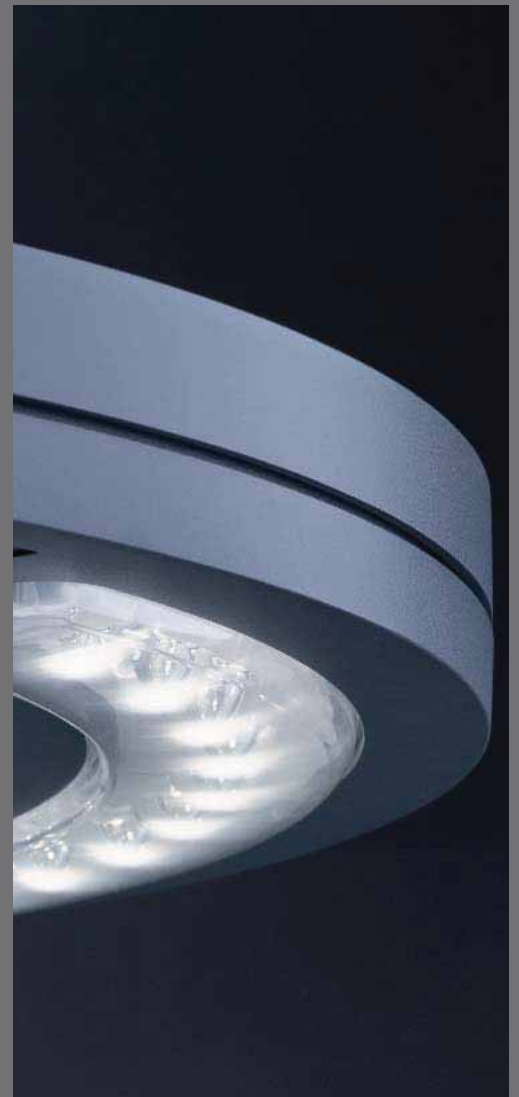
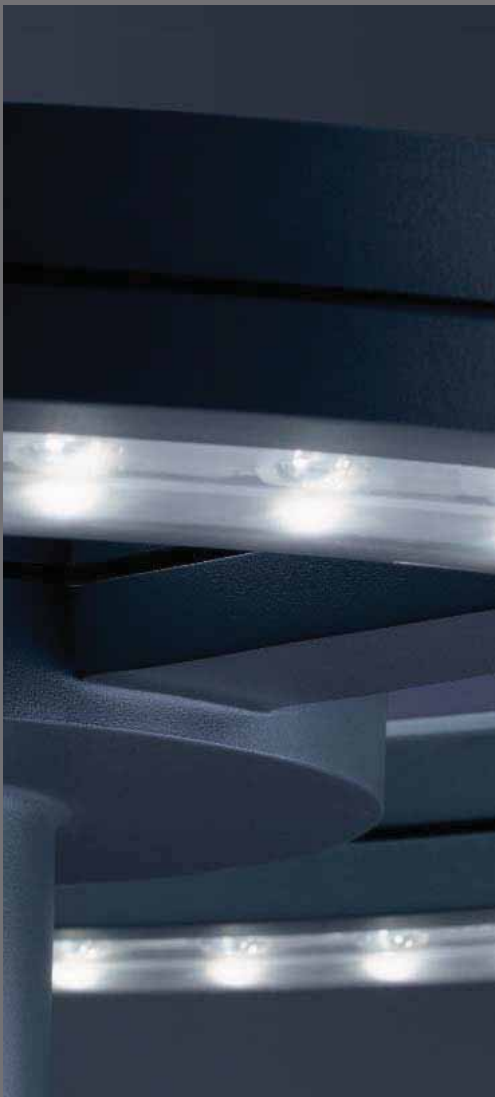


we-ef

WE-EF LEUCHTEN
General Catalogue
Asia Pacific Edition
2016-2018

Technical Information



TECHNICAL INFORMATION



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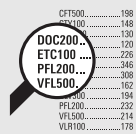
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IOS® INNOVATIVE OPTICAL SYSTEM

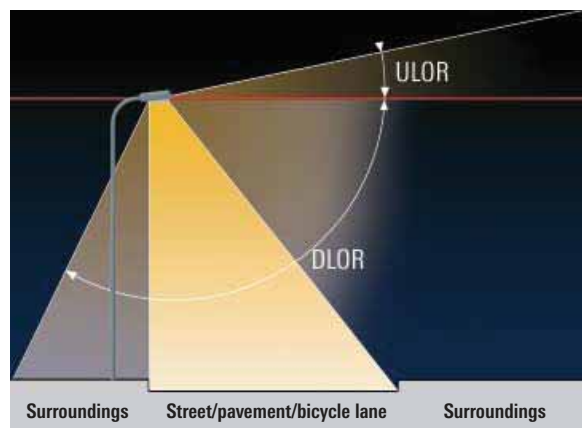
WE-EF's IOS® Innovative Optical System has been developed to satisfy two specific requirements; the first relating to the various international lighting standards that prescribe performance and focus on public amenity and safety issues; the second being the wide range of customised solutions that are typically the domain of the lighting design professional. IOS® is a complete system with a comprehensive set of solutions, including optical accessory toolkits that are purpose designed, engineered and tested.

IOS® system applies across the WE-EF range of luminaires and includes:

- In-house CAD design.
- Precision manufactured optical system.
- High photometric performance, beam efficiency and control.
- Superior glare control and visual comfort through appropriate shielding angles.
- Tooling exclusive to WE-EF.
- Optional optical accessory toolkit.

In street and area lighting applications, IOS® features full cut-off light distribution in compliance with European standard EN 13201 (Class G3/G4/G5/G6):

- Zero light emission above the 90° horizontal.
- Tightly controlled 'candela' intensities in the critical high-angle glare zone at 80°-90° (from nadir).
- Solutions to light trespass and dark skies concerns.



ULOR: The main purpose of an optical system is to direct light onto a specified target surface. Particularly in streetlighting applications, any amount of light that is emitted above the horizontal, must be considered not merely as being wasteful, but equally so as polluting the night sky. The Upward Light Output Ratio (ULOR) is a measure of how much light escapes from a luminaire into the sky. Obviously, a ULOR of zero per cent is desirable. The better the optical system, the lower the burden on our environment.

IOS® for LED (Light Emitting Diodes)

With LEDs being vastly different from traditional light sources such as metal halide, a very different approach to designing optical systems is required. The LED's tiny dimensions, its unique own light distribution pattern, as well as its highly sensitive thermal characteristics pose great challenges to any specialist involved in such an endeavour. While most optics found in the market are lens based, it is striking to see fundamentally different approaches towards the actual function and performance of such systems. For example, in street and area lighting applications, a common approach is to combine LEDs with individual, symmetric or elliptical lenses which are then selectively aimed, as a means of achieving a uniform distribution. Through this multi-spot technique, the resulting interaction and overlapping of beams delivers overall light levels and, to some extent, uniformity. WE-EF's engineers have taken the opposite approach by pioneering a radically different, multi-layer technique, the OLC® One LED Concept: All LEDs within a luminaire are fitted with identical, CAD engineered lenses, and aimed in the same direction. As a result, illumination on the target surface will uniformly increase in intensity if more LEDs are added (or, conversely, be reduced if LEDs are removed), while uniformity levels always remain fully intact.

OLC® One LED Concept

The OLC® technology presents an ideal, future proof solution for street and area lighting applications. It combines the multi-layer lighting approach with modular PCB/LED/lens engineering and thereby balances the need for safety with visual comfort and energy savings.

Main features of OLC® One LED Concept:

- CAD-engineered and precision manufactured lenses deliver a tightly controlled light distribution while reducing light pollution to an absolute minimum.
- In case of failure of one or several LEDs within a luminaire, light levels drop, while uniformity is retained.
- Modular PCB/LED/lens assemblies can be replaced in case of failure or for upgrading.
- The system is 'future proof' and, when upgraded to next generation LEDs, will retain its photometric integrity.



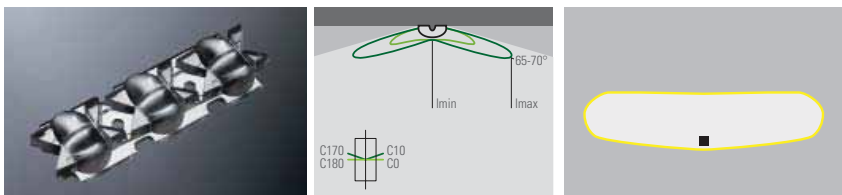
Common multi-spot approach.



