ERCO

LEDs in ERCO luminaires

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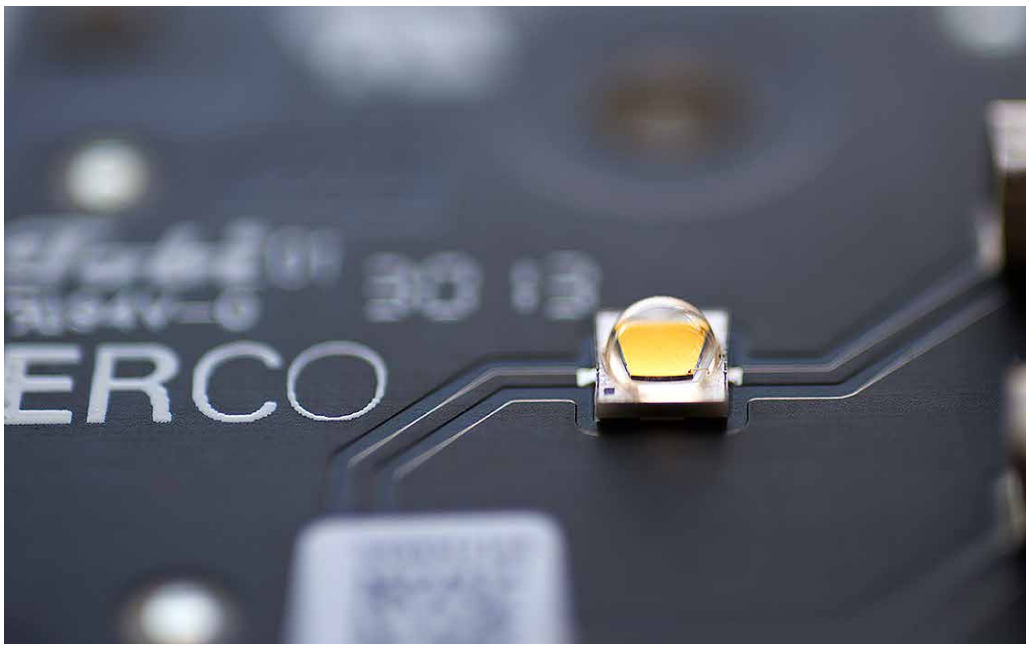

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LEDs in ERCO luminaires

The following pages give details of the LEDs used at ERCO. The consistently high quality of these LEDs is the result of a selection process based on criteria which we have described here for your information.

Technical data
ERCO uses the same High-power or Mid-power LEDs for the entire product range. This results in the enormous advantage for users that the quality of light always remains at a consistently high level.
For flexible use, in addition to the six standard light colours, controllable (tunable white) colour spectra are also available for some applications.

LED modules
ERCO luminaire systems in the catalogue are differentiated according to the efficiency of their LED modules. The separate consideration of module luminous flux, luminaire luminous flux and connected load enables better evaluation of the photometric and energetic efficiency. In addition to the module values, the efficiency data for the complete luminaire is separately specified in the catalogue and data sheet for this purpose.

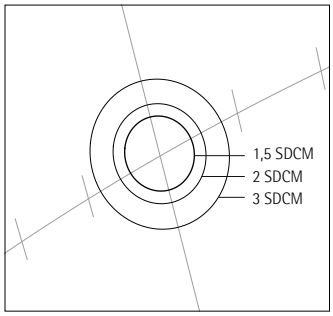
High-power LED						
Colour temperature	2700K	3000K	3000K	3500K	4000K	4000K
Luminous efficacy*	99lm/W	105lm/W	101lm/W	121lm/W	138lm/W	128lm/W
Colour rendering	CRI 92	CRI 92	CRI 97	CRI 92	CRI 82	CRI 92
Lumen maintenance	L90/B10 up to 50,000 hours					
Failure rate	0.1% up to 50,000 hours					
Mid-power LED						
Colour temperature	2700K	3000K	3000K	3500K	4000K	4000K
Luminous efficacy*	118lm/W	156lm/W	127lm/W	137lm/W	156lm/W	137lm/W
Colour rendering	CRI 92	CRI 82	CRI 92	CRI 92	CRI 82	CRI 92
Lumen maintenance	L80/B50 up to 50,000 hours					
Failure rate	0.1% up to 50,000 hours					
Chip-on-board LED (COB)						
Colour temperature	2700K	2700K	3000K	3000K		
Luminous efficacy*	138lm/W	115lm/W	142lm/W	120lm/W		
Colour rendering	CRI 82	CRI 92	CRI 82	CRI 92		
Lumen maintenance	L80/B50 up to 50,000 hours					
Colour temperature	3000K fashion	3500K	4000K	4000K		
Luminous efficacy*	101lm/W	125lm/W	149lm/W	128lm/W		
Colour rendering	CRI 92	CRI 92	CRI 82	CRI 92		
Lumen maintenance	L80/B50 up to 50,000 hours					

