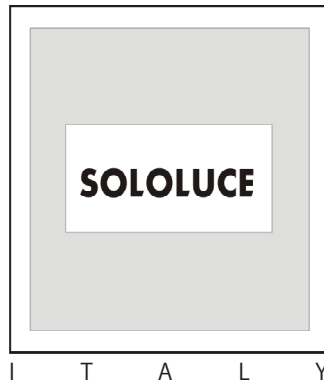


# Lighting Solutions

## 2014

**A**t Sololuce , we believe the best lighting is found in the balance of Beauty and Control. This harmony is the soul of Sololuce and is the means by which we impart beauty and control to people's lives. To create warm shades, cool tones and rich comfort in a naturally adaptive way.


















All accomplished with the most subtle and natural of mediums known... Light

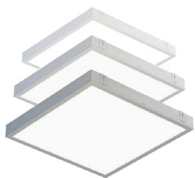






# Sololuce LED Lighting Solutions

	Esplanda Page 03		Modulo Page 04		Leaf Page 06
	Urbano Page 08		Fantasi Page 09		StyLux Page 10
	Sirrus Page 12		Krypton Page 13		
	Fogo Page 14		Fogo Plus Page 15		Primus Page 16
	Primus Plus Page 17		Spot Page 18		Dot Page 19
	Pluto Page 20		Pluto Mini Page 22		Light Lines Page 23



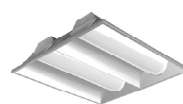
PanaLux

Page 24



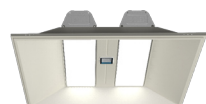
PanaSlim

Page 25



Matrix

Page 26



Qulsar

Page 28



Anteras

Page 29



Aura

Page 30



Orbik

Page 31



Cielos I

Page 32



Cielos II

Page 33



Lumen

Page 34



Briton

Page 36



Micros

Page 37



Arcos

Page 38



Panos

Page 39



Credos

Page 40



Maximo

Page 41



Sandos

Page 42



Troll

Page 43



Corona

Page 44



Volo

Page 45



Capri

Page 46



Vista

Page 47



Mobile Nano

Page 48



Siena

Page 49



Aqua

Page 50



Alicia Nano

Page 51



Retta

Page 52



Retta S

Page 53



TinyLux

Page 54



Rail

Page 55



Vivo

Page 56



Bella

Page 57



Vela

Page 58



Zen

Page 59



Stilo

Page 60



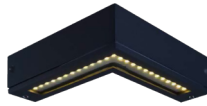
Gimble

Page 61



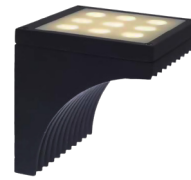
Cubo

Page 62



Cona

Page 63



Meso

Page 64



Moon

Page 65



Jinni

Page 66



Orion

Page 67



Brik

Page 68



Ovale

Page 69



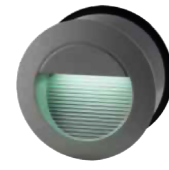
Iris-Q

Page 70



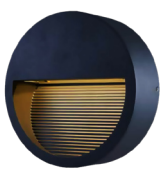
Stepo

Page 71



Neptune

Page 72



Iris-R

Page 73



Apollo

Page 74



Neo

Page 75



Cendo

Page 76



Box

Page 77



Polo

Page 78



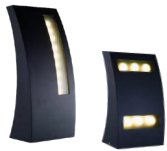
Neero

Page 80



Luxor

Page 81



Rondo, Vento

Page 82



Nova

Page 83



Quanto

Page 84



Punto

Page 85



IDUS

Page 86



Inox

Page 87



Atom

Page 88



Tile

Page 89



Disk

Page 90



Linea

Page 92



H<sub>2</sub>O-Beam

Page 93



H<sub>2</sub>O flood

Page 94



Powerlux

Page 96



Titan

Page 98



Indure

Page 100



Sundown

Page 102



Pulsar

Page 104



Optagon

Page 105



Notte

Page 106



Tiara

Page 107



Duetto

Page 108



Policar

Page 109



Policar Ecoled

Page 110



Luna

Page 111



Canlux

Page 112




Xenon, Proton

Page 113




Electron

Page 114




Line

Page 115




Bar

Page 116




Mini-Bar

Page 117



CabLux

Page 118



CabLux II

Page 119




CabLux III

Page 120



Colourbright

Page 121



Reflex

Page 122



Sierra

Page 124



# Sololuce Fluorescent Lighting Solutions



Halo

Page 127



Exe

Page 128



Avent

Page 130



Magnum

Page 132



Extend

Page 134



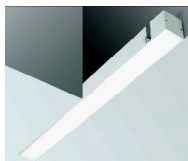
Optimus

Page 136



Moonlight Box

Page 138



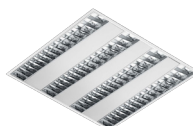
Moonlight  
Box- Recess

Page 140



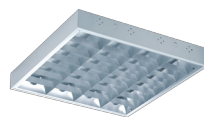
Element

Page 142



Quadra-  
Recess

Page 144



Quadra-  
Surface

Page 146



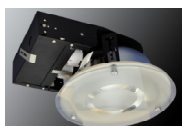
Stand I &  
Stand II

Page 148



Bollard

Page 150



Perfetto

Page 151



Perfetto  
Polyamide

Page 154



Perfetto  
Polyamide  
Signora

Page 155

	<p>Ellepta</p> <p>Page 156</p>		<p>Orion</p> <p>Page 158</p>		<p>Ovale</p> <p>Page 159</p>
	<p>Brik</p> <p>Page 160</p>		<p>ALTA</p> <p>Page 161</p>		<p>Bella</p> <p>Page 162</p>
	<p>Tonda</p> <p>Page 163</p>		<p>Samussa</p> <p>Page 164</p>		<p>Moon</p> <p>Page 165</p>
	<p>Vivo</p> <p>Page 166</p>		<p>Cubo</p> <p>Page 167</p>		
	<p>Punto</p> <p>Page 168</p>		<p>Quanto</p> <p>Page 169</p>		<p>Nova</p> <p>Page 170</p>
	<p>EasyLux</p> <p>Page 171</p>				
	<p>Policar</p> <p>Page 172</p>		<p>Policar Plus</p> <p>Page 174</p>		<p>Stagna New</p> <p>Page 176</p>



## Inductalux

Page 178



## Luna

Page 181



## Battens

Page 182



## Linea

Page 183



## Classique

Page 184



## Acrylux

Page 186



## Bagno

Page 187

# Sololuce HID Lighting Solutions



Colline

Page 191



Munza

Page 195



Velocity

Page 198



Oliver

Page 200



TriLume

Page 202



Esplanda

Page 204



Square

Page 206



Marte

Page 207



Marte Plus

Page 208



Marte-Element

Page 209



Marte-Line

Page 210



Marte Sigma

Page 211



Marte Zigma

Page 212



Marte-Trend

Page 213



Hermis

Page 214



Sirrus

Page 215



Krypton

Page 216



Globus

Page 217



Pelican

Page 218



Berlin

Page 219



Madrid

Page 220



Oslo

Page 221



IDUS

Page 222



Albano

Page 223



Neero

Page 224



Albano Jr

Page 226



Trapez

Page 227



Riviera

Page 228



Challenger

Page 230



Pinguino &  
Pinguino Nano

Page 232



Tornado

Page 234



Torch

Page 236



Beamer

Page 237



Trendo

Page 240



Cendo

Page 241



Cendo Ceiling

Page 242



LukLite

Page 243



WallPak

Page 244



Orbit

Page 245



Muna

Page 246



Impact

Page 248



Milano

Page 249



Notte

Page 250



Tiara

Page 251



Interics

Page 252



Ace

Page 253



Mobile

Page 254



Kevi

Page 255



Kris

Page 256



Siena

Page 257



Alicia Nano

Page 258



Aqua

Page 259



Volo

Page 260



Capri

Page 261



Vista

Page 262



Corona

Page 263

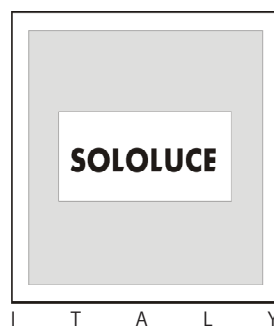


Mobile Nano

Page 264



## LED Lighting



LED Lighting





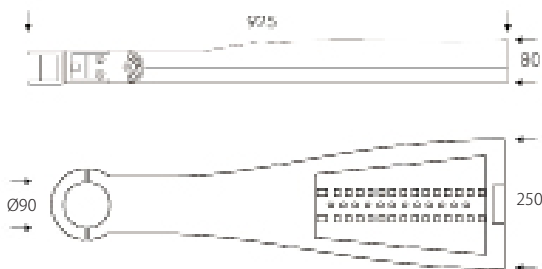
## Product description

Specially designed luminaire with only 80mm thickness in pressure die cast aluminum housing with IP66 ingress protection for dust and jet proofing & powder coated externally after cromate conversion to make it withstand the harsh outside weather conditions. Thermally tested and suitable for 36w and 72w LED. Confirms to ANSI C78.377A for nominal CCT & chromaticity. LEDs with high efficacy 123lm/watt have been used in the luminaire. No IR and UV radiation from LEDs. Luminaire is designed such as that heat is conducted and convected away thru' efficient thermal path designed and validated by the chip manufacturers to keep the Junction Temperature  $T_j$  within defined limits to achieve 50,000 + hours of life. Sololuce uses Cree , Bridgelux Osram or Philips Lumileds chips. Batwing optics has been achieved using external lenses. This ensures maximum Pole to Pole distance while achieving the requisite lux levels. Fixture has integral pole mount bracket for easy installation. Fixture can be aimed for wider front coverage. Fixture is suitable for sub main roads, service roads , car parks, Hotel/ Mall outdoor areas etc .

LED 1101-36  
LED 1101-72

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Esplanda

Model No	Wattage	Nominal Voltage *(V)
LED 1101-36	36w	240 / 110
LED 1101-72	72w	240 / 110

\* other voltages also available /please ask for quote



Modulo LED luminaire has set the standard for an LED outdoor luminaire family, designed completely according to energy efficiency and lighting quality requirements.

Simple, functional design comes together with high power LEDs and outstanding photometrics. Available in six different sizes, the Modulo family provides an efficient, sustainable and future proof solution for every typical application field of technical street lighting.

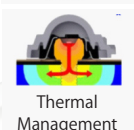
The concept of the replaceable optical module is also highly future-fit and can be simply upgraded and thus ensures a sustainable and future proof use of the high quality luminaire housing.

### Special Features

- Optical module unit with high power LEDs for sustainability, suitability for the future and easy maintenance with simple replacement encapsulated LED module,
- Ready to plug in Module with IP66 protection
- Constant luminous flux for precise, highly efficient road lighting
- Dependable gear tray with electrical and electronic components, simply accessible and replaceable
- Long system service life and low luminous flux loss via optimised thermal management (>50,000 hrs)
- Low power consumption with very good photometric results ensures efficient and economic road lighting
- Luminaire housing and mast adapter of diecast aluminium
- Recommended application residential areas, streets, residential and main and service roads for large pole to pole spacing upto 30...40m



Specially designed electronic circuit for soft start to save stress on LEDs and other components



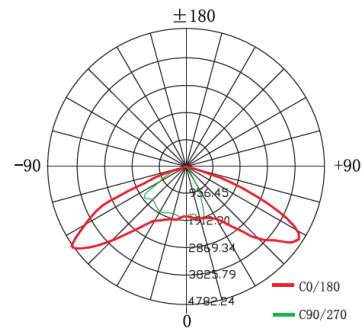
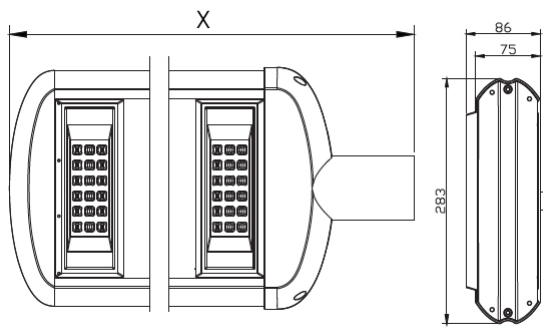
Thermally efficient design to keep the LED junction temperature within defined limits.



Luminaire is powder coated after chromate conversion to make the powder coat last longer

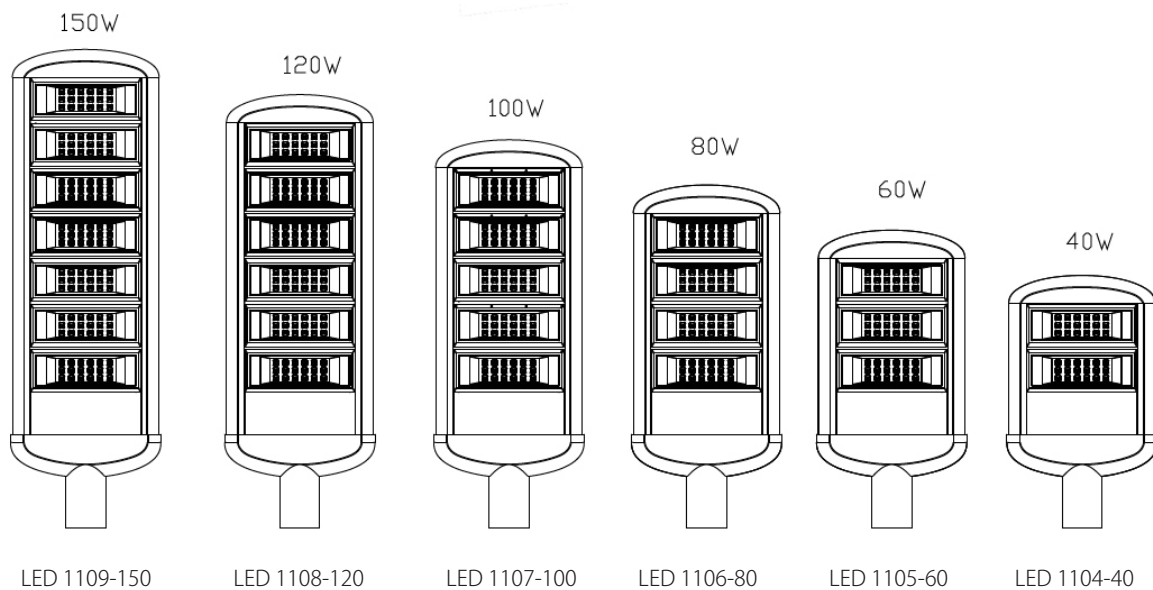
### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Model no.	LED 1109-150	LED 1108-120	LED 1107-100	LED 1106-80	LED 1105-60	LED 1104-40
X	793	713	633	553	473	393

\*Dimensions in mm



#### Technical Data: Modulo

Model No	Wattage	Nominal Voltage *(V)
LED 1104-40	40w	240 / 110
LED 1105-60	60w	240 / 110
LED 1106-80	80w	240 / 110
LED 1107-100	100w	240 / 110
LED 1108-120	120w	240 / 110
LED 1109-150	150w	240 / 110

\* other voltages also available /please ask for quote

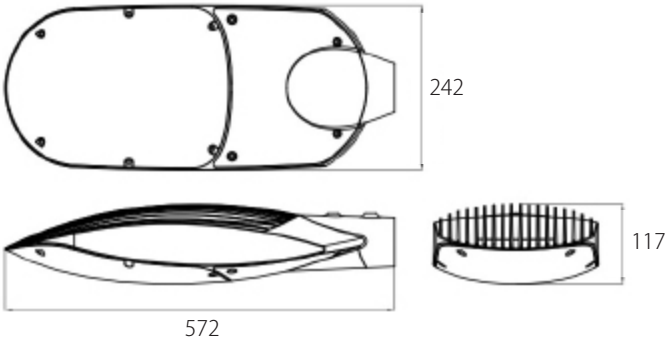


LED 1646

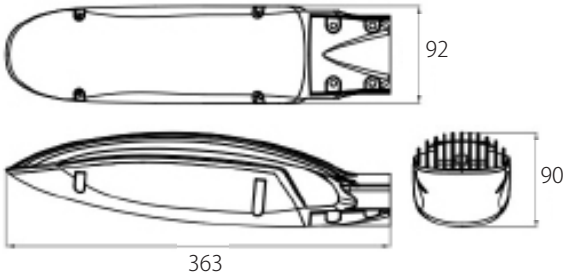


LED 1645

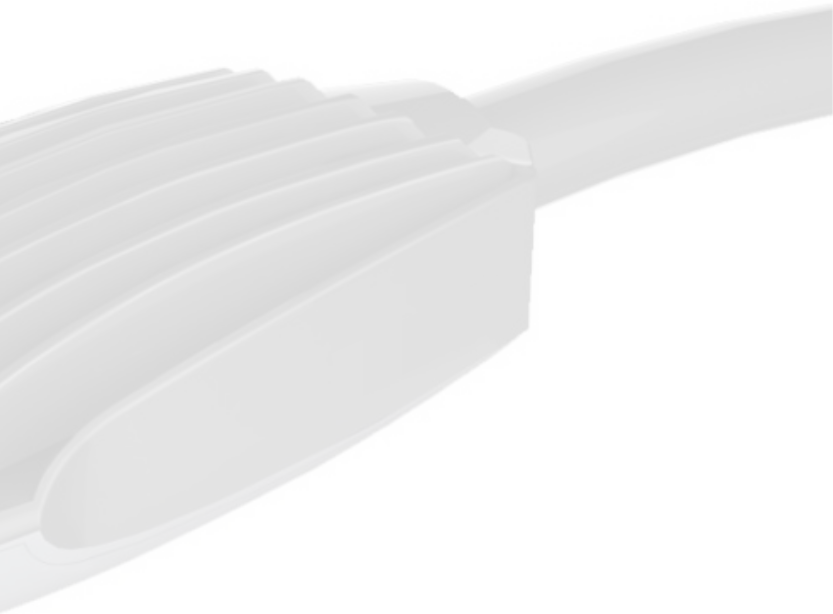
The clean and curved look of the die cast aluminum housing contrasted against the curved diffuser creates a classically contemporary appearance which enables the fixture to compliment the modern as well as historic architecture. The unique styling of Leaf presents a striking accent to contemporary architecture. Translucent /Opal refractor minimize dayform mass while subtly refracting light at night. External fins created to provide the thermal dissipation to LEDs mimic the curvature of the profile, while functioning to reduce heat provide aerodynamic nature to luminaire . The luminaire has buit-in batwing optics to provide the maximum light distribution .



LED 1646



LED 1645



Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Technical Data: Leaf

Model No	Wattage	Nominal Voltage *(V)
LED 1645-26	26w	240 / 110
LED 1646-58	58w	240 / 110
LED 1646-92	92w	240 / 110

\* other voltages also available /please ask for quote

Product description

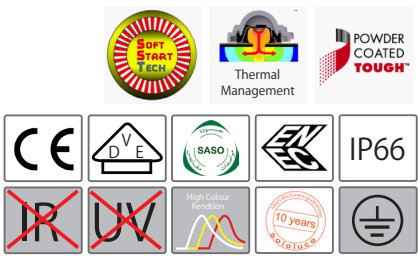
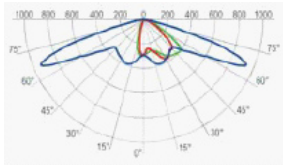
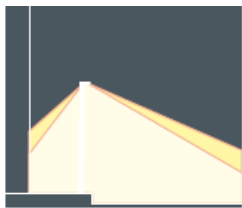
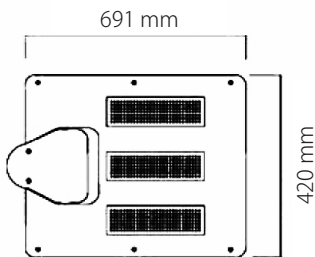
The apparent simplicity hides advanced technology. functional and technical detail.

Clean lines and high performance make Urbano suitable in any urban context be it city square, street light, Public place, Service lane, airport or mall surrounds.

Made of pressure die cast aluminum housing with pure silicon gaskets , ss hardware and powder coated externally. Luminaire is available in 27w and 60w Led .

Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Technical Data: Urbano

Model No	Wattage	Nominal Voltage *(V)
LED 1102-27	27w	240 / 110
LED 1102-60	60w	240 / 110

\* other voltages also available /please ask for quote



## Product description

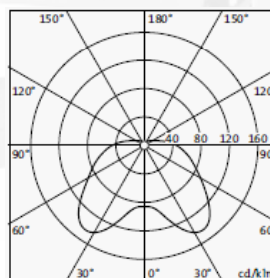


The Fantasi luminaire is distinguished by the formally matched unit of mounting and circular luminaire construction and their simplified form. Fantasi bears the efficient lighting technology consisting of Led with specially designed optics. The radial faceted optics enable efficient use of Led light sources. Only the areas in which the light is actually needed and desired are illuminated. In combination the pollution of the night sky is combatted by reducing the stray light to a minimum.

Due to the special construction of the luminaire the light source appears to float, giving the Fantasi an elegant appearance. The Fantasi is not only ideally suited for the lighting of city centres, parks and residential areas, but also for malls and recreation zones.

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Fantasi

Model No	Wattage	Nominal Voltage *(V)
LED 1103-40	40w	240 / 110
LED 1103-80	80w	240 / 110

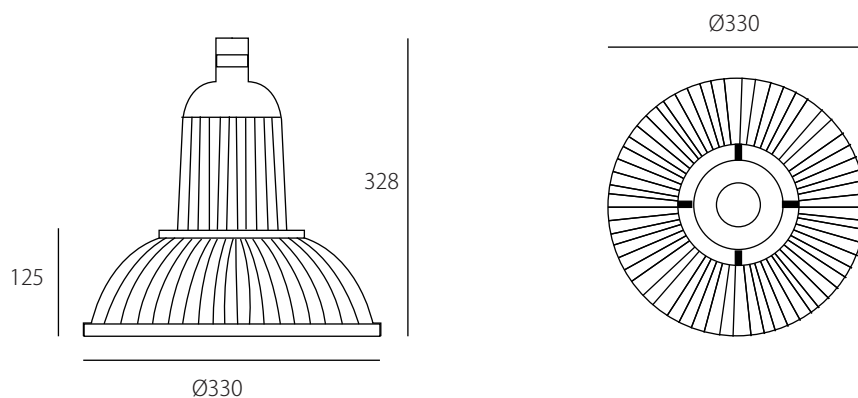
\* other voltages also available /please ask for quote





Aesthetically designed luminaire suitable for both interior and exterior applications for showrooms, hypermarkets, exhibition hall, mall interior or outdoor urban lighting, pedestrian walkways, parking areas and commercial/retail complexes, manufactured in anti-corrosive pressure die-cast aluminium, and toughened glass cover.

StyLux has special mounting arrangement for LEDs which is result of extensive research in optics and aesthetics.



#### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



#### Technical Data: StyLux

Model No	Wattage	Nominal Voltage *(V)
LED 1660-24	24w	240 / 110
LED 1660-36	36w	240 / 110

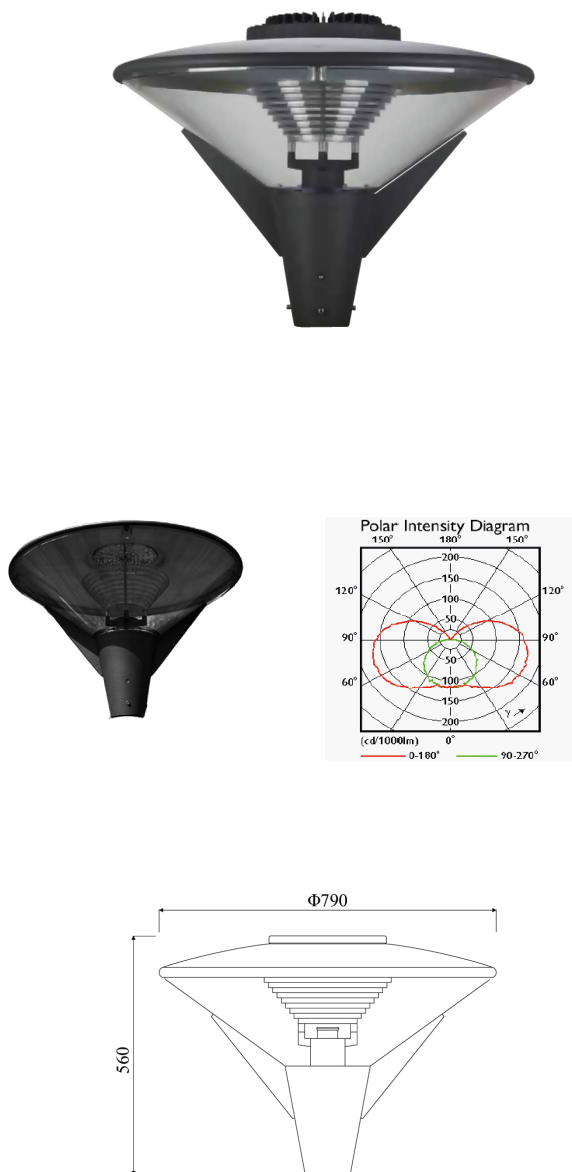
\* other voltages also available /please ask for quote

## Product description

Since its introduction the Sirrus has set the standard internationally for combining high lighting levels and excellent uniformity in large car parks and amenity areas. Its attractive and universal appearance also lends itself to a wide number of applications.

Sirrus is made of die cast aluminum body with Polycarbonate vandal resistant lens. Thermally tested and suitable for 40w LED. Confirms to ANSI C78.377A for nominal CCT & chromaticity. LEDs with high efficacy 123lm/watt have been used in the luminaire. No IR and UV radiation from LEDs. Luminaire is designed such as that heat is conducted and convected away thru' efficient thermal path designed and validated by the chip manufacturers to keep the junction temperature  $T_j$  within defined limits to achieve 50,000 + hours of life. Sololuce uses Cree , Bridgelux , Osram or Philips Lumileds chips.

360 deg optics has been achieved using external lenses. This ensures lighting in circular area around the pole . Fixture has integral pole mount sleeve .



## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Sirrus

Model No	Wattage	Nominal Voltage *(V)
LED 1305-40	40w	240 / 110

\* other voltages also available /please ask for quote

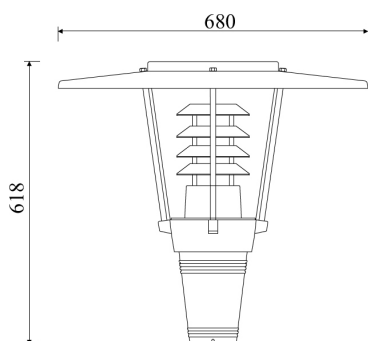
## Product description



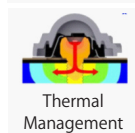
Krypton LED combines exceptional design with modern technology and is the ideal solution for walkways, parks and squares. It complements its location to give a unique atmosphere. Krypton is made in corrosion free die cast aluminium and vandal resistant PC, giving it superior durability. Krypton is designed to be pole top mounted on 4 to 5 m columns using the slip over mounting sleeve with spigot entry.

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



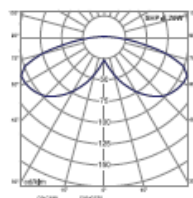
Specially designed electronic circuit for soft start to save stress on LEDs and other components



Thermally efficient design to keep the LED junction temperature within defined limits.



Luminaire is powder coated after chromate conversion to make the powder coat last longer



## Technical Data: Krypton

Model No	Wattage	Nominal Voltage *(V)
LED 1306-40	40w	240 / 110

\* other voltages also available /please ask for quote

Product description

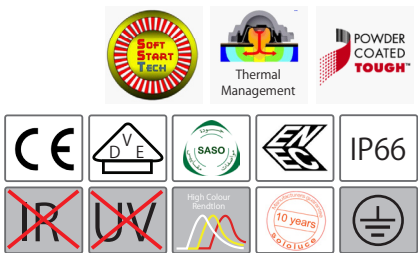
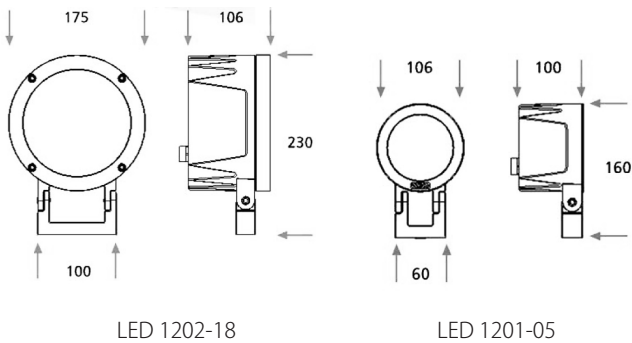
Fogo’s geometrical design and refined optics introduce a new dimension to lighting. The possibility of matching elements of different shapes and sizes is highly stimulating for the lighting designer’s creativity, giving them the opportunity to create a lighting installation where lighting efficiency meets high-end aesthetics. Particular care is given to designing the heat dissipation system and PCB control electronics, thus obtaining a fixture with excellent lighting technology performance as well as being remarkably reliable and long-lived.

This pressure die cast aluminum finned fixture is available in 5w and 18w led and in two sizes .



Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Technical Data: Fogo

Model No	Wattage	Nominal Voltage *(V)
LED 1201-05	5w	240 / 110
LED 1202-18	18w	240 / 110

\* other voltages also available /please ask for quote

### Product description



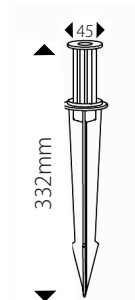
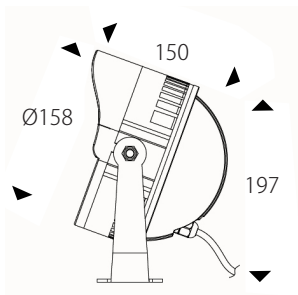
This compact spike light combines efficiency and functionality with an attractive appearance. By using latest-generation LEDs, Fogo + achieves the highest levels of performance as spikelight – but uses minimal energy.

Made in pressure die cast aluminum body with IP66 ingress protection with pure silicon gaskets and stainless steel hardware .

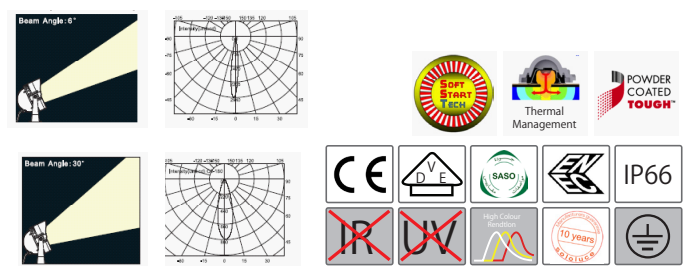
Luminaire comes in two optical options of 6 deg and 30 deg beam. LEDs available in warm white or cool white.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Optional



### Technical Data: Fogo Plus

Model No	Wattage	Beam Angle	Nominal Voltage *(V)
LED 1564-24	24w	6°	240 / 110
LED 1564-24	24w	30°	240 / 110

\* other voltages also available /please ask for quote



## Product description

Minimal design makes Primus able to satisfy a wide array of lighting needs in parks, gardens, facades and avenues. The many applications, be the wallmountings, ground, or pole-mountings, make Primus ideal for every residential area or commercial area.

Extremely high quality secondary optics are designed to optimise product performance and chromatic features of the light beam. Diode distribution in the electronic card is designed specifically to achieve maximum evenness in light projection.

Made of pressure die cast aluminum housing with pure silicon gaskets and SS hardware , Fixture is with IP66 ingress protection .

### Compliances:

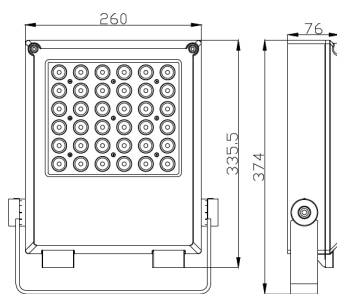
- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



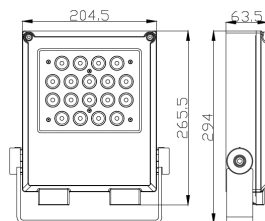
LED 1207-72



LED 1206-36



LED 1207-72



LED 1206-36



### Technical Data: Primus

Model No	Wattage	Nominal Voltage *(V)
LED 1206-36	36w	240 / 110
LED 1207-72	72w	240 / 110

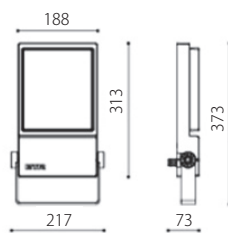
\* other voltages also available /please ask for quote

## Product description

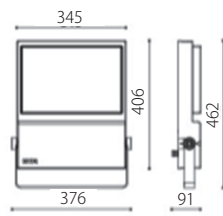


LED 1501-36

LED 1502-72



LED 1501-36



LED 1502-72

Specially designed highly thermally efficient Primus Plus is a beauty during the day and a wonder at night. Primus Plus is made to satisfy a wide array of lighting needs in parks, gardens, Facades and avenues. The many applications, be the wall mountings, ground, or pole-mountings, make Primus Plus ideal for facade Lighting, Monuments, residential area or commercial area.

Extremely high quality secondary optics are designed to optimise product performance and chromatic features of the light beam. Diode distribution in the electronic card is designed specifically to achieve maximum evenness in light projection.

Made of pressure die cast aluminum housing with pure silicon gaskets and SS hardware, Fixture is with IP66 ingress protection.



15°



25°



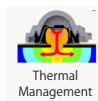
45°



60°

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Primus Plus

Model No	Wattage	Beam Angle	Nominal Voltage *(V)
LED 1501-36A	36w	15°	240 / 110
LED 1501-36B	36w	30°	240 / 110
LED 1501-36C	36w	45°	240 / 110
LED 1501-36D	36w	60°	240 / 110
LED 1502-72A	72w	15°	240 / 110
LED 1502-72B	72w	30°	240 / 110
LED 1502-72C	72w	45°	240 / 110
LED 1502-72D	72w	60°	240 / 110

\* other voltages also available /please ask for quote



## Product description

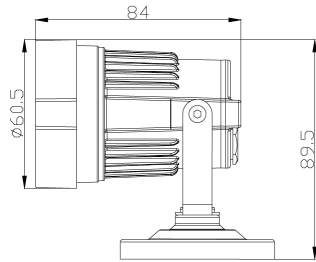
Series of adjustable spotlights in 1w & 3W. can be used both indoors and/or outdoors and are available in pre-treated die cast aluminium with a protection rating up to IP66. They are very easy to install in walls or on ground with screws. Ideal for lighting plants, flowerbeds, small paths, doorways and signs.

## Compliances:

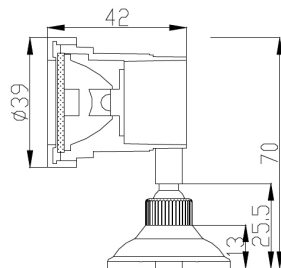
- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



LED 1205



LED 1204



15°



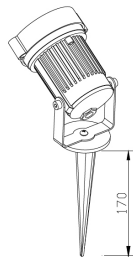
25°



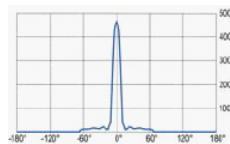
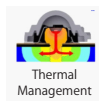
45°



60°



Spike available as an accessory



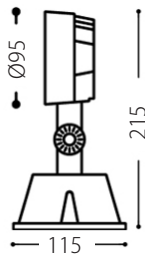
## Technical Data: Spot

Model No	Wattage	Beam Angle	Nominal Voltage *(V)
LED 1204-01/15	1w	15°	240 / 110/12v DC
LED 1204-01/25	1w	25°	240 / 110/12v DC
LED 1204-01/45	1w	45°	240 / 110/12v DC
LED 1204-01/60	1w	60°	240 / 110/12v DC
LED 1205-03/15	3w	15°	240 / 110/12v DC
LED 1205-03/25	3w	25°	240 / 110/12v DC
LED 1205-03/45	3w	45°	240 / 110/12v DC
LED 1205-03/60	3w	60°	240 / 110/12v DC

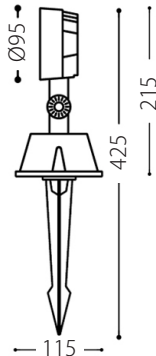
\* other voltages also available /please ask for quote



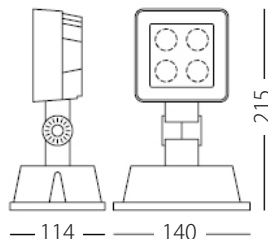
LED 1441-03



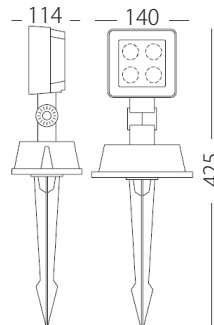
LED 1442-03



LED 1443-03



LED 1444-03



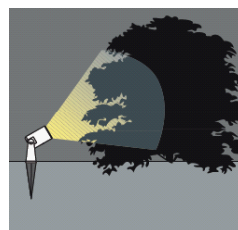
## Product description

Adjustable spotlights in 3w & 4w. can be used both indoors and/or outdoors and are available in pre-treated die cast aluminium with a protection rating up to IP66.

They are very easy to install in walls with screws and plugs or in the ground with a peg/spike. Ideal for lighting plants, flowerbeds, small paths, doorways and signs

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Dot

Model No	Wattage	Nominal Voltage *(V)
LED 1441-03	03w	240 / 110/12v DC
LED 1442-03	03w	240 / 110/12v DC
LED 1443-04	04w	240 / 110/12v DC
LED 1444-04	04w	240 / 110/12v DC

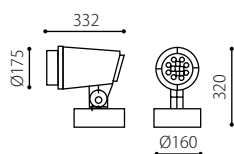
\* other voltages also available /please ask for quote

# Pluto





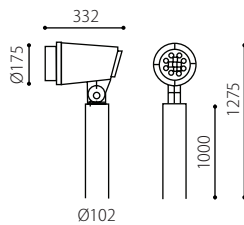
LED 1503



LED 1503



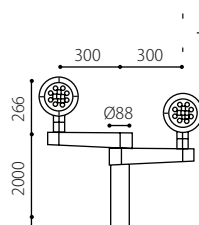
LED 1504



LED 1504



LED 1505



LED 1505

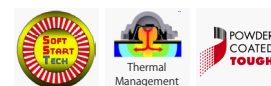
## Product description

Creating Landscapes, Enhancing Facade Details, Creating ambiance or highlighting things of substance, Pluto has the power to accomplish its job worth mentioning. A set of three models designed around pressure die cast fixture in IP66 protection class available in 15w single head and 30w double head.

Fixture is available as Ground Mount, 1000mm pole mount or twin head 2000mm pole mount.

## Compliances:

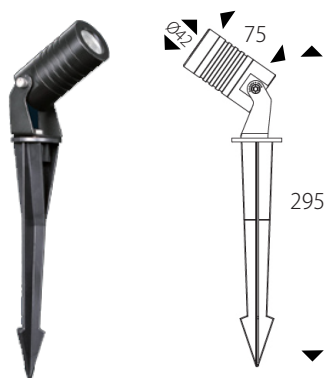
- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



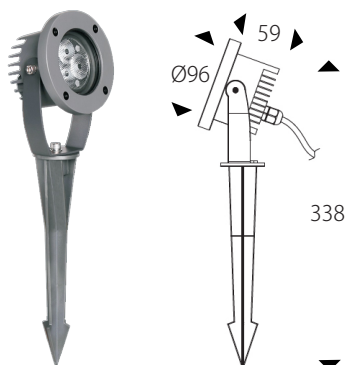
## Technical Data: Pluto

Model No	Wattage	Beam Angle	Nominal Voltage *(V)
LED 1503-15A	15w	15°	240 / 110
LED 1503-15B	15w	30°	240 / 110
LED 1503-15C	15w	45°	240 / 110
LED 1503-15D	15w	60°	240 / 110
LED 1504-15A	15w	15°	240 / 110
LED 1504-15B	15w	30°	240 / 110
LED 1504-15C	15w	45°	240 / 110
LED 1504-15D	15w	60°	240 / 110
LED 1505-30A	2x15w	15°	240 / 110
LED 1505-30B	2x15w	30°	240 / 110
LED 1505-30C	2x15w	45°	240 / 110
LED 1505-30D	2x15w	60°	240 / 110

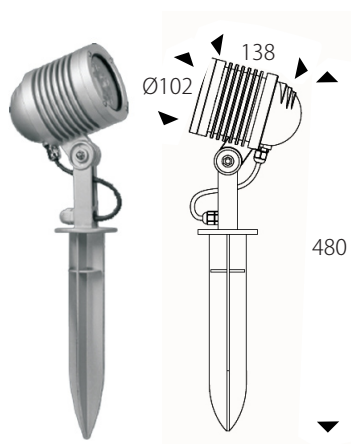
\* other voltages also available /please ask for quote



LED 1565



LED 1566



LED 1567

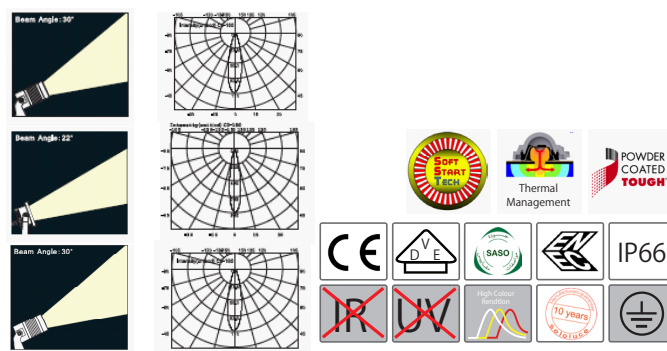
## Product description

Pluto Mini is an extensive selection of models, components and light sources that provide unrivalled flexibility for landscape /facade designers and architects, regardless of project size and lighting task. Numerous innovative details save both installation time and expense. Energy-saving technologies and durable, re-usable materials mean that these luminaires use resources economically and won't eat into your budget. The design of Pluto remains true to the designers' vision: goodlighting paints metaphors and sets the landscapes for life. The accents set by Pluto range ,wherever people go about their daily lives, create a wide variety of effects.

Made of die cast aluminum in IP66 protection available in different beam angles and wattages . LEDs available in warm white or cool white.

## Compliances:

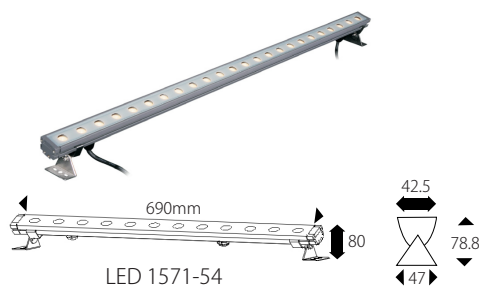
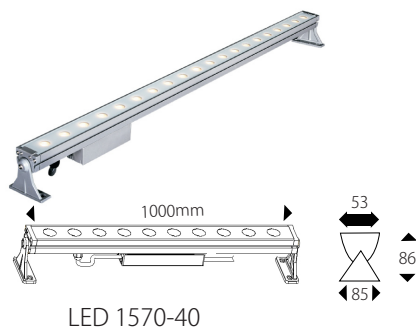
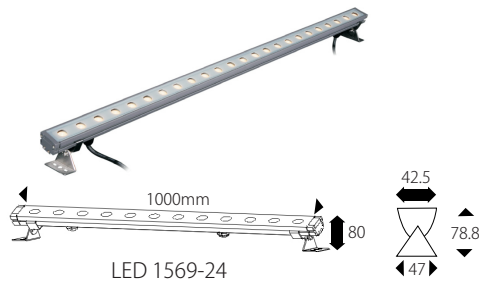
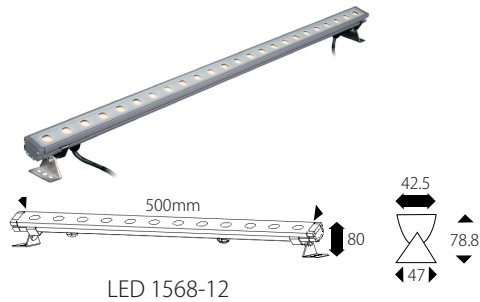
- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Pluto Mini

Model No	Wattage	Beam Angle	Nominal Voltage *(V)
LED 1565-3	3w	30°	24v DC/240v AC
LED 1566-6	6w	13°	24v DC/240v AC
LED 1566-6	6w	22°	24v DC/240v AC
LED 1567-10	10w	20°	24v DC/240v AC

\* other voltages also available /please ask for quote



### Product description

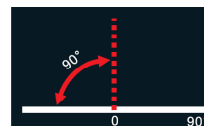
This luminaire ensemble cannot fail to impress with its low profile, slim-line design emphasised by its linear contours. Light Lines boasts a clear stylistic idiom and high functionality. Fixture optics is designed for maximum intensity and no light scattering.

Fixture is made of aluminum extrusion profiles with stainless steel/die cast brackets, pure silicon gaskets and ss hardware. Fixtures are well suited to withstand water splashes and dust and are equipped with IP66 protection.

LEDs available in warm white or cool white.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Light Lines

Model No	Wattage	Beam Angle	Nominal Voltage *(V)
LED 1568-12	12w	25°	240 / 110
LED 1569-24	24w	25°	240 / 110
LED 1570-40	40w	20°	24v DC
LED 1571-54	54w	22°	240 / 110

\* other voltages also available /please ask for quote

## Product description

Our products, developed from a constant research in terms of functionality , improvement and aestheticism , allowed us to provide clients with creative and competitive solutions which help to enhance the value of their architectural spaces.

In contemporary buildings, which are the most demanding in terms of environmental respect, lighting level, energy conservation and quality of life, the design and technologies of PanaLux range quickly stood out.

An integral indoor luminaire with backlit LED, offers the maximum usable light output without glare. Made of galvanized painted sheet the surface area offers excellent heat dissipation. Front diffuser is made of high quality PMMA/Acrylic with diffused optics.

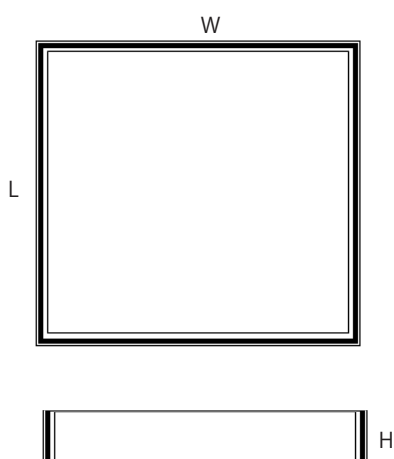
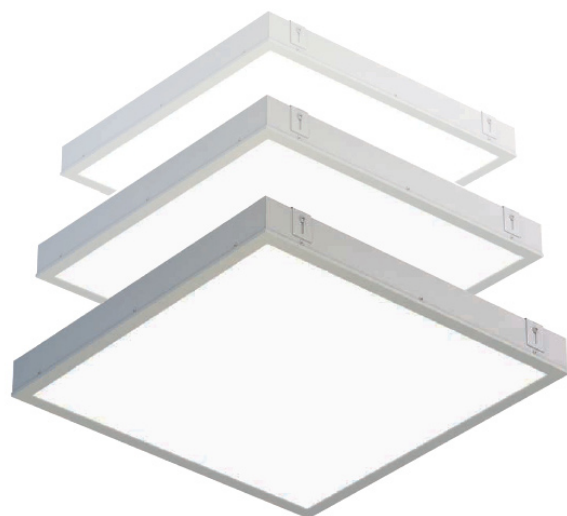
PanaLux is available in cool white /Natural white /warm white options and also with dimmer

### Options:

The fixture can be made in aluminium extrusion profile of 50mm.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Model	L	W	H
LED 1601-35	597	597	55
LED 1602-40	1197	297	55

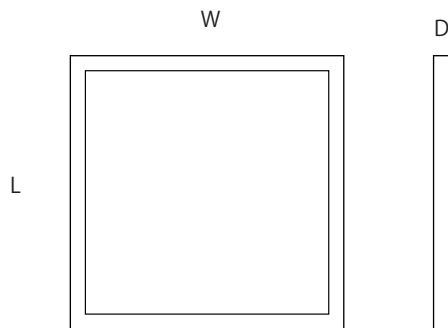


### Technical Data: PanaLux

Model No	Wattage	Nominal Voltage *(V)
LED 1601-35	35w	240 / 110
LED 1602-40	40w	240 / 110

\* other voltages also available /please ask for quote

## Product description



Ceilings will never be the same. New Sololuce PanaSlim LED, Side Lit, recessed Luminaires transform ambient lighting into an exquisite balance of refined appearance and superior efficiency. When illuminated, the panels produce a perfectly even glow that delivers exceptionally uniform light to fill the space. While off, they appear completely free of a visible light source. It's an immaculate design aesthetic, unlike anything you've seen before.

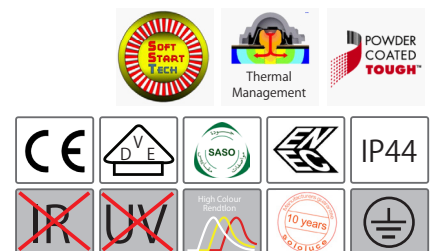
Luminaire body is made of aluminum extrusion and diffuser is made of PMMA/ Acrylic with special optics to diffuse the light evenly.

PanaSlim is available in cool white /Natural white /warm white options and also with dimmer.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

Model	L	W	D
LED 1603-16	296	296	9.7
LED 1604-40	596	596	9.7
LED 1605-71	1196	596	9.7



### Technical Data: PanaSlim

Model No	Wattage	Nominal Voltage *(V)
LED 1603-16	16w	240 / 110
LED 1604-40	40w	240 / 110
LED 1605-71	71w	240 / 110

\* other voltages also available /please ask for quote



# Matrix



## Product description

Matrix is a series of specially designed recessed luminaires consisting of a special LED profile, designed by Sololuce for this lighting concept. Due to the lateral arrangement of LEDs and the secondary lighting with highly reflective white Polymer a homogenous light surface is generated. The microprismatic material provides a non-directional light arrangement with precise glare limitation at the same time, a high light output ratio is also provided. Powerful Luminaire with high luminosity and precise glare limitation above  $65^\circ < 1000 \text{ cd/m}^2$  according to LG7. Ideal for the general lighting in offices & conference rooms. LED used are with very stable chromaticity ( $< 2 \text{ SDCM}$ ) so there are no perceptible colour deviations when using several luminaires- Premium colour rendering index  $\text{CRI} > 95$ , with R9 (red)  $> 90$  - Colour temperature 4000 / 6000K

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



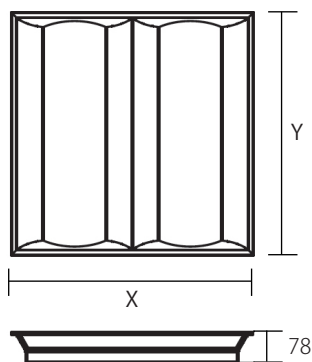
LED 1487-35



LED 1488-40



LED 1489-60



Model	X	Y	Cutout
LED 1487-35	597	597	580*580
LED 1488-40	1197	297	1180*280
LED 1489-60	1197	597	1180*580



## Technical Data: Matrix

Model No	Wattage	Nominal Voltage *(V)
LED 1487-35	35w	240 / 110
LED 1488-40	40w	240 / 110
LED 1489-60	60w	240 / 110

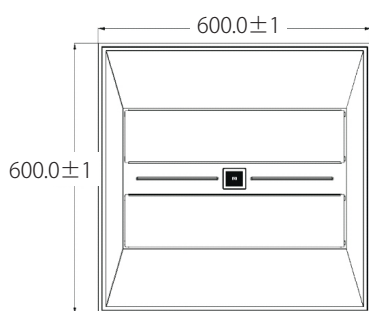
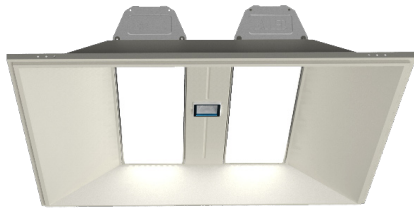
\* other voltages also available /please ask for quote

## Product description

Specially designed IP54 recessed luminaire consists of a special LED profile, designed by Sololuce for this lighting concept. Due to the lateral arrangement of LEDs and the secondary lighting with highly reflective white Polymer a homogenous light surface is generated. The microprismatic material provides a non-directional light arrangement with precise glare limitation at the same time, a high light output ratio is also provided. Powerful Luminaire with high luminosity and precise glare limitation above  $65^\circ < 1000 \text{ cd/m}^2$  according to LG7. Ideal for the general lighting in offices & conference rooms. LED used are with very stable chromaticity ( $< 2 \text{ SDCM}$ ). So there are no perceptible colour deviations when using several luminaires.

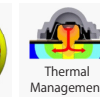
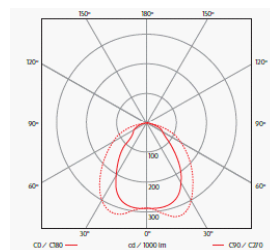
Premium colour rendering index  $\text{CRI} > 95$ , with  $\text{R9 (red)} > 90$ .

Colour temperature 2700/3000/4000 K



## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

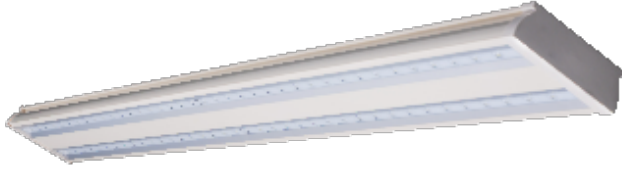


## Technical Data: Quisar

Model No	Wattage	Nominal Voltage *(V)
LED 2104-36	36w	240 / 110

\* other voltages also available /please ask for quote

## Product description

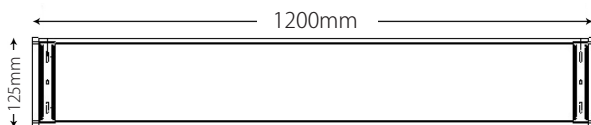


Surface mounted IP66 aluminum extrusion body fixture consists of a special LED profile, designed by Sololuce for this lighting concept. Due to the lateral arrangement of LEDs and the secondary optics creates a homogenous light surface. Specially designed optics provides a non-directional light arrangement with precise glare limitation at the same time, a high light output ratio is also provided. Powerful Luminaire with high luminosity and precise glare limitation above  $65^\circ < 1000 \text{ cd/m}^2$  according to LG7. Ideal for the general lighting in offices & conference rooms. LED used are with very stable chromaticity ( $< 2 \text{ SDCM}$ ). So there are no perceptible colour deviations when using several luminaires.

Fixture body is made of aluminium extrusion with PC diffuser & ABS end caps.

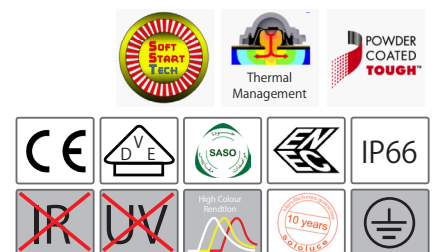
Premium colour rendering index CRI  $> 95$ , with R9 (red)  $> 90$ .

Colour temperature 2700/3000/4000 K



## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Anteras

Model No	Wattage	Nominal Voltage *(V)
LED 1474-30	30w	240 / 110

\* other voltages also available /please ask for quote

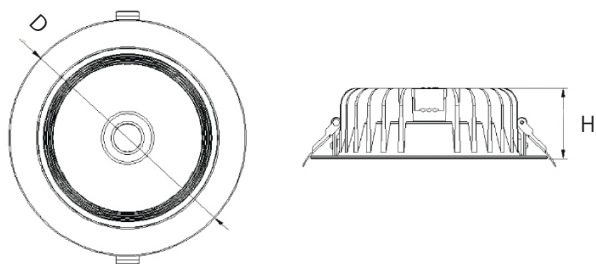
## Product description

Aura downlights support specially designed optics known as the "POLARIZING PRISM" diffuser, which polarizes and redistributes the LED light emission widening its beam spread. The LED with internal secondary optics generally has a definite beam, whilst thanks to the "POLARIZING PRISM" system the beam spread is widened out and nearly doubled achieving a final diffuse light effect. These features allow remarkably improved visual comfort as the dazzling effect is considerably reduced if the light source is directly gazed on. The emission obtained is of the "Flood" type. Measurements confirm that given a 25° secondary optics inner source, the beam emitted with the "POLARISING PRISM" filter is 50°. LED used are with very stable chromaticity (< 2 SDCM), so there are no perceptible colour deviations when using several luminaires.

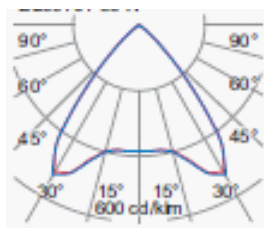
Premium colour rendering index CRI > 95, with R9 (red) > 90  
Colour temperature 2700/3000/4000 K-Fixture is made of die cast aluminum in 9w /12 w and 15w smd Led

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Model	D	H	Cut Out
LED 2101-09	148	55	125
LED 2102-12	172	60	152
LED 2103-15	200	60	175

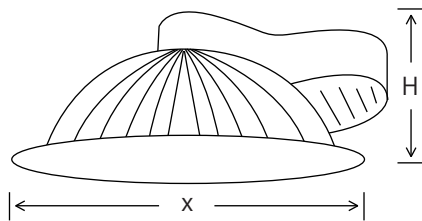


## Technical Data: Aura

Model No	Wattage	Nominal Voltage *(V)
LED 2101-09	9w	240 / 110
LED 2102-12	12w	240 / 110
LED 2103-15	15w	240 / 110

\* other voltages also available /please ask for quote

## Product description



Model	x	H	Cutout
2105	130	78	118
2106	190	96	178
2107	240	102	218

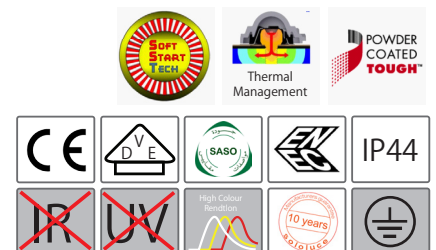
The Orbik is high output architectural LED downlight delivers exceptional 90+ CRI light while achieving over 120 lumens per watt. This breakthrough performance is achieved by combining the high efficacy and high-quality light of Cree TrueWhite® Technology. The Orbik is available in warm and cool color temperatures and features spec grade aesthetics with a polished lower reflector. It is designed to easily install, making the Orbik perfect for use as a CFL and metal halide downlight replacement in commercial new construction or retrofit applications.

Luminaire body is made of die cast aluminum with low heat resistance, installation ring made of sheet steel and white powder coated. Separate housing for LED driver, available in 7w 12w 18w & 24w LED Mounting suitable for ceiling installation with tension springs.

Application in Offices, Retail shops, Hallways, exhibition rooms, Museums etc.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Orbik

Model No	Wattage	Nominal Voltage *(V)
LED 2105-07	7w	240 / 110
LED 2105-12	12w	240 / 110
LED 2106-12	12w	240 / 110
LED 2106-18	18w	240 / 110
LED 2107-18	18w	240 / 110
LED 2107-24	24w	240 / 110

\* other voltages also available /please ask for quote

### Product description



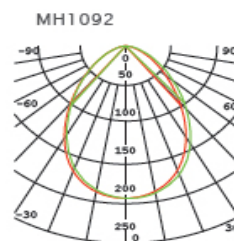
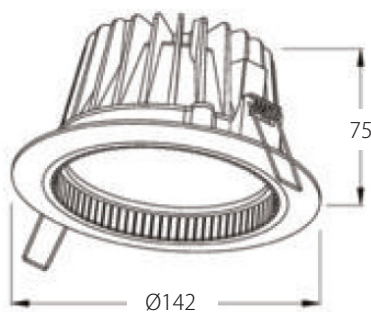
Cielos I is an IP65 downlight which support specially designed LED array mounted on horizontal die cast finned heat sink with vacuum metalized aluminum reflector.

The downlight is designed for 13w Led chip in 3000K CCT with >80 CRI and in 72 degree beam angle.

Downlight comes in with IP65 ingress protection and is available in White, Black & Grey finish.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Cielos I

Model No	Wattage	Nominal Voltage *(V)
LED 1536-13	13w	240 / 110

\* other voltages also available /please ask for quote



### Product description



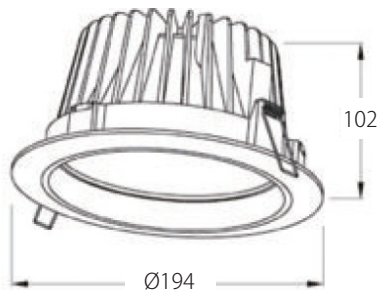
Cielos II is an IP65 downlight which support specially designed LED array mounted on horizontal die cast finned heat sink with vacuum metalized aluminum reflector.

The downlight is designed for 18w Led chip in 3000K CCT with >80 CRI and in 72 degree beam angle.

Downlight comes in with IP65 ingress protection and is available in White, Black & Grey finish.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Cielos II

Model No	Wattage	Nominal Voltage *(V)
LED 1537-18	18w	240 / 110

\* other voltages also available /please ask for quote



# LUMEN



### Product description

Lumen is a range of simple and discrete fittings, able to be installed in a multitude of situations, all the while generating maximum visual comfort. The dual adjustability of the body, the practical mechanical locks make Lumen an extremely flexible instrument. Fixture made of aluminum die cast in 9w/ 18w/ 27w and 28w LED. Sololuce has opted for very narrow selection diodes for its products, and we carry out regular checks on LEDs in order to guarantee consistency and homogeneity of the emitted light tone. LED used are with very stable chromaticity ( $< 2$  SDCM), so there are no perceptible colour deviations when using several luminaires - Premium colour rendering index CRI  $> 95$ , with R9 (red)  $> 90$ .

Colour temperature 2700/3000/4000 K Lumen effectively answer s varied lighting needs in retail situations, malls & restaurants

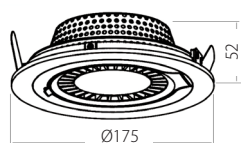
### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

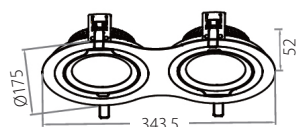


LED 2108-09

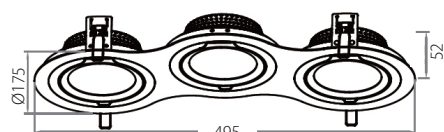
LED 2109-28



LED 2108/09



LED 2108-18



LED 2108-27



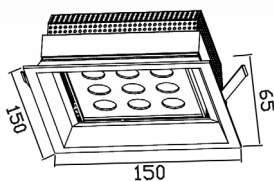
### Technical Data: Lumen

Model No	Wattage	Nominal Voltage *(V)
LED 2108-09	9w	240 / 110
LED 2108-18	18w	240 / 110
LED 2108-27	27w	240 / 110
LED 2109-28	28w	240 / 110

\* other voltages also available /please ask for quote



LED 2110-09



LED 2110-09

## Product description

Briton is a simple and discrete fittings, able to be installed in a multitude of situations, all the while generating maximum visual comfort. The dual adjustability of the body, the practical mechanical locks make Lumen an extremely flexible instrument. Fixture made of aluminum die cast in 9w LED. Sololuce has opted for very narrow selection diodes for its products, and we carry out regular checks on LEDs in order to guarantee consistency and homogeneity of the emitted light tone. LED used are with very stable chromaticity ( $< 2$  SDCM), so there are no perceptible colour deviations when using several luminaires - Premium colour rendering index CRI  $> 95$ , with R9 (red)  $> 90$ .

Colour temperature 2700/3000/4000 K Lumen effectively answer s varied lighting needs in retail situations, malls & restaurants

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Lumen

Model No	Wattage	Nominal Voltage *(V)
LED 2110-09	9w	240 / 110

\* other voltages also available /please ask for quote

### Product description



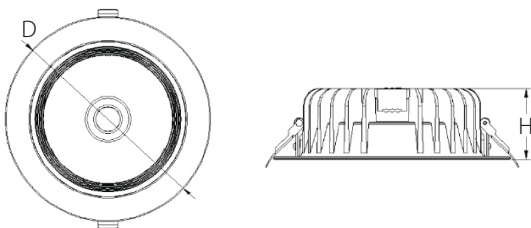
Micros downlight support specially designed LED array mounted on die cast finned heat sink with vacuum metalized aluminum reflector.

The downlight is designed for 7w Led chip in 2700 k/3000K & 5600k CCT with >80 CRI and in 30 degree beam angle.

Downlight comes in two versions with IP20 and IP65 ingress protection. IP65 version is with front glass.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Model	D	H	Cut Out
LED 1530-07	90	48	78



### Technical Data: Micros

Model No	Wattage	Nominal Voltage *(V)
LED 1530-07A	7w	240 / 110
LED 1530-07B (IP65)	7w	240 / 110

\* other voltages also available /please ask for quote

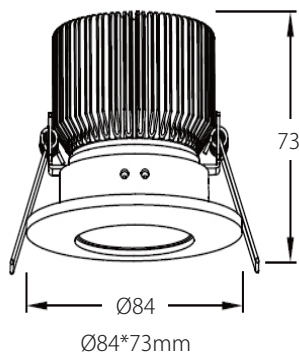
### Product description



Arcos downlight support specially designed LED array mounted on die cast finned heat sink with vacuum metalized aluminum reflector.

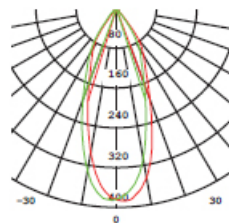
The downlight is designed for 7w Led chip in 3000K & 5600k CCT with >80 CRI and in 37 degree beam angle.

Downlight comes in with IP20 ingress protection and is available in White, Black, Grey, Chrome and Satin Nickel finish.



### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Arcos

Model No	Wattage	Nominal Voltage *(V)
LED 1531-07	7w	240 / 110

\* other voltages also available /please ask for quote

### Product description



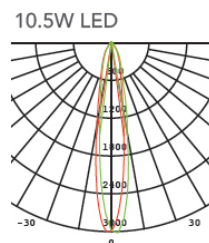
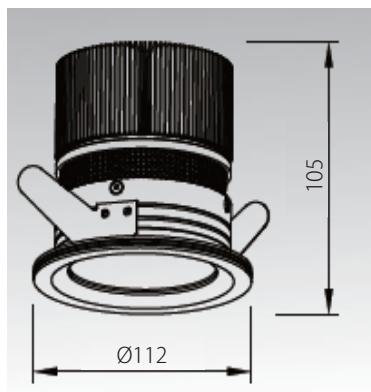
Panos downlight support specially designed LED array mounted on die cast finned heat sink with vacuum metalized aluminum reflector.

The downlight is designed for 10.5w and 15w Led chip in 3000K , 4000k & 5000k CCT with >80 CRI and in 16 & 18 degree beam angle.

Downlight comes in with IP20 ingress protection and is available in White, Black , Grey, Chrome and Satin Nickel finish.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Panos

Model No	Wattage	Nominal Voltage *(V)
LED 1532-10.5	10.5w	240 / 110
LED 1532-15	15w	240 / 110

\* other voltages also available /please ask for quote

## Product description



Credos downlight support specially designed LED array mounted on die cast finned heat sink with vacuum metalized aluminum reflector.

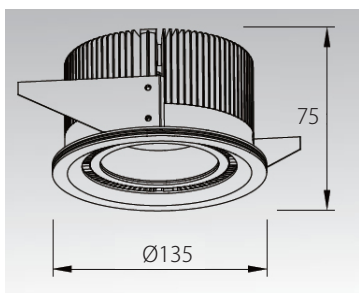
The downlight is designed in 10.5w/15w and 26w Led chip in 3000K & 5600k CCT with >80 CRI and in 16, 18 & 20 degree beam angle.

Downlight comes in with IP20 ingress protection and is available in White, Black, Grey, Chrome and Satin Nickel finish.

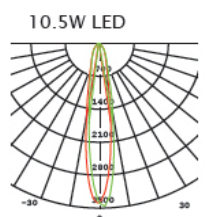


## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Cutout 125mm



## Technical Data: Credos

Model No	Wattage	Nominal Voltage *(V)
LED 1534-10.5	10.5w	240 / 110
LED 1534-15	15w	240 / 110
LED 1534-26	26w	240 / 110

\* other voltages also available /please ask for quote



### Product description



Maximo is maximum burst of light from the smallest possible downlight. Maximo supports specially designed LED array mounted on die cast finned heat sink incorporating **Synjet Active Cooling Technology** with vacuum metalized aluminum reflector.

The downlight is designed for 50w Led chip in 3000K, 4000k & 5000k CCT with >80 CRI and in 46 degree beam angle.

Downlight comes in with IP20 ingress protection and is available in White, Black & Grey finish.

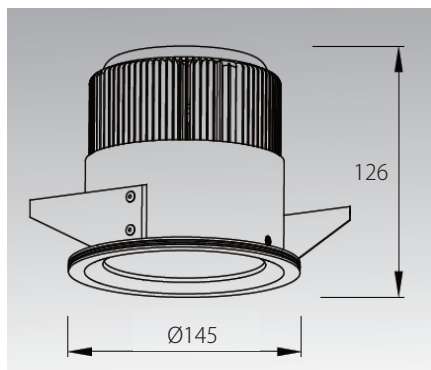
#### Synjet Active Cooling Technology :

Active cooling is the most efficient way to transfer heat from Led chip and keep it cool. It has no bearings or lubricants and runs for over 100,000 hours life.

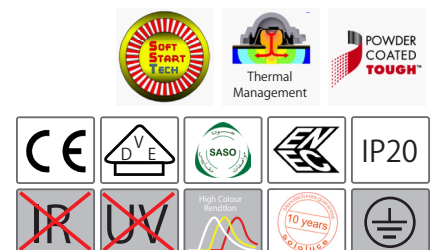
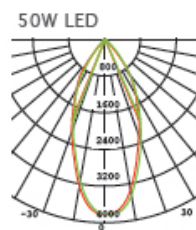


#### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Cutout 128mm



#### Technical Data: Maximo

Model No	Wattage	Nominal Voltage *(V)
LED 1535-50	50w	240 / 110

\* other voltages also available /please ask for quote



### Product description



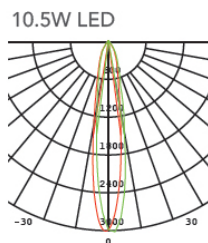
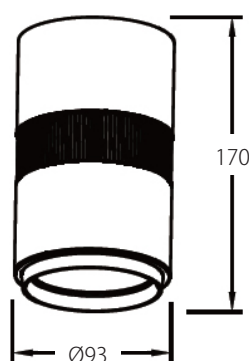
Sandos is surface mounted downlight which support specially designed LED array mounted on die cast finned heat sink with vacuum metalized aluminum reflector. Whole body is made of aluminum.

The downlight is designed for 10.5w and 15w Led chip in 3000K, 4000k & 5000k CCT with >80 CRI and in 22 degree beam angle.

Downlight comes in with IP20 ingress protection and is available in White, Black & Grey finish.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Sandos

Model No	Wattage	Nominal Voltage *(V)
LED 1533-10.5	10.5w	240 / 110
LED 1533-15	15w	240 / 110

\* other voltages also available /please ask for quote

### Product description

Troll has a basic design that guarantees light direction that fully respects the aesthetic values of the space where it resides. Two different options with the possibility of application both fixed downlight and adjustable light emission. The multitude of optics make Troll the answer to lighting requirements in covered pedestrian areas, colonnades, shelters, underpasses, Retail and malls. This range of fittings was designed to ensure easy installation as well as an efficient and economical maintenance management. Made of deep drawn aluminum housing in IP44 ingress protection. The fixture comes in fixed and adjustable optics.



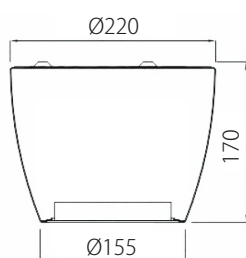
LED 1477-18



LED 1477-15



LED 1477-15



### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

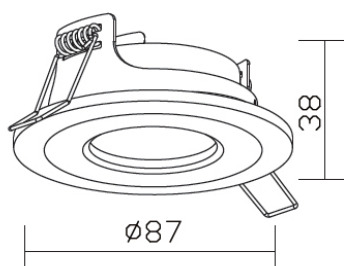


### Technical Data: Troll

Model No	Wattage	Nominal Voltage *(V)
LED 1477-18 fixed	18w	240 / 110
LED 1477-15 adjustable	15w	240 / 110

\* other voltages also available /please ask for quote

## Product description



Corona is an IP65 downlight which support MR16 and GU10 LED lamp. Available colour temperatures are 2700K, 3000K, 4000K CCT and it comes with 24/ 36 / 60 degrees beam angle with a clearly defined beam spread

Downlight comes in with IP65 ingress protection and is available in White , Black & Grey finish.

Suitable LED lamps for Corona which can replace energy consuming halogen MR16/GU10 lamps:



LED MR16 dimmable endura LED with G5.3 holder with 24/36/60 degrees beam 2700k/3000k/4000k

LED GU10 dimmable lamp with GU10 lamp holder with 25/40 degree beam angle in 2700k/3000k/4000k

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

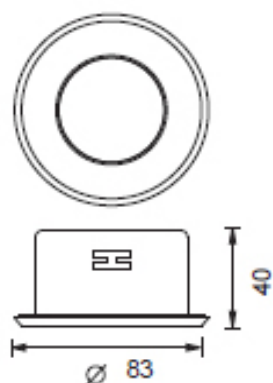


## Technical Data: Corona

Model No	Wattage	Nominal Voltage *(V)
LED 1538-04/MR16	04w	240 / 110
LED 1538-06/MR16	06w	240 / 110
LED 1538-10/MR16	10w	240 / 110
LED 1538-04/GU10	04w	240 / 110
LED 1538-06/GU10	06w	240 / 110

\* other voltages also available /please ask for quote

## Product description



### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

Volo is an IP65 downlight which support MR16 and GU10 LED lamp. Available colour temperatures are 2700K, 3000K, 4000K CCT and it comes with 24 / 36 / 60 degrees beam angle with a clearly defined beam spread

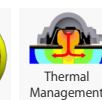
Downlight comes in with IP65 ingress protection and is available in White, Black & Grey finish.

Suitable LED lamps for Volo which can replace energy consuming halogen MR16/GU10 lamps:



LED MR16 dimmable endura LED with G5.3 holder with 24/36/60 degrees beam 2700k/3000k/4000k

LED GU10 dimmable lamp with GU10 lamp holder with 25/40 degree beam angle in 2700k/3000k/4000k



### Technical Data: Volo

Model No	Wattage	Nominal Voltage *(V)
LED 1539-04/MR16	04w	240 / 110
LED 1539-06/MR16	06w	240 / 110
LED 1539-10/MR16	10w	240 / 110
LED 1539-04/GU10	04w	240 / 110
LED 1539-06/GU10	06w	240 / 110

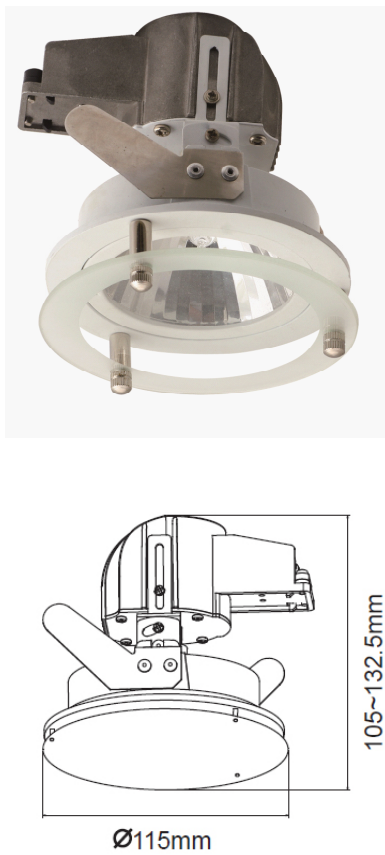
\* other voltages also available /please ask for quote

Product description

Capri is drop glass construction downlight which support MR16 and GU10 LED lamp. Available colour temperatures are 2700K, 3000K, 4000K CCT and it comes with 24 / 36 / 60 degrees beam angle with a clearly defined beam spread

Downlight comes in with IP20 ingress protection and is available in White, Crome & Grey finish.

Suitable LED lamps for Capri which can replace energy consuming halogen MR16/GU10 lamps:



LED MR16 dimmable endura LED with G5.3 holder with 24/36/60 degrees beam 2700k/3000k/4000k

LED GU10 dimmable lamp with GU10 lamp holder with 25/40 degree beam angle in 2700k/3000k/4000k

Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

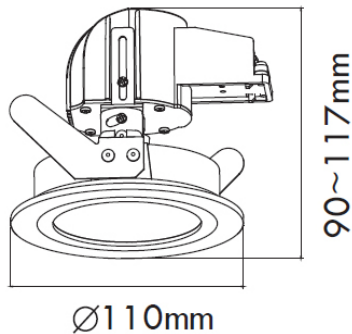
Technical Data: Capri

Model No	Wattage	Nominal Voltage *(V)
LED 1540-04/MR16	04w	240 / 110
LED 1540-06/MR16	06w	240 / 110
LED 1540-10/MR16	10w	240 / 110
LED 1540-04/GU10	04w	240 / 110
LED 1540-06/GU10	06w	240 / 110

\* other voltages also available /please ask for quote



## Product description



Vista is an IP65 downlight which support MR16 and GU10 LED lamp. Available colour temperatures are 2700K, 3000K, 4000K CCT and it comes with 24 / 36 / 60 degrees beam angle with a clearly defined beam spread

Downlight comes in with IP65 ingress protection and is available in White, Black & Grey finish.

Suitable LED lamps for Vista which can replace energy consuming halogen MR16/GU10 lamps:



LED MR16 dimmable endura LED with G5.3 holder with 24/36/60 degrees beam 2700k/3000k/4000k

LED GU10 dimmable lamp with GU10 lamp holder with 25/40 degree beam angle in 2700k/3000k/4000k

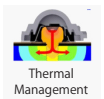
### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

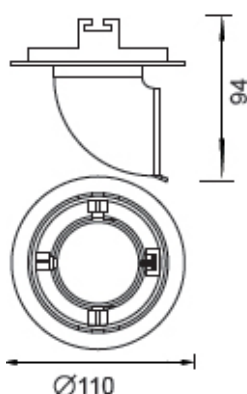
### Technical Data: Vista

Model No	Wattage	Nominal Voltage *(V)
LED 1541-04/MR16	04w	240 / 110
LED 1541-06/MR16	06w	240 / 110
LED 1541-10/MR16	10w	240 / 110
LED 1541-04/GU10	04w	240 / 110
LED 1541-06/GU10	06w	240 / 110

\* other voltages also available /please ask for quote







#### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

#### Technical Data: Mobile Nano

Model No	Wattage	Nominal Voltage *(V)
LED 1538-04/MR16	04w	240 / 110
LED 1538-06/MR16	06w	240 / 110
LED 1538-10/MR16	10w	240 / 110
LED 1538-04/GU10	04w	240 / 110
LED 1538-06/GU10	06w	240 / 110

\* other voltages also available /please ask for quote

#### Product description

Mobile Nano is an IP20 downlight which support MR16 and GU10 LED lamp. Available colour temperatures are 2700K, 3000K, 4000K CCT and it comes with 24 / 36 / 60 degrees beam angle with a clearly defined beam spread

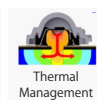
Downlight comes in with IP20 ingress protection and is available in White, Chrome, Satin Nickel and Gold colour.

Suitable LED lamps for Mobile Nano which can replace energy consuming halogen MR16/GU10 lamps:



LED MR16 dimmable endura LED with G5.3 holder with 24/36/60 degrees beam 2700k/3000k/4000k

LED GU10 dimmable lamp with GU10 lamp holder with 25/40 degree beam angle in 2700k/3000k/4000k



## Product description

Siena has been designed with light source place deep inside to create an accent lighting but without glare. This fixture is suitable to illuminate shops, restaurants, hotels, and especially galleries, exhibitions and museums.

Siena supports MR16 and GU10 LED lamp. Downlight comes in with IP20 ingress protection and is available in White, Black & Grey finish.

Suitable LED lamps for Siena which can replace energy consuming halogen MR16/GU10 lamps:



LED MR16 dimmable endura LED with G5.3 holder with 24/36/60 degrees beam 2700k/3000k/4000k

LED GU10 dimmable lamp with GU10 lamp holder with 25/40 degree beam angle in 2700k/3000k/4000k

### Options:

Siena -M: Matt finish reflector

Siena- S: Mirror finish behave reflector

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



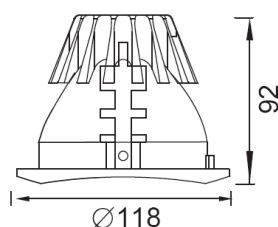
### Technical Data: Siena

Model No	Wattage	Nominal Voltage *(V)
LED1658-04/MR16	04w	240 / 110
LED 1658-06/MR16	06w	240 / 110
LED 1658-10/MR16	10w	240 / 110
LED 1658-04/GU10	04w	240 / 110
LED 1658-06/GU10	06w	240 / 110

\* other voltages also available /please ask for quote

M for matt reflector and S for mirror reflector





### Product description

Aqua has been specially designed downlight with finned die cast aluminum body with fixed head that supports MR16 and GU10 LED lamp.

Downlight comes in with IP20 ingress protection and is available in White, Black & Grey finish.

Suitable LED lamps for aqua which can replace energy consuming halogen MR16/GU10 lamps:



LED MR16 dimmable endura LED with G5.3 holder with 24/36/60 degrees beam 2700k/3000k/4000k

LED dimmable lamp with GU10 lamp holder with 25/40 degree beam angle in 2700k/3000k/4000k

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

### Technical Data: Aqua

Model No	Wattage	Nominal Voltage *(V)
LED1656-04/MR16	04w	240 / 110
LED 1656-06/MR16	06w	240 / 110
LED 1656-10/MR16	10w	240 / 110
LED 1656-04/GU10	04w	240 / 110
LED 1656-06/GU10	06w	240 / 110

\* other voltages also available /please ask for quote

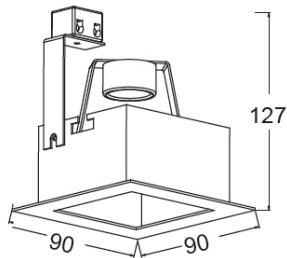


### Product description

Alicia Nano has been designed with invisible , adjustable lamp head in CRCA powder coated body that supports MR16 and GU10 LED lamp.

Downlight comes in with IP20 ingress protection and is available in White, Black & Grey finish.

Suitable LED lamps for aqua which can replace energy consuming halogen MR16/GU10 lamps:

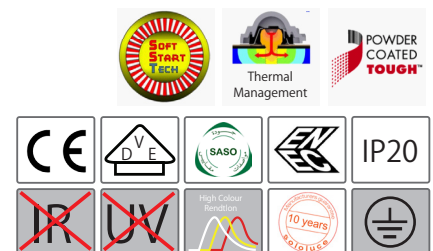


LED MR16 dimmable endura LED with G5.3 holder with 24/36/60 degrees beam 2700k/3000k/4000k

LED dimmable lamp with GU10 lamp holder with 25/40 degree beam angle in 2700k/3000k/4000k

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Alicia Nano

Model No	Wattage	Nominal Voltage *(V)
LED1657-04/MR16	04w	240 / 110
LED 1657-06/MR16	06w	240 / 110
LED 1657-10/MR16	10w	240 / 110
LED 1657-04/GU10	04w	240 / 110
LED 1657-06/GU10	06w	240 / 110

\* other voltages also available /please ask for quote

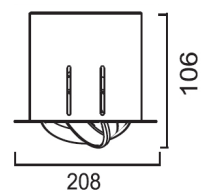


LED 1650-110-24/40 (1x10w)

LED 1650-115-24/40 (1x15w)

Beam angle 24° or 40°

240V/110V/50Hz

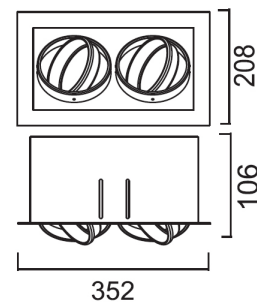


LED 1651-210-24/40 (2x10w)

LED 1651-215-24/40 (2x15w)

Beam angle 24° or 40°

240V/110V/50Hz

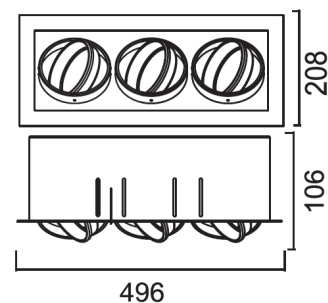


LED 1652-310-24/40 (3x10w)

LED 1652-315-24/40 (3x15w)

Beam angle 24° or 40°

240V/110V/50Hz

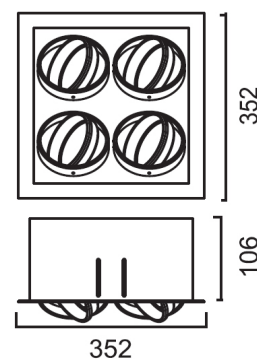


LED 1653-410-24/40 (4x10w)

LED 1653-415-24/40 (4x15w)

Beam angle 24° or 40°

240V/110V/50Hz



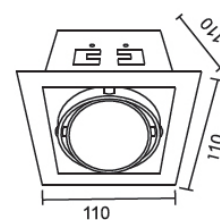
Retta fixtures accept on G53  
base lamps like AR111 available  
in 2700K and 3000K colour  
temperature.