WE-EF's multi-layer technique.

[P65] Lens – Main Features

- Pedestrian/bicycle lane distribution.
- Optimised for illuminance-based design work (maximum spacing). The '65' references the nominal angle of peak intensity from nadir (downward vertical).
- Zero light emission above the 90° horizontal (ILE Class E1/E0). Ideal for the lighting of pedestrian and bicycle lanes to EN DIN 13201, Class S2-S4. For a one-sided arrangement, spacing = 5 to 7 times MH.

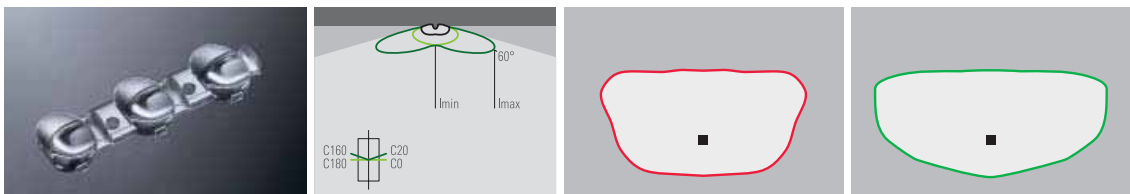


[P65] Lens for pedestrian/bicycle lane distribution.

[P65]

[S60] and [S65] Lenses – Main Features

- Streetlighting distribution.
- Optimised for luminance-based design work (high visual comfort). '60' and '65' reference the nominal angle of peak intensity from nadir (downward vertical).
- Zero light emission above the 90° horizontal (ILE Class E1/E0). Ideal for luminance based streetlighting layouts to EN DIN 13201, Class ME3-ME5. For a one-sided arrangement, spacing = 5 to 5.5 times MH, longitudinal uniformity $U_l \geq 0.4$, glare limitation $T_i < 15$ per cent.



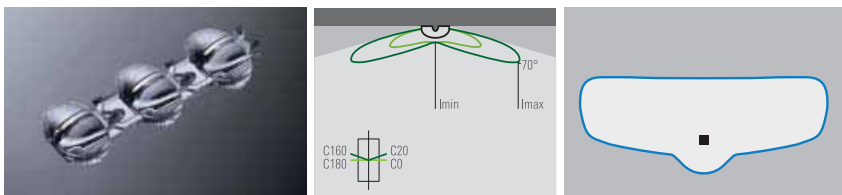
[S60] Lens for streetlighting distribution.

[S60]

[S65]

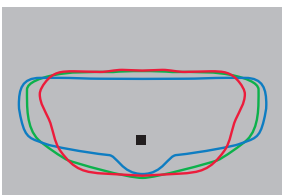
[S70] Lens – Main Features

- Streetlighting distribution.
- Optimised for illuminance-based design work (maximum spacing). The '70' references the nominal angle of peak intensity from nadir (downward vertical).
- Zero light emission above the 90° horizontal (ILE Class E1/E0). Ideal for illuminance based streetlighting layouts to EN DIN 13201, Class S1-S6. For a one-sided arrangement, spacing = 7 to 9 times MH, overall uniformity $U_o \geq 0.2-0.4$, with good visual comfort (the standard does not specify T_i values for glare limitation).



[S70] Lens for streetlighting distribution.

[S70]

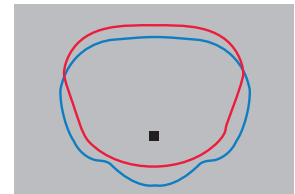
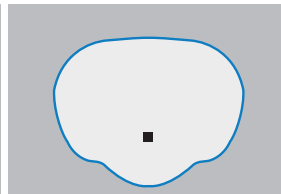
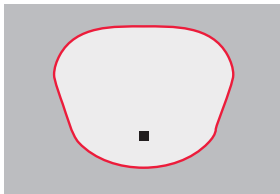
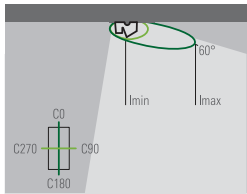


[S60] [S65] [S70] Light distribution in comparison.

IOS® INNOVATIVE OPTICAL SYSTEM

[A60] and [R65] Lenses – Main Features

- Asymmetric 'forward throw' distribution.
- Nominal angle of peak intensity through 60°-65° from nadir (downward vertical).
- Rearward light spillage limited to an angle of 10°.
- Zero light emission above the 90° horizontal (ILE Class E1/E0). Ideal for lighting public spaces where visual comfort (glare) is of concern.



[A60] Lens for asymmetric 'forward throw' distribution.

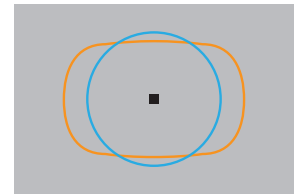
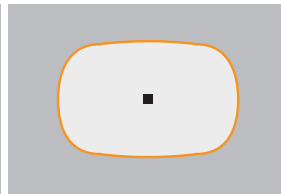
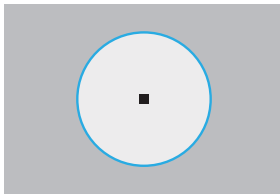
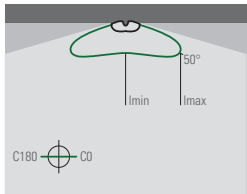
[A60]

[R65]

[A60] [R65] Light distribution in comparison.

[C50] and [R] Lenses – Main Features

- Symmetric and rectangular distribution.
- Optimised for illuminance-based design work (maximum spacing).
- Glare control index G1 in compliance with EN DIN 13201.
- Zero light emission above the 90° horizontal (ILE Class E1/E0). Ideal for public spaces where both horizontal and vertical illuminance, as well as visual comfort (glare) are of concern.



[C50] Lens for symmetric distribution.

[C50]

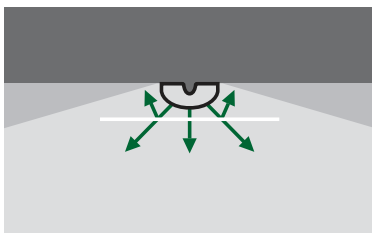
[R]

[C50] [R] Light distribution in comparison.

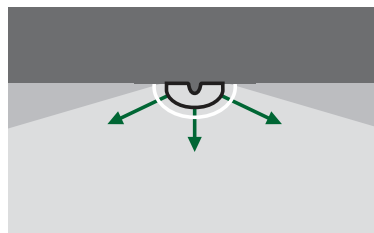
RFC™ Reflection Free Contour

The effective Light Output Ratio (LOR) of a WE-EF LED streetlighting luminaire is further improved by the use of an RFC™ main lens.

- The conventional flat glass is replaced by a UV-stabilised acrylic (PMMA) or polycarbonate (PC) main lens, featuring a contoured surface that follows the shape of the individual LED lens. The goal is to minimise the loss of light that normally occurs due to internal reflection.
- In the case of the [S60] lens, light transmission at the critical 60° (from nadir) is improved by approximately 20 per cent. With the [S70] lens, at the critical 70°, transmission is improved by approximately 30 per cent. Overall, as much as 5 per cent will be added to the Light Output Ratio (LOR) of the described luminaire types.
- In the case of the luminance-optimised [S60] lens, this results in a modest improvement in spacing of approximately 0.25 times MH. In the case of the illuminance optimised [S70] lens, a significant increase in spacing has been achieved, by up to 0.5-1.0 times MH. This adds to the economic and environmental benefits, favouring the combination of OLC® and RFC™ technologies.



Internal reflection from conventional, flat main lens.



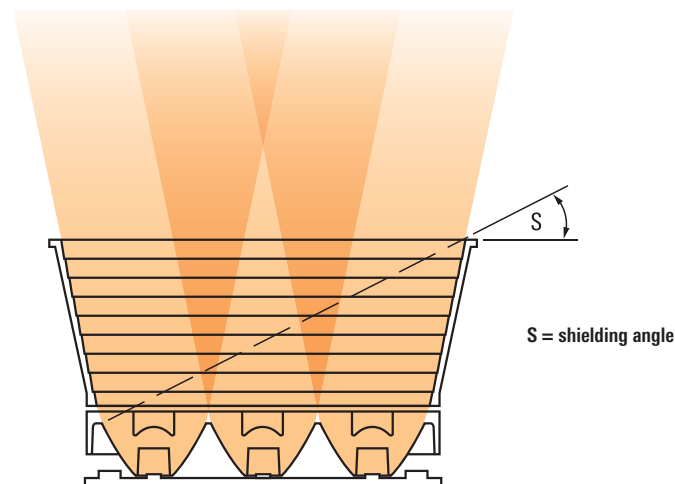
RFC™ technology delivers high light transmission.



