 mm		protected against dripping water below 15°	
3 protected against solid foreign objects >2.5 mm		protected against spray water	
4 protected against solid foreign bodies >1 mm		protected against splashing water	
5 protected against dust		protected against water jets	
6 sealed against dust		protected against heavy seas	
7 -		protected against temporary immersion	
8 -		protected against permanent immersion	



LIGHT PLANNING

DUE TO THE LARGE SELECTION, WELL THOUGHT-OUT LIGHTING PLANNING IS NECESSARY FOR EVERY ROOM IN ORDER TO CREATE AN OPTIMAL LIGHTING EXPERIENCE - THIS IS OF COURSE ABOUT FUNCTION ON THE ONE HAND AND AESTHETICS ON THE OTHER.

If the light is not right, a room that is elegantly designed and equipped with high-quality materials and furniture does not come into its own. Good lighting planning with the right luminaires ensures brilliance, emphasizes value and gives rooms the right atmosphere.

Three important factors:

Room, zone and mood light

The basic brightness in the saloon is determined by the ambient light, while the zone lighting accentuates individual areas. Both are essential for lighting that is functional on the one hand, but also increases well-being on the other. The mood light - as a third factor - supplements the room and zone light. It does not primarily serve the purpose of lighting, but acts as a light object that gives the salon an extraordinary atmosphere.

room light

The room light is the basic lighting in the saloon and is used for uniform and rather diffuse basic lighting. It is achieved using indirect or diffusely radiating luminaires, which distribute the light evenly in the room and thus ensure the necessary basic brightness for orientation. Strong differences in brightness are compensated with this light and the visual adjustment to different light zones is facilitated. The eye tires less quickly. If there is no room light at all, for example in a salon where only a reading lamp is switched on by the sofa, this is perceived as too dark and uncomfortable.

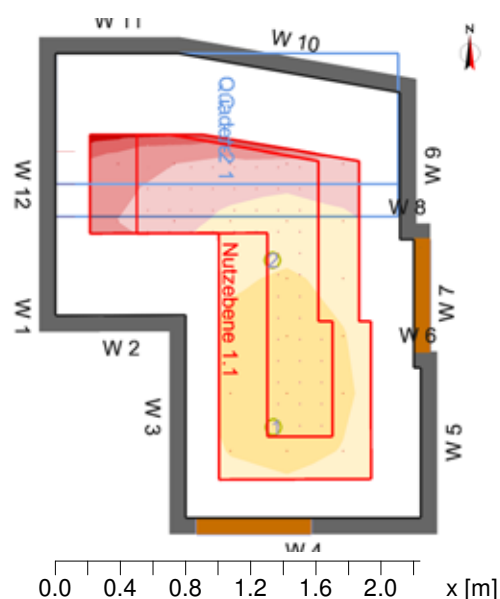
zone light

The zone light provides suitable lighting in the areas where it is needed for certain activities, such as reading, eating, working or watching TV. At the same time, it sets exciting light accents that are just as important for the harmony in the room as the even, diffusely brightening room light.

The accentuated zone lighting is usually generated by spotlights that direct their light downwards or onto the wall. The more flexible the alignment of the luminaire, the better the light can be directed to where it is needed. For example, if the dining table is illuminated solely by the room light, this creates a rather sterile and impersonal atmosphere. Zoned lighting at the table underlines the importance of this area and provides good light for eating, playing or reading.

mood light

The mood light is responsible for an extraordinary atmosphere. It creates a sense of well-being and attracts attention, but is not required for functional lighting tasks. Rather, it stands for comfort, sensuality, well-being and caresses heart and soul. This can be initiated, for example, with a colorfully illuminated wall, a beautiful light object or warm-toned cove lighting. If you take these three factors into account during planning, you have already taken a big step towards good and attractive light on board.