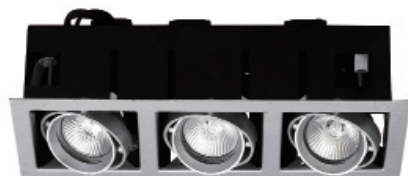
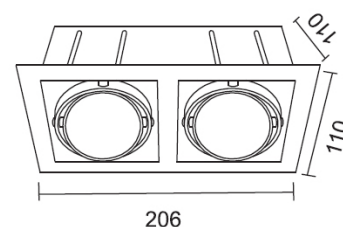
LED 1666-104 -24/36/60 (1x04w)  
 LED 1666-106 -24/36/60 (1x06w)  
 LED 1666-110 -24/36/60 (1x10w)

240V/110V/50Hz



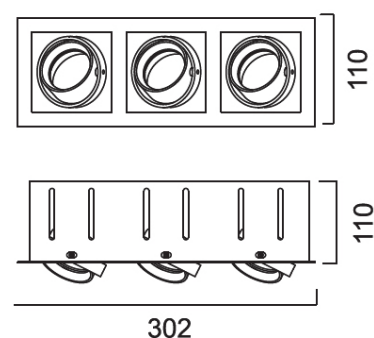
LED 1667-204 -24/36/60 (2x04w)  
 LED 1667-206 -24/36/60 (2x06w)  
 LED 1667-210 -24/36/60 (2x10w)

240V/110V/50Hz



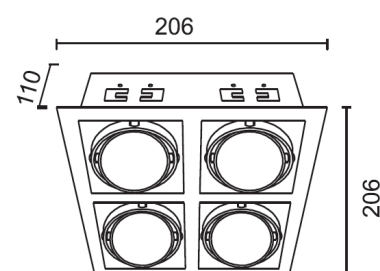
LED 1668-304 -24/36/60 (3x04w)  
 LED 1668-306 -24/36/60 (3x06w)  
 LED 1668-310 -24/36/60 (3x10w)

240V/110V/50Hz



LED 1669-404 -24/36/60 (4x04w)  
 LED 1669-406 -24/36/60 (4x06w)  
 LED 1669-410 -24/36/60 (4x10w)

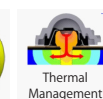
240V/110V/50Hz



Suitable LED lamps for Retta S which  
 can replace energy consuming  
 halogen MR16/GU10 lamps are:

- LED MR16 dimmable LED with G5.3  
 holder with 24/36/60 degrees beam  
 2700k/3000k/4000k

- LED dimmable lamp with GU10 lamp  
 holder with 25/40 degree beam angle in  
 2700k/3000k/4000k



Product description

Window Display Lighting

Stunning and effective window displays are key to drawing potential customers in store. Sololuce lighting has in-depth experience of designing quality, cost effective lighting products designed to give every display area the “wow” factor! Our team of inhouse designers understand the importance of making sure that your products are displayed in the most effective way and lighting should be top of everyone’s list when embarking on new ventures or refreshing tired looking displays.

TinyLux is specially designed LED luminaires for small window display lighting . Luminaires are made of aluminum with 1w LED embedded . These are non integral luminaires and seperate 6w constant current driver 350ma is used to feed 6 nos 1w luminaires .

Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Technical Data: TinyLux

Model No	Beam	Wattage	Nominal Voltage *(V)
LED 1590-01/25	25°	1w	240 / 110
LED 1591-01/25	25°	1w	240 / 110
LED 1592-01/25	25°	1w	240 / 110
LED 1593-01/25	25°	1w	240 / 110
LED 1594-03/25	25°	3w	240 / 110
LED 1595-01/25	25°	1w	240 / 110

\* other voltages also available /please ask for quote



## Product description



Rail is innovative design by Sololuce under Room Concept range.

Aluminum extrusion body with builtin low voltage LED lights embedded illuminate the wardrobe when the door is opened.

### Features:

With motion detector or rocker switch

Beespoke sizes as required

No separate ballast necessary

Wardrobe rail supports included

500mm rail consumes 5w and 1000mm, 8w approx.

Detection range 1-3m.

### Options:

Various aluminum profiles depending on the load requirements are used.

Stainless steel Bars are also available on request.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



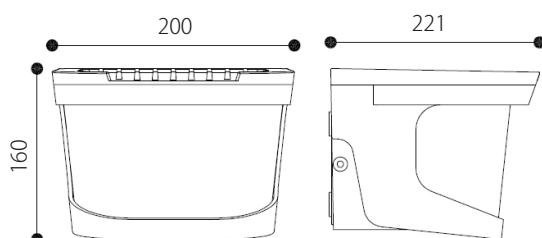
### Technical Data: Rail

Model No	Wattage	Nominal Voltage *(V)
LED 1621-05/500	5w	12v DC
LED 1622-08/1000	8w	12v DC

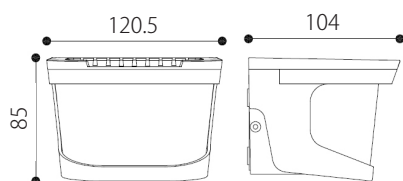
\* other voltages also available /please ask for quote

## Product description

Vivo displays an organic idiom, and its opal surface emanates uniform, diffuse light. Works wonders when mounted on wall for area lighting without intrusion or glare. Made of pressure die cast aluminum with Opal PC lens. Available in two different sizes , its application is most suitable for Exterior Villa lighting , security lighting , Hallway, Hotels or simply as tall bollard .



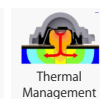
LED 1401-12



LED 1402-03

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Vivo

Model No	Wattage	Nominal Voltage *(V)
LED 1401-12	12w	240 / 110
LED 1402-03	3w	240 / 110

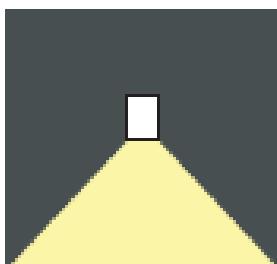
\* other voltages also available /please ask for quote



## Product description

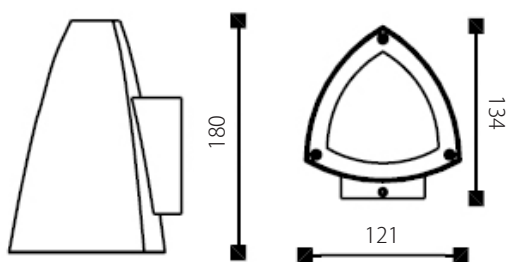
Dynamic and versatile lighting system for general and accent lighting of exhibition spaces, museums, retail outlets and modern residential buildings.

Fixture creates dynamic effect if used wisely for interior or exterior spaces. Fixture is made in aluminum in 3 w Led .



## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



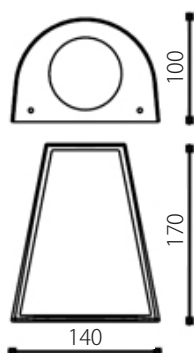
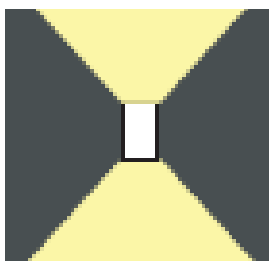
## Technical Data: Bella

Model No	Wattage	Nominal Voltage *(V)
LED 1404-03	3w	240 / 110

\* other voltages also available /please ask for quote



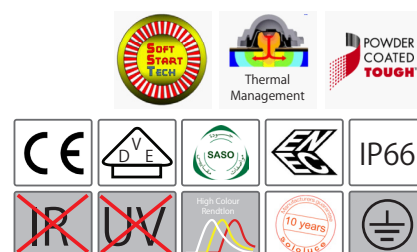
## Product description



Sometimes we need to calm down and concentrate. Our minds need a break. At Sololuce, we will do our part to eliminate noise and unnecessary frills. We believe that all details should be justified by their lighting qualities. Unnecessary design aspects have been eliminated from our products. Vela is an example of this working method. A light source, hidden discretely and suddenly light becomes experienced, distributed and noticeable. Once anonymous – almost invisible and stunningly decorative. Fixture is made in pressure die cast aluminum with corrosion resistant powder coating.

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Vela

Model No	Wattage	Nominal Voltage *(V)
LED 1405-06	6w	240 / 110

\* other voltages also available /please ask for quote

## Product description

LED technology has today made possible the construction of fixtures with substantial innovative values. Minimal power, reduced heat emission, long life span, high efficiency and extremely compact light sources allow Zen to provide effective solutions for compact luminous architectural installations. It is thus possible, at a very low cost and without any maintenance, to produce interesting luminous effects.

Made of long-lasting die cast aluminum and perfect ingress protection they are suitable for wall mounting.

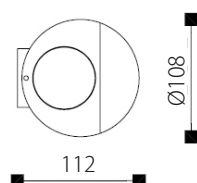
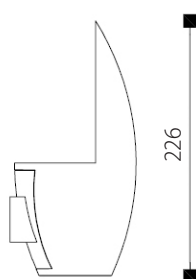
Zen is available in 5w energy efficient Led.



Rusk



Beige



## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Zen

Model No	Wattage	Nominal Voltage *(V)
LED 1403-05	5w	240 / 110

\* other voltages also available /please ask for quote

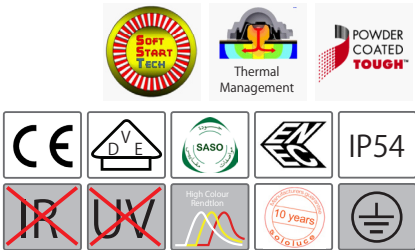
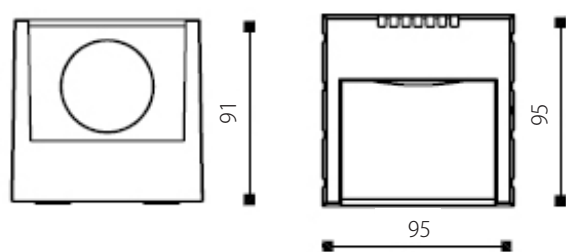
Product description

Distinctive LED wall-mounted luminaire for the illumination of wellness spaces, pools, corridors or as supplementary lighting. The luminaire can be installed with the direction of light pointing downwards. Fixture is made of die cast aluminum in 3w Led.



Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Technical Data: Stilo

Model No	Wattage	Nominal Voltage *(V)
LED 1407-03	3w	240 / 110

\* other voltages also available /please ask for quote

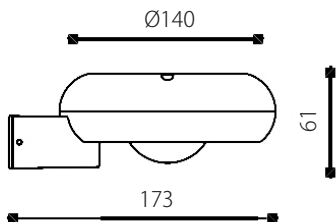
Product description



Gimble is pure functional and idiomatic design that went on to gain acceptance and be celebrated all over the world. The breathtaking fixture emanating charisma and splendour makes a statement in any room.

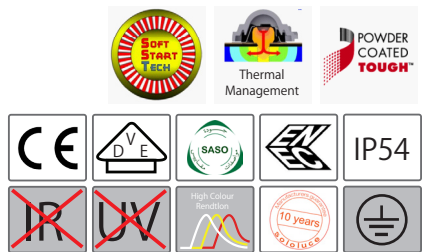
Pressure die cast aluminum body with convex lens. Pure silicon gaskets to provide IP65 protection and stainless steel screws and hardware . Fixture is cromate converted before powder coating.

Fixtures are thermally suitable to accept 3w smd Led.  
Mounting : thru side plate has great application in Hotels lobbies , Malls , Villas , Public places etc.



Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Technical Data: Gimble

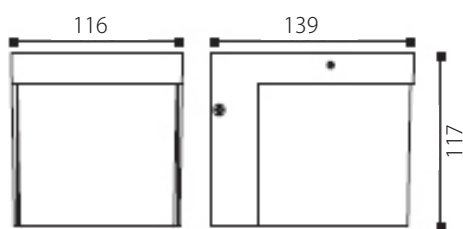
Model No	Wattage	Nominal Voltage *(V)
LED1408-03	3w	240 / 110

\* other voltages also available /please ask for quote

## Product description

A wall-mounted model featuring a subtle and essential design. This luminaire supplies effective lighting wherever an effect of soft elegance is required.

Pressure die cast housing with silicon gaskets and PC lens in IP54 ingress protection make it ideal for indoor as well as outdoor application.



## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

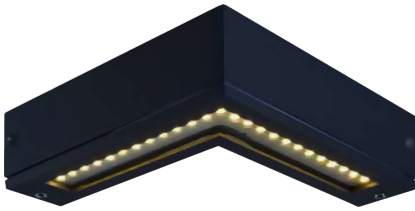


## Technical Data: Cubo

Model No	Wattage	Nominal Voltage *(V)
LED 1410-07	7w	240 / 110

\* other voltages also available /please ask for quote

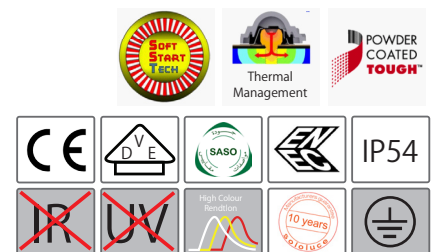
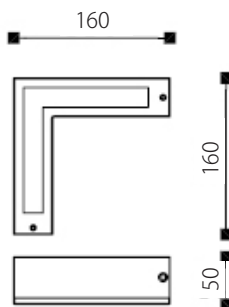
## Product description



The clean and linear design of the Cona has been developed with an eye to smoothly lighting vertical surfaces. The optics system has been specifically devised for Led. Entirely produced in die cast aluminium, offering single fixtures which can be utilised for hi-lighting Pillars, corners in residential or business premises. The Cona range allows spaces look big as it opens space which looks obstacle.

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Cona

Model No	Wattage	Nominal Voltage *(V)
LED1411-05	5w	240 / 110

\* other voltages also available /please ask for quote

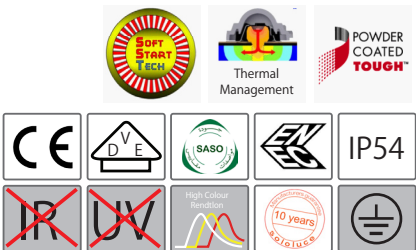
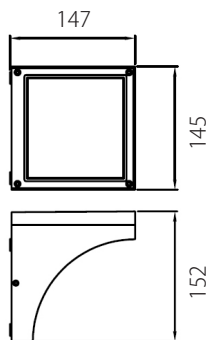


Product description

Professional projectors for general and accent lighting. The constructive sturdiness of this fixtures produced in die-cast aluminium is underlined by a design that emphasises their hardness and aesthetics . The absence of any electrical cable in view, provides additional protection against accidental damage caused by frequent cleaning or maintenance operations, especially in public spaces. Performance is maximised by roto-symmetrical optics in extra-pure aluminium and thermal flow from optics housing is controlled by a suitably aerated necking on the fixture body. The generous volume, finally, allows to apply high-performance, power LED electronics with optimal heat dissipation and guaranteed long life.

Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Technical Data: Meso

Model No	Wattage	Nominal Voltage *(V)
LED 1424-09	9w	240 / 110

\* other voltages also available /please ask for quote

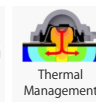
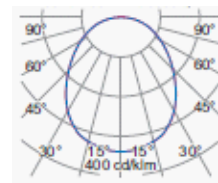
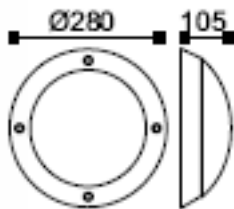
## Product description



Moon is a fitting that was born to light and enhance surfaces, details, and residential areas. A ceiling-mounting system for decorative lighting effects. Moon has been designed with innovative technologies and distributes the light flow evenly. Available in 12 w LED version .

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Moon

Model No	Wattage	Nominal Voltage *(V)
LED 1452-12	12w	240 / 110

\* other voltages also available /please ask for quote

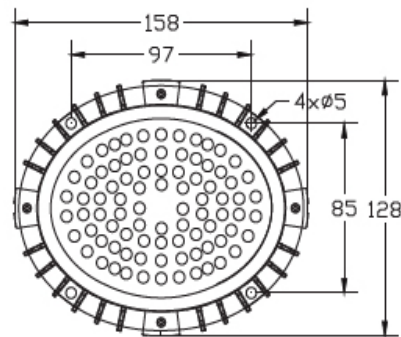
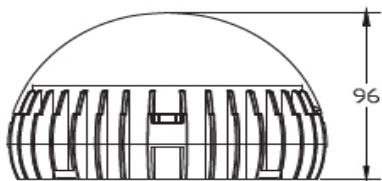


Product description

This compact LED wallpack combines efficiency and functionality with an attractive appearance. By using latest-generation LEDs, Jinni achieves the same levels of performance as wallpacks fitted with compact fluorescent lamps but uses minimal energy.

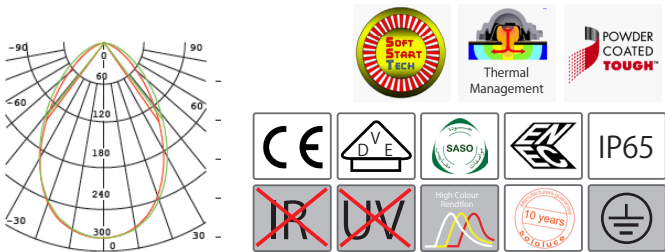
The design of Jinni remains true to the designers' vision: good lighting paints metaphors and sets the stage for life. The accents set by Jinni wherever people go about their daily lives create a wide variety of effects.

Made of die cast aluminum in IP65 ingress protection with PC lens.



Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Technical Data: Jinni

Model No	Wattage	Nominal Voltage *(V)
LED 1520-06	6w	240 / 110

\* other voltages also available /please ask for quote



### Product description

Orion is surface mounted simplistic design which brings character to the wall it is pasted on. A well accepted generic design fixture made of pressure die cast aluminum, now available in energy efficient LED in two sizes 275mm and 220mm.



LED 1457-19



LED 1460-12



LED 1458-19



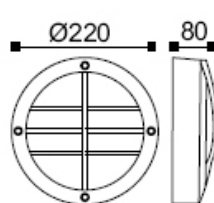
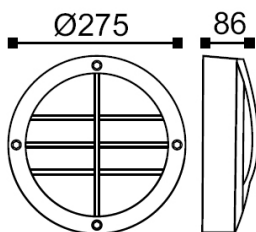
LED 1461-12



LED 1459-19

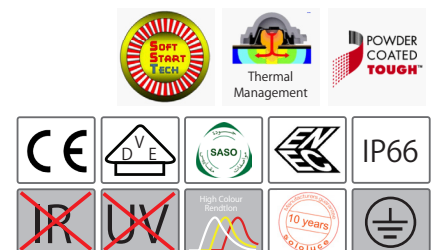


LED 1462-12



### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Orion

Model No	Wattage	Nominal Voltage *(V)
LED 1457-19	19w	240 / 110
LED 1458-19	19w	240 / 110
LED 1459-19	19w	240 / 110
LED 1460-12	12w	240 / 110
LED 1461-12	12w	240 / 110
LED 1462-12	12w	240 / 110

\* other voltages also available /please ask for quote

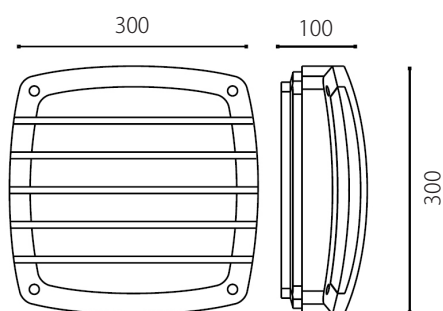
## Product description



LED 1452-19



LED 1453-19



Brik, cleanline fixture which goes with the simple architecture, used for illuminating hallway, Villas, residential apartments, Hotels etc, can be used indoor as well as Outdoors.

Made of pressure die cast aluminum with pure silicon gaskets and ss hardware , the fixture is available in 19w Led.

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

## Technical Data: Brik

Model No	Wattage	Nominal Voltage *(V)
LED 1452-19	19w	240 / 110
LED 1453-19	19w	240 / 110

\* other voltages also available /please ask for quote

### Product description

Small dimensions, but great technical characteristics. Enhancing a range of luminaires whose common elements are elegant design for many applications, in commercial to domestic areas.

Pressure die cast aluminum body with opal polycarbonate lens. Pure silicon gaskets to provide IP54 protection and stainless steel screws and hardware. Fixture is cromate converted before powder coating.

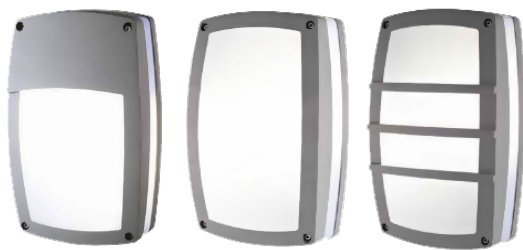
Fixtures are thermally suitable to accept 7w master Led. Mounting thru specially designed eyelids at back plate. Application : Residential apartments , Hotels , Hospitals , Villas etc.



LED 1463-07

LED 1464-07

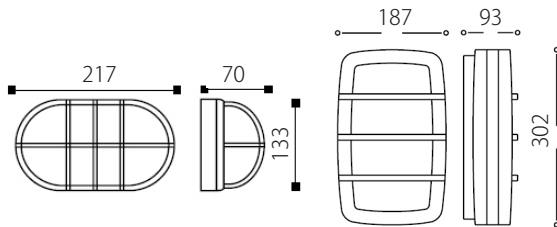
LED 1465-07



LED 1454-07

LED 1455-07

LED 1456-07



### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Ovale

Model No	Wattage	Nominal Voltage *(V)
LED 1463-07	7w	240 / 110
LED 1464-07	7w	240 / 110
LED 1465-07	7w	240 / 110
LED 1454-07	7w	240 / 110
LED 1455-07	7w	240 / 110
LED 1456-07	7w	240 / 110

\* other voltages also available /please ask for quote

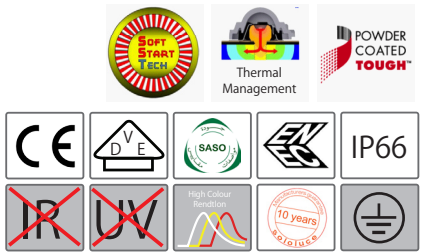
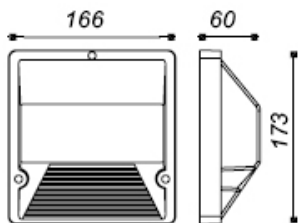


### Product description

Line of wall-mounted products, for indoor and outdoor use, designed to illuminate stairways, corridors, passageways and sidewalks. Their downward facing, diffused beam illumination also makes them the ideal solution for courtesy lighting. Convenient installation and simple electrical connections complete this range of products designed to enhance any type of passageway or connection in a home or commercial building. Housing in pressure die cast with powder coat and stainless steel hardware makes it suitable for indoor and outdoor application .

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Iris-Q

Model No	Wattage	Nominal Voltage *(V)
LED 1431	3w	240 / 110

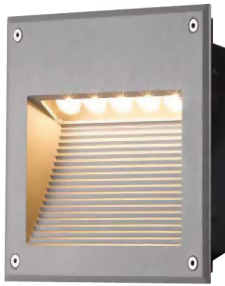
\* other voltages also available /please ask for quote

## Product description

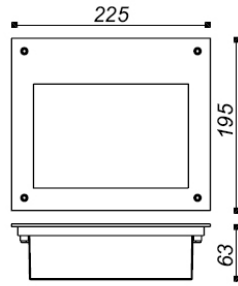
Lighting the space yet no glare to the pedestrian , Stepo does its job it is designed for . Recess mounted goes flush with the wall , invisible during the day and a light house during the night. Made of die cast aluminum in IP65 ingress protection with powder coated externally, luminaire is available in three sizes and in 02, 03 and 05 watt Led

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



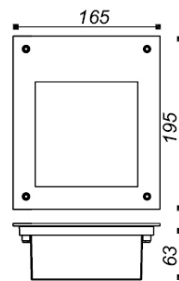
LED 1433-05



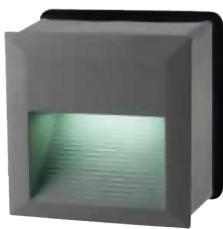
LED 1433-05



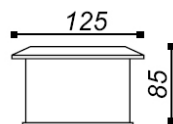
LED 1432-03



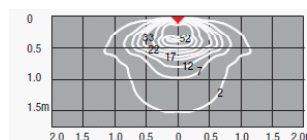
LED 1432-03



LED 1446-02



LED 1446-02



## Technical Data: Stepo

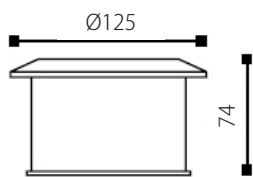
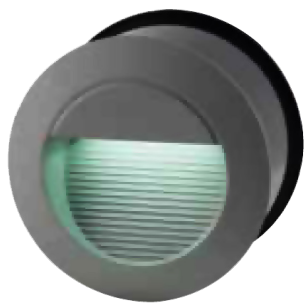
Model No	Wattage	Nominal Voltage *(V)
LED 1432-03	3w	240 / 110
LED 1433-05	5w	240 / 110
LED 1446-02	2w	240 / 110

\* other voltages also available /please ask for quote

Product description

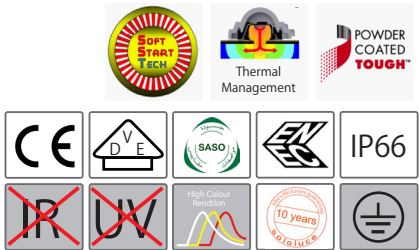
Neptune is a recess mounted glare free light in round shape. Almost hidden the fixture offers subtle light which enhances the beauty of place as well as offers guidance.

Fixture is made of die cast aluminum and is powder coated externally.



Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

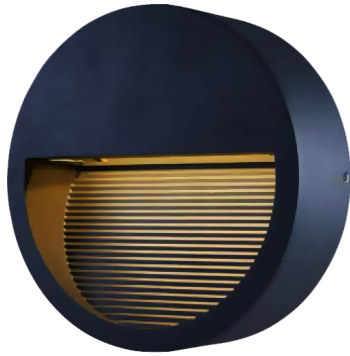


Technical Data: Neptune

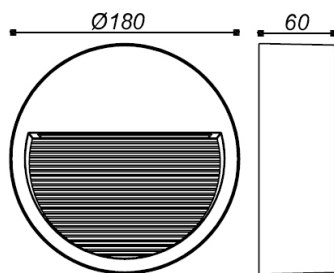
Model No	Wattage	Nominal Voltage *(V)
LED 1445-1.2	1.2w	240 / 110

\* other voltages also available /please ask for quote

### Product description



Line of wall-mounted products, for indoor and outdoor use, designed to illuminate stairways, corridors, passageways and sidewalks. Their downward facing, diffused beam illumination also makes them the ideal solution for courtesy lighting. Convenient installation and simple electrical connections complete this range of products designed to enhance any type of passageway or connection in a home or commercial building. Housing in pressure die cast with powder coat and stainless steel hardware makes it suitable for indoor and outdoor application .



### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Iris-R

Model No	Wattage	Nominal Voltage *(V)
LED 1429-05	5w	240 / 110

\* other voltages also available /please ask for quote

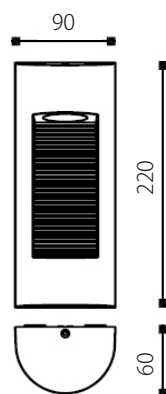


## Product description



Apollo is a surface mounted semi cylindrical fixture made in aluminum. The fixture has been designed to go with the various architectural buildings and also to give pillared enhancement to flat surfaces. The fixture is a beauty during the day and a light house during nighttime.

The fixture comes with smd type Led in 3w.



## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Apollo

Model No	Wattage	Nominal Voltage *(V)
LED 1430-03	3w	240 / 110

\* other voltages also available /please ask for quote

Product description

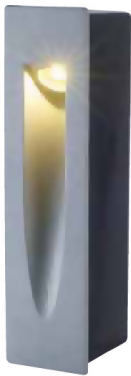
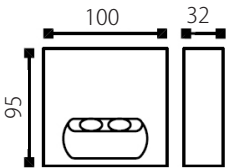
Neo’s minimal design combined with its sophisticated technical features make it suitable for use in a wide range of architectural contexts.

These surface & recessed fixtures with energy efficient LEDs create evocative light effects and are ideal for stairs, steps and ramps in general. Neo retains its bold aesthetics while mounting perfectly on/flush with the wall.

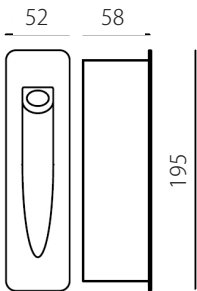
Made of non corrosive aluminum body with powder coat using pure silicon gaskets and stainless steel hardware. Luminaire is available in 02w and 03 w Led



LED 1428-02

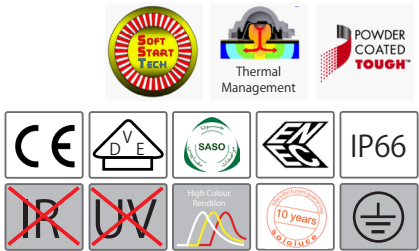
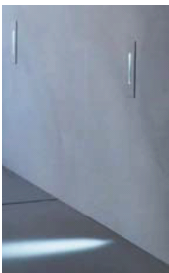


LED 1428-03



Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



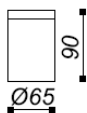
Technical Data: Neo

Model No	Wattage	Nominal Voltage *(V)
LED 1428-02	2w	240 / 110
LED 1434-03	3w	240 / 110

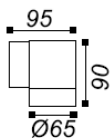
\* other voltages also available /please ask for quote



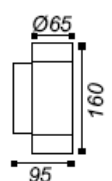
LED 1412-03



LED 1413-03



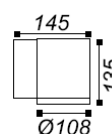
LED 1414-06



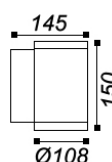
LED 1418-06



LED 1419-06



LED 1420-12



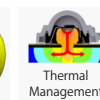
## Product description

A wall-mounted range available with single or double beams. Cendo wall & ceiling is the newest addition to the wall washer line. The ceiling version is ideal for illuminating downwards in many types of areas including doorways, covered areas, entry ways and roofs. Cendo thrives on simplicity - clean lined in design and easy to install. Fixture is made of extruded aluminium cylinder, tempered safety glass, polyester powder coating, with a pluri-processed against corrosion & AISI 304 stainless steel hardway.

Fixture is available in two sizes in 3w to 12w in single and double light emission .

## Compliances:

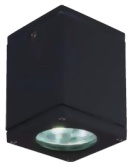
- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



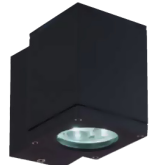
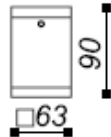
## Technical Data: Cendo

Model No	Wattage	Nominal Voltage *(V)
LED 1412-03	3w	240 / 110
LED 1413-03	3w	240 / 110
LED 1414-06	2x3w	240 / 110
LED 1418-06	6w	240 / 110
LED 1419-06	6w	240 / 110
LED 1420-12	2x6w	240 / 110

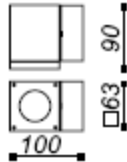
\* other voltages also available /please ask for quote



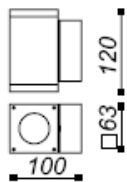
LED 1415-03



LED 1416-03



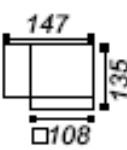
LED 1417-06



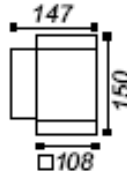
LED 1421-06



LED 1422-06



LED 1423-12



## Product description

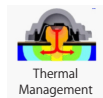
Box offers lighting system for general and accent lighting of exhibition spaces, museums, retail outlets and modern residential buildings.

Simple construction hides the complex technical features offering the best heat dissipation to the Led light source, made of sturdier die cast aluminum and tempered lens .

Fixture available in two sizes.

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Box

Model No	Wattage	Nominal Voltage *(V)
LED 1415-03	3w	240 / 110
LED 1416-03	3w	240 / 110
LED 1417-06	2x3w	240 / 110
LED 1421-06	6w	240 / 110
LED 1422-06	6w	240 / 110
LED 1423-12	2x6w	240 / 110

\* other voltages also available /please ask for quote

# POLO



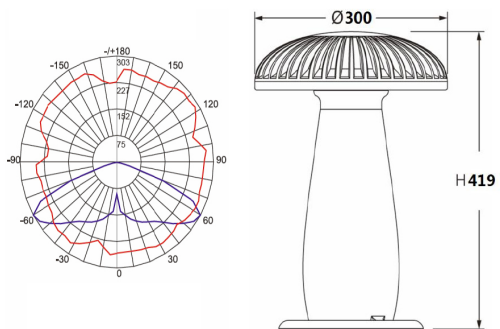
## Product description

Harmonious by day, romantic by night. Polo is the antithesis of the “decorative” Bollard which emits the balanced and non polluting light, that should be the first requirement for quality public lighting.

Fixture is made of die cast aluminum housing with non corrosive powder coating in IP66 protection with 10w smd Led .

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Polo

Model No	Wattage	Nominal Voltage *(V)
LED 1304-10	10w	240 / 110

\* other voltages also available /please ask for quote

## Product description

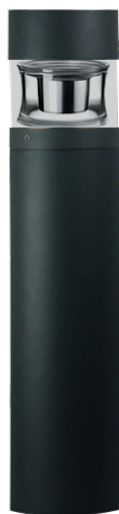
Die-cast aluminium head unit with clear polycarbonate outer tube. Shaft made of aluminum tube, externally powder coated, with Integral control gear.

Bollard supplied with anchor bolt fixing. Mounting height 800mm & 1000mm. Access to the lamp and control gear by removing the head.

Bollards in round head and flat head are available in two special Convex and Concave Optics to create dynamic surroundings in energy efficient 7w Led.



LED 1479- R-CX  
LED 1479-R-CE



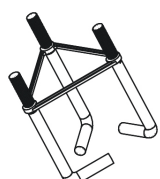
LED 1480-F-CX  
LED 1480-F-CE



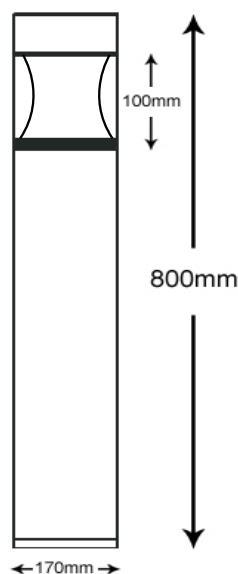
Concave Optics-CE



Convex Optics-CX

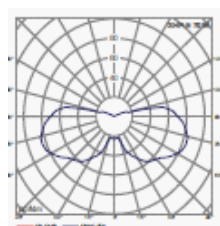


Anchor bolt mounting



## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Neero

Model No	Wattage	Nominal Voltage *(V)
LED 1479- R-CX	7w	240 / 110
LED 1479-R-CE	7w	240 / 110
LED 1480-F-CX	7w	240 / 110
LED 1480-F-CE	7w	240 / 110

\* other voltages also available /please ask for quote

## Product description



This decorative bollards for lighting pedestrian walk ways and squares has become an established feature of our range, available in LED versions it combine aesthetics and ecology Luxor LED is made of extrusion aluminium square pipe of high thermal conductivity. Excellent powder coating ensures high protection and excellent long life and is available in 8w smd Led .

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Luxor

Model No	Wattage	Nominal Voltage *(V)
LED 1427-08	8w	240 / 110

\* other voltages also available /please ask for quote



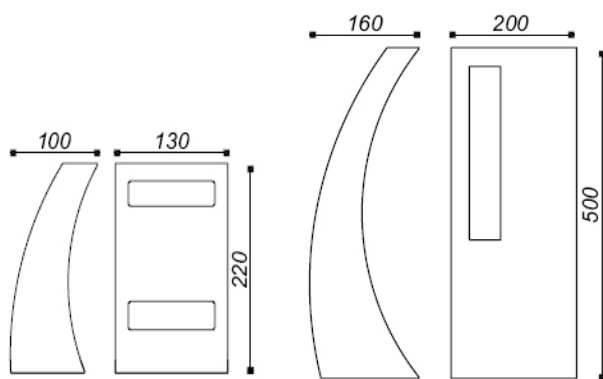
### Product description

Arch shape beautifully designed luminaires, can be used both for indoor and outdoor application. Rondo has two light windows and Vento comes with one light window. Rondo can also be used as wall mount fixture in both up or down lighting and Vento is primarily is surface mount. Both the fixtures are made of aluminum die cast.



Rondo

Vento

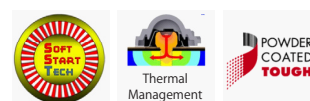


LED 1425-6

LED 1426-9

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Rondo, Vento

Model No	Wattage	Nominal Voltage *(V)
LED 1425-6	6w	240 / 110
LED 1426-9	9w	240 / 110

\* other voltages also available /please ask for quote

### Product description

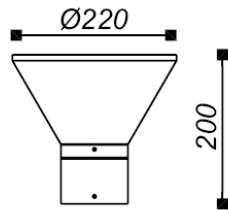
Simplistic yet innovative enough for interior as well as exterior applications, Nova suffices the lighting designers requirements.

Made in aluminum with polycarbonate lens, Nova supports highly efficient 7w master Leds.

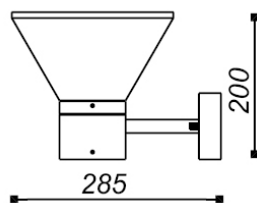
Fixture is available in wall mount and base mount models and suitable for Villas , landscapes, hotels, entertainment places etc ..



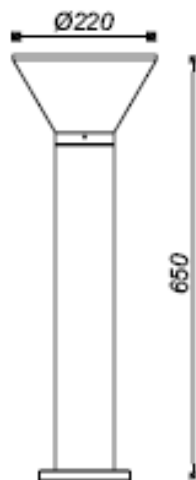
LED 1447-07



LED 1448-07



LED 1449-07



### Compliances:

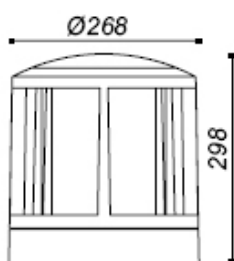
- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Nova

Model No	Wattage	Nominal Voltage *(V)
LED 1447-07	7w	240 / 110
LED 1448-07	7w	240 / 110
LED 1449-07	7w	240 / 110

\* other voltages also available /please ask for quote



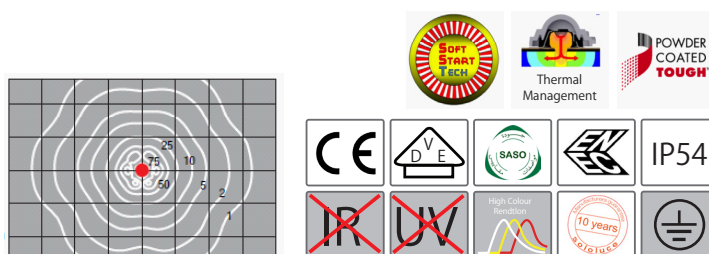
### Product description

Quanto , features a bold formal language and a subtle retro form – has been designed to cater for the area lighting / landscape lighting as an essential aid in conveying an effective, distinctive message, with a balanced price-quality ratio.

Produced in sturdy, long-lasting aluminum die cast , they are equipped with high-performance optics to optimize lamp performance and lower operating costs. Fixture with diffused PC optics is suitable both for accent and diffuse lighting of walking and transit ways.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Quanto

Model No	Wattage	Nominal Voltage *(V)
LED 1450-07	7w	240 / 110

\* other voltages also available /please ask for quote

### Product description

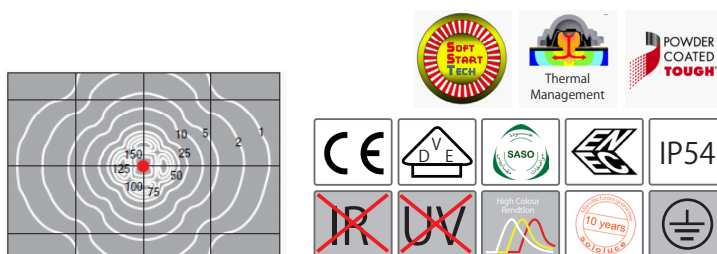
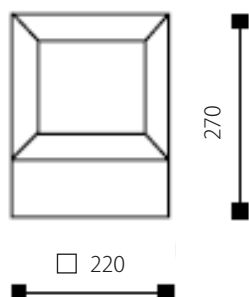


The clean and linear design of the Punto has been developed with an eye to smoothly lighting surrounding surfaces.

Fixture produced in die cast aluminium, with PC lens fixture offers right solution for exterior area lighting and landscape lighting or pathways.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Punto

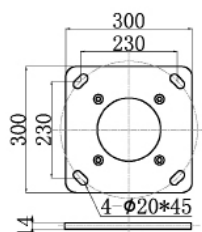
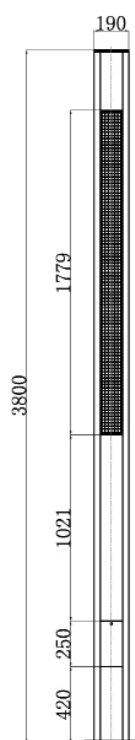
Model No	Wattage	Nominal Voltage *(V)
LED 1451-07	7w	240 / 110

\* other voltages also available /please ask for quote

## Product description

IDUS combines exceptional design with modern technology and is the ideal solution for walkways, parks and squares. It complements its location to give a unique atmosphere. IDUS is made in corrosion free extrusion aluminium and vandal resistant PC or tempered glass , giving it superior durability.

It is available in height of 3.8m in powder coated black as standard but other non standard RAL colours available on request .



## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: IDUS

Model No	Wattage	Nominal Voltage *(V)
LED1665-20	20w	240 / 110
LED 1665-40	40w	240 / 110

\* other voltages also available /please ask for quote

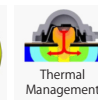
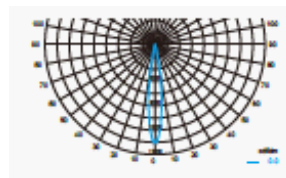
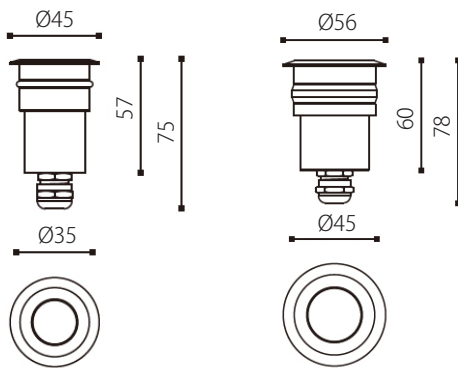
## Product description

Enhancing space while keeping low profile, Inox has been designed to create ambience. Suitable for Wall or Floor mounting, Inox is completely made in Stainless Steel with IP67 ingress protection.

It is available 15/30/45/60 degree beam and in 1w and 3w options.

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Inox

Model No	Wattage	Beam Angle	Nominal Voltage *(V)
LED 1482-01A	1w	15°	240 / 110
LED 1482-01B	1w	30°	240 / 110
LED 1482-01C	1w	45°	240 / 110
LED 1482-01D	1w	60°	240 / 110
LED 1483-03A	3w	15°	240 / 110
LED 1483-03B	3w	30°	240 / 110
LED 1483-03C	3w	45°	240 / 110
LED 1483-03D	3w	60°	240 / 110

\* other voltages also available /please ask for quote

### Product description

Thanks to Sololuce's experience in outdoor lighting a new line of products dedicated to the most private areas of the home and wellness centres has been developed. Although the water and humidity of these environments make appealing lighting difficult to achieve, these can be offered discreetly and simply by the Atom line. Complete Atom line made of non corrosive aluminum body with SS cover plate in 1 watt and 3 watt Led



LED 1437-01



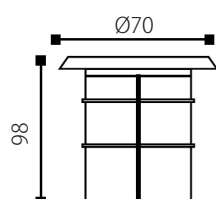
LED 1438-03



LED 1439-01

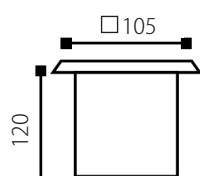


LED 1440-03



LED 1437-01

LED 1439-01



LED 1438-03

LED 1440-03

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Atom

Model No	Wattage	Nominal Voltage *(V)
LED 1437-01	1w	240 / 110/12v DC
LED 1438-03	3w	240 / 110/12v DC
LED 1439-01	1w	240 / 110/12v DC
LED 1440-03	3w	240 / 110/12v DC

\* other voltages also available /please ask for quote

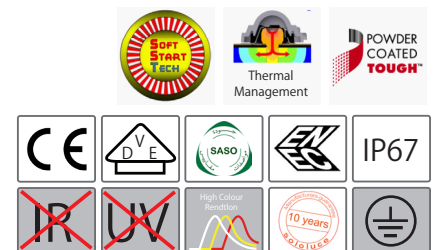
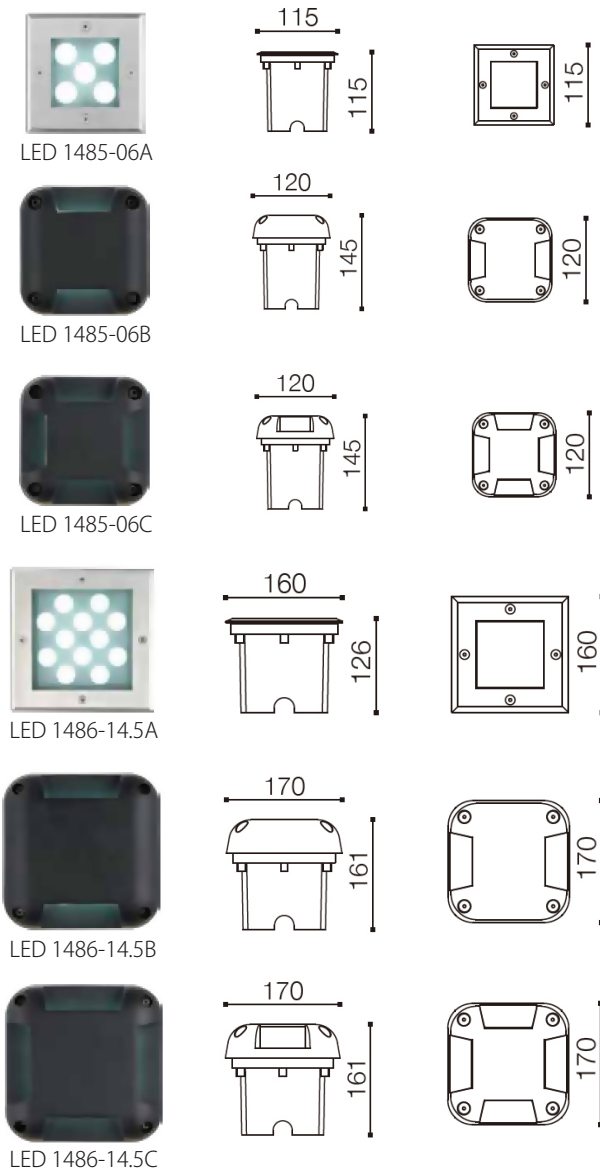
### Product description

Recessed wall and floor mounted luminaires draw the attention of architectural features.

- Light proof housing made of die cast aluminum
- Tempered safety glass, clear or matt
- Protection class IP 67.
- SS Cover
- Beam Angles - 15°, 30°, 45° & 60° in top open version .

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Tile

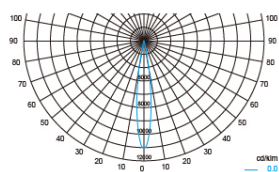
Model No	Wattage	Nominal Voltage *(V)
LED 1485-06A	6w	240 / 110
LED 1485-06B	6w	240 / 110
LED 1485-06C	6w	240 / 110
LED 1486-14.5A	14.5w	240 / 110
LED 1486-14.5B	14.5w	240 / 110
LED 1486-14.5C	14.5w	240 / 110

\* other voltages also available /please ask for quote

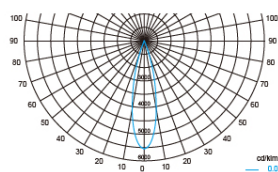




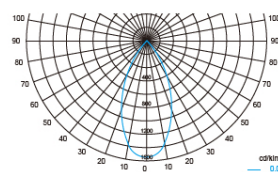
Lighting to give value, guide the way, enhance an architectural, commercial or natural space. Disk fixtures, completely made of die cast body with SS304 cover plate, are suitable to be installed in environments with aggressive weather conditions. Suitable for vehicular and pedestrian traffic as well. Available in IP67 ingress protection with energy efficient 3w, 18w and 35w LED. Available optics in beam angles of 15/30/45 & 60 degrees



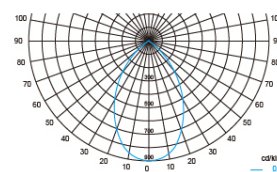
Lamp Power : 35W Beam Angle : 15°		
Distance	Average Illuminance	Diameter
4m	1750 lx	1.04 m
8m	435 lx	2.08 m
12m	190 lx	3.12 m
16m	105 lx	4.16 m
20m	65 lx	5.20 m



Lamp Power : 35W Beam Angle : 30°		
Distance	Average Illuminance	Diameter
2m	1690 lx	1.08 m
4m	420 lx	2.16 m
6m	195 lx	3.24 m
8m	105 lx	4.32 m
10m	65 lx	5.40 m



Lamp Power : 35W Beam Angle : 45°		
Distance	Average Illuminance	Diameter
2m	740 lx	1.66 m
4m	185 lx	3.32 m
6m	80 lx	4.98 m
8m	45 lx	6.64 m
10m	25 lx	8.30 m



Lamp Power : 35W Beam Angle : 60°		
Distance	Average Illuminance	Diameter
1m	1450 lx	1.15 m
2m	360 lx	2.30 m
3m	160 lx	3.45 m
4m	90 lx	4.60 m
5m	55 lx	5.75 m



Specially designed electronic circuit for soft start to save stress on LEDs and other components



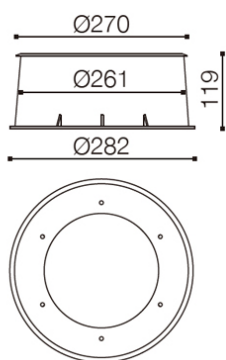
Thermally efficient design to keep the LED junction temperature within defined limits.



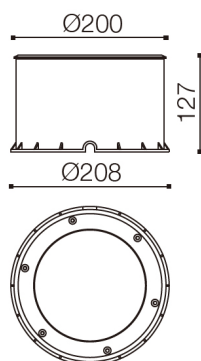
Luminaire is powder coated after chromate conversion to make the powder coat last longer

### Compliances:

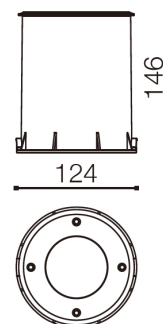
- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



LED 1208-35





LED 1209-18



LED 1210-03



## Technical Data: Disk

	Model No	Beam angle	Wattage	Nominal Voltage *(V)
	LED 1208-35 /15	15°	35w	240 / 110
	LED 1208-35 /30	30°	35w	240 / 110
	LED 1208-35 /45	45°	35w	240 / 110
	LED 1208-35 /60	60°	35w	240 / 110
	LED 1209-18/15	15°	18w	240 / 110
	LED 1209-18/30	30°	18w	240 / 110
	LED 1209-18/45	45°	18w	240 / 110
	LED 1209-18/60	60°	18w	240 / 110
	LED 1210-03/15	15°	3w	240 / 110
	LED 1210-03/30	30°	3w	240 / 110
	LED 1210-03/45	45°	3w	240 / 110
	LED 1210-03/60	60°	3w	240 / 110

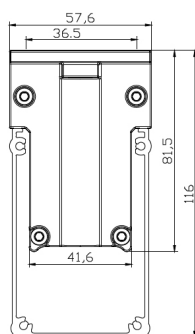
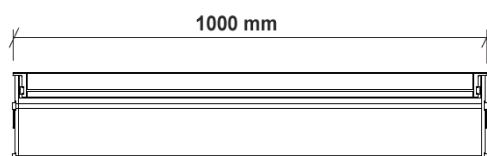
\* other voltages also available /please ask for quote

## Product description

Technology and creativity are all contained in this functional lighting instrument, offering perfect light direction. Linea is a complete system, which, via technologically evolved leds, is able to adapt itself to the most diverse architecture, building exteriors, facades, etc. Made of extruded aluminum with tempered glass in IP67 ingress protection .

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



15°



25°



45°



60°



## Technical Data: Linea

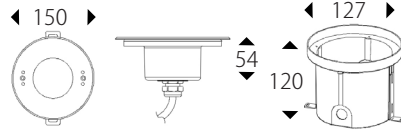
Model No	Wattage	Nominal Voltage *(V)
LED 1203-20	20w (1w LED)	240 / 110
LED 1203-10	10w (0.1w LED)	240 / 110
LED 1203-14	14w (0.3w LED)	240 / 110

\* other voltages also available /please ask for quote

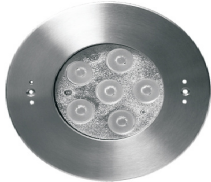
## Product description



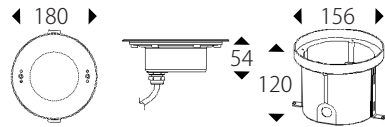
LED 1575-9



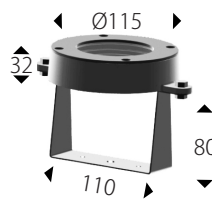
H<sub>2</sub>O beam is collection of luminaires for illuminating Fountains, Swimming Pools and water bodies. All luminaires are made of stainless steel with IP68 Ingress Protection Class. LEDs available in cool white /warm white colour



LED 1576-18



LED 1579-12

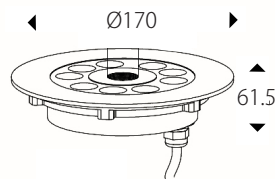


## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



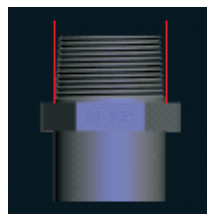
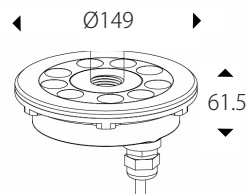
LED 1577-18



Water Jet pipe 3/8' taper for 1577/78 Models



LED 1578-18

Technical Data: H<sub>2</sub>O-Beam

Model No	Wattage	Beam Angle	Nominal Voltage *(V)
LED 1575-9 (SY/ASY)	9w	30°	24v DC
LED 1576-18 (SY/ASY)	18w	30°	24v DC
LED 1577-18	18w	25°	24v DC
LED 1578-18	18w	25°	24v DC
LED 1579-12	12w	15°	24v DC

\* other voltages also available /please ask for quote



LED 1560-7.5



LED 1561-15



LED 1562-30



LED 1563-45

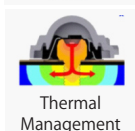
With H<sub>2</sub>O range our designers have created luminaires that cannot fail to impress with their straightforward, slim lines and highly expressive, refined stainless steel grade 316 materials. H<sub>2</sub>O discreetly fits into the water body without ever upstaging the architect's or designer's vision. The emphasis is on the light, not on the luminaire. Due to LED technology, the light effect created by these luminaires is precise and highly effective which could not be achieved so far with gas discharge lamps.

Luminaires come with IP68 ingress protection and suitable for fountain lighting / waterbodies lighting, River, stream lighting, Under bridge lighting etc.

Various optics in 15 deg/30 deg/45 deg and 60 deg available



Specially designed electronic circuit for soft start to save stress on LEDs and other components



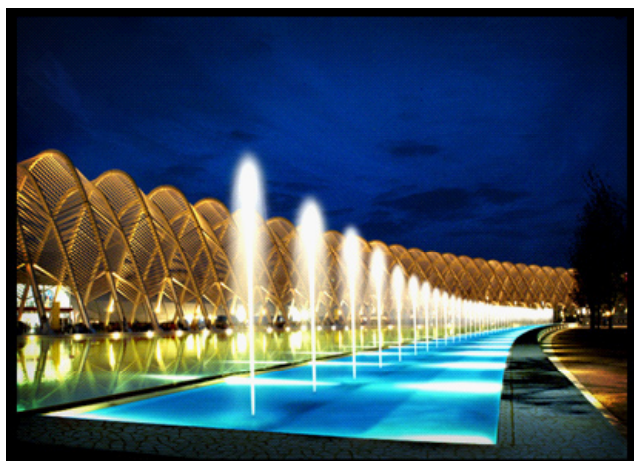
Thermally efficient design to keep the LED junction temperature within defined limits.

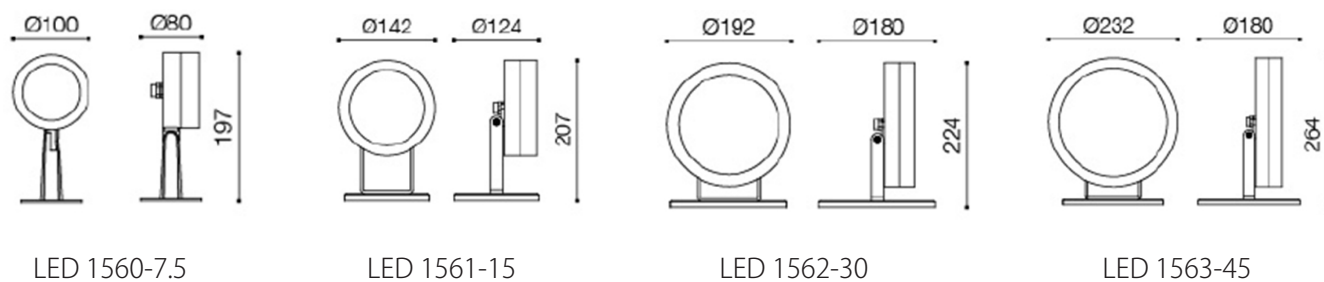


Luminaire is powder coated after chromate conversion to make the powder coat last longer

#### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Technical Data: H<sub>2</sub>O flood

	Model No	Beam angle	Wattage	Nominal Voltage *(V)
	LED 1560-7.5/15	15°	7.5w	24v DC
	LED 1560-7.5/30	30°	7.5w	24v DC
	LED 1560-7.5/45	45°	7.5w	24v DC
	LED 1560-7.5/60	60°	7.5w	24v DC
	LED 1561-15/15	15°	15w	24v DC
	LED 1561-15/30	30°	15w	24v DC
	LED 1561-15/45	45°	15w	24v DC
	LED 1561-15/60	60°	15w	24v DC
	LED 1562-30/15	15°	30w	24v DC
	LED 1562-30/30	30°	30w	24v DC
	LED 1562-30/45	45°	30w	24v DC
	LED 1562-30/60	60°	30w	24v DC
	LED 1563-45/15	15°	45w	24v DC
	LED 1563-45/30	30°	45w	24v DC
	LED 1563-45/45	45°	45w	24v DC
	LED 1563-45/60	60°	45w	24v DC

\* other voltages also available /please ask for quote



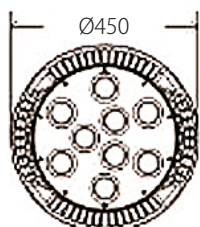




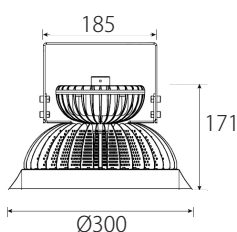
PowerLux Highbay is a clear example of stylistic idiom and high functionality. Fixture optics is designed for maximum intensity and no light scattering. Fixture is made of die cast aluminum with special fins on reflector for better heat dissipation. PowerLux is available in two sizes, smaller version is upto 120w and bigger version is upto 200w.

This versatile fixture is not only suitable for warehouse lighting but recommended for lighting of public or private environments, show rooms, halls, commercial and sport areas, etc.

Made of pressure die cast aluminum with special optics powerLED modules with external powder coat.



LED 1634



LED 1633

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Powerlux

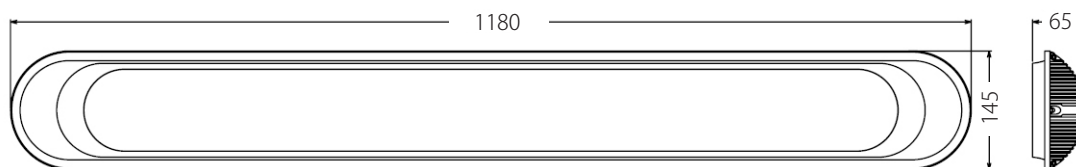
Model No	Wattage	Nominal Voltage *(V)
LED 1633-80	80w	240 / 110
LED 1633-100	100w	240 / 110
LED 1633-120	120w	240 / 110
LED 1634-150	150w	240 / 110
LED 1634-180	180w	240 / 110
LED 1634-200	200w	240 / 110

\* other voltages also available /please ask for quote





A striking appearance, when it comes to flexibility, cost saving and user-friendliness Titan offers the best solution to light all settings where no visually demanding tasks are carried out such as, warehouse, waiting rooms, corridors, reception areas, atriums, underground parking and archives. Manufactured in aluminium extrusion alloy, and PC diffuser allows professionals to design lighting installations with the utmost flexibility and lowest costs. Ceiling mount or hanging, both versions available. Fixture is made of aluminum extrusion with PC diffuser achieving IP66 protection class. Led available in warm white & white CCT.



#### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



#### Technical Data: Titan

Model No	Wattage	Nominal Voltage *(V)
LED 1635-35	35w	240 / 110
LED 1636-45	45w	240 / 110
LED 1637-70	70w	240 / 110

\* other voltages also available /please ask for quote

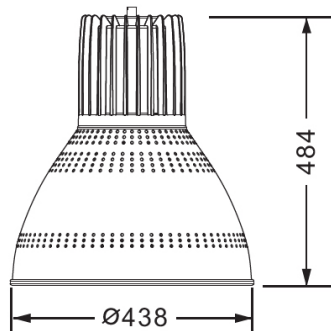
# Indure



### Product description

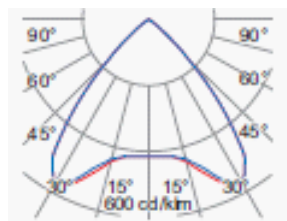


With a strong, pleasing and modern style, Indure is designed to take advantage of direct lighting for large architecturally significant buildings. High power LED guarantee top light efficiency. Component compartment made of extruded aluminium with die-cast aluminium end caps and silicon gaskets. Turned aluminium diffuser, with anodized exterior finish. Fixture is available in 90w and 120w Led.



### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Indure

Model No	Wattage	Nominal Voltage *(V)
LED 1110-90	90w	240 / 110
LED 1110-120	120w	240 / 110

\* other voltages also available /please ask for quote

# Sundown



## Product description



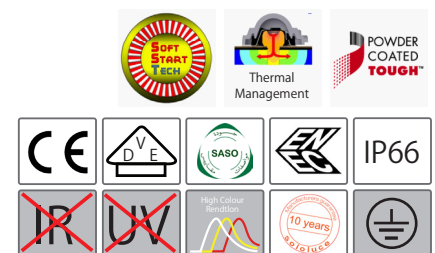
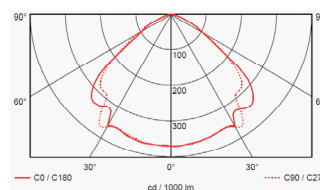
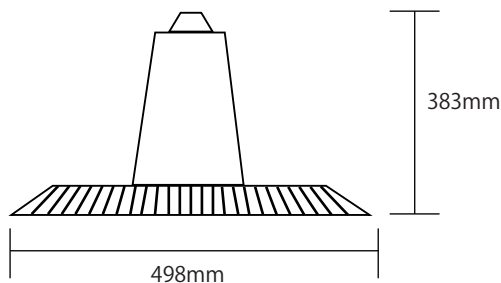
The style of this range of pendants is reminiscent of traditional industrial framing design, suitable to elegantly address the lighting design needs of settings such as factories, warehouses, shops, trade fair pavilions, shopping centres, foyers and corridors. A particularly interesting technology has been employed in the sundown pendant model, which features micro-prismatic anti-glare optics. Fixture is made of die cast aluminum with special fins on reflector for better heat dissipation.

Sundown is available in 498mm dia size, in 90w/115w and 140w Led.



## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Sundown

Model No	Wattage	Nominal Voltage *(V)
LED 1112-90	90w	240 / 110
LED 1112-115	115w	240 / 110
LED 1112-140	140w	240 / 110

\* other voltages also available /please ask for quote

## Product description

The first of its kind, the Sololuce Pulsar Series LED High Bay luminaires were designed specifically to replace conventional high bay lighting fixtures in locations like Factories, Exhibition Halls, Warehouses, Hypermarkets, Airport Hangers, Ports etc. It's low profile light weight design allows for increased mounting versatility and ease of installation. All of Sololuce long life LED luminaires are designed to meet the most demanding specification criteria while offering maximum energy savings, reduced maintenance costs, and a superior quality of light.

Luminaires are made in pressure die cast aluminum, silicon gaskets, SS hardware and powdercoated externally. Fixtures come with IP66 ingress protection.



LED 1490-70



LED 1491-100



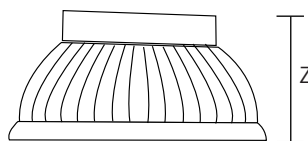
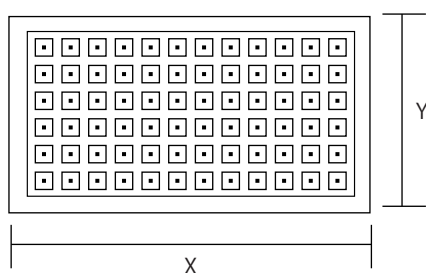
LED 1492-130



LED 1493-160



LED 1494-200



### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

Model	X	Y	Z
LED 1490-70	300	265	220
LED 1491-100	380	265	220
LED 1492-130	460	265	220
LED 1493-160	535	265	220
LED 1494-200	620	265	220



### Technical Data: Pulsar

Model No	Wattage	Nominal Voltage *(V)
LED 1490-70	70w	240 / 110
LED 1491-100	100w	240 / 110
LED 1492-130	130w	240 / 110
LED 1493-160	160w	240 / 110
LED 1494-200	200w	240 / 110

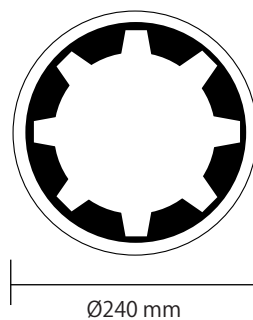
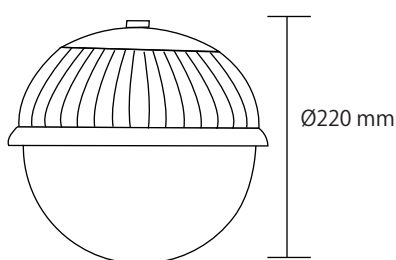
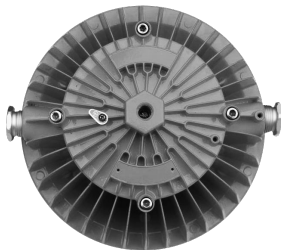
\* other voltages also available /please ask for quote

### Product description

An exclusive design where high performance meets top-quality finishes. The round shape, offers more surface area to allow better heat dissipation in this compact size .

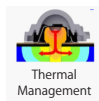
Particular care taken in designing the heat dissipation system and the PCB control electronics allows to fully exploit the potentiality of each individual LED, capable of reaching high lighting efficiency .

Die cast aluminum fixture is available in 25w,40w & 60w Led in IP66 protection class .



### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Optagon

Model No	Wattage	Nominal Voltage *(V)
LED 1478-25	25w	240 / 110
LED 1478-40	40w	240 / 110
LED 1478-60	60w	240 / 110

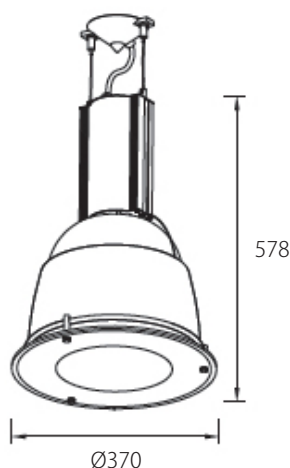
\* other voltages also available /please ask for quote





LED 1475-30

LED 1475-50

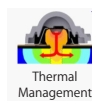
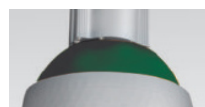
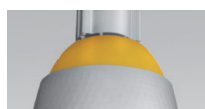


## Product description

Notte stands for modern luminaire design for shopping centres and exhibition spaces, representative public buildings, airports, hotels and restaurants. The exceptional aesthetics of this luminaire is one persuasive factor; the technology that combines decades of Sololuce experience with the highest quality standards is another. Installing these luminaires is easy, and their equally easy maintenance underscores the holistic concept that is so typical of Sololuce. Notte thus seamlessly integrates into modern architectural surroundings and excels as a modern intervention in heritage buildings. Housing is made of heat dissipating cooling fins made of aluminum extrusion profile, aluminum reflector with frosted drop glass with weather resistant powder coat after cromate concersion process. Pure silicon gaskets and stainless steel hardware.

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

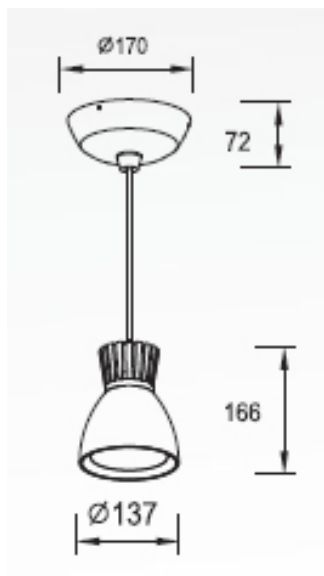


## Technical Data: Notte

Model No	Wattage	Nominal Voltage *(V)
LED 1475-30	30w	240 / 110
LED 1475-50	50w	240 / 110

\* other voltages also available /please ask for quote

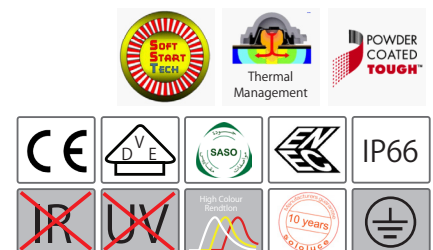
### Product description



Tiara stands for modern luminaire design for shopping centres and exhibition spaces, representative public buildings, airports, hotels and restaurants. The exceptional aesthetics of this luminaire is one persuasive factor; the technology that combines decades of Sololuce experience with the highest quality standards is another. Installing these luminaires is easy, and their equally easy maintenance underscores the holistic concept that is so typical of Sololuce. Tiara thus seamlessly integrates into modern architectural surroundings and excels as a modern intervention in heritage buildings. Housing is made of heat dissipating cooling fins made of die cast aluminum, aluminum reflector with front glass with weather resistant powder coat after chromate conversion process. Pure silicon gaskets and stainless steel hardware.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Tiara

Model No	Wattage	Nominal Voltage *(V)
LED 1499-12	12w	240 / 110

\* other voltages also available /please ask for quote

Product description

LED in the heart of fixture with round opal polycarbonate tube with endcaps offers energy efficient solutions for lighting underground tunnels, Railway stations, Bus stops, parking areas, pathways in both wall or ceiling mount applications.

Color temperature available:  
2700k-3000k, 4000k-4500k, 6000k-6500k

Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Model	L	D	H
LED 1630	720	90	97
LED 1631	1350	90	97
LED 1632	1620	90	97

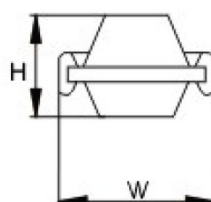
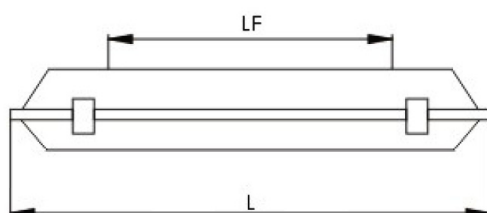


Technical Data: Duetto

Model No	Wattage	Nominal Voltage *(V)
LED 1630-14	14w	240 / 110
LED 1631-24	24w	240 / 110
LED 1632-35	35w	240 / 110

\* other voltages also available /please ask for quote

## Product description



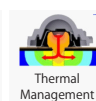
Model	L	W	H	LF
LED 1470-18	600	85	70	340
LED 1471-36	1200	85	70	830

A polycarbonate exterior and an original and technological design makes these LED fittings stand out. IP66 certifies the elevated resistance to dust and water penetration, making the fittings ideal instruments for work spaces, industrial areas, stations, undergrounds, pedestrian areas, parking areas or other spaces that have both interior as well as exterior components. Lighting is homogeneous and direct glare is reduced thanks to the stripes on the entire body of the fitting.

Available in two lengths 600 and 1200 mm, in two wattages of 18 and 36w .

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Policar

Model No	Wattage	Nominal Voltage *(V)
LED 1470-18	18w	240 / 110
LED 1471-36	36w	240 / 110

\* other voltages also available /please ask for quote

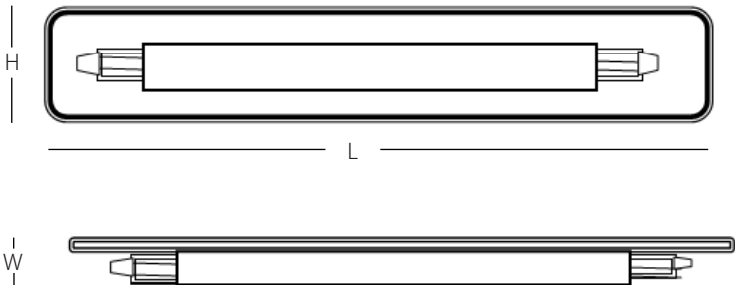
Product description



Policar Ecoled is specially designed weatherproof Led luminaire from Sololuce design centre .  
Sleek polycarbonate exterior body with MCPCB with Leds mounted on it with requisite thermal heat dissipation .  
A polycarbonate exterior and an original and technological design makes these LED fittings stand out. IP66 certifies the elevated resistance to dust and water penetration, making the fittings ideal instruments for work spaces, industrial areas, stations and undergrounds, pedestrian areas,, parking areas or other spaces that have both interior as well as exterior components.  
Lighting is homogeneous and direct glare is reduced thanks to special optics inbuilt .

Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Technical Data: Policar Ecoled

Model No	Wattage	L*W*H	Nominal Voltage *(V)
LED 1616-10	10w	600*62*70	240 / 110
LED 1617-20	20w	1200*62*70	240 / 110
LED 1618-28	28w	1500*62*70	240 / 110

\* other voltages also available /please ask for quote

### Product description



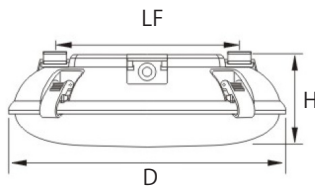
Simplistic Luna hides the most intricate electronic inside. Intelligent Heat dissipation designed without destroying the beauty of luminaire. Surface mounted Polycarbonate fixture suitable for car parks, Halls, Foyers and Hypermarkets. Available in two sizes of 300mm and 350mm with smd mounted Led of 15w and 20w.

Clear/opal polycarbonate cover option available.

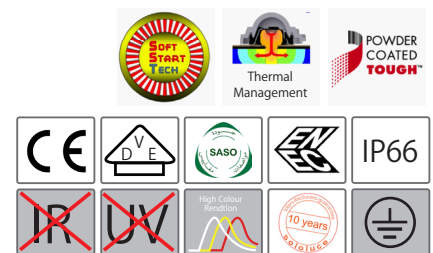


### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



Model	D	H	LF
LED 1472-15	300	100	200
LED 1473-20	350	107	250



### Technical Data: Luna

Model No	Wattage	Nominal Voltage *(V)
LED 1472-15	15w	240 / 110
LED 1473-20	20w	240 / 110

\* other voltages also available /please ask for quote

## Product description

The benefits of good vertical lighting in petrol stations recently received serious attention. The typical long operation hours of petrol stations demands highly efficient lighting. Drivers require to see clearly for improved safety. And even at a distance, light glow brightly acting as a beacon for the weary traveler.

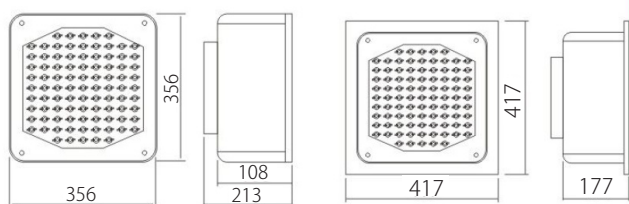
Canlux is efficient , low glare, recessed / surface-mounted specially designed luminaire for lighting of filling stations and other canopies. Luminaire is available in 80w and 100w led with 130 degree optics . Aluminium front visor (powdercoated in white) which carries heat-resistant toughened glass and silicon rubber gasket. Canlux offers Excellent uniform light distribution with a omni-directional beam, ensured by specially placed optics. The beam pattern creates excellent vertical illuminance as required on vertically oriented objects like pump islands. Specially designed mounting arrangement allows quick and easy installation. Luminaire is insect free and provides IP66 protection. Fixture is suitable for use in Petrol and service stations area with overhead canopies Installation . Designed for surface as well as recess mounting on a false ceiling.



LED 1495



LED 1496



LED 1495

LED 1496

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Canlux

Model No	Wattage	Nominal Voltage *(V)
LED 1495-80	80w	240 / 110
LED 1495-100	100w	240 / 110
LED 1496-80	80w	240 / 110
LED 1496-100	100w	240 / 110

\* other voltages also available /please ask for quote



## Product description

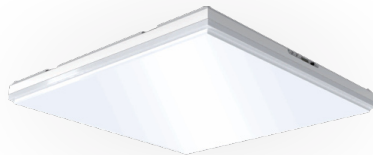
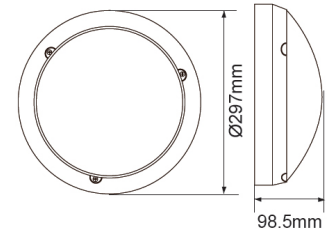
Xenon and Proton are Infrared Motion Sensor based LED ceiling luminaire which can identify day and night automatically, adopting PIR sensor and integrated circuit. When a human body enters its detecting zone, the PIR sensor's light goes on, once leaving, the light will go off according to its set time. Fixture Housing is made of die casting aluminium / sheet metal with static plastic-spraying finish & UV-resistant powder.



LED 1466-15

### Xenon

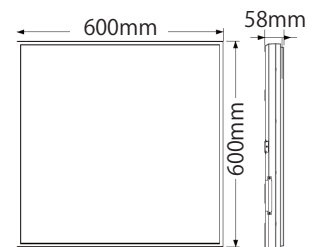
Rated load 15w  
LED specifications: 96 nos smd  
Detection angle 360 degree  
Detection range 10m radius adjustable  
Installation height 2.5 to 3.5m  
Time delay 6sec to 8minute



LED 1481-90

### Proton

Rated load 90w **adjustable**  
LED specifications: 400 nos smd  
Detection angle 360 degree  
Detection range 8 m radius adjustable  
Installation height 2.5 to 3.5m  
Time delay 6sec to 8minute



## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Xenon, Proton

Model No	Wattage	Nominal Voltage *(V)
LED 1466-15	15w	240 / 110
LED 1481-90	90w (adjustable)	240 / 110

\* other voltages also available /please ask for quote



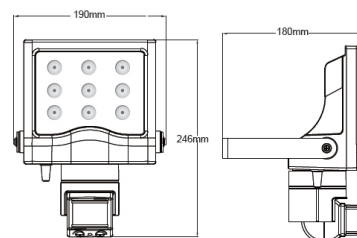
## Product description

Electron is a Infrared Motion Sensor based LED Floodlight which can identify day and night automatically, adopting PIR sensor and integrated circuit. When a human body enters its detecting zone, the PIR sensor's light goes on, once leaving, the light goes off according to its set time. Fixture Housing is made of die cast aluminium with static plastic-spraying finish, UV-resistant powder



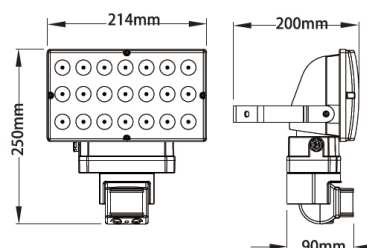
### Prima 1

Rated load 15w  
LED specifications: 9 nos high power LED  
Detection angle 180 degree  
Detection range 10-12m  
Installation height >1.8m-3.5m  
Detection motion speed 0.6-1.5m/s  
Time delay 8sec to 7minute



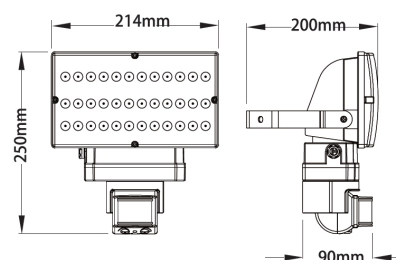
### Prima 2

Rated load 28w  
LED specifications: 18 nos high power LED  
Detection angle 180 degree  
Detection range 10-12m  
Installation height >1.8m-3.5m  
Detection motion speed 0.6-1.5m/s  
Time delay 8sec to 7minute



### Prima3

Rated load 48w  
LED specifications: 36 nos high power LED  
Detection angle 180 degree  
Detection range 10-12m  
Installation height >1.8m-3.5m  
Detection motion speed 0.6-1.5m/s  
Time delay 8sec to 7minute



## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Electron

Model No	Wattage	Nominal Voltage *(V)
LED 1467-15	15w	240 / 110
LED 1468-28	28w	240 / 110
LED 1469-48	48w	240 / 110

\* other voltages also available /please ask for quote

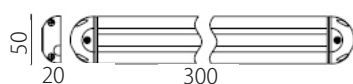
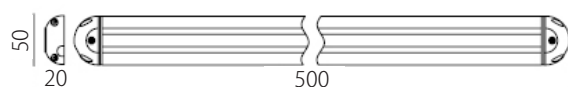
## Product description

Line featuring the possibility of setting up continuous rows. A luminous ribbon to light pathways, passageways, corridors, or to underline architectural elements. The minimal design, the installation perfectly flush with the wall, make Line integrate perfectly into any architectural or environmental context.

Line is made of corrosion resistant extruded aluminium body, tempered safety glass, mechanical and thermal shock resistant, corrosion resistant die-cast aluminium endcaps, polyester powder coating, with a pluri-processed against corrosion (passed the exposure of over 1500 hours in a saline mist environment), AISI 304 stainless steel hardware & silicone rubber gaskets.

