Lighting Tools Exterior

Chapter 10
Appendix

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AN OSRAM BUSINESS

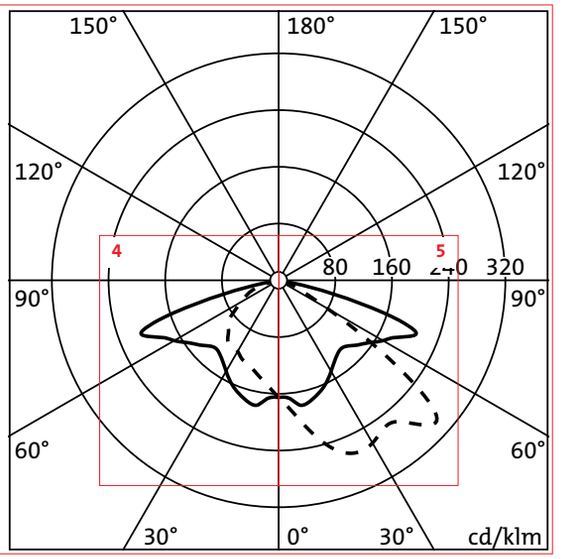
10 Appendix

Light distribution curve

6 5NA559E1ST0C236

2 1 x HST 250W/220

1 ϕ 30000 lm



3

C 0/180 C 90/270

7

Lichtstärkeklasse nach

EN13201-2: G4

1 ϕ: luminous flux of lamp in [lm] according to manufacturer specifications, measured at 25°C ambient temperature and unshielded. With LED, the net luminaire luminous flux ϕ_N

2 Quantity, type and light colour of lamp, usually according to the ZVEI lamp designation system

3 Light distribution as polar curve.
Specification of γ angle in [°]
Specification of luminous intensities I in [cd/klm]. The actual luminous intensities are calculated via multiplication with luminous flux of the lamp in [lm] divided by 1000.
The centre of the auxiliary circle (scale of luminous intensities I) or initial point of the auxiliary lines (scale of γ angle) is the light focal point of the luminaire or median point of the light emission aperture

4 Continuous line:
Luminous intensities I at C180°
Dotted line:
Luminous intensities I at C270°

5 Continuous line:
Luminous intensities I at C0°
Dotted line:
Luminous intensities I at C90°

6 Order number of luminaire, with accessories where applicable

7 Luminous intensity class according to EN13201-2 for outdoor luminaires

The specifications in the photometric data are based upon measurement results with gonio-photometers and Ulbricht spheres according to valid measurement criteria and are only significant for the specified luminaire type in combination with the specified light sources. Depending upon the type of luminaire, the most reasonable or possible specifications are selected.

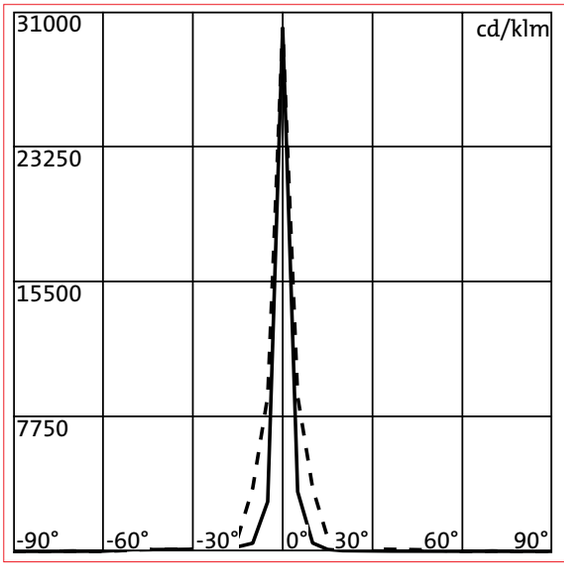
More detailed photometric specifications for all products at **www.siteco.de**

Additional photometric explanations for narrow distribution spotlights/projectors for outdoor applications

5NA75601WP11

1 x HIT-DE-h15 2000W/959 I=187 ϕ 200000 lm

8



10

I_{max} 30089 cd/klm bei γ 0°

8

	C 0/180	C 90/270
α50%	2 x 2,2°	2 x 3,6°
α10%	2 x 5,3°	2 x 10,9°

9

8 Light distribution as Cartesian diagram with levels C0° and C180°, and C90° and C270°

9 $\alpha_{50\%}$: half-peak divergence in [°]. This specifies at which angle the luminous intensity I still consists of 50% of maximum value.

$\alpha_{10\%}$: one-tenth peak divergence in [°]. This specifies at which angle the luminous intensity I still consists of 10% of maximum value.
Angle specifications usually define the sum of angles in the levels CO° and C180° or C90° and C270°, e.g. 2 x 10°

10 I_{max} : Imax : maximum value of luminous intensity I in [cd/klm] and γ angle at which this is emitted.

Supplementary photometric explanations for asymmetric distribution floodlights

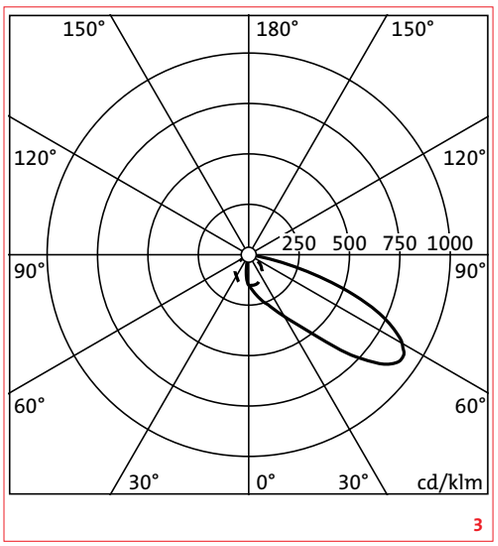
5NA75901WS03

1 x HIT-DE-h15 2000W/854 I=274 lm 230000 lm

I_{max} 917 cd/klm

12 Kippung 56°

11 A 0 (C 0/180) B 0



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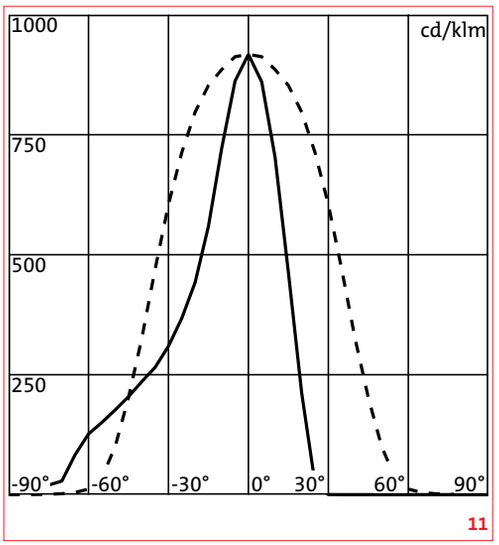


11

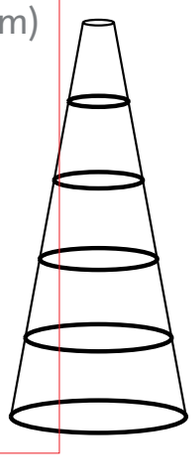
11 Light distribution as Cartesian diagram with levels A0° (identical with levels C0° and C180°) and level B0°

12 Inclination: with floodlights the luminaire is tilted before measuring so far that the maximum in levels A0 and B0 is equivalent to $\gamma = 0°$. In this way, the width of the light emission can be more precisely determined than with a measurement with C levels, thus enabling a higher measurement accuracy.

Some luminaires were measured with C levels; here no tilt is specified.
The tilt angle in the Cartesian diagram corresponds to the angle to which the floodlight in the polar curve emits light asymmetrically to the vertical.

Light Cone Diagram

In the case of rotosymmetrical distribution luminaires, the light cone diagram describes the illuminance values occurring on the measuring plane with respect to the distance to the luminaire, vertically to the light direction. The cone shell and thus the circular intersections between cone and planes are described by the half-peak divergence, i.e. the angle at which light output is still 50% of maximum light output. Within these circles the medial illuminance Em and the maximal illuminance Emax are specified with a maintenance factor of 0.8.



13 H(m)	14 ø(m)	15 Emax(lx)	16 Em(lx)
1	1.78	422	267
2	3.55	106	67
3	5.33	47	30
4	7.10	26	17
5	8.88	17	11

Maintenance factor = 0.8

13 Distance of plane to luminaire in [m]

14 Diameter of light cone in [m]

15 Maximal horizontal illuminance Emax within light cone in [lx]

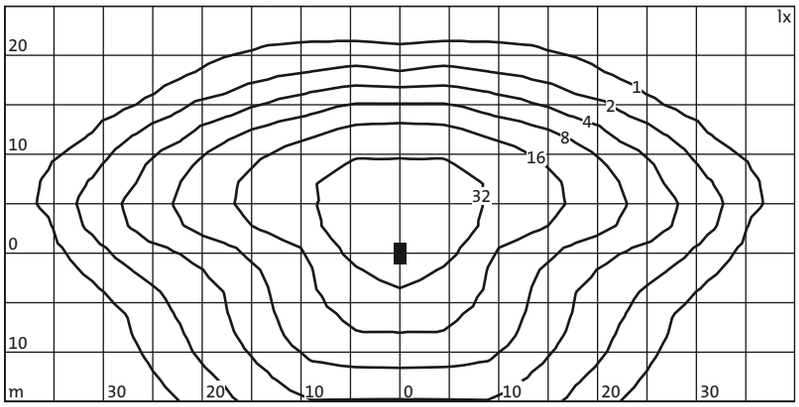
16 Medial horizontal illuminance Em within light cone in [lx]

Isolux curves/individual luminaire

Isolux curves represent illuminance distribution upon virtual or real surfaces, e.g. on a road, on a floor or a wall.
Points of equal illuminance E in [lx] ('Isolux') are connected with a curve.

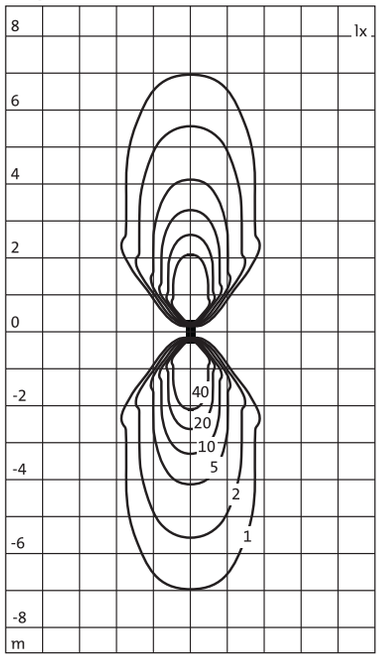
The illuminance values are dependent upon the distance between luminaire and surface. A maintenance factor of 0.8 is applied.
Isolux curves demonstrate the effect of the lighting characteristics of a luminaire (rotosymmetrical / asymmetric / linear).

Lichtpunkthöhe 10 m Neigung 0°



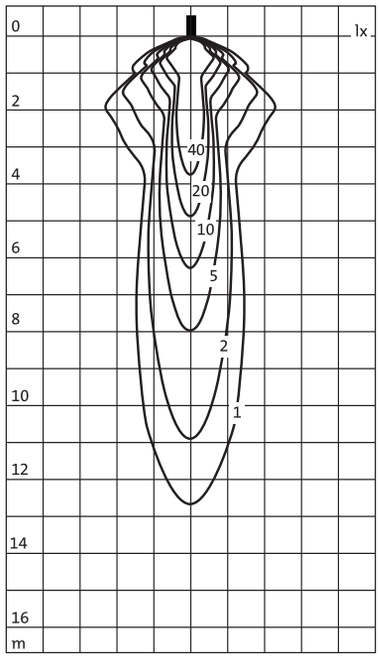
5AA52002M

2xQPAR51 35W

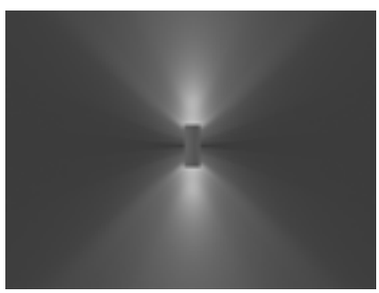


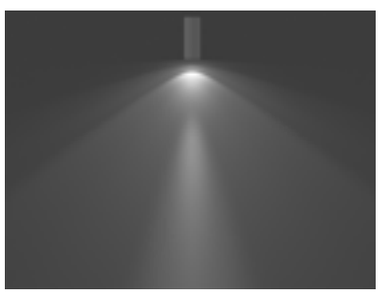
5AA52090E

1xQR-CBC51/IRC 20W 10°



Distance of luminaire to wall: 100mm





10°

Certification symbols

Luminaires with the VDE symbol have been approved by the VDE inspection and certification institute. The basis for approval are the safety regulations applicable in Germany

The ENEC symbol (European Norm Electrical Certification) is a European inspection and certification symbol for luminaires and electrical components within luminaires.
It testifies to compliance with the European standards for safety and work practice. A 10 signifies that inspection was carried out by the VDE. The VDE symbol can be additionally attached to the luminaire

IP 20 — Protection against touching active, live parts with fingers

IP 23 — Protection against touching live parts with fingers and against the ingress of spray water (e.g. rain). According to EN 60598, luminaires are inspected in their specific installation situations. With indoor luminaires this is the normative recess box that protects against the ingress of water into the luminaire. This special protection can be recognised by the specification IPX3 'Lichtaustrittsöffnung/aperture'

IP 40 — Protection against access into luminaire housing via a 1 mm thick wire

IP 43 — Protection against access into luminaire housing via a 1 mm thick wire and against ingress of spray water

IP 44 — Protection against access into luminaire housing via a 1 mm thick wire and against ingress of splash water

IP 50 — Dust-protected luminaire

IP 54 — Dust and splash water-protected luminaire

IP 55 — Dust and water jet-protected luminaire

IP 60 — Dust-tight luminaire

IP 65 — Dust-tight and water-jet protected luminaire

IP 66 — Dustproof and protected against strong water jets.
Note: With tunnel luminaires with the additional specification of 6 bars. The luminaire is tested with a pressure of 6 bars with a water jet nozzle according to RVS 09.02.41 Section 6.3.8.

IP 67 — Dust and water-tight luminaire

Protection against electric shock is implemented with basis isolation and connection of all touchable metal components with the earth conductor

Live parts are equipped with protective isolation in addition to the basis isolation. Connection of an earth conductor is not permitted unless a special terminal for through-wiring is integrated

Protection against electric shock is based on the use of safety extra-low voltage

Luminaires with F designation are suitable for direct mounting to normally flammable surfaces.
The F designation, as requirements of the DIN VDE 0100 series of standards, can be used until the end of the transition period to 11.04.2012.
Following this time the designation may no longer be applied to luminaires.
There is then only the negative designation with the two following symbols

Luminaires with FF designation are suitable for environments that are subject to danger from dust or fibres according to VDE 0710, Section 5 (no longer valid since 08/2005).
Luminaires corresponding with the EN 60 589-2-24 standard are designated with the D symbol

Luminaires with the D symbol are according to EN 60 598-2-24 suitable for workplaces in danger of fire from dust or fibres.
The luminaire, in addition to the D symbol requirement, also corresponds to VDS 2499 requirements with the specified material for the optical enclosure.
The FF designation is still used due to its high level of familiarity. The requirements of the no longer valid VDE 0710-5 are complied to with the specified diffuser material and distances. A label in the luminaire informs about further characteristics

ZONE 2 — Luminaires approved for explosion-hazard zone 2 according to Ex-guideline 94/9/EG.
Explosion-hazard zone 2 according to ElexV 1996: areas where explosive atmospheres from gases, vapours or haze are not expected, but if they still occur then probably only seldom and for a short time

ZONE 22 — Luminaires approved for explosion-hazard zone 22 according to Ex-guideline 94/9/EG.
Explosion-hazard zone 22 according to ElexV 1996: areas where explosive atmospheres from whirled-up dust are not expected, but if they still occur then probably only seldom and for a short time

Certification symbols

Successful vibration testing for verification of safety with vibration induced from earthquakes and comparable load cases. (e.g. required for use in nuclear power plants)
Test certificates on request

Luminaire is suitable for use with railway platforms/tracks. The angle-dependent maximum luminous intensities correspond to the specifications of German Railways.

IK 07

Luminaire tested for impact energy of 2.00 joules. IK 07 designation according to EN 50102

Luminaire is suitable for max. temperatures deviating from EN 60 598. In compliance with EN 60 598, luminaires are designed for nominal ambient temperatures of +25°C. Partial operation at +35°C is possible.

Luminaires tested for protection against flying balls according to the latest European standard EN 12 193 (or DIN VDE 0710)

IK 09

Luminaire tested for impact energy of 10.00 joules. IK 09 designation according to EN 50102

Luminaire tested for protection against flying balls in tennis areas according to DIN VDE 0710

IK 10

Luminaire tested for impact energy of 20.00 joules. IK 10 designation according to EN 50102

Product technology/quality criteria

Siteco Savelight

Siteco Savelight
Safety and convenience package for protecting luminaire and for gentle lamp operation
- Ignitor with digital automatic power disconnection
- Ballast with thermal protection
- Power reduction (ECO) with integral timer for lamp start at full load

Radio management for transmission of control commands in 433.42 MHz ISM band

CE

The CE symbol only documents compatibility with European guidelines valid for the product.
The CE symbol is applied on the manufacturer's own responsibility and as such is not an approval designation

REZY

Recycling symbol of the corrugated cardboard industry

DALI

DALI (Digital Addressable Lighting Interface) is an interface definition for controlling digitally dimmable ballasts.
A maximum of 64 DALI ballasts can be operated on one control line. These can be grouped in a maximum of 16 overlapped groups. A maximum of 16 lighting scenes can be stored. The definition of the protocol is regulated in the appendix of EN 60929

iF product design award 2011

Symbol for good industrial design. Products designated with the IF logo have been distinguished by the Industrieforum Design Hanover for outstanding product design

DER GRÜNE PUNKT

No application for our packaging (see Interseroh)

INTERSEROH RECYCLING

All luminaire packaging from Siteco Beleuchtungstechnik GmbH is accepted free of charge by the company of Interseroh and disposed of in an environmentally friendly way

Product technology- and quality criteria for lighting management systems

Movement detection

Daylight control

IR

Infrared receiver

Button operation

Entry in detection range

Exiting of detection range

Information symbols with installation instructions

Wear protective gloves (avoid fingerprints)

Luminaire is suitable for use indoors and in unprotected installations outdoors

Luminaire is suitable for use indoors

Luminaire is suitable for use in unprotected installations outdoors

Luminaire may only be mounted away from the hand area. This area consists of 2.5m upwards and 1.25m to the side and below from the stand location of the person

Luminaire is suitable for use in protected installations outdoors. It must not be exposed to outdoor weathering. X and Y are minimal dimensions for protruding over luminaire edge. Indoor luminaires are fundamentally unsuitable for use in unprotected installations outdoors

”Two-manmounting” recommended due to reasons of safety

Installation and maintenance only by duly qualified personnel

Sections of the installation instructions bearing this symbol refer to the condition on delivery

- Further information in the installation instructions for accessory parts
- Please observe specifications of lamp manufacturers for application of lamps

CAUTION! Pay special attention during installation

Do not use countersunk screws for installation

Note end mark/identification (no limit stop fitted)

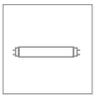
Precise alignment must be ensured

Adjustment possibilities for lamp position are specified

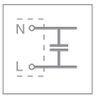
Adjustment possibilities for reflector position are specified

Protective earth connection

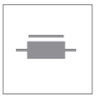
Capacitance of the PF correction capacitor



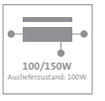
Watt rating and number of lamps to be fitted



Circuit with PF correction



Control gear suitable for specified lamp rating

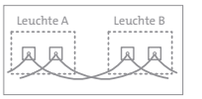


Caution: the luminaire contains a conventional ballast with two power tappings. With device replacement, correct clamping according to state of delivery must be observed

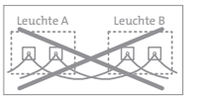
Caution! voltage, disconnect from power before opening

Disconnect mains plug

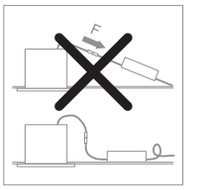
Unplug mains connector before starting any maintenance work



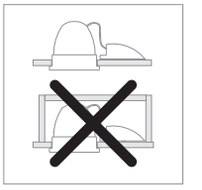
Luminaire suitable for looping through



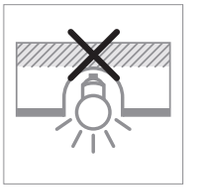
Luminaire not suitable for looping through



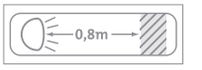
The connection cable must not be subjected to tensile loads after installation



Luminaire may only be installed in open ceiling cavities. Installation in noise/fire prevention boxes is impermissible



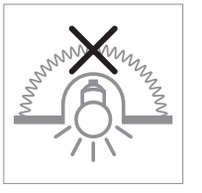
After installation, luminaire must not be too near lower edge of unfinished ceiling otherwise function or safety is impaired. Notes on required distances in installation instructions



A minimum distance (e.g. 0.8m here) to illuminated surfaces must be maintained

Surface-mountable luminaire not suitable for direct fixing to normal, flammable surfaces (only suitable for fixing to non-flammable surfaces)

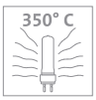
Recessed luminaire not suitable for direct fixing to normal, flammable surfaces (only suitable for fixing to non-flammable surfaces)



The recessed luminaire is not suitable for covering with thermal insulating material.

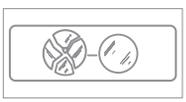
Information symbols with installation instructions

Warning of danger to hands from e.g. crushing or sharp edges



Warning of hot lamp bulbs. Danger of burning exists with all lamps shortly after switching off

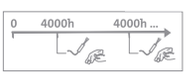
Luminaire only suitable for operation with a cover glass



Damaged protective covers must be replaced immediately. Operation with damaged cover not permissible

Lamp must be approved for use in “open” luminaires. (“open” luminaires also include luminaires with plastic enclosure or with plastic reflector)

Hot surface e.g. in ballast area: only use suitable cables or observe suitable cable routing



Specification of recommended cleaning intervals and processes (e.g. clean luminaire with water jet and soft lint-free cloth every 4000 hours)

Cleaning only with a soft lint-free cloth

Must not be cleaned with a damp cloth

Special cleaning instruction for specific luminaire materials

Cleaning with hoover with suitable attachment nozzle

At end of service life, luminaire must be recycled. See **www.siteco.com** for recycling companies
EAR number for Siteco: DE 84791082

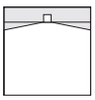
Windage area in shown projection without evaluation with air resistance coefficient (max. value is 1.2 acc. to EN 60598-2-3)

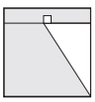
Protective earth. Earthing of product in system, installation or device required for correct functionality, but not part of protection against electric shock

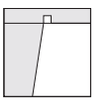
Light distribution

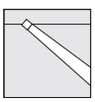

Recessed ceiling luminaire, direct narrow distribution

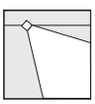

Recessed ceiling luminaire, direct medium/wide distribution

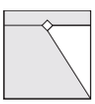

Recessed ceiling luminaire, direct wide/diffuse distribution

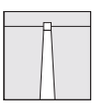

Recessed ceiling wallwasher

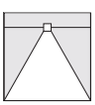

Recessed ceiling ground wallwasher

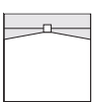

Recessed ceiling directional spot tiltable | narrow distribution

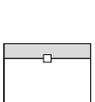

Recessed ceiling directional spot tiltable | medium distribution

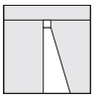

Recessed ceiling wallwasher tiltable

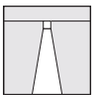

Semi-recessed ceiling luminaire, direct narrow distribution

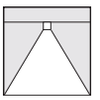

Semi-recessed ceiling luminaire, direct medium/wide distribution

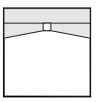

Semi-recessed ceiling luminaire, direct wide/diffuse distribution

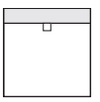

Semi-recessed ceiling luminaire, direct wide/diffuse distribution with ceiling illumination

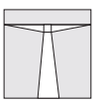

Surface-mounted ceiling luminaire, direct asymmetric narrow distribution

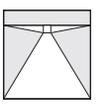

Surface-mounted ceiling luminaire, direct narrow distribution

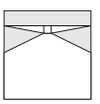

Surface-mounted ceiling luminaire, direct medium/wide distribution

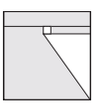

Surface-mounted ceiling luminaire, direct wide/diffuse distribution

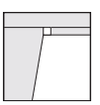

Surface-mounted ceiling luminaire, direct diffuse distribution

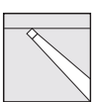

Surface-mounted ceiling luminaire, direct, narrow distribution with ceiling illumination

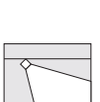

Surface-mounted ceiling luminaire, direct, medium/wide distribution with ceiling illumination

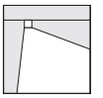

Surface-mounted ceiling luminaire, direct, wide/diffuse distribution with ceiling illumination

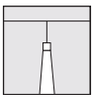

Surface-mounted ceiling wallwasher

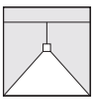

Surface-mounted ceiling ground wallwasher

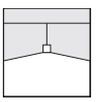

Symmetric floodlight/ projector/spot in system rail, ceiling surface mounting, narrow distribution

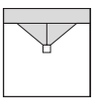

Symmetric spot, ceiling surface mounting, direct medium/wide distribution

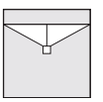

Asymmetric floodlight ceiling surface mounting

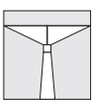

Suspended luminaire, direct narrow distribution

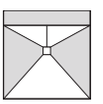

Suspended luminaire, direct medium/wide distribution

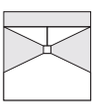

Suspended luminaire, direct wide/diffuse distribution

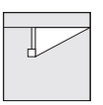

Suspended luminaire, direct/indirect wide/diffuse distribution

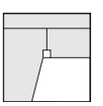

Suspended luminaire, indirect medium/wide distribution

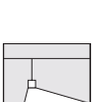

Suspended luminaire, direct/indirect narrow distribution with ceiling illumination