HOW MANY LUX DO I NEED WHERE?

	benchmark
Bedroom	45 lux
Living room	80 lux
Bathroom	150 lux
Corridor	200 lux
Study room	300 lux
[desk]	[500 lux]

YOU SHOULD AVOID THAT!



A SINGLE, CENTRALLY PLACED LIGHT IN THE ROOM (ROOM LIGHT ONLY).

A single, centrally placed lamp in the room cannot do justice to the diverse lighting tasks and a cozy atmosphere on board and should be avoided at all costs! Perfect room lighting consists of basic lighting in the form of room light, zone lighting, for example using wall lights, and accent lighting that emphasizes certain areas or objects.



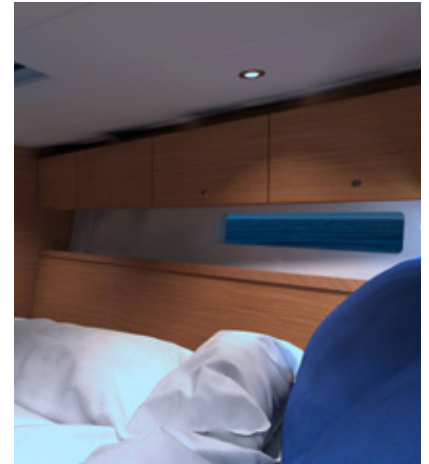
CRI 70

CRI >90

LED LIGHTS WITH WORSE COLOUR REPRODUCTION

Luminaires with a color rendering index of less than 80 are unsuitable for lighting in a living room, they make wood tones appear dull or people look unhealthy. Good LED lights can be recognized by a CRI value of >90.

Illuminants can have different color rendering properties despite the same light colour. If there is a lower proportion of red in the color spectrum of an LED, the red colors of objects are only imperfectly reproduced.



THE WRONG COLOR TEMPERATURE

When selecting the lights, attention should be paid to the specified color temperature. A warm white color temperature of less than 3,300 Kelvin should be selected for living rooms and bedrooms. It becomes even cosier when LEDs are used that change their color temperature when dimmed, so-called dim-to-warm or dim2warm lights.



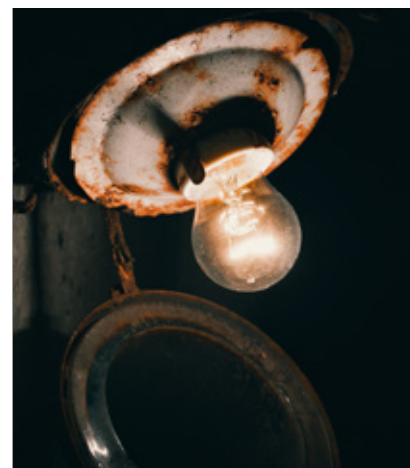
TOO DARK

Having the right amount of light is essential for eye health. Dim basic lighting may appear cozy, but reading a book puts unnecessary strain on the eyes. Therefore, a reading lamp should definitely be used for reading. But it is also important to have sufficient light for other activities, such as preparing food in the kitchen. Otherwise it is sometimes difficult to judge whether the food in the pan and pot has already reached its cooking point.



NON-DIMMABLE LIGHTS

If flexible lighting is desired, dimmable lights are of course essential. So that you don't get angry afterwards that the atmosphere can't be controlled and adapted according to the occasion, you should urgently pay attention to this. When brightness is needed to get work done the lights can be turned up to full, but when it's time for the leisurely part of the day it's nice to be able to soften the light a bit too.



USE INTERIOR LIGHTS OUTSIDE

As the name suggests, indoor lights are designed for indoor use and not for outdoors. It's dry inside, the rooms are closed and the light fulfills different tasks than outside. Especially on board a yacht, it is of course important that outdoor lights are particularly protected against the ingress of water and other weather-related influences. In addition, there are other requirements outdoors, for example in terms of light intensity or light colour. It can also be an advantage if the lights do not emit ultraviolet and infrared light, as this can attract annoying insects.