The contour of the main lens follows the shape of the individual LED lens, thereby minimising internal reflections within the luminaire.

Control Shield

A number of LED luminaires featured in this catalogue combine symmetric beam optics with an integral control shield for enhanced glare control and high visual comfort.



LED ENGINEERING

Terminology and Definitions

Most terms and definitions used in this section are taken from 'Guidelines for Project Design Safety in LED Lighting' (Leitfaden Planungssicherheit in der LED-Beleuchtung), a document published by the German Electrical and Electronics Manufacturers' Association (ZVEI) in November 2013.

Rated Input Power P (W)

The electrical power from the mains supply, as consumed by a luminaire including its integral electrical and electronic components.

Rated Luminous Flux ϕ_v (lm)

Total radiant flux of a luminaire in its visible range; also referred to as 'initial luminous flux'.

Luminaire Efficacy η_v (lm/W)

The ratio of a luminaire's total luminous flux versus its rated input power.

Rated Ambient *Operating* Temperature T_a (°C)

The maximum ambient temperature at which a luminaire can be operated whilst maintaining all safety-relevant parameters. WE-EF luminaires are generally designed for operation at $T_a = 25^\circ\text{C}$. In most cases, test data confirm higher ratings, often at 40°C or more.

Rated Ambient *Performance* Temperature T_q (°C)

The maximum ambient temperature at which a luminaire delivers, for example, the specified values for luminous flux and service life. Data published in this catalogue are based on a rated ambient performance temperature of $T_q = 25^\circ\text{C}$.

Rated Service Life $L_x B_y$ (h)

The number of hours after which, from a group of LED luminaires:

- the luminous flux has dropped to x (%).
- y (%) of luminaires in the same group have dropped below the specified luminous flux.

Example: Requirement ' $L_{90} B_{10} - 60,000$ h' means that after 60,000 hours, the group of LED luminaires in question must still provide 90 per cent of the initial luminous flux, whereby 10 per cent of the luminaires are permitted to provide less than 90 per cent of the initial luminous flux.





LED ENGINEERING

Thermal Management

As a luminaire manufacturer, WE-EF’s challenge is to create the best possible thermal conditions inside its products so that, as far as technically feasible, LEDs are able to operate under optimum conditions, without failures. This objective can only be successfully achieved through reference to product data sheets published by the LED manufacturers, which are generally based on their internal test results and mathematical calculations. Determining if LEDs are operating at their optimum inside a luminaire will, for example, affect service life and luminous flux performance. These are significantly more complex tasks than those that have to be carried out for conventional lamps, and therefore require meticulous attention.

LED – Thermal Resistance (R_{th})

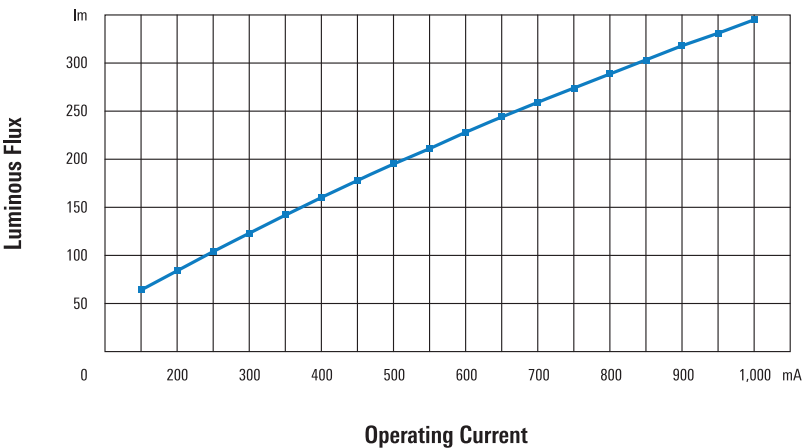
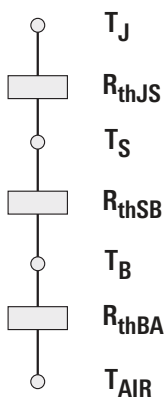
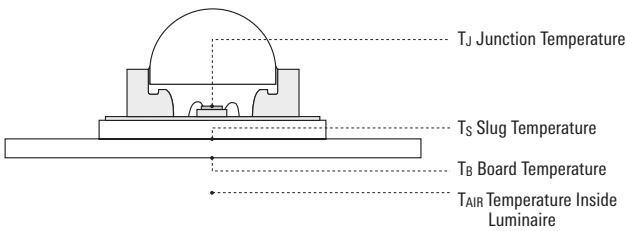
During recent years, LED developments have focussed on reducing thermal resistance in LEDs, i.e. $R_{th} = R_{thJS} + R_{thSB} + R_{thBA}$ (resistance between LED chip and contact area to the heat sink). The lower the thermal resistance, the less heat the LED is exposed to, which in turn increases luminous flux while reducing ageing and, thereby, extends service life. Luminaire manufacturers are able to influence thermal resistance by:

- Developing purpose designed, optimised heat sinks.
- Ensuring clean and level contact surfaces between LED circuit boards and heat sinks.
- Selecting LED circuit board materials with high thermal conductivity, e.g. aluminium, copper or ceramics.

LED – Operating Current (I_f)

LEDs may be operated at different currents. While 700, 1050 and 1,400 mA are most commonly applied now-a-days, developments are showing a clear trend towards 2,000 to 4,000 mA. The greater the operating current, the greater the luminous flux. Unfortunately, the relationship between these two parameters is a degressive one; meaning, when the current is increased, the luminous flux will increase only sub-proportionately – in other words, efficacy (lumens per watt) drops. This phenomenon becomes even more pronounced at increased junction temperatures.

At the current state of technology, it is between 350 and 1,400 mA that LEDs feature a desirable, more or less linear, relationship between operating current and luminous flux. LED manufacturers are expected to launch 2,000 to 4,000 mA rated LEDs with similar, close-to-linear performance characteristics in the foreseeable future.



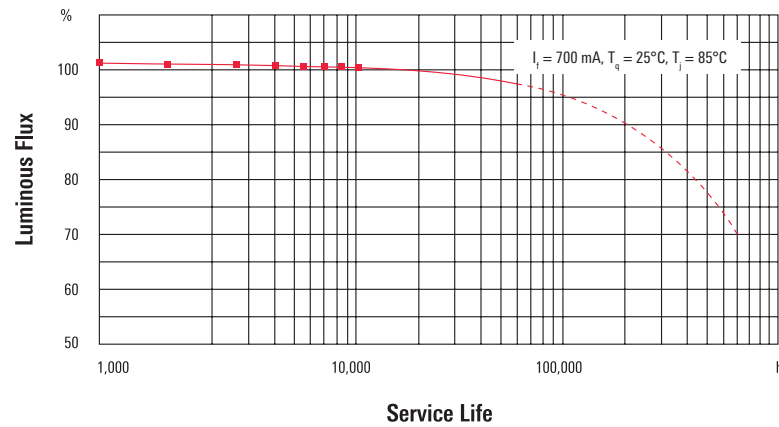
LED – Service Life and Junction Temperature (T_j)

Service life data published by LED manufacturers are based on values measured over a period of at least 6,000 hours, in accordance with LM-80-08. The combination of relevant test results with mathematical models, in line with TM-21, allows conclusions to be drawn regarding LED behaviour over a considerably greater period of time - up to six times the measurement period.

Likewise, luminaire manufacturers must also subject their products to extensive series of tests, so as to allow meaningful statements to be made about system service life. (WE-EF luminaires are subjected to a minimum 10,000 hours of continuous testing.)

