Luminaires

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Luminaires

The aims of luminaire or "lamp" or "chandelier" are:

- **distribution, filtering and "changing" of light;**
- **fitting, wearing and protecting the light source;**
- **supplying the light source with the electrical energy (connection to the mains).**

Tasks of luminaire

- **Power supply to the light source;**
- **direction, distribution, filtering of the light;**
- **protection against glare;**
- **maintenance of the operating temperature of the light source;**
- **easy installation and maintenance;**
- **protection against foreign bodies, dust and water;**
- **fit into the architecture or interior design;**
- **be economical.**

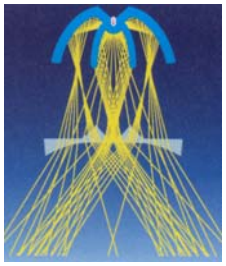
Requirements for luminaires

Luminaires must comply with:

- photometrical requirements,
- mechanical requirements,
- electrical requirements and
- design requirements.

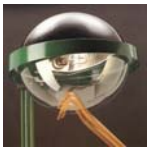
Requirements for luminaires

Photometrical requirements:



- luminous flux distribution,
- spatial distribution of luminous intensity,
- glare control and
- good efficiency.

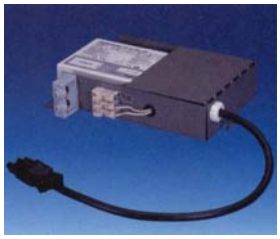
Requirements for luminaires



Mechanical requirements:

- good mechanical strength,
- resistance against heat, chemicals, sunlight (UV),
- Protection against ingress of foreign bodies and water,
- simple design (structure), easy installation and maintenance,
- durability.

Requirements for luminaires



Electrical requirements:

- operational reliability,
- protection against electric shock,
- EMC protection,
- simple design (easy operation, installation and maintenance),
- long lifespan of parts.

Requirements for luminaires

Design requirements:

- aesthetic appearance and design,
- good finishing,
- harmonious integration into the final environment (internal or external).

Elements of luminaires

Basic elements of a luminaire:

- photometrical elements,
- mechanical elements,
- electrical elements.

Elements of luminaires

Photometrical elements

are intended for reflection, distribution, limitation … of light:

- reflector
- refractor
- raster

They can be made of reflective or transmisive materials with different properties.

Elements of luminaires

Mechanical elements

may be used for carrying, fixation and protection of the light sources:

- housing
- supporting structure
- hanging and attaching devices
- protection glasses or nets
- focusing devices.

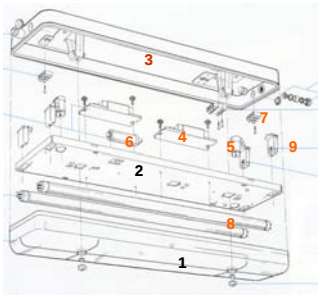
Elements of luminaires

Electrical elements

are used to connect light source to mains, to improve power factor and for EMC compatibility:

- holders (sockets)
- ballasts
- internal wiring
- capacitors
- switches
- terminals.

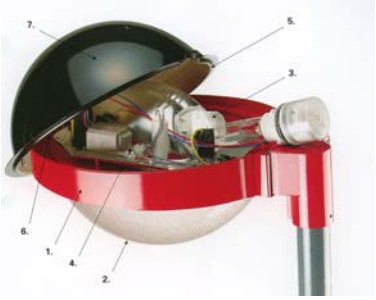
Elements of luminaires



1. refractor
2. reflector
3. housing
4. ballast
5. starter
6. capacitor
7. terminals
8. lamps
9. sockets

photometrical
mechanical
electrical

Elements of luminaires



1. housing
2. refractor
3. reflector
4. ballast
5. no tools needed for dismounting
6. seal
7. hood

photometrical
mechanical
electrical

Division of luminaires

According to the number and type of light sources: incandescent lamps, halogen lamps, discharge lamps, HID lamps, LEDs...

According to location of use: inside, outside...