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Line

Model No	Wattage	Nominal Voltage *(V)
LED 1435-3.6	3.6w	240 / 110/12v DC
LED 1436-6	6w	240 / 110/12v DC

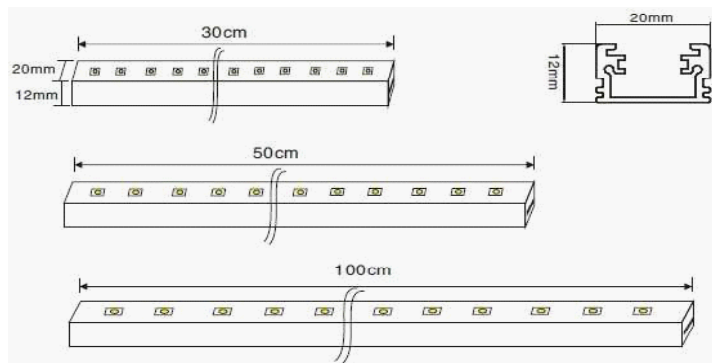
\* other voltages also available /please ask for quote

## Product description

Creating ambience or just as functional light Bar does both jobs efficiently. Made of aluminium extrusion body with silicon cover, Bar has IP54 protection. It is available in 4.5w, 7.5w and 15w, in 3000, 6000 or Amber+White mix colour.

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: Bar

Model No	Wattage	Length	Nominal Voltage *(V)
LED 1521-4.5	4.5w	30cm	12v DC
LED 1522-7.5	7.5w	50cm	12v DC
LED 1523-15	15w	100cm	12v DC

\* other voltages also available /please ask for quote

## Product description

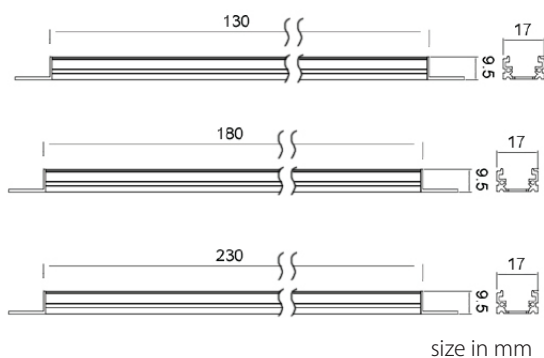


IR sensor for auto on-off

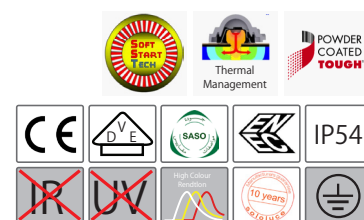
The design-oriented cabinet lighting system is an individual luminaire lighting system, and hence offers a wealth of solutions for a wide range of applications – from undercabinet lights, cupboard lighting, kitchen shelf, showcase lighting and ambience lighting. Made of aluminium extrusion body with silicon cover, Mini-Bar has IP54 protection. It is available in 1.44w, 2.16 and 2.88 w, in 3000, 6000 or Amber+White mix colour.

## Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



size in mm



## Technical Data: Mini-Bar

Model No	Wattage	Length	Nominal Voltage *(V)
LED 1525-1.44	1.44w	13cm	12v DC
LED 1526-2.16	2.16w	18cm	12v DC
LED 1527-2.88	2.88w	23cm	12v DC

\* other voltages also available /please ask for quote

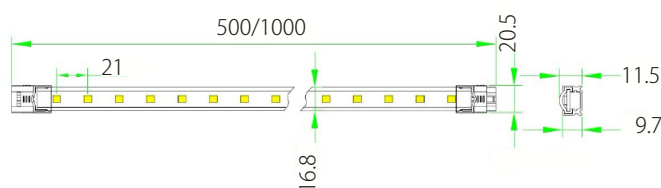
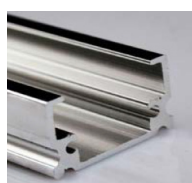
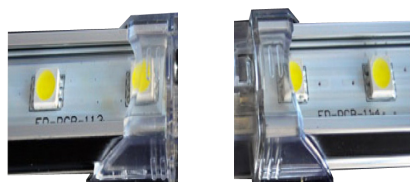
## Product description

With transparent endcover connectors Cablux is a continuous-row Lighting system. CabLux is both an individual luminaire and a row lighting system, and hence offers a wealth of solutions for a wide range of applications – from Retail to offices. Contemporary, sleek design and the differentiated use of aluminium in a natural, anodised finish lend the system its uncluttered, clean lines. The top cover is polycarbonate sleeve which offers the LED an IP54 protection.

CabLux is available in 4.8w and 9.6w in 3000K, 6000K or Red, Blue, Green, Yellow and Amber colour. Standard lengths available are 500mm and 1000mm.

## Compliances:

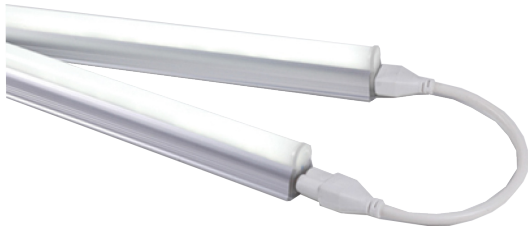
- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



## Technical Data: CabLux

Model No	Wattage	Length	Nominal Voltage *(V)
LED 1550-4.8	4.8w	50cm	12v DC
LED 1551-9.8	9.6w	100cm	12v DC

\* other voltages also available /please ask for quote



Connection thru cable or direct docking

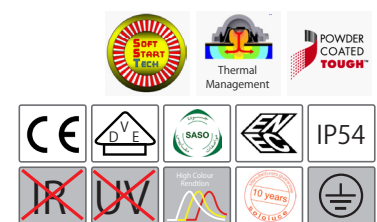
### Product description

Cabinet lighting system is an individual luminaire or continuous row system offers solutions for a wide range of applications – from Cove Lighting, undercabinet lights, cupboard lighting, kitchen shelf, showcase lighting and ambience lighting.

Made of aluminium extrusion body with opaque cover, CabLux II has IP54 protection. It is available in 4W, 7W, 11W and 14 W, in 3000, & 6000 colour.

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



### Technical Data: Cablux II

Model No	Wattage	Length	Nominal Voltage *(V)
LED 1552-04	4w	30cm	240 / 110
LED 1553-07	7w	50cm	240 / 110
LED 1554-11	11w	87cm	240 / 110
LED 1555-14	14w	113cm	240 / 110

\* other voltages also available /please ask for quote



IR Sensor operated model LED 1587



Touch Switch operated model LED 1588

**Accessories for model LED 1588**

90° Connector



180° Connector

**Product description**

Specially designed aluminum extrusion Cablux solves all the lighting requirements of Cabinet Lighting, Wardrobe Lighting, Accent Lighting , Bar Lighting and Mood Lighting etc .

Cablux is available in two versions with IR switch and Touch Switch .

Touch Switch operated Model 1588 also can be interconnected linearly and at right angle using Straight Connector and Angular Connector available as accessories. Warm white and White colour LEDs with 120 degree beam angle .

Varous other accessories like extension wires / Splitter box etc are offered , while offering complete project solutions .

**Compliances:**

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution

**Technical Data: CabLux III**

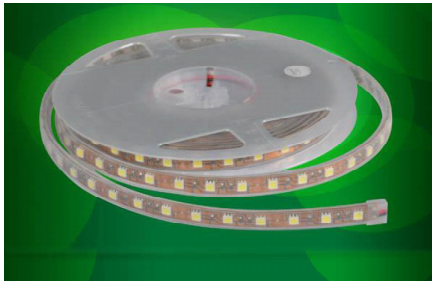
Model No	Wattage	Length	Nominal Voltage *(V)
LED 1587-5	5w	500mm	12v DC
LED 1587-10	10w	1000mm	12v DC
LED 1588-5	5w	500mm	12v DC
LED 1588-10	10w	1000mm	12v DC

\* other voltages also available /please ask for quote





LED 1581



LED 1582



LED 1583 (DuoLED)

### Product description

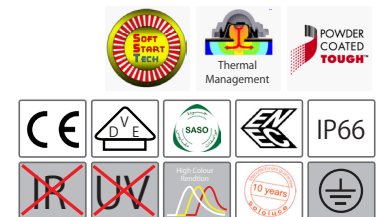
Super bright LED strip lights with 3528/5050 SMD LEDs. Our Colourbright series offers super bright LED strips in multiple colors like red, green, blue, warm white, and bright white.

Residential grade LED strip lighting is perfect for accent lighting, under cabinet lighting, bar lighting, task lighting, and pretty much anything you can think of. Our LED strip lights are flexible enough to bend around corners. We use the highest quality 3528 or 5050 LEDs.

We have strips in IP20 for indoor application and IP66 for outdoor application .

### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies with UNI 10819 light pollution



### Technical Data: Colourbright

Model No	IP	Wattage /5m Reel	Nominal Voltage *(V)
LED 1581-24	20	24w	12/24v DC
LED 1581-48	20	48w	12/24v DC
LED 1581-36	20	36w	12/24v DC
LED 1581-72	20	72w	12/24v DC
LED 1582-24	66	24w	12/24v DC
LED 1582-48	66	48w	12/24v DC
LED 1582-36	66	36w	12/24v DC
LED 1582-72	66	72w	12/24v DC
LED 1583-96	20	96w	12/24v DC
LED 1583-96	66	96w	12/24v DC

\* other voltages also available /please ask for quote



# Reflex



LED 1625-12



LED 1627-08



LED 1626-12



LED 1628-12



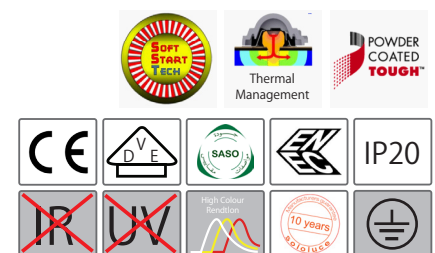
LED 1629-08

The reflex versions of the indoor series are the transposition of the concept of "soft light" (direct plus indirect) meant as a new frontier of lighting quality, that has been very successful for creating ambience in indoor. Quality in light means total absence of glare, perfect diffusion and great visual comfort. Furthermore the reflex models assure an efficient lighting, omni-directional extended (round beam) so as to guarantee a good uniformity

Made of Polycarbonate top shade with inbuilt LED and aluminum stand with touch dimming option as standard.

#### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



#### Technical Data: Reflex

Model No	Wattage	Ø*Height	Nominal Voltage *(V)
LED 1625-12	12w	306*1500	240 / 110
LED 1626-12	12w	306*1500	240 / 110
LED 1627-08	8w	306*415	240 / 110
LED 1628-12	12w	306*1500	240 / 110
LED 1629-08	8w	270*415	240 / 110

\* CCT; 2700-3200K/4000-4500K

### Product description

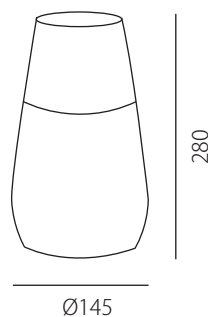
Light emanating out of specially engineered omni directional optics. This 15w LED fixture creates ambience for indoor as well as outdoor spaces.

Fixture has base made in pressure die cast aluminum with externally powder coated in IP54 protection class.



### Compliances:

- Complies with IES LM80-08 Lumen maintenance of light source
- Complies with IES LM79-08
- Complies with IES TM21 for L70 measurements
- ANSI C136.31-2001 vibration test compliance
- Complies TM15 for BUG rating
- Complies with UNI 10819 light pollution



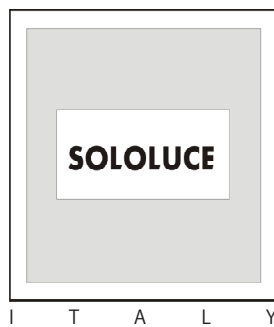
### Technical Data: Sierra

Model No	Wattage	Nominal Voltage *(V)
LED 1641-15	15w	240 / 110

\* other voltages also available /please ask for quote



# Fluorescent Lighting



Fluorescent Lighting



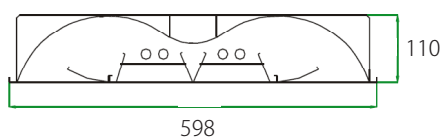
### Product description

The lighting effect created by Halo is very similar to that created by daylight with its uniform luminance levels. Long-term studies have shown that lighting quality similar to daylight enhances the employees' performance and sense of well-being.

Halo's unique lighting effect is achieved through a combination of optics and a lighting chamber. The direct optics increases the throughput of light while the indirect optic breaks up the lamp image perfectly.

### EUROPEAN STANDARDS

The wiring of our luminaires is halogen-free and with diminished smoke production in accordance with harmonised document HD22.9 S3. All Sololuce luminaires are constructed in accordance with electrical safety standards EN 60598-1 and EN 60598-2.



Dim: 598\*598\*110



### Technical Data: Halo

Model No	Lamp	Nominal Voltage (V)	Control Gear
PLL5126-236MB	2X36 PLL	240 / 110	MB
PLL5126-236EB	2X36 PLL	240 / 110	EB
FTL5126-214	2X14 T5	240 / 110	EB
PLL5126-255MB	2X55 PLL	240 / 110	MB
PLL5126-255EB	2X55 PLL	240 / 110	EB

\* DALI / Dimmable control gear / Emergency Lighting available on request

EXE



extraordinary idea

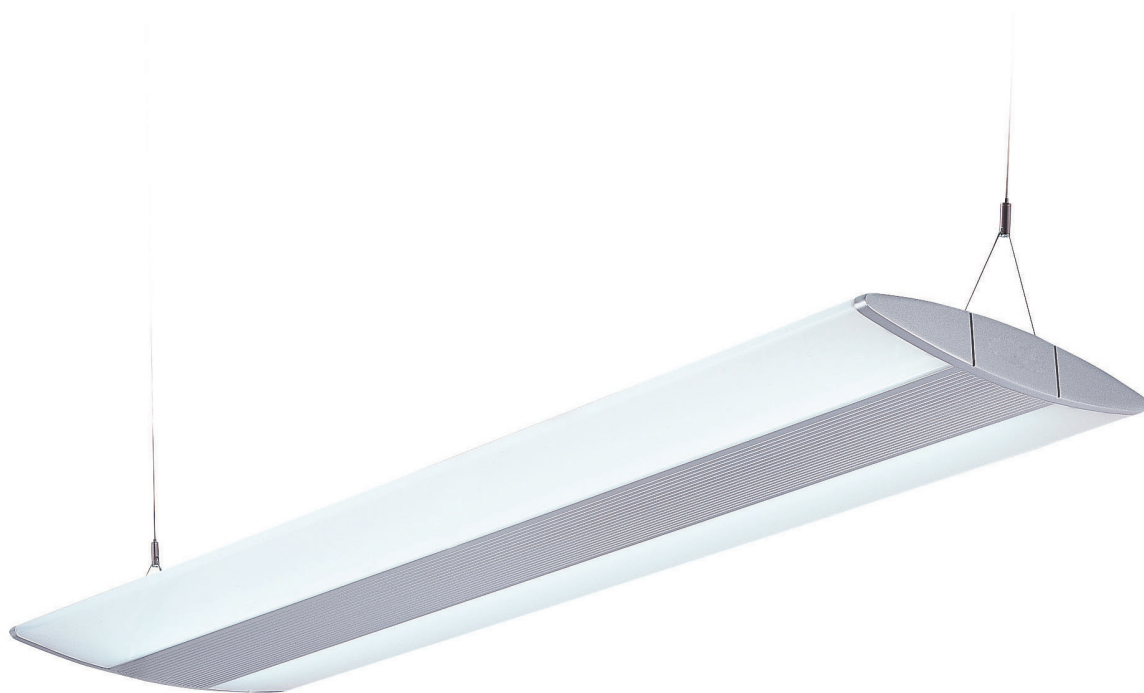


There are ideas that will change your life. Sometimes it just takes very little: a colour, a shape, a line and spaces unfold around you, change their appearance, succeed in exciting you. That's what happens with Exe. The extensible system of universal light gives a unique character to rooms. As your own one. Thus it becomes really special to think up your world.

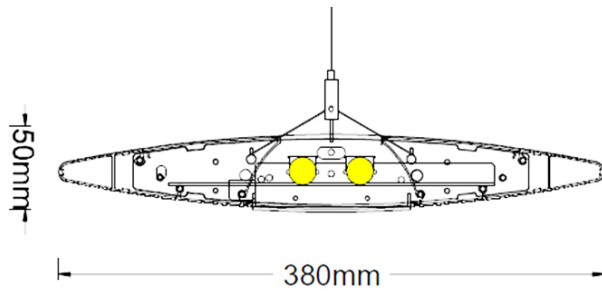
Exe, the extraordinary idea....







Wellness not only at home, but also in the office. This is now possible thanks to Avent, a new lighting concept suitable for office workplace illumination. Indirect/direct radiating, ergonomic and convenient, with large, organic, V-shaped luminous surfaces. Avent creates precise micro-prismatic light directing elements in combination with convex, satin diffusers distribute the light softly and evenly. Pleasant light flows down, while indirect light is led upwards. Space and shape become tangible.



Model no.	Size (L*W*D) mm
FTL5103-228	1200*380*50
FTL5103-235	1500*380*50

### Luminaire housing

Luminaire is made of aluminum extrusion profile with opal PMMA diffuser Silver grey thermopainted

### Optics:

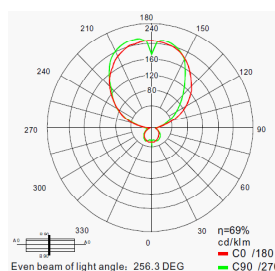
It opens up 90% light in upward direction and 10% light downwards .

### Option:

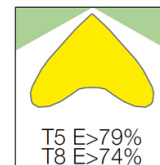
Interconnection of luminaires possible in project lighting using die cast components .

### EUROPEAN STANDARDS

The wiring of our luminaires is halogen-free and with diminished smoke production in accordance with harmonised document HD22.9 S3. All Sololuce luminaires are constructed in accordance with electrical safety standards EN 60598-1 and EN 60598-2. Suitable for VDU applications in accordance with EN 12464-1 due to low luminance  $L < 1000 \text{ cd/m}^2$  at critical angles above  $65^\circ$  in all planes.



200 cd/m<sup>2</sup> 65°



### Technical Data: Avent

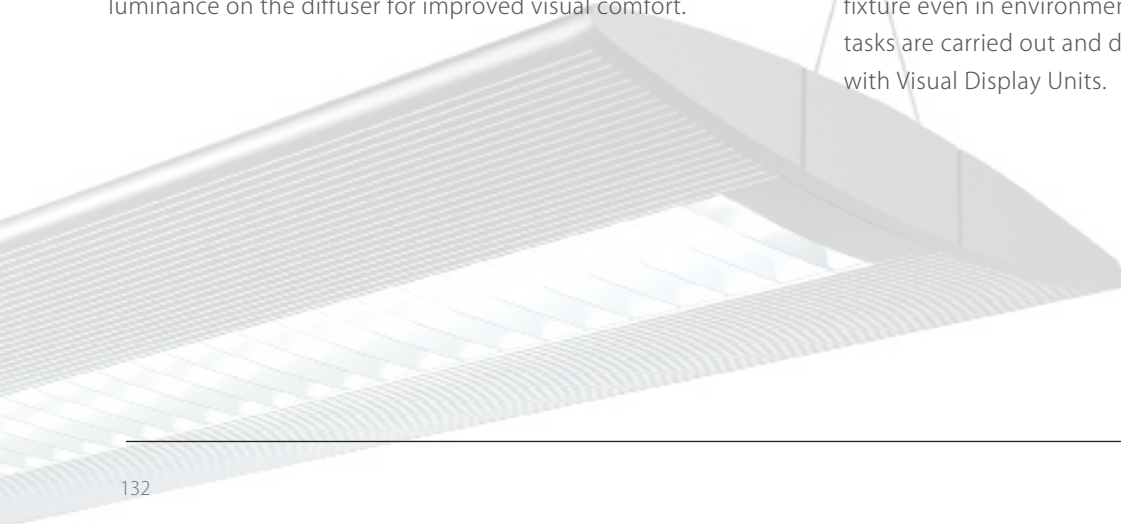
Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL5103-228	2x28 T5	240 / 110	EB
FTL5103-235	2X35 T5	240 / 110	EB

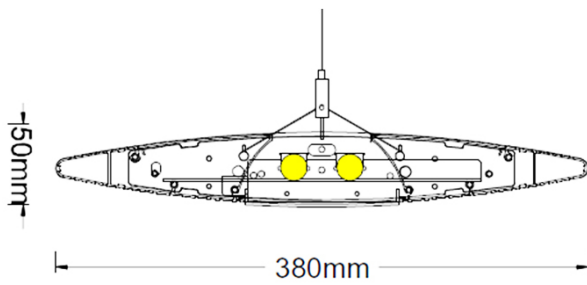
\* DALI / Dimmable control gear / Emergency Lighting available on request



Minimalist design and lighting comfort for office settings in just 50mm thickness. Magnum is the result of top-level aesthetic and lighting design research which joins innovative and functional design with state-of-the-art lighting technology. Designed for pendant installation, both single and in a system, Magnum boasts the utilisation of an innovative optical principle by which the PMMA diffuser or the Dark light louvre optics are used with respect to the profile section. In this way, a small portion of the emitted light is guided onto the upper surface of the fixture. This contributes to creating a striking, diffuse light effect, which contains the perceived high luminance on the diffuser for improved visual comfort.

With Magnum it is also possible to manage the modality by which to light a room: direct, indirect or combined in a single fixture. Despite its minimal thickness, thanks to its shape the structure can house two optics compartments: one in the lower part and one in the upper section, each one of which houses two new-generation linear fluorescent light sources. Opal diffusers are available for direct emission. Alternatively it is possible to select lamellar technique dark light optics for controlled, low-luminance direct emissions ( $L < 1.000 \text{ cd/m}^2$  per  $\alpha > 65^\circ$  with  $UGR < 19$ ). Its photometric features allow to install the fixture even in environments where visually demanding tasks are carried out and directly above work surfaces with Visual Display Units.





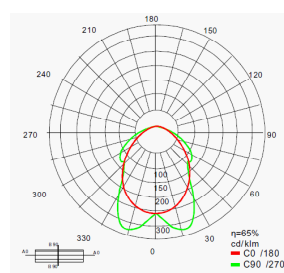
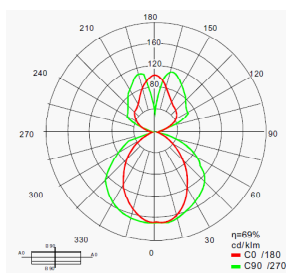
Model no.	Size (L*W*D) mm
FTL5104-228	1200*380*50
FTL5104-235	1500*380*50

### Luminaire housing

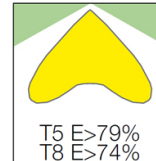
Luminaire is made of aluminum extrusion profile with opal PMMA diffuser or Louvre, Silver grey thermopainted

### Optics

40% up light & 60% downlight  
or 100% down light



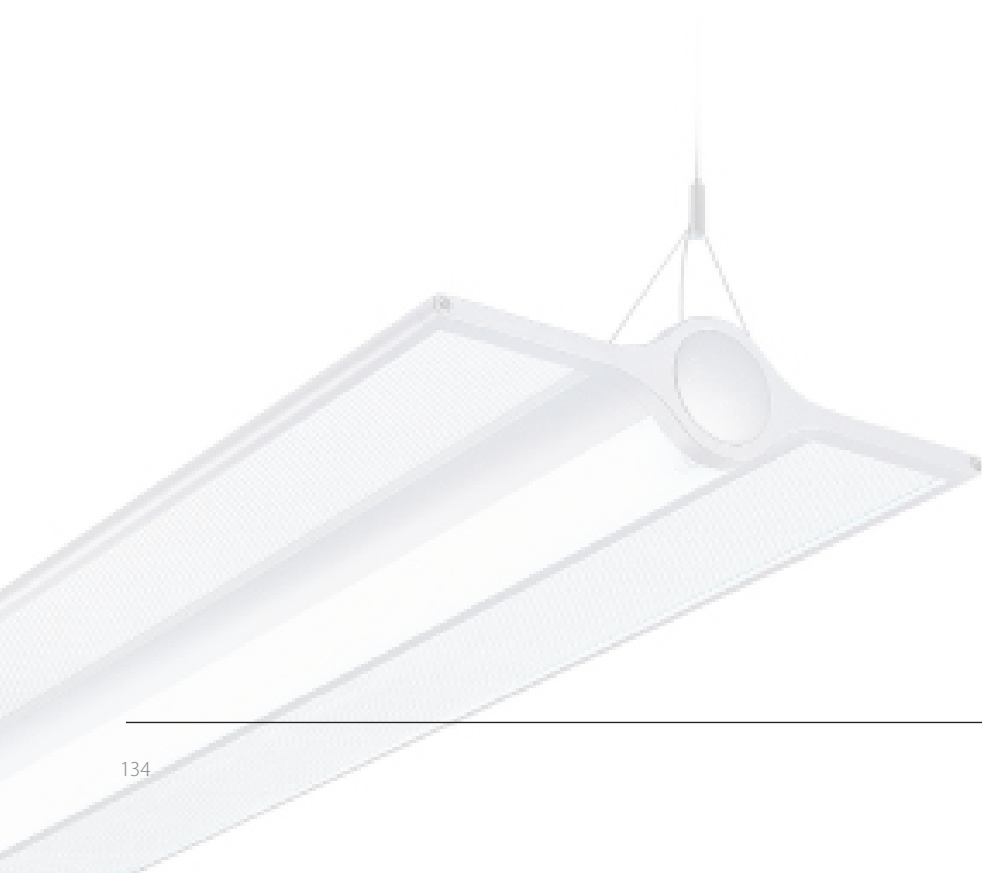
200 cd/m<sup>2</sup> 65°



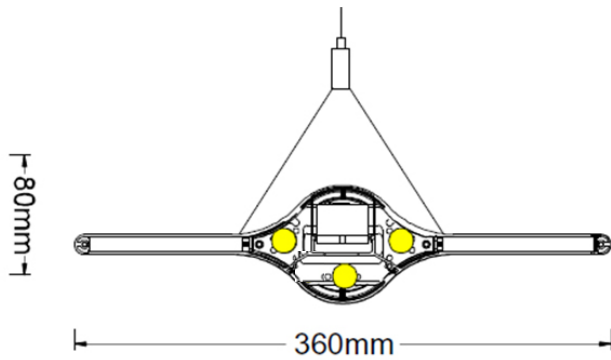
### Technical Data: Magnum

Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL5104-228 PMMA	2x28 T5	240 / 110	EB
FTL5104-235 PMMA	2X35 T5	240 / 110	EB
FTL5104-228 I- LOUVER	2x28 T5	240 / 110	EB
FTL5104-235 I- LOUVER	2X35 T5	240 / 110	EB

\* DALI / Dimmable control gear / Emergency Lighting available on request



The form and finish of the screens emit homogenous and comforting light , which is diffused both upward and downward. Extend's formal design is complemented by soft and distinctive lighting, and it has garnered significant and growing acclaim throughout the years.



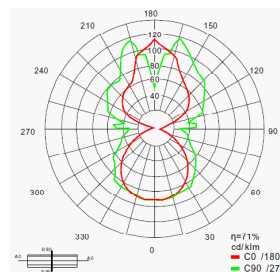
### Luminaire housing

Aluminum profile frame with extruded central pipe and semi-transparent prismatic PMMA diffuser.  
Silver grey thermopainted

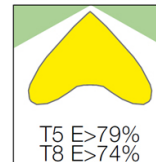
### Optics

Aluminum reflectors with 60% uplight and 40% downlight.

Model no.	Size (L*W*D) mm
FTL5105-328	1200*360*80
FTL5105-335	1500*360*80



200 cd/m<sup>2</sup> 65°



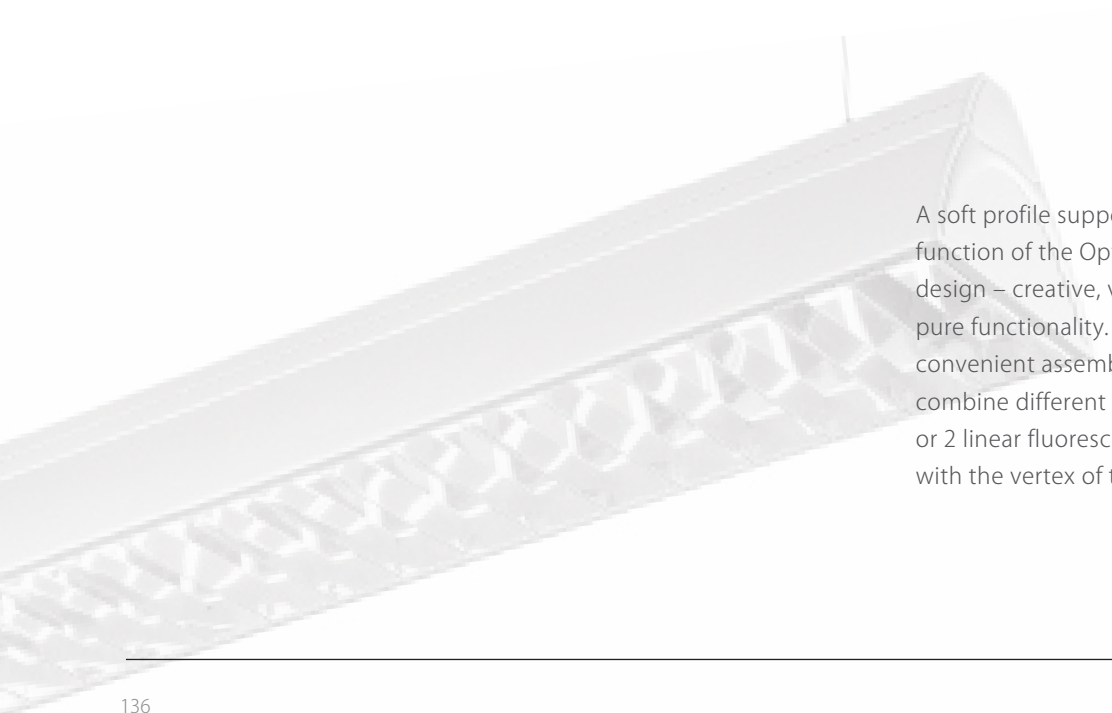
T5 E>79%  
T8 E>74%



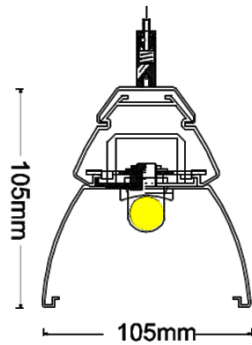
### Technical Data: Extend

Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL5105-328	3x28 T5	240 / 110	EB
FTL5105-335	3X35 T5	240 / 110	EB

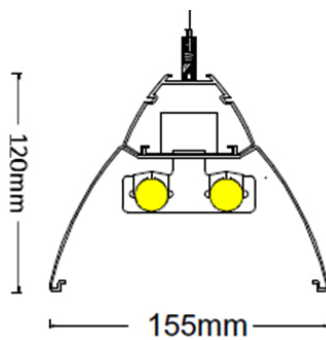
\* DALI / Dimmable control gear / Emergency Lighting available on request



A soft profile supports the lighting technology function of the Optimus and characterises its design – creative, versatile, effective, it expresses pure functionality. The design effort focused on convenient assembling and the possibility to combine different functions. Optimus houses 1 or 2 linear fluorescent lamps and can be installed with the vertex of the profile for direct lighting.



Model no.	Size (L*W*D) mm
FTL5106-128	1210*105*105
FTL5106-135	1510*105*105



Model no.	Size (L*W*D) mm
FTL5106-228	1210*155*120
FTL5106-235	1510*155*120

### Luminaire housing

Aluminum profile frame with aluminum reflector, ABS end caps and Silver grey/white thermopainted

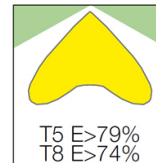
### Optics

Aluminum reflector with PMMA diffuser or I louvre/ 100% downlight

### EUROPEAN STANDARDS

The wiring of our luminaires is halogen-free and with diminished smoke production in accordance with harmonised document HD22.9 S3. All Sololuce luminaires are constructed in accordance with electrical safety standards EN 60598-1 and EN 60598-2. Suitable for VDU applications in accordance with EN 12464-1 due to low luminance  $L < 1000 \text{ cd/m}^2$  at critical angles above  $65^\circ$  in all planes.

200 cd/m<sup>2</sup> 65°

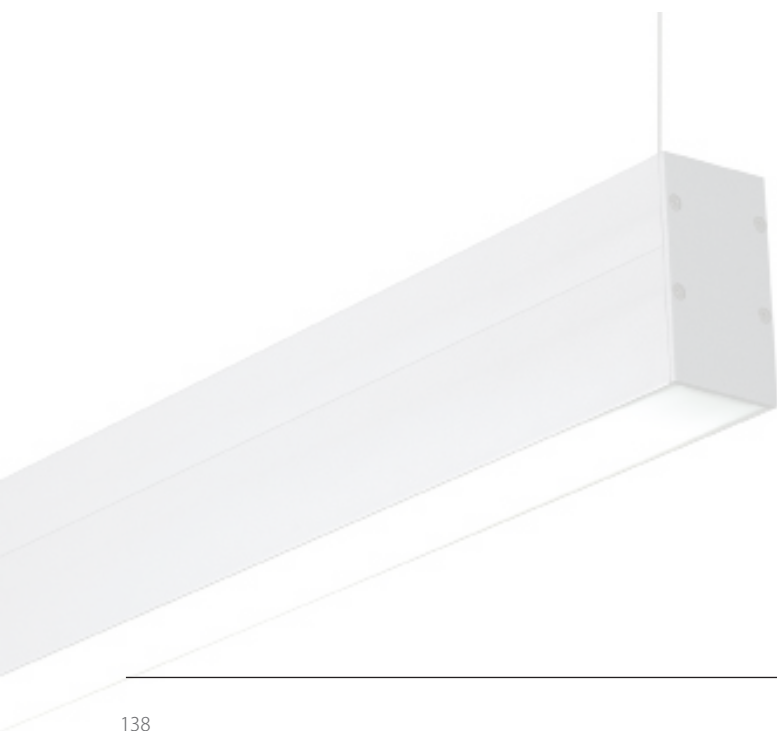
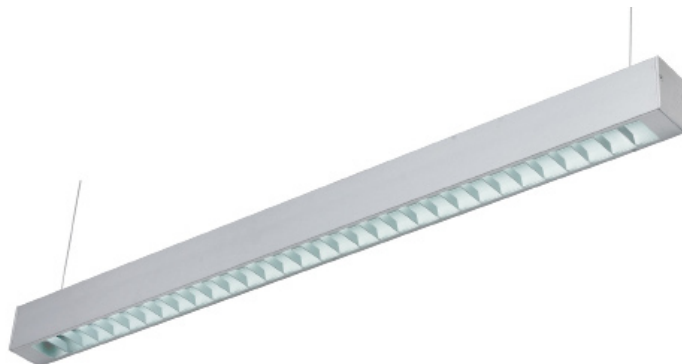


### Technical Data: Optimus

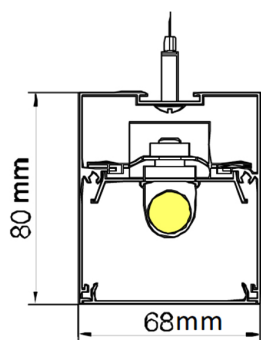
Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL5106-128	1x28 T5	240 / 110	EB
FTL5106-228	2x28 T5	240 / 110	EB
FTL5106-135	1x35 T5	240 / 110	EB
FTL5106-235	2x35 T5	240 / 110	EB

\* DALI / Dimmable control gear / Emergency Lighting available on request

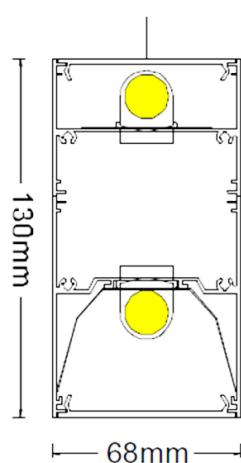




Moonlight Box is a fluorescent fitting with high performance lamps, and has technologically advanced characteristics and flexibility in its design. Easy to install and maintain they offer a wide range of light emissions. Symmetrical dark light with louvers for offices, and general lighting when a diffusing protection screen PMMA is applied. They can be lined up in a continuous line without interruptions, and they can create designs when used in a set pattern.



FTL5102



FTL5102UD

**Luminaire housing**

Aluminum profile frame with aluminum reflector  
Silver grey/white thermopainted

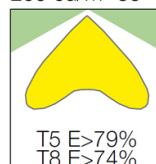
**Optics**

5102 Model: Aluminum reflector with PMMA diffuser or louver/ 100% downlight

5102UD: Aluminum reflector with PMMA diffuser or louver/ 50% Uplight & 50% downlight

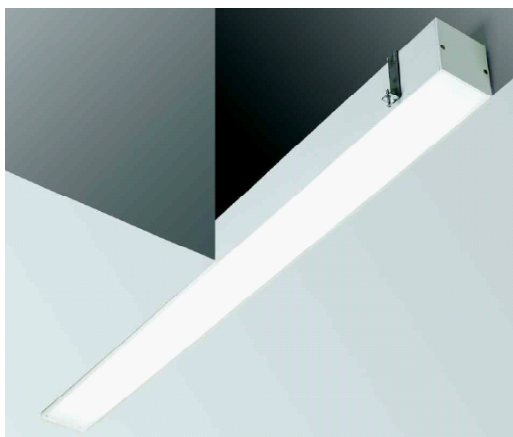
**EUROPEAN STANDARDS**

The wiring of our luminaires is halogen-free and with diminished smoke production in accordance with harmonised document HD22.9 S3. All Sololuce luminaires are constructed in accordance with electrical safety standards EN 60598-1 and EN 60598-2. Suitable for VDU applications in accordance with EN 12464-1 due to low luminance  $L < 1000 \text{ cd/m}^2$  at critical angles above  $65^\circ$  in all planes.

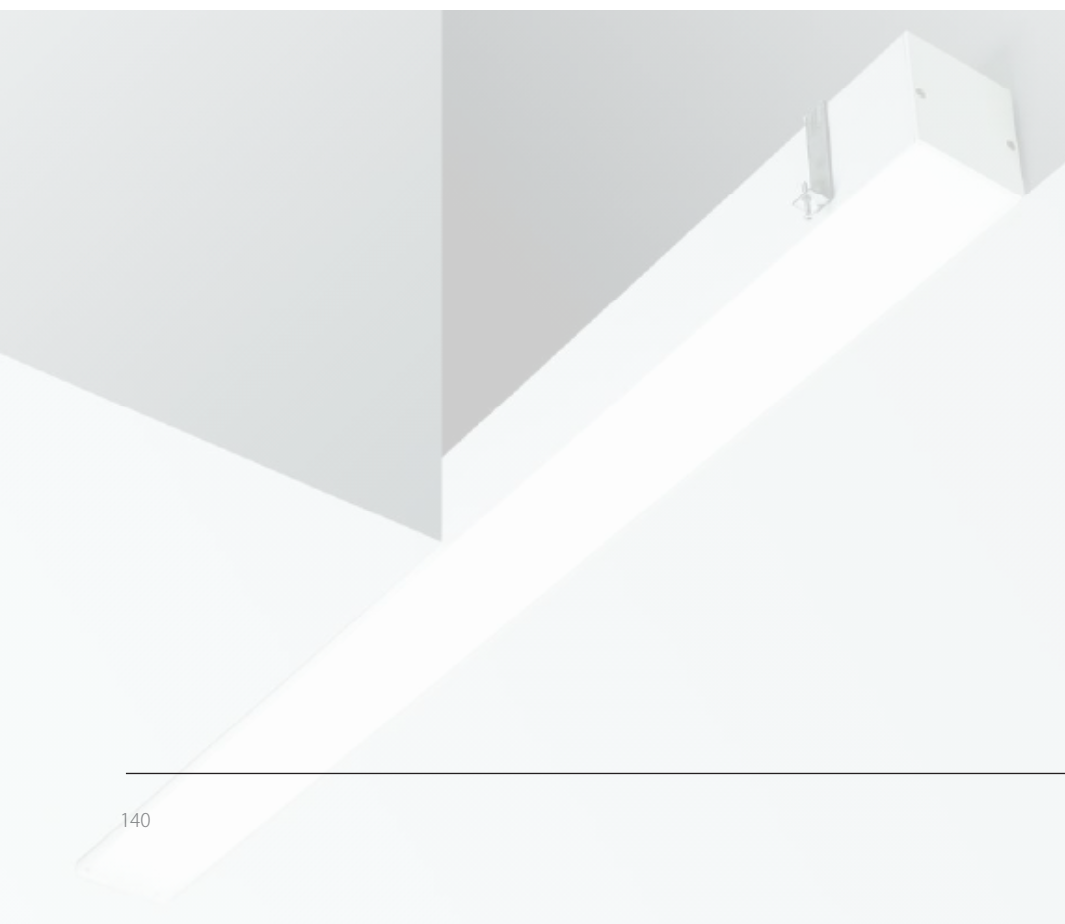
200 cd/m<sup>2</sup> 65°**Technical Data: Moonlight Box**

Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL5102-128	1x28 T5	240 / 110	EB
FTL 5102-135	1X35 T5	240 / 110	EB
FTL 5102-228	2x28 T5	240 / 110	EB
FTL 5102-235	2X35 T5	240 / 110	EB
FTL 5102UD-228	2x28 T5	240 / 110	EB
FTL5102UD-235	2X35 T5	240 / 110	EB

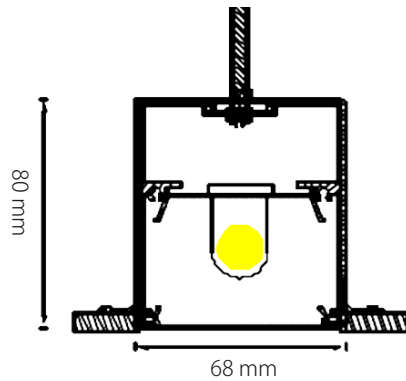
\* DALI / Dimmable control gear / Emergency Lighting available on request



Moonlight Box -Recess is a Trimless Design which integrated into ceiling system with homogeneous light distribution. Particularly suitable for reception areas or circulation routes.



# Trimless



Model no.	Size (L*W*D) mm
FTL5108-128	1200*68*80
FTL5108-135	1500*68*80

### Luminaire housing

Luminaire housing of non deformable extruded aluminium, pure aluminum reflector & externally Silver grey/white thermopainted

### Optics

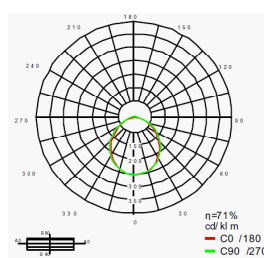
Aluminum reflector with PMMA diffuser or I louvre.

### Options

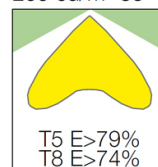
In continuous row lighting Shadowless overlapping lamp trays are supplied

### EUROPEAN STANDARDS

The wiring of our luminaires is halogen-free and with diminished smoke production in accordance with harmonised document HD22.9 S3. All Sololuce luminaires are constructed in accordance with electrical safety standards EN 60598-1 and EN 60598-2. Suitable for VDU applications in accordance with EN 12464-1 due to low luminance  $L < 1000$  cd/m<sup>2</sup> at critical angles above 65° in all planes.



200 cd/m<sup>2</sup> 65°



T5 E>79%  
T8 E>74%



### Technical Data: Moonlight Box - Recess

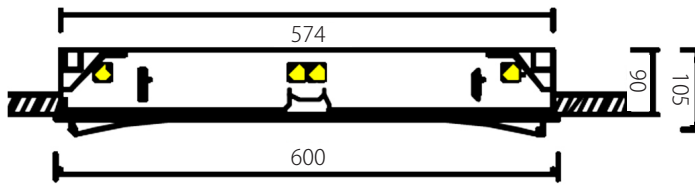
Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL5108-128PMMA	1x28 T5	240 / 110	EB
FTL5108-135PMMA	1X35 T5	240 / 110	EB
FTL 5108 128 I- LOUVRE	1x28 T5	240 / 110	EB
FTL 5108 135 I- LOUVRE	1X35 T5	240 / 110	EB

\* DALI / Dimmable control gear / Emergency Lighting available on request



Element . it is balanced, rational and rigorous, the lighting element is an evolution in the way that light is shed: its way of being used becomes evermore flexible and its capacity of blending with the surrounding architecture makes it a true building material, thanks to its non-intrusive yet non-mimetic design, which is not brazenly decorative. The recessed lighting elements retract into the ceiling to hide away from sight and leave the light free.

Element not only lights the work areas but also the ceiling and creates ambience of openness ,giving a feel of sky inside.



### Luminaire housing

Housing of galvanised steel sheet, Frame made of aluminium & powdercoated Standard equipment with electronic ballast . Adjustable recessed brackets for ceiling thicknesses 1-40 mm Relamping requires no tools. Front diffuser in Out Bend Opal PMMA or Central I louvre + Out Bend Opal PMMA

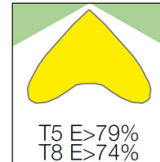
### Optics:

Glare free optics created by PMMA structure

### EUROPEAN STANDARDS

The wiring of our luminaires is halogen-free and with diminished smoke production in accordance with harmonised document HD22.9 S3. All Sololuce luminaires are constructed in accordance with electrical safety standards EN 60598-1 and EN 60598-2. Suitable for VDU applications in accordance with EN 12464-1 due to low luminance  $L < 1000 \text{ cd/m}^2$  at critical angles above  $65^\circ$  in all planes.

200 cd/m<sup>2</sup> 65°



### Technical Data: Element

Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL5117-414 PMMA	4x14 T5	240 / 110	EB
FTL5117-414 PMMA+I- louvre	4X14 T5	240 / 110	EB

\* DALI / Dimmable control gear / Emergency Lighting available on request



The louvre concept developed in Sololuce's R&D laboratories optimises the two most important lighting requirements - Maximum efficiency and perfect uniformity

**Optical system**

Highly-specular reflector, made of high-purity post-anodised aluminium, for narrow/wide angle light distribution. Micro-segmented parabolic louvre made of anodised aluminium with a surface purity of 99.98 %. Suitable for VDU applications in accordance with EN 12464-1 due to low luminance  $L < 1000 \text{ cd/m}^2$  at critical angles above  $65^\circ$  in all planes. Louvre retention by means of spring-tensioned clips, providing earth continuity. Louvre can be lowered and hung from either side without tools.

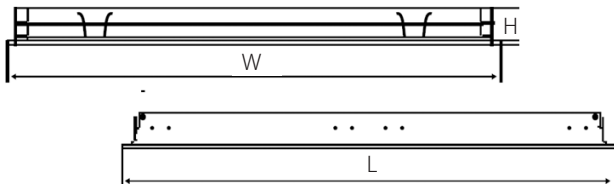
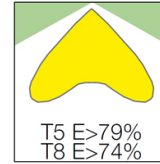


**Luminaire body**

Bezel ring made of sheet steel, galvanised, powder-coated white, securely connected to the reflector. Recessed ceiling mounting by means of rapid-mounting springs. Perforated sheet separation in between in T5 range.

**EUROPEAN STANDARDS**

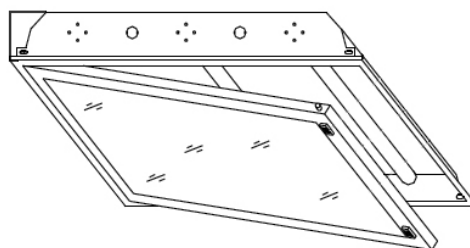
The wiring of our luminaires is halogen-free and with diminished smoke production in accordance with harmonised document HD22.9 S3. All Sololuce luminaires are constructed in accordance with electrical safety standards EN 60598-1 and EN 60598-2.

200 cd/m<sup>2</sup> 65°T5 E>79%  
T8 E>74%**Technical Data: Quadra-Recess**

Model No	Lamp	Nominal Voltage (V)	Control Gear	L*W*H
FTL 5111-128	1X28 T5	240 / 110	EB	1198*185*55
FTL5111-228	2X28 T5	240 / 110	EB	1198*298*55
FTL5112-314	3X14 T5	240 / 110	EB	598*598*55
FTL5112-414	4X14 T5	240 / 110	EB	598*598*55
FTL5113-214	2X14 T5	240 / 110	EB	598*298*55
FTL5111-236	2X36 T8	240 / 110	EB/MB	1198*298*55
FTL5112-318	3X18 T8	240 / 110	EB/MB	598*598*55
FTL5112-418	4X18 T8	240 / 110	EB/MB	598*598*55
FTL5113-218	2X18 T8	240 / 110	EB/MB	598*298*55

\* DALI / Dimmable control gear / Emergency Lighting available on request

\* add EB for electronic ballast /MB for magnetic ballast



Model also available in PMMA/PC - opal /clear /diamond cover with IP54 ingress protection.





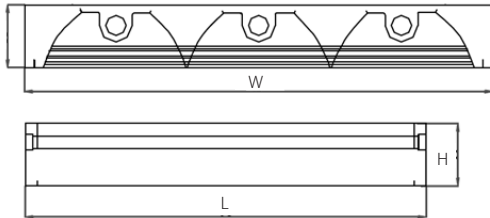
Sololuce's surface mounted luminaires are made of sheet steel, galvanised, powder-coated white, securely connected to the reflector. Fixture comes in different size for T5 & T8 fixtures

**Optical system:**

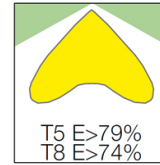
Highly-specular reflector, made of high-purity post-anodised aluminium, for narrow/wide angle light distribution. Micro-segmented parabolic louvre made of anodised aluminium with a surface purity of 99.98%. Suitable for VDU applications in accordance with EN 12464-1 due to low luminance  $L < 1000 \text{ cd/m}^2$  at critical angles above  $65^\circ$  in all planes. Louvre retention by means of spring-tensioned clips, providing earth continuity. Louvre can be lowered and hung from either side without tools.

### EUROPEAN STANDARDS

The wiring of our luminaires is halogen-free and with diminished smoke production in accordance with harmonised document HD22.9 S3. All Sololuce luminaires are constructed in accordance with electrical safety standards EN 60598-1 and EN 60598-2.



200 cd/m<sup>2</sup> 65°

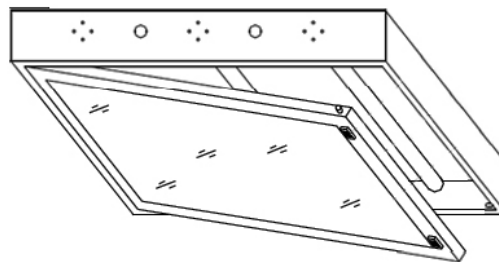


### Technical Data: Quadra-Surface

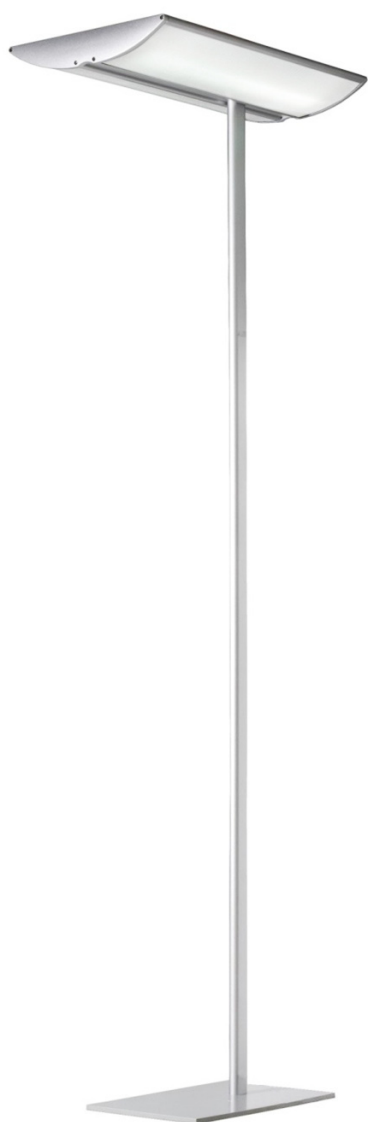
Model No	Lamp	Nominal Voltage (V)	Control Gear	L*W*H
FTL5114-128	1X28 T5	240 / 110	EB	1170*185*80
FTL5114-228	1X28 T5	240 / 110	EB	1170*298*80
FTL5115-314	3X14 T5	240 / 110	EB	570*598*80
FTL5115-414	4X14 T5	240 / 110	EB	570*598*80
FTL5116-214	2X14 T5	240 / 110	EB	570*298*80
FTL5114-136	1X36 T8	240 / 110	EB/MB	1220*185*80
FTL5114-236	2X36 T8	240 / 110	EB/MB	1220*300*80
FTL5115-318	3X18 T8	240 / 110	EB/MB	610*600*80
FTL5115-418	4X18 T8	240 / 110	EB/MB	610*600*80
FTL5116-218	2X18 T8	240 / 110	EB/MB	610*300*80

\* DALI / Dimmable control gear / Emergency Lighting available on request

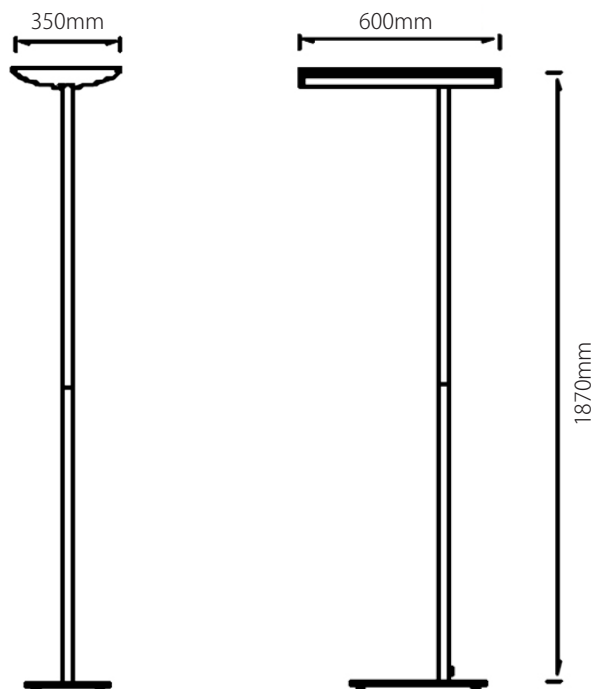
\* add EB for electronic ballast /MB for magnetic ballast



Model available also in PMMA/ PC opal /clear /diamond cover  
Standard fixtures are with Electronic ballast / for magnetic please add MB with model.



Stand I FTL5118-255



Give character to free space, creating an inviting space is what the Stand Range has been designed for.

Free-standing luminaires

can be positioned wherever required: in any location in the room, at any position relative to the task area; there they focus their light onto the specific visual task – economically and efficiently.

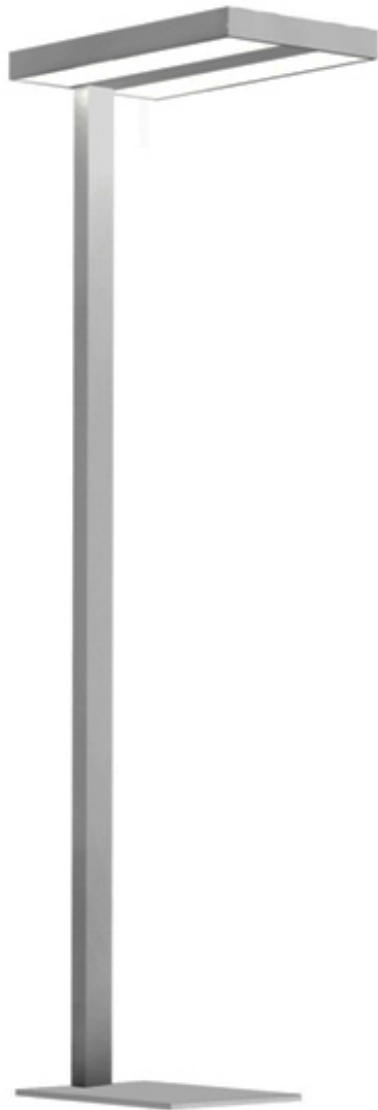
**Stand Body:**

Made in aluminum extrusion profiles with PMMA diffuser.

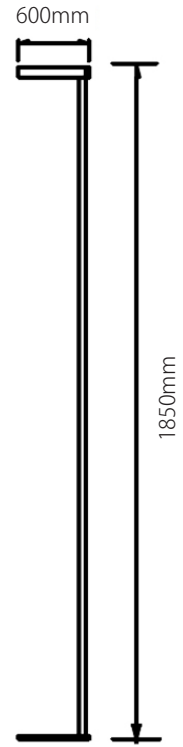
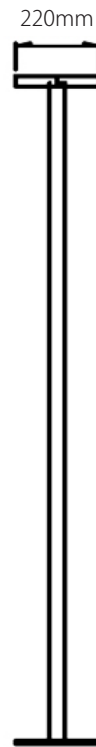
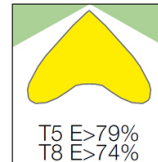
**Optics:**

Stand I : 90% uplight+10% downlight

Stand II : 80% downlight + 20% uplight



Stand II FTL5119-214

200 cd/m<sup>2</sup> 65°

IP20

## Technical Data: Stand I &amp; Stand II

Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL5118-255	2X55 PLL	240 / 110	EB
FTL5119-214	2X14 T5	240 / 110	EB

\* DALI / Dimmable control gear / Emergency Lighting available on request

## Product description

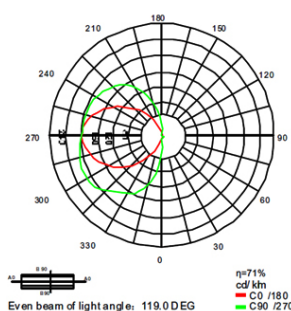
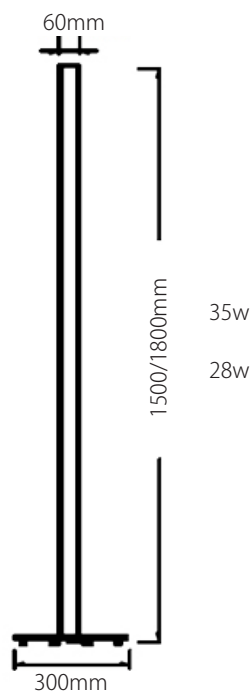
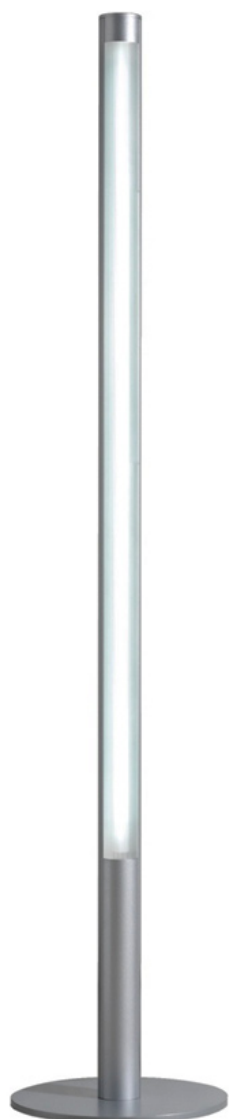
Cylindrical shape Bollard is designed to break the monotonous ambience of space. Made of aluminum extrusion profiles Bollard is available in two heights of 1500mm & 1800mm.

### Stand Body:

Made in aluminum extrusion profiles with PMMA diffuser

### Optics:

Opal PMMA diffuser, forward light emission.



## Technical Data: Bollard

Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL 5109-128	1X28 T5	240 / 110	EB
FTL5109-135	1X35 T5	240 / 110	EB

\* DALI / Dimmable control gear / Emergency Lighting available on request



Perfetto from Sololuce is large family of downlights of high quality materials and advanced technical designs.

**-Bodies, fixing systems and equipment boxes in galvanized painted steel or polyamide re-enforced with fibreglass.**

**-Reflectors of high purity anodized aluminium**

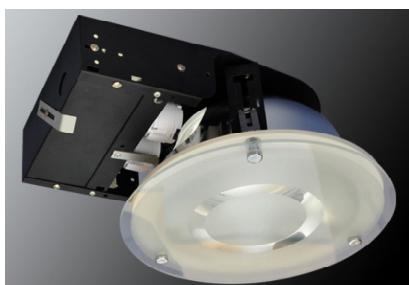
All downlights have the option of :

Electromagnetic (MB) equipment in high power factor, electronic (EB) equipment and dimmable electronic equipment.

In version 1-10V and by push button or DALI included according to the version. In models with symmetrical horizontal optics for compact fluorescence, the equipment holding box is supplied attached in Integral models and separate in Non- Integral models .

**Finished in colour: Black , white or grey.**



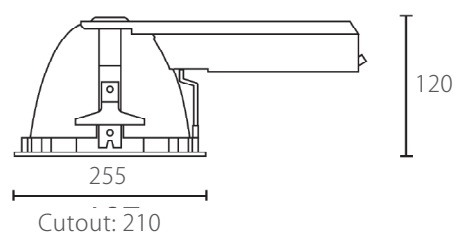
**Integral Version****Model Nos.**

CFL5150-242 EB/MB

CFL5150-226 EB/MB

CFL5150-218 EB/MB

240V/110V/50Hz

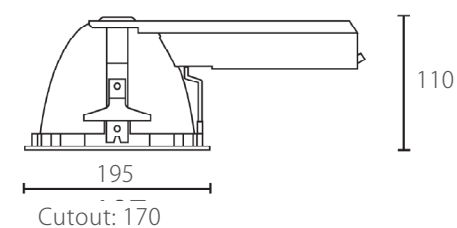
**Integral Version****Model Nos.**

CFL5151-242 EB/MB

CFL5151-226 EB/MB

CFL5151-218 EB/MB

240V/110V/50Hz

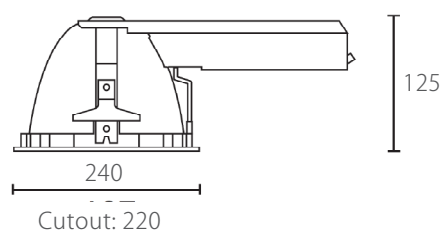
**Integral Version****Model Nos.**

CFL5154-242 EB/MB

CFL5154-226 EB/MB

CFL5154-218 EB/MB

240V/110V/50Hz

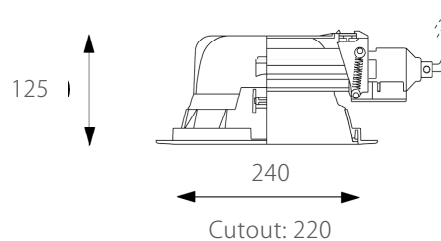
**Non-integral Version****Model Nos.**

CFL5152-242 EB/MB

CFL5152-226 EB/MB

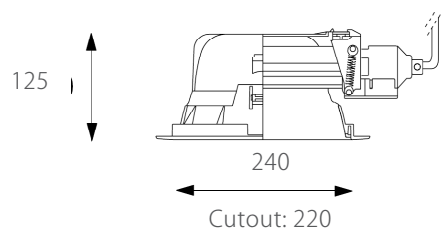
CFL5152-218 EB/MB

240V/110V/50Hz

**Non-integral Version****Model Nos.**

CFL5153-242 E27

240V/110V/50Hz



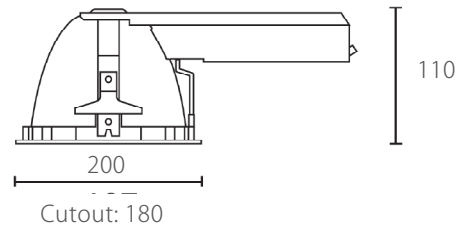
**Integral Version****Model Nos.**

CFL5155-226 EB/MB

CFL5155-218 EB/MB

CFL5155-213 EB/MB

240V/110V/50Hz

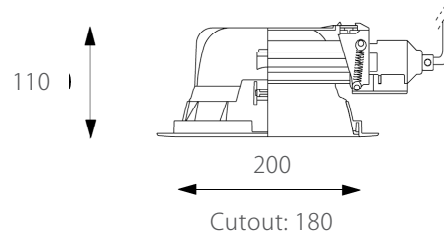
**Non-integral Version****Model Nos.**

CFL5156-226 EB/MB

CFL5156-218 EB/MB

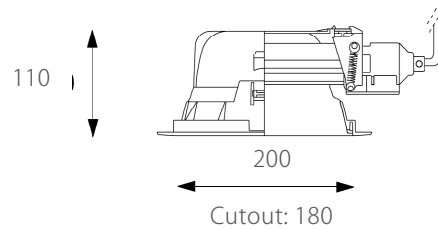
CFL5156-213 EB/MB

240V/110V/50Hz

**Non-integral Version****Model Nos.**

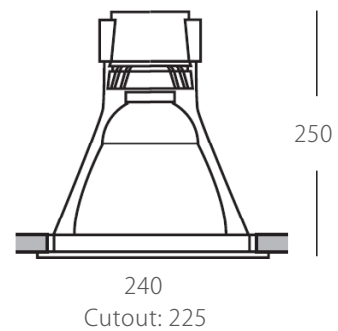
CFL5157-226 E27

240V/110V/50Hz

**Non-integral Version****Model Nos.**

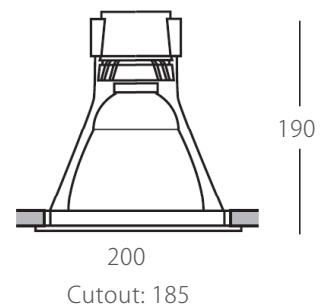
CFL5159-126 E27

240V/110V/50Hz

**Non-integral Version****Model Nos.**

CFL5158-118 E27

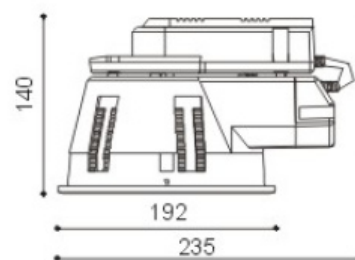
240V/110V/50Hz



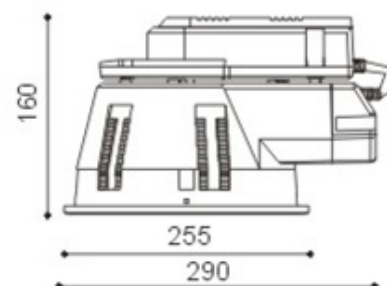




Polyamide , engineered plastic , double insulated body with pure aluminum reflector in plain anodised (A), Turbo Louver(B),Beehive Louvre( C) or in Frosted Glass (D)  
CFL 5162-213 EB-A/B/C/D



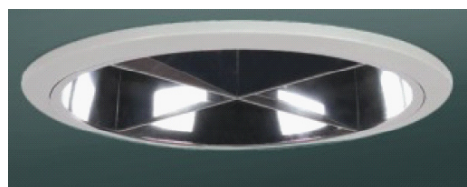
Polyamide , engineered plastic , double insulated body with pure aluminum reflector in plain anodised (A), Turbo Louver(B),Beehive Louvre( C) or in Frosted Glass (D)  
CFL 5163-226 EB-A/B/C/D  
CFL 5163-218 EB-A/B/C/D pton.



#### Reflector Options:



Plain anodised (A)



Turbo Louver(B)



Beehive Louvre( C)



Frosted Glass (D)

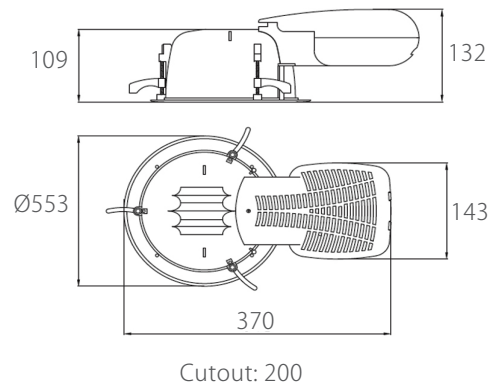
- Polycarbonate symmetric reflector vacuum metalized with pure 99% aluminium powder
- Decorative ring at sight in technopolymer available in white, chrome and colour gold
- Adjustable fixing bracket that guarantees a perfect fixing in the false ceiling (min. 4 max 33 mm)
- G24/E27 lampholder and certified cabling
- Also available without built in cable box



#### integral Version

##### Model Nos.

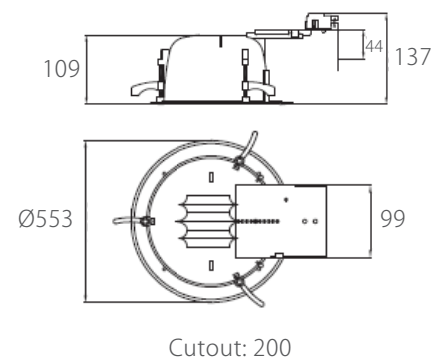
CFL 5236-113 EB/MB  
CFL 5236-118 EB/MB  
CFL 5236-126 EB/MB  
CFL 5236-213 EB/MB  
CFL 5236 218 EB/MB  
CFL 5236-226 EB/MB



#### Non-integral Version

CFL 5236 126 E27  
CFL 5236 226 E27

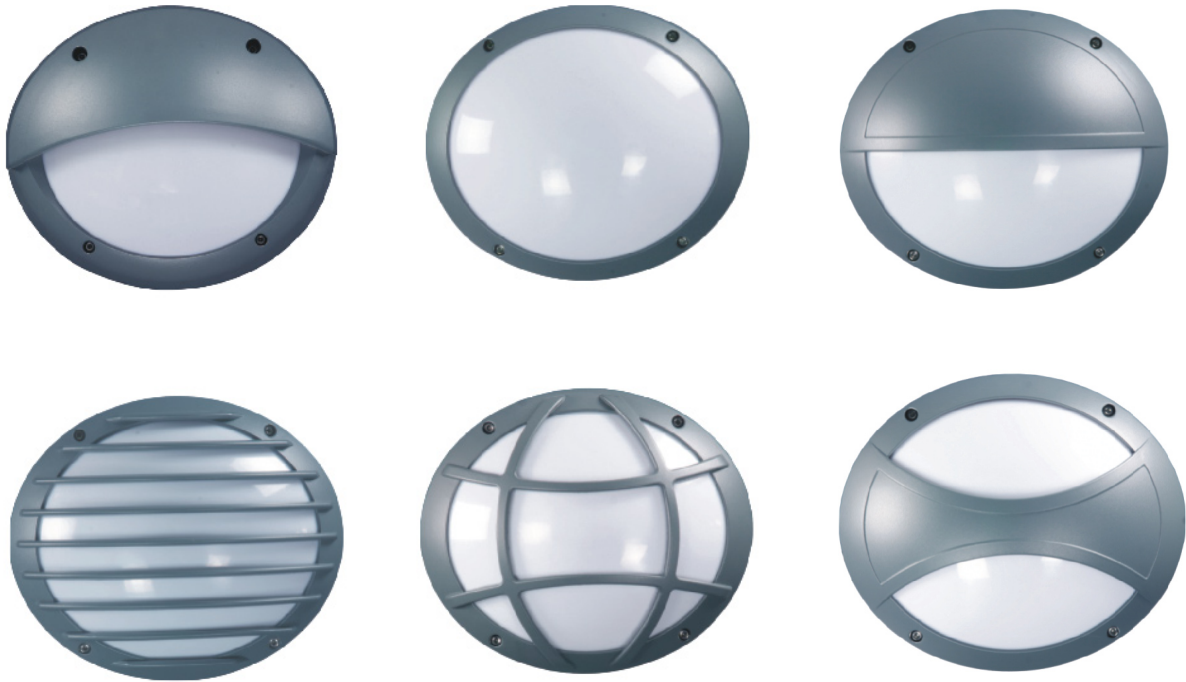
240V/110V/50Hz



Ballast Mountang Arrangement

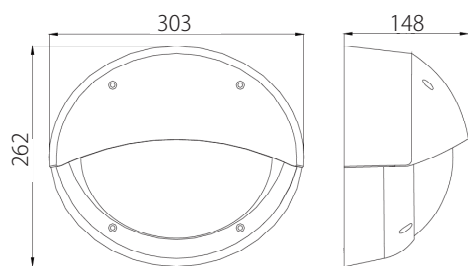


Optional Accessories

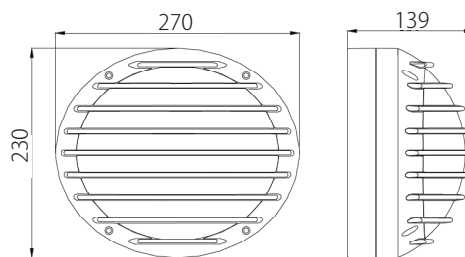


Classic wall mounted elliptical luminaire adds visual structure to a simple form. Opal acrylic lens provides soft symmetrical distribution. Fixtures are completely made in pressure die cast aluminum in six different bezel options. All hardware is stainless steel.

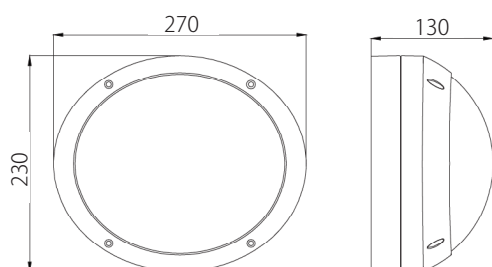
Standard colors; matte silver grey metallic or black. Special colors available.



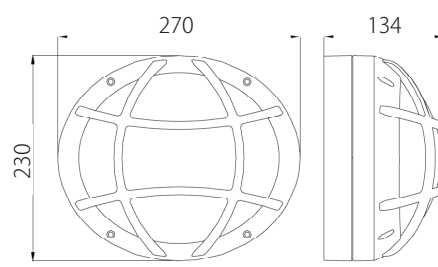
CFL 5177



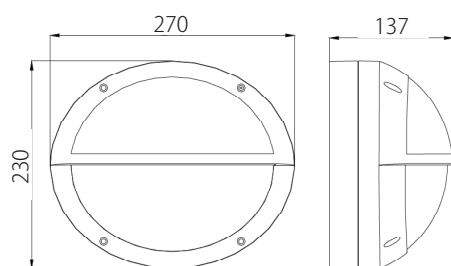
CFL 5180



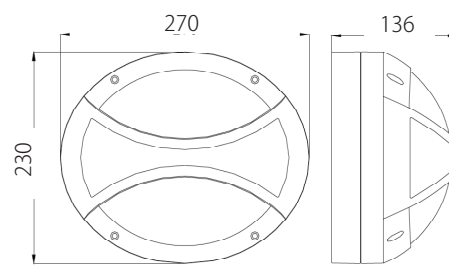
CFL 5178



CFL 5181



CFL 5179



CFL 5182



### Technical Data: Ellepta

Model No	Wattage	Nominal Voltage (V)
CFL 5177-120-E27	1X20w	240 / 110
CFL 5178-120-E27	1X20w	240 / 110
CFL 5179-120-E27	1X20w	240 / 110
CFL 5180-120-E27	1X20w	240 / 110
CFL 5181-120-E27	1X20w	240 / 110
CFL 5182-120-E27	1X20w	240 / 110

## Product description

Orion is surface mounted simplistic design which brings character to the wall it is pasted on. A well accepted generic design fixture made of pressure die cast aluminum, now available in energy efficient CFL in two sizes 275mm and 220mm.



CFL-5169 FC



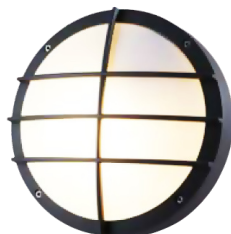
CFL-5167 FC



CFL-5169 HC



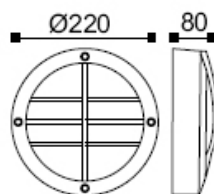
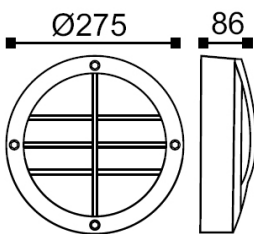
CFL-5167 HC



CFL-5169 GR



CFL-5167 GR



## Technical Data: Orion

Model No	Wattage	Nominal Voltage *(V)
CFL-5169 EB/MB-FC	19w	240 / 110
CFL-5169 EB/MB-HC	19w	240 / 110
CFL-5169 EB/MB-GR	19w	240 / 110
CFL-5167 EB/MB-FC	12w	240 / 110
CFL-5167 EB/MB-HC	12w	240 / 110
CFL-5167 EB/MB-GR	12w	240 / 110

\* other voltages also available /please ask for quote

FC: Full Cut

HC: Half Cut

GR: Grill

## Product description

Small dimensions, but great technical characteristics. Enhancing a range of luminaires whose common elements are elegant design for many applications, in commercial to domestic areas.

Pressure die cast aluminum body with opal polycarbonate lens. Pure silicon gaskets to provide IP54 protection and stainless steel screws and hardware. Fixture is chromate converted before powder coating.

Mounting thru specially designed eyelids at back plate  
Application: Residential apartments, Hotels, Hospitals, Villas etc.



CFL 5201-118 HC



CFL 5201-118 FC



CFL 5201-118 GR



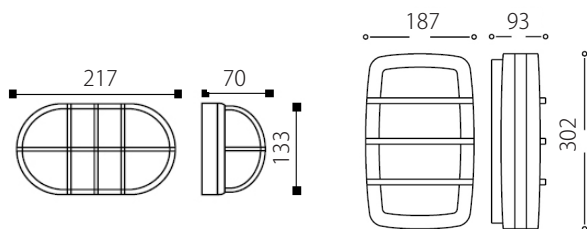
CFL 5202-118 HC



CFL 5202-118 FC



CFL 5202-118 GR



## Technical Data: Ovale

Model No	Wattage	Nominal Voltage *(V)
CFL 5201-118 EB/MB-HC	18w	240 / 110
CFL 5201-118 EB/MB-FC	18w	240 / 110
CFL 5201-118 EB/MB-GR	18w	240 / 110
CFL 5202-118 EB/MB-HC	18w	240 / 110
CFL 5202-118 EB/MB-FC	18w	240 / 110
CFL 5202-118 EB/MB-GR	18w	240 / 110

\* other voltages also available /please ask for quote

FC: Full Cut

HC: Half Cut

GR: Grill

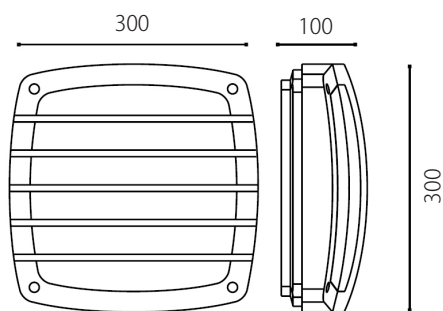
## Product description



CFL-5168-218 FC



CFL-5168-218 GR



## Technical Data: Brik

Model No	Wattage	Nominal Voltage *(V)
CFL-5168-218 EB/MB-FC	2X18w	240 / 110
CFL-5168-218 EB/MB-GR	2X18w	240 / 110

\* other voltages also available /please ask for quote

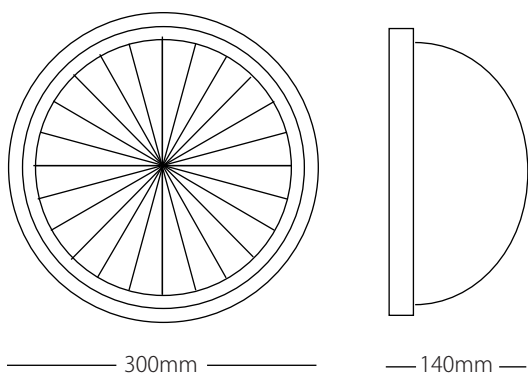
FC: Full Cut

GR: Grill



Product description

Alta is a generic Polycarbonate wall/ceiling mount fixture . Simple yet elegant fixture. Multiple rings encircling the PC refractor allow a warm glow to radiate outward. Alta is suitable for Indoor and canopy area lighting



Technical Data: ALTA

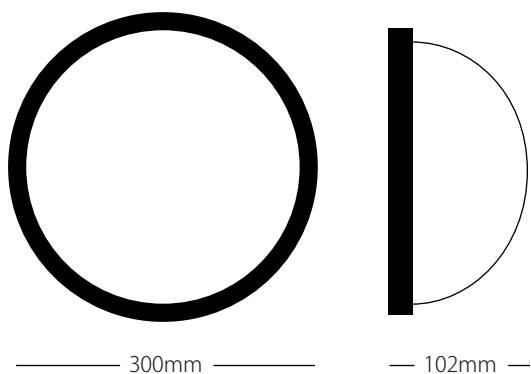


Model No	Lamp	Nominal Voltage (V)	Control Gear
CFL 5192-1x75/E27	1X75w	240 / 110	-
CFL5192-2X9MB	2X9w	240 / 110	MB



Product description

Wall or Ceiling mount Bella creates beautiful effects. Opal PC refractor radiates glarefree light. Completely made of no yellowing polycarbonate, Bella is suitable for indoor / canopy applications.

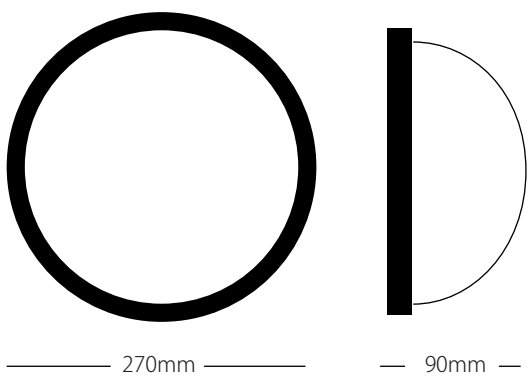


Technical Data: Bella

Model No	Lamp	Nominal Voltage (V)	Control Gear
CFL 5193-1x75E27	1X75w	240 / 110	-
CFL5193-2X9MB	2X9w	240 / 110	MB

Product description

The contemporary styling of Tonda presents a striking accent to classical architecture. Translucent PC lens minimize dayform mass while subtly refracting light at night. Completely made of no yellowing polycarbonate, Tonda is suitable for indoor / canopy applications.



Technical Data: Tonda



Model No	Lamp	Nominal Voltage (V)	Control Gear
CFL 5194-1x75E27	1X75w	240 / 110	-
CFL5194-2X9MB	2X9w	240 / 110	MB

Product description

Samussa is ceiling / Wall mounted fixture required at places where little high light levels are required. Suitable to accept upto 2x18w CFL, the fixture creates bright effects. Completely made of no yellowing polycarbonate, Samussa is suitable for indoor / canopy applications.



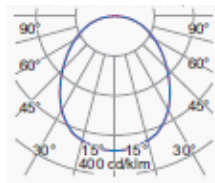
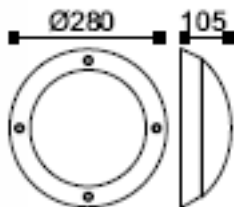
Technical Data: Samussa



Model No	Lamp	Nominal Voltage (V)	Control Gear
CFL 5195-1X100W E27	1X75w	240 / 110	-
CFL 5195-2X13MB	2X13w	240 / 110	MB
CFL 5195-2X18MB	2X18w	240 / 110	MB

### Product description

Moon is a pressure die cast aluminum body fitting that was born to light and enhance surfaces, details, and residential areas. A ceiling-mounting system for decorative lighting effects. Moon has been designed with innovative technologies and distributes the light flow evenly. Available in 18w CFL version.



### Technical Data: Moon

Model No	Wattage	Nominal Voltage *(V)
CFL 5205-118 EB/MB	1X18w	240 / 110

\* other voltages also available /please ask for quote

Product description

Vivo displays an organic idiom, and its opal surface emanates uniform, diffuse light. Works wonders when mounted on wall for area lighting without intrusion or glare. Made of pressure die cast aluminum with Opal PC lens. Available in two different sizes , its application is most suitable for Exterior Villa lighting, Security lighting, Hallway, Hotels or simply as tall bollard.



Technical Data: Vivo

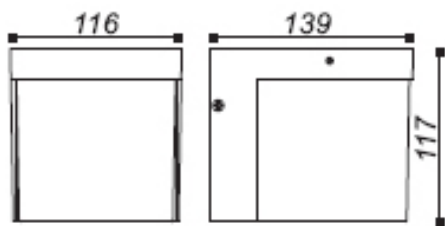
Model No	Wattage	Nominal Voltage *(V)
CFL 5203-118 E27	1X18w	240 / 110

\* other voltages also available /please ask for quote

Product description

A wall-mounted model featuring a subtle and essential design. This luminaire supplies effective lighting wherever an effect of soft elegance is required.