Suspended luminaire, direct/indirect medium/wide distribution

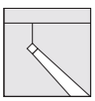

Suspended luminaire, direct/indirect wide/diffuse distribution

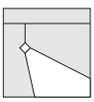

Suspended ceiling washer

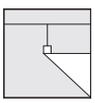

Suspended ground wallwasher

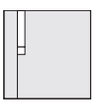

Suspended luminaire, direct asymmetric distribution

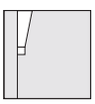
Light distribution

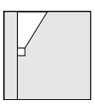

Spot in suspended system rail, direct narrow distribution

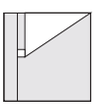

Symmetric spot in suspended system rail, direct, medium/wide distribution

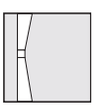

Suspended wallwasher

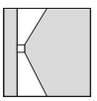

Surface-mounted wall luminaire, indirect asymmetric narrow distribution

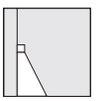

Surface-mounted wall luminaire indirect narrow distribution

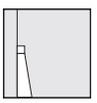

Surface-mounted wall luminaire indirect medium/wide distribution

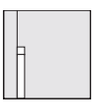

Wall surface-mounted ceiling washer

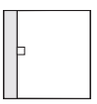

Surface-mounted wall luminaire, direct/indirect narrow distribution

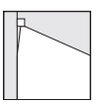

Surface-mounted wall luminaire, direct/indirect medium/wide distribution

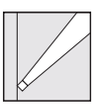

Surface-mounted wall luminaire, direct medium/wide distribution

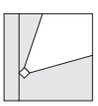

Surface-mounted wall luminaire, direct narrow distribution

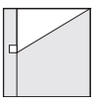

Surface-mounted wall luminaire, direct asymmetric narrow distribution

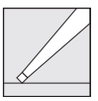

Surface-mounted wall luminaire diffuse distribution

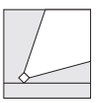

Asymmetric floodlight wall surface mounting

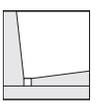

Symmetric floodlight/projector wall surface mounting narrow distribution

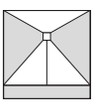

Symmetric floodlight/projector wall surface mounting wide/medium distribution

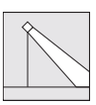

Recessed wall ceiling washer

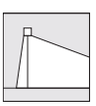

Symmetric floodlight/projector installation in ground, narrow distribution


Symmetric floodlight/projector wall surface mounting medium/wide distribution


Asymmetric floodlight installation in ground

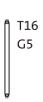

Floorstanding uplight, direct/indirect medium/wide distribution


Symmetric floodlight/projector mast mounting narrow distribution

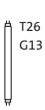

Asymmetric floodlight mast mounting

Lamps

Light emitting diodes



Fluorescent tube, d= 16mm, for ECG, double-ended



Fluorescent tube, d= 26mm, for ECG or LLCG, double-ended

Twin tube compact fluorescent lamp for LLCG, plug-in base

Twin tube compact fluorescent lamp for ECG, plug-in base

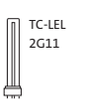
Twin double tube compact fluorescent lamp for LLCG, plug-in base

Twin double tube compact fluorescent lamp for ECG, plug-in base

Triple double tube compact fluorescent lamp for LLCG, plug-in base

Triple double tube compact fluorescent lamp for ECG, plug-in base

Triple double tube compact fluorescent lamp for higher ambient temperatures, for ECG, bayonet base



Twin tube compact fluorescent lamp for LLCG and ECG, plug-in base

Triple double tube reflector compact fluorescent lamp, integrated ECG

Lamps

Circular fluorescent lamp for ECG, plug-in base

Fluorescent lamp with loop form for LLCG, plug-in base

Metal halide lamp with ellipsoid bulb and quartz burner, screw base

Metal halide lamp with ellipsoid bulb and ceramic burner, screw base

Metal halide lamp with reflector and ceramic burner, burst-proof, bayonet base

Metal halide lamp with reflector and ceramic burner, burst-proof, bayonet base

Metal halide lamp with tubular bulb and ceramic burner, bayonet base

Metal halide lamp with tubular bulb and ceramic burner, bayonet base

Metal halide lamp with tubular bulb and ceramic burner, plug-in base

Metal halide lamp with tubular bulb and ceramic burner, plug-in base

Metal halide lamp with tubular bulb and ceramic burner, plug-in base

Metal halide lamp with tubular bulb and ceramic burner, suitable for hot re-ignition, plug-in base

Metal halide lamp with tubular bulb and ceramic burner, suitable for hot re-ignition, plug-in base

Metal halide lamp with tubular bulb and ceramic burner, bayonet base

Metal halide lamp with ellipsoid bulb and ceramic burner, burst-proof, screw base

Metal halide lamp with tubular bulb and ceramic burner, for HS ballast, plug-in base

Metal halide lamp with tubular bulb and quartz burner, plug-in base

Metal halide lamp with tubular bulb and quartz burner, suitable for hot re-ignition, plug-in base

Metal halide lamp with tubular bulb and quartz burner, suitable for hot re-ignition, plug-in base

Metal halide lamp with tubular bulb and quartz burner, screw base

Metal halide lamp with tubular bulb and ceramic burner, double-ended

Metal halide lamp with tubular bulb and quartz burner, double-ended

Metal halide lamp with quartz burner, double-ended

Metal halide lamp with quartz burner, double-ended

Mercury vapour lamp with ellipsoid bulb, screw base

High pressure sodium vapour lamp with ellipsoid bulb, internal ignitor, screw base

High pressure sodium vapour lamp with ellipsoid bulb, screw base

High pressure sodium vapour lamp with tubular bulb, screw base

High pressure sodium vapour lamp with tubular bulb, double-ended

High pressure sodium vapour lamp with tubular bulb and ceramic burner, plug-in base

Low voltage tungsten halogen lamp with tubular bulb, plug-in base

Low voltage tungsten halogen lamp with reflector, plug-in base

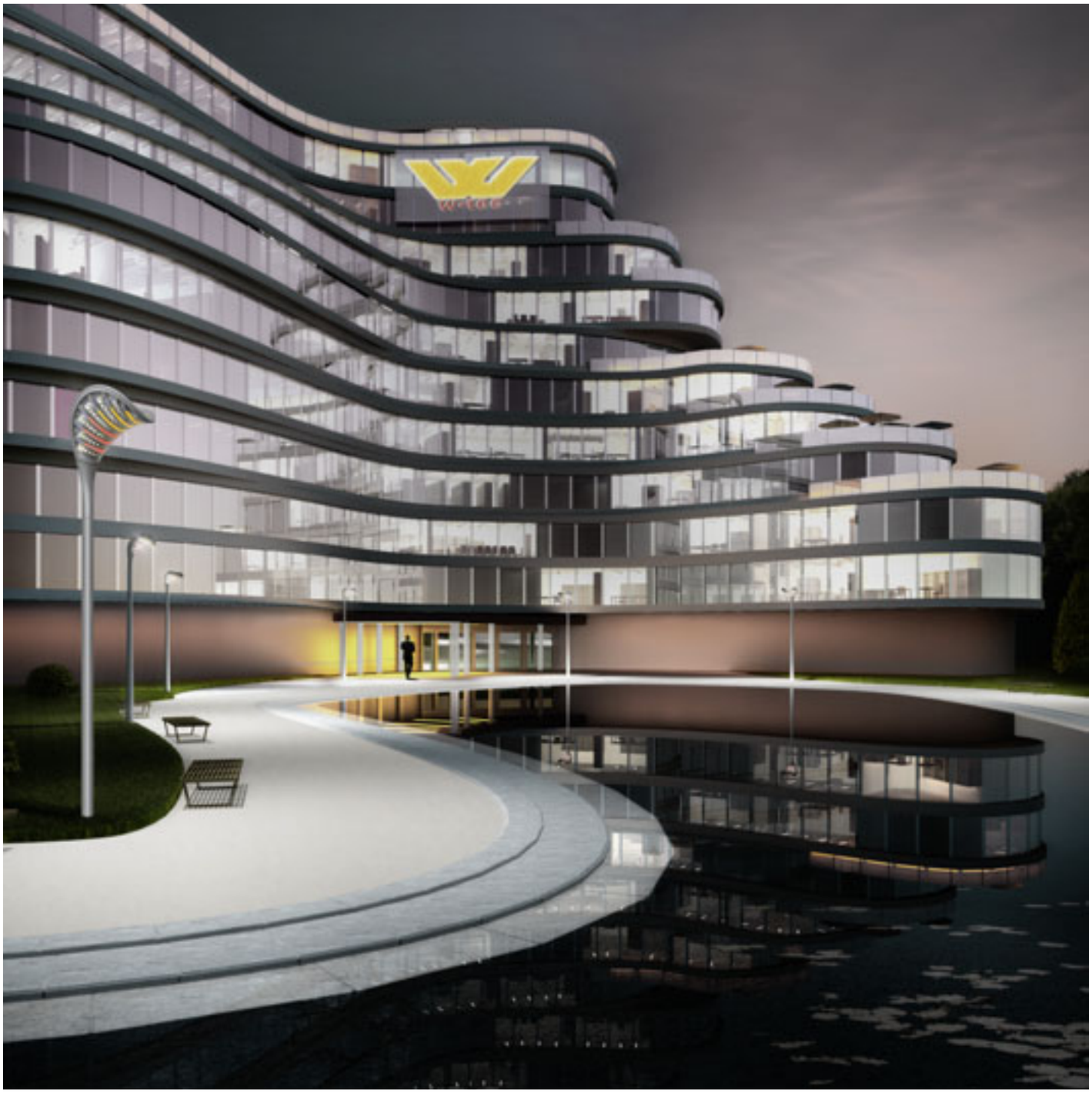
High voltage tungsten halogen lamp with tubular bulb, screw base

High voltage tungsten halogen lamp with tubular bulb, double-ended

High voltage tungsten halogen lamp with reflector, bayonet base

High voltage incandescent lamp with ellipsoid bulb, screw base

High voltage incandescent lamp with tubular bulb, screw base



Lighting with LED

History

It has been possible to create white light via semiconductors since the end of the nineties of the last century. These light emitting diodes (in short: LED) emit blue or ultraviolet radiation that is transformed to white light with a phospor coating. LEDs have existed for much longer that emit almost monochrome light (e.g. red, orange, green) of mainly a single wavelength. The efficiency of LEDs was initially below 30 lm/W, but has now progressed to up to 150lm/W. LED technology is subject to continuous development, thus giving consumers a further technical light source in addition to sources such as incandescent lamps, low pressure and high pressure discharge lamps.

LED chips

LEDs are so-called semiconductor diodes belonging to the electroluminescence radiators. They are based on semiconductor connections manufactured in a complex process (epitaxy) on a carrier material disc (wafer). Following epitaxy they are then laser-cut into small rectangles (LED chips) to dimensions of approximately 0.3 x 0.3 mm to 2.0 x 2.0 mm.

Package, chip on board, primary optics, PCB, control units

The LED manufacturer fits the chips into small housings (packages) where they are electrically connected, coated with phosphor and in some applications equipped with a lens (primary optic). The luminaire manufacturer welds the packages to a PCB and interconnects them according to company specifications (e.g. series or parallel connections). The control units are matched to these circuit diagrams.

As an alternative to packages, the chips are applied directly to the PCB (Chip on Board, COB) and electrically contacted. Also offered on the market are LED modules, meaning PCBs to which the packages or chips have been applied according to requirements and which luminaire manufacturers can then integrate.

Secondary optics, luminance, glare

Luminaire manufacturers equip the LED packages or modules with further optics (reflectors, diffusers and lenses) for light control. The compact size of the LED chips enables highly precise light guidance with very small optical components at the same time, and because LEDs only emit in one direction (hemisphere), losses via optical surfaces are usually lower than with other light sources. The luminance of an LED chip is very high with up to 50 million cd/sq. m,. and thus special measures are needed to prevent glare.

Voltage, current intensity, wattage, luminous flux

In order for LEDs to emit light, regulated DC current must be applied to their cathodes and anodes. In addition, forward voltage (c. 3V) must at least be applied to each LED chip. When forward voltage is exceeded, current flows through the LED and this then emits light. LEDs can usually be operated with various current intensities (e.g. 350mA, 700mA or 1000mA). They accordingly emit various light intensities. Yet the relation between electrical current intensity and luminous flux is not linear, meaning that luminous flux increases with increasing current intensity, but at the same time forward voltage as well. This means that the less an LED is fed with current, the higher is the luminous efficacy (lumens/watt).

Temperature, thermal management, system failure, cooling

In contrast to other light sources, LEDs usually do not emit ultraviolet or infrared radiation. Heat is produced at the chip or at a specific limitation surface within the semiconductor. If this heat surpasses the limit values specified by manufacturers as T-junction temperatures then this negatively affects the temperature-sensitive semiconductor: luminous flux decreases with increasing temperature and irreparable damage threatens, including total failure. The higher the temperature applied, the greater the danger of this happening.

The precondition for a long system service life and reliable operation is therefore cooling systems that dissipate heat rapidly and efficiently to the environment to keep the LED temperature low.

This in turn requires selecting materials with low thermal resistances and sufficiently large surfaces/heat sinks for releasing heat to the environment (passive cooling). Ventilators can also be integrated if necessary (active cooling). Only in this way is it possible to ensure long service life, high energy efficiency and low failure rates.

Binning, light colour, colour rendering

Each LED chip or package is activated briefly by the manufacturer and forward voltage, luminous flux and colour locus (light colour) are tested.

Because of product technology these three properties of LEDs are subject to deviation, and to achieve homogeneity the LED manufacturer sorts LEDs into so-called bins according to one or more of these characteristics.

In order to guarantee that the light colour and/or brightness of LEDs match existing installations with future purchases or upgrades, Siteco has developed a special tracking and tracing system. This enables the complete traceability of performance data of LEDs used until the binning process. Corresponding values are stored for each luminaire so that if LEDs or LED modules are exchanged, constant light colour across LED generations is ensured.

The colour rendition of white LEDs can differ extensively according to the phosphor system used. Light colours from warm white to daylight white are possible, whereby warm white colours have less efficiency due to thicker phosphor coatings.

Switching behaviour, dimming, system efficiency

LEDs can be activated and deactivated almost without time delays, and many switching processes (pulses) are possible within a single second.

This property is exploited for dimming LEDs (dual dimming). The process ensures optimal light output ratio across the complete dimming range. Alternatively, luminaires can be dimmed by reducing current intensity. This increases efficiency.

The total efficiency of the luminaire is however also determined by the efficiency of the control units. The more precisely control units or operating electronics are matched to LEDs, the higher is system efficiency. With the Basic, Plus and Premium function packages, Siteco sets milestones in efficiency with the control of LED systems according to requirements, and this allows the saving of up to 80% of energy when compared to conventional lamps with comparable outdoor lighting installations.

Luminaire light output ratio, luminaire luminous flux, maintenance factor

In contrast to other light sources, the luminous flux of LEDs cannot be measured independently to their housings as they require the thermal connection to the housing, and this is why it is not possible to determine the luminaire light output ratio according to the normal method (ratio of luminous flux of the lamp at 25°C to the luminaire luminous flux at 25°C). The luminaire light output ratio of an LED luminaire is 100%.

When considering the quality of LED luminaires and as a measure of efficiency, the ratio of net luminous flux to power consumption (lm/W) is used. More precise definitions of luminaire quality, optics and electronics are achieved by the additional consideration of luminous flux on the working plane (SLEEC factor for example).

The maintenance factor for Siteco outdoor LED luminaires needs to be redefined according to the special properties of LED technology. Until now, with conventional lamps only the luminaire maintenance factor was of validity for luminaire manufacturers, but now all three elements of the maintenance factor – the lamp luminous flux maintenance factor, lamp service life factor and luminaire maintenance factor must be considered.
Page 17 of this appendix demonstrates this for Siteco outdoor LED luminaires.

Sensible applications

The strengths of LEDs can be sourced from the above properties to specify particular applications.

Possibilities:
- coloured LEDs: very pure, saturated colours (e.g. for colour floodlighting indoors and outdoors, show effects, colour mixing applications)
- variable luminous flux via differing current intensities (e.g. dimmed operation indoors and outdoors/road lighting)
- very rapid switching (e.g. display applications)
- high colour rendering possible (e.g. shop and museum lighting)
- no UV and IR radiation (e.g. for museum lighting; lighting of goods with limited life spans; road lighting with low attraction for nocturnally active insects)
- high luminous flux and service life with low ambient temperatures (e.g. road lighting; lighting of cold stores and freezers)
- high energy efficiency and long service life while maintaining optimal electrical and thermal peripheral conditions are possible (low-maintenance/ maintenance-free luminaires for indoors and outdoors)
- small, precise and efficient optical systems (e.g. spotlights, road lighting)
- flexible construction designs

Challenges, quality standards, warranty

The diverse characteristics, parameters that can be influenced and rapid technical advancements with LEDs represent many challenges for luminaire manufacturers that in the end are reflected in the quality, appearance and operational life spans of their products.

Because Siteco is convinced of the quality and reliability of its LED products the company offers an additional warranty on all LED luminaires. Page 16 of this appendix has more detailed information.

Warranty for LED components in SITECO luminaires

Duration of warranty

For products with a nominal service life of ≥ 50,000 operating hours, SITECO offers a warranty over a period of five years according to warranty conditions. This warranty includes all LED modules, LED control units and other LED components integrated in luminaires with a nominal service life of ≥ 50,000 operating hours as specified by the technical documents.

For products with a nominal service life of < 50,000 hours, SITECO offers a warranty over a period of three years according to warranty conditions. This warranty includes all LED modules, LED control units and other LED components integrated in luminaires with a nominal service life of < 50,000 operating hours as specified by the technical documents.

The period of warranty begins with the time of installation, but at the latest three months following dispatch by Siteco.

Warranty conditions
This warranty is valid under the following conditions:

- The products are used in compliance with the product information and application instructions
- The products are registered with Siteco three months after commissioning at the latest
- The product is not exposed to mechanical loads
- If maintenance work is required according to installation and operating instructions, this is documented
- Limit values for temperatures and voltages must not be exceeded
- This warranty only covers product failures caused by material, construction or manufacturing errors
- The warranty refers to mortality above the nominal failure rate of 0.2% per 1,000 operating hours. Reduction of luminous flux to a value of 0.6% per 1,000 operating hours is normal and does not validate warranty claims
- With replacement of LED modules, deviations to illumination properties may result from application-related modification of the luminous flux of LED modules operated, and also from the results of technical progress.
- The specified service life is achieved when the luminaires are operated in conformity with the conditions specified by the manufacturer, the applicable standards and valid directives.
- This warranty covers all relevant deliveries after 1 July 2010, without tunnel luminaires

This warranty is rendered invalid when modifications or repairs are made to LED luminaires and LED modules without prior written approval from Siteco.

Warranty coverage

With failures that exceed the nominal failure rate, Siteco will repair the defective components, supply spare parts or credit the customer for defective products. All additional costs resulting from the warranty service (e.g. disassembly, reinstallation, shipping of faulty products, disposal, travel times, lifting facilities and scaffolding) must be met by the customer. Other costs such as costs resulting from failure of the installation or other damage as well as consequential damages are not covered by this warranty.
Warranty services will only be provided by Siteco until the warranty period of the original supply is terminated. Components or products returned to Siteco in warranty situations become the property of Siteco.

Enforcement of warranty rights

Warranty rights can be claimed by any person upon presentation of invoice for the products specified above and installed in a country in the European Union, in Turkey, Croatia, Macedonia, Switzerland and Norway.
Warranty claims must be made immediately following occurrence of a defect by written communication of the registration number to

Siteco Beleuchtungstechnik GmbH
Department QM3
Georg-Simon-Ohm-Strasse 50
83301 Traunreut | Germany

More information via our website
http://www.siteco.com/de/service/garantie.html

Siteco reserves the right to inspect the validity of the warranty claim in accordance with the warranty conditions.

This warranty does not limit contractual or legislative claims of the purchaser that can be claimed against the seller or manufacturer according to the specific conditions.

Maintenance factor with Siteco LED outdoor luminaires

The technological transformation caused by LED technology has also caused a change in consideration of the maintenance factor. Until now, luminaire manufacturers only had to bear in mind the luminaire maintenance factor (LMF).

Maintenance factor until now (conventional lamp):

MF =	LLMF x	LSF x	LMF
Maintenance factor	Lamp luminous flux maintenance factor	Lamp service life factor	Luminaire maintenance factor
	Lamp manufacturer		**Luminaire manufacturer**

With the use of LED technology, a luminaire manufacturer must now take into account all three elements of the maintenance factor, as LEDs have become an integral part of the complete concept of a luminaire.

Maintenance factor with LED luminaires:

MF =	LLMF x	LSF x	LMF
Maintenance factor	Lamp luminous flux maintenance factor	Lamp service life factor	Luminaire maintenance factor
	Luminaire manufacturer		

Because the functionality and capabilities of LEDs differ fundamentally from conventional light sources, there are now new features to be considered with the specific characteristics of this maintenance factor comparison. It must also be considered how different manufacturers handle the technical possibilities and potential of LEDs and take these into account.

About the specific factors:

1. LLMF (lamp luminous flux maintenance factor)

This considers the physically-dependent luminous flux decrease of a lamp over the complete lamp service life (degradation). LEDs are also subject to this ageing process. And here as well there is an age-dependent reduction in luminous flux. How this reduction in luminous flux is specified is dependent upon a wide variety of factors such as the quality of LEDs, their current feed and also thermal management.
This is why with Siteco luminaires there is no fixed LLMF value but a value individually specified according to the LEDs used in the luminaire. This value is taken from the characteristic curve of the manufacturer.
All LLMF values refer though to an operating life of 50,000 hours and a nominal ambient temperature of 25° C.
In Central Europe the average outdoor temperature during luminaire operating hours is +5° C. This temperature, 20 K less than ambient temperature in laboratory conditions, leads in practice to improvements in efficiency and service life.
The factor is

- 0.88 with Streetlight 10 mini Basic
- 0.83 with Streetlight 10 midi Basic

Improvement of the LLMF via intelligent control (with Plus and Premium versions): Because Siteco cleverly exploits the electronic control capabilities of LEDs for increasing efficiency, the age-dependent reduction in luminous flux of LEDs is compensated for with power tracking. This ensures constant luminous flux over the complete service life of 50,000 hours. This function for constant luminous flux control is available with all LED outdoor luminaires with the Plus and Premium functional packages.

The LLMF is therefore for example

- 1.0 with Streetlight 10 mini Plus and Premium
- 1.0 with Streetlight 10 midi Plus and Premium

2. LSF (lamp service life factor)

This considers premature failing of lamps. Because of the high demand for quality when selecting LEDs for Siteco outdoor luminaires, the probability of failure of an LED is very low. The failure rate is between 0 and 2%. The LSF is therefore 0.98 with all Siteco LED outdoor luminaires.

3. LMF (luminaire maintenance factor)

The LMF considers the following factors:
1. protection rating in the lamp compartment
2. cleaning interval
3. air impurities in the luminaire vicinity

The protection rating with Siteco outdoor LED luminaires is always IP5x or IP6x. The cleaning interval and air impurities are criteria that need to be specified individually according to situation and on-site conditions.

The factor is specified for the protection rating in relation to the cleaning interval (1, 2, 3 ,4 years) and soiling from the vicinity (low, middle, high). The values can be seen in the table expanded for the special features of Siteco LED luminaires.

Table for defining the LMF for Siteco outdoor LED luminaires (05.2011)

Further information about the maintenance factor for Siteco LED outdoor luminaires on the internet at
http://www.siteco.de/uploads/tx_usersitecodownloads/Wartungsfaktor_LED_Aussenleuchten.pdf

Cleaning interval (in years)	1,0			2,0			3,0			4,0		
Air pollution	L	M	H	L	M	H	L	M	H	L	M	H
Protection rating of lamp compartment												
IP 5X	0,99	0,96	0,96	0,97	0,92	0,91	0,95	0,88	0,82	0,94	0,85	0,75
IP 6X	1,00	0,98	0,98	0,98	0,95	0,95	0,97	0,93	0,90	0,96	0,92	0,86

Air pollution: L = low; M = medium; H = high

New lamp technology with fluorescent lamps and compact fluorescent lamps

Since the commercial launching of fluorescent lamps in the 1930's these have been technically improved in a continuous fashion.
Improvements/modifications affected:

- Colour rendering
- Light colours
- Service Life
- Luminous flux
- Temperature dependence of luminous flux
- Efficiency
- Construction forms
- Dimmability
- Ballasts

Two current developments: with conventional fluorescent lamps, mercury in liquid or gas form is sealed in the lamp bulb. The mercury is excited to emit UV radiation by applying voltage to electrodes, and the UV radiation on the phosphorous material on the inner of the bulb is transformed to light.
This process is strongly dependent upon temperature. The lamp wattage [W], luminous flux [lm] and luminous efficacy [lm/W] are dependent upon mercury vapour pressure. With very low temperatures (<0°C) fluorescent lamps emit very low light quantities (e.g. 25% at 0°C), the maximum lamp wattage is usually achieved between 30°C and 35°C, maximum luminous flux between 35°C and 40°C and maximum luminous efficacy between 40°C and 45°C. Above these temperatures these values reduce. Luminous flux reduces because the UV radiation emitted is absorbed again in the mercury vapour. Essential for mercury vapour pressure is the temperature at the coolest location in the bulb, the cold spot temperature.

Amalgam lamps

Since the beginning of the 21st century, tubular fluorescent lamps and compact fluorescent lamps have been available that use so-called amalgam technology. (e.g. OSRAM 'CONSTANT', PHILIPS 'TOP')

With amalgam technology, an amalgam body (alloy of mercury with other metals) is additionally contained in the lamp bulb. This absorbs a part of the mercury and thus regulates the mercury vapour pressure. The result of this is that mercury vapour pressure and therefore luminous flux remains almost constant over a wider temperature range.

Tubular amalgam lamps already have a higher luminous flux than conventional lamps at 25°C. Luminaires equipped with amalgam lamps usually have a higher luminaire light output ratio (factor up to 1.5). This effect is greater with higher temperatures in the luminaires. Amalgam lamps are also highly suitable for applications with lower ambient temperatures (e.g. road lighting, cold store lighting).

In principle, all normal lamps can be replaced with amalgam lamps of equal wattage and with the same bases. Amalgam lamps feature longer start-up behaviour than normal lamps and are therefore not suitable for security lighting. The lamps light with a reddish hue in the start-up phase.

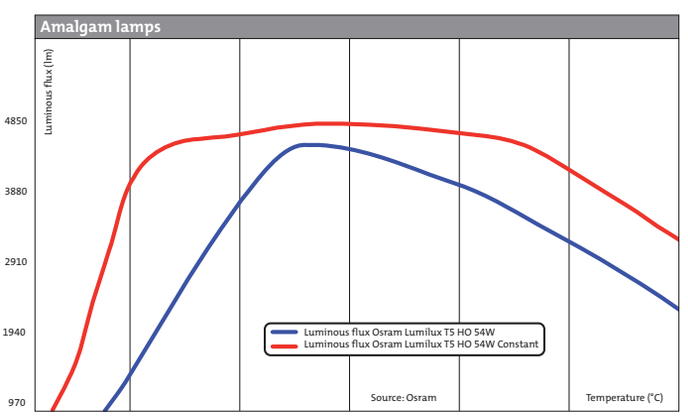
Amalgam lamps have different dimming behaviour to normal lamps and should therefore not be dimmed below 30% as the colour otherwise shifts towards red. Please also observe the technical information from the lamp manufacturers.