The service life information that can be derived from this process is based on various assumptions that need to be clearly documented. The following essential data must be included in relevant test reports:

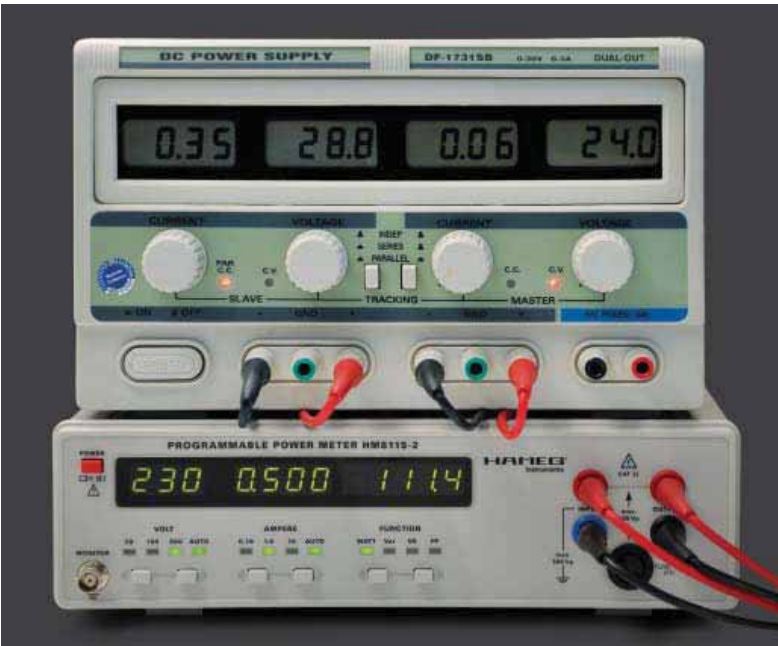
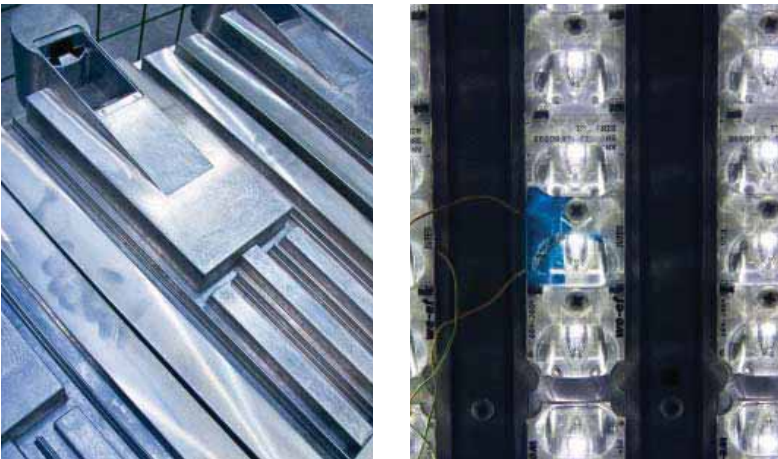
- Rated ambient performance temperature (T_q).
- LED operating current (I_f).
- Service life (L_xB_y).



Depending on operating current I_f and system performance, LED junction temperatures T_j vary from luminaire to luminaire. For luminaires featured in this catalogue, when fitted with the listed maximum number of LEDs and operated at I_f = 700 mA and T_q = 25°C, the resulting junction temperature reaches a maximum of approximately T_j = 85°C.

Should the actual on-site, mean ambient temperature for example stand at 30°C (vs. T_q = 25°C), then the junction temperature T_j will increase by the same differential (30°C to 25°C).

Like conventional lamps, LEDs age and the initial (nominal) luminous flux drops the longer an LED is in use. The lower the thermal load to which LEDs are exposed, the lower the decline in luminous flux. The diagram shown below depicts the relationship between an LED’s time of operation and its luminous flux (at I_f = 700 mA and T_q = 25°C, T_j = 85°C).



LED ENGINEERING

Maintenance Factor for Lighting Calculations

For professional project planning, application of a realistic and product specific maintenance factor (MF) for lighting calculations is crucial. If the maintenance factor is too high, overly optimistic results will be proven wrong by actual, on-site light levels falling below those defined by safety and other relevant standards. However, if the factor is too low, great opportunities to save on investment and operational costs (total cost of ownership) will be lost.

Traditionally, while using conventional lamps, luminaire manufacturers have provided information pertaining only to the luminaire maintenance factor (LMF), typically 0.8. However, with the introduction of LEDs, this approach has changed; with the use of high-quality LED systems, a maintenance factor of 0.9 or greater is often achievable. Since the LED light source is an integral part of the luminaire, three parameters are used to calculate the MF:

MF = LLMF x LSF x LMF

MF: Maintenance Factor

LLMF: LED/Lamp Lumen Maintenance Factor

LSF: LED/Lamp Survival Factor

LMF: Luminaire Maintenance Factor

LED/Lamp Lumen Maintenance Factor (LLMF)

The LED luminous flux that can be expected after a defined operating period can be calculated by multiplying its rated value with a factor that represents ageing performance. For example: VFL540 [S70] 4000K (108-0910):

- Nominal luminous flux: 8,854 lm.
- Rated luminous flux: 8,164 lm.

For a rated ambient performance temperature of 25°C, an operating current of 700 mA and an operating period of 60,000 h, Fig.1 indicates LLMF = 0.925. The theoretical minimum luminous flux at 60,000 h is calculated as 8,164 lm x 0.925 = 7,552 lm.

T _a = 25°C				
I _f [mA]	T _j ^{***} [°C]	TM-21 [1,000 h]	LLMF at 60,000 h	Theoretically Expected Service Life [1,000 h]
				L95
350*	45	>60	0.975	170
500*	55	>60	0.950	150
700*	69	>60	0.925	120
1,050**	80	>60	0.950	90
1,400**	90	>60	0.925	80
* reference LED: XP-G2				
** reference LED: XP-L				
*** recorded mean junction temperature (varies from luminaire to luminaire)				

Fig. 1 LED/Lamp Lumen Maintenance Factor (LLMF).

LED/Lamp Survival Factor (LSF)

LED manufacturers' data sheets indicate very low failure rates, due to SIC technology employed in the production process. After 60,000 hours of operation at I_f = 700/1,050/1,400 mA, a practically negligible failure rate of approximately 750 ppm applies:

- LSF = 1

Luminaire Maintenance Factor (LMF)

Operational behavior and performance of LED luminaires differ significantly from their conventional HID counterparts. As a result, maintenance factors for WE-EF LED street and area lighting luminaries are reassessed in line with CIE154-2003, with two of the main contributing factors being (see Fig. 2):

- Minimised attraction of insects due to dramatically reduced emission of heat and UV light.
- Reduction of dust and dirt deposits on main lens due to low thermal convection.

I _f [mA]	T _j ^{***} [°C]	LLMF	LSF	LMF (4 Years, IP6x)			MF		
				N	M	H	N	M	H
350*	45	0.975	1	0.96	0.92		0.94	0.90	
500*	55	0.950	1	0.96	0.92		0.92	0.88	
700*	69	0.925	1	0.96	0.92		0.89	0.85	
1,050**	80	0.950	1	0.96	0.92		0.92	0.88	
1,400**	90	0.925	1	0.96	0.92		0.89	0.85	
* reference LED: XP-G2				N = low pollution environment					
** reference LED: XP-L				M = moderate pollution environment					
*** recorded mean junction temperature (varies from luminaire to luminaire)				H = high pollution environment					

Fig. 2 Recommended Maintenance Factor (MF) at 60,000 h.

Ambient Temperature – Practical Considerations

Luminous flux and mean service life data shown in this catalogue are – as required by EN 60598-1 for luminaires – based on a rated ambient performance temperature of $T_q = 25^{\circ}\text{C}$. However, conditions at the site of use frequently vary from this standard and may therefore significantly affect the photometric qualities and service life of an installation. If the actual mean ambient temperature falls below 25°C , luminous flux and service life will improve; if temperatures exceed 25°C , they will decrease.

For a meaningful assessment of a luminaire’s performance, it is recommended to take night-time temperatures of an installation’s actual location as reference – to be on the safe side, the average night-time temperature of the hottest month. The table on this page details ambient temperatures (night-time) for cities in the Asia Pacific region. Comprehensive and detailed worldwide data are available at www.weatherbase.com.