According to luminous flux distribution: direct, indirect...

According to housing: closed, opened ...

According to protection against ingress of foreign bodies and water...

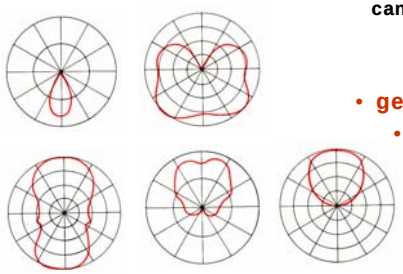
According to protection against electric shock.

According .....

Luminous flux distribution

Depending on the distribution of luminous flux the luminaires can be divided into:

- **direct**
- **semidirect**
- **general diffusing**
- **semi-indirect**
- **indirect**

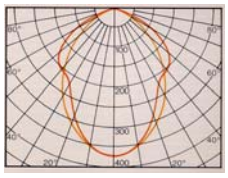


Luminous flux distribution

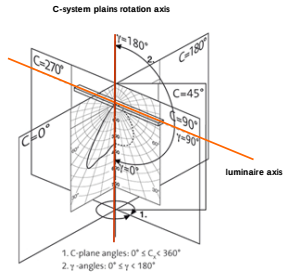
	Lower half-space Φ (%)	Upper half-space Φ (%)
A Direct	90-100	10-0
B Semidirect	60-90	40-10
C General diffusing	40-60	60-40
D Semi-indirect	10-40	90-60
E Indirect	0-10	100-90

Spatial distribution of luminous intensity

Spatial distribution of luminous intensity is very important for the lighting design as enables the calculation of illuminance on the lit surface. Usually it is shown on the polar diagrams on a certain plain.



Spatial distribution of luminous intensity



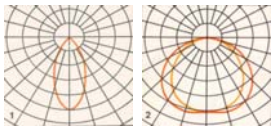
We distinguish between three systems of plains:

- A-system,
- B-system,
- C-system

(polar diagrams) to show the distribution of luminous intensity.

C-system plains

Spatial distribution of luminous intensity

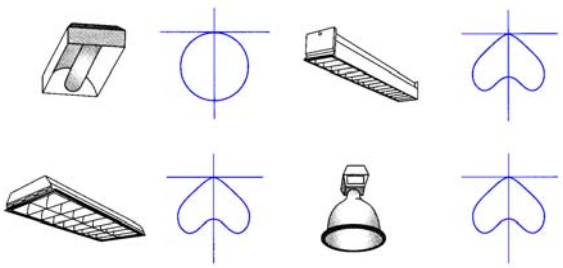


Floodlights have a narrower distribution curve of luminous intensity as the luminaires for general lighting.

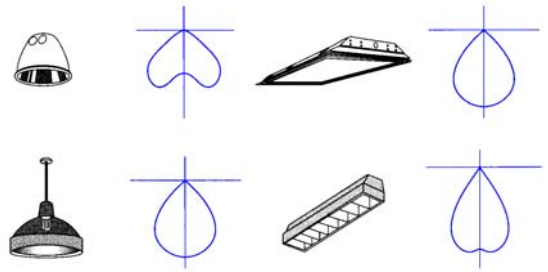
Distribution can be:

- rotationally symmetrical
- rotationally asymmetrical

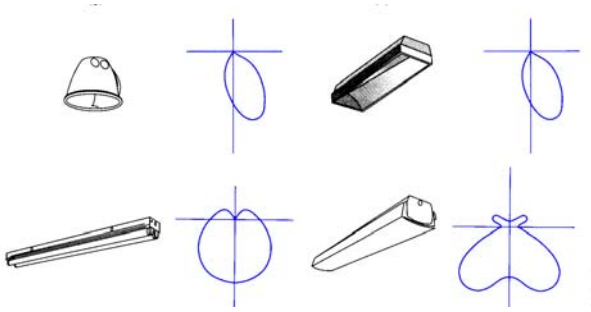
Spatial distribution of luminous intensity