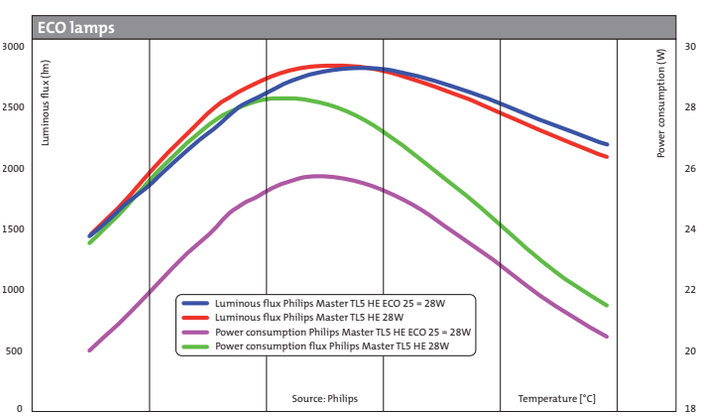
Comparison of the luminous flux of Osram Lumilux T5 HO 54W Constant with Osram Lumilux T5 HO 54W

'ECO lamps'

Recently, tubular fluorescent lamps and compact fluorescent lamps have been offered that are marketed as ECO lamps, e.g. PHILIPS PL-R ECO, OSRAM DULUX T/E HE, PHILIPS TL5 ECO, OSRAM T5 ES.
These lamps in principle are constructed identically to normal lamps but the gas filling and phosphorous material have been improved.
Temperature behaviour is almost identical to that of normal lamps.
In principle, all normal lamps can be replaced with ECO lamps that are intended for operation with the same ballast.
If these lamps are operated with current-controlled ballasts (with Siteco this applies to all non-dimmable ECGs), the connected load is reduced by an average of almost 10% with the same luminous flux. This however fluctuates depending upon the type of luminaire and wattage.
If these lamps are operated with wattage-controlled ballasts (with Siteco this applies to all dimmable ECGs), the luminous flux is increased by an average of up to 10% with the same consumption in undimmed condition. This however fluctuates depending upon the type of luminaire and wattage. ECO lamps (as with normal lamps) are suitable for operation in luminaires where in operation the cold spot of the lamp is about 35 to 45°C, as here the maximum values for luminous flux (lm) and luminous efficacy (lm/W) are achieved. Please also observe the technical information from the lamp manufacturers.

Comparison of Philips Master TL5 HE ECO 25 = 28W with Philips Master TI5 HE 28W






WENZEL
Heinz Schauperl

ZVEI	Wattage	Base	Luminous flux	Efficiency (lm/W)	Light colour	Colour rendering	ILCOS	OSRAM	PHILIPS	Havells Sylvania	GE
Fluorescent tubes											
T16	13	G5	1150	88	ww	1B	FDH-13/30/1B-L/P-G5-16/550	–	MASTER TL5 HE Eco 13=14W/830	–	–
T16	13	G5	1150	88	nw	1B	FDH-13/40/1B-L/P-G5-16/550	–	MASTER TL5 HE Eco 13=14W/840	–	–
T16	14	G5	1200	86	ww	1B	FDH-14/30/1B-L/P-G5-16/549	HE 14 W/830	MASTER TL5 HE 14W/830	FHE 14W/830	F14W/T5/830/WM
T16	14	G5	1200	86	nw	1B	FDH-14/40/1B-L/P-G5-16/549	HE 14 W/840	MASTER TL5 HE 14W/840	FHE 14W/840	F14W/T5/840/WM
T16	21	G5	1900	90	ww	1B	FDH-21/30/1B-L/P-G5-16/849	HE 21 W/830	MASTER TL5 HE 21W/830	FHE 21W/830	F21W/T5/830/WM
T16	21	G5	1900	90	nw	1B	FDH-21/40/1B-L/P-G5-16/849	HE 21 W/840	MASTER TL5 HE 21W/840	FHE 21W/840	F21W/T5/840/WM
T16	25	G5	2450	98	ww	1B	FDH-25/30/1B-L/P-G5-16/1150	HE 25 W/830 ES	MASTER TL5 HE Eco 25=28W/830	–	–
T16	25	G5	2450	98	nw	1B	FDH-25/40/1B-L/P-G5-16/1150	HE 25 W/840 ES	MASTER TL5 HE Eco 25=28W/840	–	–
T16	28	G5	2600	93	ww	1B	FDH-28/30/1B-L/P-G5-16/1149	HE 28 W/830	MASTER TL5 HE 28W/830	FHE 28W/830	F28W/T5/830/WM
T16	28	G5	2600	93	nw	1B	FDH-28/40/1B-L/P-G5-16/1149	HE 28 W/840	MASTER TL5 HE 28W/840	FHE 28W/840	F28W/T5/840/WM
T16	32	G5	3100	97	ww	1B	FDH-32/30/1B-L/P-G5-16/1450	HE 32 W/830 ES	MASTER TL5 HE Eco 32=35W/830	–	–
T16	32	G5	3100	97	nw	1B	FDH-32/40/1B-L/P-G5-16/1450	HE 32 W/840 ES	MASTER TL5 HE Eco 32=35W/840	–	–
T16	35	G5	3300	94	ww	1B	FDH-35/30/1B-L/P-G5-16/1449	HE 35 W/830	MASTER TL5 HE 35W/830	FHE 35W/830	F35W/T5/830/WM
T16	35	G5	3300	94	nw	1B	FDH-35/40/1B-L/P-G5-16/1449	HE 35 W/840	MASTER TL5 HE 35W/840	FHE 35W/840	F35W/T5/840/WM
T16	20	G5	1650	83	ww	1B	FDH-20/30/1B-L/P-G5-16/550	–	MASTER TL5 HO Eco 20=24W/830	–	–
T16	20	G5	1650	83	nw	1B	FDH-20/40/1B-L/P-G5-16/550	–	MASTER TL5 HO Eco 20=24W/840	–	–
T16	24	G5	1750	73	ww	1B	FDH-24/30/1B-L/P-G5-16/549	HO 24 W/830	MASTER TL5 HO 24W/830	FHO 24W/830	F24W/T5/830/WM
T16	24	G5	1750	73	nw	1B	FDH-24/40/1B-L/P-G5-16/549	HO 24 W/840	MASTER TL5 HO 24W/840	FHO 24W/840	F24W/T5/840/WM
T16	39	G5	3100	79	ww	1B	FDH-39/30/1B-L/P-G5-16/849	HO 39 W/830	MASTER TL5 HO 39W/830	FHO 39W/830	F39W/T5/830/WM
T16	39	G5	3100	79	nw	1B	FDH-39/40/1B-L/P-G5-16/849	HO 39 W/840	MASTER TL5 HO 39W/840	FHO 39W/840	F39W/T5/840/WM
T16	50	G5	4400	88	ww	1B	FDH-50/30/1B-L/P-G5-16/1150	HO 50 W/830 ES	MASTER TL5 HO Eco 50=54W/830	–	–
T16	50	G5	4400	88	nw	1B	FDH-50/40/1B-L/P-G5-16/1150	HO 50 W/840 ES	MASTER TL5 HO Eco 50=54W/840	–	–
T16	54	G5	4450	82	ww	1B	FDH-54/30/1B-L/P-G5-16/1149	HO 54 W/830	MASTER TL5 HO 54W/830	FHO 54W/830	F54W/T5/830/WM
T16	54	G5	4450	82	nw	1B	FDH-54/40/1B-L/P-G5-16/1149	HO 54 W/840	MASTER TL5 HO 54W/840	FHO 54W/840	F54W/T5/840/WM
T16	45	G5	4100	91	ww	1B	FDH-45/30/1B-L/P-G5-16/1450	HO 45 W/830 ES	MASTER TL5 HO Eco 45=49W/830	–	–
T16	45	G5	4100	91	nw	1B	FDH-45/40/1B-L/P-G5-16/1450	HO 45 W/840 ES	MASTER TL5 HO Eco 45=49W/840	–	–
T16	49	G5	4300	88	ww	1B	FDH-49/30/1B-L/P-G5-16/1449	HO 49 W/830	MASTER TL5 HO 49W/830	FHO 49W/830	F49W/T5/830/WM
T16	49	G5	4300	88	nw	1B	FDH-49/40/1B-L/P-G5-16/1449	HO 49 W/840	MASTER TL5 HO 49W/840	FHO 49W/840	F49W/T5/840/WM
T16	73	G5	6150	84	ww	1B	FDH-73/30/1B-L/P-G5-16/1450	HO 73 W/830 ES	MASTER TL5 HO Eco 73=80W/830	–	–
T16	73	G5	6150	84	nw	1B	FDH-73/40/1B-L/P-G5-16/1450	HO 73 W/840 ES	MASTER TL5 HO Eco 73=80W/840	–	–
T16	80	G5	6150	77	ww	1B	FDH-80/30/1B-L/P-G5-16/1449	HO 80 W/830	MASTER TL5 HO 80W/830	FHO 80W/830	F80W/T5/830/WM
T16	80	G5	6150	77	nw	1B	FDH-80/40/1B-L/P-G5-16/1449	HO 80 W/840	MASTER TL5 HO 80W/840	FHO 80W/840	F80W/T5/840/WM
T16-I	24	G5	1950	81	ww	1B	FDH-24/30/1B-L/P-G5-16/550	HO 24 W/830 CONSTANT	–	–	–
T16-I	24	G5	1950	81	nw	1B	FDH-24/40/1B-L/P-G5-16/550	HO 24 W/840 CONSTANT	–	–	–
T16-I	39	G5	3400	87	ww	1B	FDH-39/30/1B-L/P-G5-16/850	HO 39 W/830 CONSTANT	–	–	–
T16-I	39	G5	3400	87	nw	1B	FDH-39/40/1B-L/P-G5-16/850	HO 39 W/840 CONSTANT	–	–	–
T16-I	49	G5	4650	95	ww	1B	FDH-49/30/1B-L/P-G5-16/1450	HO 49 W/830 CONSTANT	–	–	–
T16-I	49	G5	4650	95	nw	1B	FDH-49/40/1B-L/P-G5-16/1450	HO 49 W/840 CONSTANT	MASTER TL5 HO TOP 49W/840	–	–
T16-I	54	G5	4850	90	ww	1B	FDH-54/30/1B-L/P-G5-16/1150	HO 54 W/830 CONSTANT	–	–	–
T16-I	54	G5	4850	90	nw	1B	FDH-54/40/1B-L/P-G5-16/1150	HO 54 W/840 CONSTANT	MASTER TL5 HO TOP 54W/840	–	–
T16-I	80	G5	6800	85	ww	1B	FDH-80/30/1B-L/P-G5-16/1450	HO 80 W/830 CONSTANT	–	–	–
T16-I	80	G5	6800	85	nw	1B	FDH-80/40/1B-L/P-G5-16/1450	HO 80 W/840 CONSTANT	MASTER TL5 HO TOP 80W/840	–	–
T26	18	G13	1350	75	ww	1B	FD-18/30/1B-E-G13-26/590	L 18 W/830	MASTER TL-D Super 80 18W/830	F18W/830	F18W/T8/830/POLYLUX
T26	18	G13	1350	75	nw	1B	FD-18/40/1B-E-G13-26/590	L 18 W/840	MASTER TL-D Super 80 18W/840	F18W/840	F18W/T8/840/POLYLUX
T26	36	G13	3350	93	ww	1B	FD-36/30/1B-E-G13-26/1200	L 36 W/830	MASTER TL-D Super 80 36W/830	F36W/830	F36W/T8/830/POLYLUX
T26	36	G13	3350	93	nw	1B	FD-36/40/1B-E-G13-26/1200	L 36 W/840	MASTER TL-D Super 80 36W/840	F36W/840	F36W/T8/840/POLYLUX
T26	38	G13	3300	87	ww	1B	FD-38/30/1B-E-G13-26/1047	L 38 W/830	MASTER TL-D Super 80 38W/830	F38W/830	–
T26	38	G13	3300	87	nw	1B	FD-38/40/1B-E-G13-26/1047	L 38 W/840	MASTER TL-D Super 80 38W/840	F38W/840	–
T26	58	G13	5200	90	ww	1B	FD-58/30/1B-E-G13-26/1500	L 58 W/830	MASTER TL-D Super 80 58W/830	F58W/830	F58W/T8/830/POLYLUX
T26	58	G13	5200	90	nw	1B	FD-58/40/1B-E-G13-26/1500	L 58 W/840	MASTER TL-D Super 80 58W/840	F58W/840	F58W/T8/840/POLYLUX
Compact fluorescent lamps											
TC-S	9	G23	600	67	ww	1B	FSD-9/30/1B-I-G23	DULUX S 9 W/830	MASTER PL-S 9W/830/2P	Lynx-S 9W 830	F9BX/830
TC-S	9	G23	600	67	nw	1B	FSD-9/40/1B-I-G23	DULUX S 9 W/840	MASTER PL-S 9W/840/2P	Lynx-S 9W 840	F9BX/SPX41/840
TC-S	11	G23	900	82	ww	1B	FSD-11/30/1B-I-G23	DULUX S 11 W/830	MASTER PL-S 11W/830/2P	Lynx-S 11W 830	F11BX/830
TC-S	11	G23	900	82	nw	1B	FSD-11/40/1B-I-G23	DULUX S 11 W/840	MASTER PL-S 11W/840/2P	Lynx-S 11W 840	F11BX/840
TC-SEL	9	2G7	600	67	ww	1B	FSD-9/30/1B-E-2G7	DULUX S/E 9 W/830	MASTER PL-S 9W/830/4P	Lynx-SE 9W 830	–
TC-SEL	9	2G7	600	67	nw	1B	FSD-9/40/1B-E-2G7	DULUX S/E 9 W/840	MASTER PL-S 9W/840/4P	Lynx-SE 9W 840	F9BX/840/4P
TC-SEL	11	2G7	900	82	ww	1B	FSD-11/30/1B-E-2G7	DULUX S/E 11 W/830	MASTER PL-S 11W/830/4P	Lynx-SE 11W 830	–
TC-SEL	11	2G7	900	82	nw	1B	FSD-11/40/1B-E-2G7	DULUX S/E 11 W/840	MASTER PL-S 11W/840/4P	Lynx-SE 11W 840	F11BX/840/4P
TC-D	10	G24d-1	600	60	ww	1B	FSQ-10/30/1B-I-G24d=1	DULUX D 10 W/830	MASTER PL-C 10W/830/2P	Lynx-D 10W 830	F10DBX/T3/830/2P
TC-D	10	G24d-1	600	60	nw	1B	FSQ-10/40/1B-I-G24d=1	DULUX D 10 W/840	MASTER PL-C 10W/840/2P	Lynx-D 10W 840	F10DBX/T3/840/2P
TC-D	13	G24d-1	900	69	ww	1B	FSQ-13/30/1B-I-G24d=1	DULUX D 13 W/830	MASTER PL-C 13W/830/2P	Lynx-D 13W 830	F13DBX/T3/830/2P
TC-D	13	G24d-1	900	69	nw	1B	FSQ-13/40/1B-I-G24d=1	DULUX D 13 W/840	MASTER PL-C 13W/840/2P	Lynx-D 13W 840	F13DBX/T3/840/2P
TC-D	18	G24d-2	1200	67	ww	1B	FSQ-18/30/1B-I-G24d=2	DULUX D 18 W/830	MASTER PL-C 18W/830/2P	Lynx-D 18W 830	F18DBXT4/SPX30/830
TC-D	18	G24d-2	1200	67	nw	1B	FSQ-18/40/1B-I-G24d=2	DULUX D 18 W/840	MASTER PL-C 18W/840/2P	Lynx-D 18W 840	F18DBXT4/SPX41/840
TC-D	26	G24d-3	1800	69	ww	1B	FSQ-26/30/1B-I-G24d=3	DULUX D 26 W/830	MASTER PL-C 26W/830/2P	Lynx-D 26W 830	F26DBXT4/SPX30/830
TC-D	26	G24d-3	1800	69	nw	1B	FSQ-26/40/1B-I-G24d=3	DULUX D 26 W/840	MASTER PL-C 26W/840/2P	Lynx-D 26W 840	F26DBXT4/SPX41/840
TC-DEL	10	G24q-1	600	60	ww	1B	FSQ-10/30/1B-E-G24q=1	DULUX D/E 10 W/830	MASTER PL-C 10W/830/4P	Lynx-DE 10W 830	F10DBX/T3/830/4P
TC-DEL	10	G24q-1	600	60	nw	1B	FSQ-10/40/1B-E-G24q=1	DULUX D/E 10 W/840	MASTER PL-C 10W/840/4P	Lynx-DE 10W 840	F10DBX/T3/840/4P
TC-DEL	13	G24q-1	900	69	ww	1B	FSQ-13/30/1B-E-G24q=1	DULUX D/E 13 W/830	MASTER PL-C 13W/830/4P	Lynx-DE 13W 830	F13DBX/T3/830/4P
TC-DEL	13	G24q-1	900	69	nw	1B	FSQ-13/40/1B-E-G24q=1	DULUX D/E 13 W/840	MASTER PL-C 13W/840/4P	Lynx-DE 13W 840	F13DBX/T3/840/4P
TC-DEL	18	G24q-2	1200	67	ww	1B	FSQ-18/30/1B-E-G24q=2	DULUX D/E 18 W/830	MASTER PL-C 18W/830/4P	Lynx-DE 18W 830	F18DBX/SPX30/830/4P
TC-DEL	18	G24q-2	1200	67	nw	1B	FSQ-18/40/1B-E-G24q=2	DULUX D/E 18 W/840	MASTER PL-C 18W/840/4P	Lynx-DE 18W 840	F18DBX/SPX41/840/4P
TC-DEL	26	G24q-3	1800	69	ww	1B	FSQ-26/30/1B-E-G24q=3	DULUX D/E 26 W/830	MASTER PL-C 26W/830/4P	Lynx-DE 26W 830	F26DBX/SPX30/830/4P
TC-DEL	26	G24q-3	1800	69	nw	1B	FSQ-26/40/1B-E-G24q=3	DULUX D/E 26 W/840	MASTER PL-C 26W/840/4P	Lynx-DE 26W 840	F26DBX/SPX41/840/4P
TC-T	26	GX24d-3	1800	69	ww	1B	FSM-26/30/1B-I-GX24d=3	DULUX T 26 W/830 PLUS	MASTER PL-T 26W/830/2P	Lynx-T 26W 830	F26TBX/SPX30/830/A/2P
TC-T	26	GX24d-3	1800	69	nw	1B	FSM-26/40/1B-I-GX24d=3	DULUX T 26 W/840 PLUS	MASTER PL-T 26W/840/2P	Lynx-T 26W 840	F26TBX/SPX41/840/A/2P
TC-TEL	13	GX24q-1	900	69	ww	1B	FSMH-13/30/1B-GX24q=1	DULUX T/E 13 W/830 PLUS	MASTER PL-T 13W/830/4P	–	–
TC-TEL	13	GX24q-2	900	69	nw	1B	FSMH-13/40/1B-GX24q=1	DULUX T/E 13 W/840 PLUS	MASTER PL-T 13W/840/4P	–	–
TC-TEL	14	GR14q-1	1050	75	ww	1B	FSM6H-14/30/1B-L/P-GR14q=1	DULUX T/E 14 W/830 HE	MASTER PL-R Eco 14W/830/4P	–	–
TC-TEL	14	GR14q-1	1050	75	nw	1B	FSM6H-14/40/1B-L/P-GR14q=1	DULUX T/E 14 W/840 HE	MASTER PL-R Eco 14W/840/4P	–	–

ZVEI	Wattage	Base	Luminous flux	Efficiency (lm/W)	Light colour	Colour rendering	ILCOS	OSRAM	PHILIPS	Havells Sylvania	GE
Compact fluorescent lamps (cont.)											
TC-TEL	17	GR14q-1	1250	74	ww	1B	FSM6H-17/30/1B-L/P-GR14q=1	DULUX T/E 17 W/830 HE	MASTER PL-R Eco 17W/830/4P	–	–
TC-TEL	17	GR14q-1	1250	74	nw	1B	FSM6H-17/40/1B-L/P-GR14q=1	DULUX T/E 17 W/840 HE	MASTER PL-R Eco 17W/840/4P	–	–
TC-TEL	18	GX24q-2	1200	67	ww	1B	FSMH-18/30/1B-GX24q=2	DULUX T/E 18 W/830 PLUS	MASTER PL-T 18W/830/4P	Lynx-TE FSD 18W 830	–
TC-TEL	18	GX24q-2	1200	67	nw	1B	FSMH-18/40/1B-GX24q=2	DULUX T/E 18 W/840 PLUS	MASTER PL-T 18W/840/4P	Lynx-TE FSD 18W 840	–
TC-TEL	26	GX24q-3	1800	69	ww	1B	FSMH-26/30/1B-GX24q=3	DULUX T/E 26 W/830 PLUS	MASTER PL-T 26W/830/4P	Lynx-TE FSD 26W 830	–
TC-TEL	26	GX24q-3	1800	69	nw	1B	FSMH-26/40/1B-GX24q=3	DULUX T/E 26 W/840 PLUS	MASTER PL-T 26W/840/4P	Lynx-TE FSD 26W 840	–
TC-TEL	32	GX24q-3	2400	75	ww	1B	FSMH-32/30/1B-GX24q=3	DULUX T/E 32 W/830 PLUS	MASTER PL-T 32W/830/4P	Lynx-TE FSD 32W 830	–
TC-TEL	32	GX24q-3	2400	75	nw	1B	FSMH-32/40/1B-GX24q=3	DULUX T/E 32 W/840 PLUS	MASTER PL-T 32W/840/4P	Lynx-TE FSD 32W 840	–
TC-TEL	42	GX24q-4	3200	76	ww	1B	FSMH-42/30/1B-GX24q=4	DULUX T/E 42 W/830 PLUS	MASTER PL-T 42W/830/4P	Lynx-TE FSD 42W 830	–
TC-TEL	42	GX24q-4	3200	76	nw	1B	FSMH-42/40/1B-GX24q=4	DULUX T/E 42 W/840 PLUS	MASTER PL-T 42W/840/4P	Lynx-TE FSD 42W 840	–
TC-TEL	57	GX24q-5	4300	75	ww	1B	FSMH-57/30/1B-E-GX24q=5	–	MASTER PL-T 57W/830/4P	–	F57QBX/830/A/4P/LL
TC-TEL	57	GX24q-5	4300	75	nw	1B	FSMH-57/30/1B-E-GX24q=5	–	MASTER PL-T 57W/840/4P	–	F57QBX/840/A/4P/LL
TC-TELI	13	GX24q-1	900	69	ww	1B	FSM-13/30/1B-E-GX24q=1	–	–	–	F13TBX/SPX30/830/A/4P
TC-TELI	13	GX24q-2	900	69	nw	1B	FSM-13/40/1B-E-GX24q=1	–	–	–	F13TBX/SPX41/840/A/4P
TC-TELI	18	GX24q-2	1200	67	ww	1B	FSM-18/30/1B-E-GX24q=2	–	MASTER PL-T TOP 18W/830/4P	Lynx-TE Amalgam 18W 830	F18TBX/SPX30/830/A/4P
TC-TELI	18	GX24q-2	1200	67	nw	1B	FSM-18/40/1B-E-GX24q=2	–	MASTER PL-T TOP 18W/840/4P	Lynx-TE Amalgam 18W 840	F18TBX/SPX41/840/A/4P
TC-TELI	26	GX24q-3	1800	69	ww	1B	FSM-26/30/1B-E-GX24q=3	DULUX T/E 26 W/830 CONSTANT	MASTER PL-T TOP 26W/830/4P	Lynx-TE Amalgam 26W 830	F26TBX/SPX30/830/A/4P
TC-TELI	26	GX24q-3	1800	69	nw	1B	FSM-26/40/1B-E-GX24q=3	DULUX T/E 26 W/840 CONSTANT	MASTER PL-T TOP 26W/840/4P	Lynx-TE Amalgam 26W 840	F26TBX/SPX41/840/A/4P
TC-TELI	32	GX24q-3	2400	75	ww	1B	FSM-32/30/1B-E-GX24q=3	DULUX T/E 32 W/830 CONSTANT	MASTER PL-T TOP 32W/830/4P	Lynx-TE Amalgam 32W 830	F32TBX/SPX30/830/AP4P
TC-TELI	32	GX24q-3	2400	75	nw	1B	FSM-32/40/1B-E-GX24q=3	DULUX T/E 32 W/840 CONSTANT	MASTER PL-T TOP 32W/840/4P	Lynx-TE Amalgam 32W 840	F32TBX/SPX41/840/A/4P
TC-TELI	42	GX24q-4	3270	78	ww	1B	FSM-42/30/1B-E-GX24q=4	DULUX T/E 42 W/830 CONSTANT	MASTER PL-T TOP 42W/830/4P	Lynx-TE Amalgam 42W 830	F42TBX/830/A/4P
TC-TELI	42	GX24q-4	3270	78	nw	1B	FSM-42/40/1B-E-GX24q=4	DULUX T/E 42 W/840 CONSTANT	MASTER PL-T TOP 42W/840/4P	Lynx-TE Amalgam 42W 840	F42TBX/841/A/4P
TC-TELI	57	GX24q-5	4300	75	ww	1B	FSMH-57/30/1B-GX24q=5	–	MASTER PL-T TOP 57W/830/4P	–	–
TC-TELI	57	GX24q-5	4300	75	nw	1B	FSMH-57/40/1B-GX24q=5	–	MASTER PL-T TOP 57W/840/4P	–	–
TC-TELI	60	2G8-1	4000	67	ww	1B	FSM6H-60/30/1B-L/P-2G8=1	–	MASTER PL-H 60W/830/4P	–	–
TC-TELI	60	2G8-1	4000	67	nw	1B	FSM6H-60/40/1B-L/P-2G8=1	–	MASTER PL-H 60W/840/4P	–	–
TC-TELI	85	2G8-1	6000	71	ww	1B	FSM6H-85/30/1B-L/P-2G8=1	–	MASTER PL-H 85W/830/4P	–	–
TC-TELI	85	2G8-1	6000	71	nw	1B	FSM6H-85/40/1B-L/P-2G8=1	–	MASTER PL-H 85W/840/4P	–	–
TC-TELI	120	2G8-1	9000	75	ww	1B	FSM-8H-120/30/1B-L/P-2G8=1	–	MASTER PL-H 120W/830/4P	–	–
TC-TELI	120	2G8-1	9000	75	nw	1B	FSM-8H-120/40/1B-L/P-2G8=1	DULUX 120 W/840 HO CONSTANT	MASTER PL-H 120W/840/4P	–	–
TC-LEL	18	2G11	1200	67	ww	1B	FSD-18/30/1B-E-2G11	DULUX L 18 W/830	MASTER PL-L 18W/830/4P	Lynx-L 18W 830	F18BX/830
TC-LEL	18	2G11	1200	67	nw	1B	FSD-18/40/1B-E-2G11	DULUX L 18 W/840	MASTER PL-L 18W/840/4P	Lynx-L 18W 840	F18BX/840
TC-LEL	24	2G11	1800	75	ww	1B	FSD-24/30/1B-E-2G11	DULUX L 24 W/830	MASTER PL-L 24W/830/4P	Lynx-L 24W 830	F24BX/830
TC-LEL	24	2G11	1800	75	nw	1B	FSD-24/40/1B-E-2G11	DULUX L 24 W/840	MASTER PL-L 24W/840/4P	Lynx-L 24W 840	F24BX/840
TC-LEL	36	2G11	2900	81	ww	1B	FSD-36/30/1B-E-2G11	DULUX L 36 W/830	MASTER PL-L 36W/830/4P	Lynx-L 36W 830	F36BX/830
TC-LEL	36	2G11	2900	81	nw	1B	FSD-36/40/1B-E-2G11	DULUX L 36 W/840	MASTER PL-L 36W/840/4P	Lynx-L 36W 840	F36BX/840
TC-LEL	40	2G11	3500	88	ww	1B	FSDH-40/30/1B-2G11	DULUX L 40 W/830	MASTER PL-L 40W/830/4P	Lynx-LE 40W 830	F40BX/830
TC-LEL	40	2G11	3500	88	nw	1B	FSDH-40/40/1B-2G11	DULUX L 40 W/840	MASTER PL-L 40W/840/4P	Lynx-LE 40W 840	F40BX/840
TC-LEL	55	2G11	4800	87	ww	1B	FSDH-55/30/1B-2G11	DULUX L 55 W/830	MASTER PL-L 55W/830/4P	Lynx-LE 55W 830	F55BX/830
TC-LEL	55	2G11	4800	87	nw	1B	FSDH-55/40/1B-2G11	DULUX L 55 W/840	MASTER PL-L 55W/840/4P	Lynx-LE 55W 840	F55BX/840
TC-LEL	80	2G11	6500	81	ww	1B	FSDH-80/30/1B-2G11	DULUX L 80 W/830	MASTER PL-L 80W/830/4P	–	F80BX/830
TC-LEL	80	2G11	6500	81	nw	1B	FSDH-80/40/1B-2G11	DULUX L 80 W/840	MASTER PL-L 80W/840/4P	–	F80BX/840
TC-LELI	40	2G11	3500	88	nw	1B	FSDH-40/40/1B-2G11	DULUX L 40 W/840 CONSTANT	–	–	–
TC-LELI	55	2G11	4800	87	nw	1B	FSDH-55/40/1B-2G11	DULUX L 55 W/840 CONSTANT	–	–	–
TC-LELI	80	2G11	6500	81	nw	1B	FSDH-80/40/1B-2G11	DULUX L 80 W/840 CONSTANT	–	–	–
TCR-TSE flat	6	GX53	235	39	ww	1B	–	–	–	Micro-Lynx Luna 6W GX53 830 White	–
TCR-TSE flat	6	GX53	235	39	nw	1B	–	–	–	Micro-Lynx Luna 6W GX53 840 White	–
Circular fluorescent lamps											
T16-R	22	2GX13	1800	82	ww	1B	FC-22/30/1B-E-2GX13-16	FC 22 W/830	–	–	FC22W/T5/830
T16-R	22	2GX13	1800	82	nw	1B	FC-22/40/1B-E-2GX13-16	FC 22 W/840	–	–	FC22W/T5/840
T16-R	40	2GX13	3200	80	ww	1B	FC-40/30/1B-E-2GX13-16	FC 40 W/830	–	–	FC40W/T5/830
T16-R	40	2GX13	3200	80	nw	1B	FC-40/40/1B-E-2GX13-16	FC 40 W/840	–	–	FC40W/T5/840
T16-R	55	2GX13	4200	76	ww	1B	FC-55/30/1B-E-2GX13-16	FC 55 W/830	–	–	FC55W/T5/830
T16-R	55	2GX13	4200	76	nw	1B	FC-55/40/1B-E-2GX13-16	FC 55 W/840	–	–	FC55W/T5/840
T16-RI	22	2GX13	1800	82	ww	1B	FSCH-22/30/1B-L/P-2GX13-16	–	MASTER TL5 Circular 22W/830	–	–
T16-RI	22	2GX13	1800	82	nw	1B	FSCH-22/40/1B-L/P-2GX13-16	–	MASTER TL5 Circular 22W/840	–	–
T16-RI	40	2GX13	3300	83	ww	1B	FSCH-40/30/1B-L/P-2GX13-16	–	MASTER TL5 Circular 40W/830	–	–
T16-RI	40	2GX13	3300	83	nw	1B	FSCH-40/40/1B-L/P-2GX13-16	–	MASTER TL5 Circular 40W/840	–	–
T16-RI	55	2GX13	4200	76	ww	1B	FSCH-55/30/1B-L/P-2GX13-16	–	MASTER TL5 Circular 55W/830	–	–
T16-RI	55	2GX13	4200	76	nw	1B	FSCH-55/40/1B-L/P-2GX13-16	–	MASTER TL5 Circular 55W/840	–	–
Fluorescent lamps, loop-shaped											
TC-DD	16	GR8	1050	66	ww	1B	FSS-16/27/1B-I-GR8	CFL SQUARE 16 W/827 2-Pin	PL-Q 16W/827/2P	Lynx-Q 16W 827	F162D/827
TC-DD	16	GR8	1050	66	ww	1B	FSS-16/30/1B-I-GR8	–	PL-Q 16W/830/2P	–	–
TC-DD	16	GR8	1050	66	nw	1B	FSS-16/35/1B-I-GR8	CFL SQUARE 16 W/835 2-Pin	–	Lynx-Q 16W 835	F162D/835
TC-DD	16	GR8	1050	66	nw	1B	FSS-16/40/1B-I-GR8	–	–	Lynx-Q 16W 840	–
TC-DD	16	GR8	1050	66	tw	1B	FSS-16/60/1B-I-GR8	–	–	–	F162D/860
Metal halide lamps with elliptical bulb and quartz burner											
HIE m	70	E27	4700	67	ww	1B	MES/UB-70/30/1B-H-E27-55/144	HQI-E 70/WDL coated	–	HSI-MP 70W CO 3K E27	–
HIE m	70	E27	5100	73	nw	1B	MES/UB-70/38/1B-H-E27-55/144	HQI-E 70/NDL coated	–	HSI-MP 70W CO 4K E27	–
HIE m	100	E27	7900	79	ww	1B	MES/UB-100/29/1B-H-E27-55/144	HQI-E 100/WDL coated	–	HSI-MP 100W CO 3K E27	–
HIE m	100	E27	7700	77	nw	1B	MES/UB-100/38/1B-H-E27-55/144	HQI-E 100/NDL coated	–	HSI-MP 100W CO 4K E27	–
HIE m	150	E27	11600	77	ww	1B	MES/UB-150/29/1B-H-E27-55/144	HQI-E 150/WDL coated	–	HSI-MP 150W CO 3K E27	–
HIE m	150	E27	11500	77	nw	1B	MES/UB-150/38/1B-H-E27-55/144	HQI-E 150/NDL coated	–	HSI-MP 150W CO 4K E27	–
HIE/S m	250	E40	18000	72	nw	2A	ME-250/45/2A-H-E40-/V	–	MASTER HPI Plus 250W/745 BU E40	Britelux HSI-SX 250W/CO	ARC250/D/H/740/E40
HIE/S m	250	E40	17000	68	tw	1A	MES/UB-250/52/1A-H-E40-90/226	HQI-E/P 250/D coated	–	–	–