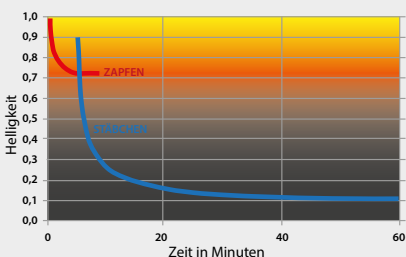
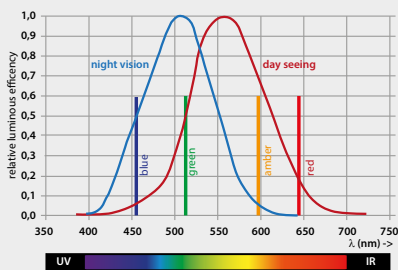
NIGHT DRIVE

If the eye, which has been adapted to darkness, is exposed to a light source (other than red light), the ability to see at night is lost within seconds, since the rods react immediately to the light source.

With its spectral curve, red light is beyond the sensitivity of rods (see blue curve in sketch). It has no effect on the adaptation process, so the night vision ability is retained for a long time!

Other colors, with the exception of the color amber, are within the receptive range of the rods and thus affect the adaptation process more or less quickly.

Lights that can be switched to red are therefore recommended for driving at night.



Zeitlicher Verlauf der Anpassung des Auges an die Dunkelheit.



LIGHT IN THE SALON

Whether to read, watch TV or play, whether alone or together - the salon is a room in which everyone spends quality time in their own way. So that it can be enjoyed to the full, the right lighting mood must be found for every occasion. A single, centrally placed ceiling light is just enough for the necessary basic lighting. Something more is needed to create a homely atmosphere in the room: multifunctionality is the key word, and in the salon this applies not only to the room itself, but also to the lighting.

For the correct placement of the lights, individual zones in the saloon are determined depending on use. In this way, decentralized lighting can be installed individually. Combined with an indirect room light, which shines towards the ceiling and brightens it, and individual mood lights, which set additional accents, that certain extra cosiness is ensured.

The room light is responsible for the basic brightness and should be dimmable if possible in order to gently support the accent lights. Strong light contrasts, which are tiring for the eye, are thereby softened. Wide and diffusely radiating wall, ceiling or table lamps should be used here.

However, luminous ceilings or coves are also suitable for indirect lighting: luminous ceilings provide a diffuse light that creates the feeling of having an open sky above you, as if you were in a kind of inner courtyard. Coves, on the other hand, are cornices running close to the ceiling with built-in LED strips. They give the impression of a floating ceiling. In order to distribute the light evenly, they are provided with linear LED strips that overlap at the ends. If there are no coves in the room itself, profiles can be used instead, the luminaire body of which forms the cove itself.

Alternatively, there are also individual lights for living areas that can create a similar effect over a large area. With RGB-controlled LEDs, there is also the option of letting them shine in different colors or color gradients.

Table or pendant lights, on the other hand, are the means of choice when it comes to installing zone lighting. These brighter light zones - for example above a table - give the room structure and liveliness. It is important that the light accents stand out clearly from the basic lighting.

FOR READING HOURS

Where is the best place to spend leisurely hours reading? Right! In the drawing room. But to ensure that this is really the case, special attention must be paid to the lighting technology. Not only is a precisely aligned light for illuminating the reading area extremely important, the ambient light must also be right. Because: If only the book is brightly lit, but the background is black, the eye is constantly faced with the challenge of having to compensate for strong differences in brightness. The result: You get tired quickly and a leisurely hour of reading becomes an effort instead of relaxation.

In order to achieve good basic brightness for reading as well, indirect lighting using ceiling or wall lights is required. Bright walls emit the light pleasantly soft and evenly into the environment. In order to tailor the lighting to the individual

needs of each person, these lights should all be dimmable.