* Determination of luminous efficacy: LED module High-power / Mid-power / COB at 700 / 120 / 1050 mA; Ts 25°

Note: all data are statistical averages.

LEDs in ERCO luminaires

LED selection
As is the case with all semiconductor products, white LEDs exhibit a degree of production tolerance. Such tolerances exist in areas such as the colour loci, lumen maintenance, and forward bias. ERCO considers all these criteria in the selection of its LEDs providing users with the highest possible quality.



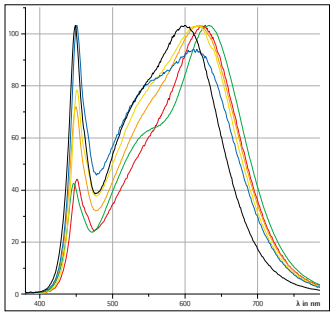
Colour consistency (SDCM)
The SDCM value (Standard Deviation of Colour Matching) is used to qualify a light source with regard to colour consistency (colour location deviation).
The SDCM (Standard Deviation of Colour Matching) value defines an LED in terms of colour consistency (chromaticity variation). It is based on a study conducted by American engineer David MacAdam and describes the degree of deviation from a defined chromaticity coordinate in the CIE diagram. According to MacAdam, the coordinates of all colours perceived as identical lie within an ellipse around the reference colour location. The system, created by adding further ellipses of increasing size, is used to classify the maximum colour deviation of light sources. Occasionally also referred to as MacAdam ellipse of a certain step size, the commonly accepted term is now SDCM. The higher the SDCM value, the greater the possible deviation of the light colour from the colour coordinates specified in the technical data of the light source.
In addition to LED selection, the current applied to the LED module and the operating temperature of a luminaire also influence the SDCM value. Higher temperatures may cause a shift in the colour location. The operating temperature depends on external conditions such as the ambient temperature, the operating current and the heat management of a luminaire.

SDCM for ERCO LED modules with High-power LEDs
ERCO LED modules with High-power LEDs demonstrate very good colour consistency. The LEDs are selected with a special binning process, giving the modules an excellent typical initial value of SDCM ≤ 1.5. See the appropriate data sheet for the specific value for the respective luminaire.

SDCM for ERCO LED modules with Mid-power LEDs
ERCO LED modules with Mid-power LEDs achieve the excellent typical initial value of SDCM ≤ 1.5. ERCO achieves this by carefully selecting and combining the LEDs on the modules. See the specific data sheet for the concrete value for the respective luminaire.

Production
ERCO LED modules in Lüdenscheid, Germany

LEDs in ERCO luminaires



Spectrum
LEDs in ERCO luminaires have a continuous spectrum, thereby ensuring good to very good colour rendering for neutral white (4000K) and very good colour rendering for warm white (2700 – 3000K). The LEDs deliver practically no UV or IR radiation and have a low damage factor making them ideal particularly for the illumination of sensitive and valuable objects.

Luminaires with tunable white enable the setting of colour temperature. This allows the light colour to be adapted to daylight and specific visual tasks based on the principle of HCL (Human Centric Lighting).