Pressure die cast housing with silicon gaskets and PC lens in IP54 ingress protection make it ideal for indoor as well as outdoor application.



Technical Data: Cubo

Model No	Wattage	Nominal Voltage *(V)
CFL 5204-111	1X11w	240 / 110

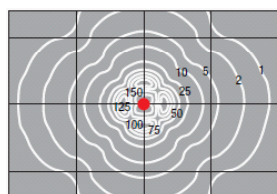
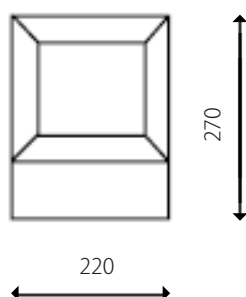
\* other voltages also available /please ask for quote

### Product description



The clean and linear design of the Punto has been developed with an eye to smoothly lighting surrounding surfaces.

Fixture produced in die cast aluminium, with PC lens fixture offers right solution for Interior exterior area lighting and landscape lighting or pathways .



### Technical Data: Punto

Model No	Wattage	Nominal Voltage *(V)
CFL 5207-126 EB/MB	1X26w	240 / 110

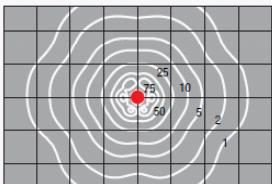
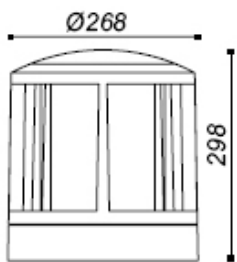
\* other voltages also available /please ask for quote

Product description



Quanto which feature a bold formal language and a subtle retro design – has been designed to cater for the area lighting /landscape lighting as an essential aid in conveying an effective, distinctive message, with a balanced price-quality ratio.

Produced in sturdy, long-lasting aluminum die cast , they are equipped with high-performance, optics to optimize lamp performance and lower operating costs. Fixture with diffused PC optics is suitable both for accent and diffuse lighting of walking and transit ways.



Technical Data: Quanto

Model No	Wattage	Nominal Voltage *(V)
CFL 5206-126EB/MB	1X26W	240 / 110

\* other voltages also available /please ask for quote



## Product description

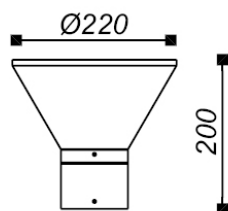
Simplistic yet innovative enough for interior as well as exterior applications, Nova suffices the lighting designers requirements.

Made in aluminum with polycarbonate lens, Nova supports highly efficient 18w CFL.

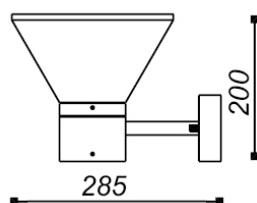
Fixture is available in wall mount and base mount models and suitable for Villas , landscapes, hotels, entertainment places etc..



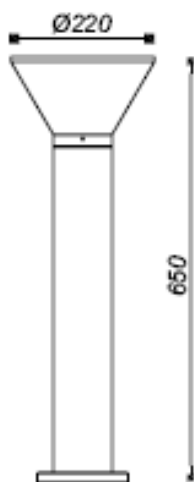
CFL-5210-118



CFL-5211-118



CFL-5212-118



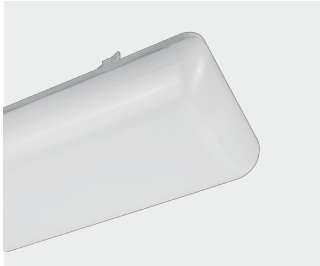
## Technical Data: Nova

Model No	Wattage	Nominal Voltage *(V)
CFL-5210-118 MB/EB	1X18w	240 / 110
CFL-5211-118 MB/EB	1X18w	240 / 110
CFL-5212-118 MB/EB	1X18w	240 / 110

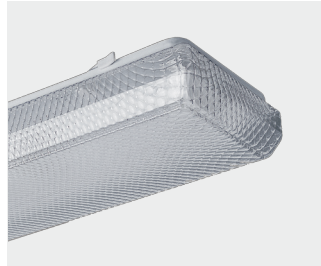
\* other voltages also available /please ask for quote

## Product description

Transparencies that allow light to go through the luminaire, enveloping it and thus integrating it into the place. This is the essence of the new series EasyLux. The fact that the luminaire body is translucent allows playing with the opal sheets that set at different places inside the luminaire send the light out onto the area intended, resulting in two basic models: a Prismatic model, and an opal model. All models can be surface mounted to either ceiling or walls



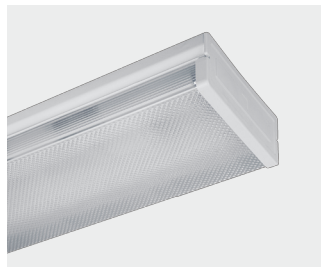
FTL5122-Opal



FTL5122-Prismatic



FTL5124/25-Opal



FTL5124/25-Prismatic

### Luminaire Housing & Optics:

Bodies in white painted galvanized steel, Diffusers of PMMA in Opal, Prismatic.

### European Standards:

The wiring of our luminaires is halogen-free and with diminished smoke production in accordance with harmonised document HD22.9 S3. All Sololuce luminaires are constructed in accordance with electrical safety standards EN 60598-1 and EN 60598-2.

### Dimension (L\*W\*D):

FTL 5122-236: 1267\*188\*66

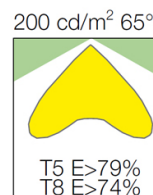
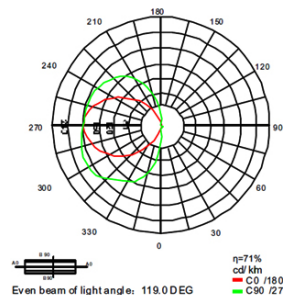
FTL 5124-218: 628\*176\*65

FTL 5125-236: 1238\*176\*65

FTL 5125 (S)-136: 1238\*78\*65

### Optics:

Also available in TS lamp option



## Technical Data: EasyLux

Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL5122-236 Opal	2X36 T8	240 / 110	EB/MB
FTL5122-236 Prismatic	2X36 T8	240 / 110	EB/MB
FTL5124-218 Opal	2X18 T8	240 / 110	EB/MB
FTL5124-218 Prismatic	2X18 T8	240 / 110	EB/MB
FTL5125-236 Opal	2X36 T8	240 / 110	EB/MB
FTL5125-236 Prismatic	2X36 T8	240 / 110	EB/MB
FTL5125 (S)-136	1X36 T8	240 / 110	EB/MB

\* DALI / Dimmable control gear / Emergency Lighting available on request

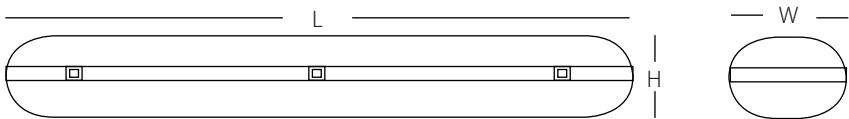


The Policar™ are robust IP66 corrosion resistant, moisture and dust proof fittings for industrial type applications, suitable for use with T8 and T5 fluorescent lamps to provide high performance efficient lighting.

Manufactured in compressed polyester reinforced with fibre glass , with dished clear polycarbonate cover. Polyurethane gasket to guarantee an IP 66 rating. Suitable for use in multi-storey car parks, changing areas and factories, plant rooms, loading bays , construction sites. chemically aggressive or corrosive atmospheres e.g. road / rail tunnels, chemical and oil production plants, marine / coastal type environments, galvanic treatment areas, livestock, abattoirs and food industries.

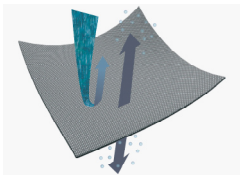
Policar fittings are designed with the need to make installations and maintenance as fast and easy as possible, particularly considering the harsh environments in which they may be installed. The Policar series consists of two models: for T5 and T8 fluorescent bulbs.

Gear Tray manufactured in white lacquered steel plate (RAL 9010). Plastic Clips as standard and stainless steel under request.

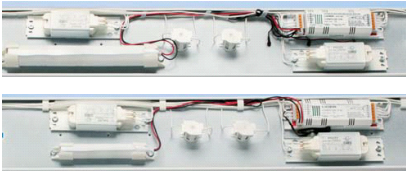


Special Features

- Vandal and heat resistant robust polycarbonate body
- UV stabilised polycarbonate (IK10) diffuser
- Linear prisms designed to optimise light output and reduce glare
- Stainless steel clips & polyurethane sealing gasket
- Stainless steel fixing brackets for ceiling mounting
- Retained diffuser for easy maintenance



Equipped with IP66 anti-vacuum breathing device as an option.



**Option:**  
 Non Maintained emergency luminaire  
 - with 3 hrs emergency backup  
 - with 1 hr emergency backup



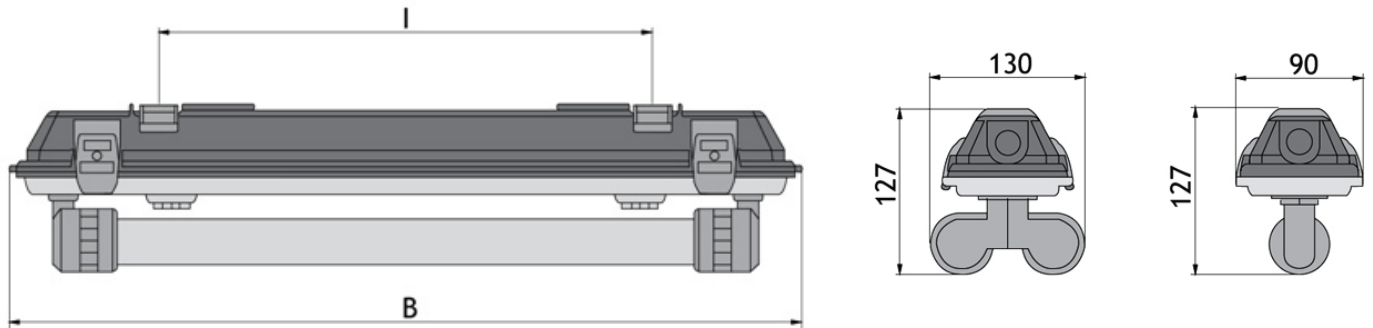
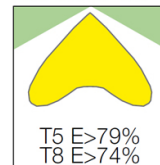
Technical Data: Policar

Model No	Lamp	Nominal Voltage (V)	Control Gear	L*W*H
FTL 5170-118	1X18 T8	240 / 110	EB/MB	650*80*80
FTL 5171-218	2X18 T8	240 / 110	EB/MB	650*120*80
FTL 5172-136	1X36 T8	240 / 110	EB/MB	1260*80*80
FTL 5173-236	2X36 T8	240 / 110	EB/MB	1260*120*80
FTL 5174-128	1X28 T5	240 / 110	EB	1260*80*80
FTL5175 -228	2X28 T5	240 / 110	EB	1260*120*80





Waterproof fittings suitable for civil, commercial, industrial and public areas where is demanded protection against dust and moisture. Housing is made of polycarbonate with high degree of impact resistance. Silicon anti-ageing sealing gasket. Protection tube made of transparent polycarbonate smooth finished and dust protected unbreakable and self-extinguishing , Electronic ballast standard for Policar Plus .

200 cd/m<sup>2</sup> 65°

### Technical Data: Policar Plus

Model No	Lamp	Nominal Voltage (V)	Control Gear	I*B
FTL 5184-118EB	1X18 T5	240 / 110	EB	660*382
FTL 5185-218EB	2X18 T5	240 / 110	EB	660*406
FTL 5186-136EB	1X36 T5	240 / 110	EB	1274*735
FTL 5187-236EB	2X36 T5	240 / 110	EB	1274*735

\* DALI / Dimmable control gear / Emergency Lighting available on request

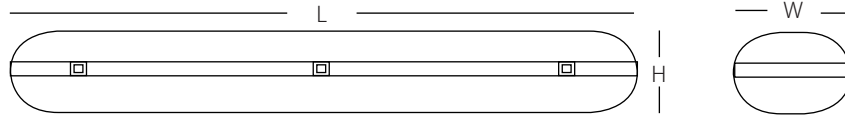


The Stagna™ are with specially designed PC refractor to give architects a better choice over the standard box type weatherproof fixture, strictly complying the standards.

Stagna are robust IP66 corrosion resistant, moisture and dust proof fittings for industrial type applications, suitable for use with T8 and T5 fluorescent lamps to provide high performance efficient lighting.

Manufactured in compressed polyester reinforced with fibre glass , with designer clear polycarbonate cover. Polyurethane gasket to guarantee an IP 66 rating. Suitable for use in multi-storey car parks, changing areas and factories, plant rooms, loading bays , construction sites. chemically aggressive or corrosive atmospheres e.g. road / rail tunnels, chemical and oil production plants, marine / coastal type environments, galvanic treatment areas, livestock, abattoirs and food industries.



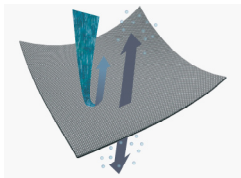


The Stagna series consists of two models: for T5 and T8 fluorescent bulbs.

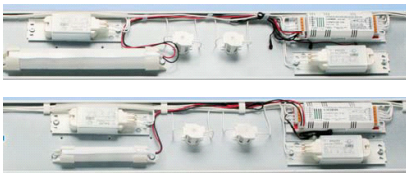
**Gear Tray** manufactured in white lacquered steel plate (RAL 9010). Plastic Clips as standard and stainless steel under request.

### Special Features

Vandal and heat resistant robust polycarbonate body UV stabilised polycarbonate (IK10) diffuser. Linear prisms designed to optimise light output and reduce glare Stainless steel clips & polyurethane sealing gasket Stainless steel fixing brackets for ceiling mounting retained diffuser for easy maintenance



Equipped with IP66 anti-vacuum breathing device as an option.



### Options:

- Non Maintained emergency luminaire
- with 3 hrs emergency backup
- with 1 hr emergency backup

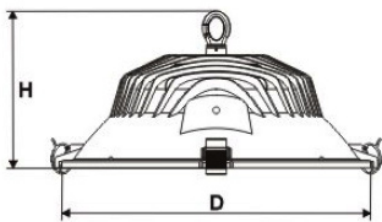


### Technical Data: Stagna New

Model No	Wattage	L*W*H	Nominal Voltage *(V)
FTL 5230-118 EB/MB	1X18w	664*110*90	240 / 110
FTL 5231-218 EB/MB	2X18w	660*180*90	240 / 110
FTL 5232 136 EB/MB	1X36w	1270*110*90	240 / 110
FTL 5233 236 EB/MB	2X36w	1270*180*90	240 / 110
FTL 5234 128 EB	1X28w	1270*110*90	240 / 110
FTL 5235 228 EB	2X28w	1270*180*90	240 / 110

\* other voltages also available /please ask for quote

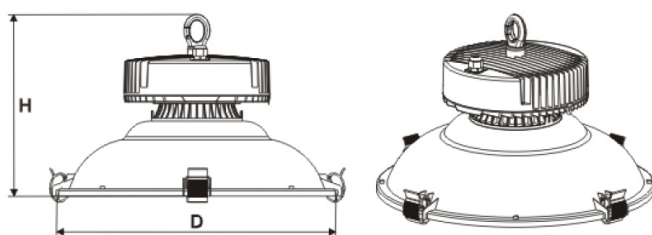




Model	D	H
IND 5221-40/60	360	247
IND 5221-80/100	400	237
IND 5221-120/150/200	507	256
IND 5221-250/300	556	281

Practically maintenance-free, induction lighting offers many features that make it an attractive light source and is emerging as one of the newest technologies in lighting. With a 100,000 hour rated life, these systems seldom need replacing. Particularly useful in applications where lamp replacement is cumbersome and expensive, as in some outdoor applications and in hard-to-reach areas such as tunnels, airports, public facilities, freezers, and many others.

- Ultra-Long Life-** 100,000 hour rated life, perfect for hard-to-reach applications
- Instant Startup and re-start-** must for Public Places
- Vibration Proof Lighting-** ideal choice for industrial and outdoor uses
- High powerfactor (>.0.98) and low THD-** energy efficient
- Operates from - 35° c-** Good for cold storage lighting
- Low Total Cost of Ownership-** reduced energy and maintenance costs
- Crisp White Light-** choice of color temperatures
- Outstanding Color Performance-** no shift over lamp life, high 80+ color rendering
- High Reliability Stable Light Output-** no variation over a wide range of temperatures and voltage fluctuations
- High efficacy**



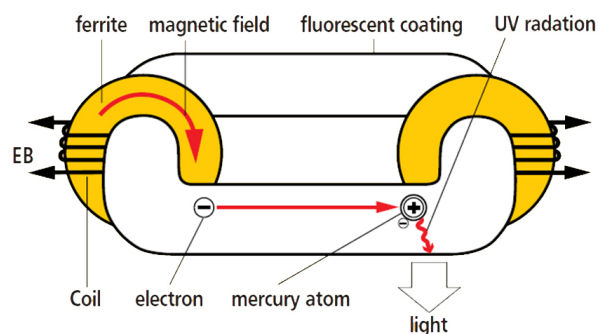
Model	D	H
IND 5222-40/60	358	289
IND 5222-80/100	399	289
IND 5222-120/150	478	312
IND 5222-200	506	320
IND 5222-250/300	556	331

### The Principle

Electromagnetic transformers consisting of ferrite rings with metal coils, create an electromagnetic field around a gas-filled glass tube, using a high frequency that is generated by an electronic ballast. The discharge path, induced by the coils, forms a closed loop causing acceleration of free electrons, which collide with mercury atoms and excite the electrons. As the excited electrons from these atoms fall back from this higher energy state to a lower stable level, they emit ultraviolet radiation. The UV radiation created is converted to visible light as it passes through a phosphor coating on the surface of the tube. The shape of the induction lamp maximizes the efficiency of the fields that are generated.

### How it Works

The ballast generates the high frequency current that drives the inductively coupled discharge. The ballast contains an integrated circuit (IC) chip, which controls the operating frequency and allows the electrodeless fluorescent lamp to work properly with a ballast power factor of up to .99 for lower power consumption. This control feature is especially beneficial where fluctuations in the power supply are more than 10% of rated voltage. The ballast also meets EMC requirements, and the circuit board is designed for dust, humidity, and corrosion resistance.





IND 5221



IND 5222



## Technical Data: Inductalux

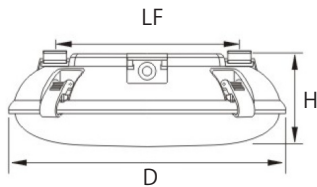
Model No	Wattage	Nominal Voltage *(V)
IND 5221-40	40w	240 / 110
IND 5221-60	60w	240 / 110
IND 5221-80	80w	240 / 110
IND 5221-100	100w	240 / 110
IND 5221-120	120w	240 / 110
IND 5221-150	150w	240 / 110
IND 5221-200	200w	240 / 110
IND 5221-250	250w	240 / 110
IND 5221-300	300w	240 / 110
IND 5222-40	40w	240 / 110
IND 5222-60	60w	240 / 110
IND 5222-80	80w	240 / 110
IND 5222-100	100w	240 / 110
IND 5222-120	120w	240 / 110
IND 5222-150	150w	240 / 110
IND 5222-200	200w	240 / 110
IND 5222-250	250w	240 / 110
IND 5222-300	300w	240 / 110

\* other voltages also available /please ask for quote

### Product description

Simplistic Luna hides the most intricate electronic inside. Intelligent Heat dissipation designed without destroying the beauty of luminaire. Surface mounted Polycarbonate fixture suitable for car parks, Halls, Foyers and Hypermarkets. Available in two sizes of 300mm and 350mm with CFL/ Circline & 2D lamp options.

Clear/opal polycarbonate cover option available.



Model	D	H	LF
CFL 5208	300	100	200
CFL 5209	350	107	250



### Technical Data: Luna

Model No	Wattage	Nominal Voltage *(V)
CFL 5208-122 T5 Circline	1X22w	240 / 110
CFL 5208-128 T5 Circline	1X28w	240 / 110
CFL 5208-128 2D	1X28w	240 / 110
CFL 5208-132 2D	1X32w	240 / 110
CFL 5208-226 PLC/EB	2X26w	240 / 110
CFL 5209-132 T5 Circline	1X32w	240 / 110
CFL 5209-140 T5 Circline	1X40w	240 / 110
CFL 5209-155 T5 Circline	1X55w	240 / 110
CFL 5209-155 2D	1X55w	240 / 110
CFL 5209-326 PLC/EB	3X26w	240 / 110

\* other voltages also available /please ask for quote

### Product description

Heavy duty industrial Batten for 28Watt T5 and 36 Watt T8 fluorescent lamp, for surface mounting on wall and ceiling. Its sturdy compact construction in combination with or without special reflectors with improved distribution help in addressing different application areas. The Batten is made form CRCA sheet steel powder coated gray and white cover. The reflector can be either powder coated or sandwiched aluminium. Batten family is a range of robust industrial solutions suitable for lighting general industrial spaces like panel rooms, switch gear rooms etc.



### Technical Data: Battens

Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL 5188 136	1X36 T8	240 / 110	EB/MB
FTL 5189-236	2X36 T8	240 / 110	EB/MB
FTL 5190-128	1X28 T5	240 / 110	EB
FTL 5191-228	2X28 T5	240 / 110	EB

\* DALI / Dimmable control gear / Emergency Lighting available on request

\* ADD Ref Painted/ Ref aluminum with model no, if required

### Product description

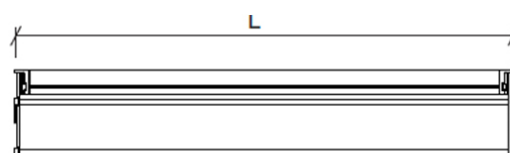
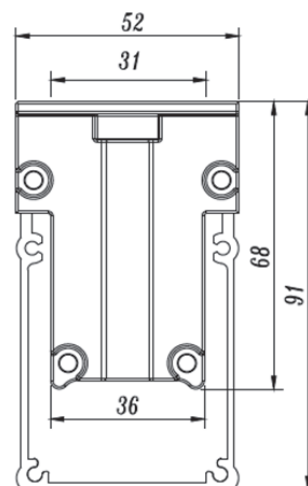
Technology and creativity are all contained in this functional lighting instrument, offering perfect light direction. Linea is a complete system, which, via technologically evolved T5 Lamp, is able to adapt itself to the most diverse architecture: building exteriors, and buildings, details, facades, etc..

#### Fixture Features :

Made of extruded aluminum with tempered glass in IP67 ingress protection.

Silicon gaskets

Galvanized gear plate



L: 618mm for 14W

L: 1218mm for 28W



#### Technical Data: Linea

Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL 5165-14	1X14w	240 / 110	EB
FTL 5166-28	1X28w	240 / 110	EB



Classique range offers solutions for architectural buildings or villas which have been designed considering country's culture and values.

Made of cast aluminum, silicon seals, embellishments and hard glass, fixtures offer longlasting solutions.



CFL 5240-142 E27  
380x260xH800



CFL 5241-142 E27  
400x260xH590



CFL 5242-242 E27  
595x375xH1200



CFL 5243-242 E27  
410x260xH680





Technical Data: Acrylux

Model No	Wattage	Nominal Voltage *(V)
CFL 5220-100 E27	100w	240 / 110

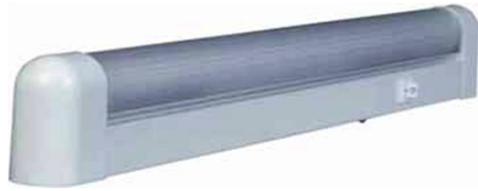
\* other voltages also available /please ask for quote

### Product description

Bagno is general application lighting fixtures available in engineered plastic , sheet meta pr aluminum extrusion profiles.

Standard models are in T5/T8 flourescent tubes but option of LED tubes also available.

Bagno mobile is for aimed lighting application and can be used as Mirror light or for lighting wall hangings etc.



FTL 5225/26



FTL 5227



### Technical Data: Bagno

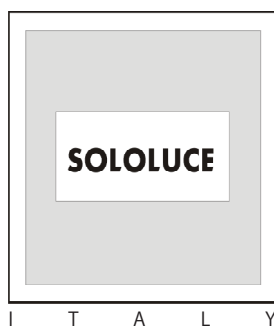
Model No	Wattage	Nominal Voltage *(V)
FTL 5225-20	20w	240 / 110
FTL 5226-40	40w	240 / 110
FTL 5227-13	13w	240 / 110

\* other voltages also available /please ask for quote





## HID Lighting



I T A L Y

HID Lighting





T H E C O L L I N E

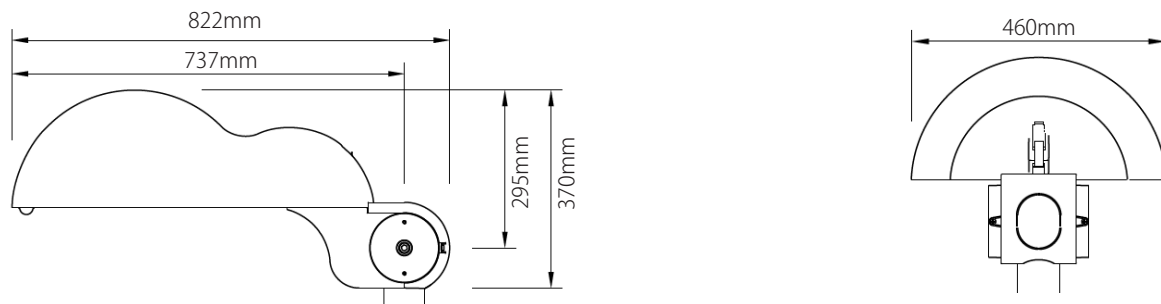
**Designed by:** Giancarlo Ventrucchi

Night light at its best.....

Sololuce is continuously developing successful and innovative concepts for exterior lighting. Trend setting standard products and customised solutions offer simple maintenance and long life whilst conforming to engineering standards, attractively accentuating our environment and light up the way to the future.

Our lighting solutions are devised and tested using the most advanced computer- aided processes. This is followed by practical trials in our own test facilities. Virtually unique in the world, these enable us to realistically demonstrate the most varied lighting situations to our customers.





### Fixture Features:

The avant-garde housing is available with flat glass. Extremely rugged, high grade diecast aluminium, a material becoming increasingly popular worldwide, can resist intense heat, high exposure to ozone and UV radiation, rain, hail, snow and sea water, is available in two surface finishes; Black & Grey. Other non standard finishes are also available on request.

Fixture uses high grade aluminum reflector for perfect batwing street optics, all hardware is of stainless steel and is externally powder coated after cromate conversion.

Luminare completely complies with IP66 requirements for optical and control gear requirements and comes with engineered plastic control gear tray for achieving class II requirements.



### Wide open. Everything there.

The wide opening simplifies maintenance. The opened top of Colline is supported by a Hinge lock mechanism; on Colline a stable hing holds the opened top flap securely in place and braces it against the wind.

### Hands-on concept

**QUICK  LOCK**

Despite the high sealing pressure, Colline luminaire is quite simple to open. Their intelligent quick lock mechanism responds to a minimum of force. The single-handed lever is pure user-friendliness so that you can easily grip it and open or close the housing safely and conveniently – with or without a glove.

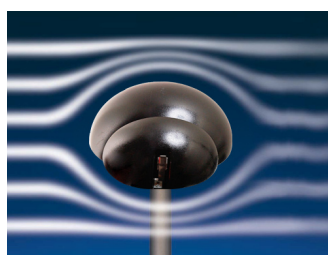
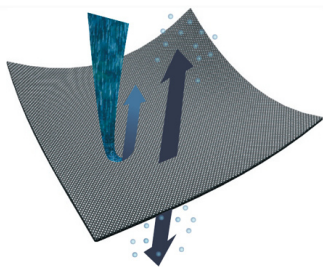
### 9 way flexibility

You can fix the lamp holder of Colline luminaires in nine different positions to precisely define the radiation angle forwards and backwards. This creates optimal lighting for every kind of application. In narrow side streets and on major thoroughfares, at intersections and bus stops, on bridges and in avenues, solve every imaginable lighting application.



### Colline is equipped with Controlled Breathing Technology ( CBT )

Ventilating is a thing of the past. As of today, breathing is in. Until now, the simplest solutions also created the greatest problems. In order to ventilate a casing, there have been various counter measures that were cost and time intensive such as interior heating, trickling holes or external ventilation elements. Often, required degree of protection could no longer be guaranteed. With CBT , these approaches are unnecessary, because it prevents the problems from occurring. The CBT has a micro-porous, PTFE membrane that literally lets the casing breathe, which then compensates different pressures inside and outside the casing. Hence, condensation is reduced to a minimum while the high-tech membrane seals CBT in such a way that dirt and water can not penetrate into the inside of the casing. CBT meets the high requirements of IP 66 .



### Aerodynamic Design

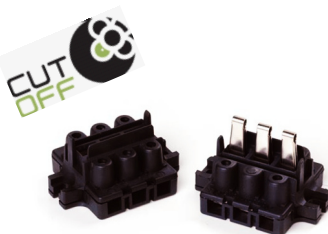


Designed to be aerodynamic to offer low windage load on Pole and confirm to safety standards.



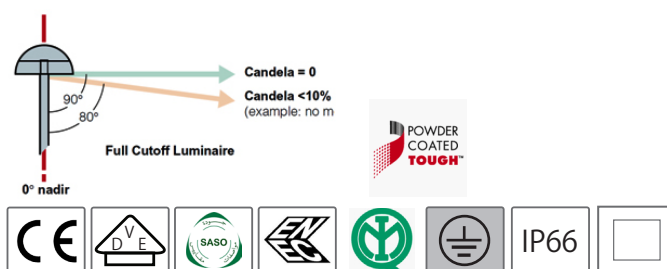
### Dark Sky Compliant

Colline complies with dark sky association's specifications.



### Auto cut off Technology

The use of quick-disconnect terminals ensures safe and easy ballast maintenance.



### Technical Data: Colline

Model No	Wattage	Nominal Voltage (V)
HID 6107-250	250w	240 / 110
HID 6107-400	400w	240 / 110
HID 6107-600	600w	240 / 110

Suitable for both HPSV & MH lamps

**Designed by:** Giorgio Palermo



Giving form to the night....

During the day buildings and landscapes outline the shape of our world, but at night, artificial light shapes our environment.

Munza has been designed to bring character to Urban life, this pressure die cast fixture is suitable for lighting Service Roads, Parks, Malls entry, Public Places, Parks, walkways etc..

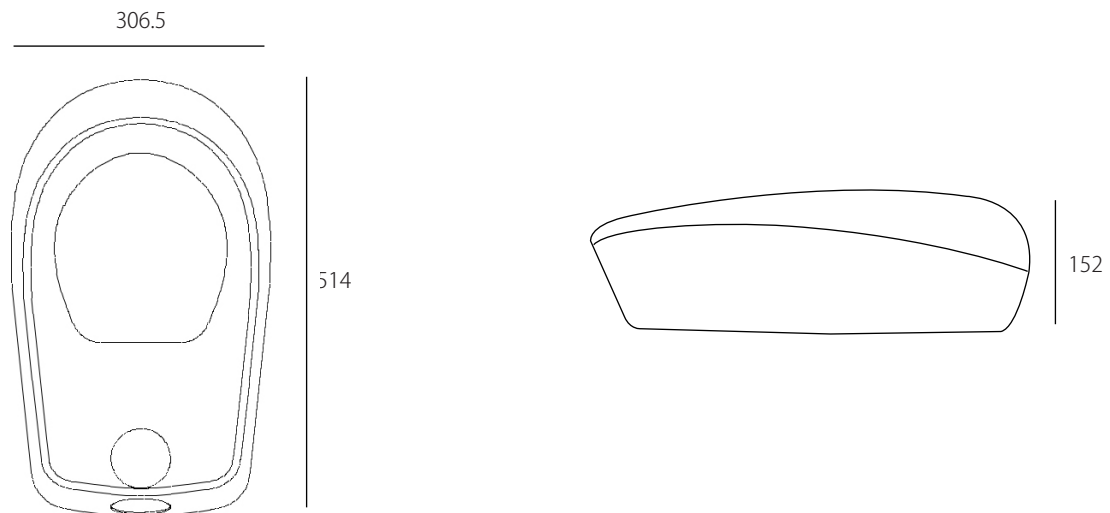
As the fixture carries colours with character we have made it available in bright as well in subtle colours.

#### Fixture Features :

The avant-garde housing is available with flat glass and Drop Glass. Extremely rugged in high grade die cast aluminium.

Fixture uses high grade aluminum reflector for perfect batwing street optics, all hardware is of stainless steel and is externally powder coated after cromate conversion.

Luminare completely complies with IP66 requirements for optical and control gear requirements and comes with engineered plastic control gear tray for achieving class II requirements.



### 9 way flexibility

Lamp Holder of Munza luminaires creates nine different optics to precisely define the radiation angle forwards and backwards. This creates optimal lighting for every kind of application. In narrow side streets and on major thoroughfares, at intersections and bus stops, on bridges and in avenues, solve every imaginable lighting application.

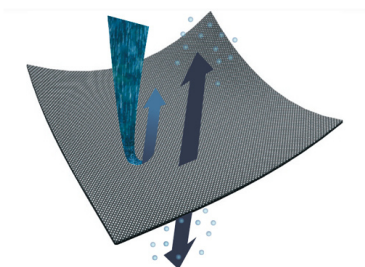


### Lamp Options

Munza luminaires optics is suitable to accept PGJ5/G12 and E 27 lamp holders.

### Munza is equipped with Controlled Breathing Technology ( CBT )

Ventilating is a thing of the past. As of today, breathing is in. Until now, the simplest solutions also created the greatest problems. In order to ventilate a casing, there have been various counter measures that were cost and time intensive such as interior heating, trickling holes or external ventilation elements. Often, required degree of protection could no longer be guaranteed. With CBT, these approaches are unnecessary, because it prevents the problems from occurring. The CBT has a micro-porous, PTFE membrane that literally lets the casing breathe, which then compensates different pressures inside and outside the casing. Hence, condensation is reduced to a minimum while the high-tech membrane seals CBT in such a way that dirt and water can not penetrate into the inside of the casing. CBT meets the high requirements of IP 66.

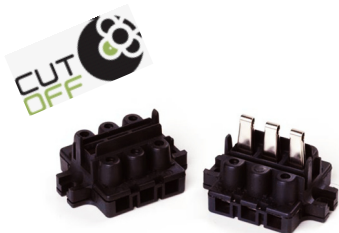




### Aerodynamic Design

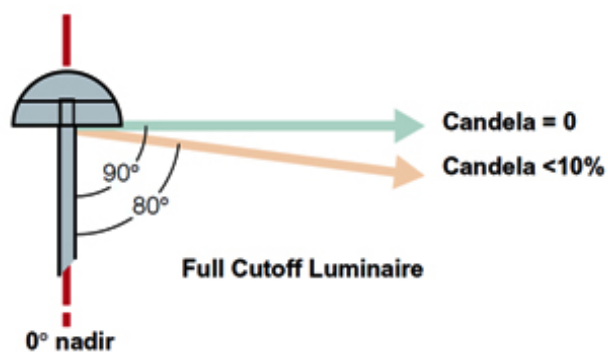


Designed to be aerodynamic to offer low windage load on Pole and confirm to safety standards.



### Auto cut off Technology

The use of quick-disconnect terminals ensures safe and easy ballast maintenance.



### Dark Sky Compliant

Munza is full cutoff luminaire and complies with dark sky association's specifications.



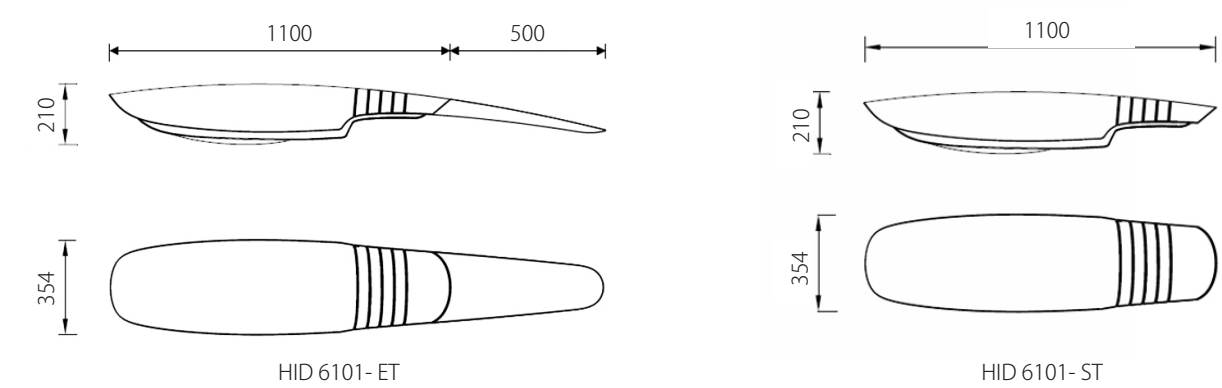
### Technical Data: Munza

Model No	Wattage	Nominal Voltage (V)
HID 6108-35-PGj5	35w	240 / 110
HID 6108-70-G12/G27	70w	240 / 110
HID 6108-100-G12/G27	100w	240 / 110
HID 6108-150-G12/G27	150w	240 / 110



**Harmonious by day, romantic by night.**

Velocity is the antithesis of the “decorative” glaring lamp posts which deny the balanced and non polluting light control, that should be the first requirement for quality public lighting. Designed with sober and timeless shapes, Velocity , brings life to Urban Areas and Roads .



- Fixture features:**
- corrosion resistant die-cast aluminium body
  - IP66 ingress Protection
  - tempered glass screens
  - AISI 304 stainless steel hardware
  - silicone rubber gaskets
  - polyester powder coating, with a pluri-processed against corrosion (passed the exposure of over 1500 hours in a saline mist environment)
  - 60mm dia pole inlet

**Confirms to**  
EN 60598-1  
EN 60598-2-1  
EN 60598-2-3

**Options:**  
Two models available one with decorative extended top (ET)and one with short top (ST)



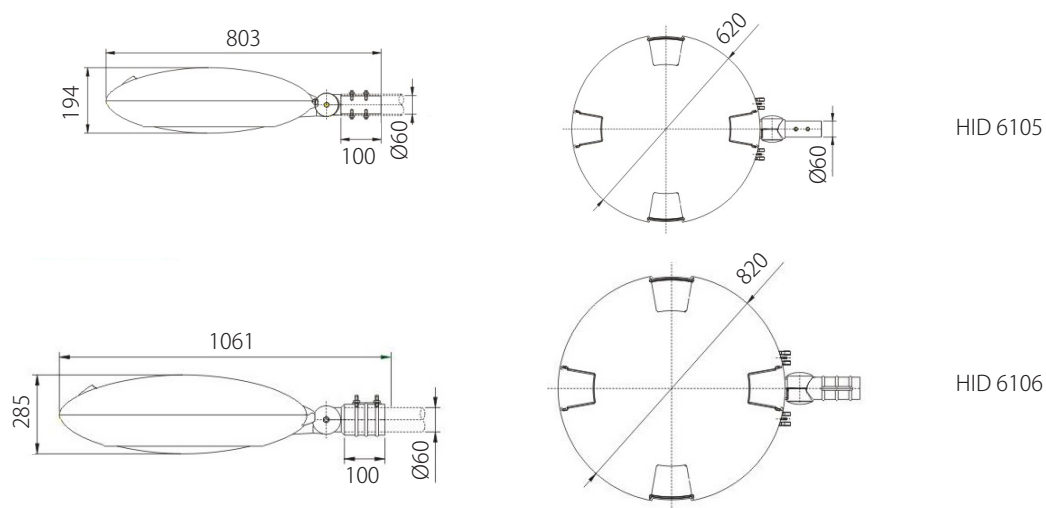
Technical Data: Velocity

Model No	Wattage	Nominal Voltage (V)
HID 6101- 250/400-ET	250/400w	240 / 110
HID 6101-250/400-ST	250/600w	240 / 110



**Subtle Statement .....****The Oliver is the perfect luminaire**

for projects that want to make a subtle statement. The sleek lines of this very resilient luminaire harmonize with any setting. The technology inside this luminaire is designed to give the Oliver a long life and make it easy to perform maintenance when needed. The smoothly engineered shape of the Oliver combined with its gracefully arching creates a uniquely subtle appearance. The gentle curvature allows the fixture to spatially define paths or roadways. Two luminaire sizes are available to meet proportional requirements of large or small scale applications. The heavy pressure die cast aluminum housing is fitted with a tempered glass lens with single clamp for easy relamping. Fully closed reflector assembly with easy access to the ballast tray.



#### All details at a glance.

Under the wide opening top, all components are clearly arranged – for fast relamping, regular electrical inspection.

#### Fixture features:

Corrosion resistant die-cast aluminium body, IP66 ingress Protection, tempered glass screens  
AISI 304 stainless steel hardware, silicone rubber gaskets, polyester powder coating, with a pluri-processed against corrosion (passed the exposure of over 1500 hours in a saline mist environment) and 60mm dia pole inlet

#### Confirms to

EN 60598-1  
EN 60598-2-1  
EN 60598-2-3

#### Options:

Two models available one upto 600w and other upto 400w



#### Technical Data: Oliver

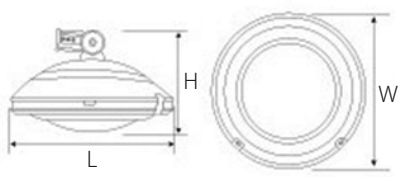
Model No	Wattage	Nominal Voltage (V)
HID 6105-70	70w	240 / 110
HID 6105-150	150w	240 / 110
HID 6105-250	250w	240 / 110
HID 6105-400	400w	240 / 110
HID 6106 -400	400w	240 / 110
HID 6106-600	600w	240 / 110



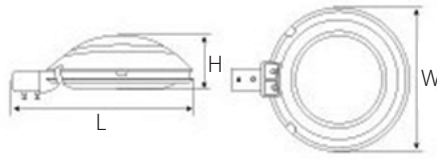


The TriLume series' timeless styling blends with a broad range of architecture. Three sizes are available to meet diverse proportional requirements. This TriLume series fulfils the requirements of lighting Roads, Squares and Public spaces for pedestrians, guaranteeing maximum visual comfort and at the same time a piece of urban furnishing which is an expression of contemporary design.

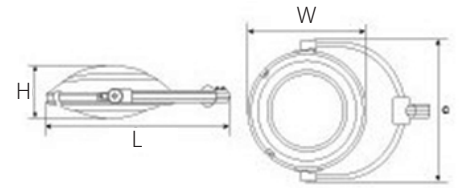




Model	L	W	H
HID 6112 TM	600	600	330
HID 6111 TM	500	500	310



Model	L	W	H
HID 6112 SM	780	600	240
HID 6111 SM	680	500	220



Model	L	C	W	H
HID 6112 BM	880	750	600	240
HID 6111 BM	780	650	500	220

### Fixture features:

Corrosion resistant die-cast aluminium body, IP66 ingress Protection, tempered drop glass, AISI 304 stainless steel hardware, silicone rubber gaskets, polyester powder coating, with a pluri-processed against corrosion (passed the exposure of over 1500 hours in a saline mist environment) and 60mm dia pole inlet

### Options :

Two sizes , each having three variants

Top Pole Mount (TM)

Side Pole Mount (SM)

Bracket Pole Mount (BM)



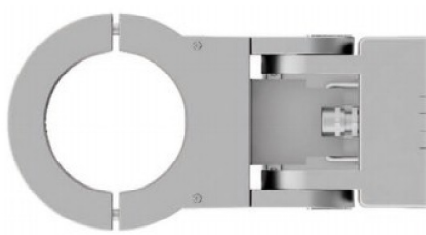
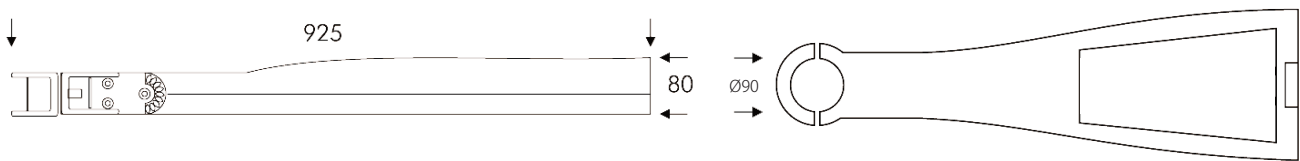
### Technical Data: TriLume

Model No	Wattage	Nominal Voltage (V)
HID 6111-70 -TM	70w	240 / 110
HID 6111-150 -TM	150w	240 / 110
HID 6111-70 -SM	70w	240 / 110
HID 6111-150 -SM	150w	240 / 110
HID 6111-70 -BM	70w	240 / 110
HID 6111-150 -BM	150w	240 / 110
HID 6112-250 -TM	250w	240 / 110
HID 6112-400 -TM	400w	240 / 110
HID 6112-250 -SM	250w	240 / 110
HID 6112-400 -SM	400w	240 / 110
HID 6112-250 -BM	250w	240 / 110
HID 6112-400 -BM	400w	240 / 110

Fixture Suitable for both HPSV & MH lamps



The Esplanda body features compact thickness, essential design and straight lines in a HID fitting for street lighting in urban and interurban areas. Esplanda brings Euro-tech styling to roadway lighting applications. One luminaire available for HID lamp or energy saving PLL lamp creates a unique visual accent. The sleek housing and doorframe are heavy-duty die cast aluminum with heat dissipation fins at the backside. Clear impact resistant tempered glass lens and horizontal lamp reflector provides effective illumination.



Die Cast Pole Mount Attachment



Technical Data: Esplanda

Model No	Wattage	Nominal Voltage (V)
HID 6117-70 G12	70w	240 / 110
HID 6117-150 G12	150w	240 / 110
HID 6117-48 PLL	48w	240 / 110



## Product description

SQUARE are a range of high performance compact street cum floodlights with a distinctive linear geometry and shallow depth making them suitable for various contemporary and stylish applications like Discreet positioning with minimum visual impact , such as lofts, eaves and terraces. Architectural appealing design with highperformance.

The SQUARE range is available for lamps up to 400W.

Suitable for following light distribution:

- symmetrical,
- asymmetrical medium beam for tennis court lighting
- street lighting

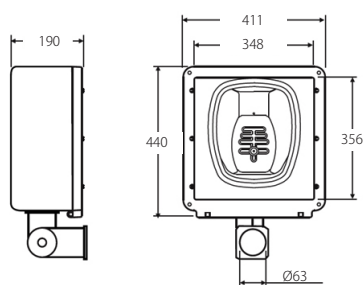
The SQUARE range of fittings are suitable for use in areas sensitive to sky glow where regulations require strict control of upward light pollution.



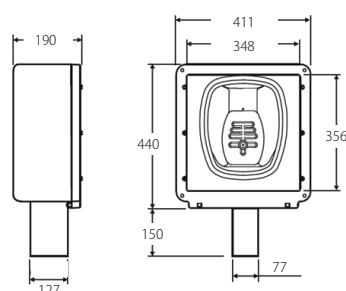
HID 6129



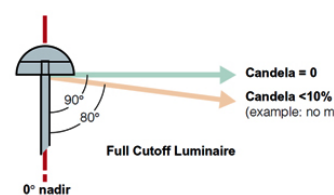
HID 6130



HID 6129



HID 6130



## Technical Data: Square

Model No	Wattage	Nominal Voltage (V)
HID 6129-250 SF	250w	240 / 110
HID 6129-400 SF	400w	240 / 110
HID 6130-250 PM	250w	240 / 110
HID 6130-400 PM	400w	240 / 110

## Product description

### Housing:

Pressure Die cast aluminum housing with textured powdercoat finish over a chromate conversion coating with hinged top & lens frame. SS clips for easy maintenance. Suitable for vertical & horizontal mounting.

### Reflector:

High efficiency one piece extra wide beam pattern for maximum pole spacing.

### Lens:

Tempered Curved glass lens

### Lampholder:

Porcelain 5kv pulse rated E40 lampholder. Lead wires rated for 200°C

### Mounting:

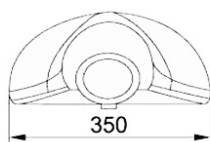
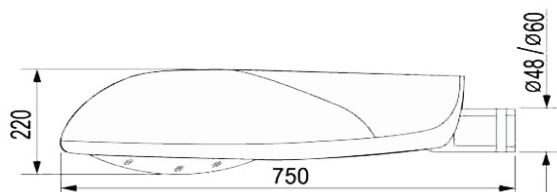
Unique mounting design allows vertical or horizontal spigot mounting. Pole entry dia 48mm to 60mm.

### Wattage:

Marte : HPSV/Metal Halide 150W-400W

### Listing & Ratings:

CE , IP66



### Technical Data: Marte

Model No	Wattage	Nominal Voltage *(V)
HID 6162-150	150w	240 / 110
HID 6162-250	250w	240 / 110
HID 6162-400	400w	240 / 110

\* other voltages also available /please ask for quote

## Product description



HID 6164



HID 6163

**Housing:**

Pressure Die cast aluminum housing with textured powdercoat finish over a chromate conversion coating with hinged top & lens frame. SS clips for easy maintenance. Suitable for vertical & horizontal mounting.

**Reflector:**

High efficiency one piece extra wide beam pattern for maximum pole spacing..

**Lens:**

Tempered Curved /flat glass lens

**Lampholder:**

Porcelain 5kv pulse rated E40 lampholder. Lead wires rated for 200°C

**Mounting:**

Unique mounting design allows vertical or horizontal spigot mounting. Pole entry dia 48mm to 60mm .

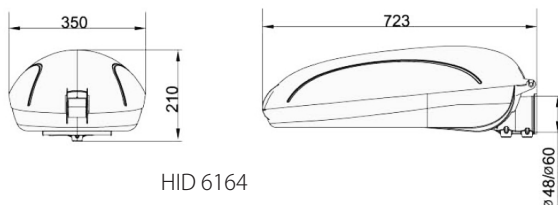
**Wattage:**

Marte Plus – I : HPSV/Metal Halide: 70W to 150W

Marte Plus – II : HPSV/Metal Halide 250W-400W

**Listing & Ratings:**

CE , IP66



HID 6164



HID 6163



## Technical Data: Marte Plus

Model No	Wattage	Nominal Voltage *(V)
HID 6163-70	70w	240 / 110
HID 6163-150	150w	240 / 110
HID 6164-250	250w	240 / 110
HID 6164-400	400w	240 / 110

\* other voltages also available /please ask for quote

## Product description

### Housing:

Pressure Die cast aluminum housing with textured powdercoat finish over a chromate conversion coating with hinged top & lens frame. SS clips for easy maintenance. Suitable for vertical & horizontal mounting.

### Reflector:

High efficiency one piece extra wide beam pattern for maximum pole spacing.

### Lens:

Tempered Curved /flat glass lens

### Lampholder:

Porcelain 5KV pulse rated E40 lampholder. Lead wires rated for 200°C

### Mounting:

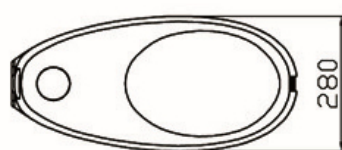
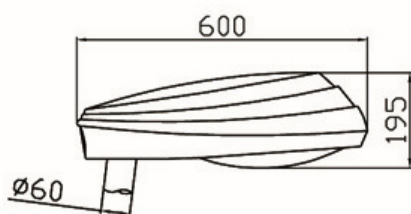
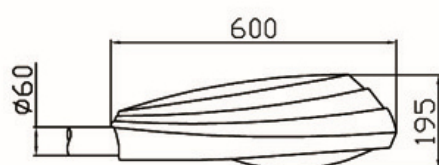
Unique mounting design allows vertical or horizontal spigot mounting. Pole entry dia 48mm to 60mm.

### Wattage:

Marte element : HPSV/Metal Halide : upto 250W

### Listing & Ratings:

CE , IP66



## Technical Data: Marte – Element

Model No	Wattage	Nominal Voltage *(V)
HID 6165-150	150w	240 / 110
HID 6165-250	250w	240 / 110

\* other voltages also available /please ask for quote



Product description



**Housing:**  
Pressure Die cast aluminum housing with textured powdercoat finish over a chromate conversion coating with hinged top & lens frame. SS clips for easy maintenance. Suitable for vertical & horizontal mounting.

**Reflector:**  
High efficiency one piece extra wide beam pattern for maximum pole spacing.

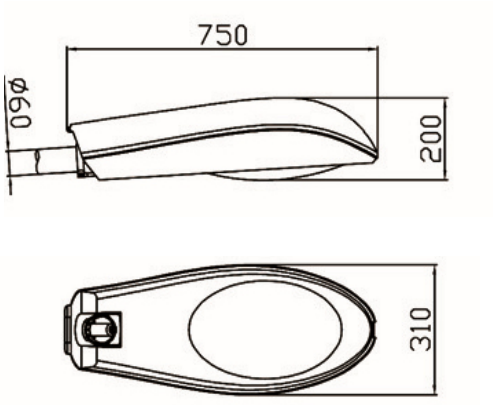
**Lens:**  
Tempered Curved glass lens

**Lampholder:**  
Porcelain 5kv pulse rated E40 lampholder. Lead wires rated for 200°C

**Mounting:**  
Unique mounting design allows vertical or horizontal spigot mounting.

**Wattage:**  
Marte Line: HPSV/Metal Halide: upto 400W

**Listing & Ratings:**  
CE , IP66



Technical Data: Marte – Line

Model No	Wattage	Nominal Voltage *(V)
HID 6166-250	250w	240 / 110
HID 6166-400	400w	240 / 110

\* other voltages also available /please ask for quote

## Product description

### Housing:

Pressure Die cast aluminum housing with textured powdercoat finish over a chromate conversion coating with hinged top & lens frame. SS clips for easy maintenance. Suitable for vertical & horizontal mounting.

### Reflector:

High efficiency one piece extra wide beam pattern for maximum pole spacing.

### Lens:

Tempered Curved/Flat glass lens

### Lampholder:

Porcelain 5kv pulse rated E40 lampholder. Lead wires rated for 200°C

### Mounting:

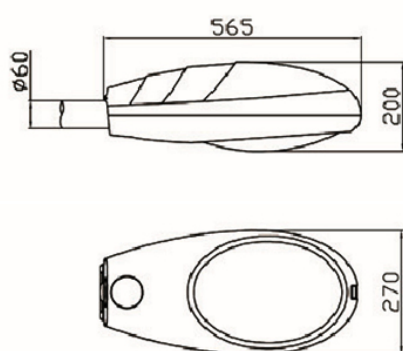
Unique mounting design allows vertical or horizontal spigot mounting.

### Wattage:

Marte Sigma : HPSV/Metal Halide : upto 250W

### Listing & Ratings:

CE: IP66



## Technical Data: Marte Sigma

Model No	Wattage	Nominal Voltage *(V)
HID 6167-150	150w	240 / 110
HID 6167-250	250w	240 / 110

\* other voltages also available /please ask for quote

Product description



**Housing:**  
Pressure Die cast aluminum housing with textured powdercoat finish over a chromate conversion coating with hinged top & lens frame. SS clips for easy maintenance. Suitable for vertical & horizontal mounting.

**Reflector:**  
High efficiency one piece extra wide beam pattern for maximum pole spacing.

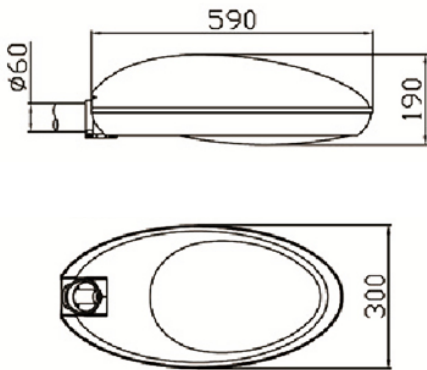
**Lens:**  
Tempered Curved/Flat glass lens

**Lampholder:**  
Porcelain 5kv pulse rated E40 lampholder. Lead wires rated for 200°C

**Mounting:**  
Unique mounting design allows vertical or horizontal spigot mounting.

**Wattage:**  
Marte Sigma : HPSV/Metal Halide upto 250W

**Listing & Ratings:**  
CE , IP66



Technical Data: Marte Sigma

Model No	Wattage	Nominal Voltage *(V)
HID 6168-150	150w	240 / 110
HID 6168-250	250w	240 / 110

\* other voltages also available /please ask for quote

## Product description

**Housing:**

Pressure Die cast aluminum housing with textured powdercoat finish over a chromate conversion coating with hinged top & lens frame. SS clips for easy maintenance. Suitable for horizontal mounting.

**Reflector:**

High efficiency one piece extra wide beam pattern for maximum pole spacing.

**Lens:**

Tempered Curved glass lens

**Lampholder:**

Porcelain 5kv pulse rated E40 lampholder. Lead wires rated for 200°C

**Mounting:**

Unique mounting design allows horizontal spigot mounting 48 dia /60dia respectively

**Wattage:**

Marte Trend I:: HPSV/Metal Halide : upto 150W

Marte Trend II:: HPSV/Metal Halide : upto 400W

**Listing & Ratings:**

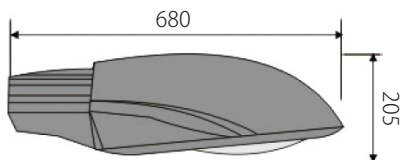
CE , IP66



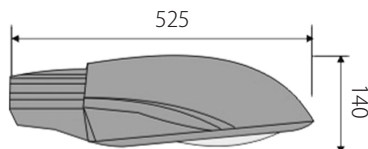
HID 6170



HID 6169



HID 6170



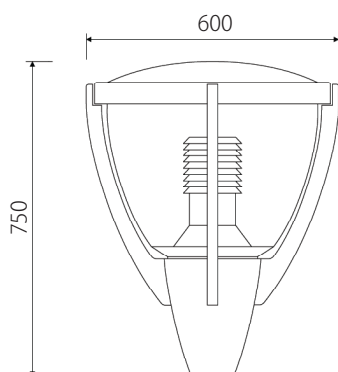
HID 6169



## Technical Data: Marte - Trend

Model No	Wattage	Nominal Voltage *(V)
HID 6169-70	70w	240 / 110
HID 6169-150	150w	240 / 110
HID 6170-250	250w	240 / 110
HID 6170-400	400w	240 / 110

\* other voltages also available /please ask for quote



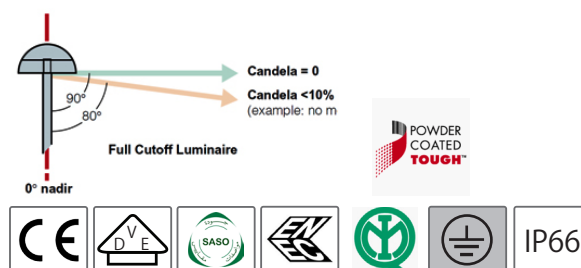
## Product description

Hermis represents timeless styling that blends with a broad range of architecture. Optimal size meets diverse proportional requirements. The clean look of the die cast aluminum housing contrasted against the curved polycarbonate diffuser and dome top creates a classically contemporary appearance. Integrated pole top fitter anchors die cast steel support to the curved shade and cast top cap.

The dome shapes clear PC lens extends through the shade forming an aperture to subtly highlight the luminaire night form. Internal louvers mimic the curvature of the shade profile, while functioning to reduce brightness.

### Fixture features:

- Hermis is made of die cast aluminum body with Polycarbonate vandal resistant lens Thermally tested and suitable for upto 150w HID lamps
- IP66 ingress Protection
- AISI 304 stainless steel hardware
- silicone rubber gaskets
- polyester powder coating, with a pluri-processed against corrosion (passed the exposure of over 1500 hours in a saline mist environment)



### Technical Data: Hermis

Model No	Wattage	Nominal Voltage (V)
HID 6104-70	70w	240 / 110
HID6104-150	150w	240 / 110

## Product description



Since its introduction the Sirrus has set the standard internationally for combining high lighting levels and excellent uniformity in large car parks and amenity areas. Its attractive and universal appearance also lends itself to a wide number of applications.

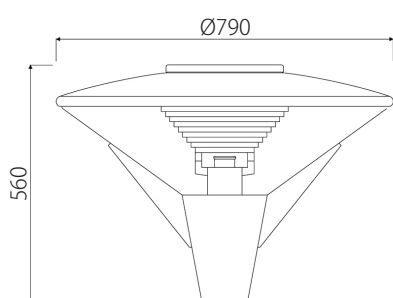
360 deg optics has been achieved using external lenses. This ensures lighting in circular area around the pole. Fixture has integral pole mount sleeve with 85mm pole entry.

### Fixture features:

Sirrus is made of die cast aluminum body with Polycarbonate vandal resistant lens

Thermally tested and suitable for upto 150w HID lamps

- IP66 ingress Protection
- AISI 304 stainless steel hardware
- silicone rubber gaskets
- polyester powder coating, with a pluri-processed against corrosion (passed the exposure of over 1500 hours in a saline mist environment)



### Technical Data: Sirrus

Model No	Wattage	Nominal Voltage (V)
HID 6102-70	70w	240 / 110
HID 6102-150	150w	240 / 110

Suitable for both HPSV & MH lamps

## Product description

Krypton combines exceptional design with modern technology and is the ideal solution for walkways, parks and squares. It complements its location to give a unique atmosphere.

Krypton is designed to be pole top mounted on 4 to 5m columns using the slip over mounting sleeve of 85mm spigot entry.

### Fixture features:

- Krypton is made of die cast aluminum body with Polycarbonate vandal resistant lens
- Thermally tested and suitable for upto 150w HID lamps
- IP66 ingress Protection
- AISI 304 stainless steel hardware
- silicone rubber gaskets
- polyester powder coating, with a pluri-processed against corrosion (passed the exposure of over 1500 hours in a saline mist environment)

### Options:

Three models , with Cap, without Cap and with Cap and side bars available with same diffuser.



## Technical Data: Krypton

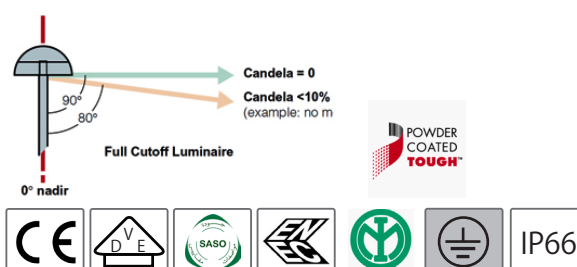
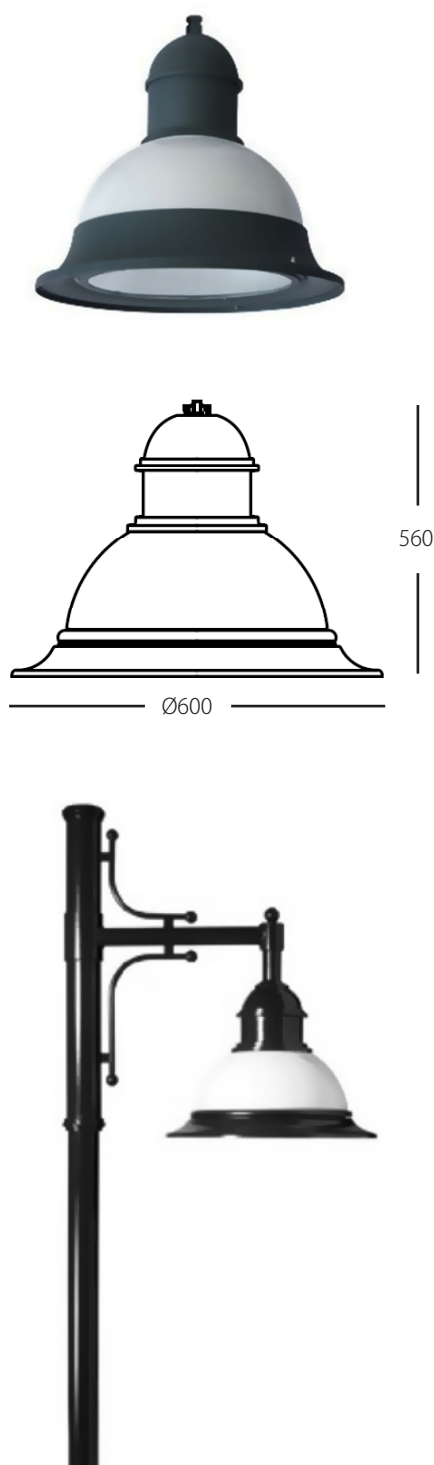
Model No	Wattage	Nominal Voltage (V)
HID 6103-70A	70w	240 / 110
HID 6103-150A	150w	240 / 110
HID 6103-70B	70w	240 / 110
HID 6103-150B	150w	240 / 110
HID 6103-70C	70w	240 / 110
HID 6103-150C	150w	240 / 110

## Product description

The Globus is one of the most versatile luminaires offered by Sololuce. This classic shape encompassing most of the exclusive Sololuce's innovations, the Globus can fit into any environment; be it the main street of a small Alaskan village or the downtown of a high-tech center. Combined with today's efficient optics, Globus embodies the tradition of excellence in Sololuce products. Harmonizing beautifully with virtually any urban setting, the Globus luminaires are representative of the new generation of lighting units. Constructed from top-quality materials, the Globus maintains excellent performance in even the most demanding environments. The Smart-seal optical systems (IP66) of the Globus virtually eliminate Luminaire Dirt Depreciation (LDD), while the tool free access to the lamp and electrical components make maintenance a breeze.

### Fixture features:

- corrosion resistant die-cast aluminium body with hydroformed aluminum reflector
- IP66 ingress Protection
- Tempered flat glass
- AISI 304 stainless steel hardware
- silicone rubber gaskets
- polyester powder coating, with a pluri-processed against corrosion (passed the exposure of over 1500 hours in a saline mist environment)
- 32mm dia pole inlet



### Technical Data: Globus

Model No	Wattage	Nominal Voltage (V)
HID 6110-70	70w	240 / 110
HID 6110-150	150w	240 / 110

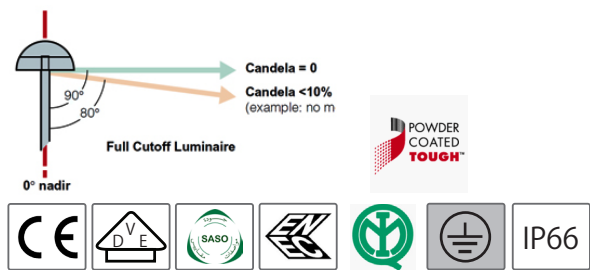
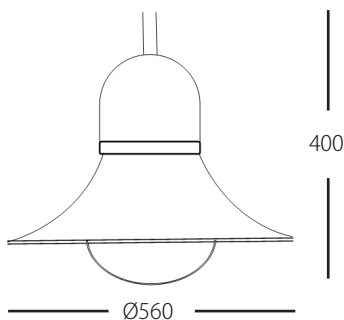


Product description

Pole top with wide-spread distribution .  
Designed for the illumination of walkways, open pedestrian scale landscape areas, parking areas, and roadways , featuring wide-spread distribution . Pole top luminaires with die-cast aluminum housings , PC diffuser with optical texture & Pure anodized aluminum reflector system .  
Luminaire is suitable to accept upto 150w HID lamp

Fixture features:

- corrosion resistant die-cast aluminium body with spun aluminum shade
- IP66 ingress Protection
- PC diffuser
- AISI 304 stainless steel hardware
- silicone rubber gaskets
- polyester powder coating, with a pluri-processed against corrosion (passed the exposure of over 1500 hours in a saline mist environment)
- 32mm dia pole inlet



Technical Data: Pelican

Model No	Wattage	Nominal Voltage (V)
HID 6109-70	70w	240 / 110
HID 6109-150	150w	240 / 110

### Product description

New lamp post for a new way of lighting.....

The smoothly engineered shape of the Berlin creates a uniquely subtle appearance. The gentle curvature of acrylic diffuser allows the luminaires to spatially define paths, circles, parks and city centres.

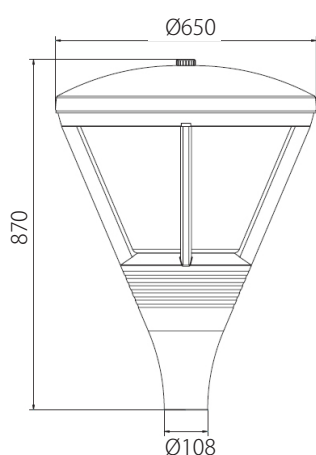
#### Fixture Features:

The Fibreglass reinforced engineered plastic housing and acrylic refractor with integrated pole top fitter anchors rods to support the flat spun aluminum top cap. All hardware is stainless steel.

Luminaire is available in 150w/250w and 400w HPS high pressure sodium/MH metal halide lamp.

Standard colors is black (BK) ,dark grey(GY)(RAL7016), light grey(LG)(RAL7042)

Post-top is suitable for  $\Phi 76\text{mm} \times 90\text{mm}$  tenons



### Technical Data: Berlin

Model No	Wattage	Nominal Voltage (V)
HID 6141-150	150w	240 / 110
HID 6141-250	250w	240 / 110
HID 6141-400	400w	240 / 110

## Product description

The Madrid Post -Tops in symmetrical optic fulfils the requirement of lighting squares and public spaces for pedestrians, guaranteeing maximum visual comfort and at the same time a piece of urban furnishing which is an expression of contemporary design. The light flow is not emitted upwards, in compliance with the strictest rules for limiting light pollution. The high efficiency lamps and optics allow big reductions in energy consumption.

### Fixture Features :

Luminaires are made of Fibreglass reinforced engineered plastic with excellent impact resistance upto IK10. The diffuser lens is made of high efficiency non- yellowing acrylic with inside reflector and canopy made of aluminum. Luminaire is available in 70w /150w HPS high pressure sodium, /MH metal halide lamp. Standard colors is black (BK) , dark grey(GY)(RAL7016) , light grey(LG)(RAL7042) . Post-top is suitable for  $\Phi 76\text{mm} \times 90\text{mm}$  tenons

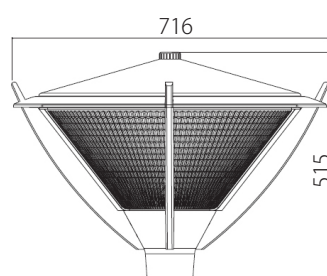
Madrid is available in two options, Bare and with side supports.



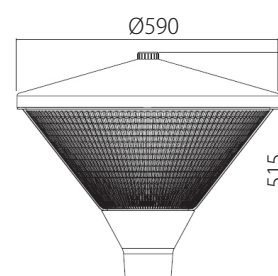
HID 6138



HID 6139



HID 6139



HID 6138



### Technical Data: Madrid

Model No	Wattage	Nominal Voltage (V)
HID 6138-70	70w	240 / 110
HID 6138-150	150w	240 / 110
HID 6139-70	70w	240 / 110
HID 6139-150	150w	240 / 110



### Product description

The OSLO offers clean, functional styling to blend with a broad range of architecture. The sleek construction meet diverse proportional requirements. The cylindrical translucent acrylic lens extends through the shade forming an aperture to subtly highlight the luminaire night form.

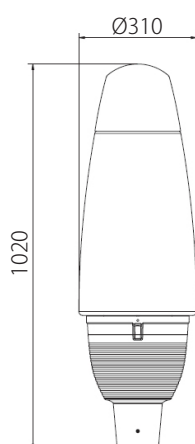
#### Fixture Features:

The Fibreglass reinforced engineered plastic housing with integrated pole top fitter and flat spun aluminum top cap. All hardware is stainless steel.

Luminaire is available in 70W//150W HPS high pressure sodium/MH metal halide lamp.

Standard colors is black (BK) ,dark grey(GY)(RAL7016),light grey(LG)(RAL7042)

Post-top is suitable for  $\Phi 76\text{mm} \times 90\text{mm}$  tenons.



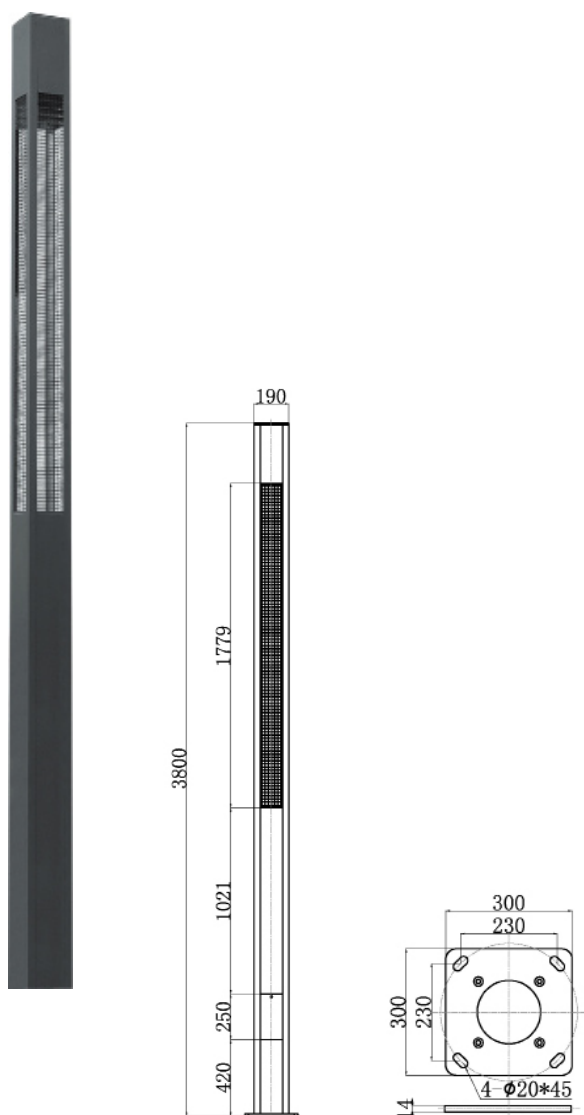
### Technical Data: Oslo

Model No	Wattage	Nominal Voltage (V)
HID 6140-70	70w	240 / 110
HID 6140-150	150w	240 / 110

### Product description

IDUS combines exceptional design with modern technology and is the ideal solution for walkways, parks and squares. It complements its location to give a unique atmosphere. IDUS is made in corrosion free extrusion aluminium and vandal resistant PC or tempered glass , giving it superior durability.

It is available in height of 3.8m in powder coated black as standard but other non standard RAL colours available on request .



### Technical Data: IDUS

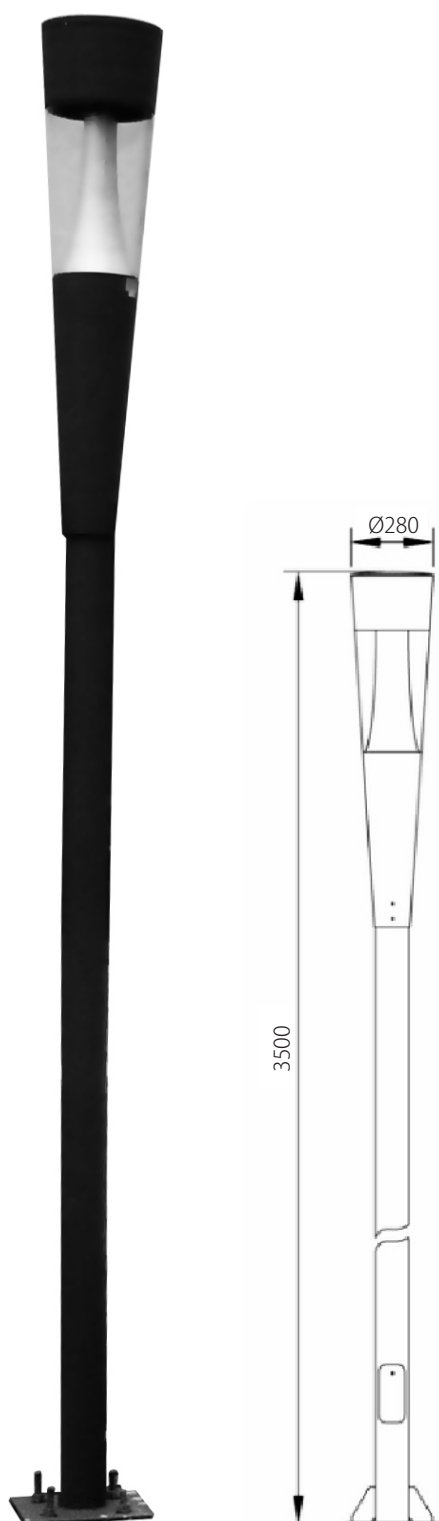
Model No	Wattage	Nominal Voltage *(V)
HID 6195-70G12	70w	240 / 110
HID 6195-150G12	150w	240 / 110

\* other voltages also available /please ask for quote

### Product description

Albano is contemporary high performance Tall bollard, combining style with a robust design, manufactured in high quality materials and finishing. They provide functional and dramatic effect lighting with aesthetics suitable for entrances, paths, walkways, courtyards, gardens, public area and security lighting. Albano is high quality corrosion resistant fitting suitable for outdoor installations, for harsh ambient conditions, such as coastal or marine environments, to provide an aesthetic solution on prestigious projects.

Albano is manufactured in extruded aluminium with an organically shaped column with internal anti-glare aluminum louvre. All hardware is of stainless steel with silicon gaskets. Luminaire complies IP66 protection class. Accessories available include an anchorage base. Light performance in accordance with indirect light control emission regulations.



### Technical Data: Albano



Model No	Wattage	Nominal Voltage (V)
HID 6125-70	70w	240 / 110
HID 6125-150	150w	240 / 110



Neero bollards are suitable for outdoor and indoor installation providing functional and dramatic effect lighting for entrances, paths, walkways, courtyards, gardens, public area and security lighting . Fully equipped with fixing rods for anchoring the fixture to the ground.

Neero bollards are designed to provide quality and performance offering the following features:

**Lighting performance;** high lighting levels, glare control, zero upward light pollution and high uniformity.

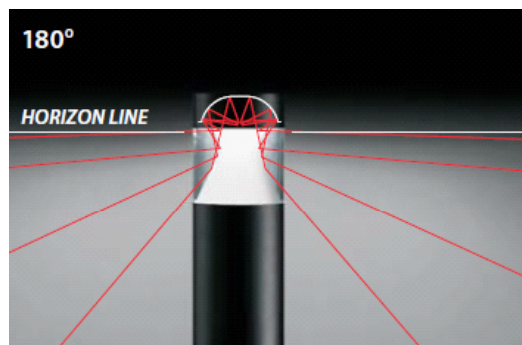
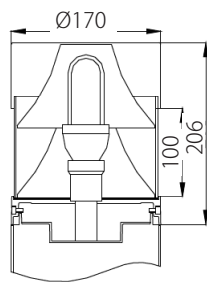
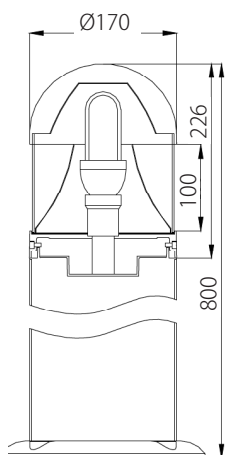
**Style and engineering performance;** robust design and construction, functional with clean and simple lines, discreet blending with surroundings.

**Quality materials;** available in extruded aluminium, strong impact resistant UV stabilized clear polycarbonate lamp cover.

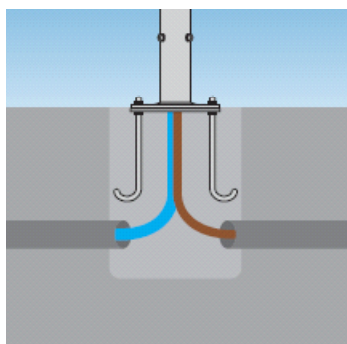
**Variety and options;** supplied in 800mm & 1000mm standard height extruded aluminium polyester painted in a choice of colours, variety of light sources and optics, range of accessories. A high performing adaptable product suitable for a variety of installations, Landscape, public and pedestrian areas.

#### Optics:

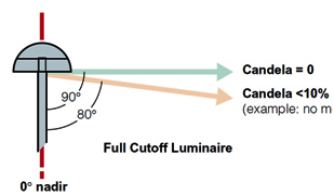
3 different optic options,  
Aluminum Louvre AL , Die Cast Louvre DL and Opaque PC are available in two different heads as standard feature.



180° LIGHT DISTRIBUTION BELOW HORIZONTAL.



Flange mounting (FT) with fixing rods secured by concrete. The baseplate, which also acts as a template, ensures a level fixing.



### Technical Data: Neero

Model No	Wattage	Nominal Voltage (V)
HID 6115 -35AL	35w	240 / 110
HID 6115-70AL	70w	240 / 110
HID 6115-35DL	35w	240 / 110
HID 6115-70DL	70w	240 / 110
HID 6115-35PC	35w	240 / 110
HID 6115-70-PC	70w	240 / 110
HID 6116-35AL	35w	240 / 110
HID 6116-70AL	70w	240 / 110
HID 6116-35DL	35w	240 / 110
HID 6116-70DL	70w	240 / 110
HID 6116-35PC	35w	240 / 110
HID 6116-70-PC	70w	240 / 110



Product description

Albano Jr is high performance bollard, combining style with a robust design, manufactured in high quality materials and finishing. They provide functional and dramatic effect lighting with aesthetics suitable for entrances, paths, walkways, courtyards, gardens, public area and security lighting. Albano Jr is high quality corrosion resistant fitting suitable for outdoor installations , for harsh ambient conditions, such as coastal or marine environments, to provide an aesthetic solution on prestigious projects.

Albano Jr is manufactured in extruded aluminium with an organically shaped column with internal anti-glare aluminum louvre. All hardware is of stainless steel with silicon gaskets. Luminaire complies IP66 protection class. Accessories available include an anchorage base. Light performance in accordance with indirect light control emission regulations.



Technical Data: Albano Jr

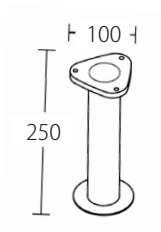
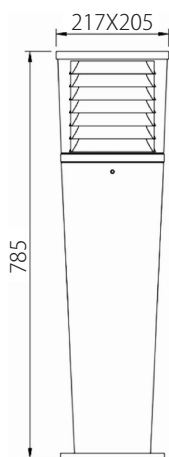
Model No	Wattage	Nominal Voltage *(V)
HID 6161-35	35w	240 / 110
HID 6161-70	70w	240 / 110

\* other voltages also available /please ask for quote

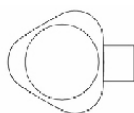
Product description

Trapez has been conceived for use on pathways, parks and gardens, both in public and residential areas. It is made of extruded aluminium with high resistance to oxidation, aluminum louvres , vandal proof polycarbonate diffuser and stainless steel fixings. High performance optic obtaining very powerfull lighting output with cut-off to fulfill the most strict regulations relative to indirect light emission.

Special Root Mount accessory is available for high abuse areas.



Root Mount



Technical Data: Trapez

Model No	Wattage	Nominal Voltage (V)
HID 6126-20 PGj5	20w	240 / 110
HID 6126-70 G12	70w	240 / 110



Riviera is a range of 1000W and 2000W Symmetrical /asymmetrical high performance floodlights designed for indoor and outdoor sports lighting applications. Based on a wealth of knowledge gained through our experience of world wide installations, combined with application of the latest technologies in research and development and the use of high performance lamps, Riviera can be considered as the ultimate choice for large area and sports lighting applications. One of the most important aims during the development of the Riviera range was to study the anti-glare system and its effect on the athletes; as well as the upward light pollution and the problems caused by sky glow.



Beam optics available in DE/E40 lamp holder in symmetric/asymmetric options



Flood optics available in DE/E40 lamp holder in symmetric/asymmetric options

**Riviera's main features:**

**Efficiency:** the high efficiency of the luminaire is achieved by the use of high quality high purity aluminium reflectors and high transmission clear glass, providing a coefficient of light transmission > 90%. **Uniformity:** The heads of the reflector have been studied in order to enlarge the light emission. **Photometric flexibility:** Available with broad and narrow distribution reflectors, and a wide range of high performance lamp options, provides the lighting designer with the photometric flexibility to satisfy a variety of lighting applications for general area and professional sports lighting. **Limited windage surface:** The relatively low weight and reduced windage surface area of the Riviera fittings makes them ideal for mounting on light weight structures leading to installation cost savings. **Fast installation and easy maintenance:** Quick and easy installations and adjustments are provided. Rear access to lamp chamber provides easy lamp replacement without the need to move or adjust the floodlight from its focused position.