Flexibly adjustable lights offer the possibility of aligning the light exactly where it is needed at the moment. Wall or clip-on lights with a movable light head on a flexible arm are therefore ideally suited. In this way, the light can always be aligned quickly and easily as soon as the sitting or lying position is changed. Authentic reading pleasure is achieved above all through good color rendering: This works particularly well with lights with a color rendering index of over 90.

Such a light source should be placed either to the side or behind the reader. The eye is then neither dazzled by the direct light from the front nor by a reflection on the paper. Especially when reading, you have to pay special attention to the individual person and their needs,

because the following applies: In old age, twice as much brightness is required for good visual performance and sensitivity to glare also increases significantly with age.

Perfectly matched

The salon is often used by different people at the same time for very different purposes. Therefore, one point is essential when planning the lighting: so that the reading light of one person does not disturb the other when working on the laptop and does not create any distracting light reflections on the screen, all the lights in the room should be coordinated and glare-free.





LIGHT IN THE BUNK



You lie comfortably in the bunk in the evening and want to end the day with a good book. Your partner, on the other hand, is exhausted from a long day of vacation and wants to go to sleep. If you do read a few chapters too many, you'll find it hard to get out of bed in the morning. The only thing that helps is lighting that simulates sunrise. In front of the mirror while getting ready for a new day, you should have a clear view and sufficient light when choosing your wardrobe. So light in the bunk has to meet quite a few requirements.

light in the bedroom

In order for this to succeed, of course, the first thing to do is to ensure a basic level of brightness. This is traditionally achieved with a ceiling light that is placed in the middle of the room. A more individual alternative to this are functional or wall-related surface-mounted lights or recessed spotlights. These can also ensure the required basic brightness in the room, but at the same time also take on other

functions. For example, they illuminate the wardrobe or set the stage for pictures or other objects that are to be emphasized. Another modern option to create good basic lighting in your bedroom are light lines. These immerse the room, for example in the form of light coves, in a soft and diffuse light. In addition, they are dimmable and can be controlled via an app, so that they quickly achieve the desired brightness.

light in bed

Table lamps on the bedside table or permanently installed wall lamps next to the bed are particularly suitable for reading. This gives you the best view both in the morning and in the evening and you can relax and immerse yourself in your book. In addition, flexibly rotating and swiveling lamp heads or lamps with movable arms that can be individually adjusted can help here.

It is also important that these lights can always be switched on and off and dimmed separately from each other. And so that you don't have

to get out of bed again, the corresponding switch should definitely not be more than an arm's length away.



LIGHT IN THE PANTRY



You have to cook on the water too. To ensure that nothing goes wrong in the galley kitchen, optimal lighting conditions must prevail here. Otherwise, accidents can easily happen when handling hot stovetops, bubbling pots and sharp knives. In addition to minimizing the risk of accidents, good light in the pantry also makes work easier and creates a nice atmosphere. After all, cooking should be fun! Here, too, is the basic ingredient: good general lighting.

It provides the necessary basic brightness and provides orientation in the room. In the pantry, for example, wide-angle ceiling lights are suitable. In the best case, two of these are installed asymmetrically in the room. But downlights distributed over the entire ceiling surface are also a good solution here. When it comes to illuminance, care should be taken to ensure that it is

300 to 500 lux. On the one hand, this is important for safety reasons and, on the other hand, to ensure good color reproduction. This is the only way the chef can judge correctly whether everything is right, so that there are no disappointments on the plate at the end. Therefore, a CRI of at least 80 or higher should also be ensured here.

light in the workplace

Of course, there is a special focus on the lighting of the work areas. Care must be taken here to ensure that no disturbing shadows are created. This occurs, for example, when there is only one light in the room radiating from the middle of the ceiling. So it is mostly your own shadow that hinders you in your work. Decentralized lights that illuminate the work area from the front, from above or from the side are therefore more suitable. In the