Damage factor
The relative damage factor is used to assess suitable light sources for conservation requirements such as in museums. It specifies the ratio of the damaging radiation intensity and the illuminance. Warm white LED lighting is even better suited for delicate objects than low-voltage halogen lamps with or without UV filter.

Light source	Relative damage factor f (mW/lm)
LED 2700K, CRI 92	0.151
LED 3000K, CRI 92	0.165
LED 3000K, CRI 97	0.160
LED 3500K, CRI 92	0.170
LED 4000K, CRI 82	0.190
LED 4000K, CRI 92	0.198

Reference colours R_a (CRI)

Evaluation of colour rendering using R_a (CRI)
Colour rendering refers to the ability of a light source to reproduce colours faithfully in comparison with an ideal or natural light source. One method used to quantify the colour rendering quality with maximum objectivity is the colour rendering index, CRI, also sometimes referred to as R_a in parts of Europe. It is calculated by comparing the colour rendering of the test source to that of a reference illuminant with correlated colour temperatures. A colour rendering index between 90 and 100 is considered very good, and a value between 80 and 90, as good. The CRI method as the only normatively valid process until now is highly controversial in expert circles and should only be used as a rough guide for a light source. For the best results, comparison of several light sources during a visual assessment may be worthwhile.

Reference colours TM-30

Evaluation of colour rendering according to TM-30
As an alternative to the R_a /CRI process, TM-30 defines the values R_f und R_g. These reference the similarity to a test light source and reference spectrum with regard to colour fidelity (R_f - fidelity) and saturation (R_g - gamut). The reference light source is a "black body" or standard CIE-D light source. R_f is comparable with R_a and the calculation method and maximum value of 100 are identical. By considering 99 instead of 8 reference colours, lower values often result with R_f compared to R_a /CRI.

R_g specifies the colour range, i.e. the size of the displayable colour space. A light source with precise, true-to-nature colour rendering has an R_g value of 100; both smaller and larger values are possible.

R_f and R_g on their own however do not provide definitive information about the colour rendering quality of a light source. This is only possible with the colour vector graphic that displays the size and direction of colour shift for selected test colours compared to a reference light source.

If the determined curve is located outside the circumference valid for the reference, colours in this area are rendered with oversaturation. If the curve is inside, the corresponding colours are rendered with a lower saturation.