**SPECIFICATIONS**

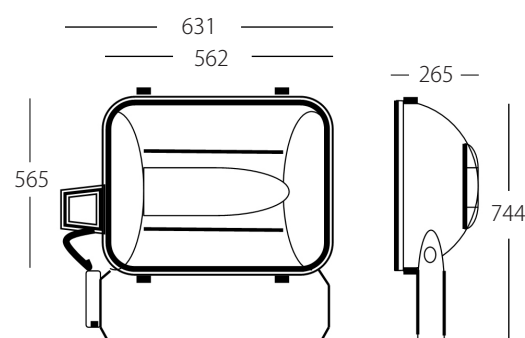
Body in die-cast aluminium finished polyester powder coated. Cover fixing clips in stainless steel with safety hook. Ignitor housing complete with ignitor mounted directly to body. Reflectors in high purity aluminium. Lamp supports in ceramic with stainless steel retaining spring and nickel-plated brass contacts. Internal cables in silicon. Hot dipped galvanised steel mounting bracket. Retaining gaskets in silicon.

**Lamp Options**

E40/RX7s/ HQI Powerstar Osram/  
Venture/GE

**Control Gear Box**

Seperate Control Gear Box for  
1000w and 2000w.

**Technical Data: Riviera**

Model No	Wattage	Nominal Voltage (V)
HID 6144-1000- FL-SY-E40/DE	1000w	240 / 380
HID 6144 1000-FL-ASY-E40/DE	1000w	240 / 380
HID 6144-1000-BM-SY-E40/DE	1000w	240 / 380
HID 6144-1000-BM-ASY-E40/DE	1000w	240 / 380
HID 6144-2000-FL-SY-E40/DE	2000w	240 / 380
HID 6144-2000-FL-ASY-E40/DE	2000w	240 / 380
HID-6144-2000-BM-SY-E40/DE	2000w	240 / 380
HID 6144-2000-BM-ASY-E40/DE	2000w	240 / 380

FL- Flood Optics

BM- Beam Optics

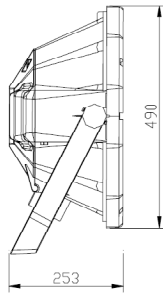
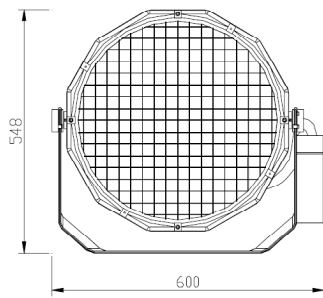
SY- Symmetrical

ASY- Asymmetrical



Challenger in three alternative reflector versions is designed to provide highly efficient illumination of larger areas with 1kW and 2kW lamps. The floodlight is particularly suitable for lighting sports complexes, airports and industrial/commercial areas. Usually pole or mast mounted the floodlight may also be fixed direct to structures such as spectator stands and buildings. The distribution is asymmetric in the vertical plane. A range of baffles and optics are available for light control.





#### Fixture Features:

High pressure die cast aluminium body , Heat resistant toughened front glass for use with lamps of 1000w to 2000w, all with remote control gear

The asymmetric beam options have an integral baffle to control upward spread of light

Power cut-off safety switch fitted to 2kW lamp version

K12s-7 lamp holder

Rear access for easy maintenance

#### OPTIONS AND EXTRAS

Narrow asymmetric beam options (for side lighting of sports stadiums etc) or narrow projector beam options (for lighting over long distances such as corner towers of stadiums)

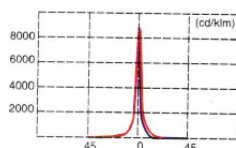
Medium Beam

Wide Beam

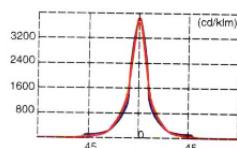
#### SPORTS FLOODLIGHTING

	Top Level Lux Level	Club Level Lux Level
Football	800	120
Rugby	500	120
Hockey	500	250
Tennis	500	260
Athletics	500	300
Bowls	300	200
Basketball	300	200
Netball	300	200
Volleyball	300	200

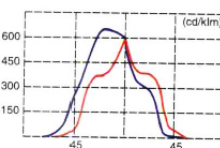
The illuminance levels recommended above are guide levels. Specified levels for individual sports can be found from the sports association responsible or the Sports Council. The CIBSE provides guidance on general area lighting and the user, i.e. rail, port, may also have their own particular specification



Narrow Beam



Medium Beam



Wide Beam



#### Technical Data: Challenger

Model No	Wattage	Nominal Voltage *(V)
HID 6157-1000NB/MB/WB	1000w	240
HID 6157-2000NB/MB/WB	2000w	380

\* floodlights fitted with 2kW control gear will require a 3 phase electrical supply



Designed by: Giorgio Palermo



HID 6114-250/400

light  
emission  
certified



performance  
attention to details  
originality  
sustainability



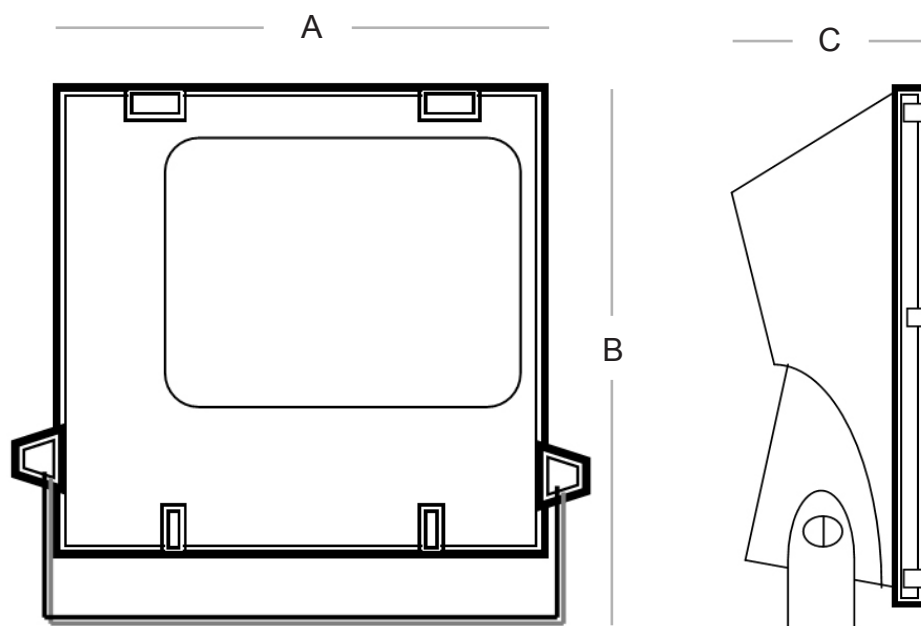
HID 6113-70/150

The apparent simplicity hides advanced technology. Functional and technical detail, clean lines and high performance make Pinguino suitable in any environmental context ...

Features of Pinguino include the manufacturing details and careful selection of the materials.

A product that will last in time, a design that does not have anything ephemeral, where the functionality plays a decisive role to guarantee the maximum safety without losing its general formal symmetry.





Model	A	B	C
Pinguino	426	506	163
Pinguino Nano	250	452	129

**Features:**

Die-cast aluminium body with wide cooling fins. . Steel support bracket. Polyester powder paint resistant to corrosion, atmospheric conditions and salt spray fog. Anode polished and oxidated 99,85 aluminium reflector. Thermal-shock resistant tempered glass diffuser. Corrected wiring on removable zinc-plated steel plate. Stainless steel external clamps .

Luminaire complies with the EN 60598-1 and EN 60598-2-5 Standards

**Options:**

Two models available : one with 70/150w and second with 250/400w HID lamp.

**Technical Data: Pinguino & Pinguino Nano**

Model No	Wattage	Nominal Voltage (V)
HID 6113-70 Pinguino Nano	70w	240 / 110
HID 6113-150 Pinguino Nano	150w	240 / 110
HID 6114-250 Pinguino	250w	240 / 110
HID 6114-400 Pinguino	400w	240 / 110



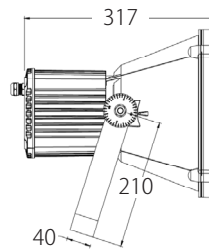
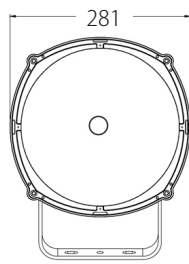


Tornado is a powerful beam luminaire for use as facade lighting, pile lighting, bridge lighting or for creating accent at public place.

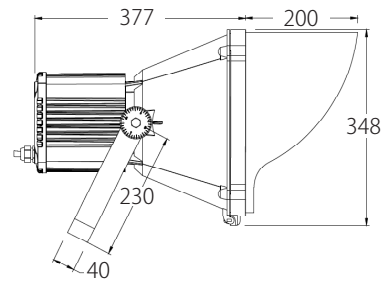
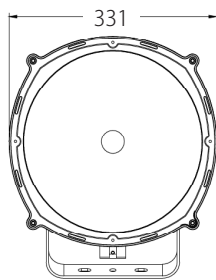
Non Integral with separate gearbox, Luminaire is available from 70w till 1000w in Metal Halide or Sodium vapour lamps.

The unique design is made of aluminum die cast with pure aluminum reflectors, Tempered glass, silicon gaskets and stainless steel hardware. Anti Glare Hood, anti glare Grid or colour glass available as an accessory.

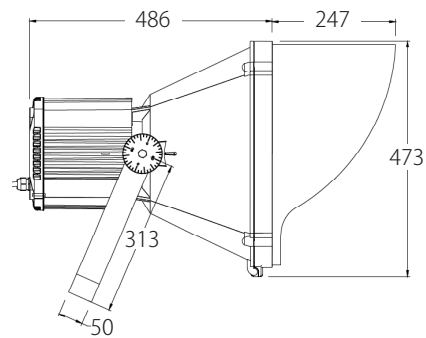
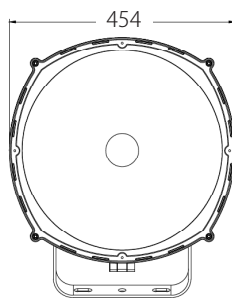
**Options:** Narrow Beam, Medium beam and Batwing optics available.



HID 6121



HID 6122



HID 6123



## Technical Data: Tornado

Model No	Wattage	Nominal Voltage (V)
HID 6121-70NB/MB	70w	240 / 110
HID 6122-150NB/MB/BW	150w	240 / 110
HID 6122-250NB/MB/BW	250w	240 / 110
HID 6123-400NB/MB/BW	400w	240 / 110
HID 6123-1000NB/MB	1000w	240 / 110

NB: Narrow Beam

MB: Medium Beam

BW: Batwing

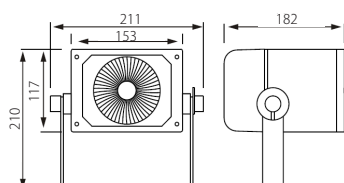
## Product description

Precision must be combined with excellent performance. Torch is the perfect choice for every architectural context. It is ideal for illuminating façades, trees, green spaces. An innovative series, equipped with a sophisticated optical system for high efficiency light sources. Torch offers a technologically advanced response to every project requirement, helping to create ever new effective and dynamic lighting effects. A compact optical body available in two sizes, makes Torch a flexible solution to suit the most different project requirements.

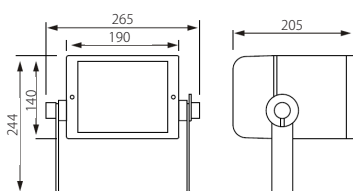
### Fixture features:

Made of pressure die cast aluminum housing with tempered glass, silicon gaskets and stainless steel hardware.

Luminaire is available in symmetric/asymmetric and beam optics or with Glare Control version.



HID 6135



HID 6136



### Technical Data: Torch

Model No	Wattage	Nominal Voltage (V)
HID 6135-35 G12	35w	240 / 110
HID 6136-70 DE -SY/ASY	70w	240 / 110
HID 6136 150 DE -SY/ASY	150w	240 / 110
HID 6136-70G12 BM/GC	70w	240 / 110
HID 6136-150G12 -BM/GC	150w	240 / 110

Symmetric-SY

Asymmetric -ASY

Beam version -BM

Glare Control - GC





6124-70/150 FX

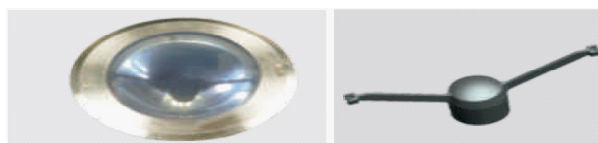
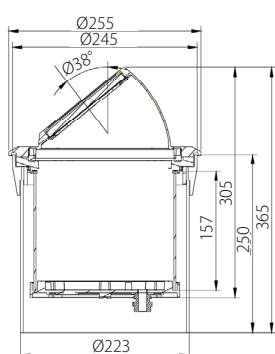
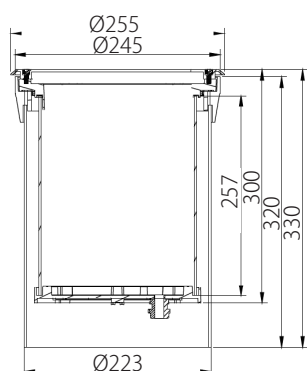


6124-70/150 AJ

Beamer luminaire is constructed from high quality die cast aluminium and materials to ensure reliability and longevity during installation. Technopolymer outer recessing enclosure provides high corrosion resistance and strength. Toughened safety clear float glass IK10 (21Joule). Anti-ageing single piece (no joints) high and low temperature heat resistant silicone gaskets, with excellent compressibility and shape recovery to ensure a maintained IP67 seal. Stainless steel ring offers high corrosion resistance & High performance and 99.85% pure aluminium pre-anodised and polished reflectors provides the necessary punch to the light beam.



## Accessories for: 6124-70/150 FX



Glareshop



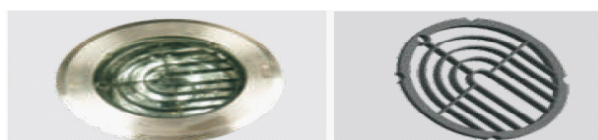
External Grill



Hood



Internal Grill



Internal Grill Designer

## 6124-70/150 AJ



One Way Cap



Two Way Cap



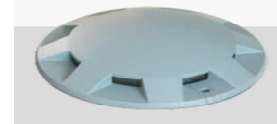
Three Way Cap



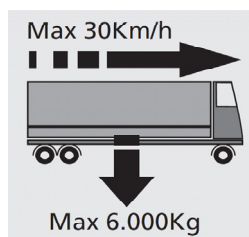
Four Way Cap



Five Way Cap



Six Way Cap



12mm tempered safety glass which can resist the passage of vehicles with a maximum pressure of 2 tons and at a maximum speed of 30 km/h. Lens temperatures (T°) for all the luminaires in the ICARE range, measured according to European standard EN 60598-2-13,



IP68 - Connector available at request.



## Technical Data: Beamer

Model No	Wattage	Nominal Voltage (V)
HID 6124-70FX	70w	240 / 110
HID 6124-150FX	150w	240 / 110
HID 6124-70AJ	70w	240 / 110
HID 6124-150AJ	150w	240 / 110

### Product description

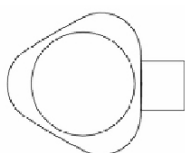
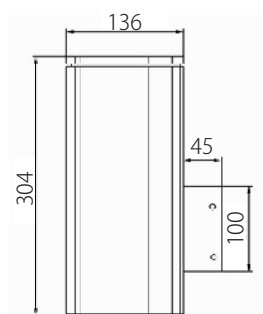
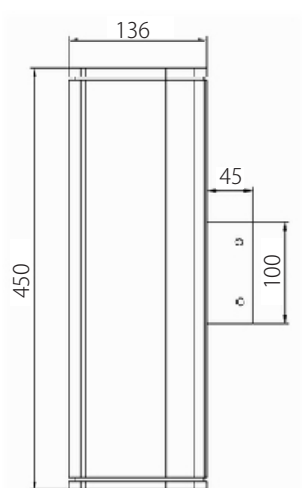
Triangular shape , wall mounted up and down luminaire in die cast / extruded aluminium body with high resistant to oxidation , IP 65 protection and with tempered glass. Thanks to a easy mounting system, Trendo can be easily installed and removed by one person only, reducing installation and maintenance costs. Trendo is designed for medium large buildings. Available in two models to answer all lighting design needs.



HID6127



HID6128



### Technical Data: Trendo

Model No	Wattage	Nominal Voltage (V)
HID 6127-2X20 -PGj5	2X20w	240 / 110
HID 6128-20 -PGj5	20w	240 / 110

## Product description

Cendo HID is defined by its simplistic styling. Two sizes are available to meet diverse proportional requirements. The Extrusion aluminum housing with die cast end covers support the flat tempered glass lens. Asymmetrical reflectors provides added light control.

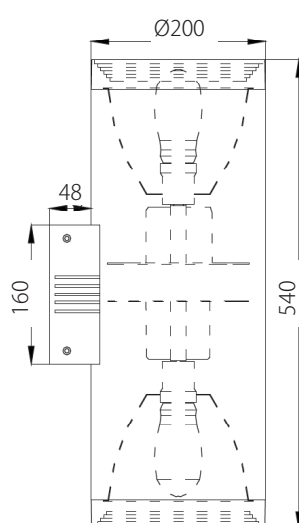
All hardware is stainless steel , with pure silicon gaskets provide complete ingress protection against dust and water .



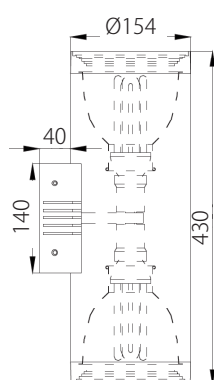
HID 6118



HID 6119



HID 6118



HID 6119



## Technical Data: Cendo

Model No	Wattage	Nominal Voltage (V)
HID 6118-2x70-G12	2x70w	240 / 110
HID 6119-2x150-PAR38	1x150w	240 / 110



### Product description

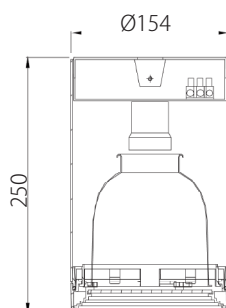
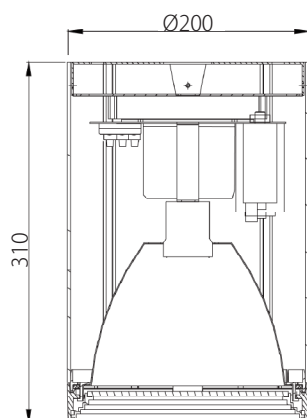
Surface mounted luminaires distinguishes through a minimal mounting effort . Housing made of extruded aluminium, powder coated, supporting ring made of die cast aluminum , front tempered glass and highly polished reflector.



HID 6151



HID 6150



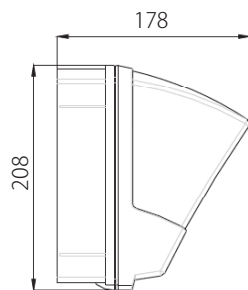
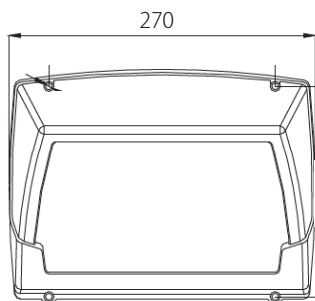
### Technical Data: Cendo Ceiling

Model No	Wattage	Nominal Voltage (V)
HID 6150-35-G12	35w	240 / 110
HID 6150-20PLC -E27	20w	240 / 110
HID 6151-70	70w	240 / 110
HID 6151-150	150w	240 / 110

### Product description

Contemporary wall mounted luminaire adds visual structure to a simple form. Trans-lucent tempered glass provides soft symmetrical distribution.

Fixture is made of die cast aluminum with all hardware in stainless steel.




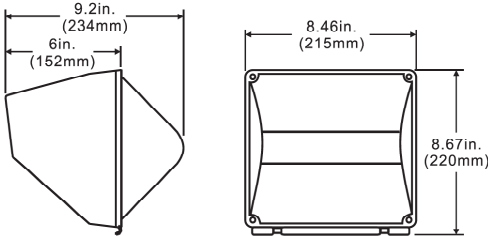
### Technical Data: LukLite

Model No	Wattage	Nominal Voltage (V)
HID 6120-70	70w	240 / 110
HID 6120-42 CFL EB	42w	240 / 110
HID 6120-42 CFL MB	42w	240 / 110


Wallpak family compises of four models suitable to fullfil every need of lighting requirements of Indusrtly, commercial or residential security by way of providing effective illuminaiton on areas , pathways or surround boundaries.

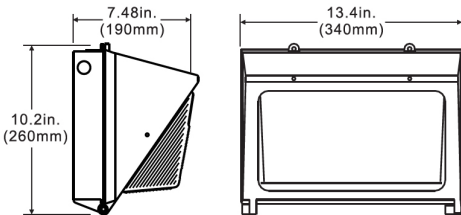
Made of pressure die cast with high impact borosilicate glass (PC in 70w models) lens , pure silicon gaskets, stainless steel hardware and powder coated, fixtures offer the utmost quality to the user.






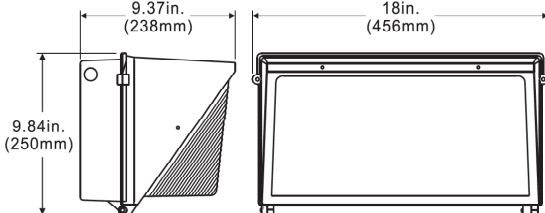
HID 6131






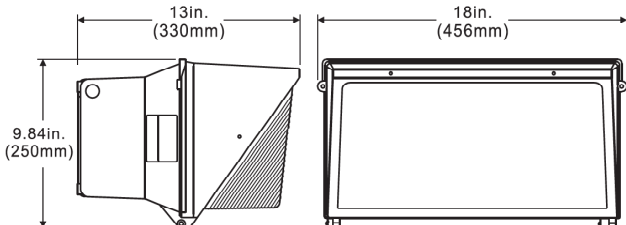
HID 6132













HID 6133





HID 6134



Technical Data: WallPak

Model No	Wattage	Nominal Voltage (V)
HID 6131-70	70w	240 / 110
HID 6132-150	150w	240 / 110
HID 6133-250	250w	240 / 110
HID 6134-400	400w	240 / 110

### Product description

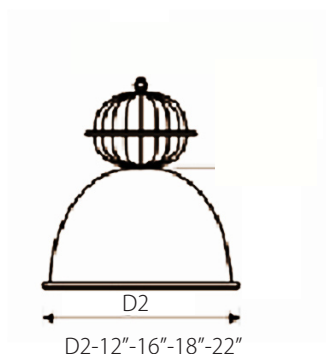
Orbit is designed to fully respect the aesthetic values of the space where it resides. Designed in three different sizes depending on the wattage of lamp used, make Orbit the answer to lighting requirements in modern retails, trade fair pavilions, shopping centres, foyers, corridors and warehouse lighting.

#### Fixture Features:

Housing incorporating cooling fins, made of die-cast aluminium. Strengthened main reflector made of 99.98% pure aluminium, chemically polished and anodised. The toughened front glass is clamped to achieve IP65 protection.

#### Options :

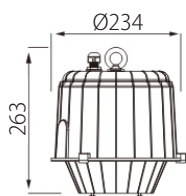
Plain or faceted aluminum reflectors or acrylic decorative refractors are available in various diameters .



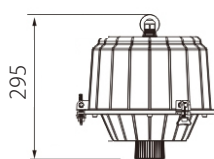
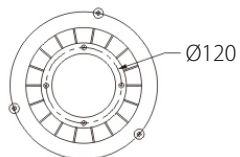
#### Technical Data: Orbit

Model No	Wattage	Nominal Voltage *(V)
HID 6158-35 G12	35w	240 / 110
HID 6158-70	70w	240 / 110
HID 6159-150	150w	240 / 110
HID 6160-250	250w	240 / 110
HID 6160-400	400w	240 / 110

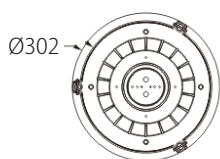
\* other voltages also available /please ask for quote



HID 6142



HID 6143



Technologically advanced, environmentally responsible and performance driven ...

Take a closer look to see how Sololuce's Muna brings new levels of performance, innovation and design to the art and science of illuminating large commercial and industrial spaces.

Sololuce high bay fixtures enhance light quality and provide energy-efficient alternatives to traditional HID fixtures. Many traditional HID fixtures can create glare and uneven illumination known as "hot spots" but Sololuce high bay fixtures provide a more evenly illuminated surface and reduce overhead glare. Two different models of Sololuce high bay fixtures are available , Muna and Muna + .

**Fixture Features :**

Housing incorporating cooling fins, made of die-cast aluminium. Strengthened main reflector made of 99.98% pure aluminium, chemically polished and anodised. The toughened front glass is clamped into the aluminium bezel. Fully integral control gear.

**Options :**

Plain or faceted aluminum reflectors or acrylic decorative refractors are available in various diameters.



Reeded Ø 485



Plain Ø 485



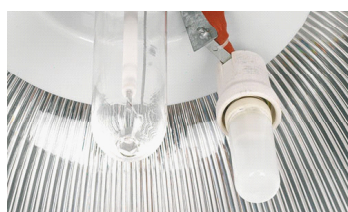
Facetted Ø 480



Plain Ø 560





Acrylic Ø 410/495/570



**Auxiliary lamp option**, a 150 watt tungsten halogen lamp is lit whilst the HID lamp warms up to full output, then a sensor turns the auxiliary lamp off. Particularly useful if power is unintentionally interrupted. Auxiliary lamp can be used as an emergency lamp also, which lights up when the main supplies goes off.

**Technical Data**

Muna	Model No	Wattage	Nominal Voltage (V)
	HID 6142-70	70w	240 / 110
	HID 6142-150	150w	240 / 110
	HID 6142-250	250w	240 / 110
	HID 6142-400	400w	240 / 110

Muna Plus	Model No	Wattage	Nominal Voltage (V)
	HID 6143-250	250w	240 / 110
	HID 6143-400	400w	240 / 110



## Product description

Powerful suspended fixtures for high pressure discharge lamps of excellent chromatic yield and great efficiency, recommended for lighting of public or private environments, show rooms, halls, commercial and sport areas, etc. Conceived to last, with non-perishable materials, it is anyhow a product that can be completely and instantly recycled thanks to the easily disassembled modular construction.

## Fixture Features:

Housing incorporating cooling fins, made of die-cast aluminium. Strengthened main reflector made of 99.98% pure aluminium, chemically polished and anodised. The toughened front glass is clamped to achieve IP65 protection.

## Options :

Plain or faceted aluminum reflectors or acrylic decorative refractors are available in various diameters .



Reeded Ø 485



Plain Ø 485



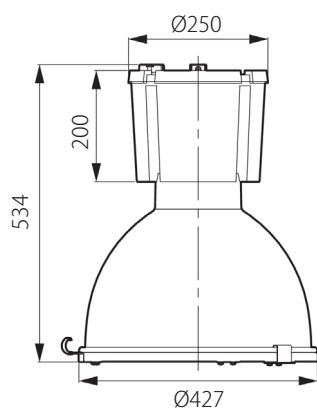
Facetted Ø 480



Plain Ø 560



Acrylic Ø 410/495/510



**Auxiliary lamp option**, a 150 watt tungsten halogen lamp is lit whilst the HID lamp warms up to full output, then a sensor turns the auxiliary lamp off. Particularly useful if power is unintentionally interrupted. Auxiliary lamp can be used as an emergency lamp also, which lights up when the main supplies goes off.



## Technical Data: Impact

Model No	Wattage	Nominal Voltage *(V)
HID 6155-150	150w	240 / 110
HID 6155-250	250w	240 / 110
HID 6155-400	400w	240 / 110

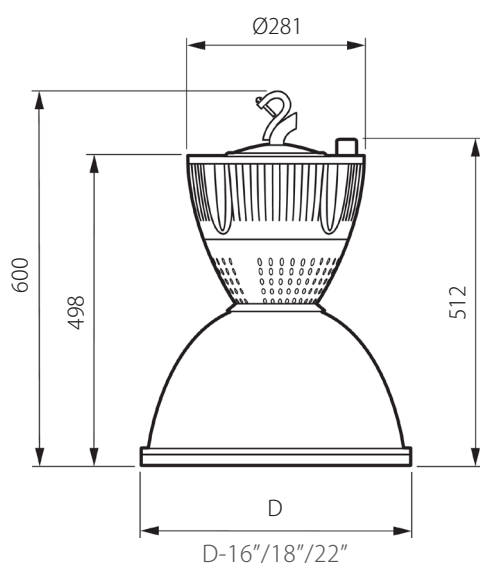
\* other voltages also available /please ask for quote

### Product description

Refined and elegant the design perfected by a pleasant touch of colour. Pendant lighting fixture suitable for illumination of working surfaces , Hypermarkets and indoor spaces in general. It gives soft, glare free and homogeneous lighting of proper level , thanks to a semi-satin finish aluminium reflector coupled to a textured diffusing glass. The drilled cap allows an efficient ventilation for a low temperature operation. Indoor luminaires capable of lighting in a superlatively professional and economic way any type of internal space.

### Fixture Features:

Housing incorporating cooling fins, made of die-cast aluminium. Strengthened main reflector made of 99.98% pure aluminium, chemically Matt polished and anodised. The toughened front glass is clamp sealed.



Top view of Gear Box.



### Technical Data: Milano

Model No	Wattage	Nominal Voltage *(V)
HID 6156-70	70w	240 / 110
HID 6156-150	150w	240 / 110
HID 6156-250	250w	240 / 110

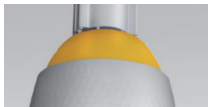
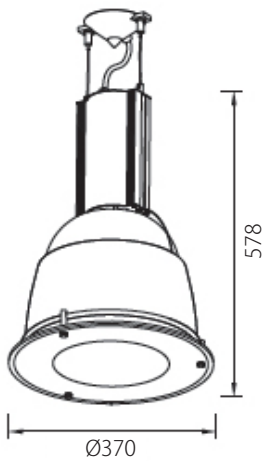
\* other voltages also available /please ask for quote



Product description



Notte stands for modern luminaire design for shopping centres and exhibition spaces, representative public buildings, airports, hotels and restaurants. The exceptional aesthetics of this luminaire is one persuasive factor; the technology that combines decades of Sololuce experience with the highest quality standards is another. Installing these luminaires is easy and their equally easy maintenance underscores the holistic concept that is so typical of Sololuce. Notte thus seamlessly integrates into modern architectural surroundings and excels as a modern intervention in heritage buildings. Housing is made of heat dissipating cooling fins made of aluminum extrusion profile, aluminum reflector with frosted drop glass with weather resistant powder coat after cromate concersion process. Pure silicon gaskets and stainless steel hardware .



Technical Data: Notte

Model No	Wattage	Nominal Voltage *(V)
HID 6190-70	70w	240 / 110

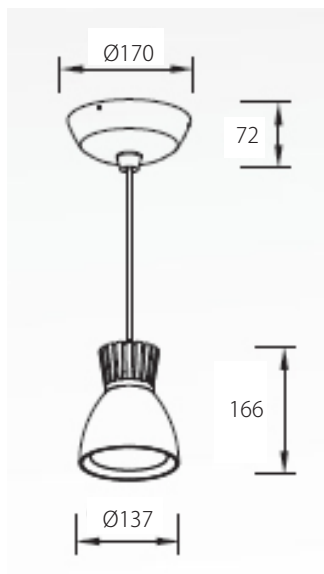
\* other voltages also available /please ask for quote

\*\* other lamp wattages available

### Product description



Tiara stands for modern luminaire design for shopping centres and exhibition spaces, representative public buildings, airports, hotels and restaurants. The exceptional aesthetics of this luminaire is one persuasive factor; the technology that combines decades of Sololuce experience with the highest quality standards is another. Installing these luminaires is easy and their equally easy maintenance underscores the holistic concept that is so typical of Sololuce. Tiara thus seamlessly integrates into modern architectural surroundings and excels as a modern intervention in heritage buildings. Housing is made of heat dissipating cooling fins made of die cast aluminum, aluminum reflector with front glass with weather resistant powder coat after cromate concersion process. Pure silicon gaskets and stainless steel hardware .



### Technical Data: Tiara

Model No	Wattage	Nominal Voltage *(V)
HID 6191-70	70w	240 / 110

\* other voltages also available /please ask for quote

### Product description

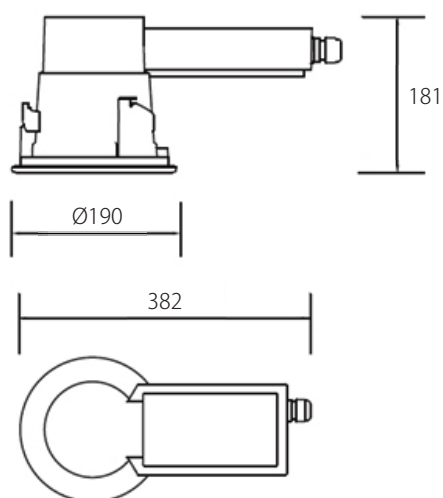
Interics is a tough luminaire with IP66 protection class for outdoor ceiling application.

It is made with high quality corrosion resistant pressure die cast aluminum, with high performance optics for use with a variety of light sources.

Accurate photometric control, High Light Output Ratios, Zero Upward Light Pollution, Long life and reliability makes it the ideal solution for outdoor canopy lighting. Fixture comes with Anti-ageing pure silicone gasket, Stainless steel external screws, hardware and externally powder coated & Partially frosted safety glass cover.

#### Options :

- Stainless steel frame in 316 SS or Die cast aluminium frame
- anti-glare louvre.



#### Technical Data: Interics

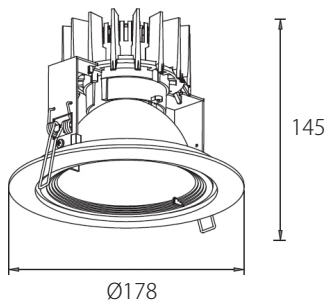
Model No	Wattage	Nominal Voltage *(V)
HID 6185-20/G8.5	20w	240 / 110
HID 6185-35/G12	35w	240 / 110
HID 6185-50/G12	50w	240 / 110

\* other voltages also available /please ask for quote

Product description

Ace is designed for 70w metal halide lamp for shops, restaurants, hotels, galleries, exhibitions halls and museums . Specially designed aluminum die cast fins keeps the temperature of metal halide within required parameters and hence avoids colour shift .

Fixture has 3mm thick tempered and dotted front glass to eliminate direct glare . Ace is a fixed head fixture in IP20 protection class and comes in white , black and grey as standard finishes.



Technical Data: Ace

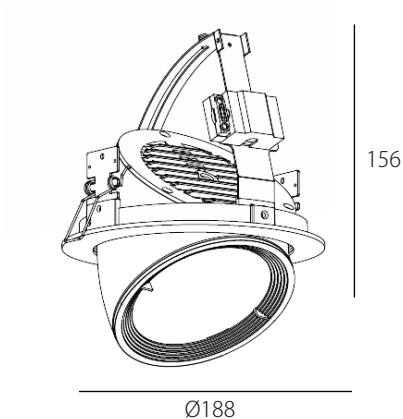
Model No	Wattage	Nominal Voltage *(V)
HID 6178-35-G12	35w	240 / 110
HID 6178-70-G12	70w	240 / 110

\* other voltages also available /please ask for quote

Product description

Mobile is designed for 70w/150w metal halide lamp for shops, restaurants, hotels, galleries, exhibitions halls and museums .

Fixture has 3mm thick tempered front glass & adjustable head in IP20 protection class and comes in white , black and grey as standard finishes.



Technical Data: Mobile

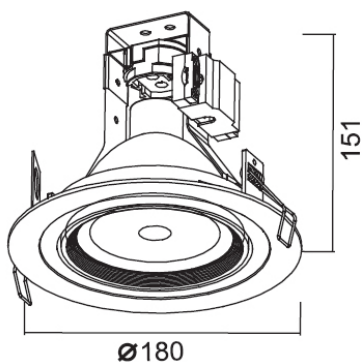
Model No	Wattage	Nominal Voltage *(V)
HID 6179-70-G12	70w	240 / 110
HID 6179-150-G12	150w	240 / 110

\* other voltages also available /please ask for quote

### Product description

Kevi is a round head metal halide luminaire suitable for accepting 35w and 70w G12 MH Lamp .

Fixture comes with adjustable head in IP20 ingress protection and in white , black and grey as standard finishes.



### Technical Data: Kevi

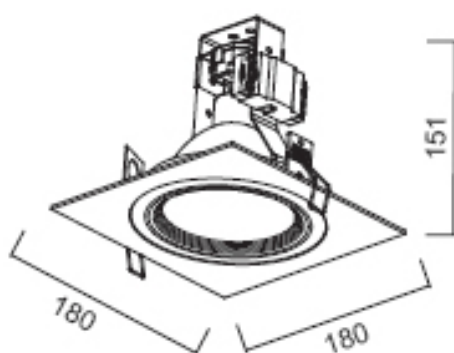
Model No	Wattage	Nominal Voltage *(V)
HID 6180-35-G12	35w	240 / 110
HID 6180-70-G12	70w	240 / 110

\* other voltages also available /please ask for quote

### Product description

Kris is a square head metal halide luminaire suitable for accepting 35w and 70w G12 MH Lamp.

Fixture comes with adjustable head in IP20 ingress protection and in white, black and grey as standard finishes.



### Technical Data: Kris

Model No	Wattage	Nominal Voltage *(V)
HID 6181-35-G12	35w	240 / 110
HID 6181-70-G12	70w	240 / 110

\* other voltages also available /please ask for quote

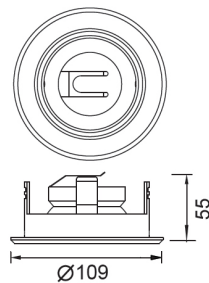
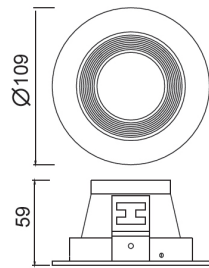
### Product description

Siena has been designed with light source placed deep inside to create an accent lighting but without glare. This fixture is suitable to illuminate shops, restaurants, hotels, and especially galleries, exhibitions and museums.

Siena support MR16 in GU5.3 and GU10 base halogen lamps

Most of halogen MR16 lamps provide bright light for accent lighting and are available in 3000K colour temperature and beam angle of 36°/25° with 100 Ra colour rendering.

Downlight comes in White, Black & Grey finish.



#### Options:

Siena -M: Matt finish reflector

Siena- S: Mirror finish behive reflector



#### Technical Data: Siena

Model No	Wattage	Nominal Voltage *(V)
HID 6182-120-GU5.3/GU10	20w	240 / 110
HID 6182-135-GU5.3/GU10	35w	240 / 110
HID 6182-150-GU5.5/GU10	50w	240 / 110

\* other voltages also available /please ask for quote

M for matt reflector and S for mirror reflector



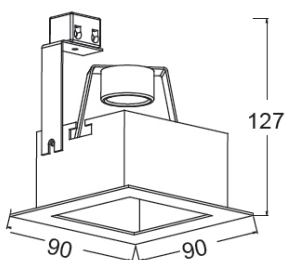
### Product description



Alicia Nano has been designed with invisible, adjustable lamp head in CRCA powder coated body which support MR16 in GU5.3 and GU10 base halogen lamps

Most of halogen MR16 lamps provide bright light for accent lighting and are available in 3000K colour temperature and beam angle of 36°/25° with 100 Ra colour rendering.

Downlight comes in White, Black & Grey finish.



### Technical Data: Alicia Nano

Model No	Wattage	Nominal Voltage *(V)
HID 6177-120-GU5.3/GU10	20w	240 / 110
HID 6177-135-GU5.3/GU10	35w	240 / 110
HID 6177-150-GU5.5/GU10	50w	240 / 110

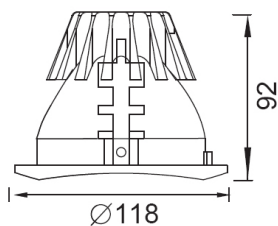
\* other voltages also available /please ask for quote

### Product description

Aqua has been specially designed downlight with finned die cast aluminum body with fixed head which support MR16 in GU5.3 and GU10 base halogen lamps

Most of halogen MR16 lamps provide bright light for accent lighting and are available in 3000K colour temperature and beam angle of 36°/25° with 100 Ra colour rendering.

Downlight comes in White, Black & Grey finish.



### Technical Data: Aqua

Model No	Wattage	Nominal Voltage *(V)
HID 6176-120-GU5.3/GU10	20w	240 / 110
HID 6176-135-GU5.3/GU10	35w	240 / 110
HID 6176-150-GU5.5/GU10	50w	240 / 110

\* other voltages also available /please ask for quote

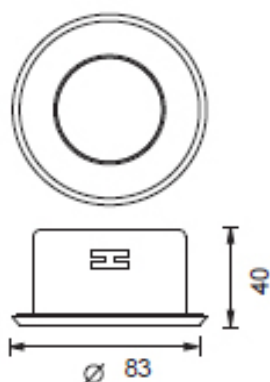
### Product description



Volo is an IP65 downlight which support MR16 in GU5.3 and GU10 base halogen lamps

Most of halogen MR16 lamps provide bright light for accent lighting and are available in 3000K colour temperature and beam angle of 36°/25° with 100 Ra colour rendering.

Downlight comes in White, Black & Grey finish.



### Technical Data: Volo

Model No	Wattage	Nominal Voltage *(V)
HID 6172-120-GU5.3/GU10	20w	240 / 110
HID 6172-135-GU5.3/GU10	35w	240 / 110
HID 6172-150-GU5.5/GU10	50w	240 / 110

\* other voltages also available /please ask for quote

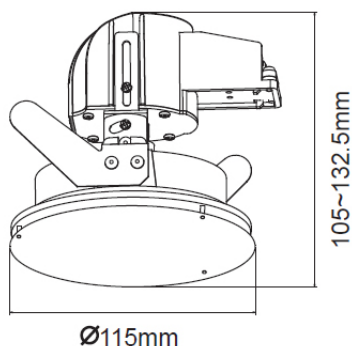
### Product description



Capri is drop glass construction downlight which support MR16 in GU5.3 and GU10 base halogen lamps

Most of halogen MR16 lamps provide bright light for accent lighting and are available in 3000K colour temperature and beam angle of 36°/25° with 100 Ra colour rendering.

Downlight comes in White, Black & Grey finish.



#### Technical Data: Capri

Model No	Wattage	Nominal Voltage *(V)
HID 6173-120-GU5.3/GU10	20w	240 / 110
HID 6173-135-GU5.3/GU10	35w	240 / 110
HID 6173-150-GU5.5/GU10	50w	240 / 110

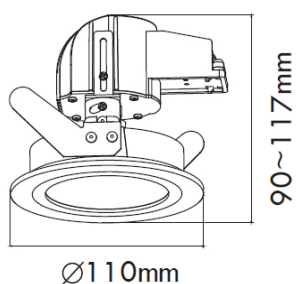
\* other voltages also available /please ask for quote

### Product description

Vista is an IP65 downlight which support MR16 in GU5.3 and GU10 base halogen lamps

Most of halogen MR16 lamps provide bright light for accent lighting and are available in 3000K colour temperature and beam angle of 36°/25° with 100 Ra colour rendering.

Downlight comes in White, Black & Grey finish.



### Technical Data: Vista

Model No	Wattage	Nominal Voltage *(V)
HID 6174-120-GU5.3/GU10	20w	240 / 110
HID 6174-135-GU5.3/GU10	35w	240 / 110
HID 6174-150-GU5.5/GU10	50w	240 / 110

\* other voltages also available /please ask for quote

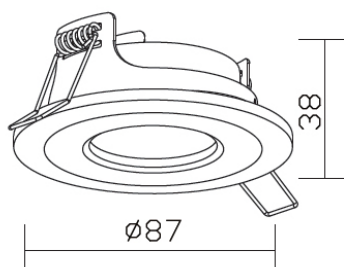
### Product description



Corona is an IP65 downlight which support MR16 in GU5.3 and GU10 base halogen lamps

Most of halogen MR16 lamps provide bright light for accent lighting and are available in 3000K colour temperature and beam angle of 36°/25° with 100 Ra colour rendering.

Downlight comes in White, Black & Grey finish.



#### Technical Data: Corona

Model No	Wattage	Nominal Voltage *(V)
HID 6171-120-GU5.3/GU10	20w	240 / 110
HID 6171-135-GU5.3/GU10	35w	240 / 110
HID 6171-150-GU5.5/GU10	50w	240 / 110

\* other voltages also available /please ask for quote

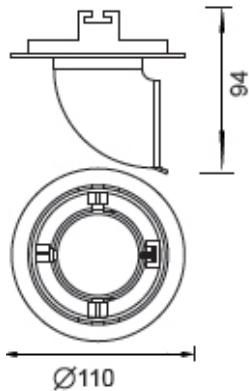
Product description



Mobile Nano is an IP20 downlight which support MR16 in GU5.3 and GU10 base halogen lamps

Most of halogen MR16 lamps provide bright light for accent lighting and are available in 3000K colour temperature and beam angle of 36°/25° with 100 Ra colour rendering.

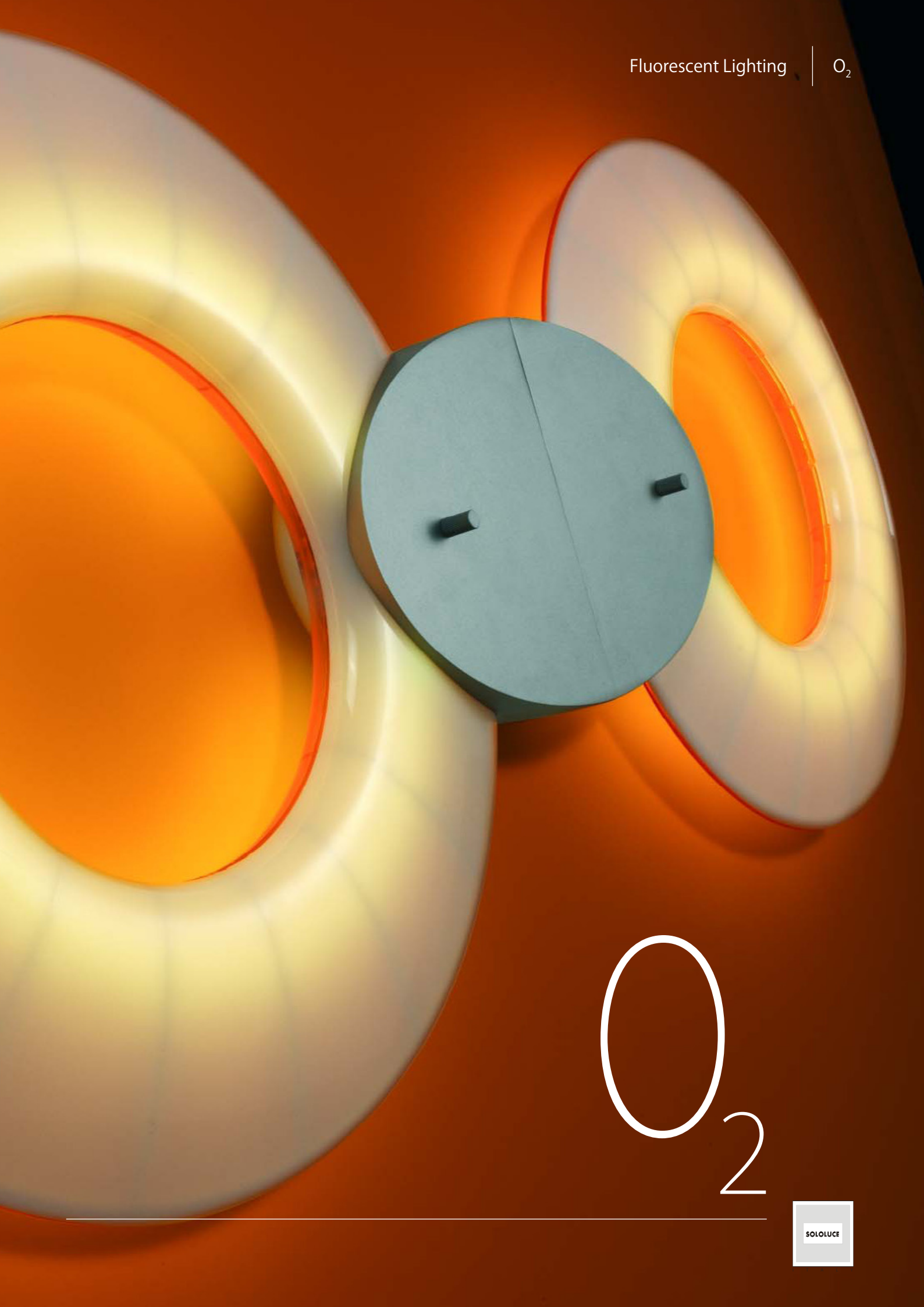
Downlight comes in White, Black & Grey finish.



Technical Data: Mobile Nano

Model No	Wattage	Nominal Voltage *(V)
HID 6175-120-GU5.3/GU10	20w	240 / 110
HID 6175-135-GU5.3/GU10	35w	240 / 110
HID 6175-150-GU5.5/GU10	50w	240 / 110

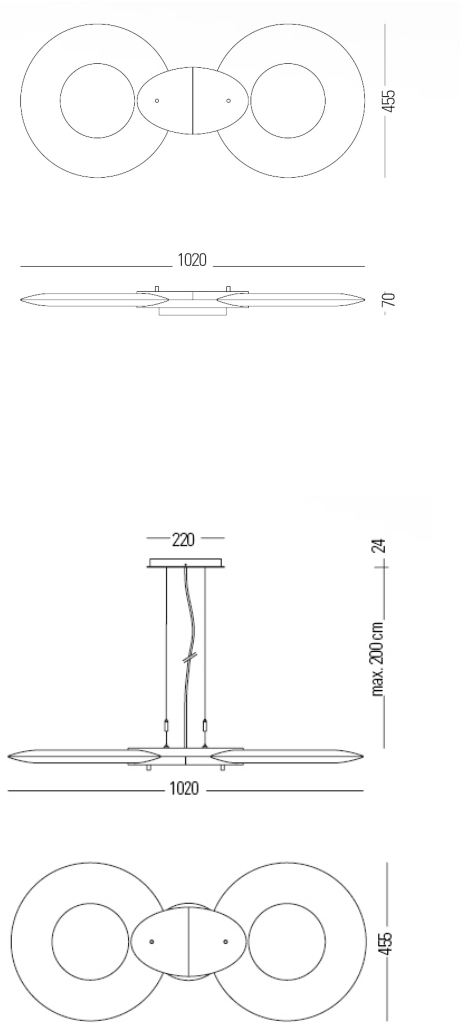
\* other voltages also available /please ask for quote



O<sub>2</sub>



O<sub>2</sub> lighting system is a range of products designed for T5 circular fluorescent lamps. It offers diffused lighting with high and efficient lumen output. Die casting silver paint body and metachrilate transparent shade. Wide range of shade colors. The several possible colors ombination able different uses in any application where high lumen performance and modern style concept are requested. Suspended lamps, table, wall and ceiling application complete our offer. Electronic feeding by electronic device to combine high quality standard with the lowest electric consumption.



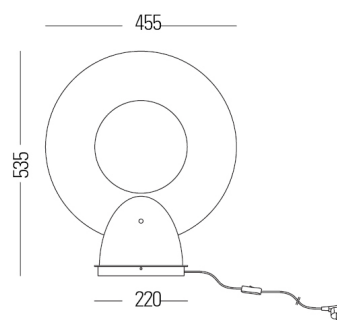
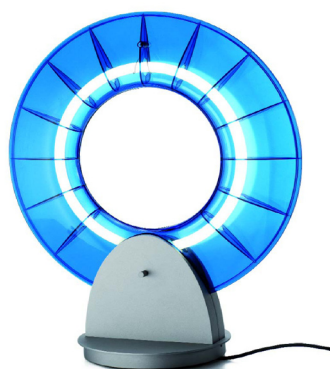
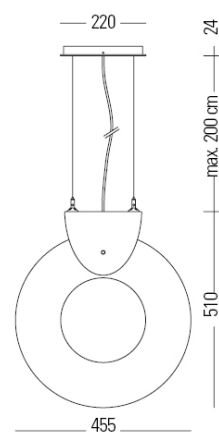
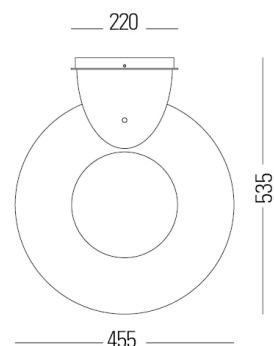
Technical Data: O<sub>2</sub>

Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL 5245-2x55-C	2X55w	240 / 110	EB
FTL 5245-2x55-W	2X55w	240 / 110	EB
FTL 5245-2x55-H	2X55w	240 / 110	EB

C- Ceiling Mount

W- Wall Mount

H- Hanging

Technical Data: O<sub>2</sub>

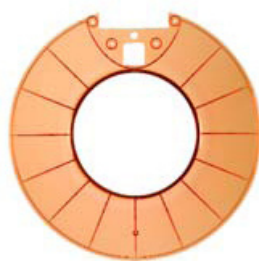
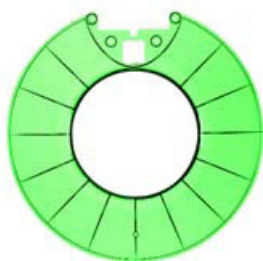
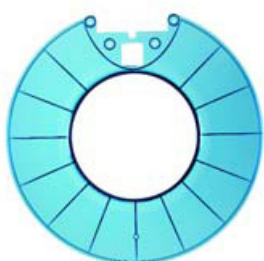
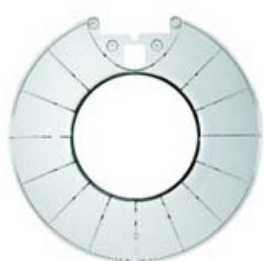
Model No	Lamp	Nominal Voltage (V)	Control Gear
FTL 5246-1x55-C	1X14w	240 / 110	EB
FTL 5246-1x55-W	1X14w	240 / 110	EB
FTL 5246-1x55-H	1X28w	240 / 110	EB
FTL 5246-1x55-D	1X28w	240 / 110	EB

C- Ceiling Mount

W- Wall Mount

H- Hanging

D- Desk





## LED Lighting Information



## Solid-State Lighting Standards

This fact sheet lists the key performance and safety standards applicable to LED-based lighting products.

### Product Performance and Measurement Standards

ANSI/NEMA Standards

ANSI/NEMA oversees the creation, promulgation and use of thousands of industry norms and guidelines, including the following key standards of relevance to SSL products.

#### ANSI/NEMA Standards

ANSI/NEMA oversees the creation, promulgation and use of thousands of industry norms and guidelines, including the following key standards of relevance to SSL products.

C78.377-2008	<b>Specifications for the Chromaticity of Solid State Lighting Products</b> <ul style="list-style-type: none"><li>• Specifies the recommended chromaticity (color) ranges for white light LEDs with various correlated color temperatures (CCTs).</li></ul>
NEMA SSL-1†	<b>Power Supply</b> <ul style="list-style-type: none"><li>• Will specify operational characteristics and electrical safety of SSL power supplies and drivers.</li></ul>
C82.77-2002	<b>Harmonic Emission Limits – Related Power Quality Requirements for Lighting</b> <ul style="list-style-type: none"><li>• Specifies the maximum allowable harmonic emission of SSL power supplies.</li></ul>

#### IESNA Documents

IESNA is the recognized North American technical authority on illumination.

TM-16-05	<b>IESNA Technical Memorandum on Light Emitting Diode (LED) Sources and Systems</b> <ul style="list-style-type: none"><li>• This technical memorandum provides a general description of LED devices and systems, and answers common questions about the use of LEDs.</li></ul>
RP-16-05 Addendum a	<b>Nomenclature and Definitions for Illuminating Engineering</b> <ul style="list-style-type: none"><li>• This document provides industry standard definitions of lighting terms, including all lighting technologies. Addendum a provides definitions of solid state lighting terms.</li></ul>
LM-79-08	<b>IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products</b> <ul style="list-style-type: none"><li>• Specifies procedures for measuring total luminous flux, electrical power, luminous efficacy, and chromaticity of SSL luminaires and replacement lamp products.</li></ul>
LM-80-08	<b>IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources</b> <ul style="list-style-type: none"><li>• Specifies procedures for determining lumen maintenance of LEDs and LED modules (but not luminaires) related to effective useful life of the product.</li></ul>
TM-21†	<b>Lumen Depreciation Lifetime Estimation Method for LED Light Sources</b> <ul style="list-style-type: none"><li>• Will provide a method for determining an LED luminaire or integral replacement lamp's expected operating life, based on initial performance data collected per IES-LM-80.</li></ul>
LM-XX†	<b>Method for the Measurements of High-Power LEDs</b> <ul style="list-style-type: none"><li>• Will provide a standardized method for thermal, electrical and photometric measurements of high-power LEDs.</li></ul>

†Currently under development.

### NFPA Requirements

70-2005

#### National Electrical Code

- Most SSL products must be installed in accordance with the National Electrical Code.

### FCC Requirements

47 CFR Part 15

#### Radio Frequency Devices

- Specifies FCC requirements for maximum allowable unintended radio-frequency emissions from electronic components, including SSL power supplies and electronic drivers.

## Color Quality of White LEDs

Color quality has been one of the key challenges facing white light-emitting diodes (LEDs) as a general light source. This fact sheet reviews the basics regarding light and color and summarizes the most important color issues related to white light LEDs, including recent advances.



Unlike incandescent and fluorescent lamps, LEDs are not inherently white light sources. Instead, LEDs emit light in a very narrow range of wavelengths in the visible spectrum, resulting in nearly monochromatic light. This is why LEDs are so efficient for colored light applications such as traffic lights and exit signs. However, to be used as a general light source, white light is needed. The potential of LED technology to produce high-quality white light with unprecedented energy efficiency is the impetus for the intense level of research and development currently being supported by the U.S. Department of Energy.

## White Light from LEDs

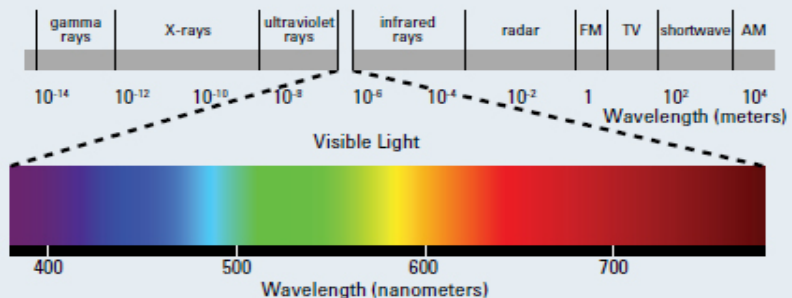
White light can be achieved with LEDs in two main ways: 1) phosphor conversion, in which a blue or near-ultraviolet (UV) chip is coated with phosphor(s) to emit white light; and 2) RGB systems, in which light from multiple monochromatic LEDs (red, green, and blue) is mixed, resulting in white light.

The phosphor conversion approach is most commonly based on a blue LED. When combined with a yellow phosphor (usually cerium-doped yttrium aluminum garnet or YAG:Ce), the light will appear white to the human eye. Research continues to improve the efficiency and color quality of phosphor conversion.

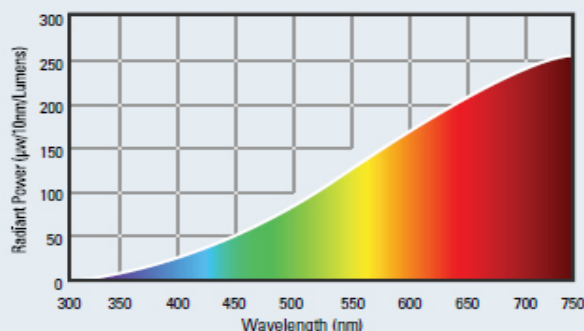
The RGB approach produces white light by mixing the three primary colors - red, green, and blue. The color quality of the resulting light can be enhanced by the addition of amber to "fill in" the yellow region of the spectrum. Status, benefits, and trade-offs of each approach are explored on next page.

### What is White Light?

We are accustomed to lamps that emit white light. But what does that really mean? What appears to our eyes as "white" is actually a mix of different wavelengths in the visible portion of the electromagnetic spectrum. Electromagnetic radiation in wavelengths from about 380 to 770 nanometers is visible to the human eye.



Incandescent, fluorescent, and high-intensity discharge (HID) lamps radiate across the visible spectrum, but with varying intensity in the different wavelengths. The spectral power distribution (SPD) for a given light source shows the relative radiant power emitted by the light source at each wavelength. Incandescent sources have a continuous SPD, but relative power is low in the blue and green regions. The typically "warm" color appearance of incandescent lamps is due to the relatively high emissions in the orange and red regions of the spectrum.



Example of a Typical Incandescent Spectral Power Distribution

## Comparison of White Light LED Technologies



Each approach to producing white light with LEDs (described on previous page) has certain advantages and disadvantages. The key trade-offs are among color quality, light output, luminous efficacy, and cost. The technology is changing rapidly due to intensive private and publicly funded research and development efforts in the U.S., Europe, and Asia. The primary pros and cons of each approach at the current level of technology development are outlined below.

Technology	Advantages	Disadvantages
Phosphor conversion	<ul style="list-style-type: none"><li>• Most mature technology</li><li>• High-volume manufacturing processes</li><li>• Relatively high luminous flux</li><li>• Relatively high efficacy</li><li>• Comparatively lower cost</li></ul>	<ul style="list-style-type: none"><li>• High CCT (cool/blue appearance)</li><li>• Warmer CCT may be less available or more expensive</li><li>• May have color variability in beam</li></ul>
RBG	<ul style="list-style-type: none"><li>• Color flexibility, both in multicolor displays and different shades of white</li></ul>	<ul style="list-style-type: none"><li>• Individual colored LEDs respond differently to drive current, operating temperature, dimming, and operating time</li><li>• Controls needed for color consistency add expense</li><li>• Often have low CRI score, in spite of good color rendering</li></ul>

Most currently available white LED products are based on the blue LED + phosphor approach. Phosphor-converted chips are produced in large volumes and in various packages (light engines, arrays, etc.) that are integrated into lighting fixtures. RGB systems are more often custom designed for use in architectural settings.



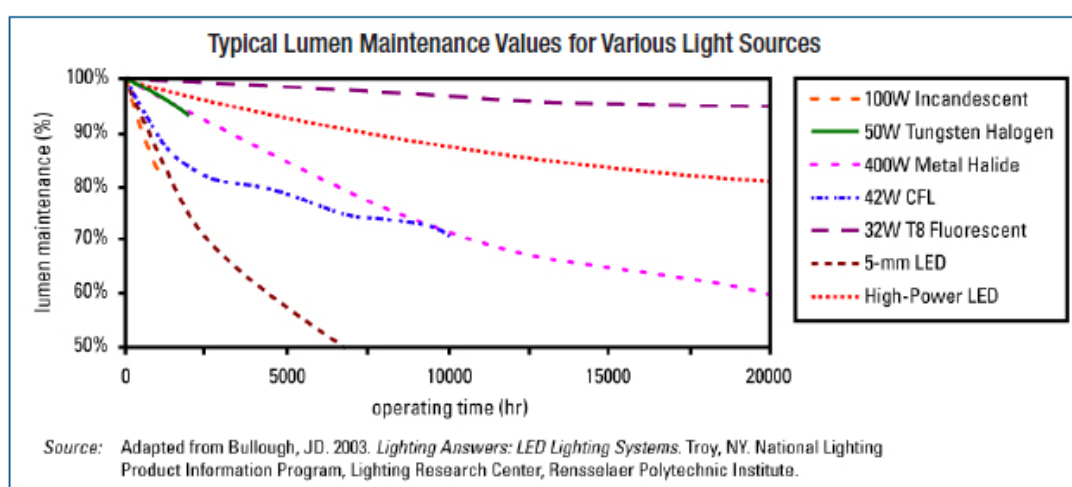
## Lifetime of White LEDs

One of the main “selling points” of LEDs is their potentially very long life. Do they really last 50,000 hours or even 100,000 hours? This fact sheet discusses lumen depreciation, measurement of LED useful life, and the features to look for in evaluating LED products.

### Lumen Depreciation

All electric light sources experience a decrease in the amount of light they emit over time, a process known as lumen depreciation. Incandescent filaments evaporate over time and the tungsten particles collect on the bulb wall. This typically results in 10-15% depreciation compared to initial lumen output over the 1,000 hour life of an incandescent lamp.

In fluorescent lamps, photochemical degradation of the phosphor coating and accumulation of light-absorbing deposits cause lumen depreciation. Compact fluorescent lamps (CFLs) generally lose no more than 20% of initial lumens over their 10,000 hour life. High-quality linear fluorescent lamps (T8 and T5) using rare earth phosphors will lose only about 5% of initial lumens at 20,000 hours of operation. The primary cause of LED lumen depreciation is heat generated at the LED junction.



LEDs do not emit heat as infrared radiation (IR), so the heat must be removed from the device by conduction or convection. Without adequate heat sinking or ventilation, the device temperature will rise, resulting in lower light output. While the effects of short-term exposure to high temperatures can be reversed, continuous high temperature operation will cause permanent reduction in light output. LEDs may continue to operate even after their light output has decreased to very low levels. This becomes an important factor in determining the effective useful life of the LED.

### Defining LED Useful Life

To provide an appropriate measure of useful life of an LED, a level of acceptable lumen depreciation must be chosen. At what point is the light level no longer meeting the needs of the application? The answer may differ depending on the application of the product. For a common application such as general lighting in an office environment, research has shown that the majority of occupants in a space will accept light level reductions of up to 30% with little notice, particularly if the reduction is gradual. Therefore a level of 70% of initial light level could be considered an appropriate threshold of useful life for general lighting. Based on this research, the Alliance for Solid State Illumination Systems and Technologies (ASSIST), a group led by the Lighting Research Center (LRC), recommends defining useful life as the point at which light output has declined to 70% of initial lumens (abbreviated as L70) for general lighting and 50% (L50) for LEDs used for decorative purposes. For some applications, a level higher than 70% may be required.

## Terms

**Lumen depreciation** – the decrease in lumen output that occurs as a lamp is operated.

**Rated lamp life** – the life value assigned to a particular type lamp. This is commonly a statistically determined estimate of average or median operational life. For certain lamp types other criteria than failure to light can be used; for example, the life can be based on the average time until the lamp type produces a given fraction of initial luminous flux. **Life performance curve** – a curve that presents the variation of a particular characteristic of a light source (such as luminous flux, intensity, etc.) throughout the life of the source. Also called lumen maintenance curve.

## Measuring Light Source Life

The lifetimes of traditional light sources are rated through established test procedures. For example, CFLs are tested according to LM-65, published by the Illuminating Engineering Society of North America (IESNA). A statistically valid sample of lamps is tested at an ambient temperature of 25° Celsius using an operating cycle of 3 hours ON and 20 minutes OFF. The point at which half the lamps in the sample have failed is the rated average life for that lamp. For 10,000 hour lamps, this process takes about 15 months.

Full life testing for LEDs is impractical due to the long expected lifetimes. Switching is not a determining factor in LED life, so there is no need for the on-off cycling used with other light sources. But even with 24/7 operation, testing an LED for 50,000 hours would take 5.7 years. Because the technology continues to develop and evolve so quickly, products would be obsolete by the time they finished life testing.

The IESNA has developed a procedure (IES LM-80) for measurement of lumen maintenance for LED devices (e.g., LED packages, arrays, modules); however, this method does not cover LED luminaires or integral replacement lamps. LM-80 also does not provide guidance for estimating or extrapolating lumen maintenance beyond the 6,000 hour measurement period prescribed in the test method. To address long-term performance of LED products, the IESNA is currently developing a companion estimation method (IES TM-21) to estimate LED lumen maintenance and service life beyond 6,000 hours. TM-21 will utilize LM-80 data collected at multiple operating temperatures. Because of their potentially long life and impracticality of complete testing, estimates of the life of LEDs will likely be based on the extrapolation of limited test data. It is, therefore, important at this technology's early stage to be conservative in design decisions based on expected useful life.

## LED Lifetime Characteristics

How do the lifetime projections for today's white LEDs compare to traditional light sources?

Light Source	Range of Typical Rated Life (hours)* (varies by specific lamp type)	Estimated Useful Life (L <sub>70</sub> )
Incandescent	750-2,000	
Halogen incandescent	3,000-4,000	
Compact fluorescent (CFL)	8,000-10,000	
Metal halide	7,500-20,000	
Linear fluorescent	20,000-30,000	
High-Power White LED		35,000-50,000**

\*Source: lamp manufacturer data.

\*\*Depending on drive current, operating temperature, etc. some manufacturers are claiming useful life (L<sub>70</sub>) values greater than 100,000 hours.

Electrical and thermal design of the LED system or fixture determine how long LEDs will last and how much light they will provide. Driving the LED at higher than rated current will increase relative light output but decrease useful life. Operating the LED at higher than design temperature will also decrease useful life significantly. Most manufacturers of high-power white LEDs estimate a lifetime of around 30,000 hours to the 70% lumen maintenance level, assuming operation at 350 milliamps (mA) constant current and maintaining junction temperature at no higher than 90°C. However, the thermal robustness of LEDs continues to improve, allowing for higher drive currents and higher operating temperatures. For example, manufacturers of high-power white LEDs typically estimate a lifetime of around 50,000 hours to the 70% lumen maintenance level, assuming operation at 700 milliamps (mA) constant current or higher, at maintained junction temperatures above 100°C.

## Luminaire Efficacy

The use of light-emitting diodes (LEDs) as a general light source has forced changes in test procedures used to measure lighting performance. This fact sheet describes the concept of luminaire efficacy and the technical reasons for its applicability to LED-based lighting fixtures.



Lighting energy efficiency is a function of both the light source (the light “bulb” or lamp) and the fixture, including necessary controls, power supplies and other electronics, and optical elements. The complete unit is known as a luminaire.

Traditionally, lighting energy efficiency is characterized in terms of lamp ratings and fixture efficiency. The lamp rating indicates how much light (in lumens) the lamp will produce when operated at standard room/ambient temperature (25 degrees C). The luminous efficacy of a light source is typically given as the rated lamp lumens divided by the nominal wattage of the lamp, abbreviated lm/W. The fixture efficiency indicates the proportion of rated lamp lumens actually emitted by the fixture; it is given as a percentage. Fixture efficiency is an appropriate measure for fixtures that have interchangeable lamps for which reliable lamp lumen ratings are available. However, the lamp rating and fixture efficiency measures have limited use-

fulness for LED lighting at the present time, for two important reasons:

- 1) There is no industry standard test procedure for rating the performance of LED devices or packages.
- 2) The luminaire design and the manner in which the LEDs are integrated into the luminaire have a material impact on the performance of the LEDs.

These two issues are discussed in greater detail below. Given these limitations, how can LED luminaires be compared to traditional lighting technologies? As an example, the table below compares two recessed downlight fixtures, one using a 13-watt CFL and the other using an array of LEDs. The table differentiates data related to the light source and data resulting from actual luminaire measurements. Luminaire photometry shows that in this case the LED fixture has input wattage and light output similar to the CFL fixture, and matches the CFL product’s luminaire efficacy. This example is based on a currently available, residential-grade, six-inch diameter downlight. LED downlight performance continues to improve rapidly, with some LED retrofit products surpassing CFL downlights in luminaire efficacy.

Example: Comparison of CFL and LED Downlight Luminaires		
Light Source		
Lamp lumen rating	860 lm	
Light source wattage	13 W	1 W
LED manufacturer declared “typical luminous flux”		-100 lm per LED*
Number of lamps/LEDs per fixture	1	12
Luminaire Measurements		
Luminaire lumens	514 lm	589 lm
Measured luminaire wattage	12 W	14 W
Fixture efficiency	60%	
Luminaire efficacy	42 lm/W	42 lm/W

Items in *italics* are not based on industry standard test procedures as published by ANSI/IESNA.

\*Depends on specific LED used. Estimate is based on “typical luminous flux” declared by LED manufacturer on the product datasheet, which assumes 25°C LED junction temperature.

## No LED rating standard

Traditional light sources (incandescent, fluorescent, and high-intensity discharge) are rated for luminous flux according to established test procedures. In contrast, there is no standard procedure for rating the luminous flux of LEDs. LED light output estimates (as reported on manufacturer datasheets) are typically based on a short (<1 second) pulse of power applied to the LED chip, usually with junction temperature held at 25 degrees C. This is because LED chips must be binned for luminous flux and color during the manufacturing process. To run them any longer without a heat sink would damage them. LED manufacturers usually list “minimum” and “typical” luminous flux on their product datasheets. There is no standardization of the test conditions, or the meaning of “typical.” Further, there is no standard test procedure for measuring the luminous flux of LED arrays, such as multiple LEDs mounted on a circuit board.

## Impact of luminaire design

For all light sources, there is a difference between rated luminous flux of the lamp and actual performance in a luminaire. However, traditional light sources installed in luminaires operate relatively predictably because the performance of traditional light sources in a wide range of luminaire types, applications, and use conditions is well documented and understood. LED technology is at a far earlier stage of development, so experience and documentation of performance within luminaires is lacking. The efficiency of LEDs is very sensitive to heat and optical design, which increases the relative importance of luminaire design. Ensuring necessary light output and life of LEDs requires careful thermal management, typically requiring the use of the fixture housing as a heat sink or at least as an element in the heat removal design. Luminaires therefore have a fundamental and typically large effect on the luminous flux produced by the LEDs, and on the rate of lumen depreciation over time. LED “drop-in” replacement lamps, such as Edison-based reflector lamps or MR-16 replacements, are in theory designed to provide the necessary heat sinking for the LEDs, but given their installation in fixtures not specifically designed for LEDs, good heat management will be a challenge. In summary, luminous flux—and by extension, luminous efficacy—must be measured at the luminaire level for two primary reasons: 1) no standard procedures are available for rating LED devices on their own, and; 2) the amount of light emitted by a fixture cannot be predicted reliably based on available information about LED devices and fixtures. The lighting industry has adopted luminaire efficacy as the preferred measure of LED performance, as evident in the development of a new test procedure based on this approach

### Terms

**Photometry** – the measurement of quantities associated with light, including luminance, luminous intensity, luminous flux, and illuminance.

**Integrating sphere** – a device that enables geometrically total luminous flux to be determined by a single measurement. The usual type is the Ulbricht sphere with associated photometric equipment for measuring the indirect illuminance of the inner surface of the sphere.

**Goniophotometer** – an apparatus for measuring the directional light distribution characteristics of light sources, luminaires, media, and surfaces. Goniophotometry can be used to obtain total luminaire flux (lumens) and efficacy (lumens/watt), but not the color metrics (chromaticity, CCT, and CRI).

**Spectroradiometer** – an instrument for measuring radiant flux (visible and non-visible) as a function of wavelength. Visible radiation measurements can be converted into luminous intensity (candela) and flux (lumens).

## Thermal Management of White LEDs

LEDs won't burn your hand like some light sources, but they do produce heat. In fact, thermal management is arguably the most important aspect of successful LED system design. This fact sheet reviews the role of heat in LED performance and methods for managing it.

All light sources convert electric power into radiant energy and heat in various proportions. Incandescent lamps emit primarily infrared (IR), with a small amount of visible light. Fluorescent and metal halide sources convert a higher proportion of the energy into visible light, but also emit IR, ultraviolet (UV), and heat. LEDs generate little or no IR or UV, but convert only 20%-30% of the power into visible light; the remainder is converted to heat that must be conducted from the LED die to the underlying circuit board and heat sinks, housings, or luminaire frame elements. The table below shows the approximate proportions in which each watt of input power is converted to heat and radiant energy (including visible light) for various white light sources.

### Relative Power Conversion for "White" Light Sources

**Relative Power Conversion for "White" Light Sources**

	Incandescent <sup>†</sup> (60W)	Fluorescent <sup>†</sup> (Typical linear CW)	Metal Halide <sup>‡</sup>	LED*
Visible Light	8%	21%	27%	20-30%
IR	73%	37%	17%	~ 0%
UV	0%	0%	19%	0%
Total Radiant Energy	81%	58%	63%	20-30%
Heat (Conduction + Convection)	19%	42%	37%	70-80%
Total	100%	100%	100%	100%

<sup>†</sup> IESNA Handbook

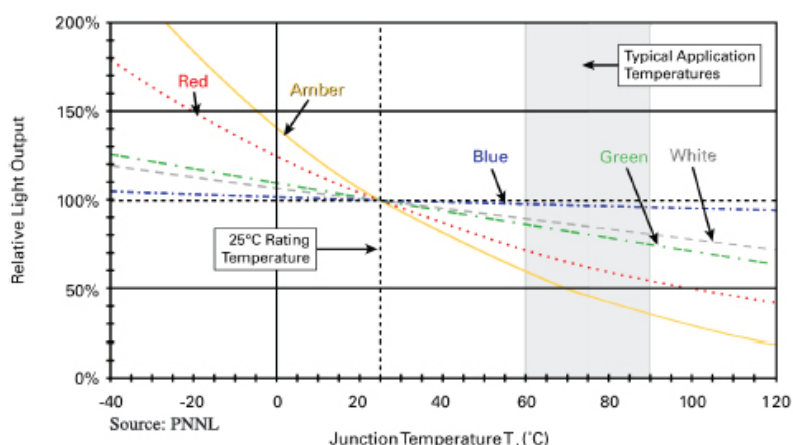
<sup>‡</sup> OSRAM SYLVANIA

\* Varies depending on LED efficacy. This range represents best currently available technology in color temperatures from warm to cool. DOE's SSL Multi-Year Program Plan (Mar 2009) calls for increasing extraction efficiency to more than 50% by 2025.

### Why does thermal management matter?

Excess heat directly affects both short-term and long-term LED performance. The short-term (reversible) effects are color shift and reduced light output while the long-term effect is accelerated lumen depreciation and thus shortened useful life.

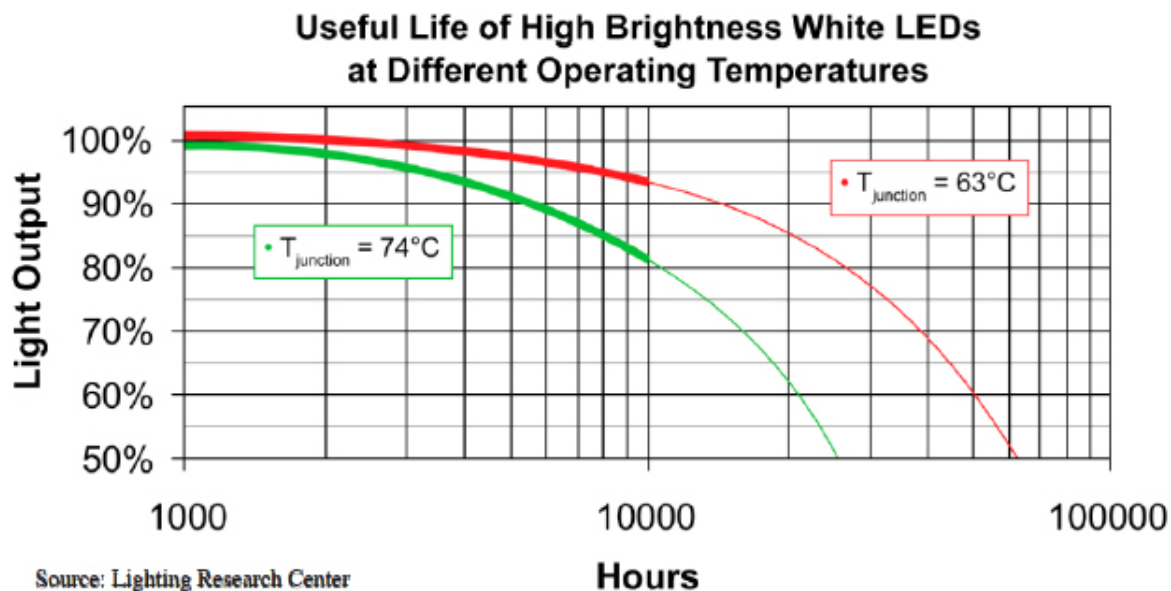
The light output of different colored LEDs responds differently to temperature changes, with amber and red the most sensitive, and blue the least. (See graph at right.) These unique temperature response rates can result in noticeable color shifts in RGB-based white light systems if operating  $T_j$  differs from the design parameters. LED manufacturers test and sort (or "bin") their products for luminous flux and color based on a 25 millisecond power pulse, at a fixed  $T_j$  of 25°C (77°F). Under constant current operation at room temperatures and with engineered heat mitigation mechanisms,  $T_j$  is typically 60°C or greater. Therefore white LEDs will provide at least 10% less light than the manufacturer's rating, and the reduction in light output for products with inadequate thermal design can be significantly higher.





Continuous operation at elevated temperature dramatically accelerates lumen depreciation resulting in shortened useful life. The chart below shows the light output over time (experimental data to 10,000 hours and extrapolation beyond) for two identical LEDs driven at the same current but with an 11°C difference in  $T_j$ . Estimated useful life (defined as 70% lumen maintenance) decreased from ~37,000 hours to ~16,000 hours, a 57% reduction, with the 11°C temperature increase.

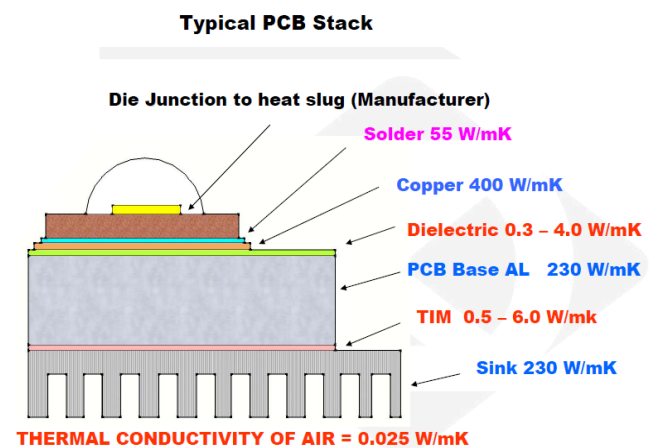
However, the industry continues to improve the durability of LEDs at higher operating temperatures. For example, manufacturers of high-power white LEDs typically estimate a lifetime of around 50,000 hours to the 70% lumen maintenance level, assuming operation at 700 mil-amps (mA) constant current or higher, at maintained junction temperatures above 100°C.



### What determines junction temperature?

Three things affect the junction temperature of an LED: drive current, thermal path, and ambient temperature. In general, the higher the drive current, the greater the heat generated at the die. Heat must be moved away from the die in order to maintain expected light output, life, and color. The amount of heat that can be removed depends upon the ambient temperature and the design of the thermal path from the die to the surroundings.

The typical high-flux LED system is comprised of an emitter, metal-core printed circuit board (MCPCB), and some form of external heat sink. The emitter houses the die, optics, encapsulant, and heat sink slug (used to draw heat away from the die) and is soldered to the MCPCB. The MCPCB is a special form of circuit board with a dielectric layer (non-conductor of current) bonded to a metal substrate (usually aluminum). The MCPCB is then mechanically attached to an external heat sink which can be a dedicated device integrated into the design of the luminaire or, in some cases, the chassis of the luminaire itself. The size of the heat sink is dependent upon the amount of heat to be dissipated and the material's thermal properties.



Heat management and an awareness of the operating environment are critical considerations to the design and application of LED luminaires for general illumination. Successful products will use superior heat sink designs to dissipate heat, and minimize  $T_j$ . Keeping the  $T_j$  as low as possible and within manufacturer specifications is necessary in order to maximize the performance potential of LEDs.