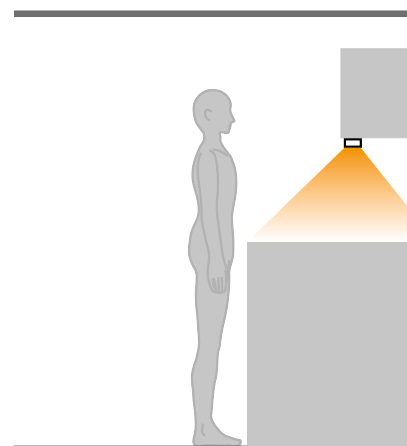
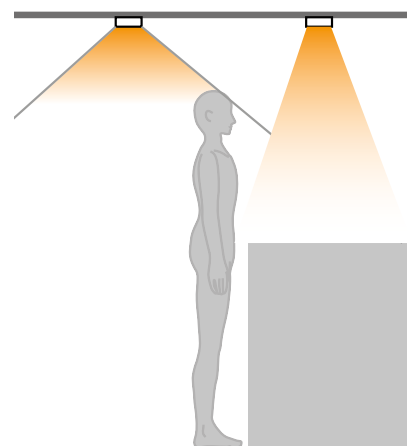
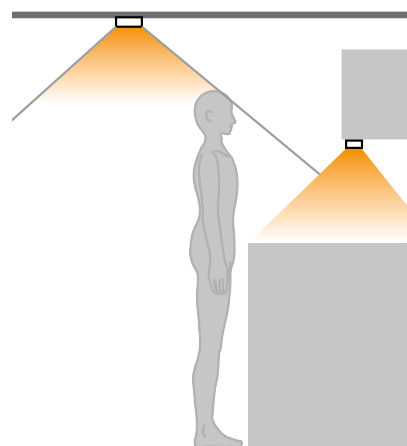
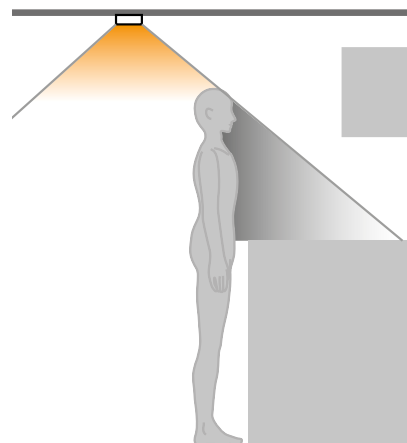
pantry, kitchen wall cabinets are particularly suitable because suitable lighting can be embedded on the underside, which shines onto the work surface. Here, too, the following applies: Illuminance should not fall below at least 300 to 500 lux. If the lighting is installed in the pantry later, powerful LED under-cabinet lights or linear LED profiles are ideal. Important: When selecting the lights, attention should be paid to fire protection symbols (F, M or MM).