ZVEI	Wattage	Base	Luminous flux	Efficiency (lm/W)	Light colour	Colour rendering	ILCOS	OSRAM	PHILIPS	Havells Sylvania	GE
Metal halide lamps with elliptical bulb and quartz burner (cont.)											
HIE/S m	250	E40	19000	76	tw	1A	ME/UB-250/52/1A-H-E40-90/226	HQI-E 250/D PRO	–	–	–
HIE/S m	250	E40	17000	68	tw	1A	ME/UB-250/60/1A-H-E40-90/226	–	–	–	ARC250/D/H/960/E40
HIE/S m	250	E40	18000	72	tw	2A	ME-250/67/2A-H-E40-90/225/V	–	MASTER HPI Plus 250W/767 BU E40	–	–
HIE/S m	400	E40	40000	100	nw	2B	ME/UB-400/46/2B-H-E40-120/285/H45	HQI-E 400/N	–	Britelux HSI-SX 400W/CO/P	–
HIE/S m	400	E40	32500	81	nw	2A	ME-400/45/2A-H-E40-/V	–	MASTER HPI Plus 400W/745 BU E40	–	–
HIE/S m	400	E40	31000	78	tw	1A	MES/UB-400/45/1A-H-E40-120/290	HQI-E/P 400/D coated	–	–	–
HIE/S m	400	E40	34000	85	tw	1A	ME/UB-400/52/1A-H-E40-120/290	HQI-E 400/D PRO	–	–	–
HIE/S m	400	E40	32500	81	tw	2A	ME-400/67/2A-H-E40-90/225/V	–	MASTER HPI Plus 400W/767 BU E40	–	–
HIE m	1000	E40	100000	100	nw	2B	ME-1000/37/2B-H-E40-165/380/H45	HQI-E 1000/N	–	–	–
Metal halide lamps with elliptical bulb and ceramic burner											
HIE-CE/S-od m	50	E27	4000	80	nw	1B	ME-50/28/1B-H-E27	–	MASTER CityWhite CDO-ET 50W/828 E27	–	–
HIE-CE/S-od m	70	E27	5600	80	ww	1B	ME-70/28/1B-H-E27	–	MASTER CityWhite CDO-ET 70W/828 E27	–	–
HIE-CE/S-od m	70	E27	5300	76	ww	1B	ME-70/30/1B-H-E27	–	–	–	CMH70/E/UVC/U/830/E27/D
HIE-CE/S-od m	70	E27	5600	80	ww	1A	ME-70/40/1A-H-E27	–	–	–	CMH70/UVC/O/U/940/E27/D
HIE-CE/S-od m	100	E27	8500	85	ww	1B	ME-100/30/1B-H-E27	–	–	–	CMH100/E/UVC/U/830/E27/D
HIE-CE/S-od m	100	E40	8300	83	ww	1B	ME-100/28/1B-H-E40	–	MASTER CityWhite CDO-ET 100W/828 E40	–	–
HIE-CE/S-od m	150	E27	12300	82	nw	1A	ME-150/40/1A-H-E27	–	–	–	CMH150/UVC/O/U/940/E27/D
HIE-CE/S-od m	150	E40	12500	83	ww	1B	ME-150/28/1B-H-E40	–	MASTER CityWhite CDO-ET 150W/828 E40	–	–
HIE-CE/S m	250	E40	24500	98	ww	1B	ME/UB-250/30/1B-H-E40-90/226	HCI-E 250/830 WDL PB	–	–	CMH250/E/UVC/U/830/E40/D
HIE-CE/S m	250	E40	22500	90	nw	1A	ME/UB-250/42/1A-H-E40-90/226	HCI-E 250/942 NDL PB	–	–	–
Metal halide lamps with elliptical bulb and ceramic burner, burst-proof											
HIE-CE-P m	35	E27	3300	94	ww	1B	MES/UB-35/30/1B-H-E27-54/138	HCI-E/P 35/830 WDL PB coated	–	–	–
HIE-CE-P m	35	E27	3100	89	nw	1A	MES/UB-35/42/1A-H-E27-54/138	HCI-E/P 35/942 NDL PB coated	–	–	–
HIE-CE-P m	50	E27	4000	80	ww	1B	MES/UB-50/30/1B-H-E27-54/138	HCI-E/P 50/830 WDL PB coated	–	–	–
HIE-CE-P m	70	E27	6700	96	ww	1B	MES/UB-70/30/1B-H-E27-54/138	HCI-E/P 70/830 WDL PB coated	–	–	–
HIE-CE-P m	70	E27	6300	90	nw	1A	MES/UB-70/42/1A-H-E27-54/138	HCI-E/P 70/942 NDL PB coated	–	–	–
HIE-CE-P m	100	E27	8500	85	ww	1B	MES/UB-100/30/1B-H-E27-54/138	HCI-E/P 100/830 WDL PB coated	–	–	–
HIE-CE-P m	100	E27	8300	83	nw	1A	MES/UB-100/42/1A-H-E27-54/138	HCI-E/P 100/942 NDL PB coated	–	–	–
HIE-CE-P m	150	E27	13700	91	ww	1B	MES/UB-150/30/1B-H-E27-54/138	HCI-E/P 150/830 WDL PB coated	–	–	–
HIE-CE-P m	150	E27	13700	91	nw	1A	MES/UB-150/42/1A-H-E27-54/138	HCI-E/P 150/942 NDL PB coated	–	–	–
Metal halide lamps with tubular bulb and ceramic burner											
HIT-TC-CE	20	PGJ5	1650	83	ww	1B	MC-20/30/1B-H-PGJ5	–	MASTERColour CDM-Tm Mini 20W/830 PGJ5	–	–
HIT-TC-CE	35	PGJ5	3000	86	ww	1A	MC-35/30/1A-H-PGJ5	–	MASTERColour CDM-Tm Mini 35W/930 PGJ5	–	–
HIT-TC-CE	20	GU6.5	1700	85	ww	1B	MT/UB-20/30/1B-H/E-GU6,5-13/57	HCI-TF 20/830 WDL PB	MASTERColour CDM-Tm Mini 20W/830 GU6.5	CMI-Tmini 20W/WDL UVS	CMH20/T/UVC/830/GU6.5
HIT-TC-CE	35	GU6.5	3400	97	ww	1A	MT/UB-35/30/1A-H/E-GU6,5-13/57	HCI-TF 35/930 WDL PB	MASTERColour CDM-Tm Mini Elite 35W/930 GU6.5	–	CMH35/T/UVC/930/GU6.5 Ultra
HIT-TC-CE	35	GU6.5	3400	97	nw	1A	MT/UB-35/42/1A-H/E-GU6,5-13/57	–	–	–	CMH35/T/UVC/942/GU6.5
HIT-TC-CE	20	G8.5	1700	85	ww	1B	MT/UB-20/30/1B-H/E-G8,5-15/81	HCI-TC 20/830 WDL PB	MASTERColour CDM-TC 20W/830 G8.5	–	CMH20/TC/UVC/U/830/G8.5 PLUS
HIT-TC-CE	35	G8.5	3400	97	ww	1B	MT/UB-35/30/1B-H-G8,5-15/81	HCI-TC 35/830 WDL PB	MASTERColour CDM-TC 35W/830 G8.5	CMI-TC 35W/WDL UVS	CMH35/TC/UVC/U/830/G8.5 PLUS
HIT-TC-CE	35	G8.5	2800	80	ww	1A	MT/UB-35/30/1A-H-G8,5-15/81	HCI-TC 35/930 WDL PB Shoplight	MASTERColour CDM-TC Elite 35W/930 G8.5	–	CMH35/TC/UVC/U930/G8.5 Ultra
HIT-TC-CE	35	G8.5	3900	111	ww	1A	MT/UB-35/30/1A-H-G8,5-15/81	–	MASTERColour CDM-TC Elite Light Boost 35W/930 G8.5	–	–
HIT-TC-CE	35	G8.5	3200	91	nw	1A	MT/UB-35/42/1A-H-G8,5-15/81	HCI-TC 35/942 NDL PB	MASTERColour CDM-TC 35W/942 G8.5	–	CMH35/TC/UVC/U942/G8.5
HIT-TC-CE	50	G8.5	5400	108	ww	1A	MT/UB-50/30/1A-H-G8,5-15/81	–	MASTERColour CDM-TC Elite 50W/930 G8.5	–	–
HIT-TC-CE	70	G8.5	6900	99	ww	1B	MT/UB-70/30/1B-H-G8,5-15/81	HCI-TC 70/830 WDL PB	MASTERColour CDM-TC 70W/830 G8.5	CMI-TC 70W/WDL UVS	CMH70/TC/UVC/U/830/G8.5 PLUS
HIT-TC-CE	70	G8.5	6300	90	ww	1A	MT/UB-70/30/1A-H-G8,5-15/81	HCI-TC 70/930 WDL PB Shoplight	MASTERColour CDM-TC Elite 70W/930 G8.5	–	CMH70/TC/UVC/U/930/G8.5 ULTRA
HIT-TC-CE	70	G8.5	7800	111	ww	1A	MT/UB-35/30/1A-H-G8,5-15/81	–	MASTERColour CDM-TC Elite Light Boost 70W/930 G8.5	–	–
HIT-TC-CE	70	G8.5	5900	84	nw	1A	MT/UB-70/42/1A-H-G8,5-15/81	HCI-TC 70/942 NDL PB	MASTERColour CDM-TC 70W/942 G8.5	–	CMH70/TC/UVC/U/942/G8.5
HIT-CE c	20	G12	1800	90	ww	1B	MT-20/30/1B-H-G12	–	MASTERColour CDM-T 20W/830 G12	–	CMH20/T/UVC/U/830/G12 PLUS
HIT-CE c	35	G12	3600	103	ww	1B	MT/UB-35/30/1B-H-G12-19/100	HCI-T 35/830 WDL PB	MASTERColour CDM-T 35W/830 G12	CMI-T 35W/WDL UVS	CMH35/T/UVC/U/830/G12 PLUS
HIT-CE c	35	G12	2800	80	ww	1A	MT/UB-35/30/1A-H-G12-19/100	HCI-T 35/930 WDL PB Shoplight	MASTERColour CDM-T Elite 35W/930 G12	–	CMH35/T/UVC/U/930/G12 Ultra
HIT-CE c	35	G12	3900	111	ww	1A	MT/UB-35/30/1A-H-G12-19/100	–	MASTERColour CDM-T Elite Light Boost 35W/930 G12	–	–
HIT-CE c	35	G12	3500	100	nw	1A	MT/UB-35/42/1A-H-G12-19/100	HCI-T 35/942 NDL PB	MASTERColour CDM-T 35W/942 G12	–	CMH35/T/UVC/U/842/G12
HIT-CE c	50	G12	5400	108	ww	1A	MT/UB-50/30/1A-H-G12-19/100	–	MASTERColour CDM-T Elite 50W/930 G12	–	–
HIT-CE c	70	G12	7300	104	ww	1B	MT/UB-70/30/1B-H-G12-19/100	HCI-T 70/830 WDL PB	MASTERColour CDM-T 70W/830 G12	CMI-T 70W/WDL UVS	CMH70/T/UVC/U/830/G12
HIT-CE c	70	G12	6300	90	ww	1A	MT/UB-70/30/1A-H-G12-19/100	HCI-T 70/930 WDL PB Shoplight	MASTERColour CDM-T Elite 70W/930 G12	–	CMH70/T/UVC/U/930/G12 ULTRA
HIT-CE c	70	G12	7800	111	ww	1A	MT/UB-35/30/1A-H-G8,5-15/81	–	MASTERColour CDM-T Elite Light Boost 70W/930 G12	–	–
HIT-CE c	70	G12	6800	97	nw	1A	MT/UB-70/42/1A-H-G12-19/100	HCI-T 70/942 NDL PB	MASTERColour CDM-T 70W/942 G12	CMI-T 70W/NDL UVS	CMH70/T/UVC/U/942/G12
HIT-CE c	100	G12	9500	95	ww	1B	MT/UB-100/30/1B-H-G12-19/100	HCI-T 100/830 WDL PB	–	–	–
HIT-CE c	100	G12	11000	110	ww	1A	MT/UB-100/30/1A-H-G12-19/100	–	MASTERColour CDM-T Elite 100W/930 G12	–	–
HIT-CE c	100	G12	9300	93	nw	1A	MT/UB-100/42/1A-H-G12-19/100	HCI-T 100/942 NDL PB	–	–	–
HIT-CE c	150	G12	15000	100	ww	1B	MT/UB-150/30/1B-H-G12-25/105	HCI-T 150/830 WDL PB	MASTERColour CDM-T 150W/830 G12	CMI-T 150W/WDL UVS	CMH150/T/UVC/U/830/G12
HIT-CE c	150	G12	15000	100	ww	1A	MT-150/30/1A-H-G12	–	MASTERColour CDM-T Elite 150W/930 G12	–	–
HIT-CE c	150	G12	14500	97	nw	1A	MT/UB-150/42/1A-H-G12-25/105	HCI-T 150/942 NDL PB	MASTERColour CDM-T 150W/942 G12	CMI-T 150W/NDL UVS	CMH150/T/UVC/U/942/G12
HIT-CE-od c	45	PGZ12	4300	96	ww	2B	MT-45/28/2B-H-PGZ12	–	MASTER CosmoWhite CPO-TW 45W/628 PGZ12	CMO-TW 45W	–
HIT-CE-od c	60	PGZ12	6800	113	ww	2A	MT-60/28/2A-H-PGZ12	–	MASTER CosmoWhite CPO-TW 60W/728 PGZ12	CMO-TW 60W	–
HIT-CE-od c	90	PGZ12	10450	116	ww	2A	MT-90/28/2A-H-PGZ12	–	MASTER CosmoWhite CPO-TW 90W/728 PGZ12	CMO-TW 90W	–
HIT-CE-od c	140	PGZ12	16500	118	ww	2A	MT-140/28/2A-H-PGZ12	–	MASTER CosmoWhite CPO-TW 140W/728 PGZ12	CMO-TW 140W	–
HIT-CE/S c	250	G22	26000	104	ww	1A	MT/UB-250/30/1A-H-G22-28/175	HCI-TM 250/930 WDL MD PB	–	–	–
HIT-CE/S c	250	GY22	26000	104	ww	1A	MT/UB-250/30/1A-H-GY22-28/175	HCI-TM 250/930 WDL HR PB	–	–	–
HIT-CE/S c	250	G22	25000	100	nw	1A	MT/UB-250/42/1A-H-G22-28/175	HCI-TM 250/942 NDL MD PB	–	–	–
HIT-CE/S c	250	GY22	25000	100	nw	1A	MT/UB-250/42/1A-H-GY22-28/175	HCI-TM 250/942 NDL HR PB	–	–	–
HIT-CE/S c	400	G22	41000	103	ww	1A	MT/UB-400/30/1A-H-G22-34/175	HCI-TM 400/930 WDL PB	–	–	–
HIT-CE/S c	400	GY22	41000	103	ww	1A	MT/UB-400/30/1A-H-GY22-34/175	HCI-TM 400/930 WDL HR PB	–	–	–
HIT-CE/S c	400	G22	40000	100	nw	1A	MT/UB-400/42/1A-H-G22-34/175	HCI-TM 400/942 NDL PB	–	–	–
HIT-CE/S c	400	GY22	40000	100	nw	1A	MT/UB-400/42/1A-H-GY22-34/175	HCI-TM 400/942 NDL HR PB	–	–	–
HIT-CE/S-od c	50	E27	4150	83	ww	1B	MT-50/28/1B-H-E27	–	MASTER CityWhite CDO-TT 50W/828 E27	–	–
HIT-CE/S-od c	50	E27	5000	100	ww	2A	MT-50/30/2A-H-E27	–	–	–	CMH50/TT/UVC/730/E27 STREETWISE