## Heat sink design



The applicable heat transport mechanisms are conduction via the heat sink, convection and thermal radiation to the surroundings. The objective of this chapter is not to indicate exactly how to calculate a heat sink, but to give some guidelines on how to improve its performance. Although a heat sink can have many (complex) shapes, the following discussion is based on a disk type of heat sink. The results for square plates, etc., are more or less the same provided the surface areas are equal. The type of material used has a relatively large influence on the final result. For example, a comparison of the thermal conductivity ( $k$ ) of copper with that of corrosion-resistant steel (below) shows that a substantially smaller heat sink can be made with copper. In practice, the best material for heat sinks is (soft) aluminum.

The thickness ( $d$ ) of the heat sink disk is also of major importance. Assuming the use of different heat sinks of the same diameter but made from different materials, the same effect in terms of temperature difference will be achieved if the product of thermal conductivity ( $k$ ) and disk thickness ( $d$ ) is constant.

This means more or less the same result is obtained with a disk of 1 mm copper, 2 mm aluminum, 4 mm brass, 8 mm steel or 26 mm corrosion-resistant steel. Increasing the diameter, and thereby also the surface area, of the heat sink disk also leads to an improvement, but the effect is smaller for larger diameters and depends on the thermal conductivity ( $k$ ) of the material and the thickness ( $d$ ).

Thermal radiation can also form a substantial part of the total heat transfer, and is of the same order as for convection. This depends strongly on the emission coefficient (see table) of the surface, which lies between 0 and 1. For example, a polished aluminum surface has a very low emission coefficient, while that of a painted surface is very high.

### Thermal conductivity

Material	W/mK
Copper	400
Aluminum	200
Brass	100
Steel	50
Corrosion-resistant steel	15

### Emission coefficients

Material	W/mK	Emission coefficient
Aluminium	new/polished	0.04 - 0.06
	oxidized	0.2 - 0.3
	anodized	0.8
Steel	painted	0.8 - 0.95
	new/polished	0.03 - 0.07
	heavily oxidized	0.7 - 0.8

## Case temperature and thermal circuit

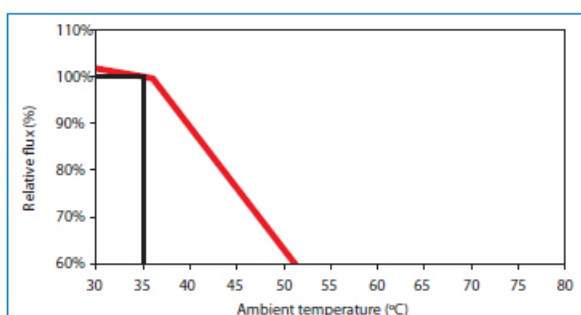
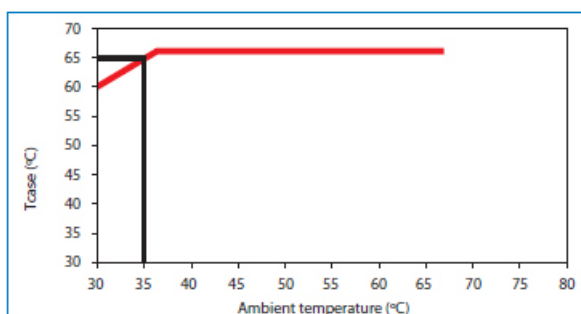
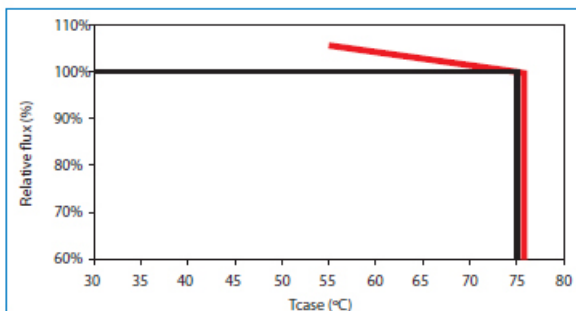
To ensure the performance of the LED Module system, manufacturers define  $T_c$  at the back surface of the LED module of say  $65^\circ\text{C}$ . At that case temperature the junction temperature of the LEDs is assured and the indicated performances (lifetime, light output, lumen maintenance) can be realized. Above a  $T_c$  of  $65^\circ\text{C}$ , a thermal circuit will be engaged. This circuit will dim the LED module. The graphs below display the typical case temperature and relative flux as a function of ambient temperature, for a calculated heat sink performance of  $1\text{ K/W}$ . The performances of light output, light maintenance and lifetime are related to the  $T_c$  value.

### Case temperature and LED module performance

The LED modules which are nominally designed for a case temperature of  $65^\circ\text{C}/149^\circ\text{F}$ . The flux is then 100%. The graphs below show the relative light output (flux) as a % of the nominal case temperature. As you can see, if the operating condition of the LED module is lower than the  $T_c$  point, performance will increase.

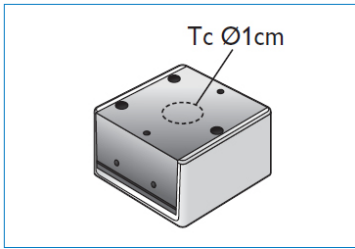
### Operation in free air

In general LED modules are not designed for operation in free air. Instead LED module has a build-in concept for integration into luminaires.





## Size of heat sink



Temperature test point Tc

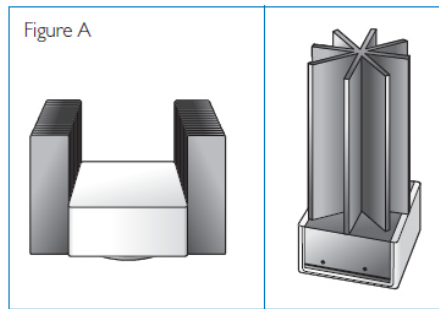


Figure A

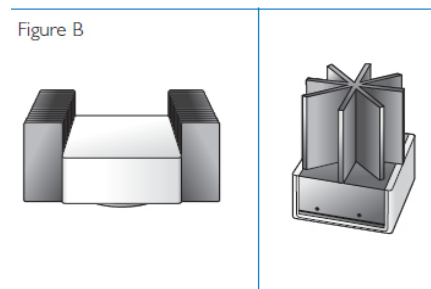


Figure B

Lets consider a LED module that consumes 18 W or 45 W and contain a built-in heat sink. Deducting the driver efficiency and the energy that is effectively giving light leaves a heat dissipation of 15W and 38W, respectively, that needs to be taken away from the module. The sink at the sides and back of the module is the contact area for the external heat sink. The heat sink transports the heat away from the module and is connected to the heat sink, with either the use of the pre-made screw holes or side grooves.

The performance (lifetime and amount of light) of the module depends heavily on the thermal management. Therefore the temperature of the test point (Tc) is important. During the thermal design process, the aim is to keep the Tc temperature below the stated maximum (65° C). Although the LED module will not fail due to a higher temperature, the effect of insufficient cooling will mean that the light output of the LEDs is automatically dimmed, So the better the thermal management (low Tc of the LED module), the better the performance of the luminaire (lifetime and light output). Here is a differentiation opportunity for luminaire manufacturers.

## Active and passive cooling

There are two thermal cooling options, passive and active cooling.

**Passive cooling systems** are made so that hot air moves upwards, and an airflow is created along the surfaces. This is called natural convection.

**Active cooling systems** have airflow that is forced with a fan or Syn-Jet, which enhances the thermal capacity of the heat sink. As a result, a smaller heat sink can be used and orientation of the heat sink is no issue anymore. Negative aspects of active cooling is the possibility of additional noise caused by a fan, as well as incremental energy consumption. Note that the OEM needs to engineer a cooling solution that matches the entire system's lifetime and intended application. There are many standard heat sinks available which are relatively cost effective. When comparing active cooling, the form factor of the total system is approximately two times larger.

## Passive cooling

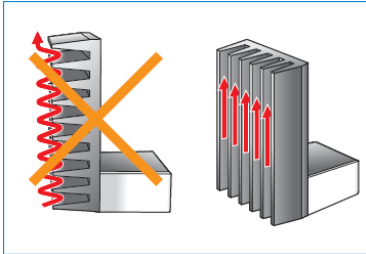
There are two passive thermal solutions.

As shown on the left sides of Figure A and B, the solution with the heat sinks connected to the sides of the module has the advantage of lower height, but a larger diameter. The disadvantage is an extra thermal resistance path from test point Tc (in the center of the rear surface) to the sides where the heat sinks are connected. As shown on the right sides of Figure A and B, the heat sink is connected to the backside of module. This configuration provides no extra thermal resistance, though to achieve this same cooling capacity, extra height is required.

## Air flow

Before starting with any calculation, an important point to consider is the airflow.

In general, hot air is moving upwards with relatively low speed. The form and position of the heat sink is influencing the airflow. In the picture on the left, the fins are perpendicular to the airflow which reduces the efficiency of the heat sink. This situation should be avoided.



A better way to position the fins is indicated in the picture on the right, where the fins are parallel to the airflow direction. Closing the top of the profile will reduce the effectiveness of the heat sink as well, and should be avoided during design and installation.

## Thermal design

There are two main thermal paths to consider — from the temperature test point to the side surfaces and from the heat sink to the ambient temperature (warming up and dynamic behavior are not discussed here, as a static situation is normally found in lighting applications).

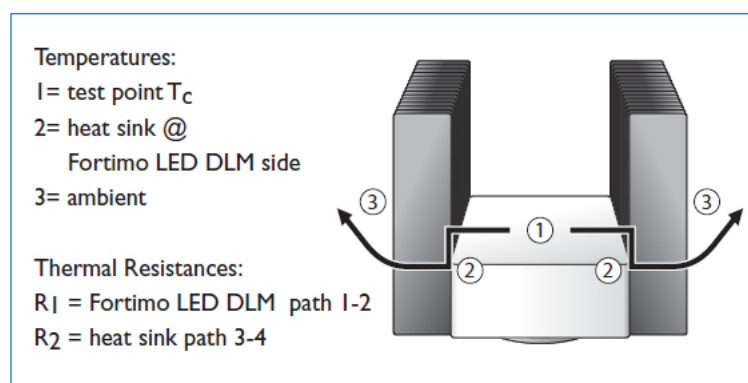
### From the temperature test point $T_c$ (point 1) to the side surfaces (point 2)

- This is already measured by manufacturer and is 0.2 K/W. Please note that if you attach the heat sink directly to the back of the module, the 0.2 K/W should be considered.

### From the heat sink to ambient (point 3)

The thermal resistance of a heat sink is normally given in a datasheet, but it is based on a few assumptions:

- A certain thermal power has to be applied, as the efficiency of the heat sink is lower at low energy levels
- The temperature of the backside of the heat sink is homogeneous
- An air flow can freely flow over the surfaces



Thermal path basic solutions

## Thermal model

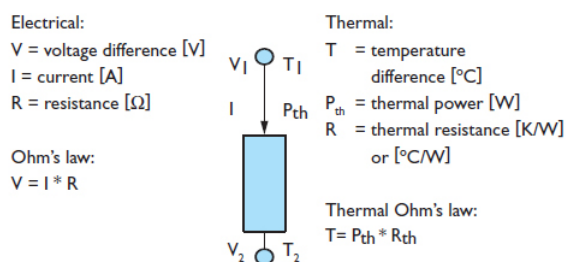
Standard STATIC thermal situations can be modeled with so-called thermal resistances. These resistances behave like electrical resistors. Below the analogy between electrical and thermal resistors is explained. Electrical units are shown on the left, with thermal equivalents shown on the right.

With a known voltage difference at a certain current, it is possible to calculate an electrical resistor with Ohm's law. The same is possible with a thermal resistor. If the temperature difference is known as well as the thermal power, the thermal resistance can be calculated with thermal Ohm's law.

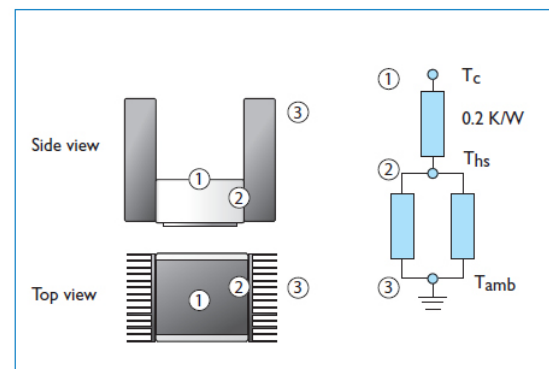
In the figures below you see the two most important thermal resistances.

The following are some notable conditions:

- From test point  $T_c$  to side surface of the LED module, where the heat sinks are connected
- From side surface of LED module to ambient. As we have connected two heat sinks, both will have a similar thermal resistance in parallel
- In the specification the maximum  $T_c$  is given, in case of a LED module system this is  $65^\circ\text{C}$



Electrical and thermal analogy



Thermal resistance of LED module

## Calculating your heat sink

We start with 3 thermal calculation formulas:

- Formula 1 (f1) is the relation between temperature difference, thermal power and thermal resistance. With this formula, the needed thermal resistance can be calculated when the thermal power and temperature difference are known.
- Formula 2 (f2) shows how to calculate the replacement of two parallel resistors, with one equivalent.
- Formula 3 (f3) shows the replacement equivalent of 2 resistors in series, simply add the values.

Next we gather all available information, as can be found in the datasheet, application details and design choices.

From the datasheet:

Maximum test point temperature:  $T_{c-max} = 65^{\circ}C$

Thermal power LED module :  $P_{th} = 20W$

Thermal resistance from Tc to side surface:  $R_{th-Tc-to-side-surface} = 0.2K/W$

Maximum temperature in application:  $T_{ambient-max} = 35^{\circ}C$  chosen in this case.

In this case we install the product below ceiling, which is the ambient temperature of the product.

The maximum temperature differs per application and can be lower or higher, than the now chosen  $35^{\circ}C$ .

Below we calculate the needed thermal resistance of the heat sink, so that in worst case scenarios, the maximum temperature of the test point Tc is below its maximum.

### Formulas:

Thermal:  $\Delta T = R_{th} \times P_{th}$  f1

Parallel:  $R_{th-R1+R2} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$  f2

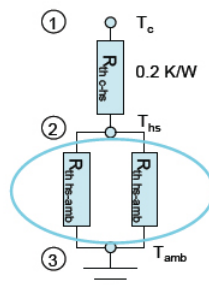
Series:  $R_{tot} = R_1 + R_2$  f3

### Available information:

$T_{c-max} = 65^{\circ}C$   
 $P_{th-Fortimo2000} = 20W$  (2000Lm, 3000K)  
 $R_{th-Tc-to-hs} = 0.2K/W$   
 $T_{ambient-max} = 35^{\circ}C$

### To be calculated:

$R_{th}$  both heat sinks



Thermal resistance of heat sink

### 1. Calculation of total maximum thermal resistance: (f1)

$\Delta T_{ambient-Tc} = 65 - 35 = 30^{\circ}C$   
 $R_{th-Tc-ambient} = (T_{ambient} - T_c) / P_{th} = 30 / 20 = 1.5K/W$

### 2. Calculation of thermal resistance two heat sinks: (f3)

$R_{th-hs-ambient} = R_{th-Tc-hs} + R_{th-hs-ambient}$

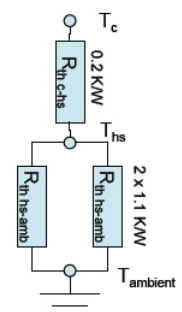
$R_{th-hs-ambient} = 1.5 - 0.2 = 1.3K/W$

### 3. Calculation of thermal resistance per identical heat sink: (f2)

$R_1 = R_2$  and  $R_{tot-hs-amb} = 1 / (1/R_1 + 1/R_2)$

$R_{tot} = 1 / (2/R_1) = R_1/2 \Rightarrow R_1 = 2R_{tot}$

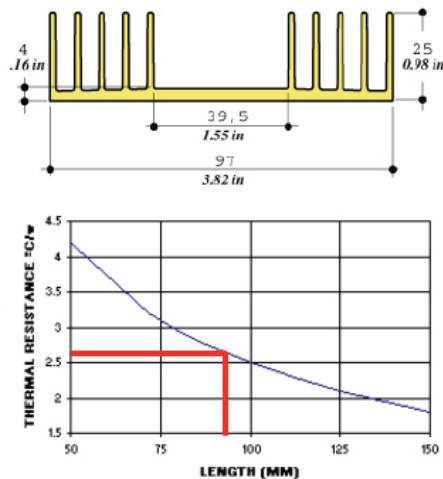
$R_1 = R_{th-single heat sink} = 2 * 1.3 = 2.6K/W$



Thermal resistance of heat sink

Example of standard heat sink:

- Needed 2.6 K/W
- Heat sink: Marston 28DN
- Length @ 2.6 K/W = 90 mm (red line)
- Width= 97 mm height= 25 mm, #fins= 10  
 $R_{th} = 2.6 \text{ K/W}$  per heat sink (data sheet)



Thermal resistance of heat sink

Now we know the thermal resistance of the needed heat sink. This heat sink dimension is such that at maximum power and maximum ambient temperature, the temperature of the test point  $T_c$  is at or below its maximum of  $65^\circ \text{C}$ . This is the worst case scenario, which means that normally the test point temperature  $T_c$  is lower. This assures lifetime and light output will be according to specifications.

## Shape of heat sink

When looking into heat sink suppliers, remember that the shape is determining the thermal resistance of the heat sink. In this case, the length is a design parameter. The graph at left, shows the thermal resistance of the heat sink, with increasing length. With the parameters provided in this example, we need a 2.6 K/W heat sink and the red line indicates that this profile has the stated value with a length of approx. 90 mm.

There are many variations in fin number, length of fins, length of heat sink and so on. With special thermal design software, a tailor-made solution can be found as well.

With the use of a standard thermocouple, all important temperatures can be measured and compared to theoretical values.

On the left you see the standard set-up for thermal testing of the LED module system which includes two connected heat sinks and three thermocouples.

Key thermocouple test points are:

- At test point  $T_c$
- At the heat sink interface of the LED module
- At the ambient temperature in situation

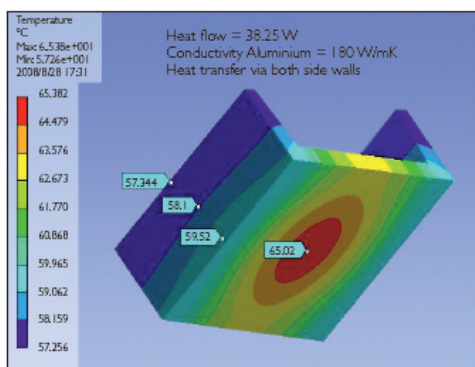


With this simple set-up, all important values can be measured and compared to the theoretical values. It's important to assure good thermal contact between LED module and the heat sinks. We recommend using thermal pads or thermal paste. Furthermore, it is very important that there is no moving air in the room. This will influence the measurement heavily.

## How to measure $T_c$

In case you have no direct or easy access to connect a thermocouple to the defined  $T_c$  point, we recommend connecting the thermocouple to one of the sides of the LED module.

The heat sink that is integrated in the LED module ensures that temperature difference for  $T_c$  point to both sides is minimal. In the visual on the left, you see this difference is approximately 8 degrees with a LED module. If a heat sink is connected to the back of the module, this temperature difference will reduce to 4 degrees.



## Understanding Photometric Reports for SSL Products

Given the complex functional relationship between light-emitting diode (LED) light sources and luminaire or replacement lamp components, solid-state lighting (SSL) products do not lend themselves to traditional photometric methods, which were developed separately for lamps and luminaires (i.e., relative photometry). Consequently, the Illuminating Engineering Society of North America (IESNA) developed an SSL product testing method based on absolute photometry, which characterizes a luminaire or replacement lamp as a whole—and acknowledges the unique thermal, optical and electrical properties of these integral products.

### The LM-79 Report

IESNA has developed test methods for a broad range of light sources and luminaire types, each providing test protocols specific to the unique attributes of the tested lighting products. For SSL products, LM-79 testing addresses the following key measurements: [electrical characteristics](#), [light output](#), [luminous intensity distribution](#), and [color characteristics](#).

Another important measure of SSL performance, lumen maintenance, is addressed in a separate IESNA test method (IES LM-80-08). LM-79 does not prescribe a specific testing report format or contents, but instead makes the general requirement that the report “... shall list all significant data for each SSL product tested together with performance data.”<sup>1</sup> LM-79 results are critical for evaluating SSL products against application requirements, comparing with other lighting products—and qualifying for the ENERGY STAR® voluntary labeling program.

### Electrical Characteristics

LM-79 prescribes the power supply characteristics and electrical instrumentation setup for SSL product testing, and requires that the tested product be operated at its rated voltage (AC or DC). Measurements are typically collected for input voltage (in volts, V), input current (in amperes, A), and input power (in watts, W). These data are used to calculate luminaire efficacy (expressed in lumens per watt, lm/W)—a core indicator of SSL product performance. It is important that separate electrical measurements are taken for each type of photometric test included in the LM-79 report (i.e., integrating sphere and distribution methods discussed below), so that luminaire efficacy is calculated using light output and power measurements from the same test.

### Light Output (Luminous Flux) Essential Data

Total light output (i.e., luminous flux, expressed in lumens, lm) can provide a general indication of how a lighting product stacks up against application needs and/or products it is intended to replace. By extension, luminaire efficacy (lm/W) indicates how efficiently the product generates its light output. Both total light output and luminaire efficacy are major criteria for ENERGY STAR qualification. LM-79 allows two different methods for measuring total luminous flux, one or both of which may be referenced in a test report. The [integrating sphere method](#), as the name suggests, integrates the total light output of a tested source to produce a single measurement. In contrast, the distribution (i.e., goniophotometer) method collects multiple luminous intensity measurements around the source’s horizontal and vertical axes, which are converted and summed as total luminous flux. Total light output measurements may be presented as a single value, or as the summed values in zonal lumen summary tables. The sample zonal lumen summary in Figure 1 shows the cumulative lumen totals for different vertical angle “zones,” with the 0° – 180° zone (highlighted) representing the total light output (in the case of this recessed downlight, no light is emitted above 90° vertical). If both integrating sphere and goniophotometry have been performed, then two sets of total light output and luminaire efficacy values may be provided—these values may differ by 3% due to typical measurement uncertainties. ENERGY STAR for SSL also establishes zonal lumen requirements for many applications, to help ensure that SSL products perform similarly to the traditional lighting products they replace.

Zone	Lumens	%FIXT
0-30	702	68.69
0-40	971	95.06
0-60	1021	99.98
0-90	1022	100.00
90-180	0	0.00
<b>0-180</b>	<b>1022</b>	<b>100.00</b>

Figure 1. Detail from Typical Zonal Lumen Summary Table



### Calculating Luminaire Efficacy

Although input power and light output values may be presented in multiple locations and formats within an LM-79 report, a luminaire efficacy value might not be included in the document. Calculating this value is straightforward, following a few simple steps:

- Step #1** Note the tested product's total light output—either a single value from an integrating sphere test, or a summed zonal lumen value from a goniophotometer test. For example, the total lumen output value from the zonal lumen summary table in Figure 1 is **1,022 lm**.
- Step #2** Note the measured input power *from the same photometric test as the total light output*. For this example, assume a value of **23.3 W**.
- Step #3** Divide the total light output by input power to obtain the tested product's luminaire efficacy. Completing the example:  
 $1,022 \text{ lm} / 23.3 \text{ W} = 43.9 \text{ lm/W}$

## Luminous Intensity Distribution

### Essential Data

In addition to how much light an SSL product produces, it is important to understand where the product directs its light output. LM-79 reports typically present luminous intensity distribution data in both tabular and polar graph formats. A polar graph allows the reader to quickly assess whether the luminaire or replacement lamp has a “narrow” or “broad” distribution, and gauge its symmetry. For example, Figure 2 illustrates an SSL downlight that produces its highest luminous intensity directly below the fixture (i.e., 0° or nadir), tapering off with essentially no light output above 45° vertical. The solid and dashed lines represent two vertical “slices” made along and across the fixture (i.e., at 0° and 90° horizontal, respectively). The two distributions are nearly identical, suggesting that the light distribution (“beam”) is essentially symmetrical about the vertical axis. The polar graphs correspond with tabular intensity data for different vertical and horizontal angles (expressed in candelas, cd), and may be referred to as a “candela distribution” or “candlepower summary.” Luminous intensity values are a key component of illuminance calculations, and distribution data can be provided by the testing laboratory in standardized “IES file” electronic format, compatible with lighting calculation and visualization software.

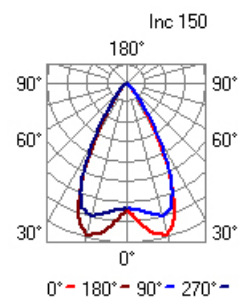


Figure 2. Sample Polar Luminous Intensity Distribution Graph.  
Image credit: Luminaire Testing Laboratory, Inc.

### Useful Features

Luminous intensity distribution data inform a range of other lighting metrics used to characterize visual comfort and SSL product performance. Directional lamps, such as halogen MR16 and PAR lamps, are typically characterized by their center beam candlepower (CBCP) and beam angle, and these measures are useful when comparing LED replacement lamps with their traditional counterparts. Although CBCP and beam angle are often not included in LM-79 reports, they can be approximated from tabular intensity data (see “Comparing Directional Lamps”).

### Comparing Directional Lamps

If not presented in the LM-79 report, CBCP and beam angle for directional LED replacement lamps can be derived from tabular intensity data. Figure 3 presents the candela (intensity) distribution data for an LED PAR38 replacement lamp, and a corresponding polar intensity graph. The important features of the table are the **vertical angles** (left column) and **intensity data** for each vertical angle (right column). Vertical angles describe the location of data points relative to the center beam (or axis) of the lamp, as illustrated in the polar intensity graph. As is common for directional lamps, only one set (plane) of intensity data is provided, and the beam is assumed to be symmetrical around its central axis.

With the lamp pointed downward, a vertical angle of 0° describes the center of a directional lamp's beam, the single point at which the CBCP is determined—in this case, **1855 cd** (yellow highlight). **Beam angle** is defined as **two times the vertical angle** at which the intensity is **50% of the maximum**. In this example, the maximum intensity is the CBCP (1855 cd) and 50% maximum occurs at approximately 15° (green highlight). Because this vertical angle describes only one-half of the beam, the beam angle would be approximately 30°.

The CBCP and beam angle data should be used to verify the claimed values from the LED replacement lamp's packaging and/or catalog listing. The data can also be compared with that for halogen MR16 lamps to determine if the LED product will provide the “punch” and distribution needed for the lighting application.

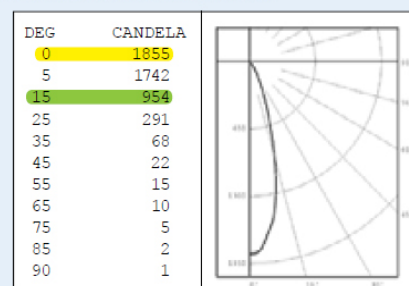


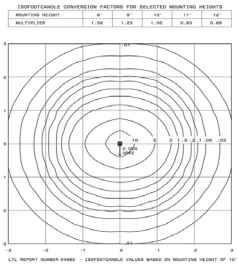
Figure 3. Sample Tabular Intensity Data and Polar Intensity Plot for an LED PAR38 replacement lamp. Image credit: Independent Testing Laboratories, Inc.

Luminance summaries (expressed in candelas per square meter,  $\text{cd}/\text{m}^2$ ) are structured similarly to luminous intensity tables, with data that roughly correlates with perceived “brightness” of a light source from different observer positions. As an example, excessive luminance—particularly at higher vertical angles—could potentially result in visual discomfort from glare. Many test reports also provide an isoilluminance plot, an illustration of a tested product’s predicted illuminance pattern and resulting initial light levels (expressed in footcandles,  $\text{fc}$ ). As shown in Figure 4, the diagram (also called an “isofootcandle plot”) uses contour lines to delineate the light pattern and horizontal illuminance levels below the tested product, with a conversion chart included for different mounting heights. The scale of the x and y axes is expressed in multiples of the mounting height, so it is important to convert to actual distances and use the same mounting heights when comparing with other products.

## Color Characteristics

### Essential Data

SSL luminaires and lamps may be used to replace and/or integrate with other traditional “white light” products. Consequently, it is important to measure and describe SSL color characteristics. LM-79 prescribes methods for measuring the total radiant power (spectral content) of SSL products, from which chromaticity coordinates, correlated color temperature (CCT), and color rendering index (CRI) can be derived. ENERGY STAR for SSL also establishes application-specific limits for these measures. Typically, a product’s spectral power distribution (SPD) is presented in a graph format (Figure 5), which allows the reader to evaluate the relative amount of radiant power (expressed in milliwatts per nanometer,  $\text{mW}/\text{nm}$ ) across the range of wave-lengths in the visible spectrum (expressed in nanometers,  $\text{nm}$ ), or approximately 380 – 780  $\text{nm}$ . Some reports may provide spectral radiant power measurements in tabular format, in 10  $\text{nm}$  increments.





## Additional Information

### Thermal Measurements

LED performance and service life are closely tied to the LED's operating temperature, which can be extrapolated from readings at a designated temperature measurement point (TMP, also known as a "hot spot") on the SSL luminaire or replacement lamp. LM-79 does not address product operating temperature or its measurement; however, TMP data is required separately under LM-80 for LED lumen maintenance life testing. Having surface temperature measurements also allows the reader to determine if a sample product was operating at similar temperatures in different photometric tests, as different operating temperatures could affect light output and efficacy.

### Sample and Testing Description

Test reports should identify the testing laboratory and clearly indicate that LM-79 was used, as well as identify the photometric methods used (integrating sphere and/or goniophotometer) and a listing of the testing equipment used. Some reports may also provide equipment calibration dates and/or descriptions of reference standards and their traceability. Because SSL product performance is closely linked to its components, physical construction and thermal characteristics, it is important that the report explicitly identify the particular version of the product tested. Attention should also be paid to secondary optics and other accessories (e.g., lenses, diffusers, trimrings, etc.) that can affect product performance, and whether these items were in place during testing.

### Conclusions

Photometric reports for SSL products under LM-79 present basic measures—electrical, light output and efficacy, light distribution, and color characteristics—that inform a number of other useful report features. For example, luminous intensity distribution data form the basis of polar intensity graphs, fixture luminance tables, and isoilluminance plots. Spectral radiant flux measurements are used to generate SPD graphs and tables, as well as determine chromaticity coordinates, CCT and CRI. Even if not included in a particular lab report, the data and information discussed here is typically collected by and available from the testing laboratory at their customer's request.

### Ambient temperature calculation for LED fixture

LED luminaire with an off-the-shelf heat sink with a thermal resistance of 0.47°C/W. With the heat sink thermal resistance value, the maximum ambient temperature can be calculated with the following formula:

$$T_j = T_a + (R_{th\ b-a} \times P_{total}) + (R_{th\ j-sp} \times P_{LED})$$

$T_j$  = LED junction temperature  
 $T_a$  = Ambient temperature  
 $R_{th\ b-a}$  = Heat sink thermal resistance  
 $P_{LED}$  = Single LED power consumption  
= (Operating current) x (Typical Vf @ Operating current)  
 $P_{total}$  = Total power consumption = (# LEDs) x  $P_{LED}$   
 $R_{th\ j-sp}$  = LED package thermal resistance

Example luminaire values:

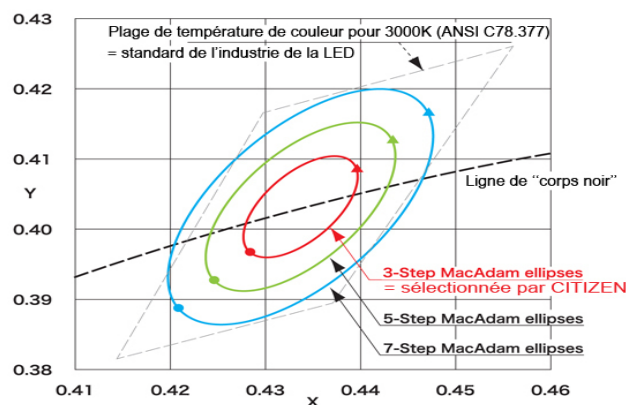
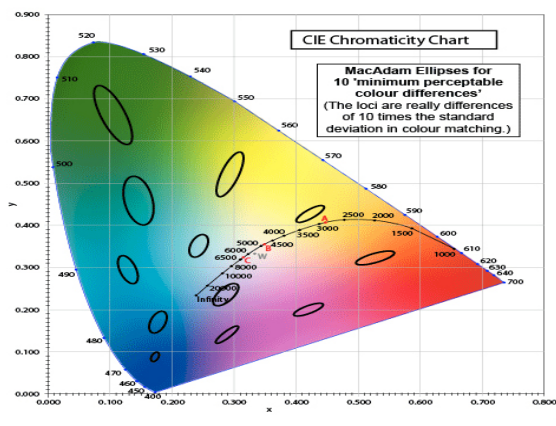
$T_{j\ MAX}$  = 80°C  
 $R_{th\ b-a}$  = 0.47°C/W  
 $P_{LED}$  = 0.35 A x 3.3 V = 1.155 W  
 $P_{total}$  = 16 x 1.155 W = 18.48 W  
 $R_{th\ j-sp}$  = 8°C/W

$$\begin{aligned}T_{a\ MAX} &= T_{j\ MAX} - (R_{th\ b-a} \times P_{total}) - (R_{th\ j-sp} \times P_{LED}) \\T_{a\ MAX} &= 80^\circ\text{C} - (0.47^\circ\text{C/W} \times 18.48\ \text{W}) - (8^\circ\text{C/W} \times 1.155\ \text{W}) \\T_{a\ MAX} &= 80^\circ\text{C} - 8.6856^\circ\text{C} - 9.24^\circ\text{C} \\T_{a\ MAX} &= 62^\circ\text{C}\end{aligned}$$

A maximum ambient temperature of 62°C for the example luminaire is acceptable for this indoor application. For an operating environment needing higher maximum ambient temperature, either the maximum junction temperature should be raised (which may impact lifetime) or the thermal system ( $R_{th\ b-a}$ ) improved (e.g., better heat sink).

## LED Colour Difference Metrics: SDCM & MacAdam Ellipses

SDCM is an acronym which stands for Standard Deviation Colour Matching. SDCM has the same meaning as a "MacAdam ellipse". A 1-step MacAdam ellipse defines a zone in the CIE 1931 2 deg (xy) colour space within which the human eye cannot discern colour difference. Most LEDs are binned at the 4-7 step level, in other words you certainly can see colour differences



in LEDs that are ostensibly the same colour.

The science behind colour difference specifications was established by Dr David MacAdam in 1942. MacAdam's experiments relied upon visual observation of the so-called Just Noticeable Colour Difference (JND) between two very similar coloured lights. Just Noticeable Difference is defined as the colour difference where 50% of observers see a difference and 50% of observers do not see a difference. The zones with standard deviations of colour matching (SDCM), were found to be elliptical in the CIE 1931 2 deg observer colour space. The size and orientation of the ellipses varied greatly depending upon the location in the colour space diagram. The zones were observed to be largest in the green and smaller in the red and blue.

Due to the variable nature of the colour produced by white light LEDs, a convenient metric for expressing the extent of the colour difference within a batch (or bin) of LEDs is the number of SDCM (MacAdam) ellipses steps in the CIE colour space that the LEDs fall into. If the chromaticity coordinates of a set of LEDs all fall within 1 SDCM (or a "1-step MacAdam ellipse"), most people would fail to see any difference in colour. If the colour variation is such that the variation in chromaticity extends to a zone that is twice as big (2 SDCM or a 2-step MacAdam ellipse), you will start to see some colour difference. A 2-step MacAdam ellipse is better than a 3-step zone, and so on.

It should be noted that SDCM ellipses are often shown in the CIE colour space diagram at a ten times magnification (see image above) because they would otherwise be too small to be seen clearly when viewed in the complete CIE diagram.

MacAdam's experiments demonstrated that the size of an SDCM ellipse is quite small, which means that the human vision system is very good at discriminating colour differences when viewing two light sources at the same time. If we consider the size of the 1-step SDCM ellipse at an arbitrary 3,000K colour temperature, the CCT range is  $\pm 30K$ , and the corresponding  $u'v'$  range (the chromaticity coordinates in the 1976 CIE Uniform Colour Space) is  $\pm 0.001$ . In other words, if we view two LEDs with a CCT difference of more than 60K, the chances are that we will see a colour difference. The table below relates the number of SDCM ellipse steps to the range of CCT and chromaticity coordinates for a 3000K colour temperature light source.

SDCM	CCT @ 3000K	$\Delta UV$
1x	$\pm 30K$	$\pm 0.0007$
2x	$\pm 60K$	$\pm 0.0010$
4x	$\pm 100K$	$\pm 0.0020$
7-8x	$\pm 175K$	$\pm 0.0060$

Within the lighting industry, reference is often made to the standard IES LM-79-08 “Approved Method of Electrical & Photometric Measurements of Solid State Lighting Products” published by the Illuminating Engineering Society of North America (IESNA). This in turn references the American standard ANSI C78.377-2008 “Specification for the Chromaticity of Solid State Lighting Products” which places white light LEDs used for illumination into standard colour groups which all have the same “nominal” correlated colour temperatures (CCTs). The size of the ANSI C78.377 nominal CCT quadrangle is a 7-step MacAdam ellipse. A 7 to 8-step SDCM is currently representative of the variation in chromaticity of high brightness white LEDs used for illumination.

### Dimming LED Lighting

A luminaire using HB-LEDs is more complex than a typical incandescent or fluorescent fixture, and contains several elements that are specific to the LEDs. Firstly, the LEDs themselves cannot be used directly, but must be mounted onto a circuit board that provides physical support, interconnection and cooling. The complete assembly of LEDs onto the circuit board is commonly referred to as a light engine, which is cooled by a heatsink. Second, the LEDs must be supplied with a DC current that is accurately controlled to provide the required light level without exceeding the LED rating. The current control function is provided by a driver. Finally, in the case of LEDs operating from AC power, there must be a power supply (PSU) that converts the AC into DC for the driver, and provides safety isolation.



## Fluorescent Lighting Information

## Main ballast functions

The optimum functioning of fluorescent lamps largely depends on the properties of the control gear used. As with all gas-discharge light sources, fluorescent lamps cannot function properly when they are operated directly from the mains supply voltage. Certain electrical and/or electronic devices have to be built into the lamp circuit, either in the lamp itself or externally in the form of what is called control gear.

The control gear performs a number of functions:

- it limits and stabilises the lamp current, a necessary measure in view of the negative resistance characteristic of gas-discharge lamps (viz. when the lamp current increases, the lamp voltage will decrease),
- it ensures that the lamp continues to operate despite the fact that twice during each frequency cycle of the mains supply the voltage is zero,
- it provides the ignition voltage (higher than the normal operation voltage) for the initial lamp starting,
- it supplies controlled energy to heat the lamp electrodes during ignition (warm-start ballasts), and in some cases also during normal operation (regulating ballasts).

In addition to these basic functions, the control gear must fulfil a number of other, equally important requirements. It must:

- ensure a sufficiently high power factor,
- limit the harmonic distortion of the mains current,
- if possible, present a high impedance to frequencies used for switching purposes in automatic frequency-regulation circuits (AFRC or Actadis) in outdoor applications,
- offer adequate suppression of any electromagnetic interference (EMI) that might be produced by the lamp/ballast system and that could otherwise interfere with other electronic equipment,
- limit the short-circuit current and/or the current during running-up of the lamp, to protect the lamp electrodes from overloading,
- switch off the lamps when these cannot be ignited normally. This safety requirement is only valid for the HF ballasts,
- keep the lamp voltage, lamp current and lamp power within the specification during mains-voltage variations.

Finally, there is a third group of requirements dictated by the needs of both luminaire manufacturer and user: to have control gear of small dimensions, long life, low losses (also with a view to controlled temperature), and a non-audible noise level.

With the electromagnetic control gear system, various separate components, including ballast, starter, capacitors and filter coils, help fulfil all these requirements together with the lamp.

In the case of the electronic HF ballast, and also in the induction lighting system, all the above-mentioned functions have been integrated into one electronic device, which might be called the 'black box'.

## Luminaire classifications

There are basically three ways of classifying luminaires as far as their design and construction are concerned:

1. According to the sort of protection offered against electric shock, viz. electrical safety.
2. According to the degree of protection provided against the ingress of foreign bodies (e.g. dust and moisture).
3. According to the degree of flammability of the supporting surface for which the luminaire is designed.

The following are summaries of the classifications detailed in IEC 598 - Part 1.

### Electrical safety

(four luminaire classes)

The electrical safety classification drawn up by the IEC embraces four luminaire classes: Class 0, I, II and III.

The official definitions are too long to be reproduced in full here, but can be summarised as follows:

Class 0 - symbol



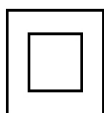
(Note: Applicable to ordinary luminaires only, viz. a luminaire without special protection against dust or moisture). These are luminaires that are electrically insulated. There is no provision for earthing. The housing may be of an insulating material, which wholly or partly performs the insulating function, or it may be of metal that is insulated from current-carrying parts. Class 0 luminaires may include parts with reinforced insulation or double insulation.

Class I - symbol



Luminaires in this class, apart from being electrically insulated, are also provided with an earthing point (labelled) connecting all those exposed metal parts that could conceivably become live in the presence of a fault condition. Where the luminaire is provided with a flexible power lead, this must include an earth wire. Where this is not the case, the degree of electrical protection afforded by the luminaire is the same as that afforded by one of Class 0. Where a connection block is employed instead of a power lead, the metal housing must be connected to the earth terminal on the block. The provision made for earthing the luminaire must in all other respects satisfy the requirements laid down for Class I.

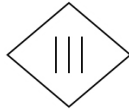
Class II - symbol



Class II luminaires are so designed and constructed that exposed metal parts cannot become live. This can be achieved by means of either reinforced or double insulation, there being no provision for protective earthing. In the case of a luminaire provided with an earth contact as an aid to lamp starting, but where this earth is not connected to exposed metal parts, the luminaire is nevertheless regarded as being of Class II. A luminaire having double or reinforced insulation and provided with an earth connection or earth contact must be regarded as a Class I luminaire. However, where the earth wire passes through the luminaire as part of the provisions for through-wiring the installation, and is electrically insulated from the luminaire using Class II insulation, then the luminaire remains Class II.



## Class III - symbol



The luminaires in this class are those in which protection against electric shock relies on supply at Safety Extra-Low Voltage (SELV), and in which voltages higher than those of SELV (50 V AC r.m.s.) are not generated. An AC operating voltage of 42 volt maximum is common. A Class III luminaire should not be provided with a means for protective earthing. The standard ballasts are developed for Class I luminaires. Information for other Classes can be obtained from the local Sololuce Lighting organisation. The earthing of ballasts with metal housing depends on the class and construction of the luminaire. See also IEC 598.

### Class 1 luminaire (luminaire has safety earth connection):

1. Metal housing of ballast can be touched during lamp removal. Metal housing must be connected to safety earth (via bottom plate or connector).
2. Metal housing of ballast (incl. ignition aid) cannot be touched during lamp removal. Only functional earthing is required for proper ignition and EMC

### Class 2 luminaire (luminaire has no safety earth connection):









3. Metal housing of ballast (incl. ignition aid) cannot be touched during lamp removal.

Only internal functional connection between ballast and ignition aid is needed for reliable ignition and EMC. Today many luminaires are Class 1 and the metal ballast housing can be touched during lamp removal. All these ballasts must be connected to the safety earth via bottom plate or earth connector if available.

## Dust and moisture protection (IP classification)


The IP (International Protection) system drawn up by the IEC classifies luminaires according to the degree of protection afforded against the ingress of foreign bodies, dust and moisture. The term foreign bodies includes such things as tools and fingers coming into contact with live parts.


The designation to indicate the degrees of protection consists of the characteristic letters IP followed by two numerals (three numerals in France) indicating conformity with the conditions stated in two tables (here combined into one). The first of these so-called 'characteristic numerals' is an indication of the protection against the ingress of foreign bodies and dust, while the second numeral indicates the degree of sealing against the penetration of water. The third numeral in the French system indicates the degree of impact resistance.

IEC classification according to the degree of dust and moisture protection					
Dust protection			Moisture protection		
First numeral	Symbol	Degree of protection	Second numeral	Symbol	Degree of protection
0		Non-protected	0		Non-protected
1		Protected against solid objects greater than 50 mm	1		Protected against dripping water
2		Protected against solid objects greater than 12 mm	2		Protected against dripping water when tilted up to 15°
3		Protected against solid objects greater than 2.5 mm	3		Protected against spraying water
4		Protected against solid objects greater than 1.0 mm	4		Protected against splashing
5		Dust-protected	5		Protected against water jets
6		Dust-tight	6		Protected against heavy seas
			7		Protected against effects of immersion
			8		Protected against submersion

Example: IP 65 indicates a luminaire, that is dust-tight, and waterjet proof.

Degree of flammability of the mounting surface

Luminaires cannot be mounted on just any convenient surface. The flammability of that surface and the temperature of the luminaire mounting plate impose certain restrictions in this respect. Naturally, if the surface is non-combustible, or if a certain distance spacer is employed, there is no problem. For the purpose of classification, the IEC defines flammable surfaces as being either normally flammable or readily flammable. Normally flammable refers to those materials having an ignition temperature of at least 200 °C and that will not deform or weaken at this temperature. Readily flammable are those materials that cannot be classified as either normally flammable or noncombustible. Materials in this category are not suitable as mounting surfaces for luminaires. Suspended mounting is then the only solution. The permitted temperature of that part of the luminaire housing coming into contact with the mounting surface is laid down in the so-called F-requirements. Luminaires that satisfy these requirements may bear the symbol  on type plate. On the basis of these requirements, the following classification has been drawn up:

IEC luminaire classification according to flammability	
Classification	Symbol
Luminaires suitable for direct mounting only on non-combustible surfaces	No symbol, but a warning notice is required
Luminaires without built-in ballasts or transformers suitable for direct mounting on normally flammable surfaces	No symbol
Luminaires with built-in ballasts or transformers suitable for direct mounting on normally flammable surfaces	 on type plate

## Fluorescent Lamps

### Range

The low-pressure mercury vapour lamp, or fluorescent lamp, is by far the most widespread of all discharge lamp types. It is employed almost universally: in indoor applications like shops, theatres, etc., in social and civil interiors, but also in street and tunnel lighting. The introduction of the more compact versions has led to its application in homes too. There are many different versions of the fluorescent lamp, including very special lamp types used for reprography, disinfection, sun-tanning, inspection and analysis, various photochemical processes and effect lighting, but they all work on the same principle. It is not the purpose of this Guide to mention all the various types and their sometimes special gear requirements. Technical aspects of the lamps will only be dealt with in, so far as they are directly related to the gear employed. Low-pressure mercury vapour lamps can be divided in five groups:

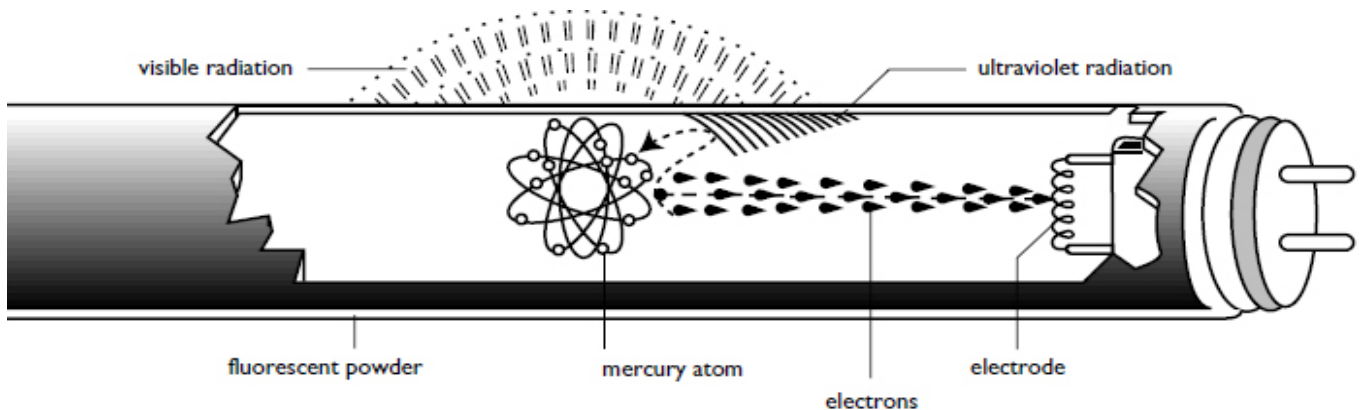


Fig. 17 Working principle of a tubular fluorescent lamp.

#### 1) Tubular fluorescent lamps

The tubular fluorescent lamp works on the low-pressure mercury discharge principle (Fig. 17). The discharge tube has an electrode sealed into each end and is filled with an inert gas and a small quantity of mercury, the latter being present in both liquid and vapour form. The inside of the tube is coated with a mixture of fluorescent powders. These convert the ultraviolet radiation of the mercury discharge into longer wavelengths within the visible range. A great many different fluorescent powders or 'phosphors' are available for almost any desired colour temperature and colour rendering characteristic. Unlike an incandescent lamp, a fluorescent lamp cannot be connected directly to the mains. Some device to limit the electric current flowing through it must be included in the circuit. This device can be an HF ballast or an electromagnetic ballast with starter. To facilitate starting, the electrodes of most fluorescent lamps are preheated prior to ignition, which is accomplished by means of a preheat current. Starting without preheating of the electrodes is also possible, but at the cost of lamp life, as most lamps are not designed for so-called cold ignition.

The tubular fluorescent lamp group can be further sub-divided as follows (see Fig. 18):

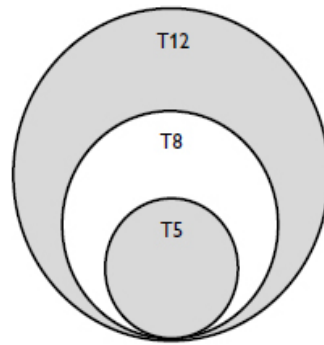


Fig. 18 Comparison of tube diameter of different 'TL' lamps.

- a) Straight miniature lamps with G5 lamp cap, with a diameter of 16 mm (code T5, which means that they have a diameter of 5 times 1/8 inch) and with a length dictated by the wattage and by common building modules. This type of lamp can be stabilised with both electromagnetic and electronic gear.
- b) Straight 'TL' lamps with a diameter of 38 mm (code T12) and with a length dictated by the wattage and by common building modules. These so-called 'old' or 'thick' 'TL' lamps are stabilised by electromagnetic gear. The normal versions have by now in most cases been replaced by the modern 'lamps, especially in Europe.
- c) Straight 'TL'D lamps with G13 lamp cap and 26 mm diameter (code T8), the so-called 'thin' lamps. This most popular krypton-filled type can nowadays be stabilised with both electronic and electromagnetic gear.
- d) Straight 'TL'5 lamps, with higher wattages than the miniature lamps and the benefits of the 'TL'D New Generation lamps. They are 5 cm shorter than the equivalent T8 types and are operated on HF gear. The reason for the reduced length is that optimum compatibility with the most common standard European ceiling systems is obtained that way.

There are two ranges:

'TL'5 HE 14, 21, 28 and 35 W High Efficiency lamps.

'TL'5 HO 24, 39, 49, 54 and 80 W High Output lamps.

## 2) Bent fluorescent lamps

- a) The circular 'TL'E lamp has a special 4-pin lamp cap (G10q) and a diameter of 29 mm (code T9). They are available in lamp wattages of 22-32-40-60 W and can be stabilised with electronic or electromagnetic ballasts.
- b) The U-shaped 'TL'U has the standard G13 lamp caps and a diameter of 31 mm. Available in lamp wattages 20-40-65 W and are stabilised on electronic or electromagnetic ballasts.
- c) The 'TL'5C (Circular) lamps with lamp cap 2GX13 are in 22 and 40 W with a diameter of 18 mm. They can only be stabilised with HF gear.

### 3) Non-integrated compact fluorescent lamps

Starting from the straight fluorescent lamp, reduction of the tube length and tube diameter (10 - 16 mm) and combination of two or more such small tubes into one lamp, has led to the PL lamp family with a considerably reduced lamp length. In this way a wide lumen package in small dimensions is obtained. This offers considerable energy savings when used as a replacement for incandescent lamps.

In the case of non-integrated lamps, the lamp and ballast are separated.

In principle they can be sub-divided as follows:



- the PL-S and PL-L /DULUX-L XT with 2 parallel tubes
- the PL-C /DULUX T/E with 4 tubes in square formation
- the PL-T with 6 tubes.

The parallel tubes are connected by bends or bridges, so electrically they are one tube. Apart from this, various colours are available, and most types are available in two versions:

- 2-pin version, with the starter incorporated in the lamp cap, stabilised with electromagnetic gear, and
- 4-pin version, stabilised with electromagnetic or electronic gear.

Due to the different wattages and versions available, there is a wide variation in lamp caps, information on which can be found in the lamp documentation. Lamp and gear are separated, giving more freedom to the luminaire designer and an increased lifetime of the lighting system, since the lamps can be replaced.

### 4) Integrated compact fluorescent lamps

The arc tubes and the electronic gear are integrated to form one complete lamp with a standard lamp cap: E14, E27 or B22 for the mains voltage range 230-240 V/50-60 Hz.

## Stabilisation

As described earlier, the main ballast function is to stabilise the lamp current, as a fluorescent lamp cannot function properly when it is operated directly on the mains voltage. The first and foremost function of a ballast is to limit the electric current passing through the lamp to a value prescribed for that particular lamp rating. All discharge lamps need such a current-limiting device because they have a negative voltage-current characteristic (see Fig. 19).

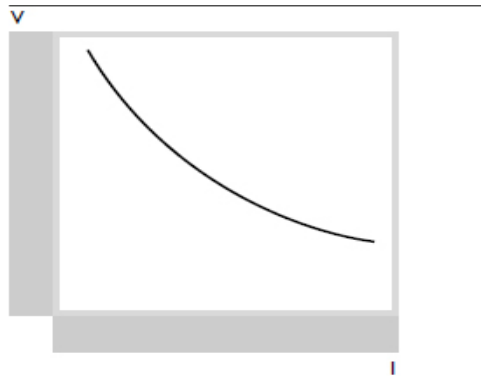


Fig. 19 Current/voltage characteristic of a gas discharge (simplified). The voltage required decreases as the current increases. The characteristic is negative, meaning that the current will without limit if no measures are taken.

Without a current-limiting device in the circuit (lamp voltage = mains voltage), the slightest increase of the lamp current would cause a drop in lamp voltage. But as the mains voltage is still applied to the lamp, the lamp voltage cannot decrease, so the current will now increase even further. This process of steeply rising current will soon cause the lamp to fail or the fuse to blow. On the other hand, at a slight decrease of the lamp current the lamp voltage has to increase. As the mains voltage is still applied, it will become too low for stable operation and the lamp will extinguish.

The presence of a ballast between the lamp and the mains-voltage connection (Fig. 20) limits the current flowing through the lamp. The lamp current – being equal to the ballast current supplied to the lamp – is now fixed by the quotient of the ballast voltage and the ballast impedance.

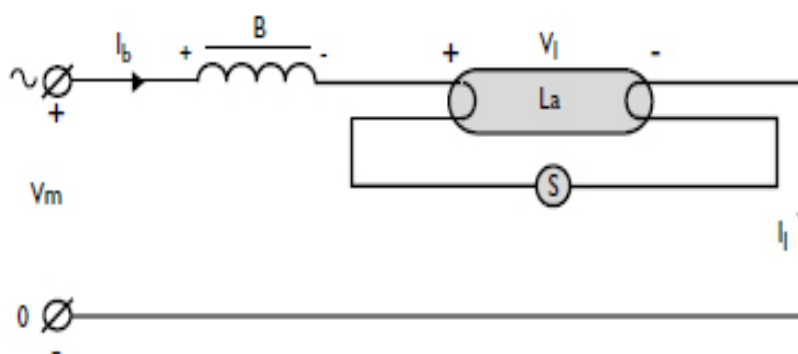


Fig. 20 Current limitation by means of a ballast in a simple discharge circuit.



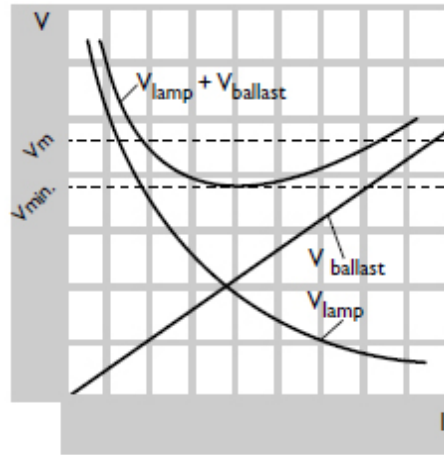


Fig. 21 Current/voltage characteristic of a circuit with a ballast in series with the lamp. Thanks to the ballast, the required lamp voltage increases with increasing lamp current, leading to a stable situation.

As the ballast voltage is the difference between the mains voltage and the lamp voltage, the maximum lamp current is limited by the mains voltage. In this way a stable operating point is obtained for all mains voltages higher than the minimum voltage  $V_{min}$  (see Fig. 21).

$$\begin{aligned}
 I_{lamp} &= I_{ballast} \\
 I_{ballast} &= V_{ballast} / Z_{ballast} \\
 V_{ballast} &= V_{mains} - V_{lamp}
 \end{aligned}
 \quad \Rightarrow \quad
 I_{lamp} = (V_{mains} - V_{lamp}) / Z_{ballast}$$

Another very important function of the ballast is to keep the power consumption of the lamp within certain margins so as to prevent too high a temperature in the cathodes, which would result in a diminished lamp life. The power of the lamp is equal to the lamp voltage  $V_{la}$  times the lamp current  $I_{la}$  times a constant, which is called the lamp factor ( $\alpha_{la}$ ):

$$P_{la} = V_{la} \cdot I_{la} \cdot \alpha_{la}$$

The lamp factor  $\alpha_{la}$  depends on the shape of the lamp voltage and the lamp current, and is therefore also called the 'shape factor'. The value depends on the method of stabilisation and is approx. 0.8 for electromagnetically stabilised lamps and 0.99 for HF stabilised lamps. In stable operation the voltage across the lamp is rather constant under all circumstances. Therefore the lamp power (and so the light output) is depends mainly on the lamp current.

The level of the mains voltage is important, as well as the impedance of the ballast. The influence of the frequency of the mains voltage is a hidden factor: this variable influences the impedance of the choke ballast, as  $Z = \omega L$  with  $\omega = 2\pi f$  ( $f$  = frequency). The inductance  $L$  depends on the number of copper windings and the dimensions and material of the core of the ballast. From this it follows that the higher the frequency, the smaller the ballast can be. With the electromagnetic ballast for 50 or 60 cycles we need a 'big' copper/iron ballast, while in the HF ballasts with much higher operating frequencies a small ballast with ferromagnetic material can be employed.

### Ignition and run-up

In most cases a cold tubular fluorescent lamp will not start when the mains voltage is applied. This is because the ignition voltage is usually higher than the mains voltage. Some sort of starting aid is therefore needed to ignite the lamp. In practice, this involves one or more of the following solutions:

- Preheating the electrodes to facilitate electron emission.
- Providing an external conductor on or near the lamp tube, which is either floating, earthed or connected to one of the electrodes ('TL'M lamps). The electric field so created facilitates the initial discharge. An alternative solution, which serves the same purpose, is the provision of an internal conductive coating on the tube wall.
- Providing an internal auxiliary electrode in the form of one or two metallic strips along the inside of the tube.
- Providing a voltage peak sufficiently high to initiate the discharge.

The voltage level at which a fluorescent lamp will ignite is called its ignition voltage. In most lamp types special measures have been taken in the construction of the lamp to keep this ignition voltage as low as possible: the use of a starting gas as a Penning mixture (see Fig. 22) and the application of a starting aid to trigger the initial ionisation of the gas ('TL'M) are examples of this.

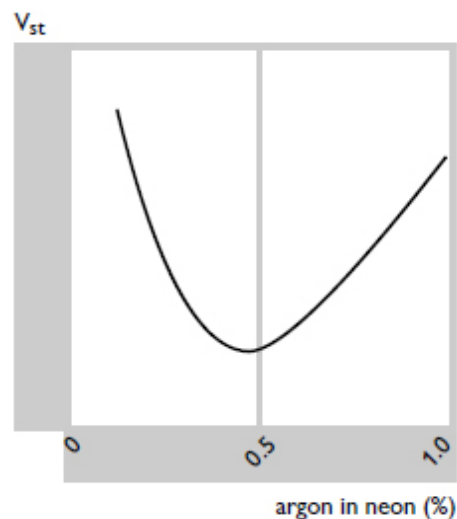


Fig. 22 Starting voltage ( $V_{st}$ ) as a function of percentage (%) of argon to neon (Penning effect).

There are three principal ways of igniting the lamp:

1. **The cold start:** ignition is obtained by applying a high initial voltage to the lamp electrodes. Immediate ignition is obtained without any preheating. This method of ignition needs rigid/robust lamp electrodes, a rather high ignition voltage ( $> 800$  V r.m.s.) and enough energy to pass from the initial ignition to the stable burning situation. This procedure is used in the HF-Basic ballasts and is the reason that the switching lifetime of the lamps is less than in the next two systems.

2. **The warm start:** by preheating the lamp electrodes and – once they are at emission temperature – applying a peak voltage just high enough to initiate the discharge. The electrodes can be thinner and the applied starting voltage lower (see Fig. 23). The preheat time must be long enough. For the warm-start with an HF ballast a preheat time of approx. 1 second is needed with the correct current, whilst the open-circuit voltage of the lamps is low enough to prevent ignition at this stage. At the end of this time a higher open-circuit voltage will ignite the lamp reliably. Thanks to this procedure, the switching lifetime of the lamps is nearly independent of the switching cycle.

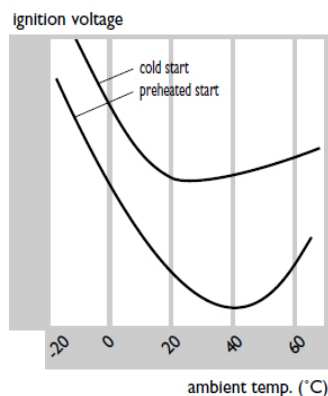


Fig. 23 Influence of ambient temperature on the required ignition voltage, both with cold and with preheated (warm) start.

3. **The rapid start:** here a certain ignition voltage and preheat current are supplied simultaneously to the lamp. As long as the cathodes are not hot enough, the lamp will not ignite. When, after a certain time, the cathodes are hot enough, the lamp will ignite at the applied ignition voltage (see Fig. 24 point P of the so-called Z-curve).

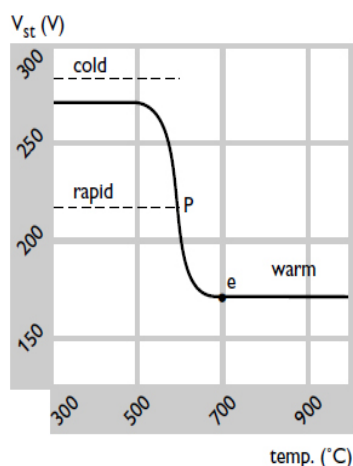


Fig. 24 Starting voltage ( $V_{st}$ ) as a function of electrode temperature. Point e represents the emission temperature, viz. the point at which the electrode emits sufficient electrons

Glow-switch starters do function in combination with these ignition systems: as the closing time of the bimetallic contact is not well defined, it is not certain that the lamp electrodes are at emission temperature when the glow-switch starter opens. Also, the height of the ignition peak can vary rather a lot. This can be noticed in practice when the glow-switch starter works several times before the lamp ignites. This flickering gets worse at low ambient temperatures, at low mains voltages, or with aged lamps. The starting of amalgam lamps, requires a higher ignition voltage than that of the standard fluorescent lamps, especially below 10 °C.

The initial ignition (first break-down) results in a low electric current between the two main electrodes. The excitation potential and ionisation potential are very close together, and consequently after a short time many free electrons are present in the discharge, resulting more or less in the nominal lamp current.

After ignition, the lamp will heat up and the temperature of the coldest spot will rise, causing a rise in the mercury vapour pressure, which determines the arc voltage of a given lamp. In what time thermal equilibrium is reached depends on the lamp type and its surroundings (ambient temperature, open/closed luminaire). Normal 'TL' lamps in normal applications have a run-up time of 2-3 minutes to reach stable lamp voltage and a level of 90 per cent of the maximum light output.

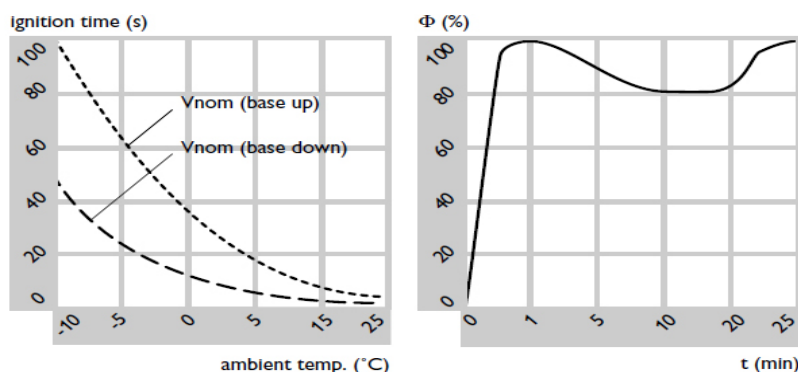


Fig. 25 Typical ignition time and run-up behaviour of an amalgam lamp operated on an electromagnetic ballast

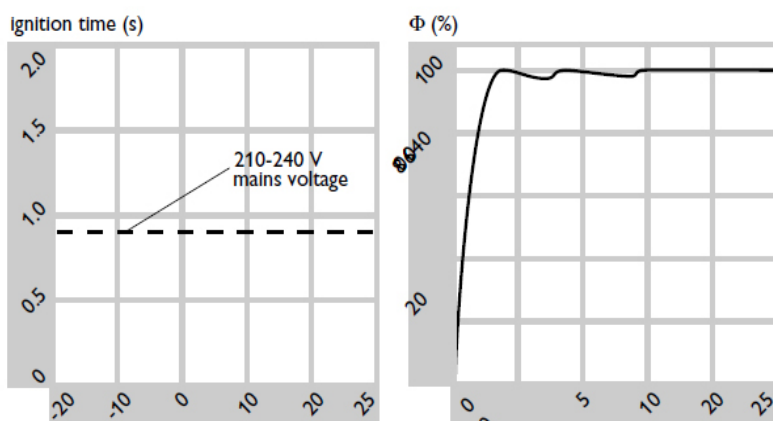


Fig. 26 Typical ignition time and run-up behaviour of a PL\*E/C lamp.

The run-up phase for amalgam /induction lamps is longer, due to the amalgam filling. It takes more time for the mercury to evaporate from the amalgam, so it takes longer to reach the stable lamp voltage. But a lighting level of 80 per cent is attained within one minute also with these lamps (see Figs 25 and 26).

### Lamp behaviour as a function of the frequency

Supplied by a mains voltage of 230 V/ 50 Hz and stabilised with an electromagnetic ballast, the lamp voltage and lamp current of a fluorescent lamp are not pure sine waves (see Fig. 27).

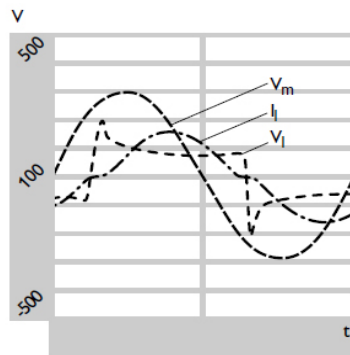


Fig. 27 Waveform of mains voltage ( $V_m$ ), lamp voltage ( $V_l$ ) and lamp current ( $I_l$ ).

Every time the current passes through zero, the lamp is 'out' and needs a certain re-ignition voltage peak to reignite. The electrical energy supplied to the lamp in the form of  $V_{la}$  and  $I_{la}$  is transformed into the lamp power  $W_{la}$  with a certain lamp factor, called  $\alpha_{la}$ , according to the equation:

$$W_{la} = \alpha_{la} \cdot V_{la} \cdot I_{la}$$

Typical values for an electromagnetically stabilised 50 Hz 'T8-36W lamp are:

$$\begin{aligned} V_{la} &= 103 \text{ volt} \\ I_{la} &= 0.44 \text{ ampere} \\ W_{la} &= 36 \text{ watt} \\ \text{so } \alpha_{la} &= 0.79 \end{aligned}$$

The period of time that a lamp is 'out' will decrease by raising the frequency of the lamp current, resulting in a lower re-ignition peak. At increasing frequency both lamp current and lamp voltage will become more sinusoidal, resulting in a higher lamp factor  $\alpha_{la}$  (see Fig. 28).

Typical values for a 36 W 'T8 lamp stabilised by HF gear are:

$$\begin{aligned} V_{la} &= 103 \text{ volt} \\ I_{la} &= 0.32 \text{ ampere} \\ W_{la} &= 32 \text{ watt} \\ \text{so } \alpha_{la} &= 0.99 \end{aligned}$$

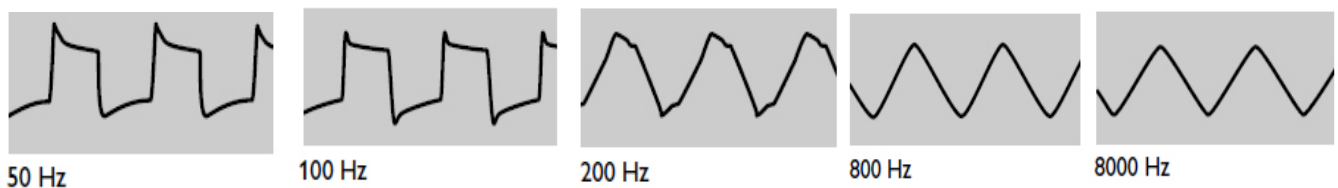


Fig. 28 Lamp voltage as a function of frequency for a 'T8- 36 W lamp.

As a result of the improved lamp factor, the lamp current can be lower for a given wattage in the discharge. This reduces the losses in the electrodes even further, giving an extra improvement in lamp efficacy (see Fig. 29).

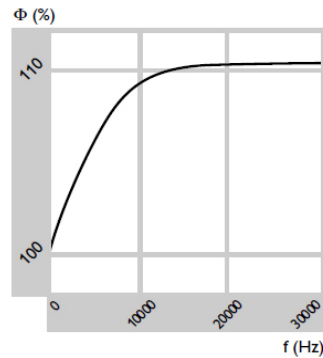


Fig. 29 Luminous flux ( $\Phi$ ) of a fluorescent lamp as a function of supply frequency ( $f$ ) at constant lamp factor.

For low-pressure mercury vapour lamps at a fixed lamp power, a 10 per cent higher efficiency can be achieved at frequencies of more than 10 kHz. To avoid audible disturbance, the working frequency must be more than 20 kHz. But while much higher frequencies will result in a smaller stabilisation coil, they will also result in higher losses in the electronic switching devices and more radiointerference problems. Different operating frequencies are therefore used, mainly depending on lamp type. The practical working frequency is between 24 kHz and 31 kHz for most HF ballasts.

### Lamp and system efficiency

The lamp efficiency is expressed in a figure called the luminous efficacy. It indicates the efficiency of the lamp in transforming electrical energy into light and is expressed in lumen per watt (lm/W). The light or radiated power is 'weighed' according to the eye-sensitivity curve for visible light. The amount of light generated by a lamp is called the luminous flux or lumen output. It is a variable figure, depending on many factors including the phosphors employed (colour), lamp tube dimensions, gas mixture and pressure, and so forth (see Fig. 30 and Table).

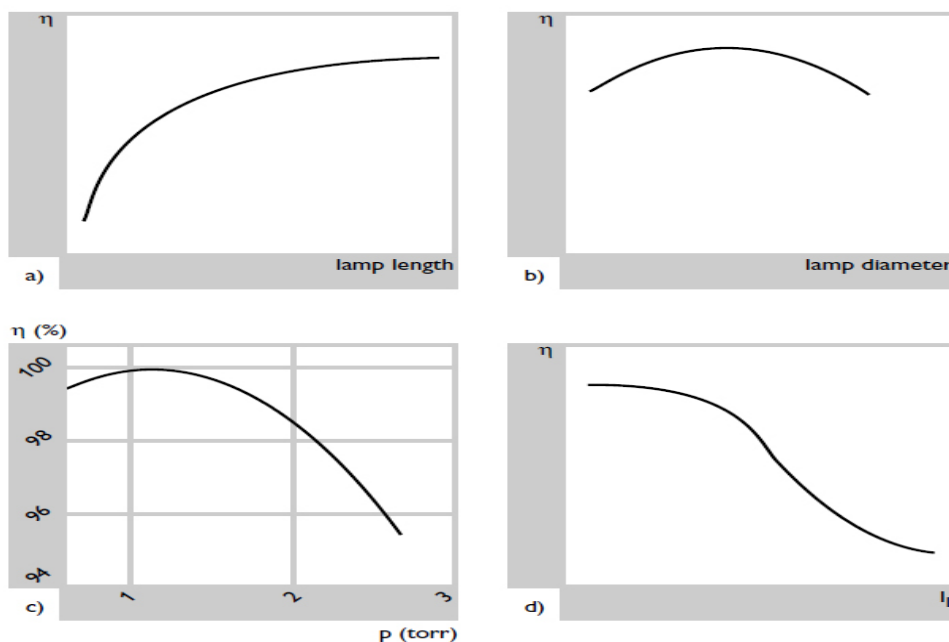


Fig. 30 Lamp efficiency as a function of lamp length (a), lamp diameter (b), argon pressure (c) and current (d).

Indicative comparison of 'TL' lamp generations					
'TL' types from 1945 (4 foot)	Diameter	Power	Luminous flux at 100 hrs	Luminous efficacy at 100 hrs	Luminous flux at 10 000 hrs
	mm	W	lm	lm/W	%
T12 Standard	38	40	2850	72	73
T8 Standard	26	36	2850	79	73
T8 Better	26	36	3350	93	85
T8 with HF ballast	26	32	3200	100	85
T8 with HF better version	26	32	3200	100	92
T5 with HF ballast	16	28	2900	104	92

Note 1: Luminous flux and efficacy are only applicable for colours /827, /830, /835 and /840.

With regard to the gear employed, the working frequency and the lamp current are important. A higher lamp current results in a lower efficiency for certain lamp wattage. The luminous efficacy of all fluorescent lamps increases with the lamp wattage. This is due to the fact that the power needed to keep the lamp electrodes at optimum temperature is relatively lower for higher lamp wattages (longer lamps) than for lower wattages (shorter lamps). All manufacturers publish the Nominal Luminous Flux in their documentation, which is the lamp luminous flux under the following conditions:

- the lamp has burned for 100 hours prior to the readings being taken (burning-in period),
- the lamp is burning in draught free air at a defined ambient temperature (usually 25 °C) and in a specified burning position,
- after switching on, the lamp has had sufficient time to heat up and stabilise for thermal equilibrium,
- the lamp is running at its nominal voltage, nominal current and stabilised nominal mains voltage,
- batches of lamps are read for the average value.

When one of these conditions changes, the nominal flux changes with it. For the total system efficiency, the losses in the gear are important. Since HF ballasts normally have lower losses than the electromagnetic ballasts, the total system efficiency is higher with HF gear than with electromagnetic gear.

Effects of temperature

For every fluorescent lamp there is an optimum for the efficiency related to the pressure of the mercury in the gas-discharge tube. The mercury gas pressure is directly related to the coldest spot of the discharge tube, the so-called 'cold spot'. With straight T8 lamps this cold spot will normally be in the middle of the lamp on the underside. For T5 lamps the coldest spot is at the marking side where the coldest spot is created by a greater distance from the electrode to the lamp end. With PL lamps the cold spot is situated at the lamp ends near the bridge between the separate tubes, see Fig. 31

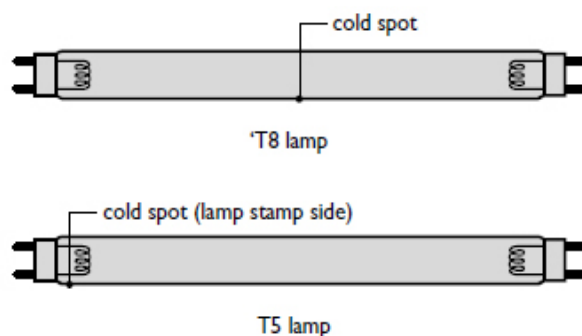


Fig. 31 Cold spots of T8 and T5 lamps



Depending on the burning position of the lamp, the temperature of the cold spot can vary and with it also the light output and efficiency (see Fig. 32). The same lamp mounted in a closed luminaire will reach a higher temperature than in an open luminaire, so the lumen output will differ. Graphs are available for all lamps, showing the relative light output of the bare lamp as a function of the ambient temperature. The influence of the luminaire must be found separately by measurement (see Figs 33). In principle, the gear employed has no influence on the temperature of the cold spot and consequently on the light output.

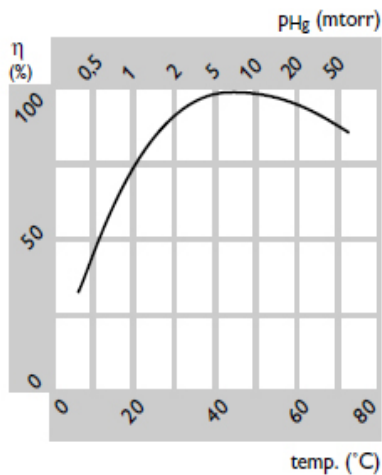


Fig. 32 Lamp efficiency as a function of mercury pressure and ambient temperature.

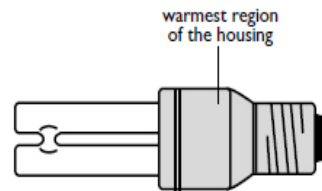


Fig. 33a Warmest region on the housing of a PL lamp.

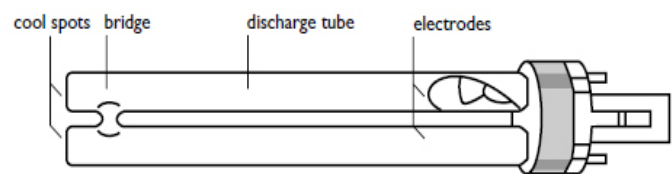


Fig. 33b Cold spot at the tube ends near the bridge of a PL lamp.

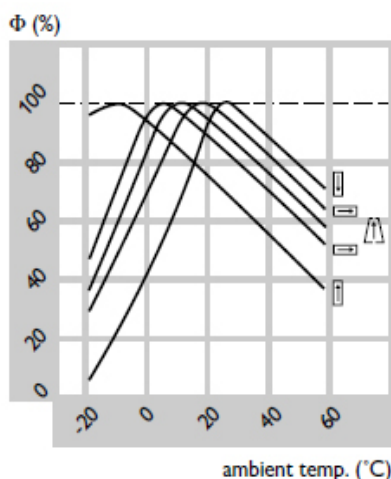


Fig. 33c Relative luminous flux of PL lamps as a function of the ambient temperature and burning position.

Only in closed luminaires will the inside temperature be influenced by the watt losses of the gear. So HF ballasts will have less influence than electromagnetic gear, due to their lower losses.

The optimum mercury vapour pressure for tube diameters of 26 and 38 mm is about 0.8 Pa, and this is reached at a tube wall temperature of about 40 °C. This is not much higher than the usual ambient temperature of 20 to 25 °C, and the heat generated by the discharge is sufficient to reach the required operating temperature of 40 °C without special measures.

If the temperature is low (for example, outdoor lighting in winter), it is desirable to operate the fluorescent lamp in a well-closed luminaire. The new 'T5 lamp is optimised for an ambient temperature of 35 °C. For the luminous flux as a function of the ambient temperature, see Fig. 36 a/b. If the wall temperature is above the ideal operating temperature, artificial cooling of the lamps might be useful, but this requires extra facilities.

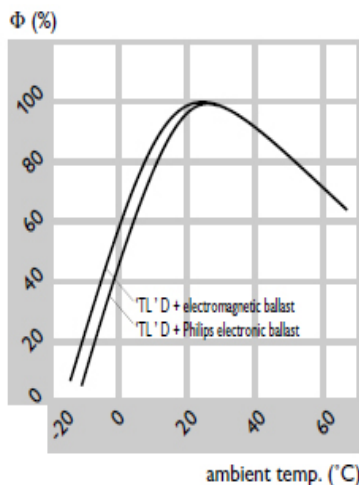


Fig. 36a Luminous flux as a function of ambient temperature for 'TL'D lamps operated on different control gear.

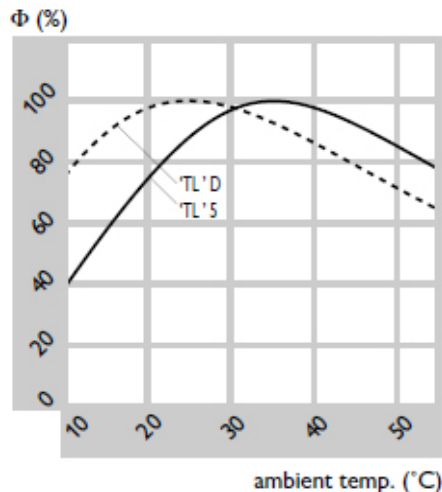


Fig. 36b Comparison of luminous flux as a function of ambient temperature between 'TL'D and TL5 HE lamps.

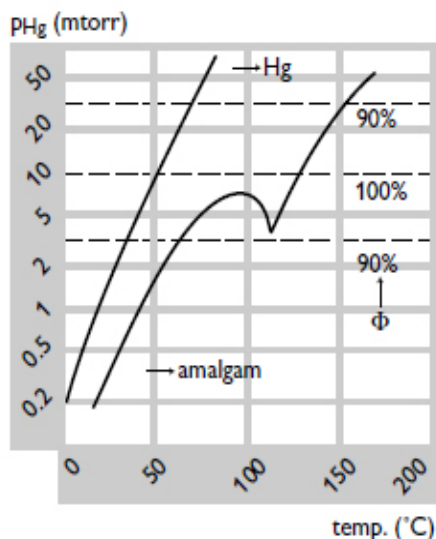


Fig. 37 The influence of amalgam on the mercury pressure and on the luminous output of an amalgam lamp.

By adding amalgam to the mercury gas filling it is possible to guarantee a light output of more than 90 per cent of the maximum in the amalgam temperature region between 550 and 120  $^{\circ}\text{C}$  (see Fig. 37). This measure is taken in induction lamps, where the minimum temperature inside the glass tube is about 90  $^{\circ}\text{C}$ .

## Optimum operation

As has been said there are many different types of fluorescent lamps, each in different lamp wattages, lamp voltages and lamp currents. Although the differences in behaviour are not so wide as with high-intensity gas-discharge lamps (SON-SOX-HPL-HPI-MHD), each type has its own pros and cons.

What they have in common though, is that they need the correct ballast and ignition system for optimum performance. In fact, each type needs its own specific gear. For this reason one should take care to use the recommended gear in combination with the chosen lamp. Especially when using electromagnetic ballasts, the combination must be correct for the available mains voltage (220, 230 or 240 V / 50 or 60 Hz). HF ballasts cover a wider mains-voltage range, which can be found in the product data sheets.

When the wrong components are chosen, one can expect problems: for example, with:

- lifetime of lamps and gear
- temperatures
- starting/run-up
- stable burning
- radio interference
- light output

## Lamp life and depreciation

The data published by lamp manufacturers for life expectancy and lumen depreciation are obtained from large representative groups of lamps in laboratory tests under controlled conditions (see for example Figs. 38 and 39). These include, amongst others:

- nominal supply voltage and appropriate circuitry
- specified burning position
- specified switching cycle
- free-burning, mounted on test racks (not in a luminaire)
- no vibrations or shocks
- specified ambient temperature, mostly 25 °C.

Any change in these circumstances will affect a lamp's lifetime.