LEDs in ERCO luminaires

Ratio of R_f to R_g

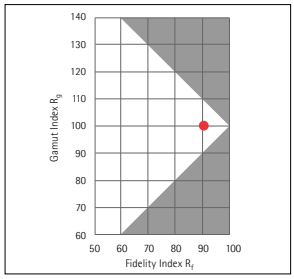
Colour vector diagram

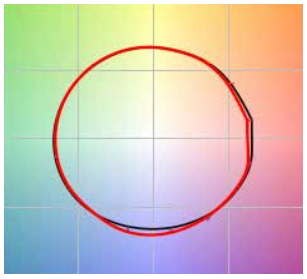
Reference
ERCO LED

ERCO LED 2700K

R_f 91
R_g 100

R_a / CRI 92

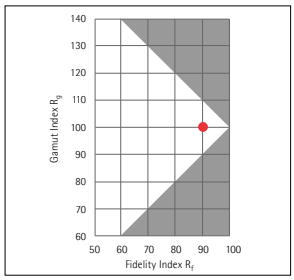


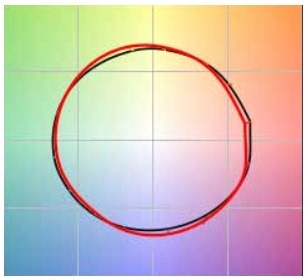


ERCO LED 3000K

R_f 90
R_g 100

R_a / CRI 92

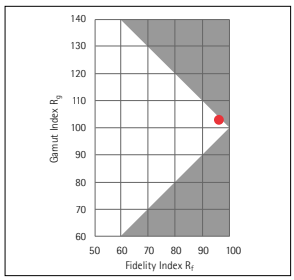


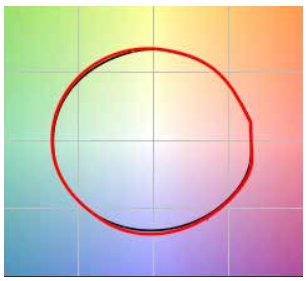


ERCO LED 3000K

R_f 96
R_g 103

R_a / CRI 97

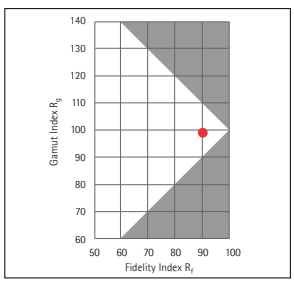


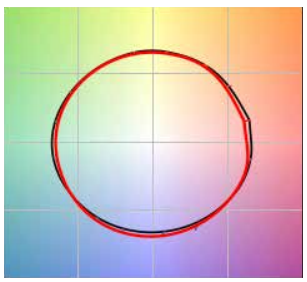


ERCO LED 3500K

R_f 90
R_g 98

R_a / CRI 92

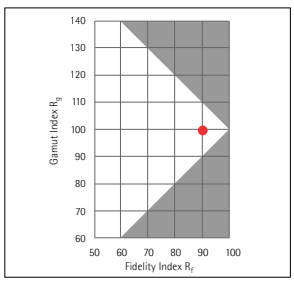


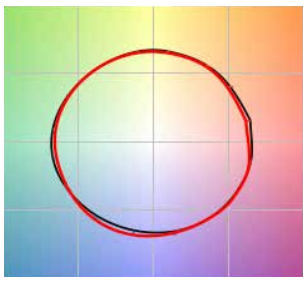


ERCO LED 4000K

R_f 90
R_g 99

R_a / CRI 92

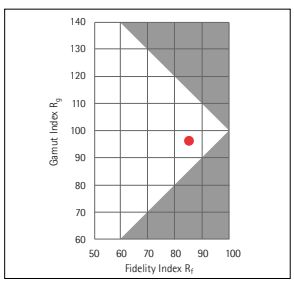


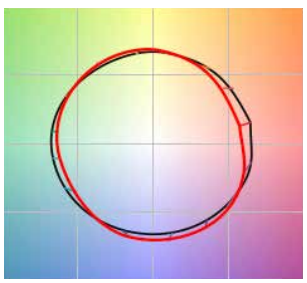


ERCO LED 4000K

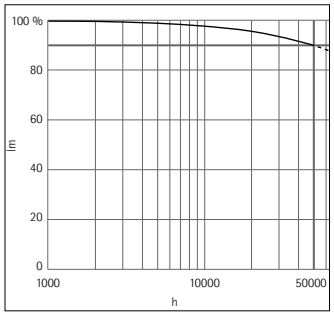
R_f 85
R_g 97

R_a / CRI 82





LEDs in ERCO luminaires



Functional life
LEDs have a very low failure rate, meaning they produce light over an exceptionally long period of time. The failure rate of the High-power LEDs used by ERCO is on average less than 0.1% up to 50,000 hours. In contrast to conventional lamps, which have a failure rate of 50%, the term "functional life" therefore is not very useful for planning purposes.

Lumen maintenance
As with other light sources, the luminous flux of LEDs decreases over time so that from a certain point the illuminance originally required is no longer achieved. The reliability and efficiency of LEDs depend largely on its operating conditions. ERCO luminaires therefore are thermally designed to remain below the critical temperature range when properly operated to ensure maximum luminous flux over a long life.

Since total failure of an LED is very rare, LEDs are more accurately defined by using the lumen maintenance factor over a specific period of time. As a blanket value it is common practice to indicate the time after which the luminous flux for a specific percentage of all LEDs has reduced to 70%, 80% or 90% of their original luminous flux.
The standard specification of LEDs currently used in the market is L70/B50 50,000h, i.e. after 50,000 hours, only 50% of the LEDs used still achieve 70% of their original luminous flux.

L and B values
The L value represents the percentage of original luminous flux that the LED continues to achieve after the specified number of operating hours.
By definition, the B value reveals nothing about the total failure of an LED. It indicates the percentage of LEDs that fall below the L value after the specified number of operating hours.
If no B value is indicated, B50 should always be assumed.