Asia Pacific

Ambient temperatures (Asia Pacific region)	Night-time maximum average	Night-time minimum average	Day/night annual average
Bangkok	26°C APR	21°C JAN	28°C
Beijing	22°C JUL	-8°C JAN	12°C
Colombo	26°C MAY	23°C JAN	27°C
Hanoi	26°C JUN	15°C JAN	23°C
Ho Chi Minh City	26°C MAY	22°C JAN	28°C
Hong Kong	27°C JUL	14°C JAN	23°C
Jakarta	23°C SEP	22°C JAN	28°C
Kuala Lumpur	23°C APR	22°C JAN	27°C
Kuching	23°C MAY	22°C JAN	27°C
Macau	27°C JUL	13°C JAN	22°C
Manila	25°C MAY	21°C JAN	27°C
Mumbai	26°C MAY	17°C JAN	27°C
New Delhi	28°C MAY	7°C JAN	25°C
Osaka	24°C AUG	1°C JAN	16°C
Phnom Penh	24°C APR	21°C JAN	27°C
Seoul	22°C AUG	-6°C JAN	12°C
Shanghai	25°C JUL	1°C JAN	16°C
Singapore	25°C APR	23°C JAN	27°C
Taipei	25°C JUL	12°C JAN	22°C
Tokyo	23°C AUG	1°C JAN	15°C
Vientiane	25°C APR	17°C JAN	26°C
Yangon	25°C MAY	18°C JAN	27°C

Australia/New Zealand

Ambient temperatures (Asia Pacific region)	Night-time maximum average	Night-time minimum average	Day/night annual average
Adelaide	15°C JAN	6°C JUL	16°C
Auckland	16°C JAN	8°C JUL	16°C
Brisbane	21°C JAN	9°C JUL	20°C
Cairns	23°C JAN	17°C JUL	25°C
Canberra	12°C JAN	1°C JUL	12°C
Christchurch	12°C JAN	1°C JUL	12°C
Darwin	25°C JAN	19°C JUL	27°C
Hobart	11°C JAN	4°C JUL	12°C
Melbourne	13°C JAN	5°C JUL	14°C
Perth	17°C FEB	7°C JUL	18°C
Sydney	18°C JAN	6°C JUL	17°C
Wellington	17°C JAN	2°C JUL	16°C

PRODUCT INFORMATION

5CE Superior Corrosion Protection



Outstanding and long lasting anti-corrosion properties can only be achieved by a comprehensive, integrated approach. The result of many years of research and development, hands-on testing and practical experience, WE-EF’s unique 5CE system encompasses five critical elements:

- 1. Substrate
- 2. Conversion coating
- 3. Powder
- 4. PCS hardware
- 5. Process control



Powder application



PCS hardware

1. Substrate

A marine-grade, low copper content aluminium alloy is used for all above ground luminaires. Typical alloy composition:

Cu	≤	0.1 %	Zn	≤	0.1 %
Mg	≤	0.1 %	Pb	≤	0.1 %
Si	=	10.0-13.5 %	Sn	≤	0.05 %
Fe	≤	1.0 %	Ti	≤	0.2 %
Mn	≤	0.5 %	Al	=	Balance
Ni	≤	0.1 %			

2. Conversion Coating

The multi-step pre-treatment and conversion coating process includes degreasing, deoxidising, etching and depending on product, non-hazardous trivalent chromium or zirconium conversion coating. Both are considered the most effective conversion coats available for aluminium substrates.

Trivalent chromium conversion coating process:

- Alkaline degreasing/mild etching.
- Clear water rinse.
- Counterflow clear water rinse.
- Deoxidising etching.
- Clear water rinse.
- Counterflow clear water rinse.
- Trivalent chromium conversion coating (540-650 mg/m²).
- Clear water rinse.
- Counterflow demineralised water rinse.
- Hot air drying.

Zirconium conversion coating process:

- Acidic degreasing/etching.
- Clear water rinse.
- Counterflow clear water rinse.
- Demineralised water rinse.
- Zirconium (+polymer) conversion coating (3-10 mg/m²).
- Hot air drying.

Strict controls are constantly maintained over the parameters of every step in each process, such as purity, pH, chemical concentrations, temperature, etc. This ensures the best achievable substrate penetration and uniformity of the conversion coat, thereby ensuring optimum corrosion resistance and powdercoat adhesion.

3. Powder

UV-stabilised, architectural grade polyester powder is electrostatically applied (60-100 µm) and oven cured at ~ 200°C. The grade of polyester powder used is based on saturated polyester resins. Combined with UV resistant cross-linking agents and selected pigments, it features outstanding resistance to atmospheric ageing and UV light exposure. Properly applied to a suitable metal substrate, the resulting powdercoat finish exhibits excellent outdoor durability, and complies with German GSB and European QUALICOAT standards.

4. PCS Hardware



All exposed hardware is made from austenitic stainless steel, and additionally sealed with a tough, impregnated polymer coat, which fulfils two functions:

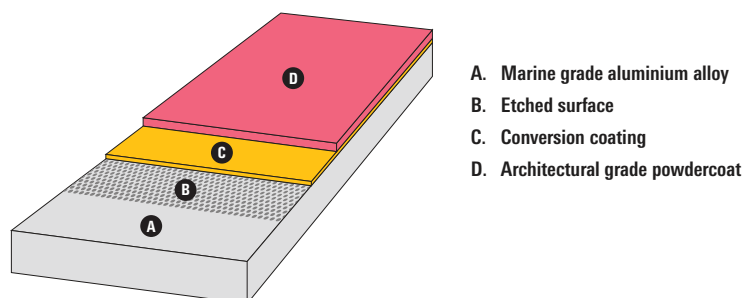
- Reduced friction between male and female thread causes tighter fit between connected parts.
- Non-metallic barrier between the two metals, aluminium and steel, prevents galvanic corrosion that otherwise occurs, when metals of dissimilar electronegativities are in contact.

5. Process Control

All materials and production steps are part of a tightly controlled process under ISO9001 quality assurance. It includes regular spectrometer analysis of aluminium alloy used, on-going monitoring of chemicals concentration in the pre-treatment phase, quality control checks on finished parts, up to 3,000 hours salt spray exposure tests etc.

The Final Product

The final result is a quality product of excellent corrosion resistance, that can be serviced after years of operation, and features a powdercoat finish of outstanding adhesion and colour stability.



5CE+Primer



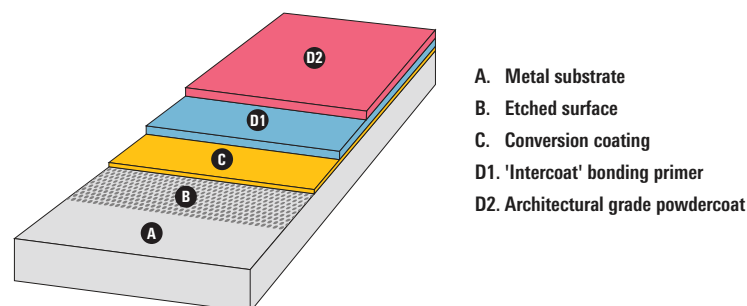
+Primer

For installations where corrosion protection over and above the 5CE system is required, 5CE+Primer introduces an additional element to the process:

1. Substrate
2. Conversion coating
+ Primer
3. Powder top coat
4. PCS hardware
5. Process control

Primer

Immediately after conversion coating, a specially formulated 'intercoat' bonding epoxy primer is electrostatically applied (80-100 µm), and initially semi-cured in a 180°C oven. Following the subsequent application of the polyester powder top coat, full curing and essential 'intercoat' bond is achieved at 200°C.



Added Durability

As with the 5CE system, 5CE+Primer provides for a quality product of excellent corrosion resistance that can be serviced after years of operation, and features a powdercoat finish of outstanding adhesion and colour stability. Added durability from the 'intercoat' bonding epoxy primer makes it particularly suitable for coastal and aggressive environments, and for example for pole installations in pedestrian areas.

Luminaires

WE-EF luminaires may be custom ordered to feature the described 5CE+Primer finish.

PRODUCT INFORMATION

ASC® Anti Slip Coating for Inground Luminaires



A translucent, tough and highly abrasion resistant ceramic material is fused into the surface of the luminaire's safety glass lens. Slip resistance, as required in pedestrian traffic and wet environments, conforms with DIN 51130 (class R10) and AS/NZS4586:1999 (class V). Corresponding tests were performed at the German BIA and the Australian CSIRO institutes. Arranged in a stochastic (irregular) pattern, the ASC® Anti Slip Coating has only moderate effect on the luminaire's light distribution and LOR (light output ratio). International patents apply.

Factory-sealed Luminaires



Fully assembled in a humidity controlled environment, a factory-sealed luminaire is pre-wired and fitted with the specified light source (LED or HID). The luminaire does not need to be opened during installation. Mains connection is made either in a separate terminal box or externally. These features provide for fast and cost saving on-site installation, as well as the avoidance of installation errors.

Lenses and Diffusers

Toughened safety glass, borosilicate glass, acrylic (PMMA) and UV-stabilised polycarbonate (PC) are used throughout the WE-EF product range. Usage is depending on product and application. Safety glass lenses used in inground luminaires are load rated up to 5 tonnes.