ZVEI	Wattage	Base	Luminous flux	Efficiency (lm/W)	Light colour	Colour rendering	ILCOS	OSRAM	PHILIPS	Havells Sylvania	GE	«EYE IWASAKI»
Metal halide lamps with tubular bulb and ceramic burner (cont.)												
HIT-CE/S-od c	70	E27	6300	90	ww	1B	MT-70/28/1B-H-E27	–	MASTER CityWhite CDO-TT 70W/828 E27	–	–	
HIT-CE/S-od c	70	E27	7640	109	ww	1B	MT-70/30/2A-H-E27	–	–	–	CMH70/TT/UVC/730/E27 STREETWISE	
HIT-CE/S-od c	70	E27	7000	100	ww	1B	MT/UB-70/30/1B-H-E27-30/150	HCI-TT 70/830 WDL PB	–	–	CMH70/TT/UVC/830/E27	
HIT-CE/S-od c	70	E27	6400	91	nw	1A	MT-70/42/1A-H-E27	–	MASTERColour CDM-TT 70W/942 E27	–	–	
HIT-CE/S-od c	100	E40	8800	88	ww	1B	MT-100/20/1B-H-E40	–	MASTER CityWhite CDO-TT 100W/828 E40	–	–	
HIT-CE/S-od c	100	E40	10900	109	ww	1B	MT-100/30/2A-H-E40	–	–	–	CMH100/TT/UVC/730/E40 STREETWISE	
HIT-CE/S-od c	100	E40	10000	100	ww	1B	MT/UB-100/30/1B-H-E40-46/204	HCI-TT 100/830 WDL PB	–	–	CMH100/TT/UVC/830/E40	
HIT-CE/S-od c	150	E40	13500	90	ww	1B	MT-150/28/1B-H-E40	–	MASTER CityWhite CDO-TT 150W/828 E40	–	–	
HIT-CE/S-od c	150	E40	16300	109	ww	1B	MT-150/30/2A-H-E40	–	–	–	CMH150/TT/UVC/730/E40 STREETWISE	
HIT-CE/S-od c	150	E40	14500	97	ww	1B	MT/UB-150/30/1B-H-E40-46/204	HCI-TT 150/830 WDL PB	–	–	CMH150/TT/UVC/830/E40	
HIT-CE/S-od c	150	E40	12000	80	nw	1A	MT-150/42/1A-H-E40	–	MASTERColour CDM-TT 150W/942 E40	–	CMH150/UVC/T/U/842/E40	
HIT-CE/S-od c	250	E40	22500	90	ww	1B	MT-250/28/1B-H-E40	–	MASTER City White CDO-TT 250W/828	–	–	
HIT-CE/S c	250	E40	26000	104	ww	1B	MT/UB-250/30/1B-H-E40-46/226	HCI-T 250/830 WDL PB	–	–	CMH250/TT/UVC/U/830/E40	
HIT-CE/S c	250	E40	25000	100	nw	1A	MT/UB-250/42/1A-H-E40-46/226	HCI-T 250/942 NDL PB	–	–	–	
HIT-CE/S c	400	E40	42000	105	ww	1B	MT/UB-400/30/1B-H-E40	–	–	–	CMH400/TT/UVC/VBU/830/E40	
HIT-DE-CE	35	RX7s	3400	97	ww	1B	MD/UB-35/30/1B-H-RX7s-21/114,2/P45	–	–	–	CMH35/TD/UVC/830/RX7s	
HIT-DE-CE	70	RX7s	6800	97	ww	1B	MD/UB-70/30/1B-H-RX7s-21/114,2/P45	HCI-TS 70/830 WDL PB	MASTERColour CDM-TD 70W/830 RX7s	CMI-TD 70W/WDL UVS	CMH70/TD/UVC/830/RX7S	
HIT-DE-CE	70	RX7s	6700	96	nw	1A	MD/UB-70/42/1A-H-RX7s-21/114,2/P45	HCI-TS 70/942 NDL PB	MASTERColour CDM-TD 70W/942 RX7s	CMI-TD 70W/NDL UVS	CMH70/TD/UVC/942/RX7S	
HIT-DE-CE	150	RX7s-24	14800	99	ww	1B	MD/UB-150/30/1B-H-RX7s24-24/132/P45	HCI-TS 150/830 WDL PB	MASTERColour CDM-TD 150W/830 RX7s	CMI-TD 150W/WDL UVS	CMH150/TD/UVC/830/RX7S-24	
HIT-DE-CE	150	RX7s-24	14200	95	nw	1A	MD/UB-150/42/1A-H-RX7s24-24/132/P45	HCI-TS 150/942 NDL PB	MASTERColour CDM-TD 150W/942 RX7s	CMI-TD 150W/NDL UVS	CMH150/TD/UVC/942/RX7S-24	
HIT-DE-CE	250	Fc2	25000	100	ww	1B	MD/UB-250/30/1B-H-Fc2-25/163/P45	HCI-TS 250/830 WDL PB	–	–	–	
HIT-DE-CE	250	Fc2	23000	92	nw	1A	MD/UB-250/42/1A-H-Fc2-25/163/P45	HCI-TS 250/942 NDL PB	–	–	–	
Metal halide lamps with tubular bulb and ceramic burner, burst-proof												
HIT-CE-P c	35	E27	3150	90	ww	1B	MTS/UB-35/30/1B-H-E27-30/130	–	–	–	<<CMT35/DW>>	
HIT-CE-P m	35	E27	3000	86	ww	1B	MTS coated/UB-35/30/1B-H-E27-30/130	–	–	–	<<CMT35F/DW>>	
HIT-CE-P c	70	E27	6700	96	ww	1B	MTS/UB-70/30/1B-H-E27-32/128	HCI-T/P 70/830 WDL PB clear	–	–	–	
HIT-CE-P c	70	E27	6600	94	nw	1A	MTS/UB-70/42/1A-H-E27-32/128	HCI-T/P 70/942 WDL PB clear	–	–	–	
HIT-CE-P c	100	E27	9000	90	ww	1B	MTS/UB-100/30/1B-H-E27-40/133	HCI-T/P 100/830 WDL PB clear	–	–	–	
HIT-CE-P c	100	E27	8800	88	nw	1A	MTS/UB-100/42/1A-H-E27-40/133	HCI-T/P 100/942 WDL PB clear	–	–	–	
HIT-CE-P c	150	E27	14500	97	ww	1B	MTS/UB-150/30/1B-H-E27-40/133	HCI-T/P 150/830 WDL PB clear	–	–	–	
HIT-CE-P c	150	E27	14500	97	nw	1A	MTS/UB-150/42/1A-H-E27-40/133	HCI-T/P 150/942 WDL PB clear	–	–	–	
Metal halide lamps with tubular bulb and quartz burner												
HIT/S c	250	E40	20500	82	nw	2B	MT-250/45/2B-H-E40-/H	–	MASTER HPI-T Plus 250W/645 E40	Britelux HSI-TSX 250W	ARC250/T/H/742/E40	
HIT/S c	250	E40	20000	80	tw	1A	MT-250/53/1A-H-E40	HQI-T 250/D	–	HSI-T 250W / 6K	ARC250/T/H/960/E40	
HIT/S c	400	E40	35000	88	tw	1A	MC/UB-400/52/1A-H-E40-62/285	HQI-BT 400/D	–	HSI-T 400W / 6K	–	
HIT/S c	400	E40	35000	88	nw	2B	MT-400/45/2B-H-E40-/H	–	MASTER HPI-T Plus 400W/645 E40	Britelux HSI-TSX 400W	ARC400/T/H/742/E40	
HIT/S c	400	E40	42000	105	nw	2B	MT/UB-400/35/2B-H-E40-46/273/P45	HQI-T 400/N	–	–	–	
HIT/S c	600	G22	55000	92	nw	1B	MT/UB-600/45/1B-H-G22-34/188	HQI-TM 600/NDL	–	–	–	
HIT/S c	600	GY22	55000	92	nw	1B	MT/UB-600/45/1B-H-GY22-34/188	HQI-TM 600/NDL HR	–	–	–	
HIT/S c	600	G22	58000	97	tw	1A	MT/UB-600/60/1A-H-G22-34/188	HQI-TM 600/D	–	–	–	
HIT/S c	600	GY22	58000	97	tw	1A	MT/UB-600/60/1A-H-GY22-34/188	HQI-TM 600/D HR	–	–	–	
HIT c	1000	G22	92000	92	nw	1B	MT/UB-1000/45/1B-H-G22-38/188	HQI-TM 1000/NDL	–	–	–	
HIT c	1000	GY22	92000	92	nw	1B	MT/UB-1000/45/1B-H-GY22-38/188	HQI-TM 1000/NDL HR	–	–	–	
HIT c	1000	G22	97000	97	tw	1A	MT/UB-1000/60/1A-H-G22-38/188	HQI-TM 1000/D	–	–	–	
HIT c	1000	GY22	97000	97	tw	1A	MT/UB-1000/60/1A-H-GY22-38/188	HQI-TM 1000/D HR	–	–	–	
HIT c	1000	E40	110000	110	nw	2B	MT-1000/35/2B-H-E40-76/345/P30	HQI-T 1000/N	–	–	–	
HIT c	1000	E40	85000	85	nw	2B	MT-1000/43/2B-H-E40-/H	–	HPI-T 1000W/643 E40 220V	HSI-T 1000W/4K	–	
HIT c	1000	E40	85000	85	tw	1A	MT-1000/60/1A-H-E40-76/340/P30	HQI-T 1000/D	–	–	SPL1000/T/H/960/E40	
HIT-I c	2000	E40	190000	95	nw	2B	MT-2000/40/2B-E/I-E40-100/430/P30	–	–	–	SPL2000/I/T/H/640/E40	
HIT-I c	2000	E40	200000	100	nw	2B	MT-2000/45/2B-E/I-E40-100/430/P30	HQI-T 2000/N	–	HSI-T 2000W-S4K 380V/I	–	
HIT-I c	2000	E40	180000	90	tw	1A	MT-2000/60/1A-E/I-E40-100/430/P30	HQI-T 2000/D/I	–	–	SPL2000/I/T/H/960/E40	
HIT-DE/S	400	Fc2	36000	90	nw	1B	MD/UB-400/42/1B-H-Fc2-31/206/P45	HQI-TS 400/NDL	–	–	–	
HIT-DE/S	400	Fc2	37000	93	tw	1A	MD/UB-400/52/1A-H-Fc2-31/206/P45	HQI-TS 400/D PRO	–	–	–	
HIT-DE I=187	1000	K12s-36	90000	90	nw	1B	MN-1000/44/1B-H-Kabelschuh-36/187/P15	HQI-TS 1000/NDL/S	–	–	–	
HIT-DE I=187	1000	K12s-36	90000	90	tw	1A	MN-1000/59/1A-H-Kabelschuh-36/187/P15	HQI-TS 1000/D/S	–	SA HSI-TD 1000W/D CABLE SLV	–	
HIT-DE I=187	2000	K12s-36	215000	108	nw	1B	MN-2000/44/1B-H-Kabelschuh-36/187/P15	HQI-TS 2000/NDL/S	–	–	–	
HIT-DE I=187	2000	K12s-36	200000	100	tw	1A	MN-2000/59/1A-E-Kabelschuh-36/187/P15	HQI-TS 2000/D/S	MHN-SB 2000W/956 400V K12s-7	HSI-TD 2000W/D	–	
HIT-DE I=274	2000	K12s-36	230000	115	nw	2B	MN-2000/42/2B-E-Kabelschuh-32/274/P15	HQI-TS 2000W/N/L	–	–	–	
HIT-DE I=274	2000	K12s-36	205000	103	tw	1B	MN-2000/54/1B-E-Kabelschuh-32/274/P15	HQI-TS 2000W/D/L	–	–	–	
Metal halide lamps with reflector and ceramic burner												
HIPAR51-CE-P/10°	20	GX10	–	–	ww	1B	MRS/UB-20/30/1B-H-GX10	–	MASTERColour CDM-R Mini 20W/830 GX10 MR16 10D	–	CMH20/MR16/UVC/830/GX10/SP	
HIPAR51-CE-P/25°	20	GX10	–	–	ww	1B	MRS/UB-20/30/1B-H-GX10	–	–	–	CMH20/MR16/UVC/830/GX10/FL	
HIPAR51-CE-P/40°	20	GX10	–	–	ww	1B	MRS/UB-20/30/1B-H-GX10	–	MASTERColour CDM-R Mini 20W/830 GX10 MR16 40D	–	CMH20/MR16/UVC/830/GX10/WFL	
HIPAR51-CE-P/10°	35	GX10	–	–	ww	1A	MRS/UB-35/30/1A-H-GX10	–	MASTERColour CDM-R Mini Elite 35W/930 GX10 10D	–	CMH35/MR16/UVC/930/GX10/SP Ultra	
HIPAR51-CE-P/25°	35	GX10	–	–	ww	1A	MRS/UB-35/30/1A-H-GX10	–	MASTERColour CDM-R Mini Elite 35W/930 GX10 25D	–	CMH35/MR16/UVC/930/GX10/FL Ultra	
HIPAR51-CE-P/40°	35	GX10	–	–	ww	1A	MRS/UB-35/30/1A-H-GX10	–	MASTERColour CDM-R Mini Elite 35W/930 GX10 40D	–	CMH35/MR16/UVC/930/GX10/WFL Ultra	
HIPAR51-CE-P/12°	35	GX10	–	–	nw	1A	MRS/UB-35/42/1A-H-GX10	–	–	–	CMH35/MR16/UVC/942/GX10/SP	
HIPAR51-CE-P/25°	35	GX10	–	–	nw	1A	MRS/UB-35/42/1A-H-GX10	–	–	–	CMH35/MR16/UVC/942/GX10/FL	

ZVEI	Wattage	Base	Luminous flux	Efficiency (lm/W)	Light colour	Colour rendering	ILCOS	OSRAM	PHILIPS	Havells Sylvania	GE
Metal halide lamps with reflector and ceramic burner (cont.)											
HIPAR51-CE-P/40°	35	GX10	–	–	nw	1A	MRS/UB-35/42/1A-H-GX10	–	–	–	CMH35/MR16/UVC/942/GX10/WFL
HIR111-CE-P	20	GX8.5	–	–	ww	1B	MRS/UB-20/30/1B-H-GX8.5-111/95/10	HCI-R111 20W/830 PB 10D	MASTERColour CDM-R111 20W/830 GX8.5 10D	–	–
HIR111-CE-P	20	GX8.5	–	–	ww	1B	MRS/UB-20/30/1B-H-GX8.5-111/95/24	HCI-R111 20W/830 PB 24D	MASTERColour CDM-R111 20W/830 GX8.5 24D	–	–
HIR111-CE-P	20	GX8.5	–	–	ww	1B	MRS/UB-20/30/1B-H-GX8.5-111/95/40	HCI-R111 20W/830 PB 40D	–	–	–
HIR111-CE-P	35	GX8.5	–	–	ww	1B	MRS/UB-35/30/1B-H-GX8.5-111/95/10	HCI-R111 35W/830 PB 10D	MASTERColour CDM-R111 35W/830 GX8.5 10D	–	–
HIR111-CE-P	35	GX8.5	–	–	ww	1B	MRS/UB-35/30/1B-H-GX8.5-111/95/24	HCI-R111 35W/830 PB 24D	MASTERColour CDM-R111 35W/830 GX8.5 24D	–	–
HIR111-CE-P	35	GX8.5	–	–	ww	1B	MRS/UB-35/30/1B-H-GX8.5-111/95/40	HCI-R111 35W/830 PB 40D	MASTERColour CDM-R111 35W/830 GX8.5 40D	–	–
HIR111-CE-P	35	GX8.5	–	–	nw	1A	MRS/UB-35/42/1A-H-GX8.5-111/95/10	HCI-R111 35W/942 PB 10D	MASTERColour CDM-R111 35W/942 GX8.5 10D	–	–
HIR111-CE-P	35	GX8.5	–	–	nw	1A	MRS/UB-35/42/1A-H-GX8.5-111/95/24	HCI-R111 35W/942 PB 24D	MASTERColour CDM-R111 35W/942 GX8.5 24D	–	–
HIR111-CE-P	35	GX8.5	–	–	nw	1A	MRS/UB-35/42/1A-H-GX8.5-111/95/40	HCI-R111 35W/942 PB 40D	MASTERColour CDM-R111 35W/942 GX8.5 40D	–	–
HIR111-CE-P	70	GX8.5	–	–	ww	1B	MRS/UB-70/30/1B-H-GX8.5-111/95/10	HCI-R111 70W/830 PB 10D	MASTERColour CDM-R111 70W/830 GX8.5 10D	–	–
HIR111-CE-P	70	GX8.5	–	–	ww	1B	MRS/UB-70/30/1B-H-GX8.5-111/95/24	HCI-R111 70W/830 PB 24D	MASTERColour CDM-R111 70W/830 GX8.5 24D	–	–
HIR111-CE-P	70	GX8.5	–	–	ww	1B	MRS/UB-70/30/1B-H-GX8.5-111/95/40	HCI-R111 70W/830 PB 40D	MASTERColour CDM-R111 70W/830 GX8.5 40D	–	–
HIR111-CE-P	70	GX8.5	–	–	nw	1A	MRS/UB-70/42/1A-H-GX8.5-111/95/10	HCI-R111 70W/942 PB 10D	MASTERColour CDM-R111 70W/942 GX8.5 10D	–	–
HIR111-CE-P	70	GX8.5	–	–	nw	1A	MRS/UB-70/42/1A-H-GX8.5-111/95/24	HCI-R111 70W/942 PB 24D	MASTERColour CDM-R111 70W/942 GX8.5 24D	–	–
HIR111-CE-P	70	GX8.5	–	–	nw	1A	MRS/UB-70/42/1A-H-GX8.5-111/95/40	HCI-R111 70W/942 PB 40D	MASTERColour CDM-R111 70W/942 GX8.5 40D	–	–
High pressure sodium vapour lamps with ellipsoid bulb											
HSE-I	50	E27	3800	76	ww	4	SE-50/20/4-H/I-E27-70/156	NAV-E 50/I 4Y	SON 50W/220 I E27	SHP 50W/CO-I	LU50/85/MO/D/I/E27 1/12
HSE-I	70	E27	6300	90	ww	4	SE-70/20/4-H/I-E27-70/156	NAV-E 70/I 4Y	SON 70W/220 I E27	SHP 70W/CO-I	LU70/90/MO/D/I/E27 1/12
HSE-MF	50	E 27	3500	70	ww	4	SE-50/20/4-H-E27-70/156	NAV-E 50 SUPER 4Y	MASTER SON PIA 50W/220 E27	SHP-S 50W/CO-E	LU50/85/XO/D/27
HSE-MF	70	E 27	5600	80	ww	4	SE-70/20/4-H-E27-70/156	NAV-E 70 SUPER 4Y	MASTER SON PIA 70W/220 E27	SHP-S 70W/CO-E	LU 70/XO/SBY/D/E27
HSE-MF	100	E40	10200	102	ww	4	SE-100/20/4-H-E40-75/186	NAV-E 100 SUPER 4Y	MASTER SON PIA Plus 100W/220 E40	SHP-S 100W	LU 100/XO/SBY/D/E40
HSE-MF	150	E40	17000	113	ww	4	SE-150/20/4-H-E40-90/226	NAV-E 150 SUPER 4Y	MASTER SON PIA Plus 150W/220 E40	SHP-S 150W	LU150/100/XO/D/40
HSE-MF	250	E40	31100	124	ww	4	SE-250/20/4-H-E40-90/226	NAV-E 250 SUPER 4Y	MASTER SON PIA Plus 250W/220 E40	SHP 250W	LU250/XO/D/40
HSE-MF	400	E40	55500	139	ww	4	SE-400/20/4-H-E40-120/290	NAV-E 400 SUPER 4Y	MASTER SON PIA Plus 400W/220 E40	SHP 400W	LU400/SBY/D/40
HSE	1000	E40	120000	120	ww	4	SE-1000/20/4-H-E40-165/370	NAV-E 1000	SON 1000W/220 E40	–	LU1000/110/D/40
High pressure sodium vapour lamps with tubular bulb											
HST-MF	50	E27	4400	88	ww	4	ST-50/20/4-H-E27-38/156	NAV-T 50 SUPER 4Y	MASTER SON-T PIA Plus 50W/220	SHP-TS 50W	LU 50/XO/SBY/T/E27
HST-MF	70	E27	6600	94	ww	4	ST-70/20/4-H-E27-38/156	NAV-T 70 SUPER 4Y	MASTER SON-T PIA Plus 70W/220 E27	SHP-TS 70W	LU 70/XO/SBY/T/E27
HST-MF	100	E40	10700	107	ww	4	ST-100/20/4-H-E40-47/210	NAV-T 100 SUPER 4Y	MASTER SON-T PIA Plus 100W/220 E40	SHP-TS 100W	LU 100/XO/SBY/T/E40
HST-MF	150	E40	17500	117	ww	4	ST-150/20/4-H-E40-47/210	NAV-T 150 SUPER 4Y	MASTER SON-T PIA Plus 150W/220 E40	SHP-TS 150W	LU 150/XO/SBY/T/E40
HST-MF	250	E40	33200	133	ww	4	ST-250/20/4-H-E40-47/257	NAV-T 250 SUPER 4Y	MASTER SON-T PIA Plus 250W/220 E40	SHP-TS 250W	LU 250/XO/SBY/T/E40
HST-MF	400	E40	56500	141	ww	4	ST-400/20/4-H-E40-47/285	NAV-T 400 SUPER 4Y	MASTER SON-T PIA Plus 400W/220 E40	SHP-TS 400W	LU 400/XO/SBY/T/E40
HST-MF	600	E40	90000	150	ww	4	ST-600/20/4-H-E40-47/285	NAV-T 600 SUPER 4Y	MASTER SON-T PIA Plus 600W/220 E40	SHP-TS 600W	LU600/XO/T/40
HST	1000	E40	130000	130	ww	4	ST-1000/20/4-H-E40-65/355	NAV-T 1000	SON-T 1000W/220 E40	SHP-T 1000W	LU1000/110/T/40 4pk
HST-DE-MF-h45	70	RX7s	6800	97	ww	4	SD-70/20/4-H-RX7s-20/114,2/P45	NAV-TS 70 SUPER 4Y	–	SHP - TD 70W	–
HST-DE-MF-h45	150	RX7s-24	15000	100	ww	4	SD-150/20/4-H-RX7s24-23/132/P45	NAV-TS 150 SUPER 4Y	–	SHP - TD 150W	–
HST-DE-h45	250	Fc2	25500	102	ww	4	SD-250/20/4-H-Fc2-23/206/P45	NAV-TS 250	–	–	–
HST-DE-h45	400	Fc2	48000	120	ww	4	SD-400/20/4-H-Fc2-23/206/P45	NAV-TS 400	–	–	–
HST-CRI	50	GX12-1	2400	48	ww	1B	STH-50/25/1B-GX12-1	–	MASTER SDW-TG Mini 50W/825 GX12-1	–	–
HST-CRI	100	GX12-1	4900	49	ww	1B	STH-100/25/1B-GX12-1	–	MASTER SDW-TG Mini 100W/825 GX12-1	–	–
Low voltage tungsten halogen lamps with tubular bulb											
QT12-UVr-ax 12V	20	GY6.35	290	15	ww	1A	HSGST/UB-20-12-GY6,35-15	64427S	Capsuleline 20W GY6.35 12V CL 4000h	–	M76/Q20/GY6.35
QT12-UVr-ax 12V IRC	20	GY6.35	420	21	ww	1A	HSG/F-20-12-GY6.35	–	MASTERCapsule 20W GY6.35 12V IR	–	–
QT12-UVr-ax 12V IRC	25	GY6.35	500	20	ww	1A	HSGST/UB/IB-25-12-GY6,35	64429 ECO	–	–	–
QT12-UVr-ax 12V IRC	28	GY6.35	500	18	ww	1A	HSGST/UB/IB-28-12-GY6,35	–	–	Capsule ECO 12V 28W LP GY6.35	–
QT12-UVr-ax 12V IRC	30	GY6.35	750	25	ww	1A	HSG/F-30-12-GY6.35	–	MASTERCapsule 30W GY6.35 12V IR	–	–
QT12-UVr-ax 12V	35	GY6.35	580	17	ww	1A	HSGST/UB-35-12-GY6,35-15	64432S	–	Capsule 12V 35W LP GY6.35	M75/Q35/GY6.35
QT12-UVr-ax 12V IRC	35	GY6.35	860	25	ww	1A	HSGST/UB/IB-35-12-GY6,35	64432 ECO	–	–	–
QT12-UVr-ax 12V IRC	40	GY6.35	900	23	ww	1A	HSGST/UB/IB-40-12-GY6,35	–	–	Capsule ECO 12V 40W LP GY6.35	–
QT12-UVr-ax 12V IRC	45	GY6.35	1250	28	ww	1A	HSG/F-45-12-GY6.35	–	MASTERCapsule 45W GY6.35 12V IR	–	–
QT12-UVr-ax 12V	50	GY6.35	900	18	ww	1A	HSGST/UB-50-12-GY6,35-15	64440S	Capsuleline 50W GY6.35 12V CL 4000h	Capsule 12V 50W LP GY6.35	M74/Q50/GY6.35
QT12-UVr-ax 12V IRC	50	GY6.35	1180	24	ww	1A	HSGST/UB/IB-50-12-GY6,35	64440 ECO	–	–	–
QT12-UVr-ax 12V IRC	60	GY6.35	1700	28	ww	1A	HSG/F-60-12-GY6.35	–	MASTERCapsule 60W GY6.35 12V IR	–	–
QT12-UVr-ax 12V IRC	60	GY6.35	1650	28	ww	1A	HSGST/UB/IB-60-12-GY6,35	64447 ECO	–	–	–
QT12-UVr-ax 12V	75	GY6.35	1450	19	ww	1A	HSGST/UB-75-12-GY6,35-15	64450S	Capsuleline 75W GY6.35 12V CL 4000h	Capsule 12V 75W HP GY6.35	M73/Q75/GY6.35
QT12-UVr-ax 12V	90	GY6.35	1800	20	ww	1A	HSGST/UB-90-12-GY6,35-15	64458S	–	–	–
QT12-UVr-ax 12V	100	GY6.35	2200	22	ww	1A	HSG/C/UB-100-12-GY6.35	–	Capsuleline 100W GY6.35 12V CL 4000h	Capsule 12V 100W HP GY6.35	M180/Q100/GY6.35
Low voltage tungsten halogen lamps with reflector											
QR-CBC51/10° IRC	20	GU5.3	380	19	ww	1A	HRGS/UB/IB 20-12-GU5,3-51/10	48860 ECO SP	–	–	Q20MR16HIR/CCG10
QR-CBC51/24° IRC	20	GU5.3	365	18	ww	1A	HRGS/UB/IB 20-12-GU5,3-51/24	48860 ECO FL	–	–	Q20MR16HIR/CCG24
QR-CBC51/36° IRC	20	GU5.3	403	20	ww	1A	HRGS/UB/IB 20-12-GU5,3-51/36	48860 ECO WFL	MASTERLine ES 20W GU5.3 12V 36D	–	Q20MR16HIR/CCG36
QR-CBC51/60° IRC	20	GU5.3	373	19	ww	1A	HRGS/UB/IB 20-12-GU5,3-51/60	48860 ECO VWFL	–	–	–
QR-CBC51/10° IRC	28	GU5.3	–	–	ww	1A	HRGS/UB/IB 28-12-GU5,3-51/10	–	–	FMT 28W SP 10° ECO	–
QR-CBC51/38° IRC	28	GU5.3	–	–	ww	1A	HRGS/UB/IB 28-12-GU5,3-51/38	–	–	FMW 28W WFL 38° ECO	–
QR-CBC51/8° IRC	30	GU5.3	–	–	ww	1A	HRGS-30-12-GU5.3-50/8	–	MASTERLine ES 30W GU5.3 12V 8D	–	–
QR-CBC51/10° IRC	30	GU5.3	–	–	ww	1A	HRGS-30-12-GU5.3-50/10	–	–	–	Q30MR16HIR/CCG10
QR-CBC51/24° IRC	30	GU5.3	–	–	ww	1A	HRGS-30-12-GU5.3-50/24	–	MASTERLine ES 30W GU5.3 12V 24D	–	Q30MR16HIR/CCG24
QR-CBC51/36° IRC	30	GU5.3	–	–	ww	1A	HRGS-30-12-GU5.3-50/36	–	MASTERLine ES 30W GU5.3 12V 36D	–	Q30MR16HIR/CCG36
QR-CBC51/60° IRC	30	GU5.3	–	–	ww	1A	HRGS-30-12-GU5.3-50/60	–	MASTERLine ES 30W GU5.3 12V 60D	–	–
QR-CBC51/8° IRC	35	GU5.3	–	–	ww	1A	HRGS-35-12-GU5.3-50/8	–	MASTERLine ES 35W GU5.3 12V 8D	–	–
QR-CBC51/10° IRC	35	GU5.3	–	–	ww	1A	HRGS/UB/IB-35-12-GU5,3-51/10	48865 ECO SP	–	–	Q35MR16HIR/CCG10
QR-CBC51/24° IRC	35	GU5.3	902	26	ww	1A	HRGS/UB/IB-35-12-GU5,3-51/24	48865 ECO FL	MASTERLine ES 35W GU5.3 12V 24D	–	Q35MR16HIR/CCG24
QR-CBC51/36° IRC	35	GU5.3	1137	32	ww	1A	HRGS/UB/IB-35-12-GU5,3-51/36	48865 ECO WFL	MASTERLine ES 35W GU5.3 12V 36D	–	Q35MR16HIR/CCG36
QR-CBC51/60° IRC	35	GU5.3	1127	32	ww	1A	HRGS/UB/IB-35-12-GU5,3-51/60	48865 ECO VWFL	MASTERLine ES 35W GU5.3 12V 60D	–	–
QR-CBC51/10° IRC	40	GU5.3	–	–	ww	1A	HRGS/UB/IB-40-12-GU5,3-51/10	–	–	EXT 40W SP 10° ECO	–
QR-CBC51/38° IRC	40	GU5.3	–	–	ww	1A	HRGS/UB/IB-40-12-GU5,3-51/38	–	–	EXN 40W WFL 38° ECO	–
QR-CBC51/60° IRC	40	GU5.3	–	–	ww	1A	HRGS/UB/IB-40-12-GU5,3-51/60	–	–	FNV 40W VWFL 60° ECO	–