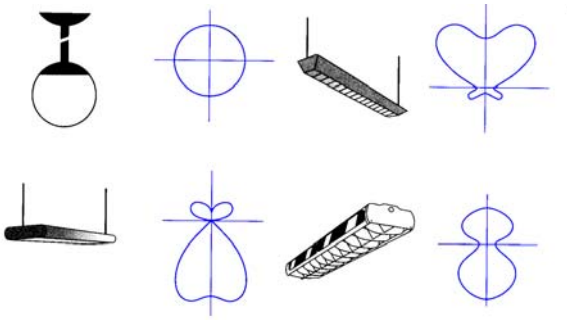
Spatial distribution of luminous intensity



Spatial distribution of luminous intensity

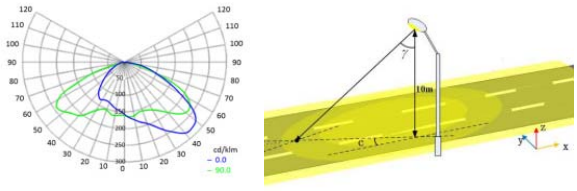


Spatial distribution of luminous intensity

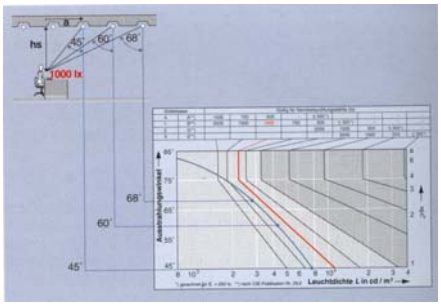


Spatial distribution of luminous intensity

Polar diagram of the spatial distribution of luminous intensity for road lighting luminaire.



Angular distribution of luminance



Angular distribution of luminance can be used for the determination of glare in the room (not in EN 12464).

For certain room and a certain nominal illuminance, the luminance angular distribution curve must lie to the left of the limit curve.

Efficiency of luminaire

Two different luminaire efficiencies can be defined:

- **optical efficiency**

is defined as ratio between luminous flux from the luminaire and total nominal luminous flux from all the light sources in luminaire;

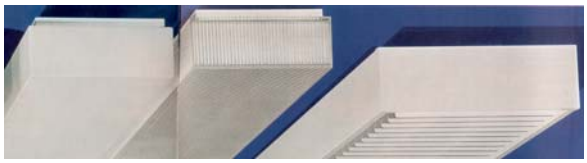
- **operating efficiency**

is defined in the same way but instead of the total nominal flux of the light sources the real luminous flux influenced also by installation (position of light sources) and ambient conditions (temperature) is used.

Efficiency of luminaire

Efficiency of luminaire tell us how much of the luminous flux produced by light sources in luminaire actually leave luminaire and can be used for illumination of the (working) area.

Efficiency depends on used materials and construction of the luminaire.



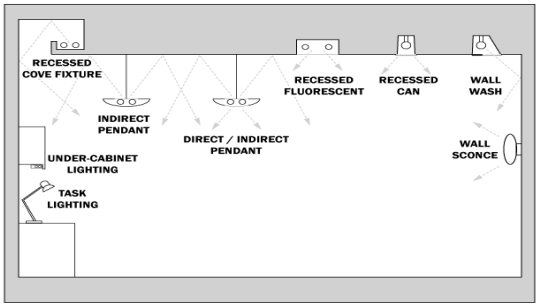
Opal cap Prismatic cap Louver

Efficiency of luminaire

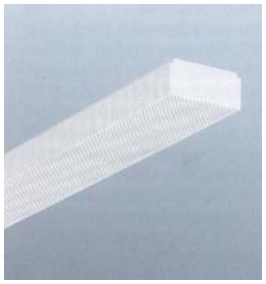
Benchmark values of efficiency of different luminaires with fluorescent lamps:

- Bare fluorescent lamp ... 92%
- luminaire with white reflector ... 70%-75%
- Luminaire with specular reflector ... 71%-76%
- Luminaire with specular louver (wide) ... 70%-75%
- Luminaire with specular louver (narrow) ... 55%
- Luminaire with opal cap ... 50%-65%
- Luminaire with prismatic cap (ceiling mounted) ... 60%-70%
- Luminaire with prismatic cap (recessed) ... 60%-70%
- Pendant luminaire with specular louver... 80%

Overview of luminaires



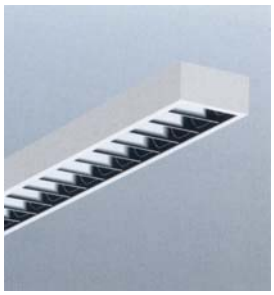
Overview of luminaires



Ceiling mounted luminaire with opal or prismatic cap for fluorescent lamps.

Used for general lighting in offices and similar rooms.

Overview of luminaires



Ceiling mounted luminaire with louver for fluorescent lamps.

Used for general lighting in offices and similar rooms. Can be used individually or in series (stripes).

Overview of luminaires

Track mounted luminaire with wide louver and reflector for fluorescent lamps. Used mostly in industrial and merchandise lighting.

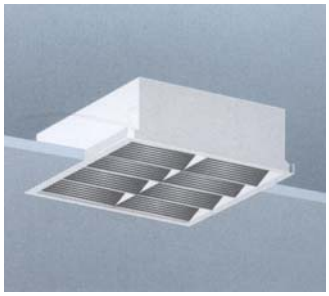
Overview of luminaires

Recessed luminaire with specular narrow louver for fluorescent lamps. Narrow louver is mostly used in rooms with displays as it causes less glare as wide louver.

Overview of luminaires

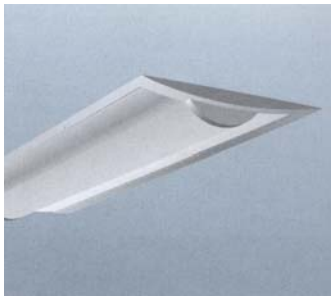
Impact resistant recessed luminaire for fluorescent lamps. Used in sports halls (protected against impact with ball).

Overview of luminaires



Recessed luminaire in quadratic form (60 cm raster) with specular louver and (compact) fluorescent lamps.

Overview of luminaires



Recessed luminaire with fluorescent lamps and direct-indirect luminous flux distribution. Used for indoor lighting (offices, meeting rooms, class rooms, lecture halls ...).

Overview of luminaires

Recessed wall flood luminaire wit asymmetrical spatial distribution of luminous intensity for fluorescent lamps. Used for illuminations of vertical surfaces in salesrooms, exhibition halls, offices, corridors ...).

Overview of luminaires

Pendant luminaire with fluorescent lamps and specular louver for direct-indirect lighting. Used in modern offices or rooms with high ceiling.

Overview of luminaires

Pendant work-zone luminaire wit specular louver and fluorescent lamps. Used for modern office lighting.

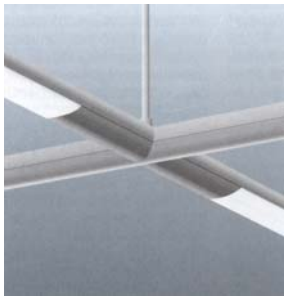
Overview of luminaires

Pendant luminaire with fluorescent lamps and specular reflector. It has very narrow angular distribution of luminous intensity and is used for rooms with high ceiling (like supermarkets or similar merchandise premises).

Overview of luminaires

Recessed “light ribbon” with luminaires equipped with fluorescent lamps and specular louver.

Overview of luminaires



Tubetrack luminaire with fluorescent lamps for general lighting. Used in meeting and communication zones and entrance areas.

Overview of luminaires

Ceiling mounted downlight luminaire (downlighter) with compact fluorescent lamp, tungsten halogen lamp (lower rooms) or high pressure metal halide lamp (higher rooms).

Overview of luminaires

Recessed downlighter with compact fluorescent lamp for decorative general lighting. Used in reception areas, shops, restaurants …

Overview of luminaires

recessed downlighter with specular louver and compact fluorescent lamp. Used for general lighting in interiors with greater requirements for glare control.