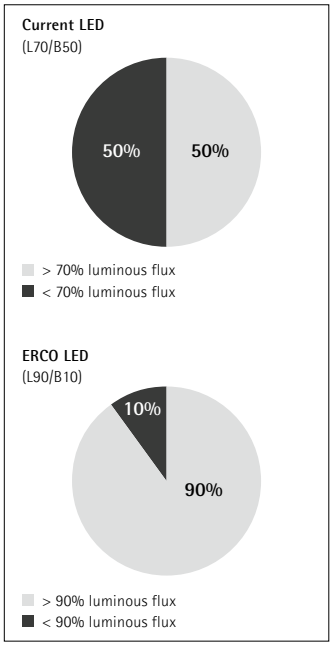
Operating duration
The reference point is always the operating time together with the L and B values.

LEDs used by ERCO
High-power LEDs
ERCO uses High-power LEDs with the specification L90/B10 50,000h, meaning 90% LEDs still achieve 90% of their original luminous flux in up to 50,000 hours. The residual 10% of the LEDs still have up to 89% of their original luminous flux with a failure rate rate of 0.1%.
In accordance with manufacturer specifications the High-power LEDs used by ERCO have a specification of L90/B50 up to 100,000 hours.

Mid-power LEDs
The Mid-power LEDs used by ERCO are specified at up to 50,000h with L80/B50 and a failure rate of 0.1%.

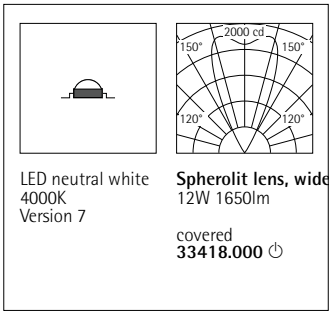
COB (Chip-on-board) LEDs
The COB LEDs used by ERCO are specified with L80/B50 at up to 50,000h.

Current information about the LEDs can be found on the data sheets of the respective articles.



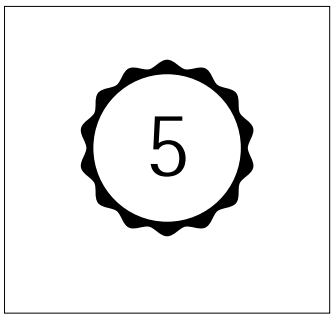
Comparing the reduction in luminous flux of a standard LED with an ERCO high-power LED after 50,000 operating hours illustrates the superior efficiency of ERCO LEDs.

Forward voltage
Due to the manufacturing process, LEDs of the same type vary in terms of their forward voltage. This is the voltage drop across an LED, in other words, the volts it "consumes". Together with the constant operating current, forward voltage defines the power consumption of an LED luminaire using the simple formula of voltage (volt) x current (ampere) = power (watt). Therefore, if the forward voltage of LEDs were to fluctuate, the energy requirement of the luminaires, though otherwise similar, would also vary. Consistent energy consumption across luminaires of the same design can only be guaranteed if the LEDs used in them are selected for their forward voltage. ERCO is one of the few luminaire manufacturers that specifies consistency in forward voltage as part of its selection criteria. The goal is to give the user assurance that the energy requirement specified for the luminaires used relates to actual figures.



Version
LEDs and control gear are continually advanced. In order to clearly identify which LEDs are used in a product, ERCO specifies a version number alongside the article number, which is found on each luminaire. This number applies to a luminaire range and bears no reference to the LED generation, i.e. luminaires from different product ranges may use the same LED generation despite the difference in version number. The version number is important for the user to know and must be stated particularly when reordering luminaires.

Within a given production year, ERCO always uses the latest generation of LEDs in all luminaires with a warm white or neutral white light colour.



The guarantee terms pertaining to the voluntary manufacturer's guarantee of 5 (five) years given by ERCO GmbH on ERCO products shall apply in addition to our General Terms and Conditions.

Full details of these current guarantee terms are available on request by e-mailing guarantee@erco.com

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