ZVEI	Wattage	Base	Luminous flux	Efficiency (lm/W)	Light colour	Colour rendering	ILCOS	OSRAM	PHILIPS	Havells Sylvania	GE
Low voltage tungsten halogen lamps with reflector (cont.)											
QR-CBC51/8° IRC	45	GU5.3	–	–	ww	1A	HRGS-45-12-GU5.3-50/8	–	MASTERLine ES 45W GU5.3 12V 8D	–	–
QR-CBC51/8° IRC	45	GU5.3	–	–	ww	1A	HRGS-45-12-GU5.3-50/10	–	–	–	Q45MR16HIR/CCG10
QR-CBC51/24° IRC	45	GU5.3	–	–	ww	1A	HRGS-45-12-GU5.3-50/24	–	MASTERLine ES 45W GU5.3 12V 24D	–	Q45MR16HIR/CCG24
QR-CBC51/36° IRC	45	GU5.3	–	–	ww	1A	HRGS-45-12-GU5.3-50/36	–	MASTERLine ES 45W GU5.3 12V 36D	–	Q45MR16HIR/CCG36
QR-CBC51/60° IRC	45	GU5.3	–	–	ww	1A	HRGS-45-12-GU5.3-50/60	–	MASTERLine ES 45W GU5.3 12V 60D	–	–
QR-CBC51/10° IRC	50	GU5.3	1455	29	ww	1A	HRGS/UB/IB-50-12-GU5,3-51/10	48870 ECO SP	–	–	–
QR-CBC51/24° IRC	50	GU5.3	1549	31	ww	1A	HRGS/UB/IB-50-12-GU5,3-51/24	48870 ECO FL	–	–	–
QR-CBC51/36° IRC	50	GU5.3	1466	29	ww	1A	HRGS/UB/IB-50-12-GU5,3-51/36	48870 ECO WFL	–	–	–
QR-CBC51/60° IRC	50	GU5.3	1474	29	ww	1A	HRGS/UB/IB-50-12-GU5,3-51/60	48870 ECO VWFL	–	–	–
QR111/8° IRC	30	G53	–	–	ww	1A	HMGS/UB/IB-30-12-G53-111/8	–	MASTERLine 111 30W G53 12V 8D	–	–
QR111/24° IRC	30	G53	–	–	ww	1A	HMGS/UB/IB-30-12-G53-111/24	–	MASTERLine 111 30W G53 12V 24D	–	–
QR111/6° IRC	35	G53	–	–	ww	1A	HMGS/UB/IB-35-12-G53-111/6	48832 ECO SP	–	–	–
QR111/24° IRC	35	G53	–	–	ww	1A	HMGS/UB/IB-35-12-G53-111/24	48832 ECO FL	–	–	–
QR111/8° IRC	45	G53	–	–	ww	1A	HMGS/UB/IB-45-12-G53-111/8	–	MASTERLine 111 45W G53 12V 8D	–	–
QR111/24° IRC	45	G53	–	–	ww	1A	HMGS/UB/IB-45-12-G53-111/24	–	MASTERLine 111 45W G53 12V 24D	–	–
QR111/45° IRC	45	G53	–	–	ww	1A	HMGS/UB/IB-45-12-G53-111/45	–	MASTERLine 111 45W G53 12V 45D	–	–
QR111/6° IRC	50	G53	–	–	ww	1A	HMGS/UB/IB-50-12-G53-111/6	48835 ECO SP	–	–	–
QR111/24° IRC	50	G53	–	–	ww	1A	HMGS/UB/IB-50-12-G53-111/24	48835 ECO FL	–	–	–
QR111/40° IRC	50	G53	–	–	ww	1A	HMGS/UB/IB-50-12-G53-111/40	48835 ECO WFL	–	–	–
QR111/6° IRC	60	G53	–	–	ww	1A	HMGS/UB/IB-60-12-G53-111/6	48837 ECO SP	–	–	–
QR111/8° IRC	60	G53	–	–	ww	1A	HMGS/UB/IB-60-12-G53-111/8	–	MASTERLine 111 60W G53 12V 8D	–	–
QR111/24° IRC	60	G53	–	–	ww	1A	HMGS/UB/IB-60-12-G53-111/24	48837 ECO FL	MASTERLine 111 60W G53 12V 24D	–	–
QR111/40° IRC	60	G53	–	–	ww	1A	HMGS/UB/IB-60-12-G53-111/40	48837 ECO WFL	–	–	–
QR111/45° IRC	60	G53	–	–	ww	1A	HMGS/UB/IB-60-12-G53-111/45	–	MASTERLine 111 60W G53 12V 45D	–	–
QR111/6°	100	G53	–	–	ww	1A	HMGS-100-12-G53-111/6	41850 SP	–	–	–
QR111/8°	100	G53	–	–	ww	1A	HMGS-100-12-G53-111/8	–	–	SA111 SP 8º	AR111 100W12V SP
QR111/24°	100	G53	–	–	ww	1A	HMGS-100-12-G53-111/24	–	–	SA111 SP 24º	AR111 100W12V FL
QR111/40°	100	G53	–	–	ww	1A	HMGS-100-12-G53-111/40	41850 WFL	–	–	–
QR111/45°	100	G53	–	–	ww	1A	HMGS-100-12-G53-111/45	–	–	SA111 WFL 45º	AR111 100W12V WFL
High voltage tungsten halogen lamps with tubular bulb											
QT32/c	70	E27	1180	17	ww	1A	HSGST/F/UB-70-230-E27	64400	EcoClassic30 70W E27 230V T32 CL	–	–
QT32/c	100	E27	1800	18	ww	1A	HSGST/F/UB-100-230-E27	64401	–	–	–
QT32/c	105	E27	1980	19	ww	1A	HSGST/F/UB-105-230-E27	–	EcoClassic30 105W E27 230V T32 CL	–	–
QT32/c	150	E27	2870	19	ww	1A	HSGST/F/UB-150-230-E27	64402	–	–	–
QT32/c	205	E27	4200	20	ww	1A	HSGST/F/UB-205-230-E27	64404	–	–	–
QT-DE12 IRC	48	R7s	815	17	ww	1A	HDG-48-230-R7s-74,9	64684 ECO	Plusline ES Compact 78mm 2y 48W R7s 230V 1BB	DE ECO 78MM 48W 230V R7S	–
QT-DE12	60	R7s	840	14	ww	1A	HDG-60-230-R7s-74,9	64688	–	–	–
QT-DE12 IRC	80	R7s	1450	18	ww	1A	HDG-80-230-R7s-74,9	64490 ECO	Plusline ES Compact 78mm 2y 80W R7s 230V 1BB	DE ECO 78MM 80W 230V R7S	–
QT-DE12	100	R7s	1900	19	ww	1A	HDG-100-230-R7s-74,9	–	–	–	K12 C100W 230V R7S
QT-DE12 IRC (l=74,9)	120	R7s	2300	19	ww	1A	HDG-120-230-R7s-74,9	64695 ECO	Plusline ES Compact 78mm 2y 120W R7s 230V 1BB	DE ECO 78MM 120W 230V R7S	–
QT-DE12 IRC (l=114,2)	120	R7s	2300	19	ww	1A	HDG-120-230-R7s-114.2	64696 ECO	Plusline ES Small 118mm 2y 120W R7s 230V 1BB	DE ECO 118MM 120W 230V R7S 2000H	–
QT-DE12 IRC (l=114,2)	130	R7s	2440	19	ww	1A	HDG-130-230-R7s-114,2	–	–	–	K11 C130W 230V R7S
QT-DE12 IRC	160	R7s	3300	21	ww	1A	HDG-160-230-R7s-114,2	64698 ECO	Plusline ES Small 118mm 2y 160W R7s 230V 1BB	DE ECO 118MM 160W 230V R7S 2000H	–
QT-DE12 IRC	200	R7s	4000	20	ww	1A	HDG-200-230-R7s-114,2	–	–	–	K9 C200W 230V R7S
QT-DE12 IRC	225	R7s	5000	22	ww	1A	HDG-225-230-R7s-114,2	–	–	–	K9/Q225 T3/230V HIR
QT-DE12 IRC	230	R7s	5000	22	ww	1A	HDG-230-230-R7s-114,2	64701 ECO	–	DE ECO 118MM 230W 230V R7S 2000H	–
QT-DE12	240	R7s	4900	20	ww	1A	HDG-240-230-R7s-114,2	–	Plusline ES Small 118mm 2y 240W R7s 230V 1BB	–	–
QT-DE12 IRC	330	R7s	7400	22	ww	1A	HDG-330-230-R7s-114,2	–	–	–	K1 C330W 230V R7S
QT-DE12 IRC	375	R7s	9400	25	ww	1A	HDG-375-230-R7s-114,2	–	–	–	K1/Q375 T3/230V HIR
QT-DE12 IRC	400	R7s	9000	23	ww	1A	HDG-400-230-R7s-114,2	64702 ECO	Plusline ES Small 118mm 2y 400W R7s 230V 1BB	DE ECO 118MM 400W 230V R7S 2000H	–
QT-DE12	500	R7s	9500	19	ww	1A	HDG-500-230-R7s-114,2	–	–	–	K1/Q500 T2.5/CL
QT-DE12-h15	750	R7s	16100	21	ww	1A	HDG-750-230-R7s-185,7	64560	Plusline Large 750W R7s 230V	DE 230V 750W	–
QT-DE12-h15	1000	R7s	22000	22	ww	1A	HDG-1000-230-R7s-185,7	64740	Plusline Large 1000W R7s 230V	DE 230V 1000W	K4/Q1000 T3/CL
High voltage tungsten halogen lamps											
QPAR51/25°	18	GU10	–	–	ww	1A	HAGS-18-230-GU10-51/25	–	EcoH TWIST 18W GU10 230V 25D	HI-SPOT ES50 ECO 18W FL 25°	–
QPAR51/36°	20	GU10	–	–	ww	1A	HAGS-20-230-GU10-51/36	–	–	–	Q20MR16/230/FL
QPAR51/25°	25	GU10	–	–	ww	1A	HAGS-25-230-GU10-51/25	–	Twistline Alu 2000h 25W GU10 230V 25D	–	–
QPAR51/50°	25	GU10	–	–	ww	1A	HAGS-25-230-GU10-51/50	–	EcoH TWIST 25W GU10 230V 50D	–	–
QPAR51/25°	28	GU10	–	–	ww	1A	HAGS-28-230-GU10-51/25	–	–	HI-SPOT ES50 ECO 28W FL 25°	–
QPAR51/30°	28	GU10	–	–	ww	1A	HAGS-28-230-GU10-51/30	64819 ECO	–	–	–
QPAR51/20°	35	GU10	–	–	ww	1A	HAGS-35-230-GU10-51/20	–	Twistline Alu 2000h 35W GU10 230V 20D	HI-Spot ES50 20° 35W 230V Superia ECO	–
QPAR51/35°	35	GU10	–	–	ww	1A	HAGS/UB-35-230-GU10-51/35	64820 FL	–	–	Q35MR16/230/FL
QPAR51/40°	35	GU10	–	–	ww	1A	HAGS-35-230-GU10-51/40	–	Twistline Alu 2000h 35W GU10 230V 40D	HI-Spot ES50 40° 35W 230V Superia ECO	–
QPAR51/50°	35	GU10	–	–	ww	1A	HAGS-35-230-GU10-51/50	–	EcoH TWIST 35W GU10 230V 50D	–	–
QPAR51/25°	40	GU10	–	–	ww	1A	HAGS-40-230-GU10-51/25	–	–	HI-SPOT ES50 ECO 40W FL 25°	–
QPAR51/30°	40	GU10	–	–	ww	1A	HAGS-40-230-GU10-51/30	64823 ECO	–	–	–
QPAR51/50°	40	GU10	–	–	ww	1A	HAGS-40-230-GU10-51/50	–	–	HI-SPOT ES50 ECO 40W WFL 50°	–
QPAR51/20°	50	GU10	–	–	ww	1A	HAGS-50-230-GU10-51/20	–	Twistline Alu 2000h 50W GU10 230V 20D	HI-Spot ES50 20° 50W 230V Superia ECO	–
QPAR51/25°	50	GU10	–	–	ww	1A	HAGS-50-230-GU10-51/25	–	Twistline Alu 3000h 50W GU10 230V 25D	–	Q50MR16/230/25°
QPAR51/35°	50	GU10	–	–	ww	1A	HAGS/UB-50-230-GU10-51/35	64824 FL	–	–	Q50MR16/230/36°
QPAR51/40°	50	GU10	–	–	ww	1A	HAGS-50-230-GU10-51/40	–	Twistline Alu 2000h 50W GU10 230V 40D	HI-Spot ES50 40° 50W 230V Superia ECO	–
QPAR51/50°	50	GU10	–	–	ww	1A	HAGS-50-230-GU10-51/50	–	Twistline Alu 3000h 50W GU10 230V 50D	–	–

Please note: Subject to alteration. The list represents a selection from manufacturers' lamp ranges.
Specifications for luminous flux, efficiency, colour temperature, colour rendition and burning position as well as the ILCOS code mostly correspond to the first specified manufacturer's lamp designation in a row. It is the responsibility of the user to ascertain suitability of lamps for Siteco luminaires.

Lamps typically used for outdoor lighting

- LED
- High pressure sodium vapour lamps (HS..., preferably with improved colour rendering)
- Low pressure sodium vapour lamps (LS..., only for special applications)
- Fluorescent lamps in tubular shape (T..., preferably with amalgam technology)
- Compact fluorescent lamps (TC..., preferably with amalgam technology)
- Metal halide lamps (HI..., preferably with ceramic arc tube)
- High pressure mercury vapour lamps (HME, no longer recommended)

Selection criteria for lamps

- Light colour and colour rendering
- Power
- Service Life
- Luminous efficacy
- Climatic environment
- Operating devices

Lamps – end of service life

Lamp service life can be defined according to various criteria. Since the electrical behaviour of lamps can change significantly after the useful life cited by the manufacturer elapses; at the end of the useful life lamps must be replaced as quickly as possible to protect operating devices, and to avoid unnecessary functional disturbances.

High pressure discharge lamps reach the end of useful life when:

- The light colour of the lamp significantly changes
- A significant loss of brightness occurs, e.g. the luminous flux decreases by 70 %
- The lamp no longer ignites
- Periodic going out and igniting of the lamp occurs (cycling)

Fuse protection

Lighting systems must be fused to protect devices and lines. Lamp current is the basis for dimensioning the fusing.

Use fuses with slo-blo tripping characteristics to fuse high pressure discharge lamps. If using wire fuses a configuration of twice the rated current of the lamp suffices. If automatic circuit breakers are provided then the circuit breakers should have switch-off characteristic “C”. When adjusting to the high limit value 10 x LS rated current, with fuse protection with 2 x rated lamp current no trip will occur.

Lamp type	**LED**	**Metal halide lamps with ceramic arc tube**	**Metal halide lamps with quartz burner**	**High pressure sodium vapour lamps**	**High pressure sodium lamps with improved colour rendering**	**Low pressure sodium lamps**
ZVEI designation e.g.	–	HIR111-CE-P, HIPAR51-CE-P, HIT-CE, HIT-TC-CE, HIT-DE-CE, HIE-CE, HIE-CE-P	HIT, HIT-DE, HIE	HST, HST-DE, HSE	HST-CRI	LST
Light colour [K]	2600 – 10000	2800 – 4200	2900 – 6700	2000	2500	Monochromatic yellow, 590 nm
Colour rendering level	1A	1A – 1B	1A – 2B	4	1B	–
Colour rendering index Ra	9x	9x – 8x	9x – 6x	3x – 2x	8x	–
Light yield [lm/W] (System lamp-ballast, without optics and housing)	< 150 (at 350mA)	68 – 89	58 – 113	56 – 120	34 – 44	100 – 172
Average service life [h] (time after which 50 % of the lamps are still intact)	–	9000 – 12000	4000 – 12000	18000 – 32000	15000	22000
Useful life [h] (luminous flux reduction to 70 %)	0 – 80000 (at 350mA)	2000 – 9000	3000 – 7000	> 32000	8000 – 12000	> 24000
Possible dependencies of the service life	Thermal management	Lamp concept operation on electronic ballast or conventional ballast	Lamp concept operation on electronic ballast or conventional ballast	Lamp concept op. on electr. ballast or conventional ballast	Lamp concept operation on electr. ballast or conventional ballast	Lamp concept
Dependency luminous flux on ambient temperature	high	low	low	low	low	low
Start-up time	immediate	Several minutes	Several minutes	Several minutes	Several minutes	Several minutes
Re-ignition	immediate	after > 10 min; for restricted types with high technical complexity, immediately possible				
Dimming	stepless from 0 – 100%	Conditional; for restricted types infinite from approx. 30 –100 %			no	no

Lamp type	**tubular, circular fluorescent lamps**	**tubular, circ. fluorescent lamps with amalgam technology**	**Compact fluorescent lamps**	**Compact fluorescent lamps with amalgam technology**	**Tungsten halogen lamps**	**Incandescent lamps**
ZVEI designation e.g.	T16, T26, T16-R	T16-RI, T16-I	TC-S, TC-SEL, TC-D, TC-DEL, TC-T, TC-TEL, TC-LEL, TCR-TSE flat, TC-DD	TC-LELI, TC-TELI	QT12, QT32, QT-DE11/12, QR-CBC51, QR111, QPAR51	A55, A65, A80
Light colour [K]	2700 – 18000	3000 – 6500	2700 – 6500	2700 – 4000	2900 – 3000	2800
Colour rendering level	1A – 2B	1B	1A – 2B	1B	1A	1A
Colour rendering index Ra	9x – 6x	8x	9x – 6x	8x	100	100
Light yield [lm/W] (System lamp-ballast, without optics and housing)	32 – 87	69 – 79	46 – 70	68 – 80	18 – 22 (at 350 mA)	10 – 15
Average service life [h] (time after which 50 % of the lamps are still intact)	9000 – 95000	45000 – 75000	9000 – 45000	17000 – 22000	2000 – 5000	1000
Useful life [h] (luminous flux reduction to 70 %)	30000 – 75000	> 30000	8000 – 16000	12000	> 5000	> 1000
Possible dependencies of the service life	Switch frequency, operation on on ECG or LLCG, dimming	Switch frequency, dimming	Switch frequency, operation on on ECG or LLCG, dimming	Switch frequency, dimming	Switch frequency, lamp voltage	Switch frequency, lamp voltage
Dependency luminous flux on ambient temperature	high	medium	high	medium	low	low
Start-up time	a few seconds	several seconds	a few seconds	several seconds	immediate	immediate
Re-ignition	immediate	immediate	immediate	immediate	immediate	immediate
Dimming	Infinite from 1 – 100%	Infinite from 30 – 100%	Type-dep. Infinite from 1 – 100%	Infinite from 30 – 100%	Infinite from 0 – 100%	Infinite from 0 – 100%

Please note: Subject to alteration. The table provides a starting point for the typical characteristics of the different lamp types. The specific characteristics of a certain lamp can deviate from those cited in the table. The information provided by the lamp manufacturer is authoritative.

EuP regulation with regard to technical luminaires

A complete description of the EuP regulation can be found for example at **www.eur-lex.europa.eu**

For luminaires containing these components, documentation regarding efficiency, disposal, maintenance and cleaning is required. Valid specifications can be found on our website at **www.siteco.com**.

Ballasts integrated in luminaires correspond at least to energy efficiency class EEI = B2 (conventional ballasts) or A3 (electronic ballasts, non-dimmable). We do however aim to use devices with designation EEI = A2 or A1 if possible and available.

The symbols used in instructions for maintenance and disposal are detailed in the Symbol explanations section.
It must be fundamentally indicated that luminaires contain components that are subject to maintenance or repair. This includes optical enclosures, sealing materials, electrical components and lamps. The state of ageing, soiling, wear or damage is dependent on specific operating conditions and cannot be randomly specified. As a result it is in the interests of system operators to define reasonable cycles for monitoring, repair and maintenance.

Lighting planning

Introduction

Today streetlighting is planned in accordance with the standard series DIN EN 13201 'Road lighting'.

Overview of planning steps

- Definition of the public traffic area, starting with typical speed of the main user and other approved users
- Selection of a lighting situation (A1 to E2) (see table)
- Selection of a lighting classification (ME, S, A, CE, ES, EV lighting classification)
- Determination of the associated quality code numbers (luminance, illuminance, etc.) in accordance with the lighting classifications

Lighting situations A1 to B2 lead to the ME lighting classifications for which luminance values are valid are quality criteria. The lighting situations C1 to E2 lead to the S and CE lighting classifications. Illuminances apply for these lighting classifications.

Lighting situations according to DIN 13201-1

Typical speed of main user	Main user	Other permitted users	Excluded users	Lighting situation	Application examples
> 60 km/h	motorised traffic	none	slow-moving vehicles cyclists pedestrians	A1	Motorways, heavy traffic roads such as expressways or bypasses with or without central borders
		slow-moving vehicles	cyclists pedestrians	A2	Main roads and transit roads
		slow-moving vehicles cyclists pedestrians	none	A3	Main roads and transit roads
30…60 km/h	motorised traffic slow-moving vehicles	cyclists pedestrians	none	B1	Main roads, collection roads, residential roads
	motorised traffic slow-moving vehicles cyclists	pedestrians	none	B2	Main roads, collection roads, residential roads
5…30 km/h	cyclists	pedestrians	motorised traffic slow-moving vehicles	C1	Cycle paths, pedestrian paths, pavements
	motorised traffic pedestrians	none	slow-moving vehicles cyclists	D1	Motorway rest locations
		slow-moving vehicles cyclists	none	D2	Railway station forecourts, bus stations
	motorised traffic cyclists	slow-moving vehicles pedestrians	none	D3	Service roads, residential streets
	motorised traffic slow-moving vehicles	none	none	D4	Low-traffic zones and play roads, markets, parking lots
walking speed	cyclists pedestrians		none		
	pedestrians	none	motorised traffic slow-moving vehicles cyclists	E1	Pedestrian zones, pedestrian paths, shopping zones
		motorised traffic slow-moving vehicles cyclists	none	E2	Company roads, routes for loading/supply traffic, bus stops

Lighting classes according to DIN EN 13201-2

Photometric system values for traffic roads according to the ME and comparable CE lighting classes in compliance with DIN EN 13201-2 Roadway luminance with dry road surface

	Roadway luminance with dry roadsurface			Threshold value	Ambient illuminance ratio
Class	L_m in cd/m² Maintenance value	U_0	U_1	TI in % Maximum value 1)	SR 2)
ME1	2.0	0.4	0.7	10	0.5
ME2	1.5	0.4	0.7	10	0.5
ME3a	1.0	0.4	0.7	15	0.5
ME3b	1.0	0.4	0.6	15	0.5
ME3c	1.0	0.4	0.5	15	0.5
ME4a	0.75	0.4	0.6	15	0.5
ME4b	0.75	0.4	0.5	15	0.5
ME5	0.5	0.35	0.4	15	0.5
ME6	0.3	0.35	0.4	15	0.5

1) with light sources with lower luminance, 5% higher is permissible
2) this criterion is only applicable when traffic surfaces without own photometric requirements border the roadway

Comparable class		
	E_m in lx Maintenance value	U_0 in lx Maintenance value
CE0	50	0.4
CE1	30	0.4
CE2	20	0.4
CE3	15	0.4
CE4	10	0.4
CE5	7.5	0.4

Photometric system values for pedestrian and cycle areas according to S and A lighting classes in compliance with DIN EN 13201-2

	Horizontal illuminance	
Class	E_m in lx Maintenance value	E_{min} in lx Maintenance value
S1	15	5
S2	10	3
S3	7.5	1.5
S4	5	1
S5	3	0.6
S6	2	0.6
S7	spec. not achieved	spec. not achieved

	Semi-spherical illuminance	
Class	E_{hs} in lx Maintenance value	U_0
A1	5	0.15
A2	3	0.15
A3	2	0.15
A4	1.5	0.15
A5	1	0.15
A6	spec. not achieved	spec. not achieved

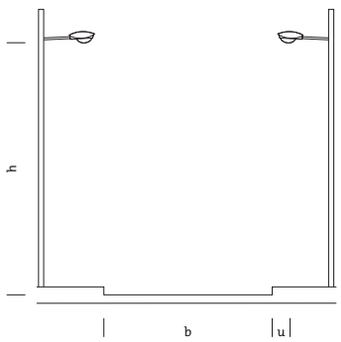
Photometric system values for semi-spherical and vertical illuminance according to ES and EV lighting classes in compliance with DIN EN 13201-2

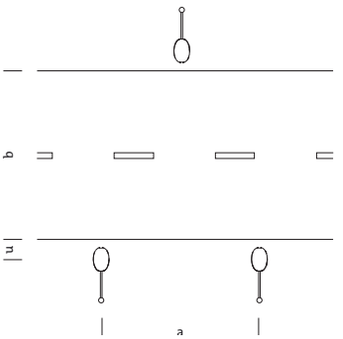
	Semi-spherical illuminance
Class	$E_{sc, min}$ in lx Maintenance value
ES1	10
ES2	7.5
ES3	5
ES4	3
ES5	2
ES6	1.5
ES7	1
ES8	0.75
ES9	0.5

	Vertical illuminance
Class	$E_{v, min}$ in lx Maintenance value
EV1	50
EV2	30
EV3	10
EV4	7.5
EV5	5
EV6	0.5

Luminous intensity classes

Class	Maximum values of luminous intensity in cd/klm			Other requirements
	to 70°	to 80°	to 90°	
G1	-	200	50	none
G2	-	150	30	none
G3	-	100	20	none
G4	500	100	10	Luminous intensity = 0cd above 95°
G5	350	100	10	Luminous intensity = 0cd above 95°
G6	350	100	0	Luminous intensity = 0cd above 90°





Residential road | parameters for planning

Road surface Typ	q_0	Maintenance factor HST 50W	HIT-CE 70W
R3	0,08	0,71	0,59

Road geometry w (m)	h (m)	u (m)	Evaluation class	Luminaire	Order no.	Optical enclosure	Inclination of luminaire head	Lamp	Arrangement Position	Lamp position LP Reflector position RP	Mounting distance a (m)	Result E (lx)	U_0	E_{min} (lx)
6,0	5,0	0	CE3	SQ 50	5NA557E1JT0G	flat cover	3°	HST 50W	offset on both sides	LP2/RP8	22	8,7	0,42	
				FANTASiE	5NA31221CE08	–	0°	HIT-CE 70W	offset on both sides		23	8,4	0,41	
			S3	SQ 50	5NA557E1JT0G	flat cover	3°	HST 50W	offset on both sides	LP2/RP3	31	7,5		1,6
				FANTASiE	5NA31221CE08	–	0°	HIT-CE 70W	one-sided		26	7,6		2,1
			S4	SQ 50	5NA557E1JT0G	flat cover	3°	HST 50W	offset on both sides	LP2/RP3	33,5	6,9		1,1
				FANTASiE	5NA31221CE08	–	0°	HIT-CE 70W	one-sided		31	6,4		1,1

Collecting road | parameters for planning

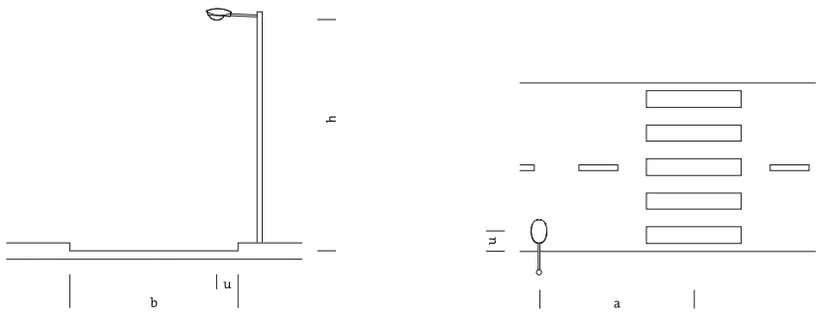
Road surface Typ	q_0	Maintenance factor HST 50W	HST 70W	HST 100W
R3	0,08	0,71	0,71	0,71