Overview of luminaires

Recessed spotlights with low voltage tungsten halogen lamp and turning possibility.

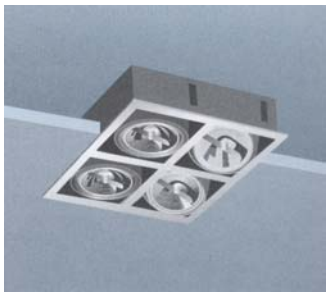
Overview of luminaires

Smaller recessed spotlight with low voltage tungsten halogen lamp. Used mostly for decorative purposes.

Overview of luminaires

Recessed spotlight for (low voltage) tungsten halogen lamps or HP metal halide lamps. It can be turned in different directions.

Overview of luminaires



Combination of four adjustable spotlights with AR111 lamps (tungsten halogen, HP metal halide, LED). Used mostly in (small) shops, restaurants, bars …

Overview of luminaires

(Pendant) high bay luminaire with specular reflector for high pressure discharge lamps. Used mostly in high industrial bays or in shopping malls.

Overview of luminaires

Pendant (high bay) luminaire with specular reflector for high pressure metal halide (sodium) lamps. Used in industrial bays and in shopping malls.

Overview of luminaires

Spotlight with integrated transformer for low voltage tungsten halogen lamps. Used for highlighting smaller objects.

Overview of luminaires

Adjustable spotlight for HP metal halide lamps with integrated ballast.

Overview of luminaires

Smaller adjustable spotlight for low voltage tungsten halogen lamps with reflector. For use with special socket in e.g. shopping windows …

Overview of luminaires

Adjustable spotlight with tungsten halogen lamps of HP metal halide lamps. Transformer or ballast is integrated into carrier.

Overview of luminaires

Spotlight for tungsten halogen or HP metal halide lamps with integrated transformer or ballast. It is intended to be used on a conductor rail.

Overview of luminaires

Crystal pendant luminaire (chandelier) with decorative incandescent lamps or tungsten halogen lamps (or even LED lamps).

Overview of luminaires

Table top luminaire with low voltage tungsten halogen lamp or LED.

Overview of luminaires

Decorative wall mounted luminaire (uplighter) with compact fluorescent lamps for “soft” light without much shadows and glare.

Overview of luminaires

Decorative wall mounted luminaire for tungsten halogen lamps or compact fluorescent lamps. Used in high ceiling corridors or representative rooms.

Overview of luminaires

Wall mounted luminaire with fluorescent lamp. Used in horizontal or vertical position for illumination of mirrors (in toilets, bathrooms, wardrobes ...).

Overview of luminaires

Wall mounted luminaire for illumination of stairs and paths. Can be used with tungsten halogen lamps, compact fluorescent lamps or LEDs.

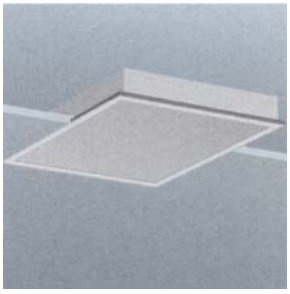
Overview of luminaires

ecorative pendant luminaire wit low voltage tungsten halogen lamp connected to conductor wires. Used mostly in residential premises.

Overview of luminaires

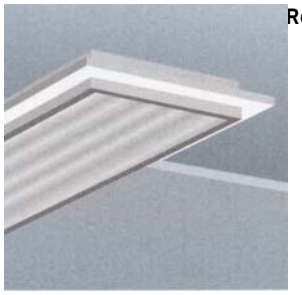
Ceiling mounted luminaire with fluorescent lamps for use in wet and damp rooms (laundries, kitchens …). Must have high IP protection mark.

Overview of luminaires



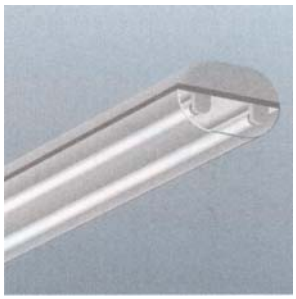
Recessed luminaire with fluorescent lamps and sealed prismatic cap. Used in chemical laboratories and in pharmacy.