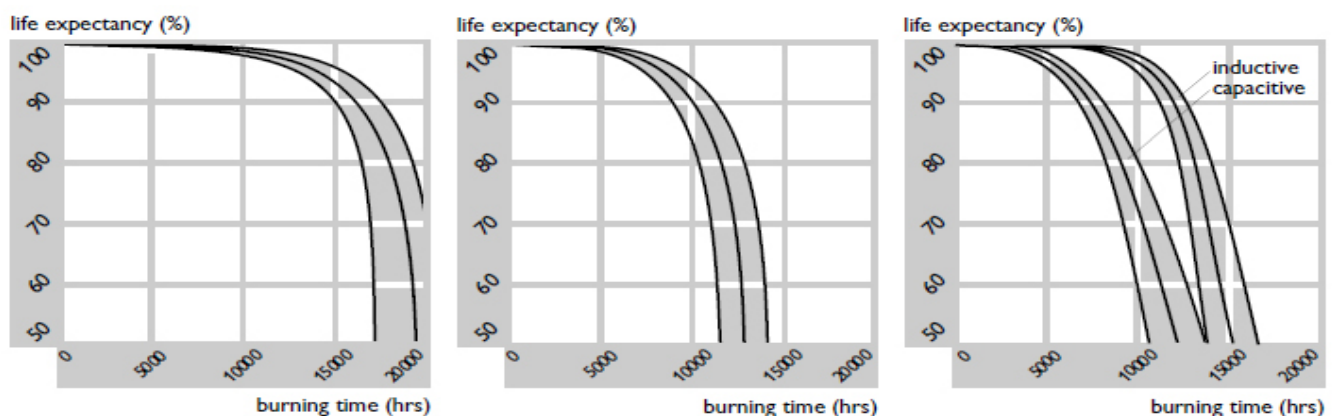


Fig. 38a Life expectancy curve for T8 super/80 New Generation on HF gear; warm start.

Fig. 38b Life expectancy curve for T8 Super/80 New Generation on HF gear; cold start.

Fig. 38c Life expectancy curve for T8 Super/80 New Generation on conventional gear.

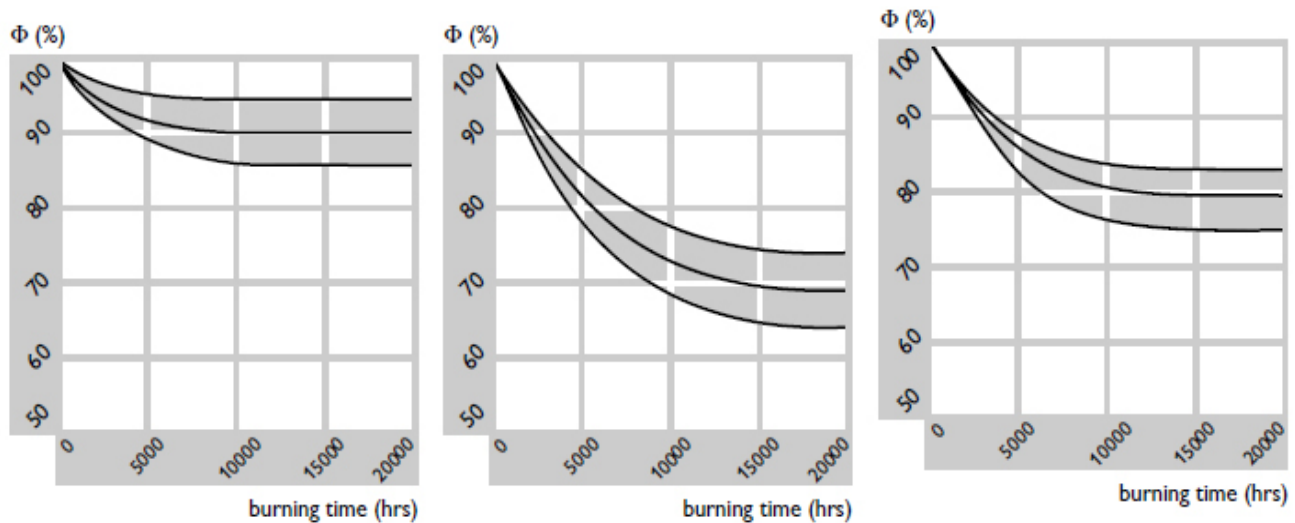


Fig. 39a Lumen maintenance in % for T8 Super /80 New Generation and TL5.

Fig. 39b Lumen maintenance in % for T8 standard colours on conventional gear.

Fig. 39c Lumen maintenance in % for T8 /90 de Luxe colours.

The type of circuitry can also influence lamp life or lumen maintenance. For example, due to the controlled starting process the life expectancy of fluorescent lamps operated on a warm-start HF ballast is higher than on electromagnetic gear.

#### Lamp life on electromagnetic L and LC circuits

For conventional, electromagnetic operation, the electrodes are preheated when the switch starter is closed. At the moment the switch starter opens, the lamp may or may not ignite. Whether or not the lamp will ignite depends on the 'produced' ignition voltage. This again depends on the mains voltage at the moment the switch starter opens. If the lamp does not ignite, more attempts will follow until the lamp does ignite. Lamp life is also influenced by the type of starter used. For conventional operation, important differences exist between L (inductive) and LC (with series capacitor) operation. For LC operation the preheat current through the electrodes is much lower than with L operation, which results in a lower electrode temperature at ignition. After the lamp is ignited, the lamp current is higher than with L operation. As a consequence the electrode temperature is then relatively high. Because of these differences it is not possible to have the optimum switching behaviour for both L and LC operation. A compromise has to be chosen. The situation is further complicated by the rather strong influence of two different operation conditions:

- Preheat current and lamp current increase with the mains voltage. In general, lamp life will decrease with increasing mains voltage.
- The necessary ignition voltage is temperature dependent. This means that results of switching tests will be different for different ambient temperatures.

#### Lamp life on warm-ignition ballast

With 'warm-ignition' HF ballasts, the electrode is preheated in a well-defined way. After the preheat time, the lamp is ignited with a sufficiently high voltage. Due to the preheated ignition, the performance on faster switching cycles is very good. Lamp life is also improved for slow switching cycles. This is caused by the optimum relation between lamp current and electrode heating current. The presented lamp life values are the average figures over the lamp and ballast range. In comparison with conventional operation:

- performance on fast switching cycles is improved,
- lamp life will not depend on mains voltage (mains independence!),
- lamp life will not depend on ambient temperature

## Lamp life on cold-ignition ballast

When 'TL' lamps are operated without the appropriate electrode preheat current, lamp life will be reduced with more frequent lamp ignition. In the past, guidelines have been developed to design the cold ignition in such a way that the 'ignition damage' is limited. After lamp ignition, the 'glow-to-arc transition' has to take place within 100 ms. This is reached when the ballast delivers the appropriate amount of power during the glow phase (defined by IEC). When this is the case, lamp life will be comparable to operation on a conventional L circuit for switching cycles greater than 5 hours. Also important for lamp life is the electrode temperature during operation. For electronic operation, the heat balance of the electrode differs significantly from that with conventional operation. Without extra electrode heating, a certain minimum lamp current has to be maintained to obtain the appropriate lamp life. For this reason the so-called  $\alpha$ -control has been developed: the electrode current is maintained at the optimum value during both the ignition phase and the normal running, and at all dimming levels and temperatures for all IEC compliant lamp types. Another factor influencing the life of fluorescent lamps is the type of phosphors used: the modern lamps with /80 and /90 colours have a considerably lower light depreciation during their burning life than do the lamps with other fluorescent materials, say, colour /33 or /25 (see Fig. 39). Specific information on lamp life and light depreciation is in most cases available from the local Lamp organisation.

## Influence of switching cycle

Fluorescent lamps may be required to be switched on and off more than only a few times per 24 hours, especially when they are used in combination with controls such as movement detectors or light cells. The influence of the switching cycle on the lifetime of the different types of fluorescent lamps is different in different lamp circuits. The 'average' lamp-life data presented are typical values. They are the average of different tests. Batch deviations occur due to deviations in the materials used and in lamp processing, and to different types and batches of gear. Differences in 'application parameters', such as mains voltage, ambient temperature and starter, can also have a negative influence on lamp life, especially for conventional operation. These effects are almost absent for HF operation. The standard deviation of the 'typical' lamp life values is 10 to 20 per cent.

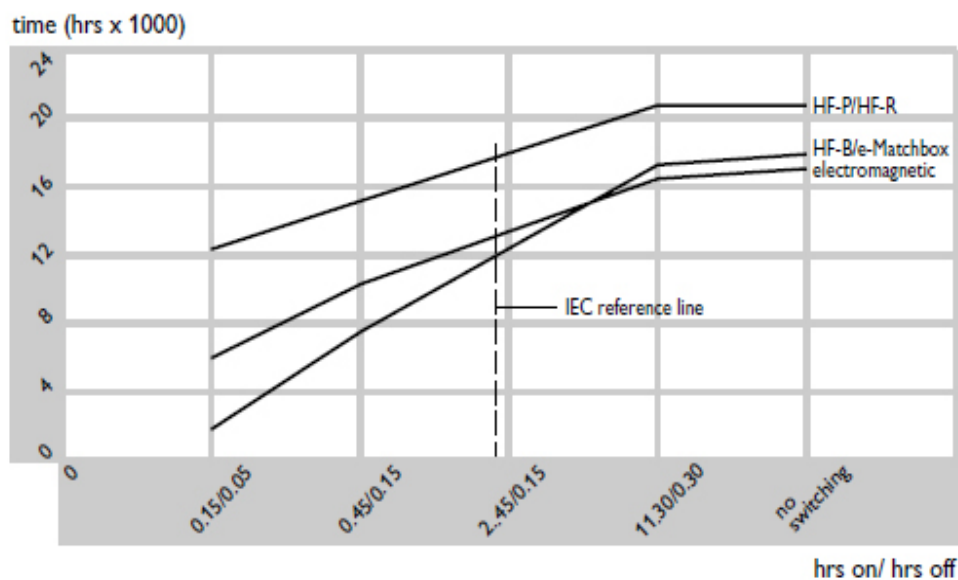


Fig. 40 Influence of switching cycle (in hours per start) on lamp life for 'TL'D.

## Stroboscopic effect and striations

The stroboscopic effect is the apparent change of motion of an object when illuminated by periodically varying light of the appropriate frequency. Flicker is the fluctuation of the lamp's light output on account of movement of the discharge arc on the electrodes. Striations are noticeable as a pattern of more or less bright regions in the long discharge tube. This pattern can move through the discharge tube. It can appear when the lamp is cold or when the lamp is dimmed down to too low a level. One or more of these three phenomena may appear, especially in combination with conventional gear. In the case of HF ballasts, the first two effects are not noticeable, thanks to the inertia of the fluorescent material, which cannot follow the high operating frequency and also because the ballast limits the light modulation in the 50 Hz mains to a large extent. However, at low ambient temperatures and/or at low dimming levels striations can also occur with HF ballasts.

## Electronic lamp control gear

### Electronic high-frequency system

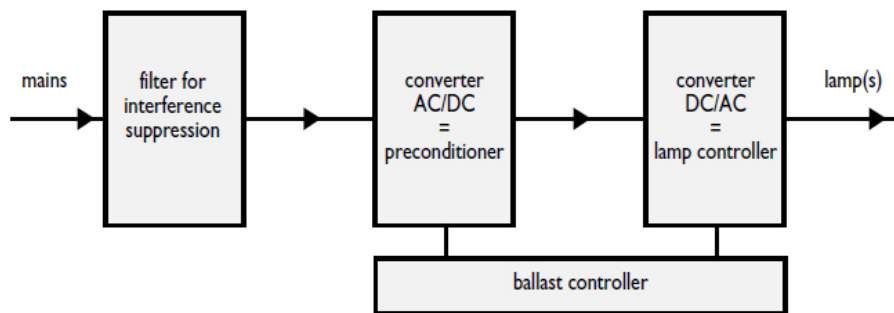


Fig. 43 Block diagram indicating the main functions of an electronic HF ballast system.

Block diagram (see Fig. 43)

Although the electronic HF ballast system is integrated into one single 'black box', its different functions can be divided into a number of individual blocks. In broad outline: after passing a low-pass (RFI) filter, the mains voltage is rectified in an AC/DC converter. This converter also contains the buffer capacitor, which is charged with current via this DC voltage. In the DC/AC converter the DC voltage is transformed into an HF voltage, which provides the power for the lamp controller. The ballast controller controls all these functions

### Circuit diagram (see Fig. 44)

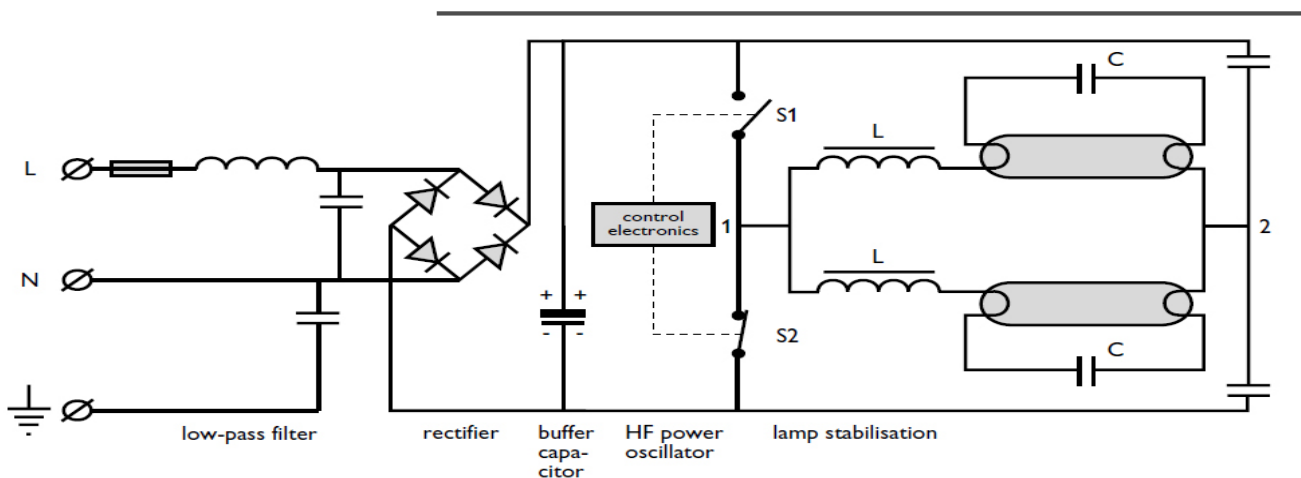


Fig. 44 Circuit diagram of an electronic control system (version with two lamps in parallel).



The low-pass filter has four functions:

- Limitation of the harmonic distortion, so that its level remains within international standards (see Fig. 45).
- Limitation of radio interference, which would otherwise be injected from the HF ballast into the mains. Here also international standards are to be adhered to.
- Protection of the electronic components against high mains voltage peaks.
- Inrush current limitation.

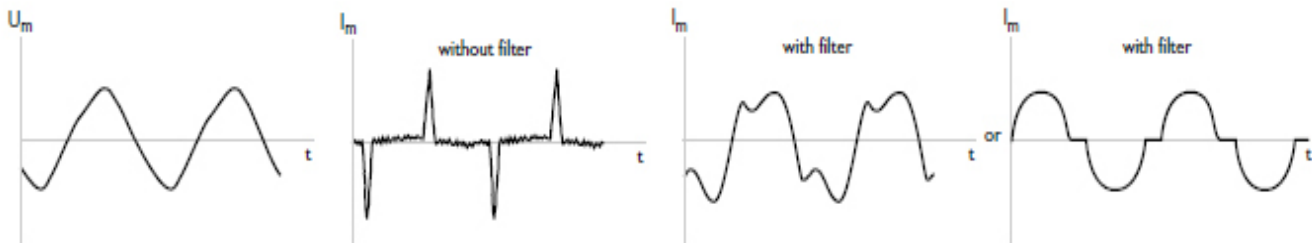


Fig. 45 Mains voltage and mains current, the latter without and with low-pass filter.

The low-pass filter is fully electronic. The different functions (lowpass filter, RFI suppression, inrush limiter and transient limiter) are separated (see Fig. 46).

The advantages of the fully electro-nic version compared with the older 'split' version with a separate filter coil, include: it is smaller, lighter, has a high power factor, the light output is independent of mains-voltage fluctuations, and there is no 50 Hz hum.

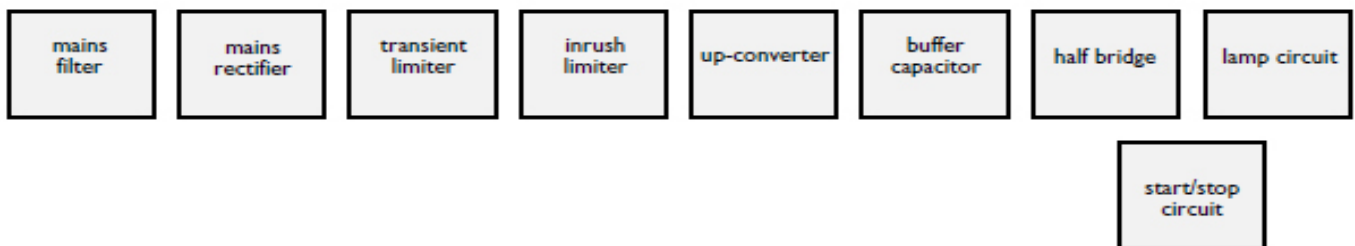


Fig. 46 Fully electronic and integrated low-pass filter.

The rectifier consists of a full diode bridge. The buffer capacitor in principle determines the shape of the lamp current and the mains current. It has to be chosen carefully in order to minimise the modulation in the lamp current (and thus the modulation in the light output). With a 'high' capacitor value the modulation in the light output is less than with a 'low' capacitor value, but the mains current waveform is more distorted (less sinusoidal), resulting in higher harmonic distortion (see Fig. 47). Furthermore, the level of the inrush current depends on the value of this buffer capacitor. The HF power oscillator is the heart of the electronic ballast. Controlled by the ballast controller the semiconductor switches S1 and S2 (Fig. 44) are switched at a frequency ranging from 30 to 100 kHz, so creating an HF square-wave voltage between the points 1 and 2. The frequency is regulated by the ballast controller. The controller contains all necessary sensors and intelligence to manage the mains input and lamp output functions of the electronic ballast, such as the preheating process, lamp power, stop circuit or safety switch-off, mains voltage fluctuations and mains frequency variations and sometimes over-voltage detection.

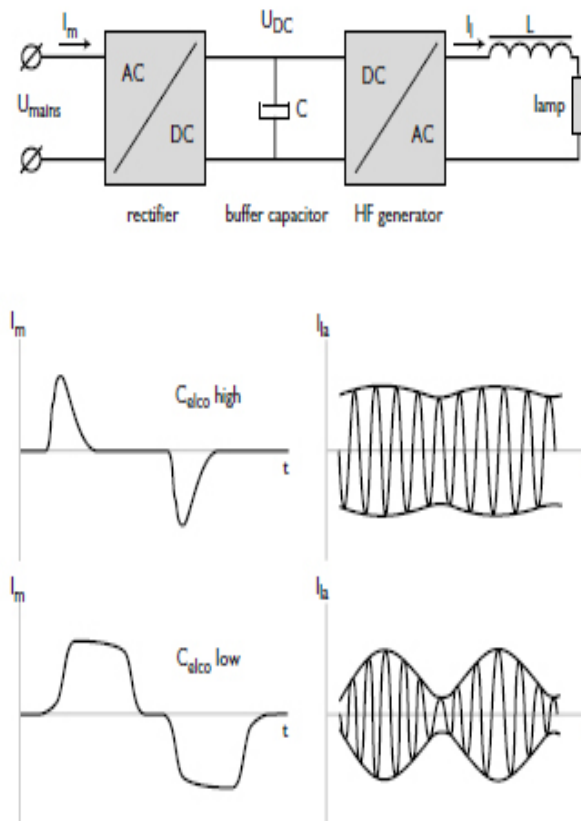


Fig. 47 Circuit with rectifier, energy buffer and HF generator. The curves show the lamp and mains current at high and low capacitance of the energy buffer for a typical CFL lamp.

The HF square-wave voltage is fed to the series connection of the lamp and the HF choke coil  $L$  (stabilisation coil). In the twin-lamp parallel version both lamp branches are connected in parallel with a choke coil for each lamp (Fig. 44). In the twin-lamp series version and in the single-lamp version, there is only one branch between the points 1 and 2 with one choke coil (see Fig. 48).

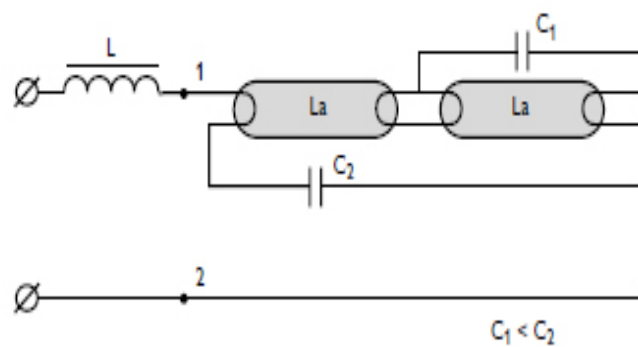


Fig. 48 Twin-lamp series version with only one branch between the points 1 and 2 with one choke coil.

Capacitors connected in parallel to the lamps are necessary for, among other things, the preheating and starting process: during preheating the current flows through the lamp electrodes and through these parallel capacitors.

## Choice of frequency

As described the operating frequency should be above 10 kHz for 'T8 lamps to obtain 10 per cent more efficacy, compared with the 50 Hz operation, and above 20 kHz to be above the human threshold of audibility. On the other hand, it should be below approximately 100 kHz to limit the losses in the ferrite coils and transistors. Apart from these considerations there is a third factor to be considered: like all lamps, fluorescent lamps emit not only visible light, but also have a variable amount of infrared emission. Modulated in a high frequency, this can disturb infrared remote controls as used for televisionsets, audio, video, transmission systems and data communication. The lowest practical frequency for these systems is found in the RC5 system, working on 36 kHz. So the operating frequency for HF fluorescent lamps should not be 18 kHz or 36 kHz. Nowadays the frequency range from 30 kHz to 40 kHz is more or less reserved for IR systems. It is for this reason that various operating frequencies have been chosen for the newer generation of HF ballasts: an operating frequency of about 45 kHz was chosen for the new generation HF ballasts.

## Ignition and re-ignition

As described a fluorescent lamp with cold cathodes needs up to an ignition peak voltage of more than 800 V r.m.s. depending on the lamp type, which means 1500 V top value. Due to this cold starting process emitter material will sputter away from the lamp electrodes. Frequent switching will thus result in a noticeably shorter lifetime. Another possibility is to bring the lamp electrodes up to their emission temperature before ignition by means of preheating. This is done by applying a frequency different from the operating frequency (normally higher) to the LC starting circuit for about 1.4 second to ensure a low open circuit voltage during the preheat phase (approx. 250 V) and a sufficiently high preheat current (see Figs 49).

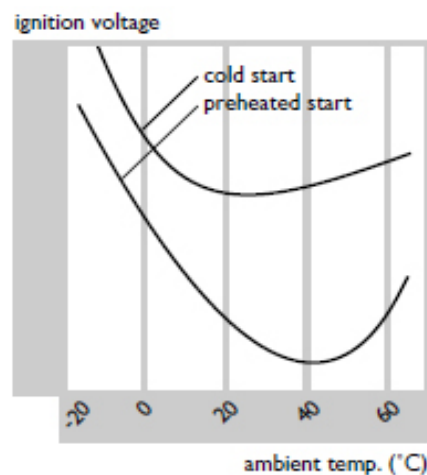
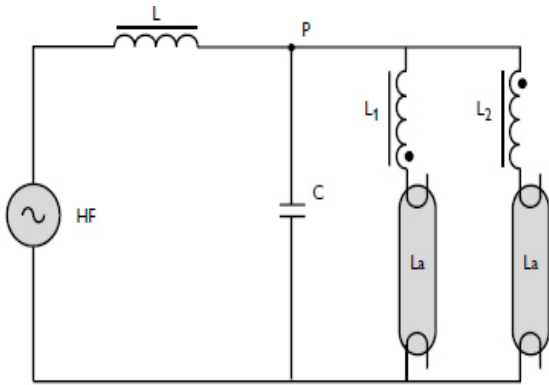


Fig. 49 Required ignition voltage as a function of the ambient temperature with preheated and non-preheated electrodes.

After the preheat time, a voltage of approx. 500 V (depending on the lamp type) is applied, again by changing the frequency, sufficient for reliable ignition during a maximum of approx. 0.2 second. The lamp ignites at the first ignition peaks and then the ignition voltage stops. After the preheat and ignition phase, the lamp gets its normal operating voltage (between approximately 50 V and 200 V, depending on the lamp type)

There are two ways of preheating:

- current preheating, with a more or less constant current through the cathodes
- voltage preheating, with a voltage depending on the actual working frequency (viz. dim level) where the cathode current is higher at lower dimming levels. Due to this warm start, the lifetime of the lamps is not so much dependent upon the switching cycle as compared with the cold start method and conventional gear. At the moment of ignition, the energy in the LC circuit is high enough to transfer the initial glow discharge into the stable burning discharge. After ignition the electronic ballast adopts its normal operating frequency. No extra voltage is necessary for re-ignition at this working frequency, as the plasma in the discharge remains conductive at this high frequency.



Ignition of a twin lamp ballast works on the same principle: in the preheat phase the voltage at point P (Fig. 51) is 300 V. In the ignition phase, this voltage will be 500 V, giving the required ignition voltage for both lamps. Once one lamp is ignited, the voltage at point P changes to 300 V, which is divided into 100 V for the lamp and 200 V for the transformer coil L1.

Fig. 51 Ignition with a twin-lamp HF ballast.

As transformer coil L2 is wound in the opposite direction, the open voltage for lamp 2 is still  $300 + 200 = 500$  V until the second lamp ignites as well. The run-up time of fluorescent lamps is very short, as the lamps get their nominal lamp voltage almost immediately. But with the amalgam lamps (CFL) it takes a few minutes before the amalgam is warmed up sufficiently to evaporate the amount of mercury necessary for the full light output. It can also take a few minutes for the lamp tube to reach its optimum temperature. All HF ballasts have an automatic stop circuit. Should a lamp fail to ignite at the first attempt (for example at the end of its lifetime), the electronics switch off the ballast after about 5 s. In this way, the so-called anomalous condition that can be found with starter circuits is avoided, resulting in:

- after the switch-off, system losses of only 1 W
- no annoying flashes of the non-starting lamp or heating up of the lamp caps
- no unnecessary radio interference.

After having replaced the lamp, most ballasts are immediately ready for operation again and the lamp starts without having to reset the mains (switching the mains supply off and on again). This means that lamp replacement can be done while the mains power remains on. Although not recommended, this is often done in practice. Should the lamp extinguish as a result of an interruption or dip in the mains voltage, instant re-ignition is guaranteed as soon as the voltage returns. With the twin-lamp ballasts, the stop circuit switches off both lamps when one lamp fails or when either is not connected to the ballast. This is because the ballast control system is comparing both lamp currents and must make them equal in stable operation. If one of the currents is zero after the ignition phase, the other will become zero as well.

Sometimes so-called 'independent lamp operation' is offered with twin-lamp ballasts. This feature suggests that if, in a twin-lamp system, one of the lamps should fail, the other one will continue to operate. However, with many such twin-ballasts this is only true as long as the system is not switched off. Once the mains is switched off, the intact lamp will fail to ignite at subsequent switch on. There are some special twin-ballasts available that do offer such independent operation, but these are also special as regards their (higher) price. In spite of this, this independent operation will be the trend for the future. Some HF four-lamp ballast contains two parallel circuits of two lamps. Should one lamp fail, the other lamp of the same branch will be switched, but the second branch will continue to work.

## Cut-off principle

The cut-off principle minimises the current through the lamp electrodes shortly after the lamp is ignited. Not only does this save energy, it also lowers the temperature at the lamp ends. The standard T8 lamp is optimised for a tube wall temperature of 40 °C, which is reached at an ambient temperature in the luminaire of 200 to 25 °C. The cold spot is in the middle of the lamp (see Fig. 52 ). The T5, however, is developed to function in smaller luminaires at an higher wall temperature of 45 °C, which should be reached at an ambient temperature in the luminaire of 35 °C. The cold spot is at one end of the lamp. Without cut-off (see Fig. 53), this cold spot would become too warm, meaning that the lamp would function optimally at an ambient temperature of 27 °C. With cut-off (Fig. 53), the optimum is reached at an ambient temperature of 35 °C (see Fig. 54).

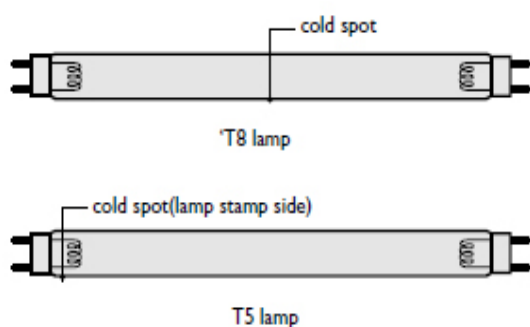


Fig. 52 Cold spot of T8 and T5 lamp.

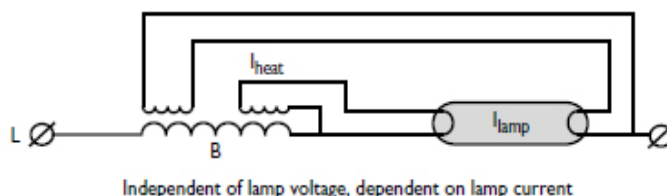
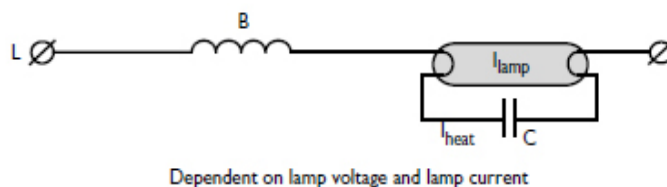


Fig. 53 Cut-off principle

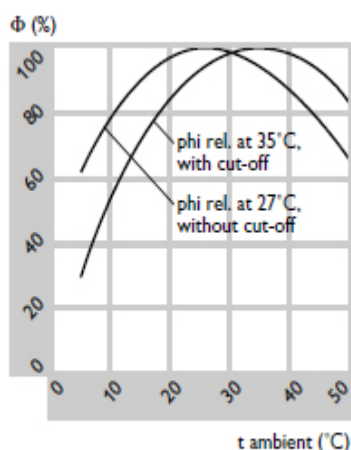


Fig. 54 Luminous flux with T5 and HF ballast with and without cut-off.

## Harmonic distortion

Due to the rectification that takes place and the presence of a buffer capacitor, the mains current is temporarily zero and has a peak waveform (see Fig. 55). According to Fourier's law, the peak waveform can be split up in the fundamental and its higher harmonic components. The frequency spectrum can be measured by a spectrum analyser (see Fig. 56). Assuming the fundamental to be 100 per cent, the higher harmonics can be expressed as a percentage of the fundamental. International standards such as IEC 555-2 and EN 61000-3-2 restrict the amount of higher harmonics in the mains current for lamp circuits of more than 25 W.

For the example of the fluorescent lamp the following results are obtained:

Harmonics		$I_{n,eff}$	$I_{n,eff} / I_{1,eff}$	IEC requirement
Number	Frequency (Hz)	(mA)	(%)	(%)
1	50	96	100	100
2	100	0	0	2
3	150	89	92	30 $\cdot \lambda$
5	250	74	77	10
7	350	57	59	7
9	450	40	41	5
$\geq 11$	550	25	26	3

where  $\lambda$  = the power factor of the circuit.

Due to the circuitry, only the odd harmonics are present in the mains current.

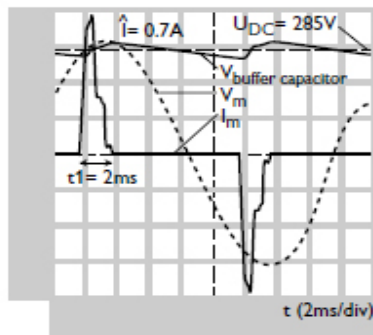


Fig. 55 Voltage and current shapes with a double-sided rectifier.

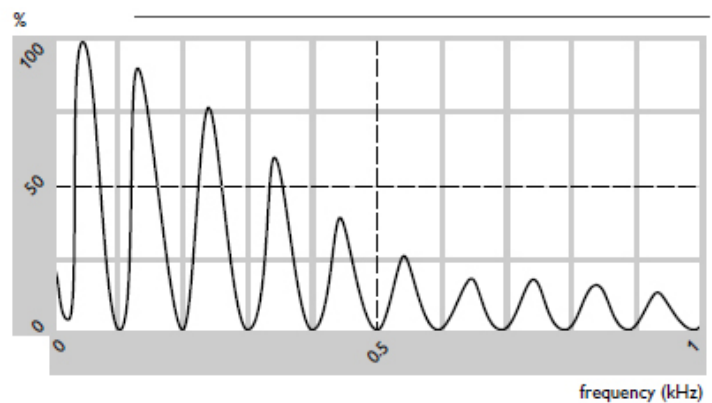


Fig. 56 Frequency spectrum of the mains current for a fluorescent lamp

Comparing the results with the requirements, it can be seen that the limits are exceeded. This is due to the absence of the mains filter. For the fluorescent lamp ballast, this is acceptable, as the total system power is less than 25 W. To adjust to the stated requirements for the maximum amount of higher harmonics, the circuit current has to be filtered. This can be achieved by a low-pass filter, which may consist either of a copper-iron coil or a fully electronic circuit. All good HF ballasts have such a low-pass filter and are therefore designed in accordance with the regulations laid down in the IEC standards. The electronic ballast system gives the following indicative values:

Harmonics Number	$I_{n,eff} / I_{1,eff}$ (%)		
	HF 128 TLD	HF 258 TLD	HF 258 TLD
1	100	100	100
3	7	6.5	10
5	2.5	2	2
7	2	2	2
9	1.5	1.5	1
$\geq 11$	1.5	1	1
THD (%)	8	7.5	12

In this case the harmonics are well within the limits.

The term THD (Total Harmonic Distortion) is defined as:

$$THD = \sqrt{\sum_{n=2}^{\infty} \left( \frac{I_n}{I_1} \right)^2} = \sqrt{\frac{I_2^2 + I_3^2 + I_4^2 + \dots}{I_1^2}}$$

which means the root mean square of the sum of all the higher harmonics divided by the fundamental. It can be calculated from the values obtained by the spectrum analyser, and for the lamp example this value is 1.44 (= 144 %). Nowadays, even with very simple handheld instruments, this value can be measured very accurately. For compliance with the standards the measurements of the higher harmonics are made with a supply voltage with a THD maximum of 2 %. In practice, however, the THD of the supply voltage can be much higher. According to the EN standard 50160 "Voltage characteristics of electricity supplied by public distribution systems" of November 1999 the maximum permitted THD for the supply voltage is 8 % for 95 % of the time .

Odd harmonics				Even harmonics	
Not multiples of 3		Multiples of 3			
Order h	Relative voltage (%)	Order h	Relative voltage (%)	Order h	Relative voltage (%)
5	6	3	5	2	2
7	5	9	1.5	4	1
11	3.5	15	0.5	6-24	0.5
13	3	21	0.5		
17	2				
19-25	1.5				

This means that in practice the values for the harmonics in the supply current can be higher than the published values. The actual values then greatly depend on the harmonics present in the supply voltage. No problem should be expected when the THD of the supply voltage complies with the mentioned IEC 50160.

## Power factor

In present-day publications the term power factor  $\lambda$  or P.F. is employed and ' $\cos \varphi$ ' is no longer used. The phase angle between the fundamental wave of the mains voltage and the fundamental of the mains current is called  $\varphi$ . This angle can be calculated or measured, and in the case of HF ballast circuits is nearly zero degrees (see Fig. 57), so extra compensation with compensating capacitors, as is the case in the conventional circuits, is not necessary.

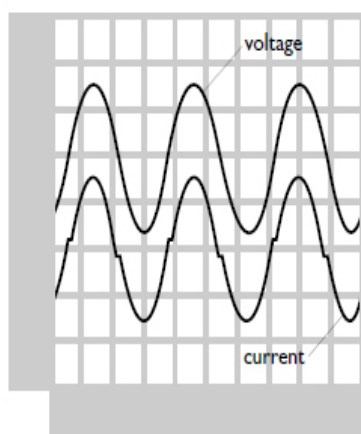


Fig. 57 The near-zero phase angle in an HF ballast circuit.



In practice, most supply voltage waveforms approach the sine wave shape rather well. In that case, the dissipated power is:

$$P = U_{\text{eff}} \cdot I_{1,\text{eff}} \cdot \cos \varphi$$

with  $I_{1,\text{eff}}$  = the fundamental component of the mains current.

This means that the dissipated power is determined only by the fundamental of the mains current. Higher harmonics of the mains current do not play a role for the lamp and ballast power, but they do contribute to the power losses in the cabling and thus influence the minimum diameter of the cable needed in the electrical installation. If the mains voltage is not a pure sine wave, additional power will be dissipated in the lamp and the ballast. In practice, the cosine of the angle  $\varphi$  is between 1 and 0.93 capacitive for HF lamp circuits. The power factor of the circuit is the quotient of the actual consumed power and the product of the values of the mains voltage and mains current (r.m.s. values):

P.F. or  $\lambda$  = total wattage / mains voltage x mains current.

With RMS equipment these values can be measured very well.

The power factor is determined by:

- the phase angle  $\varphi$
- the distortion of mains voltage and mains current.

If the mains voltage has a good sine wave (little or no distortion), the power factor will depend only on the harmonics in the mains current, according to the following formula:

$$\text{P.F.} = \cos \varphi / \sqrt{1 + \text{THD}^2}$$

where THD stands for Total Harmonic Distortion of the mains current. This means that circuits having a different  $\cos \varphi$  can have the same power factor:

1. In a conventional circuit without parallel compensation the mains current is virtually sinusoidal (THD = 0.1), but the phase shift between mains voltage and mains current is about 60 electrical degrees, resulting in  $\cos \varphi = 0.5$  and a power factor of 0.5.
2. In the electronic circuit the phase shift is nearly zero ( $\cos \varphi = 1$ ), but there are a lot of harmonics in the mains current, giving a THD value of about 1.44 (or 144 per cent), which results in a power factor of 0.57.

The energy suppliers have to deliver to the circuit an apparent power of:

$$S = V_{\text{mains}} \cdot I_{\text{mains}}$$

but they only get paid for the average power

$$P = \lambda \cdot V_{\text{mains}} \cdot I_{\text{mains}}$$

The electrical distribution system (cabling, transformers) must be capable of handling a current of  $I_{\text{mains}}$  instead of a current of  $\lambda \cdot I_{\text{mains}}$ . P.F. This calls for thicker cabling and heavier transformers and introduces higher distribution losses. The supply authorities therefore demand compensation of the phase shift and limitation of the harmonic distortion by requiring a power factor of 0.85 or more for lamp circuit powers of 25 W and more. The power factor of H.F. ballasts is  $>0.95$ , but leading.

## Inrush current

The current that flows during the very first few milliseconds when switching on a luminaire or an entire lighting installation is called the inrush current. This current is very important when making the right choice of switchgear and fusing, e.g. circuit breakers. The inrush current is determined in part by the circuitry in use and in part by the properties of the mains supply, viz. the mains-supply impedance and the supply-cable resistance. The moment of switching in relation to the sine wave of the supply voltage also determines the value of the inrush current. The highest inrush current is when the ballast is connected to the mains at the peak of the mains voltage.

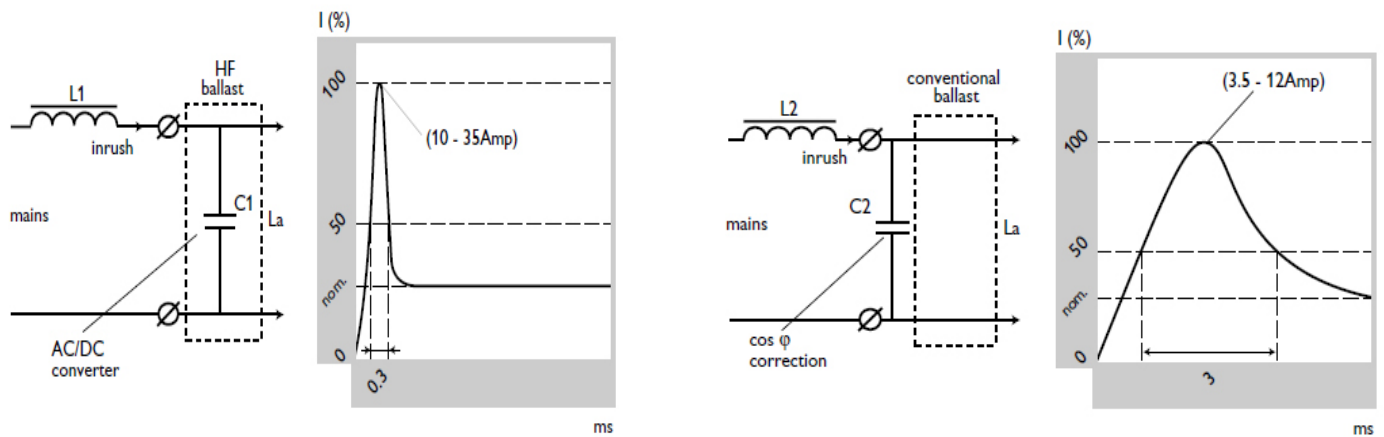


Fig. 58 The inrush current of an HF ballast compared with that of a conventional ballast.

With the introduction of HF ballast systems the effect of the inrush current became more important. There are two reasons for this:

1. Due to the electronics employed, more HF ballasts will switch on at the same instant, which adds to the value of the individual inrush currents to be supplied by the mains. Conventional ballasts switch on at random, avoiding this phenomenon.
2. For the same lamp wattage, the inrush-current pulse of an HF ballast is in principle higher and narrower than that of a conventional ballast (see Fig. 58). With an HF ballast, the inrush current loads the buffer capacitor C1, while in the conventional case the parallel compensating capacitor C2 is loaded. The value of C2 is lower than that of C1, which explains the trend of the currents. Compare, for example, the values for a 36 W T8 lamp: conventional  $C2 = 3.6 \mu F$ , HF ballast  $C1 = 10 \mu F$ .

For the typical current/time curves of Fig. 58 we assume that the inductance of L1 equals that of L2. As a result, the  $I^2t$  value of HF ballasts is higher than with conventional ballasts. The inrush current can trigger Mains Circuit Breakers (MCBs), fuses or relays (as used in control systems) when the inrush currents peak in the hatched part of Fig. 59. According to the graphs, the maximum current of relay contacts is lower than that of MCBs (where the inrush current is sensed by a coil). When the coil of an MCB trips because the inrush current exceeds a maximum level, the main contacts (which are normally quite heavy, since they are so constructed as to be capable of switching off the current caused by short-circuiting) switch off, which explains the different behaviour with respect to normal relays.

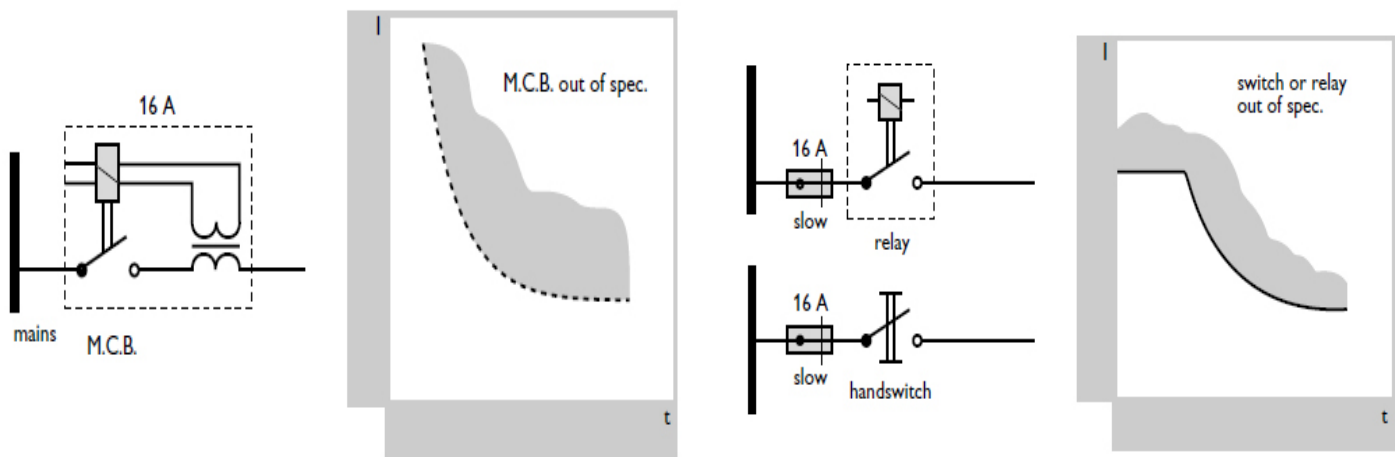


Fig. 59 Inrush currents may trigger MCBs, fuses or relays when they peak in the hatched part of the curves.

With the fully-electronic filter, the maximum inrush current is reached when the mains voltage is at its maximum value at the moment of switching on. The maximum value can be as much as 200 times the nominal mains current value, depending on the properties of the mains and RFI filter. Details for the various ballast types can be found in the product data sheets.

### Circuit breakers and fusing

The main purpose of protection devices such as mains or micro circuit breakers (MCBs) and fuses is to protect the cabling and the distribution part of the lighting installation from damage in the case of a failure or overload in the system. The rating of the protection devices is therefore primarily related to the cable core used in the installation, following the various national and international safety standards. In lighting installations, the commonly used MCBs and fuses have a rating of 10 A or 16 A. It will be evident that a 16 A device can handle a 1.6 higher load than can a 10 A device. To prevent undesirable tripping of the MCB or the fuse from blowing, two criteria normally have to be taken into account:

- the maximum current during switching on or off in the part of the lighting installation that is protected by the MCB or fuse,
- the total nominal operating current during stable operation.

Also, in multi-lamp luminaires, the hot wires should be of equal length to avoid variation in lumen output between the lamps. The hot points are not marked on the ballast separately, but they can easily be found: on the ballast connection diagram the hot points are those terminals that have the shortest lamp wiring drawn. Correct wiring is essential for correct functioning. Installation rules in most countries do not permit the routing of mains wiring and other wiring (e.g. control wiring, telecommunication wiring) together in the same cable ducts. The main reasons for this are the need to obtain optimum safety and to prevent disturbances and faulty connections.

## Lifetime

The overall lifetime of an electronic ballast is determined by the lifetime of each individual component employed in the ballast and the effect of voltage, current and temperature occurring. The lifetime of an individual component is mainly dependent upon the quality of the material employed in manufacture and the manufacturing process. Usually, each component is checked not only for proper functioning immediately after manufacture, but also in use. Typical for electronic components is that if they have defects, these will show up in the early hours of operation. After this so-called burn-in period failures will only very seldom occur. Professional electronic ballasts undergo a burn-in period for a specified period before leaving the factory. The purpose of this is to reduce the chances of early failures in an installation as much as possible. In order to control the failure rate of a complete ballast, the method of calculating the Mean Time Between Failures (MTBF) is adopted. This takes into account the MTBF of all the individual components. The failure rate is divided by the MTBF. Since the maximum temperature within a luminaire is very important for the lifetime of a ballast, the calculations are normally based on a temperature of 65 °C at a defined spot on the ballast enclosure. The quality of the design and of the components must result in a certain specified calculated failure rate. For most electronic ballasts this is set to 1 per cent at 5000 hours.

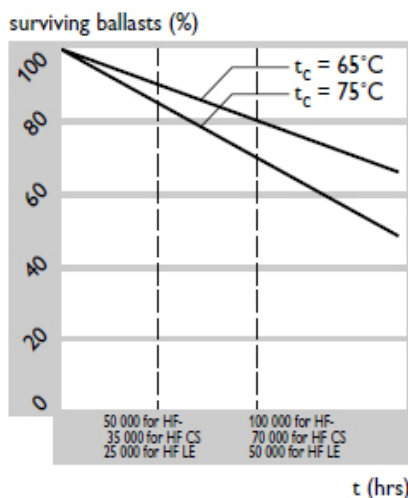
According to the equation:

$$R_t = e^{-\lambda t} \text{ or } \ln R_t = -\lambda t$$

where  $R_t$  = remaining ballasts after the time  $t$ , and  $\lambda$  = the failure rate  $1\%/5000\text{h} = 0.20 \cdot 10^{-5}$ , it is found that 36.7 per cent of the ballasts are still operational after 500 000 h, or 50 per cent after 346 000 h. The 10 per cent failure rate is reached after 52 680 h. The temperature dependence of the failure rate can also be calculated.

For most electronic ballasts this gives the following figures:

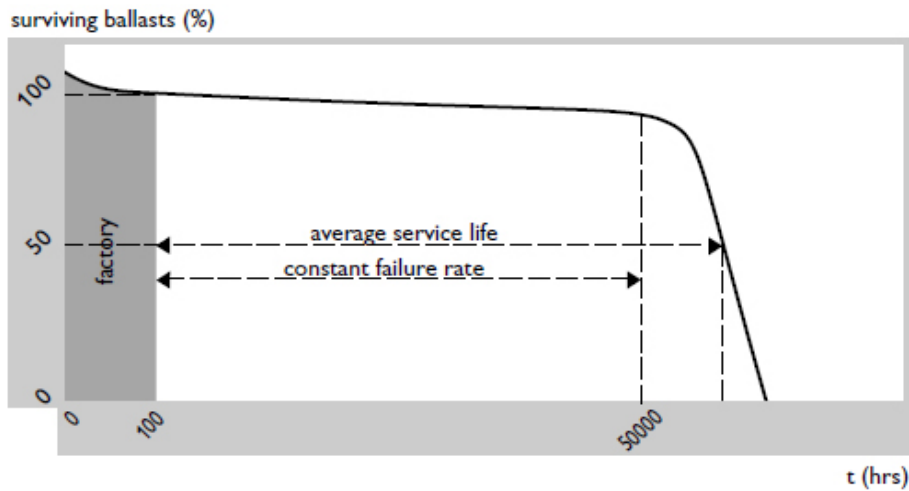
Test-point temperature (°C)	Failure rate (% per 1000h)		
	HF	HF cold start	low end HF
55	0.15	0.20	0.30
65	0.20	0.28	0.40
75	0.30	0.43	0.60



These calculated figures are verified by lifetime tests for the various ballasts (see Fig. 64).

Fig. 64 Mean Time Between Failures (MTBF).

One of the reasons for the increase in the failure rate at higher temperatures is the temperature dependency of capacitors employed, especially the electrolytic buffer capacitor. In order to verify the outcome of calculations, lifetime tests are continuously carried out on batches of ballasts. It is found that during a long period after the burn-in period the lifetime of the ballasts is in accordance with the calculated failure rate. But after this long period, the failure rate then increases very rapidly, ultimately resulting in the end of the lifetime of the batch of ballasts (see Fig. 65).



**Fig. 65** Lifetime curve of electronic ballasts, showing rapidly increasing failure rate after a certain period.

There are two major reasons for this phenomenon: drying up of the liquid of the electrolytic capacitors, and degradation of the soldered contacts. The soldered contacts are specified to have a lifetime of 2500 to 3000 switches in the temperature-change test of -20 ° to +100 °C. This wide temperature range of 120 degrees will not be found in practice; temperatures between + 20 ° and + 60 °C (a range of 40 degrees) are more likely.

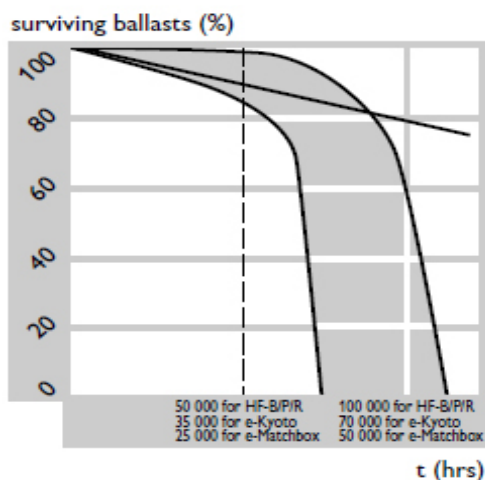
The actual switching lifetime can be calculated from the following equation:

$$N_{\text{switch}} = 2500 \times (120 / \text{practical temperature range})^2.$$

So in the example:

$$N = 2500 \times (120/40)^2 = 2500 \cdot 9 = 22\,500 \text{ times.}$$

Supposing the average burning time of the fluorescent lamps is 2 hours, this would result in a lifetime of the complete ballast of  $2 \times 22500 = 45\,000$  hours.



The time after which 50 per cent of the ballasts have failed is called the average service lifetime. For most ballasts in normal operation, this average lifetime is approximately 50 000 h at a fixed specified case temperature (65 °C). A temperature increase of 10 degrees halves this average service lifetime (thus, 75 °C gives 25 000 h), while 10 degrees lower doubles this figure (55 °C gives 100 000 h). Taking into account the various tolerances and spreading results in Fig. 66.

**Fig. 66** Total of failure mechanisms.

## Effects of mains voltage fluctuations

The mains voltage to which a luminaire is connected is never constant; it is influenced, for example, by the switching on and off of other loads. Therefore, the voltage level can only be guaranteed between minimum and maximum tolerances. Moreover, the nominal voltage can differ from country to country. In the UK, for example, the nominal voltage is 240 V compared with 230 V for the rest of Western Europe. The nominal operating voltage of a ballast can be found in the product data sheets. It may be a fixed value, as is the case with conventional ballasts. With respect to voltage fluctuations, there are two requirements:

1. A general safety requirement. No unsafe situation should occur within the range  $V_{\text{nominal}} \pm 10\%$  (in this regard attention should, for example, be paid to lifetime, temperatures, voltages).
2. A performance requirement. The circuit must perform within specified limits within the range  $V_{\text{nominal}} - 8\%$  to  $+6\%$  (in this regard attention should, for example, be paid to lumen output, currents, (re-)ignition).

And, again with respect to voltage fluctuations, the electronic ballasts can be divided in two groups:

1. A group in which the circuit power, lumen output, lamp current, etc. vary noticeably with fluctuations in the mains voltage.

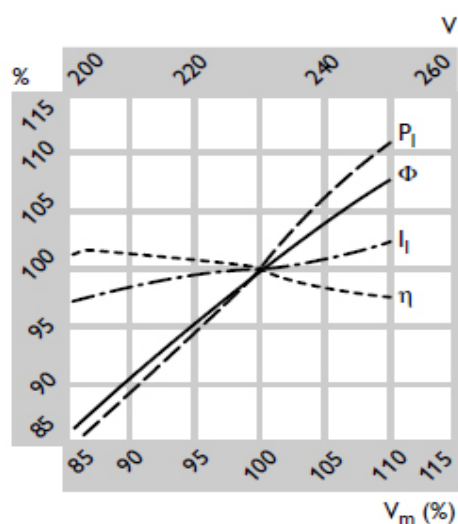


Fig. 67 Considerable influence of mains-voltage fluctuations on lamp power ( $P_l$ ), luminous flux ( $\Phi$ ), efficacy ( $\eta$ ) and lamp current ( $I_l$ )

2. A group based on the independent mains principle, where the lamp power and lumen output hardly change with variations in the mains voltage (see Fig. 68). It must be kept in mind that with the independent mains principle (sometimes also called constant-wattage) the mains current will rise with decrease in mains voltage.

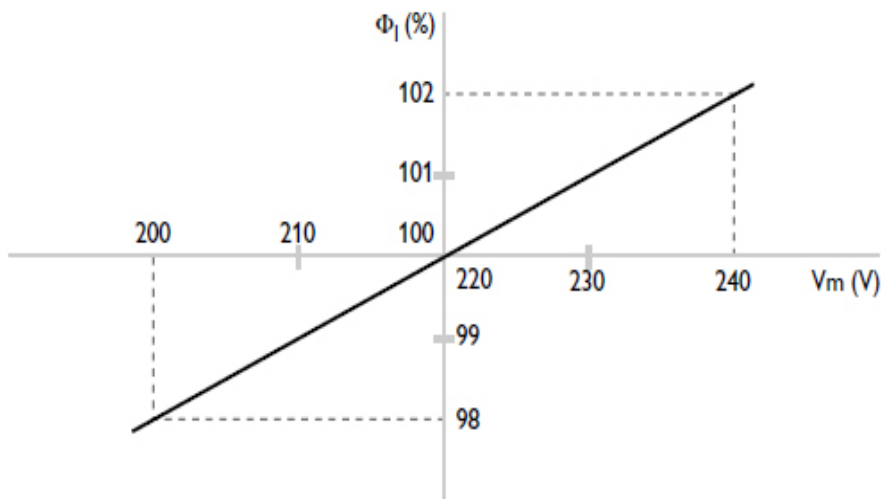
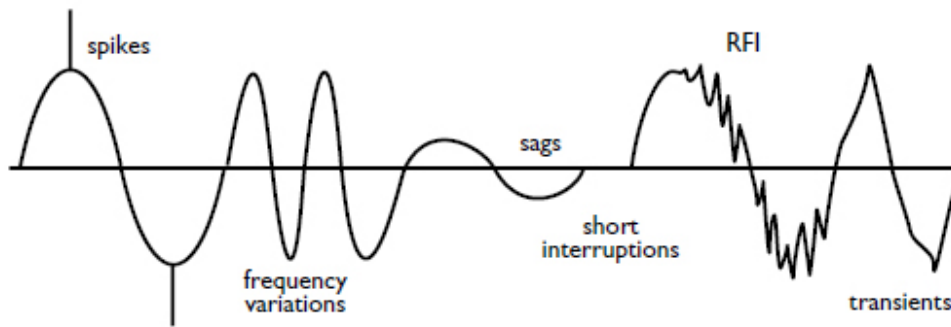


Fig. 68 Constant-wattage ballasts (e.g. HF-R). For a given mains voltage variation between 200 V and 240 V, the light output remains constant (tolerance  $\pm 2$  %).

All ballasts can withstand a certain over-voltage for a specified time, for example 380 V for 5 minutes. See for this point the product data sheets. Moreover, some electronic ballasts have an over-voltage detection. When the mains voltage rises above a certain value (usually 280 V r.m.s.), perhaps, due to a fault in the installation or a mistake in a testing procedure, the lamps are switched off. This switch-off feature provides a clear indication that the installation is not functioning properly and that corrective action is necessary. The lamps remain off until the unduly high mains voltage is corrected and the ballast is reset. Resetting must be done by switching off the mains supply to the ballast. After the ballast has switched off the lamps (in case of over-voltage), the high mains voltage is still connected to the input circuit. It is therefore essential that corrective action be taken immediately.





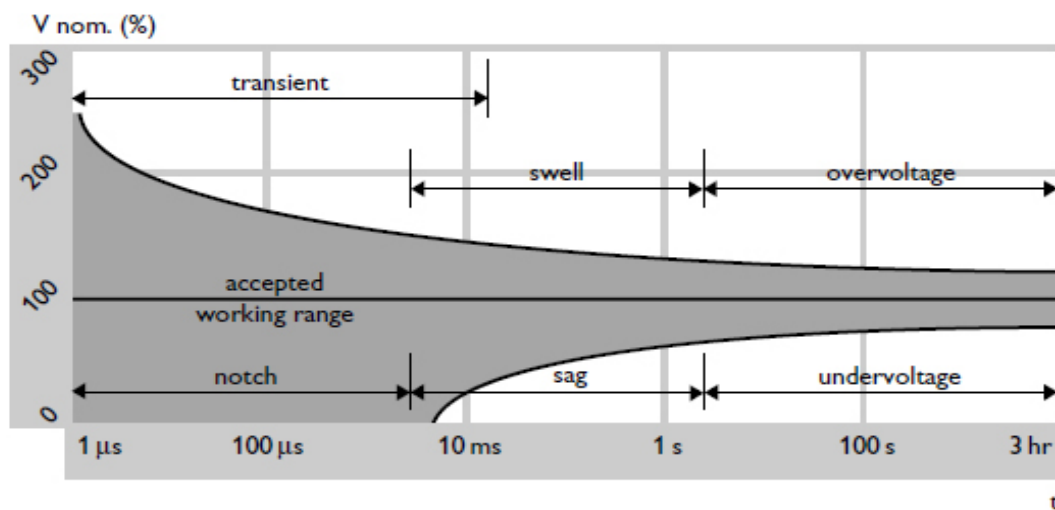
*Fig. 69 Different types of mains-voltage disturbances.*

## Transients and dips

The mains supply voltage can be disturbed in many ways, see Figs 69 and 70.

Disturbances of short duration, especially, can cause an interruption of the light output. Example, quoted from IEC 1000-2-2:5:

'At present as an approximate guide, it can be stated that an individual consumer in a town may suffer on average one to four times a month from voltage dips which exceed 10 % of the nominal supply voltage and which are due to causes outside his premises. The duration of these voltage dips is usually between 60 ms and 3 s, but durations of around 10 ms are possible mainly when faults are eliminated by fuses.' In rural areas, generally supplied by overhead lines, the voltage dips are much more frequent, but no useful estimates of the rates of occurrence of such dips are available.



*Fig. 70 Effects and duration of mains-voltage deviations.*

Peaks or transients can also damage the electronic ballast. There are several old, new or revised recommendations and standards covering this subject. To comply with the latest norms, Good ballasts are, or will be, designed according to the latest norm IEC 1547 (draft): Equipment for general lighting purposes - EMC immunity requirements. This ensures a very good immunity to the most common mains-supply distortions.

## Ambient and operating temperatures

The behaviour of the total lighting system (viz. lamp, ballast, luminaire, wiring, mounting and supply voltage) with change in temperature is mainly based on the temperature of the lamp in the actual situation. In general, the specifications of electrical components are not valid under  $-15^{\circ}\text{C}$  /  $-25^{\circ}\text{C}$ , so below these temperatures there is no guarantee for proper functioning of the ballasts.

The ambient temperature range for the HF ballasts in the compact lamps is from  $-20^{\circ}$  to  $+55^{\circ}\text{C}$ . Mounted in a luminaire, the hottest spot should be below  $100^{\circ}\text{C}$ . The ambient temperature range of 'T8' and PL-L HF ballasts is indicated on the ballast with the letter ta and ranges from  $-15^{\circ}/200$  to  $+50^{\circ}/70^{\circ}\text{C}$ . Due to the low watt losses in the HF ballasts, the temperature rise  $\Delta t$  of the ballast itself is limited to a maximum of approximately 15 degrees. Exceptions are, however, possible. An electronic ballast is usually built into a luminaire, so the ambient temperature around the ballast cannot be predicted exactly. A test point, tc, is therefore defined on the outside of the ballast enclosure, for which a maximum permitted temperature is specified for. This is normally  $75^{\circ}\text{C}$ . The test point will reach this temperature when the ambient temperature around the ballast is  $50^{\circ}$ – $60^{\circ}\text{C}$ , depending on the type of ballast. As long as the temperature of the test point remains below the specified maximum, the components will not be subjected to temperature overload.

The tc value is built up as follows:

Room temperature (e.g.  $25^{\circ}\text{C}$ ) plus temperature rise in the luminaire (e.g.  $25^{\circ}\text{C}$ ) equals ambient temperature for the ballast ( $50^{\circ}\text{C}$  in this case). Ambient temperature plus temperature rise of the ballast itself (e.g.  $15^{\circ}\text{C}$ ) gives  $t_c = 50^{\circ} + 15^{\circ} = 65^{\circ}\text{C}$ .

From this it follows that the room temperature directly influences the test-point temperature. The temperature rise of the air in the luminaire has to be measured. Variations of  $15^{\circ}\text{C}$  between a completely closed plastics luminaire and an open (bare lamp) metal luminaire are possible. Also, the distance from the ceiling influences the cooling properties of a luminaire, for example:

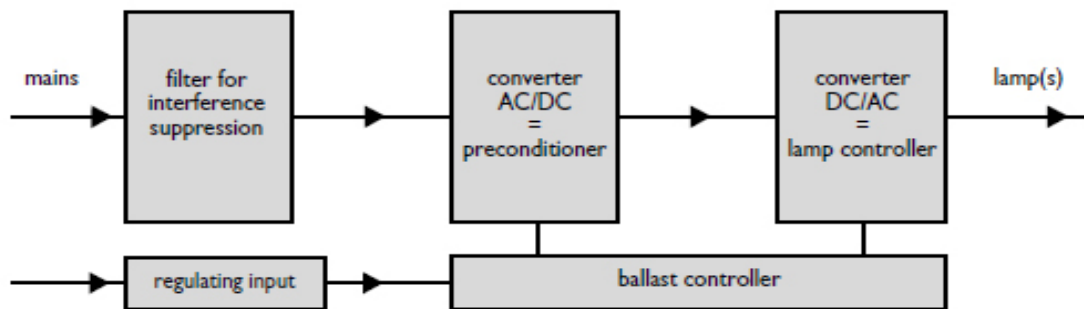
Distance to ceiling (cm)	0	1.25	2.5	5	10	15
Temperature drop (K)	0	1.5	6	14	20	22.5

As the enclosures of the electronic devices are often made of thin metal or some type of plastics, the measurement of the temperature at the test point must be done very carefully. The use of a rather large test finger, as supplied with some multimeters, will undoubtedly indicate temperatures that are too low. Measurements must be made by means of thermocouples, which must be firmly glued to the surface (and not, for instance, with adhesive tape). The most common application of fluorescent ballasts is in indoor installations. When employed in outdoor installations, the luminaire must be of the closed type, minimum classification IP54. In cold situations, especially, striation may occur. In order to avoid the negative influence of humidity on ballast components and metal connections, special lacquered ballasts are available.

## Light regulation with HF ballasts

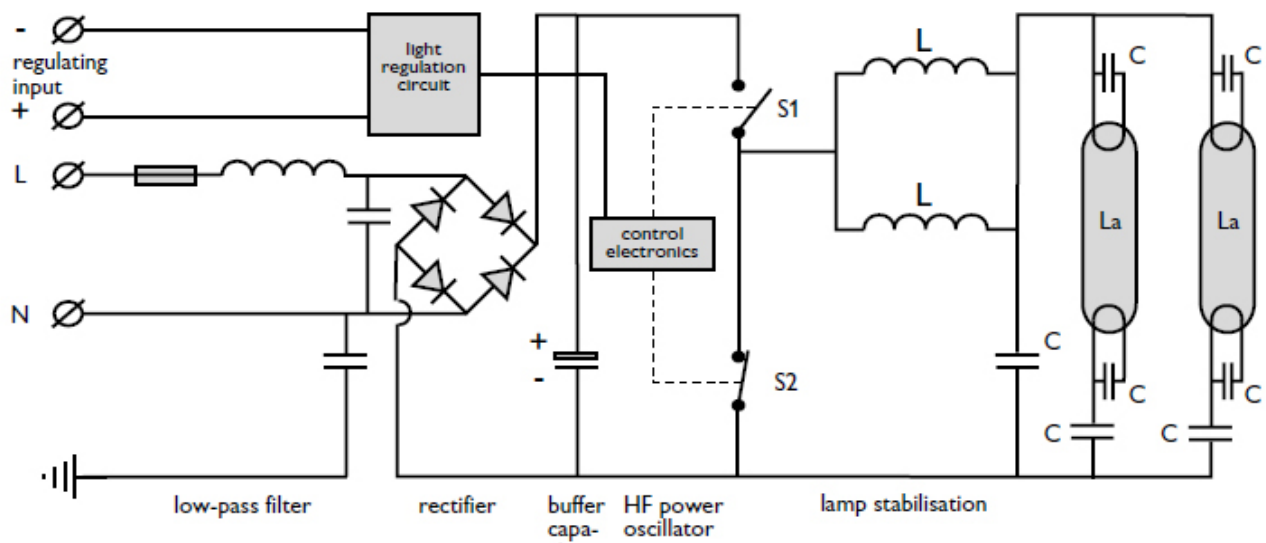
### General: block and circuit diagrams

Besides the standard range of HF ballasts, a range of dimmable fluorescent ballasts that allow for the adjustment of lighting levels to suit personal preferences whilst at the same time providing the opportunity for additional savings on energy. Compared with the standard HF ballast, an additional light regulation circuit is incorporated, that varies the operation frequency for the lamps, according to the regulating input voltage (see Fig. 78). The control voltage is supplied to the connections '+' and '-' at the HF ballast and to the connections 'DA' for the HF- DALI (Digital Addressable Lighting Interface) version.



**Fig. 78 Block diagram for an HF regulation ballast.**

Operating switches S1 and S2 (see Fig. 79) at a higher frequency results in a lower lamp current, and so the light output decreases.



**Fig. 79 General circuit diagram of an HF ballast for light regulation.**

There are nowadays two ways to supply the control voltage to the regulating ballast, namely analogue and digital. The most common is analogue in which the input voltage for the light regulation circuit may vary from 0 V to 10 V DC: 1 V results in a minimum lighting level and 10 V in a maximum lighting level. In addition to the analogue dim input, a digital dim input is used in the DALI ballast. The major European ballast and controls manufacturers support both of these systems, which guarantees compatibility between the various controls and ballasts.

### The dimming process

The nominal operating frequency of the HF ballasts is around 48 kHz. At this frequency the lamp reaches its nominal 100 % operating values. The ballast controller can, activated by the light regulation circuit, vary the operating frequency between 48 kHz and 90 kHz. Basically, the regulating process can be understood as follows: At higher operating frequencies the impedance of the lamp current stabilisation coil  $L$  increases, resulting in a lower current. At the same time, the impedance of the capacitor  $C$  across the lamp decreases (capacitor impedance =  $1/\omega C$ , with  $\omega = 2\pi f$ ). The electrode current is a prerequisite for stable regulation of the lamps. Operating switches  $S1$  and  $S2$  (see Fig. 79) at a higher frequency results in a lower lamp current, and so the light output decreases. The electronic regulating ballasts contain more complicated circuits to optimise these currents within the operating area, with the lowest possible power.



## H.I.D. Lighting Information

## High Intensity Discharge (HID) Lamps

### Range

The first discharge lamp Low Pressure Sodium lamp, introduced in 1932, was for an installation for street lighting. Nowadays a broad range of HID lamps is used in almost all applications, not only in sport stadiums, along highways, as urban lighting or to light large areas, but also in shops, museums, theatres and even in homes. Discharge lamps work on the principle that part of the energy released during the discharge through a gas is used to generate light. This happens in the discharge tube with sealed in electrodes, and filled with one or more metals and a starting gas, see fig.3. A voltage applied to the electrodes affects the free electrons in the gas, which start moving towards the positive pole. In doing so, they collide with the atoms in the gas. This results in heat development, electromagnetic radiation and ionisation. The electromagnetic radiation is of specific wavelengths, depending on the metals employed. Part of this radiation is visible light right away, whilst another part, in the ultraviolet range, may subsequently be converted into visible light by means of a fluorescent layer on the inner wall of the lamp.



Fig. 3. Discharge tube of an HID lamp.

The starting behaviour of individual lamp

#### 1. High-pressure mercury lamps

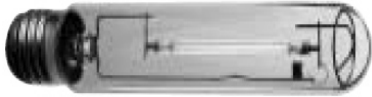


Fig. 8. High-pressure mercury lamp.

Fig. 8. High-pressure mercury lamp.

The combination of the gas filling, electrode emitter and auxiliary electrodes makes the lamps start on normal mains supply voltage; there is no need for an ignitor. There is a relationship between minimum supply voltage and ambient temperature. For example: at 20°C ambient temperature a supply voltage of 180 V will ignite the lamp, while at -18°C a minimum supply voltage of 210 V is needed for proper ignition. There are no special requirements for wiring or cabling. The re-ignition time is a maximum of 10 minutes. Immediate hot re-ignition is not possible (Edison fitting). The run-up time is approximately 5 minutes. The coating on the outer bulb is a fluorescent layer for converting the UV into visible light. Because of high lamp-voltage, the lamp only can be dimmed with the risk of extinguishing.

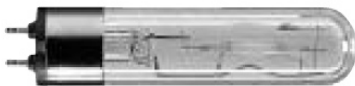
## 2. High-pressure sodium lamps



*Fig. 9. High-pressure sodium lamp.*

Fig. 9. High-pressure sodium lamp.

To start Sodium elliptical and Sodium Tubular lamps properly, a starting voltage is required that has to be not only sufficiently high, but its peak must also have the right shape with a certain rise-time and pulse-width. Sodium 70 W-I lamps have an internal starter with a bi-metal strip, which has to cool down after extinction. Their re-ignition time is therefore approximately 15 minutes. All other SON lamp types have a re-ignition time of 2 to 3 minutes and a run-up time of approx. 5 minutes.



*Fig. 10. White SON lamp.*

Fig. 10. White SON lamp.

The SDW-T lamp types run up in 2 minutes and the re-ignition time is 1 minute with the CSLS control unit. The coating on the outer bulb is to spread the concentrated light from the relatively small discharge tube over the much greater surface of the outer bulb. The SON lamps produce hardly any UV. Lamps can be dimmed to 50% power with conventional gear and to 35% with appropriate electronic gear.

## 3. Metal halide lamps



*Fig. 11. Metal halide lamp.*

Fig. 11. Metal halide lamp.

The starting peak for proper ignition of Metal halide lamps does not have the same shape as that for sodium lamps. As the maximum ignition voltage peaks are under 1000 V (except for the 2 kW/380 V system, where  $V_{max} = 1500$  V) there are no special requirements for cabling or wiring. The re-ignition time of metal halide lamps is 15-20 minutes maximum and, due to the use of Edison lamp bases and holders, immediate hot re-ignition is not possible.



*Fig. 12. Double-ended metal halide lamp.*

Fig. 12. Double-ended metal halide lamp.

Double-ended metal halide lamps, such as the MHD-LA and SA types, are suitable for hot restrike with devices producing 35 kV to 50 kV. It must be ensured, of course, that the applied luminaire is also released for hot restrike. To ensure proper ignition of these lamp types, higher starting voltages are needed than with the E40 metal halide types. The re-ignition time of these lamps is between 10 and 15 minutes. All metal halide lamps mentioned have a run-up time of between 3 and 5 minutes. Because of negative effects on colour-shift, maintenance and lamp life these lamp-types cannot be dimmed.



#### 4. Low-pressure sodium lamps



Fig. 13. Low-pressure sodium lamp.

Fig. 13. Low-pressure sodium lamp.

For low-pressure sodium lamps in particular, the right choice of circuit components is very important for the starting and run-up phase. With the standard circuits all lamps run up in about 12 minutes and they restrike immediately, with the exception of the SOX 180 W and SOX-E 131, which restrike after 10 minutes. The required pulse height for proper ignition is between 1000 and 1400 V, but more important is that the circuit delivers enough energy to pass through the run-up phase. It is not only the luminous flux and colour characteristics that change during the run-up period: the same happens to the lamp voltage and current. In most lamps the lamp voltage increases and the lamp current decreases during the run-up period. This is due to the pressure build-up as a result of the increasing gas temperature (Fig. 14).

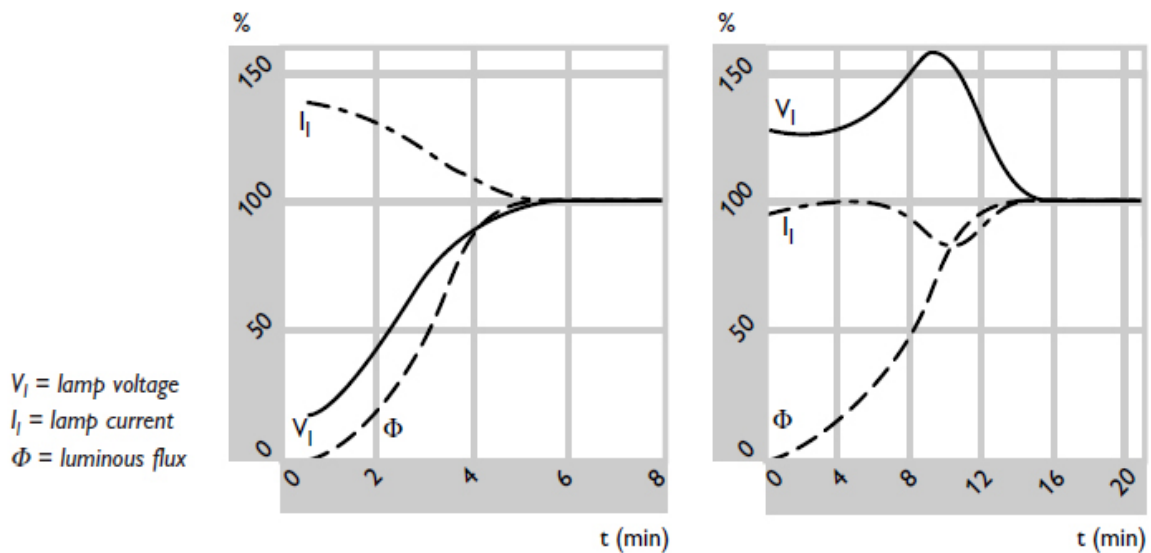


Fig. 14. Comparison between the run-up characteristics of a high-pressure mercury lamp (left) and a low-pressure sodium lamp (right).

In low-pressure sodium lamps and some fluorescent lamps, however, the opposite is true, which can be explained by the change in the composition of the filling gas as a result of vaporisation (see Fig. 14). SOX lamps cannot be dimmed.

## HID Lamp behaviour as function of the frequency

HID lamps do not properly function on DC (Direct Current). This is due to the one side emission of the electrodes and the de-mixing of the gas. Practically all HID lamps are developed for conventional gear on a 50 or 60 Hz mains supply. Electromagnetic and hybrid solutions (conventional gear in combination with electronics) work on these frequencies. Low-frequency square-wave electronic HID ballasts operate on a frequency between 70 and 400 Hz, which prevents flickering. Fully electronic ballasts for HID lamps are becoming available with higher operating frequencies (10-500 kHz). The frequency and waveform of an electronic ballast cannot be chosen freely, but are dependent on lamp type, condition and temperature. A wrong choice of frequency and/or waveform can have a very negative effect on lamp performance and/or lifetime. Laboratory experiments have shown that the different types of HID lamps can only be stabilised at certain frequency bands. Outside these restricted bands, not only may the efficiency drop, but the discharge tube may be mechanically damaged by acoustic resonance, or electrodes may break off. Electronic gear units are therefore only suitable for specified lamp types. Conversely, some HID lamps can only be operated on their electronic gear since there is no conventional alternative. The sorts of benefits obtained with fluorescent lamps (26-34 kHz) are difficult to achieve.

## Lamp and system efficiency

Lamp efficiency is expressed in a figure called the luminous efficacy. It indicates the efficiency of the lamp in transforming electrical energy into light and is expressed in lumens per watt (lm/W). The amount of light generated by a lamp is called its luminous flux or lumen output. It is a variable figure, depending on many factors. In all documentation, the published figure is the nominal luminous flux, which is the lamp flux under the following conditions:

- the lamp has already burned for 100 hours (burning-in period) prior to measurement,
- the lamp is burning in free air,
- after switching on, the lamp has had sufficient time to heat up and stabilise for thermal equilibrium,
- the lamp is running at its nominal voltage, nominal current, rated ambient temperature, defined burning position and stabilised nominal mains voltage,
- the nominal luminous flux is based on the average value obtained from a batch of lamps.

The instant one of these conditions changes, the nominal flux changes with it.

Lamp types are indicated with a nominal wattage. This is not always the power actually dissipated in the lamp. The luminous efficacy is calculated by dividing the nominal lumen output by the actual power dissipated. The luminous efficacy of all HID lamps increases with the lamp wattage. This is because the power needed to keep the lamp electrodes at optimum temperature is relatively less for higher lamp wattages. For example, for mercury it varies from 36 lm/W for the 50 W type to 59 lm/W for the 1 kW type.

As the published figures for the lamps do not include circuit losses, the efficacy figures for the total system are lower. The figures published are for lamps stabilised by the electromagnetic circuits. With electronic gear there is a limited increase of efficacy.

The main part of the energy is converted into heat. A relatively small part is converted into visible light, (see Fig. 15).

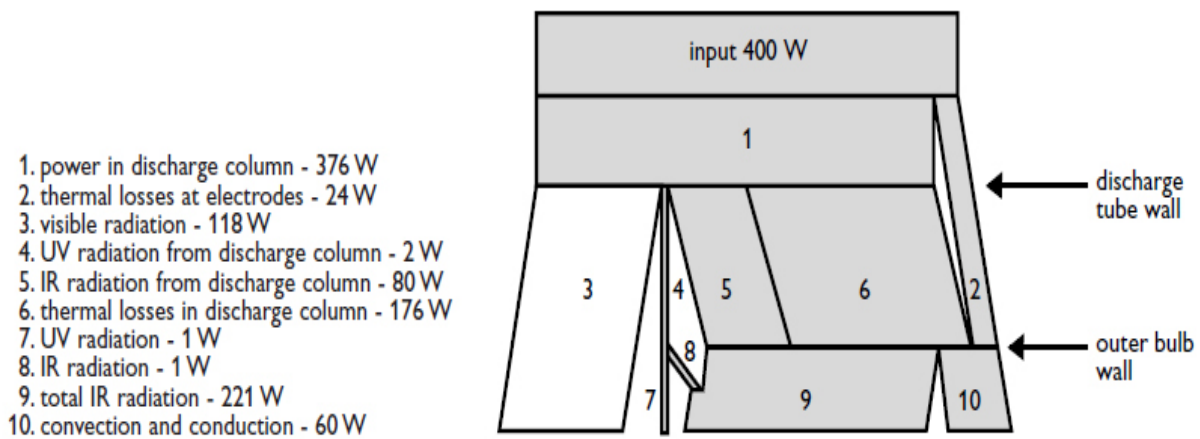


Fig. 15. Energy balance of an Sodium tubular 400 W lamp.

## Effects of temperature

### Low temperatures

Although the temperature of the discharge is of prime importance for the operation of discharge lamps, high-intensity gas-discharge (HID) lamps are not very sensitive to changes in the ambient temperature. There are two major reasons for this:

1. The discharge tube of most lamp types is enclosed in an outer lamp bulb and most of the HID lamps in floodlighting and other outdoor applications are placed in an enclosed luminaire, so that there is no direct contact between the outside air and the gas-discharge tube.

2. HID lamps operate at fairly high discharge-tub temperatures, so that the changes in ambient temperature are relatively small, compared with the actual burner temperature of a working HID lamp. Provided they are operated on the correct ballast and ignitor, all HID lamps will ignite at temperatures down to  $-20^{\circ}\text{C}$ , while some types will even ignite at  $-40^{\circ}\text{C}$ . SON and SOX lamps even will function without difficulty at temperatures down to  $-50^{\circ}\text{C}$ . The only exception is the mercury lamp: the mercury gas pressure of which is more sensitive to low temperatures. Due to the electronic components, the permitted temperature range for the ignitors is from  $-20^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$ . Also the compensating capacitors are mostly limited to  $-25^{\circ}\text{C}$ . In practice there is not much difference in light output within the normal ambient temperature range of  $-20$  to  $+40^{\circ}\text{C}$  during stable operation. Of course the run-up time (time to reach a certain light output) can be longer at lower temperatures. High temperatures For all lamps there are two critical values, which are mentioned in the lamp specification:

1. The maximum permitted temperature of the lamp base, dictated by the construction ( $200^{\circ}\text{C}$  for E27 and BY22 due to the cement and  $250^{\circ}\text{C}$  for E40, due to the mechanical construction).

2. The maximum temperatures of the outer bulb wall are  $450$ – $650^{\circ}\text{C}$  for the tubular lamp types and  $350^{\circ}\text{C}$  for the ovoid types. The ovoid types are mostly covered with a powder – diffusing or fluorescent – and these powders reduce in efficacy at temperatures higher than  $350^{\circ}\text{C}$ .

For lamps with no outer jacket, such as MHD-SA, the maximum values allowed are somewhat higher:

$300$ – $350^{\circ}\text{C}$  pinch temperature and  $920$ – $980^{\circ}\text{C}$  bulb wall temperature.

When built correctly into a luminaire, higher ambient temperatures (which are limited by the luminaire) do not influence the behavior of HID lamps. Common values for indoor luminaires are 25°C, and for outdoor luminaires 35°C, while some industrial luminaires can have 45°C ambient temperature as maximum. The temperature inside a luminaire will increase when, due to inadequate maintenance the light cannot leave the luminaire unhindered, (e.g. dirty front glass or optics). Then there can be a slight negative influence on lifetime and light output, especially with SON and metal halide lamps.