Road geometry w (m)	h (m)	u (m)	Evaluation class	Luminaire	Order no.	Optical enclosure	Inclination of luminaire head	Lamp	Arrangement Position	Lamp position LP Reflector position RP	Mounting distance a (m)	Result L (cd/m²)	U_0	U_1	T_I (%)	SR
6,0	6,0	1,5	ME4a	DL® 500 Midi	5NA247E1MT0AS08	flat cover	3°	HST 70W	offset on both sides	LP1 / RP5	20,5	0,76	0,64	0,6	13,20	0,67
				SQ 100	5NA558E1MT0C436	convex cover	3°	HST 50W	offset on both sides	LP1 / RP9	17,5	0,76	0,57	0,65	14,40	0,57
			ME4b	DL® 500 Midi	5NA247E1MT0AS08	flat cover	3°	HST 70W	offset on both sides	LP1 / RP5	20,5	0,76	0,64	0,6	13,20	0,67
				SQ 100	5NA558E1MT0C436	convex cover	3°	HST 50W	offset on both sides	LP1 / RP9	17,5	0,76	0,57	0,65	14,40	0,57
			ME5	DL® 500 Midi	5NA247E1MT0AS08	flat cover	3°	HST 70W	offset on both sides	LP1 / RP5	22,5	0,69	0,57	0,56	14,30	0,68
				SQ 100	5NA558E1MT0C436	convex cover	3°	HST 50W	offset on both sides	LP1 / RP9	18	0,72	0,57	0,65	14,90	0,57
7,5	8,0	1,5	ME4a	DL® 500 Maxi	5NA246E1NT0AS08	flat cover	3°	HST 100W	one-sided	LP1 / RP4	30	0,78	0,48	0,66	14,10	0,53
				SQ 100	5NA558E1MT0C436	convex cover	3°	HST 70W	offset on both sides	LP1 / RP9	21,5	0,76	0,63	0,64	12,30	0,59
			ME4b	DL® 500 Maxi	5NA246E1NT0AS08	flat cover	3°	HST 100W	one-sided	LP1 / RP4	30	0,78	0,48	0,66	14,10	0,53
				SQ 100	5NA558E1MT0C436	convex cover	3°	HST 70W	offset on both sides	LP1 / RP8	23	0,77	0,56	0,54	13,90	0,56
			ME5	DL® 500 Maxi	5NA246E1NT0AS08	flat cover	3°	HST 70W	offset on both sides	LP1 / RP3	29	0,51	0,53	0,45	13,20	0,62
				DL® 500 Maxi	5NA246E1NT0AS08	flat cover	3°	HST 100W	offset on both sides	LP1 / RP4	33	0,75	0,43	0,45	14,60	0,53
			ME5	SQ 100	5NA558E1MT0C436	convex cover	3°	HST 70W	offset on both sides	LP1 / RP1	30	0,52	0,58	0,58	13.70	0,64

Main road | parameters for planning

Road surface Typ	q0	Maintenance factor HST 100W	HST 150W
R3	0,08	0,71	0,75

Road geometry w (m)	h (m)	u (m)	Evaluation class	Luminaire	Order no.	Optical enclosure	Inclination of luminaire head	Lamp	Arrangement Position	Lamp position LP Reflector position RP	Mounting distance a (m)	Result L (cd/m²)	U_0	U_1	T_I (%)	SR
7,5	8,0	1,5	ME3b	SQ 100	5NA 558 E-1PT0C236	flat cover	3°	HST 150W	one-sided	LP2 / RP9	32	1,07	0,53	0,65	≅14,90	0,64
				SR 100	5NA 552 E-1NT01	diffuser	3°	HST 100W	one-sided	LP40 / RP5	24	1,05	0,44	0,62	14,40	0,54
				SR 100	5NA 552 E-1NT01	diffuser	8°	HST 100W	one-sided	LP45 / RP4	25	1,04	0,44	0,62	14,00	0,53
				SR 100	5NA 552 E-1NT01	diffuser	15°	HST 100W	one-sided	LP45 / RP2	26	1,03	0,48	0,63	14,40	0,55
9,0	10,0	1,5	ME3b	SQ 100	5NA 558 E-1PT0C236	flat cover	3°	HST 150W	one-sided	LP2 / RP7	31	1,01	0,41	0,66	11,40	0,61
				SR 100	5NA 552 E-1PT01	diffuser	3°	HST 150W	one-sided	LP35 / RP5	34	1,01	0,45	0,68	14,90	0,68
				SR 100	5NA 552 E-1PT01	diffuser	8°	HST 150W	one-sided	LP35 / RP3	35	1,03	0,43	0,69	14,80	0,68
				SR 100	5NA 552 E-1PT01	diffuser	15°	HST 150W	one-sided	LP35 / RP3	33	1,02	0,48	0,64	13,20	0,72



Pedestrian crossing | parameters for planning

Road surface Typ	q_0	Maintenace factor HST 100W	HST 150W	HST 250W
R3	0,08	0,8	0,8	0,8

Road geometry b (m)	h (m)	u (m)	Luminaire	Order no.	Optical enclosure	Inclination of luminaire head	Lamp	Arrangement Position	Distance from ped. crossing a (m)	Result E_v (lx)	E_{min} (lx)
3,5	7,5	0	SR 200	5NA553E1PT01FL	cover	3°	HST 150W	one-sided	7,75	49,5	33,6
5,0	6,0	0	SR 200	5NA553E1PT01FL	cover	3°	HST 100W	one-sided	6,0	40,8	9,4
		2	SR 200	5NA553E1PT01FL	cover	3°	HST 100W	one-sided	6,5	45,3	16,4
6,0	7,5	0	SR 200	5NA553E1PT01FL	cover	3°	HST 150W	one-sided	7,5	44,8	19,7
6,5	6,0	0	SR 200	5NA553E1PT01FL	cover	3°	HST 150W	one-sided	6,75	65,9	13,5
		2	SR 200	5NA553E1PT01FL	cover	3°	HST 100W	one-sided	6,75	42,2	16,7
7,0	7,5	0	SR 200	5NA553E1PT01FL	cover	3°	HST 150W	one-sided	7,5	43,8	17,7
	8,0	0	SR 200	5NA553E1PT01FL	cover	3°	HST 150W	one-sided	10,0	38,9	17,1
		2	SR 200	5NA553E1PT01FL	cover	3°	HST 150W	one-sided	10,0	39,7	19,8
8,0	7,5	0	SR 200	5NA553E1PT01FL	cover	3°	HST 150W	one-sided	7,5	40,4	11,8
	8,0	0	SR 200	5NA553E1ST01FL	cover	3°	HST 250W	one-sided	10,0	58,5	22,4
		2	SR 200	5NA553E1ST01FL	cover	3°	HST 250W	one-sided	10,0	63,9	36,8
10,0	7,5	2	SR 200	5NA553E1PT01FL	cover	3°	HST 150W	one-sided	7,75	40,0	12,8
	8,0	0	SR 200	5NA553E1ST01FL	cover	3°	HST 250W	one-sided	8,0	52,5	9,0
		2	SR 200	5NA553E1ST01FL	cover	3°	HST 250W	one-sided	8,0	63,9	16,9
		0	SR 200	5NA553E1ST01FL	cover	3°	HST 250W	one-sided	7,5	54,6	10,9
		2	SR 200	5NA553E1ST01FL	cover	3°	HST 250W	one-sided	7,5	62,5	19,6
10,0	9,0	0	SR 200	5NA553E1ST01FL	cover	3°	HST 250W	one-sided	7,75	45,4	12,9
10,0	10,0	2	SR 200	5NA553E1ST01FL	cover	3°	HST 250W	one-sided	9,5	41,3	20,6

Term Calculation equation	Explanation	Applications
Maintenance value - new value $\text{new value} = \frac{\text{Maintenance value}}{\text{Maintenance factor}}$	All luminances specified in DIN EN 13201 “Road lighting” are shown as maintenance values, i.e. limit value, after which, if exceeded, the installation must be maintained. The lighting installation must be planned with a maintenance factor that takes all influences into consideration in order to arrive at the new value. However the standard does not contain any numeric recommendations for the maintenance factor.	Since the standard does not make any recommendations for maintenance factors, the LiTG (German lighting technology association) recommends the following reference factors for simplified project planning: • 0.57 for outdoor lighting installations with a 3-year maintenance cycle • 0.50 for outdoor lighting installations with significant soiling
Maintenance factor	The maintenance factor WF is comprised of: • LLWF lamp luminous flux maintenance factor (takes flux depreciation of lamp into account) • LLDF lamp service life factor (takes the probability of failure of lamp type used into account) • LWF luminaire maintenance factor (takes flux depreciation of lamp and luminaire due to soiling into account)	The specific maintenance factors depend on environmental, operational, and ageing conditions. Detailed information is provided in the technical report CIE 154 'Maintenance of outdoor lighting systems'.

Tools for the calculation of outdoor lighting systems

The modernisation of obsolete streetlighting systems pays off. Around 2.7 billion kWh of energy, 1.6 million tons of CO^2 and therefore 400 million euros are available for this in Germany alone. The quickest way to implement this is the refurbishment of old lighting installations with new, energy-efficient luminaires and lighting technologies. With Siteco's online calculation programme you can easily find out which energetic savings potential exists. Our website has tools such as the SLEO and the cost efficiency calculator for such purposes:

SLEO – Street Lighting Energy Optimizer

The SLEO (Street Lighting Energy Optimiser) is a road lighting optimisation programme for existing and new standard road geometries, selected luminaire types and standard lamp configurations.
SLEO enables you to rapidly locate efficient, standard-compliant road lighting solutions without detailed knowledge of lighting calculation methods.

SLEO makes available the following information:
- the energy consumption of the old system
- the CO^2 emission of the old system
- the energy consumption of the new system
- the energy savings compared to the old system in kWh and %
- the CO^2 savings compared to the old system
- the SLEEC factor as a new standard for evaluating economy in road lighting

Further information or direct to the SLEO calculation programme at
http://www.siteco.de/de/produkte/planungswerkzeuge/sleo.html

Cost Efficiency Calculator

The Siteco Cost Efficiency Calculator is a web application for evaluating the cost efficiency of two outdoor lighting installations.
The installations ('comparison installation' and 'new installation') can be compared to each other over a variable service life in terms of investment costs and operating costs. For evaluating cost efficiency the amortisation of an investment over the service life is calculated both statically and dynamically and displayed in figures and tables.

The cost efficiency calculator makes available the following information and services:
- a clear comparison of the old and new system
- precise data for investment, operating and energy costs
- reliable amortisation calculations
- tabular and graphical display of results
- simple step-for-step user guidance
- creation and saving of individual projects
- documentation and download of results as PDF files

Further information or direct to the cost efficiency calculator at
http://www.siteco.de/de/produkte/planungswerkzeuge/wirtschaftlichkeitsberechnung.html

What is light immission?

Immission is the admittance of particles or radiation into a system.

Light immission specifies the ingress of electro-magnetic radiation of the visible wavelength range into a system. This can be natural light (daylight/moonlight/light from stars) or artificial light (electric lamps). Visible in this sense means visible for people or animals. UV radiation appears as light to animals but cannot be seen by humans.

The phrase light immission is used in particular in connection with the emittance of artificial light into the environment, whereby light is in this sense considered a 'pollutant'. Light pollution is an often-used term. But in contrast to other pollutants that collect and therefore have a long-term effect, light pollution only exists as long as the light is existent. Long-term consequences for the environment are therefore not caused by light itself but indirectly by changes during the effects of light.

During the day the influence of artificial light for the environment is low, as daylight in contrast is much more intensive.

By night the opposite is true. Artificial light sources then dominate, for example road lighting, car headlights and building illumination. This then influences specific processes in the environment that would other be implemented in darkness. Towns and cities are covered by 'domes of light', meaning the sky is brightened by the scattered artificial light.

A conflict exists between the desired effect of lighting (the recognition of objects) and the undesired effects on the environment.

What are the short-term and long-term effects of light immission?

Effects on animals and people:

- The behaviour of nocturnal animals is disrupted by artificial light, especially by the blue and UV components in the spectrum of lamps: the light from road luminaires attracts insects such as moths and beetles. they become easy prey and can no longer breed. Surveys from the year 2000 show that in Germany in a single Summer night an average of 150 insects die at a road luminaire. If this is calculated for the approx. 9 million road luminaires on German roads then that is over one billion insects each night.
- Artificial light represents a problem for the navigation and orientation of migrating birds. Light sources and domes at night lead birds to fly in the wrong direction. The animals often pay for this with their life.
- Nocturnally active animals need darkness for searching for food and some also for procreation. Negative effects from artificial light are also known with water-fleas, fish, amphibians and tortoises.
- Animals active during the day need darkness for sleeping, relaxing and for regenerating.

Effects on flora:

- Plants need the day/night rhythm for photosynthesis and are influenced in their growth cycle by artificially brightened surroundings. That which is desired for cultivated plants in garden centres can become a problem for sensitive natural plants when they bloom earlier than in their natural cycle for example and are thus attacked by frost.

Cultural influences:

- Brightening of the night sky makes it appear almost devoid of stars. In this way a source of inspiration for people for thousands of years is lost and modern professional astronomy is hindered.
- Outdoor areas that are too brightly illuminated strongly limit lighting design. The design-based use of artificial light presumes a dark environment; otherwise contrast is lacking.

What is Dark Sky?

Dark Sky is an initiative that has been organised in particular by astronomers to limit the quantity of light immissions. They have founded various organisations, including the International Dark Sky Association (IDA).

Which solution approaches exist and how can Siteco support you with these?

Lighting installations in outdoor applications are set up for specific purposes, the importance of which should be appraised in each case:

- Recognition of carriageways, vehicles and people for preventing accidents and violence (road lighting)
- Recognition/presenting of architecture and advertising surfaces for orientation, for town planning and for advertising purposes
- Illumination of sports facilities
- Signal systems (traffic lights)

Planning:
Light should in general be economically handled when planning and designing lighting systems. Lighting should only be planned where it is necessary, with only sufficient intensity for fulfilling the lighting task (illuminance or luminance). Our sales representatives would be glad to offer you professional support with planning.

Lighting technology:
Suitable optics enable only desired surfaces to be illuminated. In particular, useless direct radiation of lighting into the sky can be limited in this way.

Siteco luminaires with minimised light immission (luminous flux into the upper hemisphere < 3%) are designated with the following symbols in the catalogue:

Conventional lamp technology:
Luminaires with conventional lamp technology attract nocturnally active insects via the spectral combination of their emitted light. The higher the UV component, the greater is the attraction for insects. Mercury vapour lamps (HME) with their cold blue light are particularly attractive to insects. High pressure sodium vapour lamps (HST) also emit light with a UV component that attracts and endangers insects.

LED technology:

LEDs emit light without an ultraviolet component and therefore do not attract insects. In addition, with the use of intelligent control, the level of illuminance can be adapted according to needs. Dimming of luminous flux as with the Streetlight 10 Plus for example reduces even further the attraction of the luminaires for nocturnal insects. Because the lower the illuminance, the less interest the insects have.

What is the importance of light immission in various countries?

Germany:
In Germany the Federal Immission Protection Regulation (BImSchG) bears validity The commission for immission protection has drawn up a directive for the measurement and evaluation of light immission for greater specification purposes. Similar directives (although without technical guidelines) exist in Czechia, Great Britain and Lichtenstein.

Slovenia:
Since 22 September 2007 Slovenia is the first EU country with legislation against light pollution. Information in Slovenian at **www.temnonebo.org**

Italy:
Legislation has been adopted in various regions. The Lombardy regulation (2000, 2004) can be seen as a pioneer, which is why Italians are suggesting it as the basis for European legislation.

Road lighting

- Irritating residents
- "Polluting" the night sky
- Unnecessary energy consumption

- Undisturbed sleep for residents
- No radiation into the night sky
- Maximum light yield

Facade illumination

Conventional projector (symmetric):

- "Pollutes" the night sky
- Lessens the desired effect
- Higher energy consumption

Optimised projector (symmetric):

- Precisely aims the light on the object
- Prevents light immission
- Achieves a maximum image effect

Localised lighting

Symmetric distribution floodlight:

- Irritation of residents
- Undesired illumination of the house facade
- Unnecessary energy consumption

Asymmetric distribution floodlight:

- No light emission
- Does not irritate the residents
- Good installation efficiency

1 Light radiation into the sky
2 Undesired illumination of vertical surfaces (e.g. building facades)

Instant hot re-ignition

The security luminaire area, technical traffic critical areas and logistics hubs require illumination that is as free of interruption as possible. Special ignition devices are required for immediate (within 0.2 seconds) re-ignition of high-pressure lamps that go out for system reasons after a voltage interruption or a power failure.
Due to these instant re-ignition devices) a transient voltage of 20...40 kVs is applied to the lamp, which makes it possible to ignite the lamp in hot status. Due to the high ignition voltages only lamps with 2-sided connection are suitable. The usual cooling procedure necessary before ignition can take place with a normal ignitor unnecessary. Multiple repeat ignition processes can damage and impair the function of lamp and ignition device.

Suitable lamps for hot re-ignition	**Required ignition voltage**
HIT-DE-Ce 70/150/250W	25 kVs
HIT-DE 150/250/400/1000W	35 kVs
HIT-DE 2000W/D/S cable	40 kVs
HST-DE 70/150/250/400W	25 kVs
HCI-TM 250/400... HRPB	25 kVs
HQI-TM 600/1000... HR	25 kVs

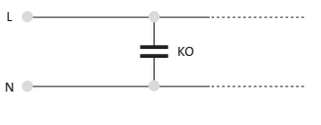
Siteco offers outdoor luminaires in versions with p.f. correction. The power factor is influenced by the compensation capacitor (cosφ).

Circuit diagrams and wiring diagrams

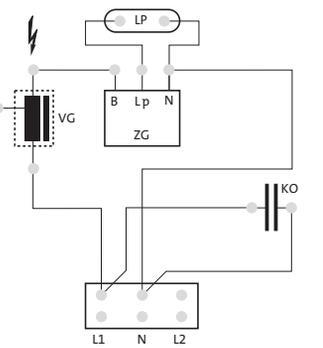
LP = Lamp
St = Starter
VG = Ballast
ZG = Ignition device
KO = Capacitor
UR = Changeover relay (power-switch)
L1 = Connection outer conductor L1
N = Connection for neutral conductor
L2 = Connection outer conductor L2 or control line
L_{ST} = Connection control line

SDI – Siteco® Digital Interface

- for parameterising Siteco 'Plus' ECGs with the Siteco® Service Box
- for dimming 'Plus' luminaires
- for data querying in case of servicing; for 'Basic' luminaires



Compensation capacitors
The compensation capacitors used are PCB free (EN 61048/49/VDE 056 Part 61/62)



1x HSE/HST 50...400W | For luminaires to 100W interchangeable ballasts (50/70W or 70/100W are integrated). For luminaires with ballast 70/100W an E 40 socket is integrated. A 70W lamp can only be used with appropriate socket adapter.

Ignitors

The highly efficient metal vapour lamps and high pressure sodium lamps require a suitable ignition device. The ignition devices for HCI, HIT/HIE and HSE/HST lamps provide ignition voltage from 1.8...5 kV depending on the type. The ignition devices work as superimposed-pulse ignitors. This means that the ignition devices are in the power circuit, and if a lamp is defective the ignition device attempts to ignite without interruption; this can destroy the ignition device or cause disturbances in the power supply network. To exclude the possibility of this situation occurring, an ignition device with automatic power disconnection is available.

Ignition device with automatic power disconnection
Advantages:

- There are no pulses of the HS lamps at the end of the lamp's service life
- Reduction of interfering pulses in the network
- Easier identification of defective lamps
- Self-protection of the ignition device – longer service life

Disadvantage: higher price

Please note: when changing lamps under voltage the ignition device must be reset by voltage interruption for a test.

Not all metal vapour and high pressure sodium lamps require an ignition device for ignition. Thanks to an ignition device integrated in the lamp or special fillings of the burner the mains voltage in conjunction with the ballast suffices for ignition.

Lamp types for operation without ignition device
Metal halide lamps

- HIT 2000N, 2000/DI

High pressure sodium lamps

- HSE-I 50, 70
- HSE-X 110, 210, 35

Notes on circuits
power reduction/power subsidence/twilight switching

General

To save energy at times of lower traffic density there are luminaires with special equipment that make it possible to reduce lamp power and associated luminous flux. HME and HSE/HST lamps can be operated with power reduced to 50 % of nominal power, the prerequisite in this regard is that start-up must occur at nominal power.
If the light is started up, when already switched to 50 % light mode, then usually operating status is not stable (too little light, shortened lamp service life). For these cases there is a reducing relay with timer.

Advantages of a reducing relay with timer:

- Lamp start always occurs at 100 % (requirement of the lamp manufacturer)

Please note: test of the power reduction feature: the power reduction relay is switched over only after the timer period of approximately 6 minutes has elapsed.

Power reduction for high-pressure lamps (HD lamps)
Amplitude control

The most widely used method of reducing lamp current is the use of ballasts with impedances (tap or supplemental choke). Power consumption is controlled via the impedance value. The minimum supply voltages should not be underranged.
For Siteco lamps, ballasts with taps are used because at full load the core proportion of the supplemental impedance is used, and thus the thermal load of the ballast is significantly lower. This also has a positive effect on the service life of the ballast.
Impedance is switched over without current interruption in the lamp current circuit by a special changeover relay. Changeover can be optimally executed via a control line, or via a programmable changeover relay with a fixed, set time.

Activated reducing relay

Standard in the system with control line, because it is cost-effective and can be optimally controlled by activation from the central location as needed (matched to the traffic density according to workdays, holidays, shift times, etc.).

Rigid changeover relay

Good solution for networks without control line, where energy savings are achieved via decrease in luminous flux. A specified period for reducing switching is programmed and is self-activated every night.

Currently 2 types of relays are offered:

- Tridonic ZRM U6M A001

Components that must be installed in the luminaire, and which must be programmed from the control cabinet after the luminaire is installed, and which can also be re-programmed at later points in time from the control cabinet (advantage: Luminaires can be re-programmed centrally).

- Philips Chronosense

Component that must be installed in the luminaire, and that must be adjusted before installation. Re-programming by changing the switch combination in the individual luminaires. (Advantage: (Easy to program, disadvantage: Requires a lot of effort to change switch times and mechanical switches)

Lowering the supply voltage

Voltage lowering via transformers or electronic components

Phase angle control and phase cut-off control

Phase and angle and phase cut-off of a part of the sinusoidal a.c. voltage, thus the effective value is lowered. The mains voltage is not available for the entire period.
Prior to and after the zero crossing the voltage remains switched off for up to 5 ms, this can cause re-ignition problems.

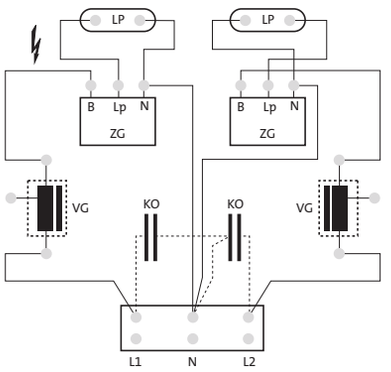
Sector control

Voltage sectors are produced from the mains voltage before or after the peak value, which however do not go to zero.
The electronics are more complex, however re-ignition is assured.

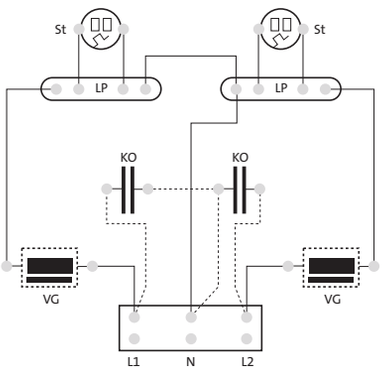
Additional processes:

In addition to the processes described above for lamps with sinusoidal operating parameters, there are lamp systems that are operated via voltage pulse groups. In such systems the power is reduced via frequency, amplitude, or pulse width modulation of the pulse groups.

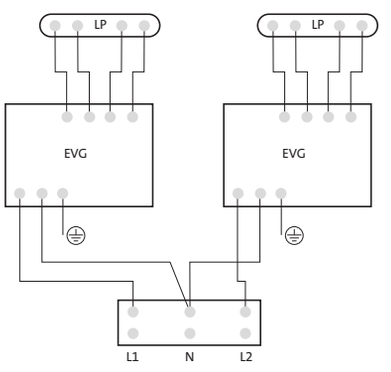
Notes on circuits – power reduction variants



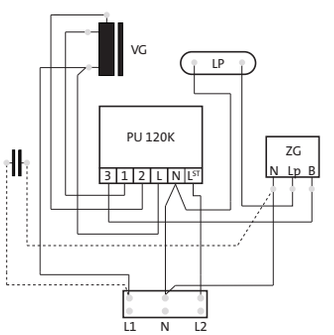
2x HSE 70...250W | for 2-lamp luminaires both lamps are always routed separately to the connection terminal, so that individual wiring is possible.



2x TC-LEL 18/24W with LLCG | luminaires for Dulux lamps with CCG are equipped with a starter. For 2-lamp luminaires both lamps are always routed separately to the connection terminal, so that individual wiring is possible.



2x TC-LEL 18/4W | for 2-lamp luminaires both lamps are always routed separately to the connection terminal, so that individual wiring is possible.



1x HSE 70...400W with reducing circuit | integrated power changeover circuit for luminous flux subsidence at reduced traffic volume
LST = 230V: 100% light
PST = 0V: 50 % light
Utilisation of 1-piece ballasts with use of the iron core even in reduced mode for extending ballast service life.

Materials commonly used

The lifespan and functionality of luminaires are determined by the construction and type or characteristics of materials used. As such, high importance is attached to mechanical properties for supporting elements, optical characteristics for reflectors and protective cover glasses of lamp compartments, corrosion resistance and electrical characteristics, thermal behaviour especially of electrical components and temperature resistance with silicate glass. With special requirements with extreme mechanical loads for example, hot and cold temperature loads or applications in tropical regions where resistance against termites is also required, the selection of suitable materials and the handling of these is elementary.

Material	**Properties**	**Used for**
Diecast aluminium	High-strength due to appropriate design for technical high-quality multi-function parts. Surface coating specified for the respective implementation	Housing
Steel	Parts with rigorous mechanical requirements, coated or galvanised for interior parts, or hot-dipped galvanised for parts that are exposed to environmental influences, surface is of higher quality than a galvanically zinc-coated surface.	Bearing elements
Deep-drawn aluminium sheet	Low weight, surface coating specified for the respective implementation	Housing
Polyester resin, fibre-glass reinforced (UP-GF 25)	25% glass fibre, high impact resistance, and dimensional stability, low weight, thanks to a structured surface long-term stability relative to environmental influences is significantly increased. The coating offers effective protection against glass fibre bloom on the surface	
Aluminium highly polished, anodised	Free of pores, completely levelled, permanently resistant corundum hardness surface for predominantly directed reflection, not sensitive to dust	Reflectors
Aluminium plated	Plated coating made of ultra-pure 99.99% AL ensures optimum reflector quality	
Polybutylene terephtalate (PBT)	Continuous temperature to 135°C, premium reflector quality due to aluminium metallized surface with supplemental clear-coat protection for secondary reflectors	
Polyphenylen sulphide (PPS)	Continuous use temperature 180°C, premium reflector quality with metallized aluminium surface	
Silicate glass, machine-hardened	Safety glass, depending on quality resistant to temperature change to 250°C, if broken disintegrates into small crumbs	Optical covers
Silicate glass, chemically hardened	Safety glass, resistant to temperature changes, with high mechanical strength. If broken disintegrates into lancets. Protective grid is required if parts can fall down in the event of damage	
Ceramic glass	Resistant to changing temperature and offers high mechanical strength. Is used where temperatures greater than 250°C occur, can be stressed to 600°C	
Polycarbonate (PC)	Impact resistant plastic, temperature resistant to 130°C. Yellowing, brittleness if there is UV stress. Yellowing can be delayed by installed or applied UV stopper (factor 10 coating)	
Polymethylmetacrylate (PMMA)	Has the best optical characteristics of all lighting technology materials, is UV resistant, can be stressed to 90°C, and has excellent resistance to weather and aging	
Silicon	Dimensionally stable, can be stressed to 230°C, seals	
EPDM	Can be stressed to 80°C	
Felt	Can be stressed to 90°C, breathable	
Silicon	Can be stressed to 170°C/200°C, mechanically stressed/non-stressed lines	
EVA	Can be stressed to 130°C	
Heat-resistant PVC	Can be stressed to 105°C	
Standard PVC	Can be stressed to 90°C	

The role of plastics in luminaire manufacturing

For modern luminaire manufacturing plastic parts have become important and proven functional elements. Due to the higher energy efficiency level of plastics, plastics are accounting for an ever greater proportion of parts. If the luminaire is used as intended the normal course of aging of these plastic parts is assured. Impermissible stresses and damaging influences however reduce aging resistance; the table below shows possible relationships.