prebit Surfaced Wall- /Ceiling Lights UB01-3

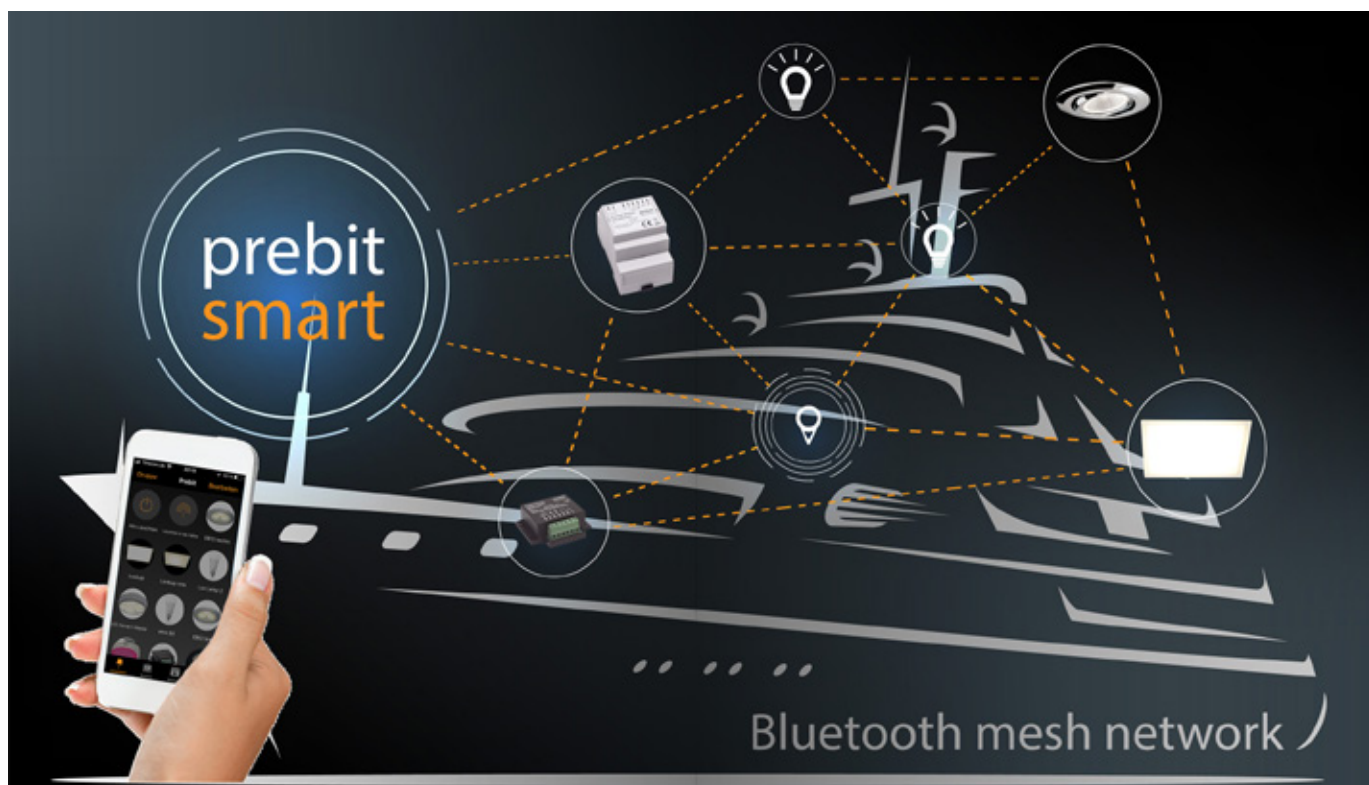


Linear LEDs in aluminum profile



LIGHT CONTROL

MOBILE DEVICES AS REMOTE CONTROL



Lighting concepts that are based on personal preferences through targeted light control and can be adapted to specific needs depending on the situation create a very special atmosphere. Whether it's preparing a great dinner in the pantry or enjoying a cozy get-together in the lounge, smart lighting is a great option here. With a tap of your finger on a smartphone, tablet or display on the wall, the light can be controlled and the mood in the entire room can be changed. Smart Lighting

Smart lighting is, as the name suggests, "smart": First of all, the light

can be easily changed, for example using voice control. In this way, the light can be adapted to the mood and situation without having to move from your seat.

If you come back to the yacht after a nice day on land, the system recognizes this automatically and illuminates the entire living area with cozy after-work lighting. When leaving the yacht, on the other hand, the light goes out automatically or continues to simulate a presence, so that potential burglars are deterred. You can also play with different lighting moods. In this way, the lighting can simulate a sunrise in the morning: the brightness only

increases slowly in order to gently and in a good mood wake up even those who find it difficult to get out of bed. In the evening, exactly the opposite follows: the light mimics a sunset. The light slowly fades and creates a cozy evening atmosphere. The lighting control on the entire boat can be set according to the human-centric lighting concept, which ensures harmony and well-being.

The possibilities for smart lighting are great: from the simple control of the lighting via a remote control to a lighting system that runs through the entire yacht and is networked with each other. Lighting scenarios

ensure an individually tailored feel-good atmosphere. In addition to the artificial light, blinds or music can of course also be operated via the smart control.