Gasketing

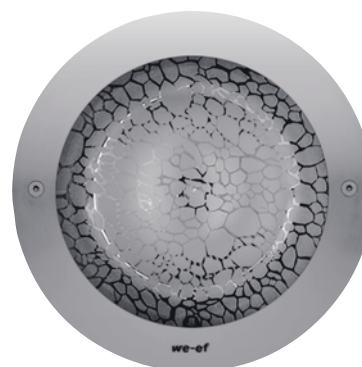
Weatherproof and non-ageing silicone rubber is used extensively in the WE-EF range. It provides excellent sealing qualities in corrosive and high temperature environments. A number of luminaires features CCG (Controlled Compression Gasket) technology, enhancing long-term, maintained, high IP ratings.

Electronic Converters

LED converters developed especially for exterior lighting applications are used. Features include constant current operation, surge protection, continuous dimming (optional), nominal lifetime $\geq 50,000$ h according to TM21-IES at T_a 25°C.

Voltage

WE-EF luminaires and electrical accessories are supplied ready for connection to a 230 V 50 Hz supply. Control gear for other voltages and frequencies is available on request.



ASC® Anti Slip Coating for inground uplight luminaires for increased safety in public areas.



Factory-sealed luminaires do not need to be opened during installation.



As with all components, electronic converters (drivers) are engineered for reliability and longevity.

Electrical Protection

German and European industrial standards DIN/EN 60598, VDE 0711 and DIN 40050, specify electrical protection and IP classification of luminaires. WE-EF products comply with these as well as with equivalent international standards. WE-EF luminaires conform to electrical protection class I. The compulsory earthing terminal is marked with the symbol ⊕. In the event of a fault, a correctly installed luminaire shall cause the circuit protection device to trip. Special luminaire versions with protection according to Class II ⊞ are available on request.

Ambient Temperatures

The WE-EF range of products is generally designed for operation at 25°C. In many cases, test data confirm higher ratings, at 40°C or more. For installations where excessive ambient temperatures exist, special luminaires and equipment can be supplied on request.

IP-Classification

The International Protection code (IP) classifies luminaires according to their protection against the ingress of dust, solid foreign bodies and water.

- IP1X Protection against solid objects of diameter greater than 50 mm
- IP2X Protection against finger touch and solid objects of diameter greater than 12 mm
- IP3X Protection against solid objects of diameter greater than 2.5 mm
- IP4X Protection against solid objects of diameter greater than 1.0 mm
- IP5X Complete protection against solid objects and harmful dust deposits (dust proof)
- IP6X Total protection against dust (dust-tight)

- IPX1 Protection against vertically dripping water (drip proof)
- IPX2 Protection against dripping water up to 15° from the vertical
- IPX3 Protection against spraying water or falling rain up to 60° from the vertical (rain proof)
- IPX4 Protection against splashing water from any direction (splash proof)
- IPX5 Protection against water jets from any direction (jet proof)
- IPX6* Protection against heavy seas or powerful water jets (water jet tight)
- IPX7* Protection against the effects of immersion (watertight - immersible)
- IPX8* Protection against submersion (pressure watertight - submersible)

The combination of both numerals describes the IP classification of a luminaire. All WE-EF luminaires are marked accordingly, e.g. IP66 (dust and water jet tight).

* WE-EF luminaires that comply with IPX7 and/or IPX8 are always additionally tested to meet IPX6 requirements under DIN/EN 60529. This is because the test conditions and procedures for IPX7 and IPX8 differ significantly from those for IPX6 and compliance for all is not automatically assured.

Standards

WE-EF luminaires and poles are designed to conform with present DIN/EN and VDE standards. Furthermore, all luminaires manufactured for the European market bear the CE standards conformity mark. WE-EF is constantly developing and improving its products. The technical information given, including data and designs, can be subject to change without prior notice. The dimensions and weights stated are approximate values, subject to manufacturing tolerances. Special finishing, executions and constructions are available on request.

Installation

Installation instructions are provided with all WE-EF products. Suitably qualified personnel must be engaged for installation and maintenance in compliance with the latest applicable regulations and relevant legislation.

Customer Service

Supported by WE-EF expertise, authorised representatives provide planning services to consulting engineers, lighting designers and other professionals. The current status of our global distribution network as well as substantial technical and product information, such as product specifications, photometric data and DIALUX plug-in can be obtained by visiting the WE-EF website at www.we-ef.com.

IK-Classification

DIN/EN 62262 classifies the degrees of protection that luminaires provide against external mechanical impacts.

- IK01 Protection against 0.14 J (joules) impact energy
(equivalent to specified impact from 0.2 kg polyamide hammer)
- IK02 Protection against 0.20 J (joules) impact energy
(equivalent to specified impact from 0.2 kg polyamide hammer)
- IK03 Protection against 0.35 J (joules) impact energy
(equivalent to specified impact from 0.2 kg polyamide hammer)
- IK04 Protection against 0.50 J (joules) impact energy
(equivalent to specified impact from 0.2 kg polyamide hammer)
- IK05 Protection against 0.70 J (joules) impact energy
(equivalent to specified impact from 0.2 kg polyamide hammer)
- IK06 Protection against 1 J (joules) impact energy
(equivalent to specified impact from 0.5 kg polyamide hammer)
- IK07 Protection against 2 J (joules) impact energy
(equivalent to impact of 0.5 kg steel weight dropped from 400 mm height)
- IK08 Protection against 5 J (joules) impact energy
(equivalent to impact of 1.7 kg steel weight dropped from 300 mm height)
- IK09 Protection against 10 J (joules) impact energy
(equivalent to impact of 5.0 kg steel weight dropped from 200 mm height)
- IK10 Protection against 20 J (joules) impact energy
(equivalent to impact of 5.0 kg steel weight dropped from 400 mm height)

LIGHTING DATA AND PROJECT SUPPORT

Light Distribution (Fig. 1 and 2)

The three dimensional light distribution pattern of a luminaire is measured by means of a photo goniometer. Depending on their application, WE-EF luminaires feature light distributions that are either symmetric, bi-symmetric or asymmetric. Luminous intensities are measured in cd/klm, and form the basis for lighting design calculations. This catalogue features a range of different photometric diagrams, in order to enable the lighting practitioner to conduct rough calculations. Detailed and precise calculations can be made by using lighting design software.

Isolux Diagram (Fig. 3)

Illuminance, as a measure, indicates how strongly a surface is lit. The distribution of illuminance on a surface is presented by the isolux diagram. All points of identical illuminance levels are connected by a line. Variations in mounting height or aiming of a luminaire will result in an altered diagram.

Luminance Diagram (Fig. 4)

Luminaires with opal or frosted lenses are generally used for orientation. For functional and aesthetic evaluation, the level of the average luminance on the lens, as well as its uniformity, have to be taken into consideration.

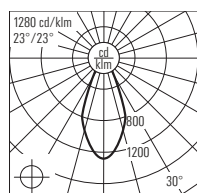


Fig. 1

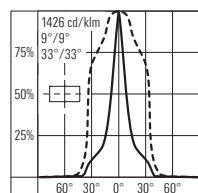


Fig. 2

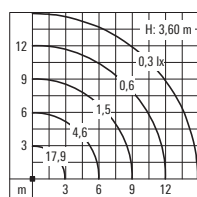


Fig. 3

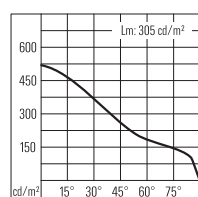
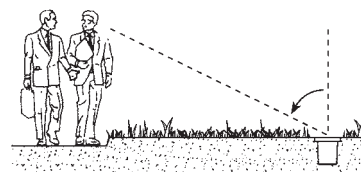


Fig. 4

Luminance diagrams shown in this catalogue present the lens' luminance as a function of the observer's viewing angle. They are based on a maintenance factor of 1.0 for new installations. The unit of measure is candelas per square metre (cd/sqm).