Overview of luminaires



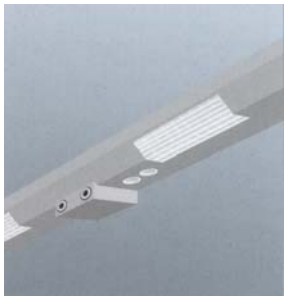
Recessed luminaire with fluorescent lamps and high IP protection (IP 54 to IP 65) and resistant to chemicals, cleaners, disinfectants. Used in cleaning and washing rooms ...

Overview of luminaires



Ceiling mounted luminaire with fluorescent lamps with IP 66 and Ex mark. Used in rooms with flammable atmosphere.

Overview of luminaires



Hospital care unit with direct and indirect luminaire and fluorescent lamps.

Overview of luminaires

Wall mounted luminaire for illuminated emergency sign with compact fluorescent lamp and integrated battery.

Overview of luminaires

Illuminated emergency exit sign for recessed mounting with compact lamp or LEDs. It is usually equipped with own battery and special ballast.

Overview of luminaires

Lighting system with optical fibers equipped with tungsten halogen lamp or HP metal halide lamp. Light is guided through optic fibers. Used in museums or for “star ceiling”.

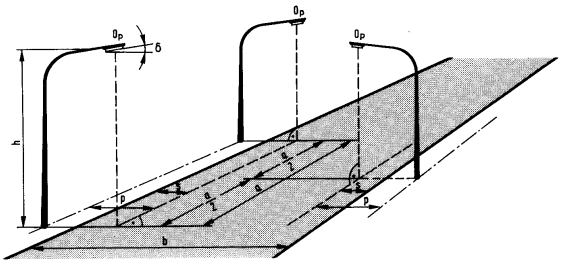
Road lighting luminaires

Basic parameters for road lighting luminaires:

- installed luminous flux
- efficiency
- mounting height
- tilt δ
- glare index

Road lighting luminaires

Geometry of the road lighting installation:



Road lighting luminaires

Based on the used shielding the road lighting luminaires can be divided into:

	max. allowed luminous intesity at the angle:	
Luminaire	80 deg.	90 deg.
cutoff	30 cd/1000 lm	10 cd/1000 lm
semicutoff	100 cd/1000 lm	50 cd/1000 lm
noncutoff	-	1000 cd (abs.)

The maximal absolute value of luminous intensity at 90° is always 1000 cd

Overview of road lighting luminaires

Road lighting luminaire with high pressure sodium or metal halide lamp for pole mounting. Used for illumination of roads and areas for motor vehicles.

Overview of road lighting luminaires

Modern decorative street lighting luminaire for pedestrian areas equipped with HP hetal halide lamp and special louver for light redirection toward ground.

Overview of road lighting luminaires

Decorative double-arm street luminaire for pedestrian areas with HP lamps or compact fluorescent lamps with appropriate optics (shade).

Overview of road lighting luminaires

Luminaire for outdoor lighting with compact fluorescent lamp and decorative appearance for illumination of pedestrian areas.

Overview of road lighting luminaires

Decorative luminaire for outdoor pole installation. Designed for lighting of old city centers...

Overview of road lighting luminaires

Decorative wall mounted luminaire for outdoor installation. Designed for street lighting in old city centers or lighting of facades of older houses. Different light sources can be used.

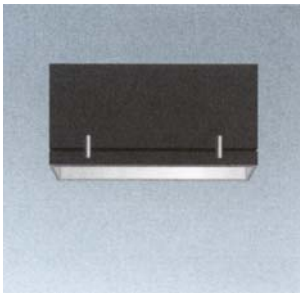
Overview of road lighting luminaires

Pillar luminaire for outdoor installation in a lower or a higher version for different light sources. It is mainly used for lighting of parks and other pedestrian areas.