## Optimum operation

There are many different types of HID lamps, each in different lamp wattages, lamp voltages and lamp currents. Each type has its own advantages and disadvantages, to be found in the lamp data sheets. What they have in common though, is that they need the correct ballast and ignition system for optimum performance. In fact, each type needs its own specific gear. For this reason one should take care to use the recommended gear in combination with the chosen lamp. Especially when using electromagnetic ballasts, the combination must be correct for the available mains voltage (220, 230 or 240 V / 50 or 60 Hz). HF ballasts cover a wider mains-voltage range, which can be found in the product data sheets. When the wrong components are chosen, one can expect problems: for example, with:

- lifetime of lamps and gear
- temperatures
- starting/run-up
- stable burning
- radio interference
- light output

The burning position has also to be taken in account for correct operation.

## Lamp life and depreciation

There are various different definitions of the lamp life:

- the technical, individual life is the number of hours after which one particular lamp fails. This greatly depends on the practical circumstances, and is therefore of no practical use.
- the guaranteed life is a certain agreement by contract between the supplier and the user. The operating conditions are specified in the contract. This lifetime can differ from the concepts of life normally used.
- the average rated life time is the number of burning hours which have elapsed when 50 per cent of a large batch of lamps have failed. This life-expectancy figure is normally published by the lamp manufacturers
- the economic life is the number of burning hours after which the total light output of an installation, under specific conditions, suffers a depreciation of about 30 per cent.
- the economic life, based on running costs is the number of operating hours between group replacements of lamps for which the calculated running costs are the lowest, without the lighting level dropping below a specified minimum value. The most important cause of light depreciation (declining luminous flux) is the blackening of the discharge tube by particles from the electrodes: emitter and tungsten. A certain amount of lamp blackening during life is normal and unavoidable. The blackening is caused by a thin layer of electrode material deposited during life on the inner wall of the discharge tube. However, accelerated blackening can also occur when radiation (infrared) is reflected back to the discharge tube by the optical system or when the volume of the optic is too small for a proper heat balance. A second reason for light depreciation is when a fluorescent powder is used. The powder ages due to photochemical reactions; the crystals will slowly lose their ability to transform the UV into visible light.

The data published by lamp manufacturers for life expectancy and lumen depreciation are obtained from large representative groups of lamps in laboratory tests under controlled conditions (Figs. 16 and 17).

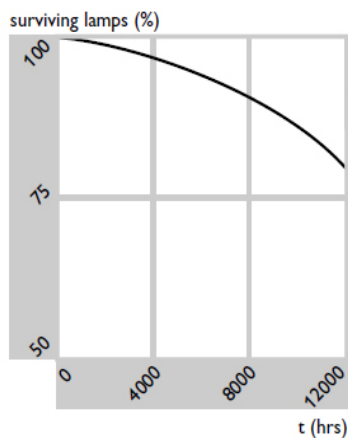


Fig. 16. Life expectancy curve of high-pressure mercury lamps when operated under standard conditions.

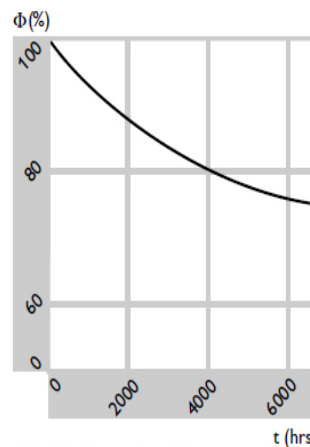


Fig. 17. Example of lumen maintenance curve of a metal halide lamp.

These tests include, amongst others:

- nominal supply voltage and appropriate circuitry,
- specified burning position,
- specified switching cycle,
- free burning, mounted on test racks (
- no vibrations or shocks,
- specified ambient temperature, mostly 25°C.

Any change in these circumstances will affect the lifetime. The major end-of-life causes and related behavior of a HID lamp are:

1. The many chemical reactions that are taking place in the discharge tube, causing the tube to leak. The hot gasses will flow through this leak into the outer bulb, noticeable as a weak discharge in the outer bulb. In very rare cases, the discharge tube will break and hot parts may cause a rupture of the outer bulb. In general, HID lamps will reach end of life passively, without shattering of the outer bulb.
2. The chemical composition changes or the operating temperature is too high: the lamp voltage rises and the lamp starts cycling and/or extinguishes.
3. The outer bulb or discharge tube leaks very slowly: the lamp changes colour and will fail to operate in a short time span.
4. An overload, such as a short-circuited ballast or, say, a 35W lamp in a 70W installation, will result a short life, with a possible shattering of the outer bulb. Until now, it was not possible to protect the lamp against such an overload situation.
5. Rectification (DC current) can occur when one electrode is worn out and the other is still emitting electrons. This will introduce DC current in the circuit with possible overheating of the ballast. A protection device in the circuit, such as a thermal switch, built in into the ballast, will protect the circuit when this happens (see IEC 61167).
6. A loose contact in the circuit or lamp can cause uncontrolled current in the circuit. Also here a thermal switch or another device will protect the system.

In the case of quartz lamps there is a risk of explosion at end of life due to the re-crystallization and weakening of quartz material at the hottest part in the burner. As a precaution against this risk, it is always recommended that a front glass be used with this type of lamp. Very few burners will shatter at the end of life because of a sudden overload (caused by a problem/short circuit in the gear). However, because shattering cannot be excluded, some types of lamps must be burnt in a fully enclosed luminaire that is able to contain all the broken (hot!) parts of the lamp. With some other types, all broken parts will be contained in the reflector or outer envelope and therefore these lamps can be used in open luminaires.

With the exception of SOX (-E) lamps, the type of circuitry has no influence on lamp life or lumen maintenance, provided, of course, that the gear is designed to the relevant standards and specifications. For the SOX (-E) lamps the circuitry chosen will have a bearing on lamp life and even more so on lumen output.

Dimming is only permissible with SON (-T) lamps. Provided that lamps are always started at nominal conditions and that dimming to less than 50 per cent of the nominal power is carried out slowly. Operating a lamp with a 220 V ballast on a 230 V mains must be seen as over-running and will reduce both lamp life as well as ballast life.

### Influence of switching cycle

Nowadays HID lamps may be required to be switched on and off more than only a few times per 24 hours, especially when they are used in combination with controls, such as movement detectors or light cells. Since frequent switching generally has a negative influence on the lifetime of HID lamps, the lamp life-times as published by the manufacturers are usually based on tests with a specific switching frequency. For lamps, used in sports lighting installations, the cycle on which the figures are based are, for instance, 5 hours on and 1 hour off, whereas for other outdoor applications and indoor use a sequence of 11 hours on and 1 hour off is mostly used. Especially when the switching frequency is so high that the lamp has to restart while it is still warm, problems are particularly to arise. The control gear will repeatedly try to re-ignite the lamp. This will continue until the vapour pressure is sufficiently low for the lamp to restart. The 'average' lamp-life data presented are typical values. They are the average of different tests. Batch deviations occur due to deviations in the materials used and in lamp processing, and to different types and batches of gear. Differences in 'application parameters', such as mains voltage, ambient temperature and starter, can also have a negative influence on lamp life. The standard deviation of the 'typical' lamp life values is 10 to 20 per cent.

## Stroboscopic effect, flicker and striations

The stroboscopic effect is the apparent change of motion of an object when illuminated by periodically varying light of the appropriate frequency. There are various sorts of flicker. The light output of a lamp varies with the level of the mains supply voltage. Therefore there are restrictions set in IEC 61000-3-3 for voltage fluctuations as caused, for example, by a varying electrical load, (see Fig.18). The disturbing effect depends not only on the magnitude of the voltage fluctuations, but also on the repetition rate.

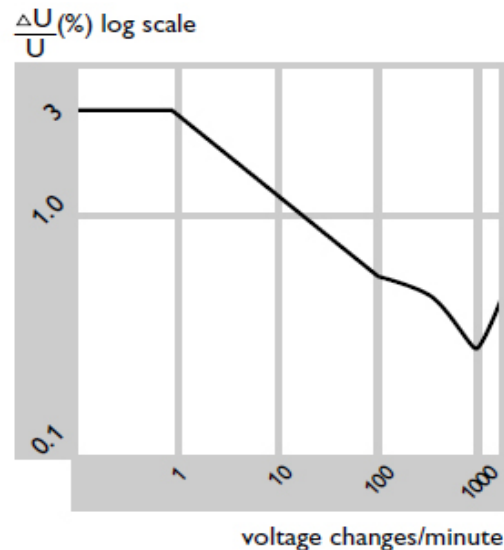
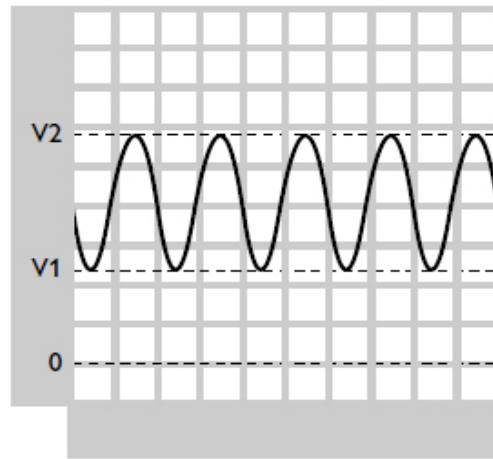


Fig. 18. Magnitude of maximum permissible voltage changes with respect to number of voltage changes per minute.

The most dangerous frequency is between 2.5 and 15 periods per second. Car drivers can experience this when driving along a tree-lined road when the sun is low at the horizon. It can also happen in a tunnel when the luminaires are badly spaced in relation to the speed of the traffic. An asymmetric lamp voltage results in a light flicker with the mains frequency (50/60Hz). In normal situations the lamp voltage is symmetrical. This kind of flicker can occur at the end of the life of a lamp, when an ignitor abusively comes in every positive or negative period or when the electronic ballast has a defect. Lamps burning in vertical position are more sensitive than horizontal burning lamps. Another sort of flicker is that caused by the fluctuation of the light output of the lamp on account of movement of the discharge arc on the electrodes. Although the length of the arc remains constant, the place where it strikes the electrode may vary. This 'dancing' of the arc has no constant frequency and depends on various factors, including lamp position, supply voltage, temperature, age of the lamp (electrode). This phenomenon is also called flatter and has an irregular low frequency (< 50 Hz). Striations are noticeable as a pattern of more or less bright regions in the (elongated) discharge tube and only occur in low-pressure lamps (TL and SOX).

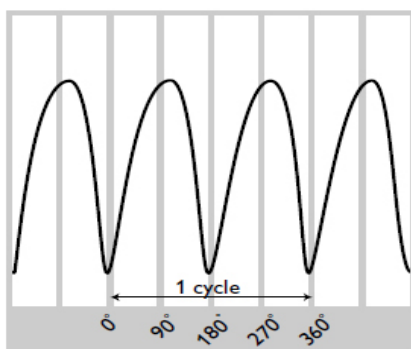
This pattern can move along the discharge tube. It may appear when the lamp is cold or when the lamp is dimmed down too much. An HID lamp operating on an alternating current will exhibit a fluctuating light output, as the lamp extinguishes and restrikes every half cycle of the supply. The lamp current goes through zero twice per period and the light output varies to some extent with these cyclic changes in the lamp current. So this light alternation (light ripple) has double the mains frequency and may cause the stroboscopic effect, (see as example Fig. 19).



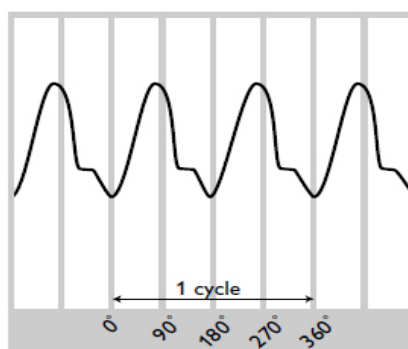


**Fig. 19. Light output of 2000 W lamp.**

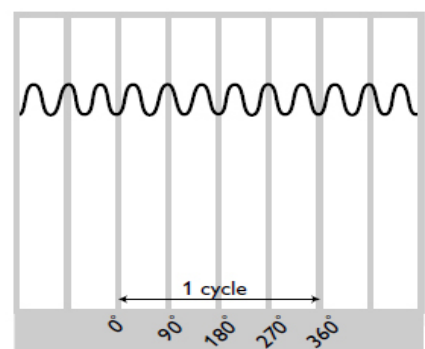
The effect is different for mercury/metal halide and high-pressure sodium lamps. Here the fluctuation of the light output is noticeable and may cause a stroboscopic effect, created by the pulsating light. The solution is to spread the lamps over the three phases of the supply (see Fig. 20), so that the minimum light output of one lamp coincides with high light outputs of the two other lamps.



**a) light from one phase**



**b) light from two phases**



**c) light from three phases**

**Fig. 20. Prevention of the stroboscopic effect by spreading the lighting over the three phases of the supply.**

Low-power lamps are more sensitive to flicker than lamps with higher power. This is one of the reasons why dimming of these lamps is not recommended on conventional gear. With the fully electronic HID-ballasts for low-wattage metal halide lamps there is no flicker at all. Mercury lamps with the fluorescent layer on the outer bulb also contain some phosphorescent substance with after-glow properties, thus eliminating the light ripple to a large extent.

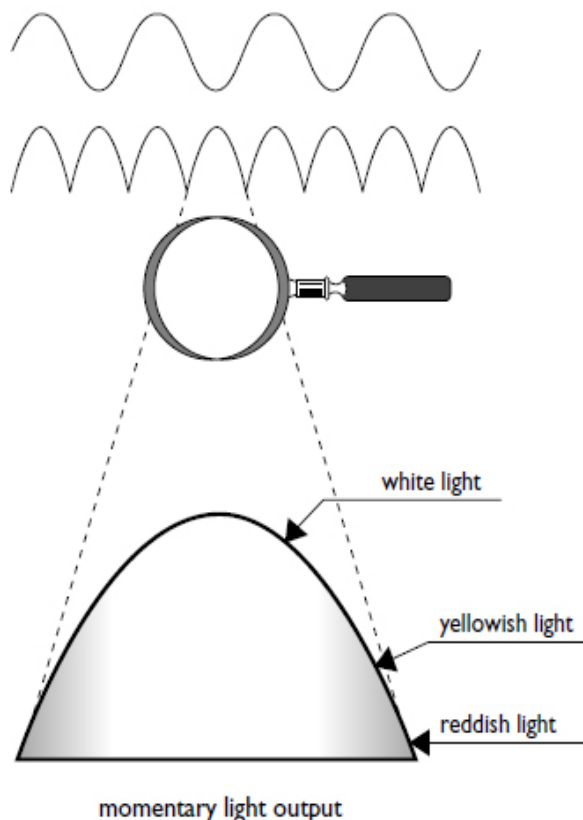
## Sodium lamps

Here the fluctuation of the light output is scarcely noticeable. This is because the sodium discharge exhibits a certain degree of after-glow, which is normally sufficient to bridge the dark periods in the 50/60 Hz cycle of the mains voltage. Although these lamps are less sensitive to flicker than the previous group, some stroboscopic effect may sometimes occur, as, for example, with aged lamps.

## HID lamps and cameras

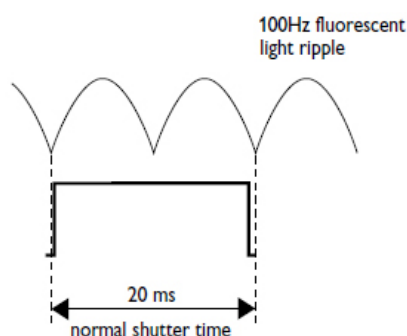
Light fluctuations in HID lamps may also have an effect on the quality of camera pictures.

This phenomenon may become apparent when CCD colour cameras operate in auto-shutter mode and the lighting of the area is predominantly with HID lamps. The auto-shutter mode is normally selected when the cameras are equipped with manual or fixed iris lenses and the automatic light response is controlled by an electronic shutter system in the camera. The greater the amount of light, the shorter the shutter time, and hence the shorter the period of light integration in the sensor. For example, with a shutter time of 1/1000th of a second, the light integration of the CCD sensor is only 1 ms. Within the normal CCIR scanning period of 20 ms (50 Hz) the 1/1000th of a second the light integration time is just a snap-shot in the normal frame scanning period. Hence, the sensitivity of the camera is reduced. As described before, the light output of HID lamps varies continuously from minimum (at zero crossing) to maximum during the positive and negative phases of the mains voltage, twice during one mains voltage cycle. In other words: the HID lamp is flashing 100 times per second. Due to the inertia of our eyes, viewing a scene illuminated with HID lamps, gives the impression of a white and continuous light output.



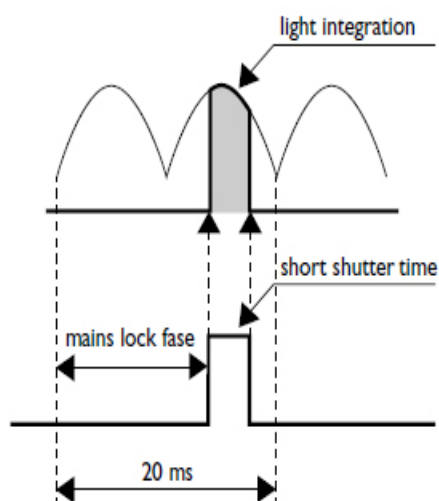
**Fig. 21. Colour shift during the 100 Hz light ripple of a HID lamp.**

The light ripple of a HID lamp is illustrated in Fig. 21. When the automatic shutter in the camera is switched off, the two light ripples of the lamp are integrated during the normal 20 ms frame integration time of the sensor and consequently the light impression is white. This is illustrated in Fig. 22.



**Fig. 22.** The 20 msec frame integration time of a CCD colour camera with the automatic shutter switched off, compared with the 100 Hz light ripple.

Using the automatic shutter in sufficiently illuminated scenes, the shutter speed increases. Consequently, light integration in the sensor takes place during a shorter period of time. Depending on the position where the light integration (snap-shot) takes place with respect to the mains phase (light ripple), it is now possible that a TV frame is shot during the non-standard excitation of the light, (see Fig. 23).



**Fig. 23.** Using the automatic shutter and with the camera locked to mains frequency, it is possible to shoot stable and white pictures.

It can be said that the light at this point in time is not white and that the light output is less. If the phase of the camera shutter remains constant with respect to the mains phase, the automatic light control and the white balance circuits in the camera will compensate for these effects and stable pictures are produced. This situation is obtained by locking the camera frame synchronisation to the mains (mains lock). When there is no fixed phase relationship between the scanning frequency of the camera (free running) and the mains frequency, the camera will take a snap-shot of the scene at varying phases of the lamp light output. This causes a colour fading to become visible. The extent of colour fading depends on the type of light in the area. In applications where the scene is illuminated with just one lamp, stabilised by conventional gear, the risk of colour fading is at its maximum.

It is recommended that cameras be locked to the mains frequency and that the phase of the camera synchronisation be adjusted such that the camera signal output is maximum. If mains lock is not possible in such an application, the lens iris should be closed to the point where the colour fading just disappears. Now the shutter speed is less (full frame integration) and there is the additional benefit that the sensor smear effect is less.

This method cannot be used in applications that need short shutter speeds to suppress movement blur. In other cases (three-phase installation or high-frequency stabilised) this phenomenon will not occur.

## Dimming SODIUM LAMPS

For Sodium lamps, dimming to 50% lamp power (flux at 35%) has no influence on lamp life or lumen maintenance, and there are no pronounced colour point changes. Below 50% lamp power the colour will shift and the output approaches a monochromatic colour. Recent experience with the modern electronic ballast's family shows that dimming to 35% lamp power (20% flux) has no significant effect on lifetime and maintenance.

## Other HID lamp types

The other HID lamp types do not offer benefits with regards to dimming. On the contrary, mostly exhibit a dramatic shortening in lifetime, sometimes with extreme colour shifts.

## Shocks and Vibrations

The length of the discharge arc, together with the vapour pressure in the discharge tube, determines the lamp voltage. If the balance of the discharge arc is disturbed by shocks or vibrations, the arc will nevertheless try to maintain itself. But to do that, it has to travel a longer path than when it is an undisturbed line, and therefore it requires a higher voltage. If that higher voltage is not available, the lamp will extinguish. After some time the lamp will start automatically. But until that happens, the electrodes will have had to withstand the high ignition voltage and current, which are reducing the lamp's life. Due to their greater arc length, low-pressure sodium lamps are more sensitive to vibrations than other HID lamps. In general, HID lamps have a superior resistance to shocks and vibrations compared to incandescent and halogen lamps.

## Burning position

Some lamp types, such as Mercury and Sodium, can operate in any position. Others are subject to certain restrictions, as can be found in the product information of the HID lamps. These restrictions ensure proper functioning of the lamps and/or influence the lamp life (positively). Metal halide lamps in general are to be operated horizontally, unless specifically designed for vertical burning, as in the case with Metal Halide marked (BU = base up). CDM-T and TC have universal burning position.

When metal halide lamps are used in positions other than specified, the different metals in the gas mixture will start to separate. They 'float' on top of each other, which causes layers of different coloured light: a rainbow effect. In that case, the lamp colour normally shifts. Low-pressure sodium lamps are also best operated horizontally. The lower wattage lamps may be used vertically, but the base should then be at the top. This is to prevent a cool area being created behind the electrodes which would affect lamp life in two different ways: the sodium, which would collect there, would attack the electrodes and the even distribution of the sodium over the discharge tube would be disturbed.

The lamp voltage of a horizontal operating lamp is somewhat higher than when vertical operated. Due to convection the discharge arc is curved upwards, giving a longer length. Therefore a horizontal lamp will extinguish earlier in lifetime than vertical operated.

## Colour rendering and colour shift

The colour properties of HID lamps can be characterised by the following parameters:

- chromatic co-ordinates (colour points X,Y),
- correlated colour temperature (Tk),
- general colour rendering index (Ra).

The colour properties of HID lamps depend mainly on the gases used and the temperature of the discharge tube. The low-pressure sodium lamp mainly emits radiation with a wavelength of about 589 nm -a radiation perceived by us as orange-yellow. This radiation is characteristic for low-pressure sodium.

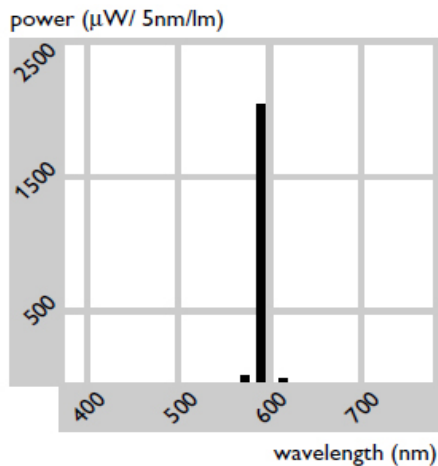


Fig. 24. Spectrum of a SOX lamp.

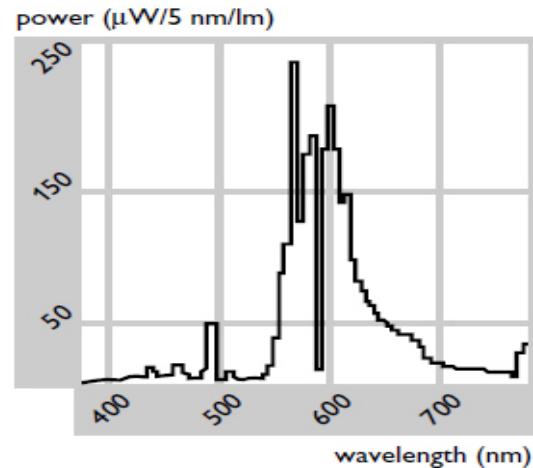


Fig. 25. Spectrum of a SON-T lamp.

When the pressure in the sodium discharge is increased, the monochromatic spectrum changes into a "multi-line" one, and the typical low-pressure sodium colour changes into golden-white light.

The radiation of mercury vapour lamps is distributed over the spectrum, in the UV, violet, blue, green and yellow ranges, so that the light of the mercury discharge makes a whiter impression than that of the sodium discharge. The more wavelengths there are in the visible part of the spectrum of a gas discharge and the more they are distributed over the spectrum, the more natural the light of that lamp appears to us. For that reason use is also made of mixtures of a number of metals. An example of this is the HPI-lamp.

The chromatic co-ordinates X,Y and Z represent the amount of red, blue and green in the light.

As  $X+Y+Z = 1$ , only X and Y are published. The correlated colour temperature defines the appearance of the white light and is expressed in Kelvin. Low colour temperatures ( $< 3300\text{K}$ ) give a warm impression (yellowish), while a high colour temperature ( $> 5000\text{K}$ ) gives a cool impression (blue).

With these two figures we can place any lamp in the Colour Triangle, (see Fig. 27):

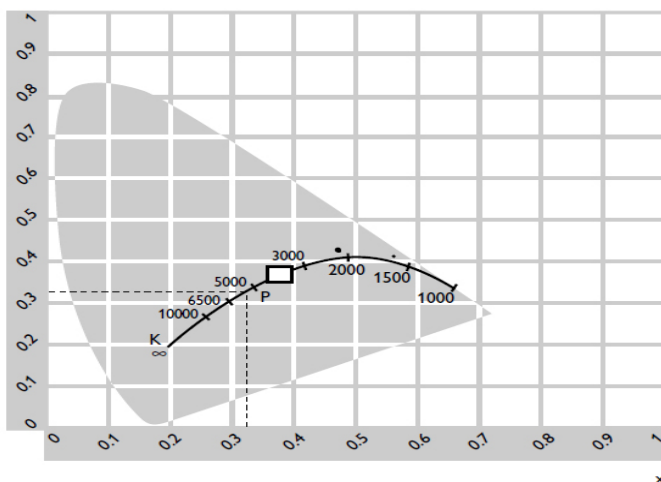


Fig. 27. CIE Chromaticity Diagram (Colour Triangle).

P White point  
● SON lamps  
● SOX lamps  
□ HPI lamps

- SOX low-pressure sodium lamps: correlated colour temperature of about 1700K,
- SON (- T) high-pressure sodium lamps: correlated colour temperature of about 2000K,
- HPL-N high-pressure mercury lamps and HPI(- T) metal halide lamps: correlated colour temperature between 3200 K and 4700 K.

The Colour Rendering Index (Ra) gives an indication of how colours appear under a given light source. The colour-rendering index of most HID lamps is fairly low. In the case of the SOX low-pressure sodium lamp there is absolutely no question of colour rendering.

The SON (-T) high-pressure sodium lamps have a Ra of 20 to 60.

The newest lamps, such as MHN(W)-TD and CDM lamps, have colour rendering indices that make them suitable for applications in which proper colour rendering is required. HID lamps with poor colour rendering will have to be used in applications where colour is of secondary importance and where these lamps are preferred on account of other positive properties. Changes in the discharge tube temperature cause shifts in the composition of the metal vapour mixture, which then result in colour point and consequently colour temperature shifts.

The usual manufacturing tolerances already give a certain spread in the chromatic co-ordinates, especially with metal halide lamps. As lamp life progresses, the discharge temperature will rise, e.g. owing to blackening, so that the colour temperature will become lower. External factors such as the mains voltage, the ambient temperature, the spread in ballast impedance or the burning position (metal halide lamps) can have some effect. Conventional control gear cannot correct for these phenomena. But by monitoring the actual mains voltage, lamp voltage and lamp current, electronic ballasts can regulate and supply the lamp with, for example, a constant lamp power. Or a constant colour temperature can be realised (e.g. White SON). Or a certain lamp can have two different colour temperatures, when supplied with two different lamp currents.

### Photochemical reaction (PET, D.F.)

Within the spectrum of electromagnetic waves that are produced by a discharge we can distinguish three groups of radiation: Infrared, visible and ultraviolet (UV). Sometimes the lamp is so designed that it passes a part of the UV radiation:

- on purpose for lamps where the UV is used for photochemical processes: e.g. some of the reproduction techniques are based on it, as is suntanning of the skin, and dermatological treatments of the skin

- unintentionally, in which case special filters must be used to protect against this kind of radiation. This unintentional output of UV is of importance in areas where people work, where materials are used that are sensitive to UV, or both. In order to quantify the impact of UV, two factors are introduced:

- PET: Permissible Exposure Time at an illuminance level of 1000 lux, i.e. the time that an average person can be exposed to 1000 lux without any harmful or negative consequence. If this factor is 24 (hours) or more, no damage is to be expected

- D, D.F. or fc: Damage Factor, expressing the damage that is done to exposed objects, e.g. fading of textiles. Both figures can be found in the lamp specifications.

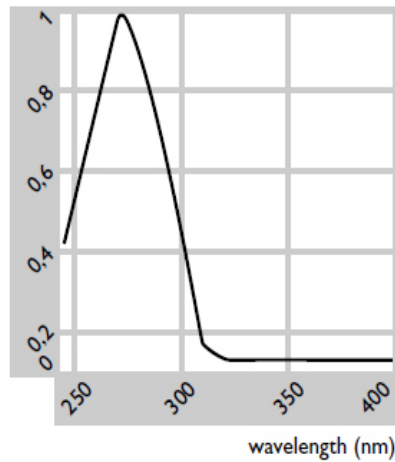


Fig. 28. Relative spectral effectiveness versus wavelength.

The time needed to acquire this maximum dose can be calculated from the spectral power distribution of the light source and an assumed illuminance level of 1000 lux. This time is called Permissible Exposure Time (PET). It is clear that the time humans are exposed to the light should not exceed the PET. From the so-called NIOSH-curve, see fig 28, it can be seen that the relative effectiveness of UV depends on the wavelength. The effectiveness is especially high for short wavelengths, viz. 250-320 nm. Another effect of UV (and blue light) is the risk of fading (= losing colours) of the goods illuminated by it.

This fading risk depends on:

- the type of material that is being illuminated. Studies show that some materials are extremely sensitive to UV radiation.
- the illumination level, defined by the lighting design: very high beam intensities look theatrical, but also involve very high fading risks.
- the exposure time until fading becomes visible.
- the damaging effect of the UV emitted by a light source.

The damaging effect of the source can be expressed by a damage factor ( $D/f_c$ ). It must be noted that not only UV causes fading, but also the radiation in the visible part of the spectrum, where blue is most damaging and red has a low damaging effect.

The relation between these variables is:

$$\text{Fading risk} = E \cdot t \cdot D/f_c$$

in which:

$E$  = illuminance value on the objects

$t$  = exposure time

$D/f_c$  = damage factor of the light source

The UV radiation emitted by the discharge tube can be filtered by the outer bulb, by a fluorescent layer on the outer bulb, by the UV blocking front glass of a luminaire or by special UV filters.

When the radiation is not properly shielded, or when exposure times are exceeded, harmful effects can occur to people: conjunctivitis ('welding eyes' or heavy irritation of the eyes), skin irritation etc.



## HID Electromagnetic lamp control gear

The term 'ballasts' is generally reserved for current limiting devices, including resistors, choke coils and (autoleak) transformers. Other items of auxiliary equipment are compensating capacitors, filter coils and starters or ignitors. Some systems (SOX) use an additional series capacitor for stabilisation. With all these components all the control functions that are necessary for the operation of standard HID lamps can be carried out.

### Stabilisation

Stabilisation, the need for current stabilisation for HID lamps has been described, resulting in the following two formulae:

$$I_{\text{lamp}} = \frac{V_{\text{mains}} - V_{\text{lamp}}}{Z_{\text{ballast}}}$$

and:  $P_{\text{lamp}} = V_{\text{lamp}} \cdot I_{\text{lamp}} \cdot \alpha_{\text{lamp}}$

where

$I_{\text{lamp}}$	= the current through the lamp
$V_{\text{mains}}$	= the mains voltage
$V_{\text{lamp}}$	= the voltage across the lamp
$Z_{\text{ballast}}$	= the impedance of the ballast
$P_{\text{lamp}}$	= the power of the lamp
$\alpha_{\text{lamp}}$	= a constant called the lamp factor

From these formulae it can be concluded that the power of the lamp (and therefore the light output) is influenced by:

- the lamp voltage  $V_{\text{lamp}}$ , which in turn is highly dependent on the operating temperature, Ambient and operating temperatures) and on the lamp current, according to the negative lamp characteristic.
- the lamp current  $I_{\text{lamp}}$ , which is dependent on the mains voltage, Effects of mains voltage fluctuations), the lamp voltage and the linearity of the ballast impedance. Stabilisation of the lamp power, or rather: suppression of its possible variations, is therefore of the utmost importance

Perfect suppression, however, is impossible with the standard EM ballasts, and it is important to know the margins within which the lamp power varies – for example, when calculating the maximum power capacity needed for an installation.

There are two tools for indicating the influences of the factors mentioned: the ballast and lamp lines, and the so-called trapezoidal or quadrilateral diagram.

## Ballast and lamp lines

A set of ballast and lamp lines is shown in Fig. 29. The ballast lines indicate the relationship between the lamp voltage and the lamp power for a given ballast (viz. a given ballast impedance) and for three levels of mains voltage: the rated level of the ballast, 95 per cent of the rated level, and the rated level plus 10 V. There is a set of such lines for each type of ballast, available at the ballast manufacturer. The figure gives the lines for a typical choke coil ballast. Four so-called lamp lines are also plotted in the diagram (dotted lines). A lamp line gives lamp voltages and lamp powers for different levels of mains voltage. For example, the first lamp line gives lamp voltages and lamp powers at the 100-hour condition of the lamp ( $L_{nom}$ ).

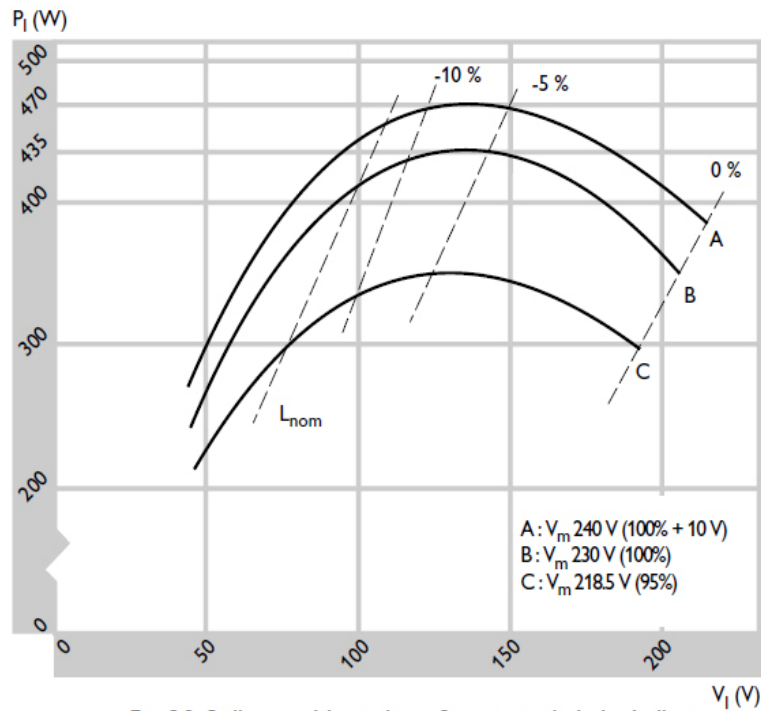


Fig. 29. Ballast and lamp lines for a typical choke ballast, based on 230 V mains voltage.

The line marked 0% gives lamp voltages and lamp powers above which lamp operation is not possible. It is called the extinction line: it indicates the set of extinguishing lamp voltages (at which the lamp starts cycling) at different levels of the mains voltage, provided that these are steady.

If, on the other hand, the mains voltage is not steady, and should suddenly drop by 5% or 10%, the extinguishing voltage will drop with it. The lines marked -5% and -10% give the extinguishing voltage for these situations. The operation point of a HID lamp lies at the point of intersection of the relevant ballast line and lamp line. Since the lamp voltage of high-pressure sodium lamps increases during life, the actual lamp line will shift to the right of the initial one

For a given electrical circuit (ballast + mains voltage), this means that the operating point will travel along the ballast line during lamp life. According to the rate of increase of the voltage, the lamp power will first rise and after some time fall again.

### Quadrilateral diagram

The limits within which the operation point must stay for satisfactory lamp performance can be conveniently specified by means of a so-called quadrilateral (or trapezoidal) diagram, especially for SON lamps, (see Fig. 30).

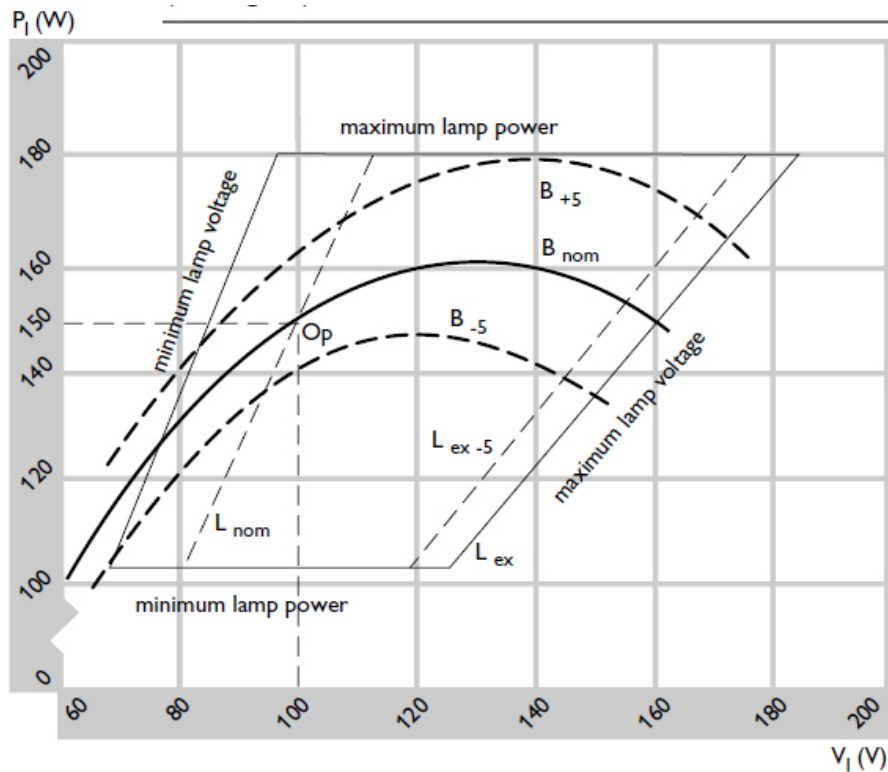


Fig. 30. Quadrilateral diagram of 150 W high-pressure sodium lamp.

- $B_{nom}$  = ballast line for nominal mains voltage
- $B_{+5}$  = ballast line for 5% over-voltage
- $B_{-5}$  = ballast line for 5% under-voltage
- $L_{nom}$  = lamp line for nominal operating conditions
- $L_{ex}$  = lamp line for maximum lamp voltage (extinguishing line)
- $L_{ex-5}$  = extinguishing line for 5% under-voltage
- $O_p$  = operating point

The upper boundary defines the maximum permissible power dissipated in the lamp, for which its lifetime is still acceptable. The lower boundary, marking the minimum permissible power in the lamp, is to ensure an acceptable luminous flux and a satisfactory warming-up time. The left-hand boundary defines the lowest permissible lamp voltage, and its position is marked by a lamp line.

This line is not very critical, but remaining within this boundary can indirectly prevent an excessive lamp current. The right-hand boundary is also marked by a lamp line and indicates the highest permissible lamp voltage, above which the lamp will extinguish. In view of the possible occurrence of mains voltage surges, the lamp should always be operated well within this boundary line. In order to avoid undesirable variations in light output as a consequence of mains-voltage fluctuations, the lamp voltage must be not more than approximately half the value of the mains voltage (100 to 130 V), and the impedance should be as linear as possible.

### Responsibility of ballast and luminaire manufacturers

Two of the main factors influencing lamp performance have been dealt with: the ballast properties and the operating temperature. Obviously, the first factor is of concern to the ballast manufacturer, whilst the second is chiefly determined by the design and construction of the luminaire.

Thus, together with the lamp manufacturer, the ballast and luminaire manufacturers impose certain limitations on their products so as to ensure that they operate within specification. When selecting the lamp circuit and determining the design of a ballast, the ballast designer will make sure that variations in the supply voltage - caused by ballast tolerances and mains voltage fluctuations - will under no circumstances cause the ballast line to cross the lower or upper boundaries of the quadrilateral diagram. The lamp designer, meanwhile, has to keep the initial value of the lamp voltage to the right of the left-hand boundary line, by taking care that the tolerances on lamp voltage are as tight as possible. He must also ensure that the lamp voltage does not cross the right-hand boundary line before the lamp has reached its predicted life span. Similarly, it is the responsibility of the luminaire manufacturer to ensure that the discharge tube cannot reach so high a temperature that the operation point exceeds, or even lies near to, the right-hand boundary line of the quadrilateral diagram.

### Ignition and re-ignition

#### Ignition

Earlier section Lamps, Ignition, the need for ignition of an HID lamp has been described.

Basically, there are four different ignition systems

1. no external ignitor,
2. two-pole parallel ignitor,
3. three-pole semi-parallel or impulser ignitor,
4. three-pole superimposed pulse or series ignitor.

The role of the ballast in the ignition process depends on the ignition system:

ad 1: a) The lamp can ignite on the available open voltage:

I) The mains voltage is high enough, as with Mercury lamps. The ballast has no special ignition function.

II) The mains voltage is not high enough. The ballast must produce the required open-circuit voltage, as with the autoleak transformers for SOX lamps.

b) The lamp cannot ignite on the available open-circuit voltage: An internal starting device must produce the necessary peak voltage, as with the glowswitch starter in SON(-I). The peak voltage  $L \frac{dI}{dt}$  depends on the ballast impedance, so ballast and starter must be specific to the lamp type.

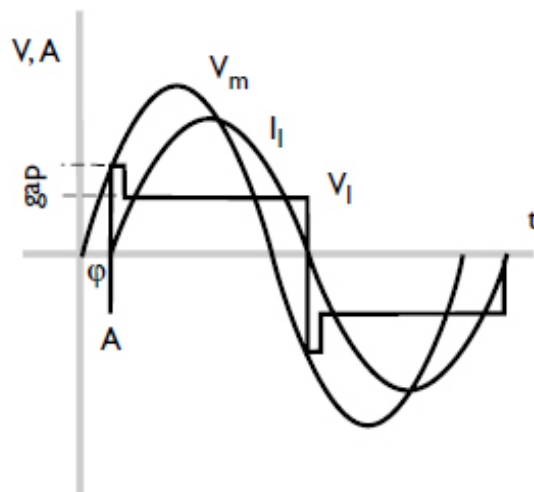
ad 2: The ballast impedance determines the current for charging the ignitor capacitor and so the ignition peak. Ballast and parallel ignitor are therefore a fixed combination for a certain lamp type (SOX, HPI-T).

ad 3: With the three-pole semi-parallel ignitor system the ballast also reacts as a voltage transformer to transform the ignitor capacitor voltage up to the required peak voltage. The location of the tapping on the ballast is therefore very critical, as it is situated in such a way that one semi-parallel ignitor can be used for several lamp types (SON) with the appropriate ballasts.

ad 4: In the three-pole superimposed pulse or series ignitor system, the ballast has no special function during ignition. In all cases the ballast has to limit the current through the lamp to the specified value during ignition and run-up of the lamp. Except in case 4, the ignition peak voltage is present on the ballast terminal that is connected to the lamp.

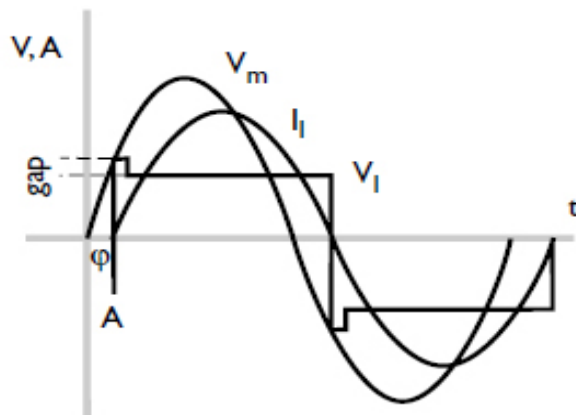
### Re-ignition

Energy is supplied to the discharge in the form of electrons. The lamp current, just like the mains voltage, is sinusoidal, with a frequency of 50 Hz or 60 Hz. If the energy flow is zero (at lamp current reversal), the lamp stops burning and in theory would have to be re-ignited. This could be done by supplying additional energy to the electrodes via a higher lamp voltage, as is done when initially starting the lamp. But from the moment the lamp has reached its stationary condition, the lamp voltage is constant. And yet, in practice, the lamp does not extinguish at current reversal. The reason for this is that the phase shift introduced by the inductive element of the ballast ensures that the mains voltage is not zero at the moment that the lamp current is zero. Because of the inductive properties of choke coil ballasts, a phase shift occurs between the mains voltage and the lamp current (see Fig. 31). So, at the moment of current reversal, the lamp voltage would be equal to the mains voltage, since the voltage over the ballast is zero. The difference (gap) between the mains voltage and the momentary lamp voltage as a consequence of the phase shift ensures proper re-ignition of the lamp at the moment the current passes the point of reversal (zero-point A in Fig. 31).



**Fig. 31.** Lamp current ( $I_l$ ), lamp voltage ( $V_l$ ) and mains voltage ( $V_m$ ) as functions of time.

If now the lamp voltage rises during its lifetime, the gap between the mains voltage and the average lamp voltage decreases. In the end it will become too small to ensure re-ignition (see Fig. 32), and the lamp extinguishes. It has to cool down before it can start again. After restarting, the lamp voltage quickly rises to the extinguishing level again. The lamp starts cycling and has to be replaced. By using self-stopping ignitors this cycling process can be interrupted.



*Fig. 32. Voltage gap between  $V_m$  and  $V_l$  being too small to re-ignite the lamp.*

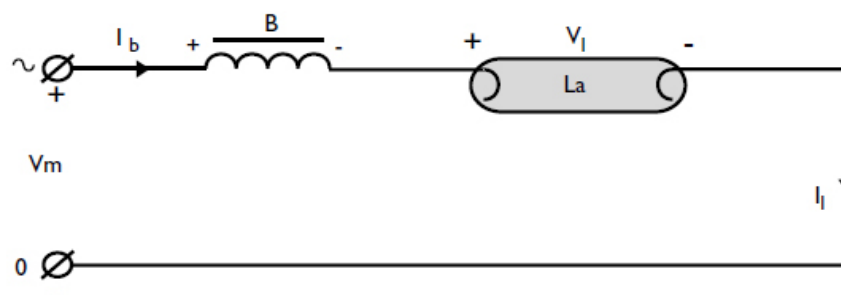
## Types of ballasts

### 1 Resistor ballasts

Current limitation by means of resistor ballasts is a very uneconomic form of current limitation. This is because electrical energy is dissipated in the form of heat in the resistor. Limitation of lamp current by means of a simple resistor is only used in self-ballasted blended-light lamps, where a filament is connected in series with the discharge tube. This filament, incorporated in the lamp, also takes part in the light production of the lamp. For this reason, the luminous efficacy of blended-light lamps is lower than that of other HID lamps. On the other hand, the advantage of this system without external ballast is that an installation with incandescent lamps can easily be converted to a system with a much longer life by simply replacing the incandescent lamps by blended-light lamps. An extra advantage of such an exchange is the higher efficacy of blended-light lamps compared to the equivalent incandescent versions.

### 2 Capacitor ballasts

A capacitor used as a ballast causes only very little losses, but cannot be used by itself, as this would give rise to very high peaks in the lamp current wave-form at each half cycle. Only at very high frequencies can a capacitor serve satisfactorily as a ballast.



*Fig. 33. Schematic diagram of a HID lamp operated on a choke ballast.*

### 3 Chokes, inductive or reactor (R) ballasts

Choke coils are frequently used as current limiting devices in gas-discharge lamp circuits (see Fig. 33). They cause somewhat higher losses than does a capacitor, but produce far less distortion in the lamp current at 50 Hz. Moreover, in combination with an ignitor, they can be made to produce the high voltage pulse needed to ignite the lamp. In practice, a choke ballast consists of a large number of windings of copper wire on a laminated iron core. Current limitation by means of resistor ballasts is a very uneconomic form of current limitation. This is because electrical energy is dissipated in the form of heat in the resistor. It operates on the self-inductance principle. The impedance of such a ballast must be chosen to suit the mains supply voltage and frequency, the lamp type and the voltage of the lamp, to ensure that the lamp current is at the correct value. In other words, for each supply voltage, each type of lamp requires its own choke as a ballast with a specific impedance setting.

Heat losses, occurring due to the ohmic resistance of the windings and hysteresis in the core, much depend on the mechanical construction of the ballast and the diameter and length of the copper wire. The right ballast for a given lamp and supply voltage should be chosen by consulting documentation and/or ballast markings. Ballasts can have taps for different lamp types (e.g. for HP 50/80 W or SON 50/70 W) or for different supply voltages (e.g. 230/240 V or 380/400/415 V). In some cases several ballasts can be combined to form a new ballast (e.g. two parallel HP 1000 W, 220 V ballasts form one HP 2000 W, 220 V ballast). But the ballast for a 400 W HP lamp is not the same as that for a 400 W SON lamp. Some ballasts may have another tapping for the connection of a semi-parallel ignitor. It is important to use the correct ignitor/ballast combination and to connect these items according to the wiring diagram on the ignitor. The most important value for stabilisation is the ballast impedance. It is expressed as the voltage-current ratio in ohms ( $\Omega$ ) and is defined for a certain mains voltage, mains frequency and calibration current (normally the nominal lamp current). Chokes can be used for virtually all discharge lamps, provided that one condition is fulfilled: the mains voltage should be about twice the arc voltage of the lamp. If the mains voltage is too low, another type of circuit should be used, such as the autoleak or constant-wattage circuits.

The advantages of a choke coil are:

- the wattage losses are low in comparison to those of a resistor,
- it is a simple circuit: the ballast is connected in series with the lamp. The disadvantages of a choke coil are:
  - the current in a lamp with choke circuit exhibits a phase shift with respect to the applied voltage, the current lagging behind the voltage, resulting in a power factor of ca. 0.5 inductive
  - a high starting current: in inductive circuits the starting current is about 1.5 times the rated current.
  - sensitivity to mains voltage fluctuations: variations in the mains voltage cause variations in the current through the lamp.

### 4 Autoleak transformers or high-reactance autotransformers (HX)

If the mains voltage is lower than about twice the arc voltage of the lamp - as is the case with low-pressure sodium lamps - the mains voltage has first to be stepped up. This could of course be done by a separate step-up transformer. A better solution is to combine the functions of transformer and choke in one piece of equipment. Autoleak transformers perform this combined operation: part of their secondary winding acting as a choke coil (Fig. 34). This configuration saves on windings and thus on wattage losses, space and weight. It also improves the re-ignition of the lamp, thanks to the higher open circuit voltage.



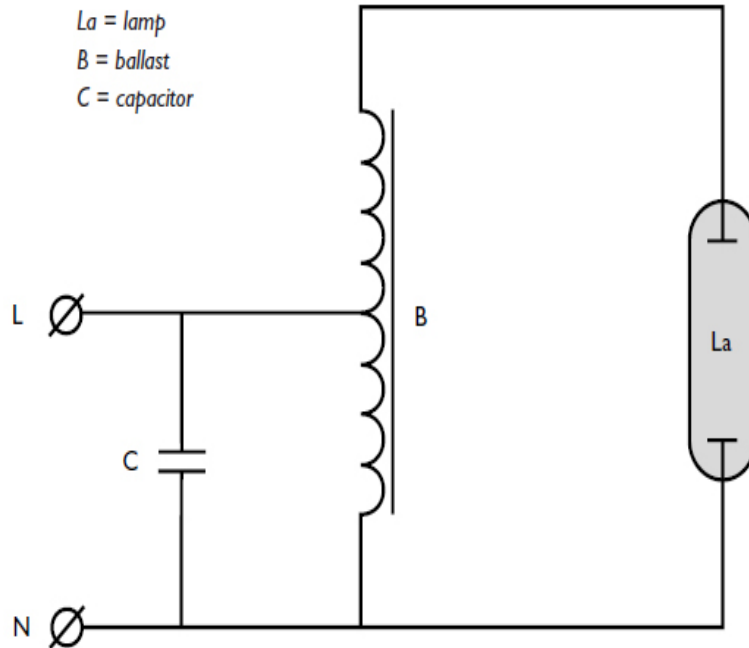


Fig. 34. Circuit diagram of a low-pressure sodium lamp with an autoleak transformer.

Just as with the choke coil, compensation capacitors may be necessary in order to improve the power factor. Autoleak transformers for low-pressure sodium lamps also fulfil the function of an ignition device, making a separate ignitor superfluous. Compared with normal choke ballasts, the autoleak transformer has the advantage of a higher open-circuit voltage (no ignitor). The disadvantages are: higher wattage losses, because such ballasts are larger and more expensive.

### 5 Constant-wattage hybrid circuits (SOX)

The constant-wattage hybrid circuit is shown in Fig. 35. The primary circuit consists of a linear self-inductance  $Z_1$  in series with a saturated inductance  $Z_2$ . The voltage across  $Z_2$  is transformed up to the required voltage. The secondary circuit consists of a capacitor in series with the lamp. The capacitor value is well-defined with a narrow tolerance ( $\pm 4\%$ ) for stabilisation of the lamp current.

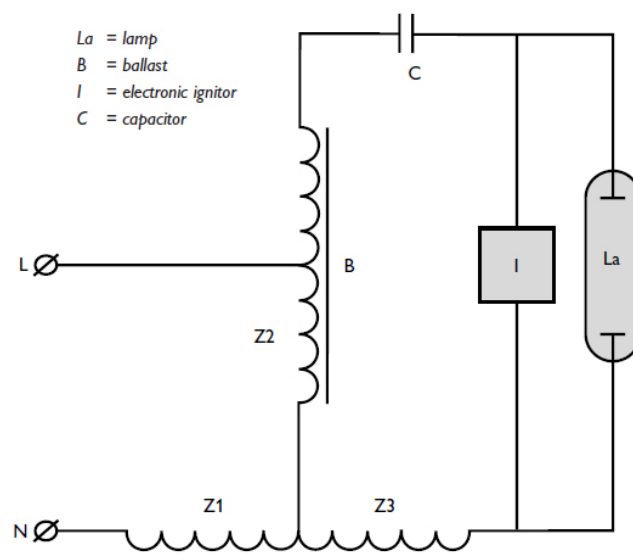


Fig. 35. Constant-wattage hybrid circuit.

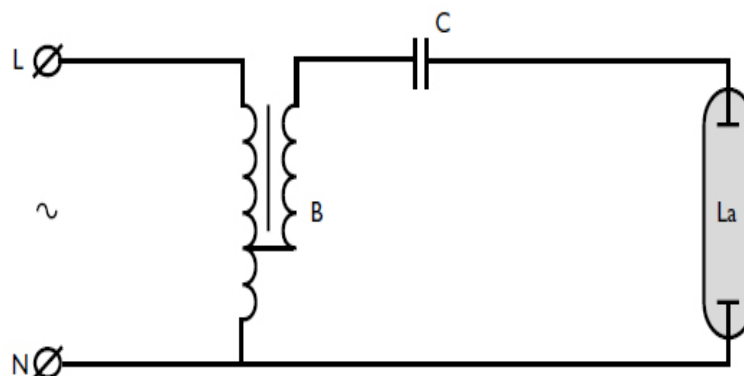
Z3 is necessary to avoid flickering of the lamp, especially during run-up. An electronic ignitor with built-in capacitor is placed in parallel to the lamp and provides the voltage peaks required to ignite the discharge. It also essential for the quick re-ignition of the lamp.

The advantages of the constant-wattage hybrid circuit are:

- the system supplies a squarer lamp-current waveform, so that the dark period in each cycle is reduced, resulting in smooth re-ignition,
- mains-voltage fluctuations have little influence on the lamp wattage, because the circuit is of the constantwattage type,
- re-ignition of the lamp when warm is no problem, thanks to the electronic ignitor,
- suppression of audio-frequency signals is done by the coil-capacitor combination, so no extra filter coil is needed,
- little mains current distortion occurs, because harmonics from the lamp are attenuated in the ballast circuit,
- a good power factor. The constant-wattage hybrid circuit has no real disadvantages, although it is more complicated and physically larger than a normal choke.

## 6 Constant-wattage circuit

In the USA, the constant-wattage circuit is widely used in lighting systems with mercury and high-pressure sodium lamps, (see Fig. 36). It consists of an autoleak transformer with a capacitor in series with the lamp. Use of the capacitor allows the lamp to operate with better wattage stability when the supply voltage fluctuates. It performs a double function here: it takes part in the ballasting of the lamp circuit and it corrects the power factor.



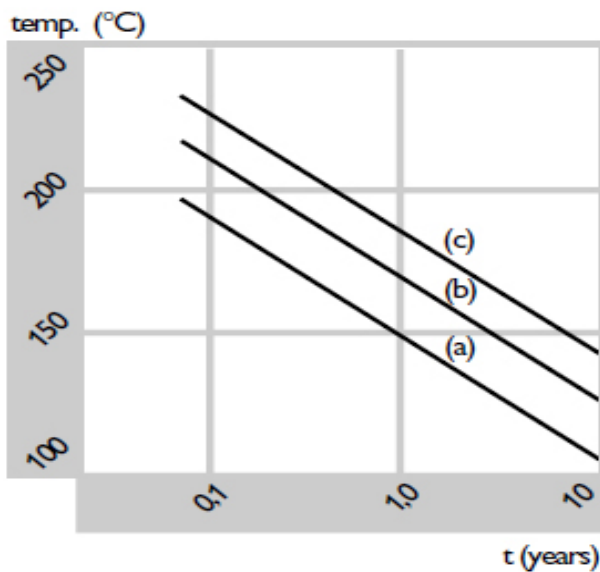
*Fig. 36. Constant wattage autotransformer circuit.*

The advantages of the constant wattage circuit are:

- variations in the mains voltage up to some 10 per cent have virtually no effect on the lamp current.
- a favourable power factor.
- a low run-up current. The system does, however, also have its disadvantages:
- the wattage losses in the transformer are high.
- the autoleak transformer is large, heavy and expensive.
- arc-voltage fluctuations result in considerable wattage fluctuations: the changes have to be “dissipated” by the ballast.

## Maximum coil temperature $t_w$ (lifetime) and $\Delta T$

A ballast, like most electrical components, generates heat due to its ohmic resistance and magnetic losses. Each component has a maximum temperature that may not be exceeded. For ballasts it is the temperature of the choke coil during operation that is important. The maximum permissible coil temperature  $t_w$  is marked on the ballast. Coil insulating material, in combination with lacquer, encapsulation material, etc., is so chosen that below that temperature the life specified for the ballast is achieved. A  $t_w$  value of  $130^\circ\text{C}$  is usual nowadays with a coil insulating class F ( $150^\circ\text{C}$ ) or class H ( $180^\circ\text{C}$ ). Under standard conditions, an average ballast life of ten years may be expected in the case of continuous operation at a coil temperature of  $t_w$ . As a rule of thumb, a  $10^\circ\text{C}$  temperature rise above the  $t_w$  value will halve its expected life (see Fig. 37). If, for instance, the operating temperature is  $20^\circ\text{C}$  above the  $t_w$  value, one may expect a ballast life of 2.5 years of continuous operation. If no  $t_w$  value is marked on the ballast, a maximum of  $105^\circ\text{C}$  is assumed for the coil temperature. As the ballast normally does not function continuously, the actual life of the ballast can be very long.



**Fig. 37.** The nominal life of choke coils in relation to the permitted rated maximum operating temperature of a ballast winding  $t_w$ , dependent on insulation material:

- a) class A:  $t_w$   $105^\circ\text{C}$ ,
- b) class E:  $t_w$   $120^\circ\text{C}$ ,
- c) class F or H:  $t_w$   $130^\circ\text{C}$ .

It also takes some hours before the thermal equilibrium is reached in the ballast, which again increases the practical ballast lifetime. To verify the  $t_w$  marking, accelerated lifetime tests are done at ballast temperatures above 200°C for 30 or 60 days. Another value marked on the ballast is the coil temperature rise  $\Delta t$ . This is the difference between the absolute coil temperature and the ambient temperature in standard conditions, and is measured by a method specified in IEC Publication 60922 (EN 60922). Common values for  $\Delta t$  are from 50 to 70 degrees in steps of 5 degrees. The coil temperature rise is measured by measuring the ohmic resistance of the cold and warm copper coil and using the formula:

$$\Delta t = \{(R_2 - R_1)/R_1\} \times (234.5 + t_1) - (t_2 - t_1)$$

or:

$$\Delta t_c = R_2/R_1 \times (t_1 + 234.5) - 234.5$$

where  $R_1$  = initial cold coil resistance in ohm (at start of measurement)

$R_2$  = warm coil resistance in ohm (at end of measurement)

$t_2$  = ambient temperature at measuring  $R_2$  in Celsius

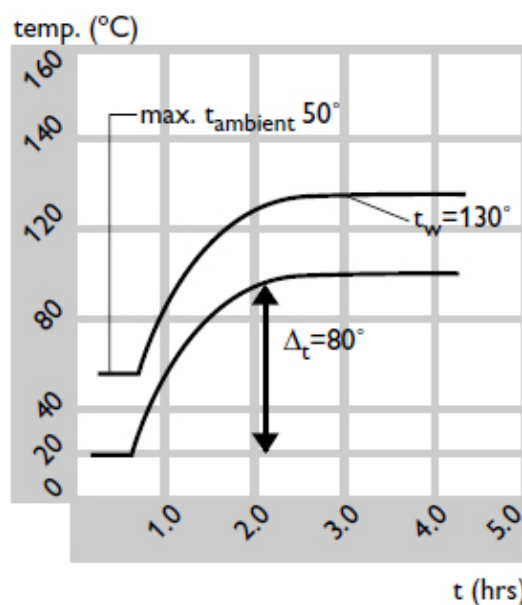
$t_1$  = ambient temperature at measuring  $R_1$  in Celsius

$t_c$  = calculated warm coil temperature in Celsius

$$\Delta t = t_c - t_2 \text{ in Kelvin}$$

The value 234.5 applies to copper wire; in the case of aluminium wire, the value 229 should be used. So a ballast marked with  $t_w$  130 and  $\Delta t$  70, will have the specified 10 years average life in continuous operation at standard conditions at an ambient temperature of 130°C - 70°C = 60°C. When the ambient temperature around the ballast is higher, a shorter ballast life has to be accepted, or sufficient air circulation or cooling has to be applied. The so-called ambient temperature mentioned in this section is not the room or outside temperature, but the temperature of the micro-environment of the ballast. Built into a luminaire or ballast box, the air temperature around the ballast is higher than the outside ambient temperature. This higher temperature has to be added to the coil temperature rise  $\Delta t$  to find the absolute coil temperature:

$$t_c = t_2 + \Delta t, \text{ (see fig. 38).}$$



**Fig. 38. Relation between  $t_w$ ,  $\Delta t$  and absolute ballast temperature.**

### Main ignitor functions and operation

Basically, there is only one function for an ignitor: to deliver the proper ignition voltage for starting the discharge in an HID lamp. But different ignitor types are required because different HID lamps require differing ignition voltages: the shape of the voltage peak, the number of voltage pulses within a certain period, the instant of application of the voltage itself, the amount of energy available and the amplitude, they all play a part in creating an optimum situation for establishing a discharge. Besides which, there are various ignition systems in use. After ignition the ignitor has to stop producing ignition peaks. This can be controlled by sensing the lamp voltage or lamp current and/or by a timer function. The voltage level at which an HID lamp will ignite is called its ignition voltage. In most lamp types special measures have been taken in the construction of the lamp to keep this ignition voltage as low as possible: the use of a starting gas as a Penning mixture (see Fig. 41) and the application of auxiliary electrodes to trigger the initial ionisation of the gas are examples of this. In the case of high-pressure mercury lamps, these measures are sufficient: these lamps will start on the mains voltage. Therefore, no separate ignitor is required and the ballast has no special function in the ignition process either. In other cases an internal glow-switch starter, built into the lamp, is sufficient to ignite the lamp, as with the lowwattage SON(-I) lamp.

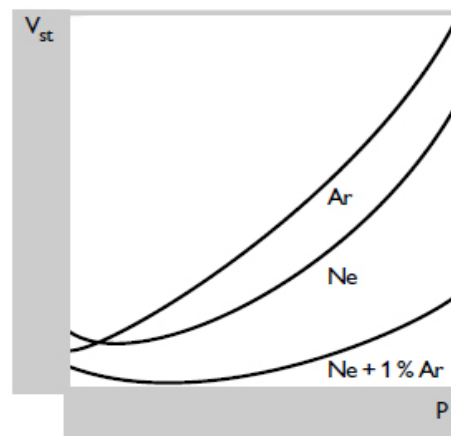


Fig. 41. Starting voltage curve: dependence of starting voltage ( $V_{st}$ ) on gas pressure ( $p$ ) for neon, argon and a mixture of the two. The addition of argon to neon clearly leads to a lower starting voltage level (Penning effect).

But all other types of HID lamps, including metal halide and low and high-pressure sodium lamps, require an external ignition device, either as an integral part of the ballast, or as an separate item of the control gear. This external ignition device must supply the voltage peaks necessary for starting the gas discharge. Mechanical switches such as relays or bi-metal switches may be used, but due to the high costs of replacement in outdoor applications, these have never become popular. Electronic ignitors prove to be the solution. They are based on the principle of a capacitor which is first charged via a diode and then discharged via a thyristor and so producing ignition peaks. When autoleak transformers are used as a ballast, a separate ignitor is not required, since the transformer already supplies the necessary starting voltage.

With cold lamps the required voltage pulses are of the order of 1 kV to 5 kV, while the maximum permitted amplitude of the pulse is limited by the lamp construction and by the type of lampholder. The ignition takes place immediately after the ignition pulse occurs. Required minimum and maximum peak voltages:

HPL 50-1000 W	0,3 kV
HPI 250-2000 W	0,6...1,4 kV
SOX 35-90 W	0,7...1 kV
SOX 135-180 W	0,7...1,4 kV
SON (CDM-TT) 50-70 W	1,8...2,5 kV
SON 100-1000 W	2,8...5,0 kV
CDM/MH 35..2000 W	3,2...5,0 kV

Apart from the peak amplitude also the peak width, the number of peaks and the position of the pulse in the mains sine wave are important, see for example Fig. 42.

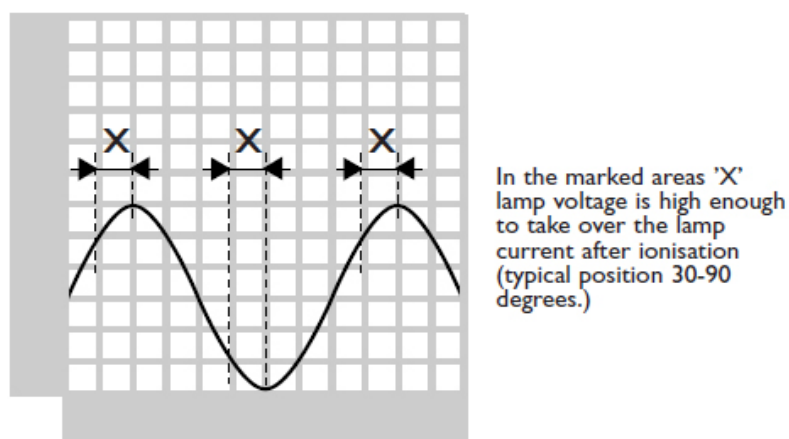


Fig. 42. Pulse position for reliable ignition.

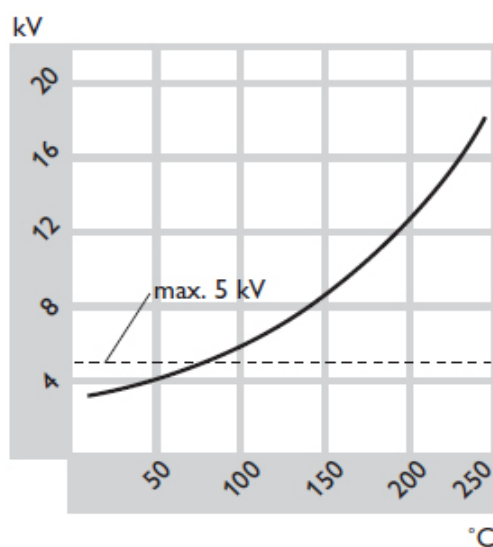


Fig. 43. Ignition voltage required for a typical high-pressure mercury lamp as a function of lamp temperature.

In the case of hot lamps (see Fig. 43) that have extinguished because of a power failure, accelerated ignition is possible at a certain stage as the lamps cool down. Hot metal halide lamps, for example, restart after 5 to 15 minutes and high-pressure sodium lamps without bi-metal after about 1 minute. The ignitors used in the hybrid circuit of SOX lamps enable the lamps to restart immediately when they are still warm. To restrike hot HID lamps, peak voltages of between 20 kV and 70 kV (depending on lamp type) are necessary. These peak voltages are produced by the Hot Restrike device, which in fact is just a special ignitor. HR devices, are available on the market. The ballasts and compensating capacitors are the same in standard and HR circuits. The difference is that the lamp, lampholder, lamp cabling and luminaire must be able to stand the high ignition voltages. This means employing a double ended lamp (no Edison fitting) and ensuring that there are sufficient creepage and clearance distances in the luminaire. HR devices stop producing the high ignition peaks when the lamp is ignited or, by use of a timer, after a few seconds. The wiring diagram differs from that of standard ignitors. Not only the lamp-HR device combination, but also the applied luminaire must be released for the HR application.

## Ignitor types

In principle, there are three different types of ignitors or ignition systems: semi-parallel, series and (full) parallel.

### Semi-parallel (impulser) type ignitors

The preferred type of Sololuce ignitors are of the semiparallel impulser type. This means that one ignitor terminal is connected to a ballast tapping. In this way the ballast acts as a voltage transformer to create the high ignition voltage. It is therefore essential to use the ignitor in combination with a properly tapped ballast. With this type of ignition the ballast coil is exposed to the high pulse voltage and must have sufficient insulation quality to withstand the high voltage energy. By making use of the ballast coil instead of a separate ignitor coil (as described below) with the series ignitor, the total system of ballast and ignitor can be cheaper and the ignition pulse has a higher energy content, which results in more reliable ignition.

### Series or Superimposed pulse type ignitors

The second family of ignitors is of the superimposed pulse type. Here the high voltage peak is generated in a separate transformer in the series ignitor. The ballast therefore has no ignitor tap and the coil is not exposed to the high pulse voltage peak and so the ballast can be cheaper. Nevertheless, the total system (ballast and ignitor) may be more expensive than the semi-parallel system. This is because the lamp current is passing through the ignitor, resulting in higher watt losses and possible hum, also during stable operation. In general this type of ignitor has to be mounted close to the lamp.

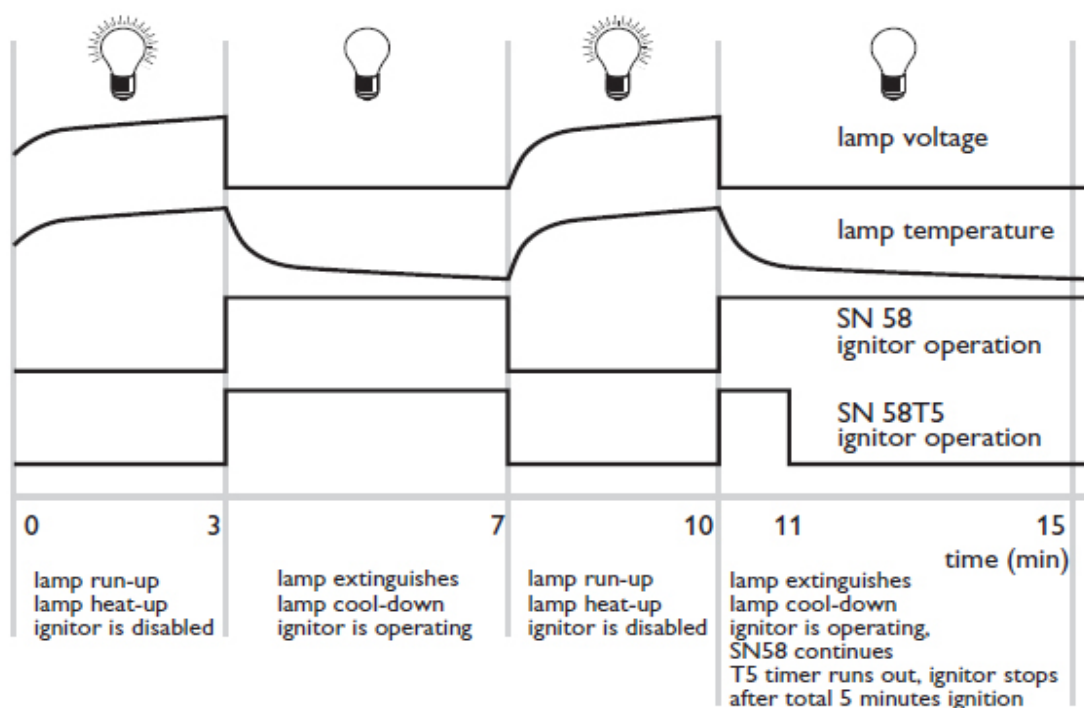
### Parallel ignitors

The third group of ignitors is called parallel ignitors, as the ignitor is connected directly across the lamp. The ballast has no extra ignition function. No high peak voltages can be created by this system (typical 500-750 V for HPI-T, maximum 1500 V for BSX 180) and so the ballast is not exposed to high voltages.



## Self-stopping ignitors

Standard ignitors keep on functioning when the lamp is not ignited, when the lamp is defective or when the lamp is cycling. During the lifetime of SON, MH and CDM lamps, the lamp voltage will rise, depending on the lamp type with, by between 1 and 4 volt per 1000 burning hours. At a certain moment, the available mains voltage will be too low for stable operation and the lamp will extinguish. But after cooling down, the lamp will restart again, runs up to its high lamp voltage, and again extinguish. This repeating sequence is called cycling. In normal situations the effective ignition time of the ignitor is very short, but in the cycling situation the effective ignition time is extended dramatically. This can lead to early ballast and/or ignitor failures. Therefore self-stopping versions, which stop after 5 or 15 minutes, are available to avoid the cycling behaviour (see Fig. 44) at the end of lamp life .



**Fig. 44. Cycling behaviour at the end of lamp life with a normal and a self-stopping ignitor.**

The operation of the ignitors is controlled by the lamp voltage. Counting down from the minutes indicated by the number after the T, the timer holds as soon as the lamp has ignited, whilst the remaining time is retained in the memory. The memory function has been implemented to allow for re-ignition if the lamp extinguishes as a result of temporary voltage dips. Consequently, these ignitors are resistant to voltage dips within the timer setting. Resetting the mains supply (disconnecting) for a minimum of 20 seconds is necessary to be able to again restart with the full ignition time available.

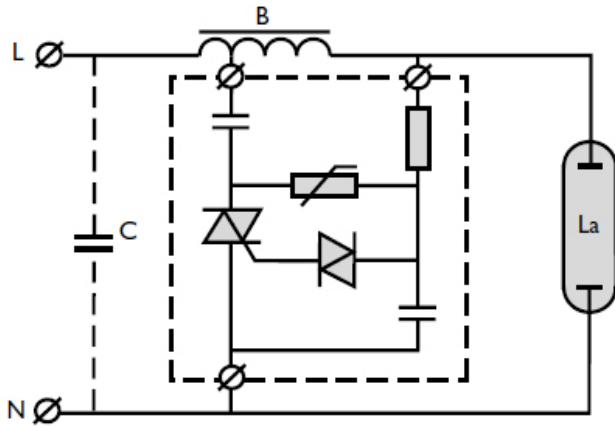
### Reasons for applying self-stopping ignitors:

- no annoying cycling, and so reduction of radio interference,
- reduced risk of creating of the DC-current, which leads to possible overheating of the ballast,
- prolonged lifetime of ignitor.

## Comparison between semi-parallel and superimposed (series) ignition systems

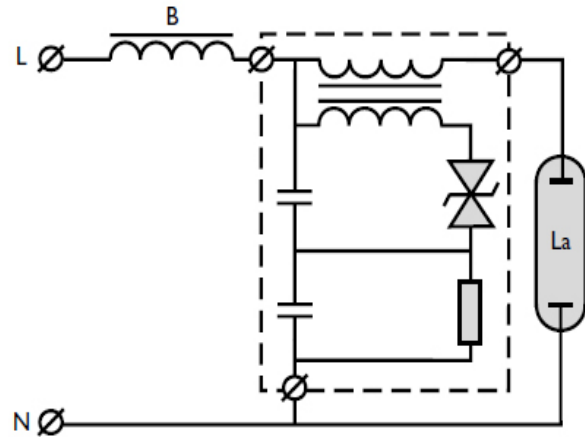
For the ignition of lamps such as high-pressure sodium or metal halide lamps, the choice basically exists between two systems previously mentioned namely:

- semi-parallel, IMP, also called impulser (see Fig. 45) or
- superimposed pulse, SIP, also called series (see Fig. 46).



**Fig. 45. Semi-parallel ignition system.**

*La* = lamp  
*B* = ballast  
*C* = capacitor



**Fig. 46. Superimposed ignition system.**

*La* = lamp  
*B* = ballast

The semi-parallel system is an arrangement in which the ballast and ignitor form a matched pair: the one cannot operate without the other. The ignitor uses the ballast to generate the ignition pulse for the lamp. The series ignitor works more or less without the ballast. In many cases the two systems are seen as being interchangeable. However, when they are closely compared, a number of differences become evident:

1. During normal lamp operation, the semi-parallel ignitor is no longer part of the current-carrying section of the electrical circuit. This implies that the ignitor does not consume any power and is therefore not self-heating. The series ignitor, on the other hand, is connected in series with the lamp and so always consumes some power.
2. Because the semi-parallel ignitor uses the ballast to generate the ignition pulse, it can fulfil this task very effectively. This high energy content ensures reliable lamp ignition. Furthermore, it permits of considerable distances between ballast/ignitor and lamp, so enabling the gear to be located more remotely: distances of 20 m, under nominal conditions, are no exception. The series ignitor produces smaller ignition peaks with less energy and must be connected close to the lamp.
3. As the semi-parallel ignitor is making use of the ballast to generate the ignition pulse, it contains no transformer. This means that there are no components inside the ignitor, that could otherwise cause irritating hum in the longer term. For indoor applications in particular this is an important consideration. The series ignitor makes use of a transformer in series with the lamp.
4. Some lamps can display a rectifying effect towards the end of their technical life. Metal halide lamps, more than high-pressure sodium types, tend to exhibit this, but there is always a chance of occurrence. A semiparallel ignitor is not connected in the current-carrying section of the circuit and will therefore not be affected by this phenomenon. Series ignitors will be damaged by the DC current, unless special precautions are taken.

For lamp types that do exhibit rectifying effects at the end of life, so-called thermo-switch ballasts are recommended, because the built-in thermo-switch will then protect the ballast from any hazardous lamp behaviour. Hence, when a thermo-switch ballast is required, it is advisable to employ a self-stopping semi-parallel ignitor system. In this way, maximum circuit protection can be assured.

5. Also from a commercial point of view too, the semiparallel system offers many benefits. In principle, the ignitor is power-independent: one ignitor can be used for a large number of lamps. This results in logistical advantages as well as financial gain (especially with higher wattage circuits) since the price of the ignitor does not rise with increasing lamp wattage. It should be noted, by the way, that a perception exists that in the semi-parallel system the ballast might be destroyed should the lamp does not ignite (for whatever reason). The ignition pulse would adversely affect the ballast and ultimately destroy it. However, in practice, there is however no noticeable difference between the performance of the semi-parallel system and the superimposed system. In the semi-parallel circuit, the ballast is stressed by the ignition pulse, whilst in the superimposed circuit the ignitor is stressed. But all components are developed and constructed to withstand this situation.

## Lifetime

Under normal conditions, an ignitor actually operates for only a few cycles, once every day, when the lights are switched on. The ignitor case temperature at this time is the ambient temperature. Under these conditions, the actual ignitor life expended is insignificant (less than one second per day, see Fig. 47). Even if the lights were turned off momentarily, once each day, it requires only about one minute of pulsing by the ignitor to re-ignite the lamp. Assuming an ignitor case temperature of 90°C (worst case), an operating period of one minute per day would total to only about five hours of actual operation per year. Since average ignitor life at 90°C is 800 hours, the use of five hours per year is only an insignificant portion of the total lifetime.

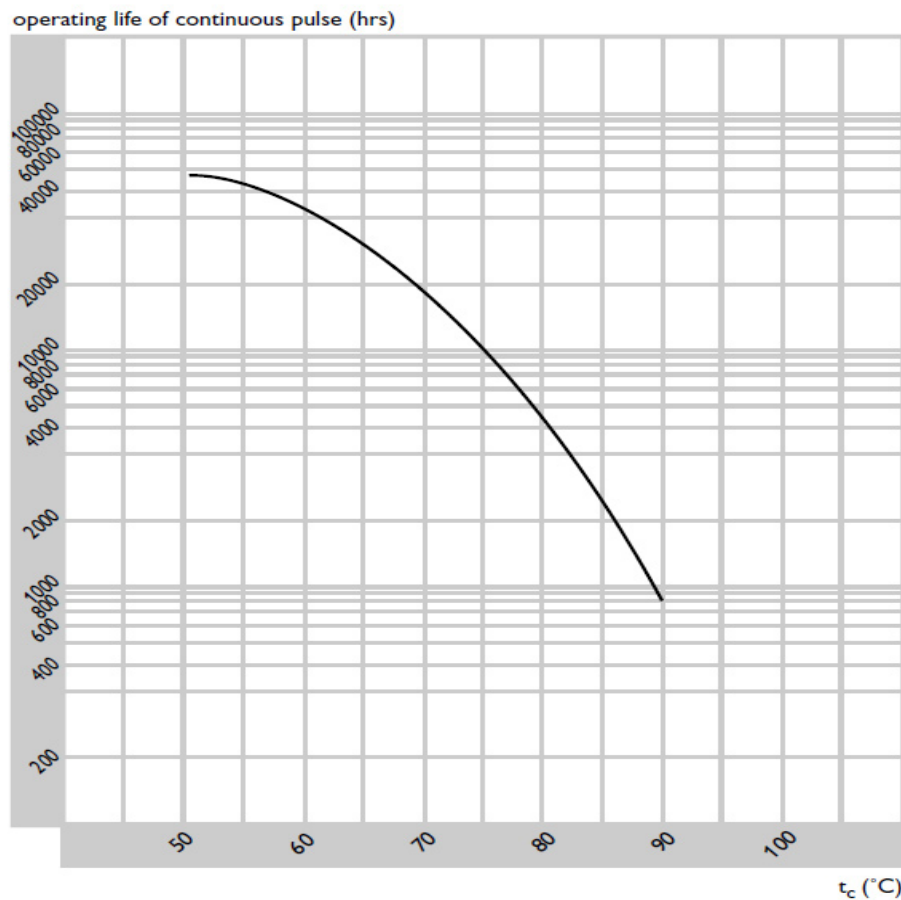


Fig. 47. Estimated operating life of ignitors as a function of case temperature.

On the other hand, ignitor life can be used up at a significant rate when an inoperative lamp remains in an energised socket for extended periods of time. In this instance, the ignitor may be pulsing from 8 to 24 hours per day, depending on the lighting application.

Experience has shown that ignitor case temperatures typically run about 15°C above the luminaire ambient temperature. Assuming a very severe application with a 75°C case temperature, a total of 10 000 hours of proper functioning can be expected. If, however, the ignitor were pulsing 24 hours per day (i.e. continuously), this would result in a shorter ignitor life. The ignitors are specified for 30 days, but tested for 60 days continuous operation. The situation is slightly different with series ignitors, as the transformer coil is stressed by the lamp current. Although the specification is the same for series and semi-parallel ignitors, in some applications the series ignitor is replaced together with the defective lamp.