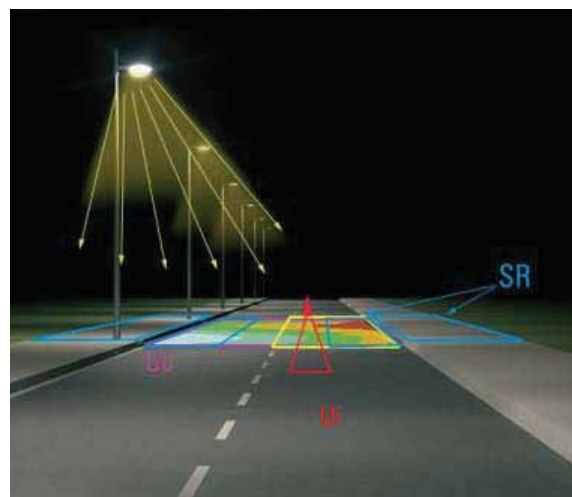
Depending on the angle of view, the human eye will perceive varying intensity levels from the same luminous surface.

Project Support

WE-EF's customer service includes lighting design and planning support for project engineers, lighting consultants and other professionals. While varying specific customer requirements and installation practices are taken into consideration, the following German/European standards are generally used as a working basis:

DIN EN 12193 Sports lighting

DIN EN 13201 Streetlighting



Streetlighting evaluation criteria:

L_m = Average luminance (cd/m²)

U_o = Overall uniformity L_{min}/L_m

U_l = Longitudinal uniformity L_{min}/L_{max}

T_i = Threshold increment (disability glare index)

SR = Surround ratio (ambient illuminance ratio)

E_m = Average illuminance (lux)

E_{min} = Minimum illuminance (lux)

Sports Lighting
Recommendations (excerpt) as per DIN EN 12193

Outdoor	Class I			Class II			Class III		
	Em (lux)	Emin/Em	Ra ≥	Em (lux)	Emin/Em	Ra ≥	Em (lux)	Emin/Em	Ra ≥
Riding - jumping & dressage, light athletics	500	0.7	60	200	0.5	60	100	0.5	20
Basketball, soccer, handball, rugby, volleyball	500	0.7	60	200	0.6	60	75	0.5	20
Golf (Driving Range)*	-	-	-	-	-	-	100	0.8	20
Hockey	500	0.7	60	200	0.7	60	200	0.7	20
Competition swimming, water polo	500	0.7	60	300	0.7	60	200	0.5	20
Tennis	500	0.7	60	300	0.7	60	200	0.6	20
Horse racing* - trotting track, race track and derby	200	0.6	60	100	0.4	60	50	0.2	20

Indoor	Class I			Class II			Class III		
	Em (lux)	Emin/Em	Ra ≥	Em (lux)	Emin/Em	Ra ≥	Em (lux)	Emin/Em	Ra ≥
Badminton, ice-hockey, fencing*, hockey, squash, table-tennis	750	0.7	60	500	0.7	60	300	0.7	20
Basketball, handball, fist-ball, volleyball, judo	750	0.7	60	500	0.7	60	200	0.5	20
Riding - jumping & dressage, light athletics	500	0.7	60	300	0.6	60	200	0.5	20
Competition swimming, water polo	500	0.7	60	300	0.7	60	200	0.5	20
Tennis	750	0.7	60	500	0.7	60	300	0.5	20

Streetlighting
Recommendations (excerpt) as per DIN EN 13201

Roads within city limits	Class	Lm (cd/m²)	Traffic volume <7000 vehicles/day				Class	Lm (cd/m²)	Traffic volume >7000 vehicles/day			
			Uo	UI	Ti (%)	SR			Uo	UI	Ti (%)	SR
Within built-up areas (to include vehicles parking)	ME5	0.5	0.35	0.4	15	0.5	ME4b	0.75	0.4	0.5	15	0.5
Within built-up areas (no vehicles parking)	ME4b	0.75	0.4	0.5	15	0.5	ME4b	0.75	0.4	0.5	15	0.5
No buildings (no vehicles parking)	ME3c	1.0	0.4	0.5	15	0.5	ME3c	1.0	0.4	0.5	15	0.5

Main roads	Class	Lm (cd/m²)	Uo	UI	Ti (%)	SR	Class	Lm (cd/m²)	Uo	UI	Ti (%)	SR
At high speeds > 70 km/h	ME4a	0.75	0.4	0.6	15	0.5	ME4a	0.75	0.4	0.6	15	0.5
At moderate speeds < 70 km/h	ME4a	0.75	0.4	0.6	15	0.5	ME4a	0.75	0.4	0.6	15	0.5

Motorways	Class	Lm (cd/m²)	Uo	UI	Ti (%)	SR
	ME4a	1.0	0.4	0.7	15	0.5

Roads outside of built-up areas	Class	Lm (cd/m²)	Uo	UI	Ti (%)	SR	Class	Lm (cd/m²)	Uo	UI	Ti (%)	SR
	ME4a	0.75	0.4	0.6	15	0.5	ME4a	0.75	0.4	0.6	15	0.5

Country roads	Normal traffic volume			High traffic volume		
	Class	Em (lux)	Emin (lux)	Class	Em (lux)	Emin (lux)
Without built-up verges, cycle or foot paths	S5	3.0	0.6	S4	5.0	1.0
With built-up verges, cycle or foot paths	S4	5.0	1.0	S3	7.5	1.5

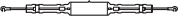
* Additional requirements for vertical illuminance apply.

LAMP CHART

This catalogue lists lamp designations in accordance with the lamp designation system of the German electrotechnical industry. The lamp chart is for comparison purposes only. It may not be complete and errors are excepted.

Due to market developments as well as ongoing research and development by the manu-
facturers, lamp availability and specifications may change. Ensure that both, availability
and all technical data, are checked prior to application.

	MH (Metal Halide Lamps)			OSRAM	PHILIPS	GE
	HIT-TC-CE 20W/830 PGJ5	Ra > 85	3000 K	---	CDM-Tm 20W/830 PGJ5	---
	HIT-TC-CE 35W/930 PGJ5	Ra > 85	3000 K	---	CDM-Tm 35W/930 PGJ5	---
	HIT-TC-CE 20W/830 GU6.5	Ra > 80	3000 K	HCI-TF 20W/830 WDL PB	CDM-Tm Mini GU6.5 20W/830	CMH20/T/UVC/830/GU6.5
	HIT-TC-CE 35W/930 GU6.5	Ra > 90	3000 K	HCI-TF 35W/930 WDL PB	CDM-Tm Elite Mini GU6.5 35W/930	CMH35/T/UVC/930/GU6.5
	HIT-TC-CE 35W/942 GU6.5	Ra > 90	4200 K	---	---	CMH35/T/UVC/942/GU6.5
	HIT-TC-CE 20W/830 G8.5	Ra > 80	3000 K	HCI-TC 20W/830 WDL PB	---	CMH20/TC/UVC/U/830/G8.5
	HIT-TC-CE 35W/830 G8.5	Ra > 80	3000 K	HCI-TC 35W/830 WDL PB	CDM-TC 35W/830	CMH35/TC/UVC/U/830/G8.5
	HIT-TC-CE 35W/942 G8.5	Ra > 90	4200 K	HCI-TC 35W/942 NDL PB	---	---
	HIT-TC-CE 70W/830 G8.5	Ra > 80	3000 K	HCI-TC 70W/830 WDL PB	CDM-TC 70W/830	CMH70/TC/UVC/U/830/G8.5
	HIT-TC-CE 70W/942 G8.5	Ra > 90	4200 K	HCI-TC 70W/942 NDL PB	---	CMH70/TC/UVC/U/942/68.5
	HIT-CE 20W/830 G12	Ra > 80	3000 K	---	CDM T 20W/830	---
	HIT-CE 35W/830 G12	Ra > 80	3000 K	HCI-T 35W/830 WDL PB	CDM T 35W/830	CMH35/T/UVC/U/830/G12
	HIT-CE 35W/942 G12	Ra > 90	4200 K	HCI-T 35W/942 NDL PB	CDM T 35W/942	CMH35/T/UVC/U/942/G12
	HIT-CE 70W/830 G12	Ra > 80	3000 K	HCI-T 70W/830 WDL PB	CDM T 70W/830	CMH70/T/UVC/U/830/G12
	HIT-CE 70W/942 G12	Ra > 90	4200 K	HCI-T 70W/942 NDL PB	CDM T 70W/942	CMH70/T/UVC/U/942/G12
	HIT-CE 100W/830 G12	Ra > 85	3000 K	HCI-T 100W/830 WDL PB	---	---
	HIT-CE 100W/942 G12	Ra > 90	4200 K	HCI-T 100W/942 NDL PB	---	---
	HIT-CE 150W/830 G12	Ra > 85	3000 K	HCI-T 150W/830 WDL PB	CDM T 150W/830	CMH150/T/UVC/U/830/G12
	HIT-CE 150W/942 G12	Ra > 90	4200 K	HCI-T 150W/942 NDL PB	CDM T 150W/942	CMH150/T/UVC/U/942/G12
	HIT-CE 250W/830 G12	Ra > 85	3000 K	---	CDM T 250W/830	---
	HIT-CE 70W/830 E27	Ra > 85	3000 K	HCI-TT 70W/830 WDL PB	---	CMH70/TT/U/830/E27
	HIT-CE 100W/830 E40	Ra > 85	3000 K	HCI-TT 100W/830 WDL PB	CDO-TT 100W/828	---
	HIT-CE 150W/830 E40	Ra > 85	3000 K	HCI-TT 150W/830 WDL PB	---	CMH150/TT/U/830/E40
	HIT-CE 250W/830 E40	Ra > 85	3000 K	HCI-T 250W/830 WDL PB	---	CMH250/TT/U/830/E40
	HIT-CE 250W/942 E40	Ra > 90	4200 K	HCI-T 250W/942NDL PB	---	-
	HIT 250W/952 E40	Ra > 90	5200 K	HQI-T 250W/952 D	---	---
	HIT 400W/635 E40	Ra > 65	3500 K	HQI-T 400W/635 N	---	---
	HIT 400W/952 E40	Ra > 90	5200 K	HQI-BT 400W/952 D	---	---
	HIT 1000W/973 E40	Ra > 90	7250 K	HQI-T 1000W/973 D	---	SPL1000/T/H/960/E40
	HIE-CE 35W/830 E27	Ra > 85	3000 K	HCI-E/P 35W/830 WDL PB coated*	---	---
	HIE-CE 35W/942 E27	Ra > 90	4200 K	HCI-E/P 35W/942 NDL PB coated*	---	---
	HIE-CE 50W/830 E27	Ra > 85	3000 K	HCI-E/P 50W/830 WDL PB coated*	---	---
	HIE-CE 50W/942 E27	Ra > 90	4200 K	HCI-E/P 50W/942 NDL PB coated*	---	---
	HIE-CE 70W/830 E27	Ra > 85	3000 K	HCI-E/P 70W/830 WDL PB coated*	---	---
	HIE-CE 70W/942 E27	Ra > 90	4200 K	HCI-E/P 70W/942 NDL PB coated*	---	---
	HIE-CE 100W/830 E27	Ra > 85	3000 K	HCI-E/P 100W/830 WDL PB coated*	---	CMH100/E/U/830/E27/D
	HIE-CE 100W/942 E27	Ra > 90	4200 K	HCI-E/P 100W/942 NDL PB coated*	---	---
	HIE-CE 150W/930 E27	Ra > 90	3000 K	HCI-E/P 150W/930 WDL PB coated*	---	---
	HIE-CE 150W/942 E27	Ra > 90	4200 K	HCI-E/P 150W/942 NDL PB coated*	---	---