Overview of road lighting luminaires

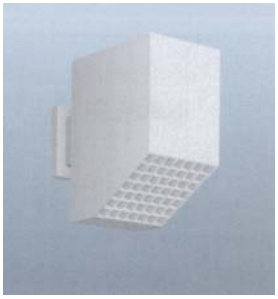
Decorative indirect street luminaire for illumination of mixed and slow traffic surface. Different light sources can be used (HP lamps).

Overview of road lighting luminaires



Ceiling mounted luminaire with IP65 protection rating for use in tunnel lighting.

Overview of outdoor luminaires



Wall mounted luminaire for outdoor installation with a compact fluorescent lamp or HP lamp. It is intended for lighting of outdoor areas near buildings (parking lots, entrances, stairways, ...).

Overview of outdoor luminaires

Ceiling mounted waterproof luminaire for outdoor installation. The light source can be incandescent or fluorescent lamps. They are used for installation under canopies, eaves, ... where we want to have a narrow cone of light.

Overview of outdoor luminaires

Ceiling mounted luminaire for outdoor installation. Different light sources can be used. Light source is protected by a plastic or glass cover which directs part of the light upward and thus illuminate also the ceiling.

Overview of outdoor luminaires

Wall mounted recessed luminaire for lighting paths or steps. It can also be used for the marking of hazardous places on the trails. Different light sources can be used.

Overview of outdoor luminaires

Floor mounted recessed luminaire for outdoor installation with LV halogen lamp or HP MH lamp intended for decorative lighting of exterior surfaces.

Overview of outdoor luminaires

Floodlight with asymmetrical beam equipped with HP sodium or metal halide lamp. Used for illuminating buildings or stadium lighting.

Overview of outdoor luminaires

Floodlight for tungsten halogen or HP metal halide lamps. Used in outdoor installation for lighting façades or protected objects.

Overview of outdoor luminaires

Spotlight or floodlight with high power tungsten halogen or HP metal halide (sodium) lamps (soffit versions).

Overview of outdoor luminaires

Waterproof luminaire for installation under water (swimming pools, ponds, fountains, ...). As a light source usually low voltage tungsten halogen lamps or LEDs are used.

Overview of outdoor luminaires

Smaller spotlight for outdoor use in gardens and parks (shall be installed so that it is driven into the ground). Designed for accent lighting of certain objects.

Protection of luminaires

Protection against electric shock:

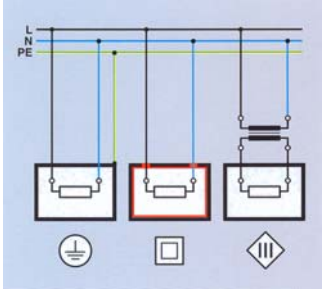
Class 0: only basic (working) insulation;

Class I: grounding of all accessible conductive parts;

Class II: double or reinforced insulation without grounding;

Class III: extra low voltage (U < 42 V).

Protection of luminaires



Protection against electric shock:

Class I

Class II

and

Class III

(from left to right)

Protection of luminaires

Protection against ingress of solid bodies and water (moisture):

IP 45 S

letters IP, two digits and additional letters
first digit: protection against ingress of solid bodies
second digit: protection against ingress of water (moisture)
additional letters

IP protection

Protection against ingress of solid bodies:

- 0 non-protected;
- 1 protected against solid objects grater than 50 mm;
- 2 protected against solid objects grater than 12,5 mm;
- 3 protected against solid objects grater than 2,5 mm;
- 4 protected against solid objects grater than 1,0 mm;
- 5 dust protected;
- 6 dust tight.

IP protection

Protection against ingress of water:

- 0 non-protected;
- 1 protected against dripping water;
- 2 protected against dripping water when tilted up to 15 °;
- 3 protected against spraying water (up to 60 °spray angle from the vertical);
- 4 protected against splashing water;
- 5 protected against water jets;
- 6 protected against heavy seas;
- 7 protected against the effects of immersion;
- 8 protected against submersion.