Technical requirements

At the beginning of the lighting planning on a yacht, it is necessary to consider where lighting and what type of lighting is required. Indoors only? Is special lighting required outdoors? Should only individual lights be controlled or is a complete smart lighting system available? Outside, smart control of the light is definitely a good idea.



Such a system can also be attached to the boat at any time afterwards. However, laying extra lines for this should only be considered if extensive renovation is necessary or if a new building is planned anyway. There are different solutions depending on the requirements:

infrared and radio

A simple solution is to control lights via infrared or radio, turn them on and off or dim them. For example, the brightness or light color can be changed using a simple remote control.

With an infrared remote control,

however, it must be noted that it only works with visual contact - similar to a TV remote control. This is not necessary with a radio trigger. He does not need visual contact and walls are not an obstacle here. However, the



communication between the wireless remote control and the light only works in one direction. So if the lighting in another room is dimmed, you will not receive any feedback as to whether this has actually happened.

Smart lighting via Bluetooth

If you want to get this feedback, you can use lights controlled via Bluetooth. This type of control allows bilateral communication between the devices and indicates the current status in an app on the

smartphone or tablet. The light can also be specifically controlled via the app: from switching on and off, to dimming, to changing the light color or color gradients. Timer functions or motion detectors can also be used with some providers. In addition, mostly battery-operated (wall) transmitters are available. If, for example, such a transmitter is installed next to the bed, the light can be conveniently switched on and off or dimmed from there.



WIE VIEL LUMEN BENÖTIGE ICH?

Folgende Lumen-Richtwerte pro Quadratmeter sollten für eine gemütliche Beleuchtung eingeplant werden:

Salon	~ 140 lm/m ²
Koje	~ 140 lm/m ²
Flur	~ 140 lm/m ²
Pantry	~ 280 lm/m ²
Bad	~ 280 lm/m ²

Smart Lighting and Smart Home

If there is WiFi and a gateway on board, this can also be used to smartly control the yacht's lighting. This variant offers even more diverse options and convenience for light control using the common wireless standards Zigbee or EnOcean.

Via a base station connected to the Internet router, control commands from a smartphone or tablet are sent to the lights via the WLAN connection. There is a wide range of options here: entire lighting programs can be played, for example lighting scenarios such as special cinema lighting for television.

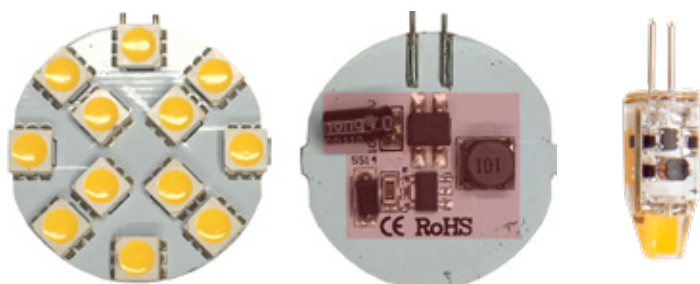
But other smart end devices such as blinds can also be controlled in this way.

Smart home via cable and bus solutions

If a yacht is newly built or renovated, a smart home system can also be installed using data cables. This option is much more complex, but offers a lot of possible variations. Cable networks such as Dali, DMX or KNX are used for this. These enable communication with a wide variety of smart home-enabled devices. Complex programs can be used and products with Bus (Binary Unit System) control electronics can be added. If one of the devices fails, this has no effect on the other connected components.

All connected devices can be controlled via various devices such as smartphones or a touch display on the wall. Various light scenes can be programmed and called up and the system can be expanded as required. Of course, the system can also be controlled via language assistants and while on the go.