	MH (Metal Halide Lamps)			OSRAM	PHILIPS	GE
	HIE-CE 250W/830 E40	Ra > 85	3000 K	HCI-E 250W/830 WDL PB coated	---	---
	HIE 400W/947 E40	Ra > 90	4700 K	HQI-E/P 400W/947 D coated	---	---
	HIE 400W/952 E40	Ra > 90	5200 K	HQI-E 400W/952 D coated	---	---
	HIT-DE-CE 70W/830 RX7s	Ra > 80	3000 K	HCI-TS 70W/830 WDL PB	CDM-TD 70W/830	CMH70/TD/UVC/830/Rx7s
	HIT-DE-CE 70W/942 RX7s	Ra > 90	4200 K	HCI-TS 70W/942 NDL PB	CDM-TD 70W/942	CMH70/TD/UVC/942/Rx7s
	HIT-DE-CE 150W/830 RX7s	Ra > 85	3000 K	HCI-TS 150W/830 WDL PB	CDM-TD 150W/830	CMH150/TD/UVC/830/Rx7s
	HIT-DE-CE 150W/942 RX7s	Ra > 95	4200 K	HCI-TS 150W/942 NDL PB	CDM-TD 150W/942	CMH150/TD/UVC/942/Rx7s
	HIT-DE 250W/830 Fc2	Ra = 80	3200K	HQI-TS 250/830 WDL	---	---
	HIT-DE 250W/842 Fc2	Ra > 85	4200 K	HQI-TS 250W/842 NDL	MHN-TD 250W/842	RC250/TD/840/Fc2
	HIT-DE 250W/951 Fc2	Ra > 90	5100 K	HQI-TS 250W/951 D	---	---
	HIT-DE 400W/842 Fc2	Ra > 85	4200 K	HQI-TS 400W/842 NDL	---	---
	HIT-DE 400W/952 Fc2	Ra > 90	5200 K	HQI-TS 400W/952 D	---	---
	HIT-SA-DE 1000W/959 Cable	Ra > 90	5900 K	HQI-TS 1000W/959 D S	---	---
	HIT-SA-DE 2000W/959 Cable	Ra > 90	5900 K	HQI-TS 2000W/959 D S	MHN-SB Pro 2000W/956/400V	---
	HIT-LA-DE 1000W/842 Cable	Ra > 80	4200 K	---	MHN-LA 1000W/842 230V	---
	HIT-LA-DE 1000W/956 Cable	Ra > 90	5600 K	---	MHN-LA 1000W/956 230V	---
	HIT-LA-DE 2000W/842 Cable	Ra > 80	4200 K	---	MHN-LA 2000W/842 400V	---
	HIT-LA-DE 2000W/956 Cable	Ra > 90	5600 K	---	MHN-LA 2000W/956 400V	---
	HPS (High Pressure Sodium Lamps)			OSRAM	PHILIPS	GE
	HSE-I-X4 50W/220 E27	Ra 20	2000K	NAV-E 50/I 4Y	SON 50W-I	LU50/85/D/I/27
	HSE-I-X4 70W/220 E27	Ra 20	2000K	NAV-E 70/I 4Y	SON 70W-I	LU70/90/D/I/27
	HSE-E-X4 50W/220 E27	Ra 20	2000K	NAV-E 50/E 4Y	SON 50W-E	LU50/85/X0/SBY/T/27
	HSE-E-X4 70W/220 E27	Ra 20	2000K	NAV-E 70/E 4Y	SON 70W-E	LU70/90/X0/T/27
	HSE-X4 100W/220 E40	Ra 25	2000K	NAV-E 100 SUPER 4Y	SON-PLUS 100W	---
	HSE-X4 150W/220 E40	Ra 25	2000K	NAV-E 150 SUPER 4Y	SON 150W	LU150/150/X0/T/40
	HSE-X4 250W/220 E40	Ra 25	2000K	NAV-E 250 SUPER 4Y	SON 250W	LU250/X0/T/40
	HSE-X4 400W/220 E40	Ra 25	2000K	NAV-E 400 SUPER 4Y	SON 400W	LU400/X0/T/40
	HSE-X4 100W/220 E40	Ra 25	2000K	NAV-E 100 SUPER 4Y	SON-PLUS 100W	---
	HST-X4 50W/220 E27	Ra 25	2000K	NAV-T 50 SUPER 4Y	SON-T PLUS 50W	LU50/90/X0/T/27
	HST-X4 70W/220 E27	Ra 25	2000K	NAV-T 70 SUPER 4Y	SON-T PLUS 70W	LU70/90/X0/T/27
	HST-X4 100W/220 E40	Ra 25	2000K	NAV-T 100 SUPER 4Y	SON-T PLUS 100W	LU100/100/X0/T/40
	HST-X4 150W/220 E40	Ra 20	2000K	NAV-T 150 SUPER 4Y	SON-T PLUS 150W	LU150/150/X0/T/40
	HST-X4 250W/220 E40	Ra 20	2000K	NAV-T 250 SUPER 4Y	SON-T 250W	LU250/X0/T/40
	HST-X4 400W/220 E40	Ra 20	2000K	NAV-T 400 SUPER 4Y	SON-T 400W	LU400/X0/T/40
	HST 1000W/220 E40	Ra 20	2000K	NAV-T 1000	SON-T 1000W	LU1000/110/T/40 4pk
	HST-DE-X4 70W/220 RX7s	Ra 25	2000K	NAV-TS 70 SUPER 4Y	---	---
	HST-DE-X4 150W/220 RX7s	Ra 25	2000K	NAV-TS 150 SUPER 4Y	---	---
	HST-DE 250W/220 Fc2	Ra 20	2000K	NAV-TS 250	---	LU250/TD
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