IP protection

Additional letters:

- f oil resistant
- H high voltage device;
- M equipment tested (water ingress) when moving parts are moving;
- S equipment tested (water ingress) when moving parts are stationary;
- W devices, which are also suitable for use in certain weather conditions.

IP protection

IP 4X, IP X5

if the level of protection (against the ingress of solid bodies or against the ingress of water) is not tested an X should be used in code.

IP protection

Luminaires are manufactured with varying degrees of protection against ingress of solid bodies and/or water.

Fire protection marking

Electrical appliances are a potential cause of the fire. Luminaires, because of hot surfaces, possible sparks ..., are no exception.

Because of that, luminaires may be mounted only on the non-combustible surfaces (e.g. concrete). On the combustible surfaces (e.g. wood) only specially marked luminaires can be installed.

Fire protection marking

- Suitable for mounting on flammable surfaces with flashpoint above 180 °C.
- Suitable for mounting on (in) furniture from materials with flashpoint above180 °C.
- Suitable for mounting on any flammable surface (follow the instructions).
- Luminaire with limited surface temperature (follow manufacturer's instructions)
- Permitted (horizontal) mounting position
- Prohibited (horizontal) mounting position






CE

EMC protection marking

Luminaires with built-in ballast can emit EM waves of higher frequencies (radio waves) to the mains (or air) and thus interfere with other users.

It is so necessary to eliminate such EMC disturbances caused by luminaire. Luminaires without EMC protection may only be used in certain industrial facilities but not in residential premises.

Label for marking the EMC protection in luminaires with fluorescent lamps.

Label for marking the EMC protection in luminaires with fluorescent lamps and electronic ballast.

Other markings

- Protection against damage with a ball (for luminaires in sport halls)
- Explosion proof luminaire for use in hazardous areas (flammable atmosphere).
- Maximum permissible ambient temperature (if deviates from 25 °C). t_a ...°C
- Use of “cool beam” lamps not allowed.
- minimum distance to illuminated surface (for spotlights).

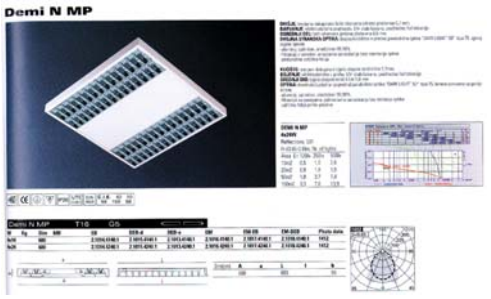
Other markings

- ENEC - European security mark for luminaires and other electrical appliances, awarded by independent testing laboratories (10 - VDE).
- GS - German symbol certifying compliance with the safety. Beside the GS mark also examiner (VDE or TÜV) is given.
- VDE - label of an independent testing laboratory under the auspices of the German association for electrical, electronic and information technologies.

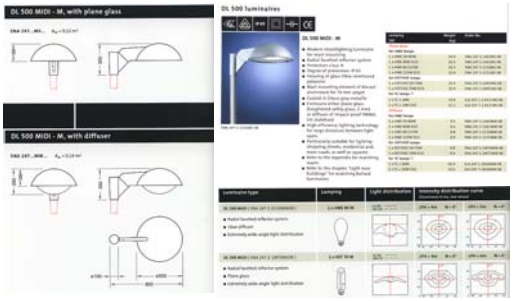
Basic luminaire data

- Manufacturer, batch, type.
- type and number of light sources, voltage, el. power.
- Luminous flux distribution.
- Luminaire efficiency.
- Luminous intensity spatial distribution diagram.
- luminance distribution curve or UGR.
- IP protection code.
- Protection against electrical shock mark.
- Marks for EMC protection and protection against fire and explosion.
- ...

Basic luminaire data



Basic luminaire data



At the end …

- Basic tasks of the luminaire are to protect and provide the needed environment to the light source and to distribute the light in a right way.
- Light source and luminaire should be selected based on needed viewing (lighting) conditions in the room.

… and now

Questions?