(picture 1)

picture 1
(Retro-Fit LED with switching regulator, there is no EMC filtering)

picture 2
(The area marked in green indicates the input filtering, the red area indicates the switching regulator)



(picture 2)

RADIO INTERFERENCE BY LED

Recently, a US Coast Guard report appeared in the media and caused uncertainty regarding LED lighting on board.

"The US Coast Guard warns of significant radio interference that can be caused by onboard LED lighting. This interference can affect both VHF radios and AIS devices as they both operate in the same frequency range..."

There is a lot to consider when choosing the right lighting on board. One point that you must not ignore is electromagnetic compatibility. Otherwise serious problems can arise:

Every electronic device and therefore also an LED light generates electromagnetic emissions (emissions) on the one hand and can be influenced by electrical or electromagnetic interference from other devices on the other (immunity). This interference between devices is called electromagnetic compatibility (EMC).

The most important relevant standards for luminaires are:
 EN 55015 / CISPR15 emissions
 EN/IEC 61547 immunity
 EN / IEC 61000-3-2 Harmonics
 EN/IEC 61000-3-3 Flickers

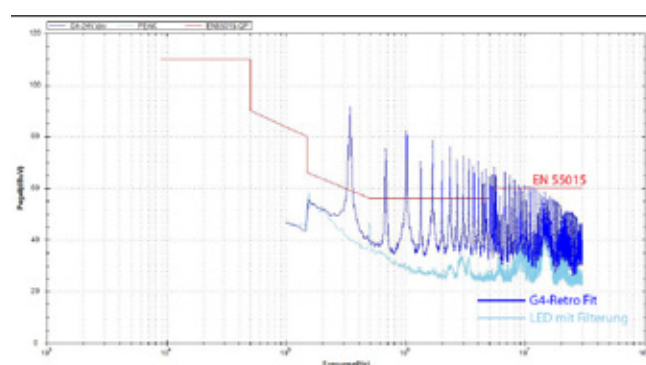
There are various EMC phenomena that can emanate from LED lights or retrofit LEDs: Conducted interference, radiated interference, the generation of harmonics and immunity to impulse interference, to name just the most important ones. Conducted interference in particular often causes considerable problems on board a yacht. In addition, for reasons of space, electrical lines and antenna cables laid in parallel over a long distance can have an unfavorable effect on radio, receiving or transmitting systems.

In general it can be said: The more electronics, the more

EMC problems can potentially arise. For this reason, complex input filters are integrated into the electronics of modern LED lights. These ensure that the interference radiation on the lines is reduced to a standard-compliant level. The inexpensive retrofit LEDs are usually not a good choice here.

interference voltage

In order to be able to assess the line-bound emission of an LED light, the interference voltage transmitted via the line network is measured. LED lights and retrofit LEDs are usually provided with an integrated switching regulator to increase the efficiency of the light. Despite the relatively low LED power of only a few watts, the steep edges of the switching controller cause a high potential for interference, which must be minimized by using appropriate interference suppression components. If there is no interference suppression, the interference voltage clearly exceeds the limit, which has significant negative consequences for radio reception or transmission.



(picture 3) EMV-Precompliance Measurement



CLOSING WORDS

W

hat must be considered when planning the lighting? Which mistakes should be avoided urgently? How do you recognize quality? And what do the symbols on the different light sources actually mean? These were all questions that might have been floating around in your head before you read this little manual. We hope we were able to shed some light into the darkness. Because we know – and now you too – that light is so much more than just illumination. You now know how our eyes deal with light and darkness, how diverse lighting can be and what is necessary to put rooms and situations in the right light - and last but not least: how all this also ensures that you feel good all around . So that this is also the case on board your yacht and in the various rooms with their very different properties and possible uses, it is worth having some basic knowledge of light and lighting and going into the planning with open eyes and know-how – too when you get help from a professional.

IMPRINT

Publisher

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Industriestr. 21
53359 Rheinbach
Tel. 02226 89228-0
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editing and design

prebit GmbH
www.prebit GmbH
Sonja schreibt
www.sonjaschreibt.de

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