Damaging influence	**Possible cause**	**Possible effect**
Impermissibly high temperature	• Increased operating voltage • Ambient temperature • Improper installation	• Deformation • Brittleness • Discolouration
Short-wave UV radiation	• High pressure mercury vapour lamps with UV proportion • Sterilising lamps	• Yellowing • Brittleness
Aggressive substances	• Plasticizers (e.g. from line insulation) • Wrong cleaning agent or disinfectant	• Crack formation • Strength reduction • Surface damage

Colours and surfaces

Colours generate moods and protect. This is also the case for outdoor luminaires. This is why luminaires for which these characteristics are important are coated. In the first case the coating increases attractiveness, in second case – or additionally – the coating is used to protect the base material.
Colour plays a significant role particularly for the decorative and classic luminaires. Colour decides whether the luminaire is integrated harmoniously in the milieu or whether the luminaire sets accents.
To achieve these objectives our outdoor luminaires and masts are given a high-quality surface treatment.

Siteco metallic grey
In order to make a particularly resistant coating available for high-quality luminaires, a new type of metallic grey coating was developed that is burned in at high temperatures and thus offers an extremely high level of resistance to climatic and mechanical influences. The Siteco metallic grey coating (similar to the metallic grey colour DB 702), contains small metal components like conventional metallic grey coatings, to increase UV protection, however it also contains a number of components that lend extreme hardness to the coating when subjected to the influence of high temperatures in the production process.

Siteco RAL colours
The Siteco RAL colours are applied in a complex burn-in process. In this regard particular value is placed on a glossy surface.
The gloss level is specified at 70 % +/- 5 %.
Naturally there are also exceptions. For many luminaires the material requires matte surface protection or the design requires a matte colour appearance. However whenever feasible we use the glossy surface –also in conjunction with a structured coating –as the self-cleaning effect through rain or snow functions significantly better with a smooth surface than it does with a matte surface. Thus selection of the surface also contributes to cost reductions since less cleaning work is required.

Recommendations for special cases

For implementation of luminaires and masts in areas subject to particular climatic stress, supplemental protection is recommended.

- Metallic grey coatings in areas with high UV radiation
- Chromatising and powder coating instead of simple coating of cast-aluminium parts, for example when using luminaires in regions associated with the potassium salt industry
- Bituminising masts in the ground transition area (via galvanisation and coating) for locations with damp and/or highly aggressive soils
- For special cases, e.g. implementation in coastal climates (salt-containing air) indoor swimming pools (chlorine-containing air) optimal surface protection can be achieved by a special primer and two-coatings

RAL 9005 black*)

RAL 9006 metallic grey*)

RAL 7035 light grey*)

DB 701

RAL 9010 pure white

RAL 9007 aluminium grey*)

Siteco® metallic grey *),**) (sim. to DB 702)

RAL 3005 burgundy*)

*) The colour charts shown can deviate from the original colour due to technical printing reasons.
**) Moreover the metallic grey particles that cannot be printed here provide a glossy etched, structured surface.

Technology and Design Center

The Technology and Design Centre from Siteco offers scope for technology, know-how, dialogue and inspiration – the experience of light and transferal of knowledge under one roof.
Let yourself be inspired by our lighting forum. Just speak to your sales representative. We can organise your personal training programme selected from our wide spectrum of training components, and can also organise the entire planning from arrival until departure.
Ergonomics, cost efficiency and environmental compatibility are the focus of our activities and also of course of our seminars. You can experience lighting in our lighting laboratory at first hand and find out more about:

- Energy-efficient solutions for indoors and outdoors with the aid of innovative lighting systems.
- The contribution of daylight systems, lighting control and LED for ergonomics, safety and environmental compatibility.
- Lighting solutions for special applications such as offices, retail spaces, industry, roads and public spaces
- Design possibilities with light
- Current standards and their consequences for lighting design

'Experience light and safety' is the motto of our luminaire test road

We show you how to illuminate public space without wasting energy and investments on our Lighting Test Road. With this unique facility we simulate the lighting of entire road sections on a 1:1 scale.

In the course of a seminar you will become familiar with the quality criteria for streetlighting systems and learn how you can more safely and more attractively design traffic routes through the use of light. With the aid of practical examples we will show you the advantages of optimally illuminated traffic zones, and will be informing you about the dangers of inadequate light for roads. Moreover we provide you with opportunities to reduce CO^2 in public lighting installations, protect nocturnal insects and to avoid light immissions.

Sales and delivery conditions

I. GENERAL

1. The scope of deliveries and/or services (hereinafter referred to as „Supplies“) shall be determined by the written declarations of both Parties. General terms and conditions of the Purchaser shall apply only if and when expressly accepted by the supplier or the provider of services (hereinafter referred to as „Supplier“) in writing.

2. The Supplier herewith reserves any industrial property rights and/or copyrights pertaining to its cost estimates, drawings and other documents (hereinafter referred to as „Documents“). The Documents shall not be made accessible to third parties without the Supplier's prior consent and shall, upon request, be returned without undue delay to the Supplier if the contract is not awarded to the Supplier. Sentences 1 and 2 shall apply mutatis mutandis to documents of the Purchaser; these may, however, be made accessible to third parties to whom the Supplier may rightfully transfer Supplies.

3. The Purchaser shall have the non-exclusive right to use standard software, provided that it remains unchanged, is used within the agreed performance parameters, and on the agreed equipment. The Purchaser may make one back-up copy without express agreement.

4. Partial Supplies shall be allowed, unless they are unreasonable to accept for the Purchaser.

II. PRICES AND TERMS OF PAYMENT

1. Prices shall be ex works and exclude packaging; value added tax shall be added at the then applicable rate.

2. If the Supplier is also responsible for assembly or erection and unless otherwise agreed, the Purchaser shall pay the agreed remuneration and any incidental costs required, e. g. travel costs, costs for the transport of tools and equipment, and personal luggage as well as allowances.

3. Payments shall be made free Supplier's paying office.

4. The Purchaser may set off only those claims that are undisputed or against which no legal recourse is possible.

III. RETENTION OF TITLE

1. Items pertaining to the Supplies („Retained Goods“) shall remain the property of the Supplier until each and every claim the Supplier has against the Purchaser on account of the business connection has been fulfilled. If the combined value of the security interests of the Supplier exceeds the value of all secured claims by more than 20%, the Supplier shall release a corresponding part of the security interest if so requested by the Purchaser.

2. For the duration of the retention of title, the Purchaser may not pledge the Retained Goods or use them as security, and resale shall be possible only for resellers in the ordinary course of their business and only on condition that the reseller receives payment from its customer or makes the transfer of property to the customer dependent upon the customer fulfilling its obligation to effect payment.

3. The Purchaser shall inform the Supplier forthwith of any seizure or other act of intervention by third parties.

4. Where the Purchaser fails to fulfil its duties, including failure to make payments due, the Supplier shall be entitled to cancel the contract and take back the Retained Goods in the case of continued failure following expiry of a reasonable time set by the Supplier; the statutory provisions that a time limit is not needed remain unaffected. The Purchaser shall be obliged to surrender the Retained Goods.

IV. TIME FOR SUPPLIES; DELAY

1. Times set for Supplies can only be observed if all Documents to be supplied by the Purchaser, necessary permits and releases, especially concerning plans, are received in time and if agreed terms of payment and other obligations of the Purchaser are fulfilled. Unless these conditions are fulfilled in time, times set shall be extended appropriately; this shall not apply where the Supplier is responsible for the delay.

2. If non-observance of the times set is due to force majeure such as mobilization, war, rebellion or similar events, e. g. strike or lockout, such time shall be extended accordingly.

3. If the Supplier is responsible for the delay (hereinafter referred to as „Delay“) and the Purchaser demonstrably suffered a loss therefrom, the Purchaser may claim a compensation as liquidated damages of 0.5 % for every completed week of Delay, but in no case more than a total of 5 % of the price of that part of the Supplies which because of the Delay could not be put to the intended use.

4. Purchaser's claims for damages due to delayed Supplies as well as claims for damages in lieu of performance exceeding the limits specified in No. 3 above shall be excluded in all cases of delayed Supplies even upon expiry of a time set to the Supplier to effect the Supplies. This shall not apply in cases of mandatory liability based on intent, gross negligence, or due to injury of life, body or health. Cancellation of the contract by the Purchaser based on statute shall be limited to cases where the Supplier is responsible for the delay. The above provisions do not imply a change in the burden of proof to the detriment of the Purchaser.

5. At the Supplier's request the Purchaser shall declare within a reasonable period of time whether the Purchaser cancels the contract due to the delayed Supplies or insists on the Supplies to be carried out.

6. If dispatch or shipment is delayed at the Purchaser's request by more than one month after notice of the readiness for dispatch was given, the Purchaser may be charged, for every month commenced, storage costs of 0.5 % of the price of the items of the Supplies, but in no case more than a total of 5 %. The parties to the contract may prove that higher or, as the case may be, lower storage costs have been incurred.

V. TRANSFER OF RISK

1. Even where delivery has been agreed freight free, the risk shall pass to the Purchaser as follows: a) if the Supplies do not include assembly or erection, at the time when the Supplies are shipped or picked up by the carrier. Upon request of the Purchaser, the Supplier shall insure the Supplies against the usual risks of transport at the expense of the Purchaser; b) if the Supplies include assembly or erection, at the day of taking over in the own works or, if so agreed, after a fault-free trial run.

2. The risk shall pass to the Purchaser if dispatch, shipping, the start or performance of assembly or erection, the taking over in the own works or the trial run is delayed for reasons for which the Purchaser is responsible or if the Purchaser has otherwise failed to accept the Supplies.

VI. ASSEMBLY AND ERECTION

Unless otherwise agreed in writing, assembly/erection shall be subject to the following provisions: 1. The Purchaser shall provide at its own expense and in good time: a) all earth and construction work and other ancillary work outside the scope of the Supplier, including the necessary skilled and unskilled labour, construction materials and tools,

b) the equipment and materials necessary for assembly and commissioning such as scaffolds, lifting equipment and other devices as well as fuels and lubricants,

c) energy and water at the point of use including connections, heating and lighting,

d) suitable dry and lockable rooms of sufficient size adjacent to the site for the storage of machine parts, apparatus, materials, tools, etc. and adequate working and recreation rooms for the erection personnel, including sanitary facilities as are appropriate in the specific circumstances. Furthermore, the Purchaser shall take all measures it would take for the protection of its own possessions to protect the possessions of the Supplier and of the erection personnel at the site,

e) protective clothing and protective devices needed due to particular conditions prevailing on the specific site.

2. Before the erection work starts, the Purchaser shall make available of its own accord any information required concerning the location of concealed electric power, gas and water lines or of similar installations as well as the necessary structural data.

3. Prior to assembly or erection, the materials and equipment necessary for the work to start must be available on the site of assembly/erection and any preparatory work must have advanced to such a degree that assembly/erection can be

started as agreed and carried out without interruption. Access roads and the assembly/erection site itself must be level and clear.

4. If assembly, erection or commissioning is delayed due to circumstances for Translation of the original German text which the Supplier is not responsible, the Purchaser shall bear the reason able costs incurred for idle times and any additional travelling of the Supplier or the erection personnel.

5. The Purchaser shall attest to the hours worked by the erection personnel towards the Supplier at weekly intervals and the Purchaser shall immediately confirm in writing if assembly, erection or commissioning has been completed.

6. If, after completion, the Supplier demands acceptance of the Supplies, the Purchaser shall comply therewith within a period of two weeks. In default thereof, acceptance is deemed to have taken place. Acceptance is also deemed to have been effected if the Supplies are put to use, after completion of an agreed test phase, if any.

VII. RECEIVING OF SUPPLIES

The Purchaser shall not refuse to receive Supplies due to minor defects.

VIII. DEFECTS AS TO QUALITY

The Supplier shall be liable for defects as to quality („Sachmängel", hereinafter referred to as „Defects",) as follows:

1. All parts or services where a Defect becomes apparent within the limitation period shall, at the discretion of the Supplier, be repaired, replaced or provided again free of charge irrespective of the hours of operation elapsed, provided that the reason for the Defect had already existed at the time when the risk passed.

2. Claims based on Defects are subject to a limitation period of 12 months. This provision shall not apply where longer periods are prescribed by law according to Sec. 438 para. 1 No. 2 (buildings and things used for a building), Sec. 479 para. 1 (right of recourse), and Sec. 634a para. 1 No. 2 (defects of a building) German Civil Code („BGB"), as well as in cases of injury of life, body or health, or where the Supplier intentionally or grossly negligently fails to fulfil its obligation or fraudulently conceals a Defect. The legal provisions regarding suspension of expiration („Ablaufhemmung"), suspension („Hemmung") and recommencement of limitation periods remain unaffected.

3. The Purchaser shall notify Defects to the Supplier in writing and without undue delay.

4. In the case of notification of a Defect, the Purchaser may withhold payments to a reasonable extent taking into account the Defect occurred. The Purchaser, however, may withhold payments only if the subject-matter of the notification of the Defect occurred is justified beyond doubt. Unjustified notifications of Defect shall entitle the Supplier to have its expenses reimbursed by the Purchaser.

5. The Supplier shall first be given the opportunity to supplement its performance („Nacherfüllung") within a reasonable period of time.

6. If supplementary performance is unsuccessful, the Purchaser shall be entitled to cancel the contract or reduce the remuneration, irrespective of any claims for damages it may have according to Art. XI.

7. There shall be no claims based on Defect in cases of insignificant deviations from the agreed quality, of only minor impairment of usefulness, of natural wear and tear or damage arising after the transfer of risk from faulty or negligent handling, excessive strain, unsuitable equipment, defective workmanship, inappropriate foundation soil or from particular external influences not assumed under the contract, or from non-reproducible software errors. Claims based on defects attributable to improper modifications or repair work carried out by the purchaser or third parties and the consequences thereof shall be likewise excluded.

8. The Purchaser shall have no claim with respect to expenses incurred in the course of supplementary performance, including costs of travel and transport, labour, and material, to the extent that expenses are increased because the subject-matter of the Supplies was subsequently brought to another location than the Purchaser's branch office, unless doing so complies with the intended use of the Supplies.

9. The Purchaser's right of recourse against the Supplier pursuant to Sec. 478 BGB is limited to cases where the Purchaser has not concluded an agreement with its customers exceeding the scope of the statutory provisions governing claims based on Defects. Moreover, No. 8 above shall apply mutatis mutandis to the scope of the right of recourse the Purchaser has against the Supplier pursuant to Sec. 478 para. 2 BGB.
10. Furthermore, the provisions of Art. XI (Other Claims for Damages) shall apply in respect of claims of damages. Any other claims of the Purchaser against the Supplier or its agents or any such claims exceeding the claims provided for in this Art. VIII, based on a Defect, shall be excluded.

IX. INDUSTRIAL PROPERTY RIGHTS AND COPYRIGHT; DEFECTS IN TITLE

1. Unless otherwise agreed, the Supplier shall provide the Supplies free from third parties' industrial property rights and copyrights (hereinafter referred to as „IPR") with respect to the country of the place of destination. If a third party asserts a justified claim against the Purchaser based on an infringement of an IPR with respect to the Supplies made by the Supplier and then used in conformity with the contract, the Supplier shall be liable to the Purchaser within the time period stipulated in Art. VIII No. 2 as follows:

a) The Supplier shall choose whether to acquire, at its own expense, the right to use the IPR with respect to the Supplies concerned or whether to modify the Supplies such that they no longer infringe the IPR or replace them. If this would be unreasonable to demand from the Supplier, the Purchaser may cancel the contract or reduce the remuneration pursuant to the applicable statutory provisions.

b) The Supplier's liability to pay damages shall be governed by Art. XI.

c) The above obligations of the Supplier shall only apply if the Purchaser (i) immediately notifies the Supplier of any such claim asserted by the third party in writing, (ii) does not concede the existence of an infringement and (iii) leaves any protective measures and settlement negotiations to the discretion of the Supplier. If the Purchaser stops using the Supplies in order to reduce the damage or for other good reason, it shall be obliged to point out to the third party that no acknowledgement of the alleged infringement may be inferred from the fact that the use has been discontinued.

2. Claims of the Purchaser shall be excluded if it is itself responsible for the infringement of an IPR.

3. Claims of the Purchaser shall also be excluded if the infringement of the IPR is caused by specifications made by the Purchaser, to a type of use not foreseeable by the Supplier or to the Supplies being modified by the Purchaser or being used together with products not provided by the Supplier.

4. In addition, with respect to claims by the Purchaser pursuant to No. 1 a) above, Art. VIII Nos. 4, 5, and 9 shall apply mutatis mutandis in the event of an infringement of an IPR.

5. Where other defects in title occur, Art. VIII shall apply mutatis mutandis.

6. Any other claims of the Purchaser against the Supplier or its agents or any such claims exceeding the claims provided for in this Art. IX, based on a defect in title, shall be excluded.

X. IMPOSSIBILITY OF PERFORMANCE; ADAPTATION OF CONTRACT

1. To the extent that Supplies are impossible to be carried out, the Purchaser shall be entitled to claim damages, unless the Supplier is not responsible for the impossibility. The Purchaser's claim for damages shall, however, be limited to an amount of 10 % of the value of the part of the Supplies which, owing to the impossibility, cannot be put to the intended use. This limitation shall not apply in the case of mandatory liability based on intent, gross negligence or injury of life, body or health; this does not imply a change in the burden of proof to the detriment of the Purchaser. The right of the Purchaser to cancel the contract shall remain unaffected.

2. Where unforeseeable events within the meaning of Art. IV No. 2 substantially change the economic importance or the contents of the Supplies or considerably affect the Supplier's business, the contract shall be adapted taking into account the principles of reasonableness and good faith. Where doing so is economically unreasonable, the Supplier shall have the right to cancel the contract. If the Supplier intends to exercise its right to cancel the contract, it shall notify the Purchaser thereof without undue delay after having realised the repercussions of the event; this shall also apply even where an extension of the delivery period had previously been agreed with the Purchaser.

XI. OTHER CLAIMS FOR DAMAGES

1. Any claims for damages and reimbursement of expenses the Purchaser may have (hereinafter referred to as „Claims for Damages"), based on whatever legal reason, including infringement of duties arising in connection with the contract or tort, shall be excluded.

2. The above shall not apply in the case of mandatory liability, e. g. under the German Product Liability Act („Produkthaftungsgesetz"), in the case of intent,

gross negligence, injury of life, body or health, or breach of a condition which goes to the root of the contract („wesentliche Vertragspflichten"). However, Claims for Damages arising from a breach of a condition which goes to the root of the contract shall be limited to the foreseeable damage which is intrinsic to the contract, unless caused by intent or gross negligence or based on liability for injury of life, body or health. The above provision does not imply a change in the burden of proof to the detriment of the Purchaser.

3. To the extent that the Purchaser has a valid Claim for Damages according to this Art. XI, it shall be time-barred upon expiration of the limitation period applicable to Defects pursuant to Art. VIII No. 2. In the case of claims for damages under the German Product Liability Act, the statutory provisions governing limitation periods shall apply.

XII. VENUE AND APPLICABLE LAW

1. If the Purchaser is a businessperson, sole venue for all disputes arising directly or indirectly out of the contract shall be the Supplier's place of business. However, the Supplier may also bring an action at the Purchaser's place of business.

2. Legal relations existing in connection with this contract shall be governed by German substantive law, to the exclusion of the United Nations Convention on Contracts for the International Sale of Goods (CISG).

XIII. SEVERABILITY CLAUSE

The legal invalidity of one or more provisions of this contract shall in no way affect the validity of the remaining provisions. This shall not apply if it would be unreasonable for one of the parties to continue the contract.

Supplementary Sales Conditions

I. Applicability, Relative Authority of Contractual Conditions

1. The sale of goods/services by Siteco (hereunder referred to as the "supplier"), will, first of all, occur in accordance with the given particular written agreements with the purchaser and then, supplementary to these, the general conditions of supply of electrical products and services (Green Supply Conditions) including their supplementary section of point III on reserving ownership, that is, the supplementary clause concerning extended reservation of ownership, will apply; as a further supplement, the present supplementary sales conditions (hereunder referred to as the "Siteco terms and conditions"), in the valid version at the time of entry into the given contract, will apply. The Siteco terms and conditions can, from among other places, be viewed and downloaded, over the internet, from **www.siteco.de**. You can also request them, by telephone or in writing, from Siteco Beleuchtungstechnik GmbH, Georg-Simon-Ohm-Str. 50, 83301 Traunreut, phone: +49 8669 33-0.

2. The inclusion of the purchaser's general terms and condit ions is hereby discounted. Contrary terms and condit ions, or such as depart from the Siteco terms and condit ions, will only form a part of the contract where they have, in the given separate case, been expressly accepted in writ ing. Any general terms and condit ions of the purchaser will also not be held to have been acknowledged if we do not again expressly discount them following receipt of them (eg. on the purchaser's standard forms).

II. Due Date Conditions of Payment, Offset

1. In the absence of diverging agreements, payments must be made, without deduction, free of charge to the supplier's point of payment. For all payments, the fulfilment date is the day on which the supplier has the payment available to it. Where delivery is delayed for reasons for which the purchaser is responsible, the delivery date will be the date on which readiness to dispatch is announced and, at the latest, the date on which the purchaser communicates that it cannot accept the goods.

2. Insofar as nothing to the contrary is agreed, the following due dates for payment apply:
- In the case of transactions with an order value of up to EUR 10,000.-: net cash upon delivery and receipt of the invoice.
- In the case of transactions with an order value exceeding EUR 10,000.- and a delivery period of up to 3 months: 1/3 of the order value upon signing of the contract, the balance upon delivery.
- In the case of transactions with an order value exceeding EUR 10,000.- and a delivery period of more than 3 months: 30% of the order value upon signing of the contract, 30% of the order value on expiry of the first third of the agreed delivery period, 30% of the order value upon expiry of the second third of the agreed delivery period, the balance upon delivery.

3. Bills of exchange shall not be accepted in settlement of payments due other than with the supplier's prior approval. Bill charges and interest paid on bills shall be refunded to the supplier separately. Cheques or drafts cannot be accepted in place of payment.

4. The client only has the right to offset claims against payments or to retain payments insofar as its claim is established as being legally valid or is undisputed. The supplier is entitled to offset, against the client's claims, throughout the Group.

III. Default

1. Where the purchaser is in default with the payment, arrears charges will, reserving the right to further claims, be calculated in accordance with §§247, 288 of the German Civil Code. In the event of delays in payment, the supplier moreover reserves the right, following relevant written communication, to discontinue the fulfilment of its obligations until the payment due has been received.

2. Where payment stops or there is an application for the opening of insolvency proceedings, the supplier's total amount receivable is immediately due for payment.

3. Where the purchaser is in default of acceptance of products or services, the supplier is entitled to demand compensation for damages, including additional costs (eg. storage costs), arising because of this. The supplier can charge a flat rate of compensation for this. It is 0.5% for every full week of delay in acceptance, but not more than 5%, in total, of the price for the given part of the supply for which the purchaser is delayed in giving its acceptance, the said delay beginning with the due date for delivery or, in the absence of a stated delivery period, with the supplier's notification that it is ready to dispatch the given goods. The supplier's right to demonstrate further damages and legal claims (particularly the compensation of additional costs, appropriate compensation, withdrawal from a contract, notice of termination of a contract) remain unaffected; the flat rate compensation will however be charged on further money claims. The purchaser is authorized to demonstrate that the supplier has incurred either no damages at all or substantially lower ones than the flat rate of compensation. Section IV, subsection 6 of the green supplier's conditions remains unaffected by this.

IV. Other

1. With reference to the EC Directive "Waste Electrical and Electronic Equipment (WEEE)", and the corresponding national regulations, the supplier shall resort to the possibility of a bilateral agreement as follows: Unless expressly agreed otherwise, the purchaser shall be responsible for proper waste management and shall recycle/dispose of the products supplied in accordance with the WEEE regulations in force at the time. If the goods are resold, the purchaser shall impose this same obligation upon the party or parties to whom the goods are sold. The supplier shall be prepared, subject to mutual agreement, to attend to recycling/disposal at the terms and conditions prevailing in the market at the time the goods are taken back.

2. Goods Returned: Credits for goods returned shall be conditional on the supplier's prior written consent. Undamaged goods in their original packing shall, subject to the supplier's prior consent, be credited to the purchaser in an amount of 70% of the price invoiced, less the costs for packaging, transport and any necessary reprocessing. No custom-made goods nor goods modified for specific projects shall be taken back. The same shall apply to any items designated as sold-off.

3. In the case of orders valued at less than EUR 500.- the supplier shall reserve the right to apply a service charge of EUR 50.-

4. Appropriate use of goods and adherence to the instructions on assembly or use are prerequisites for claims made under guarantee. Unauthorized, arbitrary changes to our products will mean that product liability, and guarantee and warranty obligations no longer apply.

5. Concerning LED components: LED components are, as a result of innovations, currently subject to a fast rate of change. The supplier therefore reserves the right to change components of lights, fitted with LEDs, as part of additional or replacement deliveries. The brightness and useful life of LEDs depend on temperature and power supply. Claims concerning faults will be limited to those existing at the time of the handing over of the given product with its given fault or faults. Faults or defects arising as a result of normal wear and tear are not covered by guarantee. Insofar as Siteco has not assured any other characteristics or qualities, in the case of LEDs that are inseparably and fixedly connected to each other in a lighting block, the failure of individual light diodes during the guarantee period does not give rise to a guarantee claim, insofar as the average luminous flux does not fall below a value of 70% of the initial light given with appropriate use and standardized measurement. Our contact for services in connection with our LED products, in the sales regions, or on our site at **www.siteco.de**, will be happy to answer any questions you may have.

6. These supplementary Siteco Beleuchtungstechnik GmbH terms and conditions, and the additional, supplementary terms and conditions stated in them, continue to be binding even in the case of the legal invalidity of individual points. Only in the case where adherence to the contract would be an undue hardship for one of the parties, does this not apply. Insofar as nothing to the contrary is expressly agreed in writing between the contracting parties, German law, to the exclusion of UN sale of goods law, alone applies to the present contractual relationship.

The place of fulfilment of the contract and the place of jurisdiction is Traunstein, Bavaria, Germany, alone.

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